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Remedial Investigation Work Plan

Love's Travel Stop 413, 1512 Highway 97, Ellensburg, Washington 98926

Prepared for

Chris Weldon
Love's Travel Stops and Country Stores
10601 North Pennsylvania Avenue
Oklahoma City, Oklahoma 73120

Prepared by

Terraphase Engineering Inc.
2105 South C Street
Tacoma, Washington 98402

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This is a draft document and the information contained herein is subject to change. It should not be relied upon; consult the final document.

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terraphase engineering

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Acronyms and Abbreviations

µg/L	micrograms per liter
µg/m^3	microgram per cubic meter
Agreed Order	Agreed Order DE 22455
Allisto	Allisto Engineering Group
bgs	below ground surface
Broadbent	Broadbent & Associates, Inc.
BTEX	benzene, toluene, ethylbenzene, and xylene
COC	contaminant of concern
DEF	Diesel Exhaust Fluid
Ecology	Washington State Department of Ecology
FSID	Facility/Site Identification
Love's	Love's Travel Stops and Country Stores
MA	Massachusetts
MTCA	Model Toxics Control Act
PAHs	polycyclic aromatic hydrocarbons
RN	Robinson Noble, Inc.
SAP	*Sampling and Analysis Plan*
Site	Love's Travel Stops Store No. 413, 1512 Highway 97, Ellensburg, Washington
Terraphase	Terraphase Engineering Inc.
Terracon	Terracon Consultants, Inc.
TPH	total petroleum hydrocarbons
TPH-g	total petroleum hydrocarbons in the gasoline range
TPH-d	total petroleum hydrocarbons in the diesel range
TPH-o	total petroleum hydrocarbons in the oil range
UST	underground storage tank
VOC	volatile organic compound

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Signatures

All geologic information, conclusions, and recommendations in this document have been prepared under the responsible charge of a Washington State Licensed Geologist or Hydrogeologist.

DRAFT _____ _____

Don Malkemus, RG, LHG — Date
Associate Hydrogeologist

DRAFT _____ _____

Kari Thomas, LG, RG — Date
Associate Geologist

DRAFT _____ _____

John Hildenbrand — Date
Principal Environmental Scientist

DRAFT _____ _____

Max Wills, LHG, CWRE — Date
Principal Hydrogeologist

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1 Introduction

Terraphase Engineering Inc. (Terraphase) has prepared this *Remedial Investigation Work Plan* (Work Plan) on behalf of Love's Travel Stops and Country Stores (Love's) to describe actions intended to complete the remedial investigation for the Love's Travel Stops Store No. 413 at 1512 US Highway 97 in Ellensburg, Washington (the "Site"; Figure 1), identified as Kittitas County parcel 376133. The Site is listed as Facility/Site ID (FSID) 18911356 on the Washington State Department of Ecology's (Ecology) Confirmed and Suspected Contaminated Sites List and the Leaking Underground Storage Tank Cleanup Site database (ID No. 5649). The Site was previously enrolled in Ecology's Voluntary Cleanup Program (VCP) under Project No. CE0352 but was withdrawn by Ecology in 2024. Investigation and remediation of the Site is now being completed under Agreed Order DE 22455 (Agreed Order). This Work Plan was developed in accordance with the conditions of the Agreed Order, effective April 8, 2025 (WAC 173-340-350).[1]

2 Site Description

This section provides a general description of the Site, including current and historical Site use and its geologic and hydrogeologic setting.

2.1 Site Setting

The 7.67-acre Site is approximately 2 miles northwest of downtown Ellensburg, approximately 290 feet north of the intersection between the Interstate 90 business spur and US Route 97 in a rural/commercial area zoned for highway commercial use (Figure 1).[2] The Site is bordered by a restaurant (Gravy Waves) and parking lot to the northwest, a man-made pond to the north, Reecer Creek to the east/northeast, a restaurant (the GrassRoots Grill, formerly Perkins restaurant) and parking lot to the southeast, and US Route 97 to the south–southwest. Beyond the GrassRoots Grill is W. University Way to the south–southeast. Beyond US Route 97 are other commercial properties including a Conoco fuel service station, Creekside Dental Ellensburg, and an IHOP restaurant. A Dairy Queen restaurant and vacant agricultural land are east of the Site and Reecer Creek; a large man-made lake borders Reecer Creek approximately 280 feet southeast of the Site. The Yakima River is approximately 2,000 feet southwest of the Site.

The Site is developed as a truck stop, with large parking areas, an approximately 2,800-square-foot commercial truck fueling island, an approximately 150-square-foot passenger vehicle fueling island, a commercial truck oil change and tire center, truck scale, and an approximately 5,800-square-foot travel center that includes a convenience store, a Subway restaurant, bathrooms, and showers (Figures 2 and 3). A bioswale is present at the northeastern corner of the Site, near Reecer Creek.

[1] "Remedial investigation." https://app.leg.wa.gov/wac/173-340-350.

[2] https://eburg.maps.arcgis.com/home/webmap/viewer.html?webmap=d726b55406f846e58f361002a877e4b3v

Underground storage tanks (USTs) at the Site are located northeast of the travel center building. Piping conveys fuel from the USTs to the commercial and passenger vehicle fueling islands via trenches on the north and northeast side of the travel center building (Figure 3).

2.2 Historical and Current Site Use

Based on historical aerial photographs, the Site and surrounding area was developed as agricultural land with irrigation ditches by at least 1956. The current path of Reecer Creek is generally consistent with the path visible on a 1956 aerial photograph. A drainage ditch cutting across the approximate center of the Site from east to west is visible in aerial photographs taken in 1956, 1964, and 1970. The Interstate 90 business spur, US Route 97, and West University Way appear to have been paved between 1970 and 1981. The GrassRoots Grill building is visible in an aerial photograph from 1981. The drainage ditch that cut across the Site appears to have been realigned to run northwest–southeast along the approximate western Site boundary, and then southwest–northeast between the GrassRoots Grill and West University Way before reconnecting with Reecer Creek at the southeast corner of the Site, as shown in the 1981 aerial photograph. City of Ellensburg stormwater maps confirm that the open ditches northwest and south–southeast of the Site are connected by underground culverts running north–south along the western Site border, with flow towards Reecer Creek.

Based on a review of Ecology UST files, the Site's fueling facility was constructed in 1982 and the original site building is present in aerial photographs from 1983 (EDR 2025). A small, approximately 500-square-foot, canopy was initially present north of the building. A commercial truck fueling canopy is visible in aerial photographs from 1990. The original building was demolished in 1996 and the existing travel center building was constructed in its place (Allisto 1996). An auto fueling canopy is visible in aerial photographs from 2000. A smaller building, likely used for commercial truck tire repair and maintenance is visible at the northern portion of the Site in the aerial photographs from 2000 to 2015. Construction of the existing larger commercial truck oil change and tire center is visible in an aerial photograph from 2019. The commercial truck fueling canopy moved to the east in 2023 (Figure 2).

Records indicate the following timeline of Site USTs (Ecology 2011). New rows are depicted when records indicate a change from the previous record:

Date	Single-Wall Steel				Double-Wall Fiberglass		
	Tank 1	Tank 2	Tank 3	Tank 4	Tank 5	Tank 6	Tank 7
1982	10,000+* leaded gas	10,000* unleaded gas	10,000** unleaded gas	10,000* diesel	-	-	-
1992	12,000 regular unleaded	12,000 unleaded	10,000** premium unleaded	20,000 diesel			
1996	Cathodic Protection Installed on Tanks 1-4						

Date	Single-Wall Steel				Double-Wall Fiberglass		
	Tank 1	Tank 2	Tank 3	Tank 4	Tank 5	Tank 6	Tank 7
2008	10,000 premium unleaded	12,000 diesel	12,000 regular unleaded	20,000 diesel	20,000 diesel		
2012	10,000 premium unleaded	12,000 diesel	12,000 regular unleaded	20,000 diesel	20,000 diesel	20,000 diesel	12,000 DEF
2016-present	10,000 premium unleaded	12,000 biodiesel	12,000 regular unleaded	20,000 diesel	20,000 diesel	20,000 diesel	12,000 DEF

Note:

All listed capacities are in gallons.

DEF = Diesel Exhaust Fluid (urea)

* Listed capacities are likely incorrect based on subsequent records indicating tank volumes as listed in 1992 with installation dates of 1982.

** Although designated Tank 3 in early UST records, this is likely the currently designated Tank 1 based on listed capacity.

Ecology UST records indicate that the Site operated as Steve's Auto Truck Stop and Grocery (owned by PBC Properties) until at least August 1993, Pilot Travel Center 389 from at least October 1996 through April 2010, and Love's Travel Stop No. 413 from at least October 2010 to present (Ecology 2011).

2.3 Geology and Hydrogeology

The Site is in the Kittitas Valley, in the northern portion of the Yakima Fold and Thrust Belt, a northwest–southeast oriented sequence of faults, anticlinal ridges, and synclinal valleys. The axis of the Kittitas Valley Syncline runs along a portion of Reecer Creek, including the northeastern Site boundary (Sadowski et al. 2020). Bedrock in the Site area consists of Miocene tholeiitic basalts and basaltic andesites of the Columbia River Basalt Group, which are underlain, interfingered, and overlain by the volcaniclastic and feldspathic sedimentary rocks of the Ellensburg Formation (Sadowski et al. 2020).

The Ellensburg Formation is overlain by glacial deposits of the Thorp Gravel, which consists of low-permeability, weathered, cemented gravel and cobbles with an interstitial clay matrix (Sadowski et al. 2020; Robinson Noble, Inc. [RN] 2000). The Thorp Gravel extends to at least 150 feet below ground surface (bgs) in water supply wells in proximity to the Site (RN 2000). Overlying the Thorp Gravel is Holocene Yakima River flood plain alluvial deposits, which consist of silt, sand, and unweathered gravel and cobbles that have been extensively modified by agricultural practices (Sadowski et al. 2020; RN 2000). The Holocene alluvial deposits extend to 6 feet bgs in the exposed wall of a gravel quarry approximately 2,500 feet north of the Site (RN 2000).

Borings have been advanced at the Site to 21 feet bgs. Lithology generally consists of dense sandy gravel or dense fine to coarse sand with intermittent layers of silt and sandy silt. Some boring logs described thicker layers of silt or sandy silt. The log for Broadbent & Associates, Inc.'s (Broadbent's) boring DP-13

describes refusal in "bedrock" at 11.5 feet bgs. Refusal in other borings was recorded between 6 and 12 feet bgs, with six boring logs describing refusal at 11.5 or 12 feet bgs. The deepest boring log available for review (recovery well RW-2) noted refusal at 21 feet bgs and "unable to drill through rocky conditions." All available boring logs are included as Appendix A. Engineered fill is present within excavation footprints and pea gravel is present in the UST cavities (Section 3).

Shallow groundwater in the Site vicinity occurs within Holocene alluvium, with the relatively impermeable Thorp Gravel acting as a barrier to infiltrating precipitation (RN 2000). Shallow groundwater would be expected to flow to the Yakima River, though Reecer Creek may act as a local discharge point. Broadbent compiled inferred groundwater flow direction and gradient from potentiometric surface maps created for quarterly monitoring events from March 2011 to March 2024. Groundwater flow direction was recorded as south (17 events), south–southwest (23 events), southwest (4 events), south–southeast (7 events), or east–northeast (1 event),[3] with gradients ranging from 0.001 to 0.023 feet per foot (Broadbent 2024). Groundwater elevation data is presented in Table 1.

Deeper groundwater used for water supply is found below the Thorp Gravel in sandy Ellensburg Formation interbeds below 150 feet bgs.

3 Previous Investigations

This section describes previous environmental investigations and interim remedial actions conducted at the Site. Figure 4 depicts previous investigation locations from 1995–2014, and Figure 5 depicts investigation locations and interim remedial actions from 2018–2024. All available boring logs are included as Appendix A. Tabulated historical data is included as Appendix B.

In **November 1995**, Professional Services Industries advanced 12 soil borings (B-1 through B-12), installed 3 monitoring wells (MW-1 through MW-3), and collected 3 "surface" soil samples (S-1-1, S-1-2, and S-2; Figure 4 [Allisto Engineering Group (Allisto) 1996]). The boring locations were based on Allisto's interpretation of the Professional Services Industries site map, which was unavailable for review. Broadbent contacted Professional Services Industries in 2010 for more information but was unable to ascertain any further details (Broadbent 2013). Results indicated detected concentrations of total petroleum hydrocarbons (TPH) in surface soil samples S-1-1 and S-2 of 29,000 and 39,000 milligrams per kilogram, respectively, as measured using the now-retired United States Environmental Protection Agency (EPA) Method 418.1.

In **July 1996**, Allisto installed 2 monitoring wells (MW-4 and MW-5), collected 17 soil samples from the product line trenches, and collected 1 sample beneath Professional Services Industries' sample S-2 (Figure 4 [Allisto 1996]). This work was completed "to facilitate the construction of a new facility." According to Allisto, the former Site building was demolished in 1996, the USTs were relined, new product lines were installed, and the former product lines were "drained, capped, and abandoned in-

[3] The monitoring event with a recorded east–northeast flow direction was during an ice and snowstorm and only 5 of the 17 wells were monitored.

place." Sample results indicated detected concentrations of TPH in the gas and diesel range (TPH-g and TPH-d, respectively) were above Ecology's Model Toxics Control Act (MTCA) Method A cleanup levels for unrestricted land use in soil, and benzene concentrations were detected above the MTCA Method A cleanup levels in groundwater.

In **August 2008**, sheen was observed on groundwater during the installation of dewatering wells associated with the installation of a 20,000-gallon diesel UST (Tank 5). A groundwater sample had concentrations of TPH-g, TPH-d, and benzene above the MTCA Method A cleanup levels (Broadbent 2013), though Terraphase could not review the laboratory data or identify the sample locations. Approximately 300 cubic yards of TPH-impacted soil was excavated and removed from the Site during the UST installation activities (Broadbent 2013). Pilot reported the impacted soil and groundwater via the Environmental Response Tracking System on September 29, 2008 (Broadbent 2013).

In **February 2010**, the City of Ellensburg stormwater manager inspected the Site stormwater system and observed that the inlet and outlet to the bioswale were clogged with sediment (Ecology 2012). A sample collected had concentrations of TPH-d and TPH in the oil range (TPH-o) above MTCA Method A cleanup levels. Terracon Consultants, Inc. (Terracon) supervised the excavation and removal of 6.47 tons of sediment from the bioswale in July 2010. No confirmation samples were collected (Terracon 2011). Ecology added the release associated with the impacted sediment to the confirmed and suspected contaminated site list as a separate case (Cleanup Site ID 11732) than that associated with the existing TPH release case (Ecology 2012).

In **August 2010**, Terracon advanced 15 borings at the Site (B-1 through B-15; Figure 3). One soil sample was collected from each boring and groundwater samples were collected from borings B-3, B-7, and B-12. Benzene, toluene, ethylbenzene, and xylenes (BTEX), TPH-g, and TPH-d were detected in the soil samples collected from B-5, B-6 (no toluene or TPH-d detected), B-7, B-10, and B-11, and in the groundwater samples collected from B-3 (benzene, ethylbenzene, and TPH-d only) and B-7.

In **October 2010**, Broadbent initiated quarterly groundwater monitoring at the Site. The initial monitoring identified that previous monitoring wells MW-2, MW-4, and MW-5 had either been destroyed or abandoned (Figure 3 [Broadbent 2011]). Samples were collected from existing monitoring wells MW-1, MW-3, and MW-6 and analyzed for TPH-d, TPH-g, polycyclic aromatic hydrocarbons (PAHs), and BTEX. All three sampled monitoring wells showed impacts above MTCA Method A screening criteria. It is unclear when and by whom MW-6 was installed.

In **September 2011**, the Site was added to the Ecology Voluntary Cleanup Program (Project No. CE0352 [Ecology 2011b]).

In **September 2012**, Broadbent supervised the advancement of 21 soil borings (DP-1 through DP-21; Figure 3 [Broadbent 2013]). One to three soil samples were collected from each boring and submitted for analysis of TPH-d, TPH-o, TPH-g, and BTEX. Two soil samples were also analyzed for PAHs (samples from boring DP-5 at 4.5 and 9 feet bgs). Grab-groundwater samples were collected from each boring and analyzed for TPH-d, TPH-o, TPH-g, and BTEX. Nine samples were also analyzed for PAHs (DP-2, DP-5, DP-10, DP-12, DP-14, and DP-18 through DP-21). The highest concentrations were detected in borings DP-4 through DP-6 and DP-10 through DP-12.

In **July 2014**, Broadbent supervised the installation of monitoring wells MW-7 through MW-11, MW-15, and MW-16, and recovery wells RW-1 and RW-2 (Broadbent 2014). Access to the adjoining property to the south was apparently not granted and therefore monitoring wells MW-12 through MW-14 were not installed. One to three soil samples were collected from each boring for laboratory analysis of BTEX, TPH-g, TPH-d, and semivolatile organic compounds. Eight shallow soil samples (MW-8 through 10, MW-15, RW-1, and RW-2) were also analyzed for TPH-o. Soil samples collected from MW-9, MW-15, RW-1, and RW-2 had concentrations of one or more analyte above MTCA Method A cleanup levels.

In **June 2018**, a release of approximately 179 gallons of "fresh" gasoline from the southwestern dispenser at the auto fueling island was reported based on inventory monitoring (Ecology 2018). RN (now Terraphase) advanced two soil borings and one extraction well (B1 and B2 and RNMW-17, respectively; Figure 5). Soil and groundwater samples were collected from the two borings, extraction well RNMW-17, and existing monitoring wells MW-1 and MW-11. All samples were submitted for analysis of TPH-g, TPH-d, TPH-o, volatile organic compounds (VOCs), and lead. Significant impacts were identified in all samples except for those collected from boring B1 (RN 2020). Groundwater monitoring in third quarter 2018 identified historical high concentrations of TPH-g and BTEX at MW-10 and MW-11 (Broadbent 2018).

In **July 2019**, RN supervised the extraction of contaminated groundwater from extraction well RNMW-17. Approximately 880 gallons were removed. Water levels in monitoring well MW-11, approximately 10 feet east of RNMW-17, were recorded during groundwater extraction and less than 0.1 feet of drawdown was recorded, suggesting minimal hydraulic connection. Samples collected from MW-11 and RNMW-17 after the extraction event showed reductions of TPH-g, benzene, toluene, and xylenes of over 95, 82, 90, and 46 percent, respectively (RN 2020).

In **March 2020**, Broadbent proposed the installation of four monitoring wells at the south-adjoining property to the Site (MW-12 through MW-14, and MW-17; Figure 6). The wells were proposed to be installed with a 10-foot screen from 4 to 14 feet bgs.

In the **first quarter 2021**, Broadbent installed MW-12 through MW-14 and MW-17. The wells were sampled for the first time in March 2021 (Broadbent 2022). No boring logs or record of the associated field investigation were available for review. Quarterly sampling of the monitoring network, including the four new wells, continued.

In **July 2023**, Love's replaced the commercial fueling diesel piping network and moved the commercial fueling dispenser island and canopy (RN 2024). The existing piping was decommissioned and removed. Soil samples collected beneath the removed piping had detected TPH-d above MTCA Method A cleanup levels, with a maximum concentration of 57,000 milligrams per kilogram. Soil within the project area was excavated to the extent practicable. The excavation did not extend below groundwater, which was encountered at 6 to 7 feet bgs. Approximate excavation limits are depicted on Figure 5, though soil immediately adjacent and below the USTs was not removed. Between July 1 and September 11, 2023, a total of approximately 2,802.72 tons of soil was removed and forty-seven soil samples were collected within the excavation limits. When sample results showed concentrations above MTCA Method A cleanup levels, soil proximal to the sample was over-excavated, if feasible; however, soil in the vicinity of nine samples with concentrations above cleanup levels could not be over-excavated (Figure 5).

Approximately 4,500 pounds of an oxygen release compound was placed within the excavation limits prior to backfill and compaction. A sample of water in the limits of the excavation was collected and submitted to assess the potential timing of the release. Based on significant biodegradation inferred from the presence of isoprenoids and the apparent absence of normal alkanes, Apex Laboratories, LLC estimated the timing of the release to be a minimum 14 years prior to sampling (i.e., 2009). The sample had a sulfur concentration of 90 parts per million, which suggested that it predated EPA's 2007 mandated maximum sulfur level of 15 parts per million (RN 2024).

In **October 2023**, approximately 700 gallons of regular unleaded gasoline overtopped UST tank 3 and spilled to the surrounding, exposed pea gravel. RN supervised the installation of two temporary recovery wells (RW-3 and RW-4; Figure 5) within the pea gravel in the excavation and observed the replacement of pea gravel around tank 3. Free-product and water were pumped from the recovery wells until no product was measured using an oil/water interface probe. Approximately 700 gallons of gasoline were recovered. RN installed four sub-slab vapor pins (VP1 through VP4; Figure 5) and collected sub-slab vapor and indoor air samples to evaluate potential human health risk. Sub-slab vapor sample results indicated concentrations below MTCA Method B cleanup levels except for naphthalene, which was detected in one sub-slab vapor sample at a concentration of 3.6 micrograms per cubic meter (µg/m^3), above the cleanup level of 2.5 µg/m^3. Indoor air carbon range 5-8 and 9-12 aliphatics (maximum detected concentrations of 570 and 110 µg/m^3, respectively) were above the MTCA Method B cleanup level for generic TPH of 46 µg/m^3. Benzene and naphthalene (maximum detected concentrations of 0.93 and 0.85 µg/m^3, respectively) were above the cancer-based MTCA Method B cleanup levels for indoor air of 0.321 and 0.074 µg/m^3, respectively (RN 2024).

In **March 2024**, Broadbent collected the most recent set of water quality data from the monitoring well network (Broadbent 2024). Impacts above MTCA Method A cleanup levels were present in MW-1, MW-3, MW-6, MW-10, MW-11, MW-12, MW-13, and MW-15. The highest concentrations were detected in the sample from MW-1 (TPH-d, TPH-g, and benzene at 1,350, 19,900, and 3,450 micrograms per liter [µg/L], respectively).

In **April 2025**, Terraphase visited the Site and collected water level elevations using an oil/water interface probe. No free product was measured. Monitoring well MW-3 was filled with asphalt. MW-11 and RNMW-17 could not be located and may have been paved over. Figure 6 depicts the existing monitoring well network. Table 1 lists monitoring well screen intervals (where known) and groundwater elevations.

4 Conceptual Site Model

This section presents a conceptual site model describing the nature and extent of contamination based on previous environmental investigations. It reflects our current understanding of Site conditions and may be revised as additional data become available.

4.1 Contaminants of Concern

The following contaminants of concern (COCs) are identified at the Site based on their detection in one or more sampled media:

- **TPH**: TPH-g, TPH-d, and TPH-o have been detected in soil and groundwater at the Site. Aliphatic hydrocarbons were measured in indoor air samples collected from within the travel center building. Free product was historically measured in Site monitoring, extraction, and recovery wells.
- **VOCs:** BTEX has routinely been detected at concentrations above MTCA Method A cleanup levels. Other VOCs, including chlorinated solvents and the fuel additives tert-butyl alcohol, ethyl tert-butyl ether, and methyl tert -butyl ether, have not been detected.
- **Lead:** Lead has been detected in groundwater samples above MTCA Cleanup levels. Lead has also been detected in soil, though generally at low concentrations.
- **PAHs:** Naphthalene has been detected in soil and groundwater above MTCA Method A cleanup levels. Other PAHs (pyrene, acenaphthene, acenaphthylene, 1-methlynaphthalene, 2-methlynaphlathne, fluorene, benzo(a)pyrene, benzo(b+k)fluoranthene) have also been detected, though generally below applicable cleanup levels.

4.2 Sources of Contamination

Based on the history of environmental investigations at the Site, multiple releases have occurred. Figure 7 shows the approximate understanding of the Site release history, summarized below:

- Soil samples collected beneath the gasoline and diesel dispenser piping in 1996 indicated the presence of TPH-g and TPH-d, respectively, suggesting releases of gasoline and diesel occurred in these areas prior to 1996 (Allisto Engineering Group 1996).
- Soil samples collected in 2010 confirmed the presence of TPH-d and TPH-g near the diesel and gasoline fueling islands, respectively. Both compounds were also detected in a boring advanced downgradient of the USTs, suggesting a release occurred at the USTs prior to 2010 (B7; Figure 4 [Terracon 2010]). TPH-g and benzene were also present in soil samples (borings B10 and B11; Figure 4 [Terracon 2010]) collected near the diesel fueling island, which suggests a gasoline fuel release in this area. This area is upgradient of the gasoline piping and fuel dispensers. The 1996 samples were not analyzed for TPH-g near the diesel fuel dispensers. Sampling conducted near these borings in 2012 did not show detections of either compound; however, both TPH-g and TPH-d were detected southeast of borings B10 and B11 in proximity to the gasoline dispenser piping (DP-5; Figure 4 [Broadbent 2012]). Therefore, it is possible that the source of the TPH-g in this area is from piping near the northwestern side of the travel center building (Figure 7), with a release from at least 2010. The forensic analysis conducted on the excavation water sample in 2023 suggests these releases were prior to 2007.
- In 2018, a release of gasoline occurred at the southwestern auto fuel dispenser (Figure 7 [RN 2020]).
- Soil contamination was identified beneath the piping along the northwestern side of the travel center building and the UST area during the replacement of piping in July 2023 at the former location of the diesel canopy (Figure 7 [RN 2024]).

- A release of approximately 700 gallons of gasoline occurred in October 2023 (Figure 7 [RN 2024]).

Residual TPH and related compounds are likely adsorbed to soil in release areas that were not excavated in 2023 and in the "smear zone" created by rising and falling water levels, allowing dissolved-phase COCs to adsorb to soil.

Free product was historically measured in monitoring wells MW-1, MW-9, MW-10, and MW-15 (last measured in 2019, 2016, 2018, and 2015, respectively), and recovery wells RW-1 and RW-2 (last measured in 2020) and RW-3 and RW-4 (last measured in 2023). No free product was measured during the 2024 or 2025 monitoring events. The previous presence of free product in monitoring and recovery wells suggests the possibility that free product is present in unmonitored portions of the water table or adsorbed to soil above the water table, which would represent an additional source.

4.3 Extent of Contamination

The following summarizes the extent of soil, groundwater, and soil vapor contamination identified at the Site:

- **Soil:** Soil with impacts above cleanup levels are present along the north side of the travel center, at the western margin of the 2023 excavation, and in the UST area. Soil impacts are also likely present throughout the footprint of the groundwater plume, as evidenced by the detections in vadose zone samples within the smear zone (MW-9, MW-15, RW-1, and RW-2). Figure 8 depicts soil sample locations with one or more analyte above MTCA Method A cleanup levels.[4] Table 2 lists the soil samples and relevant exceedances. The full soil analytical data is included in Appendix B.
- **Groundwater:** Figures 9 through 11 depict the extent of TPH-d, TPH-g, and benzene above MTCA Method A cleanup levels based on the March 2024 groundwater sampling data. The extent of these compounds generally reflects the extent of related compounds (i.e., toluene, ethylbenzene, xylenes, and naphthalene). The area of TPH-d above cleanup levels is limited to the immediate area around the travel center. TPH-g impacted groundwater extends further southwest than TPH-d impacted groundwater. Benzene extends at least as far southwest as monitoring well MW-12. All three COCs likely exist in groundwater beneath the UST area. The extent of TPH-g, TPH-d, and benzene to the northeast and TPH-g and benzene to the southwest are unknown.
- **Soil Vapor:** COCs are likely present in soil vapor in areas of soil and groundwater contamination. COCs with the potential to volatilize include BTEX and naphthalene. Benzene concentrations in groundwater above the MTCA Method B screening level for vapor intrusion to buildings include areas beneath the travel center and the Grassroots Grill. The extent of impacts to soil vapor can be assumed to include the entirety of the groundwater plume. There is also the possibility that soil vapor is present within vadose zone utility backfill in areas outside the footprint of the groundwater and soil contamination. Naphthalene is also above the vapor intrusion-based cleanup level for groundwater at monitoring well MW-15, which suggests a potential risk of naphthalene vapor

[4] Many of the soil samples with exceedances were within the area excavated in 2023 during the diesel piping replacement and canopy relocation work. These samples are not included on Figure 8, as soil related to these detections has been excavated and disposed of off Site.

intrusion at the travel center. In October 2023, sub-slab vapor samples were collected at four locations within the travel center. Indoor air samples were collected at the same time. Detected concentrations in the sub-slab samples were generally similar to the indoor air samples (Appendix B3), suggesting that the indoor air detections may not have been due to vapor intrusion. The building was not sealed during sampling and is an active fueling center, thus detections in indoor air could be due to vapors migrating from fueling operations. One exception potentially indicative of vapor intrusion is naphthalene, which was detected in two sub-slab samples at concentrations 2 to 10 times the indoor air sample concentrations. However, default attenuation factors assume a reduction of approximately 30-fold between soil vapor and indoor air. Therefore, the detected sub-slab concentrations using this conservative attenuation factor would account for only 10 to 30 percent of the indoor air concentrations. Although the October 2023 data did not definitively indicate vapor intrusion at the travel center, a single sampling event cannot rule out exposure under different meteorological conditions.

4.4 Potential Exposure Pathways

Figure 12 depicts a conceptual model of contamination sources, transport mechanisms, exposure media, exposure route, potential receptors, and whether exposure pathways are considered incomplete or potentially complete. The primary source of COCs is a direct release of fuel to subsurface soil or groundwater and continued release from residual free product, if present. Subsurface soil can leach COCs to groundwater or rising and falling groundwater can cause COCs to adsorb to subsurface soil within the smear zone. Groundwater with dissolved-phase COCs can discharge to surface water. COCs in residual free product, subsurface soil, and groundwater can volatize to soil vapor, which can enter outdoor and indoor air. A summary of the receptor evaluation is included below:

- Residential receptors: The Site is zoned for highway commercial use and there are no current or planned future residential developments within the footprint of site-related contamination. Drinking water is not sourced from the shallowest alluvial aquifer. Therefore, the residential exposure pathway is considered incomplete for current and future Site uses.
- Occupational receptors: The Site and neighboring Grassroots Grill are used for commercial purposes. Soil and groundwater contamination is below ground surface and not used as drinking water at the Site or nearby; therefore, the dermal contact and ingestion pathways are considered incomplete. However, both current and future occupational receptors could potentially inhale COCs that have migrated from soil vapor to indoor or outdoor air. Sub-slab vapor samples collected in 2023 at the travel center did not indicate vapor intrusion based on results below MTCA Method B screening levels; however, one sample event is not sufficient to rule out vapor intrusion. These pathways are also considered complete for current and future travel center and restaurant customers, though the duration of exposure for these receptors would be much less than the Site or restaurant employees. If active construction and excavation work is occurring, occupational receptors could come in contact with exposed contaminated soil or groundwater, though exposure would be minimal if proper safety precautions are implemented.

- Construction/Excavation Worker: There is no current construction at the Site. Future construction or excavation work could potentially expose contaminated subsurface soil or groundwater, leading to direct contact with these media. These workers could also potentially inhale impacted outdoor air.
- Plants: Plant roots could potentially draw COCs into plant tissue from shallow groundwater or from surface water.
- Other ecological receptors: Aquatic life and invertebrates within Reecer Creek could potentially be exposed to impacted surface water. Birds and mammals could potentially drink from Reecer Creek. Therefore, these pathways are considered potentially complete for current or future receptors.

4.5 Data Gaps

The following data gaps have been identified in our review of previous Site investigation data:

- **Soil:**
  - A confirmation sample following the 2023 soil excavation activities at the commercial truck fueling area had concentrations of COCs generally lower than MTCA Method A cleanup levels. However, several soil samples had concentrations above cleanup levels, particularly along the western boundary of the excavation. Excavation further west was in 2023 as the excavation did not extend beyond the former diesel piping re-work project area. Figure 8 depicts soil sample locations with concentration above MTCA Method A cleanup levels. The extent of soil impacts to the west of the 2023 excavation limits, and the possibility that there may be a residual source in soil within the 2023 excavation limits, are data gaps.
  - Soil samples collected north of the travel center and within unexcavated portions of the UST area had concentrations of COCs above MTCA Method A cleanup levels (Figure 8). The extent of soil impacts to the northeast and north of the travel center building and UST area, respectively, is a data gap.
- **Groundwater:**
  - The furthest downgradient sample point in the existing monitoring well network is MW-12, which had a detected benzene concentration 32.7 µg/L in the most recent groundwater monitoring event (March 2024; Figure 11), which is above the MTCA Method A cleanup level of 5 µg/L. TPH-g has also been detected in this well at concentrations up to 1,400 µg/L and above the MTCA Method A cleanup level of 800 µg/L in six of the eight sampling events. The extent of groundwater with impacts from COCs downgradient (south–-southwest) of MW-12 is unknown.
  - Groundwater has not been recently monitored in the area northeast of the travel center. The quality of groundwater in this area is considered a data gap.
  - Groundwater samples collected in 1996 were not detected above the laboratory reporting limits for lead or had low concentrations (Appendix B2). However, a dissolved lead sample collected in 2018 had a detected concentration of 46 µg/L, which is above the MTCA Method A cleanup level of 15 µg/L. Additional data is needed to rule out lead as a COC for groundwater.

- **Soil Vapor/Air:**
  - Insufficient data has been collected to evaluate occupational receptor exposure to COCs via the vapor intrusion pathway. Coupled indoor air and sub-slab vapor sampling at the travel center building in 2023 did not definitively indicate vapor intrusion conditions (Appendix B3). However, the atmospheric conditions at the time of sampling may not have been conducive to vapor intrusion (i.e., the pressure within the travel center building may not have been lower than surrounding atmospheric pressure). Additional indoor air and sub-slab sampling is warranted to assess the potential for vapor intrusion during different atmospheric conditions.
  - Benzene has been detected in groundwater samples collected from MW-12 and MW-13 above the MTCA Method B cleanup level for the vapor intrusion from groundwater of 2.4 µg/L (Appendix B2), indicating the potential for vapor intrusion to the GrassRoots Grill. The quality of soil vapor and indoor air at the GrassRoots Grill is unknown.
- **Surface Water/Sediment:** The bioswale at the northeastern corner of the Site had sediment with COCs above cleanup levels in 2010. The sediment was removed; however, no confirmation sampling was conducted. The bioswale discharges to Reecer Creek near the bioswale. The quality of surface water and sediment adjacent to the bioswale discharge is unknown.

5 Scope of Work

This section outlines the proposed scope of work to address the identified data gaps and complete the remedial investigation phase of the project. Details on sampling methodology are included in the *Sampling and Analysis Plan* (SAP) included as Appendix C. Quality assurance/quality control procedures to be followed during implementation, anticipated laboratory reporting limits, and method-specific sample requirements are described in the *Quality Assurance Project Plan* included as Appendix D. Health and safety procedures are described in the *Health and Safety Plan* included as Appendix E.

5.1 Soil Borings

Soil borings will be advanced as detailed in the SAP at the locations depicted on Figure 13 and described below:

- Borings TE-01 through TE-05 will be advanced to assess the quality of soil west of the 2023 excavation footprint. Two soil samples will be collected from each boring and submitted for analysis of TPH-g, TPH-d, MTCA VOCs, lead, and PAHs. One soil sample will be collected at the soil-groundwater interface., and potentially an additional sample will be collected closer to the surface (from the upper 5 feet bgs), if warranted. If contamination is evident based on field observations (visual, olfactory, photoionization detector results) or laboratory analytical results indicate concentrations detected above MTCA Method A cleanup levels, additional borings (TE-12 through TE-16) will be advanced 20 feet west of TE-01 through TE-05. This process will be repeated until detected concentrations of COCs are below cleanup levels.

No groundwater samples will be collected from these temporary borings as groundwater west of the excavation extent is monitored by existing monitoring wells MW-7 and MW-8, and groundwater flow direction is generally to the south/southwest in the direction of existing monitoring wells MW-1, MW-9, and MW-10.

- Borings TE-06 through TE-08 will be advanced to the northeast of the travel center, between the commercial truck fueling islands and the UST area. Two soil samples will be collected from each boring (one soil from the upper 5 feet bgs and one from the soil-groundwater interface) and submitted for analysis of TPH-g, TPH-d, MTCA VOCs, lead, and PAHs. If contamination is evident based on field observations (visual, olfactory, photoionization detector results) or laboratory analytical results indicate concentrations detected above MTCA Method A cleanup levels, additional borings (TE-17 through TE-19) will be advanced 20 feet northeast of TE-06 through TE-09. This process will be repeated until soil impacts are below cleanup levels.

  Groundwater samples will be collected from temporary wells installed within these borings as detailed in the SAP, with screen intervals extending at least 1 foot above the apparent water table. Groundwater samples will be collected as detailed in the SAP and analyzed for TPH-g, TPH-d, MTCA VOCs, total and dissolved lead, and PAHs.
- Borings TE-09 through TE-11 will be advanced within the footprint of the 2023 excavation footprint to assess current conditions and the extent of residual source in soil and/or groundwater. Borings TE-09 and TE-11 will be advanced in areas in which soil samples with detections of COCs above screening criteria were not over-excavated. Boring TE-10 will be advanced beneath the former diesel piping in the approximate location of the water sample that was collected from the excavation to assess TPH release timing (Section 3). Two soil samples will be collected from each boring (one from the upper 5 feet bgs and one from the soil-groundwater interface) and submitted for analysis of TPH-g, TPH-d, MTCA VOCs, lead, and PAHs.

  Groundwater samples will be collected from temporary wells installed within these borings as detailed in the SAP, with screen intervals extending at least 1 foot above the apparent water table. Groundwater samples will be collected as detailed in the SAP and analyzed for TPH-g, TPH-d, MTCA VOCs, total and dissolved lead, and PAHs.

Based on analytical results, at least three soil samples – one from the highest 10% TPH concentration range, one from the lowest 10% TPH concentration range, and one from the median TPH concentration range (+/- 10% of the median) – will be analyzed for extractable and volatile petroleum hydrocarbons (EPH-VPH) to evaluate the potential for site specific CULs.

5.2 Monitoring Wells

Monitoring wells will be installed using hollow-stem auger drilling methods as detailed in the SAP. Monitoring wells will be installed at the locations depicted on Figure 13 as described below:

- MW-18 will be installed between MW-7 and MW-10 as close to US Route 97 as feasible to assess the quality of groundwater in this area.

- MW-19 will be installed southwest of MW-11, and west of MW-12 as close to US Route 97 as feasible, to assess the quality of groundwater at the farthest downgradient (southwest) extent of the Site.
- MW-20 will be installed west of Grass Roots Grill, within the east sidewalk along US Route 97 to assess the quality of groundwater downgradient of the Site. If installing a well at this location is not feasible due to Washington Department of Transportation permitting requirements or utilities, an alternative location will be assessed.

At least 48 hours after installation, the monitoring wells will be developed as detailed in the SAP. Monitoring well ground surface and top of casing elevations will be surveyed by a Washington State licensed surveyor and tied to the existing monitoring well network.

5.3 Groundwater Monitoring

Quarterly monitoring will be conducted following monitoring well installation for a minimum of 4 quarters. Efforts will be made to remove the asphalt from MW-3 and locate and restore MW-11 and RNMW-17. The presence or absence of free product and the depth to the water table will be measured in each accessible monitoring and remediation well (Figure 13). Groundwater samples will be collected from each accessible well using low-flow sampling methods as detailed in the SAP and submitted for analysis of TPH-g, TPH-d, MTCA VOCs, and PAHs each quarter. Total and dissolved lead will be analyzed in the first monitoring event. If present above MTCA Method A cleanup levels, total/dissolved lead will be added as a regularly monitored analyte.

Pressure transducers will be placed in at least one Site monitoring well and programmed to collect pressure measurements once per day for 1 year to assess seasonal fluctuations of water levels. Slug testing may be performed at one or more monitoring wells to provide an estimate of hydraulic conductivity in first groundwater.

5.4 Soil Vapor Sampling

Soil-vapor wells (TSV-01 through TSV-03; Figure 13) will be installed along the northern side of GrassRoots Grill to assess the potential for vapor intrusion into the restaurant. Borings will be advanced to 5 feet bgs as detailed in the SAP. Well screens will be placed at 4.5 feet bgs, 1.5 feet above shallowest groundwater recorded in nearby MW-12. Soil-vapor wells will be sampled as detailed in the SAP and analyzed for MTCA VOCs and naphthalene using EPA Method TO-15, aromatic and aliphatic TPH using EPA Method TO-15/MA-APH Modified, and helium and oxygen using ASTM D-1946.

The existing vapor pins (VP1 through VP-4; Figure 13) will be sampled coincident with the collection of 8-hour indoor air samples (VP1-AS through VP4-AS) and an upwind outdoor air sample (OA1) using the protocols detailed in the SAP. Samples will be analyzed for MTCA VOCs and naphthalene using EPA Method TO-15 and aromatic and aliphatic TPH by EPA Method TO-15/Massachusetts- Air Phase Petroleum Hydrocarbons Modified.

5.5 Sediment and Surface Water Sampling

Sediment and collocated surface water samples will be collected at the discharge point from the Site stormwater system (bioswale) and at points upstream and downstream of the discharge (SS-01 through SS-03 and SS-01-SW through SS-03-SW, respectively; Figure 13) using procedures detailed in the SAP. Samples will be analyzed for TPH-d, TPH-g, TPH-o, MTCA VOCs, and PAHs.

These samples will assess the potential for ecological impacts from Site-related contamination.

6 Data Evaluation and Reporting

Upon completing the scope of work described in Section 5, Terraphase will prepare a remedial investigation report consistent with the requirements of MTCA as described in WAC 173-340-350(7) and 173-340-840.[5] The report will contain the results of the soil, groundwater, soil vapor, air, sediment, and surface water sampling; an updated conceptual site model; proposed cleanup levels; a summary of deviations from the Work Plan; boring logs; cross-sections; analytical laboratory reports; and data validation reports. As appropriate, tables and figures will be prepared to summarize the findings. A terrestrial ecological evaluation will be included as an appendix.

The remedial investigation report will include a preliminary screening of potential cleanup action alternatives and propose additional data needed to aid in cleanup action selection. Additional data may include parameters indicative of natural attenuation and testing of hydrogeologic parameters (porosity, hydraulic conductivity, etc.). Cleanup action alternatives likely to be considered include monitored natural attenuation, soil excavation and removal, soil-vapor extraction, chemical injection, bioaugmentation, ozone/air sparge, and groundwater pump and treat.

7 Schedule

Consistent with the Agreed Order, field work will commence within 120 days of Ecology's acceptance of the Work Plan. The remedial investigation report will be submitted to Ecology within 90 days of receipt of laboratory analytical data from the activities described in Sections 5.

8 Limitations

This document was prepared solely for Love's in accordance with professional standards at the time the services were performed. We have relied on information or instructions provided by Love's and other

[5] "General submittal requirements." https://app.leg.wa.gov/wac/173-340-840.

parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

9 References

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Tables

1 Groundwater Elevation

2 Soil Analytical Results – Compounds with Detections Above MTCA Method A Cleanup Levels

Table 1
Groundwater Elevation
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

Well	Screen Interval (ft-bgs)	Top of Casing Elevation (ft-amsl)	Gauging Date	Water Depth (ft-btoc)	Product Depth (ft-btoc)	Groundwater Elevation (ft-amsl)
MW-1	Unknown	1539.68	11/9/1995	8.54	-	1531.14
			7/24/1996	5.87	-	1533.81
			12/16/2010	7.70	-	1531.98
			3/18/2011	7.90	-	1531.78
			6/7/2011	6.63	-	1533.05
			8/25/2011	6.86	-	1532.82
			11/16/2011	8.79	-	1530.89
			3/8/2012	8.24	-	1531.44
			5/9/2012	6.66	-	1533.02
			9/22/2012	7.80	-	1531.88
			12/7/2012	8.59	-	1531.09
			3/7/2013	8.63	-	1531.05
			6/12/2013	6.92	-	1532.76
			8/27/2013	6.86	-	1532.82
			12/11/2013	8.89	-	1530.79
			3/25/2014	8.51	-	1531.17
			6/16/2014	6.86	-	1532.82
			8/19/2014	6.81	-	1532.87
			11/17/2014	8.17	-	1531.51
			3/20/2015	8.89	8.81	1530.79
			6/17/2015	7.97	-	1531.71
			9/24/2015	7.24	-	1532.44
			12/8/2015	8.31	-	1531.37
			3/10/2016	4.68	-	1535.00
			6/16/2016	7.14	-	1532.54
			9/22/2016	7.73	-	1531.95
			11/17/2016	7.93	-	1531.75
			3/23/2017	6.21	-	1533.47
			6/22/2017	7.15	-	1532.53
			9/20/2017	6.96	-	1532.72
			12/7/2017	7.99	-	1531.69
			3/19/2018	8.23	-	1531.45
			6/22/2018	6.35	-	1533.33
			9/26/2018	6.32	-	1533.36
			11/29/2018	8.67	8.66	1531.01
			3/20/2019	6.94	-	1532.74
			6/11/2019	8.29	-	1531.39
			9/22/2019	6.65	-	1533.03
			11/13/2019	10.09	9.93	1529.59
			3/25/2020	8.84	-	1530.84
			6/23/2020	6.75	-	1532.93

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MW-1	Unknown	1539.68	9/23/2020	6.10	-	1533.58
			12/9/2020	7.51	-	1532.17
			3/24/2021	8.10	-	1531.58
			6/15/2021	6.30	-	1533.38
			9/28/2021	6.81	-	1532.87
			12/8/2021	8.14	-	1531.54
			3/22/2022	8.20	-	1531.48
			6/22/2022	3.98	-	1535.70
			9/20/2022	5.82	-	1533.86
			12/20/2022	9.60	-	1530.08
			3/9/2023	8.61	-	1531.07
			6/28/2023	6.27	-	1533.41
			9/21/2023	6.90	-	1532.78
			12/9/2023	7.59	-	1532.09
			3/15/2024	8.49	-	1531.19
MW-2	Unknown	1539.61	11/9/1995	8.24	6.68	1531.37
			7/24/1996	5.37	7.30	1534.24
MW-3	Unknown	1538.93	11/9/1995	7.72	-	1531.21
			7/24/1996	5.22	-	1533.71
			12/16/2010	8.49	-	1530.44
			3/18/2011	7.03	-	1531.90
			6/7/2011	5.76	-	1533.17
			8/25/2011	5.99	-	1532.94
			11/16/2011	7.92	-	1531.01
			3/8/2012	7.34	-	1531.59
			5/9/2012	5.78	-	1533.15
			9/22/2012	6.91	-	1532.02
			12/7/2012	7.75	-	1531.18
			3/7/2013	7.81	9.25	1531.12
			6/12/2013	6.03	-	1532.90
			8/27/2013	5.96	-	1532.97
			12/11/2013	8.05	-	1530.88
			3/25/2014	7.61	-	1531.32
			6/16/2014	6.04	-	1532.89
			8/19/2014	6.02	-	1532.91
			11/17/2014	7.30	-	1531.63
			3/20/2015	7.84	-	1531.09
			6/17/2015	7.08	-	1531.85
			9/24/2015	6.40	-	1532.53
			12/8/2015	7.65	-	1531.28
			3/10/2016	4.79	-	1534.14
			3/23/2016	5.29	-	1533.64
			6/16/2016	6.24	-	1532.69

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MW-3	Unknown	1538.93	9/22/2016	6.49	-	1532.44
			11/16/2016	7.06	-	1531.87
			6/22/2017	6.32	-	1532.61
			9/20/2017	6.09	-	1532.84
			12/7/2017	7.10	-	1531.83
			3/18/2018	7.35	-	1531.58
			6/21/2018	5.33	-	1533.60
			9/26/2018	5.50	-	1533.43
			11/28/2018	7.81	-	1531.12
			3/20/2019	5.68	-	1533.25
			6/11/2019	7.61	-	1531.32
			9/22/2019	5.72	-	1533.21
			11/13/2019	8.92	-	1530.01
			3/24/2020	7.92	-	1531.01
			6/23/2020	5.90	-	1533.03
			9/23/2020	5.31	-	1533.62
			12/8/2020	7.61	-	1531.32
			3/24/2021	7.21	-	1531.72
			6/14/2021	5.52	-	1533.41
			9/28/2021	5.94	-	1532.99
			12/7/2021	7.29	8.81	1531.64
			3/22/2022	6.26	-	1532.67
			6/22/2022	4.93	-	1534.00
			9/20/2022	4.81	-	1534.12
			3/9/2023	7.69	-	1531.24
			6/28/2023	5.31	-	1533.62
			9/21/2023	6.06	-	1532.87
			12/9/2023	6.72	-	1532.21
			3/14/2024	7.12	-	1531.81
MW-4	4-19	1536.48	7/24/1996	7.12	-	1529.36
MW-5	4-12	1535.02	7/24/1996	5.07	-	1529.95
MW-6	Unknown	1539.13	12/16/2010	8.11	-	1531.02
			3/18/2011	7.54	-	1531.59
			6/7/2011	6.25	-	1532.88
			8/25/2011	6.45	-	1532.68
			11/16/2011	8.41	-	1530.72
			3/8/2012	7.86	-	1531.27
			5/9/2012	6.35	-	1532.78
			9/22/2012	7.47	-	1531.66
			12/7/2012	8.23	-	1530.90
			3/7/2013	8.23	-	1530.90
			6/12/2013	6.62	-	1532.51
			8/27/2013	6.52	-	1532.61

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Well	Screen Interval (ft-bgs)	Top of Casing Elevation (ft-amsl)	Gauging Date	Water Depth (ft-btoc)	Product Depth (ft-btoc)	Groundwater Elevation (ft-amsl)
MW-6	Unknown	1539.13	12/11/2013	8.49	-	1530.64
			3/25/2014	8.14	-	1530.99
			6/16/2014	6.53	-	1532.60
			8/19/2014	6.49	-	1532.64
			11/17/2014	7.77	-	1531.36
			3/20/2015	8.28	-	1530.85
			6/17/2015	7.66	-	1531.47
			9/24/2015	6.84	-	1532.29
			12/8/2015	8.11	-	1531.02
			3/10/2016	5.41	-	1533.72
			6/16/2016	6.68	-	1532.45
			9/22/2016	6.95	-	1532.18
			11/16/2016	7.53	-	1531.60
			3/23/2017	3.93	-	1535.20
			6/22/2017	6.82	-	1532.31
			9/20/2017	6.62	-	1532.51
			12/7/2017	7.66	-	1531.47
			3/18/2018	7.85	-	1531.28
			6/21/2018	5.85	-	1533.28
			9/26/2018	5.99	-	1533.14
			11/29/2018	8.28	-	1530.85
		1538.82	3/25/2021	7.41	-	1531.41
			6/15/2021	5.55	-	1533.27
			9/28/2021	6.15	-	1532.67
			3/22/2022	7.20	-	1531.62
			6/22/2022	5.14	-	1533.68
			12/20/2022	7.91	-	1530.91
			3/9/2023	7.65	-	1531.17
			6/27/2023	5.51	-	1533.31
			9/20/2023	6.23	-	1532.59
			12/8/2023	6.95	-	1531.87
			3/14/2024	7.36	-	1531.46
MW-7	4-14	1540.28	8/19/2014	6.43	-	1533.85
			11/17/2014	6.60	-	1533.68
			3/20/2015	8.76	-	1531.52
			6/17/2015	6.75	-	1533.53
			9/24/2015	6.55	-	1533.73
			12/8/2015	8.64	-	1531.64
			3/10/2016	5.52	-	1534.76
			6/16/2016	7.22	-	1533.06
			9/22/2016	7.82	-	1532.46
			11/17/2016	8.43	-	1531.85
			3/23/2017	6.78	-	1533.50

Table 1
Groundwater Elevation
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Well	Screen Interval (ft-bgs)	Top of Casing Elevation (ft-amsl)	Gauging Date	Water Depth (ft-btoc)	Product Depth (ft-btoc)	Groundwater Elevation (ft-amsl)
MW-7	4-14	1540.28	6/22/2017	6.56	-	1533.72
			9/20/2017	7.16	-	1533.12
			12/7/2017	8.51	-	1531.77
			3/19/2018	8.80	-	1531.48
			6/21/2018	6.36	-	1533.92
			9/26/2018	6.68	-	1533.60
			11/29/2018	9.19	-	1531.09
			3/20/2019	5.60	-	1534.68
			6/11/2019	8.53	-	1531.75
			9/22/2019	6.79	-	1533.49
			11/13/2019	10.32	-	1529.96
			3/24/2020	9.31	-	1530.97
			6/23/2020	7.11	-	1533.17
			9/23/2020	6.12	-	1534.16
			12/9/2020	8.90	-	1531.38
			3/24/2021	8.52	-	1531.76
			6/15/2021	6.75	-	1533.53
			9/28/2021	6.28	-	1534.00
			12/7/2021	8.71	-	1531.57
			3/22/2022	8.72	-	1531.56
			6/22/2022	6.44	-	1533.84
			9/20/2022	6.22	-	1534.06
			3/9/2023	9.15	-	1531.13
			6/27/2023	6.41	-	1533.87
			9/20/2023	6.45	-	1533.83
			12/8/2023	7.57	-	1532.71
			3/14/2024	8.15	-	1532.13
MW-8	4-14	1539.17	8/19/2014	6.11	-	1533.06
			11/17/2014	7.49	-	1531.68
			3/20/2015	8.01	-	1531.16
			6/17/2015	7.23	7.22	1531.94
			9/24/2015	6.52	6.58	1532.65
			12/8/2015	7.65	5.80	1531.52
			3/10/2016	5.13	7.08	1534.04
			6/16/2016	6.41	-	1532.76
			9/22/2016	6.65	-	1532.52
			11/16/2016	7.25	-	1531.92
			3/23/2017	5.58	-	1533.59
			6/22/2017	6.42	-	1532.75
			9/20/2017	6.27	-	1532.90
			12/7/2017	7.32	-	1531.85
			3/19/2018	7.57	-	1531.60
			6/22/2018	5.63	-	1533.54

Table 1
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Well	Screen Interval (ft-bgs)	Top of Casing Elevation (ft-amsl)	Gauging Date	Water Depth (ft-btoc)	Product Depth (ft-btoc)	Groundwater Elevation (ft-amsl)
MW-8	4-14	1539.17	9/26/2018	6.20	-	1532.97
			11/29/2018	8.00	-	1531.17
			3/20/2019	6.24	-	1532.93
			6/11/2019	7.66	-	1531.51
			9/22/2019	5.87	-	1533.30
			11/13/2019	10.26	-	1528.91
			3/25/2020	8.12	-	1531.05
			6/23/2020	6.02	-	1533.15
			9/23/2020	5.41	-	1533.76
			12/9/2020	7.85	-	1531.32
			3/24/2021	7.46	-	1531.71
			6/15/2021	5.64	-	1533.53
			9/28/2021	6.17	-	1533.00
			12/8/2021	8.54	-	1530.63
			3/22/2022	8.57	-	1530.60
			6/22/2022	5.11	-	1534.06
			9/20/2022	5.06	-	1534.11
			3/9/2023	8.01	-	1531.16
			6/27/2023	5.49	-	1533.68
			9/20/2023	6.23	-	1532.94
			12/8/2023	6.98	-	1532.19
			3/15/2024	7.41	-	1531.76
MW-9	4-14	1539.21	8/19/2014	6.15	-	1533.06
			11/17/2014	7.53	-	1531.68
			3/20/2015	8.04	-	1531.17
			6/17/2015	7.28	-	1531.93
			9/24/2015	6.54	-	1532.67
			12/8/2015	7.68	-	1531.53
			3/10/2016	4.96	-	1534.25
			6/16/2016	6.51	-	1532.70
			9/22/2016	6.70	-	1532.51
			11/17/2016	7.31	-	1531.90
			3/23/2017	5.62	-	1533.59
			6/22/2017	6.48	-	1532.73
			9/20/2017	6.29	-	1532.92
			12/7/2017	7.36	-	1531.85
			3/19/2018	7.60	-	1531.61
			6/22/2018	5.70	-	1533.51
			9/26/2018	5.71	-	1533.50
			11/29/2018	8.03	-	1531.18
			3/20/2019	6.17	-	1533.04
			6/11/2019	7.81	-	1531.40
			9/22/2019	5.50	-	1533.71

Table 1
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Well	Screen Interval (ft-bgs)	Top of Casing Elevation (ft-amsl)	Gauging Date	Water Depth (ft-btoc)	Product Depth (ft-btoc)	Groundwater Elevation (ft-amsl)
MW-9	4-14	1539.21	11/13/2019	9.28	-	1529.93
			3/25/2020	8.18	-	1531.03
			6/23/2020	6.10	-	1533.11
			9/23/2020	5.47	-	1533.74
			12/9/2020	7.70	-	1531.51
			3/24/2021	7.26	-	1531.95
			6/15/2021	5.68	-	1533.53
			9/28/2021	6.17	-	1533.04
			12/8/2021	7.35	-	1531.86
			3/22/2022	7.50	-	1531.71
			6/22/2022	5.16	-	1534.05
			9/20/2022	5.09	-	1534.12
			12/20/2022	7.96	-	1531.25
			3/9/2023	8.00	-	1531.21
			6/27/2023	5.54	-	1533.67
			9/21/2023	6.28	-	1532.93
			12/8/2023	6.99	-	1532.22
			3/15/2024	7.44	-	1531.77
MW-10	4-14	1539.64	8/19/2014	7.00	-	1532.64
			11/17/2014	8.33	-	1531.31
			3/20/2015	8.82	-	1530.82
			6/17/2015	8.11	-	1531.53
			9/24/2015	7.29	-	1532.35
			12/8/2015	8.66	-	1530.98
			3/10/2016	6.02	-	1533.62
			6/16/2016	7.33	-	1532.31
			9/22/2016	7.53	-	1532.11
			11/16/2016	8.12	-	1531.52
			3/23/2017	6.62	-	1533.02
			6/22/2017	7.33	-	1532.31
			9/20/2017	7.22	-	1532.42
			12/7/2017	8.21	-	1531.43
			3/19/2018	8.44	-	1531.20
			6/22/2018	6.95	-	1532.69
			9/26/2018	7.07	-	1532.57
			11/29/2018	9.06	-	1530.58
			3/20/2019	7.39	-	1532.25
			6/11/2019	8.18	-	1531.46
			9/22/2019	6.92	-	1532.72
			11/13/2019	10.26	-	1529.38
			3/24/2020	8.94	-	1530.70
			6/23/2020	6.90	-	1532.74
			9/23/2020	6.89	-	1532.75

Table 1
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Well	Screen Interval (ft-bgs)	Top of Casing Elevation (ft-amsl)	Gauging Date	Water Depth (ft-btoc)	Product Depth (ft-btoc)	Groundwater Elevation (ft-amsl)
MW-10	4-14	1539.64	12/8/2020	8.64	-	1531.00
			3/24/2021	8.30	-	1531.34
			6/15/2021	6.41	-	1533.23
			9/28/2021	6.95	-	1532.69
			12/7/2021	8.36	-	1531.28
			3/22/2022	8.40	-	1531.24
			6/22/2022	5.95	-	1533.69
			9/20/2022	6.04	-	1533.60
			3/9/2023	8.84	-	1530.80
			6/27/2023	6.37	-	1533.27
			9/20/2023	7.10	-	1532.54
			12/8/2023	7.87	-	1531.77
			3/14/2024	8.25	-	1531.39
MW-11	4-14	1539.77	8/19/2014	7.19	-	1532.58
			11/17/2014	8.53	-	1531.24
			3/20/2015	9.03	-	1530.74
			6/17/2015	8.35	-	1531.42
			9/24/2015	7.46	-	1532.31
			12/8/2015	8.66	-	1531.11
			3/10/2016	6.27	-	1533.50
			6/16/2016	7.58	-	1532.19
			9/22/2016	7.74	-	1532.03
			11/16/2016	8.34	-	1531.43
			3/23/2017	7.82	-	1531.95
			6/22/2017	7.55	-	1532.22
			9/20/2017	7.41	-	1532.36
			12/7/2017	8.45	-	1531.32
			3/19/2018	8.66	-	1531.11
			6/22/2018	6.77	-	1533.00
			9/26/2018	6.76	-	1533.01
			11/29/2018	9.07	-	1530.70
			6/11/2019	8.38	-	1531.39
			9/22/2019	7.13	-	1532.64
			11/13/2019	10.61	-	1529.16
			3/25/2020	9.18	-	1530.59
			6/23/2020	7.13	-	1532.64
			9/23/2020	6.39	-	1533.38
			12/8/2020	8.84	-	1530.93
			3/24/2021	8.50	-	1531.27
			6/15/2021	6.58	-	1533.19
			9/28/2021	7.15	-	1532.62
			12/8/2021	8.50	-	1531.27
			3/22/2022	8.57	-	1531.20

Table 1
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Well	Screen Interval (ft-bgs)	Top of Casing Elevation (ft-amsl)	Gauging Date	Water Depth (ft-btoc)	Product Depth (ft-btoc)	Groundwater Elevation (ft-amsl)
MW-11	4-14	1539.77	6/22/2022	6.17	-	1533.60
			9/20/2022	6.28	-	1533.49
			12/20/2022	6.07	-	1533.70
			3/9/2023	9.07	-	1530.70
			6/27/2023	6.58	-	1533.19
			9/21/2023	7.36	-	1532.41
			12/9/2023	8.09	-	1531.68
			3/15/2024	8.51	-	1531.26
MW-12	Unknown	1539.96	3/25/2021	9.10	-	1530.86
			6/15/2021	6.94	-	1533.02
			9/28/2021	7.58	-	1532.38
			12/8/2021	8.98	-	1530.98
			3/22/2022	9.05	-	1530.91
			6/22/2022	6.62	-	1533.34
			9/20/2022	8.01	-	1531.95
			3/8/2023	9.56	-	1530.40
			6/27/2023	7.04	-	1532.92
			9/20/2023	7.79	-	1532.17
			12/8/2023	8.54	-	1531.42
			3/14/2024	8.99	-	1530.97
MW-13	Unknown	1538.92	3/25/2021	8.63	-	1530.29
			6/15/2021	6.71	-	1532.21
			9/28/2021	6.30	-	1532.62
			12/8/2021	7.81	-	1531.11
			3/22/2022	7.66	-	1531.26
			6/22/2022	5.31	-	1533.61
			9/20/2022	5.35	-	1533.57
			3/8/2023	8.12	-	1530.80
			6/27/2023	5.72	-	1533.20
			9/20/2023	6.47	-	1532.45
			12/8/2023	7.18	-	1531.74
			3/14/2024	7.77	-	1531.15
MW-14	Unknown	1537.87	3/25/2021	6.48	-	1531.392
			6/15/2021	4.68	-	1533.19
			9/28/2021	5.21	-	1532.66
			12/8/2021	6.49	-	1531.38
			3/22/2022	6.55	-	1531.32
			6/22/2022	4.23	-	1533.64
			9/20/2022	4.15	-	1533.72
			6/27/2023	4.58	-	1533.29
			9/20/2023	5.22	-	1532.65
			12/9/2023	5.98	-	1531.89
			3/14/2024	6.37	-	1531.50

Table 1
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Well	Screen Interval (ft-bgs)	Top of Casing Elevation (ft-amsl)	Gauging Date	Water Depth (ft-btoc)	Product Depth (ft-btoc)	Groundwater Elevation (ft-amsl)
MW-15	4-14	1538.23	8/19/2014	5.50	-	1532.73
			11/17/2014	6.80	-	1531.43
			3/20/2015	7.28	-	1530.95
			6/17/2015	6.59	-	1531.64
			9/24/2015	5.82	-	1532.41
			12/8/2015	7.11	-	1531.12
			3/10/2016	4.20	-	1534.03
			6/16/2016	5.71	-	1532.52
			9/22/2016	5.96	-	1532.27
			11/17/2016	6.54	-	1531.69
			3/23/2017	4.88	-	1533.35
			6/22/2017	5.87	-	1532.36
			9/20/2017	5.65	-	1532.58
			12/7/2017	6.65	-	1531.58
			6/21/2018	4.91	-	1533.32
			9/26/2018	5.07	-	1533.16
			11/28/2018	7.33	-	1530.90
			3/18/2019	6.86	-	1531.37
			3/20/2019	5.25	-	1532.98
			6/11/2019	7.00	-	1531.23
			9/22/2019	5.34	-	1532.89
			11/13/2019	8.52	-	1529.71
			3/24/2020	7.45	-	1530.78
			6/23/2020	5.46	-	1532.77
			9/22/2020	4.89	-	1533.34
			12/8/2020	7.13	-	1531.10
			3/24/2021	6.77	-	1531.46
			6/14/2021	5.01	-	1533.22
			9/28/2021	5.51	-	1532.72
			12/7/2021	6.81	-	1531.42
			3/21/2022	6.80	-	1531.43
			6/22/2022	4.51	-	1533.72
			9/20/2022	4.40	-	1533.83

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Well	Screen Interval (ft-bgs)	Top of Casing Elevation (ft-amsl)	Gauging Date	Water Depth (ft-btoc)	Product Depth (ft-btoc)	Groundwater Elevation (ft-amsl)
MW-15	4-14	1538.23	3/9/2023	7.20	-	1531.03
			6/28/2023	4.86	-	1533.37
			9/20/2023	5.59	-	1532.64
			12/9/2023	6.24	-	1531.99
			3/14/2024	6.62	-	1531.61
MW-16	4-14	1537.76	8/19/2014	4.84	-	1532.92
			11/17/2014	6.12	-	1531.64
			3/20/2015	6.65	-	1531.11
			6/17/2015	5.93	-	1531.83
			9/24/2015	5.23	-	1532.53
			12/8/2015	6.48	-	1531.28
			3/10/2016	3.36	-	1534.40
			6/16/2016	5.03	-	1532.73
			9/22/2016	5.27	-	1532.49
			11/16/2016	5.86	-	1531.90
			3/23/2017	4.11	-	1533.65
			6/22/2017	5.13	-	1532.63
			9/20/2017	4.92	-	1532.84
			12/7/2017	5.91	-	1531.85
			3/18/2018	6.16	-	1531.60
			6/21/2018	4.20	-	1533.56
			9/26/2018	4.33	-	1533.43
			11/28/2018	6.63	-	1531.13
			3/20/2019	4.38	-	1533.38
			6/11/2019	6.47	-	1531.29
			9/22/2019	4.55	-	1533.21
			11/13/2019	7.72	-	1530.04
			3/25/2020	6.73	-	1531.03
			6/23/2020	4.75	-	1533.01
			9/23/2020	4.22	-	1533.54
			12/8/2020	6.47	-	1531.29
			3/24/2021	6.04	-	1531.72
			6/15/2021	4.31	-	1533.45
			9/28/2021	4.85	-	1532.91
			12/7/2021	6.15	-	1531.61
			3/22/2022	6.12	-	1531.64
			6/22/2022	3.80	-	1533.96
			9/20/2022	3.66	-	1534.10
			3/9/2023	6.58	-	1531.18
			6/27/2023	4.16	-	1533.60
			9/20/2023	4.96	-	1532.80
			12/8/2023	5.59	-	1532.17
			3/15/2024	5.97	-	1531.79

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Well	Screen Interval (ft-bgs)	Top of Casing Elevation (ft-amsl)	Gauging Date	Water Depth (ft-btoc)	Product Depth (ft-btoc)	Groundwater Elevation (ft-amsl)
MW-17	Unknown	1538.86	3/24/2021	8.39	-	1530.47
			6/15/2021	6.41	-	1532.45
			9/28/2021	6.91	-	1531.95
			12/8/2021	8.21	-	1530.65
			3/22/2022	8.30	-	1530.56
			6/22/2022	6.06	-	1532.80
			3/8/2023	8.92	-	1529.94
			6/27/2023	6.37	-	1532.49
			9/20/2023	7.03	-	1531.83
			12/8/2023	7.94	-	1530.92
			3/14/2024	8.38	-	1530.48
RW-1	5-20	1539.36	8/19/2014	6.50	-	1532.86
			11/17/2014	7.78	-	1531.58
			3/20/2015	8.21	-	1531.15
			6/17/2015	7.48	-	1531.88
			9/24/2015	6.73	-	1532.63
			12/8/2015	7.89	-	1531.47
			3/10/2016	5.21	-	1534.15
			6/16/2016	6.71	-	1532.65
			9/22/2016	6.86	-	1532.50
			11/17/2016	7.47	-	1531.89
			3/23/2017	5.71	-	1533.65
			6/22/2017	6.67	-	1532.69
			9/20/2017	6.47	-	1532.89
			12/7/2017	7.54	-	1531.82
			3/19/2018	7.80	-	1531.56
			6/22/2018	5.97	-	1533.39
			9/26/2018	5.90	-	1533.46
			11/29/2018	8.22	-	1531.14
			3/20/2019	6.39	-	1532.97
			6/11/2019	7.95	-	1531.41
			9/22/2019	6.09	-	1533.27
			11/13/2019	11.46	-	1527.90
			3/25/2020	8.37	-	1530.99
			6/23/2020	6.29	6.27	1533.07
			9/23/2020	5.67	5.66	1533.69
			12/9/2020	8.80	-	1530.56
			3/24/2021	7.66	-	1531.70
			6/15/2021	5.84	-	1533.52
			9/28/2021	6.35	-	1533.01
			12/8/2021	7.79	-	1531.57
			3/22/2022	7.84	-	1531.52
			6/22/2022	4.35	-	1535.01

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Well	Screen Interval (ft-bgs)	Top of Casing Elevation (ft-amsl)	Gauging Date	Water Depth (ft-btoc)	Product Depth (ft-btoc)	Groundwater Elevation (ft-amsl)
RW-1	5-20	1539.36	9/20/2022	5.25	-	1534.11
			3/9/2023	8.21	-	1531.15
			6/27/2023	5.70	-	1533.66
			9/21/2023	6.46	-	1532.90
			12/8/2023	7.23	-	1532.13
			3/15/2024	7.63	-	1531.73
RW-2	5-20	1538.21	8/19/2014	5.43	-	1532.78
			11/17/2014	6.69	-	1531.52
			3/20/2015	7.21	-	1531.00
			6/17/2015	6.51	-	1531.7
			9/24/2015	5.73	-	1532.48
			12/8/2015	7.03	-	1531.18
			3/10/2016	4.22	-	1533.99
			6/16/2016	5.72	-	1532.49
			9/22/2016	5.87	-	1532.34
			11/16/2016	6.47	-	1531.74
			3/23/2017	5.06	-	1533.15
			6/22/2017	5.66	-	1532.55
			9/20/2017	5.54	-	1532.67
			12/7/2017	6.49	-	1531.72
			6/21/2018	4.80	-	1533.41
			9/26/2018	4.96	-	1533.25
			11/28/2018	7.21	-	1531.00
			3/18/2019	6.73	-	1531.48
			3/20/2019	5.29	-	1532.92
			6/11/2019	6.94	-	1531.27
			9/22/2019	5.17	-	1533.04
			11/13/2019	8.38	-	1529.83
			3/24/2020	7.35	-	1530.86
			6/23/2020	5.42	-	1532.79
			9/22/2020	4.81	-	1533.40
			12/8/2020	7.03	4.80	1531.18
			3/24/2021	6.55	-	1531.66
			6/14/2021	4.94	-	1533.27
			9/21/2021	5.30	-	1532.91
			12/7/2021	6.72	-	1531.49
			3/21/2022	6.70	-	1531.51
			6/22/2022	4.46	-	1533.75
			9/20/2022	4.30	-	1533.91
			12/20/2022	7.12	-	1531.09
			3/9/2023	6.07	-	1532.14
			6/28/2023	4.81	-	1533.40
			9/21/2023	5.54	-	1532.67

Table 1
Groundwater Elevation
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

Well	Screen Interval (ft-bgs)	Top of Casing Elevation (ft-amsl)	Gauging Date	Water Depth (ft-btoc)	Product Depth (ft-btoc)	Groundwater Elevation (ft-amsl)
RW-2	5-20	1538.21	12/9/2023	6.25	-	1531.96
			3/14/2024	6.26	-	1531.95

Note
Unknown screen intervals are for wells without available boring logs. Depth to bottom measurements recorded (in feet below top of casing) on April 16, 2025 for accessible unknown wells are:
MW-1: 12.74, MW-6: 15.92, MW-12: 14.45, MW-14: 14.45
ft = feet
bgs = below ground surface
btoc = below top of well casing
amsl = above mean sea level

Table 2
Soil Analytical Results - Compounds with Detections Above MTCA Method A Cleanup Levels
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

Investigation	Sample Location	Date	Sample ID	Sample Depth (ft-bgs)	TPH as Gasoline	TPH as Diesel	TPH as Motor Oil	Benzene	Ethylbenzene	Toluene	Xylenes (total)	Naphthalene
		MTCA - Soil - Method A			mg/kg 30	mg/kg 2,000	mg/kg 2,000	mg/kg 0.03	mg/kg 6	mg/kg 7	mg/kg 9	mg/kg 5
Professional Services Industries 1995	MW-1	11/8/1995	B1-1/MW-1	2.5	4.3	-	-	0.1	0.18	0.057	0.31	-
		11/8/1995	B1-2/MW-1	5	2.5	-	-	<0.013	0.022	<0.013	0.053	-
	B2	11/8/1995	B2	2.5	<2	-	-	<0.013	<0.013	<0.013	<0.013	-
	MW-3	11/8/1995	B3/MW-3	10	<2	-		<0.013	<0.013	<0.013	<0.013	-
	B4	11/8/1995	B4	5	<2	-	230	<0.013	<0.013	<0.013	<0.013	-
	B5	11/8/1995	B5	5	<2	-		<0.013	<0.013	<0.013	<0.013	-
	MW-2	11/8/1995	B6/MW-2	5	<2	-	210	<0.013	<0.013	<0.013	<0.013	-
	B7	11/8/1995	B7	10	<2	-	-	<0.013	<0.013	<0.013	<0.013	-
	B8	11/8/1995	B8	10	<2	-	-	<0.013	<0.013	<0.013	<0.013	-
	B9	11/8/1995	B9-1	0.16	4.6	180	-	<0.013	<0.013	<0.013	<0.013	-
		11/8/1995	B9-2	3	6.1	-	-	<0.013	<0.013	<0.013	<0.013	-
	B10	11/8/1995	B10-1	0.16	<2	-	-	<0.013	<0.013	<0.013	<0.013	-
		11/8/1995	B10-2	3	<2	-	-	<0.013	<0.013	<0.013	<0.013	-
	B11	11/8/1995	B11	3	<2	-	-	<0.013	<0.013	<0.013	<0.013	-
	B12	11/8/1995	B12	3	<2	-	-	<0.013	<0.013	<0.013	<0.013	-
	S-01	11/8/1995	S1-1	0.16	250	-	29,000	<0.013	<0.013	<0.013	<0.013	-
		11/8/1995	S1-2	1	3.8	-	39,000	<0.013	<0.013	<0.013	<0.013	-
	S-02	11/8/1995	S-2	0.16	<2	-	-	<0.013	<0.013	<0.013	<0.013	-
Allisto Engineering Group 1996	MW-4	07/22/1996	MW-4-5	5	<10	<25	<50	-	-	-	-	-
	MW-5	07/22/1996	MW-5-5	5	<11	<29	<57	-	-	-	-	-
	S-01	07/23/1996	S-1-4	4	**2,000**	<27	<55	<6	<6	<6	**140**	-
	S-02	07/23/1996	S-2-4	4	**3,900**	-	-	<25	**49**	**120**	**350**	-
	S-03	07/23/1996	S-3-4	4	<6.1	-	-	<0.4	<0.4	<0.4	**0.36**	-
	S-04	07/23/1996	S-4-5	5	**14**	-	-	<0.4	<0.4	<0.4	**2.6**	-
	S-05	07/23/1996	S-5-5.5	5.5	<6.3	-	-	<0.4	<0.4	<0.4	<0.4	-
	S-06	07/23/1996	S-6-4.5	4.5	<6.3	-	-	<0.4	<0.4	<0.4	<0.4	-
	S-07	07/23/1996	S-7-5	5	**49**	**15,000**	-	<0.4	<0.4	<0.4	<0.4	-
	S-08	07/23/1996	S-8-4	4	<12	**1,200**	<61	-	-	-	-	-
	S-09	07/23/1996	S-9-5	5	-	**3,200**	-	-	-	-	-	-
	S-10	07/23/1996	S-10-4	4	-	**2,000**	-	-	-	-	-	-
	S-11	07/23/1996	S-11-5.5	5.5	-	**41**	-	-	-	-	-	-
	S-12	07/23/1996	S-12-6	6	-	**2,500**	-	-	-	-	-	-
	S-13	07/23/1996	S-13-5.5	5.5	-	<17	-	-	-	-	-	-
	S-14	07/24/1996	S-14-5	5	-	<16	-	-	-	-	-	-
	S-15	07/24/1996	S-15-5	5	**5,400**	-	-	**3.8**	**52**	**86**	**580**	-
	S-02	08/27/1996	S-2A-4	4	**3,100**	-	-	<38	**380**	**150**	**120**	-
	S-07	08/27/1996	S-7A-5	5	-	**10,000**	-	-	-	-	-	-
Terracon 2010	B1	08/16/2010	B1@6ft	6	<5.9	<18.5	<73.9	<0.0028	<0.0028	<0.0028	<0.0083	-
	B3	08/16/2010	B3@7 1/2ft	7.5	<7.6	<19.6	<78.2	<0.0029	<0.0029	<0.0029	<0.0086	-
	B4	08/16/2010	B4@3 1/2ft	3.5	<4.9	<18.9	<75.5	<0.0024	<0.0024	<0.0024	<0.0073	-
	B5	08/16/2010	B5@3ft	3	**436**	**94.9**	**140**	**8.65**	**9.72**	**52.8**	**45.1**	-
	B6	08/16/2010	B6@5ft	5	**7.2**	<19.2	<76.8	**0.0298**	**0.0032**	<0.0024	**0.0199**	-
	B7	08/16/2010	B7@8ft	8	**3,700**	**423**	<77	**0.153**	**45.5**	**0.554**	**247**	**1.8**
	B8	08/16/2010	B8@6ft	6	<5.3	<19.9	<79.8	<0.0029	<0.0029	<0.0029	<0.0086	-
	B9	08/16/2010	B9@7ft	7	<4.8	<18.9	<75.8	<0.0023	<0.0023	<0.0023	<0.007	-
	B10	08/16/2010	B10@5ft	5	**1,890**	**3,120**	**98.3**	**10.8**	**46.9**	**1.64**	**65.2**	-
	B11	08/16/2010	B11@4 1/2ft	4.5	**1,250**	**9,960**	**518**	**1.75**	**4.32**	**0.0302**	**7.07**	**5.8**
	B12	08/16/2010	B12@6ft	6	<5.3	<18.8	<75.2	<0.0027	<0.0027	<0.0027	<0.008	-
	B13	08/16/2010	B13@3 1/2ft	3.5	<4.9	<19	<76	<0.0024	<0.0024	<0.0024	<0.0071	-
	B14	08/16/2010	B14@5ft	5	<5.4	<18.4	<73.5	<0.0024	<0.0024	<0.0024	<0.0073	-
	B15	08/16/2010	B15@4 1/2ft	4.5	<5.1	<19.5	<78.1	<0.0025	<0.0025	<0.0025	<0.0075	-
Terracon 2011	BioSwaleD1	07/21/2011	81117058-DP-01	2	**9.4**	**2,800**	**2,600**	<0.03	**0.079**	<0.05	**1.14**	**0.59**

Table 2
Soil Analytical Results - Compounds with Detections Above MTCA Method A Cleanup Levels
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

Investigation	Sample Location	Date	Sample ID	Sample Depth (ft-bgs)	TPH as Gasoline	TPH as Diesel	TPH as Motor Oil	Benzene	Ethylbenzene	Toluene	Xylenes (total)	Naphthalene
		MTCA - Soil - Method A			mg/kg 30	mg/kg 2,000	mg/kg 2,000	mg/kg 0.03	mg/kg 6	mg/kg 7	mg/kg 9	mg/kg 5
Broadbent and Associates, Inc. 2012	DP-12	09/24/2012	DP-12-8.5 ft.	8.5	**480**	**530**	<100	<0.2	**4.3**	<0.2	**5.3**	-
	DP-13	09/24/2012	DP-13-4 ft.	4	<5	<25	<100	<0.005	<0.005	<0.005	**0.0071**	-
		09/24/2012	DP-13-8 ft.	8	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
	DP-14	09/24/2012	DP-14-5 ft.	5	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
		09/24/2012	DP-14-7.5 ft.	7.5	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
	DP-15	09/24/2012	DP-15-5 ft.	5	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
		09/24/2012	DP-15-8 ft.	8	<5	**31 L**	**250**	<0.005	<0.005	<0.005	<0.005	-
	DP-21	09/24/2012	DP-21-4 ft.	4	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
		09/24/2012	DP-21-7.5 ft.	7.5	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
	DP-04	09/25/2012	DP-4-5 ft.	5	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
		09/25/2012	DP-4-7.5 ft.	7.5	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
		09/25/2012	DP-4-9.5 ft.	9.5	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
	DP-08	09/25/2012	DP-8-5 ft.	5	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
		09/25/2012	DP-8-9 ft.	9	<5	<25	<100	<0.005	<0.005	<0.005	**0.0079**	-
	DP-09	09/25/2012	DP-9-5 ft.	5	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
		09/25/2012	DP-9-9 ft.	9	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
		09/25/2012	DP-9-12 ft.	12	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
	DP-10	09/25/2012	DP-10-5 ft.	5	<5	<25	**160**	<0.005	<0.005	<0.005	<0.005	-
		09/25/2012	DP-10-8.5 ft.	5	<5	**31 L**	**290**	<0.005	**0.012**	<0.005	**0.019**	-
	DP-11	09/25/2012	DP-11-5 ft.	5	**8**	<25	<100	**0.14**	**0.034**	**0.0061**	**0.077**	-
		09/25/2012	DP-11-8 ft.	8	<5	<25	<100	**0.0068**	<0.005	<0.005	**0.0093**	-
	DP-16	09/25/2012	DP-16-4 ft.	4	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
		09/25/2012	DP-16-9 ft.	9	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
	DP-20	09/25/2012	DP-20-8.5 ft.	8.5	<5	**26 L**	**170**	<0.005	<0.005	<0.005	<0.005	-
	DP-01	09/26/2012	DP-1-3 ft.	3	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
		09/26/2012	DP-1-9 ft.	9	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
	DP-02	09/26/2012	DP-2-4 ft.	4	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
		09/26/2012	DP-2-9 ft.	9	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
	DP-03	09/26/2012	DP-3-4 ft.	4	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
		09/26/2012	DP-3-9 ft.	9	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
	DP-05	09/26/2012	DP-5-4.5 ft.	4.5	**120**	<25	<100	<0.04	**1.5**	<0.04	**7**	**0.9**
		09/26/2012	DP-5-9 ft.	9	**1,400**	**2,300**	<1,000	<0.4	**16**	<0.4	**88**	**7.7**
	DP-06	09/26/2012	DP-6-4.5 ft.	4.5	**6.9**	<25	<100	<0.005	**0.2**	**0.0062**	**0.25**	-
		09/26/2012	DP-6-9 ft.	9	**590**	**1,000**	<1,000	<0.1	**4.1**	**0.12**	**19**	-
Broadbent and Associates, Inc. 2012	DP-07	09/26/2012	DP-7-4 ft.	4	<5	<25	<100	<0.005	**0.0054**	<0.005	**0.01**	-
		09/26/2012	DP-7-8 ft.	8	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
		09/26/2012	DP-7-12 ft.	12	<5	<25	<100	<0.005	<0.005	<0.005	**0.024**	-
	DP-17	09/26/2012	DP-17-4.5 ft.	4.5	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
		09/26/2012	DP-17-9 ft.	9	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
	DP-18	09/26/2012	DP-18-4 ft.	4	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
		09/26/2012	DP-18-9 ft.	9	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
	DP-19	09/26/2012	DP-19-3 ft.	3	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
		09/26/2012	DP-19-8 ft.	8	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
Broadbent and Associates, Inc. 2014	MW-15	07/09/2014	MW-15-3ft	3	**8.9**	<25	<100	**0.073**	**0.039**	<0.005	**0.055**	**0.026**
		07/09/2014	MW-15-5ft	5	**840**	**730**	<500	<0.2	**9.2**	<0.2	**9.5**	**9.6**
	RW-2	07/09/2014	RW-2-3ft	3	**7.2**	<25	<100	**0.023**	**0.037**	<0.005	**0.062**	**0.19**
		07/09/2014	RW-2-5ft	5	<5	<25	<100	**0.0061**	**0.016**	<0.005	**0.01**	**0.22**
	MW-8	07/10/2014	MW-8-4ft	4	<5	<25	<100	<0.01	<0.01	<0.01	<0.01	<0.025
	MW-9	07/10/2014	MW-9-3ft	3	**1,700**	**130 K**	<100	**1 V**	<5.8	**1 V**	<57	**17**
	MW-10	07/10/2014	MW-10-3ft	3	<5	<25	<100	<0.01	<0.01	<0.01	<0.01	<0.025
	RW-1	07/10/2014	RW-1-5ft	5	**33**	**100**	**150**	**0.034**	**0.6**	**0.017**	**1.7**	**0.28**
	MW-15	07/14/2014	MW-15-14ft	14	**180**	<25	-	**0.18**	**2**	**0.12**	**11**	**0.32**
	MW-16	07/14/2014	MW-16-7ft	7	<5	<25	-	<0.005	<0.005	<0.005	<0.005	<0.025
	RW-2	07/14/2014	RW-2-15ft	15	**180**	**66**	-	<0.04	**1.6**	<0.04	**8.7**	**0.54**

Table 2
Soil Analytical Results - Compounds with Detections Above MTCA Method A Cleanup Levels
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

Investigation	Sample Location	Date	Sample ID	Sample Depth (ft-bgs)	TPH as Gasoline	TPH as Diesel	TPH as Motor Oil	Benzene	Ethylbenzene	Toluene	Xylenes (total)	Naphthalene
		MTCA - Soil - Method A			mg/kg 30	mg/kg 2,000	mg/kg 2,000	mg/kg 0.03	mg/kg 6	mg/kg 7	mg/kg 9	mg/kg 5
	MW-9	07/15/2014	MW-9-10ft	10	**540**	**460**	-	<0.2	**2.7**	<0.2	**12**	**1.1**
	RW-1	07/15/2014	RW-1-10ft	10	**260**	**160**	-	<0.1	**0.67**	<0.1	**2.1**	**0.31**
		07/15/2014	RW-1-15ft	15	**86**	**80**	-	<0.01	**0.39**	<0.01	**1.6**	**0.13**
	MW-7	07/16/2014	MW-7-7ft	7	<5	<25	-	<0.005	<0.005	<0.005	<0.005	<0.025
		07/16/2014	MW-7-14ft	14	<5	<25	-	<0.005	<0.005	<0.005	<0.005	<0.025
	MW-8	07/16/2014	MW-8-10ft	10	<5	<25	-	<0.005	<0.005	<0.005	<0.005	<0.025
	MW-11	07/16/2014	MW-11-7ft	7	<5	<25	-	<0.005	<0.005	<0.005	<0.005	<0.025
		07/16/2014	MW-11-10ft	10	**40**	**300**	-	<0.02	<0.02	<0.02	<0.02	<0.025
Robinson Noble 2018	B1	08/16/2018	B1-4'	4	<10	<50	-	<0.02	<0.05	<0.1	<0.15	<0.1
	B2	08/16/2018	B2-5'	5	**796**	<50	-	**4**	**14**	**60**	**104**	**1.2**
	RNMW-17	08/16/2018	MW17-4'	4	**29,700**	<50	-	**6.4**	**280**	**2,000**	**2,480**	**1**
Robinson Noble 2023	T1	07/26/2023	T1	2.66	-	**1,500**	-	-	-	-	-	-
	T2	07/26/2023	T2	2	-	**60**	-	-	-	-	-	-
	T3	07/26/2023	T3	3	-	**100**	-	-	-	-	-	-
Robinson Noble 2023	T4	07/26/2023	T4	3	-	<53	-	-	-	-	-	-
	T5	07/26/2023	T5	2.41	-	**630**	-	-	-	-	-	-
	T6	07/26/2023	T6	2.66	-	**80**	-	-	-	-	-	-
	T7	07/26/2023	T7	2.83	-	**130**	-	-	-	-	-	-
	T8	07/26/2023	T8	2.41	-	<52	-	-	-	-	-	-
	T9	07/26/2023	T9	3	-	**13,000**	-	-	-	-	-	-
	UDC1	07/26/2023	UDC 1	3	-	**22,000**	-	-	-	-	-	-
	UDC2	07/26/2023	UDC 2	3	-	**21,000**	-	-	-	-	-	-
	UDC3	07/26/2023	UDC 3	3	-	**4,500**	-	-	-	-	-	-
	UDC4	07/26/2023	UDC 4	3	-	**35,000**	-	-	-	-	-	-
	UDC5	07/26/2023	UDC 5	3	-	**14,000**	-	-	-	-	-	-
	UDC6	07/26/2023	UDC 6	3	-	**9,100**	-	-	-	-	-	-
	UDC7	07/26/2023	UDC 7	3	-	**18,000**	-	-	-	-	-	-
	UDC8	07/26/2023	UDC 8	3	-	**23,000**	-	-	-	-	-	-
	U1	08/09/2023	U1	3.5	**17,000**	**340**	-	**1.8**	**260**	**740**	**1,800**	**19**
	U2	08/09/2023	U2	3.5	**160**	**3,800**	-	**0.38**	**8**	**8.4**	**28**	**2**
Robinson Noble 2023	U3	08/09/2023	U3	3.5	<6.8	<56	-	<0.014	<0.034	**0.13**	<0.1	<0.068
	U4	08/09/2023	U4	3.5	<5.6	<52	-	<0.011	<0.028	**0.12**	<0.084	<0.056
	U5	08/09/2023	U5	3.5	<5.6	<52	-	<0.011	<0.028	**0.19**	**0.099**	<0.056
	U6	08/09/2023	U6	3.5	**8.6**	**3,400**	-	**0.029**	**0.11**	**0.37**	**1.2**	**0.21**
	U7	08/09/2023	U7	3.5	**18**	<62	-	**0.018**	**0.12**	**0.43**	**2.8**	**0.092**
	U8	08/09/2023	U8	3.5	**260**	**57,000**	-	**0.25**	**3.9**	**5.7**	**22**	**4.7**
	U9	08/09/2023	U9	3.5	**130**	<56	-	**0.053**	**2.8**	**5.3**	**18**	**0.54**
	U10	08/09/2023	U10	3.5	<9	<63	-	<0.018	**0.068**	**0.33**	**0.58**	<0.09
	U11	08/09/2023	U11	3.5	<5.9	<53	-	<0.012	<0.029	**0.13**	**0.11**	<0.059
	U12	08/09/2023	U12	3.5	<5.5	<52	-	<0.011	<0.028	**0.11**	<0.083	<0.055
	U13	08/09/2023	U13	3.5	<5.3	<51	-	<0.011	<0.027	**0.11**	<0.08	<0.053
	U14	08/09/2023	U14	3.5	<8.3	<61	-	<0.017	<0.041	**0.2**	<0.12	<0.083
	RE1	08/23/2023	RE1	4	<18	<62	-	<0.036	<0.09	<0.18	<0.27	<0.18
	RE2	08/23/2023	RE2	4	<13	<61	-	<0.027	<0.067	<0.13	<0.2	<0.13
	RE3	08/24/2023	RE3-5	5	<8.3	<60	-	<0.017	<0.041	<0.083	<0.12	<0.083
	RE4	08/24/2023	RE4-1	1	**180**	**6,300**	-	<0.018	**0.28**	**0.17**	**2.4**	**0.87**
	RE5	08/24/2023	RE5-3	3	**120**	**15,000**	-	**0.024**	**0.78**	**0.62**	**6.6**	**0.92**
	RE6	08/24/2023	RE6-5.5	5.5	<7.9	<60	-	<0.016	<0.04	<0.079	<0.12	<0.079
	RE7	08/24/2023	RE7-5	5	<1.2	**320**	-	<0.012	<0.03	<0.061	<0.091	<0.061
	RE8	08/24/2023	RE8-5	5	**27**	**5,500**	-	<0.019	<0.047	**0.1**	**0.14**	**0.094**
	RE8	08/29/2023	RE8-5	5	<6.6	**10,000**	-	<0.013	**0.086**	<0.067	**0.5**	**0.25**
	RE9	08/29/2023	RE9-5	5	<6.6	<55	-	<0.013	**0.061**	<0.066	**0.27**	<0.066
	RE10	08/29/2023	RE10-5	5	**33**	**9,400**	-	<0.014	**0.4**	**0.19**	**2.6**	**0.5**
	RE11	08/29/2023	RE11-5	5	<7.2	**320**	-	<0.014	**0.045**	<0.072	**0.19**	<0.072

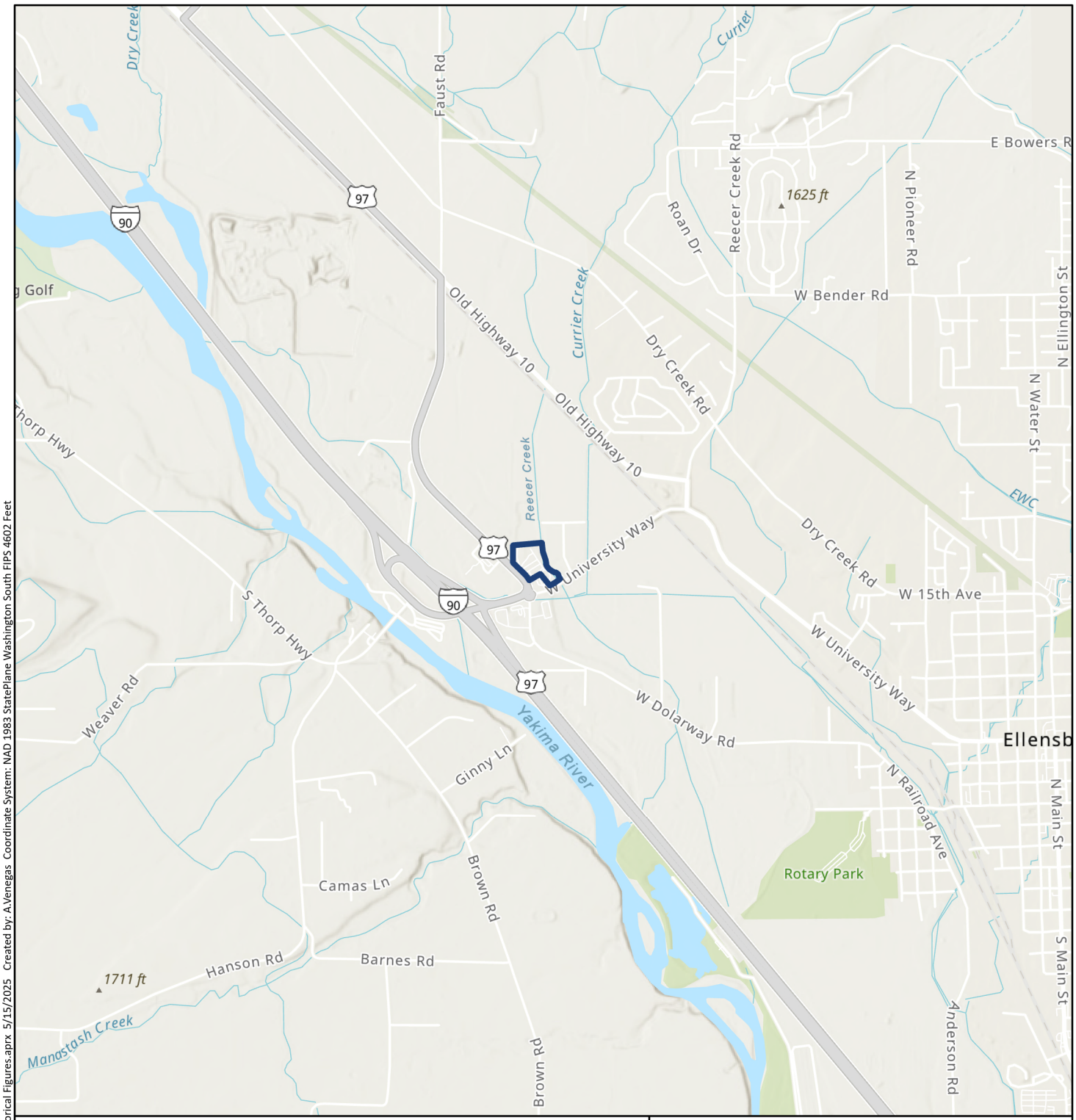
Table 2
Soil Analytical Results - Compounds with Detections Above MTCA Method A Cleanup Levels
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

Investigation	Sample Location	Date	Sample ID	Sample Depth (ft-bgs)	TPH as Gasoline	TPH as Diesel	TPH as Motor Oil	Benzene	Ethylbenzene	Toluene	Xylenes (total)	Naphthalene
		MTCA - Soil - Method A			mg/kg 30	mg/kg 2,000	mg/kg 2,000	mg/kg 0.03	mg/kg 6	mg/kg 7	mg/kg 9	mg/kg 5
Robinson Noble 2023	RE12	08/29/2023	RE12-5	5	<6.9	<56	-	<0.014	**0.13**	**0.074**	**0.57**	<0.069
	RE13	08/29/2023	RE13-5	5	<7	<57	-	<0.014	**0.063**	<0.07	**0.29**	<0.07
	RE14	08/29/2023	RE14-5	5	<6.7	<56	-	<0.013	**0.086**	**0.083**	**0.36**	<0.067
	RE15	08/29/2023	RE15-5	5	<7.7	**730**	-	<0.015	**0.046**	<0.077	**0.18**	<0.077
	RE16	08/29/2023	RE16-5	5	<6.2	<54	-	<0.012	**0.056**	<0.062	**0.23**	<0.062
	RE17	08/29/2023	RE17-5	5	<5.8	<53	-	<0.012	**0.089**	**0.061**	**0.44**	<0.059
	RE18	08/29/2023	RE18-5	5	<5.8	<53	-	<0.012	**0.065**	<0.059	**0.29**	<0.059
	RE19	08/30/2023	RE19-5	5	<8.5	**590**	-	<0.017	**0.057**	<0.085	**0.25**	**0.18**
	RE20	08/30/2023	RE20-6	6	<70	**10,000**	-	<0.014	**0.14**	<0.07	**0.89**	**0.64**
	RE21	08/30/2023	RE21-5	5	**85**	**8,800**	-	**0.02**	**0.44**	**0.3**	**3.6**	**0.67**
	RE22	08/30/2023	RE22-5	5	<12	<60	-	<0.016	**0.076**	<0.08	**0.37**	**0.13**
	RE23	08/30/2023	RE23-6	6	**190**	**14,000**	-	**0.043**	**0.084**	<0.08	**0.26**	**3.1**
	RE24	08/30/2023	RE24-5	5	**16**	**1,900**	-	<0.016	**0.094**	<0.079	**0.4**	**0.68**
	RE25	08/30/2023	RE25-5	5	**72**	**7,400**	-	**0.048**	**0.1**	<0.078	**0.38**	**1.1**
	RE26	08/30/2023	RE26-5	5	**39**	**3,900**	-	<0.016	**0.059**	<0.081	**0.21**	**0.48**
	RE27	08/30/2023	RE27-5	5	<6.4	<55	-	<0.013	**0.074**	<0.065	**0.31**	<0.065
	RE28	08/30/2023	RE28-5	5	<6	<53	-	<0.012	**0.067**	<0.06	**0.27**	<0.06
	RE29	08/31/2023	RE29-5	5	**690**	**3,400**	-	**0.81**	**31**	**0.22**	**74**	**3.7**
	RE30	08/31/2023	RE30-5	5	**1,300**	**69**	-	<0.17	**51**	**1.5**	**290**	**17**
	RE31	08/31/2023	RE31-5	5	**36**	**8,900**	-	**0.035**	**0.69**	<0.085	**1.8**	**0.48**
	RE32	08/31/2023	RE32-6	6	**300**	**21,000**	-	**0.75**	**2.2**	<0.75	**12**	**9.5**
	RE33	08/31/2023	RE33-6	6	**110**	**120**	-	**0.14**	**9.2**	**7.9**	**49**	**1.5**
	RE34	08/31/2023	RE34-5	5	**2,100**	**69**	-	<1	**95**	**6.4**	**1,400**	**56**
	RE35	08/31/2023	RE35-5	5	**140**	<62	-	**0.028**	**13**	**1.4**	**72**	**4.4**
	RE36	08/31/2023	RE36-3	3	<6.5	<55	-	<0.013	**0.27**	**0.14**	**1**	**0.75**
	RE37	08/31/2023	RE37-5	5	**36**	**3,900**	-	**0.13**	**0.081**	<0.078	**0.27**	**0.45**
	RE38	08/31/2023	RE38-6	6	**510**	**12,000**	-	**2.2**	**1.5**	**0.94**	**2.3**	**4.7**
	RE39	09/01/2023	RE39-5	5	<8.4	<61	-	<0.017	<0.042	<0.084	**0.14**	<0.084
Robinson Noble 2023	RE40	09/05/2023	RE40-5	5	<6.6	**160**	-	<0.013	<0.033	<0.066	<0.099	<0.066
	RE41	09/05/2023	RE41-6	6	**14**	**15,000**	-	**0.028**	<0.032	<0.064	**1.2**	**1.5**
	RE42	09/06/2023	RE42-5	5	<8.1	<60	-	<0.016	<0.04	<0.081	<0.12	<0.081
	RE43	09/06/2023	RE43-6	6	<8.8	<63	-	<0.018	<0.044	<0.088	<0.13	<0.088
	RE44	09/06/2023	RE44-5	5	<6.6	<55	-	<0.013	<0.033	<0.066	<0.099	<0.066
	RE45	09/06/2023	RE45-5	5	<8.2	<61	-	<0.017	<0.042	<0.083	<0.12	<0.083
	RE46	09/06/2023	RE46-5	5	<7.9	<60	-	<0.016	<0.04	<0.079	<0.12	<0.079
	RE47	09/06/2023	RE47-6	6	<6.5	**8,800**	-	<0.013	<0.033	<0.066	**0.16**	**0.19**

Note:
Soil results screened against Model Toxics Control Act (MTCA) Method A soil screening levels (August 2023). Exceedances are shaded.
Detected concentrations are **bold-faced**
mg/kg= milligrams per kilogram
- = Not analyzed/Not available
< = analyte not detected at or above laboratory reporting limit
K = TPH as diesel concentration may include contributions from lighter-end hydrocarbons that elute in the diesel-range.
V = Reporting limits were increased due to high concentrations of target analytes.
ft-bgs = feet below ground surface

Figures

1 Site Location
2 Site Plan
3 UST System Layout
4 Site Investigations 1995-2018
5 Site Investigations 2018-2024
6 Current Monitoring Well Network
7 Release History
8 Soil Samples with Detections Above MTCA Method A Cleanup Levels
9 TPH-d Extent – March 2024
10 TPH-g Extent – March 2024
11 Benzene Extent – March 2024
12 Conceptual Site Model
13 Proposed Investigation Locations



0 1,250 2,500 5,000 Feet

1 inch = 2,500 feet

N

Legend

Site Boundary

Imagery Source: ESRI World Topographic Map

SAFETY FIRST	CLIENT: Love's Travel Stops	**Site Location**
terraphase engineering	PROJECT: Love's Travel Stop #413 1512 HWY 97, Ellensburg, WA	
	PROJECT NUMBER: W053.001.003	**FIGURE 1**

File: N:\GIS\Prj\W053_Loves Ellensburg\.001\Pro Project\Historical Figures.aprx 5/15/2025 Created by: A.Venegas Coordinate System: NAD 1983 StatePlane Washington South FIPS 4602 Feet



N

0 45 90 180 Feet

1 inch = 90 feet

Aerial Imagery Source: Google Maps, August 26, 2023

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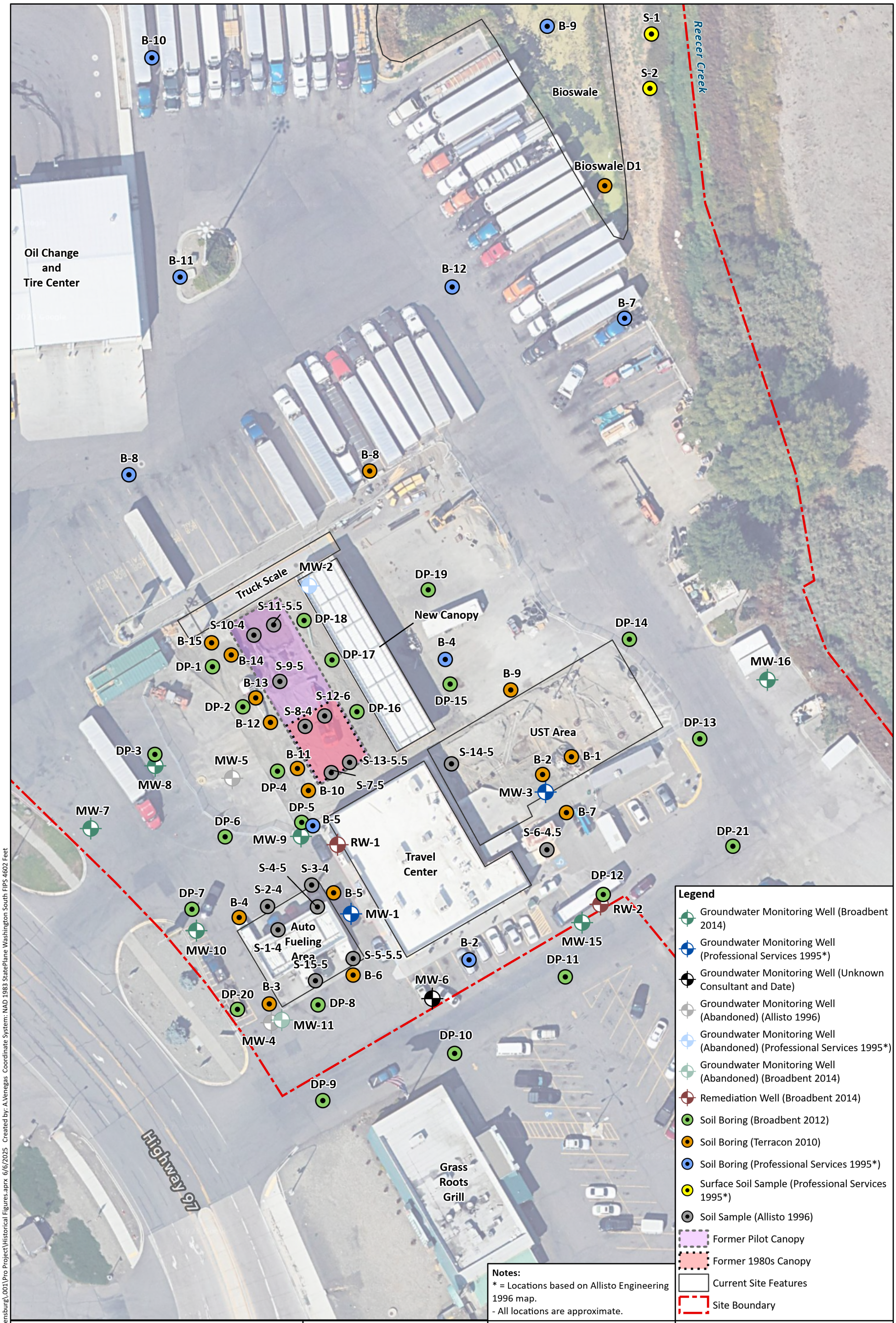
CLIENT:	Love's Travel Stops
PROJECT:	Love's Travel Stop #413 1512 HWY 97, Ellensburg, WA
PROJECT NUMBER:	W053.001.003

Site Plan

FIGURE 2

File: N:\GIS\Prj\W053_Loves Ellensburg\.001\Pro Project\Historical Figures.aprx 5/19/2025 Created by: A.Venegas Coordinate System: NAD 1983 StatePlane Washington South FIPS 4602 Feet


Truck Scale
New Canopy
Tank 7 (Diesel Exhaust Fluid)
Tank 6 (Diesel)
Tank 5 (Diesel)
Tank 4 (Diesel)
Tank 3 (Regular Unleaded)
Tank 2 (Biodiesel)
Tank 1 (Premium Unleaded)
Travel Center
Auto Fueling Area
Grass Roots Grill
Legend
Biodiesel Piping
Diesel Exhaust Fluid Piping
Diesel Piping
Diesel Piping (Suspected)
Diesel Siphon Piping
Regular Unleaded Piping
Regular Unleaded Piping (Suspected)
Super Unleaded Piping
Super Unleaded Piping (Suspected)
Vapor Piping
Vent Piping
Underground Storage Tank
Fuel Islands
Current Site Features
Site Boundary
Notes:
- Underground storage tank and piping system layout based on Sheet F2, "Underground Piping Plan" dated September 14, 2022, unless identified as "Suspected".
- All locations are approximate.
N
0 15 30 60 Feet
1 inch = 30 feet
Aerial Imagery Source: Google Maps, August 26, 2023
SAFETY FIRST
terraphase engineering
CLIENT: Love's Travel Stops
PROJECT: Love's Travel Stop #413
1512 HWY 97, Ellensburg, WA
PROJECT NUMBER: W053.001.003
UST System Layout
FIGURE 3
File: N:\GIS\Prj\W053_Loves Ellensburg\.001\Pro Project\Historical Figures.aprx 5/19/2025 Created by: A.Venegas Coordinate System: NAD 1983 StatePlane Washington South FIPS 4602 Feet


B-10
B-9
S-1
S-2
Reecer Creek
Bioswale
Bioswale D1
Oil Change
and
Tire Center
B-11
B-12
B-7
B-8
B-8
Truck Scale
MW-2
DP-19
S-11-5.5
DP-18
New Canopy
S-10-4
B-15
B-14
DP-17
DP-1
S-9-5
B-13
DP-2
S-12-6
S-8-4
DP-16
B-12
B-4
DP-15
B-9
DP-14
MW-16
DP-13
UST Area
S-14-5
B-2
B-1
MW-3
B-7
DP-3
MW-8
MW-5
B-11
S-13-5.5
DP-4
B-10
S-7-5
MW-7
DP-5
B-5
DP-6
MW-9
RW-1
Travel
Center
S-6-4.5
DP-21
S-4-5
S-3-4
DP-12
RW-2
DP-7
S-2-4
B-4
B-5
MW-1
Auto
Fueling
Area
S-1-4
MW-10
S-5-5.5
B-6
S-15-5
B-3
DP-20
DP-8
MW-11
MW-4
MW-6
B-2
MW-15
DP-11
DP-10
DP-9
Highway 97
Grass
Roots
Grill
Legend
Groundwater Monitoring Well (Broadbent 2014)
Groundwater Monitoring Well (Professional Services 1995*)
Groundwater Monitoring Well (Unknown Consultant and Date)
Groundwater Monitoring Well (Abandoned) (Allisto 1996)
Groundwater Monitoring Well (Abandoned) (Professional Services 1995*)
Groundwater Monitoring Well (Abandoned) (Broadbent 2014)
Remediation Well (Broadbent 2014)
Soil Boring (Broadbent 2012)
Soil Boring (Terracon 2010)
Soil Boring (Professional Services 1995*)
Surface Soil Sample (Professional Services 1995*)
Soil Sample (Allisto 1996)
Former Pilot Canopy
Former 1980s Canopy
Current Site Features
Site Boundary
Notes:
* = Locations based on Allisto Engineering 1996 map.
- All locations are approximate.
N
0
25
50
100
Feet
1 inch = 50 feet
Aerial Imagery Source: Google Maps, August 26, 2023
SAFETY FIRST
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CLIENT: Love's Travel Stops
PROJECT: Love's Travel Stop #413
1512 HWY 97, Ellensburg, WA
PROJECT NUMBER: W053.001.003
Site Investigations 1995-2018
FIGURE 4
File: N:\GIS\Prj\W053_Loves Ellensburg\.001\Pro Project\Historical Figures.aprx 6/6/2025 Created by: A.Venegas Coordinate System: NAD 1983 StatePlane Washington South FIPS 4602 Feet

RE13-5
RE11-5
RE7-5
RE16-5
RE6-5.5
RE12-5
RE5-3
RE3-5
Truck Scale
RE18-5
RE8-5
T8
RE4-1
RE44-5
UDC8
T7
RE17-5
New Canopy
RE47-6
UDC7
T6
RE45-5
UDC6
T5
RE14-5
RE9-5
RE19-5
RE28-5
UDC5
T4
RE46-5
RE27-5
U7
U12
U13
RE10-5
RE15-5
UDC4
T3
RE1-4
RE36-3
U10
RE43-6
UDC3
U6
UST Area
RE44-6
T2
U2
U3
RE42-5
RE23-6
U8
U11
RE40-5
RE20-6
UDC2
T1
U1
RE41-6
RE31-5
T9
U5
U4
U9
RE2-4
RE38-6
UDC1
RE21-5
RE24-5
RW-4
AS2, AS4, AS6
RE39-5
RW-3
VP4
VP3
RE37-5
AS1, AS3
VP2
RE33-6
RE22-5
RE35-5
RE32-6
VP1
RE30-5
Travel
Center
RE34-5
RE29-5
RE25-5
RE26-5
Auto
Fueling
Area
B2
MW-14
RNMW-17
B1
MW-13
MW-12
Grass
Roots
Grill
MW-17

Legend

- Remedial Soil Sample from Excavation (Robinson Noble 2023)
- Remedial Soil Sample from Test Pit (Robinson Noble 2023)
- Trunk Line Sample (Robinson Noble 2023)
- Under Dispenser Containment Soil Sample (Robinson Noble 2023)
- Underground Storage Tank Nest Sample
- Air Sample (Robinson Noble 2023)
- Sub-Slab Vapor Pin (Robinson Noble 2023)
- Soil Boring (Robinson Noble 2018)
- Remediation Well (Robinson Noble 2018)
- Recovery Well (Robinson Noble 2023)
- Groundwater Monitoring Well (Broadbent 2021)
- Remedial Excavation Limits (2023)
- UST Area Excavation Limits (2023)
- Current Site Features
- Site Boundary

Notes:
- Robinson Noble is now Terraphase Engineering, Inc.
- Shallow soil within the UST Area Excavation Limits were removed to expose UST piping (i.e., not considered to be part of the remedial excavation).
- All locations are approximate.

N

0 15 30 60 Feet

1 inch = 30 feet

Aerial Imagery Source: Google Maps, August 26, 2023

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CLIENT: Love's Travel Stops

PROJECT: Love's Travel Stop #413
1512 HWY 97, Ellensburg, WA

PROJECT NUMBER: W053.001.003

Site Investigations 2018-2024

FIGURE 5

File: N:\GIS\Prj\W053_Loves Ellensburg\.001\Pro Project\Historical Figures.aprx 6/9/2025 Created by: A.Venegas Coordinate System: NAD 1983 StatePlane Washington South FIPS 4602 Feet



Legend

- Groundwater Monitoring Well
- Remediation Well
- Abandoned/Missing Groundwater Monitoring Well
- Abandoned Remediation Well
- Site Boundary

Note:

- MW-3 observed to be filled with asphalt in May 2025, but is not yet considered abandoned.
- All locations are approximate.

N

0 25 50 100 Feet

1 inch = 50 feet

Aerial Imagery Source: Google Maps, August 26, 2023

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CLIENT:	Love's Travel Stops
PROJECT:	Love's Travel Stop #413 1512 HWY 97, Ellensburg, WA
PROJECT NUMBER:	W053.001.003

Current Monitoring Well Network

FIGURE 6

File: N:\GIS\Prj\W053_Loves Ellensburg\.001\Pro Project\Historical Figures.aprx 5/19/2025 Created by: A.Venegas Coordinate System: NAD 1983 StatePlane Washington South FIPS 4602 Feet

Truck Scale

New Canopy

UST Area

Travel Center

Auto Fueling Area

Grass Roots Grill

Highway 97

Legend

- Pre-1996 Release
- Pre-2007 Release
- 2018 Gasoline Release
- October 2023 Gasoline Release
- Underground Storage Tank
- Fuel Islands
- Biodiesel Piping
- Diesel Exhaust Fluid Piping
- Diesel Piping
- Diesel Piping (Suspected)
- Diesel Siphon Piping
- Regular Unleaded Piping
- Regular Unleaded Piping (Suspected)
- Super Unleaded Piping
- Super Unleaded Piping (Suspected)
- Vapor Piping
- Vent Piping
- Current Site Features
- Site Boundary

Notes:

- Underground storage tank and piping system layout based on Sheet F2, "Underground Piping Plan" dated September 14, 2022, unless identified as "Suspected".
- All locations are approximate.

N

0 15 30 60 Feet

1 inch = 30 feet

Aerial Imagery Source: Google Maps, August 26, 2023

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CLIENT: Love's Travel Stops

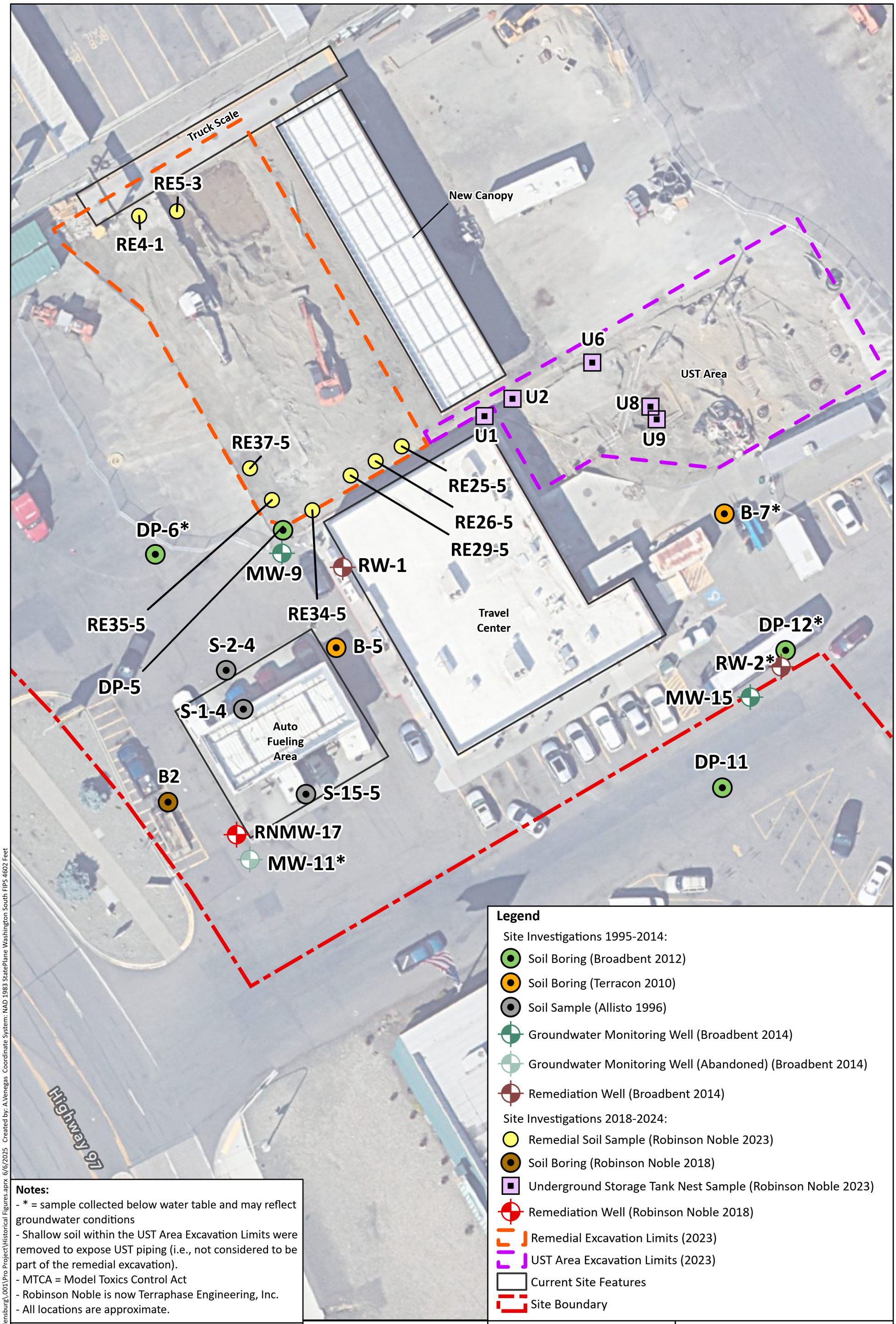
PROJECT: Love's Travel Stop #413
1512 HWY 97, Ellensburg, WA

PROJECT NUMBER: W053.001.003

Release History

FIGURE 7

File: N:\GIS\Prj\W053_Loves Ellensburg\.001\Pro Project\Historical Figures.aprx 5/22/2025 Created by: A.Venegas Coordinate System: NAD 1983 StatePlane Washington South FIPS 4602 Feet



Notes:
- * = sample collected below water table and may reflect groundwater conditions
- Shallow soil within the UST Area Excavation Limits were removed to expose UST piping (i.e., not considered to be part of the remedial excavation).
- MTCA = Model Toxics Control Act
- Robinson Noble is now Terraphase Engineering, Inc.
- All locations are approximate.

N

0 15 30 60 Feet

1 inch = 30 feet

Aerial Imagery Source: Google Maps, August 26, 2023

SAFETY FIRST

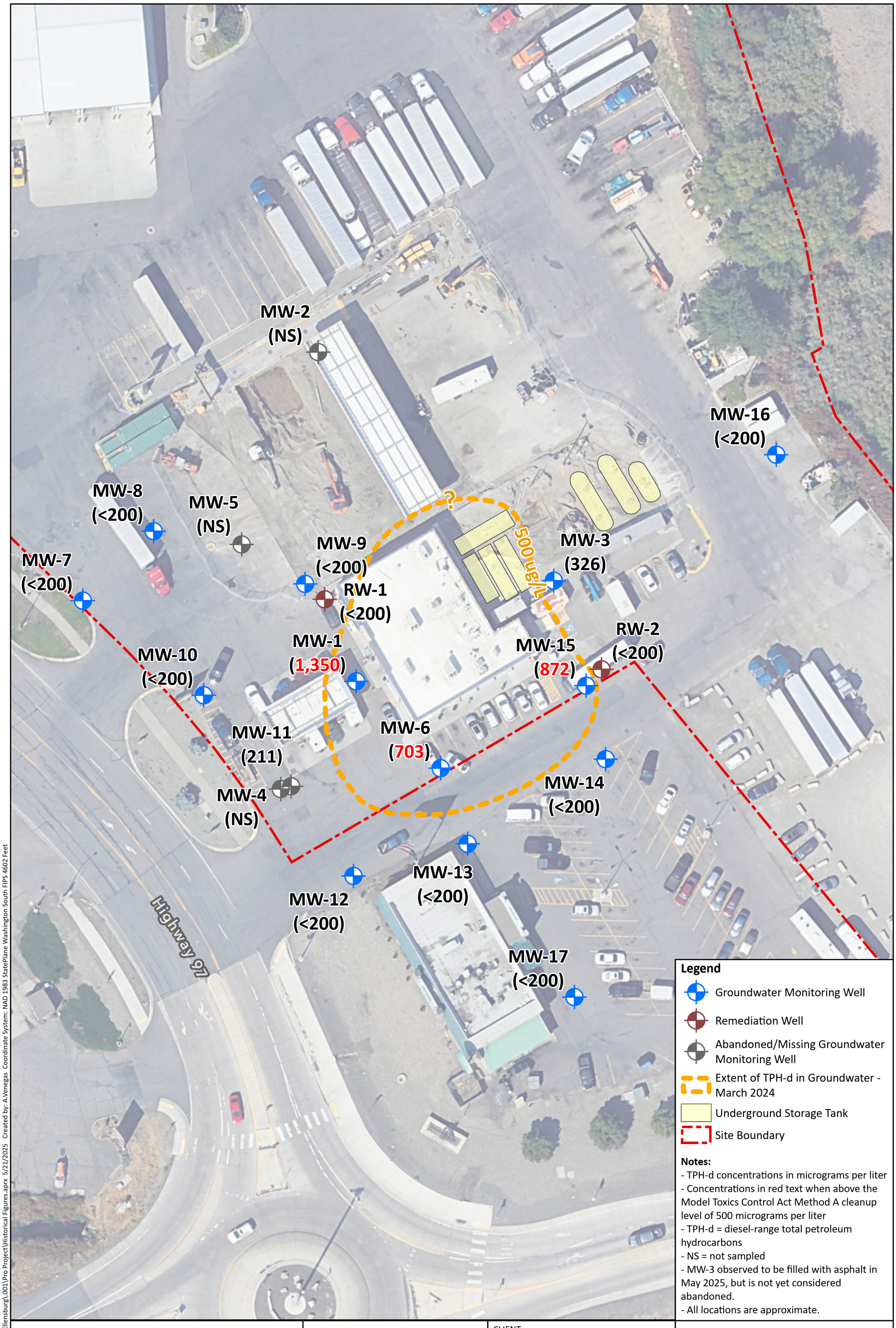
terraphase engineering

CLIENT:	Love's Travel Stops
PROJECT:	Love's Travel Stop #413 1512 HWY 97, Ellensburg, WA
PROJECT NUMBER:	W053.001.003

Soil Samples with Detections Above MTCA Method A

FIGURE 8

File: N:\GIS\Prj\W053_Loves Ellensburg\.001\Pro Project\Historical Figures.aprx 6/6/2025 Created by: A.Venegas Coordinate System: NAD 1983 StatePlane Washington South FIPS 4602 Feet


MW-2
(NS)
MW-16
(<200)
MW-8
(<200)
MW-5
(NS)
MW-9
(<200)
MW-3
(326)
MW-7
(<200)
RW-1
(<200)
500 ug/L
MW-1
(1,350)
RW-2
(<200)
MW-15
(872)
MW-10
(<200)
MW-11
(211)
MW-6
(703)
MW-14
(<200)
MW-4
(NS)
MW-13
(<200)
MW-12
(<200)
MW-17
(<200)
Highway 97
Legend
Groundwater Monitoring Well
Remediation Well
Abandoned/Missing Groundwater Monitoring Well
Extent of TPH-d in Groundwater - March 2024
Underground Storage Tank
Site Boundary
Notes:
- TPH-d concentrations in micrograms per liter
- Concentrations in red text when above the Model Toxics Control Act Method A cleanup level of 500 micrograms per liter
- TPH-d = diesel-range total petroleum hydrocarbons
- NS = not sampled
- MW-3 observed to be filled with asphalt in May 2025, but is not yet considered abandoned.
- All locations are approximate.
N
0 25 50 100 Feet
1 inch = 50 feet
Aerial Imagery Source: Google Maps, August 26, 2023
SAFETY FIRST
terraphase engineering
CLIENT: Love's Travel Stops
PROJECT: Love's Travel Stop #413
1512 HWY 97, Ellensburg, WA
PROJECT NUMBER: W053.001.003
TPH-d Extent in Groundwater - March 2024
FIGURE 9
File: N:\GIS\Prj\W053_Loves Ellensburg\.001\Pro Project\Historical Figures.aprx 5/21/2025 Created by: A.Venegas Coordinate System: NAD 1983 StatePlane Washington South FIPS 4602 Feet

MW-2
(NS)

MW-16
(<100)

MW-8
(<100)

MW-5
(NS)

MW-9
(322)

MW-3
(2,340)

MW-7
(<100)

RW-1
(225)

500 ug/L

5,000 ug/L

MW-1
(19,900)

MW-15
(5,560)

RW-2
(299)

MW-10
(145)

MW-14
(306)

MW-6
(1,630)

MW-4
(NS)

MW-11
(722)

MW-13
(432)

MW-12
(598)

Highway 97

MW-17
(<100)

Legend

- Groundwater Monitoring Well
- Remediation Well
- Abandoned/Missing Groundwater Monitoring Well
- Extent of TPH-g in Groundwater - March 2024
- Underground Storage Tank
- Site Boundary

Notes:

- TPH-g concentrations in micrograms per liter
- Concentrations in red text when above the Model Toxics Control Act Method A cleanup level of 800 micrograms per liter
- TPH-g = gasoline-range total petroleum hydrocarbons
- NS = not sampled
- MW-3 observed to be filled with asphalt in May 2025, but is not yet considered abandoned.
- All locations are approximate.

N

0 25 50 100 Feet

1 inch = 50 feet

Aerial Imagery Source: Google Maps, August 26, 2023

SAFETY FIRST

terraphase engineering

CLIENT: Love's Travel Stops

PROJECT: Love's Travel Stop #413
1512 HWY 97, Ellensburg, WA

PROJECT NUMBER: W053.001.003

TPH-g Extent in Groundwater - March 2024

FIGURE 10

File: N:\GIS\Prj\W053_Loves Ellensburg\.001\Pro Project\Historical Figures.aprx 5/21/2025 Created by: A.Venegas Coordinate System: NAD 1983 StatePlane Washington South FIPS 4602 Feet

MW-2
(NS)

MW-16
(<1.00)

MW-8
(<1.00)

MW-5
(NS)

MW-9
(1.48)

MW-3
(906)

MW-7
(<1.00)

RW-1
(4.27)

MW-10
(8.26)

MW-1
(3,450)

MW-15
(400)

RW-2
(2.49)

500 ug/L

5 ug/L

50 ug/L

MW-6
(185)

MW-14
(<1.00)

MW-4
(NS)

MW-11
(44.6)

MW-13
(15.5)

MW-12
(32.7)

Highway 97

MW-17
(<1.00)

Legend

- Groundwater Monitoring Well
- Remediation Well
- Abandoned/Missing Groundwater Monitoring Well
- Extent of Benzene in Groundwater - March 2024
- Underground Storage Tank
- Site Boundary

Notes:

- Benzene concentrations in micrograms per liter
- Concentrations in red text when above the Model Toxics Control Act Method A cleanup level of 5 micrograms per liter
- NS = not sampled
- MW-3 observed to be filled with asphalt in May 2025, but is not yet considered abandoned.
- All locations are approximate.

N

0 25 50 100 Feet

1 inch = 50 feet

Aerial Imagery Source: Google Maps, August 26, 2023

SAFETY FIRST

terraphase engineering

CLIENT: Love's Travel Stops

PROJECT: Love's Travel Stop #413
1512 HWY 97, Ellensburg, WA

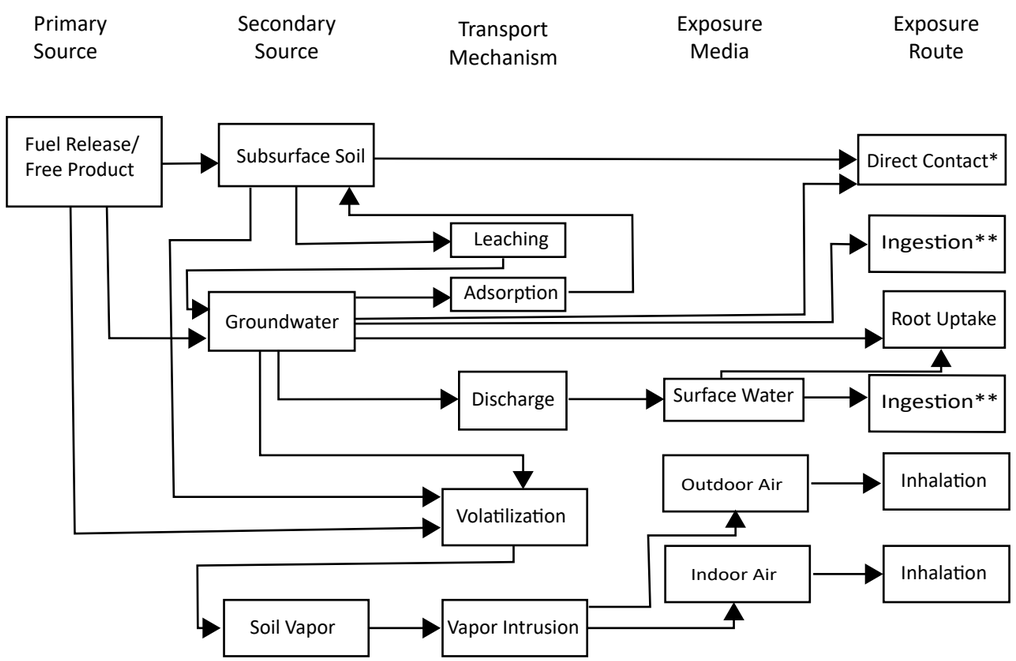
PROJECT NUMBER: W053.001.003

Benzene Extent in Groundwater - March 2024

FIGURE 11

File: N:\GIS\Prj\W053_Loves Ellensburg\.001\Pro Project\Historical Figures.aprx 5/21/2025 Created by: A.Venegas Coordinate System: NAD 1983 StatePlane Washington South FIPS 4602 Feet

Pathways



Receptors

Residential		Occupational		Construction/ Excaavation Worker		Trespasser/ Customer		Plants		Invertebrates		Birds		Mammals		Aquatic Life	
—	—	—	—	—	○	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	○	○	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	○	○	○	○	○	○	○	○
—	—	○	○	—	○	○	○	—	—	—	—	—	—	—	—	—	—
—	—	○	○	—	—	○	○	—	—	—	—	—	—	—	—	—	—
Current	Future	Current	Future	Current	Future	Current	Future	Current	Future	Current	Future	Current	Future	Current	Future	Current	Future

Notes:

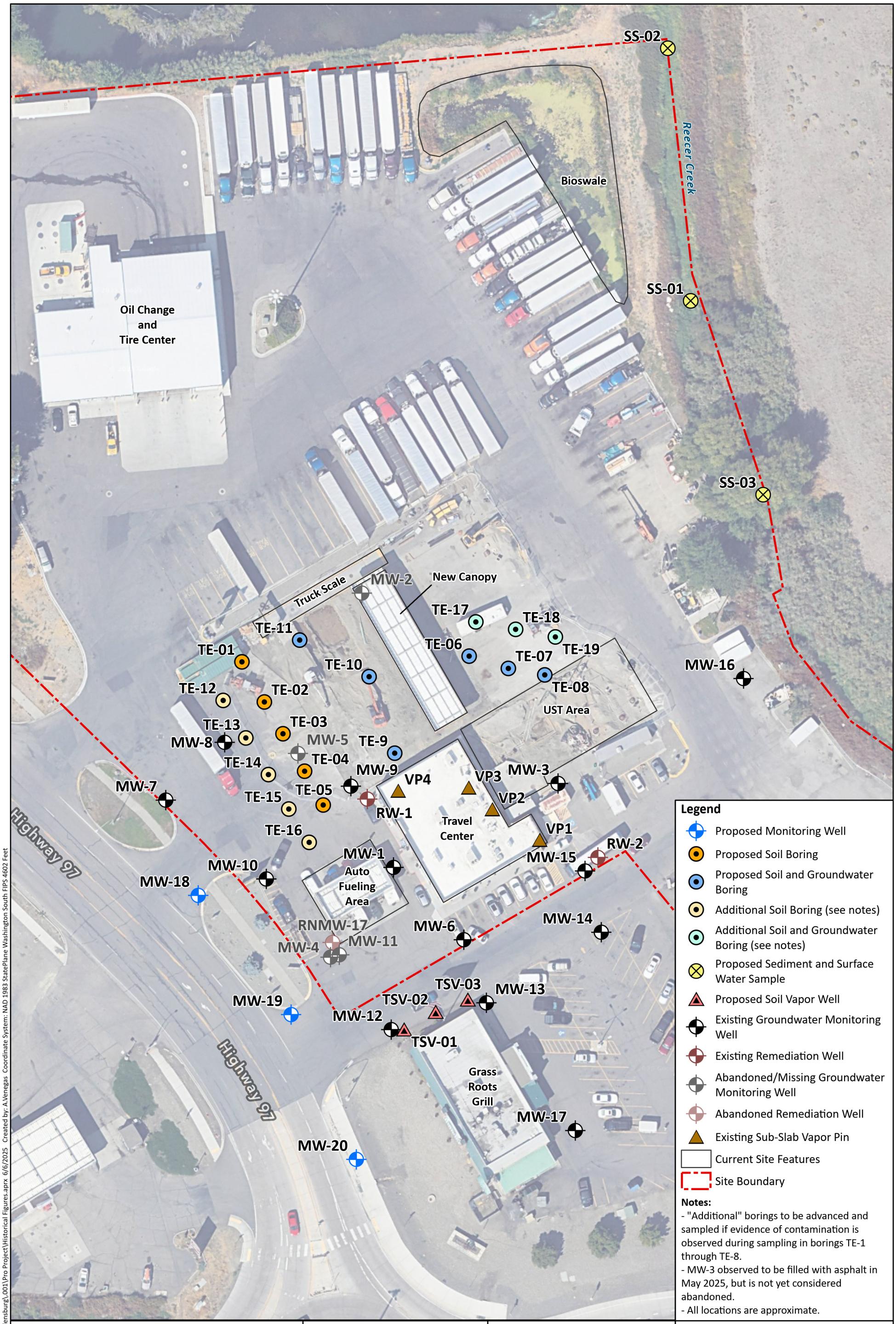
* "Direct Contact" includes incidential ingestion, dermal contact, and inhalation from soil.

** "Ingestion" includes dermal contact and inhalation from tap water or surface water.

○ Potentially complete pathway

— Incomplete pathway

SAFETY FIRST	CLIENT: Love's Travel Stops	**Potential Exposure Pathways**
terraphase engineering	PROJECT: Love's Travel Stop #413 1512 HWY 97, Ellensburg, Washington	
	PROJECT NUMBER: W053.001.003	**FIGURE 12**



Notes:
- "Additional" borings to be advanced and sampled if evidence of contamination is observed during sampling in borings TE-1 through TE-8.
- MW-3 observed to be filled with asphalt in May 2025, but is not yet considered abandoned.
- All locations are approximate.

N

0 25 50 100 Feet

1 inch = 60 feet

Aerial Imagery Source: Google Maps, August 26, 2023

SAFETY FIRST

terraphase engineering

CLIENT: Love's Travel Stops

PROJECT: Love's Travel Stop #413
1512 HWY 97, Ellensburg, WA

PROJECT NUMBER: W053.001.003

Proposed Investigation Locations

FIGURE 13

File: N:\GIS\Prj\W053_Loves Ellensburg_001\Pro Project\Historical Figures.aprx 6/6/2025 Created by: A.Venegas Coordinate System: NAD 1983 StatePlane Washington South FIPS 4602 Feet

Appendix A

Boring Logs

Table 3. Magnitude and Direction of Groundwater Gradient
Former Pilot Travel Center #389, 1512 Highway 97
Ellensburg, Kittitas County, Washington

Date	Approximate flow direction	Approximate hydraulic gradient (ft/ft)
3/18/2011	South	0.003
6/7/2011	Southwest	0.003
8/25/2011	South	0.003
11/16/2011	South	0.003
3/8/2012	Southwest	0.003
5/9/2012	South	0.004
9/22/2012	South-Southwest	0.004
12/7/2012	South-Southwest	0.004
3/7/2013	South-Southwest	0.003
6/12/2013	South-Southwest	0.004
8/27/2013	South-Southwest	0.003
12/11/2013	South-Southwest	0.002
3/25/2014	South-Southwest	0.003
6/16/2014	South-Southwest	0.003
8/19/2014	South-Southwest	0.004
11/17-18/2014	South-Southwest	0.004
3/20/2015	South	0.004
6/17/2015	South	0.005
9/24/2015	South	0.003
12/8-9/2015	South-Southwest	0.004
3/10/2016	South-Southwest	0.007
6/16-17/2016	South-Southwest	0.023
9/22/2016	South-Southwest	0.004
11/16-17/2016	South-Southwest	0.004
3/23/2017	South-Southwest	0.008
6/22/2017	South-Southwest	0.005
9/20/2017	South-Southwest	0.005
12/7/2017	South-Southwest	0.005
3/18-3/19/2018	South-Southwest	0.005
6/21-6/22/2018	Southwest	0.002
9/26/2018	South	0.002
11/29/2018	South	0.004
3/20/2019	South	0.005
6/11/2019	South-Southwest	0.006
11/13/2019	Southwest	0.003
3/24/2020	South-Southwest	0.004
6/23/2020	South	0.003
9/22-23/2020	South-Southeast	0.001
12/8-9/2020	**South**	**0.003**

BROADBENT

LITHOLOGIC AND MONITOR WELL CONSTRUCTION LOG

PROJECT NAME: PTC 389 SITE ADDRESS: Interstate 90 at State Route 97, Ellensburg, WA

PROJECT NUMBER: 10-08-102 LEGAL DESC: APN:

LOGGED BY: Taylor Lancelot FACILITY ID OR WAIVER: NOI NUMBER:

DATE: 9/26/2012 START: 07:35 DRILLING COMPANY: Pacific Soil and Water DRILLER: Marcus

WELL ID: DP-1 STOP: 08:05 DRILLING METHOD: 6600 GeoProbe SAMPLE METHOD: GeoProbe

DEPTH (FEET)	BORING DIAMETER: 4"	SAMPLE ID	PID	MOISTURE	COLOR	CONSISTENCY	GRAIN SIZE	CLASSIFICATION	REMARKS & ODORS
0							7" Asphalt 8" Concrete		
1							Large Gravel, No Recovery to 2.5'		
2									
				Dry	Brown	Medium	Noncohesive, Nonplastic Silt with 20% Gravel	ML	None
3		DP-1-3ft.	9.1	Moist	Brown	Medium	Nonplastic Silt with 40% Sand	ML	None
4				Moist	Brown	Medium	Sandy Silt, Nonplastic	ML	None
5	GROUT								
6							No Recovery From 5' to 7.5'		
7									
				Moist	Brown	Medium	Low Plasticity Sandy Silt	ML	None
8				Moist	Light Brown	Very Loose	Sandy, Well Graded Gravel (Up to 1.5" Diameter)	GW	None
9		DP-1-9ft.	5.6						
10									

TOTAL BORING DEPTH: 10.0' PAGE NO: 1 OF 1 ESTIMATED GROUNDWATER DEPTH: 9.75'

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.

BROADBENT

LITHOLOGIC AND MONITOR WELL CONSTRUCTION LOG

PROJECT NAME: PTC 389 | SITE ADDRESS: Interstate 90 at State Route 97, Ellensburg, WA

PROJECT NUMBER: 10-08-102 | LEGAL DESC: | APN:

LOGGED BY: Taylor Lancelot | FACILITY ID OR WAIVER: | NOI NUMBER:

DATE: 9/26/2012 | START: 10:34 | DRILLING COMPANY: Pacific Soil and Water | DRILLER: Marcus

WELL ID: DP-2 | STOP: - | DRILLING METHOD: 6600 GeoProbe | SAMPLE METHOD: GeoProbe

DEPTH (FEET)	BORING DIAMETER: 4"	SAMPLE ID	PID	MOISTURE	COLOR	CONSISTENCY	GRAIN SIZE	CLASSIFICATION	REMARKS & ODORS
							8" Asphalt 10" Concrete		
1							Large Gravel No Recovery to 3'		
2									
3				Dry	Brown	Loose	Low plasticity, Sandy Silt with 30% Gravels	ML	None
				Slight	Brown Gray	Loose	Sandy Silt, Non-Cohesive, Non-Plastic	ML	None
4		DP-2-4ft.	1.1						
5	GROUT			Slight	Gray	Loose	Sandy Silt, Non-Cohesive, Non-Plastic	ML	None
							No Recovery From 5' to 6'		
6				Slight	Gray	Loose	Sandy Silt, Non-Cohesive, Non-Plastic	ML	None
				Slight	Brown	Medium	Low Plasticity Sandy Silt with Little Gravels	ML	None
7			0.0	Slight	Tan	Loose	Sandy, Well Graded Gravel (Up to 1.5" Diameter)	GW	None
8									
9		DP-2-9ft.	0.9	Moist	Tan	Loose	Sandy, Well Graded Gravel, with 1" Layered White Rock	GW	None
▼									
10				Wet	Gray	Very Loose	Well Graded Gravel with Some Sand	GW	None

TOTAL BORING DEPTH: 10.0' | PAGE NO: 1 OF 1 | ▼ ESTIMATED GROUNDWATER DEPTH: 9.5'

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.

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BROADBENT

LITHOLOGIC AND MONITOR WELL CONSTRUCTION LOG

PROJECT NAME: PTC 389 SITE ADDRESS: Interstate 90 at State Route 97, Ellensburg, WA

PROJECT NUMBER: 10-08-102 LEGAL DESC: APN:

LOGGED BY: Taylor Lancelot FACILITY ID OR WAIVER: NOI NUMBER:

DATE: 9/26/2012 START: 11:26 DRILLING COMPANY: Pacific Soil and Water DRILLER: Marcus

WELL ID: DP-3 STOP: - DRILLING METHOD: 6600 GeoProbe SAMPLE METHOD: GeoProbe

DEPTH (FEET)	BORING DIAMETER: 4"	SAMPLE ID	PID	MOISTURE	COLOR	CONSISTENCY	GRAIN SIZE / CLASSIFICATION		REMARKS & ODORS
0							8" Asphalt 4" Concrete		
1							Large Gravel No Recovery to 3'		
2									
3				Dry	Tan	Loose	Silty, Sandy, Well Graded Gravel (Up to 1" Diameter)	GW-GM	None
4		DP-3-4ft.	0.0	Dry	Brown	Loose	Silty, Sandy, Well Graded Gravel (Up to 1" Diameter)	GW-GM	None
5	GROUT			Slight	Brown	Medium	Sandy Silt with Trace Grave, Non-Plastic	ML	None
							No Recovery From 5' to 6'		
6				Dry	Tan	Loose	Silty, Sandy, Well Graded Gravel (Up to 1.5" Diameter)	GW-GM	None
7				Moist	Brown	Very Loose	Sandy, Well Graded Gravel (Up to 1.5" Diameter)	GW	None
8							Approximately 6" of White Rock		
9		DP-3-9ft.	0.0	Wet	Brown	Very Loose	Well Graded Gravel with Some Sand	GW	None
10									

TOTAL BORING DEPTH: 10.0' PAGE NO: 1 OF 1 ESTIMATED GROUNDWATER DEPTH: 9.5'

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.

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BROADBENT

LITHOLOGIC AND MONITOR WELL CONSTRUCTION LOG

PROJECT NAME: PTC 389 | SITE ADDRESS: Interstate 90 at State Route 97, Ellensburg, WA

PROJECT NUMBER: 10-08-102 | LEGAL DESC: | APN:

LOGGED BY: Taylor Lancelot | FACILITY ID OR WAIVER: | NOI NUMBER:

DATE: 9/25/2012 | START: 14:35 | DRILLING COMPANY: Pacific Soil and Water | DRILLER: Marcus

WELL ID: DP-4 | STOP: - | DRILLING METHOD: 6600 GeoProbe | SAMPLE METHOD: GeoProbe

DEPTH (FEET)	BORING DIAMETER: 4"	SAMPLE ID	PID	MOISTURE	COLOR	CONSISTENCY	GRAIN SIZE	CLASSIFICATION	REMARKS & ODORS
0							6" Asphalt 10" Concrete		
1							Large Gravel No Recovery to 3'		
2									
3				Dry	Brown	Loose	Silty, Sandy, Well Graded Gravel (Up to 1" Diameter)	GW-GM	None
4				Slight	Dark Gray	Medium	Non Cohesive, Non Plastic Silt	ML	None
5	GROUT	DP-4-5ft.	0.0						
6							No Recovery From 5' to 6.5'		
7		DP-4-7.5ft.	0.0	Very Moist Wet	Dark Gray Brown	Soft Loose	Medium Plasticity Silt with 20% Sand, Some Organic Matter Sandy, Well Graded Gravel, up to 1.5" to 2" Diameter	OH GW	None None
8									
9									
10			172						Slight

TOTAL BORING DEPTH: 10.0' | PAGE NO: 1 OF 1 | ESTIMATED GROUNDWATER DEPTH: NA

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.

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BROADBENT

LITHOLOGIC AND MONITOR WELL CONSTRUCTION LOG

PROJECT NAME: PTC 389 | SITE ADDRESS: Interstate 90 at State Route 97, Ellensburg, WA

PROJECT NUMBER: 10-08-102 | LEGAL DESC: | APN:

LOGGED BY: Taylor Lancelot | FACILITY ID OR WAIVER: | NOI NUMBER:

DATE: 9/26/2012 | START: - | DRILLING COMPANY: Pacific Soil and Water | DRILLER: Marcus

WELL ID: DP-5 | STOP: - | DRILLING METHOD: 6600 GeoProbe | SAMPLE METHOD: GeoProbe

DEPTH (FEET)	BORING DIAMETER: 4"	SAMPLE ID	PID	MOISTURE	COLOR	CONSISTENCY	GRAIN SIZE	CLASSIFICATION	REMARKS & ODORS
0							8" Asphalt 4" Concrete		
1							No Recovery to 4'		
2									
3									
4									
5	GROUT	DP-5-4.5ft.	57.6	Slight	Black	Loose	Non-Cohesive, Non-Plastic Silt	ML	Slight
				Slight	Black	Loose	Non-Cohesive, Non-Plastic Silt, Traces of Sand	ML	Slight
6							6" Layer of Sandy Silt with Trace Gravel	ML	
7			23.5	Moist	Black	Loose	Non-Cohesive, Non-Plastic Silt	ML	Slight
				Moist	Brown	Loose	Sandy, Well Graded Gravel (Up to 1.5" Diameter)	GW	Strong
8									
9		DP-5-9ft.	851	Wet	Gray	Loose	Well Graded Gravel with 20% Sand	GW	
▼									
10									

TOTAL BORING DEPTH: 10.0' | PAGE NO: 1 OF 1 | ▼ ESTIMATED GROUNDWATER DEPTH: 9.5'

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.

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BROADBENT

LITHOLOGIC AND MONITOR WELL CONSTRUCTION LOG

PROJECT NAME: PTC 389 | SITE ADDRESS: Interstate 90 at State Route 97, Ellensburg, WA

PROJECT NUMBER: 10-08-102 | LEGAL DESC: | APN:

GGED BY: Taylor Lancelot | FACILITY ID OR WAIVER: | NOI NUMBER:

DATE: 9/26/2012 | START: 15:53 | DRILLING COMPANY: Pacific Soil and Water | DRILLER: Marcus

WELL ID: DP-6 | STOP: 16:20 | DRILLING METHOD: 6600 GeoProbe | SAMPLE METHOD: GeoProbe

DEPTH (FEET)	BORING DIAMETER: 4"	SAMPLE ID	PID	MOISTURE	COLOR	CONSISTENCY	GRAIN SIZE / CLASSIFICATION		REMARKS & ODORS
0							6" Asphalt 2" Concrete		
1							Large Cobbles Approximately 6" Diameter No Recovery to 3'		
2									
3				Slight	Dark Brown	Loose	Low Plasticity Silt with 10% Gravel	ML	None
4	GROUT	DP-6-4.5ft.	17.1	Slight	Dark Brown	Medium	Medium to Low Plasticity Silt with 30% Sand, Some Plant Matter Observed	OL	Slight
5							No Recovery from 5'-6'		
6				Slight	Gray	Loose	50%Sand, 50% Silt	ML	None
7				Slight	Gray	Very Loose	Sandy, Well Graded Gravel (Up to 1.5" Diameter)	GW	
				Slight	Gray	Very Loose	Sandy, Well Graded Gravel (Up to 1.5" Diameter)	GW	
8									
9		DP-6-9ft.	328	Wet	Gray	Very Loose	Well Graded Gravel with Some Sand	GW	Strong
▼									

TOTAL BORING DEPTH: 10.0' | PAGE NO: 1 OF 1 | ▼ ESTIMATED GROUNDWATER DEPTH: 9.5'

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.

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BROADBENT

LITHOLOGIC AND MONITOR WELL CONSTRUCTION LOG

PROJECT NAME: PTC 389 | SITE ADDRESS: Interstate 90 at State Route 97, Ellensburg, WA

PROJECT NUMBER: 10-08-102 | LEGAL DESC: | APN:

LOGGED BY: Taylor Lancelot | FACILITY ID OR WAIVER: | NOI NUMBER:

DATE: 9/26/2012 | START: 16:50 | DRILLING COMPANY: Pacific Soil and Water | DRILLER: Marcus

WELL ID: DP-7 | STOP: 17:38 | DRILLING METHOD: 6600 GeoProbe | SAMPLE METHOD: GeoProbe

DEPTH (FEET)	BORING DIAMETER: 4"	SAMPLE ID	PID	MOISTURE	COLOR	CONSISTENCY	GRAIN SIZE CLASSIFICATION		REMARKS & ODORS
1							8" Asphalt 3" Concrete		
2							Large Cobbles Approximately 4-6" Diameter to 3'		
3				Dry	Tan	Loose	Sandy Silt with Poorly Graded Gravel	ML	None
4		DP-7-4ft.	11.4	Slight	Dark Gray	Loose	Low Plasticity Sandy Silt with Trace Well Graded Gravel	ML	None
5				Dry	Tan	Loose	6" Sandy Silt with Some Gravel	ML	
6							No Recovery from 5'-6'		
				Moist	Dark Gray	Loose	Well Graded Sandy Gravel (Up to 1.5" Diameter)	GW	None
7				Moist	Dark Gray	Medium	Medium Plasticity Sandy Silt	ML	None
		DP-7-8ft.	3.8						
9	GROUT			Moist	Dark Gray	Medium	Medium Plasticity Silt with 40% Sand	ML	None
10							No Recovery from 10'-12'		
12		DP-7-12ft.		Moist	Gray	Very Loose	Well Graded Sandy Gravel (Up to 1.5" in Diameter)	GW	
13 ▼				Wet	Gray	Very Loose	Well Graded Gravel with Some Sand (Up to 1.5" Diameter)	GW	None
14				Wet	Red Brown	Very Loose	Well Graded Gravel with Some Sand (Up to 1.5" Diameter)	GW	
15									
16									
17									
18									
19									

TOTAL BORING DEPTH: 14.0' | PAGE NO: 1 OF 1 | ▼ ESTIMATED GROUNDWATER DEPTH: 13.0'

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.

BROADBENT

LITHOLOGIC AND MONITOR WELL CONSTRUCTION LOG

PROJECT NAME: PTC 389 | SITE ADDRESS: Interstate 90 at State Route 97, Ellensburg, WA

PROJECT NUMBER: 10-08-102 | LEGAL DESC: | APN:

LOGGED BY: Taylor Lancelot | FACILITY ID OR WAIVER: | NOI NUMBER:

DATE: 9/25/2012 | START: 08:39 | DRILLING COMPANY: Pacific Soil and Water | DRILLER: Marcus

WELL ID: DP-8 | STOP: 09:35 | DRILLING METHOD: 6600 GeoProbe | SAMPLE METHOD: GeoProbe

DEPTH (FEET)	BORING DIAMETER: 4"	SAMPLE ID	PID	MOISTURE	COLOR	CONSISTENCY	GRAIN SIZE CLASSIFICATION		REMARKS & ODORS
1				Dry	Brown	Loose	12" Asphalt 7" Concrete Cobbles		None
2							No Recovery to 4'		
3									
4				Dry	Brown	Loose	Noncohesive Silt and Poorly Graded Gravel	ML	None
5	GROUT	DP-8-5ft.	4.7	Moist	Brown	Medium	Low Plasticity Silt with Well Graded Gravel (Up to 1.5" in Diameter)	ML	None
6							No Recovery to 7'		
7				Moist	Dark Gray	Medium	Medium Plasticity Silt with Little Gravel	ML	None
8				Very Moist	Dark Gray	Medium	Medium Plasticity Silt with 30% Sand	ML	None
9		DP-8-9ft.	0.9						
▼ 10				Wet	Dark Gray	Loose	Sandy Well Graded Gravel (Up to 2" in Diameter)	GW	None

TOTAL BORING DEPTH: 10.0' | PAGE NO: 1 OF 1 | ▼ ESTIMATED GROUNDWATER DEPTH: 9.5'

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.

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BROADBENT

LITHOLOGIC AND MONITOR WELL CONSTRUCTION LOG

PROJECT NAME: PTC 389 | SITE ADDRESS: Interstate 90 at State Route 97, Ellensburg, WA

PROJECT NUMBER: 10-08-102 | LEGAL DESC: _____ APN: _____

LOGGED BY: Taylor Lancelot | FACILITY ID OR WAIVER: _____ NOI NUMBER: _____

DATE: 9/25/2012 START: 06:40 | DRILLING COMPANY: Pacific Soil and Water DRILLER: Marcus

WELL ID: DP-9 STOP: 07:43 | DRILLING METHOD: 6600 GeoProbe SAMPLE METHOD: GeoProbe

DEPTH (FEET)	BORING DIAMETER: 4"	SAMPLE ID	PID	MOISTURE	COLOR	CONSISTENCY	GRAIN SIZE CLASSIFICATION		REMARKS & ODORS
							12" Asphalt 24" Concrete		
3				Slight	Brown	Loose	Silty, Sandy, Well Graded Gravel (Up to 1" in Diameter)	GW -GM	None
5		DP-9-5ft.	1.1	Slight	Brown	Loose	Low Plasticity Silty, Sandy, Well Graded Gravel	GW -GM	None
							No Recovery to 8'		
				Dry	Lt. Brown	Loose	Non-Cohesive Silt With Poorly Graded Gravel	ML	None
9	GROUT	DP-9-9ft.	1.8	Slight	Brown Gray	Loose	Silty, Sandy, Well Graded Gravel (Up to 1.5" in Diameter)	GW -GM	None
							No Recovery to 12'		
12		DP-9-12ft.	2.8	Moist	Brown	Medium Dense	Low Plasticity Silt with Little Gravel	ML	None
13 ▼				Wet	Gray	Loose	Sandy Well Graded Gravel (Up to 2" in Diameter)	GW	None

TOTAL BORING DEPTH: 15.0' PAGE NO: 1 OF 1 ESTIMATED GROUNDWATER DEPTH: 13.5' ▼

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BROADBENT

LITHOLOGIC AND MONITOR WELL CONSTRUCTION LOG

PROJECT NAME: PTC 389 | SITE ADDRESS: Interstate 90 at State Route 97, Ellensburg, WA

PROJECT NUMBER: 10-08-102 | LEGAL DESC: | APN:

LOGGED BY: Taylor Lancelot | FACILITY ID OR WAIVER: | NOI NUMBER:

DATE: 9/25/2012 | START: 08:00 | DRILLING COMPANY: Pacific Soil and Water | DRILLER: Marcus

WELL ID: DP-10 | STOP: 08:36 | DRILLING METHOD: 6600 GeoProbe | SAMPLE METHOD: GeoProbe

DEPTH (FEET)	BORING DIAMETER: 4"	SAMPLE ID	PID	MOISTURE	COLOR	CONSISTENCY	GRAIN SIZE CLASSIFICATION		REMARKS & ODORS
0							12" Asphalt 3" Concrete		
1									
2							No Recovery to 4'		
3									
4				Slight	Brown	Very Loose	Silty, Sandy, Poorly Graded Gravel	GP-GM	None
5	GROUT	DP-10-5ft.	3.5						
6							No Recovery to 8.5'		
7									
8									
8		DP-10-8.5ft.	0.9	Moist	Gray Brown	Medium Dense	Low Plasticity Silt with 20% Poorly Graded Gravel	ML	None
9									
▼ 9.5				Wet	Gray	Loose	Silty, Sandy, Well Graded Gravel (Up to 1.5" in Diameter)	GW-GM	None
10									

TOTAL BORING DEPTH: 10.0' | PAGE NO: 1 OF 1 | ▼ ESTIMATED GROUNDWATER DEPTH: 9.5'

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.

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BROADBENT

LITHOLOGIC AND MONITOR WELL CONSTRUCTION LOG

PROJECT NAME: PTC 389 | SITE ADDRESS: Interstate 90 at State Route 97, Ellensburg, WA

PROJECT NUMBER: 10-08-102 | LEGAL DESC: | APN:

LOGGED BY: Taylor Lancelot | FACILITY ID OR WAIVER: | NOI NUMBER:

DATE: 9/25/2012 | START: 12:30 | DRILLING COMPANY: Pacific Soil and Water | DRILLER: Marcus

WELL ID: DP-11 | STOP: 13:11 | DRILLING METHOD: 6600 GeoProbe | SAMPLE METHOD: GeoProbe

DEPTH (FEET)	BORING DIAMETER: 4"	SAMPLE ID	PID	MOISTURE	COLOR	CONSISTENCY	GRAIN SIZE / CLASSIFICATION		REMARKS & ODORS
0							12" Asphalt 4" Concrete		
1									
2									
3							Large gravel to 3' No Recovery to 4'		
4				Dry	Brown	Very Loose	Silty, Sandy, Poorly Graded Gravel (Up to 0.5" in Diameter)	GP-GM	None
5	GROUT	DP-11-5ft.	16.2	Moist	Dark Gray	Medium	Low Plasticity Silt with Little Gravel	ML	Slight
6							No Recovery to 7'		
7									
8		DP-11-8ft.	17.4	Very Moist	Dark Gray	Med. Dense	Medium Plasticity Silt with 30% Sand	ML	Slight
9									
				Wet	Gray	Loose	Sandy, Well Graded Gravel (Up to 1" in Diameter)	GW	None
10									

TOTAL BORING DEPTH: 10.0' | PAGE NO: 1 OF 1 | ESTIMATED GROUNDWATER DEPTH: 9.0'

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.

BROADBENT

LITHOLOGIC AND MONITOR WELL CONSTRUCTION LOG

PROJECT NAME: PTC 389 | SITE ADDRESS: Interstate 90 at State Route 97, Ellensburg, WA

PROJECT NUMBER: 10-08-102 | LEGAL DESC: | APN:

LOGGED BY: Taylor Lancelot | FACILITY ID OR WAIVER: | NOI NUMBER:

DATE: 9/24/2012 | START: 13:37 | DRILLING COMPANY: Pacific Soil and Water | DRILLER: Marcus

WELL ID: DP-12 | STOP: 14:36 | DRILLING METHOD: 6600 GeoProbe | SAMPLE METHOD: GeoProbe

DEPTH (FEET)	BORING DIAMETER: 4"	SAMPLE ID	PID	MOISTURE	COLOR	CONSISTENCY	GRAIN SIZE	CLASSIFICATION	REMARKS & ODORS
0							12" Asphalt		
1				Slight	Dark Brown	Medium	Non-Cohesive Silt with Little Gravel Large Cobble Gravel Layer		None
2									
3							No Recovery to 5'		
4									
5	GROUT		0.0	Slight	Brown	Loose	Non-Cohesive, Non-Plastic Silt with 50% Gravel	ML	
6							No Recovery to 7'		
7				Moist	Brown	Loose	Non-Cohesive, Non-Plastic Silt with 50% Small Gravel	ML	None
8			9.7	Moist	Gray	Medium	Gravel Approximately 2" Diameter with Silt	GM	None
9		DP-12-8.5ft.	773	Very Moist	Light Gray	Loose-Medium	Large Gravel With 30% Coarse Grain Sand	GW	Slight
				Wet	Light Gray	Medium	Large Gravel With 30% Coarse Grain Sand	GW	Strong

TOTAL BORING DEPTH: 10.0' | PAGE NO: 1 OF 1 | ESTIMATED GROUNDWATER DEPTH: 9.0'

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.

BROADBENT

LITHOLOGIC AND MONITOR WELL CONSTRUCTION LOG

PROJECT NAME: PTC 389 | SITE ADDRESS: Interstate 90 at State Route 97, Ellensburg, WA

PROJECT NUMBER: 10-08-102 | LEGAL DESC: | APN:

LOGGED BY: Taylor Lancelot | FACILITY ID OR WAIVER: | NOI NUMBER:

DATE: 9/24/2012 | START: 15:54 | DRILLING COMPANY: Pacific Soil and Water | DRILLER: Marcus

WELL ID: DP-13 | STOP: 16:27 | DRILLING METHOD: 6600 GeoProbe | SAMPLE METHOD: GeoProbe

DEPTH (FEET)	BORING DIAMETER: 4"	SAMPLE ID	PID	MOISTURE	COLOR	CONSISTENCY	GRAIN SIZE CLASSIFICATION		REMARKS & ODORS
1							12" Asphalt 2" Concrete		
2				Slight	Dark Gray	Loose	Non-Cohseive, Non-Plastic Silt	ML	None
3									
4		DP-13-4ft.	2.1	Moist	Dark Gray	Medium	Medium Plasticity Silt with Some Sand	ML	None
5				Wet	Dark Gray	Medium	Medium Plasticity Silt with Some Sand	ML	
6							No Recovery to 7.5'		
7									
		DP-13-8ft.	0.4	Wet	Light Gray	Very Loose	Sandy Gravel (Up to 0.5" in Diameter)	GW	None
9 ▼	GROUT								
10				Wet	Light Gray	Very Loose	Sandy Well Graded Gravel (Up to 1.5" in Diameter)	GW	None
11							Refusal, Bedrock Encountered at 11.5'		
12									
13									
14									
15									
16									
17									
18									
19									

TOTAL BORING DEPTH: 11.5' | PAGE NO: 1 OF 1 | ▼ ESTIMATED GROUNDWATER DEPTH: 9.0'

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.

BROADBENT

LITHOLOGIC AND MONITOR WELL CONSTRUCTION LOG

PROJECT NAME: PTC 389 SITE ADDRESS: Interstate 90 at State Route 97, Ellensburg, WA

PROJECT NUMBER: 10-08-102 LEGAL DESC: APN:

LOGGED BY: Taylor Lancelot FACILITY ID OR WAIVER: NOI NUMBER:

DATE: 9/24/2012 START: 16:48 DRILLING COMPANY: Pacific Soil and Water DRILLER: Marcus

WELL ID: DP-14 STOP: 17:21 DRILLING METHOD: 6600 GeoProbe SAMPLE METHOD: GeoProbe

DEPTH (FEET)	BORING DIAMETER: 4"	SAMPLE ID	PID	MOISTURE	COLOR	CONSISTENCY	GRAIN SIZE CLASSIFICATION		REMARKS & ODORS
0							12" Asphalt 2" Concrete		
1				Dry	Light Brown	Loose	Gravelly Silt	ML	None
2									
3				Dry	Light Brown	Loose	Silty, Sandy, Well Graded Gravel	GW-GM	None
4									
5	GROUT	DP-14-5ft.	0.0	Slightly Moist	Light Brown	Loose	Silty, Sandy, Well Graded Gavel	GW-GM	None
6							No Recovery to 7'		
7		DP-14-7.5ft.	0.0	Slightly Moist	LIght Brown	Loose	Silty, Sandy, Well Graded Gravel	GW-GM	None
8									
9				Wet	Gray	Very Loose	Well Graded Gravel (Up to 1" in Diameter)	GW	None
10									

TOTAL BORING DEPTH: 10.0' PAGE NO: 1 OF 1 ESTIMATED GROUNDWATER DEPTH: 8.5'

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.

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BROADBENT

LITHOLOGIC AND MONITOR WELL CONSTRUCTION LOG

PROJECT NAME: PTC 389 | SITE ADDRESS: Interstate 90 at State Route 97, Ellensburg, WA

PROJECT NUMBER: 10-08-102 | LEGAL DESC: | APN:

LOGGED BY: Taylor Lancelot | FACILITY ID OR WAIVER: | NOI NUMBER:

DATE: 9/24/2012 | START: 17:55 | DRILLING COMPANY: Pacific Soil and Water | DRILLER: Marcus

WELL ID: DP-15 | STOP: 18:23 | DRILLING METHOD: 6600 GeoProbe | SAMPLE METHOD: GeoProbe

DEPTH (FEET)	BORING DIAMETER: 4"	SAMPLE ID	PID	MOISTURE	COLOR	CONSISTENCY	GRAIN SIZE	CLASSIFICATION	REMARKS & ODORS
							12" Asphalt 3" Concrete		
1				Slight	Dark Brown	Medium Dense	Low-Plasticity, Cohesive Silt	ML	None
2									
3				Slight	Dark Brown	Loose	Sandy Silt with 20% Poorly Graded Gravel	ML	None
4				Moist	Light Brown	Loose	Sandy Well Graded Gravel (Up to 1" in Diameter)	GW	None
5	GROUT	DP-15-5ft.	0.0						
6							No Recovery to 8'		
7									
8		DP-15-8ft.	0.0	Slightly Moist	Light Brown	Very Loose	Sandy, Well Graded Gravel (Up to 1.5" in Diameter)	GW	None
9				Wet	Brown	Very Loose	Sandy Well Graded Gravel (Up to 2" in Diameter)	GW	None
10									

TOTAL BORING DEPTH: 10.0' | PAGE NO: 1 OF 1 | ESTIMATED GROUNDWATER DEPTH: 9.5'

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.

BROADBENT

LITHOLOGIC AND MONITOR WELL CONSTRUCTION LOG

PROJECT NAME: PTC 389 | SITE ADDRESS: Interstate 90 at State Route 97, Ellensburg, WA

PROJECT NUMBER: 10-08-102 | LEGAL DESC: | APN:

LOGGED BY: Taylor Lancelot | FACILITY ID OR WAIVER: | NOI NUMBER:

DATE: 9/25/2012 | START: 13:38 | DRILLING COMPANY: Pacific Soil and Water | DRILLER: Marcus

WELL ID: DP-16 | STOP: 14:28 | DRILLING METHOD: 6600 GeoProbe | SAMPLE METHOD: GeoProbe

DEPTH (FEET)	BORING DIAMETER: 4"	SAMPLE ID	PID	MOISTURE	COLOR	CONSISTENCY	GRAIN SIZE / CLASSIFICATION		REMARKS & ODORS
0							12" Asphalt 16" Concrete/Compacted Material		
1									
2							Large Gravel No Recovery to 3'		
3				Slight	Light Brown	Loose	Silty, Sandy Well Graded Gravel	GW-GM	None
4	GROUT	DP-16-4ft.	0.0	Slight	Gray	Medium	Low Plasticity Silt with Trace Sand and Gravel	ML	None
5							No Recovery 5-6'		
6				Slight	Light Gray	Loose	Sandy Well Graded Gravel (Up to 0.5" in Diameter)	GW	None
7				Slight	Light Gray	Loose	Sandy Well Graded Gravel (Up to 1" in Diameter)	GW	None
8									
9 ▼		DP-16-9ft.	0.0	Moist	Light Gray	Loose	Sandy Well Graded Gravel (Up to 1" in Diameter)	GW	None
10				Wet	Light Gray	Loose	Sandy Well Graded Gravel (Up to 1" in Diameter)	GW	None

TOTAL BORING DEPTH: 10.0' | PAGE NO: 1 OF 1 | ▼ ESTIMATED GROUNDWATER DEPTH: 9.0'

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.

BROADBENT

LITHOLOGIC AND MONITOR WELL CONSTRUCTION LOG

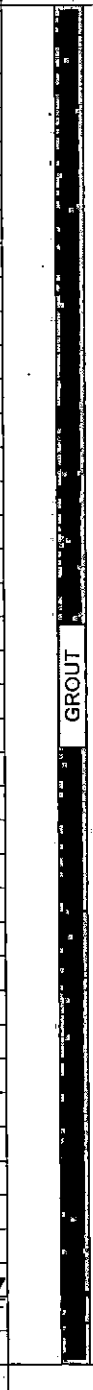
PROJECT NAME: PTC 389 | SITE ADDRESS: Interstate 90 at State Route 97, Ellensburg, WA

PROJECT NUMBER: 10-08-102 | LEGAL DESC: | APN:

LOGGED BY: Taylor Lancelot | FACILITY ID OR WAIVER: | NOI NUMBER:

DATE: 9/26/2012 | START: 09:11 | DRILLING COMPANY: Pacific Soil and Water | DRILLER: Marcus

WELL ID: DP-17 | STOP: 10:21 | DRILLING METHOD: 6600 GeoProbe | SAMPLE METHOD: GeoProbe



DEPTH (FEET)	BORING DIAMETER: 4"	SAMPLE ID	PID	MOISTURE	COLOR	CONSISTENCY	GRAIN SIZE	CLASSIFICATION	REMARKS & ODORS
0							8" Asphalt 10" Concrete		
1							Cobbles/Large Gravel (3"-6" in Diameter) to 3.5'		None
2									
3									
4				Dry	Tan	Loose	Silty, Sandy Well Graded Gravel (Up to 0.5" in Diameter)	GW-GM	None
5		DP-17-4.5ft.	3.6	Slight	Brown	Medium	Sandy Non-Cohesive, Non-Plastic Silt with Some Gravel	ML	None
6							No Recovery 5-7'		
7				Slight	Light Brown	Loose	Silty, Sandy, Well Graded Gravel (Up to 1.5" in Diameter)	GW-GM	None
8									
9		DP-17-9ft.	4.2	Moist	Gray Brown	Loose	Sandy Well Graded Gravel (Up to 1.5" in Diameter)	GW	None
10				Wet	Gray	Very Loose	Sandy Well Graded Gravel	GW	None

TOTAL BORING DEPTH: 10.0' | PAGE NO: 1 OF 1 | ESTIMATED GROUNDWATER DEPTH: 9.5'

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.

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BROADBENT

LITHOLOGIC AND MONITOR WELL CONSTRUCTION LOG

PROJECT NAME: PTC 389 | SITE ADDRESS: Interstate 90 at State Route 97, Ellensburg, WA

PROJECT NUMBER: 10-08-102 | LEGAL DESC: | APN:

LOGGED BY: Taylor Lancelot | FACILITY ID OR WAIVER: | NOI NUMBER:

DATE: 9/26/2012 | START: 06:43 | DRILLING COMPANY: Pacific Soil and Water | DRILLER: Marcus

WELL ID: DP-18 | STOP: 07:26 | DRILLING METHOD: 6600 GeoProbe | SAMPLE METHOD: GeoProbe

DEPTH (FEET)	BORING DIAMETER: 4"	SAMPLE ID	PID	MOISTURE	COLOR	CONSISTENCY	GRAIN SIZE / CLASSIFICATION		REMARKS & ODORS
0							8" Asphalt 12" Concrete		
1							Large Gravel No Recovery to 3'		
2									
3				Slight	Brown Gray	Loose	Low Plasticity Silt with Trace Gravel	ML	None
1		DP-18-4ft.	0.0	Slight	Brown	Loose	Silty, Sandy, Well Graded Gravel (Up to 1.5" Diameter)	GW-GM	None
5	GROUT								
6							No Recovery 5-8.5'		
7									
8				Slight	Light Brown	Loose	Silty, Sandy, Well Graded Gravel (Up to 1" in Diameter)	GW-GM	None
9		DP-18-9ft.	0.0	Moist	Brown	Very Loose	Sandy Well Graded Gravel	GW	None
10				Wet					

TOTAL BORING DEPTH: 10.0' | PAGE NO: 1 OF 1 | ESTIMATED GROUNDWATER DEPTH: 10.0'

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.

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BROADBENT

LITHOLOGIC AND MONITOR WELL CONSTRUCTION LOG

PROJECT NAME: PTC 389 | SITE ADDRESS: Interstate 90 at State Route 97, Ellensburg, WA

PROJECT NUMBER: 10-08-102 | LEGAL DESC: | APN:

LOGGED BY: Taylor Lancelot | FACILITY ID OR WAIVER: | NOI NUMBER:

DATE: 9/26/2012 | START: 08:17 | DRILLING COMPANY: Pacific Soil and Water | DRILLER: Marcus

WELL ID: DP-19 | STOP: - | DRILLING METHOD: 6600 GeoProbe | SAMPLE METHOD: GeoProbe

DEPTH (FEET)	BORING DIAMETER: 4"	SAMPLE ID	PID	MOISTURE	COLOR	CONSISTENCY	GRAIN SIZE / CLASSIFICATION		REMARKS & ODORS
0							8" Asphalt 6" Concrete		
2				Dry	Dark Brown	Loose	Low Plasticity Silt with Small Gravel	ML	None
3		DP-19-3ft.	4.2	Slight	Light Brown	Loose	Silty, Sandy, Well Graded Gravel (Up to 0.5" in Diameter)	GW-GM	None
5	GROUT						No Recovery 5'-8'		
8		DP-19-8ft.	15.4	Slight	Tan	Very Loose	Silty, Sandy, Well Graded Gravel (Up to 1" in Diameter)	GW-GM	None
9 ▼				Wet	Gray	Very Loose	Sandy Well Graded Gravel (Up to 1" in Diameter)	GW	None
10									

TOTAL BORING DEPTH: 10.0' | PAGE NO: 1 OF 1 | ▼ ESTIMATED GROUNDWATER DEPTH: 9.0'

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.

BROADBENT

LITHOLOGIC AND MONITOR WELL CONSTRUCTION LOG

PROJECT NAME: PTC 389 | SITE ADDRESS: Interstate 90 at State Route 97; Ellensburg, WA

PROJECT NUMBER: 10-08-102 | LEGAL DESC: | APN:

LOGGED BY: Taylor Lancelot | FACILITY ID OR WAIVER: | NOI NUMBER:

DATE: 9/25/2012 | START: 10:02 | DRILLING COMPANY: Pacific Soil and Water | DRILLER: Marcus

WELL ID: DP-20 | STOP: 11:08 | DRILLING METHOD: 6600 GeoProbe | SAMPLE METHOD: GeoProbe

DEPTH (FEET)	BORING DIAMETER: 4"	SAMPLE ID	PID	MOISTURE	COLOR	CONSISTENCY	GRAIN SIZE CLASSIFICATION		REMARKS & ODORS
1							12" Asphalt 3" Concrete		
2							Large Cobbles No Recovery to 4'		
3									
4				Slight	Light Brown	Loose	Silty, Sandy, Well Graded Gravel (Up to 1" in Diameter)	GW-GM	None
5									
6							No Recovery to 8.5'		
7									
9 ▼	GROUT	DP-20-8.5ft.	0.0	Moist	Brown	Very Loose	Silty, Sandy, Well Graded Gravel (Up to 2" in Diameter)	GW-GM	None
10									
11							No Recovery to 13'		
12									
13				Wet	Brown	Medium Dense	Medium Plasticity Silty, Sandy, Well Graded Gravel (Up to 2" in Diameter)	GW-GM	None
14				Wet	Gray	Loose	Sandy, Well Graded Gravel (Up to 1.5" in Diameter)	GW	None
15									
16									
17									
18									
19									

TOTAL BORING DEPTH: 15' | PAGE NO: 1 OF 1 | ▼ ESTIMATED GROUNDWATER DEPTH: 9.5'

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.

BROADBENT

LITHOLOGIC AND MONITOR WELL CONSTRUCTION LOG

PROJECT NAME: PTC 389 | SITE ADDRESS: Interstate 90 at State Route 97, Ellensburg, WA

PROJECT NUMBER: 10-08-102 | LEGAL DESC: | APN:

LOGGED BY: Taylor Lancelot | FACILITY ID OR WAIVER: | NOI NUMBER:

DATE: 9/24/2012 | START: 14:51 | DRILLING COMPANY: Pacific Soil and Water | DRILLER: Marcus

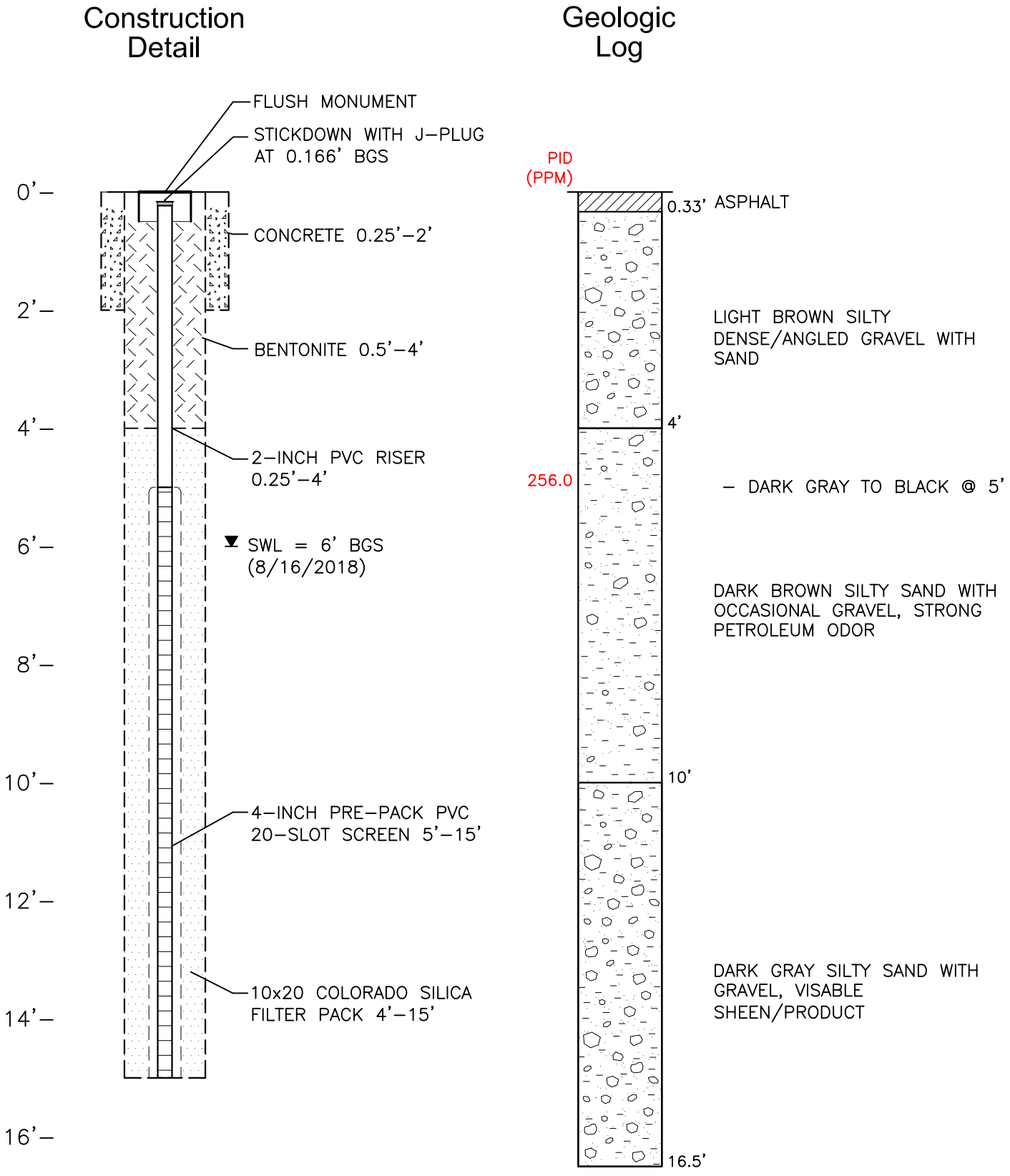
WELL ID: DP-21 | STOP: 15:42 | DRILLING METHOD: 6600 GeoProbe | SAMPLE METHOD: GeoProbe

DEPTH (FEET)	BORING DIAMETER: 4"	SAMPLE ID	PID	MOISTURE	COLOR	CONSISTENCY	GRAIN SIZE CLASSIFICATION		REMARKS & ODORS
							12" Asphalt 2" Compacted, Cemented Layer Under Asphalt		
2				Slight	Dark Brown	Loose	Cohesive, Low Plasticity Silt with 30% Small Gravel	ML	None
3				Moist	Dark Gray	Loose	Low Plasticity Silt	ML	None
4		DP-21-4ft.	18.2	Very Moist	Dark Gray	Soft	Low Plasticity Silt	ML	None
5	GROUT								
6							No Recovery to 7.5'		
7		DP-21-7.5ft.	6.9	Wet	Brown	Loose	Silty Sand with Little Gravel	SM	None
8				Wet	Light Brown	Loose	Large Gravel with 30% Sand	GP	None
9									
10									

TOTAL BORING DEPTH: 10.0' | PAGE NO: 1 OF 1 | ESTIMATED GROUNDWATER DEPTH: 8.0'

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.

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ROBINSON NOBLE	PM: JFH December 2020 3182-002A	Kittitas County T 18 N/R 18 E - 33 Well ID: BKL-234	Figure 5 Construction Detail and Geologic Log for Monitor Well 17 Love's Travel Stops and Country Stores: Ellensberg Gasoline Spill

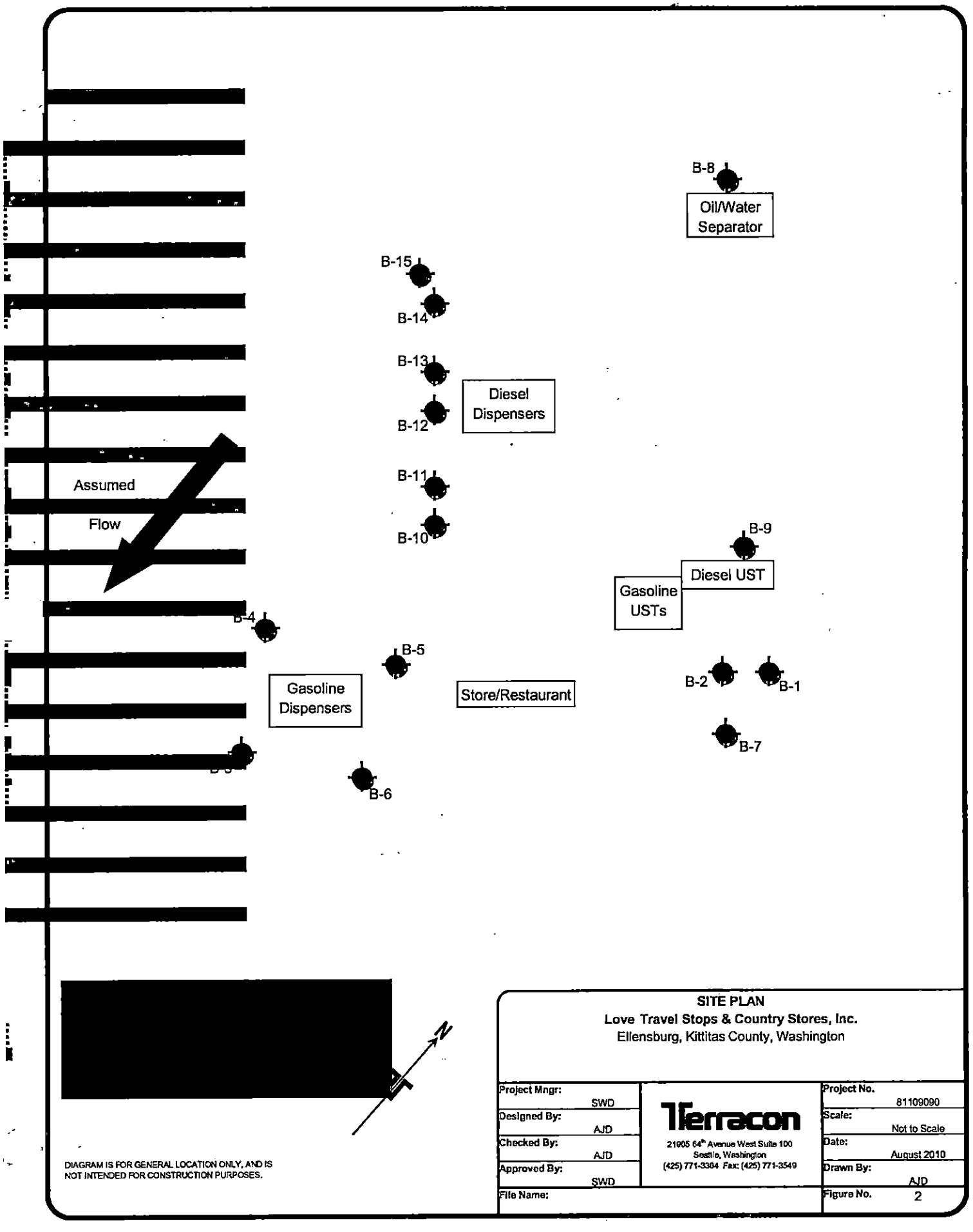


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES.

SITE PLAN

Love Travel Stops & Country Stores, Inc.

Ellensburg, Kittitas County, Washington

Project Mngr: SWD	Terracon	Project No.	81109090
Designed By: AJD	21905 64th Avenue West Suite 100 Seattle, Washington (425) 771-3304 Fax: (425) 771-3549	Scale:	Not to Scale
Checked By: AJD		Date:	August 2010
Approved By: SWD		Drawn By:	AJD
File Name:		Figure No.	2

APPENDIX B

Boring Logs

LOG OF BORING NO. B-1

CLIENT: Loves

SITE: 1512 Highway 97, Ellensburg, Washington

PROJECT: Ellensburg Loves

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, in.	SAMPLES: SPT - N BLOWS / ft.	TESTS: WATER CONTENT, %	TESTS: FIELD VAPOR TEST (PPM)*	TESTS: SOIL SAMPLE SENT TO LABORATORY
	0.25 3" Asphalt									
	Sandy GRAVEL, with Silt Brown, Medium Dense, Moist									
	2 Gravelly SAND, trace Silt Brown, Medium Dense, Moist				PP	14				
	3 SILT, with Sand Brown, Medium Stiff, Moist, Organics				PP	3.5				
	Wet	5								
	6 ▽ Sandy GRAVEL, trace Silt Brown, Medium Dense, Wet to Saturated									B1 @6FT
		10			PP	28				
	11.5 BOTTOM OF BORING Drilling refusal at 11.5 feet bgs.	15								

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

* ND indicates a reading of less than the field detection limit (FDL) of one (1) part per million isobutylene equivalents (ppmi).

WATER LEVEL OBSERVATIONS, ft		
WL	▽ 6	▼
WL	▽	▼
WL		

Terracon

BORING STARTED	08-16-10		
BORING COMPLETED	08-16-10		
RIG AMS PP 9500		DRILLER	ESN
LOGGED AJD		JOB #	81109090

BOREHOLE 99 DRAFT LOGS.GPJ TERRACON.GDT 09/03/10

LOG OF BORING NO. B-2

CLIENT: Loves

SITE: 1512 Highway 97, Ellensburg, Washington

PROJECT: Ellensburg Loves

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, in.	SAMPLES: SPT - N BLOWS / ft.	TESTS: WATER CONTENT, %	TESTS: FIELD VAPOR TEST (PPM)*	TESTS: SOIL SAMPLE SENT TO LABORATORY
	0.25 3" Asphalt **Sandy GRAVEL**, with Silt Brown, Medium Dense, Moist 1.5									
	BOTTOM OF BORING Boring terminated due to presence of concrete or asphalt at 1.5 feet.	5 10 15								

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

* ND indicates a reading of less than the field detection limit (FDL) of one (1) part per million isobutylene equivalents (ppmi).

WATER LEVEL OBSERVATIONS, ft		
WL	▽	▼
WL	▽	▽
WL		

Terracon

BORING STARTED	08-16-10		
BORING COMPLETED	08-16-10		
RIG AMS PP 9500		DRILLER	ESN
LOGGED AJD		JOB #	81109090

BOREHOLE 99 DRAFT LOGS.GPJ TERRACON.GDT 08/03/10

LOG OF BORING NO. B-3

CLIENT: Loves

SITE: 1512 Highway 97, Ellensburg, Washington

PROJECT: Ellensburg Loves

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, in.	SAMPLES: SPT - N BLOWS / ft.	TESTS: WATER CONTENT, %	TESTS: FIELD VAPOR TEST (PPM)*	TESTS: SOIL SAMPLE SENT TO LABORATORY
	0.5 4" Asphalt									
	Sandy GRAVEL, with Silt Brown, Medium Dense, Moist				PP	12				
					PP	28				
	7 ▽	5								
	SILT, with Sand Brown, Medium Stiff, Wet to Saturated									B3 @7.5Ft
	8.5				PP	22				
	GRAVEL, with Sand and Silt Brown, Medium Dense, Wet to Saturated	10								
	12									
	BOTTOM OF BORING Drilling refusal at 12 feet.	15								

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

* ND indicates a reading of less than the field detection limit (FDL) of one (1) part per million isobutylene equivalents (ppmi).

WATER LEVEL OBSERVATIONS, ft		
WL	▽ 6.5	▼
WL	▽	▼
WL		

Terracon

BORING STARTED	08-16-10		
BORING COMPLETED	08-16-10		
RIG	AMS PP 9500	DRILLER	ESN
LOGGED	AJD	JOB #	81109090

BOREHOLE 99 DRAFT LOGS.GPJ TERRACON.GDT 09/03/10

LOG OF BORING NO. B-4

CLIENT: **Loves**

SITE: **1512 Highway 97, Ellensburg, Washington**

PROJECT: **Ellensburg Loves**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, in.	SAMPLES: SPT - N BLOWS / ft.	TESTS: WATER CONTENT, %	TESTS: FIELD VAPOR TEST (PPM)*	TESTS: SOIL SAMPLE SENT TO LABORATORY
	0.25 3" Asphalt									
	Sandy GRAVEL, with Silt Brown, Medium Dense, Moist				PP	25				B4 @3.5ft
	5 **BOTTOM OF BORING**	5								
		10								
		15								

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

* ND indicates a reading of less than the field detection limit (FDL) of one (1) part per million isobutylene equivalents (ppmi).

WATER LEVEL OBSERVATIONS, ft		
WL	▽	▼
WL	▽	▼
WL		

Terracon

BORING STARTED	08-16-10		
BORING COMPLETED	08-16-10		
RIG AMS PP 9500		DRILLER	ESN
LOGGED AJD		JOB #	81109090

BOREHOLE 99 DRAFT LOGS.GPJ TERRACON.GDT 09/03/10

LOG OF BORING NO. B-5

CLIENT: **Loves**

SITE: **1512 Highway 97, Ellensburg, Washington**

PROJECT: **Ellensburg Loves**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, in.	SAMPLES: SPT - N BLOWS / ft.	TESTS: WATER CONTENT, %	TESTS: FIELD VAPOR TEST (PPM)*	TESTS: SOIL SAMPLE SENT TO LABORATORY
	0.25 3" Asphalt **Sandy GRAVEL**, with Silt Brown, Medium Dense, Moist									
	2.5 **SILT**, with Sand Gray, Medium Stiff, Moist, Organics, TPH Odor				PP	30				B3 @3ft
	5.5 **BOTTOM OF BORING**	5 10 15								

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

* ND indicates a reading of less than the field detection limit (FDL) of one (1) part per million isobutylene equivalents (ppmi).

WATER LEVEL OBSERVATIONS, ft		
WL	▽	▼
WL	▽	▼
WL		

Terracon

BORING STARTED	08-16-10		
BORING COMPLETED	08-16-10		
RIG AMS PP 9500		DRILLER	ESN
LOGGED AJD		JOB #	81109090

BOREHOLE 99 DRAFT LOGS.GPJ TERRACON.GDT 09/03/10

LOG OF BORING NO. B-6

CLIENT: Loves

SITE: 1512 Highway 97, Ellensburg, Washington

PROJECT: Ellensburg Loves

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, in.	SAMPLES: SPT - N BLOWS / ft.	TESTS: WATER CONTENT, %	TESTS: FIELD VAPOR TEST (PPM)*	TESTS: SOIL SAMPLE SENT TO LABORATORY
	0.25 3.5" Asphalt									
	Sandy GRAVEL, with Silt Brown, Medium Dense, Moist									
	2.5				PP	39				
	SILT, with Sand Brown, Medium Stiff, Moist to Wet									
	4									
	SILT, trace Sand Gray, Medium Stiff, Wet TPH Odor									B6 @5ft
	5	5								
	BOTTOM OF BORING									
		10								
		15								

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

* ND indicates a reading of less than the field detection limit (FDL) of one (1) part per million isobutylene equivalents (ppmi).

WATER LEVEL OBSERVATIONS, ft		
WL	▽	▼
WL	▽	▼
WL		

Terracon

BORING STARTED	08-16-10		
BORING COMPLETED	08-16-10		
RIG	AMS PP 9500	DRILLER	ESN
LOGGED	AJD	JOB #	81109090

BOREHOLE 99 DRAFT LOGS.GPJ TERRACON.GDT 09/03/10

LOG OF BORING NO. B-7

CLIENT: Loves

SITE: 1512 Highway 97, Ellensburg, Washington

PROJECT: Ellensburg Loves

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, in.	SAMPLES: SPT - N BLOWS / ft.	TESTS: WATER CONTENT, %	TESTS: FIELD VAPOR TEST (PPM)*	TESTS: SOIL SAMPLE SENT TO LABORATORY
	0.5 4" Asphalt									
	1.25 **Sandy GRAVEL**, with Silt Brown, Medium Dense, Moist (Fill)									
	1.5 3" Asphalt									
	Sandy GRAVEL, trace Silt Gray, Medium Dense, Moist				PP	28				
	3.5 **SILT**, with Sand Gray, Medium Stiff, Wet ▽				PP	39				
	TPH Odor	5			PP	35				B7 @8ft
	12 **BOTTOM OF BORING** Drilling refusal at 12 feet.	10								
		15								

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

* ND indicates a reading of less than the field detection limit (FDL) of one (1) part per million isobutylene equivalents (ppmi).

WATER LEVEL OBSERVATIONS, ft		
WL	▽ 6	▼
WL	▽	▼
WL		

Terracon

BORING STARTED	08-16-10		
BORING COMPLETED	08-16-10		
RIG	AMS PP 9500	DRILLER	ESN
LOGGED	AJD	JOB #	81109090

BOREHOLE 89 DRAFT LOGS.GPJ TERRACON.GDT 09/03/10

LOG OF BORING NO. B-8

CLIENT: Loves

SITE: 1512 Highway 97, Ellensburg, Washington

PROJECT: Ellensburg Loves

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, in.	SAMPLES: SPT - N BLOWS / ft.	TESTS: WATER CONTENT, %	TESTS: FIELD VAPOR TEST (PPM)*	TESTS: SOIL SAMPLE SENT TO LABORATORY
	0.5 5" Asphalt									
	Sandy GRAVEL, with Silt Brown, Medium Dense, Moist				PP	30				
	2.5 SILT, with Sand Brown, Medium Stiff, Moist				PP	38				
	5 Sandy GRAVEL, trace Silt Brown, Medium Dense, Wet to Saturated ▽	5			PP	26				B8 @6ft
	12 BOTTOM OF BORING	10								
		15								

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

* ND indicates a reading of less than the field detection limit (FDL) of one (1) part per million isobutylene equivalents (ppmi).

WATER LEVEL OBSERVATIONS, ft		
WL	▽ 6	▼
WL	▽	▼
WL		

Terracon

BORING STARTED	08-16-10		
BORING COMPLETED	08-16-10		
RIG AMS PP 9500		DRILLER	ESN
LOGGED AJD		JOB #	81109090

BOREHOLE 99 DRAFT LOGS.GPJ TERRACON.GDT 09/03/10

LOG OF BORING NO. B-9

CLIENT: Loves

SITE: 1512 Highway 97, Ellensburg, Washington

PROJECT: Ellensburg Loves

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, in.	SAMPLES: SPT - N BLOWS / ft.	TESTS: WATER CONTENT, %	TESTS: FIELD VAPOR TEST (PPM)*	TESTS: SOIL SAMPLE SENT TO LABORATORY
	0.5 4" Asphalt									
	Sandy GRAVEL, with Silt Brown, Medium Dense, Moist				PP	24				
	2.5 **SILT**, with Sand Brown, Medium Stiff, Moist to Wet									
	3.5 **Sandy GRAVEL**, trace Silt Brown, Medium Dense, Wet to Saturated ▽	5			PP	30				B9 @7ft
		10			PP	7				
					PP	30				
	16 **BOTTOM OF BORING**	15								

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

* ND indicates a reading of less than the field detection limit (FDL) of one (1) part per million isobutylene equivalents (ppmi).

WATER LEVEL OBSERVATIONS, ft		
WL	▽ 7	▼
WL	▽	▼
WL		

Terracon

BORING STARTED	08-16-10		
BORING COMPLETED	08-16-10		
RIG	AMS PP 9500	DRILLER	ESN
LOGGED	AJD	JOB #	81109090

BOREHOLE 99 DRAFT LOGS.GPJ TERRACON.GDT 09/03/10

LOG OF BORING NO. B-10

CLIENT: Loves

SITE: 1512 Highway 97, Ellensburg, Washington

PROJECT: Ellensburg Loves

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, in.	SAMPLES: SPT - N BLOWS / ft.	TESTS: WATER CONTENT, %	TESTS: FIELD VAPOR TEST (PPM)*	TESTS: SOIL SAMPLE SENT TO LABORATORY
	0.5 6" Asphalt									
	Sandy GRAVEL, with Silt Brown, Medium Dense, Moist 4				PP	30				
	SILT, with Sand, trace Gravel Gray, Medium Stiff, Wet, Organics< TPH Odor 6	5								B10 @5ft
	BOTTOM OF BORING	10 15								

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

* ND indicates a reading of less than the field detection limit (FDL) of one (1) part per million isobutylene equivalents (ppmi).

WATER LEVEL OBSERVATIONS, ft		
WL	▽	▼
WL	▽	▼
WL		

Terracon

BORING STARTED	08-16-10		
BORING COMPLETED	08-16-10		
RIG AMS PP 9500		DRILLER	ESN
LOGGED AJD		JOB #	81109090

BOREHOLE 99 DRAFT LOGS.GPJ TERRACON.GDT 09/03/10

LOG OF BORING NO. B-11

CLIENT: Loves

SITE: 1512 Highway 97, Ellensburg, Washington

PROJECT: Ellensburg Loves

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, in.	SAMPLES: SPT - N BLOWS / ft.	TESTS: WATER CONTENT, %	TESTS: FIELD VAPOR TEST (PPM)*	TESTS: SOIL SAMPLE SENT TO LABORATORY
	0.5 6" Asphalt									
	Sandy GRAVEL, with Silt Brown, Medium Dense, Moist				PP	43				
	3.5 SILT, with Sand, trace Gravel Gray, Medium Stiff, Wet, Organics, TPH Odor	5								B11 @4.5ft
	5.5 BOTTOM OF BORING	10								
		15								

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

* ND indicates a reading of less than the field detection limit (FDL) of one (1) part per million isobutylene equivalents (ppmi).

WATER LEVEL OBSERVATIONS, ft		
WL	▽	▼
WL	▽	▼
WL		

Terracon

BORING STARTED	08-16-10		
BORING COMPLETED	08-16-10		
RIG AMS PP 9500		DRILLER	ESN
LOGGED AJD		JOB #	81109090

BOREHOLE 99 DRAFT LOGS.GPJ TERRACON.GDT 09/03/10

LOG OF BORING NO. B-12

CLIENT: Loves

SITE: 1512 Highway 97, Ellensburg, Washington

PROJECT: Ellensburg Loves

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, in.	SAMPLES: SPT - N BLOWS / ft.	TESTS: WATER CONTENT, %	TESTS: FIELD VAPOR TEST (PPM)*	TESTS: SOIL SAMPLE SENT TO LABORATORY
	0.5 6" Asphalt									
	Sandy GRAVEL, with Silt Brown, Medium Dense, Moist				PP	23				
	4.5									
	SILT, with Sand, trace Gravel Gray, Medium Stiff, Wet				PP	44				
	6	5								
	Sandy GRAVEL, trace Silt Brown, Medium Dense, Wet to Saturated ▽				PP	25				B12 @6ft
	12	10								
	BOTTOM OF BORING Drilling refusal at 12 feet bgs.	15								

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

* ND indicates a reading of less than the field detection limit (FDL) of one (1) part per million isobutylene equivalents (ppmi).

WATER LEVEL OBSERVATIONS, ft		
WL	▽ 6.5	▼
WL	▽	▼
WL		

Terracon

BORING STARTED	08-16-10		
BORING COMPLETED	08-16-10		
RIG	AMS PP 9500	DRILLER	ESN
LOGGED	AJD	JOB #	81109090

BOREHOLE 99 DRAFT LOGS.GPJ TERRACON.GDT 09/03/10

LOG OF BORING NO. B-13

CLIENT: Loves

SITE: 1512 Highway 97, Ellensburg, Washington

PROJECT: Ellensburg Loves

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, in.	SAMPLES: SPT - N BLOWS / ft.	TESTS: WATER CONTENT, %	TESTS: FIELD VAPOR TEST (PPM)*	TESTS: SOIL SAMPLE SENT TO LABORATORY
	0.5 6" Asphalt									
	Sandy GRAVEL, with Silt Brown, Medium Dense, Moist				PP	24				B13 @3.5ft
	5.5 BOTTOM OF BORING	5								
		10								
		15								

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

* ND indicates a reading of less than the field detection limit (FDL) of one (1) part per million isobutylene equivalents (ppmi).

WATER LEVEL OBSERVATIONS, ft		
WL	▽	▼
WL	▽	▼
WL		

Terracon

BORING STARTED	08-16-10		
BORING COMPLETED	08-16-10		
RIG AMS PP 9500		DRILLER	ESN
LOGGED AJD		JOB #	81109090

BOREHOLE 99 DRAFT LOGS.GPJ TERRACON.GDT 09/03/10

LOG OF BORING NO. B-14

CLIENT: Loves

SITE: 1512 Highway 97, Ellensburg, Washington

PROJECT: Ellensburg Loves

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, in.	SAMPLES: SPT - N BLOWS / ft.	TESTS: WATER CONTENT, %	TESTS: FIELD VAPOR TEST (PPM)*	TESTS: SOIL SAMPLE SENT TO LABORATORY
	0.5 6" Asphalt									
	Sandy GRAVEL, with Silt Brown, Medium Dense, Moist				PP	44				
	2.5 **Sandy SILT** Brown, Medium Stiff, Wet	5								B14 @5ft
	5.5 **BOTTOM OF BORING**	10								
		15								

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

* ND indicates a reading of less than the field detection limit (FDL) of one (1) part per million isobutylene equivalents (ppmi).

WATER LEVEL OBSERVATIONS, ft		
WL	▽	▼
WL	▽	▼
WL		

Terracon

BORING STARTED	08-16-10		
BORING COMPLETED	08-16-10		
RIG AMS PP 9500		DRILLER	ESN
LOGGED AJD		JOB #	81109090

BOREHOLE 99 DRAFT LOGS.GPJ TERRACON.GDT 09/03/10

LOG OF BORING NO. B-15

CLIENT: Loves

SITE: 1512 Highway 97, Ellensburg, Washington

PROJECT: Ellensburg Loves

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, in.	SAMPLES: SPT - N BLOWS / ft.	TESTS: WATER CONTENT, %	TESTS: FIELD VAPOR TEST (PPM)*	TESTS: SOIL SAMPLE SENT TO LABORATORY
	0.5 6" Asphalt									
	Sandy GRAVEL, with Silt Brown, Medium Dense, Moist 1.5				PP	43				
	SAND, trace Silt Brown, Medium Dense, Moist 4									
	Sandy SILT Brown, Medium Stiff, Moist to Wet 5									B15 @4.5ft
	BOTTOM OF BORING	5								
		10								
		15								

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

* ND indicates a reading of less than the field detection limit (FDL) of one (1) part per million isobutylene equivalents (ppmi).

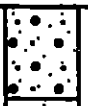
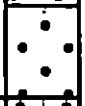
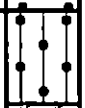
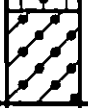
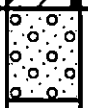
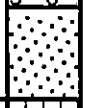
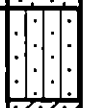
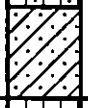
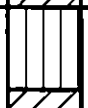
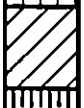
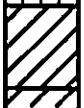
WATER LEVEL OBSERVATIONS, ft		
WL	▽	▼
WL	▽	▼
WL		

Terracon

BORING STARTED	08-16-10		
BORING COMPLETED	08-16-10		
RIG AMS PP 9500		DRILLER	ESN
LOGGED AJD		JOB #	81109090

BOREHOLE 99 DRAFT LOGS.GPJ TERRACON.GDT 09/03/10

GEOLOGIC LEGEND

COARSE-GRAINED SOILS	GRAVELS more than 1/2 of coarse fraction > No. 4 Sieve	LITTLE OR NO FINES		GW	Well-graded gravels, gravel-sand mixtures, little or no fines
				GP	Poorly-graded gravels, gravel-sand mixtures
		APPRECIABLE NO FINES		GM	Silty gravels, gravel-sand-silt mixtures
				GC	Clayey gravels, gravel-sand-clay mixtures
	SANDS more than 1/2 of coarse fraction < No. 4 Sieve	LITTLE OR NO FINES		SW	Well-graded sands, gravelly sands, little or no fines
				SP	Poorly-graded sands, gravelly sands, little or no fines
		APPRECIABLE NO FINES		SM	Silty sands, sand-silt mixtures
				SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS	SILTS AND CLAYS Liquid limit < 50			ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
				CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
				OL	Organic silts and organic silty clays of low plasticity
	SILTS AND CLAYS Liquid limit > 50			MH	Inorganic silts, micaceous or diatomoceous fine sandy or silty soils, elastic silts
				CH	Inorganic clays of high plasticity, fat clays
				OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS				Pt	Peat and other highly organic soils

SYMBOL LEGEND:

- Cement
- Sand
- Bentonite
- Driven Interval of Soil Sample
- Sample preserved for possible analysis
- No sample recovered
- Stabilized water level
- Groundwater level encountered during drilling

LEGEND TO BORING LOGS

PILOT TRAVEL CENTER
ELLENSBURG, WASHINGTON

PROJECT NO. 20-019

ALISTO ENGINEERING GROUP
PORTLAND, OREGON

20019UA-.DWG 8-18-98 DDW 1=1

ALISTO ENGINEERING GROUP
PORTLAND, OREGON

LOG OF BORING MW-4

SEE SITE PLAN

ALISTO PROJECT NO: 20-019-01 DATE DRILLED: 07/22/96

CLIENT: ADAPT Engineering

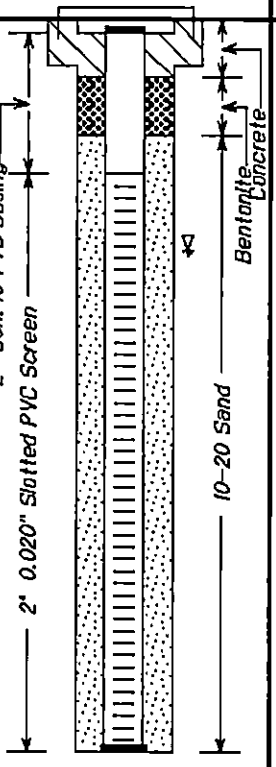
LOCATION: Pilot Travel Center, Ellensburg, Washington

DRILLING METHOD: Hollow-stem auger (8"); 2"-split spoon sampler

DRILLING COMPANY: Cascade Drilling CASING ELEVATION: 1536.48 '

LOGGED BY: J. Day APPROVED BY: Al Sevilla

BLOWS/6 IN.	PID VALUES	WELL DIAGRAN	DEPTH feet	SAMPLES	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
						GW	2" asphalt
							sandy GRAVEL: olive brown, moist; fine- to coarse-grained sand; fine to 4-inch-diameter gravel; cobbles to 8-inch-diameter.
8,11,10	ND		5			ML	sandy SILT: dark grayish brown, moist to saturated, very stiff; very fine- to medium-grained sand.
						GW	
50 (6")	NR		10				sandy GRAVEL: light brown, moist to wet, very dense; fine-to coarse-grained sand and gravel; some cobbles and silt.
							Same: at 12 feet, increase in cobbles.
50 (5")			15				Same
			20				Boring terminated at 19 feet.
			25				
			30				



ALISTO ENGINEERING GROUP
PORTLAND, OREGON

LOG OF BORING MW-5

SEE SITE PLAN

ALISTO PROJECT NO: 20-019-01 DATE DRILLED: 07/22/98

CLIENT: ADAPT Engineering

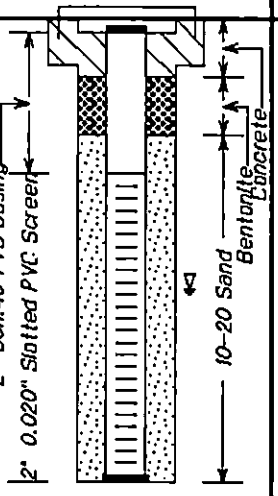
LOCATION: Pilot Travel Center, Ellensburg, Washington

DRILLING METHOD: Hollow-stem auger (8"); 2"-split spoon sampler

DRILLING COMPANY: Cascade Drilling CASING ELEVATION: 1535.02 '

LOGGED BY: J. Day APPROVED BY: Al Sevilla

BLOWS/6 IN.	PID VALUES	WELL DIAGRAN	DEPTH feet	SAMPLES	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
						GW	3" asphalt
							sandy GRAVEL: olive brown, moist; fine- to coarse-grained sand and gravel; cobbles up to 10-inch-diameter.
						SM	silty SAND: dark olive brown, moist; fine- to coarse-grained sand; trace of clay and gravel.
						GW	
11,12,14	NM		5				GRAVEL: grayish brown, moist to wet, medium dense; fine to coarse gravel; some cobbles.
50 (3")	NM		10				Same
							Auger refusal at 12 feet.
							Boring terminated at 12 feet.
			15				
			20				
			25				
			30				



BROADBENT

LITHOLOGIC AND MONITOR WELL CONSTRUCTION LOG

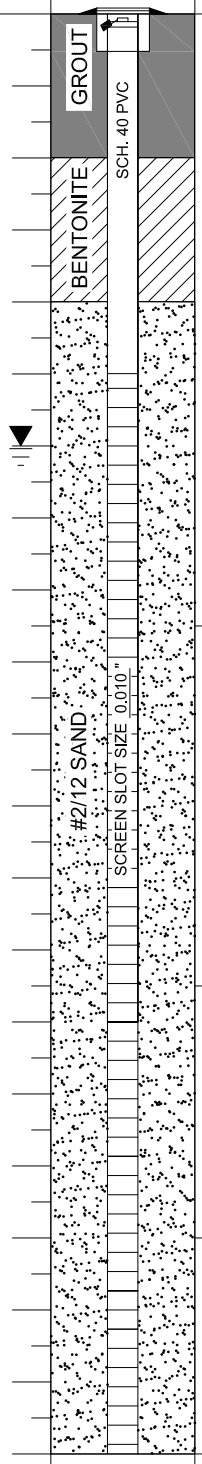
PROJECT NAME: PTC 389 | SITE ADDRESS: Interstate 90 at State Route 97, Ellensburg, WA

PROJECT NUMBER: 10-08-102 | LEGAL DESC: | APN:

LOGGED BY: Paul Green | FACILITY ID OR WAIVER: | NOI NUMBER:

DATE: 7/15/2014 | START: | DRILLING COMPANY: Cascade | DRILLER: James

WELL ID: RW-1 | STOP: | DRILLING METHOD: HSA | SAMPLE METHOD: Split Spoon



DEPTH (FEET)	WELL CASING DIAMETER: 4"	SAMPLE ID	PID (ppm)	MOISTURE	COLOR	CONSISTENCY	GRAIN SIZE	CLASSIFICATION	REMARKS, ODORS & BLOW COUNT
1							3" Asphalt Air Knife to 7'		
3			76	Moist	Dark Brown/ Gray	Soft	Slightly Cohesive Silt with Trace Gravels and Cobbles	ML	
5		RW-1-5'	120	Slightly Moist	Dark Brown	Soft	Sandy Silt with Trace Gravels	ML	
6		RW-1 7-10' (Geotech Sample)							
10		RW-1-10'	13	Wet	Medium Brown	Loose	60% Small to Large Gravels 40% Medium to Coarse Sands	GW	19/20/20 Hydrocarbon Odor
15		RW-1-15'	21	Wet	Medium Brown	Very Loose	Well Graded Fine to Coarse Sand	SW	50 for 6" Hydrocarbon Odor
19			10	Wet	Medium Brown	Very Loose	60% Small to Large Well Graded Gravel 40% Medium to Coarse Sand	GW	50 for 6" No Odor

TOTAL BORING DEPTH: 20' | PAGE NO: 1 OF 1 | ESTIMATED GROUNDWATER DEPTH: 6'

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BROADBENT

LITHOLOGIC AND MONITOR WELL CONSTRUCTION LOG

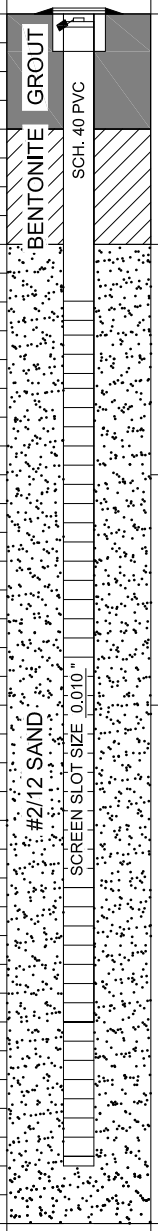
PROJECT NAME: PTC 389 | SITE ADDRESS: Interstate 90 at State Route 97, Ellensburg, WA

PROJECT NUMBER: 10-08-102 | LEGAL DESC: | APN:

LOGGED BY: Paul Green | FACILITY ID OR WAIVER: | NOI NUMBER:

DATE: 7/14/2014 | START: | DRILLING COMPANY: Cascade | DRILLER: James

WELL ID: RW-2 | STOP: | DRILLING METHOD: HSA | SAMPLE METHOD: Split Spoon



DEPTH (FEET)	WELL CASING DIAMETER: 4"	SAMPLE ID	PID (ppm)	MOISTURE	COLOR	CONSISTENCY	GRAIN SIZE / CLASSIFICATION		REMARKS, ODORS & BLOW COUNT
1–2							8" Asphalt Air Knife to 6.5' No Recovery		
3–4		RW-2-3'	76	Moist	Dark Gray	Soft	Non Cohesive Silts with 5% Small to Large Gravels	ML	Hydrocarbon Odor
5–6		RW-2-5'	44	Wet	Dark Gray	Very Loose	Poorly Graded Sands with Trace Small to Large Gravels	SP	Hydrocarbon Odor
7–8		RW-2 7-10' (Geotech Sample)							
9–10			50	Wet	Dark Gray	Medium Dense	Medium to Large Gravels 20% Coarse Sands	GW	7/14/22
11–12									
13–14									
15–16		RW-2-15'	40	Wet	Medium Brown	Medium Dense	Medium to Coarse Sand with 5% Small Gravels	SW	20/50/56
17–18									
19–20			12	Wet	Medium Brown	Medium Dense	Well Graded Fine to Coarse Sand and Small to Large Gravels with Trace Cobbles	SW	
21							Refusal at 21' Unable to Drill Through Rocky Conditions		
22–25									

TOTAL BORING DEPTH: 21' | PAGE NO: 1 OF 1 | ESTIMATED GROUNDWATER DEPTH: 6'

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BROADBENT

LITHOLOGIC AND MONITOR WELL CONSTRUCTION LOG

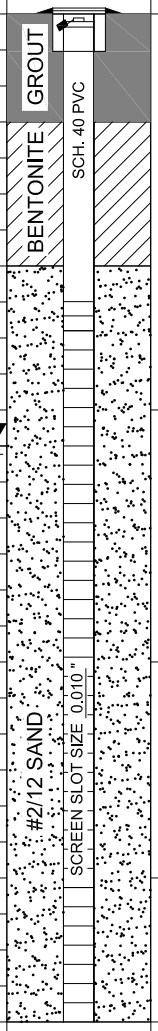
PROJECT NAME: PTC 389 | SITE ADDRESS: Interstate 90 at State Route 97, Ellensburg, WA

PROJECT NUMBER: 10-08-102 | LEGAL DESC: | APN:

LOGGED BY: Paul Green | FACILITY ID OR WAIVER: | NOI NUMBER:

DATE: 7/16/2014 | START: | DRILLING COMPANY: Cascade | DRILLER: James

WELL ID: MW-7 | STOP: | DRILLING METHOD: HSA | SAMPLE METHOD: Split Spoon



DEPTH (FEET)	WELL CASING DIAMETER: 2"	SAMPLE ID	PID (ppm)	MOISTURE	COLOR	CONSISTENCY	GRAIN SIZE / CLASSIFICATION		REMARKS, ODORS & BLOW COUNT
1							3" Asphalt Air Knife to 6'		
2							80% Cobbles		
3									
4			2	Moist	Medium Brown	Loose	Well Graded Gravel with Fine Sand and Large Cobbles	GW	
5									
6									
7		MW-7-7'	1.5	Wet	Dark Brown	Soft	Sandy Silt with 10% Small to Large Gravels	ML	12/13/13 No Odor
8									
9									
10			5.1	Wet	Medium Brown	Loose	Well Graded Gravel with 30% Coarse Sand	GW	15/21/26 No Odor
11									
12									
13							Fine to Coarse Sand with 5% Small Gravels Little to No Fines		
14		MW-7-14'	5.0	Wet	Medium Brown	Loose		SW	50 for 6"
15									
16									
17									
18									
19									
20									

TOTAL BORING DEPTH: 14' | PAGE NO: 1 OF 1 | ESTIMATED GROUNDWATER DEPTH: 6'

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LITHOLOGIC AND MONITOR WELL CONSTRUCTION LOG

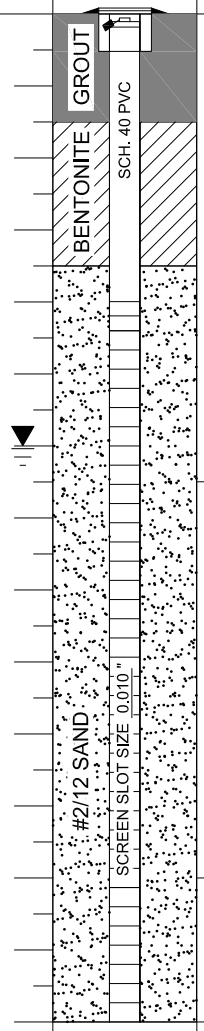
PROJECT NAME: PTC 389 | SITE ADDRESS: Interstate 90 at State Route 97, Ellensburg, WA

PROJECT NUMBER: 10-08-102 | LEGAL DESC: | APN:

LOGGED BY: Paul Green | FACILITY ID OR WAIVER: | NOI NUMBER:

DATE: 7/16/2014 | START: | DRILLING COMPANY: Cascade | DRILLER: James

WELL ID: MW-8 | STOP: | DRILLING METHOD: HSA | SAMPLE METHOD: Split Spoon



DEPTH (FEET)	WELL CASING DIAMETER: 2"	SAMPLE ID	PID (ppm)	MOISTURE	COLOR	CONSISTENCY	GRAIN SIZE	CLASSIFICATION	REMARKS, ODORS & BLOW COUNT
1							6" Asphalt		
							Air Knife to 6.5'		
2							Small Cobbles		
3									
4		MW-8-4'	25	Slightly Moist	Medium Brown	Soft	Non Cohesive Silt with Little to Medium Gravels	ML	No Odor
5			16						
6 ▼									
7			4.0	Wet	Medium Brown	Loose	Medium to Coarse Sand with 40% Small to Large Gravels	SW	50 for 6" No Odor
8									
9									
10		MW-8-10'	0.5	Wet	Medium Brown	Loose	Well Grade Fine to Coarse Sand with 10% Small to Large Gravels	SW	50 for 6" No Odor
11									
12									
13									
14			0.4	Wet	Medium Brown	Loose	Poorly Graded Fine Sand	SP	50 for 6" No Odor
15									
16									
17									
18									
19									
20									

TOTAL BORING DEPTH: 14' | PAGE NO: 1 OF 1 | ▼ ESTIMATED GROUNDWATER DEPTH: 6'

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LITHOLOGIC AND MONITOR WELL CONSTRUCTION LOG

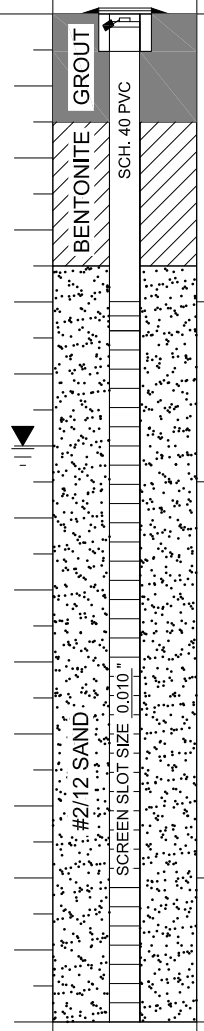
PROJECT NAME: PTC 389 | SITE ADDRESS: Interstate 90 at State Route 97, Ellensburg, WA

PROJECT NUMBER: 10-08-102 | LEGAL DESC: | APN:

LOGGED BY: Paul Green | FACILITY ID OR WAIVER: | NOI NUMBER:

DATE: 7/15/2014 | START: | DRILLING COMPANY: Cascade | DRILLER: James

WELL ID: MW-9 | STOP: | DRILLING METHOD: HSA | SAMPLE METHOD: Split Spoon



DEPTH (FEET)	WELL CASING DIAMETER: 2"	SAMPLE ID	PID (ppm)	MOISTURE	COLOR	CONSISTENCY	GRAIN SIZE / CLASSIFICATION		REMARKS, ODORS & BLOW COUNT
1							10" Asphalt Air Knife to 7'		
2									
3		MW-9-3'	1600	Slightly Moist	Dark Brown	Soft	Non Cohesive Silt	ML	Hydrocarbon Odor
4									
5			70	Slightly Moist	Dark Brown	Loose	Non Cohesive Fine Sand and Silt	SM	Slight Odor
6 ▼									
7									
8									
9									
10		MW-9-10'	140	Wet	Gray Brown	Loose	Well Graded 60% Small to Large Gravels with 40% Medium to Coarse Sands, Trace Cobbles	GW	13/12/14 Hydrocarbon Odor
11									
12									
13					Medium Brown		80% Fine Sands with 20% Small Gravels		50 for 6" No Odor
14			13	Wet		Loose		SP	
15									
16									
17									
18									
19									
20									

TOTAL BORING DEPTH: 14' | PAGE NO: 1 OF 1 | ▼ ESTIMATED GROUNDWATER DEPTH: 6'

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LITHOLOGIC AND MONITOR WELL CONSTRUCTION LOG

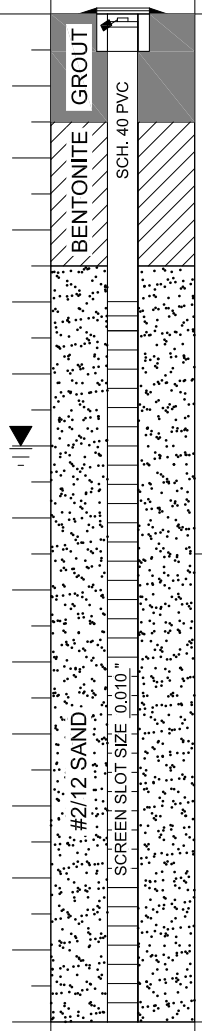
PROJECT NAME: PTC 389 | SITE ADDRESS: Interstate 90 at State Route 97, Ellensburg, WA

PROJECT NUMBER: 10-08-102 | LEGAL DESC: | APN:

LOGGED BY: Paul Green | FACILITY ID OR WAIVER: | NOI NUMBER:

DATE: 7/15/2014 | START: | DRILLING COMPANY: Cascade | DRILLER: James

WELL ID: MW-10 | STOP: | DRILLING METHOD: HSA | SAMPLE METHOD: Split Spoon



DEPTH (FEET)	WELL CASING DIAMETER: 2"	SAMPLE ID	PID (ppm)	MOISTURE	COLOR	CONSISTENCY	GRAIN SIZE / CLASSIFICATION	CLASSIFICATION	REMARKS, ODORS & BLOW COUNT
1							3" Asphalt Air Knife to 6.5'		
2							Cobbles		
3		MW-10-3'	40	Slightly Moist	Medium Brown	Loose	Sandy Silt with Little Small to Large Gravels	ML	No Odor
4									
5			2.0	Slightly Moist	Medium Brown	Loose	Sandy Silt and 40% Small to Large Gravels	ML	
6									
7									
8									
9									
10			0.0	Wet	Gray Brown	Very Loose	Well Graded Fine to Coarse Sands with 20% Small to Large Gravels	SW	9/9/6 No Odor
11									
12									
13					Medium Brown	Very Loose	Well Graded Coarse Sand with Trace Small Gravels	SW	50 for 6" No Odor
14			1.5	Wet					
15									
16									
17									
18									
19									
20									

TOTAL BORING DEPTH: 14' | PAGE NO: 1 OF 1 | ESTIMATED GROUNDWATER DEPTH: 6'

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BROADBENT

LITHOLOGIC AND MONITOR WELL CONSTRUCTION LOG

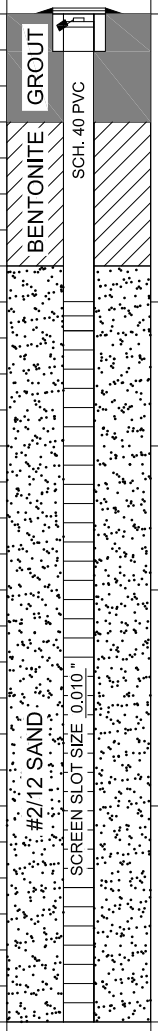
PROJECT NAME: PTC 389 | SITE ADDRESS: Interstate 90 at State Route 97, Ellensburg, WA

PROJECT NUMBER: 10-08-102 | LEGAL DESC: | APN:

LOGGED BY: Paul Green | FACILITY ID OR WAIVER: | NOI NUMBER:

DATE: 7/16/2014 | START: | DRILLING COMPANY: Cascade | DRILLER: James

WELL ID: MW-11 | STOP: | DRILLING METHOD: HSA | SAMPLE METHOD: Split Spoon



DEPTH (FEET)	WELL CASING DIAMETER: 2"	SAMPLE ID	PID (ppm)	MOISTURE	COLOR	CONSISTENCY	GRAIN SIZE / CLASSIFICATION		REMARKS, ODORS & BLOW COUNT
1							6" Asphalt Air Knife to 6'		
2									
3			0.0	Slightly Moist	Medium Brown	Medium	Sandy Silt with 10% Small to Large Gravels	ML	No Odor
4									
5			0.0	Slightly Moist	Medium Brown	Soft	Silty Sand with 10% Small to Large Gravels	SM	No Odor
6									
7		MW-11-7'	2.0	Slightly Moist	Dark Brown	Soft	Sandy Silt with Trace Gravels	ML	5/6/7 Slight Odor
8									
9									
10		MW-11-10'	30	Wet	Medium Brown	Loose	70% Well Graded Fine to Coarse Sands with 30% Small to Large Gravels	SW	6/7/10 Hydrocarbon Odor
11									
12									
13									
14			5.0	Wet	Medium Brown	Very Loose	Poorly Graded Medium Sands	SP	50 for 6" Slight Odor
15									
16									
17									
18									
19									
20									

TOTAL BORING DEPTH: 14' | PAGE NO: 1 OF 1 | ESTIMATED GROUNDWATER DEPTH: 8'

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BROADBENT

LITHOLOGIC AND MONITOR WELL CONSTRUCTION LOG

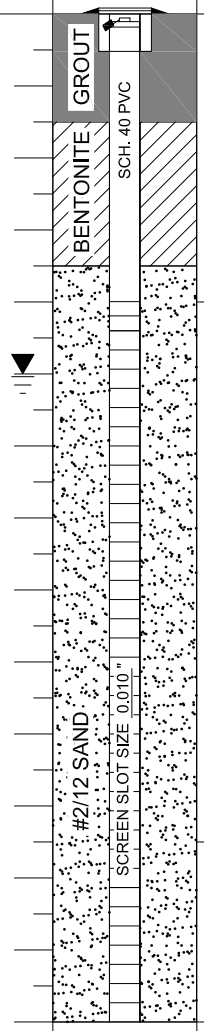
PROJECT NAME: PTC 389 | SITE ADDRESS: Interstate 90 at State Route 97, Ellensburg, WA

PROJECT NUMBER: 10-08-102 | LEGAL DESC: | APN:

LOGGED BY: Paul Green | FACILITY ID OR WAIVER: | NOI NUMBER:

DATE: 7/14/2014 | START: | DRILLING COMPANY: Cascade | DRILLER: James

WELL ID: MW-15 | STOP: | DRILLING METHOD: HSA | SAMPLE METHOD: Split Spoon



DEPTH (FEET)	WELL CASING DIAMETER: 2"	SAMPLE ID	PID (ppm)	MOISTURE	COLOR	CONSISTENCY	GRAIN SIZE / CLASSIFICATION	CLASSIFICATION	REMARKS, ODORS & BLOW COUNT
1							8" Asphalt Air Knife to 7' Limited Recovery Large Cobbles 6"-12" Diameter		
2									
3		MW-15-3'	50	Slightly Moist	Dark Gray	Soft	Sandy Silt with Trace Small Gravels	ML	Hydrocarbon Odor
4									
5		MW-15-5'	350	Wet	Dark Gray	Very Loose	Poorly Graded Fine Sands with Trace Small Gravels	SP	Hydrocarbon Odor
6									
7									
8									
9									
10			40	Wet	Dark Gray	Loose	Very Coarse Sand with Trace Small Gravels	SP	20/13/13 Hydrocarbon Odor
11									
12									
13									
14		MW-15-14'	15	Wet	Dark Brown	Very Loose	Medium to Coarse Sand	SW	13/21/20
15									
16									
17									
18									
19									
20									

TOTAL BORING DEPTH: 14' | PAGE NO: 1 OF 1 | ESTIMATED GROUNDWATER DEPTH: 5'

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.

BROADBENT

LITHOLOGIC AND MONITOR WELL CONSTRUCTION LOG

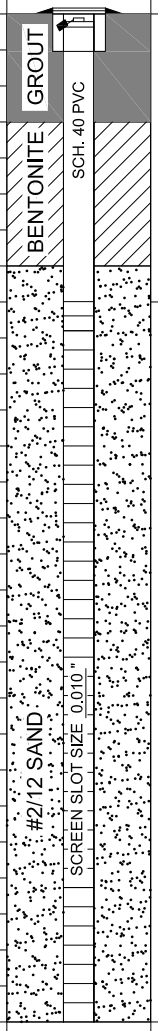
PROJECT NAME: PTC 389 | SITE ADDRESS: Interstate 90 at State Route 97, Ellensburg, WA

PROJECT NUMBER: 10-08-102 | LEGAL DESC: | APN:

LOGGED BY: Paul Green | FACILITY ID OR WAIVER: | NOI NUMBER:

DATE: 7/14/2014 | START: | DRILLING COMPANY: Cascade | DRILLER: James

WELL ID: MW-16 | STOP: | DRILLING METHOD: HSA | SAMPLE METHOD: Split Spoon



DEPTH (FEET)	WELL CASING DIAMETER: 2"	SAMPLE ID	PID (ppm)	MOISTURE	COLOR	CONSISTENCY	GRAIN SIZE / CLASSIFICATION		REMARKS, ODORS & BLOW COUNT
1							2" Asphalt Air Knife to 7' No Recovery to 3'		
2									
3			0.0	Wet	Gray Brown	Very Loose	Well Graded Coarse Sands With 20% Large Gravels	SW	No Odor
4									
5			0.0	Wet	Red Brown	Loose	Poorly Graded Fine Sands with Trace Small Gravels	SP	No Odor
6									
7		MW-16-7'	0.0						7/8/14 No Odor
8									
9									
10			0.0	Wet	Red Brown	Loose	Poorly Graded Fine Sands with 50% Medium Gravels	SP	10/12/16 No Odor
11									
12									
13									
14							No Recovery, Pushing Large Rock		
15									
16									
17									
18									
19									
20									

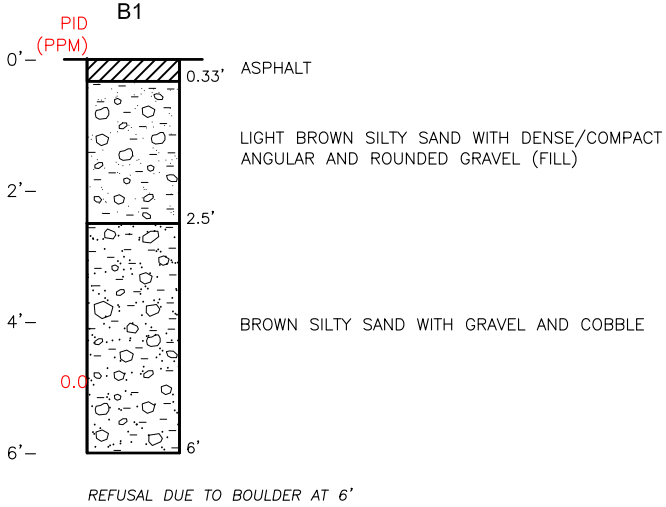
TOTAL BORING DEPTH: 14' | PAGE NO: 1 OF 1 | ESTIMATED GROUNDWATER DEPTH: 5'

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.

\\reno\public\CAD\templates\LITHLOG.DWG

GEOLOGIC LOG

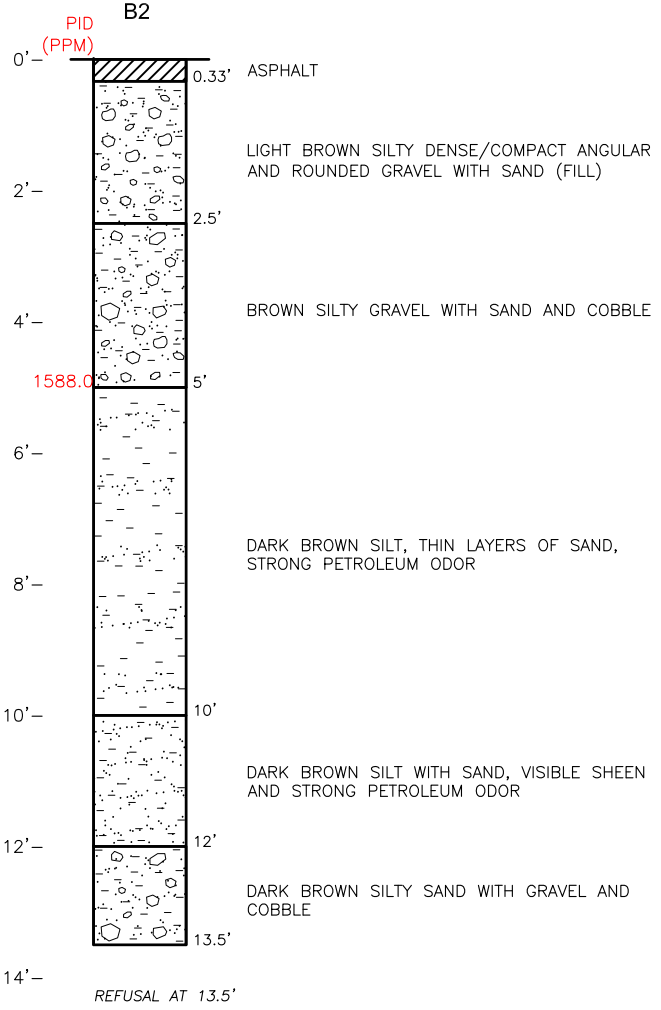
B1



REFUSAL DUE TO BOULDER AT 6'

GEOLOGIC LOG

B2



REFUSAL AT 13.5'

ROBINSON NOBLE	PM: JFH December 2020 3182-002A	Kittitas County T 18 N/R 18 E - 33	Figure 4 Geologic Log Boreholes B1 and B2 Love's Travel Stops and Country Stores: Ellensberg Gasoline Spill

Appendix B

Historical Analytical Data

Apendix B-1
Historical Analytical Data - Soil Results
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

				TPH			BTEX + naphthalene				
				TPH as Gasoline	TPH as Diesel	TPH as Motor Oil	Benzene	Toluene	Ethylbenzene	Xylenes (total)	Naphthalene
Date	**Sample Location**	**Field ID**	**Depth (feet)**	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
MTCA - Soil - Method A				30	2,000	2,000	0.03	7	6	9	5
11/08/1995	MW-1	B1-1/MW-1	2.5	4.3	-	-	0.1	0.057	0.18	0.31	-
11/08/1995	MW-1	B1-2/MW-1	5	2.5	-	-	<0.013	<0.013	0.022	0.053	-
11/08/1995	B2	B2	2.5	<2	-	-	<0.013	<0.013	<0.013	<0.013	-
11/08/1995	MW-3	B3/MW-3	10	<2	-		<0.013	<0.013	<0.013	<0.013	-
11/08/1995	B4	B4	5	<2	-	230	<0.013	<0.013	<0.013	<0.013	-
11/08/1995	B5	B5	5	<2	-		<0.013	<0.013	<0.013	<0.013	-
11/08/1995	MW-2	B6/MW-2	5	<2	-	210	<0.013	<0.013	<0.013	<0.013	-
11/08/1995	B7	B7	10	<2	-	-	<0.013	<0.013	<0.013	<0.013	-
11/08/1995	B8	B8	10	<2	-	-	<0.013	<0.013	<0.013	<0.013	-
11/08/1995	B9	B9-1	0.16	4.6	180	-	<0.013	<0.013	<0.013	<0.013	-
11/08/1995	B9	B9-2	3	6.1	-	-	<0.013	<0.013	<0.013	<0.013	-
11/08/1995	B10	B10-1	0.16	<2	-	-	<0.013	<0.013	<0.013	<0.013	-
11/08/1995	B10	B10-2	3	<2	-	-	<0.013	<0.013	<0.013	<0.013	-
11/08/1995	B11	B11	3	<2	-	-	<0.013	<0.013	<0.013	<0.013	-
11/08/1995	B12	B12	3	<2	-	-	<0.013	<0.013	<0.013	<0.013	-
11/08/1995	S-01	S1-1	0.16	250	-	29,000	<0.013	<0.013	<0.013	<0.013	-
11/08/1995	S-01	S1-2	1	3.8	-	39,000	<0.013	<0.013	<0.013	<0.013	-
11/08/1995	S-02	S-2	0.16	<2	-	-	<0.013	<0.013	<0.013	<0.013	-
07/22/1996	MW-4	MW-4-5	5	<10	<25	<50	-	-	-	-	-
07/22/1996	MW-5	MW-5-5	5	<11	<29	<57	-	-	-	-	-
07/23/1996	S-01	S-1-4	4	<11	<27	<55	<6	<6	<6	**140**	-
07/23/1996	S-01	S-1-4	4	**2,000**	-	-	-	-	-	-	-
07/23/1996	S-02	S-2-4	4	**3,900**	-	-	<25	**120**	**49**	**350**	-
08/27/1996	S-02	S-2A-4	4	**3,100**	-	-	<38	**150**	**380**	**120**	-
07/23/1996	S-03	S-3-4	4	<6.1	-	-	<0.4	<0.4	<0.4	**0.36**	-
07/23/1996	S-04	S-4-5	5	**14**	-	-	<0.4	<0.4	<0.4	**2.6**	-
07/23/1996	S-05	S-5-5.5	5.5	<6.3	-	-	<0.4	<0.4	<0.4	<0.4	-
07/23/1996	S-06	S-6-4.5	4.5	<6.3	-	-	<0.4	<0.4	<0.4	<0.4	-
07/23/1996	S-07	S-7-5	5	**49**	**15,000**	-	<0.4	<0.4	<0.4	<0.4	-
08/27/1996	S-07	S-7A-5	5	-	**10,000**	-	-	-	-	-	-
07/23/1996	S-08	S-8-4	4	<12	<30	<61	-	-	-	-	-
07/23/1996	S-08	S-8-4	4	-	**1,200**	-	-	-	-	-	-
07/23/1996	S-09	S-9-5	5	-	**3,200**	-	-	-	-	-	-
07/23/1996	S-10	S-10-4	4	-	**2,000**	-	-	-	-	-	-
07/23/1996	S-11	S-11-5.5	5.5	-	**41**	-	-	-	-	-	-
07/23/1996	S-12	S-12-6	6	-	**2,500**	-	-	-	-	-	-
07/23/1996	S-13	S-13-5.5	5.5	-	<17	-	-	-	-	-	-
07/24/1996	S-14	S-14-5	5	-	<16	-	-	-	-	-	-
07/24/1996	S-15	S-15-5	5	**5,400**	-	-	**3.8**	**86**	**52**	**580**	-
08/16/2010	B1	B1@6ft	6	<5.9	<18.5	<73.9	<0.0028	<0.0028	<0.0028	<0.0083	-
08/16/2010	B3	B3@7 1/2ft	7.5	<7.6	<19.6	<78.2	<0.0029	<0.0029	<0.0029	<0.0086	-
08/16/2010	B4	B4@3 1/2ft	3.5	<4.9	<18.9	<75.5	<0.0024	<0.0024	<0.0024	<0.0073	-
08/16/2010	B5	B5@3ft	3	**436**	**94.9**	**140**	**8.65**	**52.8**	**9.72**	**45.1**	-
08/16/2010	B6	B6@5ft	5	**7.2**	<19.2	<76.8	**0.0298**	<0.0024	**0.0032**	**0.0199**	-
08/16/2010	B7	B7@8ft	8	**3,700**	**423**	<77	**0.153**	**0.554**	**45.5**	**247**	**1.8**
08/16/2010	B8	B8@6ft	6	<5.3	<19.9	<79.8	<0.0029	<0.0029	<0.0029	<0.0086	-
08/16/2010	B9	B9@7ft	7	<4.8	<18.9	<75.8	<0.0023	<0.0023	<0.0023	<0.007	-
08/16/2010	B10	B10@5ft	5	**1,890**	**3,120**	**98.3**	**10.8**	**1.64**	**46.9**	**65.2**	-
08/16/2010	B11	B11@4 1/2ft	4.5	**1,250**	**9,960**	**518**	**1.75**	**0.0302**	**4.32**	**7.07**	**5.8**
08/16/2010	B12	B12@6ft	6	<5.3	<18.8	<75.2	<0.0027	<0.0027	<0.0027	<0.008	-
08/16/2010	B13	B13@3 1/2ft	3.5	<4.9	<19	<76	<0.0024	<0.0024	<0.0024	<0.0071	-
08/16/2010	B14	B14@5ft	5	<5.4	<18.4	<73.5	<0.0024	<0.0024	<0.0024	<0.0073	-
08/16/2010	B15	B15@4 1/2ft	4.5	<5.1	<19.5	<78.1	<0.0025	<0.0025	<0.0025	<0.0075	-
07/21/2011	BioSwaleD1	81117058-DP-01	2	**9.4**	**2,800**	**2,600**	<0.03	<0.05	**0.079**	**1.14**	**0.59**
09/26/2012	DP-01	DP-1-3 ft.	3	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
09/26/2012	DP-01	DP-1-9 ft.	9	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
09/26/2012	DP-02	DP-2-4 ft.	4	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
09/26/2012	DP-02	DP-2-9 ft.	9	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
09/26/2012	DP-03	DP-3-4 ft.	4	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
09/26/2012	DP-03	DP-3-9 ft.	9	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
09/25/2012	DP-04	DP-4-5 ft.	5	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
09/25/2012	DP-04	DP-4-7.5 ft.	7.5	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-

Apendix B-1
Historical Analytical Data - Soil Results
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

				TPH			BTEX + naphthalene				
				TPH as Gasoline	TPH as Diesel	TPH as Motor Oil	Benzene	Toluene	Ethylbenzene	Xylenes (total)	Naphthalene
Date	**Sample Location**	**Field ID**	**Depth (feet)**	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
MTCA - Soil - Method A				30	2,000	2,000	0.03	7	6	9	5
11/08/1995	MW-1	B1-1/MW-1	2.5	4.3	-	-	0.1	0.057	0.18	0.31	-
11/08/1995	MW-1	B1-2/MW-1	5	2.5	-	-	<0.013	<0.013	0.022	0.053	-
09/25/2012	DP-04	DP-4-9.5 ft.	9.5	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
09/26/2012	DP-05	DP-5-4.5 ft.	4.5	**120**	<25	<100	<0.04	<0.04	**1.5**	**7**	**0.9**
09/26/2012	DP-05	DP-5-9 ft.	9	**1,400**	**2,300**	<1,000	<0.4	<0.4	**16**	**88**	**7.7**
09/26/2012	DP-06	DP-6-4.5 ft.	4.5	**6.9**	<25	<100	<0.005	**0.0062**	**0.2**	**0.25**	-
09/26/2012	DP-06	DP-6-9 ft.	9	**590**	**1,000**	<1,000	<0.1	**0.12**	**4.1**	**19**	-
09/26/2012	DP-07	DP-7-4 ft.	4	<5	<25	<100	<0.005	<0.005	**0.0054**	**0.01**	-
09/26/2012	DP-07	DP-7-8 ft.	8	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
09/26/2012	DP-07	DP-7-12 ft.	12	<5	<25	<100	<0.005	<0.005	<0.005	**0.024**	-
09/25/2012	DP-08	DP-8-5 ft.	5	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
09/25/2012	DP-08	DP-8-9 ft.	9	<5	<25	<100	<0.005	<0.005	<0.005	**0.0079**	-
09/25/2012	DP-09	DP-9-5 ft.	5	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
09/25/2012	DP-09	DP-9-9 ft.	9	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
09/25/2012	DP-09	DP-9-12 ft.	12	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
09/25/2012	DP-10	DP-10-5 ft.	5	<5	<25	**160**	<0.005	<0.005	<0.005	<0.005	-
09/25/2012	DP-10	DP-10-8.5 ft.	5	<5	**31 L**	**290**	<0.005	<0.005	**0.012**	**0.019**	-
09/25/2012	DP-11	DP-11-5 ft.	5	**8**	<25	<100	**0.14**	**0.0061**	**0.034**	**0.077**	-
09/25/2012	DP-11	DP-11-8 ft.	8	<5	<25	<100	**0.0068**	<0.005	<0.005	**0.0093**	-
09/24/2012	DP-12	DP-12-8.5 ft.	8.5	**480**	**530**	<100	<0.2	<0.2	**4.3**	**5.3**	-
09/24/2012	DP-13	DP-13-4 ft.	4	<5	<25	<100	<0.005	<0.005	<0.005	**0.0071**	-
09/24/2012	DP-13	DP-13-8 ft.	8	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
09/24/2012	DP-14	DP-14-5 ft.	5	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
09/24/2012	DP-14	DP-14-7.5 ft.	7.5	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
09/24/2012	DP-15	DP-15-5 ft.	5	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
09/24/2012	DP-15	DP-15-8 ft.	8	<5	**31 L**	**250**	<0.005	<0.005	<0.005	<0.005	-
09/25/2012	DP-16	DP-16-4 ft.	4	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
09/25/2012	DP-16	DP-16-9 ft.	9	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
09/26/2012	DP-17	DP-17-4.5 ft.	4.5	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
09/26/2012	DP-17	DP-17-9 ft.	9	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
09/26/2012	DP-18	DP-18-4 ft.	4	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
09/26/2012	DP-18	DP-18-9 ft.	9	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
09/26/2012	DP-19	DP-19-3 ft.	3	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
09/26/2012	DP-19	DP-19-8 ft.	8	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
09/25/2012	DP-20	DP-20-8.5 ft.	8.5	<5	**26 L**	**170**	<0.005	<0.005	<0.005	<0.005	-
09/24/2012	DP-21	DP-21-4 ft.	4	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
09/24/2012	DP-21	DP-21-7.5 ft.	7.5	<5	<25	<100	<0.005	<0.005	<0.005	<0.005	-
07/09/2014	MW-15	MW-15-3ft	3	**8.9**	<25	<100	**0.073**	<0.005	**0.039**	**0.055**	**0.026**
07/09/2014	MW-15	MW-15-5ft	5	**840**	**730**	<500	<0.2	<0.2	**9.2**	**9.5**	**9.6**
07/09/2014	RW-2	RW-2-3ft	3	**7.2**	<25	<100	**0.023**	<0.005	**0.037**	**0.062**	**0.19**
07/09/2014	RW-2	RW-2-5ft	5	<5	<25	<100	**0.0061**	<0.005	**0.016**	**0.01**	**0.22**
07/10/2014	MW-8	MW-8-4ft	4	<5	<25	<100	<0.01	<0.01	<0.01	<0.01	<0.025
07/10/2014	MW-9	MW-9-3ft	3	**1,700**	**130 K**	<100	**1 V**	**1 V**	<5.8	<57	**17**
07/10/2014	MW-10	MW-10-3ft	3	<5	<25	<100	<0.01	<0.01	<0.01	<0.01	<0.025
07/10/2014	RW-1	RW-1-5ft	5	**33**	**100**	**150**	**0.034**	**0.017**	**0.6**	**1.7**	**0.28**
07/14/2014	MW-15	MW-15-14ft	14	**180**	<25	-	**0.18**	**0.12**	**2**	**11**	**0.32**
07/14/2014	MW-16	MW-16-7ft	7	<5	<25	-	<0.005	<0.005	<0.005	<0.005	<0.025
07/14/2014	RW-2	RW-2-15ft	15	**180**	**66**	-	<0.04	<0.04	**1.6**	**8.7**	**0.54**
07/15/2014	MW-9	MW-9-10ft	10	**540**	**460**	-	<0.2	<0.2	**2.7**	**12**	**1.1**
07/15/2014	RW-1	RW-1-10ft	10	**260**	**160**	-	<0.1	<0.1	**0.67**	**2.1**	**0.31**
07/15/2014	RW-1	RW-1-15ft	15	**86**	**80**	-	<0.01	<0.01	**0.39**	**1.6**	**0.13**
07/16/2014	MW-7	MW-7-7ft	7	<5	<25	-	<0.005	<0.005	<0.005	<0.005	<0.025
07/16/2014	MW-7	MW-7-14ft	14	<5	<25	-	<0.005	<0.005	<0.005	<0.005	<0.025
07/16/2014	MW-8	MW-8-10ft	10	<5	<25	-	<0.005	<0.005	<0.005	<0.005	<0.025
07/16/2014	MW-11	MW-11-7ft	7	<5	<25	-	<0.005	<0.005	<0.005	<0.005	<0.025
07/16/2014	MW-11	MW-11-10ft	10	**40**	**300**	-	<0.02	<0.02	<0.02	<0.02	<0.025
08/16/2018	B1	B1-4'	4	<10	<50	<250	<0.02	<0.1	<0.05	<0.15	<0.1
08/16/2018	B2	B2-5'	5	**796**	<50	<250	**4**	**60**	**14**	**104**	**1.2**
08/16/2018	RNMW-17	MW17-4'	4	**29,700**	<50	<250	**6.4**	**2,000**	**280**	**2,480**	**1**
07/26/2023	T1	T1	2.66	-	**1,500**	<290	-	-	-	-	-
07/26/2023	T2	T2	2	-	**60**	<260	-	-	-	-	-
07/26/2023	T3	T3	3	-	**100**	<260	-	-	-	-	-

Apendix B-1
Historical Analytical Data - Soil Results
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

				TPH			BTEX + naphthalene				
Date	Sample Location	Field ID	Depth (feet)	TPH as Gasoline	TPH as Diesel	TPH as Motor Oil	Benzene	Toluene	Ethylbenzene	Xylenes (total)	Naphthalene
				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
MTCA - Soil - Method A				30	2,000	2,000	0.03	7	6	9	5
11/08/1995	MW-1	B1-1/MW-1	2.5	4.3	-	-	0.1	0.057	0.18	0.31	-
11/08/1995	MW-1	B1-2/MW-1	5	2.5	-	-	<0.013	<0.013	0.022	0.053	-
07/26/2023	T4	T4	3	-	<53	<270	-	-	-	-	-
07/26/2023	T5	T5	2.41	-	**630**	<260	-	-	-	-	-
07/26/2023	T6	T6	2.66	-	**80**	<260	-	-	-	-	-
07/26/2023	T7	T7	2.83	-	**130**	<260	-	-	-	-	-
07/26/2023	T8	T8	2.41	-	<52	<260	-	-	-	-	-
07/26/2023	T9	T9	3	-	-	<300	-	-	-	-	-
07/26/2023	T9	T9	3	-	**13,000**	-	-	-	-	-	-
07/26/2023	UDC1	UDC 1	3	-	-	<270	-	-	-	-	-
07/26/2023	UDC1	UDC 1	3	-	**22,000**	-	-	-	-	-	-
07/26/2023	UDC2	UDC 2	3	-	-	<270	-	-	-	-	-
07/26/2023	UDC2	UDC 2	3	-	**21,000**	-	-	-	-	-	-
07/26/2023	UDC3	UDC 3	3	-	**4,500**	<270	-	-	-	-	-
07/26/2023	UDC4	UDC 4	3	-	-	<260	-	-	-	-	-
07/26/2023	UDC4	UDC 4	3	-	**35,000**	-	-	-	-	-	-
07/26/2023	UDC5	UDC 5	3	-	**14,000**	<2,100	-	-	-	-	-
07/26/2023	UDC6	UDC 6	3	-	**9,100**	<2,100	-	-	-	-	-
07/26/2023	UDC7	UDC 7	3	-	**18,000**	<1,900	-	-	-	-	-
07/26/2023	UDC8	UDC 8	3	-	**23,000**	<2,000	-	-	-	-	-
08/09/2023	U1	U1	3.5	-	**340**	<290	**1.8**	-	-	-	**19**
08/09/2023	U1	U1	3.5	**17,000**	-	-	-	**740**	**260**	**1,800**	-
08/09/2023	U2	U2	3.5	-	**3,800**	<310	**0.38**	**8.4**	**8**	-	**2**
08/09/2023	U2	U2	3.5	**160**	-	-	-	-	-	**28**	-
08/09/2023	U3	U3	3.5	<6.8	<56	<280	<0.014	**0.13**	<0.034	<0.1	<0.068
08/09/2023	U4	U4	3.5	<5.6	<52	<260	<0.011	**0.12**	<0.028	<0.084	<0.056
08/09/2023	U5	U5	3.5	<5.6	<52	<260	<0.011	**0.19**	<0.028	**0.099**	<0.056
08/09/2023	U6	U6	3.5	**8.6**	**3,400**	<310	**0.029**	**0.37**	**0.11**	**1.2**	**0.21**
08/09/2023	U7	U7	3.5	**18**	<62	<310	**0.018**	**0.43**	**0.12**	**2.8**	**0.092**
08/09/2023	U8	U8	3.5	**260**	-	<310	**0.25**	**5.7**	**3.9**	**22**	**4.7**
08/09/2023	U8	U8	3.5	-	**57,000**	-	-	-	-	-	-
08/09/2023	U9	U9	3.5	-	<56	<280	**0.053**	-	**2.8**	**18**	**0.54**
08/09/2023	U9	U9	3.5	**130**	-	-	-	**5.3**	-	-	-
08/09/2023	U10	U10	3.5	<9	<63	<320	<0.018	**0.33**	**0.068**	**0.58**	<0.09
08/09/2023	U11	U11	3.5	<5.9	<53	<260	<0.012	**0.13**	<0.029	**0.11**	<0.059
08/09/2023	U12	U12	3.5	<5.5	<52	<260	<0.011	**0.11**	<0.028	<0.083	<0.055
08/09/2023	U13	U13	3.5	<5.3	<51	<260	<0.011	**0.11**	<0.027	<0.08	<0.053
08/09/2023	U14	U14	3.5	<8.3	<61	<300	<0.017	**0.2**	<0.041	<0.12	<0.083
08/23/2023	RE1	RE1	4	<18	<62	<310	<0.036	<0.18	<0.09	<0.27	<0.18
08/23/2023	RE2	RE2	4	<13	<61	<300	<0.027	<0.13	<0.067	<0.2	<0.13
08/24/2023	RE3	RE3-5	5	<8.3	<60	<300	<0.017	<0.083	<0.041	<0.12	<0.083
08/24/2023	RE4	RE4-1	1	**180**	-	<310	<0.018	**0.17**	**0.28**	**2.4**	**0.87**
08/24/2023	RE4	RE4-1	1	-	**6,300**	-	-	-	-	-	-
08/24/2023	RE5	RE5-3	3	**120**	-	<280	**0.024**	**0.62**	**0.78**	**6.6**	**0.92**
08/24/2023	RE5	RE5-3	3	-	**15,000**	-	-	-	-	-	-
08/24/2023	RE6	RE6-5.5	5.5	<7.9	<60	<300	<0.016	<0.079	<0.04	<0.12	<0.079
08/24/2023	RE7	RE7-5	5	<1.2	**320**	<270	<0.012	<0.061	<0.03	<0.091	<0.061
08/24/2023	RE8	RE8-5	5	**27**	**5,500**	<320	<0.019	**0.1**	<0.047	**0.14**	**0.094**
08/29/2023	RE8	RE8-5	5	<6.6	**10,000**	<2,800	<0.013	<0.067	**0.086**	**0.5**	**0.25**
08/29/2023	RE9	RE9-5	5	<6.6	<55	<280	<0.013	<0.066	**0.061**	**0.27**	<0.066
08/29/2023	RE10	RE10-5	5	**33**	**9,400**	<2,900	<0.014	**0.19**	**0.4**	**2.6**	**0.5**
08/29/2023	RE11	RE11-5	5	<7.2	**320**	<290	<0.014	<0.072	**0.045**	**0.19**	<0.072
08/29/2023	RE12	RE12-5	5	<6.9	<56	<280	<0.014	**0.074**	**0.13**	**0.57**	<0.069
08/29/2023	RE13	RE13-5	5	<7	<57	<280	<0.014	<0.07	**0.063**	**0.29**	<0.07
08/29/2023	RE14	RE14-5	5	<6.7	<56	<280	<0.013	**0.083**	**0.086**	**0.36**	<0.067
08/29/2023	RE15	RE15-5	5	<7.7	**730**	<300	<0.015	<0.077	**0.046**	**0.18**	<0.077
08/29/2023	RE16	RE16-5	5	<6.2	<54	<270	<0.012	<0.062	**0.056**	**0.23**	<0.062
08/29/2023	RE17	RE17-5	5	<5.8	<53	<260	<0.012	**0.061**	**0.089**	**0.44**	<0.059
08/29/2023	RE18	RE18-5	5	<5.8	<53	<260	<0.012	<0.059	**0.065**	**0.29**	<0.059
08/30/2023	RE19	RE19-5	5	<8.5	**590**	<310	<0.017	<0.085	**0.057**	**0.25**	**0.18**
08/30/2023	RE20	RE20-6	6	<70	**10,000**	<2,800	<0.014	<0.07	**0.14**	**0.89**	**0.64**
08/30/2023	RE21	RE21-5	5	**85**	**8,800**	<1,500	**0.02**	**0.3**	**0.44**	**3.6**	**0.67**

Apendix B-1
Historical Analytical Data - Soil Results
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

				TPH			BTEX + naphthalene				
				TPH as Gasoline	TPH as Diesel	TPH as Motor Oil	Benzene	Toluene	Ethylbenzene	Xylenes (total)	Naphthalene
Date	**Sample Location**	**Field ID**	**Depth (feet)**	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
MTCA - Soil - Method A				30	2,000	2,000	0.03	7	6	9	5
11/08/1995	MW-1	B1-1/MW-1	2.5	4.3	-	-	0.1	0.057	0.18	0.31	-
11/08/1995	MW-1	B1-2/MW-1	5	2.5	-	-	<0.013	<0.013	0.022	0.053	-
08/30/2023	RE22	RE22-5	5	<12	<60	<300	<0.016	<0.08	**0.076**	**0.37**	**0.13**
08/30/2023	RE23	RE23-6	6	**190**	**14,000**	<3,000	**0.043**	<0.08	**0.084**	**0.26**	**3.1**
08/30/2023	RE24	RE24-5	5	**16**	**1,900**	<300	<0.016	<0.079	**0.094**	**0.4**	**0.68**
08/30/2023	RE25	RE25-5	5	**72**	**7,400**	<1,500	**0.048**	<0.078	**0.1**	**0.38**	**1.1**
08/30/2023	RE26	RE26-5	5	**39**	**3,900**	<300	<0.016	<0.081	**0.059**	**0.21**	**0.48**
08/30/2023	RE27	RE27-5	5	<6.4	<55	<270	<0.013	<0.065	**0.074**	**0.31**	<0.065
08/30/2023	RE28	RE28-5	5	<6	<53	<270	<0.012	<0.06	**0.067**	**0.27**	<0.06
08/31/2023	RE29	RE29-5	5	**690**	**3,400**	<310	**0.81**	**0.22**	-	-	**3.7**
08/31/2023	RE29	RE29-5	5	-	-	-	-	-	**31**	**74**	-
08/31/2023	RE30	RE30-5	5	**1,300**	**69**	<310	<0.17	**1.5**	**51**	-	**17**
08/31/2023	RE30	RE30-5	5	-	-	-	-	-	-	**290**	-
08/31/2023	RE31	RE31-5	5	**36**	**8,900**	<3,100	**0.035**	<0.085	**0.69**	**1.8**	**0.48**
08/31/2023	RE32	RE32-6	6	**300**	**21,000**	<5,800	**0.75**	<0.75	**2.2**	**12**	**9.5**
08/31/2023	RE33	RE33-6	6	**110**	**120**	<310	**0.14**	**7.9**	-	-	**1.5**
08/31/2023	RE33	RE33-6	6	-	-	-	-	-	**9.2**	**49**	-
08/31/2023	RE34	RE34-5	5	**2,100**	**69**	<340	<1	**6.4**	**95**	**1,400**	**56**
08/31/2023	RE35	RE35-5	5	**140**	<62	<310	**0.028**	**1.4**	-	-	**4.4**
08/31/2023	RE35	RE35-5	5	-	-	-	-	-	**13**	**72**	-
08/31/2023	RE36	RE36-3	3	<6.5	<55	<270	<0.013	**0.14**	**0.27**	**1**	**0.75**
08/31/2023	RE37	RE37-5	5	**36**	**3,900**	<300	**0.13**	<0.078	**0.081**	**0.27**	**0.45**
08/31/2023	RE38	RE38-6	6	**510**	**12,000**	<3,100	**2.2**	**0.94**	**1.5**	**2.3**	**4.7**
09/01/2023	RE39	RE39-5	5	<8.4	<61	<310	<0.017	<0.084	<0.042	**0.14**	<0.084
09/05/2023	RE40	RE40-5	5	<6.6	**160**	<280	<0.013	<0.066	<0.033	<0.099	<0.066
09/05/2023	RE41	RE41-6	6	**14**	**15,000**	<2,700	**0.028**	<0.064	<0.032	**1.2**	**1.5**
09/06/2023	RE42	RE42-5	5	<8.1	<60	<300	<0.016	<0.081	<0.04	<0.12	<0.081
09/06/2023	RE43	RE43-6	6	<8.8	<63	<310	<0.018	<0.088	<0.044	<0.13	<0.088
09/06/2023	RE44	RE44-5	5	<6.6	<55	<280	<0.013	<0.066	<0.033	<0.099	<0.066
09/06/2023	RE45	RE45-5	5	<8.2	<61	<300	<0.017	<0.083	<0.042	<0.12	<0.083
09/06/2023	RE46	RE46-5	5	<7.9	<60	<300	<0.016	<0.079	<0.04	<0.12	<0.079
09/06/2023	RE47	RE47-6	6	<6.5	**8,800**	<1,400	<0.013	<0.066	<0.033	**0.16**	**0.19**

Statistics								
Number of Results	173	191	152	169	169	169	169	108
Number of Detects	63	76	9	39	50	75	89	56
Minimum Concentration	<1.2	<16	<50	<0.0023	<0.0023	<0.0023	<0.005	<0.025
Minimum Detect	6.9	26	98.3	0.0061	0.0061	0.0032	0.0071	0.026
Maximum Concentration	29,700	63,000	2,600	<38	2,000	380	2,480	56
Maximum Detect	29,700	63,000	2,600	11	2,000	380	2,480	56
Average Concentration *	664	2,850	119	0.67	29	10	61	2.3
Geometric Average *	15	106	63	0.017	0.045	0.062	0.17	0.2
Median Concentration *	4.15	27.5	50	0.0075	0.035	0.025	0.099	0.093
Standard Deviation *	2,900	7,889	318	2.4	176	44	274	6.7
Geometric Standard Deviation *	12	14	2.2	11	23	27	42	8.9
95% UCL (Student's-t) *	1,028	3,794	182.1	0.977	51.51	15.95	96.09	3.363
Number of Env Standard Exceedances	49	42	1	29	14	21	28	12
Number of Env Standard Exceedances (Detects Only)	49	42	1	29	14	21	28	12
% of Detects	36	40	6	23	30	44	53	52
% of Non-Detects	64	60	94	77	70	56	47	48
% of Detects at or above Env Standards	28	22	1	17	8	12	17	11
% of Results Below Env Standards or Non-Detect	72	78	99	83	92	88	83	89

* A Non Detect Multiplier of 0.5 has been applied.

Note
Soil results screned against MTCA Method A cleanup levels. Exceedances are shaded.
Results are bold where detected.
mg/kg = milligrams per kilogram
µg/L = micrograms per liter
BTEX = benzene, toluene, ethylbenzene, and xylenes
TPH = total petroleum hydrocarbons

Apendix B-1
Historical Analytical Data - Soil Results
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

				Metal															
				Arsenic		Barium		Cadmium		Chromium (III+VI)		Lead		Mercury		Selenium		Silver	Silver
Date	**Sample Location**	**Field ID**	**Depth (feet)**	mg/kg	µg/L	mg/kg	µg/L	mg/kg	µg/L	mg/kg	µg/L	mg/kg	µg/L	mg/kg	µg/L	mg/kg	µg/L	mg/kg	µg/L
MTCA - Soil - Method A				20	-	-	-	2	-	-	-	250	-	2	-	-	-	-	-
11/08/1995	MW-1	B1-1/MW-1	2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	MW-1	B1-2/MW-1	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B2	B2	2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	MW-3	B3/MW-3	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B4	B4	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B5	B5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	MW-2	B6/MW-2	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B7	B7	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B8	B8	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B9	B9-1	0.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B9	B9-2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B10	B10-1	0.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B10	B10-2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B11	B11	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B12	B12	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	S-01	S1-1	0.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	S-01	S1-2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	S-02	S-2	0.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/22/1996	MW-4	MW-4-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/22/1996	MW-5	MW-5-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-01	S-1-4	4	-	-	-	-	-	-	-	-	**6.9**	-	-	-	-	-	-	-
07/23/1996	S-01	S-1-4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-02	S-2-4	4	-	-	-	-	-	-	-	-	**2.6**	-	-	-	-	-	-	-
08/27/1996	S-02	S-2A-4	4	-	-	-	-	-	-	-	-	**2.4**	-	-	-	-	-	-	-
07/23/1996	S-03	S-3-4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-04	S-4-5	5	-	-	-	-	-	-	-	-	**3.1**	-	-	-	-	-	-	-
07/23/1996	S-05	S-5-5.5	5.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-06	S-6-4.5	4.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-07	S-7-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/27/1996	S-07	S-7A-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-08	S-8-4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-08	S-8-4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-09	S-9-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-10	S-10-4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-11	S-11-5.5	5.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-12	S-12-6	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-13	S-13-5.5	5.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/24/1996	S-14	S-14-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/24/1996	S-15	S-15-5	5	-	-	-	-	-	-	-	-	**4.3**	-	-	-	-	-	-	-
08/16/2010	B1	B1@6ft	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B3	B3@7 1/2ft	7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B4	B4@3 1/2ft	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B5	B5@3ft	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B6	B6@5ft	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B7	B7@8ft	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B8	B8@6ft	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B9	B9@7ft	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B10	B10@5ft	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B11	B11@4 1/2ft	4.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B12	B12@6ft	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B13	B13@3 1/2ft	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B14	B14@5ft	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B15	B15@4 1/2ft	4.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/21/2011	BioSwaleD1	81117058-DP-01	2	-	<1,000	-	<1,000	-	<1,000	-	<1,000	-	<1,000	-	<100	-	<1,000	-	<1,000
09/26/2012	DP-01	DP-1-3 ft.	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-01	DP-1-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-02	DP-2-4 ft.	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-02	DP-2-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-03	DP-3-4 ft.	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-03	DP-3-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-04	DP-4-5 ft.	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-04	DP-4-7.5 ft.	7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Apendix B-1
Historical Analytical Data - Soil Results
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

				Metal															
				Arsenic		Barium		Cadmium		Chromium (III+VI)		Lead		Mercury		Selenium		Silver	Silver
Date	**Sample Location**	**Field ID**	**Depth (feet)**	mg/kg	µg/L	mg/kg	µg/L	mg/kg	µg/L	mg/kg	µg/L	mg/kg	µg/L	mg/kg	µg/L	mg/kg	µg/L	mg/kg	µg/L
MTCA - Soil - Method A				20	-	-	-	2	-	-	-	250	-	2	-	-	-	-	-
11/08/1995	MW-1	B1-1/MW-1	2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	MW-1	B1-2/MW-1	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-04	DP-4-9.5 ft.	9.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-05	DP-5-4.5 ft.	4.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-05	DP-5-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-06	DP-6-4.5 ft.	4.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-06	DP-6-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-07	DP-7-4 ft.	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-07	DP-7-8 ft.	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-07	DP-7-12 ft.	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-08	DP-8-5 ft.	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-08	DP-8-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-09	DP-9-5 ft.	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-09	DP-9-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-09	DP-9-12 ft.	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-10	DP-10-5 ft.	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-10	DP-10-8.5 ft.	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-11	DP-11-5 ft.	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-11	DP-11-8 ft.	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-12	DP-12-8.5 ft.	8.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-13	DP-13-4 ft.	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-13	DP-13-8 ft.	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-13	DP-13-4 ft.	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-13	DP-13-8 ft.	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-14	DP-14-5 ft.	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-14	DP-14-7.5 ft.	7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-15	DP-15-5 ft.	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-15	DP-15-8 ft.	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-16	DP-16-4 ft.	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-16	DP-16-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-17	DP-17-4.5 ft.	4.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-17	DP-17-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-18	DP-18-4 ft.	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-18	DP-18-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-19	DP-19-3 ft.	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-19	DP-19-8 ft.	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-20	DP-20-8.5 ft.	8.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-21	DP-21-4 ft.	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-21	DP-21-7.5 ft.	7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/09/2014	MW-15	MW-15-3ft	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/09/2014	MW-15	MW-15-5ft	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/09/2014	RW-2	RW-2-3ft	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/09/2014	RW-2	RW-2-5ft	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/10/2014	MW-8	MW-8-4ft	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/10/2014	MW-9	MW-9-3ft	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/10/2014	MW-10	MW-10-3ft	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/10/2014	RW-1	RW-1-5ft	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/14/2014	MW-15	MW-15-14ft	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/14/2014	MW-16	MW-16-7ft	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/14/2014	RW-2	RW-2-15ft	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/15/2014	MW-9	MW-9-10ft	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/15/2014	RW-1	RW-1-10ft	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/15/2014	RW-1	RW-1-15ft	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/16/2014	MW-7	MW-7-7ft	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/16/2014	MW-7	MW-7-14ft	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/16/2014	MW-8	MW-8-10ft	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/16/2014	MW-11	MW-11-7ft	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/16/2014	MW-11	MW-11-10ft	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2018	B1	B1-4'	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2018	B2	B2-5'	5	-	-	-	-	-	-	-	-	**8.6**	-	-	-	-	-	-	-
08/16/2018	RNMW-17	MW17-4'	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T1	T1	2.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T2	T2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T3	T3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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Historical Analytical Data - Soil Results
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

				Metal															
				Arsenic		Barium		Cadmium		Chromium (III+VI)		Lead		Mercury		Selenium		Silver	Silver
Date	**Sample Location**	**Field ID**	**Depth (feet)**	mg/kg	µg/L	mg/kg	µg/L	mg/kg	µg/L	mg/kg	µg/L	mg/kg	µg/L	mg/kg	µg/L	mg/kg	µg/L	mg/kg	µg/L
MTCA - Soil - Method A				20	-	-	-	2	-	-	-	250	-	2	-	-	-	-	-
11/08/1995	MW-1	B1-1/MW-1	2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	MW-1	B1-2/MW-1	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T4	T4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T5	T5	2.41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T6	T6	2.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T7	T7	2.83	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T8	T8	2.41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T9	T9	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T9	T9	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC1	UDC 1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC1	UDC 1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC2	UDC 2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC2	UDC 2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC3	UDC 3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC4	UDC 4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC4	UDC 4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC5	UDC 5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC6	UDC 6	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC7	UDC 7	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC8	UDC 8	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U1	U1	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U1	U1	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U2	U2	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U2	U2	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U3	U3	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U4	U4	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U5	U5	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U6	U6	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U7	U7	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U8	U8	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U8	U8	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U9	U9	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U9	U9	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U10	U10	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U11	U11	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U12	U12	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U13	U13	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U14	U14	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/23/2023	RE1	RE1	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/23/2023	RE2	RE2	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/24/2023	RE3	RE3-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/24/2023	RE4	RE4-1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/24/2023	RE4	RE4-1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/24/2023	RE5	RE5-3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/24/2023	RE5	RE5-3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/24/2023	RE6	RE6-5.5	5.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/24/2023	RE7	RE7-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/24/2023	RE8	RE8-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/29/2023	RE8	RE8-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/29/2023	RE9	RE9-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/29/2023	RE10	RE10-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/29/2023	RE11	RE11-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/29/2023	RE12	RE12-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/29/2023	RE13	RE13-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/29/2023	RE14	RE14-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/29/2023	RE15	RE15-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/29/2023	RE16	RE16-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/29/2023	RE17	RE17-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/29/2023	RE18	RE18-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/30/2023	RE19	RE19-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/30/2023	RE20	RE20-6	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/30/2023	RE21	RE21-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Apendix B-1
Historical Analytical Data - Soil Results
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

				Metal															
				Arsenic		Barium		Cadmium		Chromium (III+VI)		Lead		Mercury		Selenium		Silver	Silver
Date	**Sample Location**	**Field ID**	**Depth (feet)**	mg/kg	µg/L	mg/kg	µg/L	mg/kg	µg/L	mg/kg	µg/L	mg/kg	µg/L	mg/kg	µg/L	mg/kg	µg/L	mg/kg	µg/L
MTCA - Soil - Method A				20	-	-	-	2	-	-	-	250	-	2	-	-	-	-	-
11/08/1995	MW-1	B1-1/MW-1	2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	MW-1	B1-2/MW-1	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/30/2023	RE22	RE22-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/30/2023	RE23	RE23-6	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/30/2023	RE24	RE24-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/30/2023	RE25	RE25-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/30/2023	RE26	RE26-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/30/2023	RE27	RE27-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/30/2023	RE28	RE28-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE29	RE29-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE29	RE29-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE30	RE30-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE30	RE30-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE31	RE31-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE32	RE32-6	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE33	RE33-6	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE33	RE33-6	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE34	RE34-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE35	RE35-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE35	RE35-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE36	RE36-3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE37	RE37-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE38	RE38-6	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/01/2023	RE39	RE39-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/05/2023	RE40	RE40-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/05/2023	RE41	RE41-6	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/06/2023	RE42	RE42-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/06/2023	RE43	RE43-6	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/06/2023	RE44	RE44-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/06/2023	RE45	RE45-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/06/2023	RE46	RE46-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/06/2023	RE47	RE47-6	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Statistics																			
Number of Results				4	1	4	1	4	1	4	1	10	1	4	1	4	1	4	1
Number of Detects				2	0	4	0	1	0	4	0	9	0	0	0	0	0	0	0
Minimum Concentration				<1	<1,000	20.6	<1,000	<1	<1,000	5.45	<1,000	<1	<1,000	<0.52	<100	<1	<1,000	<1	<1,000
Minimum Detect				3.67	ND	20.6	ND	2.55	ND	5.45	ND	1.27	ND	ND	ND	ND	ND	ND	ND
Maximum Concentration				4.62	<1,000	193	<1,000	2.55	<1,000	31.1	<1,000	41.8	<1,000	<0.86	<100	<1	<1,000	<1	<1,000
Maximum Detect				4.62	ND	193	ND	2.55	ND	31.1	ND	41.8	ND	ND	ND	ND	ND	ND	ND
Average Concentration *				2.3		65		1		18		7.3		0.31		0.5		0.5	
Geometric Average *				1.4	500	38	500	0.75	500	14	500	3.4	500	0.3	50	0.5	500	0.5	500
Median Concentration *				2.085	500	22.55	500	0.5	500	17.1	500	2.85	500	0.265	50	0.5	500	0.5	500
Standard Deviation *				2.1		86		1		12		12		0.083		0		0	
Geometric Standard Deviation *				3.4		3		2.3		2.2		3.4		1.3		1		1	
95% UCL (Student's-t) *				4.84		165.4		2.219		31.48		14.48		0.403		0.5		0.5	
Number of Env Standard Exceedances				0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Number of Env Standard Exceedances (Detects Only)				0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
% of Detects				50	0	100	0	25	0	100	0	90	0	0	0	0	0	0	0
% of Non-Detects				50	100	0	100	75	100	0	100	10	100	100	100	100	100	100	100
% of Detects at or above Env Standards				0	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0
% of Results Below Env Standards or Non-Detect				100	100	100	100	75	100	100	100	100	100	100	100	100	100	100	100

* A Non Detect Multiplier of 0.5 has been applied.

Note
Soil results screned against MTCA Method A cleanup levels. Exceedances are shaded.
Results are bold where detected.
mg/kg = milligrams per kilogram
µg/L = micrograms per liter
BTEX = benzene, toluene, ethylbenzene, and xylenes
TPH = total petroleum hydrocarbons

Apendix B-1
Historical Analytical Data - Soil Results
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

				PAH																	
Date	Sample Location	Field ID	Depth (feet)	1-Methylnaphthalene	2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(b+k)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Phenanthrene	Pyrene
				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
MTCA - Soil - Method A				-	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	MW-1	B1-1/MW-1	2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	MW-1	B1-2/MW-1	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B2	B2	2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	MW-3	B3/MW-3	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B4	B4	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B5	B5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	MW-2	B6/MW-2	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B7	B7	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B8	B8	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B9	B9-1	0.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B9	B9-2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B10	B10-1	0.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B10	B10-2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B11	B11	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B12	B12	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	S-01	S1-1	0.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	S-01	S1-2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	S-02	S-2	0.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/22/1996	MW-4	MW-4-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/22/1996	MW-5	MW-5-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-01	S-1-4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-01	S-1-4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-02	S-2-4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/27/1996	S-02	S-2A-4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-03	S-3-4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-04	S-4-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-05	S-5-5.5	5.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-06	S-6-4.5	4.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-07	S-7-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/27/1996	S-07	S-7A-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-08	S-8-4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-08	S-8-4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-09	S-9-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-10	S-10-4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-11	S-11-5.5	5.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-12	S-12-6	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-13	S-13-5.5	5.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/24/1996	S-14	S-14-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/24/1996	S-15	S-15-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B1	B1@6ft	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B3	B3@7 1/2ft	7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B4	B4@3 1/2ft	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B5	B5@3ft	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B6	B6@5ft	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B7	B7@8ft	8	-	-	**0.104**	**0.0222**	**0.037**	<0.0075	<0.0075	<0.0075	-	<0.0075	<0.0075	<0.0075	<0.0075	**0.0141**	**0.256**	<0.0075	**0.255**	**0.0575**
08/16/2010	B8	B8@6ft	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B9	B9@7ft	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B10	B10@5ft	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B11	B11@4 1/2ft	4.5	-	-	**1.24**	**0.288**	**0.521**	**0.0178**	<0.0081	<0.0081	-	<0.0081	<0.0081	**0.0456**	<0.0081	**0.184**	**3.49**	<0.0081	**4.2**	**0.344**
08/16/2010	B12	B12@6ft	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B13	B13@3 1/2ft	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B14	B14@5ft	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B15	B15@4 1/2ft	4.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/21/2011	BioSwaleD1	81117058-DP-01	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-01	DP-1-3 ft.	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-01	DP-1-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-02	DP-2-4 ft.	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-02	DP-2-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-03	DP-3-4 ft.	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-03	DP-3-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-04	DP-4-5 ft.	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-04	DP-4-7.5 ft.	7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Apendix B-1
Historical Analytical Data - Soil Results
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

				PAH																	
Date	Sample Location	Field ID	Depth (feet)	1-Methylnaphthalene	2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(b+k)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Phenanthrene	Pyrene
				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
MTCA - Soil - Method A				-	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	MW-1	B1-1/MW-1	2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	MW-1	B1-2/MW-1	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-04	DP-4-9.5 ft.	9.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-05	DP-5-4.5 ft.	4.5	-	-	<0.025	<0.025	<0.025	<0.025	<0.025	-	<0.05	<0.025	-	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
09/26/2012	DP-05	DP-5-9 ft.	9	-	-	**0.056**	**0.068**	**0.14**	<0.025	<0.025	-	<0.05	<0.025	-	<0.025	<0.025	<0.025	**0.51**	<0.025	**0.58**	**0.11**
09/26/2012	DP-06	DP-6-4.5 ft.	4.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-06	DP-6-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-07	DP-7-4 ft.	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-07	DP-7-8 ft.	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-07	DP-7-12 ft.	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-08	DP-8-5 ft.	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-08	DP-8-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-09	DP-9-5 ft.	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-09	DP-9-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-09	DP-9-12 ft.	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-10	DP-10-5 ft.	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-10	DP-10-8.5 ft.	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-11	DP-11-5 ft.	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-11	DP-11-8 ft.	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-12	DP-12-8.5 ft.	8.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-13	DP-13-4 ft.	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-13	DP-13-8 ft.	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-14	DP-14-5 ft.	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-14	DP-14-7.5 ft.	7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-15	DP-15-5 ft.	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-15	DP-15-8 ft.	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-16	DP-16-4 ft.	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-16	DP-16-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-17	DP-17-4.5 ft.	4.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-17	DP-17-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-18	DP-18-4 ft.	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-18	DP-18-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-19	DP-19-3 ft.	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-19	DP-19-8 ft.	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-20	DP-20-8.5 ft.	8.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-21	DP-21-4 ft.	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-21	DP-21-7.5 ft.	7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/09/2014	MW-15	MW-15-3ft	3	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	-	<0.05	<0.025	-	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
07/09/2014	MW-15	MW-15-5ft	5	**5.2**	**9.4**	**0.11**	<0.025	<0.025	<0.025	<0.025	-	<0.05	<0.025	-	<0.025	<0.025	<0.025	**0.28**	<0.025	**0.4**	**0.042**
07/09/2014	RW-2	RW-2-3ft	3	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	-	<0.05	<0.025	-	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
07/09/2014	RW-2	RW-2-5ft	5	**0.11**	**0.17**	<0.025	<0.025	<0.025	<0.025	<0.025	-	<0.05	<0.025	-	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
07/10/2014	MW-8	MW-8-4ft	4	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	-	<0.05	<0.025	-	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
07/10/2014	MW-9	MW-9-3ft	3	**8.9**	**13**	<0.025	<0.025	<0.025	<0.025	<0.025	-	<0.05	<0.025	-	<0.025	<0.025	<0.025	**0.043**	<0.025	**0.086**	<0.025
07/10/2014	MW-10	MW-10-3ft	3	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	-	<0.05	<0.025	-	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
07/10/2014	RW-1	RW-1-5ft	5	**0.11**	**0.15**	<0.025	<0.025	<0.025	<0.025	<0.025	-	<0.05	<0.025	-	<0.025	<0.025	<0.025	**0.026**	<0.025	**0.039**	<0.025
07/14/2014	MW-15	MW-15-14ft	14	**0.23**	**0.38**	<0.025	<0.025	<0.025	<0.025	<0.025	-	<0.05	<0.025	-	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
07/14/2014	MW-16	MW-16-7ft	7	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	-	<0.05	<0.025	-	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
07/14/2014	RW-2	RW-2-15ft	15	**0.38**	**0.7**	<0.025	<0.025	<0.025	<0.025	<0.025	-	<0.05	<0.025	-	<0.025	<0.025	<0.025	**0.027**	<0.025	**0.037**	<0.025
07/15/2014	MW-9	MW-9-10ft	10	**0.98**	**1.9**	<0.025	<0.025	<0.025	<0.025	<0.025	-	<0.05	<0.025	-	<0.025	<0.025	<0.025	**0.14**	<0.025	**0.15**	<0.025
07/15/2014	RW-1	RW-1-10ft	10	**0.39**	**0.65**	<0.025	<0.025	<0.025	<0.025	<0.025	-	<0.05	<0.025	-	<0.025	<0.025	<0.025	**0.063**	<0.025	**0.086**	<0.025
07/15/2014	RW-1	RW-1-15ft	15	**0.15**	**0.22**	<0.025	<0.025	<0.025	<0.025	<0.025	-	<0.05	<0.025	-	<0.025	<0.025	<0.025	<0.025	<0.025	**0.032**	<0.025
07/16/2014	MW-7	MW-7-7ft	7	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	-	<0.05	<0.025	-	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
07/16/2014	MW-7	MW-7-14ft	14	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	-	<0.05	<0.025	-	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
07/16/2014	MW-8	MW-8-10ft	10	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	-	<0.05	<0.025	-	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
07/16/2014	MW-11	MW-11-7ft	7	**0.03**	**0.031**	<0.025	<0.025	<0.025	<0.025	<0.025	-	<0.05	<0.025	-	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
07/16/2014	MW-11	MW-11-10ft	10	**0.057**	**0.049**	<0.025	<0.025	<0.025	<0.025	<0.025	-	<0.05	<0.025	-	<0.025	<0.025	<0.025	**0.04**	<0.025	<0.025	<0.025
08/16/2018	B1	B1-4'	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2018	B2	B2-5'	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2018	RNMW-17	MW17-4'	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T1	T1	2.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T2	T2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T3	T3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Apendix B-1
Historical Analytical Data - Soil Results
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

				PAH																	
Date	Sample Location	Field ID	Depth (feet)	1-Methylnaphthalene	2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(b+k)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Phenanthrene	Pyrene
				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
MTCA - Soil - Method A				-	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	MW-1	B1-1/MW-1	2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	MW-1	B1-2/MW-1	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T4	T4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T5	T5	2.41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T6	T6	2.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T7	T7	2.83	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T8	T8	2.41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T9	T9	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T9	T9	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC1	UDC 1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC1	UDC 1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC2	UDC 2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC2	UDC 2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC3	UDC 3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC4	UDC 4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC4	UDC 4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC5	UDC 5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC6	UDC 6	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC7	UDC 7	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC8	UDC 8	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U1	U1	3.5	**8.9**	**21**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U1	U1	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U2	U2	3.5	**2**	**3.4**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U2	U2	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U3	U3	3.5	<0.27	<0.27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U4	U4	3.5	<0.22	<0.22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U5	U5	3.5	<0.22	<0.22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U6	U6	3.5	<0.34	**0.42**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U7	U7	3.5	<0.34	<0.34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U8	U8	3.5	**3.7**	**6.7**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U8	U8	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U9	U9	3.5	<0.28	**0.58**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U9	U9	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U10	U10	3.5	<0.36	<0.36	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U11	U11	3.5	<0.24	<0.24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U12	U12	3.5	<0.22	<0.22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U13	U13	3.5	<0.21	<0.21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U14	U14	3.5	<0.33	<0.33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/23/2023	RE1	RE1	4	<0.72	<0.72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/23/2023	RE2	RE2	4	<0.54	<0.54	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/24/2023	RE3	RE3-5	5	<0.33	<0.33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/24/2023	RE4	RE4-1	1	**0.89**	**1.5**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/24/2023	RE4	RE4-1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/24/2023	RE5	RE5-3	3	**1.2**	**2.2**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/24/2023	RE5	RE5-3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/24/2023	RE6	RE6-5.5	5.5	<0.32	<0.32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/24/2023	RE7	RE7-5	5	<0.24	<0.24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/24/2023	RE8	RE8-5	5	<0.37	<0.37	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/29/2023	RE8	RE8-5	5	<0.27	**0.27**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/29/2023	RE9	RE9-5	5	<0.27	<0.27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/29/2023	RE10	RE10-5	5	<0.29	**0.36**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/29/2023	RE11	RE11-5	5	<0.29	<0.29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/29/2023	RE12	RE12-5	5	<0.28	<0.28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/29/2023	RE13	RE13-5	5	<0.28	<0.28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/29/2023	RE14	RE14-5	5	<0.27	<0.27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/29/2023	RE15	RE15-5	5	<0.31	<0.31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/29/2023	RE16	RE16-5	5	<0.25	<0.25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/29/2023	RE17	RE17-5	5	<0.24	<0.24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/29/2023	RE18	RE18-5	5	<0.24	<0.24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/30/2023	RE19	RE19-5	5	<0.34	<0.34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/30/2023	RE20	RE20-6	6	**0.5**	**0.83**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/30/2023	RE21	RE21-5	5	**0.58**	**0.88**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Apendix B-1
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Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

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Date	Sample Location	Field ID	Depth (feet)	1-Methylnaphthalene	2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(b+k)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Phenanthrene	Pyrene
				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
MTCA - Soil - Method A				-	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	MW-1	B1-1/MW-1	2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	MW-1	B1-2/MW-1	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/30/2023	RE22	RE22-5	5	<0.32	<0.32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/30/2023	RE23	RE23-6	6	**1.6**	**3.6**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/30/2023	RE24	RE24-5	5	**1.1**	**1.7**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/30/2023	RE25	RE25-5	5	**0.55**	**0.72**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/30/2023	RE26	RE26-5	5	**0.36**	**0.58**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/30/2023	RE27	RE27-5	5	<0.26	<0.26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/30/2023	RE28	RE28-5	5	<0.24	<0.24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE29	RE29-5	5	**0.95**	**2.4**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE29	RE29-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE30	RE30-5	5	**19**	**28**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE30	RE30-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE31	RE31-5	5	**0.38**	**0.55**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE32	RE32-6	6	**5.5**	**11**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE33	RE33-6	6	<0.34	**0.47**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE33	RE33-6	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE34	RE34-5	5	**47**	**110**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE35	RE35-5	5	**0.95**	**2.8**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE35	RE35-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE36	RE36-3	3	**2.1**	**1.8**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE37	RE37-5	5	**0.54**	**0.73**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE38	RE38-6	6	**4.1**	**7.1**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/01/2023	RE39	RE39-5	5	<0.34	<0.34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/05/2023	RE40	RE40-5	5	<0.26	<0.26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/05/2023	RE41	RE41-6	6	**1.5**	**2.7**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/06/2023	RE42	RE42-5	5	<0.32	<0.32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/06/2023	RE43	RE43-6	6	<0.35	<0.35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/06/2023	RE44	RE44-5	5	<0.26	<0.26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/06/2023	RE45	RE45-5	5	<0.33	<0.33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/06/2023	RE46	RE46-5	5	<0.32	<0.32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/06/2023	RE47	RE47-6	6	<0.26	<0.26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Statistics																					
Number of Results				86	86	24	24	24	24	24	3	21	24	3	24	24	24	24	24	24	24
Number of Detects				37	42	5	3	3	1	0	0	0	0	0	2	0	3	11	0	11	5
Minimum Concentration				<0.025	<0.025	<0.025	0.0222	<0.025	<0.0075	<0.0075	<0.0075	<0.05	<0.0075	<0.0075	<0.0075	<0.0075	0.0141	<0.025	<0.0075	<0.025	<0.025
Minimum Detect				0.03	0.031	0.056	0.0222	0.037	0.0178	ND	ND	ND	ND	ND	0.0456	ND	0.0141	0.026	ND	0.032	0.042
Maximum Concentration				47	110	1.24	0.288	0.521	<0.1	<0.1	<0.1	<0.05	<0.1	<0.1	0.18	<0.1	0.2	3.49	<0.1	4.2	0.68
Maximum Detect				47	110	1.24	0.288	0.521	0.0178	ND	ND	ND	ND	ND	0.18	ND	0.2	3.49	ND	4.2	0.68
Average Concentration *				1.8	3.3	0.078	0.028	0.042	0.014	0.013	0.019	0.025	0.013	0.019	0.02	0.013	0.028	0.24	0.013	0.3	0.061
Geometric Average *				0.28	0.37	0.021	0.017	0.018	0.013	0.012	0.0091	0.025	0.012	0.0091	0.014	0.012	0.016	0.039	0.012	0.044	0.021
Median Concentration *				0.165	0.1725	0.0125	0.0125	0.0125	0.0125	0.0125	0.00405	0.025	0.0125	0.00405	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125
Standard Deviation *				5.7	13	0.25	0.057	0.11	0.008	0.0082	0.027	0	0.0082	0.027	0.035	0.0082	0.051	0.72	0.0082	0.87	0.15
Geometric Standard Deviation *				5.9	7.3	3.2	2.1	2.5	1.5	1.6	4.4	1	1.6	4.4	1.9	1.6	2.2	5.2	1.6	5.7	3.1
95% UCL (Student's-t) *				2.773	5.538	0.165	0.0482	0.0785	0.0167	0.0162	0.0641	0.025	0.0162	0.0641	0.0326	0.0162	0.0453	0.492	0.0162	0.606	0.113
Number of Env Standard Exceedances				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of Env Standard Exceedances (Detects Only)				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% of Detects				43	49	21	12	12	4	0	0	0	0	0	8	0	12	46	0	46	21
% of Non-Detects				57	51	79	88	88	96	100	100	100	100	100	92	100	88	54	100	54	79
% of Detects at or above Env Standards				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% of Results Below Env Standards or Non-Detect				100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

* A Non Detect Multiplier of 0.5 has been applied.

Note
Soil results screned against MTCA Method A cleanup levels. Exceedances are shaded.
Results are bold where detected.
mg/kg = milligrams per kilogram
µg/L = micrograms per liter
BTEX = benzene, toluene, ethylbenzene, and xylenes
TPH = total petroleum hydrocarbons

Apendix B-1
Historical Analytical Data - Soil Results
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

				Other VOC																			
				1,1,1,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,1-Dichloropropene	1,2,3-Trichlorobenzene	1,2,3-Trichloropropane	1,2,4-Trichlorobenzene	1,2,4-Trimethylbenzene	1,2-Dibromo-3-chloropropane	1,2-Dibromoethane	1,2-Dichlorobenzene	1,2-Dichloroethane	1,2-Dichloroethene(cis)	1,2-Dichloroethene(trans)	1,2-Dichloropropane	1,3,5-Trimethylbenzene	1,3-Dichlorobenzene
Date	**Sample Location**	**Field ID**	**Depth (feet)**	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
MTCA - Soil - Method A				-	2	-	-	-	-	-	-	-	-	-	-	0.005	-	-	-	-	-	-	-
11/08/1995	MW-1	B1-1/MW-1	2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	MW-1	B1-2/MW-1	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B2	B2	2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	MW-3	B3/MW-3	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B4	B4	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B5	B5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	MW-2	B6/MW-2	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B7	B7	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B8	B8	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B9	B9-1	0.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B9	B9-2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B10	B10-1	0.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B10	B10-2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B11	B11	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B12	B12	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	S-01	S1-1	0.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	S-01	S1-2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	S-02	S-2	0.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/22/1996	MW-4	MW-4-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/22/1996	MW-5	MW-5-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-01	S-1-4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-01	S-1-4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-02	S-2-4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/27/1996	S-02	S-2A-4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-03	S-3-4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-04	S-4-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-05	S-5-5.5	5.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-06	S-6-4.5	4.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-07	S-7-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/27/1996	S-07	S-7A-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-08	S-8-4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-08	S-8-4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-09	S-9-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-10	S-10-4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-11	S-11-5.5	5.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-12	S-12-6	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-13	S-13-5.5	5.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/24/1996	S-14	S-14-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/24/1996	S-15	S-15-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B1	B1@6ft	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B3	B3@7 1/2ft	7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B4	B4@3 1/2ft	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B5	B5@3ft	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B6	B6@5ft	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B7	B7@8ft	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B8	B8@6ft	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B9	B9@7ft	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B10	B10@5ft	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B11	B11@4 1/2ft	4.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B12	B12@6ft	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B13	B13@3 1/2ft	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B14	B14@5ft	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B15	B15@4 1/2ft	4.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/21/2011	BioSwaleD1	81117058-DP-01	2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.25	<0.05	<0.25	**0.72**	<0.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	**0.33**	<0.05
09/26/2012	DP-01	DP-1-3 ft.	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-01	DP-1-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-02	DP-2-4 ft.	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-02	DP-2-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-03	DP-3-4 ft.	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-03	DP-3-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-04	DP-4-5 ft.	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-04	DP-4-7.5 ft.	7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Apendix B-1
Historical Analytical Data - Soil Results
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

				Other VOC																			
				1,1,1,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,1-Dichloropropene	1,2,3-Trichlorobenzene	1,2,3-Trichloropropane	1,2,4-Trichlorobenzene	1,2,4-Trimethylbenzene	1,2-Dibromo-3-chloropropane	1,2-Dibromoethane	1,2-Dichlorobenzene	1,2-Dichloroethane	1,2-Dichloroethene(cis)	1,2-Dichloroethene(trans)	1,2-Dichloropropane	1,3,5-Trimethylbenzene	1,3-Dichlorobenzene
Date	Sample Location	Field ID	Depth (feet)	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
MTCA - Soil - Method A				-	2	-	-	-	-	-	-	-	-	-	-	0.005	-	-	-	-	-	-	-
11/08/1995	MW-1	B1-1/MW-1	2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	MW-1	B1-2/MW-1	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-04	DP-4-9.5 ft.	9.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-05	DP-5-4.5 ft.	4.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-05	DP-5-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-06	DP-6-4.5 ft.	4.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-06	DP-6-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-07	DP-7-4 ft.	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-07	DP-7-8 ft.	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-07	DP-7-12 ft.	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-08	DP-8-5 ft.	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-08	DP-8-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-09	DP-9-5 ft.	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-09	DP-9-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-09	DP-9-12 ft.	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-10	DP-10-5 ft.	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-10	DP-10-8.5 ft.	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-11	DP-11-5 ft.	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-11	DP-11-8 ft.	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-12	DP-12-8.5 ft.	8.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-13	DP-13-4 ft.	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-13	DP-13-8 ft.	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-14	DP-14-5 ft.	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-14	DP-14-7.5 ft.	7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-15	DP-15-5 ft.	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-15	DP-15-8 ft.	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-16	DP-16-4 ft.	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-16	DP-16-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-17	DP-17-4.5 ft.	4.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-17	DP-17-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-18	DP-18-4 ft.	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-18	DP-18-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-19	DP-19-3 ft.	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-19	DP-19-8 ft.	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-20	DP-20-8.5 ft.	8.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-21	DP-21-4 ft.	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-21	DP-21-7.5 ft.	7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/09/2014	MW-15	MW-15-3ft	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/09/2014	MW-15	MW-15-5ft	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/09/2014	RW-2	RW-2-3ft	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/09/2014	RW-2	RW-2-5ft	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/10/2014	MW-8	MW-8-4ft	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/10/2014	MW-9	MW-9-3ft	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/10/2014	MW-10	MW-10-3ft	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/10/2014	RW-1	RW-1-5ft	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/14/2014	MW-15	MW-15-14ft	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/14/2014	MW-16	MW-16-7ft	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/14/2014	RW-2	RW-2-15ft	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/15/2014	MW-9	MW-9-10ft	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/15/2014	RW-1	RW-1-10ft	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/15/2014	RW-1	RW-1-15ft	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/16/2014	MW-7	MW-7-7ft	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/16/2014	MW-7	MW-7-14ft	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/16/2014	MW-8	MW-8-10ft	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/16/2014	MW-11	MW-11-7ft	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/16/2014	MW-11	MW-11-10ft	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2018	B1	B1-4'	4	-	-	-	-	-	-	-	-	-	-	-	-	<0.005	-	<0.03	-	-	-	-	-
08/16/2018	B2	B2-5'	5	-	-	-	-	-	-	-	-	-	-	-	-	<0.005	-	<0.03	-	-	-	-	-
08/16/2018	RNMW-17	MW17-4'	4	-	-	-	-	-	-	-	-	-	-	-	-	<0.005	-	<0.03	-	-	-	-	-
07/26/2023	T1	T1	2.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T2	T2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T3	T3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Apendix B-1
Historical Analytical Data - Soil Results
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

				Other VOC																			
Date	Sample Location	Field ID	Depth (feet)	1,1,1,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,1-Dichloropropene	1,2,3-Trichlorobenzene	1,2,3-Trichloropropane	1,2,4-Trichlorobenzene	1,2,4-Trimethylbenzene	1,2-Dibromo-3-chloropropane	1,2-Dibromoethane	1,2-Dichlorobenzene	1,2-Dichloroethane	1,2-Dichloroethene(cis)	1,2-Dichloroethene(trans)	1,2-Dichloropropane	1,3,5-Trimethylbenzene	1,3-Dichlorobenzene
				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
MTCA - Soil - Method A				-	2	-	-	-	-	-	-	-	-	-	-	0.005	-	-	-	-	-	-	-
11/08/1995	MW-1	B1-1/MW-1	2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	MW-1	B1-2/MW-1	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T4	T4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T5	T5	2.41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T6	T6	2.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T7	T7	2.83	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T8	T8	2.41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T9	T9	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T9	T9	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC1	UDC 1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC1	UDC 1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC2	UDC 2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC2	UDC 2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC3	UDC 3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC4	UDC 4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC4	UDC 4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC5	UDC 5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC6	UDC 6	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC7	UDC 7	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC8	UDC 8	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U1	U1	3.5	-	-	-	-	-	-	-	-	-	-	-	-	<0.019	-	<0.23	-	-	-	-	-
08/09/2023	U1	U1	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U2	U2	3.5	-	-	-	-	-	-	-	-	-	-	-	-	<0.0021	-	<0.026	-	-	-	-	-
08/09/2023	U2	U2	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U3	U3	3.5	-	-	-	-	-	-	-	-	-	-	-	-	<0.0017	-	<0.021	-	-	-	-	-
08/09/2023	U4	U4	3.5	-	-	-	-	-	-	-	-	-	-	-	-	<0.0014	-	<0.017	-	-	-	-	-
08/09/2023	U5	U5	3.5	-	-	-	-	-	-	-	-	-	-	-	-	<0.0014	-	<0.017	-	-	-	-	-
08/09/2023	U6	U6	3.5	-	-	-	-	-	-	-	-	-	-	-	-	<0.0021	-	<0.025	-	-	-	-	-
08/09/2023	U7	U7	3.5	-	-	-	-	-	-	-	-	-	-	-	-	<0.0021	-	<0.026	-	-	-	-	-
08/09/2023	U8	U8	3.5	-	-	-	-	-	-	-	-	-	-	-	-	<0.021	-	<0.26	-	-	-	-	-
08/09/2023	U8	U8	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U9	U9	3.5	-	-	-	-	-	-	-	-	-	-	-	-	<0.0017	-	<0.021	-	-	-	-	-
08/09/2023	U9	U9	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U10	U10	3.5	-	-	-	-	-	-	-	-	-	-	-	-	<0.0023	-	<0.027	-	-	-	-	-
08/09/2023	U11	U11	3.5	-	-	-	-	-	-	-	-	-	-	-	-	<0.0015	-	<0.018	-	-	-	-	-
08/09/2023	U12	U12	3.5	-	-	-	-	-	-	-	-	-	-	-	-	<0.0014	-	<0.017	-	-	-	-	-
08/09/2023	U13	U13	3.5	-	-	-	-	-	-	-	-	-	-	-	-	<0.0013	-	<0.016	-	-	-	-	-
08/09/2023	U14	U14	3.5	-	-	-	-	-	-	-	-	-	-	-	-	<0.0021	-	<0.025	-	-	-	-	-
08/23/2023	RE1	RE1	4	-	-	-	-	-	-	-	-	-	-	-	-	<0.0045	-	<0.054	-	-	-	-	-
08/23/2023	RE2	RE2	4	-	-	-	-	-	-	-	-	-	-	-	-	<0.0034	-	<0.04	-	-	-	-	-
08/24/2023	RE3	RE3-5	5	-	-	-	-	-	-	-	-	-	-	-	-	<0.0021	-	<0.025	-	-	-	-	-
08/24/2023	RE4	RE4-1	1	-	-	-	-	-	-	-	-	-	-	-	-	<0.0022	-	<0.026	-	-	-	-	-
08/24/2023	RE4	RE4-1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/24/2023	RE5	RE5-3	3	-	-	-	-	-	-	-	-	-	-	-	-	<0.0017	-	<0.02	-	-	-	-	-
08/24/2023	RE5	RE5-3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/24/2023	RE6	RE6-5.5	5.5	-	-	-	-	-	-	-	-	-	-	-	-	<0.002	-	<0.024	-	-	-	-	-
08/24/2023	RE7	RE7-5	5	-	-	-	-	-	-	-	-	-	-	-	-	<0.0015	-	<0.018	-	-	-	-	-
08/24/2023	RE8	RE8-5	5	-	-	-	-	-	-	-	-	-	-	-	-	<0.0023	-	<0.028	-	-	-	-	-
08/29/2023	RE8	RE8-5	5	-	-	-	-	-	-	-	-	-	-	-	-	<0.0017	-	<0.02	-	-	-	-	-
08/29/2023	RE9	RE9-5	5	-	-	-	-	-	-	-	-	-	-	-	-	<0.0017	-	<0.02	-	-	-	-	-
08/29/2023	RE10	RE10-5	5	-	-	-	-	-	-	-	-	-	-	-	-	<0.0018	-	<0.022	-	-	-	-	-
08/29/2023	RE11	RE11-5	5	-	-	-	-	-	-	-	-	-	-	-	-	<0.0018	-	<0.022	-	-	-	-	-
08/29/2023	RE12	RE12-5	5	-	-	-	-	-	-	-	-	-	-	-	-	<0.0017	-	<0.021	-	-	-	-	-
08/29/2023	RE13	RE13-5	5	-	-	-	-	-	-	-	-	-	-	-	-	<0.0018	-	<0.021	-	-	-	-	-
08/29/2023	RE14	RE14-5	5	-	-	-	-	-	-	-	-	-	-	-	-	<0.0017	-	<0.02	-	-	-	-	-
08/29/2023	RE15	RE15-5	5	-	-	-	-	-	-	-	-	-	-	-	-	<0.0019	-	<0.023	-	-	-	-	-
08/29/2023	RE16	RE16-5	5	-	-	-	-	-	-	-	-	-	-	-	-	<0.0016	-	<0.019	-	-	-	-	-
08/29/2023	RE17	RE17-5	5	-	-	-	-	-	-	-	-	-	-	-	-	<0.0015	-	<0.018	-	-	-	-	-
08/29/2023	RE18	RE18-5	5	-	-	-	-	-	-	-	-	-	-	-	-	<0.0015	-	<0.018	-	-	-	-	-
08/30/2023	RE19	RE19-5	5	-	-	-	-	-	-	-	-	-	-	-	-	<0.0021	-	<0.026	-	-	-	-	-
08/30/2023	RE20	RE20-6	6	-	-	-	-	-	-	-	-	-	-	-	-	<0.0017	-	<0.021	-	-	-	-	-
08/30/2023	RE21	RE21-5	5	-	-	-	-	-	-	-	-	-	-	-	-	<0.002	-	<0.024	-	-	-	-	-

Apendix B-1
Historical Analytical Data - Soil Results
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

				Other VOC																			
Date	Sample Location	Field ID	Depth (feet)	1,1,1,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,1-Dichloropropene	1,2,3-Trichlorobenzene	1,2,3-Trichloropropane	1,2,4-Trichlorobenzene	1,2,4-Trimethylbenzene	1,2-Dibromo-3-chloropropane	1,2-Dibromoethane	1,2-Dichlorobenzene	1,2-Dichloroethane	1,2-Dichloroethene(cis)	1,2-Dichloroethene(trans)	1,2-Dichloropropane	1,3,5-Trimethylbenzene	1,3-Dichlorobenzene
				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
MTCA - Soil - Method A				-	2	-	-	-	-	-	-	-	-	-	-	0.005	-	-	-	-	-	-	-
11/08/1995	MW-1	B1-1/MW-1	2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	MW-1	B1-2/MW-1	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/30/2023	RE22	RE22-5	5	-	-	-	-	-	-	-	-	-	-	-	-	<0.002	-	<0.024	-	-	-	-	-
08/30/2023	RE23	RE23-6	6	-	-	-	-	-	-	-	-	-	-	-	-	<0.002	-	<0.024	-	-	-	-	-
08/30/2023	RE24	RE24-5	5	-	-	-	-	-	-	-	-	-	-	-	-	<0.002	-	<0.024	-	-	-	-	-
08/30/2023	RE25	RE25-5	5	-	-	-	-	-	-	-	-	-	-	-	-	<0.002	-	<0.024	-	-	-	-	-
08/30/2023	RE26	RE26-5	5	-	-	-	-	-	-	-	-	-	-	-	-	<0.002	-	<0.024	-	-	-	-	-
08/30/2023	RE27	RE27-5	5	-	-	-	-	-	-	-	-	-	-	-	-	<0.0016	-	<0.019	-	-	-	-	-
08/30/2023	RE28	RE28-5	5	-	-	-	-	-	-	-	-	-	-	-	-	<0.0015	-	<0.018	-	-	-	-	-
08/31/2023	RE29	RE29-5	5	-	-	-	-	-	-	-	-	-	-	-	-	**0.0064**	-	<0.026	-	-	-	-	-
08/31/2023	RE29	RE29-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE30	RE30-5	5	-	-	-	-	-	-	-	-	-	-	-	-	<0.021	-	<0.25	-	-	-	-	-
08/31/2023	RE30	RE30-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE31	RE31-5	5	-	-	-	-	-	-	-	-	-	-	-	-	<0.0021	-	<0.025	-	-	-	-	-
08/31/2023	RE32	RE32-6	6	-	-	-	-	-	-	-	-	-	-	-	-	<0.019	-	<0.23	-	-	-	-	-
08/31/2023	RE33	RE33-6	6	-	-	-	-	-	-	-	-	-	-	-	-	**0.0068**	-	<0.025	-	-	-	-	-
08/31/2023	RE33	RE33-6	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE34	RE34-5	5	-	-	-	-	-	-	-	-	-	-	-	-	**0.19**	-	<1.6	-	-	-	-	-
08/31/2023	RE35	RE35-5	5	-	-	-	-	-	-	-	-	-	-	-	-	**0.0031**	-	<0.026	-	-	-	-	-
08/31/2023	RE35	RE35-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE36	RE36-3	3	-	-	-	-	-	-	-	-	-	-	-	-	**0.0022**	-	<0.019	-	-	-	-	-
08/31/2023	RE37	RE37-5	5	-	-	-	-	-	-	-	-	-	-	-	-	**0.0041**	-	<0.024	-	-	-	-	-
08/31/2023	RE38	RE38-6	6	-	-	-	-	-	-	-	-	-	-	-	-	**0.012**	-	**0.039**	-	-	-	-	-
09/01/2023	RE39	RE39-5	5	-	-	-	-	-	-	-	-	-	-	-	-	<0.0021	-	<0.025	-	-	-	-	-
09/05/2023	RE40	RE40-5	5	-	-	-	-	-	-	-	-	-	-	-	-	**0.0017**	-	<0.02	-	-	-	-	-
09/05/2023	RE41	RE41-6	6	-	-	-	-	-	-	-	-	-	-	-	-	**0.0045**	-	<0.019	-	-	-	-	-
09/06/2023	RE42	RE42-5	5	-	-	-	-	-	-	-	-	-	-	-	-	<0.002	-	<0.024	-	-	-	-	-
09/06/2023	RE43	RE43-6	6	-	-	-	-	-	-	-	-	-	-	-	-	<0.0022	-	<0.027	-	-	-	-	-
09/06/2023	RE44	RE44-5	5	-	-	-	-	-	-	-	-	-	-	-	-	<0.0017	-	<0.02	-	-	-	-	-
09/06/2023	RE45	RE45-5	5	-	-	-	-	-	-	-	-	-	-	-	-	<0.0021	-	<0.025	-	-	-	-	-
09/06/2023	RE46	RE46-5	5	-	-	-	-	-	-	-	-	-	-	-	-	<0.002	-	<0.024	-	-	-	-	-
09/06/2023	RE47	RE47-6	6	-	-	-	-	-	-	-	-	-	-	-	-	**0.0025**	-	<0.02	-	-	-	-	-
Statistics																							
Number of Results				5	5	5	5	5	5	5	5	5	5	5	5	84	5	84	5	5	5	5	5
Number of Detects				0	0	0	0	0	0	0	0	0	0	5	0	10	0	1	0	0	0	5	0
Minimum Concentration				<0.029	<0.017	<0.05	<0.017	<0.017	<0.029	<0.017	<0.086	<0.032	<0.086	0.15	<0.086	<0.0013	<0.023	<0.016	<0.017	<0.017	<0.017	0.27	<0.023
Minimum Detect				ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.15	ND	0.0017	ND	0.039	ND	ND	ND	0.27	ND
Maximum Concentration				<0.079	<0.05	<0.24	<0.05	<0.05	<0.079	<0.05	<0.25	<0.087	<0.25	14	<0.5	0.19	<0.063	<1.6	<0.05	<0.05	<0.05	3.6	<0.063
Maximum Detect				ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	14	ND	0.19	ND	0.039	ND	ND	ND	3.6	ND
Average Concentration *				0.022	0.015	0.056	0.015	0.015	0.022	0.015	0.076	0.024	0.076	3.1	0.1	0.0048	0.018	0.03	0.015	0.015	0.015	1	0.018
Geometric Average *				0.02	0.013	0.048	0.013	0.013	0.02	0.013	0.067	0.022	0.067	0.62	0.077	0.0017	0.017	0.015	0.013	0.013	0.013	0.61	0.017
Median Concentration *				0.0155	0.0095	0.044	0.0095	0.0095	0.0155	0.0095	0.047	0.017	0.047	0.26	0.047	0.00105	0.0125	0.01225	0.0095	0.0095	0.0095	0.43	0.0125
Standard Deviation *				0.011	0.0085	0.037	0.0085	0.0085	0.011	0.0085	0.043	0.012	0.043	6.1	0.09	0.021	0.0093	0.089	0.0085	0.0085	0.0085	1.4	0.0093
Geometric Standard Deviation *				1.6	1.7	1.8	1.7	1.7	1.6	1.7	1.7	1.5	1.7	6.2	2.2	2.7	1.6	2.2	1.7	1.7	1.7	2.8	1.6
95% UCL (Student's-t) *				0.0321	0.0233	0.091	0.0233	0.0233	0.0321	0.0233	0.117	0.0348	0.117	8.901	0.186	0.0086	0.0273	0.0465	0.0233	0.0233	0.0233	2.411	0.0273
Number of Env Standard Exceedances				0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0
Number of Env Standard Exceedances (Detects Only)				0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0
% of Detects				0	0	0	0	0	0	0	0	0	0	100	0	12	0	1	0	0	0	100	0
% of Non-Detects				100	100	100	100	100	100	100	100	100	100	0	100	88	100	99	100	100	100	0	100
% of Detects at or above Env Standards				0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0
% of Results Below Env Standards or Non-Detect				100	100	100	100	100	100	100	100	100	100	100	100	95	100	100	100	100	100	100	100

* A Non Detect Multiplier of 0.5 has been applied.

Note
Soil results screned against MTCA Method A cleanup levels. Exceedances are shaded.
Results are bold where detected.
mg/kg = milligrams per kilogram
µg/L = micrograms per liter
BTEX = benzene, toluene, ethylbenzene, and xylenes
TPH = total petroleum hydrocarbons

Apendix B-1
Historical Analytical Data - Soil Results
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

				Other VOC																		
				1,3-Dichloropropane	1,3-Dichloropropene(cis)	1,3-Dichloropropene(trans)	1,4-Dichlorobenzene	2,2-Dichloropropane	2-chlorotoluene	2-hexanone	4-Chlorotoluene	4-Methyl-2-pentanone	Acetone	Bromobenzene	Bromodichloromethane	Bromoform	Bromomethane	Carbon tetrachloride	Chlorobenzene	Chlorodibromomethane	Chloroethane	Chloroform	Chloromethane
Date	**Sample Location**	**Field ID**	**Depth (feet)**	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
MTCA - Soil - Method A				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	MW-1	B1-1/MW-1	2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	MW-1	B1-2/MW-1	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B2	B2	2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	MW-3	B3/MW-3	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B4	B4	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B5	B5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	MW-2	B6/MW-2	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B7	B7	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B8	B8	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B9	B9-1	0.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B9	B9-2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B10	B10-1	0.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B10	B10-2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B11	B11	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B12	B12	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	S-01	S1-1	0.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	S-01	S1-2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	S-02	S-2	0.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/22/1996	MW-4	MW-4-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/22/1996	MW-5	MW-5-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-01	S-1-4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-01	S-1-4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-02	S-2-4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/27/1996	S-02	S-2A-4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-03	S-3-4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-04	S-4-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-05	S-5-5.5	5.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-06	S-6-4.5	4.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-07	S-7-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/27/1996	S-07	S-7A-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-08	S-8-4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-08	S-8-4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-09	S-9-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-10	S-10-4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-11	S-11-5.5	5.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-12	S-12-6	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-13	S-13-5.5	5.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/24/1996	S-14	S-14-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/24/1996	S-15	S-15-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B1	B1@6ft	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B3	B3@7 1/2ft	7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B4	B4@3 1/2ft	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B5	B5@3ft	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B6	B6@5ft	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B7	B7@8ft	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B8	B8@6ft	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B9	B9@7ft	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B10	B10@5ft	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B11	B11@4 1/2ft	4.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B12	B12@6ft	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B13	B13@3 1/2ft	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B14	B14@5ft	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B15	B15@4 1/2ft	4.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/21/2011	BioSwaleD1	81117058-DP-01	2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.5	<0.05	<0.5	<0.5	<0.05	<0.05	<0.05	<0.5	<0.05	<0.05	<0.05	<0.5	<0.05	<0.5
09/26/2012	DP-01	DP-1-3 ft.	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-01	DP-1-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-02	DP-2-4 ft.	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-02	DP-2-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-03	DP-3-4 ft.	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-03	DP-3-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-04	DP-4-5 ft.	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-04	DP-4-7.5 ft.	7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Apendix B-1
Historical Analytical Data - Soil Results
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

				Other VOC																		
Date	Sample Location	Field ID	Depth (feet)	1,3-Dichloropropane	1,3-Dichloropropene(cis)	1,3-Dichloropropene(trans)	1,4-Dichlorobenzene	2,2-Dichloropropane	2-chlorotoluene	2-hexanone	4-Chlorotoluene	4-Methyl-2-pentanone	Acetone	Bromobenzene	Bromodichloromethane	Bromoform	Bromomethane	Carbon tetrachloride	Chlorobenzene	Chlorodibromomethane	Chloroethane	Chloroform	Chloromethane
				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
MTCA - Soil - Method A				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	MW-1	B1-1/MW-1	2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	MW-1	B1-2/MW-1	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-04	DP-4-9.5 ft.	9.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-05	DP-5-4.5 ft.	4.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-05	DP-5-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-06	DP-6-4.5 ft.	4.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-06	DP-6-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-07	DP-7-4 ft.	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-07	DP-7-8 ft.	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-07	DP-7-12 ft.	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-08	DP-8-5 ft.	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-08	DP-8-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-09	DP-9-5 ft.	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-09	DP-9-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-09	DP-9-12 ft.	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-10	DP-10-5 ft.	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-10	DP-10-8.5 ft.	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-11	DP-11-5 ft.	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-11	DP-11-8 ft.	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-12	DP-12-8.5 ft.	8.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-13	DP-13-4 ft.	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-13	DP-13-8 ft.	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-14	DP-14-5 ft.	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-14	DP-14-7.5 ft.	7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-15	DP-15-5 ft.	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-15	DP-15-8 ft.	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-16	DP-16-4 ft.	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-16	DP-16-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-17	DP-17-4.5 ft.	4.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-17	DP-17-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-18	DP-18-4 ft.	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-18	DP-18-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-19	DP-19-3 ft.	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-19	DP-19-8 ft.	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-20	DP-20-8.5 ft.	8.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-21	DP-21-4 ft.	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-21	DP-21-7.5 ft.	7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/09/2014	MW-15	MW-15-3ft	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/09/2014	MW-15	MW-15-5ft	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/09/2014	RW-2	RW-2-3ft	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/09/2014	RW-2	RW-2-5ft	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/10/2014	MW-8	MW-8-4ft	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/10/2014	MW-9	MW-9-3ft	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/10/2014	MW-10	MW-10-3ft	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/10/2014	RW-1	RW-1-5ft	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/14/2014	MW-15	MW-15-14ft	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/14/2014	MW-16	MW-16-7ft	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/14/2014	RW-2	RW-2-15ft	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/15/2014	MW-9	MW-9-10ft	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/15/2014	RW-1	RW-1-10ft	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/15/2014	RW-1	RW-1-15ft	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/16/2014	MW-7	MW-7-7ft	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/16/2014	MW-7	MW-7-14ft	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/16/2014	MW-8	MW-8-10ft	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/16/2014	MW-11	MW-11-7ft	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/16/2014	MW-11	MW-11-10ft	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2018	B1	B1-4'	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2018	B2	B2-5'	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2018	RNMW-17	MW17-4'	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T1	T1	2.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T2	T2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T3	T3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Apendix B-1
Historical Analytical Data - Soil Results
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

				Other VOC																		
				1,3-Dichloropropane	1,3-Dichloropropene(cis)	1,3-Dichloropropene(trans)	1,4-Dichlorobenzene	2,2-Dichloropropane	2-chlorotoluene	2-hexanone	4-Chlorotoluene	4-Methyl-2-pentanone	Acetone	Bromobenzene	Bromodichloromethane	Bromoform	Bromomethane	Carbon tetrachloride	Chlorobenzene	Chlorodibromomethane	Chloroethane	Chloroform	Chloromethane
Date	**Sample Location**	**Field ID**	**Depth (feet)**	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
MTCA - Soil - Method A				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	MW-1	B1-1/MW-1	2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	MW-1	B1-2/MW-1	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T4	T4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T5	T5	2.41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T6	T6	2.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T7	T7	2.83	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T8	T8	2.41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T9	T9	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T9	T9	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC1	UDC 1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC1	UDC 1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC2	UDC 2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC2	UDC 2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC3	UDC 3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC4	UDC 4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC4	UDC 4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC5	UDC 5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC6	UDC 6	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC7	UDC 7	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC8	UDC 8	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U1	U1	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U1	U1	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U2	U2	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U2	U2	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U3	U3	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U4	U4	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U5	U5	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U6	U6	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U7	U7	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U8	U8	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U8	U8	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U9	U9	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U9	U9	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U10	U10	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U11	U11	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U12	U12	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U13	U13	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U14	U14	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/23/2023	RE1	RE1	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/23/2023	RE2	RE2	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/24/2023	RE3	RE3-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/24/2023	RE4	RE4-1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/24/2023	RE4	RE4-1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/24/2023	RE5	RE5-3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/24/2023	RE5	RE5-3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/24/2023	RE6	RE6-5.5	5.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/24/2023	RE7	RE7-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/24/2023	RE8	RE8-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/29/2023	RE8	RE8-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/29/2023	RE9	RE9-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/29/2023	RE10	RE10-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/29/2023	RE11	RE11-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/29/2023	RE12	RE12-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/29/2023	RE13	RE13-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/29/2023	RE14	RE14-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/29/2023	RE15	RE15-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/29/2023	RE16	RE16-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/29/2023	RE17	RE17-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/29/2023	RE18	RE18-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/30/2023	RE19	RE19-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/30/2023	RE20	RE20-6	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/30/2023	RE21	RE21-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Apendix B-1
Historical Analytical Data - Soil Results
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

				Other VOC																		
Date	Sample Location	Field ID	Depth (feet)	1,3-Dichloropropane	1,3-Dichloropropene(cis)	1,3-Dichloropropene(trans)	1,4-Dichlorobenzene	2,2-Dichloropropane	2-chlorotoluene	2-hexanone	4-Chlorotoluene	4-Methyl-2-pentanone	Acetone	Bromobenzene	Bromodichloromethane	Bromoform	Bromomethane	Carbon tetrachloride	Chlorobenzene	Chlorodibromomethane	Chloroethane	Chloroform	Chloromethane
				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
MTCA - Soil - Method A				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	MW-1	B1-1/MW-1	2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	MW-1	B1-2/MW-1	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/30/2023	RE22	RE22-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/30/2023	RE23	RE23-6	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/30/2023	RE24	RE24-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/30/2023	RE25	RE25-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/30/2023	RE26	RE26-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/30/2023	RE27	RE27-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/30/2023	RE28	RE28-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE29	RE29-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE29	RE29-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE30	RE30-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE30	RE30-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE31	RE31-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE32	RE32-6	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE33	RE33-6	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE33	RE33-6	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE34	RE34-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE35	RE35-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE35	RE35-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE36	RE36-3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE37	RE37-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE38	RE38-6	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/01/2023	RE39	RE39-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/05/2023	RE40	RE40-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/05/2023	RE41	RE41-6	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/06/2023	RE42	RE42-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/06/2023	RE43	RE43-6	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/06/2023	RE44	RE44-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/06/2023	RE45	RE45-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/06/2023	RE46	RE46-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/06/2023	RE47	RE47-6	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Statistics																							
Number of Results				5	5	5	5	5	5	1	5	1	1	5	5	5	5	5	5	5	5	5	5
Number of Detects				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Minimum Concentration				<0.029	<0.017	<0.017	<0.023	<0.029	<0.023	<0.5	<0.023	<0.5	<0.5	<0.023	<0.017	<0.05	<0.052	<0.017	<0.017	<0.017	<0.034	<0.017	<0.034
Minimum Detect				ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum Concentration				<0.079	<0.05	<0.05	<0.063	<0.079	<0.063	<0.5	<0.063	<0.5	<0.5	<0.063	<0.05	<0.24	<0.5	<0.05	<0.05	<0.05	<0.5	<0.05	<0.5
Maximum Detect				ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Average Concentration *				0.022	0.015	0.015	0.018	0.022	0.018		0.018			0.018	0.015	0.056	0.08	0.015	0.015	0.015	0.07	0.015	0.07
Geometric Average *				0.02	0.013	0.013	0.017	0.02	0.017	0.25	0.017	0.25	0.25	0.017	0.013	0.048	0.051	0.013	0.013	0.013	0.037	0.013	0.037
Median Concentration *				0.0155	0.0095	0.0095	0.0125	0.0155	0.0125	0.25	0.0125	0.25	0.25	0.0125	0.0095	0.044	0.028	0.0095	0.0095	0.0095	0.0185	0.0095	0.0185
Standard Deviation *				0.011	0.0085	0.0085	0.0093	0.011	0.0093		0.0093			0.0093	0.0085	0.037	0.097	0.0085	0.0085	0.0085	0.1	0.0085	0.1
Geometric Standard Deviation *				1.6	1.7	1.7	1.6	1.6	1.6		1.6			1.6	1.7	1.8	2.7	1.7	1.7	1.7	3.2	1.7	3.2
95% UCL (Student's-t) *				0.0321	0.0233	0.0233	0.0273	0.0321	0.0273		0.0273			0.0273	0.0233	0.091	0.172	0.0233	0.0233	0.0233	0.167	0.0233	0.167
Number of Env Standard Exceedances				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of Env Standard Exceedances (Detects Only)				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% of Detects				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% of Non-Detects				100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
% of Detects at or above Env Standards				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% of Results Below Env Standards or Non-Detect				100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

* A Non Detect Multiplier of 0.5 has been applied.

Note
Soil results screned against MTCA Method A cleanup levels. Exceedances are shaded.
Results are bold where detected.
mg/kg = milligrams per kilogram
µg/L = micrograms per liter
BTEX = benzene, toluene, ethylbenzene, and xylenes
TPH = total petroleum hydrocarbons

Apendix B-1
Historical Analytical Data - Soil Results
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

				Other VOC																	
				Dibromomethane	Dichlorodifluoromethane	Dichloromethane	Hexachlorobutadiene	Isopropylbenzene	Methyl Ethyl Ketone	Methyl Tertiary Butyl Ether	n-butylbenzene	n-propylbenzene	p-isopropyltoluene	sec-butylbenzene	Styrene	tert-Butylbenzene	Tetrachloroethene	Trichloroethene	Trichlorofluoromethane	Vinyl chloride	Xylene (m & p)	Xylene (o)
Date	**Sample Location**	**Field ID**	**Depth (feet)**	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
MTCA - Soil - Method A				-	-	0.02	-	-	-	0.1	-	-	-	-	-	-	0.05	0.03	-	-	-	-
11/08/1995	MW-1	B1-1/MW-1	2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	MW-1	B1-2/MW-1	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B2	B2	2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	MW-3	B3/MW-3	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B4	B4	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B5	B5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	MW-2	B6/MW-2	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B7	B7	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B8	B8	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B9	B9-1	0.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B9	B9-2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B10	B10-1	0.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B10	B10-2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B11	B11	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	B12	B12	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	S-01	S1-1	0.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	S-01	S1-2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	S-02	S-2	0.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/22/1996	MW-4	MW-4-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/22/1996	MW-5	MW-5-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-01	S-1-4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-01	S-1-4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-02	S-2-4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/27/1996	S-02	S-2A-4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-03	S-3-4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-04	S-4-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-05	S-5-5.5	5.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-06	S-6-4.5	4.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-07	S-7-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/27/1996	S-07	S-7A-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-08	S-8-4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-08	S-8-4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-09	S-9-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-10	S-10-4	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-11	S-11-5.5	5.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-12	S-12-6	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/23/1996	S-13	S-13-5.5	5.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/24/1996	S-14	S-14-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/24/1996	S-15	S-15-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B1	B1@6ft	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B3	B3@7 1/2ft	7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B4	B4@3 1/2ft	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B5	B5@3ft	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B6	B6@5ft	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B7	B7@8ft	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B8	B8@6ft	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B9	B9@7ft	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B10	B10@5ft	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B11	B11@4 1/2ft	4.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B12	B12@6ft	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B13	B13@3 1/2ft	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B14	B14@5ft	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B15	B15@4 1/2ft	4.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/21/2011	BioSwaleD1	81117058-DP-01	2	<0.05	<0.5	<0.5	<0.25	<0.05	<0.5	<0.05	-	**0.057**	**0.055**	**0.05**	<0.05	<0.05	<0.025	<0.03	<0.5	<0.05	**0.66**	**0.48**
09/26/2012	DP-01	DP-1-3 ft.	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-01	DP-1-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-02	DP-2-4 ft.	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-02	DP-2-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-03	DP-3-4 ft.	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-03	DP-3-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-04	DP-4-5 ft.	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-04	DP-4-7.5 ft.	7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Apendix B-1
Historical Analytical Data - Soil Results
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

				Other VOC																	
Date	Sample Location	Field ID	Depth (feet)	Dibromomethane	Dichlorodifluoromethane	Dichloromethane	Hexachlorobutadiene	Isopropylbenzene	Methyl Ethyl Ketone	Methyl Tertiary Butyl Ether	n-butylbenzene	n-propylbenzene	p-isopropyltoluene	sec-butylbenzene	Styrene	tert-Butylbenzene	Tetrachloroethene	Trichloroethene	Trichlorofluoromethane	Vinyl chloride	Xylene (m & p)	Xylene (o)
				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
MTCA - Soil - Method A				-	-	0.02	-	-	-	0.1	-	-	-	-	-	-	0.05	0.03	-	-	-	-
11/08/1995	MW-1	B1-1/MW-1	2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	MW-1	B1-2/MW-1	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-04	DP-4-9.5 ft.	9.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-05	DP-5-4.5 ft.	4.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-05	DP-5-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-06	DP-6-4.5 ft.	4.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-06	DP-6-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-07	DP-7-4 ft.	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-07	DP-7-8 ft.	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-07	DP-7-12 ft.	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-08	DP-8-5 ft.	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-08	DP-8-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-09	DP-9-5 ft.	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-09	DP-9-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-09	DP-9-12 ft.	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-10	DP-10-5 ft.	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-10	DP-10-8.5 ft.	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-11	DP-11-5 ft.	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-11	DP-11-8 ft.	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-12	DP-12-8.5 ft.	8.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-13	DP-13-4 ft.	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-13	DP-13-8 ft.	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-14	DP-14-5 ft.	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-14	DP-14-7.5 ft.	7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-15	DP-15-5 ft.	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-15	DP-15-8 ft.	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-16	DP-16-4 ft.	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-16	DP-16-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-17	DP-17-4.5 ft.	4.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-17	DP-17-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-18	DP-18-4 ft.	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-18	DP-18-9 ft.	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-19	DP-19-3 ft.	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-19	DP-19-8 ft.	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-20	DP-20-8.5 ft.	8.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-21	DP-21-4 ft.	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-21	DP-21-7.5 ft.	7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/09/2014	MW-15	MW-15-3ft	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/09/2014	MW-15	MW-15-5ft	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/09/2014	RW-2	RW-2-3ft	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/09/2014	RW-2	RW-2-5ft	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/10/2014	MW-8	MW-8-4ft	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/10/2014	MW-9	MW-9-3ft	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/10/2014	MW-10	MW-10-3ft	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/10/2014	RW-1	RW-1-5ft	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/14/2014	MW-15	MW-15-14ft	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/14/2014	MW-16	MW-16-7ft	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/14/2014	RW-2	RW-2-15ft	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/15/2014	MW-9	MW-9-10ft	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/15/2014	RW-1	RW-1-10ft	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/15/2014	RW-1	RW-1-15ft	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/16/2014	MW-7	MW-7-7ft	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/16/2014	MW-7	MW-7-14ft	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/16/2014	MW-8	MW-8-10ft	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/16/2014	MW-11	MW-11-7ft	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/16/2014	MW-11	MW-11-10ft	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2018	B1	B1-4'	4	-	-	-	-	-	-	<0.05	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2018	B2	B2-5'	5	-	-	-	-	-	-	<0.05	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2018	RNMW-17	MW17-4'	4	-	-	-	-	-	-	<0.05	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T1	T1	2.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T2	T2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T3	T3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Apendix B-1
Historical Analytical Data - Soil Results
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

				Other VOC																	
Date	Sample Location	Field ID	Depth (feet)	Dibromomethane	Dichlorodifluoromethane	Dichloromethane	Hexachlorobutadiene	Isopropylbenzene	Methyl Ethyl Ketone	Methyl Tertiary Butyl Ether	n-butylbenzene	n-propylbenzene	p-isopropyltoluene	sec-butylbenzene	Styrene	tert-Butylbenzene	Tetrachloroethene	Trichloroethene	Trichlorofluoromethane	Vinyl chloride	Xylene (m & p)	Xylene (o)
				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
MTCA - Soil - Method A				-	-	0.02	-	-	-	0.1	-	-	-	-	-	-	0.05	0.03	-	-	-	-
11/08/1995	MW-1	B1-1/MW-1	2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	MW-1	B1-2/MW-1	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T4	T4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T5	T5	2.41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T6	T6	2.66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T7	T7	2.83	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T8	T8	2.41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T9	T9	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	T9	T9	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC1	UDC 1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC1	UDC 1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC2	UDC 2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC2	UDC 2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC3	UDC 3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC4	UDC 4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC4	UDC 4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC5	UDC 5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC6	UDC 6	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC7	UDC 7	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/26/2023	UDC8	UDC 8	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U1	U1	3.5	-	-	-	-	-	-	<0.38	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U1	U1	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U2	U2	3.5	-	-	-	-	-	-	<0.043	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U2	U2	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U3	U3	3.5	-	-	-	-	-	-	<0.034	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U4	U4	3.5	-	-	-	-	-	-	<0.028	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U5	U5	3.5	-	-	-	-	-	-	<0.028	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U6	U6	3.5	-	-	-	-	-	-	<0.042	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U7	U7	3.5	-	-	-	-	-	-	<0.043	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U8	U8	3.5	-	-	-	-	-	-	<0.43	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U8	U8	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U9	U9	3.5	-	-	-	-	-	-	<0.035	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U9	U9	3.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U10	U10	3.5	-	-	-	-	-	-	<0.045	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U11	U11	3.5	-	-	-	-	-	-	<0.029	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U12	U12	3.5	-	-	-	-	-	-	<0.028	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U13	U13	3.5	-	-	-	-	-	-	<0.027	-	-	-	-	-	-	-	-	-	-	-	-
08/09/2023	U14	U14	3.5	-	-	-	-	-	-	<0.041	-	-	-	-	-	-	-	-	-	-	-	-
08/23/2023	RE1	RE1	4	-	-	-	-	-	-	<0.09	-	-	-	-	-	-	-	-	-	-	-	-
08/23/2023	RE2	RE2	4	-	-	-	-	-	-	<0.067	-	-	-	-	-	-	-	-	-	-	-	-
08/24/2023	RE3	RE3-5	5	-	-	-	-	-	-	<0.041	-	-	-	-	-	-	-	-	-	-	-	-
08/24/2023	RE4	RE4-1	1	-	-	-	-	-	-	<0.044	-	-	-	-	-	-	-	-	-	-	-	-
08/24/2023	RE4	RE4-1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/24/2023	RE5	RE5-3	3	-	-	-	-	-	-	<0.033	-	-	-	-	-	-	-	-	-	-	-	-
08/24/2023	RE5	RE5-3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/24/2023	RE6	RE6-5.5	5.5	-	-	-	-	-	-	<0.04	-	-	-	-	-	-	-	-	-	-	-	-
08/24/2023	RE7	RE7-5	5	-	-	-	-	-	-	<0.03	-	-	-	-	-	-	-	-	-	-	-	-
08/24/2023	RE8	RE8-5	5	-	-	-	-	-	-	<0.047	-	-	-	-	-	-	-	-	-	-	-	-
08/29/2023	RE8	RE8-5	5	-	-	-	-	-	-	<0.034	-	-	-	-	-	-	-	-	-	-	-	-
08/29/2023	RE9	RE9-5	5	-	-	-	-	-	-	<0.033	-	-	-	-	-	-	-	-	-	-	-	-
08/29/2023	RE10	RE10-5	5	-	-	-	-	-	-	<0.036	-	-	-	-	-	-	-	-	-	-	-	-
08/29/2023	RE11	RE11-5	5	-	-	-	-	-	-	<0.036	-	-	-	-	-	-	-	-	-	-	-	-
08/29/2023	RE12	RE12-5	5	-	-	-	-	-	-	<0.035	-	-	-	-	-	-	-	-	-	-	-	-
08/29/2023	RE13	RE13-5	5	-	-	-	-	-	-	<0.035	-	-	-	-	-	-	-	-	-	-	-	-
08/29/2023	RE14	RE14-5	5	-	-	-	-	-	-	<0.034	-	-	-	-	-	-	-	-	-	-	-	-
08/29/2023	RE15	RE15-5	5	-	-	-	-	-	-	<0.039	-	-	-	-	-	-	-	-	-	-	-	-
08/29/2023	RE16	RE16-5	5	-	-	-	-	-	-	<0.031	-	-	-	-	-	-	-	-	-	-	-	-
08/29/2023	RE17	RE17-5	5	-	-	-	-	-	-	<0.03	-	-	-	-	-	-	-	-	-	-	-	-
08/29/2023	RE18	RE18-5	5	-	-	-	-	-	-	<0.029	-	-	-	-	-	-	-	-	-	-	-	-
08/30/2023	RE19	RE19-5	5	-	-	-	-	-	-	<0.043	-	-	-	-	-	-	-	-	-	-	-	-
08/30/2023	RE20	RE20-6	6	-	-	-	-	-	-	<0.035	-	-	-	-	-	-	-	-	-	-	-	-
08/30/2023	RE21	RE21-5	5	-	-	-	-	-	-	<0.04	-	-	-	-	-	-	-	-	-	-	-	-

Apendix B-1
Historical Analytical Data - Soil Results
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

				Other VOC																	
Date	Sample Location	Field ID	Depth (feet)	Dibromomethane	Dichlorodifluoromethane	Dichloromethane	Hexachlorobutadiene	Isopropylbenzene	Methyl Ethyl Ketone	Methyl Tertiary Butyl Ether	n-butylbenzene	n-propylbenzene	p-isopropyltoluene	sec-butylbenzene	Styrene	tert-Butylbenzene	Tetrachloroethene	Trichloroethene	Trichlorofluoromethane	Vinyl chloride	Xylene (m & p)	Xylene (o)
				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
MTCA - Soil - Method A				-	-	0.02	-	-	-	0.1	-	-	-	-	-	-	0.05	0.03	-	-	-	-
11/08/1995	MW-1	B1-1/MW-1	2.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/08/1995	MW-1	B1-2/MW-1	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/30/2023	RE22	RE22-5	5	-	-	-	-	-	-	<0.04	-	-	-	-	-	-	-	-	-	-	-	-
08/30/2023	RE23	RE23-6	6	-	-	-	-	-	-	<0.04	-	-	-	-	-	-	-	-	-	-	-	-
08/30/2023	RE24	RE24-5	5	-	-	-	-	-	-	<0.04	-	-	-	-	-	-	-	-	-	-	-	-
08/30/2023	RE25	RE25-5	5	-	-	-	-	-	-	<0.039	-	-	-	-	-	-	-	-	-	-	-	-
08/30/2023	RE26	RE26-5	5	-	-	-	-	-	-	<0.04	-	-	-	-	-	-	-	-	-	-	-	-
08/30/2023	RE27	RE27-5	5	-	-	-	-	-	-	<0.032	-	-	-	-	-	-	-	-	-	-	-	-
08/30/2023	RE28	RE28-5	5	-	-	-	-	-	-	<0.03	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE29	RE29-5	5	-	-	-	-	-	-	<0.043	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE29	RE29-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE30	RE30-5	5	-	-	-	-	-	-	<0.42	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE30	RE30-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE31	RE31-5	5	-	-	-	-	-	-	<0.042	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE32	RE32-6	6	-	-	-	-	-	-	<0.38	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE33	RE33-6	6	-	-	-	-	-	-	<0.042	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE33	RE33-6	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE34	RE34-5	5	-	-	-	-	-	-	<2.6	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE35	RE35-5	5	-	-	-	-	-	-	<0.044	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE35	RE35-5	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE36	RE36-3	3	-	-	-	-	-	-	<0.032	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE37	RE37-5	5	-	-	-	-	-	-	<0.039	-	-	-	-	-	-	-	-	-	-	-	-
08/31/2023	RE38	RE38-6	6	-	-	-	-	-	-	<0.043	-	-	-	-	-	-	-	-	-	-	-	-
09/01/2023	RE39	RE39-5	5	-	-	-	-	-	-	<0.042	-	-	-	-	-	-	-	-	-	-	-	-
09/05/2023	RE40	RE40-5	5	-	-	-	-	-	-	<0.033	-	-	-	-	-	-	-	-	-	-	-	-
09/05/2023	RE41	RE41-6	6	-	-	-	-	-	-	<0.032	-	-	-	-	-	-	-	-	-	-	-	-
09/06/2023	RE42	RE42-5	5	-	-	-	-	-	-	<0.04	-	-	-	-	-	-	-	-	-	-	-	-
09/06/2023	RE43	RE43-6	6	-	-	-	-	-	-	<0.044	-	-	-	-	-	-	-	-	-	-	-	-
09/06/2023	RE44	RE44-5	5	-	-	-	-	-	-	<0.033	-	-	-	-	-	-	-	-	-	-	-	-
09/06/2023	RE45	RE45-5	5	-	-	-	-	-	-	<0.042	-	-	-	-	-	-	-	-	-	-	-	-
09/06/2023	RE46	RE46-5	5	-	-	-	-	-	-	<0.04	-	-	-	-	-	-	-	-	-	-	-	-
09/06/2023	RE47	RE47-6	6	-	-	-	-	-	-	<0.033	-	-	-	-	-	-	-	-	-	-	-	-
Statistics																						
Number of Results				5	5	5	5	5	1	84	4	5	5	5	5	5	5	5	5	5	1	1
Number of Detects				0	0	1	0	1	0	0	1	4	5	2	0	0	0	0	0	0	1	1
Minimum Concentration				<0.023	<0.034	<0.011	<0.086	<0.029	<0.5	<0.027	<0.023	<0.023	0.055	<0.023	<0.017	<0.023	<0.011	<0.011	<0.029	<0.011	0.66	0.48
Minimum Detect				ND	ND	0.029	ND	0.55	ND	ND	0.82	0.025	0.055	0.05	ND	ND	ND	ND	ND	ND	0.66	0.48
Maximum Concentration				<0.063	<0.5	<0.5	<0.25	0.55	<0.5	<2.6	0.82	1.6	1.1	0.66	<0.05	<0.063	<0.032	<0.032	<0.5	<0.05	0.66	0.48
Maximum Detect				ND	ND	0.029	ND	0.55	ND	ND	0.82	1.6	1.1	0.66	ND	ND	ND	ND	ND	ND	0.66	0.48
Average Concentration *				0.018	0.07	0.061	0.076	0.12		0.049	0.21	0.35	0.54	0.15	0.015	0.018	0.0092	0.0097	0.067	0.012		
Geometric Average *				0.017	0.037	0.021	0.067	0.034	0.25	0.025	0.034	0.063	0.37	0.035	0.013	0.017	0.0083	0.0086	0.032	0.0095	0.66	0.48
Median Concentration *				0.0125	0.0185	0.016	0.047	0.0155	0.25	0.02025	0.012	0.038	0.48	0.0125	0.0095	0.0125	0.006	0.006	0.0155	0.006	0.66	0.48
Standard Deviation *				0.0093	0.1	0.11	0.043	0.24		0.15	0.4	0.7	0.39	0.29	0.0085	0.0093	0.0048	0.0053	0.1	0.0086		
Geometric Standard Deviation *				1.6	3.2	4.7	1.7	4.8		2.2	8.3	6.7	3.2	5.8	1.7	1.6	1.6	1.7	3.4	2		
95% UCL (Student's-t) *				0.0273	0.167	0.162	0.117	0.351		0.0757	0.689	1.015	0.913	0.422	0.0233	0.0273	0.0138	0.0148	0.165	0.0199		
Number of Env Standard Exceedances				0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of Env Standard Exceedances (Detects Only)				0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% of Detects				0	0	20	0	20	0	0	25	80	100	40	0	0	0	0	0	0	100	100
% of Non-Detects				100	100	80	100	80	100	100	75	20	0	60	100	100	100	100	100	100	0	0
% of Detects at or above Env Standards				0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% of Results Below Env Standards or Non-Detect				100	100	80	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

* A Non Detect Multiplier of 0.5 has been applied.

Note
Soil results screned against MTCA Method A cleanup levels. Exceedances are shaded.
Results are bold where detected.
mg/kg = milligrams per kilogram
µg/L = micrograms per liter
BTEX = benzene, toluene, ethylbenzene, and xylenes
TPH = total petroleum hydrocarbons

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		TPH			BTEX + naphthalene				
		TPH as Gasoline	TPH as Diesel	TPH as Motor Oil	Benzene	Toluene	Ethylbenzene	Xylenes (total)	Naphthalene
Date	**Location Code**	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MTCA - GW - Method A		-	500	500	5	1,000	700	1,000	160
MTCA - GW - Method B - VI		-	-	-	2.4	15,000	2,800	320	8.8
08/16/2010	B12	<50	<80	<400	<1	<1	<1	<3	-
08/16/2010	B3	<250	**4,140**	<400	**96.7**	<1	**3**	<3	-
08/16/2010	B7	**25,400**	**4,970**	**837**	**932**	**84.4**	**1,520**	**4,820**	-
09/26/2012	DP-01	<250	<250	-	<0.5	<0.5	<0.5	<0.5	-
09/26/2012	DP-02	<250	<250	-	<0.5	<0.5	<0.5	<0.5	-
09/26/2012	DP-03	<250	<250	-	<0.5	<0.5	<0.5	<0.5	**0.037**
09/25/2012	DP-04	**7,300**	**7,700**	-	<2	<2	<2	**2.6**	-
09/26/2012	DP-05	**35,000**	**3,300**	<500	**21**	**80**	**1,300**	**5,300**	**360**
09/26/2012	DP-06	**43,000**	**14,000**	**570**	<20	**200**	**1,300**	**4,900**	-
09/26/2012	DP-07	<250	<250	<500	<0.5	**0.65**	**0.96**	**3.7**	-
09/25/2012	DP-08	**470**	<250	-	**12**	**0.65**	**3.9**	**5.3**	-
09/25/2012	DP-09	**1,200**	<250	-	**68**	**1.4**	<0.5	**1.7**	-
09/25/2012	DP-10	**11,000**	**6,100**	-	**410**	**8.4**	**410**	**420**	**120**
09/25/2012	DP-11	**47,000**	**3,900**	-	**940**	**1,200**	**2,000**	**6,400**	-
09/24/2012	DP-12	**18,000**	**120,000**	-	**240**	**100**	**1,300**	**4,700**	**120**
09/24/2012	DP-13	<250	**2,200**	-	<0.5	**0.68**	<0.5	<0.5	-
09/24/2012	DP-14	<250	<250	-	<0.5	**1**	<0.5	**0.61**	**0.064**
09/24/2012	DP-15	<250	<250	-	<0.5	**0.78**	<0.5	<0.5	-
09/25/2012	DP-16	<250	<250	-	<0.5	<0.5	<0.5	<0.5	-
09/26/2012	DP-17	<250	-	-	<0.5	**0.69**	<0.5	<0.5	-
09/26/2012	DP-18	<250	-	-	<0.5	<0.5	<0.5	<0.5	<0.02
09/26/2012	DP-19	<250	-	-	<0.5	**0.56**	<0.5	<0.5	<0.04
09/25/2012	DP-20	<250	<250	-	**2.9**	**0.52**	**0.79**	**1.5**	**0.54**
09/24/2012	DP-21	<250	<250	-	<0.5	**0.72**	<0.5	<0.5	**0.043**
08/16/2018	B2-W	**255,000**	**69,300**	<400	**5,500**	**24,600**	**1,900**	**11,800**	**167**
08/16/2018	RNMW-17	**521,000**	**20,800**	<400	**5,600**	**33,200**	**2,500**	**9,310**	**240**
06/13/2019	RNMW-17	-	-	-	-	-	-	-	-
08/22/2019	RNMW-17	**25,500**	<200	<400	**776**	**3,320 E**	**653**	**5,020**	**70**
08/22/2019	RNMW-17	**25,500**	<200	<400	-	-	-	-	-
03/26/2021	RNMW-17	-	-	-	-	-	-	-	**0.044**
04/09/2021	RNMW-17	**1,800**	<200	<400	**310**	**116**	**13**	**290**	**5.8**
09/30/2021	RNMW-17	**320**	<200	<400	**21**	<1	**4.2**	**29**	<5
11/09/1995	MW-1	-	-	-	**18**	**1.4**	**3.9**	**5.9**	-
07/24/1996	MW-1	**52**	<250	-	**9.1**	**0.8**	**0.7**	**2.6**	-
12/16/2010	MW-1	**1,400**	**750**	-	**20**	**9.9**	**31**	**12**	**17**
03/18/2011	MW-1	**83,600**	**14,000**	**2,010**	**2,620**	**8,080**	**1,090**	**7,470**	**70.1**
06/07/2011	MW-1	**104,000**	**22,500**	<3,800	**3,200**	**9,420**	**1,710**	**11,300**	**158**
08/25/2011	MW-1	**71,000**	**336**	<190	**3,480**	**10,700**	**1,450**	**8,480**	**164**
11/16/2011	MW-1	**29,000**	**1,700**	-	**1,100**	**2,700**	**980**	**5,400**	**110**
03/08/2012	MW-1	**64,000**	**3,000**	-	**4,900**	**8,400**	**970**	**13,000**	**150**
05/09/2012	MW-1	**48,000**	**4,200**	-	**4,400**	**5,200**	**320**	**9,800**	**79**
09/22/2012	MW-1	**110,000**	**3,400**	**2,300**	**9,200**	**20,000**	**1,100**	**15,000**	**170**
12/07/2012	MW-1	**21,000**	**6,500 Z**	**5,800**	**1,800**	**1,300**	**790**	**5,300**	**81**
03/07/2013	MW-1	**9,200**	**1,700**	**960**	**620**	**350**	**270**	**1,600**	**46**
06/12/2013	MW-1	**70,000**	**1,200**	-	**7,600**	**14,000**	**500**	**9,800**	**72**
08/27/2013	MW-1	**75,000**	**1,700**	-	**5,500**	**9,500**	**720**	**11,000**	**91**
12/11/2013	MW-1	**19,000**	**900**	-	**1,200**	**290**	**390**	**2,900**	**41**
03/25/2014	MW-1	**24,000**	**2,800 Z**	-	**1,900**	**990**	**730**	**4,100**	**50**
06/16/2014	MW-1	**42,000**	**2,500 Z**	**1,300**	**5,100**	**2,600**	**870**	**8,000**	**110**
08/19/2014	MW-1	<30,000	**2,300 Z**	-	**3,900**	**980**	**660**	**8,300**	**83**
11/18/2014	MW-1	**19,000**	**2,000**	-	**3,600**	**310**	**810**	**2,900**	**98**
03/20/2015	MW-1	**35,000**	**4,700**	-	**1,600**	**2,700**	**900**	**5,100**	**89**
06/16/2015	MW-1	**44,000**	**1,500**	-	**5,900**	**290**	**2,000**	**11,000**	-
06/17/2015	MW-1	**55,000**	**1,200 K**	-	**5,300**	**5,700**	**1,600**	**8,400**	**100**
09/24/2015	MW-1	**48,000**	**3,500**	-	**5,300**	**620**	**1,400**	**8,900**	**120**

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		TPH			BTEX + naphthalene				
		TPH as Gasoline	TPH as Diesel	TPH as Motor Oil	Benzene	Toluene	Ethylbenzene	Xylenes (total)	Naphthalene
Date	**Location Code**	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MTCA - GW - Method A		-	500	500	5	1,000	700	1,000	160
MTCA - GW - Method B - VI		-	-	-	2.4	15,000	2,800	320	8.8
12/08/2015	MW-1	**30,000**	**2,300**	-	**2,400**	**310**	**1,500**	**6,200**	**36**
03/10/2016	MW-1	**49,000**	**2,400**	-	**4,700**	**470**	**1,900**	**11,000**	**70**
06/16/2016	MW-1	-	-	-	-	-	-	-	**100**
09/22/2016	MW-1	**59,000**	**780 K**	-	**6,700**	**370**	**3,100**	**20,000**	**190**
11/17/2016	MW-1	**47,000**	**530 K**	-	**5,600**	**290**	**2,000**	**10,000**	**160**
03/23/2017	MW-1	**49,000**	**1,400 K**	-	**6,100**	**1,000**	**2,400**	**18,000**	**200**
06/22/2017	MW-1	**55,000**	**1,500 K**	-	**4,900**	**380**	**2,000**	**9,300**	**110**
09/20/2017	MW-1	**45,000**	**1,700 K**	-	**5,700**	**280**	**2,000**	**8,000**	**280**
12/07/2017	MW-1	**50,000**	**620 K**	-	-	-	-	-	-
12/07/2017	MW-1	-	-	-	**6,000**	**260**	**2,300**	**8,700**	**280**
03/19/2018	MW-1	**40,000**	**2,400 K**	-	-	-	-	-	-
03/19/2018	MW-1	-	-	-	**5,800**	**320**	**2,700**	**10,000**	**210**
03/19/2018	MW-1	-	-	-	-	-	-	-	<320
06/22/2018	MW-1	**53,000**	**4,000 K**	-	**5,600**	**1,200**	**2,500**	**17,000**	**110**
06/22/2018	MW-1	-	-	-	-	-	-	-	**710**
08/16/2018	MW-1	**77,100**	**1,850**	<400	**2,700**	**534**	**217**	**6,020**	**217**
09/26/2018	MW-1	**39,000**	**1,500**	-	-	-	-	-	-
09/26/2018	MW-1	-	-	-	**4,300**	**630**	**2,200**	**8,800**	**280**
11/29/2018	MW-1	**35,000**	**3,000 K**	-	-	-	-	-	-
11/29/2018	MW-1	-	-	-	**3,200**	**130**	**2,100**	**4,200**	**180**
03/20/2019	MW-1	-	-	-	**390**	**35**	**700**	**1,200**	**0.35**
03/20/2019	MW-1	**11,000**	**1,500 K**	-	-	-	-	-	-
06/11/2019	MW-1	-	-	-	**6,600**	**580**	**4,000**	**20,000**	**220**
06/11/2019	MW-1	**48,000**	**910 K**	-	-	-	-	-	-
09/22/2019	MW-1	-	-	-	**6,300**	**690**	**2,000**	**12,000**	**260**
09/22/2019	MW-1	**54,000**	**3,500 K**	-	-	-	-	-	-
03/25/2020	MW-1	**39,000**	**2,100 K**	-	-	-	-	-	-
03/25/2020	MW-1	-	-	-	**4,700**	**200**	**2,600**	**5,800**	**200**
06/23/2020	MW-1	**54,000**	**4,400 Z**	-	**6,200**	**390**	**2,300**	**7,100**	**54**
09/23/2020	MW-1	**38,000**	**2,100 K**	-	**5,200**	**170**	**2,100**	**6,400**	**160**
12/09/2020	MW-1	-	-	-	**5,400**	**120**	**1,800**	**5,000**	**140**
03/24/2021	MW-1	**52,000**	**870 K**	-	**7,800**	**160**	**2,200**	**7,700**	-
03/25/2021	MW-1	-	-	-	-	-	-	-	**200**
04/09/2021	MW-1	**60,000**	**360**	<400	**3,700**	**61**	**1,000**	**5,300**	**230**
06/15/2021	MW-1	**31,000**	**3,900 K**	-	**4,200**	**130**	**1,300**	**6,400**	**91**
09/28/2021	MW-1	**72,000**	**3,100 K**	-	**11,000**	**240**	**3,800**	**10,000**	**370**
09/30/2021	MW-1	**22,000**	<200	<400	**4,500**	**55**	**1,600**	**4,000**	**170**
12/08/2021	MW-1	**33,000**	**91,000 K**	-	**4,100**	**42**	**2,000**	**4,300**	**230 J**
03/22/2022	MW-1	**35,000**	**6,100 Z**	-	**6,600**	**53**	**1,600**	**7,000**	**280**
06/22/2022	MW-1	**25,000**	**3,600 Z**	-	**4,200**	**45**	**1,000**	**3,000**	**80**
09/20/2022	MW-1	**28,000**	**2,500 K**	-	**5,100**	**50**	**1,600**	**4,100**	**180**
12/20/2022	MW-1	**27,000**	**6,300 Z**	-	**5,000**	**27**	**1,700**	**3,000**	**290**
03/09/2023	MW-1	**21,000**	**4,800 Z**	-	**3,100**	**24**	**1,300**	**2,700**	**300**
06/28/2023	MW-1	**39,000**	**5,300 Z**	-	**5,100**	**42**	**1,400**	**4,100**	**280**
09/21/2023	MW-1	**29,000**	**3,500 K**	-	**5,400**	**45**	**1,400**	**3,600**	**260**
12/09/2023	MW-1	-	**960**	-	**4,660**	**30.3**	**1,210**	**3,140**	**196**
03/15/2024	MW-1	**19,900**	**1,350**	-	**3,450**	<50	**1,100**	**1,590**	<250
12/16/2010	MW-2	**140,000**	**200,000**	-	**610**	**4,700**	**2,000**	**14,000**	**560**
11/09/1995	MW-2	-	-	-	<0.5	<0.5	<0.5	<0.5	-
07/24/1996	MW-2	<50	<250	-	<0.5	<0.5	<0.5	**1.4**	-
11/09/1995	MW-3	-	-	-	**0.7**	<0.5	<0.5	<0.5	-
07/24/1996	MW-3	**260**	<250	-	**8.1**	**45**	**2.9**	**29**	-
12/16/2010	MW-3	<250	<250	-	**23**	**0.8**	**2.9**	**2.9**	**0.55**
03/18/2011	MW-3	**3,210**	**815**	<190	**28**	**11.3**	**94.6**	**108**	**12.4**
06/07/2011	MW-3	**2,560**	**3,320**	<940	**65.3**	**7**	**129**	**104**	**27.2**

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		TPH			BTEX + naphthalene				
		TPH as Gasoline	TPH as Diesel	TPH as Motor Oil	Benzene	Toluene	Ethylbenzene	Xylenes (total)	Naphthalene
Date	**Location Code**	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MTCA - GW - Method A		-	500	500	5	1,000	700	1,000	160
MTCA - GW - Method B - VI		-	-	-	2.4	15,000	2,800	320	8.8
08/25/2011	MW-3	**1,220**	**462**	<190	**17.2**	**1.1**	**34.4**	**30.6**	**7.1**
11/16/2011	MW-3	**1,200**	**820**	-	**18**	<0.5	**52**	**20**	**11**
03/08/2012	MW-3	**2,600**	**1,200**	-	**140**	**4.7**	**190**	**150**	**19**
05/09/2012	MW-3	**2,500**	**3,900**	-	**110**	**10**	**200**	**190**	**11**
09/22/2012	MW-3	**1,100**	**510**	<500	**31**	**2.9**	**44**	**22**	**7.4**
12/07/2012	MW-3	**960**	**650 Z**	<500	**24**	**0.9**	**64**	**15**	**9.6**
03/07/2013	MW-3	**1,600**	**1,200**	**520**	**36**	**0.55**	**79**	**21**	**13**
06/12/2013	MW-3	**1,100**	**2,000**	-	**35**	**1.2**	**29**	**3.8**	**3.9**
08/27/2013	MW-3	**1,100**	**1,000**	-	**21**	**0.68**	**25**	**5**	**5.4**
12/11/2013	MW-3	**1,400**	**1,300**	-	**41**	<1	**26**	**1.7**	**5.1**
03/25/2014	MW-3	**2,000**	**2,900**	-	**53**	<1	**150**	**43**	**9.9**
06/16/2014	MW-3	**670**	**690**	<500	**21**	<0.5	**18**	**2.4**	**4.9**
08/19/2014	MW-3	**460**	**460**	-	**17**	<0.5	**1.7**	**0.52**	**3.2**
11/18/2014	MW-3	**690**	**440**	-	**14**	<0.5	**12**	**0.56**	**5.5**
03/20/2015	MW-3	**920**	**780**	-	**14**	<0.5	**16**	**0.76**	**4.3**
06/16/2015	MW-3	**13,000**	**690**	-	**1,200**	**6,700**	**85**	**520**	-
06/17/2015	MW-3	**1,200**	**990**	-	**21**	**1.6**	**8.7**	**1.6**	**7.9**
09/24/2015	MW-3	**790**	**760**	-	**16**	**0.52**	**1.9**	**0.66**	**5.5**
12/08/2015	MW-3	**1,200**	**1,500**	-	**22**	**0.55**	**11**	**0.86**	**2.7**
03/10/2016	MW-3	**1,700**	**1,000**	-	**160**	**220**	**70**	**15**	**15**
06/16/2016	MW-3	-	-	-	-	-	-	-	**12**
09/22/2016	MW-3	**2,700**	**550 K**	-	**320**	**57**	**180**	**620**	**10**
11/16/2016	MW-3	**5,500**	**650**	-	**170**	**250**	**400**	**1,400**	**30**
03/23/2017	MW-3	**4,100**	**1,600**	-	**190**	**20**	**310**	**320**	**91**
06/22/2017	MW-3	**2,600**	**580**	-	**61**	**6.8**	**140**	**330**	**36**
09/20/2017	MW-3	**920**	**420**	-	**21**	**2.2**	**7.4**	**17**	**28**
12/07/2017	MW-3	**1,400**	**530 K**	-	-	-	-	-	-
12/07/2017	MW-3	-	-	-	**49**	**15**	**9.9**	**22**	**45**
03/18/2018	MW-3	**1,600**	**1,200 K**	-	-	-	-	-	-
03/18/2018	MW-3	-	-	-	**37**	**6.3**	**8.1**	**10**	**33**
03/18/2018	MW-3	-	-	-	-	-	-	-	**62**
06/21/2018	MW-3	**2,300**	**760 k**	-	**23**	**3**	**28**	**50**	**39**
06/21/2018	MW-3	-	-	-	-	-	-	-	**67**
09/26/2018	MW-3	**1,500**	**950**	-	-	-	-	-	-
09/26/2018	MW-3	-	-	-	**27**	**3.7**	**5.6**	**12**	**34**
11/28/2018	MW-3	**1,500**	**970 K**	-	-	-	-	-	-
11/28/2018	MW-3	-	-	-	<0.02	<0.02	<0.02	<0.02	**4.3**
03/20/2019	MW-3	-	-	-	**29**	**1.4**	**1.4**	**1.6**	**0.068**
03/20/2019	MW-3	**1,300**	**1,000 K**	-	-	-	-	-	-
06/11/2019	MW-3	-	-	-	**15**	**7.1**	**5.3**	**9.3**	**24**
06/11/2019	MW-3	**1,600**	**1,700 K**	-	-	-	-	-	-
09/22/2019	MW-3	-	-	-	**12**	**1.8**	**0.77**	**2.5**	**16**
09/22/2019	MW-3	**1,000**	**1,700**	-	-	-	-	-	-
11/13/2019	MW-3	**630**	**820**	-	**9.1**	<0.5	<0.5	<0.5	**6.6**
11/13/2019	MW-3	-	-	-	**9.1**	<0.5	<0.5	<0.5	**6.6**
11/13/2019	MW-3	**630**	**820 K**	-	-	-	-	-	-
03/24/2020	MW-3	**920**	-	-	-	-	-	-	-
03/24/2020	MW-3	-	**5,500**	-	-	-	-	-	-
03/24/2020	MW-3	-	-	-	**20**	**0.98**	**1.1**	**1.3**	**10**
06/23/2020	MW-3	**1,100**	**2,000 Z**	-	**5.3**	**0.52**	**2.3**	**1.2**	**16**
09/23/2020	MW-3	**1,100**	**1,000 K**	-	**5.6**	**0.6**	**0.9**	**1.6**	**5.5**
12/08/2020	MW-3	-	-	-	**7.6**	**0.52**	<0.5	**0.57**	**7.6**
03/24/2021	MW-3	**960**	**2,600**	-	**9.8**	**2**	**0.53**	**0.58**	**2.2**
06/14/2021	MW-3	**1,100**	**27,000**	-	**17**	**15**	**0.8**	**2**	**2.9**
09/28/2021	MW-3	**1,000**	**879 K**	-	**5.4**	**0.64**	<0.5	**0.5**	**1.6**

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		TPH			BTEX + naphthalene				
		TPH as Gasoline	TPH as Diesel	TPH as Motor Oil	Benzene	Toluene	Ethylbenzene	Xylenes (total)	Naphthalene
Date	**Location Code**	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MTCA - GW - Method A		-	500	500	5	1,000	700	1,000	160
MTCA - GW - Method B - VI		-	-	-	2.4	15,000	2,800	320	8.8
12/07/2021	MW-3	**1,000**	**1,200 K**	-	**8.4**	**0.83**	<0.5	**0.54**	-
12/08/2021	MW-3	-	-	-	-	-	-	-	**3.4**
03/22/2022	MW-3	**1,100**	**1,500**	-	**4.3**	**1.1**	**1.7**	<0.5	**2.7**
06/22/2022	MW-3	**900**	**890**	-	**3.2**	**1.6**	<0.5	**5.1**	**1**
09/20/2022	MW-3	**870**	**650 K**	-	**4.2**	**1.4**	<0.5	**8.4**	<0.4
03/09/2023	MW-3	**860**	**1,400 K**	-	**1.6**	<0.5	<0.5	**1.2**	<2
06/28/2023	MW-3	**1,600**	**750 K**	-	**38**	**59**	**50**	**360**	<8
09/21/2023	MW-3	**1,100**	**550 K**	-	**13**	**1.3**	**9**	**230**	<8
12/09/2023	MW-3	-	**225**	-	**955**	**264**	**6.15**	**170**	<5
03/14/2024	MW-3	**2,340**	**326**	-	**906**	**141**	<20	**65.3**	<100
07/24/1996	MW-4	<50	<250	-	<0.5	<0.5	<0.5	<0.5	-
07/24/1996	MW-5	<50	<250	-	<0.5	<0.5	<0.5	<0.5	-
07/24/1996	MW-6	<50	<250	-	**8.9**	**0.6**	<0.5	**0.6**	-
03/18/2011	MW-6	**303**	**287**	**814**	**39.5**	**1**	**13.2**	**18.7**	**0.57 J**
06/07/2011	MW-6	**490**	**318**	**1,060**	**90.4**	**1.2**	**12.9**	**9.6**	**0.85 J**
08/25/2011	MW-6	**67.8 J**	<94	<190	**2.3**	<0.5	<0.5	<1	<0.94
11/16/2011	MW-6	<250	<250	-	**11**	<0.5	**0.78**	<0.5	**0.052**
03/08/2012	MW-6	<250	**460 L**	-	**24**	<0.5	**2.4**	**2.4**	**0.34**
05/09/2012	MW-6	<250	<250	-	**14**	<0.5	**1.2**	<0.5	**0.16**
09/22/2012	MW-6	<250	<250	<500	<0.5	<0.5	<0.5	<0.5	**0.056**
12/07/2012	MW-6	**850**	**250**	**870**	**250**	**4**	**11**	**6.1**	**0.26**
03/07/2013	MW-6	**550**	**670 L**	**3,100**	**39**	<0.5	**0.94**	**1.1**	**0.11**
06/12/2013	MW-6	**730**	**310 L**	-	**130**	**1.1**	**5.2**	**1.8**	**0.26**
08/27/2013	MW-6	**1,300**	**1,700 L**	-	**330**	**2**	**13**	**7.3**	**0.53**
12/11/2013	MW-6	**350**	**440 L**	-	**30**	<1	<1	<1	**0.23**
03/25/2014	MW-6	**360**	**1,200 L**	-	**33**	<0.5	**0.79**	**0.58**	**0.21**
06/16/2014	MW-6	**630**	**4,100 L**	**14,000**	**130**	**5.8**	**7.4**	**0**	**0.62**
08/19/2014	MW-6	**1,400**	**1,100 L**	-	**500**	**52**	**21**	**9**	**0.64**
11/18/2014	MW-6	**310**	**1,300 L**	-	**14**	**55**	**2.4**	**1.8**	**0.14**
03/20/2015	MW-6	<250	**3,500 L**	-	**3.1**	**35**	<0.5	<0.5	<0.4
06/16/2015	MW-6	<250	**670 L**	-	**2.3**	**1.6**	**0.76**	**1.4**	-
06/17/2015	MW-6	**480**	**830 L**	-	**60**	**86**	**2.1**	**1.9**	**0.14**
09/24/2015	MW-6	**980**	**1,900 L**	-	**410**	**34**	**13**	**24**	<0.4
12/08/2015	MW-6	**2,100**	**850 L**	-	**560**	**20**	**37**	**58**	<0.4
03/10/2016	MW-6	**2,800**	**680 L**	-	**470**	**18**	**61**	**110**	**1.4**
06/16/2016	MW-6	-	-	-	-	-	-	-	<0.4
09/22/2016	MW-6	**590 L**	**570 L**	-	**170**	**9.6**	**10**	**23**	**0.47**
11/16/2016	MW-6	**550**	**570 L**	-	**190**	**1.9**	**10**	**11**	**0.25**
03/23/2017	MW-6	**860**	**970 L**	-	**69**	**1**	**17**	**5.8**	**0.43**
06/22/2017	MW-6	**490**	**520 L**	-	**49**	**2.4**	**2.7**	**8.1**	<0.04
09/20/2017	MW-6	**760**	**560 L**	-	**140**	<1	**2.1**	**1.1**	**1**
12/07/2017	MW-6	**880**	**700 L**	-	-	-	-	-	-
12/07/2017	MW-6	-	-	-	**220**	**1.9**	**3.2**	**4.2**	**1**
03/18/2018	MW-6	**890**	**1,000 L**	-	-	-	-	-	-
03/18/2018	MW-6	-	-	-	**190**	**1.4**	**5.6**	**3.1**	**0.64**
03/18/2018	MW-6	-	-	-	-	-	-	-	<8
06/21/2018	MW-6	**1,100**	**1,000 L**	-	**240**	**19**	**4.6**	**10**	**1.9**
06/21/2018	MW-6	-	-	-	-	-	-	-	**58**
09/26/2018	MW-6	**2,000**	**5,500 L**	-	-	-	-	-	-
09/26/2018	MW-6	-	-	-	**280**	**49**	**18**	**61**	<0.2
11/29/2018	MW-6	<250	**1,500 L**	-	-	-	-	-	-
11/29/2018	MW-6	-	-	-	**6.2**	**39**	**0.55**	**0.73**	**0.13**
03/25/2021	MW-6	**1,800**	**620 L**	-	**200**	**2.5**	**4**	**3.3**	**0.53**
06/15/2021	MW-6	**1,700**	**480 L**	-	**160**	**3.4**	**8**	**5.8**	**0.93**
09/28/2021	MW-6	**1,400**	**480 L**	-	**230**	**3.1**	**2.5**	**3.2**	**0.84**

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		TPH			BTEX + naphthalene				
		TPH as Gasoline	TPH as Diesel	TPH as Motor Oil	Benzene	Toluene	Ethylbenzene	Xylenes (total)	Naphthalene
Date	**Location Code**	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MTCA - GW - Method A		-	500	500	5	1,000	700	1,000	160
MTCA - GW - Method B - VI		-	-	-	2.4	15,000	2,800	320	8.8
03/22/2022	MW-6	**760**	**900 L**	-	**68**	**0.59**	<0.5	**0.89**	**0.2**
06/22/2022	MW-6	**540**	**490 L**	-	**32**	<0.5	<0.5	**0.68**	<0.02
12/20/2022	MW-6	**960**	**1,000 L**	-	**160**	**1.1**	<1	**1.2**	<8
03/09/2023	MW-6	**820**	**410 L**	-	**120**	**1.3**	**1.1**	**1.1**	<4
06/27/2023	MW-6	**470**	<250	-	**32**	<0.5	<0.5	<0.5	<2
09/20/2023	MW-6	**610**	<250	-	**88**	**0.73**	<0.5	**0.6**	<2
12/08/2023	MW-6	-	**1,130**	-	**157**	**1.64**	<1	<3	<5
03/14/2024	MW-6	**1,630**	**703**	-	**185**	**1.1**	<1	<3	<5
08/19/2014	MW-7	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.02
11/18/2014	MW-7	<250	-	-	-	-	-	-	-
11/18/2014	MW-7	-	<250	-	<0.5	<0.5	<0.5	<0.5	<0.02
03/20/2015	MW-7	<250	-	-	-	-	-	-	-
03/20/2015	MW-7	-	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
06/16/2015	MW-7	<250	<250	-	<0.5	<0.5	<0.5	**0.58**	-
06/17/2015	MW-7	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.02
09/24/2015	MW-7	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
12/08/2015	MW-7	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
03/10/2016	MW-7	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
06/16/2016	MW-7	-	-	-	-	-	-	-	<0.04
09/22/2016	MW-7	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
11/17/2016	MW-7	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
03/23/2017	MW-7	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
06/22/2017	MW-7	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
09/20/2017	MW-7	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
12/07/2017	MW-7	<250	<250	-	-	-	-	-	-
12/07/2017	MW-7	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.04
03/19/2018	MW-7	<250	<250	-	-	-	-	-	-
03/19/2018	MW-7	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.04
06/21/2018	MW-7	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
09/26/2018	MW-7	<250	<250	-	-	-	-	-	-
09/26/2018	MW-7	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.04
11/29/2018	MW-7	**370**	<250	-	-	-	-	-	-
11/29/2018	MW-7	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.04
03/20/2019	MW-7	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.04
03/20/2019	MW-7	<250	<250	-	-	-	-	-	-
06/11/2019	MW-7	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.4
06/11/2019	MW-7	<250	<250	-	-	-	-	-	-
09/22/2019	MW-7	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.04
09/22/2019	MW-7	<250	<250	-	-	-	-	-	-
11/13/2019	MW-7	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
11/13/2019	MW-7	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.04
11/13/2019	MW-7	<250	<250	-	-	-	-	-	-
03/24/2020	MW-7	<250	<250	-	-	-	-	-	-
03/24/2020	MW-7	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.04
06/23/2020	MW-7	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
09/23/2020	MW-7	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
12/09/2020	MW-7	-	-	-	<0.5	<0.5	<0.5	<0.5	**0.04**
03/24/2021	MW-7	<250	<250	-	<0.5	<0.5	<0.5	<0.5	-
06/15/2021	MW-7	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
09/28/2021	MW-7	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
12/07/2021	MW-7	<250	<250	-	<0.5	<0.5	<0.5	<0.5	-
12/08/2021	MW-7	-	-	-	-	-	-	-	**0.063**
03/22/2022	MW-7	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
06/22/2022	MW-7	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
09/20/2022	MW-7	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.04

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Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		TPH			BTEX + naphthalene				
Date	**Location Code**	TPH as Gasoline µg/L	TPH as Diesel µg/L	TPH as Motor Oil µg/L	Benzene µg/L	Toluene µg/L	Ethylbenzene µg/L	Xylenes (total) µg/L	Naphthalene µg/L
MTCA - GW - Method A		-	500	500	5	1,000	700	1,000	160
MTCA - GW - Method B - VI		-	-	-	2.4	15,000	2,800	320	8.8
03/09/2023	MW-7	<250	**620 L**	-	<0.5	<0.5	<0.5	<0.5	<2
06/27/2023	MW-7	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<4
09/20/2023	MW-7	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<2
12/08/2023	MW-7	-	<200	-	<1	<1	<1	<3	<5
03/14/2024	MW-7	<100	<200	-	<1	<1	<1	<3	<5
08/19/2014	MW-8	<250	<250	-	<0.5	<0.5	<0.5	<0.5	-
11/18/2014	MW-8	<250	<250	-	<0.5	<0.5	<0.5	<0.5	**0.083**
03/20/2015	MW-8	<250	<250	-	<0.5	<0.5	<0.5	<0.5	**0.08**
06/16/2015	MW-8	<250	<250	-	<0.5	<0.5	<0.5	<0.5	-
06/17/2015	MW-8	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.02
09/24/2015	MW-8	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
12/08/2015	MW-8	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
03/10/2016	MW-8	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
06/16/2016	MW-8	-	-	-	-	-	-	-	<0.04
09/22/2016	MW-8	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
11/16/2016	MW-8	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
03/23/2017	MW-8	<250	<250	-	<0.5	<0.5	<0.5	**2.7**	**0.28**
06/22/2017	MW-8	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
09/20/2017	MW-8	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
12/07/2017	MW-8	<250	<250	-	-	-	-	-	-
12/07/2017	MW-8	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.04
03/19/2018	MW-8	<250	<250	-	-	-	-	-	-
03/19/2018	MW-8	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.04
06/22/2018	MW-8	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
09/26/2018	MW-8	<250	<250	-	-	-	-	-	-
09/26/2018	MW-8	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.04
11/29/2018	MW-8	<250	<250	-	-	-	-	-	-
11/29/2018	MW-8	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.04
03/20/2019	MW-8	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.04
03/20/2019	MW-8	<250	<250	-	-	-	-	-	-
03/20/2019	MW-8	-	-	-	-	-	-	-	**0.56**
06/11/2019	MW-8	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.04
06/11/2019	MW-8	<250	<250	-	-	-	-	-	-
09/22/2019	MW-8	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.04
09/22/2019	MW-8	<250	<250	-	-	-	-	-	-
09/22/2019	MW-8	-	-	-	-	-	-	-	**0.042**
11/13/2019	MW-8	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
11/13/2019	MW-8	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.04
11/13/2019	MW-8	<250	<250	-	-	-	-	-	-
03/25/2020	MW-8	<250	<250	-	-	-	-	-	-
03/25/2020	MW-8	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.04
03/25/2020	MW-8	-	-	-	-	-	-	-	**68**
06/23/2020	MW-8	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
09/23/2020	MW-8	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
12/09/2020	MW-8	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.04
03/24/2021	MW-8	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
06/15/2021	MW-8	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
09/28/2021	MW-8	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
12/08/2021	MW-8	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
03/22/2022	MW-8	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
06/22/2022	MW-8	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
09/20/2022	MW-8	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
03/09/2023	MW-8	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<2
06/27/2023	MW-8	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<2
09/20/2023	MW-8	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<2

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		TPH			BTEX + naphthalene				
		TPH as Gasoline	TPH as Diesel	TPH as Motor Oil	Benzene	Toluene	Ethylbenzene	Xylenes (total)	Naphthalene
Date	**Location Code**	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MTCA - GW - Method A		-	500	500	5	1,000	700	1,000	160
MTCA - GW - Method B - VI		-	-	-	2.4	15,000	2,800	320	8.8
12/08/2023	MW-8	-	<200	-	<1	<1	<1	<3	<5
03/15/2024	MW-8	<100	<200	-	<1	<1	<1	<3	<5
08/19/2014	MW-9	**1,000**	**330**	-	**0.73**	<0.5	**12**	**37**	**0.82**
11/18/2014	MW-9	**3,400**	<250	-	**53**	**8.4**	**100**	**280**	**18**
03/20/2015	MW-9	**25,000**	**420 K**	-	**160**	**30**	**690**	**1,700**	**260**
06/16/2015	MW-9	**35,000**	**750**	-	**880**	**7,800**	**1,100**	**7,300**	-
06/17/2015	MW-9	**14,000**	**390 K**	-	**160**	<10	**610**	**910**	**87**
09/24/2015	MW-9	**13,000**	**520 K**	-	**290**	**10**	**790**	**1,100**	**100**
12/08/2015	MW-9	**17,000**	**510 K**	-	**690**	**33**	**1,500**	**1,900**	**44**
03/10/2016	MW-9	<250	<250	-	**2.1**	**21**	**1.9**	**10**	**0.13**
06/16/2016	MW-9	-	-	-	-	-	-	-	**20**
03/23/2017	MW-9	**260**	<250	-	**2.1**	**17**	**8**	**27**	**0.44**
06/22/2017	MW-9	**45,000**	**710**	-	**99**	**880**	**71**	**9,100**	**71**
09/20/2017	MW-9	**10,000**	<250	-	**390**	**680**	**420**	**1,800**	**62**
12/07/2017	MW-9	**5,300**	<250	-	-	-	-	-	-
12/07/2017	MW-9	-	-	-	**69**	**170**	**230**	**940**	**27**
03/19/2018	MW-9	**1,300**	**280 K**	-	-	-	-	-	-
03/19/2018	MW-9	-	-	-	**4.6**	**18**	**35**	**230**	**1.8**
03/19/2018	MW-9	-	-	-	-	-	-	-	**10**
06/22/2018	MW-9	<250	<250	-	<0.5	**2.1**	**1**	**2.9**	<0.2
09/26/2018	MW-9	<250	<250	-	-	-	-	-	-
09/26/2018	MW-9	-	-	-	<0.5	<0.5	**0.67**	**2.1**	<0.04
11/29/2018	MW-9	**740**	<250	-	-	-	-	-	-
11/29/2018	MW-9	-	-	-	**14**	**11**	**25**	**75**	<0.04
03/20/2019	MW-9	-	-	-	**1.1**	**3.2**	**6.3**	**29**	-
03/20/2019	MW-9	<250	<250	-	-	-	-	-	-
06/11/2019	MW-9	-	-	-	**25**	**320**	**930**	**9,200**	**35**
06/11/2019	MW-9	**29,000**	**370 K**	-	-	-	-	-	-
09/22/2019	MW-9	-	-	-	<0.5	<0.5	**0.58**	**3**	-
09/22/2019	MW-9	<250	<250	-	-	-	-	-	-
03/25/2020	MW-9	**18,000**	**580 K**	-	-	-	-	-	-
03/25/2020	MW-9	-	-	-	**53**	**310**	**170**	**4,500**	-
06/23/2020	MW-9	**1,900**	<250	-	**2**	**3.9**	**38**	**200**	-
06/25/2020	MW-9	-	-	-	-	-	-	-	**1.2**
09/23/2020	MW-9	**610**	<250	-	**1.6**	**1.7**	**13**	**48**	**1.9**
12/09/2020	MW-9	-	-	-	**250**	**260**	**950**	**4,500**	**82**
03/24/2021	MW-9	**29,000**	**490 K**	-	**65**	**190**	**850**	**5,100**	**75**
06/15/2021	MW-9	**2,200**	**340 K**	-	**2.4**	**1.9**	**55**	**170**	**7.8**
09/28/2021	MW-9	**2,000**	<250	-	**3.2**	**2.3**	**46**	**100**	**11**
12/08/2021	MW-9	**18,000**	**18,000 K**	-	**210**	**48**	**570**	**1,900**	**66**
03/22/2022	MW-9	**17,000**	**700 K**	-	**53**	**59**	**760**	**3,100**	**63**
06/22/2022	MW-9	**310**	<250	-	**0.9**	<0.5	**1.2**	**1.5**	<0.04
09/20/2022	MW-9	<250	<250	-	**0.53**	<0.5	**5.4**	**3.5**	<0.04
12/20/2022	MW-9	**1,500**	**370 K**	-	**13**	**0.97**	**32**	**12**	**6**
03/09/2023	MW-9	**600**	**250 K**	-	**3.6**	<0.5	**5.6**	**2.4**	<2
06/27/2023	MW-9	**470**	<250	-	**2.1**	<0.5	**7.4**	**5.1**	**2.8**
09/21/2023	MW-9	<250	**700**	-	**1.5**	<0.5	**2.7**	**0.57**	<2
12/08/2023	MW-9	-	**1,720**	-	**3.96**	<1	<1	**19.5**	<5
03/15/2024	MW-9	**322**	<200	-	**1.48**	<1	**2.69**	<3	<5
08/19/2014	MW-10	<250	<250	-	**4.5**	<0.5	<0.5	<0.5	<0.02
11/18/2014	MW-10	<250	<250	-	**8.4**	<0.5	<0.5	<0.5	**0.042**
03/20/2015	MW-10	<250	<250	-	**14**	**0.93**	**1.1**	**1.5**	**0.23**
06/16/2015	MW-10	<250	<250	-	<0.5	**0.73**	<0.5	**0.63**	-
06/17/2015	MW-10	<250	<250	-	**11**	<0.5	<0.5	<0.5	**0.041**
09/24/2015	MW-10	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04

Appendix B-2
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Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		TPH			BTEX + naphthalene				
		TPH as Gasoline	TPH as Diesel	TPH as Motor Oil	Benzene	Toluene	Ethylbenzene	Xylenes (total)	Naphthalene
Date	**Location Code**	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MTCA - GW - Method A		-	500	500	5	1,000	700	1,000	160
MTCA - GW - Method B - VI		-	-	-	2.4	15,000	2,800	320	8.8
12/08/2015	MW-10	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
03/10/2016	MW-10	**790**	<250	-	**180**	**2.1**	**13**	**14**	**4**
06/16/2016	MW-10	-	-	-	-	-	-	-	<0.04
09/22/2016	MW-10	<250	<250	-	**6.1**	<0.5	<0.5	<0.5	<0.04
11/16/2016	MW-10	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
03/23/2017	MW-10	**1,200**	<250	-	**300**	**4.2**	**27**	**80**	**16**
06/22/2017	MW-10	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
09/20/2017	MW-10	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
12/07/2017	MW-10	<250	<250	-	-	-	-	-	-
12/07/2017	MW-10	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.04
03/19/2018	MW-10	<250	<250	-	-	-	-	-	-
03/19/2018	MW-10	-	-	-	**5.4**	<0.5	<0.5	<0.5	<0.04
06/22/2018	MW-10	**74,000**	<250	-	**2,000**	**26,000**	**820**	**9,900**	**31**
06/22/2018	MW-10	-	-	-	-	-	-	-	<800
09/26/2018	MW-10	**83,000**	<250	-	-	-	-	-	-
09/26/2018	MW-10	-	-	-	**5,700**	**27,000**	**1,800**	**12,000**	**41**
03/20/2019	MW-10	-	-	-	**830**	**15,000**	**1,600**	**14,000**	**72**
03/20/2019	MW-10	**62,000**	<250	-	-	-	-	-	-
06/11/2019	MW-10	-	-	-	**230**	**11,000**	**2,100**	**20,000**	**70**
06/11/2019	MW-10	**52,000**	<250	-	-	-	-	-	-
09/22/2019	MW-10	-	-	-	**7.4**	**89**	**13**	**210**	**4**
09/22/2019	MW-10	**890**	<250	-	-	-	-	-	-
11/13/2019	MW-10	**1,300**	<250	-	**12**	**120**	**13**	**380**	**0.27**
11/13/2019	MW-10	-	-	-	**12**	**120**	**13**	**380**	**0.27**
11/13/2019	MW-10	**1,300**	<250	-	-	-	-	-	-
03/24/2020	MW-10	**5,400**	<250	-	-	-	-	-	-
03/24/2020	MW-10	-	-	-	**15**	**5**	**34**	**560**	**7**
06/23/2020	MW-10	**4,400**	<250	-	**110**	**180**	**31**	**360**	**0.39**
09/23/2020	MW-10	**4,800**	<250	-	**60**	**510**	**65**	**890**	**5.7**
12/08/2020	MW-10	-	-	-	**9**	<0.5	**2.3**	**19**	**0.11**
03/24/2021	MW-10	**370**	<250	-	**12**	<0.5	**1.8**	**13**	<0.04
06/15/2021	MW-10	**280**	<250	-	**4.5**	**2.1**	**2.5**	**24**	<0.04
09/27/2021	MW-10	-	-	-	-	-	-	-	**0.47**
09/28/2021	MW-10	<250	<250	-	**4.8**	<0.5	**1.6**	**42**	-
12/07/2021	MW-10	<250	<250	-	**11**	<0.5	**0.56**	**2.4**	-
12/08/2021	MW-10	-	-	-	-	-	-	-	**0.17**
03/22/2022	MW-10	**710**	<250	-	**16**	**3.6**	**4.3**	**170**	<0.04
06/22/2022	MW-10	**30,000**	<250	-	**120**	**4,000**	**760**	**9,900**	**20**
09/20/2022	MW-10	<250	<250	-	**2.7**	**0.94**	**2.2**	**8.6**	<0.04
03/09/2023	MW-10	<250	<250	-	**4.7**	<0.5	<0.5	**0.75**	<2
06/27/2023	MW-10	<250	<250	-	**0.73**	<0.5	**2**	**14**	<2
09/20/2023	MW-10	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<2
12/08/2023	MW-10	-	<200	-	<1	<1	<1	<3	<5
03/14/2024	MW-10	**145**	<200	-	**8.26**	<1	<1	<3	<5
08/19/2014	MW-11	**1,200**	**970**	-	**1**	<0.5	**5.8**	**0.63**	**0.33**
11/18/2014	MW-11	**650**	**830**	-	**0.53**	<0.5	<0.5	<0.5	**0.54**
03/20/2015	MW-11	**3,900**	**4,100**	-	**970**	**920**	**13**	**34**	<0.04
06/16/2015	MW-11	<250	<250	-	**60**	<0.5	**0.9**	**0.53**	-
06/17/2015	MW-11	**6,600**	**550**	-	**1,600**	**950**	**140**	**460**	**2.7**
09/24/2015	MW-11	**1,200**	**440**	-	**580**	**6.4**	**35**	**26**	**1.8**
12/08/2015	MW-11	**2,300**	**1,400**	-	**1,100**	<5	**11**	**5.6**	<0.04
03/10/2016	MW-11	<250	<250	-	**72**	**0.97**	<0.5	**1.3**	<0.08
06/16/2016	MW-11	-	-	-	-	-	-	-	<0.04
09/22/2016	MW-11	<250	<250	-	**11**	<0.5	**0.5**	<0.5	**0.16**
11/16/2016	MW-11	<250	**380**	-	**4.6**	<0.5	<0.5	<0.5	**0.22**

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Love's Travel Stop #413, Ellensburg, Washington

		TPH			BTEX + naphthalene				
		TPH as Gasoline	TPH as Diesel	TPH as Motor Oil	Benzene	Toluene	Ethylbenzene	Xylenes (total)	Naphthalene
Date	**Location Code**	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MTCA - GW - Method A		-	500	500	5	1,000	700	1,000	160
MTCA - GW - Method B - VI		-	-	-	2.4	15,000	2,800	320	8.8
03/23/2017	MW-11	<250	<250	-	**0.57**	<0.5	<0.5	<0.5	<0.04
06/22/2017	MW-11	<250	**920**	-	**3.6**	<0.5	**2.4**	**2.4**	**0.36**
09/20/2017	MW-11	<250	**350**	-	**2.5**	<0.5	**1.3**	<0.5	**0.41**
12/07/2017	MW-11	<250	<250	-	-	-	-	-	-
12/07/2017	MW-11	-	-	-	**0.58**	<0.5	<0.5	<0.5	**0.35**
03/19/2018	MW-11	<250	**430**	-	-	-	-	-	-
03/19/2018	MW-11	-	-	-	<0.5	<0.5	<0.5	<0.5	**0.38**
03/19/2018	MW-11	-	-	-	-	-	-	-	<2
06/22/2018	MW-11	**75,000**	**420 K**	-	**3,800**	**36,000**	**680**	**5,600**	**72**
06/22/2018	MW-11	-	-	-	-	-	-	-	<2,000
08/16/2018	MW-11	**193,000**	<200	<400	**4,450**	**16,900**	**1,400**	**8,800**	**81**
09/26/2018	MW-11	**130,000**	<250	-	-	-	-	-	-
09/26/2018	MW-11	-	-	-	**7,200**	**42,000**	**4,500**	**33,000**	**120**
11/29/2018	MW-11	**47,000**	**560 K**	-	-	-	-	-	-
11/29/2018	MW-11	-	-	-	**3,000**	**4,400**	**1,800**	**9,900**	**51**
03/20/2019	MW-11	-	-	-	**7,700**	**39,000**	**2,100**	**19,000**	**65**
03/20/2019	MW-11	**110,000**	**710 K**	-	-	-	-	-	-
06/11/2019	MW-11	-	-	-	**2,400**	**1,700**	**400**	**1,500**	**7.9**
06/11/2019	MW-11	**7,100**	**340 K**	-	-	-	-	-	-
08/22/2019	MW-11	**6,020**	<200	<400	**776**	**158 E**	**112**	**1,130**	**18**
08/22/2019	MW-11	**6,020**	<200	<400	**776**	**158**	**112**	**1,130**	**18**
09/22/2019	MW-11	-	-	-	**2,300**	**3,800**	**350**	**1,800**	**14**
09/22/2019	MW-11	**15,000**	**340 K**	-	-	-	-	-	-
11/13/2019	MW-11	**2,300**	**320 K**	-	**240**	<2.5	**4.8**	**450**	**0.38**
11/13/2019	MW-11	-	-	-	**240**	<2.5	**4.8**	**450**	**0.38**
11/13/2019	MW-11	**2,300**	**320 K**	-	-	-	-	-	-
03/25/2020	MW-11	**1,600**	**420 K**	-	-	-	-	-	-
03/25/2020	MW-11	-	-	-	**350**	**6.8**	**5.2**	**19**	**2.5**
06/23/2020	MW-11	**2,400**	<250	-	**440**	**150**	**110**	**170**	**2.4**
09/23/2020	MW-11	**6,400**	<250	-	**650**	**870**	**270**	**1,600**	**6.1**
12/08/2020	MW-11	-	-	-	**10**	**3.3**	<0.5	**25**	**2.1**
03/24/2021	MW-11	**330**	**340**	-	**11**	**0.62**	<0.5	**0.5**	**0.49**
04/09/2021	MW-11	**680**	<200	<400	**83**	**1.9**	**1.1**	**4.1**	**9.4**
06/15/2021	MW-11	**500**	<250	-	**280**	**9.3**	**35**	**57**	**0.63**
09/27/2021	MW-11	-	-	-	-	-	-	-	**3.4**
09/28/2021	MW-11	**3,000**	<250	-	**220**	**14**	**130**	**1,100**	-
09/30/2021	MW-11	**1,000**	**590**	<400	**140**	<1	**4.1**	**58**	**6.9**
12/08/2021	MW-11	**280**	**1,900**	-	**3.4**	**0.92**	<0.5	**1.4**	**0.39**
03/22/2022	MW-11	<250	**340**	-	**22**	<0.5	<0.5	<0.5	**0.33**
06/22/2022	MW-11	**640**	<250	-	**280**	<1.5	**25**	**54**	**0.44**
09/20/2022	MW-11	**6,800**	**250 K**	-	**390**	**20**	**260**	**2,800**	**4.2**
12/20/2022	MW-11	**710**	**660**	-	**37**	**0.9**	<0.5	<0.5	<2
03/09/2023	MW-11	**310**	<250	-	**31**	**0.69**	<0.5	<0.5	<2
06/27/2023	MW-11	**260**	<250	-	**95**	**0.52**	**8.1**	**5**	<4
09/21/2023	MW-11	**1,000**	**800**	-	**180**	**4**	**3**	**110**	<8
12/09/2023	MW-11	-	**345**	-	**67.4**	**2.94**	<1	**6.91**	<5
03/15/2024	MW-11	**722**	**211**	-	**44.6**	<1	<1	**3.52**	<5
08/22/2019	MW-12	-	-	-	**776**	**3,320 E**	**653**	**5,020**	**70**
03/25/2021	MW-12	**1,400**	<250	-	**92**	**1.1**	**0.69**	**1.6**	-
03/26/2021	MW-12	-	-	-	-	-	-	-	**0.046**
06/15/2021	MW-12	<250	<250	-	**6.2**	<0.5	<0.5	<0.5	**0.074**
09/27/2021	MW-12	-	-	-	-	-	-	-	<0.04
09/28/2021	MW-12	<250	<250	-	**1.6**	<0.5	<0.5	<0.5	-
12/08/2021	MW-12	<250	<250	-	**8.2**	<0.5	<0.5	**0.51**	**0.041**
03/22/2022	MW-12	**990**	<250	-	**50**	**0.61**	<0.5	**1.1**	**0.37**

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		TPH			BTEX + naphthalene				
		TPH as Gasoline	TPH as Diesel	TPH as Motor Oil	Benzene	Toluene	Ethylbenzene	Xylenes (total)	Naphthalene
Date	**Location Code**	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MTCA - GW - Method A		-	500	500	5	1,000	700	1,000	160
MTCA - GW - Method B - VI		-	-	-	2.4	15,000	2,800	320	8.8
06/22/2022	MW-12	**570**	<250	-	**9.9**	<0.5	<0.5	<0.5	**0.27**
09/20/2022	MW-12	**850**	<250	-	**8.7**	**0.58**	<0.5	<0.5	<0.2
03/08/2023	MW-12	**960**	<250	-	**36**	**0.78**	<0.5	**1.1**	<2
06/27/2023	MW-12	**900**	<250	-	**12**	**1.5**	<0.5	**0.52**	<2
09/20/2023	MW-12	**900**	<250	-	**6.6**	**0.81**	<0.5	**0.57**	<2
12/08/2023	MW-12	-	<200	-	**14.5**	<1	<1	<3	<5
03/14/2024	MW-12	**598**	<200	-	**32.7**	**1.08**	<1	<3	<5
03/25/2021	MW-13	**2,900**	**310**	-	**31**	<1	**4.4**	**2.1**	-
03/26/2021	MW-13	-	-	-	-	-	-	-	**3**
06/15/2021	MW-13	**910**	<250	-	**31**	<0.5	**1.1**	**0.5**	**0.096**
09/28/2021	MW-13	**1,200**	<250	-	**60**	**1.1**	**1**	**8**	<0.2
12/08/2021	MW-13	**290**	<250	-	**8.4**	<0.5	<0.5	<0.5	**0.18**
03/22/2022	MW-13	**890**	<250	-	**17**	<0.5	**0.53**	<0.5	**0.45**
06/22/2022	MW-13	<250	<250	-	**16**	<0.5	<0.5	<0.5	<0.04
09/20/2022	MW-13	**850**	<250	-	**46**	**1.2**	<1	**3.4**	<0.04
03/08/2023	MW-13	**440**	<250	-	**9.4**	<0.5	<0.5	<0.5	<0.2
06/27/2023	MW-13	**720**	<250	-	**34**	**1.9**	<0.5	**1.6**	<4
09/20/2023	MW-13	**1,700**	<250	-	**75**	**1.5**	**0.54**	**16**	<4
12/08/2023	MW-13	-	<200	-	**20.2**	<1	<1	<3	<5
03/14/2024	MW-13	**432**	<200	-	**15.5**	<1	<1	<3	<5
03/25/2021	MW-14	**770**	**380**	-	<0.5	<0.5	<0.5	**1**	-
03/26/2021	MW-14	-	-	-	-	-	-	-	**0.04**
06/15/2021	MW-14	<250	<250	-	<0.5	<0.5	<0.5	<0.5	**0.04**
09/28/2021	MW-14	**360**	<250	-	**5.4**	**0.51**	<0.5	**0.51**	**0.086**
12/08/2021	MW-14	**270**	<250	-	**1.9**	<0.5	<0.5	<0.5	**0.11**
03/22/2022	MW-14	**310**	**270**	-	**0.94**	<0.5	<0.5	<0.5	**0.41**
06/22/2022	MW-14	<250	<250	-	**0.66**	**0.78**	<0.5	<0.5	**0.14**
09/20/2022	MW-14	<250	<250	-	<0.5	**1**	<0.5	<0.5	**0.052**
06/27/2023	MW-14	<250	<250	-	**20**	**1.6**	<0.5	**0.81**	<2
09/20/2023	MW-14	**300**	<250	-	**6.8**	**0.92**	<0.5	**1.1**	<2
12/09/2023	MW-14	-	<200	-	**1.12**	<1	<1	<3	<5
03/14/2024	MW-14	**306**	<200	-	<1	<1	<1	<3	<5
08/19/2014	MW-15	<40,000	**600 K**	-	**3,400**	**210**	**2,900**	**12,000**	**320**
03/20/2015	MW-15	**15,000**	**1,600**	-	**630**	**20**	**800**	**2,800**	**49**
06/16/2015	MW-15	**23,000**	**560**	-	**870**	**89**	**2,700**	**3,300**	-
03/10/2016	MW-15	**33,000**	**2,400 K**	-	**600**	<50	**4,000**	**6,800**	**190**
06/16/2016	MW-15	-	-	-	-	-	-	-	**160**
09/22/2016	MW-15	**20,000**	**740 K**	-	**830**	**35**	**3,600**	**2,800**	**200**
11/17/2016	MW-15	**7,200**	**280 K**	-	**160**	<10	**850**	**900**	**60**
03/23/2017	MW-15	**34,000**	**2,000 K**	-	**1,100**	**12**	**2,900**	**3,500**	**440**
06/22/2017	MW-15	**27,000**	**1,100 K**	-	**1,000**	<15	**3,000**	**2,400**	**430**
09/20/2017	MW-15	**22,000**	**1,800 K**	-	**1,200**	<15	**3,200**	**1,500**	**560**
12/07/2017	MW-15	**5,400**	**280 K**	-	-	-	-	-	-
12/07/2017	MW-15	-	-	-	**170**	<4	**670**	**600**	**120**
03/18/2018	MW-15	**11,000**	**880 K**	-	-	-	-	-	-
03/18/2018	MW-15	-	-	-	**370**	**12**	**1,800**	**2,000**	**160**
03/18/2018	MW-15	-	-	-	-	-	-	-	**280**
06/21/2018	MW-15	**19,000**	**760 K**	-	**1,100**	**95**	**3,100**	**2,100**	**220**
06/21/2018	MW-15	-	-	-	-	-	-	-	**460**
09/26/2018	MW-15	**13,000**	**800 K**	-	-	-	-	-	-
09/26/2018	MW-15	-	-	-	**890**	**130**	**1,800**	**1,100**	**190**
11/28/2018	MW-15	**5,900**	**1,000 K**	-	-	-	-	-	-
11/28/2018	MW-15	-	-	-	**210**	**5.2**	**740**	**460**	**30**
03/20/2019	MW-15	-	-	-	**20**	<1	**170**	**63**	**1.3**
03/20/2019	MW-15	**1,300**	**700 K**	-	-	-	-	-	-

Appendix B-2
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Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		TPH			BTEX + naphthalene				
		TPH as Gasoline	TPH as Diesel	TPH as Motor Oil	Benzene	Toluene	Ethylbenzene	Xylenes (total)	Naphthalene
Date	**Location Code**	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MTCA - GW - Method A		-	500	500	5	1,000	700	1,000	160
MTCA - GW - Method B - VI		-	-	-	2.4	15,000	2,800	320	8.8
06/11/2019	MW-15	-	-	-	**92**	**4.3**	**640**	**240**	**65**
06/11/2019	MW-15	**4,500**	**610 K**	-	-	-	-	-	-
09/22/2019	MW-15	-	-	-	**1,100**	**32**	**1,900**	**790**	**250**
09/22/2019	MW-15	**14,000**	**880 K**	-	-	-	-	-	-
11/13/2019	MW-15	**1,100**	**1,000 K**	-	**20**	<0.5	**110**	**21**	**7.8**
11/13/2019	MW-15	-	-	-	**20**	<0.5	**110**	**21**	**7.8**
11/13/2019	MW-15	**1,100**	**1,000 K**	-	-	-	-	-	-
03/24/2020	MW-15	**5,900**	**3,300 K**	-	-	-	-	-	-
03/24/2020	MW-15	-	-	-	**220**	**4.2**	**500**	**580**	**76**
06/23/2020	MW-15	**9,500**	**560 K**	-	**810**	**27**	**870**	**400**	**200**
09/22/2020	MW-15	**6,200**	**800 K**	-	**450**	**25**	**490**	**300**	**170**
12/08/2020	MW-15	-	-	-	**240**	**3.3**	**440**	**530**	**79**
03/24/2021	MW-15	**8,400**	**1,400 K**	-	**360**	**4.2**	**940**	**820**	**71**
06/14/2021	MW-15	**4,400**	**7,900**	-	**580**	**9.4**	**370**	**300**	**57**
09/28/2021	MW-15	**8,400**	**1,600**	-	**670**	**12**	**680**	**400**	**190**
12/07/2021	MW-15	**8,000**	**2,900 K**	-	**560**	**5.4**	**870**	**680**	-
12/08/2021	MW-15	-	-	-	-	-	-	-	**93**
03/21/2022	MW-15	**4,200**	**2,500 K**	-	**230**	**4.4**	**380**	**260**	**81**
06/22/2022	MW-15	**4,600**	**1,100 K**	-	**670**	**16**	**200**	**65**	**92**
09/20/2022	MW-15	**7,800**	**1,200 K**	-	**1,400**	**9.7**	**880**	**290**	**190**
03/09/2023	MW-15	**3,700**	**1,400 K**	-	**160**	**1.7**	**190**	**78**	**83**
06/28/2023	MW-15	**3,100**	**770 K**	-	**450**	**6.3**	**29**	**16**	**110**
09/20/2023	MW-15	**4,600**	**1,200**	-	**480**	**8.7**	**44**	**21**	**130**
12/09/2023	MW-15	-	**964**	-	**429**	<10	**147**	**52.3**	**115**
03/14/2024	MW-15	**5,560**	**872**	-	**400**	<10	**324**	**79.7**	**113**
08/19/2014	MW-16	<250	<250	-	<0.5	<0.5	<0.5	<0.5	**0.096**
11/18/2014	MW-16	<250	<250	-	<0.5	<0.5	<0.5	<0.5	**1.6**
11/18/2014	MW-16	-	-	-	-	-	-	-	<0.02
03/20/2015	MW-16	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
06/16/2015	MW-16	<250	<250	-	<0.5	<0.5	<0.5	<0.5	-
06/17/2015	MW-16	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.02
09/24/2015	MW-16	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
12/08/2015	MW-16	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
03/10/2016	MW-16	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
06/16/2016	MW-16	-	-	-	-	-	-	-	<0.04
09/22/2016	MW-16	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
11/16/2016	MW-16	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
03/23/2017	MW-16	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
06/22/2017	MW-16	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
09/20/2017	MW-16	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
12/07/2017	MW-16	<250	<250	-	-	-	-	-	-
12/07/2017	MW-16	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.04
03/18/2018	MW-16	<250	<250	-	-	-	-	-	-
03/18/2018	MW-16	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.04
06/21/2018	MW-16	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
09/26/2018	MW-16	<250	<250	-	-	-	-	-	-
09/26/2018	MW-16	-	-	-	<0.5	<0.5	<0.5	<0.5	**1.2**
11/28/2018	MW-16	<250	<250	-	-	-	-	-	-
11/28/2018	MW-16	-	-	-	<0.5	<0.5	<0.5	<0.5	**0.23**
03/20/2019	MW-16	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.04
03/20/2019	MW-16	<250	<250	-	-	-	-	-	-
06/11/2019	MW-16	-	-	-	<0.5	<0.5	<0.5	<0.5	**0.47**
06/11/2019	MW-16	<250	<250	-	-	-	-	-	-
09/22/2019	MW-16	-	-	-	<0.05	<0.05	<0.05	<0.05	**0.15**
09/22/2019	MW-16	<250	<250	-	-	-	-	-	-

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		TPH			BTEX + naphthalene				
		TPH as Gasoline	TPH as Diesel	TPH as Motor Oil	Benzene	Toluene	Ethylbenzene	Xylenes (total)	Naphthalene
Date	**Location Code**	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MTCA - GW - Method A		-	500	500	5	1,000	700	1,000	160
MTCA - GW - Method B - VI		-	-	-	2.4	15,000	2,800	320	8.8
11/13/2019	MW-16	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
11/13/2019	MW-16	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.04
11/13/2019	MW-16	<250	<250	-	-	-	-	-	-
03/25/2020	MW-16	<250	<250	-	-	-	-	-	-
03/25/2020	MW-16	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.04
06/23/2020	MW-16	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
09/23/2020	MW-16	<250	<250	-	<0.5	<0.5	<0.5	<0.5	**0.11**
12/08/2020	MW-16	-	-	-	<0.5	<0.5	<0.5	<0.5	<0.4
03/24/2021	MW-16	<250	<250	-	<0.5	<0.5	<0.5	<0.5	**0.059**
06/15/2021	MW-16	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
09/28/2021	MW-16	<250	<250	-	<0.5	<0.5	<0.5	<0.5	**0.24**
12/07/2021	MW-16	<250	<250	-	<0.5	<0.5	<0.5	<0.5	-
12/08/2021	MW-16	-	-	-	-	-	-	-	<0.04
03/21/2022	MW-16	-	-	-	-	-	-	-	**0.046**
03/22/2022	MW-16	<250	<250	-	<0.5	<0.5	<0.5	<0.5	-
06/22/2022	MW-16	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
09/20/2022	MW-16	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
03/09/2023	MW-16	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<2
06/27/2023	MW-16	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<2
09/20/2023	MW-16	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<2
12/08/2023	MW-16	-	<200	-	<1	<1	<1	<3	<5
03/15/2024	MW-16	<100	<200	-	<1	<1	<1	<3	<5
03/24/2021	MW-17	**870**	<250	-	**10**	**0.73**	**0.51**	**1.4**	-
06/15/2021	MW-17	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
09/28/2021	MW-17	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
12/08/2021	MW-17	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
03/22/2022	MW-17	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
06/22/2022	MW-17	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<0.04
03/08/2023	MW-17	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<2
06/27/2023	MW-17	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<2
09/20/2023	MW-17	<250	<250	-	<0.5	<0.5	<0.5	<0.5	<2
12/08/2023	MW-17	-	<200	-	<1	<1	<1	<3	<5
03/14/2024	MW-17	<100	<200	-	<1	<1	<1	<3	<5
08/19/2014	RW-1	**740**	<250	-	**2.9**	<0.5	**15**	**42**	**4.4**
11/18/2014	RW-1	<250	<250	-	**4.8**	<0.5	**3.2**	**0.71**	**48**
03/20/2015	RW-1	**400**	<250	-	**19**	**0.76**	**2.7**	**1.9**	**2.2**
06/16/2015	RW-1	<250	<250	-	<0.5	**1.4**	<0.5	<0.5	-
06/17/2015	RW-1	<250	<250	-	**13**	<0.5	**2**	<0.5	**0.64**
09/24/2015	RW-1	<250	<250	-	**76**	<0.5	<0.5	<0.5	<0.04
12/08/2015	RW-1	**350**	<250	-	**69**	**0.87**	**30**	**1.5**	**0.51**
03/10/2016	RW-1	<250	<250	-	**63**	<0.5	<0.5	<0.5	<0.04
06/16/2016	RW-1	-	-	-	-	-	-	-	<0.04
09/22/2016	RW-1	<250	<250	-	**110**	<1	<1	<1	**0.1**
11/17/2016	RW-1	**290**	<250	-	**150**	<1	<1	**1.1**	**0.071**
03/23/2017	RW-1	**500**	<250	-	**110**	**3.8**	**9.4**	**1.6**	<0.04
06/22/2017	RW-1	**490**	<250	-	**160**	<1	<1	**11**	**0.36**
09/20/2017	RW-1	**530**	<250	-	**210**	**2.2**	<1	**1.3**	**0.71**
12/07/2017	RW-1	**630**	<250	-	-	-	-	-	-
12/07/2017	RW-1	-	-	-	**180**	**3**	**5.4**	**2.3**	**0.96**
03/19/2018	RW-1	<250	<250	-	-	-	-	-	-
03/19/2018	RW-1	-	-	-	**35**	<0.5	**0.81**	<0.5	**0.14**
03/19/2018	RW-1	-	-	-	-	-	-	-	<2
06/22/2018	RW-1	<250	<250	-	<0.5	<0.5	<0.5	<0.5	**0.1**
06/22/2018	RW-1	-	-	-	-	-	-	-	<2
09/26/2018	RW-1	<250	<250	-	-	-	-	-	-

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Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		TPH			BTEX + naphthalene				
		TPH as Gasoline	TPH as Diesel	TPH as Motor Oil	Benzene	Toluene	Ethylbenzene	Xylenes (total)	Naphthalene
Date	**Location Code**	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MTCA - GW - Method A		-	500	500	5	1,000	700	1,000	160
MTCA - GW - Method B - VI		-	-	-	2.4	15,000	2,800	320	8.8
09/26/2018	RW-1	-	-	-	**28**	<0.5	<0.5	<0.5	**0.047**
11/29/2018	RW-1	-	-	-	-	-	-	-	<0.04
11/29/2018	RW-1	<250	<250	-	-	-	-	-	-
11/29/2018	RW-1	-	-	-	**28**	**0.53**	<0.5	<0.5	<0.04
03/20/2019	RW-1	-	-	-	**22**	<0.5	**0.57**	**0.56**	<0.04
03/20/2019	RW-1	<250	<250	-	-	-	-	-	-
06/11/2019	RW-1	-	-	-	**130**	**2.2**	**1.1**	**2.2**	**0.13**
06/11/2019	RW-1	**250**	<250	-	-	-	-	-	-
09/22/2019	RW-1	-	-	-	**120**	**3**	**0.74**	**1.5**	**0.38**
09/22/2019	RW-1	**430**	<250	-	-	-	-	-	-
11/13/2019	RW-1	<250	<250	-	**19**	**0.67**	<0.5	**0.57**	**0.089**
11/13/2019	RW-1	-	-	-	**19**	**0.67**	<0.5	**0.57**	**0.089**
11/13/2019	RW-1	<250	<250	-	-	-	-	-	-
03/25/2020	RW-1	<250	<250	-	-	-	-	-	-
03/25/2020	RW-1	-	-	-	**45**	<0.5	<0.5	**0.54**	**0.18**
06/23/2020	RW-1	<250	<250	-	**45**	<0.5	<0.5	<0.5	**0.1**
09/22/2020	RW-1	-	-	-	-	-	-	-	**0.044**
09/23/2020	RW-1	<250	<250	-	**7.2**	<0.5	<0.5	<0.5	-
12/09/2020	RW-1	-	-	-	**13**	<0.5	<0.5	<0.5	**0.11**
03/24/2021	RW-1	<250	<250	-	**20**	<0.5	**1.5**	**0.65**	**0.19**
06/15/2021	RW-1	<250	<250	-	**11**	<0.5	<0.5	<0.5	**0.26**
09/28/2021	RW-1	<250	<250	-	**21**	<0.5	<0.5	<0.5	**1.1**
12/08/2021	RW-1	**250**	<250	-	**41**	**0.71**	**1.4**	**2.4**	**1.9**
03/22/2022	RW-1	**650**	<250	-	**63**	**3.4**	**19**	**18**	**3.9**
06/22/2022	RW-1	<250	<250	-	**4.2**	<0.5	<0.5	<0.5	**0.13**
09/20/2022	RW-1	<250	<250	-	**15**	<0.5	<0.5	<0.5	**0.075**
03/09/2023	RW-1	<250	<250	-	**5.4**	<0.5	<0.5	<0.5	<2
06/27/2023	RW-1	<250	<250	-	**0.95**	<0.5	<0.5	<0.5	<2
09/21/2023	RW-1	<250	<250	-	**1.8**	<0.5	<0.5	<0.5	<2
12/08/2023	RW-1	-	<200	-	**5.34**	<1	<1	<3	<5
03/15/2024	RW-1	**225**	<200	-	**4.27**	<1	<1	<3	<5
08/19/2014	RW-2	**7,900**	**310 K**	-	**47**	<20	**530**	**2,700**	**55**
11/18/2014	RW-2	**6,800**	**260 K**	-	**49**	<4	**380**	**770**	-
03/20/2015	RW-2	**2,400**	**270**	-	**39**	<1.5	**100**	**210**	**20**
06/16/2015	RW-2	**3,500**	<250	-	**160**	**34**	**380**	**240**	-
06/17/2015	RW-2	**4,300**	**480 K**	-	**250**	**6.6**	**260**	**480**	**28**
09/24/2015	RW-2	**14,000**	**440 K**	-	**680**	<25	**970**	**2,300**	**110**
12/08/2015	RW-2	**2,700**	**370 K**	-	**110**	**1.6**	**210**	**170**	**18**
03/10/2016	RW-2	**2,200**	<250	-	**59**	**11**	**180**	**150**	**14**
06/16/2016	RW-2	-	-	-	-	-	-	-	**13**
09/22/2016	RW-2	**6,000**	<250	-	**240**	**11**	**960**	**370**	**52**
11/16/2016	RW-2	**2,700**	<250	-	**93**	**1.6**	**500**	**140**	**31**
03/23/2017	RW-2	**1,200**	**1,500**	-	**23**	**1.5**	**130**	**48**	**20**
06/22/2017	RW-2	**2,000**	**410**	-	**59**	**8.9**	**130**	**35**	**21**
09/20/2017	RW-2	**1,800**	**360**	-	**43**	**6.4**	**90**	**7.6**	**24**
12/07/2017	RW-2	**1,100**	<250	-	-	-	-	-	-
12/07/2017	RW-2	-	-	-	**31**	**1**	**19**	**2**	**18**
03/18/2018	RW-2	-	-	-	**44**	**1.2**	**36**	**9.7**	**29**
03/18/2018	RW-2	-	-	-	-	-	-	-	**49**
03/19/2018	RW-2	**1,400**	**280 K**	-	-	-	-	-	-
06/21/2018	RW-2	**1,200**	**360 K**	-	**22**	**29**	**71**	**42**	**0.42**
06/21/2018	RW-2	-	-	-	-	-	-	-	**65**
09/26/2018	RW-2	**1,600**	**260 K**	-	-	-	-	-	-
09/26/2018	RW-2	-	-	-	**35**	**7.6**	**76**	**16**	**1.5**
11/28/2018	RW-2	**1,100**	<250	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
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		TPH			BTEX + naphthalene				
		TPH as Gasoline	TPH as Diesel	TPH as Motor Oil	Benzene	Toluene	Ethylbenzene	Xylenes (total)	Naphthalene
Date	**Location Code**	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MTCA - GW - Method A		-	500	500	5	1,000	700	1,000	160
MTCA - GW - Method B - VI		-	-	-	2.4	15,000	2,800	320	8.8
11/28/2018	RW-2	-	-	-	**13**	**0.51**	**5.4**	**1.3**	**3**
03/20/2019	RW-2	-	-	-	**20**	<0.5	**5.4**	**1.5**	**0.17**
03/20/2019	RW-2	**780**	<250	-	-	-	-	-	-
06/11/2019	RW-2	-	-	-	**64**	**41**	**210**	**110**	**23**
06/11/2019	RW-2	**2,000**	**820 K**	-	-	-	-	-	-
09/22/2019	RW-2	-	-	-	**17**	**4.4**	**13**	**16**	**13**
09/22/2019	RW-2	**1,500**	**430 K**	-	-	-	-	-	-
11/13/2019	RW-2	**850**	**250 K**	-	**15**	<0.5	**1.3**	**1.4**	**4.4**
11/13/2019	RW-2	-	-	-	**15**	<0.5	**1.3**	**1.4**	**4.4**
11/13/2019	RW-2	**850**	**250 K**	-	-	-	-	-	-
03/24/2020	RW-2	**1,300**	**1,000 K**	-	-	-	-	-	-
03/24/2020	RW-2	-	-	-	**26**	**0.71**	**4.7**	**15**	**8.2**
06/23/2020	RW-2	**1,300**	**1,100 Z**	-	**11**	**1.8**	**9.4**	**15**	**5.7**

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Historical Analytical Results - Groundwater
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Love's Travel Stop #413, Ellensburg, Washington

		TPH			BTEX + naphthalene				
		TPH as Gasoline	TPH as Diesel	TPH as Motor Oil	Benzene	Toluene	Ethylbenzene	Xylenes (total)	Naphthalene
Date	**Location Code**	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MTCA - GW - Method A		-	500	500	5	1,000	700	1,000	160
MTCA - GW - Method B - VI		-	-	-	2.4	15,000	2,800	320	8.8
09/22/2020	RW-2	**1,500**	**520 K**	-	**15**	**4.7**	**9.4**	**24**	**0.52**
12/08/2020	RW-2	-	-	-	**10**	**0.67**	<0.5	**2.2**	**1.8**
03/24/2021	RW-2	**1,300**	**620 K**	-	**19**	**0.98**	**1.9**	**4.1**	**2.1**
06/14/2021	RW-2	**960**	**870 K**	-	**20**	**18**	**0.99**	**7.4**	**5.4**
09/21/2021	RW-2	**1,000**	**510 K**	-	**9.5**	**1.1**	<0.5	**3.1**	-
09/28/2021	RW-2	-	-	-	-	-	-	-	**1.2**
12/07/2021	RW-2	**910**	**380 K**	-	**12**	**1.3**	<0.5	**2.1**	-
12/08/2021	RW-2	-	-	-	-	-	-	-	**0.92**
03/21/2022	RW-2	**1,300**	**680**	-	**7**	<0.5	**0.61**	**3.5**	-
03/22/2022	RW-2	-	-	-	-	-	-	-	**2.5**
06/22/2022	RW-2	**1,200**	**570**	-	**10**	**2.1**	**3.3**	**22**	**1.5**
09/20/2022	RW-2	**900**	**400 K**	-	**3**	**0.75**	<0.5	**1.4**	**0.49**
12/20/2022	RW-2	**1,200**	**400 K**	-	**3.7**	<0.5	<0.5	**2.1**	<2
03/09/2023	RW-2	**880**	**360 K**	-	**1.7**	<0.5	<0.5	**1.4**	<2
06/28/2023	RW-2	**1,100**	**460 K**	-	**16**	**18**	**0.67**	**41**	<2
09/21/2023	RW-2	**590**	**370 K**	-	**1.6**	**1.4**	<0.5	**1.6**	<2
12/09/2023	RW-2	-	<200	-	**229**	**4.49**	<1	<3	<5
03/14/2024	RW-2	**299**	<200	-	**2.49**	<1	<1	<3	<5

Statistics

Number of Results	558	571	41	589	589	589	589	580
Number of Detects	343	268	13	422	311	327	368	362
Minimum Concentration	<50	<80	<190	<0.02	<0.02	<0.02	0	<0.02
Minimum Detect	52	211	520	0.53	0.51	0.5	0	0.037
Maximum Concentration	521,000	200,000	14,000	11,000	42,000	4,500	33,000	<2,000
Maximum Detect	521,000	200,000	14,000	11,000	42,000	4,500	33,000	710
Average Concentration *	9,646	1,728	1,351	616	740	309	1,305	39
Geometric Average *	902	337	525	15	2.7	5.2	0	1.4
Median Concentration *	700	125	470	16	0.75	1.1	1.7	1
Standard Deviation *	31,422	11,015	2,715	1,589	3,983	707	3,477	93
Geometric Standard Deviation *	8.4	3.8	3.6	27	20	29		25
95% UCL (Student's-t) *	11,838	2,487	2,209	724.3	1,011	357	1,541	44.87
Number of Env Standard Exceedances	0	201	13	392	34	92	136	174
Number of Env Standard Exceedances (Detects Only)	0	201	13	392	34	92	136	174
% of Detects	61	47	32	72	53	56	62	62
% of Non-Detects	39	53	68	28	47	44	38	38
% of Detects at or above Env Standards	0	35	32	67	6	16	23	30
% of Results Below Env Standards or Non-Detect	100	65	68	33	94	84	77	70

* A Non Detect Multiplier of 0.5 has been applied.

Note
Groundwater samples screened against MTCA Method A cleanup levels (January 2023). Exceedances shaded.
Groundwater samples ares also screened against MTCA Method B cleanup levels for vapor intrusion (January 2023). Exceedances in red text.
Detected compounds are bold
BTEX = benzene, toluene, ethylbenzene, and xylenes
µg/L = microgram per liter
PAH = polycylic aromatic hydrocarbon
TPH = total petroleum hydrocarbons
VOC = volatile organic compound
E = The sample appears to extend to a ligther hydrocarbon range than diesel.
L = diesl concentration may include contributions from heavier-end hydrocarbons that elute in the diesel range.
K = diesel concentration may include contributions from lighter-end hydrocarbons that elute in the diesel range.
Z = diesel concentration may include contributions from lighter-end and heavier-end hydrocarbons that elute in the diesel range.
J = estimated value.

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Historical Analytical Results - Groundwater
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		Flash Point	Metal	PAH																	
Date	Location Code	Flash Point	Lead	1-Methylnaphthalene	2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(b+k)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Phenanthrene	Pyrene
		degrees F	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	µg/L	µg/L
MTCA - GW - Method A		-	15	-	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-
MTCA - GW - Method B - VI		-	-	0.17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-03	-	-	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
09/25/2012	DP-04	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-05	-	-	-	-	**8.6**	<2	<2	<2	<2	-	<4	<2	-	<2	<2	<2	**11**	<2	**11**	<2
09/26/2012	DP-06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-10	-	-	-	-	**3.7**	<2	<2	<2	<2	-	<4	<2	-	<2	<2	<2	**9.3**	<2	**8.3**	<2
09/25/2012	DP-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-12	-	-	-	-	<4	<4	<4	<4	<4	-	<8	<4	-	<4	<4	<4	<4	<4	<4	<4
09/24/2012	DP-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-14	-	-	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
09/24/2012	DP-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-18	-	-	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
09/26/2012	DP-19	-	-	-	-	<0.04	<0.04	<0.04	<0.04	<0.04	-	<0.08	<0.04	-	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
09/25/2012	DP-20	-	-	-	-	**0.034**	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.094**	<0.02	<0.02	<0.02
09/24/2012	DP-21	-	-	-	-	**0.089**	<0.04	**0.06**	<0.04	<0.04	-	<0.08	<0.04	-	<0.04	<0.04	<0.04	**0.28**	<0.04	<0.04	<0.04
08/16/2018	B2-W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2018	RNMW-17	-	**46**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/13/2019	RNMW-17	**>210**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/22/2019	RNMW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/22/2019	RNMW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/26/2021	RNMW-17	-	-	**0.12**	**0.033**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
04/09/2021	RNMW-17	-	-	6.2	<5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/30/2021	RNMW-17	-	-	<5	<5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/09/1995	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/24/1996	MW-1	-	<5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/16/2010	MW-1	-	-	-	-	**1.3**	<0.4	**0.45**	<0.4	<0.4	-	<0.8	<0.4	-	<0.4	<0.4	<0.4	**2.7**	<0.4	**2.6**	**0.45**
03/18/2011	MW-1	-	-	14.7	**27.6**	**0.37 J**	<0.94	<0.94	<0.094	<0.094	<0.094	-	<0.094	<0.094	<0.094	<0.094	<0.94	**1.4**	<0.094	**1.1**	<0.94
06/07/2011	MW-1	-	-	44.9	**93.2**	**1.7**	**0.62 J**	**6.3**	**0.12**	**0.062 J**	**0.041 J**	-	**0.1**	**0.035 J**	**0.12**	<0.094	**0.29 J**	**4.7**	**0.04 J**	**6**	**0.83 J**
08/25/2011	MW-1	-	-	22.3	**40.8**	**0.41 J**	<0.94	<0.94	<0.094	<0.094	<0.094	-	<0.094	<0.094	<0.094	<0.094	<0.94	**1.2**	<0.094	**0.68**	<0.94
11/16/2011	MW-1	-	-	-	-	**0.36**	**0.11**	**0.07**	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	**0.028**	**0.82**	<0.02	**0.74**	**0.069**
03/08/2012	MW-1	-	-	-	-	<4	<4	<4	<4	<4	-	<8	<4	-	<4	<4	<4	<4	<4	<4	<4
05/09/2012	MW-1	-	-	-	-	<1	<1	<1	<1	<1	-	<2	<1	-	<1	<1	<1	**1.8**	<1	**1.1**	<1
09/22/2012	MW-1	-	-	-	-	<4	<4	<4	<4	<4	-	<8	<4	-	<4	<4	<4	<4	<4	<4	<4
12/07/2012	MW-1	-	-	-	-	**1.5**	<1	<1	<1	<1	-	<2	<1	-	<1	**1**	<1	**2.4**	<1	**2.8**	<1
03/07/2013	MW-1	-	-	-	-	<1	<1	<1	<1	<1	-	<2	<1	-	<1	<1	<1	<1	<1	<1	<1
06/12/2013	MW-1	-	-	-	-	**0.41**	**0.12**	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	**0.029**	**1.1**	<0.02	**1**	**0.092**
08/27/2013	MW-1	-	-	-	-	**0.63**	<0.4	<0.4	<0.4	<0.4	-	<0.8	<0.4	-	<0.4	<0.4	<0.4	**1.2**	<0.4	**0.9**	<0.4
12/11/2013	MW-1	-	-	9.3	**17**	**0.42**	<0.4	<0.4	<0.4	<0.4	-	<0.8	<0.4	-	<0.4	<0.4	<0.4	**0.81**	<0.4	**0.6**	<0.4
03/25/2014	MW-1	-	-	11	**19**	**0.28**	**0.11**	<0.02	**0.039**	<0.02	-	**0.056**	**0.047**	-	**0.039**	**0.042**	**0.048**	**0.89**	**0.041**	**0.98**	**0.11**
06/16/2014	MW-1	-	-	20	**31**	**0.57**	<0.02	**0.061**	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	**0.034**	**1.7**	<0.02	**0.9**	**0.094**
08/19/2014	MW-1	-	-	16	**24**	<1	<1	<1	<1	<1	-	<2	<1	-	<1	<1	<1	**1.4**	<1	<1	<1
11/18/2014	MW-1	-	-	20	**29**	<1	<1	<1	<1	<1	-	<2	<1	-	<1	<1	<1	**1.7**	<1	<1	<1
03/20/2015	MW-1	-	-	25	**32**	<2	<2	<2	<2	<2	-	<4	<2	-	<2	<2	<2	<2	<2	<2	<2
06/16/2015	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/17/2015	MW-1	-	-	16	**29**	<1	<1	<1	<1	<1	-	<2	<1	-	<1	<1	<1	**1.1**	<1	<1	<1
09/24/2015	MW-1	-	-	21	**28**	<1	<1	<1	<1	<1	-	<2	<1	-	<1	<1	<1	<1	<1	<1	<1

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Flash Point	Metal	PAH																	
		Flash Point	Lead	1-Methylnaphthalene	2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(b+k)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Phenanthrene	Pyrene
Date	**Location Code**	degrees F	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	µg/L	µg/L
MTCA - GW - Method A		-	15	-	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-
MTCA - GW - Method B - VI		-	-	0.17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2015	MW-1	-	-	**7.7**	**11**	<1	<1	<1	<1	<1	-	<2	<1	-	<1	<1	<1	<1	<1	<1	<1
03/10/2016	MW-1	-	-	**13**	**19**	<2	<2	<2	<2	<2	-	<4	<2	-	<2	<2	<2	<2	<2	<2	<2
06/16/2016	MW-1	-	-	**14**	**34**	<2	<2	<2	<2	<2	-	<4	<2	-	<2	<2	<2	<2	<2	<2	<2
09/22/2016	MW-1	-	-	**22**	**65**	<2	<2	<2	<2	<2	-	<4	<2	-	<2	<2	<2	<2	<2	<2	<2
11/17/2016	MW-1	-	-	**19**	**57**	<2	<2	<2	<2	<2	-	<4	<2	-	<2	<2	<2	<2	<2	<2	<2
03/23/2017	MW-1	-	-	**31**	**57**	<2	<2	<2	<2	<2	-	<4	<2	-	<2	<2	<2	<2	<2	<2	<2
06/22/2017	MW-1	-	-	**15**	**33**	<4	<4	<4	<4	<4	-	<8	<4	-	<4	<4	<4	<4	<4	<4	<4
09/20/2017	MW-1	-	-	**45**	**71**	<2	<2	<2	<2	<2	-	<4	<2	-	<2	<2	<2	<2	<2	<2	<2
12/07/2017	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-1	-	-	**45**	**72**	<4	<4	<4	<4	<4	-	<8	<4	-	<4	<4	<4	<4	<4	<4	<4
03/19/2018	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	MW-1	-	-	**35**	**61**	<4	<4	<4	<4	<4	-	<8	<4	-	<4	<4	<4	<4	<4	<4	<4
03/19/2018	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2018	MW-1	-	-	**20**	**35**	<2	<2	<2	<2	<2	-	<4	<2	-	<2	<2	<2	<2	<2	<2	<2
06/22/2018	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2018	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-1	-	-	**52**	**75**	<4	<4	<4	<4	<4	-	<8	<4	-	<4	<4	<4	<4	<4	<4	<4
11/29/2018	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	MW-1	-	-	**33**	**37**	<10	<10	<10	<10	<10	-	<20	<10	-	<10	<10	<10	<10	<10	<10	<10
03/20/2019	MW-1	-	-	**0.26**	<0.1	**0.16**	<0.1	<0.1	<0.1	<0.1	-	<0.2	<0.1	-	<0.1	<0.1	<0.1	**0.18**	<0.1	<0.1	<0.1
03/20/2019	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-1	-	-	**38**	**71**	<2	<2	<2	<2	<2	-	<4	<2	-	<2	<2	<2	<2	<2	<2	<2
06/11/2019	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-1	-	-	**46**	**67**	<4	<4	<4	<4	<4	-	<8	<4	-	<4	<4	<4	<4	<4	<4	<4
09/22/2019	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	MW-1	-	-	**48**	**65**	<4	<4	<4	<4	<4	-	<8	-	-	<4	<4	<4	<4	<4	<4	<4
06/23/2020	MW-1	-	-	**9.7**	**17**	<4	<4	<4	<4	<4	-	<8	<4	-	<4	<4	<4	<4	<4	<4	<4
09/23/2020	MW-1	-	-	**26**	**36**	<4	<4	<4	<4	<4	-	<8	<4	-	<4	<4	<4	<4	<4	<4	<4
12/09/2020	MW-1	-	-	**30**	**48**	<2	<2	<2	<2	<2	-	<4	<2	-	<2	<2	<2	<2	<2	<2	<2
03/24/2021	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2021	MW-1	-	-	**34**	**63**	<2	<2	<2	<2	<2	-	<4	<2	-	<2	<2	<2	<2	<2	<2	<2
04/09/2021	MW-1	-	-	**120**	**190**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/15/2021	MW-1	-	-	**24**	**42**	<2	<2	<2	<2	<2	-	<4	<2	-	<2	<2	<2	<2	<2	<2	<2
09/28/2021	MW-1	-	-	**78**	**120**	<4	<4	<4	<4	<4	-	<8	<4	-	<4	<4	<4	**4**	<4	**4.2**	<4
09/30/2021	MW-1	-	-	**12**	**25**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	MW-1	-	-	**75**	**140**	<2	<2	<2	<2	<2	-	<4	<2	-	<2	<2	<2	**7.4**	<2	**8.3**	<2
03/22/2022	MW-1	-	-	**80**	**120**	<4	<4	<4	<4	<4	-	<8	<4	-	<4	<4	<4	**5.8**	<4	<4	<4
06/22/2022	MW-1	-	-	**20**	**23**	<4	<4	<4	<4	<4	-	<8	<4	-	<4	<4	<4	<4	<4	<4	<4
09/20/2022	MW-1	-	-	**44**	**65**	<2	<2	<2	<2	<2	-	<4	<2	-	<2	<2	<2	**3.4**	<2	<2	<2
12/20/2022	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/09/2023	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/28/2023	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/21/2023	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/09/2023	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/15/2024	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/16/2010	MW-2	-	-	-	-	**19**	<10	<10	<10	<10	-	<20	<10	-	<10	<10	<10	**37**	<10	**56**	<10
11/09/1995	MW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/24/1996	MW-2	-	<5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/09/1995	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/24/1996	MW-3	-	<5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/16/2010	MW-3	-	-	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	**0.024**	<0.02	**0.025**	**0.056**	<0.02	**0.049**	**0.038**
03/18/2011	MW-3	-	-	**5.1**	**5.2**	<0.94	<0.94	<0.94	<0.094	<0.094	<0.094	-	<0.094	<0.094	<0.094	<0.094	<0.94	**0.7 J**	<0.094	<0.94	<0.94
06/07/2011	MW-3	-	-	**13.7**	**20.3**	**0.61 J**	<0.94	<0.94	<0.094	<0.094	<0.094	-	<0.094	<0.094	<0.094	<0.094	<0.94	<0.94	<0.094	**1.1**	<0.94

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Flash Point	Metal	PAH																	
Date	Location Code	Flash Point	Lead	1-Methylnaphthalene	2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(b+k)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Phenanthrene	Pyrene
		degrees F	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	µg/L	µg/L
MTCA - GW - Method A		-	15	-	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-
MTCA - GW - Method B - VI		-	-	0.17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/25/2011	MW-3	-	-	**5.2**	**4.9**	**0.31 J**	<0.94	<0.94	<0.094	<0.094	<0.094	-	<0.094	<0.094	<0.094	<0.094	<0.94	**1.2**	<0.094	**0.55 J**	<0.94
11/16/2011	MW-3	-	-	-	-	**0.38**	**0.082**	**0.094**	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	**0.022**	**0.83**	<0.02	**0.72**	**0.062**
03/08/2012	MW-3	-	-	-	-	<1	<1	<1	<1	<1	-	<2	<1	-	<1	<1	<1	**1.2**	<1	<1	<1
05/09/2012	MW-3	-	-	-	-	<0.4	<0.4	<0.4	<0.4	<0.4	-	<0.8	<0.4	-	<0.4	<0.4	<0.4	**1.5**	<0.4	**0.59**	<0.4
09/22/2012	MW-3	-	-	-	-	**0.3**	<0.2	<0.2	<0.2	<0.2	-	<0.4	<0.2	-	<0.2	<0.2	<0.2	**1.5**	<0.2	**0.58**	<0.2
12/07/2012	MW-3	-	-	-	-	**0.43**	<0.4	<0.4	<0.4	<0.4	-	<0.8	<0.4	-	<0.4	<0.4	<0.4	**0.94**	<0.4	**0.44**	<0.4
03/07/2013	MW-3	-	-	-	-	**0.54**	<0.2	<0.2	<0.2	<0.2	-	<0.4	<0.2	-	<0.2	<0.2	<0.2	**1.4**	<0.2	**0.44**	<0.2
06/12/2013	MW-3	-	-	-	-	**0.29**	**0.051**	<0.02	**0.021**	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.92**	<0.02	**3**	**0.037**
08/27/2013	MW-3	-	-	-	-	**0.42**	<0.1	<0.1	<0.1	<0.1	-	<0.2	<0.1	-	<0.1	<0.1	<0.1	**1**	<0.1	<0.1	<0.1
12/11/2013	MW-3	-	-	**2.3**	**1**	**0.37**	<0.1	<0.1	<0.1	<0.1	-	<0.2	<0.1	-	<0.1	<0.1	<0.1	**1**	<0.1	**0.33**	<0.1
03/25/2014	MW-3	-	-	**3.6**	**1.2**	**0.27**	**0.033**	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.67**	<0.02	**0.16**	**0.063**
06/16/2014	MW-3	-	-	**2.6**	**1.5**	**0.31**	<0.02	**0.052**	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**1.1**	<0.02	**0.26**	**0.055**
08/19/2014	MW-3	-	-	**1.9**	**0.82**	<0.4	<0.4	<0.4	<0.4	<0.4	-	<0.8	<0.4	-	<0.4	<0.4	<0.4	**0.67**	<0.4	<0.4	<0.4
11/18/2014	MW-3	-	-	**2.7**	**1.4**	**0.28**	<0.2	<0.2	<0.2	<0.2	-	<0.4	<0.2	-	<0.2	<0.2	<0.2	**0.7**	<0.2	<0.2	<0.2
03/20/2015	MW-3	-	-	**2.1**	**1.3**	<0.2	<0.2	<0.2	<0.2	<0.2	-	<0.4	<0.2	-	<0.2	<0.2	<0.2	**0.55**	<0.2	<0.2	<0.2
06/16/2015	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/17/2015	MW-3	-	-	**4.4**	**6.1**	**0.24**	<0.2	<0.2	<0.2	<0.2	-	<0.4	<0.2	-	<0.2	<0.2	<0.2	**0.81**	<0.2	**0.4**	<0.2
09/24/2015	MW-3	-	-	**3.4**	**3.6**	<0.2	<0.2	<0.2	<0.2	<0.2	-	<0.4	<0.2	-	<0.2	<0.2	<0.2	**0.39**	<0.2	**0.28**	<0.2
12/08/2015	MW-3	-	-	**0.95**	**0.34**	**0.17**	<0.1	<0.1	<0.1	<0.1	-	<0.2	<0.1	-	<0.1	<0.1	<0.1	**0.32**	<0.1	<0.1	<0.1
03/10/2016	MW-3	-	-	**3**	**2.4**	<0.2	<0.2	<0.2	<0.2	<0.2	-	<0.4	<0.2	-	<0.2	<0.2	<0.2	**0.34**	<0.2	<0.2	<0.2
06/16/2016	MW-3	-	-	**2.6**	**4.2**	**0.68**	<0.2	<0.2	<0.2	<0.2	-	<0.4	<0.2	-	<0.2	<0.2	<0.2	**0.25**	<0.2	<0.2	<0.2
09/22/2016	MW-3	-	-	**1.8**	**3.3**	<0.2	<0.2	<0.2	<0.2	<0.2	-	<0.4	<0.2	-	<0.2	<0.2	<0.2	**0.5**	<0.2	<0.2	<0.2
11/16/2016	MW-3	-	-	**3.8**	**8.3**	**0.21**	<0.2	<0.2	<0.2	<0.2	-	<0.4	<0.2	-	<0.2	<0.2	<0.2	**0.69**	<0.2	**0.3**	<0.2
03/23/2017	MW-3	-	-	**11**	**13**	<2	<2	<2	<2	<2	-	<4	<2	-	<2	<2	<2	<2	<2	<2	<2
06/22/2017	MW-3	-	-	**5.4**	**5**	<2	<2	<2	<2	<2	-	<4	<2	-	<2	<2	<2	<2	<2	<2	<2
09/20/2017	MW-3	-	-	**5**	**4.7**	<1	<1	<1	<1	<1	-	<2	<1	-	<1	<1	<1	<1	<1	<1	<1
12/07/2017	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-3	-	-	**8.5**	**9.2**	<2	<2	<2	<2	<2	-	<4	<2	-	<2	<2	<2	<2	<2	<2	<2
03/18/2018	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/18/2018	MW-3	-	-	**7.3**	**8.7**	<1	<1	<1	<1	<1	-	<2	<1	-	<1	<1	<1	<1	<1	<1	<1
03/18/2018	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/21/2018	MW-3	-	-	**13**	**8.2**	<2	<2	<2	<2	<2	-	<4	<2	-	<2	<2	<2	<2	<2	<2	<2
06/21/2018	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-3	-	-	**10**	**8.1**	<1	<1	<1	<1	<1	-	<2	<1	-	<1	<1	<1	<1	<1	<1	<1
11/28/2018	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/28/2018	MW-3	-	-	**2.1**	<0.02	**0.24**	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.42**	<0.02	<0.02	<0.02
03/20/2019	MW-3	-	-	<0.02	<0.02	**0.03**	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.032**	<0.02	<0.02	**0.037**
03/20/2019	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-3	-	-	**11**	**9.6**	**0.42**	<0.2	<0.2	<0.2	<0.2	-	<0.4	<0.2	-	<0.2	<0.2	<0.2	**1.1**	<0.2	**0.5**	<0.2
06/11/2019	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-3	-	-	**6.6**	**4.3**	<1	<1	<1	<1	<1	-	<2	<1	-	<1	<1	<1	<1	<1	<1	<1
09/22/2019	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-3	-	-	**4.9**	**1.8**	<1	<1	<1	<1	<1	-	<2	<1	-	<1	<1	<1	<1	<1	<1	<1
11/13/2019	MW-3	-	-	**4.9**	**1.8**	<1	<1	<1	<1	<1	-	<2	<1	-	<1	<1	<1	<1	<1	<1	<1
11/13/2019	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2020	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2020	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2020	MW-3	-	-	**8.7**	**6.4**	<1	<1	<1	<1	<1	-	<2	<1	-	<1	<1	<1	<1	<1	<1	<1
06/23/2020	MW-3	-	-	**11**	**13**	<1	<1	<1	<1	<1	-	<2	<1	-	<1	<1	<1	**1.1**	<1	<1	<1
09/23/2020	MW-3	-	-	**5.1**	**2.3**	<1	<1	<1	<1	<1	-	<2	<1	-	<1	<1	<1	<1	<1	<1	<1
12/08/2020	MW-3	-	-	**8.9**	**3.9**	<1	<1	<1	<1	<1	-	<2	<1	-	<1	<1	<1	**1**	<1	<1	<1
03/24/2021	MW-3	-	-	**0.54**	**3**	<0.5	<0.5	<0.5	<0.5	<0.5	-	<1	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
06/14/2021	MW-3	-	-	**5.6**	**3.7**	<0.5	<0.5	<0.5	<0.5	<0.5	-	<1	<0.5	-	<0.5	<0.5	<0.5	**0.72**	<0.5	<0.5	<0.5
09/28/2021	MW-3	-	-	**7.7**	**7.8**	**0.56**	<0.5	<0.5	<0.5	<0.5	-	<1	<0.5	-	<0.5	<0.5	<0.5	**1**	<0.5	**0.74**	<0.5

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Flash Point	Metal	PAH																	
Date	Location Code	Flash Point	Lead	1-Methylnaphthalene	2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(b+k)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Phenanthrene	Pyrene
		degrees F	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	µg/L	µg/L
MTCA - GW - Method A		-	15	-	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-
MTCA - GW - Method B - VI		-	-	0.17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2021	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	MW-3	-	-	**8.1**	**8.1**	**0.56**	<0.5	<0.5	<0.5	<0.5	-	<1	<0.5	-	<0.5	<0.5	<0.5	**1.2**	<0.5	**0.62**	<0.5
03/22/2022	MW-3	-	-	**9.3**	**1.4**	<0.5	<0.5	<0.5	<0.5	<0.5	-	<1	<0.5	-	<0.5	<0.5	<0.5	**1**	<0.5	<0.5	<0.5
06/22/2022	MW-3	-	-	**1.1**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	<1	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
09/20/2022	MW-3	-	-	**0.93**	<0.2	**0.24**	<0.2	<0.2	<0.2	<0.2	-	<0.4	<0.2	-	<0.2	<0.2	<0.2	**0.46**	<0.2	<0.2	<0.2
03/09/2023	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/28/2023	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/21/2023	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/09/2023	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/14/2024	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/24/1996	MW-4	-	**6**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/24/1996	MW-5	-	<5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/24/1996	MW-6	-	**6**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/18/2011	MW-6	-	-	<0.94	<0.94	<0.94	<0.94	<0.94	<0.094	<0.094	<0.094	-	<0.094	<0.094	<0.094	<0.094	<0.94	<0.94	<0.094	<0.94	<0.94
06/07/2011	MW-6	-	-	<0.94	<0.94	<0.94	<0.94	<0.94	<0.094	<0.094	<0.094	-	<0.094	<0.094	<0.094	<0.094	<0.94	<0.94	<0.094	<0.94	<0.94
08/25/2011	MW-6	-	-	<0.94	<0.94	<0.94	<0.94	<0.94	<0.094	<0.094	<0.094	-	<0.094	<0.094	<0.094	<0.094	<0.94	<0.94	<0.094	<0.94	<0.94
11/16/2011	MW-6	-	-	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
03/08/2012	MW-6	-	-	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.03**	<0.02	**0.024**	<0.02
05/09/2012	MW-6	-	-	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.032**	<0.02	<0.02	**0.023**
09/22/2012	MW-6	-	-	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.043**	<0.02	<0.02	**0.024**
12/07/2012	MW-6	-	-	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.034**	<0.02	**0.024**	**0.041**
03/07/2013	MW-6	-	-	-	-	<0.04	<0.04	<0.04	<0.04	<0.04	-	<0.08	<0.04	-	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
06/12/2013	MW-6	-	-	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
08/27/2013	MW-6	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.2	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
12/11/2013	MW-6	-	-	**0.021**	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.02**	<0.02	<0.02	<0.02
03/25/2014	MW-6	-	-	<0.2	**0.23**	<0.2	<0.2	<0.2	<0.2	<0.2	-	<0.4	<0.2	-	<0.2	<0.2	<0.2	**0.22**	<0.2	**0.39**	**0.21**
06/16/2014	MW-6	-	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	<0.4	<0.2	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
08/19/2014	MW-6	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.2	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	**0.12**	**0.16**
11/18/2014	MW-6	-	-	**0.036**	**0.044**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	**0.029**	-	<0.02	<0.02	<0.02	<0.02	<0.02	**0.03**	**0.036**
03/20/2015	MW-6	-	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	<0.4	<0.2	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
06/16/2015	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/17/2015	MW-6	-	-	**0.046**	**0.044**	<0.025	**0.03**	<0.025	**0.046**	**0.039**	-	**0.085**	**0.14**	-	**0.096**	**0.037**	**0.088**	<0.025	**0.07**	**0.084**	**0.18**
09/24/2015	MW-6	-	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	<0.4	<0.2	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
12/08/2015	MW-6	-	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	<0.4	<0.2	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
03/10/2016	MW-6	-	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	<0.4	<0.2	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
06/16/2016	MW-6	-	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	<0.4	<0.2	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
09/22/2016	MW-6	-	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	<0.4	<0.2	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
11/16/2016	MW-6	-	-	**0.025**	**0.063**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
03/23/2017	MW-6	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.2	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
06/22/2017	MW-6	-	-	**0.032**	<0.02	<0.02	<0.02	<0.02	**0.021**	<0.02	-	<0.04	<0.02	-	**0.029**	<0.02	<0.02	<0.02	<0.02	**0.022**	**0.031**
09/20/2017	MW-6	-	-	**0.14**	**0.15**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.029**	<0.02	**0.036**	**0.036**
12/07/2017	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-6	-	-	**0.19**	**0.2**	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.2	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
03/18/2018	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/18/2018	MW-6	-	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	<40	<0.2	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
03/18/2018	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/21/2018	MW-6	-	-	**0.57**	**0.47**	<0.2	<0.2	<0.2	<0.2	<0.2	-	<0.4	<0.2	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
06/21/2018	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-6	-	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	<0.4	<0.2	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
11/29/2018	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	MW-6	-	-	**0.057**	**0.063**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	**0.037**	**0.025**
03/25/2021	MW-6	-	-	**0.54**	**0.73**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.032**	<0.02	**0.026**	**0.027**
06/15/2021	MW-6	-	-	**1.3**	**1.7**	<0.2	<0.2	<0.2	<0.2	<0.2	-	<0.4	<0.2	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
09/28/2021	MW-6	-	-	**1.5**	**2**	<0.04	<0.04	<0.04	<0.04	<0.04	-	<0.08	<0.04	-	<0.04	<0.04	<0.04	**0.051**	<0.04	<0.04	<0.04

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Flash Point	Metal	PAH																	
		Flash Point	Lead	1-Methylnaphthalene	2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(b+k)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Phenanthrene	Pyrene
Date	**Location Code**	degrees F	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	µg/L	µg/L
MTCA - GW - Method A		-	15	-	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-
MTCA - GW - Method B - VI		-	-	0.17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/22/2022	MW-6	-	-	**0.56**	**0.45**	<0.4	<0.04	<0.04	<0.04	<0.04	-	<0.08	<0.04	-	<0.04	<0.04	<0.04	**0.047**	<0.04	<0.04	<0.04
06/22/2022	MW-6	-	-	**0.12**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.02	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
12/20/2022	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/09/2023	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2023	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2023	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/14/2024	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/19/2014	MW-7	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
11/18/2014	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/18/2014	MW-7	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
03/20/2015	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2015	MW-7	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
06/16/2015	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/17/2015	MW-7	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
09/24/2015	MW-7	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
12/08/2015	MW-7	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
03/10/2016	MW-7	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
06/16/2016	MW-7	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
09/22/2016	MW-7	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
11/17/2016	MW-7	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
03/23/2017	MW-7	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
06/22/2017	MW-7	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
09/20/2017	MW-7	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
12/07/2017	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-7	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
03/19/2018	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	MW-7	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
06/21/2018	MW-7	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
09/26/2018	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-7	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
11/29/2018	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	MW-7	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
03/20/2019	MW-7	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
03/20/2019	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-7	-	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	<0.4	<0.2	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
06/11/2019	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-7	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
09/22/2019	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-7	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
11/13/2019	MW-7	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
11/13/2019	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2020	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2020	MW-7	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
06/23/2020	MW-7	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
09/23/2020	MW-7	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
12/09/2020	MW-7	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
03/24/2021	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/15/2021	MW-7	-	-	**0.037**	**0.043**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
09/28/2021	MW-7	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
12/07/2021	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	MW-7	-	-	**0.2**	**0.34**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.048**	<0.02	**0.054**	<0.02
03/22/2022	MW-7	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
06/22/2022	MW-7	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
09/20/2022	MW-7	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Flash Point	Metal	PAH																	
		Flash Point	Lead	1-Methylnaphthalene	2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(b+k)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Phenanthrene	Pyrene
Date	**Location Code**	degrees F	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	µg/L	µg/L
MTCA - GW - Method A		-	15	-	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-
MTCA - GW - Method B - VI		-	-	0.17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/09/2023	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2023	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2023	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/14/2024	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/19/2014	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/18/2014	MW-8	-	-	**0.056**	**0.072**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
03/20/2015	MW-8	-	-	**0.026**	**0.038**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
06/16/2015	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/17/2015	MW-8	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
09/24/2015	MW-8	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
12/08/2015	MW-8	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
03/10/2016	MW-8	-	-	<0.02	<0.02	<0.02	<0.02	<0.92	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
06/16/2016	MW-8	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
09/22/2016	MW-8	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
11/16/2016	MW-8	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
03/23/2017	MW-8	-	-	**0.23**	**0.22**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.029**	<0.02	<0.02	<0.02
06/22/2017	MW-8	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
09/20/2017	MW-8	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
12/07/2017	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-8	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
03/19/2018	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	MW-8	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
06/22/2018	MW-8	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
09/26/2018	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-8	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
11/29/2018	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	MW-8	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
03/20/2019	MW-8	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
03/20/2019	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-8	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
06/11/2019	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-8	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
09/22/2019	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-8	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	**0.027**	**0.021**	<0.02	<0.02	<0.02	<0.02	<0.02
11/13/2019	MW-8	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	**0.027**	**0.021**	<0.02	<0.02	<0.02	<0.02	<0.02
11/13/2019	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	MW-8	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
03/25/2020	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/23/2020	MW-8	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
09/23/2020	MW-8	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
12/09/2020	MW-8	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
03/24/2021	MW-8	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
06/15/2021	MW-8	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
09/28/2021	MW-8	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
12/08/2021	MW-8	-	-	**0.032**	**0.049**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.025**	<0.02	**0.034**	<0.02
03/22/2022	MW-8	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
06/22/2022	MW-8	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
09/20/2022	MW-8	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
03/09/2023	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2023	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Flash Point	Metal	PAH																	
		Flash Point	Lead	1-Methylnaphthalene	2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(b+k)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Phenanthrene	Pyrene
Date	**Location Code**	degrees F	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	µg/L	µg/L
MTCA - GW - Method A		-	15	-	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-
MTCA - GW - Method B - VI		-	-	0.17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2023	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/15/2024	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/19/2014	MW-9	-	-	**0.59**	**0.61**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.079**	<0.02	**0.049**	**0.027**
11/18/2014	MW-9	-	-	**6.5**	**7.9**	**0.027**	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.15**	<0.02	**0.15**	<0.02
03/20/2015	MW-9	-	-	**85**	**190**	<0.4	<0.4	<0.4	<0.4	<0.4	-	<0.8	<0.4	-	<0.4	<0.4	<0.4	**0.59**	<0.4	**0.48**	<0.4
06/16/2015	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/17/2015	MW-9	-	-	**27**	**59**	<0.4	<0.4	<0.4	<0.4	<0.4	-	<0.8	<0.4	-	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
09/24/2015	MW-9	-	-	**37**	**51**	<1	<1	<1	<1	<1	-	<2	<1	-	<1	<1	<1	<1	<1	<1	<1
12/08/2015	MW-9	-	-	**13**	**24**	<1	<1	<1	<1	<1	-	<2	<1	-	<1	<1	<1	<1	<1	<1	<1
03/10/2016	MW-9	-	-	**0.055**	**0.094**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
06/16/2016	MW-9	-	-	**6.1**	**19**	<0.4	<0.4	<0.4	<0.4	<0.4	-	<0.4	<0.4	-	<0.4	<0.4	<0.4	<0.4	<0.4	**0.52**	<0.4
03/23/2017	MW-9	-	-	**0.42**	**0.035**	**0.022**	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.055**	<0.02	**0.042**	<0.02
06/22/2017	MW-9	-	-	**37**	**25**	<2	<2	<2	<2	<2	-	<4	<2	-	<2	<2	<2	<2	<2	<2	<2
09/20/2017	MW-9	-	-	**20**	**22**	<2	<2	<2	<2	<2	-	<4	<2	-	<2	<2	<2	<2	<2	<2	<2
12/07/2017	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-9	-	-	**10**	**16**	<0.4	<0.4	<0.4	<0.4	<0.4	-	<0.8	<0.4	-	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
03/19/2018	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	MW-9	-	-	**1.3**	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	-	<0.8	<0.4	-	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
03/19/2018	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2018	MW-9	-	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	<0.4	<0.2	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
09/26/2018	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-9	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
11/29/2018	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	MW-9	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
03/20/2019	MW-9	-	-	**0.1**	**0.21**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
03/20/2019	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-9	-	-	**15**	**28**	<1	<1	<1	<1	<1	-	<2	<1	-	<1	<1	<1	<1	<1	<1	<1
06/11/2019	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-9	-	-	**0.024**	**0.028**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
09/22/2019	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	MW-9	-	-	**25**	**33**	<2	<2	<2	<2	<2	-	<4	<2	-	<2	<2	<2	<2	<2	<2	<2
06/23/2020	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/25/2020	MW-9	-	-	**1.5**	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	<0.4	<0.2	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
09/23/2020	MW-9	-	-	**1.4**	**0.57**	<0.04	<0.04	<0.04	<0.04	<0.04	-	<0.08	<0.04	-	<0.04	<0.04	<0.04	**0.11**	<0.04	**0.068**	<0.04
12/09/2020	MW-9	-	-	**29**	**49**	<1	<1	<1	<1	<1	-	<2	<1	-	<1	<1	<1	<1	<1	<1	<1
03/24/2021	MW-9	-	-	**27**	**51**	<1	<1	<1	<1	<1	-	<2	<1	-	<1	<1	<1	<1	<1	<1	<1
06/15/2021	MW-9	-	-	**6.6**	**8.4**	<1	<1	<1	<1	<1	-	<2	<1	-	<1	<1	<1	<1	<1	<1	<1
09/28/2021	MW-9	-	-	**11**	**13**	<1	<1	<1	<1	<1	-	<2	<1	-	<1	<1	<1	<1	<1	<1	<1
12/08/2021	MW-9	-	-	**43**	**84**	<1	<1	<1	<1	<1	-	<2	<1	-	<1	<1	<1	<1	<1	**1.2**	<1
03/22/2022	MW-9	-	-	**31**	**50**	<1	<1	<1	<1	<1	-	<2	<1	-	<1	<1	<1	<1	<1	<1	<1
06/22/2022	MW-9	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
09/20/2022	MW-9	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
12/20/2022	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/09/2023	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/21/2023	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2023	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/15/2024	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/19/2014	MW-10	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
11/18/2014	MW-10	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
03/20/2015	MW-10	-	-	**0.073**	**0.058**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
06/16/2015	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/17/2015	MW-10	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
09/24/2015	MW-10	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Flash Point	Metal	PAH																	
Date	Location Code	Flash Point	Lead	1-Methylnaphthalene	2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(b+k)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Phenanthrene	Pyrene
		degrees F	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	µg/L	µg/L
MTCA - GW - Method A		-	15	-	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-
MTCA - GW - Method B - VI		-	-	0.17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2015	MW-10	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
03/10/2016	MW-10	-	-	**1.3**	**0.14**	**0.061**	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.094**	<0.02	<0.02	<0.02
06/16/2016	MW-10	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
09/22/2016	MW-10	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
11/16/2016	MW-10	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
03/23/2017	MW-10	-	-	**3.5**	**1.5**	<0.5	<0.5	<0.5	<0.5	<0.5	-	<1	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
06/22/2017	MW-10	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
09/20/2017	MW-10	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
12/07/2017	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-10	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
03/19/2018	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	MW-10	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
06/22/2018	MW-10	-	-	**5.4**	**10**	<2	<2	<2	<2	<2	-	<4	<2	-	<2	<2	<2	<2	<2	<2	<2
06/22/2018	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-10	-	-	**5.7**	**7.1**	<2	<2	<2	<2	<2	-	<4	<2	-	<2	<2	<2	<2	<2	<2	<2
03/20/2019	MW-10	-	-	**10**	**19**	<2	<2	<2	<2	<2	-	<4	<2	-	<2	<2	<2	<2	<2	<2	<2
03/20/2019	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-10	-	-	**22**	**35**	<1	<1	<1	<1	<1	-	<2	<1	-	<1	<1	<1	<1	<1	<1	<1
06/11/2019	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-10	-	-	**2.7**	**3.5**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
09/22/2019	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-10	-	-	**0.14**	**0.11**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
11/13/2019	MW-10	-	-	**0.14**	**0.11**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
11/13/2019	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2020	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2020	MW-10	-	-	**5.9**	**9.5**	<0.2	<0.2	<0.2	<0.2	<0.2	-	<0.4	<0.2	-	<0.2	<0.2	<0.2	**0.22**	<0.2	<0.2	<0.2
06/23/2020	MW-10	-	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	<0.4	<0.2	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
09/23/2020	MW-10	-	-	**2.6**	**1.3**	<0.2	<0.2	<0.2	<0.2	<0.2	-	<0.4	<0.2	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
12/08/2020	MW-10	-	-	**0.03**	**0.042**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
03/24/2021	MW-10	-	-	<0.02	**0.029**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
06/15/2021	MW-10	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
09/27/2021	MW-10	-	-	**0.18**	**0.16**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
09/28/2021	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2021	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	MW-10	-	-	**0.32**	**0.53**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.023**	<0.02	**0.024**	<0.02
03/22/2022	MW-10	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
06/22/2022	MW-10	-	-	**1.4**	**1.4**	<0.4	<0.4	<0.4	<0.4	<0.4	-	<0.8	<0.4	-	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
09/20/2022	MW-10	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
03/09/2023	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2023	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2023	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/14/2024	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/19/2014	MW-11	-	-	<0.02	<0.02	**0.29**	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.2**	<0.02	<0.02	**0.049**
11/18/2014	MW-11	-	-	**0.14**	**0.035**	**0.17**	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.76**	<0.02	**0.049**	**0.042**
03/20/2015	MW-11	-	-	<0.02	<0.02	**0.19**	<0.02	**0.036**	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.64**	<0.02	**0.093**	<0.02
06/16/2015	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/17/2015	MW-11	-	-	**0.21**	**0.047**	**0.17**	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.54**	<0.02	<0.02	<0.02
09/24/2015	MW-11	-	-	<0.1	<0.1	**0.12**	<0.1	<0.1	<0.1	<0.1	-	<0.2	<0.1	-	<0.1	<0.1	<0.1	**0.24**	<0.1	<0.1	<0.1
12/08/2015	MW-11	-	-	<0.02	<0.02	**0.094**	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.44**	<0.02	<0.02	<0.02
03/10/2016	MW-11	-	-	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	-	<0.08	<0.04	-	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
06/16/2016	MW-11	-	-	<0.02	<0.02	**0.095**	**0.024**	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
09/22/2016	MW-11	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.085**	<0.02	<0.02	<0.02
11/16/2016	MW-11	-	-	<0.02	<0.02	**0.095**	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.3**	<0.02	<0.02	**0.021**

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Flash Point	Metal	PAH																	
Date	Location Code	Flash Point	Lead	1-Methylnaphthalene	2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(b+k)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Phenanthrene	Pyrene
		degrees F	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	µg/L	µg/L
MTCA - GW - Method A		-	15	-	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-
MTCA - GW - Method B - VI		-	-	0.17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/23/2017	MW-11	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
06/22/2017	MW-11	-	-	**0.08**	**0.038**	**0.032**	<0.02	**0.037**	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.14**	<0.02	<0.02	**0.042**
09/20/2017	MW-11	-	-	**0.14**	**0.11**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.12**	<0.02	<0.02	**0.028**
12/07/2017	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-11	-	-	<0.02	<0.02	**0.13**	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.46**	<0.02	<0.02	**0.033**
03/19/2018	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	MW-11	-	-	<0.02	<0.02	**0.093**	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.42**	<0.02	<0.02	**0.028**
03/19/2018	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2018	MW-11	-	-	**5.3**	**13**	<2	<2	<2	<2	<2	-	<4	<2	-	<2	<2	<2	<2	<2	<2	<2
06/22/2018	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2018	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-11	-	-	**15**	**19**	<2	<2	<2	<2	<2	-	<4	<2	-	<2	<2	<2	<2	<2	<2	<2
11/29/2018	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	MW-11	-	-	**4.7**	**9.1**	<1	<1	<1	<1	<1	-	<2	<1	-	<1	<1	<1	<1	<1	<1	<1
03/20/2019	MW-11	-	-	**8.5**	**11**	<2	<2	<2	<2	<2	-	<4	<2	-	<2	<2	<2	<2	<2	<2	<2
03/20/2019	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-11	-	-	**1.4**	**1.5**	<0.2	<0.2	<0.2	<0.2	<0.2	-	<0.4	<0.2	-	<0.2	<0.2	<0.2	**0.32**	<0.2	<0.2	<0.2
06/11/2019	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/22/2019	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/22/2019	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-11	-	-	**3.5**	**2.4**	<0.5	<0.5	<0.5	<0.5	<0.5	-	<1	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
09/22/2019	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-11	-	-	**0.24**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.2	<0.1	-	<0.1	<0.1	<0.1	**0.13**	<0.1	<0.1	<0.1
11/13/2019	MW-11	-	-	**0.24**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.2	<0.1	-	<0.1	<0.1	<0.1	**0.13**	<0.1	<0.1	<0.1
11/13/2019	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	MW-11	-	-	**0.85**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	<1	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
06/23/2020	MW-11	-	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	<1	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
09/23/2020	MW-11	-	-	**1.4**	**1.3**	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.2	<0.1	-	<0.1	<0.1	<0.1	**0.1**	<0.1	<0.1	<0.1
12/08/2020	MW-11	-	-	**0.58**	**0.32**	**0.12**	<0.1	<0.1	<0.1	<0.1	-	<0.2	<0.1	-	<0.1	<0.1	<0.1	**0.26**	<0.1	<0.1	<0.1
03/24/2021	MW-11	-	-	**0.34**	<0.1	**0.11**	<0.1	<0.1	<0.1	<0.1	-	<0.2	<0.1	-	<0.1	<0.1	<0.1	**0.22**	<0.1	<0.1	<0.1
04/09/2021	MW-11	-	-	**9.2**	**11**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/15/2021	MW-11	-	-	**0.14**	**0.085**	**0.06**	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.11**	<0.02	<0.02	<0.02
09/27/2021	MW-11	-	-	**0.77**	**0.5**	**0.12**	<0.1	<0.1	<0.1	<0.1	-	<0.2	<0.1	-	<0.1	<0.1	<0.1	**0.27**	<0.1	<0.1	<0.1
09/28/2021	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/30/2021	MW-11	-	-	<5	**11**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	MW-11	-	-	**0.39**	**0.14**	**0.13**	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.38**	<0.02	<0.02	**0.026**
03/22/2022	MW-11	-	-	**0.28**	<0.1	**0.14**	<0.1	<0.1	<0.1	<0.1	-	<0.2	<0.1	-	<0.1	<0.1	<0.1	**0.28**	<0.1	<0.1	<0.1
06/22/2022	MW-11	-	-	**0.17**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.2	<0.1	-	<0.1	<0.1	<0.1	**0.11**	<0.1	<0.1	<0.1
09/20/2022	MW-11	-	-	**0.9**	**0.84**	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.2	<0.1	-	<0.1	<0.1	<0.1	**0.2**	<0.1	<0.1	<0.1
12/20/2022	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/09/2023	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/21/2023	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/09/2023	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/15/2024	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/22/2019	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2021	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/26/2021	MW-12	-	-	**0.099**	**0.024**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
06/15/2021	MW-12	-	-	**1.1**	<0.02	**0.047**	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.11**	<0.02	**0.04**	<0.02
09/27/2021	MW-12	-	-	**0.11**	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.041**	<0.02	<0.02	<0.02
09/28/2021	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	MW-12	-	-	**0.092**	**0.021**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.039**	<0.02	<0.02	<0.02
03/22/2022	MW-12	-	-	**1.7**	**0.34**	**0.082**	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.16**	<0.02	**0.052**	<0.02

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Flash Point	Metal	PAH																	
		Flash Point	Lead	1-Methylnaphthalene	2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(b+k)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Phenanthrene	Pyrene
Date	**Location Code**	degrees F	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	µg/L	µg/L
MTCA - GW - Method A		-	15	-	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-
MTCA - GW - Method B - VI		-	-	0.17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	MW-12	-	-	**2**	**0.22**	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.2	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
09/20/2022	MW-12	-	-	**4.1**	**0.29**	**0.14**	<0.1	<0.1	<0.1	<0.1	-	<0.2	<0.1	-	<0.1	<0.1	<0.1	**0.33**	<0.1	<0.1	<0.1
03/08/2023	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2023	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2023	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/14/2024	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2021	MW-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/26/2021	MW-13	-	-	**10**	**17**	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.1	<0.5	-	<0.5	<0.5	<0.5	**0.69**	<0.5	<0.5	<0.5
06/15/2021	MW-13	-	-	<0.02	<0.02	**0.046**	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.023**	<0.02	<0.02	<0.02
09/28/2021	MW-13	-	-	**1.4**	**0.97**	**0.14**	<0.1	<0.1	<0.1	<0.1	-	<0.2	<0.1	-	<0.1	<0.1	<0.1	**0.19**	<0.1	**0.14**	<0.1
12/08/2021	MW-13	-	-	**1.1**	**0.45**	**0.082**	<0.02	<0.02	<0.02	<0.02	-	**0.045**	<0.02	-	<0.02	**0.031**	<0.02	**0.21**	**0.025**	**0.062**	<0.02
03/22/2022	MW-13	-	-	**2.1**	**0.25**	**0.22**	<0.1	<0.1	<0.1	<0.1	-	<0.2	<0.1	-	<0.1	<0.1	<0.1	**0.4**	<0.1	**0.2**	<0.1
06/22/2022	MW-13	-	-	**0.044**	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.026**	<0.02	<0.02	<0.02
09/20/2022	MW-13	-	-	**0.16**	**0.069**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.046**	<0.02	**0.022**	<0.02
03/08/2023	MW-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	MW-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2023	MW-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2023	MW-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/14/2024	MW-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2021	MW-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/26/2021	MW-14	-	-	**0.077**	**0.097**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
06/15/2021	MW-14	-	-	**0.078**	<0.02	**0.024**	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
09/28/2021	MW-14	-	-	**1**	**0.54**	**0.05**	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.05**	<0.02	<0.02	<0.02
12/08/2021	MW-14	-	-	**1.3**	**1.7**	**0.13**	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.25**	<0.02	**0.073**	**0.021**
03/22/2022	MW-14	-	-	**0.98**	**1.6**	**0.15**	<0.02	**0.024**	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.24**	<0.02	**0.091**	**0.022**
06/22/2022	MW-14	-	-	**0.046**	**0.02**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.024**	<0.02	<0.02	<0.02
09/20/2022	MW-14	-	-	**0.085**	**0.076**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.024**	<0.02	<0.02	<0.02
06/27/2023	MW-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2023	MW-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/09/2023	MW-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/14/2024	MW-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/19/2014	MW-15	-	-	**50**	**84**	**0.56**	<0.02	**0.05**	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	**0.03**	**1.8**	<0.02	**1.3**	**0.079**
03/20/2015	MW-15	-	-	**13**	**13**	<2	**2**	<2	<2	<2	-	<4	<2	-	<2	<2	<2	<2	<2	<2	<2
06/16/2015	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/10/2016	MW-15	-	-	**38**	**63**	<4	<4	<4	<4	<4	-	<8	<4	-	<4	<4	<4	<4	<4	<4	<4
06/16/2016	MW-15	-	-	**25**	**64**	<4	<4	<4	<4	<4	-	<8	<4	-	<4	<4	<4	<4	<4	<4	<4
09/22/2016	MW-15	-	-	**34**	**100**	<4	<4	<4	<4	<4	-	<8	<4	-	<4	<4	<4	<4	<4	<4	<4
11/17/2016	MW-15	-	-	**12**	**36**	<4	<4	<4	<4	<4	-	<8	<4	-	<4	<4	<4	<4	<4	<4	<4
03/23/2017	MW-15	-	-	**88**	**190**	<5	<5	<5	<5	<5	-	<10	<5	-	<5	<5	<5	<5	<5	<5	<5
06/22/2017	MW-15	-	-	**77**	**210**	<10	<10	<10	<10	<10	-	<20	<10	-	<10	<10	<10	<10	<10	<10	<10
09/20/2017	MW-15	-	-	**130**	**190**	<10	<10	<10	<10	<10	-	<20	<10	-	<10	<10	<10	<10	<10	<10	<10
12/07/2017	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-15	-	-	**27**	**44**	<5	<5	<5	<5	<5	-	<10	<5	-	<5	<5	<5	<5	<5	<5	<5
03/18/2018	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/18/2018	MW-15	-	-	**34**	**58**	<4	<4	<4	<4	<4	-	<8	<4	-	<4	<4	<4	<4	<4	<4	<4
03/18/2018	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/21/2018	MW-15	-	-	**56**	**63**	<2	<2	<2	<2	<2	-	<4	<2	-	<2	<2	<2	**2.7**	<2	<2	<2
06/21/2018	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-15	-	-	**21**	**72**	<4	<4	<4	<4	<4	-	<8	<4	-	<4	<4	<4	<4	<4	<4	<4
11/28/2018	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/28/2018	MW-15	-	-	**6.6**	**6.5**	<1	<1	<1	<1	<1	-	<2	<1	-	<1	<1	<1	<1	<1	<1	<1
03/20/2019	MW-15	-	-	**0.91**	**0.059**	**0.11**	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	**0.024**	**0.29**	<0.02	<0.02	**0.09**
03/20/2019	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Flash Point	Metal	PAH																	
		Flash Point	Lead	1-Methylnaphthalene	2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(b+k)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Phenanthrene	Pyrene
Date	**Location Code**	degrees F	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	µg/L	µg/L
MTCA - GW - Method A		-	15	-	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-
MTCA - GW - Method B - VI		-	-	0.17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-15	-	-	**22**	**15**	<1	<1	<1	<1	<1	-	<2	<1	-	<1	<1	<1	**1.3**	<1	<1	<1
06/11/2019	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-15	-	-	**41**	**50**	<4	<4	<4	<4	<4	-	<8	<4	-	<4	<4	<4	<4	<4	<4	<4
09/22/2019	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-15	-	-	<2	<2	<2	<2	<2	<2	<2	-	<4	<2	-	<2	<2	<2	<2	<2	<2	<2
11/13/2019	MW-15	-	-	<2	<2	<2	<2	<2	<2	<2	-	<4	<2	-	<2	<2	<2	<2	<2	<2	<2
11/13/2019	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2020	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2020	MW-15	-	-	**25**	**27**	<4	<4	<4	<4	<4	-	<8	<4	-	<4	<4	<4	<4	<4	<4	<4
06/23/2020	MW-15	-	-	**37**	**70**	<4	<4	<4	<4	<4	-	<8	<4	-	<4	<4	<4	<4	<4	<4	<4
09/22/2020	MW-15	-	-	**35**	**40**	<4	<4	<4	<4	<4	-	<8	<4	-	<4	<4	<4	<4	<4	<4	<4
12/08/2020	MW-15	-	-	**23**	**32**	<8	<8	<8	<8	<8	-	<16	<8	-	<8	<8	<8	<8	<8	<8	<8
03/24/2021	MW-15	-	-	**18**	**25**	<2	<2	<2	<2	<2	-	<4	<2	-	<2	<2	<2	<2	<2	<2	<2
06/14/2021	MW-15	-	-	**12**	**20**	<2	<2	<2	<2	<2	-	<4	<2	-	<2	<2	<2	<2	<2	<2	<2
09/28/2021	MW-15	-	-	**42**	**41**	<20	<20	<20	<20	<20	-	<40	<20	-	<20	<20	<20	<20	<20	<20	<20
12/07/2021	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	MW-15	-	-	**25**	**36**	<20	<20	<20	<20	<20	-	<40	<20	-	<20	<20	<20	<20	<20	<20	<20
03/21/2022	MW-15	-	-	**37**	**52**	<2	<2	<2	<2	<2	-	<4	<2	-	<2	<2	<2	<2	<2	<2	<2
06/22/2022	MW-15	-	-	**22**	**27**	<4	<4	<4	<4	<4	-	<8	<4	-	<4	<4	<4	<4	<4	<4	<4
09/20/2022	MW-15	-	-	**37**	**62**	<2	<2	<2	<2	<2	-	<4	<2	-	<2	<2	<2	<2	<2	<2	<2
03/09/2023	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/28/2023	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2023	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/09/2023	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/14/2024	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/19/2014	MW-16	-	-	<0.02	**0.029**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
11/18/2014	MW-16	-	-	**0.45**	**0.61**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.12**	<0.02	**0.11**	<0.02
11/18/2014	MW-16	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
03/20/2015	MW-16	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
06/16/2015	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/17/2015	MW-16	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
09/24/2015	MW-16	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
12/08/2015	MW-16	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
03/10/2016	MW-16	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
06/16/2016	MW-16	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
09/22/2016	MW-16	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
11/16/2016	MW-16	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
03/23/2017	MW-16	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
06/22/2017	MW-16	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
09/20/2017	MW-16	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
12/07/2017	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-16	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
03/18/2018	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/18/2018	MW-16	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
06/21/2018	MW-16	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
09/26/2018	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-16	-	-	**0.17**	**0.19**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
11/28/2018	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/28/2018	MW-16	-	-	**0.056**	**0.062**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
03/20/2019	MW-16	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
03/20/2019	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-16	-	-	**0.16**	**0.11**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
06/11/2019	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-16	-	-	**0.04**	**0.03**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	**0.022**
09/22/2019	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Flash Point	Metal	PAH																	
Date	Location Code	Flash Point	Lead	1-Methylnaphthalene	2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(b+k)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Phenanthrene	Pyrene
		degrees F	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	µg/L	µg/L
MTCA - GW - Method A		-	15	-	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-
MTCA - GW - Method B - VI		-	-	0.17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-16	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
11/13/2019	MW-16	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
11/13/2019	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	MW-16	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
06/23/2020	MW-16	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
09/23/2020	MW-16	-	-	<0.02	**0.031**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
12/08/2020	MW-16	-	-	<0.02	**0.023**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
03/24/2021	MW-16	-	-	**0.036**	**0.054**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
06/15/2021	MW-16	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
09/28/2021	MW-16	-	-	**0.078**	**0.13**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
12/07/2021	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	MW-16	-	-	<0.02	**0.021**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
03/21/2022	MW-16	-	-	<0.02	**0.02**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
03/22/2022	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	MW-16	-	-	<0.02	**0.02**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
09/20/2022	MW-16	-	-	<0.02	**0.02**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
03/09/2023	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2023	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2023	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/15/2024	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2021	MW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/15/2021	MW-17	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
09/28/2021	MW-17	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
12/08/2021	MW-17	-	-	**0.024**	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
03/22/2022	MW-17	-	-	**0.05**	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
06/22/2022	MW-17	-	-	**0.05**	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
03/08/2023	MW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	MW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2023	MW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2023	MW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/14/2024	MW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/19/2014	RW-1	-	-	**2**	**3.7**	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.2	<0.1	-	<0.1	<0.1	<0.1	**0.25**	<0.1	**0.18**	<0.1
11/18/2014	RW-1	-	-	**13**	**14**	**0.45**	<0.4	<0.4	<0.4	<0.4	-	<0.8	<0.4	-	<0.4	<0.4	<0.4	**0.64**	<0.4	<0.4	<0.4
03/20/2015	RW-1	-	-	**0.54**	**0.37**	**0.063**	<0.04	<0.04	<0.04	<0.04	-	<0.08	<0.04	-	<0.04	<0.04	<0.04	**0.13**	<0.04	**0.14**	<0.04
06/16/2015	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/17/2015	RW-1	-	-	**0.29**	**0.044**	<0.04	<0.04	<0.04	<0.04	<0.04	-	<0.08	<0.04	-	<0.04	<0.04	<0.04	**0.097**	<0.04	**0.069**	<0.04
09/24/2015	RW-1	-	-	**0.24**	<0.02	**0.025**	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.055**	<0.02	**0.038**	<0.02
12/08/2015	RW-1	-	-	**0.3**	**0.052**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.057**	<0.02	<0.02	<0.02
03/10/2016	RW-1	-	-	**0.052**	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.036**	<0.02	<0.02	<0.02
06/16/2016	RW-1	-	-	**0.053**	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.021**	<0.02	<0.02	<0.02
09/22/2016	RW-1	-	-	**0.063**	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.042**	<0.02	<0.02	<0.02
11/17/2016	RW-1	-	-	**0.032**	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.03**	<0.02	<0.02	<0.02
03/23/2017	RW-1	-	-	**0.036**	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
06/22/2017	RW-1	-	-	**0.36**	**0.042**	**0.031**	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.074**	<0.02	**0.027**	<0.02
09/20/2017	RW-1	-	-	**0.51**	**0.073**	**0.036**	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.088**	<0.02	**0.022**	<0.02
12/07/2017	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	RW-1	-	-	**0.73**	**0.12**	**0.029**	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.077**	<0.02	**0.021**	<0.02
03/19/2018	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	RW-1	-	-	**0.12**	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.034**	<0.02	<0.02	<0.02
03/19/2018	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2018	RW-1	-	-	**0.081**	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.022**	<0.02	<0.02	<0.02
06/22/2018	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Flash Point	Metal	PAH																	
		Flash Point	Lead	1-Methylnaphthalene	2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(b+k)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Phenanthrene	Pyrene
Date	**Location Code**	degrees F	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	µg/L	µg/L
MTCA - GW - Method A		-	15	-	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-
MTCA - GW - Method B - VI		-	-	0.17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	RW-1	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
11/29/2018	RW-1	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
11/29/2018	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	RW-1	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
03/20/2019	RW-1	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
03/20/2019	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	RW-1	-	-	**0.16**	<0.02	**0.022**	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.059**	<0.02	<0.02	<0.02
06/11/2019	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	RW-1	-	-	**0.28**	<0.02	**0.026**	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.043**	<0.02	<0.02	<0.02
09/22/2019	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	RW-1	-	-	**0.22**	**0.021**	**0.026**	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.062**	<0.02	**0.031**	<0.02
11/13/2019	RW-1	-	-	**0.22**	**0.021**	**0.026**	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.062**	<0.02	**0.031**	<0.02
11/13/2019	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	RW-1	-	-	**0.09**	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.031**	<0.02	<0.02	<0.02
06/23/2020	RW-1	-	-	**0.072**	<0.02	**0.025**	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.03**	<0.02	<0.02	<0.02
09/22/2020	RW-1	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.029**	<0.02	<0.02	<0.02
09/23/2020	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/09/2020	RW-1	-	-	**0.077**	**0.02**	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
03/24/2021	RW-1	-	-	**0.14**	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.041**	<0.02	<0.02	<0.02
06/15/2021	RW-1	-	-	**0.2**	**0.023**	**0.022**	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.022**	<0.02	<0.02	<0.02
09/28/2021	RW-1	-	-	**1**	**0.063**	**0.1**	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.22**	<0.02	<0.02	<0.02
12/08/2021	RW-1	-	-	**0.69**	**0.12**	**0.045**	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.13**	<0.02	**0.033**	**0.034**
03/22/2022	RW-1	-	-	**3.2**	<0.1	**0.13**	<0.1	<0.1	<0.1	<0.1	-	<0.2	<0.1	-	<0.1	<0.1	<0.1	**0.21**	<0.1	<0.1	<0.1
06/22/2022	RW-1	-	-	**0.11**	<0.02	<0.02	<0.1	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.024**	<0.02	<0.02	<0.02
09/20/2022	RW-1	-	-	**0.061**	<0.02	<0.02	<0.1	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.047**	<0.02	<0.02	<0.02
03/09/2023	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/21/2023	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2023	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/15/2024	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/19/2014	RW-2	-	-	**15**	**26**	**0.3**	<0.02	<0.02	<0.02	<0.04	-	<0.02	<0.02	-	<0.02	<0.02	<0.02	**1**	<0.02	**0.58**	**0.047**
11/18/2014	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2015	RW-2	-	-	**5.8**	**7.5**	<0.5	<0.5	<0.5	<0.5	<0.5	-	<1	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
06/16/2015	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/17/2015	RW-2	-	-	**5.7**	**9.2**	<0.5	<0.5	<0.5	<0.5	<0.5	-	<1	<0.5	-	<0.5	<0.5	<0.5	**0.52**	<0.5	<0.5	<0.5
09/24/2015	RW-2	-	-	**17**	**29**	<0.5	<0.5	<0.5	<0.5	<0.5	-	<1	<0.5	-	<0.5	<0.5	<0.5	**0.53**	<0.5	<0.5	<0.5
12/08/2015	RW-2	-	-	**4.8**	**5.2**	<0.2	<0.2	<0.2	<0.2	<0.2	-	<0.4	<0.2	-	<0.2	<0.2	<0.2	<0.2	<0.2	**0.22**	<0.2
03/10/2016	RW-2	-	-	**3.7**	**3.8**	<0.2	<0.2	<0.2	<0.2	<0.2	-	<0.4	<0.2	-	<0.2	<0.2	<0.2	**0.37**	<0.2	<0.2	<0.2
06/16/2016	RW-2	-	-	**2.7**	**3.2**	<0.2	<0.2	<0.2	<0.2	<0.2	-	<0.4	<0.2	-	<0.2	<0.2	<0.2	**0.21**	<0.2	<0.2	<0.2
09/22/2016	RW-2	-	-	**12**	**23**	**0.28**	<0.2	<0.2	<0.2	<0.2	-	<0.4	<0.2	-	<0.2	<0.2	<0.2	**0.64**	<0.2	**0.32**	<0.2
11/16/2016	RW-2	-	-	**6.8**	**5.4**	**0.26**	<0.2	<0.2	<0.2	<0.2	-	<0.4	<0.2	-	<0.2	<0.2	<0.2	**0.47**	<0.2	<0.2	<0.2
03/23/2017	RW-2	-	-	**5.9**	**8.4**	<0.5	<0.5	<0.5	<0.5	<0.5	-	<1	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
06/22/2017	RW-2	-	-	**7.4**	**4.1**	<0.5	<0.5	<0.5	<0.5	<0.5	-	<1	<0.5	-	<0.5	<0.5	<0.5	**0.63**	<0.5	<0.5	<0.5
09/20/2017	RW-2	-	-	**11**	**9.6**	<0.5	<0.5	<0.5	<0.5	<0.5	-	<1	<0.5	-	<0.5	<0.5	<0.5	**0.8**	<0.5	<0.5	<0.5
12/07/2017	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	RW-2	-	-	**6.4**	**4.4**	<0.5	<0.5	<0.5	<0.5	<0.5	-	<1	<0.5	-	<0.5	<0.5	<0.5	**0.56**	<0.5	<0.5	<0.5
03/18/2018	RW-2	-	-	**9**	**10**	<0.5	<0.5	<0.5	<0.5	<0.5	-	<1	<0.5	-	<0.5	<0.5	<0.5	**0.59**	<0.5	<0.5	<0.5
03/18/2018	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/21/2018	RW-2	-	-	**0.4**	<0.02	**0.19**	<0.02	<0.02	<0.02	<0.02	-	**0.065**	<0.02	-	**0.035**	<0.02	<0.02	**0.29**	<0.02	<0.02	**0.044**
06/21/2018	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	RW-2	-	-	**1**	**0.048**	**0.16**	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<20	**0.23**	<0.02	<0.02	**0.03**
11/28/2018	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Flash Point	Metal	PAH																	
		Flash Point	Lead	1-Methylnaphthalene	2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(b+k)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Phenanthrene	Pyrene
Date	**Location Code**	degrees F	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	µg/L	µg/L
MTCA - GW - Method A		-	15	-	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-
MTCA - GW - Method B - VI		-	-	0.17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/28/2018	RW-2	-	-	**2.6**	**0.13**	**0.12**	<0.1	<0.1	<0.1	<0.1	-	<0.2	<0.1	-	<0.1	<0.1	<0.1	**0.23**	<0.1	<0.1	<0.1
03/20/2019	RW-2	-	-	**0.18**	<0.02	**0.088**	<0.02	<0.02	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.19**	<0.02	<0.02	**0.032**
03/20/2019	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	RW-2	-	-	**7.8**	**8.4**	<0.4	<0.4	<0.4	<0.4	<0.4	-	<0.8	<0.4	-	<0.4	<0.4	<0.4	**0.42**	<0.4	<0.4	<0.4
06/11/2019	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	RW-2	-	-	**6.8**	**5**	<0.5	<0.5	<0.5	<0.5	<0.5	-	<1	<0.5	-	<0.5	<0.5	<0.5	**0.53**	<0.5	<0.5	<0.5
09/22/2019	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	RW-2	-	-	**2.8**	**0.91**	<0.5	<0.5	<0.5	<0.5	<0.5	-	<1	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
11/13/2019	RW-2	-	-	**2.8**	**0.91**	<0.5	<0.5	<0.5	<0.5	<0.5	-	<1	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
11/13/2019	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2020	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2020	RW-2	-	-	**4.6**	**3.9**	<0.5	<0.5	<0.5	<0.5	<0.5	-	<1	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
06/23/2020	RW-2	-	-	**4.1**	**0.99**	<0.5	<0.5	<0.5	<0.5	<0.5	-	<1	<0.5	-	-	<0.5	<0.5	**0.64**	<0.5	<0.5	<0.5

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Flash Point	Metal	PAH																	
		Flash Point	Lead	1-Methylnaphthalene	2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(b+k)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-c,d)pyrene	Phenanthrene	Pyrene
Date	**Location Code**	degrees F	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	µg/L	µg/L
MTCA - GW - Method A		-	15	-	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-
MTCA - GW - Method B - VI		-	-	0.17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2020	RW-2	-	-	<0.04	<0.04	**0.059**	<0.04	**0.041**	<0.04	<0.04	-	<0.08	<0.04	-	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	**0.052**
12/08/2020	RW-2	-	-	**3.1**	**0.61**	**0.26**	<0.2	<0.2	<0.2	<0.2	-	<0.4	<0.2	-	<0.2	<0.2	<0.2	**0.53**	<0.2	<0.2	<0.2
03/24/2021	RW-2	-	-	**3.3**	**0.48**	<0.2	<0.2	<0.2	<0.2	<0.2	-	<0.4	<0.2	-	<0.2	<0.2	<0.2	**0.39**	<0.2	<0.2	<0.2
06/14/2021	RW-2	-	-	**6.2**	**6.1**	**0.3**	<0.2	<0.2	<0.2	<0.2	-	<0.4	<0.2	-	<0.2	<0.2	<0.2	**0.62**	<0.2	<0.2	<0.2
09/21/2021	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	RW-2	-	-	**5.3**	**0.85**	**0.43**	<0.2	<0.2	<0.2	<0.2	-	<0.4	<0.2	-	<0.2	<0.2	<0.2	**1.1**	<0.2	<0.2	<0.2
12/07/2021	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	RW-2	-	-	**4.9**	**5.3**	**0.21**	<0.2	<0.2	<0.2	<0.2	-	<0.4	<0.2	-	<0.2	<0.2	<0.2	**0.54**	<0.2	<0.2	<0.2
03/21/2022	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/22/2022	RW-2	-	-	**11**	**8.9**	**0.4**	<0.2	<0.2	<0.2	<0.2	-	<0.4	<0.2	-	<0.2	<0.2	<0.2	**0.87**	<0.2	**0.25**	<0.2
06/22/2022	RW-2	-	-	**4.8**	**3.4**	**0.26**	<0.2	<0.2	<0.2	<0.2	-	<0.4	<0.2	-	<0.2	<0.2	<0.2	**0.6**	<0.2	<0.2	<0.2
09/20/2022	RW-2	-	-	<0.02	<0.02	**0.092**	<0.02	**0.049**	<0.02	<0.02	-	<0.04	<0.02	-	<0.02	<0.02	<0.02	**0.053**	<0.02	<0.02	**0.058**
12/20/2022	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/09/2023	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/28/2023	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/21/2023	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/09/2023	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/14/2024	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Statistics

Number of Results	1	7	436	436	466	466	466	466	466	9	457	465	9	465	466	466	466	466	466	466
Number of Detects	1	3	284	253	102	10	13	5	2	1	4	4	1	8	6	10	181	4	81	44
Minimum Concentration	>210	<5	<0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.041	<0.02	<0.01	0.035	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Minimum Detect	210	6	0.021	0.02	0.022	0.024	0.024	0.021	0.039	0.041	0.045	0.029	0.035	0.024	0.021	0.022	0.02	0.025	0.021	0.021
Maximum Concentration	>210	46	130	210	<20	<20	<20	<20	<20	<0.094	<40	<20	<0.094	<20	<20	<20	37	<20	56	<20
Maximum Detect	210	46	130	210	19	2	6.3	0.12	0.062	0.041	0.085	0.14	0.035	0.12	1	0.29	37	0.07	56	0.83
Average Concentration *		9.7	7.5	12	0.46	0.38	0.39	0.36	0.36	0.046	0.78	0.36	0.046	0.36	0.36	0.39	0.66	0.36	0.6	0.38
Geometric Average *	210	4.9	0.4	0.31	0.077	0.056	0.056	0.052	0.052	0.046	0.1	0.052	0.045	0.052	0.052	0.056	0.11	0.052	0.072	0.061
Median Concentration *	210	2.5	0.295	0.105	0.0945	0.02	0.02	0.01	0.01	0.047	0.02	0.01	0.047	0.02	0.015	0.02	0.11	0.01	0.05	0.043
Standard Deviation *		16	16	29	1.3	0.95	0.98	0.94	0.94	0.002	2.1	0.94	0.004	0.95	0.94	1	2.1	0.94	2.8	0.94
Geometric Standard Deviation *		2.9	21	27	7.2	7.1	7.2	7	7	1	7.2	7	1.1	7	7	7.2	7.9	7	7.8	6.8
95% UCL (Student's-t) *		21.53	8.779	14.02	0.562	0.447	0.462	0.436	0.436	0.0476	0.944	0.432	0.0481	0.436	0.437	0.473	0.819	0.436	0.821	0.449
Number of Env Standard Exceedances	0	1	227	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of Env Standard Exceedances (Detects Only)	0	1	227	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% of Detects	100	43	65	58	22	2	3	1	0	11	1	1	11	2	1	2	39	1	17	9
% of Non-Detects	0	57	35	42	78	98	97	99	100	89	99	99	89	98	99	98	61	99	83	91
% of Detects at or above Env Standards	0	14	52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% of Results Below Env Standards or Non-Detect	100	86	48	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

* A Non Detect Multiplier of 0.5 has been applied.

Note
Groundwater samples screened against MTCA Method A clea
Groundwater samples ares also screened against MTCA Meth
Detected compounds are bold
BTEX = benzene, toluene, ethylbenzene, and xylenes
µg/L = microgram per liter
PAH = polycylic aromatic hydrocarbon
TPH = total petroleum hydrocarbons
VOC = volatile organic compound
E = The sample appears to extend to a ligther hydrocarbon ra
L = diesl concentration may include contributions from heavie
K = diesel concentration may include contributions from light
Z = diesel concentration may include contributions from light
J = estimated value.

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Other VOC																			
		1,1,1,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,1-Dichloropropene	1,2,3-Trichlorobenzene	1,2,3-Trichloropropane	1,2,4-Trichlorobenzene	1,2,4-Trimethylbenzene	1,2-Dibromo-3-chloropropane	1,2-Dibromoethane	1,2-Dichlorobenzene	1,2-Dichloroethane	1,2-Dichloroethene(cis)	1,2-Dichloroethene(trans)	1,2-Dichloropropane	1,3,5-Trimethylbenzene	1,3-Dichlorobenzene
Date	**Location Code**	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	ng/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MTCA - GW - Method A		-	200	-	-	-	-	-	-	-	-	-	-	0.01	-	5	-	-	-	-	-
MTCA - GW - Method B - VI		7.1	5,400	5.9	5.1	11	130	-	-	20,000	39	240	0.042	0.3	2,500	3.5	180	77	10	170	-
08/16/2010	B12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-04	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2018	B2-W	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<1	-	-	-	-	-
08/16/2018	RNMW-17	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<1	-	-	-	-	-
06/13/2019	RNMW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/22/2019	RNMW-17	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<1	-	-	-	-	-
08/22/2019	RNMW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/26/2021	RNMW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
04/09/2021	RNMW-17	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<1	-	-	-	-	-
09/30/2021	RNMW-17	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<1	-	-	-	-	-
11/09/1995	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/24/1996	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/16/2010	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/18/2011	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/07/2011	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/25/2011	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/16/2011	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/08/2012	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
05/09/2012	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2012	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2012	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/07/2013	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/12/2013	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/27/2013	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/11/2013	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2014	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2014	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/19/2014	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/18/2014	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2015	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2015	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/17/2015	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2015	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Other VOC																			
		1,1,1,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,1-Dichloropropene	1,2,3-Trichlorobenzene	1,2,3-Trichloropropane	1,2,4-Trichlorobenzene	1,2,4-Trimethylbenzene	1,2-Dibromo-3-chloropropane	1,2-Dibromoethane	1,2-Dichlorobenzene	1,2-Dichloroethane	1,2-Dichloroethene(cis)	1,2-Dichloroethene(trans)	1,2-Dichloropropane	1,3,5-Trimethylbenzene	1,3-Dichlorobenzene
Date	**Location Code**	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	ng/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MTCA - GW - Method A		-	200	-	-	-	-	-	-	-	-	-	-	0.01	-	5	-	-	-	-	-
MTCA - GW - Method B - VI		7.1	5,400	5.9	5.1	11	130	-	-	20,000	39	240	0.042	0.3	2,500	3.5	180	77	10	170	-
12/08/2015	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/10/2016	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2016	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2016	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/17/2016	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/23/2017	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2017	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2017	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	MW-1	<80	<80	<80	<80	<80	<80	<80	<320	<320,000	<320	1,800	<480	<320	<80	<80	<80	<80	<80	400	<80
03/19/2018	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2018	MW-1	<80	<80	<80	<80	<80	<80	<80	<320	<320,000	<320	1,200	<480	<320	<80	<80	<80	<80	<80	280	<80
06/22/2018	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2018	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<1	-	-	-	-	-
09/26/2018	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/23/2020	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/23/2020	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/09/2020	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2021	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2021	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
04/09/2021	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<1	-	-	-	-	-
06/15/2021	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/30/2021	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<1	-	-	-	-	-
12/08/2021	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/22/2022	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2022	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/20/2022	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/09/2023	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/28/2023	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/21/2023	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/09/2023	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/15/2024	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/16/2010	MW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/09/1995	MW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/24/1996	MW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/09/1995	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/24/1996	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/16/2010	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/18/2011	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/07/2011	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Other VOC																			
		1,1,1,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,1-Dichloropropene	1,2,3-Trichlorobenzene	1,2,3-Trichloropropane	1,2,4-Trichlorobenzene	1,2,4-Trimethylbenzene	1,2-Dibromo-3-chloropropane	1,2-Dibromoethane	1,2-Dichlorobenzene	1,2-Dichloroethane	1,2-Dichloroethene(cis)	1,2-Dichloroethene(trans)	1,2-Dichloropropane	1,3,5-Trimethylbenzene	1,3-Dichlorobenzene
Date	**Location Code**	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	ng/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MTCA - GW - Method A		-	200	-	-	-	-	-	-	-	-	-	-	0.01	-	5	-	-	-	-	-
MTCA - GW - Method B - VI		7.1	5,400	5.9	5.1	11	130	-	-	20,000	39	240	0.042	0.3	2,500	3.5	180	77	10	170	-
08/25/2011	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/16/2011	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/08/2012	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
05/09/2012	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2012	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2012	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/07/2013	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/12/2013	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/27/2013	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/11/2013	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2014	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2014	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/19/2014	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/18/2014	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2015	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2015	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/17/2015	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2015	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2015	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/10/2016	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2016	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2016	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/16/2016	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/23/2017	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2017	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2017	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/18/2018	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/18/2018	MW-3	<1	<1	<1	<1	<1	<1	<1	<4	<4,000	<4	<1	<6	<4	<1	<1	<1	<1	<1	**1.4**	<1
03/18/2018	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/21/2018	MW-3	<1	<1	<1	<1	<1	<1	<1	<2	<2,000	<2	**9.3**	<3	<2	<1	<1	<1	<1	<1	**4.8**	<1
06/21/2018	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/28/2018	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/28/2018	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2020	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2020	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2020	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/23/2020	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/23/2020	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2020	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2021	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/14/2021	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Other VOC																			
		1,1,1,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,1-Dichloropropene	1,2,3-Trichlorobenzene	1,2,3-Trichloropropane	1,2,4-Trichlorobenzene	1,2,4-Trimethylbenzene	1,2-Dibromo-3-chloropropane	1,2-Dibromoethane	1,2-Dichlorobenzene	1,2-Dichloroethane	1,2-Dichloroethene(cis)	1,2-Dichloroethene(trans)	1,2-Dichloropropane	1,3,5-Trimethylbenzene	1,3-Dichlorobenzene
Date	**Location Code**	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	ng/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MTCA - GW - Method A		-	200	-	-	-	-	-	-	-	-	-	-	0.01	-	5	-	-	-	-	-
MTCA - GW - Method B - VI		7.1	5,400	5.9	5.1	11	130	-	-	20,000	39	240	0.042	0.3	2,500	3.5	180	77	10	170	-
12/07/2021	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/22/2022	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2022	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/09/2023	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/28/2023	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/21/2023	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/09/2023	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/14/2024	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/24/1996	MW-4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/24/1996	MW-5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/24/1996	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/18/2011	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/07/2011	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/25/2011	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/16/2011	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/08/2012	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
05/09/2012	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2012	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2012	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/07/2013	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/12/2013	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/27/2013	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/11/2013	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2014	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2014	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/19/2014	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/18/2014	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2015	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2015	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/17/2015	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2015	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2015	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/10/2016	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2016	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2016	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/16/2016	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/23/2017	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2017	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2017	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/18/2018	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/18/2018	MW-6	<2	<2	<2	<2	<2	<2	<2	<8	<8,000	<8	<2	<12	<8	<2	<2	<2	<2	<2	<2	<2
03/18/2018	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/21/2018	MW-6	<3	<3	<3	<3	<3	<3	<3	<12	<12,000	<12	<3	<18	<12	<3	<3	<3	<3	<3	<3	<3
06/21/2018	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2021	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/15/2021	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Other VOC																			
		1,1,1,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,1-Dichloropropene	1,2,3-Trichlorobenzene	1,2,3-Trichloropropane	1,2,4-Trichlorobenzene	1,2,4-Trimethylbenzene	1,2-Dibromo-3-chloropropane	1,2-Dibromoethane	1,2-Dichlorobenzene	1,2-Dichloroethane	1,2-Dichloroethene(cis)	1,2-Dichloroethene(trans)	1,2-Dichloropropane	1,3,5-Trimethylbenzene	1,3-Dichlorobenzene
Date	**Location Code**	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	ng/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MTCA - GW - Method A		-	200	-	-	-	-	-	-	-	-	-	-	0.01	-	5	-	-	-	-	-
MTCA - GW - Method B - VI		7.1	5,400	5.9	5.1	11	130	-	-	20,000	39	240	0.042	0.3	2,500	3.5	180	77	10	170	-
03/22/2022	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/20/2022	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/09/2023	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2023	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2023	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/14/2024	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/19/2014	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/18/2014	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/18/2014	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2015	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2015	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2015	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/17/2015	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2015	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2015	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/10/2016	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2016	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2016	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/17/2016	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/23/2017	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2017	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2017	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	MW-7	<1	<1	<1	<1	<1	<1	<1	<2	<2,000	<2	<1	<3	<2	<1	<1	<1	<1	<1	<1	<1
06/21/2018	MW-7	<1	<1	<1	<1	<1	<1	<1	<2	<2,000	<2	<1	<3	<2	<1	<1	<1	<1	<1	<1	<1
09/26/2018	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2020	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2020	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/23/2020	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/23/2020	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/09/2020	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2021	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/15/2021	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2021	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/22/2022	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2022	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Other VOC																			
		1,1,1,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,1-Dichloropropene	1,2,3-Trichlorobenzene	1,2,3-Trichloropropane	1,2,4-Trichlorobenzene	1,2,4-Trimethylbenzene	1,2-Dibromo-3-chloropropane	1,2-Dibromoethane	1,2-Dichlorobenzene	1,2-Dichloroethane	1,2-Dichloroethene(cis)	1,2-Dichloroethene(trans)	1,2-Dichloropropane	1,3,5-Trimethylbenzene	1,3-Dichlorobenzene
Date	**Location Code**	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	ng/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MTCA - GW - Method A		-	200	-	-	-	-	-	-	-	-	-	-	0.01	-	5	-	-	-	-	-
MTCA - GW - Method B - VI		7.1	5,400	5.9	5.1	11	130	-	-	20,000	39	240	0.042	0.3	2,500	3.5	180	77	10	170	-
03/09/2023	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2023	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2023	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/14/2024	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/19/2014	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/18/2014	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2015	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2015	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/17/2015	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2015	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2015	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/10/2016	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2016	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2016	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/16/2016	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/23/2017	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2017	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2017	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	MW-8	<1	<1	<1	<1	<1	<1	<1	<2	<2,000	<2	<1	<3	<2	<1	<1	<1	<1	<1	<1	<1
06/22/2018	MW-8	<1	<1	<1	<1	<1	<1	<1	<2	<2,000	<2	<1	<3	<2	<1	<1	<1	<1	<1	<1	<1
09/26/2018	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/23/2020	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/23/2020	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/09/2020	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2021	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/15/2021	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/22/2022	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2022	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/09/2023	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2023	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Other VOC																			
		1,1,1,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,1-Dichloropropene	1,2,3-Trichlorobenzene	1,2,3-Trichloropropane	1,2,4-Trichlorobenzene	1,2,4-Trimethylbenzene	1,2-Dibromo-3-chloropropane	1,2-Dibromoethane	1,2-Dichlorobenzene	1,2-Dichloroethane	1,2-Dichloroethene(cis)	1,2-Dichloroethene(trans)	1,2-Dichloropropane	1,3,5-Trimethylbenzene	1,3-Dichlorobenzene
Date	**Location Code**	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	ng/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MTCA - GW - Method A		-	200	-	-	-	-	-	-	-	-	-	-	0.01	-	5	-	-	-	-	-
MTCA - GW - Method B - VI		7.1	5,400	5.9	5.1	11	130	-	-	20,000	39	240	0.042	0.3	2,500	3.5	180	77	10	170	-
12/08/2023	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/15/2024	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/19/2014	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/18/2014	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2015	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2015	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/17/2015	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2015	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2015	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/10/2016	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2016	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/23/2017	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2017	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2017	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	MW-9	<1	<1	<1	<1	<1	<1	<1	<4	<4,000	<4	**100**	<6	<4	<1	<1	<1	<1	<1	**31**	<1
03/19/2018	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2018	MW-9	<1	<1	<1	<1	<1	<1	<1	<2	<2,000	<2	<1	<3	<2	<1	<1	<1	<1	<1	<1	<1
09/26/2018	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/23/2020	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/25/2020	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/23/2020	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/09/2020	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2021	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/15/2021	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/22/2022	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2022	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/20/2022	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/09/2023	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/21/2023	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2023	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/15/2024	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/19/2014	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/18/2014	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2015	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2015	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/17/2015	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2015	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Other VOC																			
		1,1,1,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,1-Dichloropropene	1,2,3-Trichlorobenzene	1,2,3-Trichloropropane	1,2,4-Trichlorobenzene	1,2,4-Trimethylbenzene	1,2-Dibromo-3-chloropropane	1,2-Dibromoethane	1,2-Dichlorobenzene	1,2-Dichloroethane	1,2-Dichloroethene(cis)	1,2-Dichloroethene(trans)	1,2-Dichloropropane	1,3,5-Trimethylbenzene	1,3-Dichlorobenzene
Date	**Location Code**	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	ng/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MTCA - GW - Method A		-	200	-	-	-	-	-	-	-	-	-	-	0.01	-	5	-	-	-	-	-
MTCA - GW - Method B - VI		7.1	5,400	5.9	5.1	11	130	-	-	20,000	39	240	0.042	0.3	2,500	3.5	180	77	10	170	-
12/08/2015	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/10/2016	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2016	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2016	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/16/2016	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/23/2017	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2017	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2017	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	MW-10	<1	<1	<1	<1	<1	<1	<1	<2	<2,000	<2	<1	<3	<2	<1	<1	<1	<1	<1	<1	<1
06/22/2018	MW-10	<200	<100	<200	<200	<200	<200	<200	<800	<800,000	<800	**560**	<1,200	<800	<200	<200	<200	<200	<200	**240**	<200
06/22/2018	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2020	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2020	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/23/2020	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/23/2020	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2020	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2021	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/15/2021	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/27/2021	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2021	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/22/2022	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2022	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/09/2023	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2023	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2023	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/14/2024	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/19/2014	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/18/2014	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2015	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2015	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/17/2015	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2015	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2015	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/10/2016	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2016	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2016	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/16/2016	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Other VOC																			
		1,1,1,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,1-Dichloropropene	1,2,3-Trichlorobenzene	1,2,3-Trichloropropane	1,2,4-Trichlorobenzene	1,2,4-Trimethylbenzene	1,2-Dibromo-3-chloropropane	1,2-Dibromoethane	1,2-Dichlorobenzene	1,2-Dichloroethane	1,2-Dichloroethene(cis)	1,2-Dichloroethene(trans)	1,2-Dichloropropane	1,3,5-Trimethylbenzene	1,3-Dichlorobenzene
Date	**Location Code**	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	ng/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MTCA - GW - Method A		-	200	-	-	-	-	-	-	-	-	-	-	0.01	-	5	-	-	-	-	-
MTCA - GW - Method B - VI		7.1	5,400	5.9	5.1	11	130	-	-	20,000	39	240	0.042	0.3	2,500	3.5	180	77	10	170	-
03/23/2017	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2017	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2017	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	MW-11	<1	<1	<1	<1	<1	<1	<1	<2	<2,000	<2	<1	<3	<2	<1	<1	<1	<1	<1	<1	<1
03/19/2018	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2018	MW-11	<500	<500	<500	<500	<500	<500	<500	<2,000	<2,000,000	<2,000	<500	<3,000	<2,000	<500	<500	<500	<500	<500	<500	<500
06/22/2018	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2018	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<1	-	-	-	-	-
09/26/2018	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/22/2019	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<1	-	-	-	-	-
08/22/2019	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	<5	-	<5	-	-	-	-	-
09/22/2019	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/23/2020	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/23/2020	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2020	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2021	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
04/09/2021	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<1	-	-	-	-	-
06/15/2021	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/27/2021	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/30/2021	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	<0.01	-	<1	-	-	-	-	-
12/08/2021	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/22/2022	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2022	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/20/2022	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/09/2023	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/21/2023	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/09/2023	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/15/2024	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/22/2019	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	<5	-	<5	-	-	-	-	-
03/25/2021	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/26/2021	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/15/2021	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/27/2021	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/22/2022	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Other VOC																			
		1,1,1,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,1-Dichloropropene	1,2,3-Trichlorobenzene	1,2,3-Trichloropropane	1,2,4-Trichlorobenzene	1,2,4-Trimethylbenzene	1,2-Dibromo-3-chloropropane	1,2-Dibromoethane	1,2-Dichlorobenzene	1,2-Dichloroethane	1,2-Dichloroethene(cis)	1,2-Dichloroethene(trans)	1,2-Dichloropropane	1,3,5-Trimethylbenzene	1,3-Dichlorobenzene
Date	**Location Code**	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	ng/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MTCA - GW - Method A		-	200	-	-	-	-	-	-	-	-	-	-	0.01	-	5	-	-	-	-	-
MTCA - GW - Method B - VI		7.1	5,400	5.9	5.1	11	130	-	-	20,000	39	240	0.042	0.3	2,500	3.5	180	77	10	170	-
06/22/2022	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2022	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/08/2023	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2023	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2023	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/14/2024	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2021	MW-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/26/2021	MW-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/15/2021	MW-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	MW-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	MW-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/22/2022	MW-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	MW-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2022	MW-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/08/2023	MW-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	MW-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2023	MW-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2023	MW-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/14/2024	MW-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2021	MW-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/26/2021	MW-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/15/2021	MW-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	MW-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	MW-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/22/2022	MW-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	MW-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2022	MW-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	MW-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2023	MW-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/09/2023	MW-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/14/2024	MW-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/19/2014	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2015	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2015	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/10/2016	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2016	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2016	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/17/2016	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/23/2017	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2017	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2017	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/18/2018	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/18/2018	MW-15	<20	<20	<20	<20	<20	<20	<20	<80	<80,000	<80	**580**	<120	<80	<20	<20	<20	<20	<20	**81**	<20
03/18/2018	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/21/2018	MW-15	<20	<20	<20	<20	<20	<20	<20	<80	<80,000	<80	**460**	<120	<80	<20	<20	<20	<20	<20	**88**	<20
06/21/2018	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/28/2018	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/28/2018	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Other VOC																			
		1,1,1,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,1-Dichloropropene	1,2,3-Trichlorobenzene	1,2,3-Trichloropropane	1,2,4-Trichlorobenzene	1,2,4-Trimethylbenzene	1,2-Dibromo-3-chloropropane	1,2-Dibromoethane	1,2-Dichlorobenzene	1,2-Dichloroethane	1,2-Dichloroethene(cis)	1,2-Dichloroethene(trans)	1,2-Dichloropropane	1,3,5-Trimethylbenzene	1,3-Dichlorobenzene
Date	**Location Code**	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	ng/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MTCA - GW - Method A		-	200	-	-	-	-	-	-	-	-	-	-	0.01	-	5	-	-	-	-	-
MTCA - GW - Method B - VI		7.1	5,400	5.9	5.1	11	130	-	-	20,000	39	240	0.042	0.3	2,500	3.5	180	77	10	170	-
06/11/2019	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2020	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2020	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/23/2020	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2020	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2020	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2021	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/14/2021	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2021	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/21/2022	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2022	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/09/2023	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/28/2023	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2023	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/09/2023	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/14/2024	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/19/2014	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/18/2014	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/18/2014	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2015	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2015	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/17/2015	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2015	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2015	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/10/2016	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2016	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2016	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/16/2016	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/23/2017	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2017	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2017	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/18/2018	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/18/2018	MW-16	<1	<1	<1	<1	<1	<1	<1	<2	<2,000	<2	<1	<3	<2	<1	<1	<1	<1	<1	<1	<1
06/21/2018	MW-16	<1	<1	<1	<1	<1	<1	<1	<2	<2,000	<2	<1	<3	<2	<1	<1	<1	<1	<1	<1	<1
09/26/2018	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/28/2018	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/28/2018	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Other VOC																			
		1,1,1,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,1-Dichloropropene	1,2,3-Trichlorobenzene	1,2,3-Trichloropropane	1,2,4-Trichlorobenzene	1,2,4-Trimethylbenzene	1,2-Dibromo-3-chloropropane	1,2-Dibromoethane	1,2-Dichlorobenzene	1,2-Dichloroethane	1,2-Dichloroethene(cis)	1,2-Dichloroethene(trans)	1,2-Dichloropropane	1,3,5-Trimethylbenzene	1,3-Dichlorobenzene
Date	**Location Code**	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	ng/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MTCA - GW - Method A		-	200	-	-	-	-	-	-	-	-	-	-	0.01	-	5	-	-	-	-	-
MTCA - GW - Method B - VI		7.1	5,400	5.9	5.1	11	130	-	-	20,000	39	240	0.042	0.3	2,500	3.5	180	77	10	170	-
11/13/2019	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/23/2020	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/23/2020	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2020	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2021	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/15/2021	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2021	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/21/2022	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/22/2022	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2022	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/09/2023	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2023	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2023	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/15/2024	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2021	MW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/15/2021	MW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	MW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	MW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/22/2022	MW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	MW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/08/2023	MW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	MW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2023	MW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2023	MW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/14/2024	MW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/19/2014	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/18/2014	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2015	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2015	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/17/2015	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2015	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2015	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/10/2016	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2016	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2016	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/17/2016	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/23/2017	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2017	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2017	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	RW-1	<1	<1	<1	<1	<1	<1	<1	<2	<2,000	<2	<1	<3	<2	<1	<1	<1	<1	<1	<1	<1
03/19/2018	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2018	RW-1	<1	<1	<1	<1	<1	<1	<1	<2	<2,000	<2	<1	<3	<2	<1	<1	<1	<1	<1	<1	<1
06/22/2018	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Other VOC																			
		1,1,1,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,1-Dichloropropene	1,2,3-Trichlorobenzene	1,2,3-Trichloropropane	1,2,4-Trichlorobenzene	1,2,4-Trimethylbenzene	1,2-Dibromo-3-chloropropane	1,2-Dibromoethane	1,2-Dichlorobenzene	1,2-Dichloroethane	1,2-Dichloroethene(cis)	1,2-Dichloroethene(trans)	1,2-Dichloropropane	1,3,5-Trimethylbenzene	1,3-Dichlorobenzene
Date	**Location Code**	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	ng/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MTCA - GW - Method A		-	200	-	-	-	-	-	-	-	-	-	-	0.01	-	5	-	-	-	-	-
MTCA - GW - Method B - VI		7.1	5,400	5.9	5.1	11	130	-	-	20,000	39	240	0.042	0.3	2,500	3.5	180	77	10	170	-
09/26/2018	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/23/2020	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2020	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/23/2020	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/09/2020	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2021	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/15/2021	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/22/2022	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2022	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/09/2023	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/21/2023	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2023	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/15/2024	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/19/2014	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/18/2014	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2015	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2015	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/17/2015	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2015	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2015	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/10/2016	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2016	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2016	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/16/2016	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/23/2017	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2017	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2017	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/18/2018	RW-2	<1	<1	<1	<1	<1	<1	<1	<4	<4,000	<4	**1.3**	<6	<4	<1	<1	<1	<1	<1	<1	<1
03/18/2018	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/21/2018	RW-2	<1	<1	<1	<1	<1	<1	<1	<4	<4,000	<4	**9.5**	<6	<4	<1	<1	<1	<1	<1	**4.3**	<1
06/21/2018	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/28/2018	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Other VOC																			
		1,1,1,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,1-Dichloropropene	1,2,3-Trichlorobenzene	1,2,3-Trichloropropane	1,2,4-Trichlorobenzene	1,2,4-Trimethylbenzene	1,2-Dibromo-3-chloropropane	1,2-Dibromoethane	1,2-Dichlorobenzene	1,2-Dichloroethane	1,2-Dichloroethene(cis)	1,2-Dichloroethene(trans)	1,2-Dichloropropane	1,3,5-Trimethylbenzene	1,3-Dichlorobenzene
Date	**Location Code**	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	ng/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MTCA - GW - Method A		-	200	-	-	-	-	-	-	-	-	-	-	0.01	-	5	-	-	-	-	-
MTCA - GW - Method B - VI		7.1	5,400	5.9	5.1	11	130	-	-	20,000	39	240	0.042	0.3	2,500	3.5	180	77	10	170	-
11/28/2018	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2020	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2020	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/23/2020	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Other VOC																			
Date	**Location Code**	1,1,1,2-Tetrachloroethane µg/L	1,1,1-Trichloroethane µg/L	1,1,2,2-Tetrachloroethane µg/L	1,1,2-Trichloroethane µg/L	1,1-Dichloroethane µg/L	1,1-Dichloroethene µg/L	1,1-Dichloropropene µg/L	1,2,3-Trichlorobenzene µg/L	1,2,3-Trichloropropane ng/L	1,2,4-Trichlorobenzene µg/L	1,2,4-Trimethylbenzene 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-Dichloroethene(cis) µg/L	1,2-Dichloroethene(trans) µg/L	1,2-Dichloropropane µg/L	1,3,5-Trimethylbenzene µg/L	1,3-Dichlorobenzene µg/L
MTCA - GW - Method A		-	200	-	-	-	-	-	-	-	-	-	-	0.01	-	5	-	-	-	-	-
MTCA - GW - Method B - VI		7.1	5,400	5.9	5.1	11	130	-	-	20,000	39	240	0.042	0.3	2,500	3.5	180	77	10	170	-
09/22/2020	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2020	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2021	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/14/2021	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/21/2021	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2021	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/21/2022	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/22/2022	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2022	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/20/2022	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/09/2023	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/28/2023	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/21/2023	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/09/2023	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/14/2024	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Statistics																					
Number of Results		24	24	24	24	24	24	24	24	24	24	24	24	38	24	38	24	24	24	24	24
Number of Detects		0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	9	0
Minimum Concentration		<1	<1	<1	<1	<1	<1	<1	<2	<2,000	<2	<1	<3	<0.01	<1	<1	<1	<1	<1	<1	<1
Minimum Detect		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.3	ND	ND	ND	ND	ND	ND	ND	1.4	ND
Maximum Concentration		<500	<500	<500	<500	<500	<500	<500	<2,000	<2,000,000	<2,000	1,800	<3,000	<2,000	<500	<500	<500	<500	<500	<500	<500
Maximum Detect		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1,800	ND	ND	ND	ND	ND	ND	ND	400	ND
Average Concentration *		19	17	19	19	19	19	19	76	76,250	76	207	114	48	19	12	19	19	19	58	19
Geometric Average *		1.6	1.6	1.6	1.6	1.6	1.6	1.6	4.6	4,553	4.6	5.4	6.8	0.51	1.6	1.1	1.6	1.6	1.6	3.5	1.6
Median Concentration *		0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.5	1,500	1.5	0.75	2.25	1	0.5	0.5	0.5	0.5	0.5	0.75	0.5
Standard Deviation *		54	52	54	54	54	54	54	216	216,187	216	446	324	174	54	44	54	54	54	113	54
Geometric Standard Deviation *		7.4	7	7.4	7.4	7.4	7.4	7.4	9.3	9.3	9.3	23	9.3	38	7.4	5.4	7.4	7.4	7.4	13	7.4
95% UCL (Student's-t) *		38.08	35.18	38.08	38.08	38.08	38.08	38.08	151.9	151,881	151.9	363.6	227.8	96.03	38.08	24.32	38.08	38.08	38.08	97.39	38.08
Number of Env Standard Exceedances		0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	3	0
Number of Env Standard Exceedances (Detects Only)		0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	3	0
% of Detects		0	0	0	0	0	0	0	0	0	0	38	0	0	0	0	0	0	0	38	0
% of Non-Detects		100	100	100	100	100	100	100	100	100	100	62	100	100	100	100	100	100	100	62	100
% of Detects at or above Env Standards		0	0	0	0	0	0	0	0	0	0	21	0	0	0	0	0	0	0	12	0
% of Results Below Env Standards or Non-Detect		100	100	100	100	100	100	100	100	100	100	79	100	100	100	100	100	100	100	88	100

* A Non Detect Multiplier of 0.5 has been applied.

Note
Groundwater samples screened against MTCA Method A clea
Groundwater samples ares also screened against MTCA Meth
Detected compounds are bold
BTEX = benzene, toluene, ethylbenzene, and xylenes
µg/L = microgram per liter
PAH = polycylic aromatic hydrocarbon
TPH = total petroleum hydrocarbons
VOC = volatile organic compound
E = The sample appears to extend to a ligther hydrocarbon ra
L = diesl concentration may include contributions from heavie
K = diesel concentration may include contributions from light
Z = diesel concentration may include contributions from light
J = estimated value.

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Other VOC																		
Date	Location Code	1,3-Dichloropropane µg/L	1,3-Dichloropropene(cis) µg/L	1,3-Dichloropropene(trans) µg/L	1,4-Dichlorobenzene µg/L	2,2-Dichloropropane µg/L	2-chlorotoluene µg/L	4-Chlorotoluene µg/L	Bromobenzene µg/L	Bromochloromethane µg/L	Bromodichloromethane µg/L	Bromoform µg/L	Bromomethane µg/L	Carbon tetrachloride µg/L	Chlorobenzene µg/L	Chlorodibromomethane µg/L	Chloroethane µg/L	Chloroform µg/L	Chloromethane µg/L	Dibromomethane µg/L	Dichlorodifluoromethane µg/L
MTCA - GW - Method A		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MTCA - GW - Method B - VI		-	-	-	5	-	-	-	630	-	1.4	220	11	0.62	340	-	15,000	1.2	150	97	4.2
08/16/2010	B12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-04	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2018	B2-W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2018	RNMW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/13/2019	RNMW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/22/2019	RNMW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/22/2019	RNMW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/26/2021	RNMW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
04/09/2021	RNMW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/30/2021	RNMW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/09/1995	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/24/1996	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/16/2010	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/18/2011	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/07/2011	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/25/2011	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/16/2011	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/08/2012	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
05/09/2012	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2012	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2012	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/07/2013	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/12/2013	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/27/2013	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/11/2013	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2014	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2014	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/19/2014	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/18/2014	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2015	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2015	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/17/2015	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2015	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Other VOC																		
		1,3-Dichloropropane	1,3-Dichloropropene(cis)	1,3-Dichloropropene(trans)	1,4-Dichlorobenzene	2,2-Dichloropropane	2-chlorotoluene	4-Chlorotoluene	Bromobenzene	Bromochloromethane	Bromodichloromethane	Bromoform	Bromomethane	Carbon tetrachloride	Chlorobenzene	Chlorodibromomethane	Chloroethane	Chloroform	Chloromethane	Dibromomethane	Dichlorodifluoromethane
Date	**Location Code**	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	µg/L	µg/L	µg/L
MTCA - GW - Method A		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MTCA - GW - Method B - VI		-	-	-	5	-	-	-	630	-	1.4	220	11	0.62	340	-	15,000	1.2	150	97	4.2
12/08/2015	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/10/2016	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2016	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2016	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/17/2016	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/23/2017	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2017	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2017	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	MW-1	<80	<80	<80	<80	<80	<80	<80	<80	<80	<80	<80	<320	<80	<80	<80	<80	<80	<320	<80	<80
03/19/2018	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2018	MW-1	<80	<80	<80	<80	<80	<80	<80	<80	<80	<80	<80	<320	<80	<80	<80	<80	<80	<320	<80	<80
06/22/2018	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2018	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/23/2020	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/23/2020	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/09/2020	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2021	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2021	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
04/09/2021	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/15/2021	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/30/2021	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/22/2022	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2022	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/20/2022	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/09/2023	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/28/2023	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/21/2023	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/09/2023	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/15/2024	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/16/2010	MW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/09/1995	MW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/24/1996	MW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/09/1995	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/24/1996	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/16/2010	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/18/2011	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/07/2011	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Other VOC																		
Date	Location Code	1,3-Dichloropropane µg/L	1,3-Dichloropropene(cis) µg/L	1,3-Dichloropropene(trans) µg/L	1,4-Dichlorobenzene µg/L	2,2-Dichloropropane µg/L	2-chlorotoluene µg/L	4-Chlorotoluene µg/L	Bromobenzene µg/L	Bromochloromethane µg/L	Bromodichloromethane µg/L	Bromoform µg/L	Bromomethane µg/L	Carbon tetrachloride µg/L	Chlorobenzene µg/L	Chlorodibromomethane µg/L	Chloroethane µg/L	Chloroform µg/L	Chloromethane µg/L	Dibromomethane µg/L	Dichlorodifluoromethane µg/L
MTCA - GW - Method A		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MTCA - GW - Method B - VI		-	-	-	5	-	-	-	630	-	1.4	220	11	0.62	340	-	15,000	1.2	150	97	4.2
08/25/2011	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/16/2011	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/08/2012	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
05/09/2012	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2012	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2012	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/07/2013	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/12/2013	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/27/2013	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/11/2013	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2014	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2014	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/19/2014	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/18/2014	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2015	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2015	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/17/2015	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2015	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2015	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/10/2016	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2016	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2016	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/16/2016	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/23/2017	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2017	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2017	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/18/2018	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/18/2018	MW-3	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<4	<1	<1	<1	<1	<1	<4	<1	<1
03/18/2018	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/21/2018	MW-3	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<1	<1	<1	<1	<2	<1	<1
06/21/2018	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/28/2018	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/28/2018	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2020	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2020	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2020	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/23/2020	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/23/2020	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2020	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2021	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/14/2021	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Other VOC																		
Date	Location Code	1,3-Dichloropropane µg/L	1,3-Dichloropropene(cis) µg/L	1,3-Dichloropropene(trans) µg/L	1,4-Dichlorobenzene µg/L	2,2-Dichloropropane µg/L	2-chlorotoluene µg/L	4-Chlorotoluene µg/L	Bromobenzene µg/L	Bromochloromethane µg/L	Bromodichloromethane µg/L	Bromoform µg/L	Bromomethane µg/L	Carbon tetrachloride µg/L	Chlorobenzene µg/L	Chlorodibromomethane µg/L	Chloroethane µg/L	Chloroform µg/L	Chloromethane µg/L	Dibromomethane µg/L	Dichlorodifluoromethane µg/L
MTCA - GW - Method A		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MTCA - GW - Method B - VI		-	-	-	5	-	-	-	630	-	1.4	220	11	0.62	340	-	15,000	1.2	150	97	4.2
12/07/2021	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/22/2022	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2022	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/09/2023	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/28/2023	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/21/2023	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/09/2023	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/14/2024	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/24/1996	MW-4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/24/1996	MW-5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/24/1996	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/18/2011	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/07/2011	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/25/2011	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/16/2011	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/08/2012	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
05/09/2012	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2012	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2012	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/07/2013	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/12/2013	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/27/2013	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/11/2013	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2014	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2014	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/19/2014	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/18/2014	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2015	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2015	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/17/2015	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2015	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2015	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/10/2016	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2016	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2016	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/16/2016	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/23/2017	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2017	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2017	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/18/2018	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/18/2018	MW-6	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<8	<2	<2	<2	<2	<2	<8	<2	<2
03/18/2018	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/21/2018	MW-6	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<12	<3	<3	<3	<3	<3	<12	<3	<3
06/21/2018	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2021	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/15/2021	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Other VOC																		
Date	Location Code	1,3-Dichloropropane µg/L	1,3-Dichloropropene(cis) µg/L	1,3-Dichloropropene(trans) µg/L	1,4-Dichlorobenzene µg/L	2,2-Dichloropropane µg/L	2-chlorotoluene µg/L	4-Chlorotoluene µg/L	Bromobenzene µg/L	Bromochloromethane µg/L	Bromodichloromethane µg/L	Bromoform µg/L	Bromomethane µg/L	Carbon tetrachloride µg/L	Chlorobenzene µg/L	Chlorodibromomethane µg/L	Chloroethane µg/L	Chloroform µg/L	Chloromethane µg/L	Dibromomethane µg/L	Dichlorodifluoromethane µg/L
MTCA - GW - Method A		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MTCA - GW - Method B - VI		-	-	-	5	-	-	-	630	-	1.4	220	11	0.62	340	-	15,000	1.2	150	97	4.2
03/22/2022	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/20/2022	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/09/2023	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2023	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2023	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/14/2024	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/19/2014	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/18/2014	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/18/2014	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2015	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2015	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2015	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/17/2015	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2015	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2015	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/10/2016	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2016	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2016	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/17/2016	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/23/2017	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2017	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2017	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	MW-7	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<1	<1	<1	<1	<2	<1	<1
06/21/2018	MW-7	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<1	<1	<1	<1	<2	<1	<1
09/26/2018	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2020	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2020	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/23/2020	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/23/2020	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/09/2020	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2021	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/15/2021	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2021	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/22/2022	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2022	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Other VOC																		
Date	Location Code	1,3-Dichloropropane µg/L	1,3-Dichloropropene(cis) µg/L	1,3-Dichloropropene(trans) µg/L	1,4-Dichlorobenzene µg/L	2,2-Dichloropropane µg/L	2-chlorotoluene µg/L	4-Chlorotoluene µg/L	Bromobenzene µg/L	Bromochloromethane µg/L	Bromodichloromethane µg/L	Bromoform µg/L	Bromomethane µg/L	Carbon tetrachloride µg/L	Chlorobenzene µg/L	Chlorodibromomethane µg/L	Chloroethane µg/L	Chloroform µg/L	Chloromethane µg/L	Dibromomethane µg/L	Dichlorodifluoromethane µg/L
MTCA - GW - Method A		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MTCA - GW - Method B - VI		-	-	-	5	-	-	-	630	-	1.4	220	11	0.62	340	-	15,000	1.2	150	97	4.2
03/09/2023	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2023	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2023	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/14/2024	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/19/2014	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/18/2014	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2015	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2015	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/17/2015	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2015	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2015	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/10/2016	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2016	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2016	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/16/2016	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/23/2017	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2017	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2017	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	MW-8	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<1	<1	<1	<1	<2	<1	<1
06/22/2018	MW-8	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<1	<1	<1	<1	<2	<1	<1
09/26/2018	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/23/2020	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/23/2020	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/09/2020	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2021	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/15/2021	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/22/2022	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2022	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/09/2023	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2023	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Other VOC																		
Date	Location Code	1,3-Dichloropropane µg/L	1,3-Dichloropropene(cis) µg/L	1,3-Dichloropropene(trans) µg/L	1,4-Dichlorobenzene µg/L	2,2-Dichloropropane µg/L	2-chlorotoluene µg/L	4-Chlorotoluene µg/L	Bromobenzene µg/L	Bromochloromethane µg/L	Bromodichloromethane µg/L	Bromoform µg/L	Bromomethane µg/L	Carbon tetrachloride µg/L	Chlorobenzene µg/L	Chlorodibromomethane µg/L	Chloroethane µg/L	Chloroform µg/L	Chloromethane µg/L	Dibromomethane µg/L	Dichlorodifluoromethane µg/L
MTCA - GW - Method A		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MTCA - GW - Method B - VI		-	-	-	5	-	-	-	630	-	1.4	220	11	0.62	340	-	15,000	1.2	150	97	4.2
12/08/2023	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/15/2024	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/19/2014	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/18/2014	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2015	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2015	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/17/2015	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2015	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2015	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/10/2016	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2016	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/23/2017	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2017	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2017	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	MW-9	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<4	<1	<1	<1	<1	<1	<4	<1	<1
03/19/2018	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2018	MW-9	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<1	<1	<1	<1	<2	<1	<1
09/26/2018	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/23/2020	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/25/2020	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/23/2020	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/09/2020	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2021	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/15/2021	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/22/2022	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2022	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/20/2022	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/09/2023	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/21/2023	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2023	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/15/2024	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/19/2014	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/18/2014	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2015	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2015	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/17/2015	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2015	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Other VOC																		
Date	Location Code	1,3-Dichloropropane µg/L	1,3-Dichloropropene(cis) µg/L	1,3-Dichloropropene(trans) µg/L	1,4-Dichlorobenzene µg/L	2,2-Dichloropropane µg/L	2-chlorotoluene µg/L	4-Chlorotoluene µg/L	Bromobenzene µg/L	Bromochloromethane µg/L	Bromodichloromethane µg/L	Bromoform µg/L	Bromomethane µg/L	Carbon tetrachloride µg/L	Chlorobenzene µg/L	Chlorodibromomethane µg/L	Chloroethane µg/L	Chloroform µg/L	Chloromethane µg/L	Dibromomethane µg/L	Dichlorodifluoromethane µg/L
MTCA - GW - Method A		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MTCA - GW - Method B - VI		-	-	-	5	-	-	-	630	-	1.4	220	11	0.62	340	-	15,000	1.2	150	97	4.2
12/08/2015	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/10/2016	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2016	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2016	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/16/2016	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/23/2017	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2017	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2017	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	MW-10	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<1	<1	<1	<1	<2	<1	<1
06/22/2018	MW-10	<200	<100	<200	<200	<200	<200	<200	<200	<200	<200	<200	<2,000	<200	<200	<200	<200	<200	<800	<200	<200
06/22/2018	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2020	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2020	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/23/2020	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/23/2020	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2020	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2021	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/15/2021	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/27/2021	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2021	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/22/2022	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2022	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/09/2023	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2023	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2023	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/14/2024	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/19/2014	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/18/2014	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2015	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2015	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/17/2015	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2015	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2015	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/10/2016	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2016	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2016	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/16/2016	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Other VOC																		
Date	Location Code	1,3-Dichloropropane µg/L	1,3-Dichloropropene(cis) µg/L	1,3-Dichloropropene(trans) µg/L	1,4-Dichlorobenzene µg/L	2,2-Dichloropropane µg/L	2-chlorotoluene µg/L	4-Chlorotoluene µg/L	Bromobenzene µg/L	Bromochloromethane µg/L	Bromodichloromethane µg/L	Bromoform µg/L	Bromomethane µg/L	Carbon tetrachloride µg/L	Chlorobenzene µg/L	Chlorodibromomethane µg/L	Chloroethane µg/L	Chloroform µg/L	Chloromethane µg/L	Dibromomethane µg/L	Dichlorodifluoromethane µg/L
MTCA - GW - Method A		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MTCA - GW - Method B - VI		-	-	-	5	-	-	-	630	-	1.4	220	11	0.62	340	-	15,000	1.2	150	97	4.2
03/23/2017	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2017	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2017	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	MW-11	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<1	<1	<1	<1	<2	<1	<1
03/19/2018	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2018	MW-11	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<2,000	<500	<500	<500	<500	<500	<2,000	<500	<500
06/22/2018	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2018	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/22/2019	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/22/2019	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/23/2020	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/23/2020	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2020	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2021	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
04/09/2021	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/15/2021	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/27/2021	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/30/2021	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/22/2022	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2022	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/20/2022	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/09/2023	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/21/2023	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/09/2023	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/15/2024	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/22/2019	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2021	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/26/2021	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/15/2021	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/27/2021	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/22/2022	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Other VOC																		
Date	Location Code	1,3-Dichloropropane µg/L	1,3-Dichloropropene(cis) µg/L	1,3-Dichloropropene(trans) µg/L	1,4-Dichlorobenzene µg/L	2,2-Dichloropropane µg/L	2-chlorotoluene µg/L	4-Chlorotoluene µg/L	Bromobenzene µg/L	Bromochloromethane µg/L	Bromodichloromethane µg/L	Bromoform µg/L	Bromomethane µg/L	Carbon tetrachloride µg/L	Chlorobenzene µg/L	Chlorodibromomethane µg/L	Chloroethane µg/L	Chloroform µg/L	Chloromethane µg/L	Dibromomethane µg/L	Dichlorodifluoromethane µg/L
MTCA - GW - Method A		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MTCA - GW - Method B - VI		-	-	-	5	-	-	-	630	-	1.4	220	11	0.62	340	-	15,000	1.2	150	97	4.2
06/22/2022	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2022	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/08/2023	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2023	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2023	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/14/2024	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2021	MW-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/26/2021	MW-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/15/2021	MW-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	MW-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	MW-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/22/2022	MW-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	MW-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2022	MW-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/08/2023	MW-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	MW-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2023	MW-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2023	MW-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/14/2024	MW-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2021	MW-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/26/2021	MW-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/15/2021	MW-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	MW-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	MW-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/22/2022	MW-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	MW-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2022	MW-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	MW-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2023	MW-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/09/2023	MW-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/14/2024	MW-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/19/2014	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2015	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2015	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/10/2016	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2016	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2016	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/17/2016	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/23/2017	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2017	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2017	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/18/2018	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/18/2018	MW-15	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<80	<20	<20	<20	<20	<20	<80	<20	<20
03/18/2018	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/21/2018	MW-15	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<80	<20	<20	<20	<20	<20	<80	<20	<20
06/21/2018	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/28/2018	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/28/2018	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Other VOC																		
Date	Location Code	1,3-Dichloropropane µg/L	1,3-Dichloropropene(cis) µg/L	1,3-Dichloropropene(trans) µg/L	1,4-Dichlorobenzene µg/L	2,2-Dichloropropane µg/L	2-chlorotoluene µg/L	4-Chlorotoluene µg/L	Bromobenzene µg/L	Bromochloromethane µg/L	Bromodichloromethane µg/L	Bromoform µg/L	Bromomethane µg/L	Carbon tetrachloride µg/L	Chlorobenzene µg/L	Chlorodibromomethane µg/L	Chloroethane µg/L	Chloroform µg/L	Chloromethane µg/L	Dibromomethane µg/L	Dichlorodifluoromethane µg/L
MTCA - GW - Method A		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MTCA - GW - Method B - VI		-	-	-	5	-	-	-	630	-	1.4	220	11	0.62	340	-	15,000	1.2	150	97	4.2
06/11/2019	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2020	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2020	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/23/2020	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2020	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2020	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2021	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/14/2021	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2021	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/21/2022	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2022	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/09/2023	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/28/2023	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2023	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/09/2023	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/14/2024	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/19/2014	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/18/2014	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/18/2014	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2015	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2015	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/17/2015	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2015	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2015	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/10/2016	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2016	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2016	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/16/2016	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/23/2017	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2017	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2017	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/18/2018	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/18/2018	MW-16	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<1	<1	<1	<1	<2	<1	<1
06/21/2018	MW-16	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<1	<1	<1	<1	<2	<1	<1
09/26/2018	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/28/2018	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/28/2018	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Other VOC																		
Date	Location Code	1,3-Dichloropropane µg/L	1,3-Dichloropropene(cis) µg/L	1,3-Dichloropropene(trans) µg/L	1,4-Dichlorobenzene µg/L	2,2-Dichloropropane µg/L	2-chlorotoluene µg/L	4-Chlorotoluene µg/L	Bromobenzene µg/L	Bromochloromethane µg/L	Bromodichloromethane µg/L	Bromoform µg/L	Bromomethane µg/L	Carbon tetrachloride µg/L	Chlorobenzene µg/L	Chlorodibromomethane µg/L	Chloroethane µg/L	Chloroform µg/L	Chloromethane µg/L	Dibromomethane µg/L	Dichlorodifluoromethane µg/L
MTCA - GW - Method A		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MTCA - GW - Method B - VI		-	-	-	5	-	-	-	630	-	1.4	220	11	0.62	340	-	15,000	1.2	150	97	4.2
11/13/2019	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/23/2020	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/23/2020	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2020	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2021	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/15/2021	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2021	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/21/2022	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/22/2022	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2022	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/09/2023	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2023	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2023	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/15/2024	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2021	MW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/15/2021	MW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	MW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	MW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/22/2022	MW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	MW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/08/2023	MW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	MW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2023	MW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2023	MW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/14/2024	MW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/19/2014	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/18/2014	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2015	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2015	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/17/2015	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2015	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2015	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/10/2016	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2016	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2016	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/17/2016	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/23/2017	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2017	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2017	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	RW-1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<1	<1	<1	<1	<2	<1	<1
03/19/2018	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2018	RW-1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<1	<1	<1	<1	<2	<1	<1
06/22/2018	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Other VOC																		
Date	Location Code	1,3-Dichloropropane µg/L	1,3-Dichloropropene(cis) µg/L	1,3-Dichloropropene(trans) µg/L	1,4-Dichlorobenzene µg/L	2,2-Dichloropropane µg/L	2-chlorotoluene µg/L	4-Chlorotoluene µg/L	Bromobenzene µg/L	Bromochloromethane µg/L	Bromodichloromethane µg/L	Bromoform µg/L	Bromomethane µg/L	Carbon tetrachloride µg/L	Chlorobenzene µg/L	Chlorodibromomethane µg/L	Chloroethane µg/L	Chloroform µg/L	Chloromethane µg/L	Dibromomethane µg/L	Dichlorodifluoromethane µg/L
MTCA - GW - Method A		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MTCA - GW - Method B - VI		-	-	-	5	-	-	-	630	-	1.4	220	11	0.62	340	-	15,000	1.2	150	97	4.2
09/26/2018	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/23/2020	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2020	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/23/2020	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/09/2020	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2021	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/15/2021	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/22/2022	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2022	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/09/2023	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/21/2023	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2023	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/15/2024	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/19/2014	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/18/2014	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2015	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2015	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/17/2015	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2015	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2015	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/10/2016	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2016	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2016	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/16/2016	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/23/2017	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2017	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2017	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/18/2018	RW-2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<4	<1	<1	<1	<1	<1	<4	<1	<1
03/18/2018	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/21/2018	RW-2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<4	<1	<1	<1	<1	<1	<4	<1	<1
06/21/2018	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/28/2018	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Other VOC																			
Date	Location Code	1,3-Dichloropropane µg/L	1,3-Dichloropropene(cis) µg/L	1,3-Dichloropropene(trans) µg/L	1,4-Dichlorobenzene µg/L	2,2-Dichloropropane µg/L	2-chlorotoluene µg/L	4-Chlorotoluene µg/L	Bromobenzene µg/L	Bromochloromethane µg/L	Bromodichloromethane µg/L	Bromoform µg/L	Bromomethane µg/L	Carbon tetrachloride µg/L	Chlorobenzene µg/L	Chlorodibromomethane µg/L	Chloroethane µg/L	Chloroform µg/L	Chloromethane µg/L	Dibromomethane µg/L	Dichlorodifluoromethane µg/L
MTCA - GW - Method A		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MTCA - GW - Method B - VI		-	-	-	5	-	-	-	630	-	1.4	220	11	0.62	340	-	15,000	1.2	150	97	4.2
11/28/2018	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2020	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2020	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/23/2020	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Other VOC																		
Date	**Location Code**	1,3-Dichloropropane µg/L	1,3-Dichloropropene(cis) µg/L	1,3-Dichloropropene(trans) µg/L	1,4-Dichlorobenzene µg/L	2,2-Dichloropropane µg/L	2-chlorotoluene µg/L	4-Chlorotoluene µg/L	Bromobenzene µg/L	Bromochloromethane µg/L	Bromodichloromethane µg/L	Bromoform µg/L	Bromomethane µg/L	Carbon tetrachloride µg/L	Chlorobenzene µg/L	Chlorodibromomethane µg/L	Chloroethane µg/L	Chloroform µg/L	Chloromethane µg/L	Dibromomethane µg/L	Dichlorodifluoromethane µg/L
MTCA - GW - Method A		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MTCA - GW - Method B - VI		-	-	-	5	-	-	-	630	-	1.4	220	11	0.62	340	-	15,000	1.2	150	97	4.2
09/22/2020	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2020	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2021	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/14/2021	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/21/2021	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2021	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/21/2022	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/22/2022	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2022	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/20/2022	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/09/2023	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/28/2023	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/21/2023	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/09/2023	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/14/2024	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Statistics																					
Number of Results		24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24
Number of Detects		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Minimum Concentration		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<2	<1	<1	<1	<1	<1	<2	<1	<1
Minimum Detect		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum Concentration		<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<2,000	<500	<500	<500	<500	<500	<2,000	<500	<500
Maximum Detect		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Average Concentration *		19	17	19	19	19	19	19	19	19	19	19	101	19	19	19	19	19	76	19	19
Geometric Average *		1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	4.7	1.6	1.6	1.6	1.6	1.6	4.6	1.6	1.6
Median Concentration *		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.5	0.5	0.5	0.5	0.5	0.5	1.5	0.5	0.5
Standard Deviation *		54	52	54	54	54	54	54	54	54	54	54	280	54	54	54	54	54	216	54	54
Geometric Standard Deviation *		7.4	7	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	10	7.4	7.4	7.4	7.4	7.4	9.3	7.4	7.4
95% UCL (Student's-t) *		38.08	35.18	38.08	38.08	38.08	38.08	38.08	38.08	38.08	38.08	38.08	199.3	38.08	38.08	38.08	38.08	38.08	151.9	38.08	38.08
Number of Env Standard Exceedances		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of Env Standard Exceedances (Detects Only)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% of Detects		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% of Non-Detects		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
% of Detects at or above Env Standards		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% of Results Below Env Standards or Non-Detect		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

* A Non Detect Multiplier of 0.5 has been applied.

Note
Groundwater samples screened against MTCA Method A clea
Groundwater samples ares also screened against MTCA Meth
Detected compounds are bold
BTEX = benzene, toluene, ethylbenzene, and xylenes
µg/L = microgram per liter
PAH = polycylic aromatic hydrocarbon
TPH = total petroleum hydrocarbons
VOC = volatile organic compound
E = The sample appears to extend to a ligther hydrocarbon ra
L = diesl concentration may include contributions from heavie
K = diesel concentration may include contributions from light
Z = diesel concentration may include contributions from light
J = estimated value.

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Other VOC																		
Date	**Location Code**	Dichloromethane µg/L	Diisopropyl ether µg/L	Ethyl-t-Butyl Ether µg/L	Hexachlorobutadiene µg/L	Isopropylbenzene µg/L	Methyl Tertiary Butyl Ether µg/L	n-butylbenzene µg/L	n-propylbenzene µg/L	p-isopropyltoluene µg/L	sec-butylbenzene µg/L	Styrene µg/L	tert-Amyl-Methyl Ether µg/L	tert-Butyl alcohol µg/L	tert-Butylbenzene µg/L	Tetrachloroethene µg/L	Trichloroethene µg/L	Trichlorofluoromethane µg/L	Vinyl chloride µg/L	Xylene (m & p) µg/L	Xylene (o) µg/L
MTCA - GW - Method A		5	-	-	-	-	20	-	-	-	-	-	-	-	-	5	5	-	0.2	-	-
MTCA - GW - Method B - VI		780	-	780	0.64	910	860	-	2,300	88	-	8,500	-	-	-	25	1.4	120	0.33	-	-
08/16/2010	B12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2010	B7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-04	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2012	DP-19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/25/2012	DP-20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2012	DP-21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2018	B2-W	-	-	-	-	-	**5**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2018	RNMW-17	-	-	-	-	-	**5**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/13/2019	RNMW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/22/2019	RNMW-17	-	-	-	-	-	<5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/22/2019	RNMW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/26/2021	RNMW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
04/09/2021	RNMW-17	-	-	-	-	-	<5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/30/2021	RNMW-17	-	-	-	-	-	<5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/09/1995	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/24/1996	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/16/2010	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/18/2011	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/07/2011	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/25/2011	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/16/2011	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/08/2012	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
05/09/2012	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2012	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2012	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/07/2013	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/12/2013	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/27/2013	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/11/2013	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2014	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2014	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/19/2014	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/18/2014	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2015	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2015	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/17/2015	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2015	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Other VOC																		
Date	**Location Code**	Dichloromethane µg/L	Diisopropyl ether µg/L	Ethyl-t-Butyl Ether µg/L	Hexachlorobutadiene µg/L	Isopropylbenzene µg/L	Methyl Tertiary Butyl Ether µg/L	n-butylbenzene µg/L	n-propylbenzene µg/L	p-isopropyltoluene µg/L	sec-butylbenzene µg/L	Styrene µg/L	tert-Amyl-Methyl Ether µg/L	tert-Butyl alcohol µg/L	tert-Butylbenzene µg/L	Tetrachloroethene µg/L	Trichloroethene µg/L	Trichlorofluoromethane µg/L	Vinyl chloride µg/L	Xylene (m & p) µg/L	Xylene (o) µg/L
MTCA - GW - Method A		5	-	-	-	-	20	-	-	-	-	-	-	-	-	5	5	-	0.2	-	-
MTCA - GW - Method B - VI		780	-	780	0.64	910	860	-	2,300	88	-	8,500	-	-	-	25	1.4	120	0.33	-	-
12/08/2015	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/10/2016	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2016	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2016	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/17/2016	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/23/2017	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2017	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2017	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	MW-1	<320	<80	<80	<320	<80	<40	<80	**200**	<80	<80	<80	<80	<800	<80	<80	<80	<80	<80	-	-
03/19/2018	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2018	MW-1	<320	<80	<80	<320	<80	<40	<80	**99**	<80	<80	<80	<80	<800	<80	<80	<80	<80	<80	-	-
06/22/2018	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2018	MW-1	-	-	-	-	-	**5**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/23/2020	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/23/2020	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/09/2020	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2021	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2021	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
04/09/2021	MW-1	-	-	-	-	-	<5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/15/2021	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/30/2021	MW-1	-	-	-	-	-	<5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/22/2022	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2022	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/20/2022	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/09/2023	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/28/2023	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/21/2023	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/09/2023	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/15/2024	MW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/16/2010	MW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/09/1995	MW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/24/1996	MW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/09/1995	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/24/1996	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/16/2010	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/18/2011	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/07/2011	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Other VOC																		
Date	**Location Code**	Dichloromethane µg/L	Diisopropyl ether µg/L	Ethyl-t-Butyl Ether µg/L	Hexachlorobutadiene µg/L	Isopropylbenzene µg/L	Methyl Tertiary Butyl Ether µg/L	n-butylbenzene µg/L	n-propylbenzene µg/L	p-isopropyltoluene µg/L	sec-butylbenzene µg/L	Styrene µg/L	tert-Amyl-Methyl Ether µg/L	tert-Butyl alcohol µg/L	tert-Butylbenzene µg/L	Tetrachloroethene µg/L	Trichloroethene µg/L	Trichlorofluoromethane µg/L	Vinyl chloride µg/L	Xylene (m & p) µg/L	Xylene (o) µg/L
MTCA - GW - Method A		5	-	-	-	-	20	-	-	-	-	-	-	-	-	5	5	-	0.2	-	-
MTCA - GW - Method B - VI		780	-	780	0.64	910	860	-	2,300	88	-	8,500	-	-	-	25	1.4	120	0.33	-	-
08/25/2011	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/16/2011	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/08/2012	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
05/09/2012	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2012	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2012	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/07/2013	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/12/2013	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/27/2013	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/11/2013	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2014	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2014	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**2.4**	<0.5
08/19/2014	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/18/2014	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2015	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2015	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/17/2015	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2015	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2015	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/10/2016	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2016	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2016	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/16/2016	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/23/2017	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2017	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2017	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/18/2018	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/18/2018	MW-3	<4	<1	<1	<4	**22**	<0.5	**4.6**	**50**	<1	**6.4**	<1	<1	<10	<1	<1	<1	<1	<1	-	-
03/18/2018	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/21/2018	MW-3	<2	<1	<1	<2	**22**	<0.5	**5.5**	**62**	<1	**6.7**	<1	<1	<10	<1	<1	<1	<1	<1	-	-
06/21/2018	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/28/2018	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/28/2018	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2020	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2020	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2020	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/23/2020	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/23/2020	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2020	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2021	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/14/2021	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Other VOC																		
Date	**Location Code**	Dichloromethane µg/L	Diisopropyl ether µg/L	Ethyl-t-Butyl Ether µg/L	Hexachlorobutadiene µg/L	Isopropylbenzene µg/L	Methyl Tertiary Butyl Ether µg/L	n-butylbenzene µg/L	n-propylbenzene µg/L	p-isopropyltoluene µg/L	sec-butylbenzene µg/L	Styrene µg/L	tert-Amyl-Methyl Ether µg/L	tert-Butyl alcohol µg/L	tert-Butylbenzene µg/L	Tetrachloroethene µg/L	Trichloroethene µg/L	Trichlorofluoromethane µg/L	Vinyl chloride µg/L	Xylene (m & p) µg/L	Xylene (o) µg/L
MTCA - GW - Method A		5	-	-	-	-	20	-	-	-	-	-	-	-	-	5	5	-	0.2	-	-
MTCA - GW - Method B - VI		780	-	780	0.64	910	860	-	2,300	88	-	8,500	-	-	-	25	1.4	120	0.33	-	-
12/07/2021	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/22/2022	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2022	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/09/2023	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/28/2023	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/21/2023	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/09/2023	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/14/2024	MW-3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/24/1996	MW-4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/24/1996	MW-5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07/24/1996	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/18/2011	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/07/2011	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/25/2011	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/16/2011	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/08/2012	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
05/09/2012	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2012	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2012	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/07/2013	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/12/2013	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/27/2013	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/11/2013	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2014	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2014	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<2.5	<2.5
08/19/2014	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/18/2014	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2015	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2015	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/17/2015	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2015	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2015	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/10/2016	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2016	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2016	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/16/2016	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/23/2017	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2017	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2017	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/18/2018	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/18/2018	MW-6	<8	<2	<2	<8	**2.2**	<1	<2	**6.4**	<2	<2	<2	<2	<20	<2	<2	<2	<2	<2	-	-
03/18/2018	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/21/2018	MW-6	<12	<3	<3	<12	<3	<1.5	<3	**4.7**	<3	<3	<3	<3	<30	<3	<3	<3	<3	<3	-	-
06/21/2018	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2021	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/15/2021	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Other VOC																		
Date	**Location Code**	Dichloromethane µg/L	Diisopropyl ether µg/L	Ethyl-t-Butyl Ether µg/L	Hexachlorobutadiene µg/L	Isopropylbenzene µg/L	Methyl Tertiary Butyl Ether µg/L	n-butylbenzene µg/L	n-propylbenzene µg/L	p-isopropyltoluene µg/L	sec-butylbenzene µg/L	Styrene µg/L	tert-Amyl-Methyl Ether µg/L	tert-Butyl alcohol µg/L	tert-Butylbenzene µg/L	Tetrachloroethene µg/L	Trichloroethene µg/L	Trichlorofluoromethane µg/L	Vinyl chloride µg/L	Xylene (m & p) µg/L	Xylene (o) µg/L
MTCA - GW - Method A		5	-	-	-	-	20	-	-	-	-	-	-	-	-	5	5	-	0.2	-	-
MTCA - GW - Method B - VI		780	-	780	0.64	910	860	-	2,300	88	-	8,500	-	-	-	25	1.4	120	0.33	-	-
03/22/2022	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/20/2022	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/09/2023	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2023	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2023	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/14/2024	MW-6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/19/2014	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/18/2014	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/18/2014	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2015	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2015	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2015	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/17/2015	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2015	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2015	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/10/2016	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2016	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2016	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/17/2016	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/23/2017	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2017	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2017	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	MW-7	<2	<1	<1	<2	<1	<0.5	<1	<1	<1	<1	<1	<1	<10	<1	<1	<1	<1	<1	-	-
06/21/2018	MW-7	<2	<1	<1	<2	<1	<0.5	<1	<1	<1	<1	<1	<1	<10	<1	<1	<1	<1	<1	-	-
09/26/2018	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2020	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2020	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/23/2020	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/23/2020	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/09/2020	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2021	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/15/2021	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2021	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/22/2022	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2022	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Other VOC																		
Date	**Location Code**	Dichloromethane µg/L	Diisopropyl ether µg/L	Ethyl-t-Butyl Ether µg/L	Hexachlorobutadiene µg/L	Isopropylbenzene µg/L	Methyl Tertiary Butyl Ether µg/L	n-butylbenzene µg/L	n-propylbenzene µg/L	p-isopropyltoluene µg/L	sec-butylbenzene µg/L	Styrene µg/L	tert-Amyl-Methyl Ether µg/L	tert-Butyl alcohol µg/L	tert-Butylbenzene µg/L	Tetrachloroethene µg/L	Trichloroethene µg/L	Trichlorofluoromethane µg/L	Vinyl chloride µg/L	Xylene (m & p) µg/L	Xylene (o) µg/L
MTCA - GW - Method A		5	-	-	-	-	20	-	-	-	-	-	-	-	-	5	5	-	0.2	-	-
MTCA - GW - Method B - VI		780	-	780	0.64	910	860	-	2,300	88	-	8,500	-	-	-	25	1.4	120	0.33	-	-
03/09/2023	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2023	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2023	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/14/2024	MW-7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/19/2014	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/18/2014	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2015	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2015	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/17/2015	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2015	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2015	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/10/2016	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2016	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2016	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/16/2016	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/23/2017	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2017	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2017	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	MW-8	<2	<1	<1	<2	<1	<0.5	<1	<1	<1	<1	<1	<1	<10	<1	<1	<1	<1	<1	-	-
06/22/2018	MW-8	<2	<1	<1	<2	<1	<0.5	<1	<1	<1	<1	<1	<1	<10	<1	<1	<1	<1	<1	-	-
09/26/2018	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/23/2020	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/23/2020	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/09/2020	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2021	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/15/2021	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/22/2022	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2022	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/09/2023	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2023	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Other VOC																			
Date	**Location Code**	Dichloromethane µg/L	Diisopropyl ether µg/L	Ethyl-t-Butyl Ether µg/L	Hexachlorobutadiene µg/L	Isopropylbenzene µg/L	Methyl Tertiary Butyl Ether µg/L	n-butylbenzene µg/L	n-propylbenzene µg/L	p-isopropyltoluene µg/L	sec-butylbenzene µg/L	Styrene µg/L	tert-Amyl-Methyl Ether µg/L	tert-Butyl alcohol µg/L	tert-Butylbenzene µg/L	Tetrachloroethene µg/L	Trichloroethene µg/L	Trichlorofluoromethane µg/L	Vinyl chloride µg/L	Xylene (m & p) µg/L	Xylene (o) µg/L
MTCA - GW - Method A		5	-	-	-	-	20	-	-	-	-	-	-	-	-	5	5	-	0.2	-	-
MTCA - GW - Method B - VI		780	-	780	0.64	910	860	-	2,300	88	-	8,500	-	-	-	25	1.4	120	0.33	-	-
12/08/2023	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/15/2024	MW-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/19/2014	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/18/2014	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2015	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2015	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/17/2015	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2015	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2015	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/10/2016	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2016	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/23/2017	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2017	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2017	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	MW-9	<4	<1	<1	<4	**3.6**	<0.5	**1.6**	**12**	<1	**2.3**	<1	<1	<10	<1	<1	<1	<1	<1	-	-
03/19/2018	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2018	MW-9	<2	<1	<1	<2	<1	<0.5	<1	<1	<1	<1	<1	<1	<10	<1	<1	<1	<1	<1	-	-
09/26/2018	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/23/2020	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/25/2020	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/23/2020	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/09/2020	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2021	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/15/2021	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/22/2022	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2022	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/20/2022	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/09/2023	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/21/2023	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2023	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/15/2024	MW-9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/19/2014	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/18/2014	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2015	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2015	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/17/2015	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2015	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Other VOC																		
Date	**Location Code**	Dichloromethane µg/L	Diisopropyl ether µg/L	Ethyl-t-Butyl Ether µg/L	Hexachlorobutadiene µg/L	Isopropylbenzene µg/L	Methyl Tertiary Butyl Ether µg/L	n-butylbenzene µg/L	n-propylbenzene µg/L	p-isopropyltoluene µg/L	sec-butylbenzene µg/L	Styrene µg/L	tert-Amyl-Methyl Ether µg/L	tert-Butyl alcohol µg/L	tert-Butylbenzene µg/L	Tetrachloroethene µg/L	Trichloroethene µg/L	Trichlorofluoromethane µg/L	Vinyl chloride µg/L	Xylene (m & p) µg/L	Xylene (o) µg/L
MTCA - GW - Method A		5	-	-	-	-	20	-	-	-	-	-	-	-	-	5	5	-	0.2	-	-
MTCA - GW - Method B - VI		780	-	780	0.64	910	860	-	2,300	88	-	8,500	-	-	-	25	1.4	120	0.33	-	-
12/08/2015	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/10/2016	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2016	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2016	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/16/2016	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/23/2017	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2017	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2017	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	MW-10	<2	<1	<1	<2	<1	<0.5	<1	<1	<1	<1	<1	<1	<10	<1	<1	<1	<1	<1	-	-
06/22/2018	MW-10	<200	<200	<200	<800	<200	<200	<200	<200	<200	<200	<200	<200	<100	<200	<200	<200	<800	<200	-	-
06/22/2018	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2020	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2020	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/23/2020	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/23/2020	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2020	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2021	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/15/2021	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/27/2021	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2021	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/22/2022	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2022	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/09/2023	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2023	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2023	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/14/2024	MW-10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/19/2014	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/18/2014	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2015	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2015	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/17/2015	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2015	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2015	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/10/2016	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2016	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2016	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/16/2016	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Other VOC																		
		Dichloromethane	Diisopropyl ether	Ethyl-t-Butyl Ether	Hexachlorobutadiene	Isopropylbenzene	Methyl Tertiary Butyl Ether	n-butylbenzene	n-propylbenzene	p-isopropyltoluene	sec-butylbenzene	Styrene	tert-Amyl-Methyl Ether	tert-Butyl alcohol	tert-Butylbenzene	Tetrachloroethene	Trichloroethene	Trichlorofluoromethane	Vinyl chloride	Xylene (m & p)	Xylene (o)
Date	**Location Code**	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	µg/L	µg/L	µg/L
MTCA - GW - Method A		5	-	-	-	-	20	-	-	-	-	-	-	-	-	5	5	-	0.2	-	-
MTCA - GW - Method B - VI		780	-	780	0.64	910	860	-	2,300	88	-	8,500	-	-	-	25	1.4	120	0.33	-	-
03/23/2017	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2017	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2017	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	MW-11	<2	<1	<1	<2	<1	<0.5	<1	<1	<1	<1	<1	<1	<10	<1	<1	<1	<1	<1	-	-
03/19/2018	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2018	MW-11	<2,000	<500	<500	<2,000	<500	<250	<500	<500	<500	<500	<500	<500	<5,000	<500	<500	<500	<500	<500	-	-
06/22/2018	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/16/2018	MW-11	-	-	-	-	-	**5**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/22/2019	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/22/2019	MW-11	-	-	-	-	-	**5.4**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-11	-	-	-	-	-	**5.4**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/23/2020	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/23/2020	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2020	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2021	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
04/09/2021	MW-11	-	-	-	-	-	<5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/15/2021	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/27/2021	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/30/2021	MW-11	-	-	-	-	-	<5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/22/2022	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2022	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/20/2022	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/09/2023	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/21/2023	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/09/2023	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/15/2024	MW-11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/22/2019	MW-12	-	-	-	-	-	<134	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2021	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/26/2021	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/15/2021	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/27/2021	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/22/2022	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Other VOC																		
Date	**Location Code**	Dichloromethane µg/L	Diisopropyl ether µg/L	Ethyl-t-Butyl Ether µg/L	Hexachlorobutadiene µg/L	Isopropylbenzene µg/L	Methyl Tertiary Butyl Ether µg/L	n-butylbenzene µg/L	n-propylbenzene µg/L	p-isopropyltoluene µg/L	sec-butylbenzene µg/L	Styrene µg/L	tert-Amyl-Methyl Ether µg/L	tert-Butyl alcohol µg/L	tert-Butylbenzene µg/L	Tetrachloroethene µg/L	Trichloroethene µg/L	Trichlorofluoromethane µg/L	Vinyl chloride µg/L	Xylene (m & p) µg/L	Xylene (o) µg/L
MTCA - GW - Method A		5	-	-	-	-	20	-	-	-	-	-	-	-	-	5	5	-	0.2	-	-
MTCA - GW - Method B - VI		780	-	780	0.64	910	860	-	2,300	88	-	8,500	-	-	-	25	1.4	120	0.33	-	-
06/22/2022	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2022	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/08/2023	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2023	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2023	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/14/2024	MW-12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2021	MW-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/26/2021	MW-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/15/2021	MW-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	MW-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	MW-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/22/2022	MW-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	MW-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2022	MW-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/08/2023	MW-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	MW-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2023	MW-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2023	MW-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/14/2024	MW-13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2021	MW-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/26/2021	MW-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/15/2021	MW-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	MW-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	MW-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/22/2022	MW-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	MW-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2022	MW-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	MW-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2023	MW-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/09/2023	MW-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/14/2024	MW-14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/19/2014	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2015	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2015	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/10/2016	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2016	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2016	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/17/2016	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/23/2017	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2017	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2017	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/18/2018	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/18/2018	MW-15	<80	<20	<20	<80	**55**	<10	<20	**180**	<20	<20	<20	<20	<200	<20	<20	<20	<20	<20	-	-
03/18/2018	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/21/2018	MW-15	<80	<20	<20	<80	**34**	<10	<20	**130**	<20	<20	<20	<20	<200	<20	<20	<20	<20	<20	-	-
06/21/2018	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/28/2018	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/28/2018	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Other VOC																		
Date	**Location Code**	Dichloromethane µg/L	Diisopropyl ether µg/L	Ethyl-t-Butyl Ether µg/L	Hexachlorobutadiene µg/L	Isopropylbenzene µg/L	Methyl Tertiary Butyl Ether µg/L	n-butylbenzene µg/L	n-propylbenzene µg/L	p-isopropyltoluene µg/L	sec-butylbenzene µg/L	Styrene µg/L	tert-Amyl-Methyl Ether µg/L	tert-Butyl alcohol µg/L	tert-Butylbenzene µg/L	Tetrachloroethene µg/L	Trichloroethene µg/L	Trichlorofluoromethane µg/L	Vinyl chloride µg/L	Xylene (m & p) µg/L	Xylene (o) µg/L
MTCA - GW - Method A		5	-	-	-	-	20	-	-	-	-	-	-	-	-	5	5	-	0.2	-	-
MTCA - GW - Method B - VI		780	-	780	0.64	910	860	-	2,300	88	-	8,500	-	-	-	25	1.4	120	0.33	-	-
06/11/2019	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2020	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2020	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/23/2020	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2020	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2020	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2021	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/14/2021	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2021	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/21/2022	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2022	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/09/2023	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/28/2023	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2023	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/09/2023	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/14/2024	MW-15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/19/2014	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/18/2014	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/18/2014	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2015	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2015	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/17/2015	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2015	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2015	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/10/2016	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2016	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2016	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/16/2016	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/23/2017	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2017	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2017	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/18/2018	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/18/2018	MW-16	<2	<1	<1	<2	<1	<0.5	<1	<1	<1	<1	<1	<1	<10	<1	<1	<1	<1	<1	-	-
06/21/2018	MW-16	<2	<1	<1	<2	<1	<0.5	<1	<1	<1	<1	<1	<1	<10	<1	<1	<1	<1	<1	-	-
09/26/2018	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/28/2018	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/28/2018	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Other VOC																		
Date	**Location Code**	Dichloromethane µg/L	Diisopropyl ether µg/L	Ethyl-t-Butyl Ether µg/L	Hexachlorobutadiene µg/L	Isopropylbenzene µg/L	Methyl Tertiary Butyl Ether µg/L	n-butylbenzene µg/L	n-propylbenzene µg/L	p-isopropyltoluene µg/L	sec-butylbenzene µg/L	Styrene µg/L	tert-Amyl-Methyl Ether µg/L	tert-Butyl alcohol µg/L	tert-Butylbenzene µg/L	Tetrachloroethene µg/L	Trichloroethene µg/L	Trichlorofluoromethane µg/L	Vinyl chloride µg/L	Xylene (m & p) µg/L	Xylene (o) µg/L
MTCA - GW - Method A		5	-	-	-	-	20	-	-	-	-	-	-	-	-	5	5	-	0.2	-	-
MTCA - GW - Method B - VI		780	-	780	0.64	910	860	-	2,300	88	-	8,500	-	-	-	25	1.4	120	0.33	-	-
11/13/2019	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/23/2020	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/23/2020	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2020	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2021	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/15/2021	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2021	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/21/2022	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/22/2022	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2022	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/09/2023	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2023	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2023	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/15/2024	MW-16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2021	MW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/15/2021	MW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	MW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	MW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/22/2022	MW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	MW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/08/2023	MW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	MW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2023	MW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2023	MW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/14/2024	MW-17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/19/2014	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/18/2014	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2015	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2015	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/17/2015	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2015	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2015	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/10/2016	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2016	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2016	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/17/2016	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/23/2017	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2017	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2017	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	RW-1	<2	<1	<1	<2	<1	<0.5	<1	<1	<1	<1	<1	<1	<10	<1	<1	<1	<1	<1	-	-
03/19/2018	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2018	RW-1	<2	<1	<1	<2	<1	<0.5	<1	<1	<1	<1	<1	<1	<10	<1	<1	<1	<1	<1	-	-
06/22/2018	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Other VOC																		
Date	**Location Code**	Dichloromethane µg/L	Diisopropyl ether µg/L	Ethyl-t-Butyl Ether µg/L	Hexachlorobutadiene µg/L	Isopropylbenzene µg/L	Methyl Tertiary Butyl Ether µg/L	n-butylbenzene µg/L	n-propylbenzene µg/L	p-isopropyltoluene µg/L	sec-butylbenzene µg/L	Styrene µg/L	tert-Amyl-Methyl Ether µg/L	tert-Butyl alcohol µg/L	tert-Butylbenzene µg/L	Tetrachloroethene µg/L	Trichloroethene µg/L	Trichlorofluoromethane µg/L	Vinyl chloride µg/L	Xylene (m & p) µg/L	Xylene (o) µg/L
MTCA - GW - Method A		5	-	-	-	-	20	-	-	-	-	-	-	-	-	5	5	-	0.2	-	-
MTCA - GW - Method B - VI		780	-	780	0.64	910	860	-	2,300	88	-	8,500	-	-	-	25	1.4	120	0.33	-	-
09/26/2018	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/29/2018	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/25/2020	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/23/2020	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2020	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/23/2020	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/09/2020	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2021	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/15/2021	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/22/2022	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2022	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/09/2023	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/27/2023	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/21/2023	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2023	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/15/2024	RW-1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08/19/2014	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/18/2014	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2015	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2015	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/17/2015	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/24/2015	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2015	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/10/2016	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/16/2016	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2016	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/16/2016	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/23/2017	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2017	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2017	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2017	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/18/2018	RW-2	<4	<1	<1	<4	**19**	<0.5	**5.2**	**56**	<1	**7.7**	<1	<1	<10	<1	<1	<1	<1	<1	-	-
03/18/2018	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/19/2018	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/21/2018	RW-2	<4	<1	<1	<4	**11**	<0.5	**3**	**33**	<1	**3.6**	<1	<1	<10	<1	<1	<1	<1	<1	-	-
06/21/2018	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/26/2018	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/28/2018	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix B-2
Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Other VOC																		
Date	**Location Code**	Dichloromethane µg/L	Diisopropyl ether µg/L	Ethyl-t-Butyl Ether µg/L	Hexachlorobutadiene µg/L	Isopropylbenzene µg/L	Methyl Tertiary Butyl Ether µg/L	n-butylbenzene µg/L	n-propylbenzene µg/L	p-isopropyltoluene µg/L	sec-butylbenzene µg/L	Styrene µg/L	tert-Amyl-Methyl Ether µg/L	tert-Butyl alcohol µg/L	tert-Butylbenzene µg/L	Tetrachloroethene µg/L	Trichloroethene µg/L	Trichlorofluoromethane µg/L	Vinyl chloride µg/L	Xylene (m & p) µg/L	Xylene (o) µg/L
MTCA - GW - Method A		5	-	-	-	-	20	-	-	-	-	-	-	-	-	5	5	-	0.2	-	-
MTCA - GW - Method B - VI		780	-	780	0.64	910	860	-	2,300	88	-	8,500	-	-	-	25	1.4	120	0.33	-	-
11/28/2018	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/20/2019	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/11/2019	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/22/2019	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11/13/2019	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2020	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2020	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/23/2020	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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Historical Analytical Results - Groundwater
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		Other VOC																		
Date	**Location Code**	Dichloromethane µg/L	Diisopropyl ether µg/L	Ethyl-t-Butyl Ether µg/L	Hexachlorobutadiene µg/L	Isopropylbenzene µg/L	Methyl Tertiary Butyl Ether µg/L	n-butylbenzene µg/L	n-propylbenzene µg/L	p-isopropyltoluene µg/L	sec-butylbenzene µg/L	Styrene µg/L	tert-Amyl-Methyl Ether µg/L	tert-Butyl alcohol µg/L	tert-Butylbenzene µg/L	Tetrachloroethene µg/L	Trichloroethene µg/L	Trichlorofluoromethane µg/L	Vinyl chloride µg/L	Xylene (m & p) µg/L	Xylene (o) µg/L
MTCA - GW - Method A		5	-	-	-	-	20	-	-	-	-	-	-	-	-	5	5	-	0.2	-	-
MTCA - GW - Method B - VI		780	-	780	0.64	910	860	-	2,300	88	-	8,500	-	-	-	25	1.4	120	0.33	-	-
09/22/2020	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2020	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/24/2021	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/14/2021	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/21/2021	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/28/2021	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/07/2021	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/08/2021	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/21/2022	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/22/2022	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/22/2022	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/20/2022	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/20/2022	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/09/2023	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06/28/2023	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09/21/2023	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12/09/2023	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03/14/2024	RW-2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Statistics

Number of Results	24	24	24	24	24	38	24	24	24	24	24	24	24	24	24	24	24	24	2	2
Number of Detects	0	0	0	0	8	6	5	11	0	5	0	0	0	0	0	0	0	0	1	0
Minimum Concentration	<2	<1	<1	<2	<1	<0.5	<1	<1	<1	<1	<1	<1	<10	<1	<1	<1	<1	<1	2.4	<0.5
Minimum Detect	ND	ND	ND	ND	2.2	5	1.6	4.7	ND	2.3	ND	ND	ND	ND	ND	ND	ND	ND	2.4	ND
Maximum Concentration	<2,000	<500	<500	<2,000	<500	<250	<500	<500	<500	<500	<500	<500	<5,000	<500	<500	<500	<800	<500	<2.5	<2.5
Maximum Detect	ND	ND	ND	ND	55	5.4	5.5	200	ND	7.7	ND	ND	ND	ND	ND	ND	ND	ND	2.4	ND
Average Concentration *	64	19	19	76	25	10	20	50	19	20	19	19	152	19	19	19	32	19	1.8	0.75
Geometric Average *	4.3	1.6	1.6	4.6	3.7	1.5	2.4	6.2	1.6	2.6	1.6	1.6	14	1.6	1.6	1.6	1.7	1.6	1.7	0.56
Median Concentration *	1.5	0.5	0.5	1.5	1.85	2.5	1.25	5.55	0.5	1.25	0.5	0.5	5	0.5	0.5	0.5	0.5	0.5	1.825	0.75
Standard Deviation *	205	54	54	216	54	27	54	73	54	54	54	54	512	54	54	54	94	54	0.81	0.71
Geometric Standard Deviation *	8.4	7.4	7.4	9.3	8.7	6.6	6.9	13	7.4	7	7.4	7.4	6.1	7.4	7.4	7.4	8.5	7.4	1.6	3.1
95% UCL (Student's-t) *	135.5	38.08	38.08	151.9	43.99	17.81	38.72	75.16	38.08	38.98	38.08	38.08	331.5	38.08	38.08	38.08	64.46	38.08	5.455	3.907
Number of Env Standard Exceedances	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of Env Standard Exceedances (Detects Only)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% of Detects	0	0	0	0	33	16	21	46	0	21	0	0	0	0	0	0	0	0	50	0
% of Non-Detects	100	100	100	100	67	84	79	54	100	79	100	100	100	100	100	100	100	100	50	100
% of Detects at or above Env Standards	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% of Results Below Env Standards or Non-Detect	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

* A Non Detect Multiplier of 0.5 has been applied.

Note
Groundwater samples screened against MTCA Method A clea
Groundwater samples ares also screened against MTCA Meth
Detected compounds are bold
BTEX = benzene, toluene, ethylbenzene, and xylenes
µg/L = microgram per liter
PAH = polycylic aromatic hydrocarbon
TPH = total petroleum hydrocarbons
VOC = volatile organic compound
E = The sample appears to extend to a ligther hydrocarbon ra
L = diesl concentration may include contributions from heavie
K = diesel concentration may include contributions from light
Z = diesel concentration may include contributions from light
J = estimated value.

Appendix B-3
Historical Analytical Results - Indoor Air and Soil Gas
Remedial Investigation Work Plan
Love's Travel Stop #413, Ellensburg, Washington

		TPH			VOC							
		C9-C10 Aromatics	C9-C12 Aliphatics	C5-C8 Aliphatics	Benzene	Ethanol	Ethylbenzene	Naphthalene	Toluene	Xylene (m & p)	Xylene (o)
Date	**Location**	µg/m3	µg/m³	µg/m³	µg/m3	µg/m³	µg/m3	µg/m3	µg/m3	µg/m³	µg/m3
MTCA - Indoor Air - Method B		46	46	46	0.321	-	457	0.074	2,290	-	-
10/06/2023	AS1	<120	<120	**570**	<1.6	**2,500 E**	12	<1.3	<37	6.4	2.4
	AS2	<120	<120	**530**	<1.6	**4,800 E**	12	<1.3	<37	4.4	<2.1
	AS3	<25	**65**	**290**	**0.86**	**2,800 E**	**6.4**	**0.48**	**12**	**4.4**	**1.5**
	AS4	<25	**110**	**200**	**0.71**	**5,600 E**	**14**	**0.85**	**19**	**4.9**	**1.6**
	AS5	<25	**81**	**390**	**0.93**	**2,100 E**	**9.2**	**0.35**	**14**	**5.0**	**1.7**
	AS6	<25	**49**	**320**	**0.79**	**2,100 E**	**9.0**	**0.50**	**13**	**4.1**	**1.4**
MTCA - Vapor Intrusion - Soil-Gas - Method B		1,500	1,500	1,500	11	-	15,000	2.5	76,000	-	-
10/13/2023	VP1	<120	<120	<370	<1.6	**1,400 E**	<2.2	<1.3	<38	**5.5**	<2.2
	VP2	<120	<120	<370	<1.6	**1,000 E**	<2.1	<1.3	<37	**4.9**	<2.1
	VP3	<130	**140**	**500**	<1.7	**2,500 E**	<2.3	**3.6**	<40	<4.6	<2.3
	VP4	<140	**500**	**460**	**1.9**	**2,700 E**	**3.9**	**1.9**	<42	**7.9**	**2.7**

Environmental Standards
Sub-slab samples (VP1 through VP4) screened against the lower of cancer and noncancer MTCA Method B soil-gas screening levels (January 2023). Exceedances are shaded.
Indoor air samples (AS1 through AS6) screened against the lower of cancer and noncancer MTCA Method B indoor air screening levels (January 2023). Exceedances are in red text.
All TPH fractions screened against the generic cleanup level for TPH.
E = The analyte response exceeded the valid instrument calibration range. The value reported is an estimate.
µg/m3 = micrograms per cubic meter
MTCA = Model Toxics Control Act
TPH = total petroleum hydrocarbons

Appendix C

Sampling and Analysis Plan

DRAFT

Sampling and Analysis Plan

Love's Travel Stop No. 413, 1512 Highway 97, Ellensburg, Washington 98926

Prepared for

Chris Weldon
Love's Travel Stops and Country Stores
10601 North Pennsylvania Avenue
Oklahoma City, Oklahoma 73120

Prepared by

Terraphase Engineering Inc.
2105 South C Street
Tacoma, Washington 98402

June 16, 2025

Project Number W053.001.003

This document is a draft and the information contained herein is subject to change. It should not be relied upon; consult the final document.

File: SAP-Loves 413 Ellensburg-W054-001-003-DTE

terraphase engineering

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Table

1 Sample Matrix

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1 Site Location

2 Proposed Site Investigation Locations

Appendix

A Standard Operating Procedures

Acronyms and Abbreviations

Alliance	Alliance Technical Group, LLC
APH	Air-Phase Petroleum Hydrocarbons
bgs	below ground surface
Client	Love's Travel Stops and Country Stores
COC	chain of custody
DUP	duplicate
Ecology	Washington State Department of Ecology
EPA	United States Environmental Protection Agency
HASP	*Health and Safety Plan*
Love's	Love's Travel Stops and Country Stores
MA	Massachusetts
MTCA	Model Toxics Control Act
PAHs	polycyclic aromatic hydrocarbons
SAP	*Sampling and Analysis Plan*
SCUM	*Sediment Cleanup User's Manual*
Site	Love's Travel Stops Store No. 413 at 1512 Highway 97 in Ellensburg, Washington
SOP	standard operating procedure
Terraphase	Terraphase Engineering Inc.
TPH	total petroleum hydrocarbons
TPH-d	total petroleum hydrocarbons in the diesel range
TPH-g	total petroleum hydrocarbons in the gasoline range
TPH-o	total petroleum hydrocarbons in the oil range
QA/QC	quality assurance/quality control
QAPP	*Quality Assurance Project Plan*
Work Plan	*Remedial Investigation Work Plan*

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Signatures

Draft

John Hildenbrand
Principal Environmental Scientist

Date

Draft

Max Wills, LHG, CWRE
Principal Hydrogeologist

Date

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1 Introduction

This *Sampling and Analysis Plan* (SAP) has been prepared by Terraphase Engineering Inc. (Terraphase), on behalf of Love's Travel Stops and Country Stores (Love's or the Client), pursuant to the remedial investigation actions for the Love's Travel Stops Store No. 413 at 1512 Highway 97 in Ellensburg, Washington (the "Site"; Figure 1). The SAP is intended to fulfil the majority of the requirements of WAC 173-340-820.[1]

The purpose of the work described in the SAP is to support remedial investigation at the Site, which includes (but is not limited to) the sampling and analysis of groundwater, surface water, sediment, soil, soil vapor, and indoor and outdoor air at the Site to further assess the nature and extent of contamination and develop the best alternatives for Site cleanup. This SAP also applies to other future sampling that may occur at the Site, both voluntarily and in response to agency directives.

2 Site Description

This section provides a general description of the Site, including current and historical Site use and its geologic and hydrogeologic setting.

2.1 Site Setting and Background

The 7.67-acre Site is approximately 290 feet north of the intersection between the Interstate 90 business spur and US Route 97 and has operated as a fueling facility with underground storage tanks (USTs) since 1982. The Site is currently developed as a truck stop, with large parking areas, an approximately 2,800-square-foot commercial truck fueling island, an approximately 150-square-foot auto fueling island, a commercial truck oil change and tire center, truck scales, and an approximately 5,800-square-foot travel center that includes a convenience store, a Subway restaurant, bathrooms, and showers. Bioswales are present at the eastern border of the Site, near Reecer Creek. Gasoline and diesel USTs at the Site are located northeast of the travel center building. Piping conveys fuel from the USTs to the commercial and auto fueling islands via trenches on the north and northeast side of the travel center building.

Several environmental investigations and remedial actions have been performed at the Site between 1995 and 2023, respectively, following reported releases. Additional details are provided in the *Remedial Investigation Work Plan* (Work Plan [Terraphase 2025]).

[1] "Sampling an analysis plans." https://app.leg.wa.gov/wac/173-340-820

Note: The Work Plan provides justification of sample locations and the QAPP provides detailed QA/QC requirements. Together, the three documents are intended to meet all of the requirements of WAC 173-340-820.

3 Contaminants of Concern

The following contaminants of concern (COCs) were identified at the Site based on their detection in one or more previously sampled media. Details regarding the sources, extents, and potential exposure pathways are presented in the Work Plan.

- Total petroleum hydrocarbons (TPH) as gasoline, diesel, and oil (TPH-g, TPH-d, and TPH-o, respectively)
- Benzene, toluene, ethylbenzene, and xylenes (BTEX)
- Polycyclic aromatic hydrocarbons (PAHs), including naphthalene
- Lead

4 Sampling Design

The sampling design for this SAP is based on the results of prior investigations and remedial activities. Table 1 presents a sample matrix with proposed sample identification, depth, analysis, analytical method, and objective. The specific parameters for each analytical method are listed in laboratory standard operating procedures (SOPs) included as Appendix A of the *Quality Assurance Project Plan* (QAPP; Appendix D of the Work Plan).

4.1 Sampling Scope and Procedures

The following subsections detail the proposed sampling scope and procedures.

4.1.1 Soil Vapor and Indoor Air

Proposed indoor air, sub-slab vapor, and soil-vapor sampling procedures are discussed below.

4.1.1.1 Indoor Air Sampling

Four indoor air samples (VP1-AS through VP4-AS), and one outdoor air sample (OA-1), will be collected coincident with the collection of sub-slab soil-vapor samples within the Love's Travel Center in accordance with Terraphase SOP 300-23-00 (Appendix A; Figure 2). To the extent possible, the indoor air samples will be collected near the vapor probes, and at a minimum will be collected within the same room. The indoor air samples will be collected within the breathing zone (3 to 5 feet above the floor) using 6-liter Summa™ canisters with a flow regulator set to collect an 8-hour time-integrated sample. One duplicate indoor air sample will be collected from the same room and at the same time as the primary sample. An outdoor air sample will be collected upwind of the building to assess ambient air quality with the inlet approximately 6 feet above ground surface. The Summa™ canisters and flow regulators will be individually certified clean by the laboratory prior to use. Following sample collection, the samples will be immediately placed in laboratory-supplied shipping containers, properly labeled, and

submitted to Alliance Technical Group, LLC (Alliance) using chain-of-custody (COC) procedures for the following analyses:

- MTCA VOCs and naphthalene using United States Environmental Protection Agency (EPA) Method TO-15
- Aromatic and aliphatic TPH using EPA Method TO-15/Massachusetts (MA) – Air-Phase Petroleum Hydrocarbons (APH) Modified

4.1.1.2 Sub-slab Soil-Vapor Pin Installation and Sampling

The existing four sub-slab soil vapor pins within the Love's Travel Center, VP1 through VP4, will be sampled coincident with the collection of 8-hour indoor air samples in accordance with Terraphase SOP 401-23-00 (Appendix A; Figure 2).

Prior to sub-slab soil-vapor sample collection, an initial leak-check test will be completed to assess the seal of the sample apparatus and fittings. With the valves at the sample canister and soil-vapor point both in the closed position, a gas-tight syringe will be used to apply a vacuum to the sampling apparatus of at least 10 inches of mercury. The valve between the tee and the purging device will then be closed to observe whether the vacuum was maintained in the sampling apparatus between the soil vapor point and the sample canister. After completing the leak-check test, a clear shroud (plastic bag) will be placed around the top of the soil vapor point and the sample apparatus. The inside of the shroud will then be enriched with helium to a minimum concentration of 10 percent, which will be measured using a portable helium detector.

After a leak check is performed, a minimum of three well volumes will be purged using a digital air pump with the flow rate set to 150 milliliters per minute. Well volumes will be calculated to include the sample tubing and an estimated pore space for the un-hydrated bentonite and sand pack. After each well volume, helium and volatile organic compound measurements will be recorded on the field forms.

After purging, a sample will be collected in 1-liter capacity Summa™ canisters fitted with a 150 milliliter-per-minute flow controller. The Summa™ canisters and flow regulators will be batch-certified clean by the laboratory. Samples will be collected within the helium-filled shroud in general accordance with applicable field sampling procedures for sub-slab soil-vapor sampling that are presented in *Vapor Intrusion Pathway: A Practical Guideline* (ITRC 2007), and *Draft Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action* (Washington State Department of Ecology [Ecology] 2018). The helium concentration inside the shroud will be measured shortly after the start of sample collection and once per minute during sample collection using the portable helium indicator. Measured helium concentrations will be recorded on the field forms. One duplicate sub-slab soil-vapor sample will be collected using a clean sample T connected to the sample train after the flow controller to maintain the same rate of flow.

Following sample collection, the samples will be immediately placed in laboratory-supplied shipping containers, properly labeled, and submitted under chain-of-custody documentation to Alliance for the following analyses:

- MTCA VOCs and naphthalene using EPA Method TO-15

- Aromatic and aliphatic TPH using EPA Method TO-15/MA-APH Modified
- Helium and oxygen using ASTM D1946

4.1.1.3 Soil-Vapor Well Installation and Sampling

Three soil-vapor wells, TSV-01 through TSV-03, will be installed along the northern side of GrassRoots Grill in accordance with Terraphase SOPs 400-24-00 and 401-24-00, respectively (Appendix A; Figure 2). Hand auger borings will be advanced to 5 feet below ground surface (bgs) at the locations of TSV-01 through TSV-03 in accordance with Terraphase SOP 508-23-00 (Appendix A). The soil vapor wells will be installed in the hand auger boreholes and will be constructed with a 6-inch stainless-steel screen, 0.25-inch Teflon tubing, and a valve at the termination. The screen will be placed at approximately 4.5 feet bgs. The probe tip for each depth will be set within a minimum of 6 inches of sand and topped with a minimum of 1 foot of dry bentonite, and hydrated bentonite will be placed above the dry bentonite to within 12 inches of the ground surface, per Ecology guidelines (2022). At the ground surface, the tubing will be fitted with an airtight valve using a compression fitting. A flush-mounted well monument will be used to secure the tubing.

Soil-gas samples will be collected from the newly installed soil-gas wells following a minimum 48-hour equilibration period after each well installation. Prior to sampling, a minimum of three well volumes will be purged using a digital air pump with the flow rate set to 150 milliliters per minute. Well volumes will be calculated to include the sample tubing and an estimated pore space for the un-hydrated bentonite and sand pack. After each well volume, helium and volatile organic compound measurements will be recorded on the field forms. Leak checks will be performed and soil vapor samples will be collected following procedures outlined in Section 4.1.1.2. One duplicate soil-vapor sample will be collected using a clean sample T connected to the sample train after the flow controller to maintain the same rate of flow.

Following sample collection, the samples will be immediately placed in laboratory-supplied shipping containers, properly labeled, and submitted under chain-of-custody documentation to Alliance for the following analyses:

- MTCA VOCs and naphthalene using EPA Method TO-15
- Aromatic and aliphatic TPH using EPA Method TO-15/MA-APH Modified
- Helium and oxygen using ASTM D1946

4.1.2 Soil Borings and Soil and Groundwater Sampling

Proposed soil boring advancement and soil and groundwater sampling procedures are discussed below.

4.1.2.1 Soil Borings

Eleven soil borings, TE-01 through TE-11, will be advanced at the Site using a direct-push drilling rig in accordance with Terraphase SOP 509-23-00 (Appendix A; Figure 2). Continuous soil samples from borings will be logged and screened for contaminants using visual observations in the field in accordance with Terraphase SOP 504-23-00 (Appendix A). Soil samples retained for chemical analysis will be

selected based on field evidence of contamination (visual, olfactory, photoionization detector results). Two discrete soil samples will be collected from each boring—one in the upper 5 feet bgs and one at the soil-groundwater interface. Samples collected for analysis of TPH and MTCA VOCs will be placed in laboratory-provided glass vials containing methanol for sample preservation in accordance with EPA Method 5035. Samples collected for other analyses will be transferred from the sleeve liner to laboratory-supplied glass containers using clean, new nitrile gloves. Each sample collected for chemical analysis will be labeled with the boring number, sample depth, and time and date of collection. Soil samples will be placed in an ice-filled cooler immediately after collection and transported to Alliance using chain-of-custody procedures for the following analyses:

- TPH-g using Method NWTPH-Gx
- TPH-d and TPH-o using NWTPH-Dx/Dx extended
- MTCA VOCs using EPA Method 8260D
- Lead using EPA Method 6020B
- PAHs using EPA Method 8270E

If contamination is evident based on field observations (visual, olfactory, photoionization detector results) or laboratory analytical results indicate concentrations detected above MTCA Method A cleanup levels, additional borings will be advanced 20 feet west of TE-01 through TE-05 (TE-12 through TE-16) and northeast of TE-06 through TE-09 (TE-17 through TE-19). This process will be repeated until soil impacts are below cleanup levels.

Based on analytical results, at least three soil samples – one from the highest 10% TPH concentration range, one from the lowest 10% TPH concentration range, and one from the median TPH concentration range (+/- 10% of the median) – will be analyzed for extractable and volatile petroleum hydrocarbons (EPH-VPH) to evaluate the potential for site specific CULs.

4.1.2.2 Grab-Groundwater Sampling

After reaching the total boring depth at TE-06 through TE-11, a new, temporary 0.75- or 1-inch PVC well with a 0.010-inch factory-slotted screen will be placed in each borehole. Groundwater samples will be collected from borings in accordance with Terraphase SOP 201-23-00 (Appendix A). A post-drilling static water level measurement will be recorded before sampling using a clean electronic sounder. A grab-groundwater sample will be collected from the temporary well through a new 3/8-inch-diameter, low-density polyethylene tubing using a peristaltic pump and transferred directly to laboratory-supplied sample containers. If turbidity is observed in the collected groundwater, the well will be purged until the groundwater is clear to the degree feasible, after which a sample will be collected. A turbid sample will be collected only if well yield is low (i.e., if the well dewaters) or after 30 minutes of purging. Samples will be collected for both total and dissolved lead. Samples submitted for analysis of dissolved lead will be filtered in the field using a new, disposable 0.45-micron filter placed between the sample tubing and the laboratory-supplied container. The samples will be labeled and placed in an ice-filled cooler immediately after collection. The samples will be transported to Alliance using COC procedures for the following analyses:

- TPH-g using Method NWTPH-Gx

- TPH-d and TPH-o using NWTPH-Dx/Dx extended
- MTCA VOCs using EPA Method 8260D
- Total and dissolved lead using EPA Method 6020B
- PAHs using EPA Method 8270E

4.1.3 Groundwater Monitoring Well Installation

Three groundwater monitoring wells, MW-18 through MW-20, will be installed in accordance with Terraphase SOP 207-23-00 (Appendix A; Figure 2). The monitoring wells will be constructed in 8-inch-diameter borings advanced using hollow-stem auger drilling methods. The monitoring well casing will consist of 2-inch-diameter PVC to approximately 15 feet bgs with a 10-foot screen interval between 5 and 15 feet bgs. The final boring depth and screen interval will be decided based on observed lithology and water levels at the time of sampling. The screen will extend at least 1 foot above the expected shallowest annual water table, if possible. The screen will consist of pre-perforated 0.010-inch slots with a sand pack of #0/30 silica sand or equivalent to minimize the intrusion of silt. The sand pack will extend from the bottom of the borehole to 1 foot above the top of the screen interval. Hydrated bentonite chips will be placed from the top of the sand pack to 2 feet above the sand pack. Neat cement grout will be placed above the bentonite seal to approximately 1 foot bgs. Concrete will be added in the upper 1 foot bgs and a protective well monument will be placed securely in the concrete. The monitoring wells will be fitted with water-tight, locking well caps.

The monitoring wells will be developed within 48 hours after installation, in accordance with Terraphase SOP 208-23-00. A minimum of 10 casing volumes will be removed from the each well during development. Purge water produced during development will be stored and disposed of as described in Section 5.4.

4.1.3.1 Transducer/Slug Testing

Following installation of the new monitoring wells, pressure transducers may be placed in select wells to collect pressure measurements to monitor changes in water level in accordance with Terraphase SOP-209-24-00 (Appendix A). Slug testing may be performed at the newly installed monitoring wells in accordance with Terraphase SOP-210-24-00 (Appendix A).

4.1.4 Groundwater Monitoring

Quarterly monitoring will be conducted following monitoring well installation for a minimum of four quarters. Accessible monitoring wells will be sampled using low-flow sampling methods in accordance with Terraphase SOP 205-23-01 (Appendix A). The presence or absence of free product, the depth to the water table, and field water quality parameters will be measured in each accessible monitoring and remediation well during each sampling event in accordance with Terraphase SOP 200-23-00 (Appendix A). If free product is present, sample collection will be modified as detailed in Terraphase SOP 203-23-00 (Appendix A). Samples submitted for analysis of dissolved lead will be filtered in the field using a new, disposable 0.45-micron filter placed between the sample tubing and the laboratory-supplied container.

The samples will be labeled and placed in an ice-filled cooler immediately after collection, and will be transported to Alliance using chain-of-custody procedures for the following analyses:

- TPH-g and TPH-d and TPH-o using Method NWTPH-Gx and NWTPH-Dx/Dx Extended, respectively
- MTCA VOCs using EPA Method 8260D
- PAHs using EPA Method 8270E
- Total and Dissolved lead (using EPA Method 6020B) will be analyzed in the first monitoring event. If it is present above MTCA Method A cleanup levels, it will be added as a regularly monitored analyte.

4.1.5 Sediment and Surface Water Sampling

Three collocated sediment and surface water samples, SS-01 through SS-03 and SS-01-SW through SS-03-SW, respectively (Figure 2), will be collected in general accordance with the Washington State Department of Ecology's *Sediment Cleanup User's Manual (SCUM), Guidance for Implementing the Cleanup Provisions of the Sediment Management Standards, Chapter 173-204 WAC* (2021).

4.1.5.1 Sediment Sampling

Sediment samples will be collected from the upper 1 foot bgs using a new disposable plastic trowel or clean shovel and transferred to laboratory-supplied glass containers using clean, new nitrile gloves. The depth of water at each sample location is important to consider and document. After identifying sample locations (e.g., at the point of discharge from an outfall or in an area of suspected sediment contamination), additional sample locations should be positioned nearby at similar depth(s) for comparison, because currents typically flow along contours of equal depth rather than across them. Samples collected for analysis of TPH and MTCA VOCs will be placed in laboratory supplied glass vials containing methanol for sample preservation in accordance with EPA Method 5035. Each sample collected for chemical analysis will be labeled with the sample ID, sample depth, and time and date of collection. Soil samples will be placed in an ice-filled cooler immediately after collection and transported to Alliance using chain-of-custody procedures for the following analyses:

- TPH-g using Method NWTPH-Gx
- TPH-d and TPH-o using NWTPH-Dx/Dx extended, respectively
- MTCA VOCs using EPA Method 8260D
- PAHs using EPA Method 8270E

4.1.5.2 Surface Water Sampling

Surface water samples will be collected at a single time and location. Samples will be collected manually by dipping a clean unpreserved sample container into the water. If the water is flowing, the sampler should be facing upstream in the middle of the stream/spring/drainage and the sample will be collected upstream of the sampler. The collection vessel (e.g., unpreserved bottle) will be uncapped, and the cap protected from contamination. The sample will be transferred from the collection vessel to clean laboratory-provided sample containers, labeled and placed in an ice-filled cooler immediately after collection, and will be transported to Alliance using COC procedures for the following analyses:

- TPH-g using Method NWTPH-Gx
- TPH-d and TPH-o using NWTPH-Dx/Dx extended, respectively
- MTCA VOCs using EPA Method 8260D
- PAHs using EPA Method 8270E

4.2 Equipment Decontamination

Decontamination will be performed to prevent the introduction of extraneous material into samples and to prevent potential cross contamination. All downhole drilling equipment will be decontaminated by one of the following methods: steam cleaning, pressure washing, or washing with a non-phosphate detergent, such as Liquinox™ or equivalent. All non-disposable sampling equipment (the electronic sounder) will be decontaminated by the procedure outlined below:

1. **Wash with non-phosphate detergent and water solution.** This step will remove visible contamination from the equipment.
2. **Rinse with potable water.** This step will rinse all the detergent solution away from equipment. Periodic changing of this water is required.
3. **Rinse with deionized water.** This step will rinse any detergent solution and potable water residues. Rinsing is most effective when water is applied using a stainless-steel Hudson-type sprayer or Nalgene® squeeze bottle while holding equipment over a 5-gallon bucket.
4. **Rinse with deionized water.** This step will be a final rinse to remove any contaminants. Rinsing is most effective when water is applied using a stainless-steel Hudson-type sprayer or Nalgene® squeeze bottle while holding equipment over a 5-gallon bucket.

Decontaminated liquids will be containerized and stored in 55-gallon drums pending analysis and disposal as described in Section 5.4.

5 Sample Handling

This section describes sample handling and custody from laboratory container ware preparation to the point of sample collection, and the relinquishment of sample custody to the laboratory.

5.1 Labeling

Sample labels will be completed and attached to the sample container for every sample collected. Soil and groundwater sample labels are made of a waterproof material backed with a water-resistant adhesive that are applied to the sample container. Air and soil-vapor sample labels are tags attached to the Summa™ canister. Labels will be filled out using waterproof permanent ink and will include, at a minimum, the sample name, the sampling date, the sampling location, the sampler's name, and the analyses to be conducted. In addition, air and soil-vapor sample labels will include the canister

identification number, manifold identification number, initial canister vacuum, and final canister vacuum.

A sample designation system will be used to identify samples for laboratory analysis. A list of identifiers used for each sample will be documented in the project logbook by the Field Team Leaders.

Each collected sample will be designated a unique sample ID (Table 1). The following information will be utilized to identify samples:

1. **Sample ID standard format:** Sample Type-##-Depth-Date
   - Examples of sample type abbreviations: MW (monitoring well), GP (sample collected from a geoprobe direct-push rig), IA (indoor air), (VP) sub-slab vapor pin, and (SV) soil vapor.
   - ## = Specific Location ID per sample type.
   - Depth = Top and bottom of sampling interval
   - Date = Month/Day/Year sample was collected (listed on the chain-of-custody form). For one-time samples (i.e., those collected from temporary borings or soil vapor points), the date need not be included.
2. **Abbreviations for types of QC samples**: Field duplicate (DUP), trip blank (TB), and field (equipment) blank (EB). Duplicates will be labeled the same as the primary sample with -DUP following the primary sample ID. No blind duplicates will be collected.

5.2 Chain-of-Custody Procedures

Each sample will be documented on the COC in accordance with Terraphase SOP 103-23-00 (Appendix A). All sample shipments for analyses will be accompanied by a completed COC, sent with the samples to the laboratory as one shipment. See the QAPP, provided as Appendix D of the Work Plan, for a copy of the COC.

The COC will identify the contents of each shipment and maintain the custodial integrity of the samples. Until the samples are shipped, the custody of the samples will be the responsibility of Terraphase. The sampling team leader or designee will sign the COC in the "relinquished by" box and note date, time, and air bill number, if applicable.

5.3 Package and Shipping

All soil and groundwater sample containers will be placed in a durable laboratory-provided cooler immediately following sample collection in accordance with Terraphase SOP 105-23-00 (Appendix A). The following sample packaging procedures will be followed:

- Ice for sample transport will be packed in zip-locked, double plastic bags. The drain plug of the cooler, if present, will be sealed with fiberglass tape to prevent melting ice from leaking out of the cooler.
- The bottom of the cooler should be lined with bubble wrap to prevent breakage during shipment or transportation on unpaved forest roads.

- Screw caps will be checked for tightness and, if not full, the sample volume level of liquid samples will be marked on the outside of the sample bottles with indelible ink.
- Sample labels will be affixed to the containers with clear tape.
- All glass sample containers will be wrapped in bubble wrap to prevent breakage.
- All sample containers will be sealed in heavy duty plastic zip-lock bags; sample numbers will be written on the outside of the plastic bags with indelible ink.
- If shipping, the empty space in the cooler will be filled with bubble wrap or Styrofoam peanuts to prevent movement and breakage during shipment and each ice chest will be securely taped shut with fiberglass strapping tape.
- Ice used to cool samples will be double-sealed in two zip-lock plastic bags and placed on top and around the samples to chill them to the correct temperature.

All vapor samples will be placed in laboratory-supplied shipping containers with laboratory-supplied shipping materials immediately following sample collection.

5.4 Investigation-Derived Waste Management

Investigation-derived waste will be temporarily stored in traffic-rated, 55-gallon steel drums. All waste will be disposed at an appropriate waste handling facility by a licensed waste disposal company following waste characterization.

The 55-gallon drums will be properly labeled with the following information:

- Description of waste (i.e., water or soil)
- Date generated
- Contact information
- Project name

Disposable personal protective and sampling equipment will be managed as non-hazardous solid waste. This disposable investigation-derived waste will be placed in plastic bags, removed from the Site by Terraphase and/or the drilling company, and transferred to an industrial waste container, the contents of which are routinely disposed in a municipal landfill.

6 Quality Assurance/Quality Control

The QAPP prepared by Terraphase, included as Appendix D of the Work Plan, provides overall quality assurance and quality control (QA/QC) guidance, sampling and laboratory analysis requirements and SOPs, and evaluation and assessment protocols, and performance standards in support of the investigation and remediation activities at the Site. Specific topics addressed in the QAPP include:

- Data quality objectives and criteria
- Project organization and responsibilities

- Sampling design and procedure
- Field instrumentation and inspection of supplies
- Sample handing and custody
- Laboratory sample storage and handling
- Analytical method requirements, target analytes and regulatory criteria
- Laboratory, field QA/QC and data assessment procedures
- Data review
- Data deliverables and data management
- Data validation and usability
- Project reporting

Field QA/QC procedures are summarized in the following subsections.

6.1.1 Field Duplicate Sampling Procedure

Field duplicate samples will be collected from the same location as the parent sample and will be analyzed for the same parameters as the parent sample, in accordance with SOP-111-23-00. One duplicate sample will be collected for every 20 environmental samples per medium (soil, sediment, water). If less than 20 samples are collected for a given media, one duplicate sample will be collected. A second duplicate sample will be collected for samples 21 to 40, a third for samples 41 to 60, etc. Field duplicate samples will be preserved and packaged in the same manner as other samples of the same matrix. Duplicate samples will be labeled as per the primary sample, but will end in "-DUP."

6.1.2 Equipment Blanks

Equipment rinsate blank samples will be collected to evaluate field sampling and decontamination procedures. One equipment rinsate blank will be collected per matrix each day that sampling equipment is decontaminated in the field. Equipment rinsate blanks will be obtained by passing deionized water through or over the decontaminated sampling devices used that day. The rinsate blanks will be collected into the same containers used for water samples and will be analyzed for the same analytes as the samples collected with the decontaminated equipment. The equipment rinsate blanks will be preserved and packaged in the manner described for the environmental samples.

6.1.3 Trip Blank Procedure

A trip blank will be included in the cooler used to ship aqueous samples for MTCA VOC analysis. The trip blank will be used to evaluate possible sample contamination from transportation between the Site and the laboratory. A trip blank will be prepared by the laboratory using the same preservation technique as that used to prepare the sample containers from the same source as the method blank water and sent to the Site in the cooler with the other sample containers. Trip blanks are not opened in the field but travel with the sample containers. One trip blank will be sent to the laboratory for analysis in each cooler that contains aqueous samples that have been collected for analysis of MTCA VOCs.

6.1.4 Field Instrumentation and Inspection of Supplies

Field instrumentation required for anticipated sampling events is also described in the QAPP (Appendix D of the Work Plan). The following field equipment is expected to be used:

- Photoionization detector
- Peristaltic pump with flow-through cell
- Electronic water level indicator
- Electronic oil/water interface probe (if DNAPL is encountered)
- Horiba U-22 water quality analyzer or equivalent (for measurement of field indicator parameters including pH, temperature, specific conductivity, dissolved oxygen, oxidation-reduction potential, turbidity, etc.)

6.1.4.1 Field Equipment Calibration

Field instruments will be calibrated in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications. Equipment to be used for the field sampling will be examined to confirm that it is in good operating condition. This includes checking the manufacturer's operating manual and the instructions for each instrument to confirm that the maintenance requirements are being observed.

In general, instruments will be calibrated daily prior to use and will be recalibrated as required. All calibration procedures performed will be documented in the field logbook. Calibration checks will be performed at the intervals specified by the manufacturer. If an internally calibrated field instrument fails to meet calibration procedures, it will be returned to the manufacturer for service.

6.1.4.2 Field Equipment Preventative Maintenance

Preventative maintenance procedures will be carried out on field equipment by Terraphase personnel in accordance with the procedures outlined in the manufacturers' specifications and/or equipment manuals. Maintenance activities involving field equipment will be recorded in the field logbook. Field equipment will be checked by field representatives prior to being used in the field. Problems encountered while operating the instrument will be documented in the field logbook. If an equipment problem is detected, or will require service, the equipment will be returned to the rental vendor or manufacturer for maintenance.

6.1.4.3 Inspection Requirements for Supplies

The sample containers used to collect aqueous and solid samples for this project will be supplied by Alliance. The containers will be pre-cleaned sample containers that will be purchased from an EPA-certified manufacturer (I-Chem 200 or equivalent container) or are cleaned using EPA protocols. The laboratory project manager and the field representatives will be ultimately responsible for checking supplies for potential contamination. Chemical reagents/solvents (e.g., hydrochloric acid and methanol for sample preservation) used by the field personnel will be provided by the laboratory.

7 Health and Safety

A Site-specific *Health and Safety Plan* (HASP) relevant to the investigation and remediation activities was completed by Terraphase (included as Appendix E of the Work Plan). Site personnel will be required to familiarize themselves with, and sign, the HASP. The HASP will identify the specific chemical compounds that have been encountered at the Site and will present the chemical properties and a task-specific health and safety risk analysis. The HASP addresses potential chemical and physical hazards at the Site, as well as physical hazards associated with the performance of the work tasks.

8 References

Interstate Technology and Regulatory Council (ITRC). 2007. *Vapor Intrusion Pathway: A Practical Guideline.* January.

Robinson Noble Inc. 2000. Hydrogeologic Characterization of the Ivan Hutchinson Pit and Proposed Expansion. April.

Sadowski, Andrew, Bodie McCosby, Megan Anderson, Todd Lau, Ashley Steiner, Andrew DuFrane, Tammy Tinnebour, and Bernard Housen. *Geologic Map of the Ellensburg North and Southern Half of the Reecer Canyon 7.5-Minute Quadrangles, Kittitas County, Washington.* December.

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Washington State Department of Ecology (Ecology). 2021. *Sediment Cleanup User's Manual (SCUM). Guidance for Implementing the Cleanup Provisions of the Sediment Management Standards, Chapter 173 -204 WAC.* Publication Number 12-09-057. Third Revision. https://apps.ecology.wa.gov/publications/SummaryPages/1209057.html.

———.2022. *Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action*. Toxics Cleanup Program, Washington State Department of Ecology. Publication No. 09-09-047. March.

Table

1 Sample Matrix

Table 1
Sample Matrix
Remedial Investigation Work Plan
Love's Travel Stop #413
1512 Highway 97, Ellensburg, Washington

Sample Name	Objective	Sample Matrix	Approximate Sample Depth (feet bgs)	Analysis									
				TPH-G	TPH-D	TPH-O	TPH-EPH & TPH-VPH	MTCA VOCs	PAHs	Lead	MTCA VOCs and Naphthalene	Aliphatic and Aromatic TPH	Oxygen and Helium
				NWPTH-Gx	NWTPH-Dx	NWTPH-Dx	NWTPH-EPH/ NWTPH-VPH	8260B	8270E	6020B	TO-15	TO-15/MA-APH Mod.	D1946
TE-01-1-TD-BD	Assess the quality of soil west of the 2023 excavation footprint	Soil	0-5	X	X		C	X	X	X			
TE-01-2-TD-BD		Soil	TBD*	X	X		C	X	X	X			
TE-02-1-TD-BD		Soil	0-5	X	X		C	X	X	X			
TE-02-2-TD-BD		Soil	TBD*	X	X		C	X	X	X			
TE-03-1-TD-BD		Soil	0-5	X	X		C	X	X	X			
TE-03-2-TD-BD		Soil	TBD*	X	X		C	X	X	X			
TE-04-1-TD-BD		Soil	0-5	X	X		C	X	X	X			
TE-04-2-TD-BD		Soil	TBD*	X	X		C	X	X	X			
TE-05-1-TD-BD		Soil	0-5	X	X		C	X	X	X			
TE-05-2-TD-BD		Soil	TBD*	X	X		C	X	X	X			
TE-##-#-TD-BD-DUP		Soil	TBD	X	X		C	X	X	X			
TE-06-1-TD-BD	Assess the extent of soil impacts to the northeast of the travel center building	Soil	0-5	X	X		C	X	X	X			
TE-06-2-TD-BD		Soil	TBD*	X	X		C	X	X	X			
TE-07-1-TD-BD		Soil	0-5	X	X		C	X	X	X			
TE-07-2-TD-BD		Soil	TBD*	X	X		C	X	X	X			
TE-08-1-TD-BD		Soil	0-5	X	X		C	X	X	X			
TE-08-2-TD-BD		Soil	TBD*	X	X		C	X	X	X			

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Sample Matrix
Remedial Investigation Work Plan
Love's Travel Stop #413
1512 Highway 97, Ellensburg, Washington

Sample Name	Objective	Sample Matrix	Approximate Sample Depth (feet bgs)	Analysis									
				TPH-G	TPH-D	TPH-O	TPH-EPH & TPH-VPH	MTCA VOCs	PAHs	Lead	MTCA VOCs and Naphthalene	Aliphatic and Aromatic TPH	Oxygen and Helium
				NWPTH-Gx	NWTPH-Dx	NWTPH-Dx	NWTPH-EPH/ NWTPH-VPH	8260B	8270E	6020B	TO-15	TO-15/MA-APH Mod.	D1946
TE-09-1-TD-BD	Assess current conditions and the extent of potential residual source in soil	Soil	0-5	X	X		C	X	X	X			
TE-09-2-TD-BD		Soil	TBD*	X	X		C	X	X	X			
TE-10-1-TD-BD		Soil	0-5	X	X		C	X	X	X			
TE-10-2-TD-BD		Soil	TBD*	X	X		C	X	X	X			
TE-11-1-TD-BD		Soil	0-5	X	X		C	X	X	X			
TE-11-2-TD-BD		Soil	TBD*	X	X		C	X	X	X			
TE-##-#-TD-BD-DUP		Soil	TBD	X	X		C	X	X	X			
SS-01	Assess the quality of sediment adjacent to the bioswale discharge	Sediment	TBD*	X	X	X		X	X				
SS-02		Sediment	TBD*	X	X	X		X	X				
SS-03		Sediment	TBD*	X	X	X		X	X				
SS-##-DUP		Sediment	TBD*	X	X	X		X	X				
SS-01-SW	Assess the quality of surface water adjacent to the bioswale discharge	Surface Water	NA	X	X	X		X	X				
SS-02-SW		Surface Water	NA	X	X	X		X	X				
SS-03-SW		Surface Water	NA	X	X	X		X	X				
SS-##-SW-DUP		Surface Water	NA	X	X	X		X	X				
TE-06-GW	Assess quality of groundwater northeast of the travel center	Groundwater	5-15	X	X			X	X	X[1]			
TE-07-GW		Groundwater	5-15	X	X			X	X	X[1]			
TE-08-GW		Groundwater	5-15	X	X			X	X	X[1]			

Table 1
Sample Matrix
Remedial Investigation Work Plan
Love's Travel Stop #413
1512 Highway 97, Ellensburg, Washington

Sample Name	Objective	Sample Matrix	Approximate Sample Depth (feet bgs)	Analysis									
				TPH-G	TPH-D	TPH-O	TPH-EPH & TPH-VPH	MTCA VOCs	PAHs	Lead	MTCA VOCs and Naphthalene	Aliphatic and Aromatic TPH	Oxygen and Helium
				NWPTH-Gx	NWTPH-Dx	NWTPH-Dx	NWTPH-EPH/ NWTPH-VPH	8260B	8270E	6020B	TO-15	TO-15/MA-APH Mod.	D1946
TE-09-GW	Assess current conditions and the extent of potential residual source in groundwater.	Groundwater	5-15	X	X			X	X	X[1]			
TE-10-GW		Groundwater	5-15	X	X			X	X	X[1]			
TE-11-GW		Groundwater	5-15	X	X			X	X	X[1]			
TE-##-GW-DUP		Groundwater	5-15	X	X			X	X	X[1]			
MW-18-[DATE]**	Assess quality of groundwater downgradient of the Site	Groundwater	5-15	X	X			X	X	X[2]			
MW-19-[DATE]**		Groundwater	5-15	X	X			X	X	X[2]			
MW-20-[DATE]**		Groundwater	5-15	X	X			X	X	X[2]			
MW-##-DUP-[DATE]**		Groundwater	5-15	X	X			X	X	X[2]			
TSV-01-[DATE]	Assess the potential for vapor intrusion into the GrassRoots Grill building	Soil Vapor	4.5-5								X	X	X
TSV-02-[DATE]		Soil Vapor	4.5-5								X	X	X
TSV-03-[DATE]		Soil Vapor	4.5-5								X	X	X
TSV-##-DUP-[DATE]		Soil Vapor	4.5-5								X	X	X
VP1-[DATE]	Assess the potential for vapor intrusion during different atmospheric conditions within the travel center building	Sub-Slab Soil Vapor	BS								X	X	X
VP2-[DATE]		Sub-Slab Soil Vapor	BS								X	X	X
VP3-[DATE]		Sub-Slab Soil Vapor	BS								X	X	X
VP4-[DATE]		Sub-Slab Soil Vapor	BS								X	X	X
VP#-DUP-[DATE]		Sub-Slab Soil Vapor	BS								X	X	X

Table 1
Sample Matrix
Remedial Investigation Work Plan
Love's Travel Stop #413
1512 Highway 97, Ellensburg, Washington

Sample Name	Objective	Sample Matrix	Approximate Sample Depth (feet bgs)	Analysis									
				TPH-G	TPH-D	TPH-O	TPH-EPH & TPH-VPH	MTCA VOCs	PAHs	Lead	MTCA VOCs and Naphthalene	Aliphatic and Aromatic TPH	Oxygen and Helium
				NWPTH-Gx	NWTPH-Dx	NWTPH-Dx	NWTPH-EPH/ NWTPH-VPH	8260B	8270E	6020B	TO-15	TO-15/MA-APH Mod.	D1946
VP1-AS-[DATE]	Assess the potential for vapor intrusion during different atmospheric conditions within the travel center building	Indoor Air	NA								X	X	
VP2-AS-[DATE]		Indoor Air	NA								X	X	
VP3-AS-[DATE]		Indoor Air	NA								X	X	
VP4-AS-[DATE]		Indoor Air	NA								X	X	
OA1-[DATE]		Outdoor Air	NA								X	X	
VP#-AS-DUP-[DATE]		Indoor Air	NA								X	X	
EB#-[DATE]	Field Rinsate Blank (Equipment Blank) QA/QC Sample	Water	NA	Same analysis as media sampled with equipment used to generate									
TB#-[DATE]	Trip Blank	Water	NA					X + naphthalene					

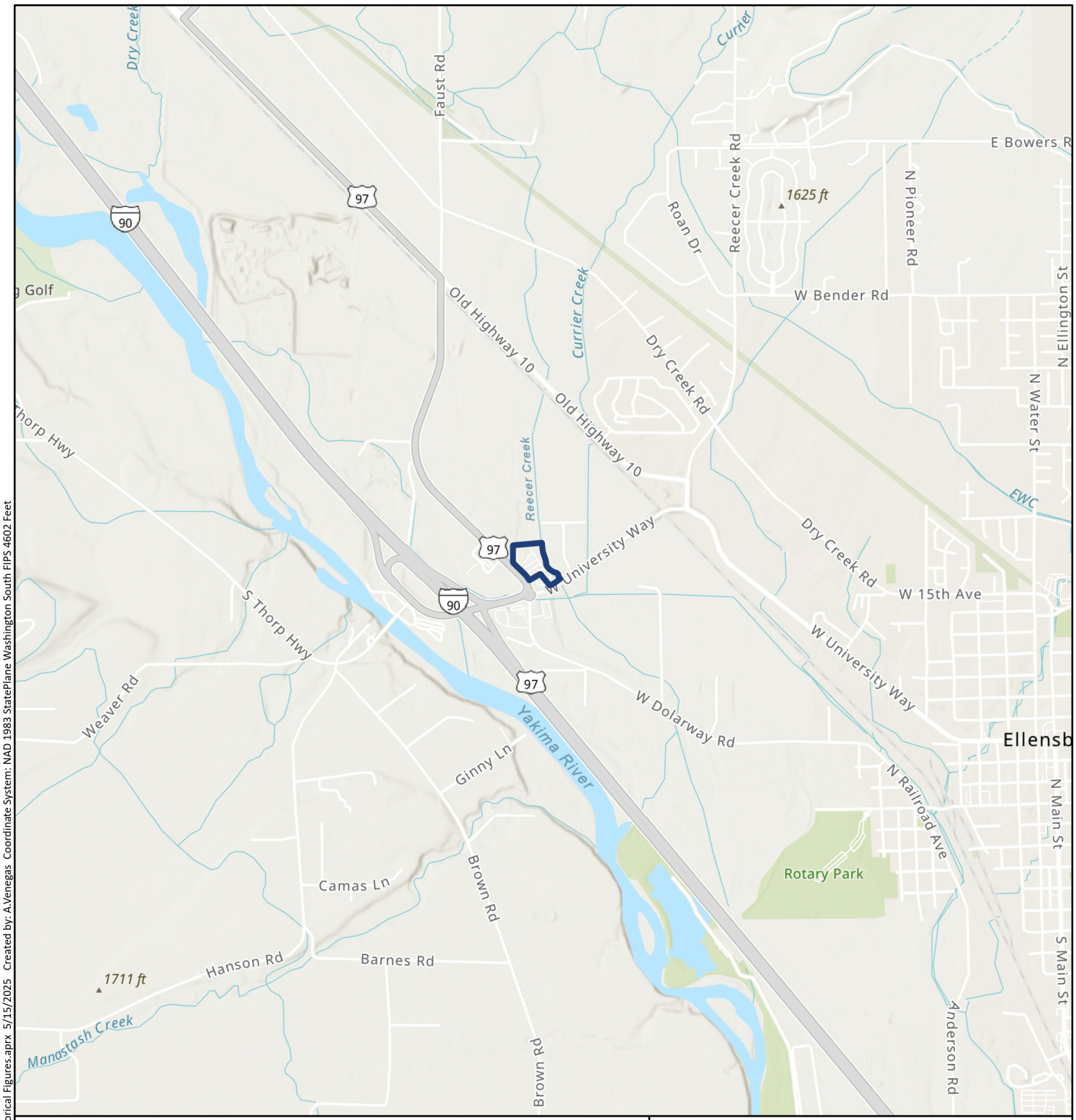
Table 1
Sample Matrix
Remedial Investigation Work Plan
Love's Travel Stop #413
1512 Highway 97, Ellensburg, Washington

Notes:
* = Soil sample to be collected from the soil-groundwater interface (soil boring samples) or dependent on relative depth of surface water (sediment samples)
** = Groundwater samples collected from all monitoring wells should follow the same nomenclature
[1] = Total and dissolved lead
[2] = Total and dissolved lead will be analyzed during the first monitoring event. Subsequent analysis of lead will be dependent on results.
[DATE] = Year/Month/Day that the sample was collected (e.g., 20250621)
BD = bottom depth. For groundwater samples, the bottom of the screen.
bgs = below ground surface
BS = below slab
C = analysis dependent on results of NWTPH analysis. At least three samples to be analyzed - one from the highest 10%, one from the lowest 10%, and one from the median range of the TPH concentrations.
EPH = extractable petroleum hydrocarbons
GW = designation for groundwater samples
MTCA = Model Toxics Contral Act
NA = not applicable
PAH = polycyclic aromatic hydrocarbon
TBD = to be determined (based on field conditions during sampling)
TD = top depth. For groundwater samples, the top of the screen.
TPH = total petroleum hydrocarbons
TPH-D = diesel and oil range TPH
TPH-G = gasoline range TPH
TPH-O = oil range TPH
VOCs = volatile organic compounds
VPH = volatile petroleum hydrocarbons
X = submit sample for specified analysis

Figures

1 Site Location

2 Proposed Site Investigation Locations



0 1,250 2,500 5,000 Feet

1 inch = 2,500 feet

N

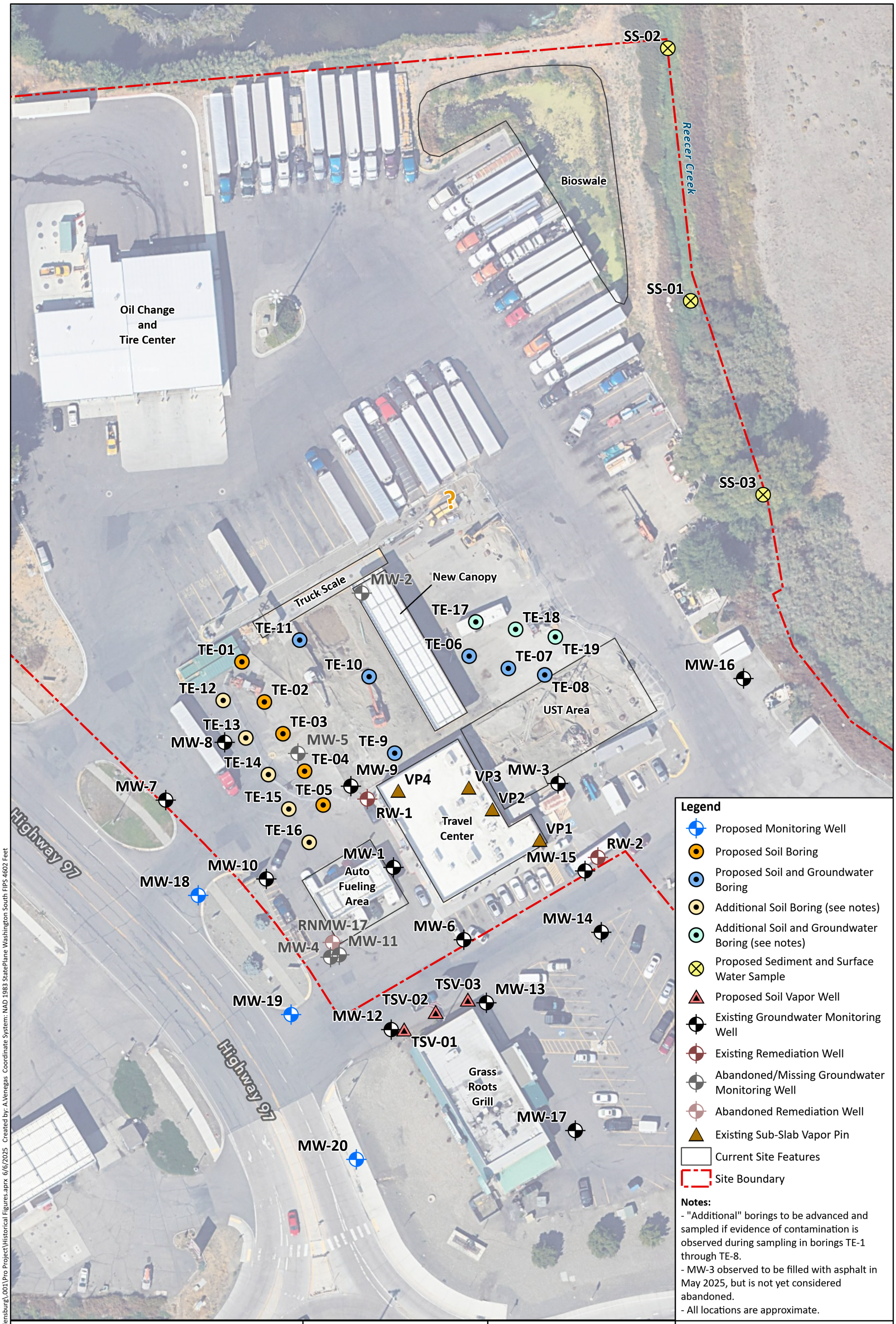
Legend

Site Boundary

Imagery Source: ESRI World Topographic Map

SAFETY FIRST	CLIENT: Love's Travel Stops	**Site Location**
terraphase engineering	PROJECT: Love's Travel Stop #413 1512 HWY 97, Ellensburg, WA	
	PROJECT NUMBER: W053.001.003	**FIGURE 1**

File: N:\GIS\Prj\W053_Loves Ellensburg\.001\Pro Project\Historical Figures.aprx 5/15/2025 Created by: A.Venegas Coordinate System: NAD 1983 StatePlane Washington South FIPS 4602 Feet



Legend

- Proposed Monitoring Well
- Proposed Soil Boring
- Proposed Soil and Groundwater Boring
- Additional Soil Boring (see notes)
- Additional Soil and Groundwater Boring (see notes)
- Proposed Sediment and Surface Water Sample
- Proposed Soil Vapor Well
- Existing Groundwater Monitoring Well
- Existing Remediation Well
- Abandoned/Missing Groundwater Monitoring Well
- Abandoned Remediation Well
- Existing Sub-Slab Vapor Pin
- Current Site Features
- Site Boundary

Notes:

- "Additional" borings to be advanced and sampled if evidence of contamination is observed during sampling in borings TE-1 through TE-8.
- MW-3 observed to be filled with asphalt in May 2025, but is not yet considered abandoned.
- All locations are approximate.

N

0 25 50 100 Feet

1 inch = 60 feet

Aerial Imagery Source: Google Maps, August 26, 2023

SAFETY FIRST

terraphase engineering

CLIENT: Love's Travel Stops

PROJECT: Love's Travel Stop #413
1512 HWY 97, Ellensburg, WA

PROJECT NUMBER: W053.001.003

Proposed Investigation Locations

FIGURE 2

File: N:\GIS\Prj\W053_Loves Ellensburg\.001\Pro Project\Historical Figures.aprx 6/6/2025 Created by: A.Venegas Coordinate System: NAD 1983 StatePlane Washington South FIPS 4602 Feet

Appendix A

Standard Operating Procedures

terraphase engineering

Standard Operating Procedure 103-23-00
Chain-of-Custody Requirements

This Standard Operating Procedure (SOP) describes the chain-of-custody (COC) procedures that will be employed during sample collection. A completed COC record must accompany every sample from the point of collection to delivery to the laboratory. A single COC record may accompany several samples, provided all samples are contained in a single batch unit (e.g., same coolers, boxes, etc.).

1. Equipment and Materials

The following is a list of equipment necessary to carry out the procedures contained in this SOP:

- Indelible ink ball-point pens
- Blank COC records
- One-gallon size resealable plastic storage bags (Ziploc® or equivalent)

2. Procedures

COCs will be kept in 1-gallon resealable plastic bags to prevent damage from melting ice, broken samples, and bad weather. If the samples are shipped to the laboratory and not hand-delivered, and a single COC is used for multiple samples of multiple coolers, then a photocopy of the original COC must be placed in each cooler. If the sampler is hand-delivering the samples to the laboratory, a single COC can be used for multiple samples of multiple coolers (i.e., a photocopy is unnecessary). A copy of every completed COC record will be retained in the project files.

COC completion and transfer procedures are discussed below.

2.1 Completion of COC Record(s)

The COC record will be completed as follows:

- The COC record is initiated in the field by the sampler(s) immediately after a sample is collected.
- COCs will vary according to laboratory, but certain data fields will always be required. These data fields include project number, sample location, sample matrix, sample ID, sample date and time, and requested analyses. Each sample ID shall be a unique identifier.
- The number of containers that makes a complete sample will be recorded in the box labeled “No. of Cont.” A sample may consist of multiple containers depending upon the analytical procedures requested.

- Any preservatives added to the containers for each analytical method will be indicated by recording the acronym or number in the box labeled "Preservatives" that corresponds to the preservative added. The preservatives and corresponding identifiers are listed on the COC record.
- The date and time (military) of sample collection will be recorded in the box labeled "Sampling Date/Time." It is very important to note the exact time each sample was collected.
- The requested analytical methods will be recorded in the table provided under the box labeled "Analyses." The analytical method should always be referenced. Generalized descriptions such as "Metals" are not acceptable unless they reference a specific list (i.e., RCRA metals, California Code of Regulations Title 22 metals, Priority Pollutant List metals, etc.).[1] Also, note whether a water sample will need to be analyzed for filtered metals, total metals, or both. Additional requests can be made for analytes, such as with silica gel cleanup for total petroleum hydrocarbons in the comments box or in the analyte line or both.
- A check mark or an "X" will be made under each analyte for which a particular sample will be analyzed. Drawing a line down the column or using quotes is not acceptable.
- Information relating to the collected sample(s) can be recorded in the box labeled "Comments." These comments may indicate special handling or analytical instructions for the laboratory (e.g., compositing instructions, confirming flammable liquid, hold, etc.) or may be used to indicate the location of sample collection.
- Additional information required on the COC record includes the person the analytical reports should be sent to, client name, site name/location, project description, project number and phase, names of all samplers involved in sample collection, where the samples are to be delivered, method of delivery, and air bill number (if applicable).

2.2 Transfer of Custody

The COC record must document transfer of custody each time the sample(s) change(s) hands. The National Enforcement Investigations Center of the United States Environmental Protection Agency defines custody as:

- The sample is within the direct possession or control (i.e., within the view) of an individual designated to have sample handling responsibilities;
- The sample was placed in a designated secure area to prevent tampering; or
- The sample is maintained in a manner that ensures that integrity of the samples is not compromised when placed in an unsecure area.

[1] Resource Recovery and Conservation Act, 42 U.S.C. § 6924(d)(d)(B), https://www.govinfo.gov/content/pkg/USCODE-2011-title42/html/USCODE-2011-title42-chap82.htm
"Characteristic of Toxicity," 22 CCR 66261.24(2)(A), https://govt.westlaw.com/calregs/title22/div4.5/ch11/art3/§66261.24
"Priority Pollutant List," 40 CFR Part 423, Appendix A, https://www.epa.gov/sites/default/files/2015-09/documents/priority-pollutant-list-epa.pdf

When transferring custody of samples, the person in custody (e.g., the sampler) must sign the box labeled "Relinquished By" and fill in the date and (military) time the custody of the samples was relinquished. The person accepting custody of the samples must then sign the box labeled "Received By" box and seal the COC inside the cooler. Most couriers have a policy against signing for custody of samples.

The pink or yellow copy (bottom) of the COC will be retained by the sampler before the samples are shipped and the remaining copies (white and yellow if there is a pink bottom sheet) of the COC are delivered to the laboratory. The pink copy will then be immediately put in the project folder. The white copy will be returned by the laboratory with the final report. If there are no carbon copies, a photograph or scan of the COC should be taken prior to shipment.

2.3 Special Notes

If samples are shipped via commercial courier on a Friday, the air bill needs to be checked for Saturday delivery, assuming that the laboratory is prepared to accept shipments on a Saturday and is notified of the shipment.

Check with the courier for specific shipping, labeling, and packaging requirements for samples known to contain flammable or hazardous materials. Proper training is required for persons who prepare or offer flammable or hazardous materials for shipment. Consult the most current edition of 49 CFR Parts 100-185.[2]

3. Reference

U.S. Environmental Protection Agency. 2005. "EPA QA Field Activities Procedure." *IT/IM Directive Procedure.* Directive No.: CIO 2105-P-02.0. July 7. https://www.epa.gov/system/files/documents/2022-09/epa_qa_field_activities_procedure.pdf.

[2] "Hazardous Materials and Oil Transportation," 49 CFR Parts 100-185, https://www.ecfr.gov/current/title-49/subtitle-B/chapter-I.

terraphase engineering

Standard Operating Procedure 105-23-00
Packaging and Shipping of Samples

This Standard Operating Procedure (SOP) describes procedures that shall be used to package and ship all non-hazardous samples. These procedures are the recommended handling procedures for all sample shipments to minimize the loss of samples associated with breakage and/or being received above the method-required temperature. These requirements are mandatory for all samples being transported by project personnel. Project personnel include all employees as well as personnel directly employed by the analytical subcontractor. Third-party courier services, regardless of whether contracted internally or by the analytical laboratory, are always considered non-project personnel. Strict adherence to these procedures shall help ensure sample integrity even if delivery is delayed.

1. Materials and Equipment

The following is a list of materials and/or equipment necessary to carry out the procedures contained in this SOP:

- Duct tape
- Clear packing tape
- Custody seals
- Ziploc (or equivalent) storage bags, various sizes
- Packing material (Styrofoam, bubble wrap, etc.)
- Mailing labels (in addition to any shipping papers)
- A site-specific Health and Safety Plan

2. Procedures

The following procedures shall be adhered to for packaging and shipping of all non-hazardous samples.

2.1 Coolers

Coolers are the most common package or containment device used to ship samples. Coolers are also used during sampling efforts to store and transport samples prior to shipping. It is very important that samples be placed in an iced cooler immediately after collection. The ice in the cooler used for shipping will last much longer if the sample containers placed into it have been pre-chilled. The following procedures shall be used when packing the cooler for shipment:

- Drain free liquid from the cooler then secure the drain on the cooler with packing tape or duct tape to prevent accidental opening.

- Place each individual sample (soil and/or ground water) in a sealable, reusable bag (Ziploc® or equivalent). Volatile organic analysis vials that are aliquots from the same sample can be placed in the same bag. It is recommended that the volatile organic analysis vials be wrapped with bubble wrap or paper towels to prevent excessive contact during shipping.
- Place the samples into the cooler. Situate the sample containers so that they do not touch each other. This is very important for aqueous samples in glass containers as they are more prone to break.
- Use plastic bubble wrap or Styrofoam peanuts as packing or filler material to prevent the samples from colliding and breaking during transportation. A thin layer of Styrofoam on the inside bottom of the cooler may help prevent breakage of the sample containers during transport. Avoid using shredded paper as packing material. If the paper becomes wet, it will no longer be useful to prevent samples from colliding. Only a minimum amount of packing material should be used as these materials insulate the samples and prevent them from being properly chilled. Plastic sample containers or cardboard can be placed between glass containers. Bags of ice may also be used as packaging material between samples. Sample containers should be snug and not easily moved within the cooler.
- Fill the cooler with ice. Ice should be double bagged in Ziploc® bags. Forty to fifty percent of the cooler capacity should contain ice to keep the samples cold during transport. If a commercial carrier such as FedEx or UPS is shipping the samples, it is best to use more ice in case delivery is delayed. Less ice may be used if the samples will be delivered by hand. As a rule of thumb, an average cooler with a capacity of approximately 48 quarts will require two to three 8-pound bags of ice.
- Place the chain-of-custody (COC) record in a Ziploc® bag and tape it to the underside of the lid of the cooler. If samples are packed in multiple coolers, the number of coolers should be marked on the COC record and a photocopy of the COC shall be placed in each cooler.
- Tape the cooler shut to prevent accidental opening or potential leakage with appropriate tape (i.e., fiber-reinforced packing tape, duct tape, or clear packing tape). Tape shall be placed around the entire perimeter of the lid/cooler seam to seal the cooler and then around the body of cooler in two or three places to secure the lid from accidentally opening. Do not tape down or otherwise restrict access to the cooler handles. Coolers used for shipping shall not have any broken or missing handles.
- Custody seals shall then be placed on the cooler to document the integrity of the shipping container. A minimum of two custody seals shall be placed on each cooler in a manner that the cooler cannot be opened without breaking the seal. Each custody seal shall be signed and dated by the person packing the cooler, and the seals shall be covered by clear packing tape to prevent accidental loss or damage during shipping.
- Affix a mailing label with the laboratory's address on the cooler. Use an adhesive label pouch provided by the shipper secured with additional clear packing tape or apply clear packing tape over the address label to prevent accidental loss or damage during shipping. The label should be used in addition to any shipping papers required by carriers.

2.2 Boxes

Some samples do not require temperature control and may be shipped in boxes. The boxes should be sturdy enough to withstand rough handling. No liquids shall ever be shipped by box. Materials suitable to be shipped by box include:

- Air samples in Summa canisters, air-tight gas sampling bags, or other non-pressurized sample containers;
- Bulk asbestos samples; and
- Soil samples for geotechnical analyses.

These materials may be securely packed in a suitable box. The box shall be sealed with packing tape and have address labels and custody seals affixed as described above.

2.3 Documentation

A copy of any applicable shipping papers shall be retained for future reference. Any pertinent shipping information should be recorded on the Daily Field Report or in the field notebook for the project with copies saved in the project folder on the appropriate Terraphase server.

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Standard Operating Procedure 111-24-00
Field Quality Control Samples

This Standard Operating Procedure (SOP) describes the procedures for the collection of field quaility control (QC) samples that are used to monitor the reproducibility and representativeness of field sampling. The QC samples are handled, transported, and analyzed in the same manner as the associated field samples. QC samples may include trip blanks, equipment blanks, and field duplicates.

Although this SOP provides guidelines for QC sampling associated with typical environmental investigation activities, certain projects may require more specific sampling and decontamination procedures (i.e., site-, state-, or regulatory program-specific guidelines, requirements, or procedures, may be applicable). Specific requirements for these types of projects and activities will be reviewed by the client manager (CM) and/or project manager (PM) and any additional requirements will be defined in a project-specific work plan, sampling plan, and/or SOPs. **These guidelines are not meant to be project-specific work plans, but rather a general reference for developing project-specific requirements.**

This SOP does not supersede Terraphase health and safety procedures or site-specific health and safety plan (HASP) requirements. In the event of conflict between this SOP and the site-specific HASP, the procedures outlined in the HASP shall prevail. All Terraphase employees shall follow the guidelines, rules, and procedures contained in the site-specific HASP followed by procedures recommended in this SOP.

1. General Procedures

This section presents specific procedures for collecting trip blanks, equipment blanks, field duplicates, and matrix-spike/matrix spike duplicates samples.

1.1 Trip blanks

Trips blanks are used to monitor possible sources of contamination from transport, storage, inadequate bottle cleaning, or laboratory methodologies. Sample containers filled at the laboratory with analyte-free water are transported to and from the site and are not opened until time of analysis.

Trip blanks are stored with the sample containers prior to and after field activities and remain with the collected samples until analyzed. Generally, there is one trip blank per volatiles analysis (e.g., volatile organic compounds [VOCs]) shipment. A trip blank should be considered when sample shipment is by FedEx or another large carrier or laboratory courier. Trip blanks should be recorded in the field notebook and on the chain-of custody form the same as all other samples.

1.2 Equipment blanks

Equipment blanks (also known as equipment rinsate blanks) are used to monitor possible sources of contamination associated with sample collection (i.e., monitors on-site sampling environment, sampling equipment decontamination, sample container cleaning, the suitability of sample preservatives and analyte-free water, and sample transport and storage conditions).

Equipment blanks are collected by pouring laboratory-supplied or distilled or deionized water over sampling tools that have been decontaminated, per the work plan, into sample containers. Equipment blanks are stored with the associated field samples until submitted for analysis.

Generally, equipment blanks are collected when site conditions indicate site-related contamination is a concern. Check project-specific work plan and/or quality assurance project plan for required frequency.

Prepare equipment blanks immediately after the equipment is cleaned in the field and before leaving the sampling site. Rinse the decontaminated sampling equipment set with the appropriate type of analyte-free water and collect the rinse water in appropriate sample containers. If a potable water rinse is the typical final step, collect the equipment blank with analyte-free water after the potable water rinse.

Equipment blanks should be recorded in the field notebook and on the chain of-custody form the same as all other samples.

1.3 Field Duplicates

Field duplicates are used to evaluate the precision and representativeness of the sampling procedures. Field duplicates are two samples collected from the same location using the same procedures. Both samples are submitted to the laboratory as individual samples with different sample identification.

Field duplicates from groundwater sampling for all analyses except volatiles analysis are collected by alternately filling sample containers from the same sampling device. Field duplicates for volatiles analysis are filled sequentially.

Soil or sediment field duplicates are collected by homogenizing the sample for all analyses except volatiles. The homogenized sample is then divided into two equal portions and placed in separate sample containers. Field duplicates for volatile analysis are collected at two adjacent sampling locations. Each sample is assigned different sample identifications.

Field duplicates are generally collected at frequency of 1 per 10 samples. Check project-specific work plan and/or quality assurance project plan for required frequency.

All field QC samples should be labeled in the field and submitted “blind” to the laboratory (i.e., as if they are separate, primary samples).

Field duplicates should be recorded in the field notebook and on the chain-of custody form the same as all other samples.

1.4 Matrix Spike/Matrix Spike Duplicates

Matrix spike (MS)and MS duplicates (MSDs) are environmental samples that are spiked in the laboratory or in the field with a known concentration of a target analyte(s) to verify percent recoveries. MS/MSD samples are primarily used to check sample matrix interferences. They can also be used to monitor error due to laboratory bias and poor precision. However, a data set of at least three or more results is necessary to statistically distinguish between laboratory performance and matrix interference.

Generally, the laboratory is required to extract and analyze MS/MSDs at a minimum frequency of 5 percent of samples being analyzed for the target analyte(s). If the project or client criteria require an MS/MSD, collect sufficient volume in the appropriate containers, and designate the sample to be used as the MS/MSD (as applicable) on the chain-of-custody form.

Calculate the percent recovery for all spiked analytes for MS/MSDs. Also calculate the relative percent difference (RPD) for each spiked analyte. The RPD is calculated using the amount detected not percent recovery. If your data will be subjected to validation, the percent recovery and the RPD will generally be determined by the validator.

2. Quality Assurance/Quality Control Frequency

Quality assurance (QA)/QC frequency is determined by project, client, or regulatory criteria and should be verified prior to sample collection. Generally, QA/QC samples are collected according to the frequency described in the table below.

Duplicate Samples	One per sampling event, 1 per 10 samples collected, or 1 every 2 weeks, whichever comes first.
Equipment Blanks	For each equipment type that is not dedicated or disposable: 1 per sampling event, 1 per 20 samples collected, or 1 every 2 weeks, whichever comes first.
Trip Blanks	One per sample delivery group, or in each cooler containing VOC soil or aqueous samples, depending on project.
MS/MSDs	One MS or MS/MSD per sampling event, 1 per 20 samples collected, or 1 every 2 weeks, whichever comes first.

3. Limitations

The following limitations apply:

- Trip blanks must never be opened in the field.
- Trip blanks are usually for VOCs only because less volatile compounds are not likely to cross-contaminate other samples by simply being in close proximity.
- Laboratory-grade water must be used during the collection of equipment blanks.
- Field duplicates must have different sample identifications.

4. References

U.S. Environmental Protection Agency Department of Solid Waste. 1986. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods.* Washington, D.C. November.

U.S. Environmental Protection Agency Office of Emergency and Remedial Response. 1990. *Quality Assurance/Quality Control Guidance for Removal Activities, Sampling QA/QC Plan and Data Validation Procedures*. Interim Final. EPA/540/G-90/004. OSWER Directive 9360.4-01. April.

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Standard Operating Procedure 200-23-00

Groundwater and Free Product Level Measurements

This Standard Operating Procedure (SOP) describes the procedures established by Terraphase for groundwater level (depth to water) and free product level (depth of free product) measurements in groundwater monitoring wells or piezometers. These guidelines may also be applicable for measuring the depth to water or free product in other types of wells (potable and non-potable) or boreholes.

Groundwater level measurements are collected to determine the depth to groundwater within a well relative to ground surface, top of the well casing, and/or an established elevation datum. Similarly, free product measurements are collected to determine the depth to non-aqueous phase liquid (NAPL) accumulated within a well relative to an established elevation datum. The accumulated thickness of NAPL within a well can be determined if the bottom of the free product can be additionally measured. Properly collected and recorded measurements can be utilized for generation of potentiometric surface maps to establish groundwater flow direction, define horizontal and vertical hydraulic gradients, evaluate variations in groundwater elevations over time, evaluate NAPL mobility or recovery, and other project-specific tasks.

Although this SOP provides guidelines for groundwater and free product level measurements, certain projects will require site-specific sampling procedures, adhering to state- or regulatory program-specific guidelines, requirements, or procedures, as applicable. Specific requirements for these types of projects will be reviewed by the Terraphase principal-in-charge/project director (PIC) and project manager (PM) and any additional requirements will be defined in a project-specific work plan, sampling plan, and/or SOP(s). **These guidelines are not meant to be project-specific work plans but rather a general reference for developing project specific requirements.**

This SOP does not supersede Terraphase health and safety procedures or site-specific health and safety plan (HASP) requirements; in the event of conflict between this SOP and the site- specific HASP, the procedures outlined in the HASP shall prevail. All Terraphase employees shall follow the guidelines, rules, and procedures contained in the site-specific HASP, followed by procedures recommended in this SOP. The Terraphase PIC and PM shall ensure that all project personnel review and sign the applicable HASP, and the signed HASP and relevant project information are maintained in the project file for the duration of the project. The signatures of the PIC and PM indicate approval of the methods and precautions outlined in the HASP.

1. Materials and Equipment

Below is a general checklist of equipment that may be required for typical groundwater level measurement efforts. This checklist only suggests general equipment that may be necessary for a project or task and should not be considered exhaustive:

1. General water and free product level measurement equipment:
   - Electronic water level indicator
   - Electronic oil/water interface probe for wells containing known or suspected NAPL
   - GPS or other locating device
   - Site map showing locations of wells
   - Well construction records and previous water level measurements
2. Project- or task-specific water and free product level measurement equipment:
   - Well lock keys
   - Steel tape measure or submersible water level meter for use in measuring total well depth
   - Decontamination supplies/equipment (non-ionic detergent, tub, brushes, etc.)
   - Wash bottles/bucket
   - Trash bags (used to dispose of gloves and any other non-hazardous waste generated during sampling)
   - Appropriate waste container (used to dispose investigation-derived wastes and/or decontamination wastes)
   - Socket wrench (manhole bolt sizes vary; most commonly require a 9/16-inch socket)
   - Water valve gate box key (for older style flush-mounted wells)
   - Pry bar (or other equivalent tool to assist in the removal of the flush-mounted well cover or handhole)
   - Syringe (or other equivalent tool, such as a turkey baster, to assist in removing standing water in flush mounted wells)
   - Extra batteries for the water level meter (usually 9-volt)
3. Miscellaneous additional suggested equipment:
   - Extra vehicle keys
   - Metal locator (to find buried/obstructed flush mounted wells)
   - First aid kit
   - Mobile phone
   - Credit card for gas and emergencies
   - Road and site maps
   - Chemical protective gloves and other personal protective equipment, as required by the HASP
   - Field notebook and field data sheets
   - Waterproof pens

- Bolt cutters (to remove rusted padlocks)
- Replacement padlocks
- Camera and extra batteries

2. Procedures

This section discusses guidelines for field work preparation, measuring water levels, and quality assurance/quality control practices.

2.1 Field Work Preparation Guidelines

Before initiating field activities, the following tasks should be completed to prepare field staff for what may be expected during implementation of the work:

- Review and sign the site-specific HASP;
- Coordinate and obtain permission for site access;
- Review project-specific work plan/sampling plan;
- Review project-specific quality assurance project plan (QAPP), where applicable;
- Review and discuss with PIC and/or PM the proposed activities or work plan/sampling plan;
- Review the standard instruction manual provided by the manufacturer of the specific equipment to be used for water level monitoring and field screening;
- Inspect the water level meter(s) for any signs of damage and test for proper operation;
- Identify well locations, specific order in which they are to be collected, and confirm the measurement datum on each well casing;
- Obtain copies of recent or historical (i.e., same season) water or free product level data to be able to anticipate the approximate depth of water or free product, minimizing unnecessary wetting of the tape and as a check of the measured levels;
- Obtain copies of well construction records (these can be used to confirm the well identification if not clearly identifiable); and
- Identify wells that are known or suspected to contain NAPL or other free product. An electronic oil/water interface meter must be used in these wells in lieu of an electronic water level indicator.

All significant field activities will be approved by the PIC and/or PM before the initiation of field activities. The sampling plan should be designed for the collection of quality data that meets the goals of the study/monitoring program. The work plan/sampling plan should generally provide for some discretion in the field depending on encountered conditions; however, any significant departure from prescribed field activities shall be approved by the PIC and/or PM.

Prior to the commencement of the field effort, inspect, test, and/or calibrate equipment that will be used to take field measurements.

2.2 General Water Level Measurement Guidelines

Water level measurements are generally taken in monitoring wells, piezometers, or boreholes using electronic water level indicators. There are different manufacturers of electronic water level indicators (e.g., Solinst, Keck, and Heron). Electronic water level indicators consist of a reel of dual conductor wire embedded within a pre-marked tape, a probe with an insulating gap between the wire attached to the end of the tape, and an indicator on the reel. Generally, tapes are marked every 1/100 of a foot and/or millimeter. When the probe comes in contact with water, the circuit is closed, and the indicator signals this contact with an audible buzzer and/or an optical light. The meters typically run on 9-volt batteries located within the reel as a power source. Many water level meters include a sensitivity adjustment on the indicator. The sensitivity adjustment diminishes potential short circuiting of the probe in moist environments, such as those encountered in a well.

The following provides a recommended list of practices for water and/or free product level measurement activities:

- Where applicable, contact the identified key site personnel upon arrival to the site and assess proposed work areas.
- All wells to be gauged should be inspected for damage, access constraints, and/or vehicle traffic proximate to the well location.
- Because groundwater or free product depth can vary due to natural fluctuations in ambient conditions (e.g., barometric pressure), all measurements for a specific sampling event should be collected within as short of a time frame as possible.
- Although equipment should be decontaminated between uses, to further limit potential cross-contamination between wells, perform measurements from least to most contaminated locations.
- All depth to water or free product measurements should be completed prior to any planned groundwater and/or product withdrawals, sampling or disturbance of groundwater unless otherwise specified in the work plan/sampling plan.
- All water or free product level measurements should be made relative to an established reference datum and recorded in the field notes. The reference datum is usually marked, notched, or etched on the well or casing at the time of installation on the north side of the inner casing. In the absence of a marked, notched, or etched reference datum, water level and depth measurements should be taken from the north side of the inner casing and marked or etched for future reference. If a casing is notched or etched at a distinct angle, the measurements should be made from the highest point in the casing. Note this procedure in the field book.
- Record in the field book the model name, number, and serial number of the electronic water level meter or interface probe to be used.
- Identify the well to be measured and confirm by checking for proper identification markings on the well, comparing location on the site map, and if needed, historical water and/or product level measurements and well construction records. If the well cannot be positively identified, contact the PIC or PM before proceeding. It may be possible to identify the well by comparison of the total well depth with the well construction records; however, such measurement should be discussed with the PIC or PM before proceeding in cases where the well is to be sampled after water level/free product measurements are collected.

- Decontaminate the water level meter probe, interface probe, and/or tape (if total well depth measurements are obtained with a tape) prior to each use.
- Remove the well cover or equivalent protective casing cover. Inspect the interior of the well box for insects, etc., that could present a biological hazard. If there is water in the well box, remove all water (at least to a level below the top of the inner well casing) prior to removing the well cap or plug. Indicate that water was removed from the well box and identify possible causes (e.g., missing bolts, damaged well cover, etc.).
- Remove the well cap or plug, noting well identification, time of day, and date in field book. Also note any abnormal conditions in the well (e.g., damaged inner casing, limited clearance between the bottom of the well box and the top of the inner well casing, absence of reference datum, etc.) If the top of the well casing has been damaged, the reference datum may no longer be accurate.
- If present, remove expansion caps and the wells allowed to equilibrate for an appropriate period prior to the collection of water level measurements. This is especially critical for wells screened below the water table or in confined units. There are no set guidelines and appropriate equilibration times can range from minutes to hours depending on well recharge, local geology and topography, and project objectives.
- Record observance of positive or negative pressure in the well upon removal of the well cap. The presence of pressure/vacuum in the well could be qualitatively assessed during loosening and removal of an expansion cap (resulting in air either being audibly pushed out or drawn in to the well casing) or using a piece of paper or other light object (i.e., easily moved or displaced by light air flow) placed immediately above the inner well casing and observing its movement (i.e., if it adheres to well casing, there is a negative pressure in the well; if it moves from the well casing, there is a positive pressure in the well). If pressure is observed, the water level should be measured multiple times over a 5- to 10-minute period to allow time for equilibration and confirm that the water level has reached static conditions.
- Monitor the headspace of well with a field screening device in accordance with the applicable manufacturer instructions. Record field screening readings in field book. The necessity and methodology to conduct field screening should be detailed in the site-specific HASP and sampling plan.
- Check that the indicator on the water level probe is working properly by pushing the test button on the reel. Replace batteries in the electronic water level meter or product interface probe if testing or operation indicates the battery is not providing sufficient power. Battery replacement during a field measurement event must be recorded in the field book.
- Lower the probe slowly into the well taking care to minimize contact with the well casing. If significant kinks are observed in the tape, attempt to straighten manually and record observations in the project field book.
- When a strong and steady signal from the indicator signals water or free product has been encountered, slowly pull the tape up until the signal ceases.
- Manually lower and raise the probe to exactly locate the water or free product interface.
- At the point where the signal indicates free water surface or free product has been encountered, measure and record the depth of the probe using the marked tape.



- If free product is encountered, continue to manually lower the probe into the well until a strong and steady signal from the indicator signals that water has been encountered. Lower and raise the probe to exactly locate the water or free product interface. Measure and record the depth of the probe using the marked tape.
- Measurements should be taken according to the established reference datum.
- Repeat the measurement to verify accuracy. Measurement should be recorded to the nearest 1/100 of a foot or to the nearest millimeter.
- If total well depth measurements are required, these should be made in reference to the top of casing as well as the ground surface. These measurements should be performed after sampling.
- Withdraw the probe from the well, replace the well cap, and re-secure the well.
- Record in the field book any abnormal conditions within the well (e.g., evidence of blockage, root growth into the well casing, separated casing sections, etc.). Inform the PIC or PM so necessary maintenance, redevelopment, or repairs are conducted before the next planned water level measurement event.

To minimize potential cross-contamination across wells, decontaminate the probe and portions of the tape that contacted water and/or product as described in the project-specific sampling plan, QAPP, and/or SOP 109, “Sampling Equipment Decontamination.”

2.3 Quality Assurance/Quality Control

Quality assurance/quality control procedures described in the project-specific work plan/sampling plan and/or QAPP must be followed throughout the water level measurement process.

3. Precautions

All field activities require recording sufficiently detailed information throughout the implementation of field work. Additionally, implementation of the work may face some difficulties. However, the following precautions should be taken to ensure safety while conducting water level measurements:

- Operate electronic water level meters and product interface probes in accordance with the manufacturer’s instructions and recommendations.
- The protective casing of flush-mount wells often fills with run-off surface water. If upon removing the well cover the top of inner well casing is submerged, utilize a syringe, turkey baster, or equivalent tool to remove the excess water before removing the well cap to avoid surface water flow into the well.
- Well keys may not work with rusted/outdated well locks; bolt cutters may be used to remove the lock, which should be replaced upon completion of water level measurement. Do not use petroleum-based solvent sprays to free seized locks as this may impact water quality in the well.
- Wells with a water-tight cap may experience a buildup of pressure, especially if they are screened below the static water level. Keep your face and body away from the top of the well when loosening or removing the cap.

- Ensure that the water level has reached the static level prior to recording the depth to water. If the water level is in a state of flux due to pressure buildup, allow ample time for the water level to stabilize to static conditions before recording the measurement (refer to Section 4.2).
- Water level probe indicator response may be indicative of potential faults that could be corrected in the field, as follows:
  - If the signal from the indicator is intermittent or weak it may be necessary to decrease the sensitivity since it may be short circuiting prior to encountering free water.
  - If there is no signal it may be necessary to increase the sensitivity since some groundwater is less conductive and may not complete the circuit.
  - If the signal is still intermittent, weak, or absent then replace the battery and reattempt the measurement.
- Cascading water may interfere with the measurement of free water, particularly inopen boreholes or rock wells.
- Some well casings have sharp edges; care should be taken when lowering orwithdrawing the tape to avoid damaging the tape and water level probe.
- Oil or other product floating on the water column may insulate the contacts of the probe resulting in a misleading indication of the depth to free water. A separate oil/water level indicator should be used if there is known or suspected product in a well.
- Note some water level indicators will have a 2- to-3-inch weight on the tip of the probe which can displace water in a well before the water indicator detects it. These models also make it difficult to detect small amounts of water in wells (i.e., less than 3 inches). If this is expected to be a potential issue, then request a model with the water indicator located on the tip of the probe.
- Meters should be inspected periodically to ensure accurate readings. Electronic water level meters and interface probes may not function properly if the electric wire is broken or cut, or if insulation is removed, exposing the wire (resulting in short circuiting). Repaired meters may have had sections of the tape removed and/or spliced and may not meet data quality objectives. Damaged or suspected damaged tapes should be repaired by the manufacturer or replaced.
- If using the water level meter for total depth measurements, confirm that the probe is designed for total immersion and the maximum acceptable depth of immersion.
- Tape lengths can be confirmed using calibrated steel tape as necessary to adhere to data quality objectives. Discrepancies in tape length must be noted in the field logbook and/or field sheet.
- For high conductivity groundwater (brine) decreasing the sensitivity control prevents bridging so a moist probe is not detected in the water.

4. Recordkeeping

Document all water level measurement locations and record all information in accordance with SOPs 100, “Field and Lab Data Management,” and 106, “Field Notebook.”

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Standard Operating Procedure 201-23-00
Grab-Groundwater Sampling



This Standard Operating Procedure (SOP) provides guidelines for collecting grab groundwater samples using direct-push technology (DPT). Grab groundwater sampling allows for the rapid collection of groundwater samples to assess groundwater conditions during a sampling event. This type of sampling strategy is typically used to assess plume boundaries or identify "hot spots" in groundwater. The data is often included in the assessment of an appropriate remedial alternative for a site, and to assess the appropriate location of groundwater monitoring wells at a site. There are limitations to the data collected from gab groundwater samples, especially as it pertains to vertical profiling of contamination. In-situ direct sensing technologies should be considered at sites with potential volatile organic compound and total petroleum hydrocarbon contamination as an initial screening tool over grab groundwater sampling. The volume of available groundwater within the borehole and turbidity of the water collected can also present challenges during an investigation.

Although this SOP provides guidelines for DPT grab groundwater sampling activities, **these guidelines are not meant to be project-specific work plans** but rather a general reference for developing project-specific requirements. Certain projects may require more site-specific sampling and decontamination procedures, including state- or regulatory program-specific guidelines, requirements, or procedures. Specific requirements for these types of projects and activities will be reviewed by the client manager and/or project manager and defined in a project-specific work plan, sampling plan, and/or SOP(s).

This SOP does not supersede Terraphase health and safety procedures or site-specific health and safety plan (HASP) requirements. In the event of conflict between this SOP and the site-specific HASP, the procedures outlined in the HASP shall prevail. All Terraphase employees shall follow the guidelines, rules, and procedures contained in the site-specific HASP followed by procedures recommended in this SOP.

1. Materials and Equipment

The following is a list of materials and/or equipment necessary to carry out the procedures contained in this SOP:

- Project work plan
- Project-specific HASP
- Personal protective equipment and air monitoring equipment as specified by the project HASP

- Applicable permits and agreements (i.e., soil boring permits, encroachment permits, access agreements, etc.)
- Underground Service Alert reference number and utility contact information
- Traffic safety equipment (e.g., traffic cones, work signs), if work is in the street or public right of way or conducted at an active facility
- DPT drill rig equipped with Hydropunch™ sample equipment or temporary PVC well casing
- Small-diameter bailer (1/2- or 3/4-inch) or peristaltic pump with tubing as directed in the work plan
- Water level meter calibrated to 0.1 feet
- Appropriate laboratory sample containers, labels, and chain of custody
- Small white board and dry erase pen (if photographing the soil cores)
- Mobile phone and/or iPad/tablet with camera
- Munsell color chart, boring logs, and soil logging equipment (if logging soil)

2. Procedures

This section discusses activities to occur prior to field/drilling and subsequent drilling and sampling procedures.

2.1 Pre-field/Pre-drilling Activities

The following must be completed prior to initiation of field or drilling activities:

- Prepare and review project HASP.
- Review the project work plan.
- Obtain applicable permits (i.e., soil boring, encroachment, excavation, etc.) and access agreements.
- Mark sample locations for one-call utility notification service (i.e., Underground Service Alert) and obtain one-call locate ticket by phone or online notification with adequate notification time as required by the service. Remember that the notification time does not include weekends and holidays.
- Complete a site walk with facility personnel who are the most knowledgeable of the location of underground facilities, if available, and/or review as-built utility drawings.
- Proposed boring locations should be scanned by a private subsurface utility locating company. Clear an area large enough to allow for step-out borings in case of refusal or other conditions that may warrant the advancement of additional borings (minimum 10- by 10-foot area).

2.2 Drilling and Sampling Procedures

Adhere to the following drilling procedures:

- The first 5 feet of the boring will be advanced using a hand auger to check for the presence of underground utilities.
- Advance boring using an exposed screen sampler or standard direct-push drill rod to the desired depth. The procedures associated with each technology are discussed further below.

- Borings should be advanced at least 2 to 4 feet into the groundwater interval to be sampled to provide sufficient volume for sampling. The interval to be sampled may depend on the purpose of the investigation, lithology, or anticipated groundwater yield.

The most appropriate sampling interval to use at a site should be determined because the location and length of a sampling interval can bias a sample. Short or long sampling screens can be used with both DPT and conventional monitoring wells; however, DPT grab methods are generally more economical and better designed to target smaller sampling intervals than conventional wells. Too small a sample interval risks missing contaminants that may be migrating through sections of the aquifer that do not fall with the screened interval, while too long a sample interval risks dilution of discrete impacts by uncontaminated intervals. It is generally recommended to use a 3- to 5-foot sampling interval, depending on the sampling method chosen and the objectives of the investigation.

2.2.1 Types of Samples

There are two sampling options that may be used:

- **Option 1 – Sealed Screen Sampler (i.e., Hydropunch™).** Use when NOT collecting soil samples for logging and/or analytical. Sealed-screen samples typically consist of a short (6-inch to 3-foot) screen nested within a sealed, water-tight tool body. Because the screen is not exposed to the formation as the sampler is advanced in to the subsurface, the screen does not become plugged or damaged. In addition, the potential for cross-contamination is greatly reduced and a true depth-discrete sample can be collected. Proceed as follows:
  - Advance the 1-3/4-inch hollow push rods with the expendable tip and sampling assembly in a closed configuration to the base of the desired sampling interval (determined by the work plan). Once at the desired sample depth, the push rods are retracted and the encased filter screen is exposed to the formation allowing groundwater to infiltrate from the formation to the screen (see illustration of exposed screen sampler).
  - Sealed-screen samplers generally are limited to collecting one sample per advance of the sampler. However, depending on the system used, multi-level sampling in a single borehole can be accomplished with sealed-screen samplers by retrieving the sampler and decontaminating it or replacing it with a clean sampler before reentering the hole to collect another sample.
- **Option 2 – Standard DPT Rod/Temporary PVC Casing.** Use when collecting soil samples for logging and/or analytical. Proceed as follows:
  - Advance the rods to the desired depth.
  - Remove rods from the borehole and install 3/4- or 1-inch-diameter PVC casing with desired screen interval into the open borehole.
  - If the temporary casing does not reach the original drilled depth, then the borehole has partially collapsed, and the boring must be re-drilled, or an alternate method of grab groundwater sampling can be utilized.
  - Alternate methods can include using an exposed screen sampler (discussed above) or standard DPT rods with a disposable drop tip.

- For the standard rod with drop tip, the boring is advanced to the desired depth, then the temporary casing is deployed into the rods. The rods are then removed, leaving the disposable tip and temporary casing in the borehole. Soil logging is not possible when utilizing this method.

2.2.2 Groundwater Sample Collection and Borehole Abandonment

Procedures for groundwater sampling and borehole abandonment include the following:

- Lower the small-diameter bailer (approximately 1/2 or 3/4 inches) through the push rods or temporary PVC casing into the screen section for sample collection. Tubing attached to a peristaltic pump can also be used for sample retrieval, if specified by the work plan. Sample collection should be in accordance with the procedures specified by the work plan and/or quality assurance project plan (if available). The number of downhole trips with the bailer (or the amount of water pumped) and time necessary to complete the sample collection is a function of sampling protocols, volume requirements, and the yield characteristics and storage capacity of the formation.
- Decant grab-groundwater sample into the applicable laboratory containers (sample bottle labels should be prepared and placed on the sample container prior to sample collection). Place the samples in a cooler chilled with ice. Glass bottles should be protected using bubble wrap or other padded packaging material. Record the sample and requested analysis on a chain-of-custody form.
- A peristaltic pump is preferable if planning to field filtering the grab groundwater samples to be analyzed for dissolved metals. A more efficient option is to have the analytical laboratory filter the samples. If the laboratory is filtering the samples, make sure they are collected in an unpreserved sample container. It is best if the samples are delivered to the laboratory the same day they are collected. The laboratory must filter and preserve the samples within 24 hours of collection. The laboratory should be notified prior to the start of the investigation that they will be filtering the samples.
- Upon completion of sample collection using the exposed screen sampler, the push rods are retrieved to the ground surface, decontaminated, and prepared for the next sampling event. Following completion of sampling using a temporary PVC casing, the casing is removed and disposed.
- The soil boring should be grouted to the surface in accordance with the applicable permits and typically under the supervision of an inspector assigned by the issuer of the soil boring permit.
- If boreholes need to be left open overnight to allow for the necessary volume of groundwater to accumulate, the borings need to be protected from intrusion of potential surface water or spills. One option is to place a small plate or cover over the boring, and secure/seal with hydrated granular bentonite. Cones or barriers should be placed around the open borehole so they are not disturbed. If leaving borings open overnight is anticipated, advise the driller before mobilizing to the site so they can bring out supplies to protect the borehole. The issuer of the boring permit will need to approve leaving the borings open as well. In general, sampling within coarse-grained sediments takes minutes, while fine-grained sediments can take several hours.

3. Documentation

The details of the boring and sampling operations will be recorded in boring logs and/or daily field logs. Any deviations from this SOP and the reason for the deviation shall be documented.

4. Special Notes

Air monitoring may be deemed necessary by the site-specific HASP. The HASP should establish action level protocol for the contaminants of concern if encountered during air monitoring activities. To monitor for fire and explosive hazards a lower explosive limit meter and a photoionization detector can be used in conjunction to monitor the air in the vicinity of the operator's breathing space during drilling activities.

Certain site characteristics and circumstances may prevent the use of DPT or the grab groundwater sampling technologies presented above. These characteristics and circumstances may include the following:

1. Shallow soils with coarse gravel, cobbles, or boulders which may be difficult to penetrate;
2. Loose, saturated granular soils or soft, wet silty soils which are not retained well by the sampler (i.e., very poor sample recovery);
3. Limited access to specific sampling locations; and
4. Required sampling depths that may exceed the practical use of DPT.

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Standard Operating Procedure 203-23-00
Groundwater Sample Collection Below LNAPL

This Standard Operating Procedure (SOP) defines and standardizes procedures for sampling groundwater in wells where light non-aqueous phase liquid (LNAPL) is present. This SOP only addresses the procedures for sample collection beneath LNAPL. General guidelines outlined in Terraphase SOPs 204 ("Groundwater Purging and Sampling"), 205 ("Groundwater Sampling – Low Flow"), and 200 ("Water Level Measurements") should still be followed, where possible.

Although this SOP provides guidelines for groundwater and free product level measurements, **these guidelines are not meant to be project-specific work plans** but rather a general reference for developing project-specific requirements. Certain projects may require more site-specific sampling procedures, including state- or regulatory program-specific guidelines, requirements, or procedures. Specific requirements for these types of projects and activities will be reviewed by the Terraphase project team and defined in a project-specific work plan, sampling plan, and/or SOP(s).

This SOP does not supersede Terraphase health and safety procedures or site-specific health and safety plan (HASP) requirements; in the event of conflict between this SOP and the site-specific HASP, the procedures outlined in the HASP shall prevail. All Terraphase employees shall follow the guidelines, rules, and procedures contained in the site-specific HASP, followed by procedures recommended in this SOP.

1. Materials and Equipment

The following is a list of materials and/or equipment necessary to carry out the procedures contained in this SOP:

- Optical oil/water interface probe with graduated measuring tape to 0.01-foot accuracy;
- Pump and associated equipment (e.g., generator, extension cords, batteries, control box, compressor, carbon dioxide or nitrogen compressed gas cylinders);
- Tubing to discharge water from the pump(s)—the tubing must be either Teflon® or Teflon®-lined polyethylene; however, when sampling for metals analysis only, the tubing may be constructed of flexible polypropylene or polyethylene;
- PVC drop tube (1.5-inch or other appropriate diameter);
- PVC rod (0.5-inch or other appropriate diameter);
- PVC end cap for drop tube;
- Tether for end cap;

- Clamps for securing drop tube to well casing;
- Appropriate sample containers and labels;
- Decontamination supplies;
- Blank chain-of-custody forms; and
- Cooler and ice for sample preservation.

2. Procedures

The following sequence of procedures will be implemented for the collection of groundwater samples beneath LNAPL.

2.1 Installation of Sampling Equipment

Sampling equipment installation will be completed as follows:

- Determine LNAPL thickness using an optical oil/water interface probe with a graduated measuring tape to 0.01-foot accuracy to collect depth to LNAPL and depth to water measurements.
- Deploy a 1.5-inch (or other appropriate diameter) PVC pipe (drop tube), with an attached end cap, through the LNAPL layer in the well. The end cap should be tethered to the drop tube so it is not lost in the well when removed and allows the drop tube to be sealed during installation. Lower the drop tube until the bottom of the tube is approximately 2 feet into the water column below the bottom of the LNAPL.
- Secure the drop tube to the well and allow the system to equilibrate, approximately one-half hour. The end cap is then removed by inserting a 0.5-inch (or other appropriate diameter) PVC rod into the drop tube and pushing on the cap until the lid is removed. The cap will be removed along with the tube upon completion of sampling.

2.2 Sampling

Lower sampling device through the 1.5-inch drop tube into the water column. Set the flow rate to the lowest pumping rate that can be sustained so that the LNAPL is not drawn into the tubing. Begin stabilizing well parameters in accordance with Terraphase SOPs 204 and 205, based on project data needs, or collecting groundwater in the sample container and continuing until enough volume is obtained for all bottleware required by the laboratory for the requested analyses.

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Standard Operating Procedure 205-23-01

Groundwater Sampling – Low Flow

1. Performance Objective

This Standard Operating Procedure (SOP) presents general guidelines established by Terraphase for the collection of groundwater samples for laboratory analysis using low-flow purging and sampling (LFPS) techniques. The purpose of LFPS is to collect groundwater samples that are representative of ambient groundwater conditions in the aquifer. This is accomplished by adjusting the intake velocity of the sampling pump to a flow rate that limits drawdown inside the well. LFPS has the following benefits over conventional purging:

- It minimizes disturbance of sediment in the bottom of the well, thereby producing a less turbid sample;
- It minimizes turbulence and aeration of the groundwater sample during sample collection;
- The amount of groundwater purged from the well is usually reduced compared to conventional groundwater purging and sampling methods, thereby reducing water management requirements;
- Groundwater samples tend to be more representative of actual aquifer conditions with respect to mobile contaminants and turbidity as LFPS causes minimal disturbance of the formation adjacent to the screened interval; and
- It is generally less prone to sampling variability, and increases sample consistency and reproducibility of data.

Although this SOP provides guidelines for collection of groundwater samples using LFPS, more specific sampling procedures (i.e., site-, state-, or regulatory program-specific guidelines, requirements, or procedures) may be applicable to a particular project. Specific requirements for each project will be reviewed by the Terraphase client manager (CM) and project manager (PM). Any additional requirements will be defined in a project-specific work plan, sampling plan, and/or SOP. **The guidelines in this SOP are not meant to be project-specific work plans, but rather serve as a general reference for developing project-specific requirements.**

This SOP does not supersede Terraphase health and safety procedures or site-specific health and safety plan (HASP) requirements. In the event of conflict between this SOP and the site-specific HASP, the procedures outlined in the HASP shall prevail. All Terraphase employees shall follow the guidelines, rules, and procedures contained in the site-specific HASP followed by procedures recommended in this SOP. The Terraphase CM and PM shall ensure that all project personnel review and sign the applicable HASP, and that the signed HASP and relevant project information are maintained in the project file for

the duration of the project. The signatures of the CM and PM indicate approval of the methods and precautions outlined in the HASP.

2. Equipment and Materials

A general checklist of equipment that may be required for typical LFPS is provided below. Additional equipment may be specified in the project-specific HASP and/or field sampling plan. This checklist includes an overall summary of general equipment typically required for LFPS but should not be considered exhaustive. More specialized sampling equipment may be required depending on project-specific preferences. Terraphase personnel should understand the equipment and materials that are required for groundwater sampling.

The following is a list of equipment necessary to carry out the procedures contained in this SOP:

1. General Groundwater Sampling Equipment Checklist:
   - Site information (e.g., maps, contact numbers, keys or lock codes for gates or access points).
   - Well construction specifications and diagrams.
   - Groundwater sampling logs and field forms from the previous sampling event, if applicable.
   - Field notebook and all-weather or permanent pens as outlined in SOP 106, “Field Notebook (without iPad).”
   - Plastic sheeting.
   - Cable ties.
   - Keys for wells.
   - Measuring tape.
   - Electronic water level indicator.
   - Sample containers (appropriate for various analysis to be performed).
   - Sample shipment containers and ancillary materials.
   - Sample labels, indelible pen or sharpie, and clear tape.
   - Chain-of-custody forms.
   - Trash bags for disposal of gloves and any other non-hazardous waste generated during sampling.
   - Department of Transportation-rated (for legal waste hauling) 55- gallon steel drums, or other appropriate waste container, for disposal of any investigation-derived wastes (IDWs) and/or decontamination wastes.
   - Labeling materials for IDW.
   - Bucket, spray bottle, distilled/deionized (DI) water, and Liquinox (or Alconox) for the decontamination of sampling and monitoring equipment.

- Personal protective and field screening equipment in accordance with the site-specific HASP (e.g., clean, chemical protective, dedicated gloves must always be worn when handling and using sample equipment).

2. Project- or Task-specific LFPS Equipment Checklist:
   - Pump and associated equipment (e.g., generator, extension cords, batteries, control box, compressor, carbon dioxide or nitrogen compressed gas cylinders).
   - Tubing to discharge water from the pump(s). The tubing must be either Teflon® or Teflon®-lined polyethylene; however, when sampling for metals analysis only, the tubing may be constructed of flexible polypropylene or polyethylene.
   - Water quality meter with flow-through cell that, at a minimum, measures temperature, pH, dissolved oxygen (DO), oxygen reduction potential (ORP), and specific electric conductance and associated manuals; turbidity measurements can be made using a separate turbidity meter (total capacity of the cell must be less than 300 milliliters [mL]).
   - Measuring container (e.g., 1-gallon plastic water jug, graduated measuring cup, or graduated cylinder).
   - Plumbing fittings (check valves, barbed “T” or “Y” fittings, stainless-steel needle valves or stainless-steel/Teflon ball valves).
   - Dedicated suspension line or tether constructed of material that minimizes interactions or alterations when in contact with groundwater or that may cause loss of analytes via sorption (e.g., poly twine, nylon string, stainless-steel, Teflon-coated stainless-steel wire, etc.) for lowering and raising the pump (pump tubing does not constitute a dedicated suspension line and should not be used for lowering and raising pump).
3. Additional Suggested Equipment:
   - Tool set (socket wrench/ set, screwdriver, multi-tool, tubing cutters, “turkey baster” and/or cup for water removal from flush-mounted well vaults).
   - Spare/replacement parts (gripper plug/well cap, well lid bolts).
   - Road and site maps.
   - Mobile phone.
   - Camera and extra batteries.

A description of the types of LFPS is provided in Attachment A.

3. Procedures

This section discusses planning considerations; initial field preparation; general LFPS guidelines; use, provision, and transport of sampling containers; and general quality assurance (QA)/quality control (QC) procedures.

3.1 Planning and Design Considerations

All significant sampling strategy decisions will be approved by the CM and/or PM before the initiation of associated field activities. A work plan/field sampling plan will be designed for the collection of quality data to meet the goals of the study/monitoring program and will include the number, location, and depths of sampling sites; number of samples; analyses and analyte detection limits to be performed on each sample; and QA/QC samples. The work plan/field sampling plan will generally provide for some discretion in the field depending on conditions encountered; however, any significant departure from prescribed sampling activities should be approved by the CM and/or PM.

When planning a low-flow sampling event for a well that will be purged, the following should be considered:

- **Pump selection.** The equipment needed for groundwater LFPS can vary greatly depending on specific site conditions and project objectives. LFPS is generally conducted at flow rates of 500 mL per minute or less. Submersible, positive-displacement pumps must be used for LFPS. In specific cases, peristaltic pumps may be appropriate and could be used for LFPS when previously approved by the CM and/or PM or defined in project-specific work plans. The more commonly used positive-displacement pumps include bladder, variable-speed submersible-centrifugal, and gear pumps. Pump selection should take into consideration a variety of well characteristics including, but not limited to, depth to water; analytes of interest; chemical incompatibilities; suspended solids concentrations; ease of decontamination; and availability of a power source. Descriptions of common LFPS equipment and a list of their advantages/limitations are provided in Attachment A.
- **Tubing.** The preferred inside diameter of tubing is one-quarter inch (1/4) and should be no greater than three-eighths of an inch (3/8). Larger tubing diameters reduce flow velocity, resulting in a corresponding increase of pump speeds to maintain flow. Increased pump speed will, in turn, elevate the potential for turbulent flow across the screened interval and this may affect the quality of the water being sampled. Conversely, any reduction in flow velocity may allow air to become trapped in the tubing and ultimately affect air-sensitive parameters or allow particulates to settle, which may affect turbidity values.
- **Flow-through cell (flow cell).** Typical flow-through cell design is not complicated and almost all share common features. Cells should be transparent to monitor the physical condition of the purge water or air bubbles passing through the system. For example, highly turbid or iron bacteria-laden water can be visually monitored for change as the purge progresses. The cell must also be sealed against unwanted exposure to the atmosphere, thus ensuring accurate measurement of air-sensitive parameters (DO, pH, etc.). The total capacity of the cell must be small (i.e., less than 300 mL) to maintain a desirable turnover rate of water coming into the cell and ensure real-time data integrity. The in-line design of the cell must also allow for purge water to enter the flow cell from a bottom port and exit at the top. The discharge of the flow cell may be fitted with a check valve.

- **Pump intake location.** When LFPS is performed correctly, the data collected should be reflective of water quality within a narrow zone along a length of well screen or fracture in an open borehole. Therefore, it is important to place the pump intake in the zone of highest contaminant concentration or contaminant flux along the screened/open-hole interval. This is particularly important in wells constructed with more than 5 feet of well screen.

  Information to be considered when selecting the pump intake depth should include:

  a. Evidence of soil contamination from boring logs and field screening techniques;

  b. Soil sampling analytical results;

  c. Vertical groundwater quality profiles; and

  d. Areas of high permeability as identified from drilling operations (i.e., water or drilling fluid injection/discharge rate changes, observation of fractures or staining on rock cores, etc.) or by borehole geophysical methods, hydrogeological field tests, or geotechnical laboratory testing results.

- **Other considerations.** Additional sampling objectives (e.g., targeted aquifer zones) may be defined in the project-specific work plan, field sampling plan, and/or SOPs that may determine different sample depths than those that would be defined based on the pump intake considerations above.

3.2 Pre-field Work Preparation Guidelines

Because samples will be collected from existing groundwater monitoring wells, field staff should review and complete pertinent tasks identified in SOP 204, “Groundwater Purging and Sampling.”

Non-dedicated sampling equipment (e.g., water level indicator, purge pump, water quality instrumentation) used to minimize potential cross-contamination of samples among wells should be decontaminated between wells, the project-specific work plan/field sampling plan, and/or QA project plan (QAPP). Used dedicated sampling equipment is considered IDW and should be managed, following the sampling event.

At a minimum, the following tasks should be completed to prepare field staff prior to implementation of the work:

- Review and sign the site-specific HASP.
- Coordinate and obtain permission for site access.
- Review project-specific work plan/field sampling plan/QAPP, where applicable.
- Review and discuss with the CM and/or PM the proposed work plan/field sampling plan or sampling strategy. Note that site geology and expected contaminants should be reviewed to determine if unpreserved bottles may be needed (e.g., anticipated effervescence due to high levels of dissolved calcium carbonate in groundwater reacting with acid preservatives).
- When contractors are used to perform the sampling or in states where sampling can only be performed by personnel licensed or certified by the state, discuss the work plan/field sampling plan with the contractor.

- Review the standard instruction manual provided by the manufacturer of the specific equipment to be used for groundwater sampling.
- Obtain the glassware/bottles in advance and check against sampling numbers to confirm that the appropriate containers and quantities are provided prior to mobilizing.
- Ensure that all equipment/materials required to complete the work have been packed prior to travel.

In addition, prior to initiating well sampling activities, Terraphase personnel should field-verify the well identity and construction against available documentation (site plans, well construction logs, etc.). It is imperative that a positive well identification be made prior to sampling using measured total well depth, well labels, site plans, and well construction records to ensure that the correct well is sampled. If total well depth is measured, proper decontamination of the water level indicator tape must be conducted before deploying the water level indicator into another well.

Further, prior to the commencement of the field effort, Terraphase personnel should inspect, test, and/or calibrate equipment that may be used to take field measurements. Pre-measuring the pump suspension line and/or discharge tubing to the individualized targeted well depths and/or pre-labeling sample containers in advance of field efforts may increase productivity. However, special care should be taken to ensure that the correct pre-labeled containers are used to collect each groundwater sample.

Unless otherwise required by the project-specific work plan/field sampling plan, sampling should begin with monitoring wells with the lowest expected groundwater contamination and proceed systematically to monitoring wells with the highest expected groundwater contamination.

3.3 General LFPS Guidelines

The purpose of LFPS is to collect groundwater samples that are representative of ambient groundwater conditions in the aquifer by adjusting the intake velocity of the sampling pump to a flow rate that limits drawdown inside the well. The following provides a general recommended list of practices for LFPS activities:

- Where applicable, contact the identified key site personnel upon arrival to the site and assess proposed work areas.
- All wells to be sampled should be inspected for damage, access constraints, and/or vehicle traffic proximate to the well location.
- Although equipment should be decontaminated between uses, to further limit potential cross-contamination between wells, perform measurements from least to most contaminated locations.
- Lay polyethylene sheeting around the well for placement of monitoring and sampling equipment and contain any accidental groundwater spilled during purging or sampling.
- Remove the well cover or equivalent protective casing cover and measure gas concentrations in accordance with the applicable manufacturer instructions and field-screening SOPs. Record field screening readings in the field notebook. The necessity and methodology to conduct field screening should be detailed in the site-specific HASP and sampling plan.

- Record the condition of the well (noting any damage to the well, plug, and/or protective casing) and any evidence of pressure (positive or negative).
- Complete all depth-to-water or free product measurements prior to any planned groundwater and/or product withdrawals, sampling, or disturbance of groundwater activities unless otherwise specified in the work plan/field sampling plan.
- Prepare the pump suspension line and discharge tubing by measuring the correct length needed so that the pump intake or bottom of discharge tubing rests at the target depth in the well. The measurements should account for the additional length needed at ground surface to appropriately anchor the suspension line and connect discharge tubing to water quality monitoring equipment. The length of tubing, from the top of the well casing to the flow-through chamber, should be the shortest length manageable to minimize (a) exposure to ambient temperature, direct sunlight, and air bubble formation, and (b) the likelihood of deposited solids or air bubbles being trapped in tubing bends and re-mobilized. If the suspension line and tubing were premeasured or ordered to premeasured lengths in advance of field efforts, make any necessary alterations based on field observations (e.g., unanticipated groundwater elevations).
- Assemble the pump, suspension line, and tubing. Inspect all sampling equipment prior to deployment, making certain that all connections are secure and equipment is in working condition. Troubleshooting pump issues is generally easier if the pump and tubing assembly are inspected prior to deployment. If not using dedicated sampling equipment, ensure all materials are properly decontaminated prior to conducting sampling.
- Slowly lower the assembly into the well using the suspension line to achieve minimal water column disturbance until the location of the tubing or pump intake reaches the predetermined depth within the well. Anchor the assembly in place by securing the suspension line at the surface and/or clamping the tubing in place via spring clamp.
- Measure and record depth to water following insertion of the pump and tubing assembly. Allow the water level to return to its static level prior to initiating purging.
- Prior to groundwater sampling, the well should be purged. Assemble the water quality meter sensor probe and flow through cell in accordance with the manufacturer's specifications.
- During initial pump startup, do not connect the pump discharge line to the flow-through cell. Monitor drawdown and adjust the flowrate as necessary to stabilize it and prevent fouling of probes by bacteria, sediment, or non-aqueous phase liquid.
- Once drawdown measurements indicate a relatively constant flow rate has been achieved, continue to run the pump for a few minutes to clear any unwanted material before connecting the pump discharge line to the flow cell.
- Carefully connect the pump discharge tubing to the influent port of the flow-through cell of the water quality meter and connect a section of clean tubing to the effluent port of the cell. The influent and effluent connections to the flow-through cell are unique and based on each meter's design; orientation of flow matters and influent/effluent ports should be marked on the flow cell.

- When water fills the cell, ensure the tubing is completely full of water, check for leaks, and make any necessary adjustments. If water is particularly turbid at the beginning of the purge, once the turbidity decreases, it can be helpful to disassemble the water quality meter sensor probe and flow through cell and rinse them with DI water to remove any residual particulates.
- For low-flow purging, evacuate groundwater at a flow rate of 100 to 500 mL per minute until the water quality parameters (e.g., pH, DO, ORP, temperature, specific conductance, and turbidity) specified in the work plan, field sampling plan, QAPP, and/or SOPs (developed based on state-specific or regulatory program-specific guidelines, requirements, or procedures) have stabilized. In the absence of specific stabilization guidance, the following parameters or any combination thereof established by the United States Environmental Protection Agency should be monitored to determine when parameter stability has been achieved:
  - pH: ± 0.1 units
  - Specific Conductance: ±3 percent
  - Temperature: ±3 percent [1]
  - DO: ± 0.3 milligrams per liter[2,3]
  - Turbidity: ±10 percent (when greater than 10 Nephelometric turbidity units)
  - ORP: ±10 millivolts
  - Water Level Drawdown: less than 0.3 feet from static[4]
- Collect measurements approximately once every 5 minutes or periodically as defined by the time it takes for purge water to adequately replace the water quality meter's flow-through cell.
  - If the purge rate decreases, the time required for purge water replacement will increase.
  - It is generally accepted that when the measurements of the monitored parameters fall within the stated range for three consecutive readings, chemical parameter stabilization has been achieved.

[1] Temperature generally tends to stabilize rapidly and is considered a relatively insensitive indicator of stability.

[2] Under some regulatory programs, the DO stability is defined in terms of percent change (e.g., in New Jersey, less than ± 10 percent change in DO indicates parameter stability).

[3] If there is a significant discrepancy between the DO and the ORP results; for example, if the DO result is greater than 2 milligrams per liter and the ORP measurement is negative millivolts (less than -100 millivolts), then either the DO and/or the ORP meter may not be appropriately calibrated or operating correctly. Recalibrate both meters and check the DO and ORP measurements again. If the issues with the DO measurements continue, consider using an in-situ probe (e.g., YSI) or Chemetrics sampler approach.

[4] During pump start-up, drawdown may exceed the 0.3-foot target and then recover as flow rate adjustments are made.

  - If the anticipated "third" reading of any individual parameter does not fall within the stated range, then the process to achieve three consecutive readings for that parameter must be restarted.
- In some situations, even with slow purge rates, a well may not recharge and be pumped dry. In these situations, under certain regulatory programs, this constitutes an adequate purge and the well can be sampled following sufficient recovery (enough volume to allow filling of all sample containers). In such cases, it is not necessary that the well be evacuated three times or that chemical parameters stabilize before it is sampled. Nonetheless, the pH, specific conductance, temperature, and turbidity should be measured and recorded during collection of the sample from the recovered volume. These data would serve as the field measurements of record for the sampling event.
- If flow rates are to be measured and a flowmeter is not available, the discharge from the effluent of the flow-through cell can be collected in a container of known volume (i.e., 1-gallon plastic water jug or a graduated cylinder) with the time to fill the container noted. When flow-rate measurements are complete, redirect the discharge as detailed above and dispose the contents of the jug or graduated cylinder into 5-gallon buckets or directly into 55-gallon drums.
- Containerize purge water. The discharge tubing should be secured such that all purged groundwater is collected in 5-gallon buckets or directly into labeled Department of Transportation-rated 55-gallon drums, depending on site conditions and purge volumes.
- Upon completion of well purging, reduce the pumping rate to less than or equal to 100 mL per minute and disconnect the water quality meter from the discharge tubing.
- Wells should be sampled as soon as possible after purging. Refer to SOP 204-23-00, "Groundwater Purging and Sampling," for guidance on groundwater sample collection procedures. If sampling for volatile organics, collect the sample for VOCs first to prevent loss of volatiles due to disturbance of the water, and fill volatile organic analysis vials to zero headspace, as described in SOP 204-23-00, "Groundwater Purging and Sampling."
- Withdraw the sampling equipment from the well, replace the well cap, and re-secure the well. If non-dedicated equipment comes in contact with groundwater, remove the equipment from the monitoring well and decontaminate. Dedicated equipment that comes in contact with groundwater should be disconnected from the non-dedicated equipment and managed as IDW.
- Record in the field book or appropriate field forms any deviations from standard procedures (i.e., sample collection prior to stabilization), the rationale for those modifications, and any abnormal conditions within the well (e.g., evidence of blockage, root growth into the well casing, separated casing sections, etc.). Inform the PIC or PM to ensure necessary maintenance, redevelopment or repairs are conducted before the next planned water sampling event.

3.4 Sample Containers

Equipment and sample containers that will come into contact with collected groundwater should be constructed of inert materials that will not affect the concentration of constituents in the water sample (i.e., glass, stainless steel, or Teflon). The level of care that needs to be taken with the materials used will depend on the level and types of groundwater constituents and the QA requirements and study goals. This should be outlined in the project-specific work plan/field sampling plan or QAPP.

The laboratory will provide appropriate sample containers prefilled with preservatives appropriate for each predetermined sample analysis. The sample volume is a function of the analytical requirements and will be specified in the work plan/field sampling plan or QAPP. Sample VOCs first to prevent loss of volatiles due to disturbance of the water and fill the volatile organic analysis vials to zero headspace, as described in Section 3.3.

3.5 Sample Transport and Storage

Samples shall be handled, transported, and stored to maintain structural and chemical qualities. All samples should be kept in an ice-filled transport container during fieldwork and covered to limit light penetration. If the cooler size allows for space between sample bottles, bubble wrap should be used to fill annular space and prevent breakage during travel. Glass bottleware should be wrapped individually in bubble wrap for further protection. If provided, pack glass sample vials in laboratory-issued foam packing cartons. If shipping groundwater samples with preservatives, confirm the sample shipments, packaging, and labeling are performed in accordance with applicable Department of Transportation requirements.

3.6 QA/QC

QA/QC procedures described in the project-specific work plan/field sampling plan and/or QAPP must be followed throughout purging, sample collection, processing, handling, and analysis. In their absence, SOP 209, “Field Quality Control Samples,” QA/QC guidelines should be reviewed.

4. Precautions and Other Considerations

All field activities require recording detailed information throughout the implementation of field work. However, certain precautions should be taken to ensure safety during groundwater sampling. Additionally, implementation of the work may face some of the following difficulties:

- Some states require that only personnel licensed or certified in the state where the work is being performed conduct the sampling. Therefore, state regulations and guidance governing groundwater should be consulted prior to conducting the work. In addition, local Terraphase staff should be contacted to review any other regional or local requirements.
- **Field staff must always remain alert and aware of their surroundings.** Groundwater sampling could involve the use of generators and associated equipment, and is subject to hazards posed by equipment, vehicle traffic, industrial machinery, hazardous chemicals and contaminants, and/or other physical, mechanical, and chemical hazards.

- Prior to mobilization, determine the location of wells and evaluate the need for security, barricading, and/or traffic control (e.g., when wells are located within a right of way).
- At sites with certain contaminants and/or subsurface conditions, potentially toxic and/or explosive gases may accumulate at and around the well as it is being sampled. Field staff will remain upwind of the well and ensure that air monitoring is conducted and personal protective equipment is used in accordance with the site-specific HASP.
- All sampler, tether, or suspension lines must be kept untangled. A plastic winder or spool winder should be used to retrieve the sampler/pump and keep the line from tangling.
- When working out of sight of the general public or when site employees are in potentially hazardous areas (e.g., wooded habitats), all field staff should utilize the "buddy system" and follow the safety measures and procedures delineated in the project-specific HASP.
- Care should be taken when opening well protective covers for the presence of spiders and insects, such as wasps or hornets.
- Well keys may not work with rusted/outdated well locks. Bolt cutters may be used to remove the lock, which should be replaced upon completion of well sampling. **Do not** use petroleum-based solvent sprays to free seized locks as it may impact water quality in the well.
- Wells with a water-tight cap may experience a buildup of pressure. Field staff must angle their face and body away from the top of the well when loosening or removing the cap.
- Certain sampling equipment configurations have tubing without a pump at the sample intake depth (e.g., bladder pump with drop tubing). Without a weight on the end of the tubing while lowering it into the well, the tubing can easily get caught on the joints between sections of the PVC well casing or on the open borehole wall due to the natural curl in the tubing from being stored in rolls. To remedy this, fasten a stainless-steel rod as a splint against the bottom few feet of tubing or simply secure a stainless-steel weight to the bottom of the tubing to straighten the curl and keep it from getting stuck. Some sampling equipment will include a weight for this purpose. Proper decontamination of the stainless-steel rod or weight is required prior to deployment into a subsequent well.
- It can be helpful to utilize Microsoft Excel to simplify purge stabilization calculations in the field and eliminate the need to transcribe purge notes into electronic form for reporting purposes. An Excel-based purge sheet can also reduce potential mistakes; however, a thorough understanding of the stabilization criteria calculations is necessary prior to use in the field. An example of a low-flow sampling purge sheet with auto-calculations is presented on Figure 1.

21	Well Evacuation Data										
23	Stabilization Criteria			± 0.1 SU	± 3 %	± 10 %	± 3 %	± 10 mV	± 10 %	0.3 ft	
24	Time	Vol.	Rate	pH	Cond.	Turb.	Temp.	ORP	DO	DTW	Appearance or
25		L	mL/min	Std	ms/cm	NTU	C	mV	mg/L	ft	Comments
27	9:54	--	550	9.86	0.240	78.9	10.18	16	11.89	23.80	Slightly silty
28	9:59	0.0	320	7.89	0.360	70.4	11.17	77	9.98	23.50	Slightly silty
29	10:04	1.6	250	7.71	0.364	58.2	11.14	93	9.84	23.30	Slightly silty
30	10:09	2.8	250	7.68	0.361	48.6	11.04	100	9.64	23.30	Clear
31	10:14	4.1	250	7.68	0.360	30.3	10.96	107	9.59	23.30	Clear
32	10:19	5.3	250	7.66	0.360	16.0	11.11	107	9.50	23.30	Clear
33	10:24	6.6	250	7.68	0.362	9.3	11.09	111	9.87	23.30	Clear
34	10:29	7.8	250	7.69	0.363	5.7	11.26	114	9.49	23.30	Clear
35	10:34	9.1	250	7.64	0.362	5.8	11.21	115	9.50	23.30	Clear
36	10:39	10.4	250	7.65	0.362	5.6	11.20	118	9.52	23.30	Clear
37	10:44	11.6	100	7.66	0.363	5.5	11.32	118	8.82	23.30	Clear

Figure 1 Groundwater Low-Flow Purge Sheet

As each parameter stabilizes for three readings within its specified criteria, cells activate green. Purge rate and depth to water cells help guide adjustments needed to comply with low flow guidance. An example of a report-ready, completed sheet is provided in ***Attachment B.***

- Pumping issues, particularly at deep wells using low-flow or intermittent-flow pumps, can be difficult to troubleshoot. A small cup of DI water can be used to test for flow. Place the end of the discharge tubing into the DI water cup during pumping to see if there is a discharge (i.e., bubbles occur). As purge water fills the tubing at depth, air is displaced and forced out the top, causing bubbles in the water. If bubbles are observed, the pump is operating and there is flow.
- Bladder pumps have several O-rings and check balls that are necessary for its operation. If bubbles are observed in the DI water during compressor discharge, but water is suctioned back into the tubing during the refill cycle, the pump's check ball isn't working properly or may be missing. Air bubbles in the discharge water that don't go away after purging for a few minutes are usually indicative of a failed O-ring.
- A small cup of DI water can be used to monitor the purge rate of intermittent-flowing bladder pumps before having water at the surface by observing the duration and/or speed of bubbles. Monitoring the duration and speed of bubbles at the beginning of the purge will allow the operator to adjust/fine-tune the air controls (refill, discharge, and pressure) to bring water to the surface.
- Stabilization of parameters when pumping at low flow rates can be difficult. Several adjustments can help make stabilization easier and enhance the rate of stabilization:
  - Minimizing the length of extra tubing at ground surface can help minimize the effect of atmospheric temperatures on purge water.
  - Insulating the tubing with tin foil and/or shading from direct sunlight can help minimize the effect of atmospheric temperatures on purge water.
  - Increasing the flow to the maximum allowable rate (based on drawdown and regulatory requirements) will help replace water in the flow-through cell more frequently, thus reducing the severity of parameter fluctuations.

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- When purging with intermittently flowing pumps (i.e., bladder pumps), collection of readings should occur during the same portion of the flow cycle (ideally at the end of a discharge cycle, so measurements are based on fresh water entering the flow-through cell) to minimize parameter fluctuations between cycles.
- For wells with slow recovery, attempts should be made to avoid purging them dry as it may affect the quality of the sample. For example, as water enters a well that has been purged dry, it may cascade down the sand pack and/or the well screen, stripping volatile organic constituents that may be present and/or introducing soil fines into the water column. A possible remedy to purging the well dry is to reduce the purge rate.
- If possible, schedule sampling of wells that have a slow recovery on the same date they are purged, after adequate volume has recovered. These types of wells should not, unless it is unavoidable, be purged at the end of one day and sampled the following day.
- Sampling equipment (e.g., air compressors) are temperature sensitive and sampling in extremely cold temperatures can complicate even trivial tasks. When sampling in these conditions, keeping sampling equipment and discharge tubing from freezing is critical. Insulating the compressor from freezing temperatures and keeping it warm between use (within a vehicle, field trailer, etc.) will help keep it functioning properly. Any interruption of flow could cause purge water in the discharge tubing to freeze; insulating the tubing and maintaining higher flow rates (within regulatory guidelines) will help keep purge water from freezing.
- Adequate preparation prior to sampling each well will save time in the long run. Ensure the generator/air compressor has fuel or that spare batteries/air canisters are available in the event stabilization takes longer than anticipated. Stopping mid-purge to refuel or acquire additional air canisters will disrupt stabilization, greatly increasing the time required to sample a well.
- Each sampling effort should minimize exposure to ambient factors (e.g., atmospheric air, wind-blown dust, vehicular exhaust).
- While purging, the time between water quality measurements can be used to organize bottleware and confirm well-specific information (e.g., sample analyses, bottles appropriately labeled, duplicate collection, field filtering).
- If the work plan/field sampling plan involves analyses requiring field preservation, avoid direct contact with laboratory-provided preservative chemicals.

5. Recordkeeping

Document sampling locations and other information related to the sampling in accordance with SOP 106, “Field Notebook (without iPad),” or using an electronic field tablet, and SOP 100, “Field and Lab Data Management.”

Attachment A

Groundwater Purging and Sampling Equipment

Attachment A:
Groundwater Purging and Sampling Equipment

Several types of well water evacuation equipment exist for the collection of groundwater samples using low-flow purging and sampling techniques. Equipment choice will depend on a variety of factors including but not limited to cost, well specifications, and sampling parameters. Two basic collection scenarios have a bearing on pump selection:

1. **Dedicated System (a permanently installed pump system in a well).** A dedicated pump system consists of a single pump and tubing set up in each permanent monitoring well. This allows consistent sampling from a targeted monitor zone without the need to install/remove the pump during each monitoring event. Typically used for long-term monitoring at sites, a dedicated system usually consists of the pump and the associated tubing, with the controller mobilized for each sampling event.
2. **Portable System (transferable from well to well).** A portable low-flow purging and sampling system allows low-flow sampling from many monitoring wells using the same pump. Commonly available portable systems are easy to disassemble, without any tools, and simple to clean to eliminate any potential cross contamination.

Bladder pumps can be used for either system; however, only those with disposable bladders and easily cleaned parts are suitable when sampling on a well-to-well basis. Variable-speed submersible-centrifugal pumps, gear, or progressive-cavity pumps can be used for either operating system if they are constructed of easy to clean, stainless-steel/Teflon® parts. Pumps constructed with impellers, helicoils, or gears, which are difficult to clean or are constructed of unacceptable plastic parts, are not suitable for sampling.

Following are brief descriptions of more commonly used pumps for low-flow groundwater purging and/or sampling.

Bladder Pumps

Bladder pumps use pneumatic pressure, a liner or bladder, and a series of check valves that allow the bladder to fill with liquid then pneumatic pressure pushes on the bladder forcing fluid from the pump. Assembly typically includes a pump, a controller, an air compressor or compressed air, and tubing.

Pneumatic bladder pumps operate with a unique, gentle action ideal for low-flow sampling. Timed on/off cycles of compressed air alternately squeeze the flexible bladder to displace water out of the pump and release it to allow the pump to refill by submergence. Following the fill cycle, compressed air or nitrogen from a cylinder or compressor at the wellhead is driven down to the pump through tubing to compress the



Figure A-1 Bladder Pump Setup (left) and Pump (right)

Source: www.soilinst.com

bladder, thus driving the water sample up to the surface through a second tubing line. The pumping sequence consists of repeated fill–compress cycles, using a pneumatic controller positioned at the wellhead. The controller is used to vary the duration and frequency of the fill–compress cycles to deliver the desired sample flow rate at the wellhead.

The bladder design offers the advantage of minimizing sample turbulence, which can result in loss of volatile organic compounds in the sample, as well as eliminating contact of the water sample with the compressed air or nitrogen used to lift the sample to the surface. Bladder pumps run easily at low rates for extended times without overheating (unlike high-speed electric pump motors, which can alter samples and ruin the pumps), and without creating any disturbance that could affect sample chemistry. Some manufacturers of bladder pumps include QED, Geotech, and Solinst.



Figure A-2 Submersible Pump

Source: www.geotechenv.com

Submersible Pumps

Submersible pumps consist of an electric motor in a stainless steel and Teflon housing that drives two or more impellers at high rates of rotation, bringing water to the surface at an uninterrupted flow during sampling. The assembly typically includes a pump, a controller, a power source, and tubing.

These pumps are light weight and versatile. To overcome potential overheating that could affect sample quality, the pumps can be provided with a cooling shroud. To avoid potential backflow issues, the pump should be provided with a check valve. In addition, to provide greater pump speed control (e.g., to account for changes in pressure and torque at the impellers) and minimize potential pump flow loss, the pump controller should be equipped with a "ten turn pot" frequency adjustment knob. Some manufacturers of submersible pumps include Geotech and Waterra.

Gear Pump

The gear pump is small and lightweight, constructed of stainless steel and Teflon®, and operates on positive displacement. The assembly typically includes a pump, controller, battery, and tubing. It functions using two or more internal Teflon® gears within a stainless-steel cavity that displaces water up the hose in a steady stream. As the gears rotate, they separate on the intake side of the pump, creating a void and suction which is filled by fluid. The fluid is carried by the gears to the discharge side of the pump, where the meshing of the gears displaces the fluid.

The pump's low rpm electric motor will not disturb the sample as it generates little heat. Compared to the submersible pumps, which have impellers, the gear pumps require less flow rate adjustments and provide more consistent flow. Fultz is a manufacturer of gear pumps.



Figure A-3 Gear Pump

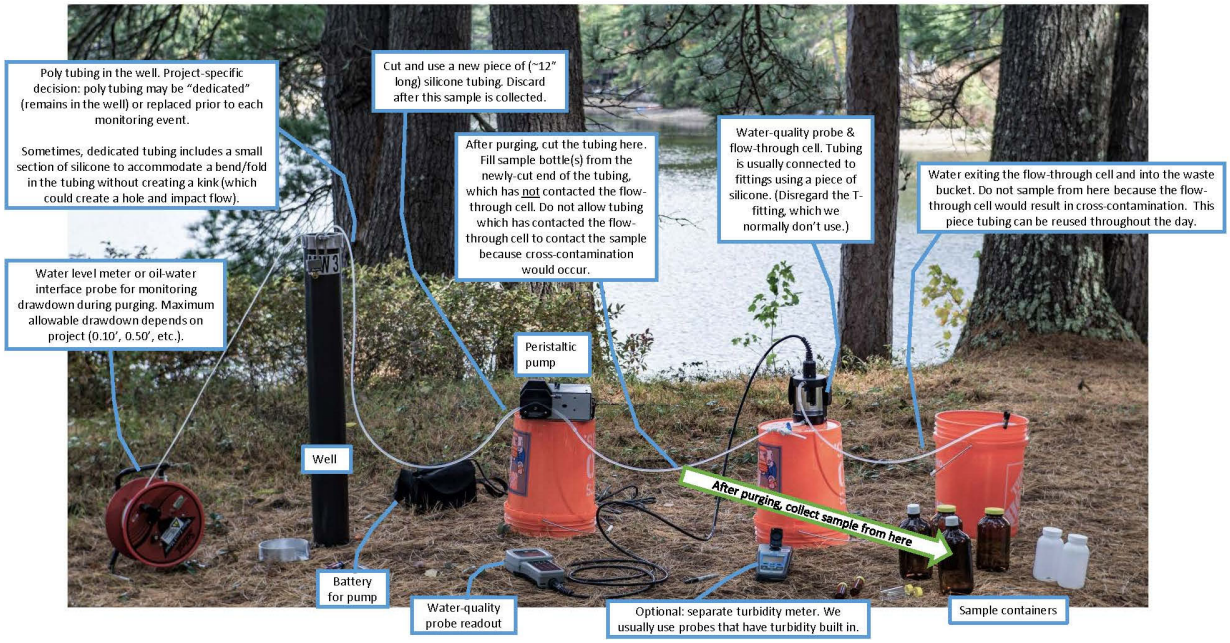
Source: www.fulzpumps.com

A comparison of the various pump options and their advantages/disadvantages is provided below.

Groundwater Sampling Pumps

Pump Type	Advantages	Disadvantages	Sampling Capability	Approximate Lift Capacity
Bladder Pump	• Acceptable for sampling for all parameters • Simple design and operation • Minimal disturbance of sample	• Large gas volumes may be needed • Only pumps with disposable bladders may be field cleaned for portable use when approved decontamination methods are employed	Acceptable for sampling for all parameters	Up to 1,000 feet
Submersible Centrifugal Pump	• Versatile and light weight. • Variable speed control for fine tuning of flow rate • Able to be thoroughly decontaminated due to ability of complete disassembly	• Sample temperature may be biased high during low- flow sampling due to high rotation rate of impellers • Motor stall possible at low pumping rates • Requires external power source • Impellers easily damaged by silty/sandy water • Difficult to clean and maintain in the field	May not be acceptable for sampling for trace contaminants, but useful for all other parameters	Up to 280 feet
Gear Pump	• Good variable speed control especially at low rates • Light weight • Does not have temperature issue as gears do not create excess heat like electric impeller pumps	• Difficult to decontaminate when in the field • Turbid purge water wears on the gears • Cannot properly handle suspended solids • Gears may be damaged in silty/sandy water • Gears may bind in water exceeding 85 degrees F.	Acceptable for sampling for all parameters	Up to 150 feet

Groundwater sampling – typical setup with peristaltic pump



Attachment B

Groundwater Purging Sheet

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Groundwater Monitoring Field Data Form

Site: Client
Address

Project No.: X001.001.001

MW-01

Date:	07/06/2023	Casing Material:	PVC	Depth to Water (ft bmp):	29.23
Purge Method:	Low Flow - Peristaltic Pump	Casing Diameter (in):	2	Well Depth (ft bmp)	35.43
Volume Units:	mL	Pump Intake (ft bmp)	35	Water Column (ft)	6.20
Purge Start Time:	08:00	Screen Interval (ft bmp):	25-35	Water Quality Meter:	Horiba
Comments:	NA				

Sampling Summary

Sample Date:	07/06/2023	COC:	NA
Sample Time:	09:05	Analysis:	PFAS 6
Sample ID:	MW01-230706	Bottles:	2
Duplicate Sample ID:	NA	Odor:	NA
Duplicate Sample Time:	NA	Remarks:	First sample of the day

Field Stabilization Parameters

Time	Flow Rate	Cuml Volume	DTW (ft bmp)	Temp (C)	pH	Conductivity (us/cm)	ORP (mV)	Disssolved Oxygen (mg/l)	Turbidity	Remarks
Historical Range:										
08:40	280	11200	29.50	24.51	5.91	2350	251	5.65	9.8	
08:45	280	12600.0	29.49	24.6	5.94	2350	244	5.36	9.1	
08:50	280	14000.0	29.49	23.24	5.97	2380	231	5.40	10.2	
08:55	280	15400.0	29.49	23.9	5.97	2380	224	5.01	10.5	
09:00	280	16800.0	29.49	23.06	5.97	2370	218	5.19	10.8	

Well Integrity Checklist

Item	Yes	No	NA	Notes
Type of Well Head				stick up
Well secured on initial inspection	X			
Is well ID visible?	X			
Sleeve around the well box in good condition	X			

Photos

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Standard Operating Procedure

Monitoring Well and Piezometer Installation

This Standard Operating Procedure (SOP) describes the procedures that shall be used when monitoring wells or piezometers are installed in consolidated and unconsolidated materials at a specific depth to collect representative ground water samples, determine ground water elevations, and provide observation points for aquifer testing. Monitoring wells are generally used for acquisition of groundwater samples, while piezometers are often smaller diameter points utilized for observation points.

These monitoring wells or piezometers will be constructed of inert materials to eliminate the effect of construction material on ground water quality. Installation activities performed in California should be completed in accordance with the applicable regulations set forth in the California Code of Regulations Water Code. Per Water Code Sections 13700 to 13806, the California Department of Water Resources (DWR) is responsible for developing well standards and maintaining records of all wells installed in the state. The DWR publishes Well Standards bulletin(s) providing well construction guidance minimum standards. Local county and/or municipality requirements for well installations may be more stringent than state requirements and should be researched and followed as applicable.

This SOP describes the protocol to be followed during the installation of groundwater monitoring wells and piezometers. Drilling and logging of boreholes for well installation will be in conformance with the SOPs for soil logging.

1. Materials and Equipment

The following is a list of materials and/or equipment necessary to carry out the procedures contained in this SOP:

- Portland cement or cement-bentonite slurry
- Locking water-tight cap
- Above-ground protective housing (e.g., flush-mount protective bolted vault with rubber gasket); steel standpipe for aboveground completion
- Concrete
- Air-monitoring (photoionization detector/lower explosive limit meter)
- Site-specific Health and Safety Plan (HASP)
- Well permit(s)

2. Procedures

This section discusses well design specifications, materials, and installation guidelines.

2.1 Well Design Specifications and Materials

The Work Plan should specify all construction details and materials for the well or piezometer. These details should be reviewed by the field staff prior to installation activities. Monitoring wells are typically 2- or 4-inch-diameter casing. Piezometers are typically 1- to 2-inch-diameter casing. Remedial (injection or extraction) wells may vary somewhat in construction standards to adequately withstand pressures of injection or extraction. Extraction wells are typically of a larger diameter, generally 4- or 6-inch casing.

The well screen and blank casing will generally consist of threaded stainless steel or Schedule 40 (minimum) PVC pipe, although steel may occasionally be used. Final screen slot size specifications may be selected after filter pack specifications have been selected. The length of slotted screen should be specified in the Work Plan. Generally, 5- to 10-foot-long screens should be targeted. Longer screen intervals may not provide as representative and depth discrete groundwater sample.

Filter pack material will be well-graded, clean sand. The filter material will generally be a standard sand gradation designed for a range of anticipated soil types. Based on field experience, a target zone that is comprised of silt might call for a #0/30 sand filter pack (or grain-size equivalent) and a 0.010-inch slot size screen. Target zones with silty sand or fine sand might be completed using a #2/16 filter pack (or equivalent) and a 0.020-inch slot size screen. To maximize well efficiency, medium sand or coarser target zones might be completed using #3 or #2/12 filter pack (or equivalent) and 0.030-inch slot screen. Ensuring that the selected filter pack sand size is compatible with the screen slot size is critical to well performance.

The field engineer/geologist shall inspect and inventory the well construction materials prior to the start of well construction. If sufficient materials are not onsite or are in unacceptable condition, well construction will not begin until appropriate materials are on site. Well materials shall be new and clean. Soiled materials will be cleaned prior to use and decontaminated if there is a potential that well materials contacted contaminated surfaces.

Prior to beginning of drilling, drilling permits from the city or county are to be obtained and the field engineer/geologist will keep a copy of the permit on site during the drilling/well installation activities.

2.2 Well Installation

The soil boring for well installation must be of a large enough diameter to provide adequate annular space for well construction materials. In general, the borehole diameter should be a minimum of 4 inches larger than the well casing diameter. For example, a 2-inch-diameter monitoring well should be installed in a borehole 6 inches in diameter or larger; typically, an 8-inch-diameter borehole will be used. Most commonly, hollow-stem auger drilling techniques are used for well installation, though mud or air rotary, or sonic techniques can also be used.

After the boring is completed to the target depth with the drill rig, the well or piezometer casing column will be assembled and installed into the borehole. Teflon tape may be wrapped around the joint threads during assembly, but no glue, solvent, or lubricating compound shall be used to make up the

connection. The well or piezometer casing column will be constructed through the augers or drilling casing and carefully lowered to ensure it is properly centered in the borehole. Depending on the total depth of the well, centralizers may be utilized to ensure the casing remains in the center of the borehole. Stainless steel or PVC centralizers can be used immediately above and below the well screen and no less frequent than every 50 feet along the length of the casing. Once the well or piezometer casing column is in place, the top open end of the casing will be fitted with a locking water-tight cap to prevent the introduction of foreign materials during well construction procedures. All construction information will be recorded in the field log and submitted by the California-licensed (C-57) well driller to the appropriate government agency (i.e., DWR).

Once the well casing is lowered to the target depth, a filter sand pack will be carefully placed around the well screen for the purpose of reducing the introduction of fines during purging and sampling procedures. The sand will be poured and allowed to free-fall through the augers or drill casings, which are incrementally raised to allow the sand to settle into the full width of the borehole, from the bottom working upwards. Clean, potable water may be added during the emplacement of the filter pack to minimize bridging (void spaces in the well annulus). The filter pack should extend a minimum of approximately one foot above the top of the screen. This safeguards against clogging of the screen by the annular seal material placed above the filter pack. During the construction of the filter pack, the depth to the sand pack will be measured frequently with a weighted tape to ensure that construction specifications are met. Sufficient time for the filter pack to settle through the water column should be provided; gentle surging may be employed to help set the filter pack. The final depth to the top of the sand filter pack should be recorded on the well construction field log.

After the sand pack is firmly placed, a minimum of one foot of bentonite pellets or chips will be placed above the sand pack to form a seal. This material will be added slowly to prevent bridging inside the augers. Bentonite pellets are recommended where the seal is submerged below the water table. For bedrock monitoring wells and piezometers, the bentonite seal will be constructed in a manner to bridge the interface between the unconsolidated and consolidated materials. When the bentonite chips are installed in non-saturated conditions, approximately 2 to 5 gallons of potable water will be added to the pellets or chips for hydration in a ratio of not less than 2 pounds of bentonite per gallon of water. Bentonite will not be used if the water is below pH 5.0 or with total dissolved solids content over 1,000 milligrams per liter. All construction data will be recorded on the well construction field log. The seal may be left and allowed to fully hydrate and set for approximately 30 minutes or per (bentonite) manufacturer specifications. Prior to grouting, the depth to the top of the transition seal and the total depth of the well will be measured using a weighted tape.

The remaining annular space will be backfilled with a neat cement grout slurry, with up to 5 percent bentonite. A county representative may require inspection of the grout mixture and grouting process. At minimum, the grout to water mix ratio should be roughly 94 pounds Portland cement (one bag) to 7 gallons potable water. Depending on the depth of grout emplacement required, a clean tremie pipe may be used to facilitate grouting. If used, the tremie pipe will then be placed inside the augers or casing and the grout will be pumped under pressure until the augers or casings are full. The augers or casing will then be withdrawn, and additional slurry will be added as needed. The slurry will fill the annular space between the well column and borehole to approximately 2 to 3 feet below ground surface. The slurry will be allowed to settle and stabilize for a minimum of 1 hour (or more for deeper wells), at which time the hole is re-inspected for subsidence. If additional slurry is needed, it will be added. The amount of



bentonite slurry, the mixture ratios of the slurry, the thickness of the slurry and any significant subsidence in the slurry level will be recorded.

A variance may be required by the permitting agency if the proposed annular seal is less than approximately 5 feet below ground surface (depths may vary by county).

Prior to installing the protective vault, the well casing will be cut level with a pipe cutter or saw. A notch in the edge of the casing, or other permanent mark should be made on the north side of the casing to facilitate consistent depth to water measurements. The finished height of the well will depend on the type of protective device to be used (e.g., flush-mount or aboveground protective casing). Wells will be locked for security and will be designed to limit surface water infiltration.

After the bentonite slurry has reached a static level, a protective standpipe or flush-mount well box will be installed in concrete (if field construction conditions permit, the concrete will extend to a depth of approximately 3 feet). If installed in a high-traffic area, a traffic-rated flush-mount well box or vault should be used. The concrete pad surrounding the standpipe or well box will be constructed so the surface slopes away from the well to enhance surface water run-off from the wellhead. As an added precaution, the annular space between the well column and protective casing can be filled with a granular material and a small hole drilled near the base of protective pipe to discharge any water that may enter the protective casing.

If required, the final step will be to paint the above ground protective casing using a highly visible and durable paint, in order to permanently attach a well designation marker.

3. Documentation

Permits to install each well will be obtained from the local health department. Fees for permits and well installations vary by agency.

Well installation data will be recorded on the soil boring log or appropriate form (see Figure 2). Installation details will include the total depth of the boring, the depth to the top and bottom of the well screen, the type of sand pack, the depth to top and bottom of the sand pack, the type of grout, the depth to top and bottom of the bentonite seal, the top and bottom of the grout, the mixture ratios for the grout, the depth to the bottom of the concrete, and any problems occurring during the installation of the well.

When a well is constructed, modified, or destroyed, drilling contractors are required to submit a Well Completion Report to the DWR. Contractors can submit the Well Completion Report and the public can access them through their Online System of Well Completion Reports (OSWCR).

4. Special Notes

The figures included in this SOP provide examples of a typical monitoring well construction diagram and a field log for recording well construction details.

To monitor for fire and explosive hazard purposes, a lower explosive limit meter and a photoionization detector may be used in conjunction to monitor the air in the vicinity of the operator's breathing space during drilling activities following the action level protocol established in the HASP. Combustible gas readings will be taken prior to the commencement of any welding or when sparking electrical tools are to be used to minimize the possibility of explosion and/or fire.

Wells are often installed in areas with known or suspected contamination to soil and/or groundwater. The HASP should include site-specific information for personal protective equipment and techniques to ensure exposure to these potential impacts is managed properly. All wastes generated during well installation activities should be managed per the project's work plan.

Figure 1:
TYPICAL FLUSH-MOUNT GROUNDWATER MONITORING WELL CONSTRUCTION DIAGRAM

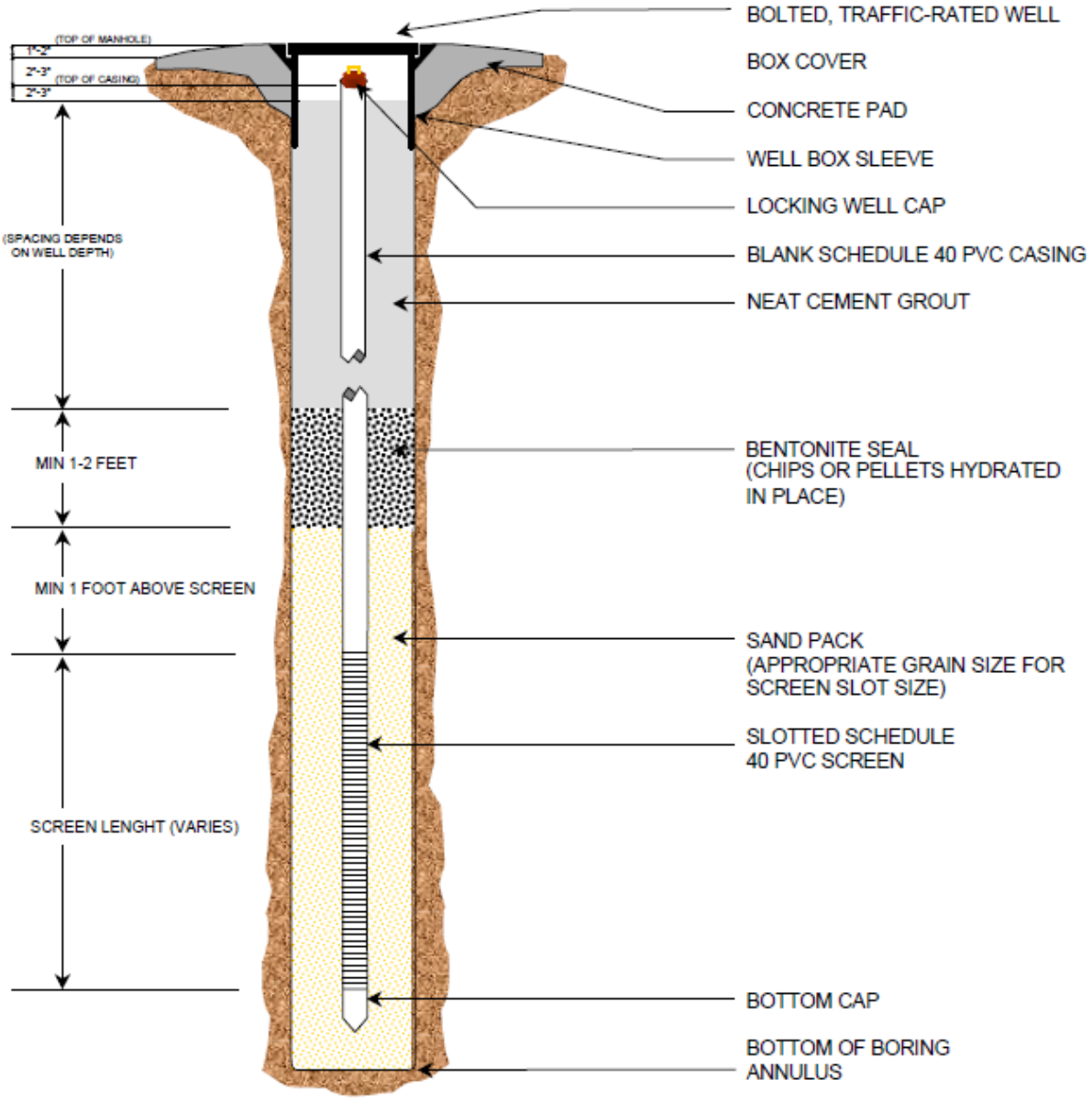


Figure 2:

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MONITORING WELL COMPLETION RECORD

DRILLING INFORMATION
DRILLING BEGAN:
DATE _____ TIME _____
WELL INSTALLATION BEGAN:
DATE _____ TIME _____
WELL COMPLETION FINISHED:
DATE _____ TIME _____
DRILLING CO. _____
DRILLER _____
LICENSE _____
DRILL RIG _____
DRILLING METHOD:
☐ HOLLOW STEM AUGER
☐ SONIC
☐ OTHER: _____
DIAMETER OF AUGERS:
ID _____ OD _____

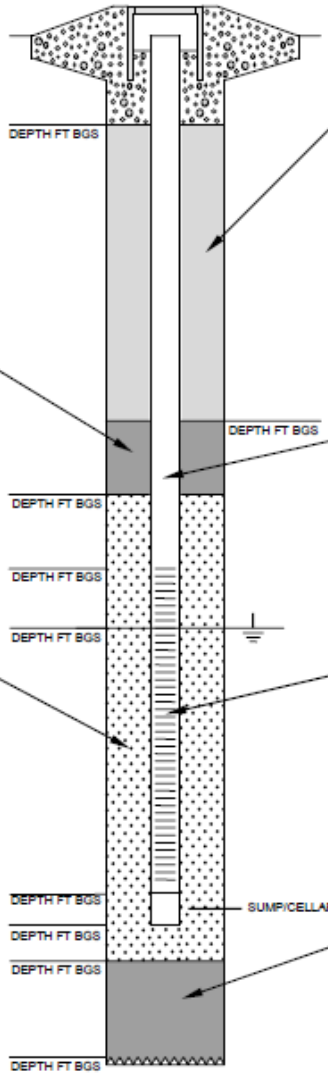
BENTONITE SEAL
AMOUNT CALCULATED _____
AMOUNT USED _____
☐ PELLETS, SIZE _____
☐ CHIPS, SIZE _____
☐ _____
PRODUCT _____
MFG. BY _____
METHOD INSTALLED
☐ POURED ☐ TREMIE
AMOUNT OF WATER USED _____

FILTER PACK
AMOUNT CALCULATED _____
AMOUNT USED _____
☐ SAND, SIZE _____
☐ FORMATION COLLAPSE:
FROM _____ TO _____
PRODUCT _____
MFG. BY _____
METHOD INSTALLED:
☐ POURED ☐ TREMIE

SURVEY INFORMATION
TOC ELEVATION _____
GROUND ELEVATION _____
NORTHING COORD. _____
EASTING COORD. _____
DATE SURVEYED _____
SURVEY CO. _____
TOC MEASURING POINT:

CENTRALIZERS USED?
☐ YES ☐ NO
CENTRALIZER DEPTHS: _____

SURFACE COMPLETION
☐ FLUSH MOUNT
☐ ABOVE GROUND W/BUMPER POST
☐ CONCRETE ☐ ASPHALT



MONITORING WELL
MONITORING WELL NO. _____
PROJECT _____
SITE _____
BOREHOLE NO. _____
WELL PERMIT NO. _____
TOC TO BOTTOM OF WELL _____

ANNULAR SEAL
AMOUNT CALCULATED _____
AMOUNT USED _____
☐ GROUT FORMULA
PORTLAND CEMENT _____
BENTONITE _____
WATER _____
☐ PREPARED MIX
PRODUCT _____
MFG. BY _____
METHOD INSTALLED
☐ POURED ☐ TREMIE

CASING
☐ SCHEDULE 40 PVC
☐ _____
PRODUCT
MFG BY. _____
CASING DIAMETER:
ID _____ OD _____
LENGTH OF CASING _____

WELL SCREEN
☐ SCHEDULE 40 PVC
☐ _____
PRODUCT _____
MFG. BY: _____
CASING DIAMETER:
ID _____ OD _____
SLOT SIZE _____
LENGTH OF SCREEN _____
LENGTH OF SUMP _____

BOREHOLE BACKFILL
AMOUNT CALCULATED _____
AMOUNT USED _____
☐ BENTONITE CHIPS, SIZE _____
☐ BENTONITE PELLETS, SIZE _____
☐ SLURRY _____
☐ FORMATION COLLAPSE
FROM _____ TO _____
PRODUCT _____
MFG. BY _____
METHOD INSTALLED:
☐ POURED ☐ TREMIE

terraphase engineering

Standard Operating Procedure

Monitoring Well and Piezometer Development

This Standard Operating Procedure (SOP) describes the procedures that will be followed during the development of monitoring wells/piezometers. The purpose of monitoring well development is to remove fines from the vicinity of the well screen to allow free flow of formation water through the well screen. Development also reduces turbidity during sampling events. The most common well development methods are surging, jetting, over-pumping, and bailing. Development should not be conducted immediately after well installation so that grouting and seal materials can adequately set. A period of 48 hours is typically adequate time for neat cement or bentonite grout mixtures to cure.

Although this procedure is typically implemented shortly after well installation, it may be necessary to redevelop a monitoring well if fines accumulate in the well. Redevelopment may be warranted if, over time, there is a drop in water yield during purging, an increase in turbidity, or sediment accumulation in the bottom of the well. It is also a good idea to develop a well it has not been sampled for a significant amount of time (multiple years).

1. Materials and Equipment

The following is a list of materials and/or equipment necessary to carry out the procedures contained in this SOP:

- Portable photoionization detector (PID) or flame ionization detector if airborne volatile contaminants are anticipated
- Multi-gas meter
- Interface probe or water level indicator
- Submersible pump (optional)
- pH, temperature, conductivity meters and appropriate calibration solutions
- Turbidity meter (if not included in the multi-parameter meter)
- Calculator
- Inertial lift pump foot valves and tubing (e.g., Waterra™)
- Surge blocks
- Dedicated or reusable bailer constructed of Teflon, stainless steel, disposable weighted
- polyethylene, or other acceptable material
- Polypropylene rope or other suitable bailer cord
- Buckets (5-gallon)

- Drums (55-gallon) or other appropriate storage container for purge water
- Latex sample gloves
- Decontamination supplies
- Health and Safety Plan (HASP)

2. Procedures

This section discusses field preparation and well development guidelines.

2.1 Field Preparation

The following preparations should be completed prior to well development:

1. Develop and record all pertinent well construction details including drilling method, well depth, well diameter, borehole diameter, screened interval, and filter length will be obtained from the well construction log for each well on the appropriate field data sheet and/or field notebook.
2. Test, calibrate, and charge all instrumentation before leaving for the field.
3. Determine the appropriate storage and disposal options for decontamination and development fluids before commencing with field activities.

The appropriate well development technique shall be at the discretion of the Project Manager. Necessary equipment and supplies will vary depending on which technique is employed.

2.2 Well Development Field Procedure

SOPs for well development in the field include the following:

1. A visual inspection of the wellhead condition documented in a field notebook before opening the well.
2. Taking PID, lower explosive limit (LEL), and/or oxygen readings of the ambient air before opening the wellhead if required by the HASP. The PID and LEL meters will be calibrated in the field according to manufacturer's specifications and recorded in the field notebook. The HASP will dictate how to proceed based on the air screening results.
3. Opening the well and determining the air conditions in the well column as specified in the HASP after the environment in the vicinity of the wellhead is deemed satisfactory. The protective casing of the well/piezometer will be unlocked, and the cap will be removed. The HASP may require PID, LEL, and/or oxygen readings of the air quality in the riser before proceeding. The HASP will dictate how to proceed based on the air screening results.
4. Allowing the monitoring well to stabilize for at least 10 minutes after removing the well cap.
5. Measuring the water level using a water level meter or, if warranted, an interface probe. The interface probe or water level indicator will be decontaminated prior to collecting water level measurements.
6. Slowly lowering the interface probe into the well column until the water level is encountered. The water level indicator will emit an audible signal when it contacts water. Measurements will be taken from the survey mark indicated on the top of the well casing. If a mark is not already indicated, the

uppermost portion of the inner casing should be used as the measurement point. This point should then be marked for future reference. Record the depth to water in the field notebook. Proceed by slowly lowering the tape until the probe touches the bottom of the well. Record the depth to bottom in the field notebook. After the water level measurement procedure is complete, the probe and all measuring tape lowered into the well will be thoroughly decontaminated.

7. Calculating the purge and well volumes in the field based on a conversion factor that represents the gallons of water in the well per foot of standing water. The following equation is used to calculate the volume of water in a well:

$$\text{Well Volume (V)} = \pi r2h(cf) \quad (1)$$

where:

π = pi (3.141592)

r = radius of monitoring well in feet (ft)

h = height of water column in ft

cf = conversion factor in gallons per cubic ft (gal/ft^3) = 7.48 gal/ft^3.

The well diameter (in inches) must be converted to the radius in feet as follows:

$$(\text{diameter}/12) * 0.5 = r \text{ (ft)} \quad (2)$$

The volume, in gallons per linear foot (lf), for various standard monitoring well diameters may be calculated as follows:

$$V \text{ (gal/lf)} = \pi r2 \text{ (cf)} \quad (3)$$

Table 1. Volume in gallons/feet for typical monitoring well diameters.

Well Diameter (inches) Well Diameter (inches)	1.0	2.0	4.0	5.0	6.0	8.0
Volume (gal/ft)	0.04	0.14	0.65	1.0	1.5	2.6

Using Table 1, field personnel may calculate well volumes knowing only the gal/ft of water per well diameter and the height of the water column using the following equation, which is modified from Equation 1:

$$\text{Well Volume (V)} = (h)(f) \quad (4)$$

where:

f = the volume in gal/ft as shown in Table 1.

The well may be developed using one of the following methods at the Project Manager's discretion:

1. Surging involves raising and lowering a surge block or surge plunger at a constant rate along the screened interval to allow water to flow through the column of tubing. This method is very effective for two-inch and four-inch monitoring wells. The surging motion forces water into the formation and loosens sediment to be pulled from the formation into the well. A foot valve is attached to the end of semi- rigid tubing and lowered into the well. The readings and notes on groundwater turbidity will be recorded in the field notebook or on the appropriate field data sheet. Low yielding

wells from which at least ten well volumes cannot be removed will be completely evacuated. Once the well is evacuated, a suitable waiting period shall be determined, and the well will be allowed to recharge. The well shall be evacuated as many times as is practical. Once the correct amount of water is purged, the valve shall be removed, and the tubing discarded. A new piece of tubing will be used in each subsequent well. The valve will be decontaminated. Note: A 2-inch-diameter well can be developed manually using the surge block method. An alternate power source (e.g., a drilling rig should be used to surge wells with a diameter greater than two inches.

2. Jetting and vacuuming involves lowering a small diameter pipe into a well a few feet above the well screen and jetting air or water into the well so that the fines are geysered out the top of the well and evacuated with a vac truck. This process will continue until the groundwater is sediment free. It is important not to force water or air across the screened interval. Doing so may cause fines in the well to clog the screen openings and/or cause hydro-fracturing near the well screen. This method is more suitable for wells completed in fractured rock.
3. Over-pumping involves pumping water from the well using a Grundfos or Whale pump, for example. Over-pumping is often conducted in conjunction with surging using a surge block or surge plunger to agitate the fines. Alternatively, the pump may be raised and lowered in the well screen interval to effectively surge the well. Water will be pumped at a rapid enough rate to draw the water down as low as possible and allowing it to recharge. This procedure will be repeated until the groundwater is sediment free. The pump will be decontaminated and documented in the field notebook.
4. Bailing involves using PVC, stainless steel, Teflon, or other acceptable materials. The bailer will be raised and lowered in the water column to agitate the fines and to move water through the well filter pack. The well will be bailed from the bottom of the water column to remove settled fines. It is important to avoid letting the bailer free fall to the bottom of the well as such an action could cause the bottom of the well casing to break. When the bailer is full, it will be retrieved, and the contents carefully transferred into a 5-gallon bucket. This procedure will be repeated until the groundwater is relatively sediment-free. When using this development technique, a new rope will be attached to the bailer for each well, and the bailer will be decontaminated between wells. Decontamination procedures will be recorded in the field notebook.

The duration for well development varies based on the well development method used. Generally, development should proceed over three successive well volumes or until the water appears clear and the pH, temperature, and conductivity have stabilized. Parameters should be measured at the start of purging and after each well volume.

In some instances, the collection of non-turbid samples is difficult or unattainable. In the event a well does not provide sediment-free samples, development may cease if:

1. A minimum of five well volumes has been removed, plus any water added during well construction and development;
2. pH, temperature, and conductivity measurements have stabilized;
3. Several procedures have been tried, or historical site data establishes a precedent for the most practical method or duration; or
4. Proper well construction has been verified.

The Project Manager shall determine the appropriate method for storing and disposing of decontamination and development water. In most cases, decontamination and development water will be stored in properly labeled 55-gallon drums and staged in a safe location.

3. Documentation

The following data will be recorded in the field notebook for each well in addition to what is outlined above:

1. Well ID;
2. Date of well installation;
3. Date and time of well development;
4. Static water level and depth to bottom before and after development;
5. Quantity of water removed and time of removal;
6. Field parameters during development;
7. Type and size/capacity of pump and/or bailer used;
8. Description of well development technique(s) used; and
9. Waste management documentation for decontamination and well development water (drum inventory or label documentation).

Any deviation from the above-described procedures will be performed only with prior approval of the Project Manager.

4. Special Notes

Extraction wells are typically better developed using equipment and methods provided by the drilling contractor. These wells typically have diameters greater than four inches and require larger equipment to achieve proper development. This equipment includes, but is not limited to, large-diameter surge blocks, large-diameter bailers, water jetting systems, and high-capacity submersible pumps. Consult with the Project Manager regarding extraction well development.

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Standard Operating Procedure 300-23-00

Indoor and Outdoor Air Sampling

This Standard Operating Procedure (SOP) describes the procedures that shall be used during the collection of air samples. In the absence of other project- or client-specific requirements, these are the recommended handling procedures to be used during air sampling to provide consistency in sample collection technique. Strict adherence to these procedures shall help ensure that air sampling results in meaningful and accurate data.

1. Materials and Equipment

The following is a list of materials and/or equipment necessary to carry out the procedures contained in this SOP:

- Summa canister (individually certified by laboratory)
- Sampling manifold with flow controller individually certified by the laboratory and pre-set to proper flow rate (to collect over an 8- or 24-hour period)
- Indoor air sampling field logs
- Building Survey and Indoor Air Screen forms[1]
- Bike locks (to secure the canisters)
- Ladders
- "AIR SAMPLING IN PROGRESS" signage
- Recommended tools:
  - Clipboard
  - 9/16-inch and 1/2-inch open end combo wrenches
  - 12-inch adjustable wrench
  - Ball point pen
  - Nitrile gloves
- Health and safety plan



Figure 1: Six-liter Summa canister with 8-hour flow controller.

[1] California Environmental Protection Agency Department of Toxic Substances Control and California Water Resources Control Boards, *Supplemental Guidance: Screening and Evaluating Vapor Intrusion, Final Draft,* February 2023.

2. Air Sampling Methods

Air sampling should be conducted over normal facility operating hours. Standard indoor air samples should be collected over a 24-hour period for residential buildings and an 8-hour period for non-residential buildings. However, time integrated samples should be set to normal operating hours (e.g., schools).

2.1 Pre-Sampling Preparation

Prior to sampling, the building should be screened for indoor air sources and a building survey form completed to inventory commercial or household products/chemicals, evaluate current building conditions including heating, ventilation, and air conditioning systems in place, typical operating hours, and condition of the existing slab. A photoionization detector should be used during the survey to document breathing zone photoionization detector readings throughout the building and identify areas of potential elevated volatile organic compounds (VOCs) prior to sampling. Detailed drawings of each building should be completed showing the locations of interior and exterior walls doors and windows, locations of building slab/floor penetrations, and locations of potential VOC-containing products. All products that contain VOCs should be listed in the Building Survey Form, including the volatile ingredients in each product (photos of the label may be sufficient). If possible, all chemicals should be removed from the building at least 24 to 72 hours prior to indoor air sampling.

Photos of suspected VOC-containing items should be taken.

Following the inventory/survey, arrangements should be made with the building occupant to remove known or suspect VOC-containing materials from the building prior to sampling, where feasible. If removal of the item(s) is not feasible, the presence should be documented.

2.2 Air Sampling Setup

The number of samples to be collected and the sample locations should be determined by the project manager and documented in a work plan. Sample locations are generally in areas where vapor intrusion is more likely to occur, such as above known elevated groundwater, soil vapor or sub-slab VOC concentrations, bathrooms, near utilities, floor drains, or obvious cracks in the slab. The number of indoor and outdoor samples to be collected and sample locations should be based on the appropriate regulatory guidance for the project.

During sampling, site conditions should match that of day-to-day operations (i.e., if during normal working conditions the air conditioning is running and/or windows or doors are left open, then that should remain consistent during sampling).

The outdoor air sample intakes should be located 6 feet off the ground. The outdoor ambient air samples should be opened for sampling approximately 30 to 60 minutes before the indoor air samples are started and closed approximately 30 to 60 minutes before the indoor air samples are closed.

The indoor air sample canisters should be placed within the breathing zone approximately 3–5 feet above ground surface unless otherwise specified in the project-specific work plan. Height requirements can be met utilizing laboratory-provided sampling canes, ladders, boxes, or existing site furniture or structures. Summa canisters outside of the facility or in highly trafficked areas should be secured with bike locks to prevent theft. "AIR SAMPLING IN PROGRESS" signage can be used to deter theft or tampering.

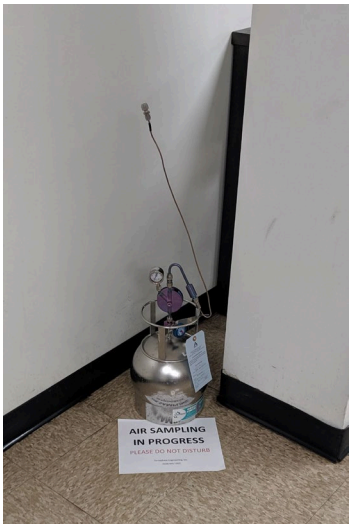


Figure 2: Six-liter Summa canister with sampling cane.

Flow controllers should be attached to the Summa cannisters through quick connect or Swagelock connections. Once samples have been placed in their positions, the Swagelock cap covering the sample collection inlet can be removed and the canister can be opened.

2.3 Air Sample Collection

Once a Summa canister has been opened, if the initial gauge reading is less than -25 inches of mercury, the canister should be replaced due to a potential leak during transportation if backup canisters are available. Vacuum gauge readings should be closely monitored and recorded during the first hour of sampling and the vacuum recorded hourly, if possible, or a minimum of 4 hours after the start of sampling. Vacuum readings should be closely monitored during the last 2 hours of sampling. Vacuum gauge readings should be recorded at the end of sampling. For 8-hour samples, gauge readings should go down approximately 2–4 inches of mercury within the first hour. For 24-hour samples, gauge readings should go down approximately 1 inch of mercury within the first hour. If gauge readings do not appear close to those ranges, Summa canisters and manifolds should be replaced as they could fill up too quickly or too slowly and not capture the intended timeframe.

Summa canisters should be closed or disconnected after the intended timeframe is completed, or sooner if the pressure gauge gets below 5 inches of mercury. If at the intended timeframe the pressure gauge has not reached 15 inches of mercury, the sample time should be extended to allow for enough sample volume for the lab to run United States Environmental Protection Agency Method TO-15 SIM.

For the analyte list, please refer to a work plan, scope of work, or discuss with the project manager.

3. Documentation

Field documentation will be maintained in the indoor air sampling field logs recording, at a minimum, the site and weather conditions observed at the time of the air sample collection (including wind speed and direction), the sample duration, the beginning and ending canister pressures, and any deviations from the above protocol. Record the laboratory-provided serial numbers for each Summa/flow controller combination used in sampling. It is recommended that the canister pressure be recorded

hourly throughout sampling. All sample logs, building survey forms, and health and safety forms are available on QNOPY.

4. Special Notes

Duplicate samples will be collected using one of the following methods:

- A single location affixed with a “T” connection that has one manifold connecting two separate Summa canisters or other sampling devices; or
- Two separate Summa canisters located adjacent to each other to be opened and closed at approximately the same time.

Each vacuum gauge should be inspected prior to use as they can sometimes be damaged during transport. Gauges that are reading well outside of their indicated range or have broken protective housing or stuck needles shall not be used.

When ordering laboratory equipment, a minimum of one extra set (i.e., Summa canister and manifold) or more should be added to the number of samples planned for collection in case of damaged equipment, leaking fittings, insufficient canister vacuum, or accidental valve opening.

When tightening threaded fittings, always tighten by hand and then tighten fully using a second “backer wrench” to secure the nut to ensure a properly tightened connection. Do not over tighten the connections using wrenches. After hand tightening, less than a quarter-turn is normally required to complete the connection.

Semivolatile organic compound sampling in indoor air should not be conducted on the same day as VOC sampling due to laboratory solvent preparation of semivolatile organic compound air sampling equipment.

terraphase engineering

Standard Operating Procedure 400-24-00

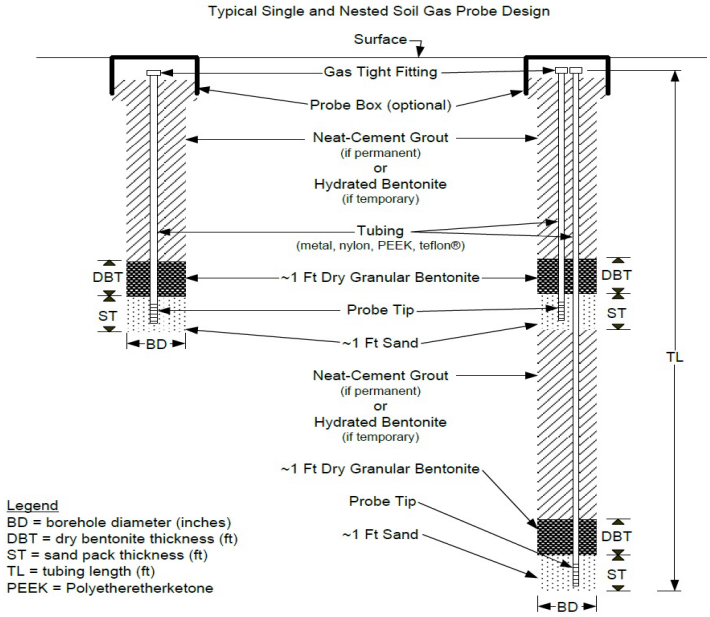
Soil-Vapor Probe Installation

This Standard Operating Procedure (SOP) defines and standardizes procedures to install soil-vapor probes for soil-vapor sample collection. These procedures are recommended for use at all soil-vapor probe locations to provide for consistent and accurate soil-vapor probe installation. Strict adherence to these procedures shall help ensure the proper collection and integrity of the soil-vapor sample.

1. Materials and Equipment

The following is a list of materials and/or equipment necessary to carry out the procedures contained in this SOP:

- Drilling equipment
- Teflon or Nylaflow tubing – ¼-inch outer diameter
- Airstone filter or stainless-steel screen
- Probe tubing cap or polycarbonate Luer-Lok™ valve
- Kiln dried sand
- Distilled water (enough for hydrating bentonite **and** mixing grout)
- Dry granular bentonite crumbles
- Bentonite chips or neat cement and bentonite powder
- Well box (optional)



Source: California Environmental Protection Agency Department of Toxic Substances Control, Los Angeles Regional Water Quality Control Board, San Francisco Regional Water Quality Control Board, *Advisory – Active Soil Gas Investigations,* July 2015.

2. Procedures

The following procedures shall be adhered to during the installation of all soil-vapor sampling probes. The boring for the probe installation may be drilled using several methods such as direct-push technology, hollow-stem auger, or hand auger; however, mud rotary drilling should never be used for soil-vapor probe borings.

2.1 Shallow/Single-Depth Probes

The screen implant and tubing will be placed down the boring to the appropriate depth using a temporary rod or pipe to ensure accurate depth of placement. For probes deeper than 15 feet, the probe implant and tubing should be affixed to a downhole rod (e.g., small-diameter PVC pipe) that remains in the boring to ensure accurate placement of the probe. For probes with multiple implants at various depths in a single boring, mark the depth of each probe at the top of the tubing that extends aboveground.

The screen implant should be centered in an approximate 1-foot-thick interval of clean sand. Approximately 6 to 12 inches of dry granular bentonite crumbles should be placed on top of the filter sand as a transition seal and hydrated in 3-inch lifts with **distilled water**. The remainder of the boring, above the transition seal, should be filled either with bentonite chips or pellets in 1-foot **distilled water** hydrated lifts (for temporary probes) or with a neat cement grout containing up to 5 percent bentonite powder (for permanent probes). The water used to mix the cement grout should be distilled water, not potable water.

The surface of the installation should be sealed with hydrated bentonite (for temporary probes) or grout (for permanent probes) and covered for protection. For temporary probes, a 2-inch-diameter PVC cover may be inserted into the surface seal and flagged to ensure that the monitoring point is visible. Temporary probes may also be buried by wrapping the probe tubing in plastic, covering with clean sand, and applying cold patch asphalt at the surface. Permanent probes should be protected by installing a well box set in concrete.

After installation, ensure the top of the probe tubing is sealed with a cap of polycarbonate valve to ensure no moisture enters the tubing and soil vapor from the probe is not released. The location of the probes will be measured and accurately marked on a field map or the location will be read using a GPS unit and the coordinates will be recorded in the field notes.

2.2 Deep/Multi-Depth Probes

For borings with more than one probe installed at various depths follow the procedures above. However, after placing the first (deepest) probe, sand pack, and granular bentonite transition seal, place the annular seal of hydrated bentonite or neat cement/bentonite grout to approximately 6 inches below the next shallowest probe depth.

Once the bentonite or grout have set enough to support the next 1-foot-thick filter sand interval, begin constructing the next shallower vapor probes using the same methodology as above. Repeat this approach on additional shallower probes, as necessary.

For borings deeper than 15 feet below ground surface, the granular bentonite transition seal and neat cement grout (if used) should be placed using a tremie pipe.

2.3 Documentation

Field documentation will be maintained in the project field notes and the probe construction details will be recorded on the Terraphase Monitoring Well Completion Record form. Field notes and the Monitoring Well Completion Record will contain, at a minimum, the site and subsurface lithology

conditions observed at the time of the soil-vapor probe installation, construction details (depth and diameter of boring, type and size of implant, length of tubing, height of sand pack, height of dry bentonite, specific types of sand/bentonite/grout used; e.g., bentonite crumbles or granular bentonite), and any deviations from the above protocol.

terraphase engineering

Standard Operating Procedure 401-24-00

Soil-Vapor and Sub-Slab Soil-Vapor Sampling

This Standard Operating Procedure (SOP) defines and standardizes soil-vapor and sub-slab vapor sample collection procedures to provide consistency in collection techniques and ensure collection of high quality, representative samples. Strict adherence to these procedures will help ensure that the sampling results in meaningful and accurate data. The sampling activities should be performed in accordance with applicable regulatory guidance.

1. Regulatory Guidance

Regulatory guidance documents vary by state or region—verify the appropriate guidance for the project location. A partial list of regulatory guidance documents is provided in the references section of this SOP. Because guidance documents are often updated, check the source to ensure the current guidance is used. If unsure which guidance applies, consult with the project manager or one of the Vapor Intrusion Discipline Group leaders. Variances from this SOP due to local requirements should be documented.

2. Equipment and Materials

The following is a list of equipment necessary to carry out the procedures contained in this SOP:

- Sample container; maximum volume of 1 liter (Summa canister, Tedlar® bag, Bottle-Vac™, or similar).
- Sampling manifold with flow controller pre-set to proper flow rate (100–200 milliliters [mL] per minute [mL/min]) from the laboratory.
- Standalone digital vacuum gauge from the laboratory.
- Sample inlet tubing (1/4-inch outer diameter [OD] Nylaflow, Teflon, or Teflon-lined tubing) with compatible fittings for connections to the probe and the sampling manifold (e.g., Swagelok or single-use polycarbonate tubing fittings). Avoid low-density polyethylene and vinyl fittings. Typically, laboratory equipment and soil-vapor wells use 1/4-inch OD diameter tubing and fittings.
- Purging device (60-mL syringe with Luer-Lok™ tip/three-way valve, air sampling pump [such as Sensidyne GilAir Plus pump], or extra Summa canister).
- Sampling shroud (see Figure 1) either constructed by Terraphase or supplied by the laboratory.



Figure 1: Soil-Vapor Sampling Shroud

- Leak detection/tracer gas, typically consisting of a helium gas tank with compatible flow regulator. Other gas or liquid tracers may be substituted on a project-specific basis. This SOP focuses on helium as it is the most commonly used tracer.
- Helium gas field detector(s); Dielectric MGD-2002 helium detector (± 0.1 percent accuracy) or similar (preferably two separate units).
- Multi-gas detection meter if methane is a concern.
- Purge volume calculator/spreadsheet.
- Soil-vapor sampling field logs (digital or paper).
- Recommended tools:
  - Flathead screwdriver
  - Open end combination wrenches (9/16- and 1/2-inch)
  - Crescent adjustable wrench (2x)
  - Scissors/snips to cut tubing
  - Ball point pen
  - Clipboard
  - Nitrile gloves
  - Fittings for connecting the soil-vapor probe to the manifold/sampling apparatus. Common fittings include:
    - Stainless-steel compression fittings/valves (e.g., 1/4-inch OD Swagelok)
    - Three-way polycarbonate stop valves (Luer-Lok™)
    - Luer-Lok™ to barb adaptors (1/4-inch OD)
    - Silicone or Tygon tubing (2-inch sections of 1/4-inch-inner-diameter tubing)
    - Zip ties (4-inch).
  - Stopwatch or other time-keeping device.
  - Health and safety plan.

3. Sampling Methods

This section presents an overview of field sampling methods and considerations.

3.1 Equilibration Times and Weather Considerations

Subsurface conditions are disturbed during drilling and soil-vapor probe placement. To allow the subsurface to equilibrate back to representative conditions, the following equilibration times should be observed before proceeding with sampling:

- Soil-vapor probes installed using direct-push technology – at least 2 hours.
- Soil-vapor probes installed by auger methods (including hand auger) – at least 48 hours.
- Sub-slab vapor probes – at least 2 hours.

See applicable guidance for recommended equilibration times based on other probe placement methods.

Soil-vapor sampling should not occur during or within 5 days after a significant rain event (0.5 inches or greater during a 24-hour period). However, soil-vapor sampling after rainfall can proceed where infiltration has not occurred, such as under buildings or beneath high-integrity pavement. The project manager should be consulted for a final decision on sampling timing based on significant rainfall events.

3.2 Shut-In Test

Prior to initiating soil-vapor purging and sampling, an initial shut-in test will be conducted to assess the integrity of the sample apparatus fittings. The sample train should first be fully assembled, including connection from the probe or well to the manifold, then to the purge line and sampling container. With the valves at the Summa canister (or other sample container) and the soil-vapor probe both in the closed position, the purging device will be used to apply a vacuum to the sampling manifold of approximately 100 inches of water (equivalent to approximately 7.4 inches of mercury [Hg]). The purge line valve will then be closed to isolate the manifold under vacuum. The shut-in test will be conducted for a minimum of 1 minute to observe whether the vacuum is maintained in the sampling manifold. Shut-in tests typically do not continue longer than 2–3 minutes. If a noticeable drop in vacuum is observed, recheck and retighten all the fittings/connections and repeat the test until there is no noticeable drop in vacuum.

3.3 Purging and Leak-Check Procedures

Purging removes stagnant air from the sampling system and the soil-vapor probe prior to sample collection. Leak checks are performed during purging to evaluate if ambient air is entering the probe or sample train during purging (and therefore could be introduced into the sample during the collection process). Leak-check methods are described in the subsections below. For quantitative leak-check methods, purging must be conducted with the entire sample train under a shroud with an atmosphere enriched by the selected tracer gas. For either qualitative or quantitative leak-check methods, the leak check setup shall be put in place at the probe or well location prior to initiating purging procedures described below.

Three purge volumes should be calculated and extracted prior to sampling. When possible, purge volumes should be calculated prior to field mobilization. One purge volume typically consists of the vapor probe filter sand (30 percent sand porosity) and dry bentonite void space (50 percent dry bentonite porosity), the tubing and probe tip volume, and any aboveground manifold volume. To aid in the calculation of the purge volumes, a purge calculator available on the Terraphase server may be used (J:\Project Management Policies and Forms\Field Forms\Soil Gas, Indoor, Outdoor Air).

Stagnant soil vapor in the probe will be purged using the selected purging device (e.g., gas-tight syringe, purge canister, or pump) with a flow rate of not greater than 200 mL/min. A higher flowrate may be applied in the case of excessive purge times; however, flowrate should return to no greater than 200 mL/min for sampling.

Vacuum on the aboveground tubing/manifold during purging and sampling will be monitored to ensure the imparted vacuum is no greater than 100 inches of water (7.4 inches of Hg). If vacuum above 100 inches of water is observed, indicating high back-pressure conditions, contact the project manager for instructions. If this occurs, the probe is either sampled using a slower purge rate with a vacuum of less than 100 inches of water or sampled using an alternative approach as allowed by the appropriate regulatory guidance or sampling of that probe is aborted.

3.3.1 Quantitative (Gaseous) Leak Check

A quantitative leak check can be performed if the selected tracer gas (helium as a default) can be measured in real time in the field using a gas detector. Prior to purging, a sample shroud will be placed over the top of the soil-vapor probe, the sample container, the manifold, and the shroud helium gas detector (if used). A good seal between the shroud and the ground surface will be ensured. The helium gas will then be introduced into the shroud via tubing. The purge line (i.e., purging device, in-line gas detector, and tubing) and the sample container will be connected to the soil-vapor probe by a three-way valve. The purging device and in-line gas detector remain outside the shroud, while the sample container, the shroud helium gas detector (if used), and the three-way valve and other tubing remain within the shroud. The figure below shows a typical shroud setup.

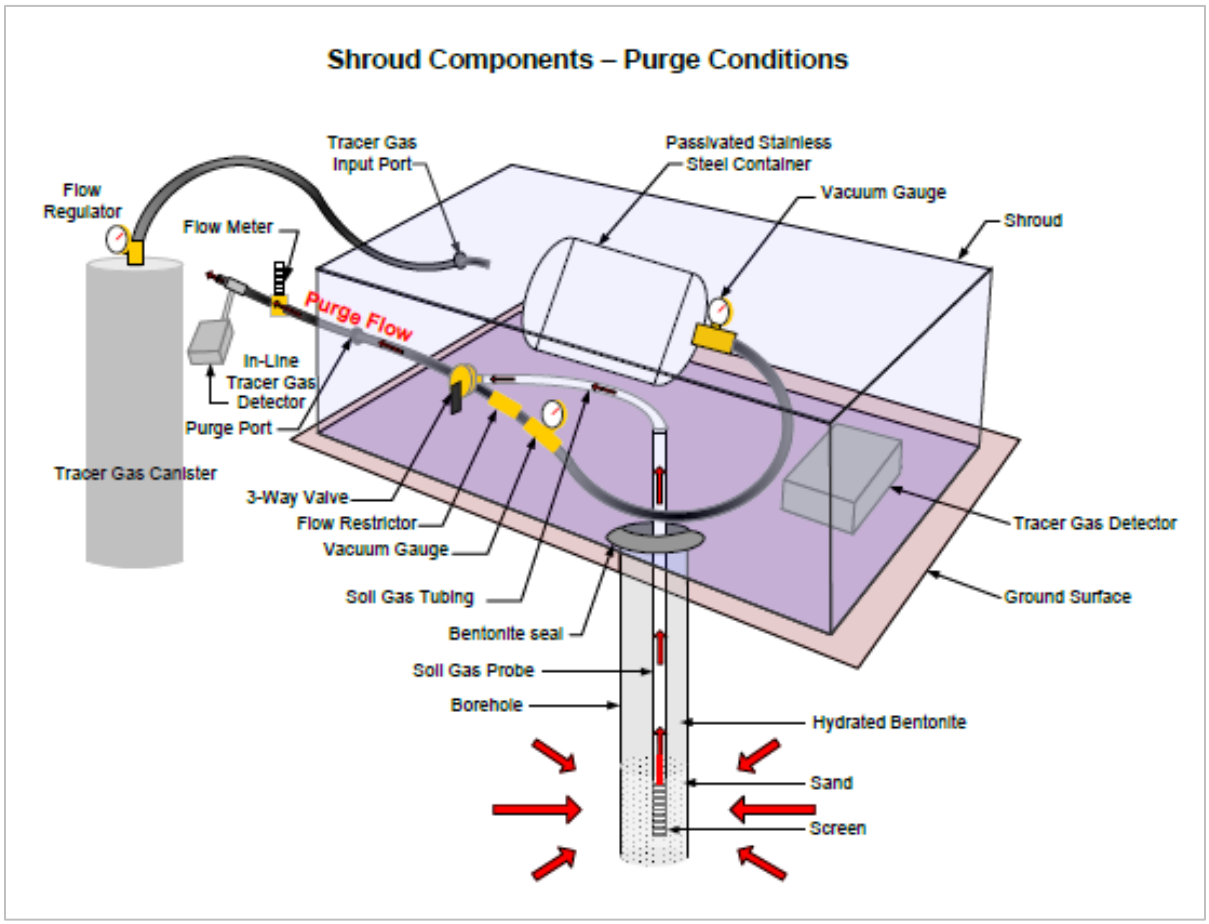


Figure 2: Shroud Components – Purge Conditions
Source: Advisory

Throughout the purging process, the helium tracer gas concentration inside the shroud should be maintained between 15 and 20 percent by observing the shroud helium detector and introducing more helium whenever the level drops below 15 percent. During purging, the helium concentration in the purged air should be measured periodically to ensure that a leak is not occurring. This will be performed by monitoring air exiting the soil-vapor purge line using the (external) helium detector to determine if helium is entering the probe or sample train during purging activities. Helium levels in the shroud and purge line will be recorded on the soil-vapor sampling field logs throughout sampling.

Helium concentrations detected in the purged air which are greater than 5 percent of the average shroud concentration during purging activities indicates that the probe should be resealed and retested. A helium tracer gas concentration in the purged air less than 5 percent of the average shroud concentration indicates the probe is sealed sufficiently and collection of the vapor sample can proceed.

After sample collection, ensure that laboratory analysis for helium is included on the laboratory chain of custody.

3.3.2 Qualitative (Liquid) Leak Check

If a quantitative (gaseous) leak-check process is not being used, a qualitative (liquid) leak check should be used to demonstrate sample integrity. Liquid tracer compounds include, but are not limited to, 1,1-diflouroethane, n-propanol, hexane, and pentane. The selected liquid leak-check compound should not be a suspected site-specific contaminant. Liquid leak checks are more commonly used when analyzing samples using an on-site mobile laboratory because the laboratory results can be provided the same day and if leaks (elevated tracer gas concentrations) are discovered, there may be an opportunity to correct the leak and resample.

Liquid tracer compounds should only be handled while using single-use disposable gloves and should be applied to a towel or clean rag by pouring or spraying away from the sampling location. Before applying the liquid tracer compound to towels or clean rags, the sampling connections between the vapor probe to the sample manifold and sample container should already be completed and ready for purging to minimize the chance the liquid tracer contaminating the sample apparatus or equipment prior to sample collection. The rags with liquid tracer compound should be stored in a zipper-sealed bag until they are ready to be used. The liquid tracer container should also be stored in a separate, closed, air-tight container away from the sampling location.

The liquid leak-check compound should be applied immediately prior to purging and sampling the probe. The gloves used to handle the liquid tracer should be carefully removed and disposed in a sealed container (e.g., zipper-sealed bag) before touching the sampling equipment. Hands should be washed between handing the liquid tracer and start of purging and sampling. If a probe is located indoors, the liquid leak check should be applied to the towel or rag outdoors, while all the doors and windows to the sample collection area are closed, and then brought to the sample location once ready for purging and sampling. If sampling is conducted outside, the liquid leak-check compound should be applied to the towel or rag in a downwind location, away from the sample equipment and probe location. If two samplers are present, following clean/dirty hands protocols is recommended, with clean hands handling the sample collection and dirty hands handling the liquid leak compound.

The bag with the liquid tracer-saturated towel or rag should then be placed near the connections from the probe, the sampling train, and sample container, and then opened just prior to purging and sampling. If necessary, especially on windy days or if the sampling train requires a large area, the saturated towel(s) can be removed from the plastic bag and placed immediately adjacent to the sample collection equipment, especially at the probe surface and connections in the sample train. Do not apply, spray, or pour the liquid tracer directly onto a fitting or any part of the sample apparatus.

The towel or rag used for the leak detection can be reused between sample locations. If reused, additional liquid compound should be applied to re-saturate the towel or rag prior to purging and sampling each location. If the purging and sampling collection takes longer than approximately 5 minutes, it is recommended that the liquid tracer be reapplied to the cloth.

After sample collection, ensure that laboratory analysis for the liquid tracer compound is included on the laboratory chain of custody.

3.4 Sample Collection

After the shut-in test has been successfully performed, the soil-vapor probe purged, and the leak-check procedure completed, sample collection shall begin. This section is specific to use of helium as a tracer. For sampling using a liquid leak-check compound, the procedures are similar but without use of the shroud, helium, and field gas detectors.

Prior to sample collection, the helium concentration inside the shroud will be measured and adjusted to the target concentration of 15 to 20 percent. The purge line will then be closed. At this point, the sample train configuration will be open from the soil-vapor probe, through the manifold/flow controller, and to the sample container. Pre-sampling data will be recorded on field forms, including shroud helium concentration and initial Summa canister vacuum.

Sampling will begin by opening the Summa canister valve or another acceptable sampling container. Sample start time shall be recorded. The concentration of helium inside the shroud and remaining Summa canister vacuum will be recorded every minute after sampling has begun. The sample container or the connected sampling manifold will be fitted by the laboratory with a vacuum gauge and critical orifice flow regulation device designed to allow sample collection at a flow rate of approximately 100 to 200 mL/min. The flow rate will be verified from the rate of change in the canister vacuum during sample collection. If sampling with a Tedlar® bag, either use a lung box with a sample pump set to a flow rate of approximately 100 to 200 mL/min or fill the Tedlar® bag using a 60-mL syringe and three-way valve at a rate of approximately one syringe volume every 20 to 30 seconds.

To stop sample collection, the Summa canister valve will be closed tightly. Sample collection shall be terminated when there is still residual vacuum left in the canister (typically 5 inches of Hg) rather than allowing the canister to fill completely to zero vacuum. The residual vacuum reading and sample stop time will be recorded on the field form. A 1-liter Summa canister will typically fill within 5 to 8 minutes at an approximate flowrate of 200 mL/min. If sample collection is slower than typical, the vacuum gauge rate of change will continue to be monitored while sampling. Sample duration should not exceed 30 minutes. If the Summa cannot be filled to a residual vacuum of 5 inches of Hg within 30 minutes, the project manager will be notified to determine if the sample should not be analyzed due to insufficient sample volume.

The samples will be submitted to the analytical laboratory under chain-of-custody protocols for analysis of the project-specific analyte list and the appropriate leak-check compound.

4. Documentation

Field purging and sampling information will be documented using a Terraphase soil gas sampling log. All entries on the forms will be completed (i.e., leaving no blank cells). A line will be placed across cells that are unused or not applicable in accordance with proper field note-taking protocols. Any deviations from the above protocols will be recorded on the sampling log. As noted, it is recommended that the canister pressure and the percentage of helium in the shroud and the purge line be recorded throughout purging and sampling. For a standard soil-vapor sampling event that typically has a sample duration of less than 10 minutes, canister pressure and shroud helium percentage readings should be measured immediately once sampling has started, at a minimum of every 1 minute thereafter, and the final readings should be recorded when the sample collection has ended.

5. Additional Recommendations

After receiving the Summa canisters from the laboratory, and prior to field mobilization, the pressure in each canister should be measured with a vacuum gauge and recorded to ensure that the appropriate negative pressure exists within the sample canister (-26 to -30+ inches of Hg). If any canister shows insufficient initial vacuum during this pre-field check, a replacement canister should be obtained from the laboratory, if possible, prior to mobilization.

Duplicate samples shall be collected from a single soil-vapor probe using a “Y” connection (also referred to as a “T-splitter”) that has one line of tubing connected to the well, branching to two lines of tubing connected to separate Summa canisters or other sampling containers. The primary and duplicate samples will be collected concurrently.

Each vacuum gauge should be inspected prior to use as they can sometimes be damaged during transport. Gauges that are reading well outside of their indicated range, have broken protective housings, or stuck needles, shall not be used.

An additional 10 percent (minimum) of extra sets of sampling equipment will be requested when ordering laboratory equipment (i.e., Summa canister and manifold) in case of damaged equipment, leaking fittings, field errors, or insufficient canister vacuum.

Delivery of sampling equipment from the laboratory will be requested at least 3 days prior to the scheduled field sampling event to allow time to inventory equipment and check canister vacuums. Do not order equipment for delivery more than 1 week in advance of sampling because canister vacuums can dissipate if allowed to sit unused for long periods.

Unused laboratory equipment after the sampling event will not be retained (i.e., all equipment will be returned to the laboratory after each event).

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Standard Operating Procedure 503-23-00
Surface and Shallow Subsurface Soil Sampling

This Standard Operating Procedure (SOP) describes the procedures that will be followed when collecting surface or shallow subsurface soil samples and the recovery of surface and shallow subsurface samples from surficial soil using hand equipment.

1. Materials and Equipment

The following is a list of materials and/or equipment necessary to carry out the procedures contained in this SOP:

- Sampling spoon, trowel, or scoop (cleaned and not plated or painted)
- Stainless-steel mixing bowl or Teflon tray
- Laboratory-provided sample containers
- Sampling gloves
- Decontamination supplies
- Site-specific health and safety plan

2. Procedures

Discrete and composite sampling procedures of surface or shallow subsurface soil are described below.

2.1 Discrete Sampling

Field staff will implement the following protocols when conducting discrete sampling:

1. All sampling equipment will be decontaminated prior to use and between sample locations in accordance with the procedures specified in the work plan.
2. If a shallow subsurface sample is desired, the trowel or spade will be used to remove the top layer of soil to the desired sample depth.
3. If required for the samplers being used, plastic sampling sleeves will be inserted in all samplers before samples are recovered. The sleeves will be used once and then discarded in an appropriate container.
4. A sampling device (e.g., spoon) will be used to remove the sample from the soil on the blade of the trowel or spade, avoiding the thin layer of soil from the area which comes in direct contact with the trowel or spade.

5. All depth intervals will be sampled with the appropriate core sampling device. The sample will then be transferred to the sample containers by pouring the soil into the appropriate containers. If it is not possible to pour the soil, a clean stainless-steel spoon or spatula may be used to facilitate the transfer.
6. The sample container will be labeled with the appropriate information. All chain-of-custody documents will be completed, and the appropriate information recorded in the field notes or report form.
7. The labeled sample container will be placed in an appropriate transport container with ice (if required) as soon as possible.
8. All sampling equipment will be decontaminated between sample locations in accordance with the procedures specified in the work plan.

2.2 Composite Samples

All composite samples are typically composed of samples from equivalent soil sample depths at multiple locations. Discrete samples that make up a composite sample will be collected as described above; however, a stainless-steel mixing bowl or Teflon tray will be used for mixing the discrete samples prior to the sample being placed in the laboratory-supplied sample containers. Composite sampling is generally not recommended when samples are to be analyzed for volatile organics.

1. Composite samples, consisting of a pre-determined number of discrete samples, may be recovered using a soil recovery probe. Dedicated plastic sampling sleeves will be used for these composite samples. The probe will be driven to an appropriate depth, and a sample recovered from the appropriate depth at each sampling location.
2. The equal volume samples will then be composted by mixing in a stainless-steel pan and then placed in a properly labeled laboratory container.
3. Where exact mapping of sample locations is required, the discrete sample locations shall be marked in such a way that they can be properly mapped.
4. Discrete soil samples can also be submitted to the analytical laboratory for compositing. When requesting the laboratory perform compositing, clearly indicate on the chain-of-custody form which discrete samples should be composited.
5. The sampling equipment shall be decontaminated between sampling zones (i.e., between areas represented by a composite sample).

3. Documentation

Each sample container will be labeled as directed by the project work plan or by the project manager and a chain-of-custody record will be completed. Field notes or a field data sheet will be kept describing the sampling procedures, sampling locations, all sample identification numbers, and any deviations from this SOP. A map or site sketch will be constructed of all sampling locations using field measurements (i.e., GPS) or from coordinates obtained from a qualified surveyor.

4. Special Notes

The decontamination process will be repeated after each use and between all discrete sample locations. If compositing strategies are used, decontamination may only be required between composite samples (i.e., not between discrete samples that form a single composite). Sample gloves shall be changed in between each location.

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Standard Operating Procedure 504-23-00

Field Screening with Photoionization or Flame Ionization Detectors

This Standard Operating Procedure (SOP) describes the procedures that that will be followed to perform headspace screening on soil and water samples using a photoionization or flame ionization detector (PID or FID, respectively).

1. Materials and Equipment

The following is a list of materials and/or equipment necessary to carry out the procedures contained in this SOP:

- PID equipped with the appropriate eV bulb, or FID, as determined in the project work plan or as determined by the project manager
- Adequate supply of appropriate calibration gas
- Adequate supply of hydrogen gas for the FID's flame fuel source
- Flow regulator for calibration gas or hydrogen gas
- Clean glass jars with lids
- Resealable, 1-quart storage bags
- Aluminum foil
- A site-specific health and safety plan



2. Procedures

The PID or FID will be calibrated in the field in accordance with the manufacturer's requirements. Calibration should be performed at a minimum interval of once per day; specifically, at the beginning of each day. An additional calibration after every 4 hours of run time is recommended. Record the time, date, and other pertinent calibration information (e.g., span setting, if appropriate) in the field notebook and equipment calibration log.

When the sample (e.g., soil or water) is collected, it will be placed into the glass sample jar until the jar is approximately half full. The mouth of the jar will be sealed with clean aluminum foil and the lid placed on the jar so that the foil is sealed against the jar. The sample ID and depth should be recorded on the

foil. The sample jar will be agitated for at least 15 seconds, taking care to avoid piercing the foil seal. The sample will be allowed to develop for 5 to 10 minutes in a warm area. The probe will be inserted through the foil seal and the maximum instrument response (which should occur after 2 to 5 seconds) will be recorded.

As an alternative, resealable storage bags may be used to screen soil samples. The sample ID and depth should be recorded on the bag. The sample will be agitated and allowed to develop in the same manner as with a glass jar.

After the sample has developed, the probe will be inserted through a small opening in the upper portion of the bag to obtain the maximum headspace reading. The opening should be immediately closed around the probe to minimize any dilution of the headspace vapor. The bag should not be squeezed during headspace measurement.

Special care will be taken to avoid inserting the probe directly into the sample (e.g., soil or water), thus preventing permanent damage to the instrument.

3. Documentation

PID or FID readings and calibration data will be recorded in the equipment calibration log, and field notes, or on an appropriate data sheet.

4. Special Notes

Where feasible, use of the PID shall be avoided in conditions where meter response is affected by high humidity. In addition, a PID or FID must be accustomed to the atmosphere that will be measured (i.e., the instrument will not work properly after taking it from a heated car or building to a cool outdoors). The equipment should be allowed to equilibrate for approximately 15 to 30 minutes before it is used.

FIDs are sensitive to methane. If methane gas is present or suspected, the sample must be screened with a charcoal filter and without the filter. The difference in results is the concentration of volatile organics present in the sample.

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Standard Operating Procedure 508-23-00

Soil Boring Installation Using a Hand Auger

This Standard Operating Procedure (SOP) defines and standardizes procedures to install soil borings using a hand auger. Soil boring activities will be conducted in support of geotechnical analysis, existing landfill cover surveys, monitoring well and piezometer installation, and soil sampling activities. Hand-auger samples will be collected from areas of the site that require shallow soil sampling or descriptions of the subsurface that may be inaccessible to direct-push or hollow-stem auger drill rigs.

1. Materials and Equipment

The following is a list of materials and/or equipment necessary to carry out the procedures contained in this SOP:

- Spade/shovel or bucket-auger with rod and handle attachments
- Concrete coring equipment
- Boring and daily field logs
- Digital camera or iPad
- Measuring tape or ruler
- Empty jars for texture analysis of soil
- Aluminum foil to cover jars to conduct headspace readings of soil
- Decontamination materials consisting of clean potable and distilled water, brushes, and non-phosphate detergent (solvents, nitric acid solution, laboratory-grade detergent, and rinse waters used to clean equipment cannot be reused)
- Fill materials (such as Portland cement grout) to properly seal or abandon the borehole
- Site-specific health and safety plan (HASP)
- Personal protective equipment, as specified by the HASP
- Air monitoring/photoionization detector or lower explosive limit meter, if deemed necessary by the HASP

2. Procedures

The target completion depth will be based on field observations and sample analysis (i.e., the purpose of the boring). In the event that refusal is encountered before a boring is completed to the target depth, the boring location may be offset approximately 5 to 10 feet from the original location, and a second attempt will be made to reach the target depth. If auger refusal is encountered at the initial offset

location, the project manager will determine whether to make additional attempts to complete the boring.

Soil samples will be collected continuously from the ground surface to the final depth of each boring using hand auger methods. Descriptions of the soil samples will be logged in the field, and observations recorded on a daily field log. Soil samples may be screened in the field with an organic vapor analyzer (e.g., a photoionization detector).

If soil samples are collected, each sample will be properly labeled and immediately placed in a cooler with ice or ice packs to maintain the proper temperature for shipping samples to the laboratory. Samples will be labeled, documented on a chain-of-custody form, and handled/transported in accordance with the proper sample handling requirements.

Upon completion of each soil boring, the boring may be backfilled with soil cuttings or with a cement or bentonite mixture, depending on county or city requirements. The surface of the borehole will be completed to match existing surface conditions.

3. Documentation

The details of the boring and sampling operations will be recorded on boring logs and/or daily field logs. Any deviations from this SOP, and the reason for the deviation, shall be documented.

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Standard Operating Procedure 509-23-00

Soil Boring Installation and Sampling Using Direct-Push Drilling

This Standard Operating Procedure (SOP) defines and standardizes procedures to advance direct-push samplers into unconsolidated material to install small-diameter monitoring wells, injection points, or soil-gas probes, or to collect soil samples for chemical and geotechnical analyses. Direct-push samples will be collected from areas that do not require installation of a large-diameter monitoring well and that are accessible to either a track- or truck-mounted drill rig.

1. Materials and Equipment

The drilling contractor will provide equipment capable of advancing direct-push samplers to required depths. In addition, the drilling contractor may be requested to bring the following equipment:

- Drive rods/Macrocore and/or Dual Tube Sampling System
- Concrete coring equipment
- Liner splitter or utility knife (for opening liners) and stainless-steel sampling knives for collecting soil samples
- Single-use acetate sample collection liners
- Decontamination materials consisting of clean potable and distilled water, a steam cleaner, brushes, and non-phosphate detergent (solvents, nitric acid solution, laboratory-grade detergent, and rinse waters used to clean equipment cannot be reused)
- Fill materials (such as Portland cement grout) to properly seal or abandon the borehole

In addition to the equipment provided by the drillers, the following materials and/or equipment will be required to carry out the procedures contained in this SOP:

- Boring and daily field log sheets
- Applicable permits and agreements (i.e., soil boring permits, encroachment permits, access agreements, etc.)
- Digital camera or iPad
- Measuring tape or ruler
- Empty jars for texture analysis of the soil
- Aluminum foil to cover jars to conduct headspace readings of soil
- Munsell color chart

- Site-specific health and safety plan (HASP)
- Personal protective equipment as specified by the HASP
- Air monitoring/photoionization detector (PID) or lower explosive limit meter, if deemed necessary by the HASP

If samples are to be collected for laboratory analysis, the following items will be necessary to properly conduct soil sampling:

- Ice and cooler
- Sample containers
- Sample labels
- Chain-of-custody form

2. Procedures

Soil boring completion depths will be based on field observations and sample analysis (i.e., the purpose of the boring). In the event that refusal is encountered before a boring is completed to a target depth, the boring location may be offset approximately 5 to 10 feet from the original location, and a second attempt may be made to complete the boring after consulting with the project manager and if the off-set location has been cleared of utilities. If refusal is encountered at the initial offset location, it is up to the project manager whether to make additional attempts to complete the boring.

The dual tube sampling system allows soil sampling to progress while simultaneously casing off the borehole. This prevents cave-in and reduces the potential to drag down contaminants from upper zones. Direct push can be conducted without the dual tube sampling system; however, the macrocore method should be conducted with caution to prevent cross-contamination.

Insert a clean acetate liner into the decontaminated sampler. Attach the sampler to the drive head on the direct-push drilling rig and hydraulically push/drive to the desired depth (generally, the samplers are pushed in 2- or 4-foot intervals). Pull the sampler from the boring using the drilling rig, open and remove the acetate liner.

The acetate liner is usually easy to remove from the sampler, but occasionally, especially when drilling through fill material or granular soils, sand or fine gravel particles may become wedged between the liner and the inside surface of the sampler, making removal of the acetate liner and sampler difficult. If this occurs, the best way to remove the acetate liner is to gently tap the sampler and pull the acetate liner from the sampler with pliers. Attempting to push the acetate liner and sample out of the macro-core with a drive rod or similar object may deform or cross-contaminate the soil sample.

The acetate liners are to be opened by placing them on a level, stable surface, and cutting them lengthwise with a splitter or utility knife. Two cuts should be made so that the upper half of the liner can be removed for logging and soil sampling while the lower portion of the liner remains in place to protect the soil sample from cross-contamination.

The boring is advanced by adding sections of drive rods to the sampler and retrieving the sampler after each sample is collected. A sampler with a new acetate liner shall be used for each consecutive sample; decontamination of the drive rods between samples is not necessary. Most samplers are equipped with

a tip which helps prevent the introduction of material from the sides of the open boring, caved materials, or heaved materials into the sampler. The tip is sometimes referred to as a “piston tip” and is usually retrievable (the tip is pushed to the top of the inside of the acetate liner as the sample is collected). The tip shall be used for each sample interval except for the initial (ground surface) sample. Please note that use of the tips will not necessarily prevent the inclusion of caved or heaved soil at the top of the samples; therefore, careful inspection and description of the soil sample is very important.

If an obstruction is encountered which cannot be penetrated during drilling, the direct-push boring will be decommissioned as described in Section 2.2 below. Any unused soil samples or waste material (including acetate liners and sampling gloves) will be properly stored. At the discretion of the project manager, soil may be separated from other waste materials such as liners, gloves, etc. The segregated soil may be stored in drums, bins, or covered with plastic.

2.1 Soil Logging

The following soil logging procedures shall be followed when using direct-push methods:

1. Generally, assume (unless there is a technically defensible reason to believe otherwise) that the top of the soil sample in the acetate liner corresponds to the top of the sample interval. For example, if sampling from 4.0 to 8.0 feet and 2.5 feet of soil sample is recovered, the length of soil recovered is from 4.0 to 6.5 feet. If this is not an adequate length or volume of soil for sampling purposes, consult the project manager as to whether the installation of an offset boring to collect additional soil sample(s) is appropriate. Note the soil column may be compressed by the advancement of the sampling equipment, especially in soft, moist, fine-grained soils. If not observed directly by the logger, always instruct the driller to indicate which end of the acetate liner is the top of the sample for reference.
2. After each direct-push sample is retrieved, the total depth of the boring and possible water level should be checked with a weighted tape measure, water level indicator, or an interface probe. Measuring the total depth will evaluate the amount of boring cave or heave and help determine what portion of the next sample may be caved or heaved material as opposed to in-place soil. This heaving and caving problem is minimized by the dual-tube sampling system. Evaluating the presence and depth to groundwater is important because partial soil sample recovery may preclude the observation and description of wet or saturated soil intervals. Furthermore, the identification of the uppermost saturated zone is critical to the selection of soil samples for chemical analyses.
3. Before filling soil sample jars, split the entire sample lengthwise with a decontaminated knife to evaluate what portion of the sample may be caved materials or boring heave. Clayey soils, especially those at depths below 12 feet, may tend to swell inward after the sampler is removed. When the sampler is inserted into the boring to collect the next consecutive sample, swelled clay from the sides of the boring may collect in the sampler. This material may appear to be in-place soil when the acetate liner is opened. (Note: swelled clayey soils, caved materials, or heave may enter the sampler even if a tip is used.)

Description of soil samples will be logged in the field and observations recorded on soil boring and daily field logs prepared by the field representative. Soil samples may be screened in the field with an organic vapor analyzer (e.g., a PID).

If soil samples are collected, each will be properly labeled and immediately placed in a cooler with ice or ice packs to maintain the proper temperature for shipping samples to the laboratory. Samples will be labeled, documented on a chain-of-custody form and handled/transported to the laboratory in accordance with the proper sample handling requirements.

2.2 Decommissioning the Boring

Direct-push borings will be decommissioned in accordance with city or county permit requirements. If granular or bentonite chips are used, the dry bentonite will be slowly poured into the boring and hydrated with potable water as it is installed. If a cement grout slurry is used, tremie pipes will be used if groundwater was encountered in the borehole. The surface of the borehole will be completed to match existing surface conditions.

3. Documentation

The details of the boring and sampling operations will be recorded on boring logs and/or daily field logs. Any deviations from this SOP and the reason for the deviation shall be documented.

4. Special Notes

Air monitoring may be deemed necessary by the site-specific HASP. The HASP should establish action level protocols for the contaminants of concern if encountered during air monitoring activities. To monitor fire and explosive hazards, a lower explosive limit meter and a PID could be used in conjunction to monitor the air in the vicinity of the operator's breathing space during drilling activities.

The following site characteristics and circumstances may prevent the use of direct-push technology:

1. Shallow soils with coarse gravel, cobbles, or boulders which may be difficult to penetrate;
2. Loose, saturated granular soils or soft, wet silty soils which are not retained well by the sampler (i.e., very poor sample recovery);
3. Limited access to specific sampling locations; and
4. Required sampling depths that may exceed the practical use of direct-push equipment.

terraphase engineering

Standard Operating Procedure 601-23-00

Surface Water Sampling

This Standard Operating Procedure (SOP) defines and standardizes procedures to collect and prepare surface water samples for field screening or laboratory analysis. Strict adherence to these procedures shall help promote consistency in project sampling and ensure sample integrity.

1. Materials and Equipment



The following is a list of materials and/or equipment necessary to carry out the procedures contained in this SOP:

- Meters, probes, and standards for in-situ measurements
- Appropriate quality control blanks (the type and number of blanks should be established with the project manager)
- Sample containers
- Waders, personal floatation device (as appropriate)
- Flat-bottom boat (if necessary)
- Personal protective equipment
- iPad for photos and field notes
- GPS unit
- A site-specific health and safety plan

2. Sampling Procedures

The following procedures shall be adhered to for the collection and preparation of all surface water samples. During each surface water sampling event, the collection of samples will begin at the downstream sampling locations and proceed progressively to the upstream locations. The designated sampling order (i.e., from downstream to upstream locations) will reduce the potential for cross-contamination of samples and excessive sediment in the water sample.

At each surface water sampling location where a sediment sample will also be collected, the surface water sample will be collected prior to collecting the sediment sample. The location of the sampling station should be identified in the field and on the site map and marked using a GPS receiver. The general location relative to permanent landmarks should also be recorded in a logbook or on an iPad and the location marked in the field where appropriate.

At each location, the following water quality parameters will be measured in the field: dissolved oxygen, specific conductivity, temperature, salinity, and pH. Measurements should be made approximately mid-depth in the water column.

Water quality measurements will be made using a YSI pro DSS meter (or equivalent). Calibration of the meter will be completed following the instrument manufacturer calibration protocols. Measurements should be obtained in situ when possible, otherwise measurements can be obtained by immersing the instrument probes in a container filled with water from each sampling location. The container used for field measurements will be decontaminated between sampling locations by rinsing the container three times with water obtained at the new sampling location prior to collecting the field measurements.

Samples will be obtained from one-half the stream depth at mid-channel, and at arm's length upstream of the torso of sampling personnel. The sample bottle shall be inverted, and lowered to one-half the water depth, and held at about a 45-degree angle with the mouth of the bottle facing upstream. Precautions should be taken to ensure that the sample collected is representative of the water body or conveyance.

Sampling personnel shall not collect turbid or sediment-containing water, which could bias the sample results. If a laboratory-supplied sample container contains a preservative added at the laboratory, then the sample will be collected from the water column using a new, clean glass container to collect the sample and transfer it into the laboratory-preserved container.

Sampling containers and appropriate preservatives are based on the analyses to be performed on each sample. Appropriate sample containers will be used for the analyses to be performed on each sample collected.

3. Equipment Selection

The following equipment may be considered for surface water sampling:

- **Dipping using a sample container:**
  - If the surface water is accessible by wading or other means, a sample may be collected directly in the sample container.
  - The sampler should face upstream and not disturb the bottom sediment.
  - If a sample bottle contains a preservative, another method must be used to fill the container so as not to displace the preservative.
- **Scoops:**
  - Stainless-steel scoops are useful for reaching out into a body of water to collect a surface water sample.
  - The scoop can be used by itself or with an extension to collect and transfer a surface water sample to the sample container.
- **Peristaltic Pumps:**
  - Peristaltic pumps can be used to sample a water column such as a shallow pond or stream.

  - Discrete samples can be collected at various depths of the water column or a vertical composite may be collected by moving the tube intake at a constant rate vertically up and down the water column over the composited interval.
  - See the U.S. Environmental Protection Agency Science and Ecosystem Support Division's (SESD) *Operating Procedures: Surface Water Sampling* (2013) if volatile organic compound sample collection is needed.
- **Discrete Depth Samplers:** When discrete samples are required from a specific depth, use a Kemmerer or Van Dorn sampler depending on the sampling needs.
- **Bailers:** Teflon bailers can be used for surface water samples if a discrete interval in the water column is not necessary. This technique may not be successful where strong currents are found.
- **Buckets:** Plastic buckets can be used to collect samples for water-quality parameter measurement when:
  - The water depth is too great for wading, it is not feasible to deploy a boat, or access is not possible, and the water column is well mixed.
  - The water body is usually accessed by a bridge and upon retrieval the water is poured into appropriate sample containers. **Caution should be exercised, and appropriate safety measures taken, if sampling from a bridge.**
- **Submersible Pumps:** Submersible pumps can collect surface water samples directly into a sample container. Consider constituents of interest when choosing the type of submersible pump and tubing to be used. See SESD's *Operating Procedures: Surface Water Sampling* for more information on this method.
- **Automatic Samplers:**
  - When unattended sampling is required (e.g., storm-event sampling, time-of-travel studies), an automatic sampler may be used. The automatic sampling device may be used to collect grab samples based on time, in-stream flow, or water level or used to collect composite samples as dictated by the study data needs.
  - The automatic sampling device should be calibrated prior to deployment to ensure the proper volume is collected. Consult the manufacturer's instruction manual for proper automatic sampler operation.
- **Trace level Mercury Sampling:** See SESD's *Operating Procedures: Surface Water Sampling*.

4. Sampling Precautions and Sample Handling and Preservation Requirements

Special precautions for surface water sampling include the following:

- A clean pair of new disposable gloves will be worn each time a different location is sampled and changed if their cleanliness is compromised.
- All background or control samples should be collected and placed in separate ice chests from waste or contaminated samples.

- Sample collection should progress from the least suspected contaminated area to the most suspected contaminated area.
- Samplers must document and photograph the condition of all samples.
- Samples should be custody sealed during long-term storage or shipment.
- Samplers must use new, verified, and certified clean.

Sample handling and preservation requirements include the following:

- Collect surface water samples by directly filling sample container from the surface water body or by decanting the water from a collection device such as a stainless-steel scoop, zip-top bag, disposable pipet, etc.
- Ensure collection device does not come in contact with the sample containers.
- Place samples into appropriate, labeled containers.
- Samples requiring reduced temperature storage should be placed on ice immediately.

5. Reference

Decker and Simmons, U.S. Environmental Protection Agency: Science and Ecosystem Support Division (SESD). 2013. *Operating Procedure: Surface Water Sampling*. February 28.

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STANDARD OPERATING PROCEDURE
Slug Test

1.0 PERFORMANCE OBJECTIVE

The purpose of this Standard Operating Procedure (SOP) is to describe the procedures that will be followed when conducting a slug test. During a slug test the water level in a well is changed rapidly, and the rate of water-level response to that change is measured. From these data, an estimate of hydraulic conductivity can be calculated using appropriate analytical methods. A slug test requires a rapid ("instantaneous") water-level change and measurement of the water-level response. A rapid change in water level can be induced in many ways, including injecting or withdrawing water, increasing or decreasing air pressure in the well casing, or adding an inert device of known volume, such a plastic rod, to displace water. The water-level changes can be measured at high frequency using submersible pressure transducers. The preferred method is to use an inert rod, as this is conducive to both the falling and rising head tests. If physical constraints such as borehole size or a limited height of the water column prevent using a rod, the secondary preference is to introduce de-ionized water and observe its dispersion to equilibrium water level conditions.

2.0 EQUIPMENT AND MATERIALS

The following is a list of equipment necessary to carry out the procedures contained in this SOP, depending on the project requirements and site conditions:

- Well keys
- Bolt cutters and extra locks
- Water level indicator (decontaminated)
- Assorted tools, such as a knife and screwdriver
- 12-volt battery or cigarette lighter plug for recharging the laptop
- Pressure transducer capable of recording water level measurements at least once every second, with a pressure rated suited for its installation depth
- Laptop computer with pre-installed software to communicate with the pressure transducer
- Decontaminated slug of known volume
- Deionized water (At least 1 gallon per well)
- String
- Graduated cylinder or other water measurement device
- Plastic squeeze bottles filled with deionized water and non-phosphate detergent for decontamination
- Paper towels or other chemically clean wipes such as Kimwipes
- Calculator
- Stopwatch
- Well construction information

- Well boring logs (if possible)
- Field sheets
- Permanent/indelible black ink pens
- Waterproof and permanent marker
- 5-gallon buckets for assisting with decontamination
- Appropriate health and safety equipment as specified in the Health and Safety Plan (HASP)
- Appropriate decontamination equipment as specified in the standard operating procedure (SOP) for sampling equipment decontamination

3.0 PROCEDURES – SLUG ROD

3.1 Instrument Calibration

Before going into the field, verify that field instruments are operating properly. Ensure that the pressure transducer pressure sensor and depth-to-water meter respond when submerged in water.

3.2 Preliminary Steps

1. Decontaminate the slug and depth-to-water meter following the procedures specified in the SOP for sampling equipment decontamination.

2. Measure the total depth of the well following the procedures specified in the SOP for water level measurements.

3. Measure the water level in the well following the procedures specified in the SOP for water level measurements. This should be repeated at the end of the test for long duration slug tests. The column of water in the well should be long enough to cover the transducer and the slug.

4. Document the static water level, well diameter, well depth, and screened interval in field notebook. The diameter of the hole, nature of filter pack, and type of screen also are documented, if known.

5. Place the transducer in the well below the level at which the slug will be submerged, but not so low that the range of transducer might be exceeded at the highest anticipated water level. Secure the transducer in place. The transducer should not move during the test.

6. Measure (estimate) the maximum length of slug line that will be used. This length should allow the slug to completely submerge, about 1 ft below water surface.

7. Allow the transducer to adjust to the new pressure and temperature following manufacturer's guidance. This also provides time for the water level to recover prior to the test.

3.3 Falling Head Test

1. Lower the clean, decontaminated slug to a point just above the water level and secure it in place. Take care not to move or kink the transducer line.

2. Prepare the data logger. The data logger should be set to record data as frequently as possible during the first minutes of the test, and it can be set to record less frequently during later time. Recording in seconds on a logarithmic time scale meets this objective.

3. Establish a starting water level for the transducer and data logger. Data analysis is based on the change in water level rather than a comparison to a standard datum. The transducer starting water level can be set to zero, a value equal to the head of water above the transducer, or any other value.

4. Begin the test by starting the data logger and then submerging the slug quickly but gently into the water to minimize disturbance at the water surface or movement of the transducer cable. Secure the slug cord to maintain its position below the water level.

5. After 1 minute and periodically thereafter, check the status of the water-level reading by collecting manual depth to water measurements, or collecting an instantaneous reading from the pressure transducer.

6. When the water level is equal to the initial water level, or when readings change less than 0.01 ft per 10 minutes, stop the test. This is the end of the falling head, or slug in test. You are now ready to begin the rising head, or slug out test.

3.4 Rising Head Test

1. Establish a starting water level for the transducer and data logger. Data analysis is based on the change in water level rather than a comparison to a standard datum. The transducer starting water level can be set to zero, a value equal to the head of water above the transducer, or any other value.

2. Prepare the data logger. The data logger should be set to record data as frequently as possible during the first minutes of the test, and it can be set to record less frequently during later time. Recording in seconds on a logarithmic time scale meets this objective.

3. Begin the test by starting the data logger and nearly simultaneously withdrawing the slug quickly but gently from the water to minimize disturbance at the water surface or movement of the transducer cable. The slug need not be withdrawn completely out of the well, but should be out of the water. Secure the slug cord to the wooden rod to maintain its position above the water level.

4. After 1 minute and periodically thereafter, check the status of the water-level reading with the data logger/transducer or with a measuring tape.

5. When the water level is equal to the initial water level, or when readings change less than 0.01 ft per 10 minutes, stop the test. This is the end of the rising head, or slug out test.

3.5 Falling Head Test – Water

If the well is constructed such that a solid slug cannot be placed in the well, or if the column of water is not long enough to accommodate a transducer and a slug, the following procedure will be implemented following the preliminary steps (Section 3.3), as applicable.

1. Use graduated cylinders or other measuring devices to measure the volume of water to produce a 3-foot rise in water level. For a 2-inch wells, this volume is 0.486 gallons or 1,840 milliliters.

2. Prepare the data logger. The data logger should be set to record data as frequently as possible during the first minutes of the test, and it can be set to record less frequently during later time. Recording in seconds on a logarithmic time scale meets this objective.

3. Establish a starting water level for the transducer and data logger. Data analysis is based on the change in water level rather than a comparison to a standard datum. The transducer starting water level can be set to zero, a value equal to the head of water above the transducer, or any other value.

4. Begin the test by starting the data logger and rapidly pour the measured water into the well, trying to pour evenly in the center of the well to prevent water accumulating on the sides of the PVC.

5. After 1 minute and periodically thereafter, check the status of the water-level reading by collecting manual depth to water measurements, or collecting an instantaneous reading from the pressure transducer.

6. When the water level is equal to the initial water level, or when readings change less than 0.01 ft per 10 minutes, stop the test.

3.6 Final Steps (all tests)

1. Upload the data from the pressure transducer and evaluate it by ensuring that the measured pressures decrease (for the falling head test) or increase (for the rising head test) throughout the test.

2. Repeat the entire procedure at least once as time permits, so two complete sets of tests have been conducted.

4.0 DOCUMENTATION

The following information for groundwater sampling is included in the field logbook and/or a Slug Test data form (Exhibit 2):

- Date
- Time
- Weather
- Personnel on site
- Site location description
- General observations
- Well designation and well location
- Condition of the well
- Initial static water level and total well depth
- Calculations (e.g., calculation of column height above transducer)
- Water level during the test and following the test
- Any irregularities or problems that may have a bearing on sampling quality
- Unusual events
- Visitors to the site

All entries in the field logbook must be printed in black ink and legible.

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STANDARD OPERATING PROCEDURE
Pressure Transducer Installation and Monitoring

1.0 PERFORMANCE OBJECTIVE

The purpose of this Standard Operating Procedure (SOP) document is to describe the procedures that shall be used when installing and monitoring a pressure transducer in monitoring wells and surface water at a specific depth to determine ground water and surface water elevations and provide data for aquifer testing. There are various models of pressure transducers, and this SOP will attempt to give a brief introduction to the most commonly used models.

This SOP describes the protocol to be followed during the installation and monitoring of pressure transducers in monitoring wells and surface water.

2.0 EQUIPMENT AND MATERIALS

The following is a list of equipment necessary to carry out the procedures contained in this SOP:

- Pressure transducer;
- Laptop with model-specific pressure transducer software installed;
- Pressure transducer model-specific user manual
- Communication cables for programming the device/downloading the logged data;
- Vented cable for vented transducers;
- Stainless-steel wire;
- PVC pipe;
- Water level sounder
- Site-specific Work Plan
- Site-specific Health & Safety Plan (HASP);
- Well construction details.
- Pliers, socket set, and basic toolbox

3.0 PROCEDURES

3.1 Transducer Model Selection and Setup

The Work Plan should specify all construction details and materials for the transducer setup, as well as monitoring well construction details (Figure 1), groundwater depths, and objectives. These details should be reviewed by the field staff prior to installation activities. Field staff should take time to familiarize themselves with the specific transducer model, user manual, and the transducer-specific software. Software needs to be downloaded, and time should be taken to learn the software before field operations commence. Using the provided software, setup the transducer to log the necessary data in the appropriate time intervals determined in the Work

Plan. Depending on the software, also enter in site specific details such as project name and site location.

3.2 Transducer Field Installation

3.2.1 Installation in Groundwater Monitoring Wells

For installation in groundwater monitoring wells, well logs, historic groundwater data, and tidal charts (if applicable) will be reviewed to understand variations in depth to groundwater. At each monitoring point the transducer will be placed so a minimum of one foot of water will be present above the transducer at all times. Refer to the user manual for maximum depths transducers may be safely submerged. Transducers must be slowly lowered into water so as to not damage the sensors. Air bubbles attached to the transducer can hinder data reliability, so it is a good idea to gently raise and lower the transducer a few times once you have reached the desired depth in an effort to dislodge any bubbles. The transducer cable will be affixed to a solid object on the surface of the well (Figure 2), with care being taken to not kink or bend the venting tube on vented transducers. A manual depth-to-water measurement will be recorded to ensure proper transducer calibration, as well as a depth to transducer measurement.

3.2.2 Installation in Surface Water

For installation in surface water, the Work Plan and any tidal charts (if applicable) will be reviewed. A polyvinyl chloride (PVC) pipe will be secured so that the bottom of the pipe extends to a depth of at least two feet below the lowest expected water level during the monitoring period. The pipe should be firmly affixed to an object such that it does not move with tide or wave action. A pressure transducer will be placed at least one foot above the bottom of the pipe. The top of the PVC pipe will be surveyed to provide a reference for tidal elevation data.

3.2.3 Calibration

Calibration is only required if monitoring for electrical conductivity. Refer to the model-specific user manual for electrical conductivity calibration procedures.

3.3 Transducer Monitoring and Data Upload

The interpretation of pressure transducer data requires several corrections, depending on the type of measurement and the nature of the aquifer. Corrections are generally needed for fluctuations in barometric pressure and groundwater density. If using vented pressure transducers, they will automatically compensate for changes in barometric pressure. TDS will be measured, and adjustments will be made to correct groundwater elevations to equivalent freshwater values.

The equivalent freshwater head was defined by Lusczynski (1961) as:

$$h_{fw} = \gamma h_m + (1 - \gamma) z$$

where:

$$\gamma = specific\ gravity\ of\ the\ groundwater$$

$$h_m = measured\ head$$

$$z = elevation\ of\ the\ middle\ of\ the\ well\ screen$$

The specific gravity of groundwater is based on TDS content, using an empirical equation for groundwater density developed by de Marsily (1986):

$$\rho = 0.000687 C_{TDS} + 998.4575$$

where:

$$\rho = groundwater\ density\ (kg\ /m^3)$$

$$C_{TDS} = TDS\ content(mg\ /l)$$

Only the initial measurement will need to be adjusted because all measurements will be normalized to the initial manual groundwater level measurement. Some pressure transducers (such as the Aqua TROLL 200) will have the option to manually enter into the software the field-recorded TDS, therefore correcting any density differences before finalizing data.

Pressure transducers will be monitored at Work Plan-specific time intervals. Transducer cables will be plugged into a laptop via USB, and the appropriate software will be utilized to record water depth and other project-specific data (i.e. electrical conductivity). At this time, manual depth to water measurements should be taken to ensure proper transducer calibration.

4.0 DOCUMENTATION

A weekly transducer log (attached) will be filled in at the time of installation and each week as the transducers are monitored.

5.0 SPECIAL NOTES

The attached Figure 1 shows an example of a typical monitoring well construction diagram. Figure 2 shows an image of a typical transducer cable (vented transducer shown) and a diagram showing a transducer installed inside a typical monitoring well.

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Figure 1:
TYPICAL FLUSH-MOUNT GROUNDWATER MONITORING WELL CONSTRUCTION DIAGRAM

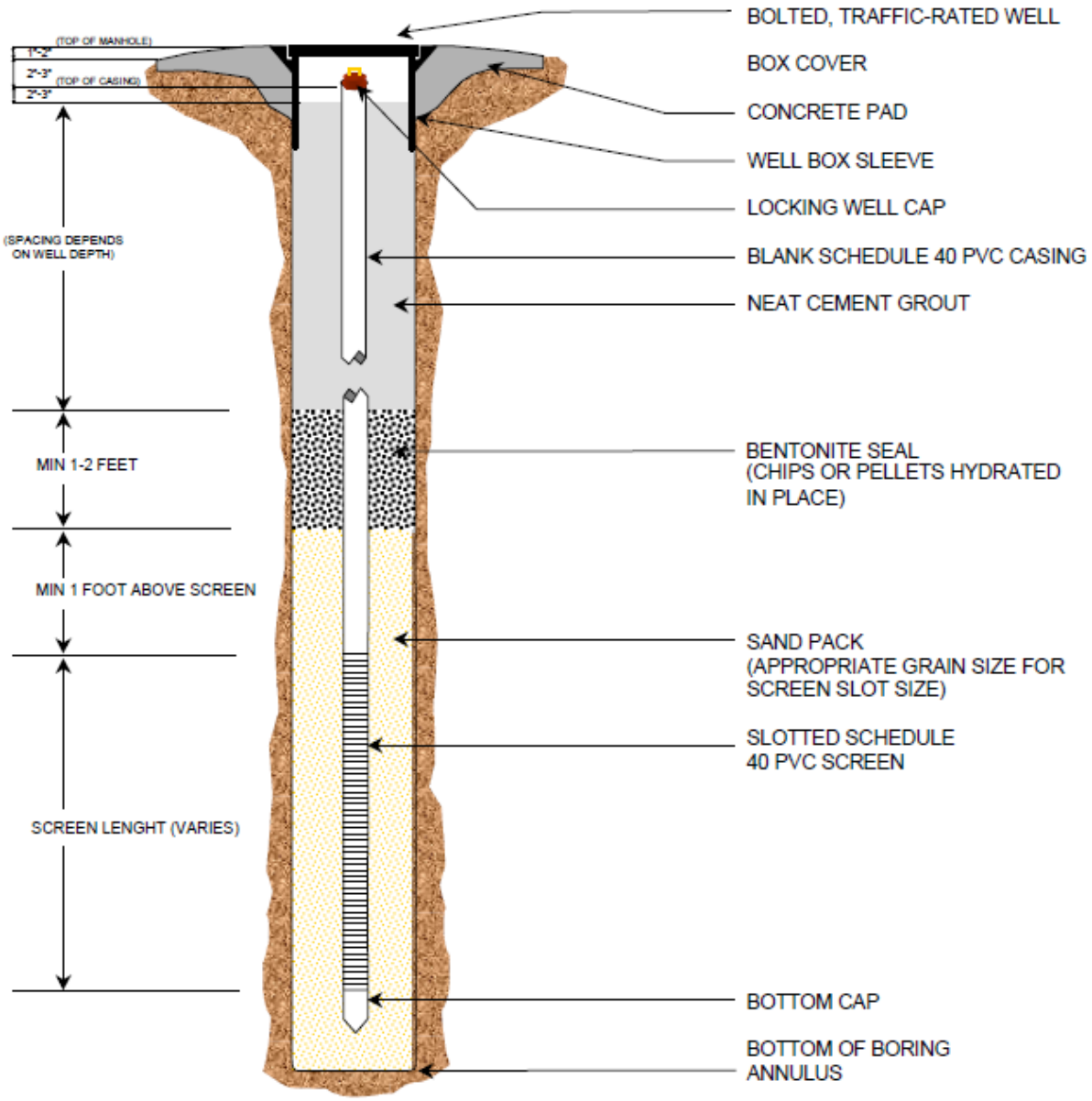


Figure 2: Transducer cable (left) and typical transducer well install (right).



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Weekly Transducer Log – MW-___

Date	Time	Battery Level (%)	Temp (°C)	Electrical Conductivity (µS/cm)	Pressure (psi)	DTW (ft BTOC)	Water Column Thickness*	Transducer Depth This Week**	Transducer Depth from last week	Difference	Percent Difference ***

* = pressure*2.307 (if reading psi)

** = Water Column Thickness + DTW

*** = |((difference)/(mean depth))|*100

Barometric unit	Water column equivalent (ft)	Water column equivalent (m)
1 psi	2.30666	0.70307
1 kPa	0.334553	0.101972
1 mbar	0.0334553	0.0101972

Appendix D

Quality Assurance Project Plan

DRAFT

Quality Assurance Project Plan

Love's Travel Stop 413, 1512 Highway 97, Ellensburg, Washington 98926

Prepared for

Washington Department of Ecology Agreed DE 22455
On Behalf of Chris Weldon
Love's Travel Stops and Country Stores
10601 North Pennsylvania Avenue
Oklahoma City, Oklahoma 73120

Prepared by

Terraphase Engineering Inc.
2105 South C Street
Tacoma, Washington 98402

June 16, 2025

Project Number W053.001.003

This document is a draft and the information contained herein is subject to change. It will not be relied upon; consult the final document.

File: QAPP-Loves #413 Ellensburg-W053-001-003

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A Laboratory Standard Operating Procedures and Quality Assurance Manuals
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Acronyms and Abbreviations

°C	degrees Celsius
%D	percent difference
%R	percent recovery
%RSD	percent relative standard deviation
µg/L	micrograms per liter
Alliance	Alliance Technical Group, LLC
Client	Love's Travel Stops and Country Stores
DBMS	database management system
DQO	data quality objective
DSR	duplicate sample result
DUP	field duplicate sample identifier
EB	equipment blank sample identifier
Ecology	Washington State Department of Ecology
EDD	electronic data deliverable
EPA	Environmental Protection Agency
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
Love's	Love's Travel Stops and Country Stores
MDL	method detection limit
MS	matrix spike
MSD	matrix spike duplicate
MTCA	Model Toxics Control Act
OSR	original sample result
PAHs	polycyclic aromatic hydrocarbons
PID	photoionization detector
QA	quality assurance
QAO	Quality Assurance Officer
QC	quality control
QAM	*Quality Assurance Manual*
QAPP	*Quality Assurance Project Plan*
RL	reporting limit
RPD	relative percent differences
S	standard deviation
SAP	*Sampling and Analysis Plan*

SOP	standard operating procedure
SR	sample result
TB	trip blank sample identifier
TPH	total petroleum hydrocarbons
TPH-d	total petroleum hydrocarbons in the diesel range
TPH-g	total petroleum hydrocarbons in the gasoline range
TPH-o	total petroleum hydrocarbons in the oil range
Site	Love's Travel Stops Store No. 413 at 1512 Highway 97 in Ellensburg, Washington
Terraphase	Terraphase Engineering Inc.
VOC	volatile organic compound

Signatures

Plan Title: Quality Assurance Project Plan, Remedial Investigation, Love's Travel Stop #413, Ellensburg, Washington

Organization(s) Implementing the Project: Love's Travel Stops and Country Stores (Love's)

Effective Date: June 11, 2025

Approvals:

Terraphase Project Manager:

DRAFT

Max Wills, LHg, CWRE — Date
Terraphase Engineering Inc.

Terraphase Quality Assurance Officer:

DRAFT

John Hildenbrand — Date
Terraphase Engineering Inc.

Ecology Project Manager:

DRAFT

Valerie Bound — Date
Toxics Cleanup Program
Central Regional Office
Washington State Department of Ecology

1 Introduction

This *Quality Assurance Project Plan* (QAPP) has been prepared by Terraphase Engineering Inc. (Terraphase), on behalf of Love's Travel Stops and Country Stores (Love's or Client), pursuant to the remedial investigation at the Love's Travel Stops Store No. 413 at 1512 Highway 97 in Ellensburg, Washington (the "Site"; Figure 1).

The QAPP provides overall quality assurance (QA) guidance, sampling and analysis requirements, and evaluation and assessment protocols for the remedial investigation at the Site. Remedial investigation activities include (but are not limited to) the sampling and analysis of groundwater, soil, soil vapor, and indoor air at the Site to define the nature and extent of contamination. Data collected as part of the remedial investigation will be used to develop the best alternatives for Site cleanup. This QAPP also applies to other sampling that may occur at the Site, both voluntarily and in response to agency directives.

The environmental sampling tasks addressed or referenced in this QAPP include the following:

- Collection of soil samples to assess concentrations of total petroleum hydrocarbons (TPH) in the gasoline, diesel, and oil ranges (TPH-g, TPH-d, TPH-o, respectively), Model Toxics Contral Act (MTCA) volatile organic compounds (VOCs), lead, and polycyclic aromatic hydrocarbons (PAHs) in soil.
- Collection of indoor air, soil vapor, and sub-slab soil vapor samples to assess concentrations of aromatic and aliphatic TPH, MTCA VOCs, and naphthalene, determine the risk of vapor intrusion to buildings potentially impacted by Site-related contamination, and develop an estimate of attenuation rates.
- Collection of groundwater samples to assess concentrations of TPH-g, TPH-d, TPH-o, MTCA VOCs, total and dissolved lead, and PAHs in groundwater.
- Collection of sediment and surface water samples to assess the potential for ecological impacts from Site-related contamination of TPH-g, TPH-d, TPH-o, MTCA VOCs, and PAHs.
- Quarterly groundwater monitoring for a minimum of four quarters. Groundwater samples will be analyzed for TPH-g, TPH-d, TPH-o, MTCA VOCs, total and dissolved lead,[1] and PAHs each quarter.

The specific objective of the QAPP is to generate data that is scientifically sound, representative, comparable, defensible, and of known quality that is sufficient to meet the investigation objectives and support the decision-making process.

This QAPP presents the organization, objectives, functional activities, and general QA/quality control (QC) activities associated with the collection and laboratory analysis of environmental samples. Laboratory QA/QC is a comprehensive program used to define and document the quality of analytical data. QA involves planning, implementation, assessment, reporting, and quality improvement to establish the reliability of laboratory data. QC procedures are the tools used to achieve this reliability.

[1] Total and dissolved lead will be analyzed in the first monitoring event. If present above MTCA Method A cleanup levels, total/dissolved lead will be added as a regularly monitored analyte.

This QAPP defines how QA and QC are applied to the environmental activities at the Site to assure that the type and quality of data generated meet project needs.

QA/QC procedures described in this QAPP are in accordance with applicable professional technical standards and Washington State Department of Ecology (Ecology) requirements.

The following topics are addressed in this QAPP:

- Project description and background
- Data quality objectives and criteria
- Project organization and responsibilities
- Sampling design and procedure
- Field instrumentation and inspection of supplies
- Sample handing and custody
- Laboratory sample storage and handling
- Analytical method requirements, target analytes and regulatory criteria
- Laboratory, field QA/QC, and data assessment procedures
- Data review
- Data deliverables and data management
- Data validation and usability
- Project reporting

In conjunction with this QAPP, which provides applicable general procedures, laboratory standard operating procedures (SOPs), screening levels, assessment procedures and performance standards, and corrective measures to support the QA program for sampling, project-specific work plans have been prepared and used to document specific procedures for Site sampling activities.

The *Remedial Investigation Work Plan* (Work Plan [Terraphase 2025]) will be used for the sampling program following agency-approval.

2 Project Description and Background

This section provides a summary of the Site description, project scope, laboratory analytical methods, and data validation and associated documentation. Additional information is presented in the Work Plan.

2.1 Site Description

The 7.67-acre Site is approximately 290 feet northeast of the intersection between the Interstate 90 business spur and U.S. Route 97 and has operated as a fueling facility since 1982. The Site is currently developed as a truck stop, with large parking areas, an approximately 2,800-square-foot commercial

truck fueling island, an approximately 150-square-foot auto fueling island, a commercial truck oil change and tire center, truck scales, and an approximately 5,800-square-foot travel center that includes a convenience store, a Subway restaurant, bathrooms, and showers. A bioswale is present at the northeastern corner of the Site, near Reecer Creek. Gasoline and diesel underground storage tanks (USTs) at the Site are located northeast of the travel center building. Piping conveys fuel from the USTs to the commercial and auto fueling islands via trenches on the north and northeast side of the travel center building.

Several environmental investigations and remedial actions have been performed at the Site since 1995. Additional details are provided in the Work Plan (Terraphase 2025).

2.2 Project Scope

The field investigations detailed in the Work Plan and subsequent investigations will be conducted under the guidance of this QAPP. Details of field investigation activities are described in Section 5 of the Work Plan and the *Sampling Analysis Plan* (SAP; Appendix C of the Work Plan). Field activities include the collection of soil, sediment, surface water, groundwater, soil-vapor, and air samples.

2.3 Laboratory Analysis

Samples will be submitted to Alliance Technical Group, LLC (Alliance) in Seattle, Washington, an Ecology-accredited laboratory, for analysis. Soil-vapor samples will be analyzed for MTCA VOCs naphthalene using U.S. Environmental Protection Agency (EPA) Method TO-15, aliphatic and aromatic TPH fractions using EPA Method TO-15/Massachusetts (MA)-Air-Phase Petroleum Hydrocarbons (APH) Modified, and helium and oxygen using ASTM D1946. Soil and groundwater samples will be analyzed for TPH-g using Method NWTPH-Gx, TPH-d and TPH-o using NWTPH-Dx/Dx extended, MTCA VOCs using EPA Method 8260D, PAHs using EPA Method 8270E, and lead[2] using EPA Method 6020B.

Table 1 presents the analytical methods, sample collection containers and volumes, preservation, holding times and associated QC sample frequency.

The laboratory performing the analyses will be responsible for QC of the reported data reported.

The laboratory will evaluate non-detected results to the method detection limits (MDLs) and report the non-detected results referencing the reporting limit (RL). The RL concentration is established by the lowest standard in the instrument calibration. For the remaining data, results that are less than the RLs but greater than or equal to the MDLs will be reported using the "J" flag (see Section 14.3).

The laboratory will provide sample containers/canisters for the investigation, prepared in accordance with method and laboratory requirements.

The analytical data will be reported in contract laboratory program-like full deliverable format in electronic data format.

[2] Groundwater samples will be analyzed for total and dissolved lead.

2.4 Data Validation

Data validation will be performed in accordance with this QAPP. Full and partial data validation will be performed for the samples collected for the investigation. Terraphase data validators will provide data validation services, with assistance from third-party data validation subcontractors as needed.

Full data validation will be performed for 100 percent of the samples collected for the investigation for each method and matrix.

Data will be evaluated using the QA/QC criteria established in the methods utilized by the laboratory for analysis, the QC requirements, and laboratory established criteria, where applicable.

Data affected by excursions will be qualified using the approach to applying data validation qualifiers listed in the following documents (or the most current guidelines) and professional judgment:

- *National Functional Guidelines for Organic Superfund Methods Data Review* (EPA 2020).
- Hazardous Waste Support Section SOP No. HW-31, "Analysis of Volatile Organic Compounds in Air Contained in Canisters by Method TO-15" (EPA 2014).

Upon request of the data validator, the laboratory will provide additional or supplemental information within 3 working days of the request during the validation process.

The specific data quality requirements (including precision, accuracy, representativeness, completeness, comparability, and sensitivity) will be assessed during data validation.

Data usability with respect to the data quality objectives and data uses will be compared to the project requirements. If the completeness objective of 95 percent is not achieved, samples will be re-collected at the discretion of the Terraphase Project Manager.

2.5 Documentation

Data generated during sampling and analysis activities will be submitted in an electronic data deliverable (EDD) format. Data will be managed in a relational database management system (DBMS). Laboratory analytical data will be provided in EDD format for direct upload into the DBMS. Data validation qualifiers will be entered into the DBMS and checked independently.

Records will be incorporated into the final project files for the samples. The field logs, data packages, and records will be included in the project files, which will be archived by the Terraphase Project Manager for a period of 10 years.

3 Data Quality Objectives and Criteria

The data quality objective (DQO) process comprises the following steps, consistent with guidance presented in the EPA's 2006 *Guidance on Systematic Planning Using the Data Quality Objectives Process*

(EPA QA/G-4). The DQO process establishes the acceptance criteria, which serve as the basis for collecting data of sufficient quality and quantity to support the goals of the project activities.

3.1 DQO Process

The DQO process consists of the following seven iterative steps:

1. **State the Problem.** A remedial investigation and feasibility study is required under MTCA to determine both the lateral and vertical nature and extent of contamination throughout all impacted media and develop the best alternatives for Site cleanup. The current extent of contamination is not fully delineated.
2. **Identify the Goal of the Study.** The activities described in the Work Plan and defined in this QAPP will be utilized to document and fully delineate the contaminants present in groundwater, soil, indoor air, sub-slab, and soil vapor at the Site.
3. **Identify Information Inputs** (the data types that will be required before project decisions can be made). The primary required data types will be analytical results from soil, groundwater, sediment, surface water, indoor air, sub-slab vapor, and soil-vapor samples. These samples will be analyzed for TPH, MTCA VOCs, PAHs, and/or lead.
4. **Define the Boundaries of the Study** (the spatial and temporal features pertinent for decision making). The study includes shallow soil and groundwater at the Site, soil vapor related to soil and groundwater contamination, and potential sediment and surface water contamination in Reecer Creek.
5. **Develop the Analytic Approach** (how will the study results be analyzed and conclusions made from the data). The results will be compared to generic or site-specific cleanup levels to establish the limits of Site-related contamination. If sampling activities do not produce sufficient analytical data to meet project objectives, then additional sample collection may be warranted. The analytical results will be compared to MTCA cleanup levels.

   To meet the DQOs for this project, the analytical results will be sufficient for comparison to the following criteria:

   - **Groundwater and soil samples:** Analytical results will be compared to MTCA Methods A cleanup levels, and to MTCA Method B cleanup levels[3] when MTCA Method A cleanup levels have not been established (Ecology 2024).
   - **Soil-vapor/indoor air samples:** Analytical results will be compared to MTCA Method B cleanup levels (Ecology 2024).
   - **Sediment/surface water:** Analytical results will be compared to MTCA cleanup levels for protection of freshwater aquatic life.
6. **Specify Performance or Acceptance Criteria** (performance or acceptance criteria that the collected data will need to achieve). Data must be of known quality to withstand scientific and legal challenges relative to its intended purpose. Completeness is the measure of the amount of valid

[3] https://ecology.wa.gov/regulations-permits/guidance-technical-assistance/contamination-clean-up-tools/clarc

data obtained from a measurement system compared to the amount expected to be obtained under normal conditions. Based on evaluation of the data in terms of precision, accuracy, representativeness, comparability, and sensitivity, a completeness objective of 95 percent of the data set has been established for the sampling activities. If the completeness objective is not met, additional sampling may be warranted.

7. **Develop the Plan for Obtaining Data.** The groundwater, soil, indoor air, sub-slab soil-vapor, and soil-vapor samples will be collected and analyzed as described in the SAP.

3.2 Analytical Levels

Analytical levels are defined by EPA as follows:

- **Screening data.** Generated by rapid, less precise methods of analysis with less rigorous sample preparation. Sample preparation steps may be restricted to simple procedures, such as dilution with a solvent, instead of elaborate extraction/digestion and cleanup. Screening data provide analyte identification and quantitation, although the quantitation may be relatively imprecise. Screening data without associated confirmation data are not considered to be data of known quality. During sampling activities, the following screening data may be measured in the field: pH, temperature, specific conductivity, dissolved oxygen, oxidation-reduction potential, turbidity, and ferrous iron.
- **Definitive data.** Generated using rigorous analytical methods, such as EPA reference methods. Data are analyte-specific, with confirmation of analyte identity and concentration. Methods produce tangible raw data in the form of paper printouts or computer-generated electronic files. Data may be generated at the Site or at an off-site location if the QA/QC requirements are satisfied. For the data to be definitive, either analytical or total measurement error(s) must be identified. The level of QC that will be performed for the definitive data involves the QC efforts, and calibration procedures described in Section 11, analytical methods listed in Table 1, and QC requirements and corrective actions listed in Tables 5 and 6. Laboratory control limits for accuracy and precision will be used to evaluate the sample data.

The QA/QC program described in this QAPP was developed to assess adherence to DQOs. The remainder of this QAPP describes the specific approaches that will be taken to achieve the required DQOs.

Precision describes the reproducibility of measurements under a given set of conditions. Specifically, it is a quantitative measure of the variability of a group of measurements that have been made in an identical manner, compared to their average value. Precision can be expressed in a variety of manners that include absolute methods such as deviation from the mean or median values, standard deviation and variance, or relative methods (e.g., relative deviation from the mean or median). The overall precision will be determined through the analysis of field duplicates, laboratory duplicates, and matrix spike (MS)/MS duplicate (MSD) samples.

Accuracy is defined as the degree of difference between measured or calculated values and the true value. The closer the numerical value of the measurement comes to the true value, or actual concentration, the more accurate the measurement is. Accuracy is expressed in terms of absolute or relative error. Accuracy will be determined through analysis of spiked samples and the analysis of standards with known concentrations.

Representativeness refers to the degree to which a sample taken from a Site accurately reflects the matrix at the Site. It is a qualitative parameter that is most concerned with the design of the sampling program. Factors that will be considered in the determination of representativeness include appropriateness of sampling and analytical methodologies, representativeness of the selected media, and representativeness of the selected analytical procedures. Representativeness will be achieved using procedures for the collection and preservation of samples as described in the QAPP and the SAP.

Comparability refers to the use of consistent procedures, second source reference standards, reporting units, and standardized data format with document control. Adherence to standard procedures and the analysis of external source standard materials maximizes the probability that data generated from a particular method at a given laboratory can be validly compared to the data of another. This QAPP provides data that will be comparable to other data collected, as standard methods will be utilized for the sampling and analysis activities.

Completeness refers to the process of obtaining the required data as outlined in the QAPP and Work Plan. Completeness is also defined as the percentage of measurements judged to be useable. Samples for which the critical data points fail completeness objectives will require reanalysis of samples (within the specified holding times) until the DQOs are met. The completeness goal has been specified at 95 percent for the sampling activities.

Sensitivity refers to a measurable concentration of an analyte that has an acceptable level of confidence. MDLs are the lowest concentration of an analyte that can be measured with 99 percent confidence that the analyte concentration is greater than zero. RLs are levels above the MDLs at which the laboratory has demonstrated the quantitation of analytes.

3.3 Field Sampling Objectives

The objective of the field sampling program is to obtain samples that represent the environmental matrix being investigated. This will be accomplished using proper sampling techniques and equipment as presented in the QAPP and SAP.

Field screening activities may not require sample collection but do involve measurements for which QA concerns are appropriate. The primary QA objective of field screening is to obtain reproducible measurements to a degree of accuracy consistent with the intended use of the measurements and to document measurement procedures.

3.4 Laboratory Objectives

To obtain data of a quality sufficient to meet the project DQOs, the laboratory will adhere to the specific analyses and QA/QC requirements in the analytical methods listed in Table 1. The methods cited in this QAPP will provide data of sufficient quality for comparisons to regulatory criteria and project action levels. The laboratory's SOPs and *Quality Assurance Manual* (QAM) are presented in Appendix A.

4 Project Organization and Responsibilities

Terraphase will be responsible for project management, sample collection, data review, data validation, and data reporting. Alliance will perform analyses for this project. Responsibilities for key project team members are summarized below. An organizational chart for the project is presented at the end of this section.

4.1 Client Personnel

Chris Weldon with Love's, the Site owner, is the Client project contact.

4.2 Terraphase Key Personnel

Key Terraphase team members are listed below.

- **Project Manager.** The Terraphase Project Manager (currently Max Wills, LHg, CWRE) is responsible for implementing the project and has the authority to commit the resources necessary to meet project objectives and requirements. The primary function is to meet the technical, financial, and scheduling objectives and will provide direction to the Terraphase project team.
- **Quality Assurance Officer (QAO).** The Terraphase QAO for this project (currently John Hildenbrand) is responsible for revising this QAPP, as necessary, and managing QA/QC review of data generated during the sample collection activities. Data processing and validation will be overseen and reviewed by the Terraphase QAO. The QAO may perform data validation activities or designate additional data validators to work under their direction.
- **Task Manager.** The Terraphase Task Manager (currently John Hildenbrand) assists the Terraphase Project Manager with completion of activities related to planning, data analysis, and report preparation.
- **Field Team Leader.** The Terraphase Field Team Leader (currently Kari Thomas, LG, RG) will be responsible for directing and coordinating the day-to-day activities while field activities are underway.
- **Field Sampling Personnel.** Terraphase field sampling personnel will be responsible for collection, packaging, preservation, and shipment of environmental samples in accordance with the QAPP and applicable EPA requirements. Field sampling personnel will also collect field data and monitor health and safety.
- **Project Health and Safety Officer.** The Terraphase Project Health and Safety Officer (currently Don Malkemus, RG, LHg) will be responsible for the enforcement of a health and safety plan requirements and communication of non-conformances and emergencies through e-mail communications. The Project Health and Safety Officer interfaces with the Corporate Health and Safety Officer (Daren Roth), as needed.

4.3 Laboratory Management

Ecology-accredited laboratory Alliance will perform analyses for this project. The respective laboratory shipping addresses and contact information are provided below:

Brianna Barnes, Project Manager
Alliance Technical Group, LLC
3600 Fremont Avenue North
Seattle, Washington 98103
206-352-3790

Brianna Barnes is the laboratory project manager responsible for coordinating laboratory analysis, supervising in-house chain of custody, scheduling sample analysis, and overseeing data review and preparation of analytical reports. It will be the responsibility of the laboratory project manager to approve final analytical reports prior to submission to Terraphase.

5 Special Training Requirements

Field personnel must comply with the training requirements for hazardous waste operations per 29 CFR § 1910.120(e).[4] Each individual must have successfully completed a 40-hour (or 24-hour) course appropriate to the level of work that is performed. In addition, each individual must complete an 8-hour refresher course within the last 12 months if the initial training was more than 12 months ago.

Personnel acting in the capacity of an on-site supervisor, directly responsible for supervising employees engaged in hazardous waste operations, shall also have successfully completed an 8-hour supervisor training course. Field personnel must have documentation (copies of certificates or identification cards) available in the project file as proof of compliance with the training requirements.

6 Sampling Design

The sampling design described in this section has been developed to ensure sampling is conducted using consistent, repeatable, and scientifically sound methods.

6.1 Sampling Network

The types of methods per media to be collected during sampling and analysis are presented in Table 1. The SAP includes a list of individual samples anticipated to be collected and their analytical

[4] Hazardous waste operations and emergency response, 29 CFR § 1910.120, https://www.ecfr.gov/current/title-29/subtitle-B/chapter-XVII/part-1910/subpart-H/section-1910.120.

requirements. The specific parameters for each method and the associated laboratory RLs and MDLs are listed in the Alliance SOPs, provided as Appendix A.

6.2 Sample Locations and Designations

Proposed sample locations are identified in the Work Plan.

A sample designation system will be used to identify samples for laboratory analysis. A list of identifiers used for each sample will be documented in the project logbook by the Field Team Leaders.

Each collected sample will be designated a unique sample ID as documented in the SAP. The following information will be utilized to identify samples:

1. **Sample ID standard format:** Sample Type-##-Depth-Date
   - Examples of sample type abbreviations: MW (monitoring well), GP (sample collected from a geoprobe direct-push rig), IA (indoor air), (VP) sub-slab vapor pin, and (SV) soil vapor.
   - ## = Specific Location ID per sample type.
   - Depth = Top and bottom of sampling interval
   - Date = Month/Day/Year sample was collected (listed on the chain-of-custody form). For one-time samples (i.e., those collected from temporary borings or soil vapor points), the date need not be included.
2. **Abbreviations for types of QC samples**: Field duplicate (DUP), trip blank (TB), and field (equipment) blank (EB). Duplicates will be labeled the same as the primary sample with -DUP following the primary sample ID. No blind duplicates will be collected.

6.3 Sampling Procedures

SOPs for the anticipated field methods, listed below, are included in Appendix A of the SAP:

- SOP 103-23-00, "Chain-of-Custody Requirements"
- SOP 105-23-00, "Packaging and Shipping of Samples"
- SOP 111-24-00, "Field Quality Control Samples"
- SOP 200-23-00, "Groundwater and Free Product Level Measurements"
- SOP 201-23-00, "Grab-Groundwater Sampling"
- SOP 203-23-00, "Groundwater Sample Collection Below LNAPL"
- SOP 205-23-01, "Groundwater Sampling – Low Flow"
- SOP 207-23-00, "Monitoring Well and Piezometer Installation"
- SOP 208-23-00, "Monitoring Well and Piezometer Development"
- SOP 209-24-00, "Slug Test"
- SOP 210-24-00, "Pressure Transducer Installation and Monitoring"
- SOP 300-23-00, "Indoor and Outdoor Air Sampling"

- SOP 400-23-00, "Soil-Vapor Probe Installation"
- SOP 401-23-00, "Soil-Vapor and Sub-Slab Soil-Vapor Sampling"
- SOP 503-23-00, "Surface and Shallow Subsurface Soil Sampling"
- SOP 504-23-00, "Field Screening with Photoionization or Flame Ionization Detectors"
- SOP 508-23-00, "Soil Boring Installation Using a Hand Auger"
- SOP 509-23-00, "Soil Boring and Sampling Using Direct-Push Drilling"
- SOP 601-23-00, "Surface Water Sampling"

6.3.1 Groundwater Sampling Procedure

Groundwater samples will be collected as detailed in the SAP and analyzed using the analytical methods listed in Table 1. QC samples will consist of field duplicates and field blanks at the quantity and frequency indicated in Table 1. Each sample cooler containing samples to be analyzed for VOCs will contain a trip blank. Each trip blank submitted to the laboratory will be analyzed for VOCs.

6.3.2 Soil Sampling Procedure

Soil samples will be collected as detailed in the SAP and analyzed using the analytical methods listed in Table 1. QC samples will consist of field duplicates and field blanks at the quantity and frequency indicated in Table 1. Each sample cooler containing samples to be analyzed for VOCs will contain a trip blank. Each trip blank submitted to the laboratory will be analyzed for VOCs.

6.3.3 Indoor Air and Sub-Slab and Soil Vapor Sampling Procedure

Indoor air, soil-vapor, and sub-slab and soil-vapor samples will be collected as detailed in the SAP and analyzed using the analytical methods listed in Table 1. QC samples will consist of field duplicates at the quantity and frequency indicated in Table 1.

6.3.4 Field Duplicate Sampling Procedure

Field duplicate samples will be collected from the same location as the parent sample and will be analyzed for the same parameters as the parent sample in accordance with SOP-111-24-00. The associated parent sample identification of the duplicate QC sample will be recorded in the field notes. Field duplicate QC samples will be collected as indicated in Table 1.

6.3.5 Field Rinsate Method Blank Sampling Procedure

A field rinsate blank will be collected for sampling when non-disposable, non-dedicated sampling equipment is used for sample collection and subsequently decontaminated in the field for use for additional sampling. The blank water used to generate the field blank will be provided by the laboratory using the same source of water as that used to prepare method blanks. Each field blank will consist of laboratory-provided, analyte-free water that is poured over or through non-disposable, non-dedicated sampling equipment that has been fully decontaminated as described in Section 6.4. If necessary,

preservatives or additives will be added to the field blank. Field blanks will be collected as indicated in Table 1.

6.3.6 Trip Blank Procedure

A trip blank will be included in the cooler used to ship aqueous samples for VOC analysis. The trip blank will be used to evaluate possible sample contamination from transportation between the Site and the laboratory. A trip blank will be prepared by the laboratory using the same preservation technique as that used to prepare the sample containers from the same source as the method blank water and sent to the Site in the cooler with the other sample containers. Trip blanks are not opened in the field but travel with the sample containers. One trip blank will be sent to the laboratory for analysis in each cooler that contains samples that have been collected for analysis of VOCs.

6.4 Decontamination of Sampling Equipment

Decontamination of non-disposable sampling and downhole drilling equipment will be performed to prevent the introduction of extraneous material into samples and to prevent potential cross-contamination. All downhole drilling equipment will be decontaminated by one of the following methods: steam cleaning, pressure washing, or washing with a non-phosphate detergent, such as Liquinox™ or equivalent. All non-disposable sampling equipment (the electronic sounder) will be decontaminated by the procedure outlined below.

The following steps will be followed for decontamination of non-disposable sample equipment:

1. **Wash with non-phosphate detergent and water solution.** This step will remove all visible contamination from the equipment. Use of a 5-gallon bucket with solution and a long-handled brush is suggested for this step. Non-phosphate detergent will be diluted as directed by the manufacturer.
2. **Rinse with potable water.** This step will rinse all the detergent solution away from equipment. Use of a 5-gallon bucket of water and a long-handled brush is suggested for this step. Periodic changing of this water is required.
3. **Rinse with deionized water.** This step will rinse any detergent solution and potable water residues. Rinsing is most effective when water is applied using a stainless-steel Hudson-type sprayer or Nalgene® squeeze bottle while holding equipment over a 5-gallon bucket.
4. **Rinse with deionized water.** This step will be a final rinse to remove any contaminants. Rinsing is most effective when water is applied using a stainless-steel Hudson-type sprayer or Nalgene® squeeze bottle while holding equipment over a 5-gallon bucket.

7 Field Instrumentation and Inspection of Supplies

Field instrumentation required for anticipated sampling events is also described in the Work Plan. The following field equipment is expected to be used:

- Photoionization detector.
- Peristaltic pump with flow-through cell.
- Electronic water level indicator.
- Electronic oil/water interface probe (if free product is encountered).
- Horiba U-22 water quality analyzer or equivalent (for measurement of field indicator parameters including pH, temperature, specific conductivity, dissolved oxygen, oxidation-reduction potential, turbidity, etc.).

7.1 Field Equipment Calibration

Field instruments will be calibrated in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications. Equipment to be used for field sampling will be examined to confirm that it is in good operating condition. This includes checking the manufacturer's operating manual and the instructions for each instrument to confirm that the maintenance requirements are being observed.

In general, instruments will be calibrated daily prior to use and will be recalibrated as required. All calibration procedures performed will be documented in the field logbook. Calibration checks will be performed at the intervals specified by the manufacturer. If an internally calibrated field instrument fails to meet calibration procedures, it will be returned to the manufacturer for service.

7.2 Field Equipment Preventative Maintenance

Preventative maintenance procedures will be carried out on field equipment by Terraphase personnel in accordance with the procedures outlined in the manufacturers' specifications and/or equipment manuals.

Maintenance activities involving field equipment will be recorded in the field logbook. Field equipment will be checked by field representatives prior to being used in the field. Problems encountered while operating the instrument will be documented in the field logbook. If an equipment problem is detected, or will require service, the equipment will be returned to the rental vendor or manufacturer for maintenance.

7.3 Inspection Requirements for Supplies

The use of standard materials of a known purity and quality is necessary for the generation of reproducible data. The laboratory will monitor the use of laboratory consumable materials including solutions, standards, and reagents as described in this QAPP.

Solvent materials are also verified prior to use. Each new lot of solvent is analyzed to verify the absence of interfering constituents. Reagent and method blanks are routinely analyzed to evaluate possible laboratory-based contamination of samples.

The sample containers used to collect aqueous and solid samples for this project will be supplied by Alliance. The containers will be pre-cleaned sample containers that will be purchased from an EPA-certified manufacturer (I-Chem 200 or equivalent container) or are cleaned using EPA protocols.

The laboratory project manager and the field representatives will be ultimately responsible for checking supplies for potential contamination.

Chemical reagents/solvents (e.g., hydrochloric acid and methanol for sample preservation) used by the field personnel will be provided by the laboratory.

8 Sample Handling and Custody

This section describes sample handling and custody from laboratory bottle ware preparation to the point of sample collection, and the relinquishment of sample custody to the laboratory.

8.1 Field and Laboratory Custody Procedures

Chain-of-custody procedures described in this QAPP will be instituted and followed throughout field activities. These procedures include field custody, laboratory custody, and evidence files. Samples are physical evidence and will be handled according to strict chain-of-custody protocols. The project organization must be prepared to produce documentation that traces the samples from the field to the laboratory and through analysis.

EPA has defined custody of evidence as follows:

- In actual possession
- In view after being in physical possession
- In a locked laboratory
- In a secure, restricted area

8.2 Sample Containers and Field Storage

Table 1 lists the proper sample collection information. If field storage is required, the samples will be stored in a secured storage facility.

Alliance will supply appropriate sample containers for aqueous and soil samples in coolers as well as preservatives, as presented in Table 1. QA measures for these samples will begin with the sample containers; pre-cleaned containers will be purchased by the laboratory from an EPA-certified manufacturer (I-Chem 200 or equivalent).

For indoor air, soil-vapor, and sub-slab soil-vapor sample collection, Alliance will provide certified-clean sample SUMMA™ canisters, as presented in Table 1. Batch- or individually-certified-clean canisters will be provided. The laboratory that certifies the canisters as clean must also conduct the analysis of the samples. The laboratory will begin the chain-of-custody document, which will follow the canister to the field and back to the laboratory.

Immediately after collection, aqueous and soil samples will be transferred to properly labeled sample containers and properly preserved if required. Table 1 lists the proper sample containers, sample volumes, preservation, and holding times.

Organic samples requiring refrigeration for preservation will be promptly transferred to coolers packed with wet ice and/or ice packs. Air samples collected in canisters do not require preservation for shipping. If field storage is required, the samples will be stored in a secured storage facility and a cooler temperature of less than or equal to 6 degrees Celsius (°C) will be maintained.

8.3 Field Documentation

The field sampler is personally responsible for the care and custody of the samples until transferred.

A field logbook, forms, or electronic media will be used to note information regarding collection of samples, activities completed, and observations. Paper field logbooks will be waterproof and bound. The logbook will be dedicated to the work assignment and pages will not be removed. Corrections will be made by drawing a single line through the incorrect data and initialing and dating the correction that was made to the side of the error. An initialed diagonal line will be used to indicate the end of an entry or the end of the day's activities. Electronic documentation will be regularly uploaded to the server for real-time review by the Project Manager.

The following presents information that may be recorded by the field sampling team:

- Name and title of author, date, and time of site entry, and physical/environmental conditions during the field activity
- Meteorological data
- Project number, client name, and Site name
- Name and title of field crew members
- Sample media
- Sample collection method, including equipment utilized
- Number and volume of samples collected
- Description of sample locations
- Date and start and end time of sample collection

- Diagrams of sampling process
- Canister and flow controller serial numbers
- Sample and QA/QC ID numbers
- Sample distribution
- Field observations
- Field measurements made and equipment used
- Calculations, results, and calibration data for field sampling and measurements
- References for maps and photographs of the sample location
- Dates and method of sample shipments

A completed sample identification label or tag that will be sequentially numbered will be attached to each investigative sample and the sample placed in a shipping container. The identification on the label/tag must be sufficient to enable cross-reference with the logbook. The sample label/tag will be recorded using waterproof, non-erasable ink and will be attached to the sample container using adhesive.

The sample labels/tags will contain the following information:

- Sample location/number identification
- Site/Project name
- Date and time of sample collection
- Whether the sample is preserved or unpreserved
- Space for laboratory sample number

8.4 Field Custody Procedures and Documentation

For aqueous and soil samples, the chain-of-custody records will be kept starting at the time that sample containers are filled and placed in the coolers for transportation to the laboratory. Once completed, the chain-of-custody record must be kept with each sample cooler at all times.

For air samples, the external chain of custody commences with the preparation of the canisters at the laboratory for shipment. The laboratory will initiate the chain-of-custody record and then transfer the canister under strict chain of custody to the field representative. The laboratory providing empty shipping containers must seal empty shipping containers with custody seals. Upon receipt of the canisters from the laboratory, the field representative will open the shipping containers to determine if the correct number of canisters was received from the laboratory.

Example chain-of-custody forms are provided in Appendix B. The following measures will be taken when completing a chain-of-custody record:

- The chain-of-custody forms will be completed in waterproof, non-erasable ink.
- The chain-of-custody forms will be completed neatly using printed text. If a simple mistake is made, the error will be lined out with a single line and initialed and dated.

- Each separate sample entry will be sequentially numbered.
- The use of "ditto" or quotation marks to indicate repetitive information in columnar entries will be avoided. If numerous repetitive entries must be made in the same column, a continuous vertical arrow will be used between the first entry and the next different entry.
- When more than one chain-of-custody form is used for a single shipment, each form will be consecutively numbered using the "page ___ of ___" format.
- If necessary, additional instructions will be placed directly onto the chain-of-custody form.
- Acronyms used on a chain-of-custody form will be defined.
- For aqueous and soil samples, the chain-of-custody form will contain the following information:
  - Laboratory name and address
  - Project name and number
  - Sample description/location
  - Date and time of sample collection
  - Type and matrix of sample
  - Number of sample containers
  - Analysis requested/comments
  - Date and signature of the field representative relinquishing custody
  - Date and signature of the laboratory representative accepting custody
  - Carrier used to ship coolers
  - Air bill number (if shipped by a commercial carrier)
- For air samples, the chain-of-custody record will contain the following information:
  - Laboratory name and address
  - Project identification and number
  - Sample description
  - Time/date of sampling start and stop
  - Required parameters and analysis
  - Container volume and quantity
  - Sampler signature, date, and time
  - Time/date shipping container opened
  - Date and signature of the field representative relinquishing custody
  - Date and signature of the laboratory representative accepting custody
  - Air bill number (if shipped by a commercial carrier)

If high concentrations are suspected to be present in the samples, a note to that effect will be included on the chain-of-custody form. In the field logbook, field samplers will note the information previously presented. Samples will be packed prior to shipment using the following procedures (where applicable):

- Select a sturdy, clean cooler in good repair. Secure and tape the drain plug with fiber or duct tape.
- Be sure the lids on all bottles are tight (will not leak) and plastic bags are sealed.
- Where applicable, add ice that has been placed in heavy-duty polyethylene bags and properly sealed on top and/or between the samples. Pack samples securely to eliminate breakage during shipment with ice packs to maintain the inside temperature of less than or equal to 6 °C.
- Sampling containers will be packed with packing materials. When possible, sample container preparation and packing for shipment will be completed in a well-organized and clean area. Sample containers will be prepared for shipment by wiping containers clean of debris/water using paper towels. Paper towels will be disposed with the single-use personal protective equipment.
- Place chain-of-custody record into a re-sealable plastic bag, tape the bag to the inner side of the cooler lid, and close the cooler and securely tape (preferably with fiber tape) the top of the cooler shut. Two custody seals will be affixed to the latch and lid of the cooler. The number of the security seal, if applicable, will be recorded on the chain-of-custody form. The custody seals will consist of adhesive-backed tape that easily rips if it is disturbed. The field sampler will initial and date the seal. The seals must be broken to open the cooler and will indicate tampering if the seal is broken before receipt at the laboratory.
- A label containing the name and address of the shipper will be placed on the outside of the container.

8.5 Sample Transportation

The field sampling team may hand deliver, ship the cooler via an overnight delivery service, or contact the laboratory to send a courier for pick up. Prior to shipment of sample coolers, the field sampling team will contact the laboratory to notify the laboratory of the shipment.

Samples will remain in the custody of the sampler until transfer of custody is completed. Transfer consists of:

- Delivery of samples to the laboratory sample custodian and/or
- Signature of the laboratory sample custodian on the chain-of-custody form as receiving the samples and signature of sampler as relinquishing the samples.

The chain-of-custody document will be completed by the field sampler and provided for each sample cooler. When transferring the possession of samples, individuals relinquishing and receiving will sign, date, and note the time on the chain of custody. Custody of samples must be continuous between parties and time gaps must not be present.

Each shipment of samples to the laboratory must have its own chain-of-custody record with the contents of the shipment, method of shipment, name of courier, and other pertinent information written on the record. The original record accompanies the shipment and the copies are kept with the

field forms and distributed to the Project Manager. A copy of the chain of custody will be transmitted to the laboratory and to the Project Manager on the same day of sample shipment. Freight bills, postal service receipts, and bills of lading will be retained as permanent documentation.

If a carrier is used to transport samples between the sampler and the laboratory, the air bill number must be written on the chain of custody.

Samples will be shipped or transported within 24 to 48 hours of being collected and will arrive at the laboratory no later than 72 hours after sample collection, unless specific alternatives are arranged with the laboratory as part of the project.

8.6 Laboratory Custody Procedures

When the samples arrive at the laboratory, the laboratory sample custodian will sign the courier's air bill or bill of lading (unless hand delivered) and will note the cooler temperature on the chain-of-custody form, where applicable. If the cooler temperature is greater than 6 °C, the Project Manager will be notified. If the samples were shipped, the courier's air bill number will be written on and attached to the chain-of-custody form. If the cooler or container/box arrives at the laboratory after hours, an external chain of custody will be properly filled out and will accompany the cooler until the laboratory receives the cooler.

The laboratory sample custodian's duties and responsibilities upon sample receipt will be to:

- Sign the record with the date and time of sample receipt.
- Note the cooler temperature on the chain-of-custody form where applicable.
- Inspect sample shipping cooler for the presence or absence of custody seals (only if shipped via overnight courier) and for container integrity.
- Sign the appropriate forms or documents, verify, and record the agreement or disagreement of information on sample documents and, if there are discrepancies, record the problem and notify the Project Manager.
- Assign a unique, sequential laboratory number for each sample upon receipt. That sample number will be placed on a label and attached to the sample container.
- Log sample information into the laboratory sample tracking system.
- Place samples in the walk-in cooler or in a secure, limited-access, sample storage area.

If QC samples have not been properly identified during sample collection, the laboratory project manager will contact the Project Manager to assign QC samples prior to the start of sample analysis.

The laboratory will immediately contact the Project Manager if issues pertaining to sample condition or documentation are detected (e.g., broken security seal; compromised sample containers; chain-of-custody information in disagreement with sample labels).

9 Laboratory Sample Storage and Handling

Laboratory personnel will be required to log samples and sample extracts in and out of storage as the analysis proceeds.

There must not be a lapse in the custody for the sample containers and exchanges of custody must be documented on the form. Samples will be returned to a secure storage area at the close of business. Care must be exercised to properly complete, date, and sign records needed to generate the data package.

Procedures to be followed by the laboratory include:

- Samples will be handled by the minimum number of people possible.
- The laboratory will set aside a secured sample storage area consisting of a clean, dry, refrigerated, isolated room.
- A specific person will be designated sample custodian. Incoming samples will be received by the custodian who will indicate receipt by signing the chain-of-custody form.
- The custodian will ensure that samples which are heat sensitive, light sensitive, radioactive, or which require special handling in other ways, are properly stored and maintained prior to analysis.
- The analytical area will be restricted to authorized personnel only.
- After sample analyses are complete, the analytical data will be kept secured and released to authorized personnel only.

10 Analytical Method Requirements, Target Analytes and Regulatory Criteria

To obtain data of a quality sufficient to meet the project DQOs, the methods listed in Table 1 will be used for analysis of the environmental samples.

The laboratory will adhere to the specific analyses and QA/QC requirements in the analytical methods listed in Table 1 and additional requirements listed in this QAPP. The most recent laboratory control limits for accuracy and precision will be used to evaluate the sample data. In addition, the QC requirements and corrective actions listed in the laboratory SOPS and QAM (Appendix A) will be adhered to.

In the event of an analytical system failure, the laboratory project manager will identify the situation and provide corrective action guidance. The Terraphase QAO will be notified and the system failure will be documented in the data package case narrative.

Matrix interferences will be identified and documented during the analytical process. Samples may be diluted only if analytes of concern generate responses exceeding the linear range of the instrument.

MDLs and RLs may only be achieved in an undiluted sample free of matrix interferences or of high concentrations of target analytes. If matrix interferences are encountered or if high concentrations of target compounds are present, established MDLs and RLs may not be achievable without impacting the instrument quality.

If the laboratory has taken appropriate actions and matrix interferences prevent the laboratory from achieving the specified detection limits, the Terraphase QAO will be contacted as soon as the situation is identified. The laboratory project manager will document, in the data package case narrative, how the laboratory demonstrated good analytical practices to attempt to achieve the specified reporting detection limits.

Blanks will not be subtracted from target analyte results.

The generated data will be input into the laboratory DBMS.

Laboratories analyzing samples for submittal to Ecology must meet the required National Environmental Laboratory Accreditation Program certification for the associated methods.

Data generated will be submitted in an EDD format that complies with the Ecology format and will be submitted to Ecology's Environmental Information Management System (EIM).[5] Data will be managed in a relational DBMS. Laboratory analytical data will be provided in EDD format for direct upload into the DBMS. For those data that are validated, the data validation qualifiers will be entered into the DBMS and checked independently.

Complete descriptions of analytical procedures to be used in the laboratory are described in the methods, QC requirements, and corrective actions listed in this QAPP and the laboratory SOPs.

10.1 Target Analytes and Detection Limits

The MDL is defined as the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. The RL is the lowest concentration that can be reliably quantified within specified limits of precision and accuracy during routine laboratory operations.

The laboratory will evaluate and report the non-detected results to the MDLs referencing the RL. The RL concentration is established by the lowest standard in the instrument calibration. For the remaining data, results that are less than the RLs but greater than or equal to the MDLs will be reported using the J flag.

For example, for a target analyte with an RL and MDL of 10 and 2 micrograms per liter (µg/L), respectively, a non-detected result is reported as 10 µg/L "U" (see Section 14.3), indicating that a concentration greater than or equal to the MDL was not detected by the laboratory. A detected concentration of 6 µg/L is reported as 6 J and a detected concentration of 23 µg/L is reported without a

[5] https://ecology.wa.gov/Research-Data/Data-resources/Environmental-Information-Management-database

laboratory flag. The laboratory must include both RLs and MDLs on the sample result sheet that is reported to the data user.

Where applicable, the RLs and MDLs listed in the laboratory SOPs (Appendix A), or the most recent MDLs and RLs, will be reported by the laboratory.

Laboratories update the MDL and RL values at least annually as part of internal laboratory policy.

11 Laboratory and Field QA/QC Procedures

The overall effectiveness of a QA/QC program depends on operating in the field and laboratory according to a program that systematically ensures the precision and accuracy of analyses by detecting errors and preventing their recurrence or measuring the degree of error inherent in the methods applied.

QA involves an integrated system of activities—planning, quality assessment, reporting, and quality improvement—to ensure that a program meets defined standards of quality with a stated level of confidence. QC involves the technical activities that measure the quality of a program so that it meets the needs of users.

11.1 Laboratory QA/QC Checks

The Laboratory SOPS and QAM (Appendix A) summarize the laboratory QC checks, frequency of analysis, control limits, and laboratory corrective actions for the analytical method to be used in this project. A brief description of laboratory QA/QC analyses is presented in the following subsections.

11.1.1 Gas Chromatography-Mass Spectrometry Tuning

Tuning and performance criteria are established to verify mass resolution, identification, and to some degree, instrument sensitivity. These criteria are not sample specific; conformance is determined using standard materials. Therefore, these criteria will be met in all circumstances.

11.1.2 Calibration

Compliance requirements for satisfactory instrument calibration are established to verify that the instrument can produce acceptable quantitative data. Initial calibration demonstrates the instrument is capable of acceptable performance at the beginning of analysis, and continuing calibration and performance checks document satisfactory maintenance and adjustment of the instrument on a day-to-day basis.

11.1.3 Blanks

Several types of blanks will be analyzed by the laboratory. Corrective action procedures will be implemented for blank analyses if target compounds are detected at concentrations greater than the

applicable criteria. The criteria for evaluation of blanks apply to any blank associated with a group of samples collected, prepared and/or analyzed at the same time, where applicable. If problems with a blank exist, data associated with the project must be carefully evaluated to determine whether there is an inherent variability in the data for the project or if the problem is an isolated occurrence not affecting other data.

A method blank is an analyte-free blank that undergoes the preparation procedures applied to a sample. These samples are analyzed to examine whether sample preparation and analysis techniques result in sample contamination. The laboratory will prepare and analyze a method blank with each group of samples that are extracted, digested, or analyzed at the same time.

Field rinsate blanks, also known as equipment blanks, are analyzed to assess contamination introduced during field sampling procedures and sample shipment. A field blank will be prepared for sampling when a particular piece of sampling equipment is employed for sample collection and subsequently decontaminated in the field for use in additional sampling. Field rinsate blank collection begins with two sets of identical bottles; one set filled with target analyte-free water provided by the laboratory, and one empty set of bottles identical to those provided for aqueous sample collection. The blank water used to generate the field blank will be provided by the laboratory using the same source of water as that used to prepare method blanks. At the field location, in an area suspected to be contaminated, the water is passed from the full set of bottles through the dedicated or field decontaminated sampling device(s) and into the empty set of bottles. This will constitute identical bottle to bottle transfer.

The field rinsate blank samples will be subject to the same analyses as the environmental samples. The field blank will be composed in the field by collecting a blank water rinse from the equipment after execution of the last step of the proper field decontamination protocol. The identical bottle to bottle transfer technique will be used to generate the field blank. Preservatives or additives will be added to the field blank, where appropriate, for the sampling parameters. One field rinsate blank will be collected for every 20 samples or 1 per sampling event for less than 20 samples for each analysis type. The field rinsate blank will be analyzed for the same parameters as the samples collected the same day that the field blank was generated. Field rinsate blanks will not be collected if all samples are collected using dedicated sampling equipment.

Trip blanks will be prepared as other samples submitted for VOC analysis and will contain analyte-free water or preservative, as appropriate. A trip blank will be prepared by the laboratory, using the same preservation technique as that used to prepare the sample containers, from the same source as the method blank water, and sent to the Site in the cooler with the other sample containers. The trip blank will undergo shipment from the sampling site to the laboratory in coolers with the environmental samples to be analyzed for VOCs. Trip blanks will be analyzed for VOCs to determine if contamination has taken place during sample handling and/or shipment. Trip blanks will be included in sample coolers at a frequency of one trip blank per cooler containing samples to be submitted for VOC analysis.

11.1.4 Internal Standards Performance

Internal standards, which are compounds not found in environmental samples, will be spiked into samples, blanks, and laboratory control samples at the time of sample preparation for applicable methods. Internal standards will meet the criteria specified in the corrective action tables.

11.1.5 Surrogate Recovery

Accuracy and matrix biases for individual samples are monitored for organic analyses using surrogate additions. Surrogates are compounds similar in nature to the target analytes; the surrogates are spiked into aqueous and solid samples, blanks, and QC samples prior to sample preparation for organic analyses. The evaluation of the results of these surrogate spikes is not necessarily straightforward. The sample itself may produce effects due to such factors as interferences and high concentrations of analytes. Since the effects of the sample matrix are frequently outside the control of the laboratory and may present relatively unique problems, the review and validation of data based on specific sample results is frequently subjective.

11.1.6 Laboratory Control/Laboratory Control Duplicate Samples

Laboratory control samples (LCSs) and LCS duplicate samples (LCSDs) are standard solutions that consist of known concentrations of the complete list of target analytes spiked into laboratory analyte-free matrix. They are prepared or purchased from a certified manufacturer from a source independent from the calibration standards to provide an independent verification of the calibration procedure. These QC samples are then prepared and analyzed following the same procedures employed for environmental sample analysis to assess method accuracy independently of sample matrix effects. Percentage recoveries are evaluated to assess the efficiency of the preparation and analysis method independent of environmental sample matrix effects. If performed by the laboratory, the LCSD is evaluated for laboratory precision.

11.1.7 MS/MSD Samples

MS/MSD data are generated to determine long-term precision and accuracy of the analytical method with respect to sample matrices. Generally, the MS/MSD data alone are not used to evaluate the precision and accuracy for associated organic samples since data may reflect specific matrix effects only present within one sample. MS/MSD samples will be spiked at the laboratory with the complete list of target analytes.

11.1.8 Analyte Identification and Quantitation

The objective of the qualitative criteria is to minimize the number of erroneous identifications of compounds. An erroneous identification can either be a false positive (reporting a compound present when it is not) or a false negative (not reporting a compound that is present). The identification criteria can be applied much more easily in detecting false positives than false negatives. Negatives or non-detect compounds represent an absence of data and are therefore much more difficult to assess.

The objective for quantitative requirements is to maximize the accuracy of data and sensitivity of the instrument. Unless sample screening indicates the presence of high concentration target analytes, samples will be analyzed undiluted to maximize sensitivity. Samples must be reanalyzed at the appropriate dilution when concentrations exceed the linear calibration range to maximize accuracy. Matrix interferences will be identified and documented. Samples may be diluted only if analytes of concern generate responses exceeding the linear range of the instrument.

11.2 Field QC Checks

QC samples will be collected during the sampling activities to evaluate data quality. Table 1 lists the sample matrices and corresponding QC samples to be collected by analysis.

11.2.1 Field Duplicate Samples

Collection of field duplicate samples provides for the evaluation of the laboratory's precision performance by comparing analytical results of two samples from the same location. They are also collected to evaluate field sample collection precision procedures.

Field duplicate samples will be collected from the same location as the parent sample and will be analyzed for the same parameters as the parent sample. The identification of the duplicate QC samples will be recorded in the field logbook.

As indicated in Table 1, 1 field duplicate sample will be collected for every 20 environmental samples or 1 per matrix for less than 20 samples.

11.2.2 Field Rinsate Blanks

One field rinsate blank, described in Section 11.1.3, will be collected for every 20 samples or 1 per sampling event for less than 20 samples for each analysis type. The field rinsate blank will be analyzed for the same parameters as the samples collected the same day that the field blank was generated. Field rinsate blanks will not be collected if all samples in each day are collected using dedicated sampling equipment.

11.2.3 Trip Blanks

Trip blanks, described in Section 11.1.3, will be included in sample coolers at a frequency of either one trip blank per cooler or one trip blank per shipment of samples sent to the laboratory for VOCs analysis.

11.2.4 Temperature Blanks

Temperature blanks will consist of vials of water that have undergone shipment from the sampling site to the laboratory in coolers with the environmental samples to be analyzed for the sampling program. The temperature of these blanks will be measured at the laboratory upon receipt of the sample cooler to verify compliance with the cooler temperature requirement.

11.3 Corrective Action

Generally, the following corrective actions may be taken by the laboratory. When analytical parameters that are within the control of the laboratory, including calibration, instrument performance, and blank criteria, are not met, the cause of the problem will be located and corrected. The analytical system will then be recalibrated. Sample analysis will not begin until calibration, instrument performance, and blank criteria are met. When matrix spike, standard, or duplicate analyses are out of control, samples analysis will cease. The problem will be investigated. Depending on the results of the overall QC program for the sample set, the data may be accepted, accepted with qualification, or determined to be unusable.

If, through the application of the corrective actions listed in this QAPP, the data is determined to be unusable, the QC analysis will be re-prepared and reanalyzed. If QC criteria are met upon reanalysis, only the new results are reported. If QC criteria are still not met upon reanalysis, both sets of sample results will be reported and the Terraphase QAO will be notified at the time of sample analysis.

If matrix interferences are suspected, the Terraphase QAO will be contacted. Unless sample screening indicates the presence of high concentration target analytes, samples may be diluted in the analysis only if analytes of concern generate responses exceeding the linear range of the instrument.

If the laboratory has taken appropriate actions and matrix interferences prevent the laboratory from achieving the specified detection limits, the Terraphase QAO will be contacted as soon as the situation is identified. The laboratory project manager will document, in the data package case narrative, how the laboratory demonstrated good analytical practices to attempt to achieve the specified reporting detection limits.

11.4 Data Assessment Procedures

The definitions and equations used for the assessment of data quality are discussed below.

- **Accuracy/bias** - A measure of the nearness of an analytical result, or a set of results, to the true value. It is usually expressed in terms of error, bias, or percent recovery (%R).

  Normally, the term accuracy is used synonymously with %R. It describes either the recovery of a synthetic standard of known value, or the recovery of known amount of analyte (spike) added to a sample of known value. The %R or accuracy can be calculated by using:

  - Standards: %R = (observed value/true value) x 100
  - Spikes: %R = [((conc. spike + sample conc.) - sample conc.) x 100)]/conc. spike

- **Precision -** Refers to the agreement or reproducibility of a set of replicate results among themselves without assumption of any prior information as to the true result. It is usually expressed in terms of the percent difference (%D) or relative percent difference (RPD).

  The %D is calculated by using:

  %D = (larger SR - smaller SR x 100)/smaller SR

  Where: SR is the sample result.

  The RPD is calculated by using:

RPD = (OSR - DSRx 100)/((OSR + DSR)/2)

Where: OSR is the original sample result and DSR is the duplicate sample result.

- **Average -** The average or arithmetic mean (X) of a set of n values (Xi) is calculated by summing the individual values and dividing by n:

$$X = (\sum Xi_{I=1\ to\ n}) \div n$$

- **Range -** The range (Ri) is the difference between the highest and lowest value in a group. For n sets of duplicate values (X2, X1), the range (Ri) of the duplicates and the average range (R) of the n sets are calculated by the following:

Ri = X2 - X1

$$R = \sum Ri_{i=1\ to\ n} \div n$$

- **Standard deviation and variation** - The standard deviation (S) of a sample of n results is the most widely used measure to describe the variability of a data set. It is calculated by using the following equation:

$$S = \sqrt{\frac{\Sigma (Xi - \overline{X})^2}{n-1}}\ n_{\ \text{to}\ i-1}$$

Where: X is the average of the n results and Xi is the value of result. Normally, X ± S will include 68 percent and X ± 2S includes about 95 percent of normally distributed data.

The variance is equal to S2. The percent relative standard deviation (%RSD), or coefficient of variation (CV), is the standard deviation divided by the mean and multiplied by 100 as follows:

CV = 100S/X

The laboratory project manager, with individual laboratory group leaders, will identify any data that will be rated as "unacceptable" based on the assessment of the QA/QC criteria.

- **Bias -** Results of sample spiking are used to calculate the QC parameter for accuracy evaluation, the %R.

%R = 100(S1 - S2)/T1

Where: T1 = True concentration of the spike

S1 = Observed spiked sample concentration

S2 = Sample concentration without spike addition

- **Sensitivity -** The measure of sensitivity is made by a comparison of laboratory RLs to the requirements for the DQOs. This comparison will be performed prior to sample analysis, with expected laboratory RLs, and following sample analysis, with actual RLs.
- **Completeness -** Completeness is the fraction of usable data obtained from a measurement system (e.g., sampling and analysis) compared to that which was planned and is calculated as follows:

Completeness = (Usable Laboratory Measurements Made/Laboratory Measurements Planned) x 100%

12 Data Review and Reporting Procedures

For data to be scientifically valid, legally defensible, and comparable, valid procedures must be used to prepare and manage the data. Specific laboratory procedures and instrumentation can be found in the laboratory SOPs and QAM. The general data production and reporting procedures described in this section will be employed at the laboratory.

12.1 Data Reduction

Data reduction consists of manual and computer data reduction procedures and calculations. Computer data reduction procedures and calculations will be checked manually by the laboratory to verify that compound identification and quantitation adhere to method requirements. The laboratory will be responsible for maintaining a listing of computer-based data reduction programs and SOPs for data reduction. Sample preparation or extraction logs will be used to document sample preparation information (for example, preparation weights, volumes, reagents). Instrument injection logs or bench sheets will also be maintained for each instrument.

12.2 Laboratory Data Review

Analytical results are generally entered into the laboratory computer system by the analyst, independently reviewed by another analyst or supervisor experienced in the method and approved by the Laboratory Manager. The following are requirements that are generally examined as part of this review:

- Initial calibration criteria were met. Standards in the calibration curve covered the expected concentration ranges of the samples including the RL.
- Initial and continuing calibrations met the acceptance criteria defined in the method standard procedure.
- Sample results fell within the range of the standard curve.
- Method blanks were processed with each analytical batch and no detectable levels of contamination were identified.
- MS/MSD and duplicate analyses were performed at the required frequency and results were within the control limits.
- LCS analyses were performed with each analytical batch and the results obtained were within control limits.
- Calculations have been accurately performed.
- Reporting units are correct.
- Data for the analysis provide a complete audit trail.
- Reported quantitation limits comply with data quality requirements.

The analyst's supervisor will check a minimum of 10 percent of the data back to raw data in the secondary review. When required analyses on the samples in a project are complete, entered, and reviewed, a report will be generated. The report will be forwarded to the assigned laboratory project manager or designee for review. The report will then be reviewed for the following items (at a minimum):

- QC data will be reviewed to identify whether internal specification and contract requirements have been met.
- Non-conformance reports, if any, will be reviewed for completion of corrective actions and their impact of results. Non-compliance and corrective action procedures will be documented in the case narrative in the final report.

The report requires the signature of the laboratory project manager or designee. Electronic data are copied onto computer tape, inventoried, and stored in an off-site secure facility or within locked cabinets on Site. This data archive system is maintained for a minimum of 10 years.

Following final review, one hardcopy of the laboratory data package and a PDF copy will be transmitted to the Project Manager.

13 Data Deliverables and Data Management

Definitive data will be generated in the laboratory. The laboratory-generated data will be entered into the laboratory DBMS and presented in data packages. The laboratory will perform the data review process, including a minimum of 10-percent check of the data back to raw data in the secondary review by a laboratory supervisor.

Data validation of the sample data may be performed as described in Section 14 of this QAPP.

Laboratory analytical data will be provided in EDD format for direct upload into the DBMS. The laboratory is responsible for providing an EDD that matches the hardcopy and electronic data package for sample and analysis information. The EDD records must be the same format (i.e., flat file format). Field samples that are not collected from the project site will not be included in the laboratory report or EDD.

The DBMS will be used to provide custom queries and reports to support data analysis and report preparation. For data that are validated, the data validation qualifiers will be entered into the DBMS by hand. The DBMS will be checked independently to minimize data transmittal error and loss.

Generally, the information flow will include the following steps:

1. Samples will be collected in the field and transported to the laboratory.
2. Samples will be analyzed at the laboratory and data generated.
3. The laboratory data will be sent to the data validator for evaluation and to the Terraphase Project Manager for preliminary evaluation.

4. Validated data will be sent to data management personnel and entered into the DBMS.
5. The final data set from the DBMS will be provided to the Terraphase Project Manager for data evaluation in terms of project goals.
6. Project decisions based on results of the data analysis will be communicated with the Client and Ecology.

Records will be incorporated into the final project files for the samples. The field logs, data packages, and records will be included in the project files. The project files will be archived by Terraphase for a period of 10 years.

14 Data Validation and Usability

This section presents the approach to validating data and evaluating data usability.

14.1 Scope of Validation

Data validation will be performed by Terraphase data validators utilizing current data validation guidance as described in the following section. Data will be evaluated using the QA/QC criteria established in the methods utilized by the laboratory for analysis, the QC requirements, and laboratory established criteria, where applicable. Upon request by the data validator, the laboratory will provide additional or supplemental information.

Level 2 data validation will be performed for 100 percent of the samples collected for the investigation.

14.2 Validation Procedures

Data validation is a process of determining the suitability of a measurement system for providing useful analytical data. Data validation is essentially a three-step process in which the analytical data's QA/QC information is first compared to a series of QA/QC criteria. Based on the results of this comparison, the analytical data are then assigned qualifiers, which provide an indication of the data's usability. Finally, an overall evaluation of the data's usability is performed.

The analytical data generated will be evaluated by the data validator using the analytical methods utilized by the laboratory, the QA/QC requirements listed in the methods, the laboratory SOPs, and professional judgment.

Data affected by excursions will be qualified using the approach to applying data validation qualifiers listed in the Hazardous Waste Support Section SOP No. HW-31, "Analysis of Volatile Organic Compounds in Air Contained in Canisters by Method TO-15," and *National Functional Guidelines for Organic Superfund Methods Data Review* (EPA 2014, 2020).

The following QA/QC information will be included in the validation, where applicable:

- QAPP compliance

- Chain-of-custody record
- Sample collection
- Sample preservation
- Leak check evaluations
- Canister filling evaluation
- Canister cleaning and certification
- Holding times
- Instrument performance (full validation only)
- Initial and continuing verification calibrations
- Blank analysis
- MS/MSD analysis
- LCS analysis
- Field duplicate analysis
- Isotopic standard (extraction and injection) performance
- Internal standards performance
- Surrogate recovery
- Gas chromatography-mass spectrometry instrument performance check/tune reports
- Target analyte quantitation, identification, and RLs (full validation only)
- Documentation completeness

14.3 Assignment of Qualifiers

Data affected by excursions from the previously described QA/QC criteria will be qualified using the current EPA validation guidance documents and professional judgment. The application of the validation guidelines will be modified to reflect method and QAPP requirements.

In accordance with the EPA guidance, and utilizing professional judgment, the following qualifiers will be applied in the data validation:

- "R" indicates that the RL or sample result is determined to be unusable due to a major deficiency in the data generation process. The data will not be used for any qualitative or quantitative purposes.
- U indicates that the analyte was analyzed for, but a concentration was not detected. The sample RL is reported. This qualifier is also used in the validation process to signify that the detection limit of an analyte was revised due to blank contamination.
- J indicates that the concentration will be considered approximate. This qualifier is used when the data validation process identifies a deficiency in the data generation process. This qualifier is also applied by the laboratory when the analyte concentration is greater than the MDL but less than the RL. In the latter case, the identification of the analyte is not in question but the quantitation of the analyte concentration may be uncertain.

- "UJ" indicates that the analyte was analyzed for, but a concentration was not detected. The sample RL is reported and will be considered approximate. This qualifier is used when the data validation process identifies a deficiency in the data generation process.
- "JN" indicates that the target analyte has been "tentatively identified" as present and the associated numerical value is the estimated concentration in the sample. This qualifier may be applied due to data interpretation issues.

The data quality evaluation results in only one type of qualifier (U, J, UJ, or R) for each analyte; in a case when several qualifiers are applicable to the same analyte, the cumulative effect of the various QA/QC excursions is employed in assigning the final data qualifiers. For example, if a sample result is affected by low surrogate recoveries, for which the UJ qualifier is applied, but low MS/MSD recoveries result in the rejection of the sample result (application of the R qualifier), the final data qualifier is R.

14.4 Data Usability Evaluation

The specific data quality requirements including precision, accuracy, representativeness, comparability, sensitivity, and completeness will be assessed during data validation. Data usability with respect to the DQOs and data uses will be compared to the project requirements. If the completeness objective of 95 percent is not achieved, samples may be recollected at the discretion of the Project Manager.

Based on the QA/QC information review and the qualifiers assigned to the analytical data, an overall evaluation of the data's usability will be performed. Data usability is defined as the percentage of data that remains unqualified or is qualified as approximate or non-detected due to blank contamination, divided by the data reported by the laboratory times 100. The percent usability excludes the data qualified as rejected due to major QA/QC excursions. The non-usable data is defined as the percentage of the data qualified as rejected divided by the data reported by the laboratory times 100. The data usability will be provided for each type of analysis performed.

The data usability evaluation considers the data parameters of precision, sensitivity, accuracy, representativeness, comparability, and completeness which are described as follows:

- Precision is evaluated through the review of field duplicate samples, laboratory duplicates, and MS/MSD samples.
- Sensitivity is evaluated through the review of RLs, blank analyses, and holding time results.
- Accuracy is evaluated through the review of MS, LCS, and internal standard recoveries; calibration; instrument performance checks; target analyte identification and quantitation; and sample preservation.
- Representativeness is evaluated through the review of sample preservation and sampling containers.
- Comparability is evaluated through the review of the analytical methods and reporting procedures for consistency.
- Completeness is defined as the overall percentage of sample results that are determined to be usable.

14.5 Data Validation Report

The data validation report will contain separate QA sections in which data quality information collected during the investigation is summarized. The validation report will include the following:

- Data validation guidelines used to evaluate the data;
- Data qualifiers applied to sample results;
- Summary of samples collected and analyses performed;
- Narrative that identifies major and minor analysis excursions detected for each parameter evaluated for each analysis;
- Additional issues and information that may be beneficial to the data user; and
- Data summary forms.

The data validation report will be prepared under the direction of the Terraphase QAO and will include the report on the usability of the data.

15 Data Assessment Procedures

Data assessment methods including laboratory QC, data evaluation, DQO reconciliation, and assessment of project completeness are discussed in this section.

15.1 Data QC Review

Data assessment is a systematic process of reviewing data against a set of criteria to identify outliers or errors and to delete suspect values or to flag them for the user. Laboratory data review starts with the laboratory QC procedures discussed in Section 11 of this QAPP.

Sample results obtained from the laboratory will be qualitatively and quantitatively assessed by the Terraphase Project Manager or designee. Factors to be considered in the data assessment will include but are not necessarily limited to the following:

- Were all samples collected and handled using the custody procedures, methodologies and SOPs proposed in the QAPP and Work Plan?
- Were samples obtained from all proposed sampling locations?
- Do any analytical results exhibit elevated laboratory RLs?
- Were any reported analytes not expected to be present?
- Which data points were found to be unusable based on the data validation results?
- Have sufficient data of appropriate quality been generated to meet the key objectives of the remedial investigation?

15.2 Data Review

The internal laboratory data review process will be used to evaluate data prior to submission to the Project Manager. Data validation will be used to determine the quality and quantity of usable analytical data generated based upon the project specific QAPP requirements.

15.3 Reconciliation with DQOs

The remedial investigation report will include an evaluation of how representative the analytical results are of the medium being evaluated based on measures such as sampling design and QC results. It will also include a discussion on the sufficiency of the data set for meeting project DQOs. The report will also contain a discussion of any unusable data and follow up actions for subsequent data collection to meet the project DQOs.

15.4 Project Completeness Assessment

The Terraphase Project Manager will examine the project data for consistency with historical data, data quality, and usability.

16 Project Reporting

The following types of reports will be prepared.

16.1 Data Validation Report

The data validation report will contain separate QA sections in which data quality information collected during the project is summarized. It will be prepared under the direction of the QAO or the designated data validator and will include the report on the usability of the data.

16.2 Remedial Investigation Report

Following the remedial investigation and subsequent sampling events, a report summarizing the results of the remedial investigation per the Work Plan and the QA/QC results, particularly those that affect the interpretation of analytical data, will be prepared.

17 References

Environmental Protection Agency (EPA). 1999a. "Compendium Method TO-15: Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially-Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry (GC/MS)." *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition.* Center for Environmental Research Information, Office of

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EPA. 2020. *National Functional Guidelines for Organic Superfund Methods Data Review*. November 2020

Washington State Department of Ecology (Ecology). 2024. *Cleanup Levels and Risk Calculation (CLARC)*. February. https://ecology.wa.gov/regulations-permits/guidance-technical-assistance/contamination-clean-up-tools/clarc.

Tables

1 Field Sampling Summary

Table 1
Field Sampling Summary
Quality Assurance Project Plan
Love's Travel Stop #413, 1512 HWY 97, Ellensburg, Washington

Parameter and Method	Matrix	Sample Containers and Volumes	Preservation	Holding Times	Quality Control Sample Frequency		
					Field Duplicate	Trip Blank	Field Rinsate Blank
TPH-g (NWTPH-Gx)[1]	Groundwater Samples	3 – 40-milliliter VOAs	HCl, Sealed and Headspace Free	Analysis within 14 days from collection for preserved samples.	One for every 20 samples collected	NA	One per 20 samples per day when using non-dedicated sampling equipment
	Soil Samples	1 – 4-ounce glass container and 2 – 40-milliliter VOAs	MeOH (VOAs)				
TPH-d (NWTPH-Dx)[1]	Groundwater Samples	1 – 500-milliliter amber glass	HCl, Sealed and Headspace Free	Extract within 14 days from collection for preserved samples.	One for every 20 samples collected	NA	One per 20 samples per day when using non-dedicated sampling equipment
	Soil Samples	1 – 4-ounce glass container	NA	Extract within 14 days from collection.			
TPH-EPH (NWTPH-EPH)[1]	Groundwater Samples	1 – 1-liter amber glass	HCl, Sealed and Headspace Free	Extract within 14 days from collection for preserved samples.	One for every 20 samples collected	NA	One per 20 samples per day when using non-dedicated sampling equipment
	Soil Samples	1 – 4-ounce glass container	NA	Extract within 14 days from collection.			
TPH-VPH (NWTPH-VPH)[1]	Groundwater Samples	3 – 40-milliliter VOAs	HCl, Sealed and Headspace Free	Analysis within 14 days from collection for preserved samples.	One for every 20 samples collected	NA	One per 20 samples per day when using non-dedicated sampling equipment
	Soil Samples	1 – 4-ounce glass container and 2 – 40-milliliter VOAs	MeOH (VOAs)				
MTCA VOCs (EPA Method 8260D)[2]	Groundwater Samples	3 – 40-milliliter VOAs	HCl, Sealed and Headspace Free	Analysis within 14 days from collection for preserved samples.	One for every 20 samples collected	1 each in cooler with VOC samples	One per 20 samples per day when using non-dedicated sampling equipment
	Soil Samples	1 – 4-ounce glass container and 2 – 40-milliliter VOAs					

Table 1
Field Sampling Summary
Quality Assurance Project Plan
Love's Travel Stop #413, 1512 HWY 97, Ellensburg, Washington

Parameter and Method	Matrix	Sample Containers and Volumes	Preservation	Holding Times	Quality Control Sample Frequency		
					Field Duplicate	Trip Blank	Field Rinsate Blank
Lead - Total and Dissolved (Field Filtered) (EPA Method 6020B)[3]	Groundwater Samples	1 – 250-milliliter polyethylene container	HNO_3	Analysis within 6 months from collection for preserved, field filtered samples.	One for every 20 samples collected	NA	One per 20 samples per day when using non-dedicated sampling equipment
Lead (EPA Method 6020B)[3]	Soil Samples	1 – 4-ounce glass container	NA	Analysis within 6 months from collection.			
PAHs (EPA Method 8270D)[4]	Groundwater Samples	1 – 500-milliliter amber glass	NA	Extract within 7 days from collection.	One for every 20 samples collected	NA	One per 20 samples per day when using non-dedicated sampling equipment
PAHs (EPA Method 8270E)[4]	Soil Samples	1 – 4-ounce glass container	NA	Extract within 14 days	One for every 20 samples collected	NA	One per 20 samples per day when using non-dedicated sampling equipment
MTCA VOCs/ Aliphatic and Aromatic TPH (EPA Method TO-15/TO-15-APH)[5]	Vapor Samples	1 – 1-liter or 6-liter Summa™ canisters	NA	Analysis within 30 days from collection.	One for every 20 samples collected	NA	NA

Table 1
Field Sampling Summary
Quality Assurance Project Plan
Love's Travel Stop #413, 1512 HWY 97, Ellensburg, Washington

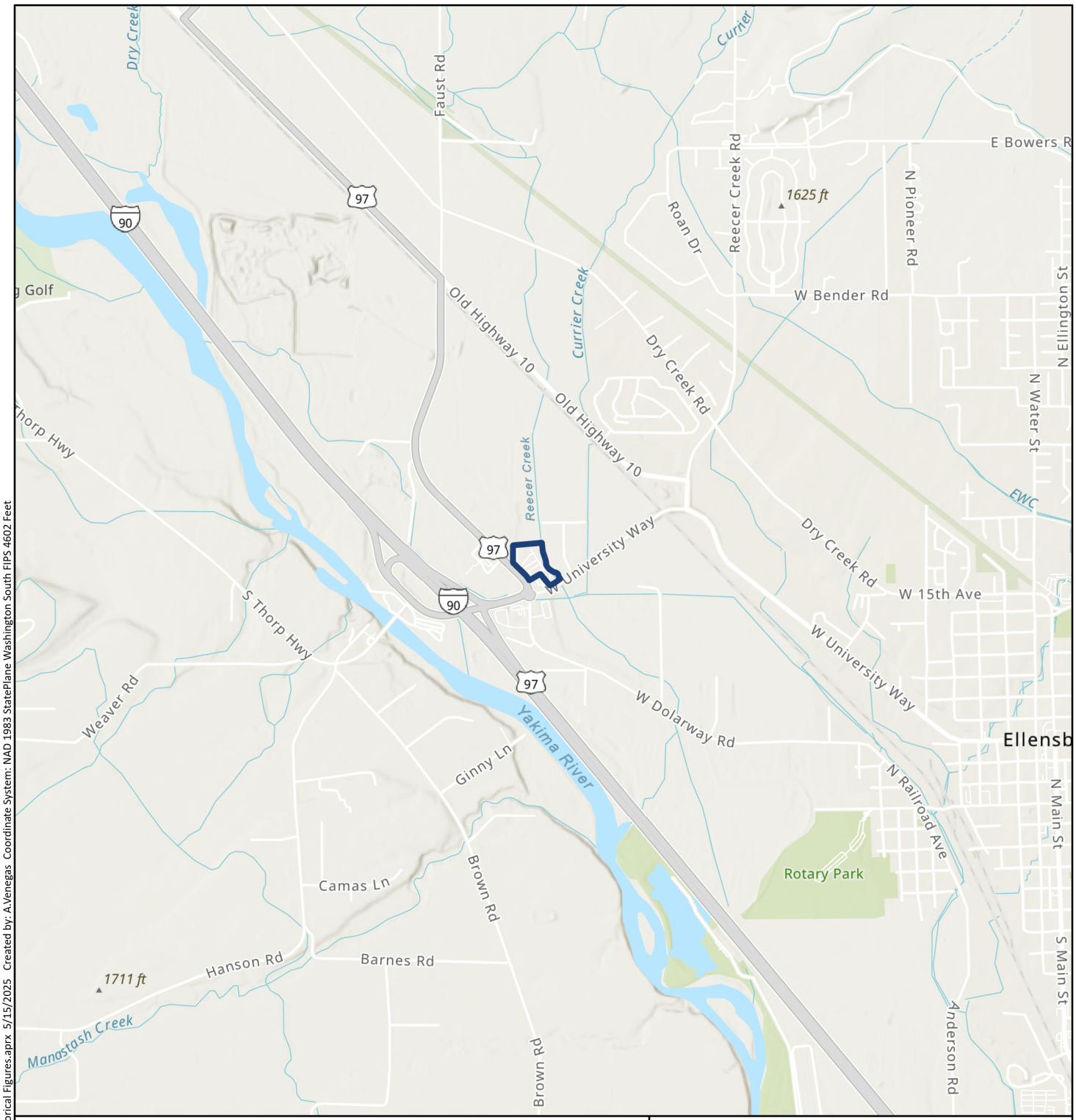
Parameter and Method	Matrix	Sample Containers and Volumes	Preservation	Holding Times	Quality Control Sample Frequency		
					Field Duplicate	Trip Blank	Field Rinsate Blank
Temperature, Conductivity, DO, ORP, Turbidity, and pH	Aqueous	Field collection and analysis	NA	NA	NA	NA	NA

Notes:
DO = dissolved oxygen
EPA = U.S. Environmental Protection Agency
EPH = extractable petroleum hydrocarbons
MTCA = Model Toxics Control Act
NA = not applicable
ORP = oxidation-reduction potential
PAH = polycyclic aromatic hydrocarbon
TPH = total petroleum hydrocarbon
TPH-d = diesel-range total petroleum hydrocarbon
TPH-g = gasoline-range total petroleum hydrocarbon
VOA = volatile organic analysis (glass container)
VOC **=** volatile organic compound
VPH = volatile petroleum hydrocarbons

Method References:
1- Washington Ecology. 1997. Analytical Methods For Petroleum Hydrocarbons. Publication Number ECY 97-602.
2- EPA. 2018. Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, SW-846, 3rd Edition. Update VI. Washington D.C.
3- EPA. 2014. Method 6020B (SW-846): Inductively Coupled Plasma-Mass Spectrometry, Revision 2. Washington, DC
4- EPA. 2018. Method 8270E (SW-846): Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry**.**
5- EPA. 1999. Air Method, Toxic Organics-15 (TO-15): Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition: Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially-Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry (GC/MS)." EPA 625/R-96/010b.

Figure

1 Site Location



0 1,250 2,500 5,000 Feet

1 inch = 2,500 feet

N

Legend

Site Boundary

Imagery Source: ESRI World Topographic Map

SAFETY FIRST	CLIENT: Love's Travel Stops	**Site Location**
terraphase engineering	PROJECT: Love's Travel Stop #413 1512 HWY 97, Ellensburg, WA	
	PROJECT NUMBER: W053.001.003	**FIGURE 1**

File: N:\GIS\Prj\W053_Loves Ellensburg\.001\Pro Project\Historical Figures.aprx 5/15/2025 Created by: A.Venegas Coordinate System: NAD 1983 StatePlane Washington South FIPS 4602 Feet

Appendix A

Laboratory Standard Operating Procedures and Quality Assurance Manuals

SOP Proprietary Information

ALLIANCE TECHNICAL GROUP, LLC - SEATTLE

STANDARD OPERATING PROCEDURE

This document has been prepared by and remains the sole property of Alliance Technical Group, LLC – Seattle (ATG Seattle). It is submitted to a client or government agency solely for its use in evaluating ATG Seattle's qualifications in connection with the particular project, Certification, or approval for which it was prepared and is to be held proprietary to ATG Seattle.

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Quality Assurance

Quality Assurance and Quality Control Programs

Alliance Technical Group, LLC - Seattle
3600 Fremont Ave N.
Seattle, WA 98103
206-352-3790

Matt Langston
Laboratory Director

Date 12/13/2024

Sean Galloway
Technical Director

Date 12/13/2024

Alex Kegley
Quality Assurance Manager

Date

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Revisions

Date	Revision #	Notation
7.18.07	1.1	Changed section 3.2 from FA-yymmdd to CHM-yymmdd
8.3.07	1.2	USDA APHIS PPQ regulations
8.3.08	1.3	General Edits and Revisions
10.20.08	1.4	General Edits and Revisions
02.15.09	1.5	Edits and Revisions (logo, syntax)
12.17.09	1.6	Updated Storage procedure re: Foreign Soil
12.22.09	1.7	Add Appendix (addendum): Foreign Soil
12.20.10	1.8	General Review
1.11.12	1.9	Edits and Revisions
3.21.12	2.0	Final
5.29.12	2.1	NELAC Edits
2.14.13	2.2	DoD Edits
6.25.13	2.3	DoD Edits – Final Review (MCR)
1.14.14	2.3.1	General Edits and Revisions (C.Ward)

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6.03.14	2.4	DoD Edits (Kari Scott, Erica Silva, M. Ridgeway)
4.16.15	2.5	Edits and Revisions (N. Masters)
2.18.16	2.6	Edits and Revisions (N. Masters)
2.23.16	2.7	Edits and Revisions (M. Dee)
3.1.16	2.8	Edits and Revisions (M. Ridgeway)
3.4.16	2.9	Edits and Revisions (N. Masters)
3.23.17	3.0	Edits and Revisions (N. Masters)
10.30.17	3.1	Edits and Revisions (E. Mar)
4.12.18	3.2	Edits, Revisions, and Review (E. Mar)
6.25.18-5.6.2019	3.3	Edits, Revisions, and Review (E. Mar, M. Ridgeway, S. Galloway)
4.13.20-5.3.20	3.4	Edits, Revisions, and Review (E.Mar, A. Kegley, M. Langston, S. Galloway)
8.3.20-8.14.20	3.5	Post-DOD Audit Edits (A. Kegley)
5.12.22	3.6	Edits and Review (A. Kegley)
4.18.23	3.7	Edits and Review (A. Kegley)
12.13.24	3.8	Edits and Review (A. Kegley)

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7. Essential Quality Control Elements

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1. INTRODUCTION AND SCOPE (TNI V1:M2 – SECTION 1, 2, 3)

1.1. The purpose of the Quality Assurance and Quality Manual is to outline the management systems for Alliance Technical Group, LLC – Seattle (ATG Seattle). The Quality Manual identifies the policies, procedures, and documentation that assure analytical services continually meet defined standards of quality, designed to provide clients with data of known and documented quality and, where applicable, demonstrate regulatory compliance.

1.2. The Quality Manual sets the standard under which all laboratory operations are performed, including the laboratory's organization, objectives, and operating philosophy. The Quality Manual has been prepared to assure compliance with the 2016 TNI Environmental Laboratory Sector Standard – Volume 1 – Management and Technical Requirements for Laboratories Performing Environmental Analysis (EL-V1-M1 through M7-ISO-2016) and the DoD Quality Systems Manual version 5.4. These Standards are consistent with ISO/IEC 17025:2017 requirements that are relevant to the scope of environmental testing services and thus, the laboratory operates a quality system in conformance with ISO/IEC 17025:2017. In addition, the policies and procedures outlined are compliant with the following accreditation and certification programs: Washington Department of Ecology, ORELAP (recognized by NELAP), and the Department of Defense.

1.3. The Quality Assurance and Quality Control (QAQC) Program is organized so that data produced from Alliance Technical Group, LLC – Seattle is traceable, reviewed multiple times and is of the utmost quality. The QAQC Program functions at the management level working through written standard operating procedures and overall laboratory quality control.

1.4. The QAQC Program provides a means by which the integrity of data can be verified. Because industrial, engineering, and environmental decisions are based on the data produced, it is essential that clear and extensive verification procedures exist and are followed. The precision, accuracy, comparability, and completeness criteria are all aspects of a data package that verify the integrity of the analysis.

1.5. Alliance Technical Group, LLC – Seattle follows approved methods (EPA, Standard Methods, ASTM, State specific methods) and has developed and implemented a quality assurance plan for a variety of laboratory analyses. The quality control program is blended with QC requirements to provide effective and efficient laboratory protocol. When it is necessary to deviate from standard methods, documentation is developed describing the properties of the method used.

1.6. The general quality assurance program utilized in each laboratory program includes considerations of the following areas:

- Personnel training
- Sample handling and control
- Equipment and supplies
- Equipment calibration and standards
- Quality control test samples
- Data handling and documentation

1.7. Laboratory training includes:

- Observing experienced operators/Chemists
- Studying applicable SOPs
- Performing analysis under direct supervision of experienced personnel
- Performing an Initial Demonstration of Capability
- Analyzing blind QC samples (if applicable)

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1.8. The Quality Assurance Manager coordinates quality assurance training. The training may consist of seminars addressing QC problems of general laboratory interest, and distribution of reports and manuals addressing QC issues.

2. SCOPE OF TESTING

2.1. Alliance Technical Group, LLC – Seattle analyzes water, drinking water, soil, sediment, oil, air, solid and wipe samples. The parameters/analytes measured, Method used and the laboratory SOPs can be found in Appendix C.

3. APPENDICES

*Note: Appendices may be updated independently of the QA Manual and will have individual revision numbers and dates.

3.1. Appendix A: Laboratory Organization Chart

3.2. Appendix B: Laboratory Floor Plan

3.3. Appendix C: Methods, SOP, and Analytes

3.4. Appendix D: Data Qualifiers

3.5. Appendix E: Chemistry

3.6. Appendix F: Instrumentation Listing/Support Equipment

3.7. Appendix G: Common Calculations

4. REFERENCES

4.1. 2016 NELAC Standards, 2016.

4.2. DoD Quality Systems Manual, Version 5.4 Final October 2021 (based on the NELAC Institute (TNI) Standards, Volume 1, September 2009, ISO/IEC 17025:2017 and ISO/IEC 17025:2005).

4.3. 2009 NELAC Standards, September 2009.

4.4. 40CFR part 136, Guidelines Establishing Test Procedures for the Analysis of Pollutants.

4.5. 40CFR part 141, National Primary Drinking Water Regulations.

4.6. Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans, QAMS-005/80, December 29, 1980, Office of Monitoring Systems and Quality Assurance, ORD, U.S. EPA, Washington, DC 20460.

4.7. RCRA QAPP Instructions, U. S. EPA Region 5, Revision: April 1998

4.8. ASTM D-5283-92. Generation of Environmental Data Related to Waste Management Activities: Quality assurance and Quality Control Planning and Implementation

4.9. “American National Standards Specification and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs (ANSI/ASQC E-4)”, 1994

4.10. EPA 2185 - Good Automated Laboratory Practices, 1995

4.11. ISO/IEC Guide 25: 1990. General requirements for the competence of calibration and testing laboratories

4.12. QA/R-2: EPA Requirements for Quality Management Plans, August, 1994

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4.13. QA/G-4: Guidance for the Data Quality Objectives Process EPA/600/R-96/055, September, 1994

4.14. QA/R-5: EPA Requirements for Quality Assurance Project Plans, Draft Final – October, 1998

4.15. QA/G-5: Guidance on Quality Assurance Project Plans, EPA/600/R-98/018, February, 1998

4.16. QA/G-6: Guidance for the Preparation of Standard Operating Procedures for Quality-Related Operations EPA/600/R-96/027, November, 1995

4.17. QA/G-9: Guidance for the Data Quality Assessment: Practical Methods for Data Analysis EPA/600/R-96/084, January, 1998

4.18. Manual for the Certification of Laboratories Analyzing Drinking Water EPA 815-r-05-004, January 2005, Fifth Edition.

4.19. Estimation of Analytical Measurement Uncertainty – Laboratory Quality and Accreditation Office Uncertainty Calculation SOP, https://www.denix.osd.mil/edqw/documents/reports/uncertainty-standard-operating-procedure/, Downloaded 2018.

4.20. Guidance for Obtaining Representative Laboratory Analytical Subsamples from Particulate Laboratory Samples, EPA/600/R-03/027, December 2003.

5. GLOSSARY AND ABBREVIATIONS USED

5.1. Glossary

5.1.1. **Accuracy**. The degree of agreement between an observed value and an accepted reference or true value. Laboratory accuracy is assessed through the analysis of MS/MSD, quality control check samples, laboratory control samples (LCS), and surrogate compound spikes for organic analyses as methods require. The accuracy of a result is affected by both systematic and random errors. Accuracy does not denote only systematic error. (See "bias".)

5.1.2. **Analyte**. Denotes 'that which is to be analyzed for' in chemical, but not physical or biological determinations.

5.1.3. **Analytical Method**. Denotes a set of written instructions specifying an analytical procedure followed by a Chemist to obtain a numerical estimate of the concentration of a determinant (analyte) in each of one or more samples.

5.1.4. **Analytical Response**. A numerical observation which is obtained when a portion of a sample is presented to a measurement sub-system (e.g., spectrophotometric measurement of the absorbency of a solution). The magnitude is related to the amount or concentration of the determinant (analyte) in that portion.

5.1.5. **Analytical Result**. Denotes a numerical estimate of the concentration of a determinant (analyte) in a sample, and is obtained by carrying out once the procedure specific in an analytical method. Note that a method may specify analysis of more than one portion of a sample to produce one analytical result. The result can also be thought of as the final value reported to the user.

5.1.6. **Analytical System**. Denotes a combination of Chemist, analytical method, equipment, reagents, standards, laboratory facilities, any other components involved in carrying out an analytical procedure.

5.1.7. **Bias**. The inaccuracy of an analytical result caused by systematic error. Bias is indicated by the mean value generated from a data set. For example, the mean value of recovery for a set of laboratory control samples will indicate the bias of the method results above or below the true sample value.

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5.1.8. **Calibration Standards**. Standards(s) of known concentration used in the calibration (standardization) procedure to determine the relationship between instrument response and concentration.

5.1.9. **Certified Reference Material**. Reference material that is supported by a certificate showing that the value and measurement uncertainty are traceable to a National Metrology Institute, such as NIST.

5.1.10. **Check Standard**. A solution of known concentration used to check the precision of analyses (and bias due to calibration). Used in conjunction with a control chart it becomes a control standard.

5.1.11. **Comparability.** An expression of the confidence with which one data set can be compared to another. Comparability is achieved by the use of routine analytical methods, achieving holding times, reporting results in common units, use of consistent detection levels, and consistent rules for reporting data.

5.1.12. **Duplicate (DUP)**. An intra-laboratory split sample documenting the precision of a method in a given sample matrix.

5.1.13. **External Standards**. Independently prepared standards used to determine the relationship between response and concentration. They are run separately from the samples.

5.1.14. **Initial Calibration**. A procedure, using a series of standards of different concentration to define the usable quantitation range of instrument. The initial calibration contains a minimum of three to five standards spanning from ten times the intended detection limit to the upper quantitation limit.

5.1.15. **Instrument Detection Limit (IDL)**. The Instrument Detection Limit (IDL) is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero.

5.1.16. **Interference**. A systematic error (bias) in the analytical result caused by the presence of a substance in the sample (or added to the sample during analysis).

5.1.17. **Internal Standard Standardization**. A calibration procedure in which the responses of analytes are determined relative to internal standards added to every sample. Used to reduce bias in calibration.

5.1.18. **Laboratory Control Sample (LCS)**. A method blank spiked with the analytes of interest at a concentration generally near the middle of the instrument calibration range. The recovery percent from this analysis is plotted to indicate the bias of the analytical method.

5.1.19. **Laboratory Information Management (LIM) System**. Sample and data management software. ATG Seattle uses Omega™ by Khemia Software, Inc.

5.1.20. **Limit of Detection (LOD).** The minimum concentration of a substance that can be detected at 3x the instrument signal to noise or greater.

5.1.21. **Limit of Quantitation (LOQ)**. The lowest concentration that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions. The LOQ is generally 2 to 10 times the LOD.

5.1.22. **Matrix Spike (MS)**. An aliquot of sample spiked with known concentrations of target analyte(s). Spiking occurs prior to sample preparation and analysis. A matrix spike is used to document the bias of a method in a given sample matrix.

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5.1.23. **Matrix Spike Duplicate (MSD)**. Intra-laboratory samples spiked with identical concentrations of target analyte(s). The spiking occurs prior to sample preparation and analysis. MSDs are used to document the precision and bias of a method in a given sample matrix.

5.1.24. **Method Blank (MB)**. A determination intended to estimate the analytical response attributable to all factors other than the determinant (analyte) in the sample. Blanks are analyzed identically to samples, but do not contain the determinant (analyte) (e.g., in water analyses, pure water is analyzed to determine the blank). Some use the term analytical blank with the same meaning given here for method blank. Not to be confused with the reagent blank.

5.1.25. **Method Detection Limit**. The Method Detection Limit (MDL) is defined as the minimum concentration of a substance that has gone through the preparation process, which can be measured and reported with 99% confidence that the analyte concentration is greater than zero. This limit is equal to or above the Instrument Detection Limit.

5.1.26. **Omega**. Omega is a laboratory information system (LIMS) specifically designed for environmental laboratories. Omega is capable of exporting (and importing) data directly to most PC based database formats or to fixed-field or delimited ASCII formats that are universally applicable across system platforms.

5.1.27. **Percent Recovery (%REC)**. That percent of a known amount of material spiked or added to a sample being analyzed which is recovered at the end of analysis.

5.1.28. **Percent Relative Standard Deviation (%RSD)**. The standard deviation relative to the mean. Also called 'coefficient of variation'.

5.1.29. **Practical Quantitation Limit (PQL)**. Limit to which analytical data is reported. The PQL is typically 3 times the MDL.

5.1.30. **Precision**. A measure of the degree to which two or more measurements are in agreement. Precision is assessed through the calculation of relative percent difference (RPD) and relative standard deviation (RSD) for replicate samples. Precision is assessed through the analysis of a sample/sample duplicate pair and/or Matrix Spike/Matrix Spike Duplicate (MS/MSD) pairs.

5.1.31. **Preparation Batch**. Environmental samples that are prepared and analyzed together with the same process, personnel, and reagents. Batches may have up to 20 environmental samples, unless otherwise specified, and have method-specified quality control samples that ensure preparation and analysis conditions are consistent with the QA program. The maximum amount of time between the start of processing the first and last sample in the batch is 24 hours.

5.1.32. **Quality Assurance (QA).** The total integrated program for assuring the reliability of monitoring and measurement data.

5.1.33. **Quality Control (QC)**. The routine application of statistically based procedures to evaluate and control the accuracy of results from analytical measurements.

5.1.34. **Random Errors**. Errors occurring when repeated analyses of identical portions of a homogeneous sample do not give a series of identical results. The results differ among themselves and are more or less scattered about some value. They are termed random because the sign and magnitude of the error of any particular result vary at random, and cannot be predicted exactly.

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5.1.35. **Reagent Blank**. Reagents used in the analyses that have not been subjected to the sample preparation (extraction) procedure. The reagent blank will generally be prepared in the same manner as the standards used in calibration. A reagent blank is used in Infrared and Atomic Absorption spectrometry to zero instrument readings before calibration or analysis. Also referred to as a zero blank.

5.1.36. **Recovery**. An estimate, usually expressed in percent, of an analytical result in comparison with a true or reference value for the analyte (e.g., an analytical recovery of 95% for compound 'X' means that the result was 95 % of the true or reference value for 'X' in the sample). It is a direct indication of analytical performance.

5.1.37. **Reference Material**. A material or substance one or more properties of which are sufficiently well established are used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials.

5.1.38. **Relative Error.** The absolute value of the percent difference between the measured value relative to its true value. It is generally applied to calibration points, which are required to be under a relative error threshold.

5.1.39. **Relative Percent Difference (RPD)**. The difference between two values determined by dividing the absolute of the difference between the first and second value by the average of the values.

5.1.40. **Representativeness.** An expression of the degree to which data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition within a defined spatial and/or temporal boundary. Representativeness is ensured by using the proper analytical procedures, appropriate methods, and meeting sample-holding times.

5.1.41. **Spike**. The addition of known amount of analyte to a sample for the purpose of judging, from the analytical percent recovery, whether there is bias due to interference present in the sample. Also referred to as fortification of the sample.

5.1.42. **Standard**. A solution of known concentration. There are two types of standards: check (or control) and calibration.

5.1.43. **Standard Operating Procedure (SOP)**. A detailed, written description of a procedure designed to systematize the performance of the procedure.

5.1.44. **Surrogate Standard**. A type of check standard. It is added to every sample in a known amount at the start of processing. The surrogate is not one of the target compounds for the analysis, but should have analytical properties similar to those compounds. The surrogate compounds are not expected to be present in environmental samples.

5.1.45. **Systematic Errors**. Errors which are indicated by a tendency of results to be greater or smaller than the true value. Usually bias can be considered to be equivalent to systematic error.

5.1.46. **Target Compound**. A compound expected in an environmental sample or for which the analysis is being conducted.

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Table 1: Abbreviations	
Abbreviation	**Definition**
AB	Accrediting Body
ANSI	American National Standards Institute
ASQC	American Society for Quality Control
ASTM	American Society for Testing and Materials
BLK	Blank
°C	Degrees Celsius
CAL	Calibration
CAS	Chemical Abstract Service
CCV	Continuing Calibration Verification
COC	Chain of Custody
CVAA	Cold Vapor Atomic Absorbance
CVAF	Cold Vapor Atomic Fluorescence
DO	Dissolved Oxygen
DOC	Demonstration of Capability
DoD	Department of Defense

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Table 1: Abbreviations	
Abbreviation	**Definition**
DUP	Duplicate
EPA	Environmental Protection Agency
ATG	Alliance Technical Group
FoPT	Field of Proficiency Testing
g/L	Grams per liter
GC-ECD	Gas Chromatography-Electron Capture Detector
GC-FID	Gas Chromatography –Flame Ionization Detector
GC-FID/PID	Gas Chromatography-Flame Ionization Detector/Photo Ionization Detector
GC-MS	Gas Chromatography-Mass Spectrometry
GC-TCD	Gas Chromatography-Thermal Conductivity Detector
IC	Ion Chromatography
ICP-MS	Inductively Coupled Plasma-Mass Spectrometry
ICV	Initial Calibration Verification
IDL	Instrument Detection Limit

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Table 1: Abbreviations	
Abbreviation	**Definition**
ISO/IEC	International Organization for Standardization/International Electrochemical Commission
LCS	Laboratory Control Sample
LFB	Laboratory Fortified Blank
LOD	Limit of Detection
LOQ	Limit of Quantitation
MB	Method Blank
MDL	Method Detection Limit
mg/Kg	Milligrams per kilogram
mg/L	Milligrams per liter
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NELAP	National Environmental Laboratory Accreditation Program
NIST	National Institute of Standards and Technology
PAH	Polycyclic Aromatic Hydrocarbon

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Table 1: Abbreviations	
Abbreviation	**Definition**
PCB	Polychlorinated Biphenyl
PQL	Practical Quantitation Limit
PT	Proficiency Test(ing)
PTP	Proficiency Testing Provider
QA	Quality Assurance
QC	Quality Control
QAM	Quality Assurance Manager
QM	Quality Manual
RL	Reporting Level
RPD	Relative Percent Difference
RSD	Relative Standard Deviation
SOPs	Standard Operating Procedures
SPK	Spike
STD	Standard
SVOC	Semi-Volatile Organic Compounds

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Table 1: Abbreviations	
Abbreviation	**Definition**
TNI	The NELAC Institute
TOC	Total Organic Carbon
µg/L	Micrograms per liter
µg/m^3	Micrograms per cubic meter
UV	Ultraviolet
VOC	Volatile Organic Compound

6. ORGANIZATION (TNI V1:M2 – SECTION 4.1)

6.1. The laboratory is a legally identifiable organization. The Tax ID number is available upon request. The laboratory operates at 3600 Fremont Ave. N. Seattle, Washington, 98103.

6.2. The laboratory is responsible for carrying out testing activities that meet the requirements of the TNI Standard, DoD QSM, State Accreditation authorities, and that meet the needs of the client. Through application of the policies and procedures outlined in this section and throughout the Quality Manual, Alliance Technical Group, LLC – Seattle is structured to ensure that the final data package produced for the client meets or exceeds regulatory standards.

6.3. An organization chart for Alliance Technical Group, LLC – Seattle is shown in Appendix A. Additional information regarding responsibilities, authority and interrelationship of personnel who manage, perform or verify testing is included in Section 7 –“Management” and Section 21 – “Personnel”. These Sections also include information on supervision, training, technical management, job descriptions, quality personnel, and appointment of deputies for key managerial personnel.

6.4. The laboratory has the resources and authority to operate a management system that is capable of identifying departures from that system and from procedures during testing, and initiates actions to minimize or prevent departures.

6.5. Management and technical personnel have the authority and resources to carry out their duties and have procedures to identify and correct departures from the laboratory’s management system.

6.6. Personnel understand the relevance and importance of their duties as related to the maintenance of the laboratory’s management system.

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6.7. Ethics and data integrity procedures (see SOP85, Section 7 – "Management" and Section 20 – "Data Integrity Investigations") ensure personnel do not engage in activities that diminish confidence in the laboratory's capabilities.

6.8. Confidentiality is maintained.

6.9. Conflict of Interest and Undue Pressure

6.9.1. The organizational structure indicated above minimizes the potential for conflicting or undue interests that might influence the technical judgment of analytical personnel. In addition, procedures are in place to prevent outside pressures or involvement in activities that may affect competence, impartiality, judgment, operational integrity, or the quality of the work performed at the laboratory.

6.9.2. All parties are required to act with complete integrity. If a conflict of interest issue arises, it is the responsibility of the Laboratory Director to resolve the conflict.

6.9.3. Arrangements, such as policies and procedures to prevent commercial, financial or other influences that may negatively affect the quality of the work or negatively reflect on the competence, impartiality, judgment or operational integrity are described in the Ethics and Data Integrity procedures.

6.9.4. Alliance Technical Group, LLC – Seattle must remain vigilant for conflicts of interest that may arise between the laboratory and clients, vendors, accrediting bodies or its own employees. If conflicts of interest are observed, they must be disclosed to upper management to allow for assessment of bias and potential impact on the laboratory. If a risk is identified, and management deems it a threat to ongoing data integrity, or other areas of concern, the risk will be minimized or eliminated. Each instance will require a case by case review of the details and a plan will be agreed upon by management.

6.9.4.1. Examples of actions that could be taken by the laboratory to eliminate or minimize risk include: changing the role of an employee to avoid ability to act on bias, enacting routine review of affected area by an unbiased party, or termination of relationship between the connected parties to eliminate impartiality.

7. MANAGEMENT (TNI V1:M2 – SECTION 4.2)

7.1. The laboratory maintains a management system that is appropriate to the scope of its activities.

7.2. Management Requirements

7.2.1. Senior management includes the Laboratory Director, Technical Director, and the Quality Assurance Manager (QAM). Management's commitment to good professional practices and to the quality of its products is defined in the Quality Policy in Section 7.4.

7.2.2. Management has overall responsibility for laboratory operations and the authority needed to generate the required quality of laboratory operations.

7.2.3. Management ensures communication within the organization to maintain an effective management system and to communicate the importance of meeting customer, statutory, and regulatory requirements.

7.2.4. Management ensures that the system of documentation is known and available so that appropriate personnel can implement their part. When changes to the management system occur or are planned, managers ensure that the integrity of the system is maintained.

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7.2.5. Management is responsible for carrying out testing activities that meet the requirements of the TNI Standard, the ISO/IEC 17025 Standard, State Accreditation authorities, and that meet the needs of the client.

7.2.6. Managers implement, maintain, and improve the management system, and identify noncompliance with the management system of procedures.

7.2.7. Managers initiate actions to prevent or minimize noncompliance.

7.2.8. Management ensures technical competence of personnel when operating equipment, performing tests, evaluating results, or signing reports and limits authority to perform laboratory functions to those appropriately trained and/or supervised. Hiring is based on education and/or years of work experience.

7.2.9. Management is responsible for defining the minimal level of education, qualifications, experience, and skills necessary for all positions in the laboratory and assuring that technical staff have demonstrated capabilities in their tasks.

7.2.10. Training is kept up to date as described in Section 21 – "Personnel" by periodic review of training records and through employee performance review.

7.2.11. Management bears specific responsibility for maintenance of the management system. This includes defining roles and responsibilities to personnel, approving documents, providing required training, providing a procedure for confidential reporting of data integrity issues, and periodically reviewing data, procedures, and documentation. The assignment of responsibilities, authorities, and interrelationships of the personnel who manage, perform, or verify work affecting the quality of environmental tests is documented in their job descriptions. Management ensures that audit findings and corrective actions are completed within required time frames.

7.2.12. Designated deputies are appointed by management during the absence of the Laboratory Director, Technical Director, or the QAM. This is a requirement if the absence is more than 15 days.

7.2.13. If a member of the Senior Management team is absent for more than 35 days, the accrediting bodies will be notified in writing.

7.3. Management Roles and Responsibilities

7.3.1. Laboratory Director

The Laboratory Director is responsible for the overall quality, safety, financial, technical, human resource, and service performance of the laboratory. The Laboratory Director provides the resources necessary to implement and maintain an effective quality and data integrity program. The Laboratory Director is responsible for:

- Defining the minimal level of experience and skills necessary for all positions in the laboratory;
- Ensuring that the training of its personnel is up-to-date;
- Documenting all analytical and operational activities;
- Overseeing preparation of analytical reports;
- Acts as an approved signatory;
- Supervising all personnel;
- Ensuring that all sample acceptance criteria is verified, and that samples are labeled, stored, and properly logged into the sample tracking system;
- Reviewing an annual Management System Review from the QAM;
- Documenting the quality of data reported by the laboratory;

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- Ensuring that the laboratory has the appropriate resources and facilities to perform requested work;
- Ensuring that personnel are free from any commercial, financial and other undue pressures that might adversely affect the quality of their work. Procedures that do not meet the standards set forth in the Quality Manual, laboratory SOPs or laboratory policies may be temporarily suspended by the Laboratory Director.
- Ensuring that all analysts and supervisors have the appropriate education and training to properly carry out the duties assigned to them and ensures that this training has been documented.
- Ensuring that appropriate corrective actions are taken to address analyses identified as requiring such actions by internal and external performance or procedural audits.
- Works with the Technical Director and QAM in the review and approval of SOPs and policies prior to their implementation and ensures all approved SOPs and policies are provided to laboratory personnel and are adhered to.
- Nominating deputies when the Technical Director or QAM is absent.
- Coordinating laboratory certifications with the QAM.
- In the event the Laboratory Director is absent from the facility, the Technical Director and/or the QAM or other designee will assume those duties.

7.3.2. Technical Director

The Technical Director supervises laboratory operations. The Technical Director's proof of experience in the fields of accreditation may be found in the employees' file. The Technical Director is responsible for:

- Staff Supervision (Laboratory Managers);
- Coordinating laboratory analyses;
- Overseeing data review;
- Acts as an approved signatory;
- Technical training and aptitude of the laboratory personnel, ensuring that all technical laboratory staff have demonstrated initial and ongoing proficiency in the activities for which they are responsible;
- Maintenance of Analytical Systems and other technologies utilized by the laboratory;
- Review of all testing procedures for improved performance and reduced cost;
- New Method Development and all R&D efforts;
- General Technical Assistance and troubleshooting of laboratory instrumentation;
- Reviews and approves SOPs and policies prior to their implementation and ensures all approved SOPs and policies are provided to laboratory personnel and are adhered to;
- Ensuring all analytical and operational activities are documented;
- Ensuring that the laboratory has the appropriate resources and facilities to perform requested work;
- Equipment purchases
- Certifying that personnel with appropriate educational and/or technical background perform all tests for which the laboratory is accredited;
- The Technical Director(s) meet the requirements specified in the Personnel Qualifications, NELAC, Accreditation Process, in Sections 4.1.7.2 and 5.2.6.1 of the TNI Standard - EL-V1M2-2016;

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- When the Technical Director is absent from the facility, the QAM and/or the Laboratory Director will assume the duties of the Technical Director.

7.3.3. Quality Assurance Manager

The QAM is responsible for the oversight and review of quality control data. As shown in Appendix A, the QAM has direct access to the Laboratory Director, to resolve any dispute involving data quality. The QAM's training and proof of experience in QA/QC procedures, knowledge of analytical methods, and the laboratory's management system are available in the employees' file. The QAM is responsible for auditing the implementation of the Quality System. The QAM has sufficient authority to stop work as deemed necessary in the event of serious QA/QC issues. Specific functions and duties include:

- Providing QA technical assistance to project staff;
- Reporting on the adequacy, status, and effectiveness of the Quality System regularly to the Laboratory Director;
- Overseeing laboratory QA;
- Overseeing QA/QC documentation;
- Acts as an approved signatory;
- Implementing and reviewing laboratory corrective actions, if necessary;
- Defining appropriate laboratory QA procedures;
- Reviewing and approving QA plans and procedures;
- Maintain documentation control;
- Maintaining a current QA Manual;
- Approving the title page of the QA Manual;
- Serving as the focal point for QA/QC and being responsible for the oversight and/or Review of quality control data;
- Ensuring that corrective actions relating to findings from the audits (internal/external) are completed;
- Having documented training and/or experience in QA/QC procedures and being knowledgeable in the quality system as defined under NELAC; having a general knowledge of the analytical test methods for which data review is performed;
- Conducting internal audits without outside (e.g., managerial) influence; on the entire technical operation at a minimum annually (this may include a system audit);
- Notifying laboratory management of deficiencies in the quality system and monitoring corrective action;
- Monitoring and maintaining laboratory certifications.
- Documenting all analytical and operational activities;
- Reviews and approves SOPs and policies prior to their implementation and ensures all approved SOPs and policies are provided to laboratory personnel and are adhered to.

7.3.4. Laboratory Manager

A Laboratory Manager is expected to perform the same responsibilities as the Laboratory Analysts (see 21.2). However, a Laboratory Manager is designated to individuals who have obtained and demonstrated thorough knowledge of procedures and are capable of performing managerial duties. The responsibilities of a Laboratory Manager are:

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- Oversee and manage the department to which they are assigned
- Ensure QA and QC measures are being followed by the assigned department
- Assist with technical operations
- Work with Technical Director and QAM to develop modified or new analytical methods
- Approve requests of necessary supplies for the department
- Propose equipment purchases
- Preserve and prepare samples
- Perform analyses
- Report results
- Ensure routine maintenance of equipment is performed
- Ensure laboratory data is delivered on time
- Ensure data backups are occurring on laboratory workstations
- Review analytical data
- Ensure that laboratory spaces are clean and safe
- Laboratory Managers may meet the requirements specified in the Personnel Qualifications, NELAC, Accreditation Process, in Sections 4.1.7.2 and 5.2.6.1 of the TNI Standard - EL-V1M2-2016.

7.3.5. Technical Project Manager

Project Managers are responsible for sending out project reports. They are able to perform the same responsibilities as Project Coordinators. The responsibilities of Project Managers are as follows:

- Acts as an approved signatory for project reports;
- Sends project reports;
- Generate electronic data deliverables (EDDs)
- Able to interpret results to clients;
- Interfacing with clients in a professional and friendly manner to serve as a liaison between them and the laboratory
- Maintaining records and contracts
- Managing client expectations
- Reviewing and interpreting client Sample Analysis Plans (SAP), permits, Quality Assurance Project Plans (QAPP), insurance requirements, and general project needs to ensure that we are able to successfully fulfill their requests
- Assist with company marketing
- Creating project quotes, invoices, and statements
- Accounts receivable
- Sample log in
- Creating bottle orders.

7.3.6. Client Services Manager

The Client Services Manager is expected to perform the same responsibilities as the Project Coordinator while overseeing the department. The responsibilities of the Client Services Manager are as follows:

- Interfacing with clients in a professional and friendly manner to serve as a liaison between them and the laboratory
- Maintaining records and contracts

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- Managing client expectations
- Reviewing and interpreting client Sample Analysis Plans (SAP), Quality Assurance Project Plans (QAPP), permits, insurance requirements, and general project needs to ensure that we are able to and successfully fulfill their requests
- Assist with company marketing
- Creating project quotes, invoices, and statements
- Accounts receivable
- Sample log in
- Creating bottle orders.

7.3.7. The following table defines who assumes the responsibilities of key personnel in their absence:

Table 2: Key Personnel Deputies	
Key Personnel	Deputy
Laboratory Director	QA Manager or Technical Director
QA Manager	Technical Director
Technical Director	QA Manager or Laboratory Director
Laboratory Manager	Laboratory Manager, Analyst, or Technical Director

7.4. Management Systems Quality Policy

7.4.1. The overall QA objectives for Alliance Technical Group, LLC – Seattle are to develop and implement procedures for laboratory analysis, sample management, and data reporting, that will provide results of known and documented quality. The quality of data is assessed for precision, accuracy, representativeness, comparability, completeness, and detection limits based upon data quality objectives detailed in this QA/QC Program. Data quality is assessed by various means, including traceability of standards, instrument performance, spike and duplicate sample analyses, and internal and external performance audits.

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7.4.2. Management's commitment to quality and to the management system is stated in the Quality Policy above, which is upheld through the application of related policies and procedures described in the laboratory's Quality Manual, SOPs and policies. The objectives of the management system and the commitment of management are to consistently provide our customers with data of known and documented quality that meets their requirements. Our policy is to use good professional practices, maintain quality, uphold the highest quality of service, and comply with the TNI Standard, DoD/ELAP and State accreditation authorities. The laboratory ensures that personnel are free from any commercial, financial, and other undue pressures, which might adversely affect the quality of work. This policy is implemented and enforced through the unequivocal commitment of management, at all levels, to the Quality Assurance principles and practices outlined in this manual. However, the primary responsibility for quality rests with each individual within the laboratory organization. Every laboratory employee must ensure that the generation and reporting of quality analytical data is a fundamental priority. Every laboratory employee is required to familiarize themselves with the quality documentation and to implement the policies and procedures in their work. All employees are trained annually on ethical principles and procedures surrounding the data that is generated. The laboratory maintains a strict policy of client confidentiality.

7.5. Ethics and Data Integrity System

The laboratory has an Ethics and Data Integrity policy that is included in SOP85. The laboratory's Ethics and Data Integrity program, training and investigations are discussed in Section 20 – "Data Integrity Investigations".

The management system is defined through the policies and procedures provided in this Quality Manual, written laboratory Standard Operating Procedures (SOPs), and policies.

7.5.1. Quality Manual

The Quality Manual contains or references required elements as defined in the TNI Standard – V1:M2, section 4.2.8.4, as well as the following required items:

- Document title;
- Laboratory's full name and address;
- Name, address (if different from above), and telephone number of individual(s) responsible for the laboratory;
- Identification of all major organizational units which are to be covered by this quality manual and the effective date of the version;
- Identification of the laboratory's approved signatories;
- The signed and dated concurrence (with appropriate names and titles), of all responsible parties including the Quality Assurance Manager, Technical Director, and the agent who is in charge of all laboratory activities, such as the Laboratory Director or Laboratory Manager;
- The objectives of the management system and contain or reference the laboratory's Policies and procedures;
- The laboratory's official quality policy statement, which shall include management system objectives and management's commitment to ethical laboratory practices and to upholding the requirements of this Standard; and
- A table of contents, and applicable lists of references, glossaries and appendices.

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7.5.2. Standard Operating Procedures (SOPs)

Standard operating procedures (SOPs) represent all phases of current laboratory operations. They include an effective date, revision number, and signature of the approving authorities and are available to all personnel. They contain sufficient detail such that someone with similar qualifications could perform the procedures. There are two types of SOPs used in the laboratory: 1) test method SOPs, which have specific requirements as outlined below, and 2) general use SOPs which document general procedures. Details for writing and who approves SOP can be found in SOP56.

Each accredited analyte or method has an SOP. Sometimes an SOP is a copy of a method, and any additions are clearly described. The laboratory's test method SOPs include the following topics, where applicable.

- Identification of the method;
- Applicable matrix or matrices;
- Limits of detection and quantitation;
- Scope and application, including parameters to be analyzed;
- Summary of the method;
- Definitions;
- Interferences;
- Safety;
- Equipment and supplies;
- Reagents and standards;
- Sample collection, preservation, shipment and storage;
- Quality control;
- Calibration and standardization;
- Procedure;
- Data analysis and calculations;
- Method performance;
- Pollution prevention;
- Data assessment and acceptance criteria for quality control measures;
- Corrective actions for out-of-control data;
- Contingencies for handling out-of-control or unacceptable data;
- Waste management;
- References; and
- Any tables, diagrams, flowcharts and validation data.

7.5.3. Order of Precedence

In the event of a conflict or discrepancy between policies, the order of precedence is as follows unless otherwise noted:

1. Quality Manual
2. SOPs and Policies
3. Other (Work Instructions, memos, flow charts, etc.)

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8. DOCUMENT CONTROL (TNI V1:M2 – SECTION 4.3)

8.1. This section describes how the laboratory establishes and maintains a process for document management. The purpose of document management is to preclude the use of invalid and/or obsolete documents. Procedures for document management include controlling, distributing, reviewing, and accepting modifications. A document control system is used to ensure that all staff has access to current policies and procedures at all times.

8.2. Documents can be SOPs, policy statements, specifications, calibration tables, charts, textbooks, posters, notices, memoranda, software, drawings, plans, etc. These may be on various media, whether hard copy or electronic, and they may be digital, analog, photographic or written.

8.3. The system consists of a document review, revision, approval system, document control and distribution. The laboratory manages three types of documents: 1) controlled, 2) approved, and 3) obsolete.

8.4. A controlled document is one that is uniquely identified, issued, tracked, and kept current as part of the management system. Controlled documents may be internal documents or external documents.

8.5. An approved document means it has been reviewed, and either signed and dated, or acknowledged in writing or by secure electronic means by the issuing authority(ies).

8.6. Obsolete documents are documents that have been superseded by more recent versions or are no longer needed.

8.7. Controlled Documents

8.7.1. The QAM controls all laboratory SOPs and the Quality Manual. Documents will be reviewed, revised (as appropriate), and approved by the Laboratory Director and/or Technical Director (or designee) and the QAM (or designee). Documents are reviewed annually (or as needed) to ensure their contents are suitable and in compliance with the current management systems requirements, and accurately describe current operations. The QAM, Technical Director or Laboratory Director may approve SOPs. The QAM has the authority to modify or update the Quality Assurance Manual. The Laboratory Director is responsible for final approval of all changes made to the Quality Assurance Manual. The revised document takes effect when signed and dated by the Laboratory Director.

8.7.2. Approved copies of documents are available to staff at all locations where operations are essential to the effective functions of the laboratory. SOPs are attached to the Documents and SOPs section of the Omega LIM System and are available to all employees. Only the current, un-editable SOP is available for use. All archived and editable versions of SOPs are stored within the SOPs folder on the shared drive. Access to this folder is limited to those parties that have administrative privileges. The documents are approved by the Laboratory Director or QAM, and then loaded into Omega.

8.7.3. If printed, the SOP is considered “uncontrolled.” Uncontrolled documents are not permitted for use. Controlled hard copies may be provided to individuals in the laboratory at the discretion of the QAM. The QAM maintains a distribution list for numbered and dated controlled hard copies and ensures that revisions are distributed appropriately. Outdated revisions issued to the staff are retrieved and destroyed.

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8.7.4. All SOPs and the Quality Assurance Manual have electronic signatures showing the approving party. The electronic signatures are added to the document by the approving manager (QAM, Technical Director or Laboratory Director). These individuals have access to their electronic signatures and the Laboratory Director has access to all electronic signatures. The signatures may be stored in the Omega LIM system and are accessible by those parties that have administrative privileges. Secondary copies of electronic signatures are stored in a SQL Database file and can only be accessed by the Laboratory Director.

8.7.5. When an SOP is no longer valid, the SOP is marked as void or deleted in Omega. The updated SOP is then loaded into Omega. The QAM keeps a list of all SOPs and the date of revision.

8.7.6. Controlled internal documents are uniquely identified with 1) a unique name or number identification, 2) revision identification, 3) page number, 4) the total number of pages (or a mark to indicate the end of the document), and 5) the signatures of the issuing authority when applicable (i.e. management), see SOP56.

8.7.7. A master list of controlled internal documents is maintained that includes location and revision dates. The controlled document list is maintained by QAM and is updated whenever there is a change to any controlled documents.

8.7.8. Controlled copies of the Quality Manual and other SOPs may be issued to clients upon request. Additional issuance of subsequent versions is also by request only. The QAM will maintain a list of documents that go out to clients. Each document issued to clients must have a confidentiality statement disclosing who is authorized to view it.

8.8. Document Changes to Controlled Documents

8.8.1. Document changes are approved by the original approving authority.

8.8.2. All document modifications must be approved; changes that are not process modifications but clarifications may be performed without revision, however approval is required. The modified document is then copied and distributed, and obsolete documents are removed according to the master list of controlled documents.

8.8.3. Amendments/modifications to documents are incorporated into a new revision and reissued when the document is reviewed and updated.

8.8.4. A reason for the modification or change can be provided as historical information in the revised document. See SOP53.

8.9. Obsolete Documents

8.9.1. All invalid or obsolete documents are removed from general distribution, or otherwise prevented from unintended use.

8.9.2. Obsolete documents retained for legal use or historical knowledge preservation are appropriately marked and retained. An electronic copy is stored for a minimum of 5 years.

8.9.3. Obsolete documents are identified as being obsolete by management. All copies of the obsolete document are collected from employees. Electronic copies of obsolete documents are moved to an “Archive” folder within its originating folder. All printed copies are destroyed (unless they contain records in which case, they are filed appropriately). Copies in Omega are marked void or deleted and replaced with the new document.

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9. REVIEW OF REQUESTS, TENDERS, AND CONTRACTS (TNI V1:M2 – SECTION 4.4)

9.1. The review of all new work assures that oversight is provided so that requirements are clearly defined, the laboratory has adequate resources and capability, and the test method is applicable to the customer's needs. This process assures that all work will be given adequate attention without shortcuts that may compromise data quality.

9.1.1. A more detailed procedure is outlined in SOP 7.

9.2. Contracts for new work may be formal bids, signed documents, verbal, or electronic. The client's requirements, including the methods to be used, must be clearly defined, documented and understood. Requirements might include target analyte lists, project specific reporting limits (if any), project specific quality control requirements (if any), turnaround time, and requirements for data deliverables. The review must also cover any work that will be subcontracted to another laboratory.

9.3. Procedure for the Review of Work Requests

9.3.1. The Laboratory Director, Technical Director, or designee, determine if the laboratory has the necessary accreditations, resources, including schedule, equipment, deliverables, and personnel to meet the work request.

9.3.2. Project Manager, Client Services Representation and/or the Laboratory Director obtains the client requirements which may include the following:

- Sample matrices
- Sample volume requirements
- Analytical methods
- Analyte lists
- Reporting limits
- Minimum Detection limits
- Quality Control limits
- Certification/Accreditation
- Turn-around times
- QA/QC data packages
- Final report formatting and electronic deliverable documents
- Payment terms
- Sample storage
- Sample disposal

9.3.3. This information is kept in the Omega LIM system, the ATG Seattle online server, and accounting system.

9.3.4. If there are questions or concerns about meeting the project objectives, the Project Manager and/or Laboratory Director will hold a review meeting to discuss the criteria.

9.3.5. The Laboratory Director, Laboratory Manager and/or Project Manager informs the client of the results of the review if it indicates any potential conflict, deficiency, lack of accreditation, or inability of the lab to the complete the work satisfactorily.

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9.3.6. The client is informed of any deviation from the contract including the test method or sample handling processes. All differences between the request and the final contract are resolved and recorded before any work begins. It is necessary that the agreement be acceptable to both the laboratory and the client. Any modifications are recorded within Alliance Technical Group, LLC - Seattle's LIM and accounting system and distributed in the form of a quote to the client.

9.3.7. The review process is repeated when there are amendments to the original scope of work by the client. Participating personnel are given copies of the amendments. The amendments are maintained within the client's folder on the fa-server Shared drive and accounting system.

9.3.8. For routine projects and other simple tasks, a review by the Project Manager is considered adequate. The Project Manager confirms that the laboratory has any required certifications, that it can meet the client's data quality and reporting requirements, and that the lab has the capacity to meet the clients turnaround needs.

9.3.9. The Project Manager submits the bid and formal quote to the client and maintains copies of any signed agreements or contracts.

9.4. Documentation of Review

9.4.1. Records are maintained for every contract or work request, when appropriate. This includes pertinent discussions with a client relating to the client's requirements or the results of the work during the period of execution of the contract. This information is maintained in the client's folder on the fa-server Shared drive.

9.4.2. Records of all project-related communication with the client (including e-mails, faxes, telephone conversations, etc.) are maintained in the project work order, project folder in the Project Manager's email.

9.4.3. All changes to work orders are maintained in the Omega LIM system.

10. SUBCONTRACTING OF ENVIRONMENTAL TESTS (TNI V1:M2 – SECTION 4.5)

10.1. A subcontract laboratory is defined as a laboratory external to this laboratory, or at a different location than the address indicated on the front cover of this manual, that performs analyses for this laboratory.

10.2. When subcontracting analytical services, the laboratory assures the work requiring accreditation is placed with an appropriately accredited laboratory or one that meets applicable statutory and regulatory requirements for performing the tests.

10.3. The laboratory will ensure that the subcontract laboratory understands the requirements and will meet the same commitments made to the client by the primary laboratory.

10.4. Procedure

10.4.1. The Client Services Manager maintains a database of subcontractors and reference file of their accreditations. The subcontracting laboratory's certificate and analyte list are reviewed by the QAM to ensure it has the appropriate accreditation.

10.4.2. Client Services notifies the client of the intent to subcontract the work in writing and requests written approval.

10.4.3. The laboratory performing the subcontracted work is identified in the final report.

10.4.4. The laboratory assumes responsibility for all subcontracting laboratories' work, except in the case where the client or a regulating authority requested or required a specific subcontracting lab be used.

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10.5. Further information regarding subcontracting of environmental tests is found in SOP 66.

11. PURCHASING SERVICES AND SUPPLIES (TNI V1:M2 – SECTION 4.6)

11.1. The laboratory ensures that purchased supplies and services that affect the quality of environmental tests are of the required or specified quality, by using approved suppliers and products. The laboratory has procedures for purchasing, receiving, and storage of supplies that affect the quality of environmental tests.

11.2. Approval of Suppliers

11.2.1. Management maintains a list of approved suppliers. Evaluation and selection of suppliers and vendors is performed, in part, on the basis of the quality of their products, their ability to meet the demand for their products, the overall quality of their services, their past history, and competitive pricing. This is achieved through the evaluation of objective evidence of quality, furnished by the supplier, which may include certificates of analysis, recommendations, and proof of historical compliance with similar programs to other clients. To ensure that quality critical consumables and equipment conform to specified requirements, all purchases from specific vendors are approved by the Technical Director.

11.2.2. Evaluation of suppliers is accomplished by ensuring the supplier ships the product or material ordered and that the material is of the appropriate quality. This is documented by signing off on the packing slips or other supply receipt documents. The purchasing documents contain data that adequately describes the services and supplies ordered.

11.3. Procedure

11.3.1. The Technical Director, Laboratory Director, or designee reviews and approves the supplier of services and supplies and approves technical content of purchasing documents to the Purchasing Manager prior to ordering.

11.3.2. The supplies received are inspected for breakage, leaks or any other damage. The supplies and chemicals are checked for date of manufacture, expiration date, concentration, grade, storage conditions, etc. (where applicable). Chemicals are then checked into Omega LIM System and labeled with an Omega number. The supplies received are stored according to manufacturer's recommendations, laboratory SOPs, or test method specifications.

11.3.3. Any documents received with the laboratory supplies (such as bottle ware) including specifications, certificates of analysis, warranties, maintenance records, calibration records, etc., are kept on file by the supplier. For items such as chemicals, standards, instrumentation etc. any certificates received are scanned and attached into the Omega record.

11.3.4. Purchased supplies and reagents that affect the quality of the tests are not used until they are inspected or otherwise verified as complying with requirements defined in the test method.

11.4. Purchase of New Equipment

11.4.1. The purchase of new equipment is reviewed by the Laboratory Director, Technical Director, and ATG corporate if necessary. During the review the need for the equipment is discussed as well as budget, technical criteria, and cost effectiveness. Once the new equipment is approved, quotes are requested from the suppliers.

11.5. SOP 5 and SOP 6 contain further information regarding ATG Seattle's procedure for purchasing and order receipt.

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12. SERVICE TO THE CLIENT (TNI V1:M2 – SECTION 4.7, 4.8)

12.1. The laboratory collaborates with clients and/or their representatives in clarifying their requests and in monitoring laboratory performance related to their work. Each request is reviewed to determine the nature of the requirements and the laboratory's ability to comply within the confines of prevailing statutes and/or regulations without risk to the confidentiality of other clients.

12.2. Client Confidentiality

12.2.1. The laboratory's confidentiality policy is not to divulge or release any information to a third party without proper authorization. Third party requests for data and information are referred to the client. Data and records identified as proprietary, privileged, or confidential are exempt from disclosure.

12.2.2. All electronic data (storage or transmissions) are kept confidential, based on technology and laboratory limitations, as required by the client or regulations.

12.2.3. Laboratory results and associated raw data are kept in confidence. Only the client may have access to the files. Access to laboratory records and LIMS data is limited to laboratory personnel except with the permission of the QAM, Technical Director, or the Laboratory Director. Records are made available to authorized accrediting authority personnel during on and off-site audits.

12.2.4. Where clients require transmission of test results by telephone, facsimile, or other electronic means, staff will ensure confidentiality is preserved.

12.3. Client Support

12.3.1. Communication with the client or their representative is maintained to provide proper instruction and modification for testing. Technical staff is available to discuss any technical questions or concerns the client may have.

12.3.2. The client or representative may be provided reasonable access to laboratory areas for witnessing testing, as long as the Laboratory Director and Laboratory Manager has been informed and has approved the request.

12.3.3. Delays or major deviations to the testing are communicated to the client immediately. The client is contacted by a Project Manager (or designee) by phone or email.

12.3.4. The laboratory will provide the client with all requested information pertaining to the analysis of their samples. An additional charge may apply for additional data/information that was not requested prior to the time of sample analysis or previously agreed upon.

12.4. Client Feedback

12.4.1. The laboratory seeks both negative and positive feedback following the completion of projects and periodically for ongoing projects. Feedback provides acknowledgement, and corrective actions when necessary.

12.4.2. Clients may supply feedback via the Alliance Technical Group, LLC - Seattle portal (Called "Flashpoint"). Within the portal the client may select to provide feedback for one of the following sections:

- Technical
- Online Account
- Billing
- Other

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12.4.3. The feedback form will automatically send an email to service@fremontanalytical.com and send an automated courtesy response to the client. This email is then distributed to the Laboratory Directory, QAM, Project Manager and Client Services Manager. For an active project, the Project Manager or Laboratory Director will coordinate the appropriate responses. For all other inquiries, the Laboratory Director (or designee) will coordinate the responses.

12.4.4. Clients may also supply feedback by sending an email directly to service@fremontanaytical.com, info.seattle@alliancetg.com, or to any laboratory staff.

12.5. Complaints

12.5.1. The purpose of this section is to assure that customer complaints are addressed, monitored and corrected. This includes requests to verify results or analytical data. Complaints provide the laboratory an opportunity to improve laboratory operation and client satisfaction.

12.5.2. Complaints by customers or other parties are reviewed by management so that appropriate action will be determined. All customer complaints are documented by the person receiving the complaint and addressed to the responsible manager. Negative customer feedback is documented as a customer complaint.

12.5.3. If it is determined that the complaint has merit, the procedures outlined in Section 15 – Corrective Action are utilized. If it is determined that a complaint is without merit, it is documented, and the client is contacted by the Laboratory Director. The details for handling customer complaints and feedback are in SOP63. In either case, the outcome of the complaint resolution process must be reviewed by an individual not involved in the original activities in question, and the client shall be notified of the end of the review process. Further details for handling customer complaints and feedback are in SOP63.

12.5.4. A complaint such as a concern that data is repeatedly late should be reviewed for preventive action (see Section 17 – “Preventive Action”) to minimize a future occurrence.

13. CONTROL OF NON-CONFORMING ENVIRONMENTAL TESTING WORK (TNI V1:M2 – SECTION 4.9)

13.1. Non-conforming work is work that does not meet acceptance criteria or requirements. Nonconformances can include departures from standard operating procedures or test methods, or unacceptable quality control results (see Section 28 – “Quality Assurance for Environmental Testing”). Identification of non-conforming work can come through customer complaints, quality control, instrument calibration, evaluating consumable materials, staff observation, final report review, management reviews, and internal and external audits.

13.2. Exceptionally Permitting Departures from Documented Policies and Procedures

13.2.1. Requests for departures from laboratory procedures are approved by the Laboratory Director and documented. Planned departures from procedures or policies do not require audits or investigations.

13.2.2. If a client requests a departure from laboratory procedures, the laboratory does not have to consider that departure as a nonconformance that requires corrective action. However, that nonconformance must be documented as a nonconformance that was approved by management. Departures are noted on the sample check-in form or in the case narrative in Omega.

13.2.3. Below are examples of departures:

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- Insufficient sample volume for a rerun;
- Holding time has already been exceeded
- Sample data is not affected by the nonconformance

13.3. Non-Conforming Work

13.3.1. Laboratory policy for control of non-conforming work is to identify the nonconformance, determine if it will be permitted, and take appropriate action. All employees are encouraged to report “stop-work” issues to any member of management when any aspect of the process does not conform to laboratory requirements, and have a member of management review the nonconformance.

13.3.2. The procedure for investigating and taking appropriate corrective actions of non-conforming work are described in Section 15 – “Corrective Actions”. Section 15.7 describes procedures for Technical Corrective Actions. Formal corrective action procedures must be followed for non-conforming work that could reoccur (beyond expected random QC failures), or where there is doubt about the laboratory’s compliance to its own policies and procedures.

13.3.3. The investigation and associated corrective actions of non-conforming work involving alleged violations of the company’s Ethics and Data Integrity policies must follow the procedures outlined in Section 20 – “Data Integrity Investigations”.

13.3.4. The laboratory evaluates the significance of the non-conforming work and takes corrective action immediately. The customer is notified if their data has been impacted. The laboratory allows the release of non-conforming data only with approval of the Laboratory Director, the QAM or their designee(s) on a case-by-case basis. Non-conforming data is clearly identified in the final report (see Section 29 – “Reporting the Results”).

13.3.5. The discovery of a nonconformance for results that have already been reported to the client must be immediately evaluated for significance of the nonconformance, its acceptability to the client, and determination of the appropriate corrective action. Reports must be re-issued within 30 days of discovery.

13.3.6. Corrective action for routine, non-recurring exceedances can be documented on raw data worksheets, logbooks, e-mail, a database or other documents. More serious corrective actions (non-conforming work that could reoccur or where there is doubt that the laboratory is in compliance with its own policies and procedures) will require a more formal corrective action process that usually includes the use of a corrective action report within the Omega LIM system.

13.4. Stop Work Procedures

13.4.1. Laboratory personnel shall notify any member of Management regarding any nonconformance. Management reviews the significance of the nonconformance and immediately develops a course of action. Any member of the management team can issue a “stop work” order as long as the Laboratory Director has been notified. If data is questionable, the Laboratory Director may be involved in the review. The Laboratory Director (or designee) will also coordinate any and all communications with the client.

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13.4.2. When an investigation of nonconformance indicates that the cause of the nonconformance requires that a method be restricted or not used until modifications are implemented, the Laboratory Director and/or Technical Director will immediately notify all personnel of the suspension/restriction. The lab will hold all relevant reports to clients pending review. All members of management must be involved in the resolution of the issue and must verify that the issue is resolved before work may resume. Personnel are notified by the Laboratory Director or Technical Director when resumption of work is authorized. The Laboratory Manager and QAM will document the issue, root cause, and resolution, using the corrective action procedures described in Section 15 – "Corrective Action".

13.4.3. The reporting of non-conforming work involving alleged violations of the company's ethics and data integrity policies must be reported to the Laboratory Director or designee. Procedures described in Section 20 – "Data Integrity Investigations. Resumption of work after work has been stopped for ethics and data integrity is authorized by the Laboratory Director.

14. IMPROVEMENT (TNI V1:M2 – SECTION 4.10)

14.1. Improvement in the overall effectiveness of the laboratory Management System is a result of the implementation of various aspects of the laboratory's management system: quality policy and objectives (Section 7 – "Management"); internal auditing practices (Section 18 – "Audits"); the review and analysis of data (Section 28 – "Quality Assurance for Environmental Testing"); the corrective action, (Section 15 – "Corrective Action") preventive action (Section 16 – "Preventive Action") process; and the annual management review of the quality management system (Section 19 – "Management Reviews") where the various aspects of the management/quality system are summarized, and evaluated and plans for improvement are developed.

14.2. At Alliance Technical Group, LLC - Seattle, additional areas are also monitored, such as on time delivery, PT performance, re-issuing reports, numbers and types of corrective actions, audit performance, complaints, control charting, and customer feedback. The monitoring of all the above parameters allows management to provide feedback to analysts in order to provide the client with the best possible data.

15. CORRECTIVE ACTION (TNI V1:M2 – SECTION 4.11)

15.1. Corrective actions are the actions taken to address occurrences of non-conformity, as well as to eliminate the causes of non-conformity in order to prevent recurrence.

15.2. Occurrences cited in external assessments, internal quality audits, data reviews, customer feedback/complaints, control of non-conforming work, or managerial reviews require corrective action.

15.3. Occurrences of nonconformance and the associated corrective actions may be documented on a Corrective Action Report form in the LIM system. Corrective actions are minimized through the development and implementation of routine internal program controls.

15.4. Corrective actions may be necessary when:

- Client data is negatively impacted by QC data being outside acceptance criteria
- Undesirable trends are detected in spike recoveries or relative percent difference (RPD) between duplicates
- There are unusual changes in detection limits
- The lab receives "Not Acceptable" evaluations of proficiency tests
- Inquiries concerning data quality are received from clients

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- Findings from Internal Audits
- Findings from External Audits
- Proper procedures are not followed
- Incorrect data is distributed to clients

15.5. General Procedure

15.5.1. The laboratory uses Omega to document and track corrective actions. Detailed directions for initiating corrective actions, entering the relevant details into Omega, and completing the Corrective Action Report process are contained in SOP48.

15.5.2. All lab staff members are responsible for reporting occurrences of nonconformance and initiating a Corrective Action Report (CAR) if necessary. The department manager or QAM to whom the nonconformance is reported will initiate the CAR.

15.5.3. CARs include a complete description of the nonconformance, an analysis of why the nonconformance occurred (Root Cause Analysis), a detailed plan for addressing the nonconformance (Corrective Action Required), an outline of actions taken to prevent the nonconformance from occurring again (QA Action Required), and review notes added periodically documenting the implementation of the corrective actions taken.

15.5.3.1. Complete Description of Nonconformance

This section of the CAR includes the circumstances under which the nonconformance occurred and a detailed description of the nonconformance.

15.5.3.2. Root Cause Analysis

This section of the CAR outlines the systematic deficiency or deficiencies that led to the occurrence of nonconformance and includes the results of any investigation into the relevant systems.

If the nonconformance is determined to be an anomaly rather than the result of a systematic deficiency, an investigation into the relevant systems may not be necessary.

15.5.3.3. Corrective Action Required

Appropriate corrective actions can be determined by the lab staff member who caused or identified the nonconformance, the corresponding Laboratory Manager, the QAM, the Technical Director, or the Lab Director. Appropriate corrective actions will address the nonconformance on the proper scale and at the proper level of detail as determined by the initiator of the CAR and as approved by the QAM.

15.5.3.4. QA Action Required

Appropriate QA Actions in response to CARs will address the underlying cause of the nonconformance, whether the nonconformance was determined to have been caused by a systematic deficiency or an anomaly. For an anomalous occurrence of nonconformance, appropriate QA Action may be minimal. For occurrences of nonconformance cause by a systematic deficiency, appropriate QA Action may be extensive and include the revision of SOPs, re-training of lab staff members, or the development and implementation of new standard practices.

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15.5.3.5. Monitoring of Corrective Action

It is the responsibility of each Laboratory Manager to monitor the implementation of corrective actions in their department, to schedule periodic reviews of that implementation, and to document all progress within the originating CAR. The schedule of review is based on guidelines developed by the QAM designed to ensure appropriate follow-up based on the nature and severity of each corrective action required.

The laboratory's internal auditing processes may be used for follow-up monitoring of corrective actions and their effectiveness if a serious issue or risk was identified.

15.6. Additional Audits

15.6.1. Where the identification of occurrences of nonconformance's or departures from normal lab procedures cast doubt on the laboratory's compliance with its own policies and procedures, or on its compliance with the TNI Standard, the laboratory ensures that the appropriate areas of activity are audited in accordance with Section 18.2 – "Internal Audits" as soon as possible.

15.7. Technical Corrective Action

15.7.1. Sample data associated with a failed quality control are evaluated for the need to be reanalyzed or qualified. Re-analysis and re-extractions are recorded in the Omega LIMS system. If a sample is unable to meet a client's quality objectives due to quality control issues and does not have sufficient sample or hold time remaining to perform additional analyses, a corrective action report will be opened to document the occurrence in the Omega LIM system (also see Section 13 – "Control of Nonconforming Environmental Testing Work").

15.7.2. Analysts routinely implement corrective actions for data with unacceptable QC measures. First level correction may include re-analysis without further assessment. If the test method SOP addresses the specific actions to take, they are followed. Otherwise, corrective actions start with assessment of the cause of the problem.

15.7.3. Corrective actions for non-systematic errors or expected random failures are documented in the Omega database. Corrective actions for occurrences of nonconformance beyond random QC failures, or where there is concern that the laboratory is not in compliance with its own policies and procedures, require a CAR.

15.7.4. If the data reported is affected adversely by the nonconformance, it is the responsibility of any analyst working on the data to alert the Laboratory Director and the responsibility of the Laboratory Director to identify the compromised data in the report to the client.

16. PREVENTIVE ACTION (TNI V1:M2 – SECTION 4.12)

16.1. Preventive action is a proactive process to identify opportunities for improvement, rather than a reaction to the identification of problems or complaints. Preventive action may include, but is not limited to: review of QC data to identify quality trends, regularly scheduled staff quality meetings to ensure staff is knowledgeable in quality procedures, review of client feedback to look for improvement opportunities, review of proficiency testing data to look for analytes that were nearly missed, annual managerial reviews, and scheduled instrument maintenance.

16.2. When improvement opportunities are identified or if preventive action is required, action plans are developed, implemented and monitored to reduce the likelihood of the occurrence of nonconformities. Procedures for preventive actions include the initiation of such actions and subsequent monitoring to ensure that they are effective.

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16.3. All personnel have the authority to offer suggestions for improvements and to recommend preventive actions; however, Management is responsible for implementing preventive action.

17. CONTROL OF RECORDS (TNI V1:M2 – SECTION 4.13)

17.1. Records are a subset of documents, usually data recordings that include annotations (such as daily refrigerator temperatures posted to a laboratory form), lists, spreadsheets, or analyst notes on a chromatogram. Records may be on any form of media, including electronic and hard copy. Records allow for the historical reconstruction of laboratory activities related to sample-handling and analysis.

17.2. The laboratory maintains a record system appropriate to its needs, records all laboratory activities, and complies with applicable standards or regulations as required. Records of original observations and derived data are retained to establish an audit trail. Records help establish factors affecting the uncertainty of the test and enable test repeatability under conditions as close as possible to the original. Records provide the direct evidence and support for the necessary technical interpretations, judgments, and discussions concerning laboratory results. The records, particularly those that are anticipated to be used as evidentiary data, provide the historical evidence needed for later reviews and analyses. Records should be legible, identifiable, and retrievable, and protected against damage, deterioration, or loss. All records referenced in this section are retained for a minimum of five years.

17.3. Records Maintained

17.3.1. Records of all procedures to which a sample is subjected while in the possession of the laboratory are kept. The laboratory retains all original observations, calculations and derived data (with sufficient information to produce an audit trail), calibration records, personnel records, and a copy of the test report for a minimum of five years from generation of the last entry in the records.

17.3.2. Scanned documents (worksheets, bench sheets, etc.) are considered original records at ATG Seattle. Once the record is scanned and verified, hard copies may be destroyed. Additionally, carbon copies of COCs are not considered originals and may be destroyed unless original observations are written on them, in which case they will be kept for a minimum of five years.

17.3.3. At a minimum, the following records are maintained by the laboratory to provide the information needed for historical reconstruction:

- All raw data, whether hard copy or electronic, for calibrations, samples and quality control measures, including analysts' worksheets and data output records (chromatograms and other instrument response readout records);
- A written description or reference to the specific method(s) used, which includes a description of the specific computational steps used to translate parametric observations into a reportable analytical value (a copy of all pertinent Standard Operating Procedures);
- Laboratory sample ID code;
- Date of analysis;
- Time of analysis is required if the holding time is seventy-two (72) hours or less, or when time critical steps are included in the analysis (e.g., extractions and incubations);
- Instrumentation identification and instrument operating conditions/parameters (or reference to such data);
- All manual calculations (including manual integrations);
- Analyst's or operator's initials/signature or electronic identification;

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- Sample preparation including cleanup, separation protocols, incubation periods or subculture, ID codes, volumes, weights, instrument printouts, meter readings, calculations, and, reagents;
- Test results (including a copy of the final report);
- Standard and reagent origin, receipt, preparation, and use;
- Calibration criteria, frequency and acceptance criteria;
- Data and statistical calculations, review, confirmation, interpretation, assessment and reporting conventions;
- Quality control protocols and assessment;
- Electronic data security, software documentation and verification, software and hardware audits, backups, and records of any changes to automated data entries;
- Method performance criteria including expected quality control requirements;
- Proficiency test results;
- Records of demonstration of capability for each analyst;
- A record of names, initials, and signatures for all individuals who are responsible for signing or initialing any laboratory record;
- Correspondence relating to laboratory activities for a specific project;
- Corrective action reports;
- Preventive action records;
- Copies of internal and external audits including audit responses;
- Copies of all current and historical laboratory SOPs, policies and Quality Manuals;
- Sample receiving records (including information on any inter-laboratory transfers);
- Sample storage records;
- Data review and verification records;
- Personnel qualification, experience and training records;
- Archive records; and
- Management reviews.

17.3.4. Precautions are taken during the reduction and storage of data to prevent introducing errors and losing or misinterpreting data. GC/MS, GC, ICP, and most General Chemistry data are retained on hard copy and in electronic media. Laboratory notebooks, bench records, and standardized forms are also used to retain data. All hard-copy data and electronic media are retained on-site.

17.3.5. If corrections are made to records such as Chains of Custody, technical records, quality records, etc., the individual making the correction must strike through the error with a single line, initial, date, and if not self-explanatory, include a justification for the change.

17.3.6. Laboratory records include the following:

17.3.6.1. Standard Operating Procedures - Any revisions to laboratory procedures are written, dated, and distributed to all appropriate individuals to ensure implementation of changes.

17.3.6.2. Equipment Maintenance Documentation - Documents detailing the receipt and specification of analytical equipment is retained. A history of the maintenance record of each system serves as an indication of the adequacy of maintenance schedules and parts inventory. As appropriate, the maintenance guidelines of the equipment manufacturer are followed. When maintenance is necessary, it is documented on a standard form in LIMS.

17.3.6.3. Calibration Records & Traceability of Standards/Reagents -- The frequency, conditions, standards, and records reflecting the calibration history of a measurement system are recorded.

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17.3.6.4. Sample Management -- A record of all procedures to which a sample is subjected while in the possession of the laboratory is maintained. These include records pertaining to:

- Sample preservation including appropriateness of sample container and compliance with holding time requirement;
- Sample identification, receipt, acceptance or rejection and log-in;
- Sample storage and tracking including shipping receipts, transmittal forms, and internal routing and assignment records; and
- Disposal of hazardous samples including the date of sample or sub-sample disposal and name of the responsible person.

17.3.6.5. Original Data -- The raw data and calculated results for all samples are maintained in laboratory notebooks, logs, bench-sheets, files, or other sample tracking or data entry forms. Instrumental output is stored in a computer file or a hard copy report. These records include:

- Laboratory sample ID code;
- Date of analysis;
- Instrumentation identification and instrument operating conditions/parameters;
- Analysis types and sample preparation information, including sample aliquots processed, cleanup, and separation protocols;
- All manual, automated, or statistical calculations;
- Confirmatory analysis data, when required to be performed;
- Review history of sample data; and
- Analyst's or operator's initials/signature.

17.3.6.6. QC Data -- The raw data and calculated results for all QC samples and standards are maintained in the manner described in the preceding paragraph. Documentation allows correlation of sample results with associated QC data. Documentation also includes the source and lot numbers of standards for traceability. QC samples include, but are not limited to control samples, Method Blanks, Matrix Spikes, and Matrix Spike Duplicates.

17.3.6.7. Correspondence -- Correspondence pertinent to a project is kept and placed in the project files.

17.3.6.8. Deviations -- All deviations from SOPs are reviewed and approved by the QA Manager or Technical Director.

17.3.6.9. Final Report -- A copy of any report issued and any supporting documentation is stored for a period of 5 years.

17.3.6.10. Administrative Records -- The following are maintained:

- Personnel qualifications, experience and training records;
- Initial and continuing demonstration of proficiency for each analyst; and
- A log of names, initials, and signatures for all individuals who are responsible for signing or initialing any laboratory records.

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17.4. Records Management and Storage

17.4.1. The laboratory maintains a record management system for control of laboratory notebooks, instrument logbooks, standards logbooks, and records for data reduction, validation, storage, and reporting. Alliance Technical Group, LLC - Seattle uses a Laboratory Information Management System (LIMS) for record management. Hand written data is recorded immediately and legibly in permanent ink; data generated by automated data collections systems is recorded electronically. Corrections are initialed and dated with the reason noted for corrections other than transcription errors. A single line strikeout is used to make corrections so that the original record is not obliterated. Backups and data storage are covered in SOP1 and SOP3.

17.4.2. Records, including electronic records, are easy to retrieve, legible, and protected from deterioration or damage; held secure and in confidence; and are available to accrediting bodies for a minimum of five years or as required by regulation or contract. Records that are stored only on electronic media are supported by the hardware and software necessary for their retrieval. Access to protected records is limited to laboratory management or their designees to prevent unauthorized access or amendment.

17.4.2.1. To ensure that documents remain free from damage, ATG Seattle will scan most hard copy records and will consider those scans as original records.

17.4.3. Additional information regarding control of data is included in Section 23.5 – “Control of Data”.

17.4.4. Procedures for identification, collection, indexing, access, filing, storage, maintenance, and disposal of quality and technical records are found in SOP1. Quality records shall include reports from internal audits and management reviews as well as records of corrective and preventive actions. The final Omega report is the primary record for analytical results.

17.4.5. Archived information and access logs are protected against fire, theft, loss, environmental deterioration, pests, and in the case of electronic records, electronic or magnetic sources. Archived records have limited access.

17.4.6. In the event of a change of ownership, mergers, or closures of the laboratory, in accordance with section 4.1.8 of the current NELAC Standards, and sections III-15 and IV-8.2 of the Manual for the Certification of Laboratories Analyzing Drinking Water, records shall be maintained and stored in good condition in an easily accessible location for a minimum of five years; a minimum of six years is required for records for on-site laboratory assessments and certification program reviews by the individual states. Clients will be given written notice to request that their records be transmitted to them. If a transfer of data to the client occurs, the client will need to assure the laboratory that regulatory agencies have access to the records for the remaining required period of time so that appropriate regulatory and state legal requirements concerning laboratory records are followed.

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17.5. Legal Chain of Custody Records

17.5.1. Evidentiary sample data is used as legal evidence. ATG Seattle does not handle evidentiary samples. For all other samples, the Chain of Custody is the documented history of any sample. It begins at the project site with the sampling personnel and continues on with the sample through transport to the laboratory where it is received, stored, analyzed, and archived under the custody of the laboratory. Chain of custody records, both hard copy and computer stored, are used to establish an intact, continuous record of the physical possession, storage and disposal of sample containers, collected samples, sample aliquots, and sample extracts or digestates. The COC records account for all time periods associated with the samples. The COC records identify individuals who physically handle the samples from the field to the laboratory. The COC forms remain with the samples during transport or shipment. When shipping containers and/or individual sample containers are submitted with or without sample custody seals, and any seals are not intact, it is recorded in the LIM system. The original COC is retained in the project file and in Omega. The scanned version of the COC is returned to the client with the final report. ATG Seattle views all COCs as legal documents.

17.5.2. It is necessary to have an accurate written record to trace the possession and handling of samples from collection through reporting.

17.5.3. A sample is in someone's "custody" if:

- It is in one's actual physical possession;
- It is in view, after being in one's physical possession;
- It is in one's physical possession and then locked up so that no one can tamper with it; or
- It is kept in a secured area, restricted to authorized personnel only.

18. AUDITS (TNI V1:M2 – SECTION 4.14)

18.1. Audits measure laboratory performance and verify compliance with accreditation/certification and project requirements. Audits specifically provide management with an ongoing assessment of the management system. They are also instrumental in identifying areas where improvement in the management/quality system will increase the reliability of data. Audits are of four main types: internal, external, performance, and system. Section 18.6 discusses the handling of audit findings.

18.2. Internal Audits

18.2.1. At a minimum annually, the laboratory prepares a schedule of internal audits to be performed during the year. These audits verify compliance within the departments regarding the requirements of the management/quality system, including analytical methods, SOPs, the Quality Manual, ethics policies, data integrity, other laboratory policies, the TNI Standard, and the DoD QSM.

18.2.2. It is the responsibility of the QAM to plan and organize audits as required by the schedule and as requested by management. Deficiencies and the corrective action are documented. These audits are carried out by trained and qualified personnel who are, wherever resources permit, independent of the activity to be audited.

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18.2.3. The auditor should not be the person responsible for the work being audited or be the supervisor of the person responsible for the work. The auditor should have the necessary qualifications to review the area being audited and use a checklist approved by the QAM. At minimum, auditors should have the same training as Project Managers (SOP59).

18.2.4. The following methods are employed routinely:

- Quality control charts are employed by all applicable analytical sections of the laboratory. QC charts are made for most quality control samples including LCS, surrogate spike recoveries, matrix spikes and matrix spike duplicates (including RPD), and sample/sample duplicate RPD. QC charts are used to monitor laboratory performance, analyze trends, detect out of control situations, explain anomalous results and prepare specialized QA/QC packages upon request by laboratory management or clients.
- Single and/or double blind performance evaluation samples are used to monitor analytical system performance with or without the knowledge of the analyst. The samples for these audits are either purchased from a commercial supplier or prepared in-house by the department manager or QA staff.
- Laboratory logbooks (i.e., instrument logs, maintenance logs, standards logs, etc.) are reviewed for completeness of entries, adherence to preventive maintenance schedules, proper standards preparation and record keeping, and adherence to established laboratory SOPs.
- All audit activity results, external and internal, are used to identify areas where additional training is needed, clarification of procedures is required, and to assess performance of the entire analytical system

18.2.5. Analytical methods will also have their corresponding preparation methods audited.

18.2.6. In addition to the scheduled internal audits, it may sometimes be necessary to conduct special audits as a follow-up to corrective actions, PT results, complaints, regulatory audits or alleged data integrity issues. These audits address specific issues.

18.2.7. The area audited, the audit findings, and corrective actions are recorded. Audits are reviewed after completion to assure that corrective actions were implemented and effective.

18.2.8. A schedule for routine internal audits is created, based on guidelines developed by the QAM, for reviewing the implementation of corrective actions and documenting each periodic review. The relevant department manager or QA analyst may be responsible for creating and adhering to the schedule of review, as well as for documenting the progress/success of the corrective action.

18.2.8.1. For analyses which only have WADOE accreditation, if the technology has been internally audited for an analysis in a given year, other tests utilizing that technology may not need to be internally audited that year.

18.2.8.1.1. The schedule determined by the QAM may reflect this in a rotation.

18.2.8.1.2. All DoD and TNI accredited analyses and procedures will be internally audited annually.

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18.3. External Audits

18.3.1. It is the laboratory's policy to cooperate and assist with all external audits, whether performed by clients or an accrediting body. Management ensures that all areas of the laboratory are accessible to auditors as applicable and that appropriate personnel are available to assist in conducting the audit.

18.3.2. Confidential Business Information (CBI) Considerations

18.3.2.1. During on-site audits, auditors may come into possession of information claimed as business confidential. A business confidentiality claim is defined as "a claim or allegation that business information is entitled to confidential treatment for reasons of business confidentiality or a request for a determination that such information is entitled to such treatment." When information is claimed as business confidential, the laboratory must place on (or attach to) the information at the time it is submitted to the auditor, a cover sheet, a stamped or typed legend, or other suitable form of notice, employing language such as "trade secret", "proprietary" or "company confidential". Confidential portions of documents otherwise non-confidential must be clearly identified. CBI may be purged of references to client identity by the responsible laboratory official at the time of removal from the laboratory. However, sample identifiers may not be obscured from the information.

18.4. Performance Audits

18.4.1. Performance audits may be Proficiency Test Samples, internal single-blind samples, double-blind samples through a provider of client, LOD/LOQ Verifications, or anything that tests the performance of the analyst and method.

18.4.2. Proficiency Test Samples are discussed in Section 28 – "Quality Assurance for Environmental Testing".

18.5. System Audits

18.5.1. The Laboratory's management system is audited though annual management reviews. Refer to Section 19 – "Management Reviews" for further discussion of management reviews.

18.6. Handling Audit Findings

18.6.1. Internal or external audit findings are responded to within the time frame agreed to at the time of the audit. The response may include action plans that could not be completed within the response time frame. A completion date is established by management for each action item and included in the response.

18.6.2. The responsibility for developing and implementing corrective actions to findings is the responsibility of the Laboratory Manager and QAM. Corrective actions are documented through the corrective action process described in Section 15 – "Corrective Actions".

18.6.3. Audit findings that cast doubt on the effectiveness of the laboratory operation to produce data of known and documented quality or that question the correctness or validity of sample results must be investigated. Corrective action procedures described in Section 15 – "Corrective Action" must be followed. Clients must be notified in writing if the investigation shows the laboratory results have been negatively affected and the clients' requirements have not been met. The client must be notified by the Laboratory Director (or designee) within 48 hours after a finding has been made. Laboratory management will ensure that this notification is done within the specified time frame.

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18.6.4. All investigations that result in findings of inappropriate activity are documented and include any disciplinary actions involved, corrective actions taken, and all appropriate notifications of clients. See Section 20 – “Data Integrity Investigation” for additional procedures for handling inappropriate activity.

19. MANAGEMENT REVIEWS (TNI V1:M2 – SECTION 4.15)

19.1. Top management reviews the management system on an annual basis and maintains records of review findings and actions.

19.2. Management Review Topics

19.2.1. At least once per year, typically during the first quarter of the year, laboratory management conducts a review of the quality system and environmental testing activities to ensure its continuing suitability and effectiveness, and to introduce any necessary changes or improvements. The review takes account of:

a) changes in internal and external issues that are relevant to the laboratory
b) fulfilment of objectives
c) suitability of policies and procedures
d) status of actions from previous management reviews
e) outcome of recent internal audits
f) corrective actions
g) assessments by external bodies
h) changes in the volume and type of the work or in the range of laboratory activities
i) customer and personnel feedback
j) complaints
k) effectiveness of any implemented improvements
l) adequacy of resources
m) results of risk identification
n) outcomes of the assurance of the validity of results
o) other relevant factors, such as monitoring activities and training

19.2.2. The outcome of the review is a written discussion of:

a) the effectiveness of the management system and its processes
b) improvement of the laboratory activities related to the fulfilment of the requirements of this
c) document
d) provision of required resources
e) any need for change

19.2.3. A meeting may be held to discuss the written reviews. Findings and follow-up actions from management reviews are recorded. Management will determine appropriate completion dates for action items and ensure they are completed within the agreed upon time frame.

19.2.4. This is a separate review from the internal audit discussed in section 18.1 and shall be completed by laboratory managerial personnel. However, internal audits and management reviews may be conducted in conjunction with each other.

19.2.5. Findings from management reviews and the actions that arise from them shall be recorded. The management shall ensure that those actions are carried out within an appropriate timescale.

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20. DATA INTEGRITY INVESTIGATIONS (TNI V1:M2 – SECTION 4.16)

20.1. Alliance Technical Group, LLC - Seattle is committed to ensuring the integrity of its data and providing valid data of known and documented quality to its clients. The elements in the ATG Seattle Ethics and Data Integrity program include:

- Documented data integrity procedures signed and dated by top management.
- An Ethics and Data Integrity Policy signed by all management and staff annually – during the annual data integrity training, or at time of employment. (See SOP 85).
- Annual data integrity training.
- Procedures for confidential reporting of alleged data integrity issues.
- An audit program that monitors data integrity (see Section 18 – "Audits") and procedures for handling data integrity investigations and client notifications.

20.2. The ATG Seattle Code of Ethics is signed annually by the Laboratory Director, Technical Director, and Quality Assurance Manager. It states:

- Alliance Technical Group, LLC – Seattle, through its management identified below, is committed to ensuring the integrity of its data and meeting the quality needs of its clients. ATG Seattle pledges to manage its business according to the following principles:
  - To produce results that are technically sound and legally defensible;
  - To present services in a confidential, honest, and forthright manner;
  - To have a clear understanding with the client as to the extent and kind of services to be rendered;
  - To provide employees with guidelines and an understanding of the ethical and quality standards required in this industry;
  - To operate facilities in a manner that protects the environment and the health and safety of employees and the public;
  - To obey all pertinent federal, state, and local laws and regulations;
  - To continually improve product and service quality;
  - To treat employees equitably, acknowledge their scientific contributions, and provide them with opportunities for professional growth and development; and
  - To deal openly, honestly, and fairly in all business and financial matters with employees, clients and the public.

20.3. Ethics and Data Integrity Procedures

20.3.1. The Ethics and Data Integrity Policy provides an overview of the program. Written procedures that are considered part of the Ethics and Data Integrity program include:

- Ethics and Data Integrity Policy (see SOP85)
- Manual integration procedures (SOP85 & SOP52)
- Corrective action procedures (SOP48)
- Procedures for Data Integrity Investigations (Section 20.5)
- Data recall procedures (SOP1)
- Data Integrity training procedures (SOP85)

20.3.2. Management reviews data integrity procedures annually and updates these procedures as needed. The Ethics and Data Integrity Policy Training is SOP85. It includes an example of the form for signatures of the lab personal.

20.3.3. Data integrity training is provided as a formal part of new employee orientation and a refresher is given annually for all employees.

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20.3.4. Employees are required to understand that any infractions of the laboratory data integrity procedures shall result in a detailed investigation that could lead to very serious consequences including immediate termination, debarment or civil/criminal prosecution. This is discussed in the Ethics and Data Integrity Policy that every employee is required to sign annually. Attendance for required training is monitored through a signature attendance sheet.

20.3.5. Data integrity training emphasizes the importance of proper written narration on the part of the analyst with respect to those cases where analytical data may be useful, but are in one sense or another partially deficient. The following topics and activities are covered:

- Organizational mission and its relationship to the critical need for honesty and full disclosure in all analytical reporting;
- How and when to report data integrity issues;
- Record keeping;
- Training, including discussion regarding all data integrity procedures;
- Data integrity training documentation;
- In-depth data monitoring and data integrity procedure documentation; and
- Specific examples of breaches of ethical behavior such as improper data manipulations, adjustments of instrument time clocks, and inappropriate changes in concentrations of standards.

20.3.6. It is the responsibility of each department manager to ensure that each member of his/her staff is trained appropriately, and to document all training and maintain all training records. The training records are maintained by the QAM.

20.3.7. When contracted technical or support personnel are used, the Technical Director or Laboratory Director is responsible for ensuring that they are trained to the laboratory's management system and data integrity procedures, competent to perform the assigned tasks, and appropriately supervised.

20.3.8. Topics covered are provided in writing to all trainees.

- The organizational mission and its relationship to the need for honesty and full disclosure in all analytical reporting;
- How and when to report data integrity issues;
- Recordkeeping;
- Discussion regarding all data integrity procedures;
- Data integrity training documentation;
- In-depth data monitoring;
- Data integrity procedure documentation;
- Improper data manipulations;
- Adjustments of instrument time clocks;
- Inappropriate changes in concentrations of standards;
- The importance of proper written narration on the part of the analyst with respect to those cases where analytical data may be useful, but are in one sense or another partially deficient;
- Written ethics agreements (not all labs can legally sign a written ethics agreement so the commitment is made by attendance at training sessions);
- Examples of improper practices;
- Examples of improper chromatographic manipulations;
- Requirements for external ethics program training;

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- Any external resources available to employees; and
- Consequences for data integrity infractions.
- Computer awareness security training

20.4. Confidential Reporting of Ethics and Data Integrity Issues

20.4.1. The Laboratory Director or Human Resources Manager is the point of contact for assisting employees with questions on ethics related matters and for reporting observations of suspected unethical behavior or business conduct. All inquiries will be acted upon in a prompt manner.

20.4.2. Employees are responsible for reporting ethics violations to the Laboratory Director or Human Resources. Matters of ethical concern that are brought to attention will be kept confidential to the maximum extent possible. The Laboratory Director may consult with management concerning resolution of ethical concerns.

20.5. Investigations

20.5.1. All investigations resulting from data integrity issues are conducted confidentially. They are documented and notifications are made to clients who received any negatively affected data that did not meet the client's data quality requirements.

20.5.2. The laboratory, as part of the overall internal auditing program, ensures that a review is conducted with respect to any evidence of inappropriate actions or vulnerabilities related to data integrity. Discovery of potential issues are handled in a confidential manner until such time as a follow up evaluation, full investigation, or other appropriate actions have been completed and the issues clarified. All investigations that result in finding of inappropriate activity will be documented and will include any disciplinary actions involved, corrective actions taken, and all appropriate notifications of clients. All documentation of these investigation and actions taken will be maintained for at least five years

21. PERSONNEL (TNI V1:M2 – SECTION 5.2)

ATG Seattle employs competent personnel based on education, training, experience and demonstrated skills as required. The laboratory's organization chart can be found in Appendix A.

21.1. Overview

21.1.1. All personnel are responsible for complying with all quality and data integrity policies and procedures that are relevant to their area of responsibility.

21.1.2. All personnel who are involved in activities related to sample analysis, evaluation of results or who sign test reports, must demonstrate competence in their area of responsibility. Appropriate supervision is given to any personnel in training and the trainer is accountable for the quality of the trainees work. Personnel are qualified to perform the tasks they are responsible for based on education, training, experience and demonstrated skills as required for their area of responsibility.

21.1.3. The laboratory provides goals with respect to education, training and skills of laboratory staff. These goals are outlined in the job description. Training needs are identified at the time of employment and when personnel are moved to a new position or new responsibilities are added to their job responsibilities. Ongoing training, as needed, is also provided to personnel in their current jobs. The effectiveness of the training must be evaluated before the training is considered complete.

21.1.4. Contracted personnel, when used, must meet the same competency standards and follow the same policies and procedures that laboratory employees must meet.

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21.2. Job Descriptions

21.2.1. Job descriptions are available for all positions that manage, perform, or verify work affecting data quality. Job descriptions are kept and managed by the Human Resources Manager.

21.2.2. Job descriptions include the specific tasks, minimum education and qualifications, skills, and experience required for each position. An overview of top management's responsibilities is included in Section 7 – "Management".

21.2.3. Laboratory Analyst

- Technical operations
- Developing modified or new analytical methods
- Order requests of supplies for the laboratory
- Proposing equipment purchases
- Sample preservation and preparation
- Performing the analyses
- Reporting the results
- Routine maintenance of equipment

21.2.4. Laboratory Technician II

- Sample preparation and extraction
- Technical operations
- Routine maintenance of equipment
- Assists Laboratory Technician I and Analysts

21.2.5. Laboratory Technician I

- Sample receipt
- Sample preservation and initial preparation
- Technical operations
- Routine maintenance and calibration of support equipment
- Assists Laboratory Technician II and Analysts

21.2.6. Project Coordinator

- Interfacing with clients in a professional and friendly manner to serve as a liaison between them and the laboratory
- Maintaining records and contracts
- Managing client expectations
- Working with Project Managers and Clients to communicate and understand special client requirements
- Creating project quotes, invoices, and statements
- Sample log in
- Creating bottle orders.
- Accounts Receivable

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21.3. Training

21.3.1. All personnel are appropriately trained and competent in their assigned tasks before they contribute to functions that can affect data quality. It is management's responsibility to assure personnel are trained. Training records are used to document management's approval of personnel competency. The date on which authorization and/or competence is confirmed is included. Training records are maintained by the QAM and at the corporate level and include records of both onsite and offsite training. See SOP59 for the forms and complete procedure.

21.3.2. Training for New Staff

21.3.2.1. All new staff members are given introductory training and orientation upon arrival. The training may be documented on a training sheet that outlines what will be covered during the training. The new employee receives Data Integrity training and must sign-off on the Ethics and Data Integrity Policy. The reading of QA manual, the Lab Safety handbook and the ATG Employee Manual is required. After completion of the general training, the new staff member is required to follow the SOP59 for analyst training.

21.3.2.2. The normal training for sample preparation or analyses is comprised of three steps:

- First, the trainee is required to read and understand the method and its SOP, all applicable safety data sheets (SDS).
- Second, the trainee observes the method or procedure in use.
- Third, the trainee performs the method or procedure under close observation by a certified analyst.

21.3.2.3. Once these steps are complete, the trainee must then perform the steps outlined in SOP59.

21.3.2.4. After successful completion of this process, the trainee is certified to perform the method or procedure on client samples. This process may vary due to method or procedure requirements, but is followed as closely as possible by all laboratory departments.

21.3.3. Ongoing Training

21.3.3.1. Staff members are given the following ongoing training:

- The employee attests, through signature, that they have read, understood, and agree to perform the latest version of the Quality Manual and any SOPs or policies they are responsible for following.
- Annually, analysts, laboratory technicians, and technical managers show continued proficiency in each method they perform by completing Continued Demonstration of Capability (CDC) analyses (can be in the form of acceptable PT results).
- Attending training related to job function as applicable.

21.3.3.2. The QAM maintains training documentation in the employees training file.

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22. ACCOMODATIONS AND ENVIRONMENTAL CONDITIONS (TNI V1:M2 – SECTION 5.3)

22.1. Environmental

22.1.1. The laboratory facility is designed and organized to facilitate testing of environmental samples. Environmental conditions are monitored to ensure that conditions do not invalidate results or adversely affect the required quality of any measurement. Such environmental conditions include a separate extraction room with a positive airflow and a separate room for metals analysis. For VOC analysis of a blank sample is continually checked for solvent contamination. Analyses could be stopped if the blank was found to be contaminated. Work would continue after the issues are resolved.

22.2. Work Areas

22.2.1. Testing occurs only within the laboratory. Laboratory space is maintained and monitored to the specifications required for laboratory space and the testing performed. Electronic balances are located away from drafts and doorways in areas where their use is not affected by vibrations. Biological work areas are sterilized between uses. Neighboring test areas of incompatible activities are effectively separated. Specific work areas are defined and access is controlled (only authorized laboratory personnel and escorted visitors may enter the work area). Good housekeeping measures are employed to avoid the possibility of contamination. Smoking, eating, and drinking is prohibited in lab space.

22.2.2. Access to, and use of, areas affecting the quality of the environmental tests is controlled by restriction of areas to authorized personnel only.

22.2.3. The laboratory work spaces are adequate for their use, and appropriately clean to support environmental testing and ensure an unencumbered work area. Work areas include:

- Entries to the laboratory
- Sample receipt area
- Sample storage area
- Sample preparation area
- Laboratory analysis area
- Chemical and waste storage area
- Data handling

22.2.4. The laboratory procedure for good housekeeping includes such measures as:

- Janitorial service either internal or contracted
- Periodic dedicated clean-up days
- Each employee is responsible for straightening up their work area daily

22.2.5. A floor plan can be found in Appendix B

22.3. Building Security

22.3.1. The laboratory is kept secure during off hours with an alarm. Visitors must be accompanied by laboratory personnel when in secure areas and must sign in before entering any functional area of the laboratory. Signs are used to designate secure areas.

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23. ENVIRONMENTAL METHODS AND METHOD VALIDATION (TNI V1:M2 – SECTION 5.4 AND SECTIONS 1.4, 1.5 AND 1.6 OF TECHNICAL MODULES TNI V1:M 3-7)

23.1. Methods and/or procedures are available for all activities associated with the analysis of the sample including preparation and testing. For purposes of this Section, “method” refers to both the sample preparation and determinative methods. The methods used and their SOPs can be found in Appendix C.

23.2. Before being put into use, a test method is confirmed by a demonstration of capability or method validation process (Appendix E).

23.3. All methods are published or documented. Deviations from the methods are allowed only if the deviation is documented, technically justified, authorized by management and accepted by the client (when applicable).

23.4. Method Selection

23.4.1. A reference method is a method issued by an organization generally recognized as competent to do so (When ISO refers to a standard method, that term is equivalent to reference method). When a laboratory is required to analyze a parameter by a specified method due to a regulatory requirement, the parameter/method combination is recognized as a reference method.

23.4.2. The laboratory will use methods that meet the needs of the client. Such methods will be based on the latest edition of the method, unless it does not meet the needs of the client. When the regulatory authority mandates or promulgates methods for a specific purpose, only those methods will be used.

23.4.3. If a method proposed by a client is considered to be inappropriate or out-of-date, the client is informed and the issue resolved before proceeding with analysis of any samples (see Section 9 – Review of Requests, Tenders and Contracts).

23.4.4. If a method is not specified by the client, an appropriate method will be selected using the process outlined below. The client will be informed of the selected method and must approve its use before being used to report data.

- If the data are to be submitted to a regulatory authority, the method(s) specified by the regulatory authority will be used.
- For drinking water compliance a method will be selected from those specified in 40 CFR Part 141, or the applicable state regulations.
- For NPDES permits, the method will be selected from those specified in 40 CFR Part 136.

23.4.5. If the end use of the data is not regulatory or if the regulatory authority does not specify a method, the laboratory will determine the client needs in terms of reporting level (e.g., LOD, LOQ), bias (e.g., screening versus quantitative) and the laboratory capabilities and capacity. Based on these criteria, the laboratory will select an appropriate method based on the following hierarchy:

- Resources from published regional, national or international standards
- Methods published by technical organizations such as ASTM, Standard Methods or AOAC
- Methods developed by the instrument manufacturer

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23.4.6. If the client has given the laboratory approval to analyze samples by an unaccredited method, the laboratory will document client approval on the final report.

23.5. Laboratory – Developed Methods

23.5.1. ATG Seattle will perform its services using analytical methodologies with published test methods which are standard of the industry. Should deviations be necessary, they will be from other recognized and appropriate methodologies unless circumstances require less traditional analytical practices. In such cases, these non-traditional methods will be complementary of standard scientific procedures and good laboratory practices.

23.6. Method Validation

23.6.1. Validation is the confirmation, by examination and objective evidence, that the particular requirements for a specific intended use are fulfilled.

23.6.2. At a minimum, reference methods are validated by performing an initial demonstration of capability. Additional requirements are discussed for each technology.

23.6.3. All methods that are not reference methods are validated before use. The validation is designed so that the laboratory can demonstrate that the method is appropriate for its intended use. All records (e.g., planning, method procedure, raw data and data analysis) shall be retained while the method is in use. Based on the validation process, the laboratory will make a statement in the SOP for the method of the intended use requirements and whether or not the validated method meets the use requirements.

23.6.4. Method Validation and Demonstration of Capability procedures can be found in:

- Appendix E – Chemistry

23.7. Control of Data

23.7.1. To ensure that data are protected from inadvertent changes or unintentional destruction, the laboratory uses procedures to check calculations and data transfers (both manual and automated).

23.7.2. Computer and Electronic Data Requirements

23.7.2.1. The laboratory assures that computers, user-developed computer software, automated equipment, or microprocessors used for the acquisition, processing, recording, reporting, storage, or retrieval of environmental test data are:

- Documented in sufficient detail and validated as being adequate for use;
- Protected for integrity and confidentiality of data entry or collection, data storage, data transmission and data processing;
- Maintained to ensure proper functioning and are provided with the environmental and operating conditions necessary to maintain the integrity of environmental test data;
- Held secure including the prevention of unauthorized access to, and the unauthorized amendment of, computer records. Data archive security is addressed in Section 17 – “Control of Records” and building security is addressed in Section 22 – “Accommodations and Environmental Conditions”.

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23.7.2.2. The laboratory controls access to all programs that are used to acquire, process, record, or report data. All computers are password-protected. Each employee is granted access only to those programs that he or she uses. The password is unique to the individual, and cannot be shared. Omega LIM system passwords are required to be updated at a minimum annually, or more frequently as needed.

23.7.2.2.1. Analytical lab computers will have a common user ID and password to prevent instrumentation errors. Lab computers will have limited access to shared folders on the network.

23.7.2.3. The laboratory utilizes the Omega LIM system to calculate final results from the raw data. Prior to implementing new calculations into Omega, the laboratory shall validate the underlying calculations by doing a hand calculation of the data.

23.7.2.4. The laboratory uses spreadsheets to reduce raw data to final results for many of the Wet Chemistry department tests. To ensure that the worksheet formulae are correct, the laboratory tests each set of cells used for input of the data as well all cells used for calculations by comparing the results of the spreadsheet with manually calculated data. All calculation cells are locked to prevent formulas from changing.

23.7.2.5. If any changes are made to the spreadsheet program, the laboratory revalidates the calculations before reporting results.

23.7.2.6. In addition, the algorithms and all spreadsheet calculations or other programs that are used to reduce raw data to a reported value will be verified upon first use.

23.7.2.7. Data from all electronic media are backed up daily to ensure that data are not lost. The backed up copies are stored on the server.

23.7.2.8. Any change in software that occurs that affects electronic data must be documented. If the change affects client electronic data, clients must be notified by the change.

23.7.3. Data Reduction: Manual Calculations

23.7.3.1. As a part of the management system, the laboratory ensures that all manual calculations are checked by another individual. In addition, all data transfers (data entry, transcribing raw or calculated data, etc.) will be checked for accuracy.

23.7.3.2. The analyst calculates final results from raw data or appropriate computer programs provide the results in a reportable format. The test methods provide required concentration units, calculation formulas and any other information required to obtain final analytical results.

23.7.3.3. The laboratory has manual integration procedures that must be followed when integrating peaks during data reduction: SOP52.

23.7.3.4. The laboratory's procedures for use of significant figures may be found in SOP55.

23.7.3.5. All raw data must be retained in the work order folder and it is maintained as described in Section 17 – "Control of Records".

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23.7.4. Data Review Procedures

23.7.4.1. Data review procedures are located in Section 28.13 – “Data Review”.

24. CALIBRATION REQUIREMENTS (TNI V1:M2 – SECT 5.5 AND SECTION 1.7 OF TECHNICAL MODULES TNI V1:M 3-7)

24.1. General Equipment Requirements

24.1.1. The laboratory provides all the necessary equipment required for the correct performance of the scope of environmental testing performed by the laboratory.

24.1.2. All equipment and software used for testing and sampling are capable of achieving the accuracy required for complying with the specifications of the environmental test methods as specified in the laboratory SOPs.

24.1.3. Equipment is operated only by authorized and trained personnel (see Section 21 – “Personnel”).

24.1.4. The laboratory has procedures for the use, maintenance, handling and storage of equipment. These procedures are readily available to laboratory personnel. Manuals provided by the manufacturer of the equipment provide information on use, maintenance, handling and storage of the equipment. The laboratory maintains an equipment table that includes additional information on storage location. This information is also kept in the Omega LIMS along with maintenance records and repairs.

24.1.5. All equipment is calibrated or verified before being placed in use to ensure that it meets laboratory specifications and relevant standard specifications. Calibration dates are kept in Omega.

24.1.6. Test equipment, including hardware and software, are safeguarded from adjustments that would invalidate the test result measurements by limiting access to the equipment and using password protection where possible (see Section 23.7 – “Control of Data”).

24.1.7. Equipment that has been subject to overloading, mishandling, given suspect results, or shown to be defective or outside specifications is taken out of service. The equipment is isolated to prevent its use or clearly labeled as being out of service until it has been shown to function properly. If it is shown that previous tests are affected, then procedures for nonconforming work are followed and results are documented (see Section 13 – “Control of Nonconforming Environmental Testing Work” and Section 15 – “Corrective Action”).

24.1.8. No equipment is used outside of the permanent control of the laboratory.

24.1.9. Each item of equipment and software used for testing and significant to the results is uniquely identified. Records of equipment and software are maintained. This information includes the following:

- Identity of the equipment and its software;
- Manufacturer’s name, type identification, serial number or other unique identifier;
- Checks that equipment complies with specifications of applicable tests;
- Current location;
- Manufacturer’s instructions, if available, or a reference to their location;
- Dates, results and copies of reports and certificates of all calibrations, adjustments, Acceptance criteria, and the due date of next calibration;

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- Maintenance plan where appropriate, and maintenance carried out to date; documentation on all routine and non-routine maintenance activities and reference material verifications;
- Any damage, malfunction, modification or repair to the equipment;
- Date placed in service;
- Condition received (ex: new, used, reconditioned);
- Operations status; and
- Instrument configuration and settings
- Current column serial numbers upon installation

24.2. Support Equipment

24.2.1. Support equipment includes, but is not limited to: balances, ovens, refrigerators, freezers, incubators, water baths, temperature measuring devices, volumetric dispensing devices, and thermal/pressure sample preparation devices. All support equipment is maintained in proper working order. Records are kept for all repair and maintenance activities (which may include service calls), in Omega.

24.2.2. All raw data records are retained to document equipment performance. These records include logbooks, data sheets, or equipment computer files.

24.2.3. If support equipment undergoes catastrophic failure in ways that can negatively impact client samples, the failing piece of support equipment will immediately be taken out of service. Clients will be notified if the lab does not have an immediate resolution.

24.2.4. Support Equipment Maintenance

24.2.4.1. Regular maintenance of support equipment, such as balances, thermometers, and fume hoods, is conducted at least annually.

24.2.4.2. Maintenance on other support equipment, such as ovens, and refrigerators, is conducted on an as needed basis.

24.2.4.3. Records of maintenance to support equipment are documented in Instrument Maintenance Logs. The logs are located in the Omega LIMS.

24.2.4.4. The list of support equipment can be found in Appendix F.

24.2.5. Support Equipment Calibration

24.2.5.1. All applicable support equipment is calibrated or verified annually over the entire range of use using NIST traceable references where available. The results the calibration of support equipment must be within specifications and recorded. If calibrations generate correction factors, all locations where the piece of equipment is referenced must be updated to the new correction factor.

24.2.5.2. Support equipment such as balances, ovens, refrigerators, freezers, and water baths are verified with a NIST traceable reference if available, each day prior to use, to ensure operation is within the expected range for the application for which the equipment is to be used. Acceptance criteria for support equipment is listed in Table 4.

24.2.5.2.1. For sample refrigerators, minimum temperatures below 0°C will require a review of the condition of all water samples in the affected refrigerator. Maximum temperatures above 8°C will require notification of temperature exceedance to the Department Manager and the Stage 1 Manager.

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24.2.5.2.2. Temperature exceedances over two consecutive days requires notification to the Department Manager and Quality Assurance Manager, a recording of all contents of the affected area and a corrective action report.

24.2.5.2.3. If it is determined that the cause of non-compliance is due to deterioration of the support equipment, the Technical Director will be notified and the piece of equipment will be taken out of service and repaired or replaced.

24.2.5.3. Class A glassware and glass microliter syringes will be replaced upon evidence of deterioration.

24.2.5.3.1. If glassware is being used to measure specific volumes, only Class A glassware will be used.

24.2.5.4. External calibration services will be used for annual balance and Eppendorf ® pipette calibrations. Calibration certificates will be stored on the server as well as in LIMS.

24.2.5.4.1. When externally calibrated support equipment's "as found" parameters are documented as "out of tolerance" the lab will first compare the parameters that the external calibrator is following against the in-lab policy.

24.2.5.4.1.1. If the "as found" parameters are passing in accordance to the QA manual, the lab will document that on the calibration certificate and re-scan the document into LIMS.

24.2.5.4.1.2. If the "as found" parameters do not pass in accordance to the QA manual, corrective action will be taken. However, there should not be cases where this occurs because pipettes and balances are verified daily according to Table 3.

24.2.5.4.2. The lab uses an ISO 17025 accredited service for annual balance calibrations.

24.2.5.4.3. The lab is not required to use an ISO 17025 accredited service for annual Eppendorf® pipette calibrations.

24.2.5.5. Volumetric dispensing devices (except Class A glassware and Glass microliter syringes) will be verified according to Table 3.

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Table 3: Calibration Acceptance Criteria for Support Equipment				
Equipment	Type of Calibration/ Number of Standards	Frequency	Acceptance Limits	Corrective Action
Analytical Balance	Accuracy determined using accredited NIST weights. Inspected and calibrated by a 17025 accredited service annually. Weights used for daily balance verification should be calibrated at least every 5 years to obtain a new ISO17025 calibration certificate.	Daily Verification	Top Loading: ±2% or ±0.02g, whichever is greater. Analytical: ±0.1% or ±0.5mg, whichever is greater.	Clean, check level, ensure lack of drafts, ensure unit is warmed up. Recheck if balance fails verification.
Thermometer	Against NIST traceable thermometer	Annually at appropriate temperature range for intended use.	N/A	Apply correction factor determined by annual verification.
Infrared Temperature Guns	Against NIST traceable thermometer	Quarterly at appropriate temperature range for intended use.	N/A	Apply correction factor determined by quarterly verification. Replace upon expiration
Eppendorf® pipettes	Delivery by weight. Using DI water, dispense into tared vessel. Record weight with devices ID number. If a solvent other than DI is measured, the density of that solvent must be accounted for	Daily verification at the volumes used or at volumes that bracket the range of use.	Bias: ± 2% nominal volume. Precision: RSD ≤ 1% of nominal volume based on at least 3 replicates	Adjust/Replace

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Table 3: Calibration Acceptance Criteria for Support Equipment				
Equipment	Type of Calibration/ Number of Standards	Frequency	Acceptance Limits	Corrective Action
Volumetric Dispensing Devices (Automatic dilutor or dispensing devices.	One delivery by weight. Using DI water, dispense into tared vessel. Record weight with devices ID number. If a solvent other than DI is measured, the density of that solvent must be accounted for.	Quarterly in house, Inspected and calibrated by accredited person annually	± 2% Calculate accuracy by dividing weight by stated volume and multiply by 100 for a percentage value.	Adjust/Replace
Non-volumetric Lab ware (Autosampler vials, VOA vials, etc.)	Delivery by weight. Using DI water, dispense into tared vessel. Record weight with device ID number.	By lot before use.	± 3% of nominal value. RSD ≤ 3% of nominal volume based on 10 replicate measurements	Replace

Table 4: Acceptance Criteria for Support Equipment		
Equipment Identification	Use	Acceptance Criteria
REFRIG 1	Samples. Standards are in the freezer	Refrigerator: <6° Freezer: < 0°C
REFRIG 2	Samples. Standards are in the freezer	Refrigerator: <6° Freezer: < 0°C
WALKIN	Sample Storage.	<6°
Ovens	Drying	± 5% set temperature

24.3. Analytical Equipment Maintenance

24.3.1. All equipment is properly maintained, inspected, and cleaned.

24.3.2. Maintenance of analytical instruments and other equipment may include regularly scheduled preventive maintenance or maintenance on an as-needed basis. Instrument malfunction may be documented in Omega maintenance log, which is part of the laboratory's permanent records. A description of what was done to repair the malfunction and proof of return to control are also documented in the log. Proof of return to control can be a statement that a QC sample was run and it passed criteria.

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Table 5: Recommended Analytical Equipment Maintenance		
Instrument	Procedure	Frequency
Cetac Mercury Analyzers	Check tubing for wear Fill rinse tank with 2% HNO3 Clean liquid gas separator Fill reductant bottle with 10% Stannous Chloride	Daily Daily As required Daily
ICP-MS	Check Pump Tubing Check liquid argon supply Check fluid level in waste container Check filters Clean or replace filters Check torch Check sample spray chamber for debris Clean and align nebulizer Replace pump tubing Clean cones	Daily Daily Daily Weekly As required Daily Monthly Monthly Monthly As required
Spectrophotometer	Check/adjust cell alignment	Annually
Mass Spectrometer	Ion gauge tube degassing Pump oil level check Pump oil changing Analyzer bake-out Analyzer cleaning Resolution adjustment	As required Monthly Semi-annually As required As required As required
Gas Chromatograph	Compare standard response to previous day or since last initial calibration Check carrier gas flow rate in column Check temp. of detector, inlet, column oven Septum replacement Glass wool replacement Check system for gas leaks with SNOOP Check for loose/fray wires and insulation Bake injector/column Change/remove sections of guard column Replace connectors/liners Change/replace column(s)	Daily via use of known compound retention Daily As required As required As required As required As required Monthly As required As required As required
Electron Capture Detector (ECD)	Detector wipe test (Ni 63) Detector cleaning	Semi-annually As required
Flame Ionization Detector (FID)	Detector cleaning	As required
Photoionization Detector (PID)	Change O-rings Clean lamp window	As required As required

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Table 5: Recommended Analytical Equipment Maintenance		
Instrument	Procedure	Frequency
HPLC	Change guard columns Change lamps Change pump seals Replace tubing Change fuses in power supply Filter all samples and solvents Change autosampler rotor/stator	As required As required Semi-annually or as required As required As required Daily As required
Balances	Class "1" traceable weight check Clean pan and check if level Field service	Daily, when used Daily At least annually
Conductivity Meter	0.01 M KCl calibration	Daily, when used
Turbidimeter	Check light bulb	Daily, when used
Deionized/Distilled Water	Check conductivity Check deionizer light Monitor for VOCs System cleaning Replace cartridge & large mixed bed resins	Daily Daily Daily As required As required
Drying Ovens	Temperature monitoring Temperature adjustments	Daily As required
Refrigerators/ Freezers	Temperature monitoring Temperature adjustment Defrosting/cleaning	Daily As required As required
Vacuum Pumps/ Air Compressor	Belts/filters checked Lubricated	Monthly, as needed Semiannually, as needed
pH/Specific Ion Meter	Calibration/check slope Clean electrode	Daily As required
Incubator	Temperature monitoring Coil and incubator cleaning	Daily As required
Centrifuge	Check brushes and bearings	Every 6 months or as needed

24.4. Instrument Calibration

24.4.1. Information on instrument calibration can be found in each method's SOP.

24.4.2. Initial instrument calibration and continuing instrument calibration verification are an important part of ensuring data of known and documented quality. If more stringent calibration requirements are included in a mandated method or by regulation, those calibration requirements override any requirements outlined here and will be documented in laboratory method SOPs.

24.4.3. Instrument calibration consists of two steps. The Initial Calibration is performed to document the instrument range of performance. A Calibration Standard analysis is performed before each day's analysis to reference daily operation to the initial calibration and calibrates the instrument for quantitation of the days' samples. Calibration Check analyses are performed at regular intervals during the analysis to track instrument performance during the analytical batch.

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24.4.4. Initial Calibration (IC)

24.4.4.1. The analyst calibrates each system with external standards. First the performance of each instrument is documented with an initial calibration curve. This curve establishes the operation range for each analyte on each instrument.

24.4.4.2. Typically, a minimum of three to five concentrations of each analyte is prepared. The low calibration standard should be three to five times the method reporting limit. The other concentrations define the linear quantitation range for the analyte and instrument.

24.4.5. Least Squares Analysis

24.4.5.1. The straight line that best fits the data points generated in the IC is determined using a linear regression analysis. The formula for estimation is found in Appendix E.

24.4.5.2. A straight line approximates the relationship between the independent actual concentration (X) and dependent instrument response (Y).

24.4.5.3. The correlation coefficient (r^2) is a determination of how closely the data fit the line. The correlation coefficient ranges from 0 to +1. At r^2=1 the data falls directly on the straight line with a slope.

24.4.5.4. At r^2=0 the relationship cannot be estimated by a straight line. Unless otherwise noted in specific analytical SOPs, an acceptable IC, r^2 must be greater than or equal to 0.990.

24.4.5.5. The correlation coefficient is calculated using the equation found in Appendix E.

24.4.5.6. Many calculators, computer spreadsheet programs, and chromatographic data systems calculate and display the values for slope (A), intercept (B), and correlation (r^2).

24.4.5.7. In gas chromatographic analyses a reagent blank is not considered one of the calibration standards and is not used in the calculation of curve fit. In infrared and atomic absorption analyses the instrument readings are set to zero using a reagent blank prior to calibration.

24.4.6. Standard Deviation of Response

24.4.6.1. Three to five calibration standards are analyzed and the response factors are determined (Appendix E)

24.4.6.2. The standard deviation of the response factors is determined to calculated the percent relative standard deviation (%RSD).

24.4.6.3. If the %RSD is less than 20 percent over the working range, linearity through the origin can be assumed and the continuing calibration response factor is used in place of a calibration curve.

24.4.6.3.1. Please see specific methods for %RSD requirements.

24.4.6.4. The working range for the instrument is defined between the lowest standard and the highest standard in the IC.

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24.4.6.5. A new initial calibration may be performed if the following conditions occur:

- Instrument has major repairs, alterations, or cleaning affecting analytical performance;
- Instrument is shut down for an extended period of time;
- Instrument fails Continuing Calibration Verification (CCV) control limits; or
- Instrument fails Laboratory Control Sample (LCS) control limits.

24.4.7. Relative Error

24.4.7.1. Multi-point calibration curves will have their points evaluated for relative error. The relative error limit for each calibration point is expressed as a percent recovery high and low limit, where the high limit is 100% + the relative error limit and the low limit is 100% - the relative error limit.

24.4.7.1.1. For calibrations points above the point associated with the LOQ, the percent recovery limits are equal to the percent recovery limits for that test's calibration verification.

24.4.7.1.2. For the calibration point associated with the LOQ, which is the highest calibration point that is less than or equal to the LOQ, the percent recovery limits are 50-150%.

24.4.7.2. The Omega LIMS calculates the percent recovery of each calibration point and flag points that do not meet their criteria.

24.4.8. Continuing Calibration Verification (CCV)

24.4.8.1. The Continuing Calibration Verification (CCV) standard refers the instrument continuing performance after a calibration has been run. It is used to check system stability during sample analyses. For details and frequency of Initial and Continuing Calibration check please refer to the SOP for the method.

24.4.8.2. CCVs are typically a single mid-range standard at approximately 20 to 80 percent of the instrument's IC range. This range may vary depending on the analytical method.

24.4.8.3. The results are quantified using the IC. For specific limits please refer to the SOP for the method.

24.4.8.4. If a CCV does not meet the control limit the standard may be re-analyzed. If it still does not meet the control limit the source of the error is determined and corrected before analysis continues.

24.4.8.4.1. DoD requires the analysis of two consecutive passing CCVs following a failing CCV, to confirm batch validity. If both do not pass, the source of the error is determined and corrected before analysis continues.

25. MEASUREMENT TRACEABILITY (TNI V1:M2 – SECTION 5.6)

25.1. Measurement quality assurance comes in part from traceability of standards to certified materials. All equipment used that affect the quality of test results are calibrated prior to being put into service and on a continuing basis (see Section 24 – "Calibration Requirements"). These calibrations are traceable to national standards of measurement where available.

25.2. If traceability of measurements to SI units is not possible or not relevant, evidence for correlation of results through interlaboratory comparisons, proficiency testing, or independent analysis is provided.

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25.3. Reference Standards

25.3.1. Reference standards are standards of the highest quality available at a given location, from which measurements are derived.

25.3.2. Reference Standards, such as ASTM Class 1 weights, are used for calibration only and for no other purpose.

25.3.3. Reference standards, such as ASTM Class 1 weights, are calibrated by an entity that can provide traceability to national or international standards.

25.4. Reference Materials

25.4.1. Reference materials are substances that have concentrations that are sufficiently well established to use for calibration or as a frame of reference.

25.4.1.1. Technical SOPs may also refer to reference materials as reference standards.

25.4.2. Reference materials, where commercially available, are traceable to national standards of measurement, or to Certified Reference Materials, usually by a Certificate of Analysis.

25.4.3. Purchased reference materials require a Certificate of Analysis where available. If a reference material cannot be purchased with a Certificate of Analysis, it is verified by analysis and comparison to a certified reference material and/or demonstration of capability for characterization.

25.4.4. Internal reference materials, such as working standards or intermediate stock solutions, are checked as far as is technically and economically practical. Working standards or intermediate stock solutions should be checked against a second source at first time of use. When a second source is not available, a vendor certified different lot is accepted as a second source. Working standards and intermediate stock solutions are given expiration dates when they are prepared based on method or regulatory requirements. These standards are used up or disposed of by the expiration date. Each method SOP has details on how often standards are made and how often the checks are required. Dates for standard makeup and expiration are in the Omega LIM system.

25.4.4.1. In the event a standard expires, the lab may choose to recertify the expired standard as described in Appendix E.

25.5. Transport and Storage of Reference Standards and Materials

25.5.1. The laboratory handles and transports reference standards and materials in a manner that protects the integrity of the materials. Reference standard and material integrity is protected by separation from incompatible materials and/or minimizing exposure to degrading environments or materials.

25.5.2. Reference standards and materials are stored according to manufacturer's recommendations, method SOP requirements and separately from samples. Storage locations are tracked in the Omega LIM system.

25.6. Labeling of Reference Standards, Reagents, and Reference Materials

25.6.1. The laboratory has procedures for purchase, receipt and storage of standards, reagents and reference materials. Purchase procedures are described in Section 11 – "Purchasing Services and Supplies" as well as SOPs 5 and 6.

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25.6.2. Expiration dates can be extended if the reference standard or material's integrity is verified. The extended date may not be beyond the expiration date of the referenced standards used to re-verify. A standard expiration date can be extended if they can be verified against a separate source. The verification will be documented in Omega. If the material is not re-verified, the expired material will be marked as expired and will no longer be used for quantitative purposes. See Appendix E for more information.

25.6.3. Reagent quality is verified during routine QC analyses.

25.7. Purchased Stock Standards, Reagents, Reference Materials and Media

25.7.1. Records for all standards, reagents, reference materials, and media include:

- The manufacturer/vendor name (or traceability to purchased stocks or neat compounds)
- The manufacturer's Certificate of Analysis or purity (if supplied)
- The date of receipt
- Recommended storage conditions
- Date of Expiration

25.7.2. This information is recorded in the Omega LIM system.

25.7.3. If the original container does not have an expiration date provided by the manufacturer or vendor it is assigned an arbitrary expiration date of one year from date of receipt, unless the Certificate of Analysis or similar documentation states "no expiration". If an expiration date is provided, it must be labeled with the assigned expiration date.

25.7.4. In methods where the purity of reagents is not specified, analytical reagent grade is used. If the purity is specified, that is the minimum acceptable grade. Purity is verified and documented according to Section 11 – "Purchasing Services and Supplies".

25.8. Prepared Standards, Reagents, Reference Materials and Media

25.8.1. Records for standards, reagents, reference materials, and media preparation include:

- Traceability to purchased stock or neat compounds
- Reference to the method of preparation
- Date of preparation
- An expiration date (that does not exceed the stock standards used) after which the material shall not be used (unless its reliability is verified by the laboratory)
- Preparer's name (if prepared)

25.8.2. All containers of prepared standards, reagents, or materials are labeled with a unique ID and an expiration date. The unique ID is determined by Omega. The Omega label is then placed on all Standards, Reagents, and Reference Materials: See SOP57.

26. COLLECTION OF SAMPLES (TNI V1:M2 – SECTION 5.7)

26.1. ATG Seattle does not provide sampling services. The laboratory's responsibility in the sample collection process lies in supplying the sampler with the necessary coolers, reagent water, sample containers, preservatives, sample labels, custody seals, COC forms, ice, and packing materials required to properly preserve, pack, and ship samples to the laboratory.

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26.2. ATG Seattle is occasionally asked to advise field-sampling personnel on appropriate sampling methodology for a particular analysis. ATG Seattle recommends that the procedures described in SW846, Update III, Chapter 3 for inorganic analytes and Chapter 4 for organic analytes, the Manual for the Certification of Laboratories Analyzing Drinking Water Section 6 and Table IV-6, or 40 CFR part 136 Table II be followed

26.3. Sampling Containers

26.3.1. The laboratory offers sampling containers for use by clients. Sample containers are obtained from an independent supplier. The independent supplier may certify that the sample containers are cleaned following EPA protocols, and that the preservatives added will not lead to contamination. Certificates of cleanliness may be provided with each case of containers, and can be forwarded upon request. In cases where we do not receive certificates from the supplier, the lab tests bottle lots for cleanliness as described in SOP45.

26.4. Preparing Container Orders

26.4.1. Containers (containing any required preservatives) are provided to the client upon request. Details for filling bottle orders can be found in SOP62.

26.5. Sampling Containers, Preservation Requirements, Holding Times

26.5.1. Sampling container, preservation and holding time requirements can be found in the following table.

Table 6: Sampling Containers, Preservation Requirements, Holding Times

Parameter	Method	Container/Preservatives	Holding Time
SOIL			
Alkalinity	SM 2320B Modified	4 to 8 oz Glass Jar / Cool 4°C	Analyze within 14 Days
Anions - Br, Cl, F, SO_4	EPA 300.0	4 to 8 oz Glass Jar / Cool 4°C	Analyze within 28 Days
Anions - NO_2, NO_3, PO_4	EPA 300.0	4 to 8 oz Glass Jar / Cool 4°C	Analyze within 48 Hours
BTEX / Gasoline Range Hydrocarbons	EPA 8260/NWTPH-Gx/EPA 8015	Field Preservation Kit / Cool 4ºC	Analyze within 14 Days if preserved. Must be preserved or analyzed within 48 hours.

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Table 6: Sampling Containers, Preservation Requirements, Holding Times			
Parameter	Method	Container/Preservatives	Holding Time
Cyanide	SM 4500-CN C,E	2-4 oz Glass Jar / Cool 4°C	Extract within 28 Days, analyze within 14 days of extraction.
Diesel Range Organics	NWTPH-Dx/EPA 8015/AK102-103	4 to 8 oz Glass Jar / Cool 4°C	Extract within 14 Days / Analyze within 40 Days of Extraction
Extractable Petroleum Hydrocarbons (EPH)	NWTPH-EPH	4 to 8 oz Glass Jar / Cool 4°C	Extract within 14 Days / Analyze within 40 Days of Extraction
Gasoline Range Organics (GRO	AK 101	2 oz glass jar / BFB surrogated MeOH / Cool 4°C	Extract within 14 days
Herbicides	EPA 8151A	4 to 8 oz Glass Jar / Cool 4°C	Extract within 14 Days / Analyze within 40 Days of Extraction
Hexavalent Chromium	EPA 7196	4 to 8 oz Glass Jar / Cool 4°C	Analyze within 28 Days
Ignitability / Flashpoint	ASTM D93/ EPA 1010	4 to 8 oz Glass Jar / Cool 4°C	Analyze within 28 Days
Langelier Index / Corrosivity	SM 2330B	2-4 oz Glass Jar / Cool 4°C	Analyze immediately
Mercury (Hg)	EPA 7471	4 to 8 oz Glass Jar / Cool 4°C	Analyze within 28 Days
Metals (Except Mercury)	EPA 6020	4 to 8 oz Glass Jar	Analyze within 6 Months
Pesticides	EPA 8081	4 to 8 oz Glass Jar / Cool 4°C	Extract within 14 Days / Analyze within 40

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Table 6: Sampling Containers, Preservation Requirements, Holding Times			
Parameter	Method	Container/Preservatives	Holding Time
			Days of Extraction
pH	EPA 9045D	2-4 oz Glass Jar / Cool 4°C	Analyze immediately
Phosphorus, Total	EPA 6020	4 to 8 oz Glass Jar / Cool 4°C	Analyze within 28 Days
Polychlorinated Biphenyls (PCBs/Aroclor)	EPA 8082	4 to 8 oz Glass Jar / Cool 4°C	Extract within one year
Semi Volatile Organic Compounds (SVOC)	EPA 8270	4 to 8 oz Glass Jar / Cool 4°C	Extract within 14 Days / Analyze within 40 Days of Extraction
Salinity	SM 2520B	4 to 8 oz Glass Jar / Cool 4°C	Analyze within 8 Days
TCLP/SPLP - Metals	1311/1312	4 to 8 oz Glass Jar / Cool 4°°C	Extract within 180 Days (Hg = 28 days)
TCLP/SPLP – Semi-Volatile Organics	1311/1312	4 to 8 oz Glass Jar / Cool 4°°C	Extract within 14 days
TCLP/SPLP - ZHE	1311/1312	4 to 8 oz Glass Jar / Cool 4°C	Extract within 14 Days
Total Organic Carbon	EPA 9060A,	4 to 8 oz Glass Jar / Cool 4°C	Analyze within 28 Days
Volatile Organic Compounds (VOC)	EPA 8260	4 to 8 oz Glass Jar / Field Preservation Kit / Cool 4°C	Analyze within 14 Days if preserved. Must be preserved or analyzed within 48 hours.
Volatile Petroleum Hydrocarbons (VPH)	NWTPH-VPH	Field Preservation Kit / Cool 4°C	Analyze within 14 Days

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Table 6: Sampling Containers, Preservation Requirements, Holding Times			
Parameter	Method	Container/Preservatives	Holding Time
WATER			
Parameter	Method	Container/Preservatives	Holding Time
Alkalinity	SM 2320B	250mL/1L Polyethylene / Cool 4°C	Analyze within 28 Days
Anions – Br, Cl, F, SO_4, Nitrate+Nitrite	EPA 300.0	250 mL Polyethylene / Cool 4°C	Analyze within 28 Days
Anions - NO_2, NO_3, PO_4	EPA 300.0	250 mL Polyethylene / Cool 4°C	Analyze within 48 Hours
Biological Oxygen Demand (BOD)	SM 5210B	500 L Polyethylene / Cool 4°C	Analyze within 48 Hours
BTEX / Gasoline Range Hydrocarbons	EPA 8260/NWTPH-Gx/EPA 8015	40 mL Glass VOA Vial / Cool 4°C, HCl	Analyze within 14 Days/Analyze within 7 days if unpreserved
Chemical Oxygen Demand (COD)	SM 5220D	250 mL Polyethylene / Cool 4°C, H_2SO_4	Analyze within 28 Days
Coliform, Fecal & Total	Colilert-18 / SM 9223B	110 mL Sterile / Cool 4°C, $Na_2S_2O_3$	Analyze within 6 hrs
Cyanide, Total	SM 4500-CN C,E	250 mL Polyethylene / Cool 4°C, NaOH	Analyze within 14 Days
Diesel Range Organics	NWTPH-Dx/ AK102-103	500 mL Amber Glass / Cool 4°C/HCl	Extract within 14 Days / Analyze within 40 Days of Extraction Extract within 7 days if unpreserved

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Table 6: Sampling Containers, Preservation Requirements, Holding Times			
Parameter	Method	Container/Preservatives	Holding Time
Dissolved Organic Carbon	SM 5310B/C	250/500 mL Amber Glass / Cool 4°C, H_2SO_4, Protect from Sunlight	Analyze within 28 Days
Dissolved Oxygen	ASTM D888	BOD Bottle / Cool 4°C	<15 min
Extractable Petroleum Hydrocarbons (EPH)	NWTPH-EPH	500 mL Amber Glass / Cool 4°C/HCl	Extract within 14 Days / Analyze within 40 Days of Extraction Extract within 7 days if unpreserved
Herbicides	EPA 8151A	500 mL Amber Glass / Cool 4°C	Extract within 7 Days / Analyze within 40 Days of Extraction
Hexavalent Chromium	EPA 7196/SM 3500 Cr6 B	250 to 500 mL Polyethylene / Cool 4°C	Analyze within 24 Hours
Ignitability / Flashpoint	ASTM D93/EPA 1010A	250 mL Amber Glass / Cool 4°C	Analyze within 28 Days
Langelier Index / Corrosivity (Alk, Ca, pH, TDS)	SM 2330B	250 mL to 1 L Polyethylene / Cool 4°C	Analyze pH immediately
Mercury (Hg)	245.1/7470	250 to 500 mL Polyethylene / Cool 4°C, HNO_3	Analyze within 28 Days
Metals, Dissolved (Except Mercury)	EPA 6020/200.8	250 to 500 mL Polyethylene (Field Filter) / Cool 4°C, HNO_3	Analyze within 6 Months

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Table 6: Sampling Containers, Preservation Requirements, Holding Times			
Parameter	Method	Container/Preservatives	Holding Time
Metals, Total (Except Mercury)	EPA 6020/200.8	250 to 500 mL Polyethylene / Cool 4°C, HNO_3	Analyze within 6 Months
Methane, Ethane, and Ethene	RSK-175	40 mL Glass VOA Vial / Cool 4°C, HCl	Analyze within 14 Days
Ammonia	SM 4500 NH_3 D	1L Polyethylene / Cool 4°C, H_2SO_4	Analyze within 28 Days
Kjeldahl	SM 4500N	500 mL to 1 L Polyethylene / Cool 4°C, H_2SO_4	Analyze within 28 Days
Oil & Grease	EPA 1664	1 L Amber Glass / Cool 4°C, HCl or H_2SO_4	Analyze within 28 Days
Pesticides	EPA 8081	500 mL Amber Glass / Cool 4°C	Extract within 7 Days / Analyze within 40 Days of Extraction
pH	SM 4500H+B	250 mL Polyethylene / Cool 4°°C	ASAP
Phosphorus, Total	EPA 365.3	4 to 8 oz Glass Jar / Cool 4°C	Analyze within 28 Days
Polychlorinated Biphenyls (PCBs/Aroclor)	EPA 8082	500 L Amber Glass / Cool 4°C	Extract within one year
Residual Chlorine	SM 4500Cl	250 mL Amber Glass / Cool 4°C	<15 min
Salinity	EPA 2520B	250 mL Polyethylene / Cool 4°C	Analyze within 8 Days

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Table 6: Sampling Containers, Preservation Requirements, Holding Times			
Parameter	Method	Container/Preservatives	Holding Time
Semi Volatile Organic Compounds (BNA, PAH)	EPA 8270	500 mL Amber Glass / Cool 4°C	Extract within 7 Days / Analyze within 40 Days of Extraction
Settleable Solids	SM 2540F	1 L Polyethylene / Cool 4°C	Analyze within 48 Hours
Total Solids (TS)	SM 2540B	250 mL Polyethylene / Cool 4°C	Analyze within 7 Days
Total Dissolved (TDS)	SM 2540C	250 mL Polyethylene / Cool 4°C	Analyze within 7 Days
Total Suspended (TSS)	SM 2540D	250 mL Polyethylene / Cool 4°C	Analyze within 7 Days
Total Volatile (TVS)	SM 2540E	250 mL Polyethylene / Cool 4°C	Analyze within 7 Days
Specific Conductance (Conductivity)	SM 2510B	250 mL Polyethylene / Cool 4°C	Analyze within 48 hrs
Sulfide	SM 4500-S^{2-}F	250 mL Polyethylene / Cool 4°C, Zn Acetate, H_2SO_4	Analyze within 7 days
Total Organic Carbons (TOC)	SM 5310B/C	250/500 mL Amber Glass / Cool 4°C, H_2SO_4, Protect from Sunlight	Analyze within 28 Days
Turbidity	EPA 180.1	250 mL Polyethylene / Cool 4°C	Analyze within 48 Hours

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Table 6: Sampling Containers, Preservation Requirements, Holding Times			
Parameter	Method	Container/Preservatives	Holding Time
Volatile Organic Compounds (VOC)	EPA 8260	40 mL Glass VOA Vial / Cool 4°C, HCl	Analyze within 14 Days/Analyze within 7 days if unpreserved
Volatile Petroleum Hydrocarbons (VPH)	NWTPH-VPH	40 mL Glass VOA Vial / Cool 4°C, HCl	Analyze within 14 Days/Analyze within 7 days if unpreserved
1,2-Dibromoethane (EDB) / 1,2-Dibromo-3-chloropropane (DBCP)	EPA 8011	2-40 mL VOA Vials / Cool 4°C, 0.5 mL $Na_2S_2O_3$	Analyze within 14 Days/Analyze within 7 days if unpreserved
DRINKING WATER			
Parameter	Method	Container/Preservatives	Holding Time
11 Regulated Metals	EPA 200.8/245.1	250 mL Polyethylene / Cool 4°C	180 Days (28 Days for Mercury) after lab preservation
Coliform, Fecal	Colilert-18	110 mL Sterile / Cool 4°C, $Na_2S_2O_3$	6 Hours
Coliform, Total	SM 9223B	110 mL Sterile / Cool 4°C, $Na_2S_2O_3$	30 Hours
Dissolved Organic Carbon (DOC)	SM 5310C	250 mL Amber Glass / Cool 4°C	Analyze within 28 Days
Lead and Copper Rule	EPA 200.8	1 L Polyethylene / Cool 4ºC, HNO_3	180 days after lab preservation
Total Organic Carbon (TOC)	SM 5310C	500 mL Amber Glass / Cool 4^0C, H_2SO_4, Protect from Sunlight	Analyze within 28 Days

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Table 6: Sampling Containers, Preservation Requirements, Holding Times			
Parameter	Method	Container/Preservatives	Holding Time
AIR			
Parameter	Method	Container/Preservatives	Holding Time
Volatile Organic Compounds	TO-15	Tedlar® Bag/Canister	Analyze within 72 hours/30 days
Sulfur Compounds	TO-15	Tedlar® Bag / Canister	Analyze within 24 hours
Siloxanes	TO-15	Tedlar® Bag/ Canister	Analyze within 72 hours/30 days
Major Gases	EPA Method 3C	Tedlar® Bag	Analyze within 72 hours

26.5.2. If preservation or holding time requirements are not met, the procedures in Section 13 – "Control of Nonconforming Environmental Testing Work" are followed.

27. HANDLING SAMPLES AND TEST ITEMS (TNI V1:M2 – SECTION 5.8 AND SECTION 1.7 OF TECHNICAL MODULES TNI V1:M 3-7)

27.1. Sample Receipt

27.1.1. When samples are received at the laboratory, the chain-of-custody is reviewed and conditions are documented. The samples are then logged into the Laboratory Information System (LIM) for sample tracking and given unique identifiers.

27.2. Chain of Custody

27.2.1. As described in section 17.5, the Chain of Custody is the documented history of any sample.

27.2.2. At the project site each sample is labeled with:

- Date and time of sampling
- Name of the client
- Name of the sampler
- Sample identification number
- Other pertinent information

27.2.3. At the same time, the Chain of Custody form is filled out in ink with the same information as well as the type of sample, address and phone number of the client, the containers and preservatives used, the analyses requested, the project name and any special handling or analytical requirements.

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27.2.4. When the samples are received at the laboratory, sample receiving checks to ensure that all samples listed on the Chain of Custody are, in fact, present and in satisfactory condition and are properly preserved.

27.3. Sample Acceptance

27.3.1. The condition of samples as the laboratory receives them directly affects the quality of the data that can be produced. Samples that are not properly preserved or handled during shipping will not reliably represent the conditions that exist at the sampling point. The laboratory must check and document the condition of the samples as submitted to verify proper handling of the samples. Any abnormalities or departures from standard conditions are recorded on the sample receipt form/original observation sheet and then input into the Omega LIM system (Sample Receipt form). The container the samples are received in are inspected at time of receipt for condition of the sample, sample label, temperature, preservatives, packaging materials, and sample seals. Information on the sample label is reconciled against information on the Chain of Custody and any discrepancies are noted. All samples are checked for proper chemical preservation, if required. Water samples for volatile organics analysis are not preserved after receipt but are checked for entrapped bubbles. The Laboratory Manager is notified if volatile samples are received without preservatives. The samples are given priority for prompt analysis.

27.3.2. All samples that require thermal preservation are considered acceptable if they are received on ice and sample arrival temperature is received at 4º C, ± 2°C. Samples that are hand delivered to the laboratory immediately after collection may not meet these criteria. In these cases, the samples will be considered acceptable if there is evidence that the chilling process has begun, such as arrival on ice. The temperature of the samples is taken using an infra-red thermometer and recorded.

27.3.3. If these conditions are not met, the client is contacted prior to any further processing. The following may occur:

- The sample is rejected as agreed with the client,
- The decision to proceed is documented and agreed upon with the client,
- The condition is noted on the Chain of Custody form and/or lab receipt documents, and
- The analytical report is noted with the conditions.

27.3.4. The client services representative logs all samples into the LIMS. The login procedure generates a work order and labels for each sample container. Sample containers are stored in a walk-in refrigerator or at the designated location for the analysis requested.

27.3.5. The laboratory has a sample acceptance policy that is made available to sample collection personnel.

27.3.6. Further information on sample acceptance is found in SOP 64.

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27.4. Sample Identification

27.4.1. Each group of samples submitted is assigned a unique work order number indicating the current year followed by a two-digit code for the month. The work order numbers are assigned sequentially throughout each calendar year. Each sample submitted within a work order is numbered sequentially beginning with 001. The samples are labeled in the order listed on the COC. The sample number includes the work order number followed by the sequential number from the COC (e.g., 110101-001A). Each container for a specific sample is assigned a letter suffix. Thus, each sample container received at ATG Seattle is assigned a unique identification number. The sample identification system includes identification for all samples, sub-samples and subsequent extracts and/or digestates. A unique identification (ID) code is placed on each sample container using a durable label.

27.4.2. The status of a work order while at ATG Seattle is tracked through the Omega LIM system which also provides the daily work order schedule.

27.4.3. The client services representative logs all samples into Omega. The login procedure generates a work order and labels for each sample container. Sample containers are stored in a walk-in refrigerator. Samples for certain volatile analyses are stored in separate refrigerators to avoid possible cross contamination.

27.4.4. Sample information is recorded in Omega under the work orders tab upon receipt.

27.4.5. Information required for log-in includes:

- Date received
- Date and time of sampling linked to the date and time of laboratory receipt
- Client
- Work order number
- Project Name
- Project Manager
- Analysis
- Client Sample ID
- Containers
- Lab Sample ID number (generated by Omega)

27.4.6. Once the sample receipt form and login have been completed, the laboratory personnel will attach a label for Omega identification on the sample containers. Sample containers are not marked for identification on the container lid. Laboratory personnel will not place marks on the label that obscures other pertinent information on the label.

27.4.7. All documentation received regarding the sample, such as memos or chain of custody, are retained and scanned into Omega for the correct work order.

27.4.8. Upon login, each employee has the ability to view a backlog of work orders to schedule the daily workload and plan future workloads. It is the responsibility of each Lab Manager to schedule work, ensure that holding times are met and that all data is reported on time.

27.4.9. Further information regarding sample log-into Omega is found in SOP 65.

27.5. USDA, Animal and Plant Health Inspection Service

27.5.1. All samples which are considered foreign and/or regulated domestic soil will be treated in accordance with USDA, APHIS, USDA APHIS PPQ compliance (SOP50). All samples will be stored in a locked container at ATG Seattle.

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27.5.2. All samples will be heat treated according to SOP50 when preparing for disposal.

27.5.3. All disposed samples will be documented.

27.5.4. Shipping container will be decontaminated with approved disinfectants.

27.5.5. All hazardous waste (including foreign and domestic soil) will be disposed of in accordance with Washington State Model Toxics Control Act (MTCA) NOTE: All foreign and/or regulated domestic soil will be noted in Omega as Foreign soil.

27.6. Sample Aliquots / Sub-sampling

27.6.1. In order for analysis results to be representative of the sample collected in the field, soil samples are homogenized, and water samples are taken from the appropriate bottle for each test.

27.6.2. Laboratory employees should take note of any extraneous materials such as rocks and twigs.

27.6.3. Laboratory employees shall not manipulate the sample material in order to obtain their exact target weight because it may produce non-representative subsamples if the sample is highly heterogeneous.

27.7. Preservation Checks

27.7.1. The following preservation checks are performed and documented after samples have been logged in:

27.7.1.1. Chlorine checks:

27.7.1.1.1. Chlorine checks occur when required by the analytical method (such as BOD-5) and upon request.

27.7.1.2. pH checks:

27.7.1.2.1. The pH of samples requiring acid/base preservation is checked upon sample receipt or upon initiation of analysis. VOC waters must be verified after analysis to preserve the integrity of the sample.

27.8. Sample Storage

27.8.1. Samples are not stored with standard reference materials or extracts. Samples with obvious high contamination or product samples are segregated from other samples. To assure that the laboratory will satisfy Chain of Custody protocols, the following laboratory conditions are maintained:

- Samples that require thermal preservation are stored under refrigeration that is ±2° C of the specified preservation temperature. For samples with a specified storage temperature of 4° C storage at a temperature above the freezing point of water to 6° C is considered acceptable.
- Sample storage area, walk-ins, refrigerators and freezers are monitored for correct temperature 7 days a week. The min/max temperature is recorded for each area.
- Samples are stored away from all standards, reagents, food, and other potentially contaminating sources to prevent cross contamination.
- Samples will remain in limited access sample storage until removed for sample preparation or analysis;
- Samples with noxious odors or that require segregation from other samples are stored within coolers.

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27.8.2. The sample storage refrigerators will have a thermometer to register storage temperature. The temperature for all refrigerators and freezers storing samples will be recorded daily.

27.8.2.1. Access to the refrigerators is restricted to designated laboratory staff only.

27.9. Sample Disposal

27.9.1. Samples are retained a minimum of 30 days after the sample has been received unless other arrangements have been made with the client.

27.9.2. Samples in air canisters are retained for 7 days after the final report has been sent to the client.

27.9.3. Samples are disposed of according to Federal, State and local regulations. Procedures are described in SOP61 for the disposal of samples, digestates, leachates, and extracts.

27.10. Sample Transport

27.10.1. Samples that are transported under the responsibility of the laboratory, where necessary, are done so safely and according to storage conditions. This includes moving bottles within the laboratory. Specific safety operations are addressed outside of this document.

27.10.2. Sample shipping procedures are described in SOP62.

28. QUALITY ASSURANCE FOR ENVIRONMENTAL TESTING (TNI V1:M1, V1:M2 – SECTION 5.9 AND SECTION 1.7 OF TECHNICAL MODULES TNI V1:M 3-7)

28.1. ATG Seattle has procedures for monitoring the validity of the testing it performs. The qualities of test results are recorded in such a way that trends are detectable, and where practicable, are statistically evaluated. To evaluate the quality of test results, the laboratory utilizes certified reference materials, control charting, proficiency testing samples, replicate or confirmation analyses comparison to historical data.

28.2. In addition to procedures for calibration, the laboratory monitors quality control measurements such as blanks, laboratory control samples (LCS), matrix spikes (MS), duplicates, surrogates and internal standards to assess precision and accuracy. Proficiency Testing samples are also analyzed to assess laboratory performance.

28.3. Quality control (QC) data are analyzed and, when found to be outside pre-defined criteria, action is taken to correct the problem and to prevent incorrect results from being reported. Data associated with quality control data outside of criteria and still deemed reportable will be qualified so the end user of the data may make a determination of the usability of the data - see Section 29 – “Reporting of Results”.

28.4. Essential Quality Control Procedures

28.4.1. The quality control procedures specified in test methods are followed by laboratory personnel. The most stringent of control procedures is used in cases where multiple controls are offered. If it is not clear which is the most stringent, that mandated by test method or regulation is followed.

28.4.2. For test methods that do not provide acceptance criteria for an essential quality control element or where no regulatory criteria exist, acceptance criteria are developed. The limits are set at +/- 30 percent, until enough data points are available to do a control chart. All control charting is done inside of Omega (See SOP47).

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28.4.3. Written procedures to monitor routine quality controls including acceptance criteria are located in the test method SOPs and include such procedures as:

- use of laboratory control samples and blanks to serve as positive and negative controls for chemistry methods;
- use of laboratory control samples to monitor test variability of laboratory results;
- use of calibrations, continuing calibrations, certified reference materials and/or PT samples to monitor accuracy of the test method;
- measures to monitor test method capability, such as limit of detection, limit of quantitation, and/or range of test applicability, such as linearity;
- use of regression analysis, internal/external standards, or statistical analysis to reduce raw data to final results;
- use of reagents and standards of appropriate quality and use of second source materials as appropriate;
- procedures to ensure the selectivity of the test method for its intended use;
- measures to assure constant and consistent test conditions, such as temperature, humidity, rotation speed, etc., when required by test method;
- use of sterility checks for equipment, media and dilution water for microbiology; and
- use of positive and negative culture controls for microbiology.

28.5. Internal Quality Control Practices

28.5.1. Analytical data generated with QC samples that fall within all prescribed acceptance limits indicate the test method is deemed to be in control.

28.5.2. QC samples that fall outside QC limits indicate the test method are deemed to be out of control (nonconforming) and that corrective action is required and/or that the data are qualified (see Section 13 – “Control of Nonconforming Environmental Testing Work” and Section 15 - “Corrective Actions”).

28.5.3. Detailed QC procedures and QC limits are included in test method SOPs, or where unspecified in the SOPs, are detailed by the use of control charts.

28.5.4. All QC measures are assessed and evaluated on an on-going basis, so that trends are detected.

28.6. General Controls

28.6.1. Positive and Negative Controls such as:

- Blanks (negative)
- Laboratory control sample (positive)
- Sterility checks and control cultures (positive and negative)

28.6.2. Selectivity is assured through:

- Absolute and relative retention times in chromatographic analyses;
- Two-column confirmation when using non-specific detectors;
- Use of acceptance criteria for mass-spectral tuning (found in test method SOPs);
- Use of the correct method according to its scope assessed during method validation; and
- Use of reference cultures (positive and negative) from a recognized manufacturer (where applicable).

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28.6.3. Consistency, Variability, Repeatability, and Accuracy are assured through:

- Recommendations or according to the processes used during method validation;
- Monitoring and controlling environmental conditions (temperature, access, proximity to potential contaminants)
- Selection and use of reagents and standards of appropriate quality; and
- Cleaning glassware appropriate to the level required by the analysis as demonstrated with method blanks (SOP46)
- For microbiology, glassware care includes use of detergents designed for laboratory use and sterilization in the autoclave
- Following SOPs and documenting any deviation, assessing for impact, and treating data appropriately;
- Testing to define the variability and/or repeatability of the laboratory results, such as replicates;
- Use of measures to assure the accuracy of the test method, including calibration and/or continuing calibrations, use of certified reference materials, proficiency test samples, or other measures; and

28.6.4. Test Method Capability (also see Section 23 – “Environmental Methods and Method Validation”) is assured through:

- Establishment of the limit of detection activity if also performing where appropriate (SOP53);
- Establishment of the limit of quantitation or reporting level (SOP53); and/or
- Establishment of the range of applicability such as linearity.

28.6.5. Data reduction is assured to be accurate by:

- selection of appropriate formulae to reduce raw data to final results such as regression;
- following specific procedures for data reduction such as manual integration procedures;
- microbiological calculations, data reduction, and statistical interpretations specified by each test method; and

28.6.6. Sample Specific controls are used to evaluate the effect of sample matrix on the performance of the selected analytical method (not a measure of laboratory performance):

- Matrix Spike and Matrix Spike Duplicate (MS/MSD)
- Surrogate Spikes
- Sample Duplicates

28.7. Essential Quality Control Elements

28.7.1. Table 7 summarizes the key elements of a quality control system for a laboratory performing chemistry and microbiology testing.

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Table 7: Essential Quality Control Elements for Chemistry			
Item	Frequency	Acceptance Criteria	Corrective Action
Negative Control (Method Blank)	1/batch	Method specific or reporting limit	Qualify data and take corrective action
Positive Control (Laboratory Control Sample)	1/batch	Method specific or determined by laboratory	Reprocess, reanalyze, or qualify data.
Matrix Spike; Matrix Spike Duplicates Note: Samples are designed as data quality indicators for a specific sample using the designated method. These controls alone are not used to judge a laboratory's performance.	Per method requirement	Method specific or determined by laboratory	Corrective action or qualify data.
Surrogate spikes See note above.	Per method requirement	Method specific or determined by laboratory	Corrective action or qualify data
Batch Duplicates See note above	Per method requirement	Method specific or determined by laboratory	Corrective action or qualify data
Continuing Calibration Verification	Per method requirement	Method specific or determined by the laboratory	Reanalyze standard immediately; Corrective action
Initial calibration Verification	After initial calibration	Method specific or determined by laboratory	Reanalyze standard immediately; Corrective action

28.8. Method Blanks

28.8.1. Method blanks are processed along with and under the same conditions as the associated samples to include all steps in the method. A method blank must be analyzed at a minimum of one per preparation batch. When no separate preparation method is used the batch is defined as the environmental samples that are analyzed with the same method and personnel, using the same lots of reagents, not to exceed the analysis of twenty environmental samples, not including method blanks, LCS, matrix spikes and matrix duplicates. The matrix of the method blank must be similar to the associated samples and be free from any analytes of interest.

28.8.2. Method blanks are not required for some analyses such as, settleable solids, flash point, temperature, percent moisture.

28.8.3. Contaminated blanks are identified according to the acceptance limits in the test method SOPs or laboratory documentation.

28.8.4. The laboratory identifies a blank as contaminated when analyte results are greater than the reporting limit. For DoD projects, blanks must be less than ½ the LOQ. Omega flags all data with a B that has a hit above the reporting limit. When a blank is determined to be contaminated, the cause must be investigated and measures taken to minimize or eliminate the problem.

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28.8.5. Data that are unaffected by the blank contamination (non-detects or other analytes) are reported unqualified. Detections in blanks may be deemed acceptable if detections in samples are greater than 10 times the detection in the method blank.

28.8.6. Sample data that are suspect due to the presence of a contaminated blank are reanalyzed, qualified, or voided.

28.9. Laboratory Control Samples

28.9.1. Laboratory Control Samples (LCS) are prepared from analyte free water or other clean matrix, and spiked with verified and known amounts of analytes for the purpose of establishing precision or bias measurements.

28.9.2. Laboratory control samples are analyzed at a frequency mandated by method, regulation, or client request, whichever is more stringent. The standard frequency of LCS preparation and analysis is one per analytical batch or as otherwise stated in a laboratory SOP. Exceptions would be for those analytes where no spiking solution is available, such as: Settleable Solids and Salinity. When no separate preparation method is used the batch is defined as the environmental samples that are analyzed with the same method and personnel, using the same lots of reagents, not to exceed the analysis of twenty environmental samples, not including method blanks, LCS, matrix spikes and matrix duplicates.

28.9.3. The analytes to be spiked in the LCS are specified in the test method SOP.

28.9.4. The results of laboratory control samples (LCS) are calculated in percent recovery (see Appendix G). This is done in Omega and can be tracked in the control chart function.

28.9.5. The individual LCS is compared to the acceptance criteria as published in the mandated test method, or where there are no established criteria, the laboratory may set the LCS limits to 70-130% until there is enough data to run control charts.

28.9.6. Analytes that fail the LCS are flagged in Omega with an “S.” Corresponding samples are flagged with a “*.”

28.9.6.1. If the majority of the analytes in an LCS fail, or if common target analytes fail, a re-extraction of the batch should be initiated.

28.9.6.2. If an analysis is consistently failing LCS recoveries, corrective action should be taken to address the root cause of the failures.

28.9.6.3. Analyte(s) that have high biased failures in the LCS do not need to be flagged if the analyte(s) in the corresponding samples are non-detect (ND).

28.10. Matrix Spikes and Matrix Spike Duplicates

28.10.1. Matrix Spikes and Matrix Spike Duplicates (MS/MSD) are environmental samples fortified with a known amount of analyte to help assess the effect of the matrix on method performance.

28.10.2. The laboratory procedure for MS/MSD includes spiking appropriate analytes at appropriate concentrations, calculating percent recoveries and relative percent difference (RPD), and evaluating and reporting the results. The procedure can be found in each method SOP. Calculations can be found in Appendix G.

28.10.3. Where there are no established criteria, the laboratory may set the percent recovery limits to 70-130% and the RPD limits to 30% until there is enough data to run control charts.

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28.10.4. For MS/MSD results outside established criteria, corrective action may be documented or the data is reported with appropriate data qualifying codes. Only the data from the spiked sample is qualified with an “S.”

28.10.4.1. If an analysis is consistently failing MS/MSD recoveries and it has been determined that sample matrix is not a factor, corrective action should be taken to address the root cause of the failures.

28.11. Batch Duplicates/Replicates

28.11.1. Duplicates and/or replicates (DUP/REP) are analyzed at a frequency mandated by analytical methods. They are prepared in the same way as their parent sample as a way to measure batch precision. Precision is measured as relative percent difference (RPD).

28.11.2. Where there are no established criteria, the laboratory may set the RPD limits to 30%. When there is enough data, the laboratory may choose to run control charts to set RPD limits.

28.11.3. For duplicate RPD results outside established criteria, corrective action may be documented or the data is reported with appropriate data qualifying codes. Only the DUP or REP will be qualified with an “R.”

28.11.3.1. Low level detections of a target analyte may result in high RPD values. In these cases, qualified data may be deemed acceptable.’

28.11.3.2. If an analysis is consistently failing DUP RPDs, and it has been determined that the sample matrix is not a factor, corrective action should be taken to address the root causes of the failures.

28.12. Surrogate Spikes

28.12.1. Surrogate spikes are substances with chemical properties and behaviors similar to the analytes of interest used to assess method performance in individual samples. Surrogates are added to all samples (in test methods where surrogate use is appropriate) prior to sample preparation or extraction, with the exception of VOC and TO-15 analysis where surrogate is added automatically by the autosamplers and preconcentrators, respectively.

28.12.2. Surrogate recovery results are compared to the acceptance criteria as published in the mandated test method. Where there are no established criteria, the laboratory uses 70-130% as surrogate recovery limits until there is enough data to run control charts. Omega flags surrogates with an “S” when they fall outside established acceptance criteria.

28.12.3. For surrogate results outside established criteria, data is evaluated to determine the impact. Corrective actions may include control charting, re-run, re-extraction, or qualifying the data as appropriate.

28.12.3.1. If an analysis is consistently failing surrogate recoveries and it has been determined that sample matrix is not a factor, corrective action should be taken to address the root cause of the failures.

28.13. Proficiency Test Samples

28.13.1. Compliance to Accreditation Requirements

28.13.1.1. The laboratory analyzes at least two TNI-compliant PT samples per calendar year for each analyte-matrix-method for which the laboratory is accredited.

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28.13.1.1.1. For DoD accreditation, if a PT is not available for a specific analyte-matrix-method combination, ATG Seattle will employ an in-lab PT procedure that evaluates performance based on repeatability. The SEA PT procedure is outlined in SOP86.

28.13.1.2. The successive PTs are analyzed at least five months apart and no more than 7 months apart unless the PT is being used for corrective action to maintain or reinstate accreditation, in which case the dates of successive corrective action PT samples for the same accreditation is at least fifteen days apart.

28.13.1.3. For analyses that only have WADOE accreditation, only one PT is required to be run per accreditation year, unless there was a failure in the last year, in which case two PTs are required to be analyzed.

28.13.1.3.1. Generally, ATG Seattle will run two PTs every year for every test besides microbiological tests.

28.13.1.4. An exception is made for analytes where there is no PT available from any PTPA approved PT provider within the year. In these cases, the lab will run the PTs in the minimum time frame the PTs are available and not at all if they are not available (TNI and WADOE only).

28.13.2. PT Sample Handling, Analysis and Reporting

28.13.2.1. The laboratory does not share PT samples with other laboratories, does not communicate with other laboratories regarding current PT sample results, and does not attempt to obtain the assigned value of any PT sample from the PT provider.

28.13.2.2. Proficiency Testing (PT) samples are treated as typical samples in the normal production process where possible, including the same analysts, preparation, calibration, quality control and acceptance criteria, sequence of analytical steps, number of replicates, and sample log-in. PT samples are not analyzed multiple times unless routine environmental samples are analyzed multiple times. Where PT samples present special conditions in the analysis process, they will be treated as laboratory samples where clients have special requests.

28.13.2.3. If PT Samples cannot be included within an analytical batch containing client samples, it is recommended that an LCS/LCSD pair be substituted for a duplicate of the PT, due to PT volume constraints.

28.13.2.4. The type, composition, concentration and frequency of quality control samples analyzed with the PT samples are the same as with typical samples.

28.13.2.5. Prior to the closing date of a study, laboratory personnel do not:

- Subcontract analysis of a PT sample to another laboratory being run for accreditation purposes.
- Knowingly receive and analyze a PT for another laboratory being run for accreditation purposes.
- Communicate with an individual from another laboratory concerning the analysis of the PT sample.
- Attempt to find out the assigned value of a PT from the PT Provider.

28.13.2.6. PT results are imported into Omega and verified. The Omega report is then used to fill out the PT provider's forms.

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28.13.2.6.1. It is important that the correct method and analyte codes that correspond to each scope be reported. If they are not, Accrediting Bodies may consider the PT a deficiency. There may be occasions where PTs must be reported multiple times due to varying method/analyte codes between accreditation scopes.

28.13.2.6.2. PTs will be reported to the Proficiency Test Reporting Limit (PTRL) as given by PT providers. These PTRLs are taken from the Field of Proficiency Test (FoPT) tables developed by TNI. Results will be deemed unacceptable if the lab reports non-detects for PTs with detections below the lab RL but above the PTRL. Project logins for PT may be used in order to ensure the lab reports to the correct PTRL. If project logins are used, it is the QAM's responsibility to maintain the PTRLs listed in each test code.

28.13.2.7. The laboratory institutes corrective action procedures for failed PT samples following the guidelines in Section 15 – "Corrective Action".

28.13.2.8. Retention of PT records is similar to that maintained for regular environmental samples. In addition, the lab maintains a copy of the online data entry summary when the PT results are submitted online.

28.14. Data Review

28.14.1. The laboratory reviews all data generated in the laboratory for compliance with method, laboratory and, where appropriate, client requirements.

28.14.2. An electronic data file is generated by the instrument and saved on computer network. The data file is loaded into LIMS. During data processing the program checks quality control measurements for acceptability. Quality control analyses that do not meet the quality control criteria are flagged. This data is checked by the analyst to ensure that a narrative is provided and the appropriate flag is attached.

28.14.3. Any data that does not meet quality assurance criteria is either re-analyzed or flagged.

28.14.4. When the analyst has finished the primary analysis review they fill out a reporting checklist and turns it in to their laboratory manager who checks for the following items:

- All required information has been recorded on the bench sheet and reporting checklist.
- QC criteria have been met or exceptions are documented in the comments section of the reporting checklist.
- Manual calculations are checked for accuracy.

28.14.5. When these checks have been completed, the reviewer signs and dates the reporting checklist to document that the review has been performed.

28.14.6. Once all analyses for a project have been completed the folder with the raw data is turned into the Project Manager or Lab Director for the final report. Data is reviewed again for completeness and accuracy, then the final report is generated.

28.14.7. The QAM, or designee, reviews a minimum of 10% of all DoD data packages for completeness and accuracy either prior to, or after reporting. Findings from these reviews are recorded and brought to the attention of the management team so appropriate action can be taken.

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29. REPORTING THE RESULTS (TNI V1:M2 – SECTION 5.10)

29.1. The result of each test performed is reported accurately, clearly, unambiguously, and objectively and complies with all specific instructions contained in the test method.

29.2. Laboratory results are reported in a test report that includes all the information requested by the client and necessary for the interpretation of the test results and all information required by the method used.

29.3. Data are reported without qualification if the results are within the working range of the instrument, and without compromised sample or method integrity.

29.4. Test Reports

29.4.1. The report format has been designed to accommodate each type of test performed and to minimize the potential for misunderstanding or misuse.

29.4.2. The laboratory does not issue multiple reports for the same samples where there is different information on each report unless required to meet regulatory needs and approved by the Lab Director.

29.4.3. Each test report generated contains the following information:

- A title, such as Analytical Report
- The name and address of the laboratory
- Unique identification of the test report, such as a Work Order
- A pagination system that ensures that each page is recognized as part of the test report and a clear identification of the end of the report, such as “3 of 10”
- The name and address of the client
- The identification of the method(s) used
- A description, the condition, and unambiguous identification of the sample(s) tested, including the client identification code
- The date of sample receipt when it is critical to the validity and application of the results
- The date and time of sample collection (if not provided, the lab assumes a sample collection time of midnight on the day of sampling)
- The date and time the tests were prepared/analyzed, at minimum for tests with a required holding time of less than 72 hours
- The time of sample preparation (DoD reports only)
- Reference to the sampling plan and procedures used by the laboratory where these are relevant to the validity or application of the results
- Case narrative
- The test results, units of measurement, an indication of when results are reported on any basis other than as received (e.g. dry weight), failures identified
- A list of laboratory qualifiers
- QC report (MB; LCS/MS/MSD/Surrogate %recovery, acceptance criteria, etc.)
- The name, function, and signature or an equivalent electronic identification of the person authorizing the test report, and the date of issue
- Where relevant, a statement to the effect that the results relate only to the samples
- Any non-accredited tests or parameters shall be clearly identified as such to the client when claims of accreditation to this Standard are made in the analytical report or in the supporting electronic or hardcopy deliverables
- The date of issuance
- Chain of Custody

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29.5. Supplemental Test Report Information

29.5.1. When necessary for interpretation of the results or when requested by the client, test reports include the following additional information:

- Deviations from, additions to, or exclusions from the test method, information on specific test conditions, such as environmental conditions, and any non-standard conditions that may have affected the quality of the results, and any information on the use and definitions of data qualifiers
- A statement of compliance/non-compliance when requirements of the management system are not met, including identification of test results that did not meet the laboratory and regulatory sample acceptance requirements, such as holding time, preservation, etc.
- Where applicable and when requested by the client, a statement on the estimated uncertainty of the measurement

29.5.2. Where appropriate and needed, opinions and interpretations may be required. When opinions and interpretations are included, the basis upon which the opinions and interpretations are documented. Opinions and interpretations are clearly marked as such in the test report in the case narrative section

- Opinions and interpretations included in a test report may comprise, but not be limited to, the following:
  - An opinion on the statement of compliance/noncompliance of the results with requirements
  - Fulfillment of contractual requirements
  - Guidance to be used for improvements
    - Additional information which may be required by specific methods or client
    - Qualification of results with values outside the calibration range as appropriate

29.5.3. In addition to the items above, for test reports that contain the results of sampling, the following is provided when necessary for the interpretation of the results:

- The date of sampling
- Unambiguous identification of the material sampled
- The locations of the sampling, including diagrams, sketches, or photographs
- A reference to the sampling plan and procedures used
- Details of any environmental conditions during sampling that may affect the interpretations of the test results
- Any standard or other specification for the sampling method or procedure, and deviations, additions to or exclusions from the specification concerned

29.6. Environmental Testing Obtained from Subcontractors

29.6.1. Test results obtained from tests performed by subcontractors are clearly identified on the test report by subcontractor name and/or accreditation number.

29.6.2. The subcontractors report their results in writing or electronically. A copy of the subcontractors report is made available to the client if requested.

29.6.3. The actual report received from the subcontractor on their letterhead with the test result is provided to the client.

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29.7. Electronic Transmission of Results

29.7.1. All test results transmitted by telephone, fax, telex, e-mail, or other electronic means comply with the requirements of the TNI Standard and associated procedures to protect the confidentiality and proprietary rights of the client (see Section 23- “Environmental Methods and Method Validation”).

29.8. Electronic Data Deliverables (EDDs)

29.8.1. The Omega LIMS produces an electronic data file; this file may be produced at the same time as the final report.

29.9. Amendments to Test Reports

29.9.1. Material amendments to a test report after it has been issued are made only in the form of another document or data transfer. All supplemental reports meet all the requirements for the initial report and the requirements of this Quality Manual.

29.9.2. When it is necessary to re-issue a report, the new report is uniquely identified and contains a reference to the original that it replaces. All prior versions are considered “voided”.

29.9.3. A revision note must be included in the case narrative describing why the revision occurred.

30. CHANGES SINCE LAST REVISION

30.1. Updated references to Fremont Analytical to Alliance Technical Group, LLC – Seattle or ATG Seattle.

30.2. Removed references to a president, human resources manager, and purchasing manager as personnel specific to the SEA location

30.3. Added discussions of relative error requirements for calibrations

30.4. Defined a Preparation Batch, with a 24-hour limit between the start of preparation for the first and last sample in the batch

30.5. Updated info@fremontanalytical.com references to info.seattle@alliancetg.com

30.6. Clarified the corrective action section that QC failures that ultimately result in the need to provide data that doesn’t meet the client’s quality needs require a corrective action report.

30.7. Updated containers to 500 mL ambers for the organics water tests that now use 500 mL ambers

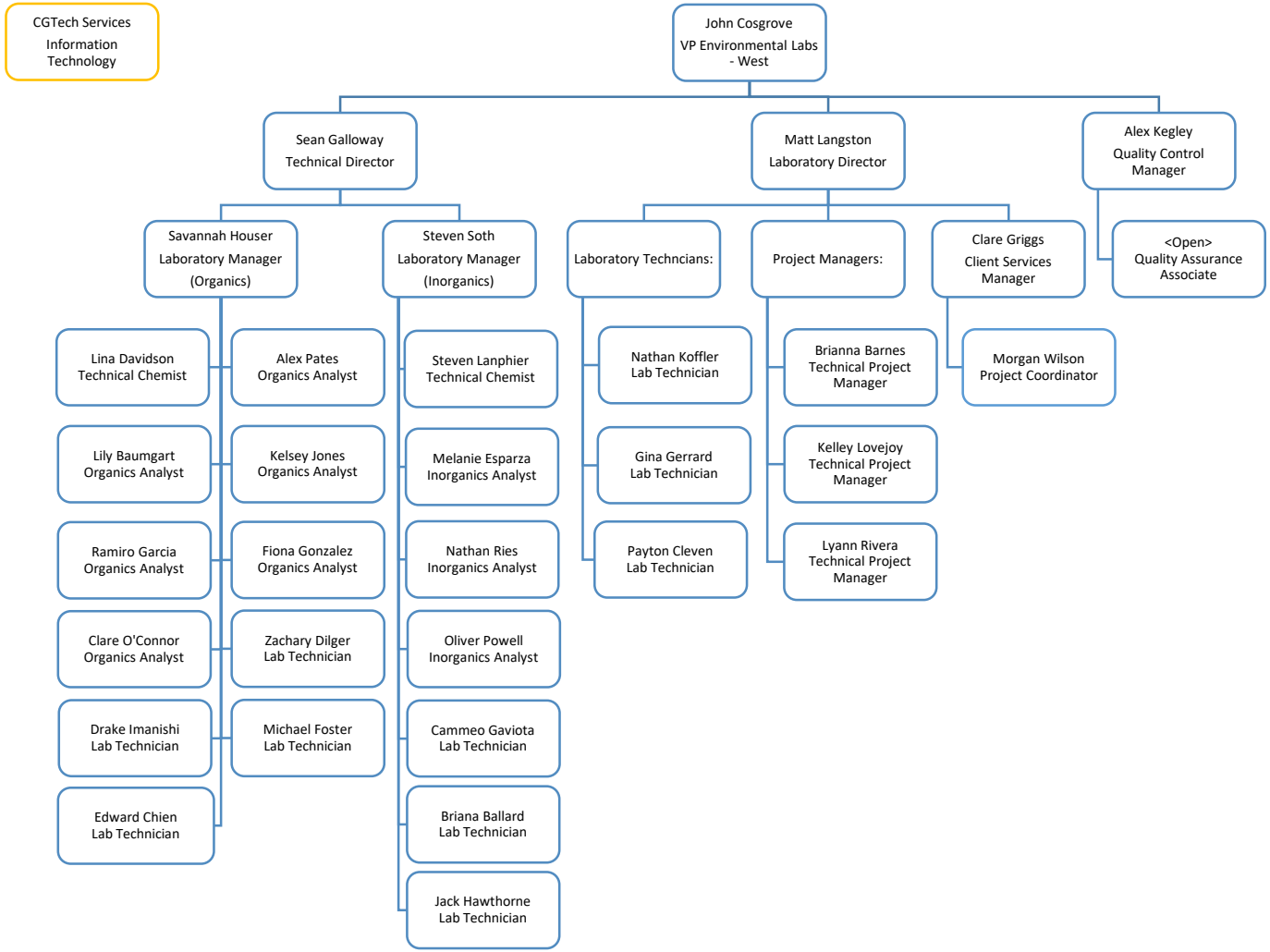
30.8. Removed requirement that 5% of calculations must be manually verified.

30.9. Added that WADOE-only PTs are generally done twice a year, aside from microbiology. This helps keep our accreditations consistent and reduce the risk of missing a PT that we were supposed to do because of a failure on an earlier one.

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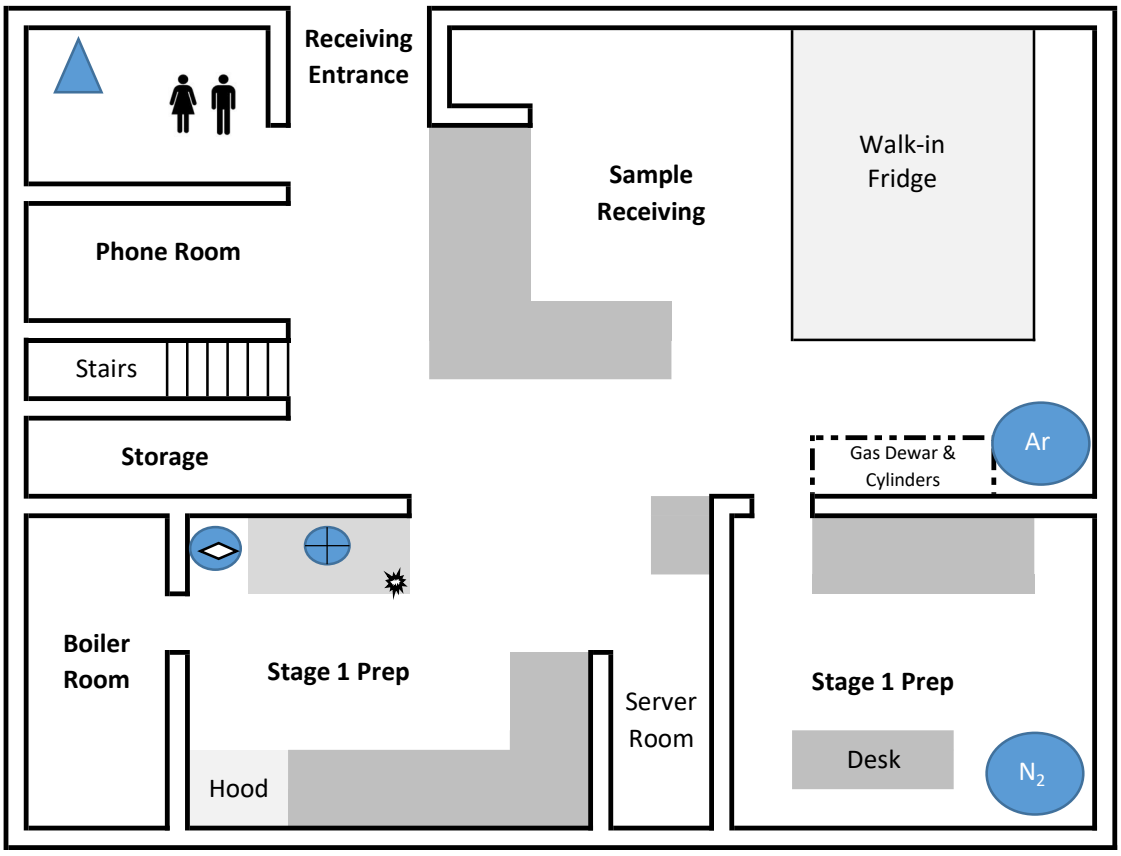
Contractors



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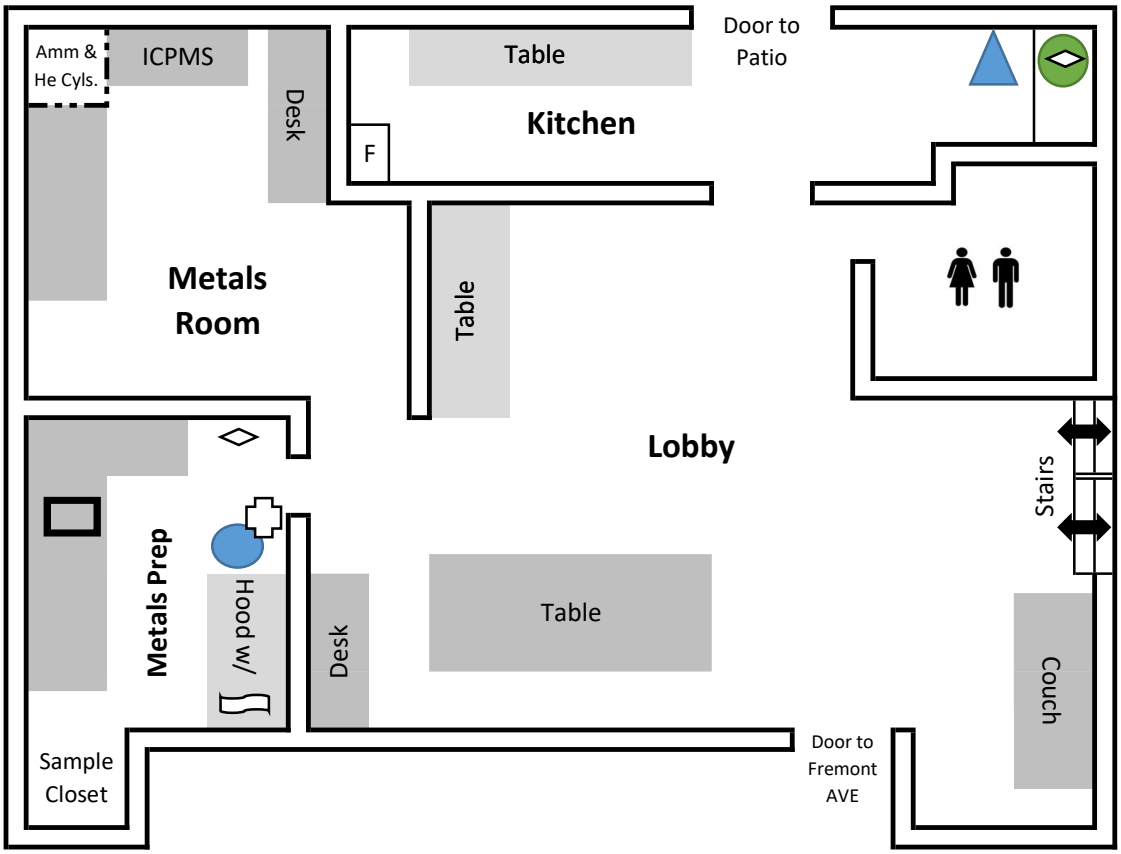
3600 Fremont AVE N - Lower Level



Symbol	Meaning	Symbol	Meaning
	DI Faucet with Eyewash	Ar	Argon Bulk Tank
	DI Water System	N_2	Liquid Nitrogen Bulk Tank
	Shower		Bench/Counter Space
	Fire Extinguisher		Restroom

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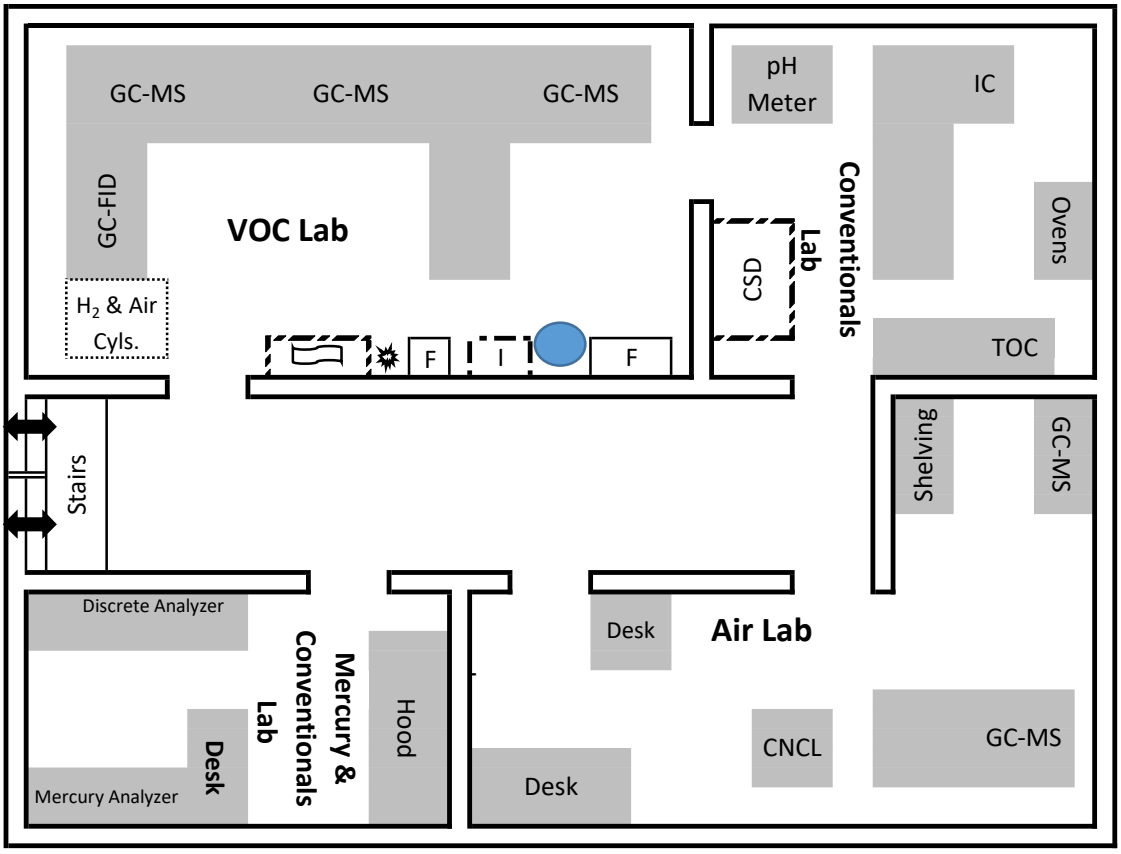
Mezzanine Floor Plan 3600 Fremont AVE N



Symbol	Meaning	Symbol	Meaning
	Fire Blanket		Safety Shower
	Eyewash Station		Restroom
	DI Faucet		Bench Space
F	Fridge		Autoclave (under bench)
	Flammable Cabinet (under hood)		Sink

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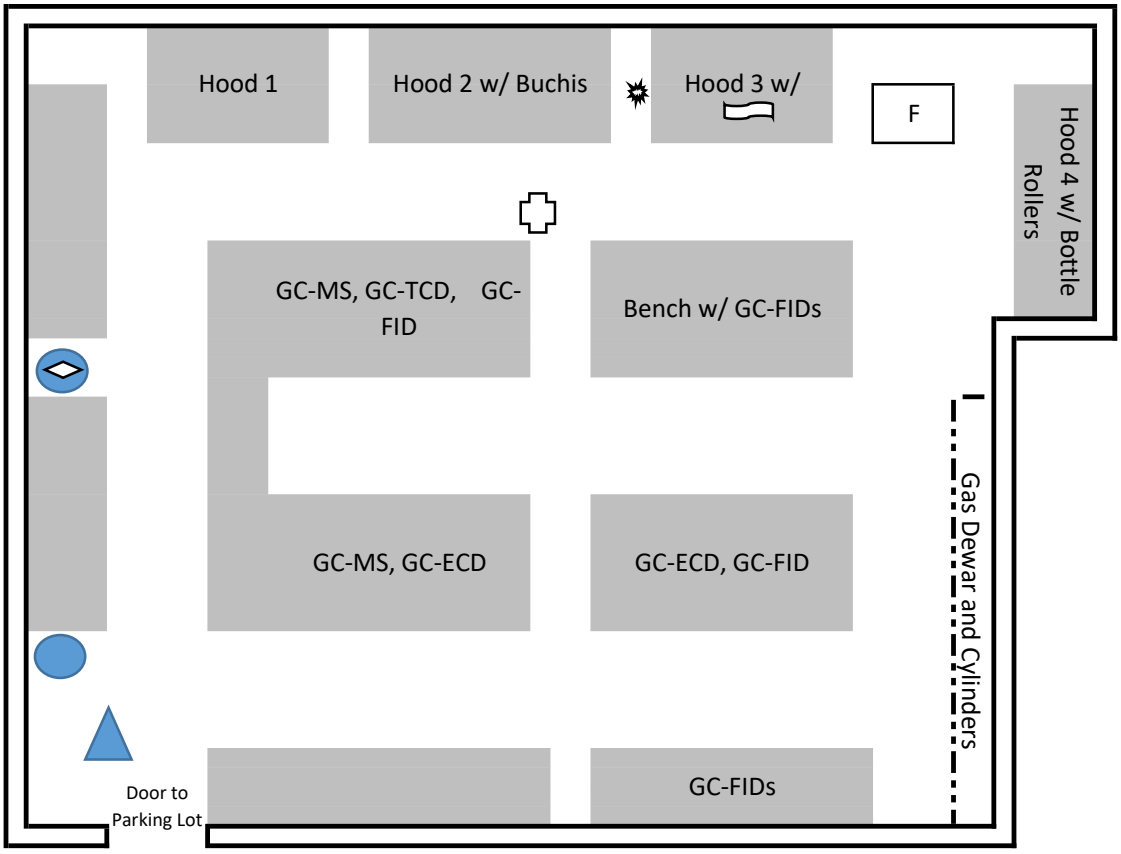
3600 Fremont AVE N - Upper Level



Symbol	Meaning	Symbol	Meaning
	Flammable Cabinet		DI Faucet
F	Fridge	CSD	Chemical Storage and Desiccators
I	Coliform Incubators		Bench Space
	Fire Extinguisher		

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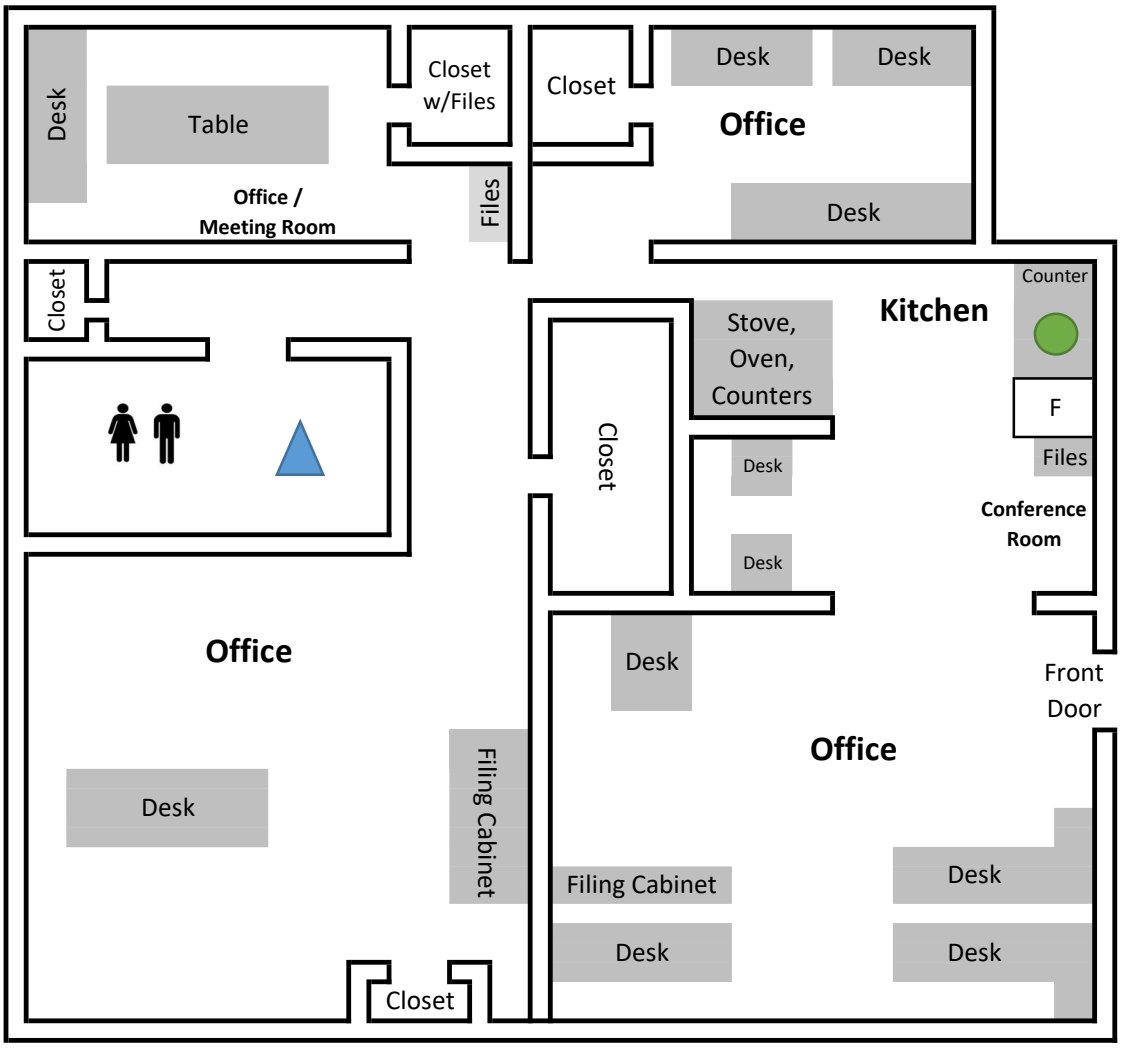
3608 N. 36th St. - Organic Extractions and Analysis



Symbol	Meaning	Symbol	Meaning
	DI Faucet		Fire Blanket
	DI Faucet with Eyewash		Flammable Cabinet (under hood)
F	Fridge		Fire Extinguisher
	Safety Shower		Bench Space

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3612 Fremont AVE N - Admin Offices



Symbol	Meaning
	Restroom
	Shower
F	Fridge
	Sink

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Appendix C
Methods and SOPs

INORGANIC ANALYTES		
Parameter/Analyte	**Methodology**	**SOP#**
Alkalinity, by Methyl Orange	EPA 310.2	SOP92
Alkalinity, by Titration	SM 2320 B	SOP75
Ammonia ISE	SM 4500-NH_3 E	SOP79
Ammonia Phenate	SM 4500-NH_3 G	SOP80
Anions	EPA 300.0	SOP68
Bulk Density	ASTM D5057	SOP42
Biological Oxygen Demand (BOD)	SM 5210B	SOP9
Cation Exchange Capacity (CEC)	EPA 9081	SOP32
Chemical Oxygen Demand (COD)	SM 5220 D	SOP83
Cyanide, Total	SM 4500-CN C/E	SOP82
Dissolved Organic Carbon (DOC)	SM 5310 C	SOP74
Enterococci	SM 9230 D	SOP95
Fecal Coliform	Colilert 18	SOP89
Ferrous Iron	SM 3500 Fe B	SOP78
Flashpoint/Ignitability	ASTM D93/EPA1010	SOP43
Grainsize/Particle Distribution	ASTM D422	SOP41
Hexavalent Chromium (Cr^{6+})	EPA 7196/SM3500 Cr B	SOP71
Microbiology QC	SM 9223B / Colilert 18	SOP87
Oil & Grease, Hexane Extractable Material (HEM)	EPA 1664A	SOP70
Organic Matter	ASTM 2974	SOP40
pH – Soils/Wastes	EPA 9045D	SOP72
pH – Waters	SM 4500-H^+ B	SOP72
Phosphorus, Total	EPA 365.3	SOP69
Residual Chloride	SM 4500 Cl G	SOP91
Specific Conductance/Salinity	SM 2510 B/2520 B	SOP76
Sulfide, Total by Methylene blue	SM 4500 S2 D	SOP90
Sulfide, Total by Titration	SM 4500-S^{2-} F	SOP81
Total Dissolved Solids (TDS)	SM 2540 C	SOP77
Total Organic Carbon (TOC) – Water	SM 5310 B	SOP74
Total Organic Carbon (TOC) – Soil	EPA 9060	SOP75
Total Settleable Solids	SM 2540 F	SOP77
Total Solids (TS)	SM 2540 B	SOP77
Total Suspended Solids (TSS)	SM 2540 D	SOP77
Turbidity	SM 2130 B	SOP67
Total Coliform	SM 9223B	SOP88

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METALS ANALYTES		
Parameter/Analyte	**Methodology**	**SOP#**
Acid Digestion – Aqueous	EPA 3010A	SOP22
Acid Digestion – Solid	EPA 3050B	SOP23
Cold Vapor Mercury	EPA 245.1	SOP29
Cold Vapor Mercury – Aqueous	EPA 7470A	SOP29
Cold Vapor Mercury – Soil	EPA 7471A	SOP29
ICP/MS Metals	EPA 200.8	SOP28
ICP/MS Metals	EPA 6020B	SOP31
Atomic Fluorescence	EPA 1631E	SOP30

ORGANIC ANALYTES		
Parameter/Analyte	**Methodology**	**SOP#**
Chlorinated Herbicides by GC/ECD	EPA 8151A	SOP24
Chlorinated Pesticides by GC/ECD	EPA 8081B/608.3	SOP14
Diesel and Heavy Oil	NWTPH-Dx / EPA 8015D / AK102 / AK103	SOP16
Gasoline Range Organics	NWTPH-Gx / EPA 8015D / AK101	SOP18
Methane, Ethane, Ethene, Acetylene in-Water by GC/FID	RSK-175	SOP20
PCBs by GC/ECD	EPA 8082A/608.3	SOP15
Semi-Volatile Organics (SVOC)	EPA 8270D/E/625.1	SOP26
Total Extractable Petroleum Hydrocarbons (EPH)	NWTPH-EPH	SOP17
Volatile Organics (VOC)	EPA 8260C/D/624.1	SOP25
Volatile Petroleum Hydrocarbons (VPH)	NWTPH-VPH	SOP19
Ethylene Dibromide and 1,2-Dibromo-3-Chloropropane	EPA 8011	SOP12

Organic Preparation		
Parameter/Analyte	**Methodology**	**SOP #**
Aqueous Extractions by Separatory Funnel	EPA 3510C	SOP35
Bottle Roller Liquid-Liquid Extraction	EPA 3510C	SOP33
Solvent Concentration	EPA 3510C	SOP34
Soil Extractions by Sonication	EPA 3550C	SOP38
PCB Cleanup: Sulfuric Acid, Florisil®, TBA	EPA 3665A, 3620C, 3660B	SOP39
Toxicity Characteristic Leaching Procedure (TCLP)	EPA 1311	SOP84
Purge and Trap and Extraction for Soil VOC Samples	EPA 5035A	SOP37
Purge and Trap for Aqueous VOC Samples	EPA 5030B	SOP36
Herbicide Preparation	EPA 8151A	SOP94

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Air Analytes		
Parameter/Analyte	**Methodology**	**SOP #**
TO-15	EPA TO-15	SOP27
Sulfur Analysis	ASTMD5504/ EPA TO-15	SOP27
Siloxanes Analysis	EPA TO-15	SOP27
Major Gases and Helium	EPA 3C/3C MOD	SOP11

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Appendix D

Data Qualifiers

*	Flagged value is not within established control limits.
A	Analysis or analyte is accredited by entity other than DoD/ELAP
B	Analyte detected in the associated Method Blank
BT	Breakthrough fraction
D	Dilution was required
E	Value above quanititation range
H	Holding times for preparation or analysis exceeded
I	Analyte with an internal standard that does not meet established acceptance criteria
J	Analyte detected below quantitation limits
MDL	Analyte reported to the Method Detection Limit (MDL)
N	Tentatively Identified Compounds
Q	Indicates a detected analyte with an initial or continuing calibration that does not meet established acceptance criteria (<20%RSD).
Q+	Indicates a detected analyte with an initial or continuing calibration that does not meet established acceptance criteria (<20%RSD) – High bias.
Q-	Indicates a detected analyte with an initial or continuing calibration that does not meet established acceptance criteria (<20%RSD) – Low bias.
S	Spike recovery outside accepted recovery limits
SGT	Silica gel treatment
R	RPD outside accepted recovery limits
ND	Not detected at the Reporting Limit
TNTC	Too numerous to count
U	Analyte detected below MDL

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APPENDIX E: CHEMISTRY – METHOD VALIDATION

Revision History

v1.0	April 8, 2013	Initial Document – M. Clements
v1.2	June 4, 2013	Edits and Revisions – M. Clements
v1.3	March 4, 2016	Edits and Revisions – N. Masters
v1.4	October 30, 2017	Edits and Revisions – E. Mar
v1.5	April 12, 2018	Edits and Revisions – E. Mar
v1.6	April 2, 2019	Edits and Revisions – E. Mar, S. Galloway
v1.7	April 27, 2020	Edits and Revisions – S. Galloway, M. Langston, E. Mar
v.1.71	March 31, 2025	Logo Update – A. Kegley

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1. QUALIFICATION AND CALIBRATION OF INSTRUMENTATION

1.1. Section 24.4 of the QA Manual includes information on calibration of support equipment. This section covers calibration of analytical equipment.

1.2. Initial instrument calibration and continuing instrument calibration verification are an important part of ensuring data of known and documented quality. If more stringent calibration requirements are included in a mandated method or by regulation, those calibration requirements override any requirements outlined here or in laboratory SOPs. Generally, procedures and criteria regarding instrument calibrations are provided in each test SOP.

1.3. New Instrument Qualification

1.3.1. When qualifying a new instrument, it is important to verify that it produces data that meet the criteria of the method it is designed to test.

1.3.2. A plan is generated that addresses any benchmarks the instrument needs to meet both specific and general. Involve anyone who will work with the instrument in designing the plan. The plan is reviewed by the Technical Director before qualification testing begins.

1.3.2.1. The plan includes specific criteria and tests used to evaluate them.

1.3.2.2. Set a timeline for completion.

1.3.2.3. Assign a person to be the leader of the qualification process. They are responsible for ensuring continued forward progress, working through emergent issues, and keeping the plan on track. Usually this is the department manager.

1.3.2.4. When the instrument qualification plan is completed, it is reviewed by the Technical Director for completeness. Once approved, testing can begin. The data produced during testing is clearly documented and attached to the instrument in Omega for traceability.

1.3.3. Common areas to include in an instrument qualification plan

1.3.3.1. Interferences

1.3.3.1.1. Ensure that a blank (including all potential sources of contamination) produces a signal low enough as to not interfere with sample quantitation.

1.3.3.1.2. If interferences are seen, work to isolate the contributing factor and reduce or eliminate the issue.

1.3.3.2. Accuracy

1.3.3.2.1. Calibrate the instrument and show that the instrument can properly assess the concentration of a known standard by relating the response to that initial calibration.

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1.3.3.2.2. The acceptance criteria to evaluate that recovery will vary depending on the method used. Refer to the appropriate SOP for more guidance.

1.3.3.3. Precision

1.3.3.3.1. Evaluate the instrument's ability to reproducibly generate a signal when given the same input multiple times.

1.3.3.3.2. Usually this is done by comparing the results of a mid-range calibration standard ran 4 times consecutively.

1.3.3.3.3. The acceptance criteria to evaluate that precision will vary depending on the method used. Refer to the appropriate SOP for more guidance.

1.3.3.4. Sensitivity

1.3.3.4.1. Instrument detection level is the concentration at which the instrument produces a signal 3X that of a blank matrix.

1.3.3.4.2. Ensure the settings used allow for an instrument detection limit that is low enough to produce usable data for client samples.

1.3.3.4.3. Refer to the appropriate SOP, client permits, and EPA regulations when evaluating the suitability of the instrument detection limit.

1.3.4. Once all necessary data has been collected, the results are summarized on the plan document, and submitted to the technical director for review. After approval, the plan will be attached to the instrument in Omega and the instrument may be used to analyze client samples.

1.4. Initial Instrument Calibration

1.4.1. Prior to bringing an instrument online, the instrument must be calibrated to demonstrate sensitivity and linearity. Sample analysis may not occur until the instrument is properly calibrated.

1.4.2. Records

1.4.2.1. Initial instrument calibration includes calculations, integrations, acceptance criteria, and associated statistics referenced in the test method SOP .

1.4.2.2. Sufficient raw data records are collected to allow reconstruction of the initial instrument calibration. These include, at a minimum, calibration date, test method, instrument, analysis date, analyte names, analysts signature or initials, concentration and response, calibration curve or response factor, or unique equation or coefficient used to reduce instrument responses to concentration.

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1.4.3. Number of Standards and Concentrations

1.4.3.1. If the reference or mandated method does not specify the number of calibration standards to use, the minimum number is three, not including blanks or a zero standard.

1.4.3.2. For instrumentation where single point calibration is recommended by manufacturer's instructions, such as with some ICP and ICP/MS technologies (with a zero and single point calibration), the following apply:

- For single point plus zero blank calibrations, the zero point and the single point standard are analyzed prior to the analysis of samples, and the linear range of the instrument established by analyzing a series of standards, one of which is at the lowest quantitation level.
- Zero blank and single point calibration standards are analyzed with each analytical batch for methods where they are specified.
- A standard corresponding to the limit of quantitation is analyzed with each analytical batch and must meet established acceptance criteria when using single point plus zero blank calibrations.
- The linearity of single point plus zero blank calibrations is verified at a frequency established by the method or the manufacturer.

1.4.3.3. The lowest calibration standards is the lowest concentration for which quantitative results can be reported without qualification.

1.4.3.4. The highest calibration standard is the highest concentration for which quantitative results can be reported. Data reported exceeding the highest calibration standards without dilutions is considered to have increased uncertainty and are reported with a qualifier code or diluted and reanalyzed.

1.4.3.4.1. For ICP-MS, a Linear Dynamic Range (LDR) study may be done so that data may be reported up to the top of the LDR.

1.5. Continuing Instrument Calibration

1.5.1. Records

1.5.1.1. The calculations and associated statistics for continuing instrument calibration are included or referenced in the test method SOP.

1.5.1.2. Sufficient raw data records are retained to allow reconstruction of the continuing instrument calibration verification. Continuing instrument calibration verification records connect the continuing verification date to the initial instrument calibration.

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1.5.2. Frequency

1.5.2.1. Calibrations are performed whenever it is expected that the analytical system may be out of calibration or might not meet continuing calibration verification (CCV) acceptance criteria.

1.5.2.2. Calibrations are verified for each compound, element, or other discrete chemical species by running a mid-point calibration standard prior to running an analytical batch. For multi-component analytes such as aroclors, chlordane, toxaphene, or total petroleum hydrocarbons, a representative chemically related substance or mixture is used.

1.5.2.3. Calibration verifications (CCVs) are performed:

- At the beginning and end of each analytical batch. Unless it is a DoD project, methods employing internal standards are only required to run one CCV at the beginning of an analytical batch. Some methods require more frequent CCVs. Many inorganic methods require a CCV to be analyzed after every 10 samples.
- When the time period for calibration or the most recent calibration verification has expired.

1.6. Evaluation, Verification, and Corrective Action

1.6.1. Criteria for the acceptance of an instrument calibration is established and defined in each method SOP. The criteria used are appropriate to the calibration technique.

1.6.1.1. Calibration points are not dropped from the middle of the curve unless the cause is determined and documented. If cause is determined and points in the middle are dropped, that same point must be dropped from all analytes. If the cause is not determined, the calibration curve is re-prepared.

1.6.1.2. If the low or high calibration point is dropped from the curve, the working curve is adjusted and sample results outside the curve are qualified as estimates.

1.6.2. Instrument calibrations are verified with a standard obtained from a second source standard. This may be from a different lot of the same standard used to calibrate, or from a standard from a completely different source. Acceptance criteria for initial calibration verifications (ICV) are listed in each method SOP as well as in LIMS.

1.6.3. Where appropriate, the laboratory has manual integration procedures (*SOP52*), which are adhered to when evaluating calibration data.

1.6.4. Any samples that are analyzed after an unacceptable initial calibration are re-analyzed. If data must go out to clients, the data will be qualified. (See Section 13 – Control of Nonconforming Environmental Testing").

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1.6.4.1. Corrective actions are performed when the initial calibration results are outside acceptance criteria.

1.6.5. Acceptance criteria for CCVs are listed in each method SOP as well as in LIMS.

1.6.6. When a CCV falls outside of acceptance criteria, two additional, consecutive CCVs may be analyzed immediately (within one hour) and prior to the analysis of any client samples. Both of these CCVs must meet acceptance criteria in order for the samples to be reported without re-analysis.

1.6.6.1. Corrective actions are initiated for CCV results that are outside of acceptance criteria (Ex. Performance maintenance, new calibration).

1.6.7. For any samples analyzed on a system with an unacceptable calibration or CCV, some results may be usable if they fall under the following conditions:

- If the acceptance criteria are exceeded high (high bias) and the associated samples are below detection, those sample results that are non-detects may be reported as un-qualified non-detects.
- If the acceptance criteria are exceeded low (low bias) and there are samples that exceed the maximum regulatory limit, those exceeding the regulatory limit may be reported with qualifiers.

2. NEW METHOD QUALIFICATION

2.1. If the lab wishes to update an existing method to a more current revision or run a new method, the following must take place:

2.1.1. The Lab Director, Technical Director, and Quality Assurance Manager must approve of the change.

2.1.2. SOPs must be updated, or if it is a new method, created.

2.1.3. In order to apply for accreditation for the new/updated method, the lab will also be required to analyze and pass two PT studies prior to application with accrediting bodies.

2.2. When changing existing, qualified parameters on an instrument, requalification could be necessary.

2.2.1. Review the proposed changes with the Technical Director. They will dictate the extent of the requalification process based on the changes. The requalification will follow the structure of the new instrument qualification process outlined above in section 1.3 with possible omissions of unaffected instrument qualities.

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3. MDL, LOD, LOQ

3.1. Reference methods are further validated by determining the Method Detection Limit (MDL), Limit of Detection (LOD), and Limit of Quantitation (LOQ). These procedures are summarized below and described in *SOP53*.

3.1.1. MDL/LOD/LOQs are verified for each quality system matrix/technology/analyte combination.

3.1.2. In addition, the action level (compliance level, project decision level, etc) may be used to establish the LOD, LOQ, and Practical Quantitation Limit (PQL/RL).

3.1.3. For tests that do not have DoD accreditation, the LOD and LOQ verification/determination will be performed annually.

3.1.4. For tests that do have DoD accreditation, the LOD and LOQ verification will be performed quarterly.

3.1.5. For all tests, 2 MDL samples will be analyzed quarterly. The final MDL study will be compiled after 12 months. If there are no samples for a given test in a given quarter, the MDL samples may be put on hold until samples are received for that analysis.

3.1.6. It is the responsibility of the department managers to ensure that MDL/LOD/LOQs are analyzed in the required time frame.

3.2. MDL – Measures precision and bias

3.2.1. For any new method or new instrument, in initial MDL study must be performed as a part of the method validation procedure. If a current instrument has been altered in a way that affects sensitivity of an instrument, an initial MDL study must be performed. An initial MDL study may also be performed on methods that have been rarely used in the last 24 months.

3.2.2. A minimum of 7 spiked samples and 7 method blanks are prepared. These samples and method blanks must be prepared in at least 3 separate batches on 3 separate calendar days. Samples and method blanks must be prepared according to their SOPs.

3.3. LOD

3.3.1. LODs are the minimum concentration of a substance that can be detected.

3.3.2. LODs are determined in samples that represent the quality system matrices to be evaluated. All sample processing/preparation steps and all determinative steps are used to validate the method for all targeted analytes. Not all possible combination of preparation and clean-up techniques require LOD verification. In this situation, the verification occurs on the worst case basis. The representative quality system matrix will be free from the target analytes of interest or interfering analytes that impact the LOD.

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3.3.3. LODs are spiked at 2-3x the established detection limit for single analyte tests, and at 1-4x the detection limit for multi-analyte tests. The apparent signal-to-noise ratio at the LOD must be at least 3x and meet all requirements for analyte identification. For analyses that do not provide a measure of noise, the signal at the LOD level must be at least three standard deviations greater than the mean of the method blank concentration. This is initially established using a minimum of four method blanks.

3.3.3.1. If the LOD verification does not meet these criteria, a higher concentration is established and must meet all criteria.

3.4. LOQ

3.4.1. The Limit of Quantitation (LOQ) is an estimate of the minimum amount of a substance that can be reported with a specified degree of confidence.

3.4.2. LOQs are not required for components or properties for which spiking solutions or QC samples are not available. These include temperature, pH, TDS, TS, TSS.

3.4.3. An LOQ study includes all sample processing and analysis steps in the analytical method. The study is performed in each quality system matrix for which the test will be performed and must meet criteria for precision and bias. The procedure is documented and all supporting data are retained. The resulting LOQ will be above the LOD.

3.4.4. The LOQ is established at or above the low calibration standard. If the low calibration level needs to be changed, the analyst must first verify with their manager that the new low level will meet method, client, and laboratory requirements.

3.4.4.1. If the LOQ verification does not meet these criteria, a higher concentration is established and must meet all criteria.

4. DEMONSTRATION OF CAPABILITY

4.1. Demonstration of Capability : A procedure to establish the ability of the analyst to generate analytical results of acceptable accuracy and precision.

4.2. Before reporting any data with a given method, a satisfactory Initial Demonstration of Capability (IDC) is performed. Thereafter, each analyst demonstrates continuing proficiency through the procedures outlined below in Continuing Demonstrations of Capability (CDC) and *SOP59,* and cover all methods as outlined in Appendix D of the QA Manual.

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4.3. The IDCs and CDCs for each analyst are documented in their training files on the FASVR shared drive. The documents identify the analyst involved, matrix, analyte(s), the method(s) performed, the laboratory specific SOP used for analysis (including revision number), the date(s) of analysis, and a summary of the results used to calculate the mean recovery, standard deviations, and Percent Relative Percent Difference (%RPD).

4.4. An IDC is performed:

- Before using any method
- Each time there is a change in instrument type, personnel, or method
- If the laboratory or analysts have not performed the method in a twelve-month period.

4.4.1. All raw data, preparation records, and calculations for each IDC are retained in Omega and on FAI's server, and are available for review.

4.4.2. In cases where the laboratory analyzes samples using a method that has been in use by the laboratory for at least one year prior to applying for accreditation, and there have been no significant changes in instrument type, personnel, or method, the Continuing Demonstration of Capability is acceptable as an IDC. Records will be kept on file to demonstrate that an IDC is not required.

4.5. Continuing Demonstration of Capability (CDC)

4.5.1. After the demonstration of capability is completed, on-going proficiency is maintained and demonstrated at least annually. Each analyst is expected to consistently meet the QC requirements of the method, the laboratory SOP, client requirements and/or the TNI Standard. CDCs are documented in each analysts file, and all records related to the demonstration are retained.

4.5.2. The laboratory uses the procedure found in *SOP59* to demonstrate CDCs.

5. RECERTIFYING SPIKES, STANDARDS, REAGENTS, AND CHEMICALS

The objective of this supplemental appendix is to outline a procedure for recertifying spikes, standards, and reagents. It is important to note that not all spikes, standards, and reagents may be recertified by the lab. If analytical SOPs specify shelf life, that shelf life must be followed. There are spikes and standards whose shelf lives are intentionally set low. Those spikes and standards may not be recertified. In these cases, FAI will purchase new spikes, standards, or reagents.

It is important that this procedure occurs prior to approaching expiration dates to ensure that the spikes, standards, and reagents being used for the lab are always current.

5.1. Reagents and Chemicals

5.1.1. If the laboratory wishes to recertify a reagent or chemical that was purchased from an external source or made in-house, because it is approaching its expiration date, the following must occur.

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5.1.2. The analyst will evaluate the last 4 batches in which the reagent in question was used.

5.1.2.1. If QC passed in all 4 batches, the reagent's expiration date may be extended up to 6 month or less.

5.1.2.2. If the QC does not pass in all 4 batches, the reagent may not be recertified and a new reagent must be made or purchased prior to expiration.

5.1.3. Prior to use:

5.1.3.1. The analyst must create a new Omega ID and Container number under Operations → Reagents.

5.1.3.2. New labels will be printed and affixed to the reagent bottle.

5.1.3.3. The analyst will be required to fill out the Reagent Recertification form which will contain the following information:

- Reagent Name
- Date of Recertification
- Old Omega container number and if applicable, lot number
- Previous Expiration Date
- Omega runs evaluated
- New Omega ID
- New Expiration Date

5.1.4. The recertification form must be attached to the linked files section of the new Omega ID to document that proper procedures were followed.

5.2. Spikes and Standards

5.2.1. If a spike or standard that was purchased from an approved vendor is approaching expiration and qualifies to be recertified, the following must occur.

5.2.1.1. The soon to be expired standard must be run, preferably in succession, with two non-expired standards, all from separate lots.

5.2.1.1.1. This analysis will be imported into an Omega Analytical Run.

5.2.1.2. The two non-expired comparison standards must pass within ± 30% from the true value.

5.2.1.3. The soon to be expired standard may be deemed acceptable if the % RSD of the concentrations of all 3 standards are within 20%.

5.2.1.4. If all criteria is met, the expiration date may be extended to 1 year or less.

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5.2.1.4.1. If the analyst suspects a quicker degradation, they should set the expiration date accordingly. It is important that analysts use good judgement in this procedure because if they do suspect quicker degradation, it may be a better option to purchase a new, certified standard.

5.2.1.5. If all criteria are not met, the standard may not be recertified and a new standards will be purchased from an approved vendor.

5.2.1.6. The analyst performing the re-certification will be required to fill out the Spike/Standard Recertification Form which will contain the following information:

- Name of Standard
- Date of Recertification
- Analytical Run in Omega
- Omega Container IDs of the three standards used for testing
- Lot numbers of the three standards used for testing
- Previous Expiration Date
- New Expiration Date
- New Omega Container ID
- A separate tab in the workbook showing %REC and %RSD calculations.

5.2.1.7. A new Omega Spike ID for the recertified standard will be created and the following information will be attached to the linked files section:

- Spike/Standard Recertification Form
- Raw data from the three standards
- Previous CoA
- CoAs from the standards that were used to recertify the standard

5.2.1.8. New container labels will be created and affixed to the standard containers.

5.3. Air Standards

5.3.1. Air standards may not be recertified in-house. The recommended protocol for expired standards are as follows:

5.3.1.1. Purchase a new certified standard from an approved vendor.

5.3.1.2. Get the air standard that is close to expiration recertified by an approved external source.

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6. GUIDELINES GOVERNING THE REUSE OF METHYLENE CHLORIDE SOLVENT RECOVERED FROM BUCHI ANALYST

6.1. Objective

6.1.1. It is Fremont Analytical, Inc's practice to reduce waste and exposure to hazardous chemicals wherever possible while producing data that is compliant with regulatory agency guidance and best practices.

6.1.2. Certain procedures use a surplus of a given reagent, which is subsequently recovered upon completion of the procedure. The appropriateness of the recovered reagent for further use may be quantitatively evaluated. These guidelines will describe the procedure for evaluating methylene chloride (DCM) recovered via vacuum distillation.

6.2. Procedure

6.2.1. Prior to Buchi Syncore Analyst operation, clean the recovery flask as follows:

6.2.1.1. Discard any collected volume from flask.

6.2.1.2. Rinse with approximately 15 mL of clean DCM and discard.

6.2.2. Operate Buchi Analyst per SOP 34. During normal operation, sample extracts are heated and subjected to vacuum distillation in order to evaporate DCM while analytes of interest are maintained in solution. DCM vapors in the condenser unit return to the liquid phase and are collected in the recovery flask.

6.2.3. Transfer recovered DCM to a clean 4-L amber glass vessel.

6.2.4. When 4-L amber glass vessel is full, proceed with certification.

6.3. Certification

6.3.1. Evaluation of reagents in general is described in SW-846 method 8000D, sections 7.1 and 9.2. FAI has adopted practices consistent with the approach described therein, namely via the use of method blanks. In addition, it is FAI's practice to evaluate suitability of recovered DCM via the use of reagent blanks as described below.

6.3.2. Each lot of recovered DCM is evaluated individually. A reagent lot is defined as one full 4-L bottle of DCM.

6.3.2.1. Using Omega, assign a unique identifier to the recovered DCM lot.

6.3.2.2. Prepare an aliquot of the DCM appropriate to the method.

6.3.2.2.1. Dx soils: transfer 10 mL of DCM into a 40-mL VOA. Add surrogate and sodium sulfate.

6.3.2.2.2. PAH soils: transfer 30 mL of DCM into a 40-mL VOA. Add surrogate and sodium sulfate. Reduce volume to 10 mL using the n-Evap hot water bath.

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6.3.2.2.3. Other analyses: prepare a reagent blank in the same manner as a method blank described in the respective analytical SOP.

6.3.2.3. Analyze the reagent blank according to the appropriate analytical methodology.

6.3.2.4. Evaluate the results against acceptance criteria

6.3.2.4.1. FAI has adopted the following limits for evaluating compliance:

6.3.2.4.1.1. Reagent lots with calculated concentration of analytes in the reagent blank less than the MDL shall be immediately approved for analytical use.

6.3.2.4.1.2. Reagent lots with analytes detected at a level greater than the MDL but below ½ the PQL may be approved for use provided data quality objectives are met.

6.3.2.4.1.3. Reagent lots with analytes detected at a level greater than ½ the PQL shall not be approved for analytical use.

6.3.2.5. Record the results of the reagent blank in Omega and link with the associated lot of DCM.

6.3.2.6. Any lot that fails the above requirements will be disposed of in solvent waste. Refer to SOP 61.

7. REFERENCES

7.1. SW-846 8000D, March 2018.

7.2. EPA TO-15A, September 2019.

7.3. Definition and Procedure for the Determination of the Method Detection Limit, Revision 2, EPA, December 2016.

7.4. TNI Standard, 2016.

7.5. DoD QSM 5.3, 2019.

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8. CHANGES SINCE LAST REVISION

8.1. Added Revision History and Table of Contents

8.2. Added section describing how to qualify new instruments – Section 1.3

8.3. Added section “Recertifying Spikes, Standards, Reagents, and Chemicals.”

8.4. Added section “Guidelines Governing the Reuse of Methylene Chloride Solvent Recovered from Buchi Analyst.”

8.5. Added section “References.”

8.6. Added section “Changes Since Last Revision.:

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Appendix F
Instrument List

Instrument ID #	Serial #:	Manufacturer	Model #	Technology
GC-3	US00062981	Hewlett Packard	5890 Series II	GC-FID
GC-9	CN12371132	Agilent	7890A	GC
GC-13	CN12371130	Agilent	7890A	GC
GC-14	CN11151019	Agilent	7890A	GC
GC 16	CN11151043	Agilent	7890A	GC-Electron Capture Detector (Micro)
GC-18	CN10191105	Agilent	7890A	GC
GC-19	CN14182004	Agilent	7820A	GC
GC-21	CN13393081	Agilent	7890B	GC
GC-24	CN17081222	Agilent	7890B	GC-FID (Dual)
GC-25	CN17093129	Agilent	7890B	GC-Electron Capture Detector (Micro)
GC-26	CN17363458	Agilent	7890B	GC
GC-27	US18183013	Agilent	7890B	GC
GC-28	US1939A006	Agilent	8890	GC-FID(Dual)
GC-29	US2245A035	Agilent	8890	GC-FID/PID
GC-30	US2447A061	Agilent	8890	FID/Dual TCD/SCD
Autosampler 1	CENTS238071411	EST Analytical	Cent WS	Autosampler
Autosampler 5	US12272003	Teledyne Tekmar	Atomx	Autosampler/ Purge & Trap
Autosampler 9	0173	Entech	7016CA	Autosampler
Autosampler 10	CN11100035	Agilent	7693	Autosampler
Autosampler 13	US14197002	Teledyne Tekmar	Atomx	Autosampler/ Purge & Trap
Autosampler 20	CN10510031	Agilent	7693	Autosampler
Autosampler 24	1919002002640	Metrohm	919 Autosampler Plus	Autosampler

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Instrument ID #	Serial #:	Manufacturer	Model #	Technology
Autosampler 25	CN17020078	Agilent	7693	Autosampler
Autosampler 26	CN17020044	Agilent	7693	Autosampler
Autosampler 27	0066	Entech	7650	Autosampler
Autosampler 28	0067	Entech	7650	Autosampler
Autosampler 29	E845788696	OI Analytical	1088AS	Autosampler
Autosampler 30	US18318079	Tekmar	Atomx XYZ	Autosampler/Purge &Trap
Autosampler 31	RO19270016	Agilent	G4514A	Autosampler
Autosampler 32	1786	Entech	7016D	Autosampler
Autosampler 33	CN91700241	Agilent	G4520, 7693	Autosampler
Autosampler 34	CN10440059	Agilent	G4514A	Autosampler
Autosampler 35	US22270008	Teledyne Tekmar	Atomx XYZ	Autosampler/Purge &Trap
Tower 1	CN13090174	Agilent	G4513A	Tower
Tower 2	CN11120112	Agilent	G4513A	Tower
Tower 3	CN11120133	Agilent	G4513A	Tower
Tower 12	CN16530056	Agilent	G4513A	Tower
Tower 13	CN16530057	Agilent	G4513A	Tower
Tower 14	CN16530050	Agilent	G4513A	Tower
Tower 15	CN19370108	Agilent	G4513A	Tower
Tower 16	CN19340050	Agilent	G4513A	Tower
Concentrator 1	EV306070510	EST Analytical	Encon Evolution	Purge & Trap
Concentrator 6	1543	ENTECH	7200	Preconcentrator
Concentrator 7	1586	ENTECH	7200CTS	Preconcentrator
Mass Spec 6	US12493A24	Agilent	5975C	Detector
Mass Spec 7	US11173714	Agilent	5975C	Detector
Mass Spec 10	US1416R202	Agilent	5977E	Detector

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Instrument ID #	Serial #:	Manufacturer	Model #	Technology
Mass Spec 11	US12493A21	Agilent	5975C	Detector
Mass Spec 12	US1446L480	Agilent	5977A	Detector
Mass Spec 13	US1747M017	Agilent	5977B	Detector
Mass Spec 14	US1628N002	Agilent	5977B	Detector
Canister Cleaning System	0133/1851	Entech	3100D/ 3108	Cleaner/Oven
Dynamic Diluter	0217	Entech	4700	Regulator
Flow Professor	0381	Entech	Flow Professor	Regulator
TCLP Tumbler	GF18N060-BMYJ1C	Environmental Express	LE1002	Tumbler
YSI DO meter/Probe	304502\13C100582	YSI	ProODO/ ProOBOD	Meter
Conductivity Probe	21032003	YSI	YSI 4310-3	Probe
Meter	20501269	YSI	MultilabIDS 4010-2W	Meter
pH METER 2	1230425626	Mettler Toledo	SevenMulti	Meter
Ammonia Ion Selective Electrode	SY1-18949	Thermo Scientific	9512HPBNWP	Probe
Turbidimeter 2	201511126	MicroTPW	20000	Meter
Turbidimeter 3	H0090811	Hannah Instruments	HI88703	Meter
C-Conductivity Meter-Extech	CE 134562	Extech Instruments	Extech Instruments	Meter
IC-2	1930200013155	Metrohm	930 Compact IC Flex	Ion Chromatography
Spectrometer	3OUJ161007	Thermo Electron Corp	Spectronic 20D+	Spectrometer
Hach DR/890 Colorimeter	071090C65914	Hach	DR/890	Colorimeter
TOC 2	P843732823	OI Analytical	Aurora 1030	Detector
TOC Soil Module	B846733063	OI Analytical	1030S	Sampler
Astoria-Pacific Discrete Analyzer	4620-1020	Astoria-Pacific	CHEMWELL-T 4600	Spectrometer
ICP-MS 2 Agilent 7850	SG22151236	Agilent	7850	Inductively Coupled Plasma Mass Spectrometer
ICP-MS Autosampler	X2DX-140313	ESI	SC-2DXS	Autosampler

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Instrument ID #	Serial #:	Manufacturer	Model #	Technology
PrepFAST ICP-MS Autosampler - ESI	X4DXCi-220515	ESI	4DXCi	Autosampler
M-7600 MERCURY ANALYZER	071201Q76	Cetac Technologies	M-7600	Cold Vapor Atomic Absorption
M-7600 Autosampler	061280A520	Cetac Technologies	ASX-520	Autosampler
Flashpoint	R02291362	Koehler	K16200	Flashpoint
Grain Size Shaker	03104325	Humboldt	H4325	Shaker

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Support Equipment

Instrument ID #	Serial Number	Manufacturer	Model #	Maintenance Activity & Frequency	Calibration Frequency
Autoclave 3	2807319	Tuttnauer	EZ10 (2540EA)	Cleaning (Monthly or as needed), Refill water supply as needed	Quarterly sterility verification
BALANCE-1	1118323397	Mettler Toledo	AG204	Calibration Weights, Cleaning, Leveling (Daily)	Daily calibration verification; Yearly calibration
BALANCE-2	B238330459	Mettler Toledo	ML802E	Calibration Weights, Cleaning, Leveling (Daily)	Daily calibration verification; Yearly calibration
BALANCE-3	1123460917	Mettler Toledo	NewClassic ML	Calibration Weights, Cleaning, Leveling (Daily)	Daily calibration verification; Yearly calibration
Balance-4	B339833406	Mettler Toledo	ME2002E	Calibration Weights, Cleaning, Leveling (Daily)	Daily calibration verification; Yearly calibration
Balance-6	B734558068	Mettler Toledo	XSE204	Calibration Weights, Cleaning, Leveling (Daily)	Daily calibration verification; Yearly calibration
Balance-7	C128142982	Mettler Toledo	MS1003TS /00	Calibration Weights, Cleaning, Leveling (Daily)	Daily calibration verification; Yearly calibration
Balance-8	C423211701	Mettler Toledo	MR204	Calibration Weights, Cleaning, Leveling (Daily)	Daily calibration verification; Yearly calibration
Balance-9	C433591714	Mettler Toledo	M204	Calibration Weights, Cleaning, Leveling (Daily)	Daily calibration verification; Yearly calibration

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Instrument ID #	Serial Number	Manufacturer	Model #	Maintenance Activity & Frequency	Calibration Frequency
OVEN-2	3N0116	Fisher Scientific	Iso -temp 500 Series	Cleaning (Weekly)	Temp Check (Daily) when in use
OVEN-3	300040806 ALT. NO. 3166764	Thermo Scientific	3511FSq	Cleaning (Weekly)	Temp Check (Daily) when in use
OVEN-4	300196029 ALT. NO. 3166764	Thermo Scientific	3511FSQ	Cleaning (Weekly)	Temp Check (Daily) when in use
OVEN-5	109N0208	Fisher Scientific	650G	Cleaning (Weekly)	Temp Check (Daily) when in use
Muffle Furnace 1	112636900119 0318	Thermo Fisher	F47195	NA	NA
Incubator-2	03101086	Labnet	I5110	Cleaning (Monthly)	Temp Check (Daily) when in use
Incubator-4	11024462	Lab-Line Instruments, Inc	490	Cleaning (Monthly)	Temp Check (Daily) when in use
Incubator 5	201900000114 79	Binder	BD023UL-120V	Cleaning (Monthly)	Temp Check (Daily) when in use
Incubator 6	11026321	Sheldon Manufacturing	SRI6P	Cleaning (as needed)	Temp Check (Daily) when in use
Incubator 7	202200000159 38	Binder	BF 115	Cleaning (as needed)	Temp Check (Daily) when in use
Incubator 8	202400000056 05	Binder	BE 056	Cleaning (as needed)	Temp Check (Daily) when in use

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Instrument ID #	Serial Number	Manufacturer	Model #	Maintenance Activity & Frequency	Calibration Frequency
Water Bath 1	300412538	Thermo Fisher	TSCIR35	Cleaning (as needed)	NA
Q-Tray Sealer 1	QTP13201401028	IDEXX	Qantitray Sealer Plus	NA	NA
Buchi Syncore Analyst 2	1000548205	Buchi	Syncore	Clean seals (daily), change seals and o-rings, top off coolant (when needed)	N/A
Buchi Syncore Analyst 3	1100033578	Buchi	Syncore Plus Analyst R-12	Clean seals (daily), change seals and o-rings, top off coolant (when needed)	N/A
N-EVAP	53571	Organomation Associates, Inc.	N-Evap	Cleaning (Bi-weekly)	N/A
Sonicator	B29259	Bransonic	B-321	Cleaning (Bi-weekly)	N/A
Sonicator 2	BGI012157640B	Branson	M3800	Cleaning Monthly	NA
CENTRIFUGE	89151	Hamilton Bell	Vanguard V6500	Cleaning (Bi-weekly)	N/A
CENTRIFUGE 2	8295	Vulron Technologies	CS6C	Cleaning (Bi-weekly)	N/A

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Instrument ID #	Serial Number	Manufacturer	Model #	Maintenance Activity & Frequency	Calibration Frequency
Centrifuge 3	160160154AA733	QuEChERS/Restek	Q-sep 3000 Centrifuge	Cleaning (Bi-weekly)	N/A
Hot Block 2	8826DISW1126	Environmental Express	SCC6002	Cleaning (Bi-weekly)	Temp Check when in use
Hot Block 4	20ZN0834	Fisher Scientific	Dry Bath Incubator	Cleaning (Bi-weekly)	Temp Check when in use
Hot Block 5	8885CECW3816	Environmental Express	SC154	Cleaning (Bi-weekly)	Temp Check when in use
Hot Block 7	N/A	CPI International	Mod Block	Cleaning (Bi-weekly)	Temp Check when in use
Hot Block 8	2020CECW5356	Environmental Express	SC154	Cleaning Monthly	Temp Check when in use
Hot Block 9	2020CECW5356	Environmental Express	SC154	Cleaning Monthly	Temp Check when in use
Hydrometer 4	230219	ICL Calibration Laboratories	40152H-C	NA	Annually (Swapped with Hydrometer 3 through ICL Program)

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Appendix G: Common Calculations

1. Calibration

1.1. Least Squares Analysis

$$A = \frac{n\sum xy \quad \sum x\sum y}{n\sum x^2 - (\sum c)^2} \qquad B = \frac{\sum y\sum x^2 - \sum x\sum xy}{n\sum x^2 - (\sum x)^2}$$

Where:

A= The line slope
B = The line intercept
x = The standard concentration
y = The instrument response value
n = The number of different standards analyzed

1.2. Correlation Coefficient

$$r^2 = \frac{A\sum y_i + B\sum x_i y_i - \frac{1}{n}(\sum y_i)^2}{\sum (y_i)^2 - \frac{1}{n}((\sum y_i)^2}$$

Where

r^2 = Correlation coefficient
A = Slope of the line
B = y-intercept
n = The number of standards in the calibration
x_i = The concentration of an individual standard compound
y_i = The chromatographic area of an individual standard compound

1.3. Response Factor - Internal Standards

$$RF = \frac{A_S * C_{IS}}{A_{IS} * C_S}$$

Where:

RF = Response factor
A_s = Peak area (or height) of the analyte or surrogate
A_{IS} = Peak area (or height) of the internal standard
C_S = Concentration of the analyte or surrogate
C_{IS} = Concentration of the internal standard

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1.4. Calibration Factor –External standards

$$CF = \frac{Peak\ area\ (or\ height) in\ the\ standard}{Concentration\ of\ the\ standard}$$

1.5. Standard Deviation of Response

$$S = \sqrt{\sum_{i=l}^{n} \frac{(X_i - X_{avg})^2}{n-1}}$$

Where

S = Standard deviation
n = Number of measurements
X_i = Response/calibration factor for each level
X_{avg} = Average of the response/calibration factors

1.6. Relative Percent Standard Deviation

$$\%RSD = \frac{S}{X_{avg}} * 100$$

Where

%RSD = Relative percent standard deviation
S = Standard deviation
X_{avg} = Average of the response/calibration factors

1.7. Percent Recovery – ICVs and CCVs

$$\%REC = \frac{C}{F} * 100$$

Where

%REC = Percentage that recovered when compared to the true value of the standard
C = Concentration measured in the ICV or CCV
F = Fortifying Concentration (True Value)

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2. Batch Quality Control

2.1. Percent Recovery – LCS/LCSDs

$$\%REC = \frac{C}{F} * 100$$

Where

%REC = Percentage that recovered when compared to the true value of the standard
C = Concentration measured in the ICV or CCV
F = Fortifying Concentration (True Value)

2.2. Percent Recovery – MS/MSDs

$$\%REC = \frac{(C_f - C_b)}{F} * 100$$

Where

%REC = Percentage that recovered when compared to the true value of the standard
C_f = Concentration in the fortified sample
C_b = Concentration in the unfortified sample
F = Fortifying Concentration (True Value)

2.3. Relative Percent Difference – DUP/MSD/LCSD

$$\%RPD = \frac{|R_1 - R_2|}{(\frac{1}{2})(R_1 + R_2)} * 100$$

Where
%RPD = Relative percent difference between the duplicate sample and its parent sample
R1 = Parent sample result
R2 = Duplicate sample result

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Determination of Hydrogen, Carbon Dioxide, Carbon Monoxide, Methane, Nitrogen, Oxygen, and Helium from Stationary Sources – Major Gases

EPA Method 3C/EPA 3C MOD

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Revision History

Version	Date	Revision
v1.0	Nov. 2011	Initial Document – M. Dee
v1.1	Nov. 2011	Edits/Revisions – M. Ridgeway
v1.2	June 18, 2018	Revisions – E. Mar
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1.0 PURPOSE

1.1 This SOP is used to determine the presence of Hydrogen, Carbon Dioxide, Carbon Monoxide, Methane, Nitrogen, Oxygen, and Helium from stationary sources.

2.0 SCOPE AND APPLICATION

2.1 This SOP applies to the analysis of Hydrogen (H_2), Carbon Dioxide (CO_2), Carbon Monoxide (CO), Methane (CH_4), Nitrogen (N_2) and Oxygen (O_2) in samples from municipal solid waste landfills and other sources when specified in an applicable subpart.

2.2 This SOP may also apply to the analysis of Helium (He) from sites where shroud sampling has been utilized. The presence of He may indicate a possible leak in the shroud.

2.3 A portion of the sample is injected into a gas chromatograph (GC) and the analyte concentrations are determined by using a Thermal Conductivity Detector (TCD) and integrating software.

3.0 RESPONSIBILITIES

3.1 It is the responsibility of the analyst performing this analysis to read and be familiar with the procedures and requirements of this SOP. It is also the responsibility of the analyst to review and adhere to all laboratory safety policies applicable to this procedure.

3.2 Each analyst who performs this analysis are required to run an Initial Demonstration of Capability (IDC) and annual Continuing Demonstrations of Capability (CDC) thereafter. The procedure for IDCs and CDCs may be found in SOP 59, *QA_Training and Proficiency of Methods.*

4.0 EQUIPMENT

4.1 *Gas Chromatograph* - GC having at least the following components.

4.2 *Separation Column* - Appropriate column(s) to resolve H_2, CO_2, CO, CH_4, N_2, O_2, He and other gas components that may be present in the sample. Restek ShinCarbon ST packed column 100/120 mesh 2 meters is an example of a suitable column.

4.2.1 Sample Loop - Teflon of stainless steel tubing of the appropriate diameter.

4.2.2 Gas Chromatography System- To maintain the column and sample loop at constant temperature.

4.2.3 Universal Detector - Thermal Conductivity Detector

4.2.4 Integrating Software – such as Chemstation or MassHunter.

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4.2.5 Teflon Tubing - Diameter and length determined by connection requirements of cylinder regulators and the GC.
4.2.6 Regulators - To control gas cylinder pressures and flow rates.
4.2.7 Adsorption Tubes - Applicable traps to remove any O_2 from the carrier gas.

4.3 Reagents

4.3.1 Calibration and Linearity Gases - The calibration gases shall be prepared in Methane and contain:

Carbon Dioxide = 20.00 %
Carbon Monoxide = 5.00 %
Hydrogen = 5.00 %
Nitrogen = 5.00 %
Oxygen = 2.60 %
Balance of Methane (62.4%)

4.3.2 Carrier Gas- Helium, high-purity.
4.3.3 Carrier Gas – Hydrogen, high-purity

5.0 SAMPLE COLLECTION, PRESERVATION AND STORAGE

5.1 Sample Collection

5.1.1 Samples may be collected in high pressure cylinders, Tedlar bags, 1L air canisters, or 6L air canisters.

5.1.1.1 Note: If samples are collected in air canisters, a dilution factor may be added to the result because the canisters will likely have to be pressurized to get sample out of them.

5.2 Holding Times

5.2.1 Tedlar bags must be analyzed within 72 hours of collection.
5.2.2 Air canisters and high pressure cylinders must be analyzed within 30 days of collection.

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6.0 PROCEDURE

6.1 Preparation of GC- Suggested GC parameters may be found in Appendix A. If the carrier gas must be switched, allow the GC to be stabilized for at least 30 minutes

6.1.1 Major Gas analysis requires a carrier gas of Helium.

6.1.2 Helium analysis requires a carrier gas of Hydrogen. The inlet pressure will drop to approximately half that of a Helium carrier gas.

6.2 Prior to sample analysis, and for each batch of 20 samples, three Standards (LCS) must be run and must visually overlay within 5% of each other.

6.2.1 Fill a Tedlar bag with the Major Gases standard.

6.2.2 Attach the Tedlar bag to the attachment on the injection port of the GC-TCD.

6.2.3 Once the GC sequence is typed, started, and ready, open the bag and purge the sample loop with standard by applying pressure to the Tedlar bag.

6.2.4 Continue purging and manually start the GC.

6.2.5 Once the GC valve switches (listen for the sound), close the bag and stop applying pressure.

6.3 Sample analysis – Analyze each sample in duplicate. The results are acceptable when the peak areas for two consecutive injections agree within 5 percent of their average. If they do not agree, run additional samples until consistent area data are obtained.

6.3.1 Tedlar Bag Analysis

6.3.1.1 Attach the sample to the attachment on the injection port of the GC-TCD.

6.3.1.2 Once the GC sequence is typed, started, and ready, open the bag and purge the sample loop by applying pressure to the bag.

6.3.1.3 Continue purging and manually start the GC.

6.3.1.4 Once the GC valve switches (listen for the sound), close the bag and stop applying pressure.

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6.3.2 High Pressure Cylinder Analysis

6.3.2.1 Attach the sample to a quick connect attachment to the injection port of the GC-TCD.
6.3.2.2 Once the GC sequence is typed, started, and ready, open the valve at the top of the cylinder to purge the loop.
6.3.2.3 Continue purging and manually start the GC.
6.3.2.4 Once the GC valve switches (listen for the sound), close the cylinder valve.

6.3.3 Air Canister Analysis

6.3.3.1 Typically, canisters are not received with enough positive pressure to get sample out of the container. Because of this, canisters need to be pressurized.
6.3.3.2 To pressurize the canister, first, record the canister pressure.
6.3.3.3 Pressurize the canister slowly to about 1-2 psi. Record the final pressure.

6.3.3.3.1 For Major Gas analysis, pressurize the canister with Helium, for bottle vacs pressurize with nitrogen on the dynamic diluter.
6.3.3.3.2 For Helium analysis, pressurize the canister with Nitrogen.

6.3.3.3.3 When analyzing samples for both helium and nitrogen, pressurize with nitrogen.

6.3.3.4 When running from a canister, bottle vac, or high-pressure cylinder, connect the correct quick connect for the type of container onto the line to run.
6.3.3.5 Follow the steps outlined in Section 6.3.1.

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7.0 QUALITY CONTROL

7.1 Major Gases

7.1.1 Upon initial qualification of the GC-TCD, a minimum three point calibration must be run to verify detector linearity.

7.1.1.1 All subsequent Major Gases calibrations may be performed using a single point calibration.

7.1.2 Each analytical run will include three analyses of the reference standard (LCS)

7.1.2.1 An LCS will be run for every 24 hour shift and every 20 samples

7.1.3 In each analytical run samples will be analyzed in replicate to demonstrate instrument stability. Acceptable RPD's are less than 30% for analyte percent of total over 2%.

7.2 Helium

7.2.1 Calibration verification – An LCS at the midpoint of the calibration must be run prior to running samples. It should fall at or within 80-120%. If the LCS falls outside of range, the instrument should be recalibrated. An example calibration is outlined in Appendix A.

7.2.1.1 An LCS will be run for every 24 hour shift and every 20 samples

7.2.2 A Method Blank (MB) will also be run prior to sample analysis and every 20 samples. This should show the system to be free from Helium contamination. If there is a detection at or above half the reporting limit, the system should be checked for contamination. A method blank will consist of ambient air.

7.2.3 In each analytical run, samples will be analyzed in replicate to demonstrate instrument stability. Acceptable RPDs are less than 30%.

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8.0 DATA ANALYSIS AND CALCULATIONS

8.1 Calculation of Major Gases as Percent of total.

8.1.1 In many cases reports will include major gases as a percent of total. For these calculations two of the three calibration standards are evaluated and an average response is calculated.

$$Response\ in\ ppm = A/B$$

Where
A = Raw analyte value in ppm
B = Percent makeup of the individual analyte in the standard.

8.1.2 All responses are normalized to account for the different sensitivities of each component. This is done by dividing the response (ppm) of each analyte by the average response of the analyte with the greatest sensitivity (CO_2).

$$Normalized\ response\ coefficient = C/D$$

Where
C = Response in ppm
D = Response CO_2 in ppm

8.1.3 The coefficient generated is the correction factor for each analyte. Carbon Dioxide will have a correction factor of 1.0

8.1.4 When a sample is analyzed the response is divided by its generated correction factor from that analytical run. A new response is generated which accounts for differing sensitivities.

$$Normalized\ sample\ response = F/E$$

Where
E = Normalized response coefficient
F = Raw sample amount in ppm

8.1.5 The Responses are then aggregated and this number is used to calculate percent of total.

$$Percent\ of\ total = \left(\frac{G}{H}\right) * 100$$

Where
G = Normalized sample response
H = Sum of the Normalized sample responses for all target analytes

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8.1.6 Refer to Appendix B when dealing with diluted sample canisters.

8.2 Helium

8.2.1 Use the concentration curve generated in Appendix A to calculate raw Helium concentration.

8.3 Dilution Factors: This calculation only applies in the event that an air canister had to be pressurized prior to analysis

$$Dilution\ factor\ = \frac{(Final\ Pressure + 14.7)}{\left[\frac{Initial\ Pressure}{2}\right] + 14.7}$$

Where
-Initial Pressure = Pressure of the canister recorded prior to N_2 or He pressurization
-Final Pressure = Pressure of the canister recorder after N_2 or He pressurization
-14.7 psia = One atmosphere

9.0 SAFETY

9.1 All samples received for analysis should be considered hazardous and handled accordingly. In addition some of the reagents used in this method are hazardous.

9.2 Before using this method, individuals who are unfamiliar with the hazards associated with these chemicals should refer to the material safety data sheets (MSDS).

10.0 METHOD PERFORMANCE

10.1 MDLs will be performed in accordance to SOP 53, *QA_MDL Submission*.

11.0 REFERENCES

11.1 Method 3C for the determination of Carbon Dioxide, Methane, nitrogen, and Oxygen from Stationary Sources.

12.0 APPENDICES

12.1 Appendix A: Example Helium Calibration

12.2 Appendix B: Preparing Helium Standard

12.3 Appendix C: Canister Dilution Reporting for Major Gases

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13.0 CHANGES SINCE LAST REVISION

13.1 Clarified that QC should be run every 20 samples

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APPENDIX A: Example Helium Calibration

Calibration Level	Volume of 2% Helium Stndard (cc)	Volume of 20% Helium Stndard (cc)	Volume of Ambient Air (cc)
0.2%	10	-	90
0.4%	20	-	80
1.0%	50	-	50
5.0%	-	25	75
10.0%	-	50	50
20.0%	-	100	0
ICB	0		100
ICV (5.0%)	-	50	50
LCS (5.0%)	-	50	50

*ICV should be prepped by a second individual, including them making a new 20% helium standard.

APPENDIX B: Preparing Helium Standard

1. Use a rough pump to evacuate the Tedlar bags labeled Helium, Nitrogen, Helium 2% and Helium 20%.
2. Attach the evacuated helium bag to the helium gas line in the conventionals room. Open the bag and then open the helium line.
3. Close the bag and the helium line once the bag has enough helium in it to make the standards (about a quarter full)
4. Using the 100 mL syringe, make each standard in their respective bags using (2% and 20% Helium Tedlar bags) the table below that lists the amount of volume of Nitrogen and Helium to add.

Standard	Volume of Helium (cc)	Volume of Lab Air (cc)
20%	50cc	200cc
2%	6cc	294cc

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APPENDIX C: Canister Dilution Reporting for Major Gases

*Scenario 1: Canister was pressurized with **Helium** prior to running* - Beginning and final pressures need to be documented and attached to the analytical run. A narrative is written documenting that the canister was pressurized with Helium. Due to Helium not being a detected analyte, the dilution factor is kept at 1. Results should add up to 100%.
*Scenario 2: Canister was pressurized with Nitrogen and Nitrogen **is not** being reported.* - Beginning and final pressures need to be documented and attached to the analytical run. A narrative is written documenting that the canister was pressurized with nitrogen. The dilution factor is calculated by the initial and final pressure and it is updated in the analytical run. The Nitrogen result can end up larger than 100% but the other analytes will be accurately calculated. Results will add up to more than 100% because Nitrogen is not accurately calculated. It is acceptable only in this scenario, as Nitrogen is not being reported.
*Scenario 3: Canister was pressurized with Nitrogen and Nitrogen **is** being reported.* - Beginning and final pressures need to be documented and attached to the run. A narrative is written documenting that the canister was pressurized with nitrogen. The dilution factor is calculated by the initial and final pressure and it is updated in the analytical run. The Nitrogen concentration will be the result of adding up the other analytes' calculated concentrations and subtracting that from 100% (it will be the balance). This will need to be manually entered into the analytical run under the "Raw Value". The calculated results should add up to 100%.

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Extractable Petroleum Hydrocarbons (EPH)

Based on Department of Ecology Method NWTPH-EPH

www.fremontanalytical.com

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Revision History

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V 1.0	Oct. 2008	Initial Document - M. Dee
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V 1.3	Feb. 2009	Edits and Revisions – M. Ridgeway
V 1.4	Feb. 2009	Edits and Revisions – P. Ho
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V 1.8	June 2015	Edits and Revisions – H. Campbell
V 2.0	June 2020	Edits and Revisions – S. Galloway
V 2.1	May 2021	Edits and Revisions – I. Hooper
V 2.2	May 2021	Edits and Revisions – M. Ridgeway
V 2.3	April 2024	Edits and Revisions – Sam Kapoi & A. Kegley
V 2.4	November 2024	Edits – Alex Pates & Savannah Houser

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1 SCOPE AND APPLICATION

1.1 This method is designed to measure the collective concentrations of extractable aliphatic and aromatic petroleum hydrocarbons in water and soil. The carbon ranges used throughout this document are given in equivalent carbon numbers (EC) which are related to the boiling point of a chemical normalized to the boiling point of the n-alkanes and its retention time in a boiling point gas chromatographic column. Extractable aliphatic hydrocarbons are collectively quantitated within five ranges: C8 through C10, >C10 through C12, >C12 through C16, >C16 through C21 and >C21 through C34. Extractable aromatic hydrocarbons are collectively quantitated within five ranges: C8 through C10, >C10 through C12, >C12 through C16, >C16 through C21 and >C21 through C34. These aliphatic and aromatic hydrocarbon ranges correspond to a boiling point range between approximately 110 °C and 550 °C.

1.2 Petroleum products suitable for evaluation by this method include, but are not limited to, kerosene and jet fuels, diesel and fuel oils and hydraulic, insulating and lubricating oils. When samples are known or suspected to contain petroleum hydrocarbons lighter than C10, the Volatile Petroleum Hydrocarbon (VPH) method must also be employed to fully evaluate the hydrocarbons present.

1.3 For reporting purposes, refer to Omega LIMS for practical quantitation limits (PQL).

1.4 This method is based on a solvent extraction, silica gel fractionation process, and gas chromatography (GC) analysis using a flame ionization detector (FID). This procedure should be used by, or under the supervision of, analysts experienced in extractable organics analysis. Analysts using this method should be skilled in the interpretation of gas chromatograms and their use as a quantitative tool.

1.5 Like all GC procedures, this method is subject to a "false positive" bias, in that non-hydrocarbon compounds eluting or co-eluting within a specified retention time window may be falsely identified and/or quantitated with the respective carbon ranges. While the cleanup procedure specified in this method to segregate aliphatic and aromatic fractions will serve to mitigate this concern, confirmatory analyses by gas chromatography/mass spectrometry (GC/MS) analysis, EPA Method 8270, or other suitable techniques is recommended in cases where significant concentrations of non-hydrocarbon compounds are known or suspected. Non-petroleum compounds identified and quantitated by GC/MS may be subtracted from the carbon ranges affected as long as the quantity and identities of the compounds are reported along with the carbon range data.

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2 SUMMARY OF METHOD

2.1 A sample submitted for EPH analysis is extracted into methylene chloride, dried over sodium sulfate, solvent exchanged into hexane, and concentrated. Sample cleanup and separation into aliphatic and aromatic fractions is conducted using column chromatography. The two extracts produced are then concentrated to final volumes of 1 mL each and are then separately analyzed by a gas chromatograph equipped with a capillary column and a flame ionization detector. The resultant chromatogram of aliphatic compounds is collectively integrated within the C8 through C10, C10 through C12, C12 through C16, C16 through C21 and C21 through C34 aliphatic hydrocarbon ranges. The resultant chromatogram of aromatic compounds is collectively integrated within the C8 through C10, C10 through C12, C12 through C16, C16 through C21 and C21 through C34 ranges.

2.2 Instrument software using average calibration response factors or a best fit line to create a calibration curve from various concentrations of known standards. The concentrations of samples and QC are evaluated against that curve.

2.3 This method is suitable for the analysis of waters, soils, and sediments.

2.4 This method is based on and constitutes a modification of the “Method for the Determination of Extractable Petroleum Hydrocarbons (EPH) Fractions” which can be found in the Washington State Department of Ecology Analytical Methods for Petroleum Hydrocarbons.

3 DEVIATIONS FROM METHOD

3.1 The two EPH standards can be used to create a fractionation check solution rather than purchase another solution.

3.2 The method specifies concentration of solvent extracts by Kuderna Danish apparatus. Alliance Technical Group employs a similar but more automated and scalable system. Please refer to SOP34_OP_EPA 3510C_Buchi.

3.3 The method specified LCS recovery limits for Aliphatic and Aromatic carbon ranges C8-C10, are not consistent with adaptation of MeCl2. The laboratory will use control chart, low recovery limits to determine this recovery range.

4 DEFINITIONS

4.1 **Extractable Petroleum Hydrocarbons (EPH)** are defined as all hydrocarbon compounds eluting from toluene through benzo(g,h,i)perylene. EPH is comprised of C8 through C10, C10 through C12, C12 through C16, C16 through C21 and C21 through C34 Aliphatic Hydrocarbons and C8 through C10, C10 through C12, C12 through C16, C16 through C21 and C21 through C34 Aromatic Hydrocarbons. EPH concentration data are reported as the aggregate concentration of the aliphatic and aromatic hydrocarbon ranges.

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4.2 **C8 through C10 Aromatic Hydrocarbons** are defined as all of the aromatic hydrocarbon compounds eluting from (and including) toluene through 1,2,3-trimethylbenzene.

4.3 **C10 through C12 Aromatic Hydrocarbons** are defined as all aromatic hydrocarbon compounds eluting after 1,2,3-trimethylbenzene through naphthalene.

4.4 **C12 through C16 Aromatic Hydrocarbons** are defined as all aromatic hydrocarbon compounds eluting after naphthalene through acenaphthene.

4.5 **C16 through C21 Aromatic Hydrocarbons** are defined as all aromatic hydrocarbons compounds eluting after acenaphthene through pyrene.

4.6 **C21 through C34 Aromatic Hydrocarbons** are defined as all aromatic hydrocarbons compounds eluting after pyrene through benzo(g,h,i,)perylene.

4.7 **C8 through C10 Aliphatic Hydrocarbons** are defined as all aliphatic hydrocarbon compounds eluting from (and including) n-octane (n-C8) through n-decane (n-C10).

4.8 **C10 through C12 Aliphatic Hydrocarbons** are defined as all aliphatic hydrocarbon compounds eluting after n-decane through n-dodecane (n-C12).

4.9 **C12 through C16 Aliphatic Hydrocarbons** are defined as all aliphatic hydrocarbon compounds eluting after n-dodecane through n-hexadecane (nC16)

4.10 **C16 through C21 Aliphatic Hydrocarbons** are defined as all aliphatic hydrocarbons eluting after n-hexadecane through n-heneicosane (nC21).

4.11 **C21 through C34 Aliphatic Hydrocarbons** are defined as all aliphatic hydrocarbons eluting after n-heneicosane through tetratriacontane (nC34).

4.12 **Aromatic Hydrocarbon Standard** is defined as a 6 component mixture (plus surrogate) of the aromatic hydrocarbons listed in Table 1. The compounds comprising the Aromatic Hydrocarbon Standard are used to (a) define and establish the windows for the Aromatic Hydrocarbon ranges, and (b) determine chromatographic response factors that can in turn be used to calculate the collective concentration of aromatic hydrocarbons in environmental samples within those hydrocarbon ranges.

4.13 **Aliphatic Hydrocarbon Standard** is defined as a 6 component mixture (plus surrogate) of the normal alkanes listed in Table 2. The compounds comprising the Aliphatic Hydrocarbon Standard are used to (a) define and establish windows for the aliphatic hydrocarbons ranges, and (b) determine chromatographic response factors that can in turn be used to calculate the collective concentration of aliphatic hydrocarbons in environmental samples within those hydrocarbon ranges.

4.14 **Analytical Batch** is defined as a group of samples with similar matrices which are processed as a unit. For Quality Control purposes, if the number of samples in such a group is greater than 20, then each group of 20 samples or less are defined as separate analytical batches.

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4.15 **Laboratory Duplicates (DUP)** are defined as split samples taken from the same sampling container and analyzed separately with identical procedures. The analysis of laboratory duplicates gives a measure of the precision associated with laboratory procedures, but not with sample collection, preservation, or storage procedures.

4.16 **Field Duplicates** are defined as two separate samples collected at the same time and location under identical circumstances and managed the same throughout field and laboratory procedures. Analyses of field duplicates give a measure of the precision associated with sample collection, preservation and storage, as well as laboratory procedures.

4.17 **Calibration Standards** are defined as a series of standard solutions prepared from dilutions of a stock standard solution, containing known concentrations of each analyte and surrogate compounds of interest.

4.18 **Calibration Check Standard** is defined as a calibration standard used to periodically check the calibration state of an instrument. The calibration check standard is prepared from the same stock standard solution as calibration standards and is generally one of the mid-level range calibration standard dilutions.

4.19 **Matrix Spiking Solution** is defined as a solution which is generally prepared independently from the calibration standards and which contain known concentrations of method analytes.

4.20 **Method Blank (MBLK)** is defined as, depending on the matrix of the samples, either reagent water or baked sodium sulfate spiked with a surrogate standard. The laboratory method blank is treated identically as with samples, exposed to all glassware, solvents, reagents, and equipment. A laboratory method blank is analyzed with every batch of samples, to determine if method analytes or other interferences are present in the laboratory environment, reagents, or equipment.

4.21 **Laboratory Control Sample (LCS)** is defined as, depending on the matrix of the samples, either reagent water or baked sodium sulfate blank fortified with a matrix spiking solution. The LCS is treated and analyzed identically as with samples and blanks and its purpose is to determine whether the methodology is in control and whether the laboratory is capable of making accurate and precise measurements at the required practical quantitation limits.

4.22 **Matrix Spike (MS)** An aliquot of sample spiked with a known concentration of target analytes. The spiking occurs prior to sample separation and is used to document the bias of a method in a given sample matrix.

4.23 **Matrix Spike Duplicate (MSD)** An intra-laboratory split sample spiked with identical concentrations of target analytes as the MS. The spiking occurs prior to sample preparation and is used to document the precision and bias of a method in a given sample matrix.

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5 INTERFERENCES

5.1 Method interferences are reduced by washing all glassware with hot soapy water and then rinsing with warm tap water, acetone, and methylene chloride.

5.2 High purity reagents must be used to minimize interference problems.

5.3 Contamination by carryover can occur whenever high-level and low-level samples are sequentially analyzed. Whenever an unusually concentrated sample is analyzed, it should be followed by the analysis of a solvent blank to check for cross-contamination.

5.4 Matrix interferences may be caused by contaminants that are co-extracted along with the analytes of interest from the sample. The type and extent of matrix interference will vary considerably from one source to another depending upon the nature and diversity of the site being sampled and may include certain solvents, halogenated hydrocarbons and phthalate esters. A silica gel cleanup procedure is used to overcome many of these interferences however, some samples may require additional cleanup procedures/approaches or analytical techniques, e.g. gel permeation chromatography and/or GC/MS, which are beyond the scope of this method.

6 SAFETY

6.1 The toxicity and carcinogenicity of each reagent used in this method has not been precisely defined. However, each chemical compound should be treated as a potential health hazard. From this viewpoint, exposure to these chemicals must be reduced to the lowest possible level by whatever means available. The laboratory is responsible for maintaining a current awareness file of Occupational Safety and Health Administration (OSHA) regulations regarding the safe handling of the chemicals specified in this method. A reference file of material safety data sheets (MSDS) should also be made available to all personnel involved in the chemical analysis.

7 EQUIPMENT AND SUPPLIES

7.1 The following glassware is used for this method:

7.1.1 1-L or 500-mL amber glass bottles for aqueous sample collection and bottle roller extractions

7.1.2 4 oz. (120 mL) glass wide-mouth jars for soil sample collection

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7.1.3 Collection vials:

7.1.3.1 Auto sampler vials: 2-mL glass vials with Teflon-lined rubber crimp caps and 4mL amber screw cap vials.

7.1.3.2 40-mL vials with Teflon-lined caps

7.1.4 100-mL glass beakers

7.1.5 25-mL graduated cylinders

7.1.6 Buchi concentration tubes

7.2 1-L Separatory funnels with Teflon stopcock

7.3 Chromatographic column: 250 mm long x 10 mm I.D.

7.4 Disposable pipets: Pasteur

7.5 Analytical balance: A top-loading balance capable of weighing to the nearest 0.1 g must be used for weighing soil samples.

7.6 A nitrogen blowdown apparatus for use in concentrating extracts.

7.7 Gas Chromatography

7.7.1 Gas Chromatograph: An analytical system complete with temperature programmable gas chromatograph for use with capillary columns is required. The data station must be capable of storing and reintegrating chromatographic data and must be capable of determining peak areas using a forced baseline projection.

7.7.2 Recommended Column: 30-m long x 0.32-mm I.D., 0.25-µm film DB-5 column (J&W Scientific) or equivalent. This column will allow for the adequate resolution of alkanes from n-C8 to n-C34.

7.7.3 Detector: A Flame Ionization Detector (FID).

7.7.4 Autosampler: An autosampler capable of making 1 to 2 µL injections is recommended.

7.8 Fractionation system (EZ-Prep apparatus)

7.8.1 Prepacked columns of silica gel for separation (Sep-Pak)

7.8.2 Lab vacuum pump for fluid movement

7.9 Buchi Evaporation apparatus: see SOP 34

7.10 Microsyringes: assorted sizes as needed.

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8 REAGENTS AND STANDARDS

8.1 Reagents

8.1.1 Reagent Water: organic free water

8.1.2 Solvents: hexane, methylene chloride, and pentane; pesticide grade or better.

8.1.3 Sodium sulfate: (ACS) granular, anhydrous. Purify by heating at 110°C for a minimum of 2 hours in a shallow tray.

8.1.4 Silica gel: 100/200 mesh (Davison Chemical grade 923 or equivalent). Heat to 150-160°C for several hours before use.

8.2 Stock Standard Solutions are purchased at prepared concentrations of 5000 µg/mL for both Aromatic components and Aliphatic components.

8.3 Surrogate Standards

8.3.1 The recommended surrogate standards are chloro-octadecane (COD) and ortho-terphenyl (OTP). Additional surrogates or surrogates other than those listed above may be used at the discretion of the analyst if their performance in the method is demonstrated as acceptable. Preparation and use of those surrogates will be in the same manner as the listed surrogate.

8.3.2 Surrogate Spiking Solution: The recommended surrogate spiking solution is comprised of a mixture of the COD and OTP surrogates in acetone. Prepare a surrogate spiking solution which contains the surrogate standards at a concentration of 4000 µg/mL. Each sample, blank, laboratory control sample and matrix spike/matrix spike duplicate are then fortified with 50 µL of the surrogate spiking solution.

8.4 Fractionation Check Solution

8.4.1 The Fractionation Check Solution is a mixture of the stock aromatic and aliphatic hydrocarbon standards at a concentration of 100 µg/mL prepared in hexane.

8.4.2 The Fractionation Check Solution is used to monitor the fractionation efficiency of different batches (lot numbers) of silica gel used to prepare the silica gel hydrocarbon fractionation columns (and Sep-Pak cartridges if used) as well as check for sample preparation errors (e.g., insufficient/excessive pentane use).

9 SAMPLE COLLECTION, PRESERVATION, SHIPMENT AND STORAGE

9.1 Aqueous samples are collected in 1-L or 500-mL amber glass bottles with Teflon-lined screw caps.

9.2 Soil and sediment samples are collected in 4 oz. (120 mL) amber wide-mouth glass jars with Teflon-lined screw caps.

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9.3 Aqueous samples must be preserved at the time of sampling by the addition of an acid to reduce the pH of the sample to less than 2.0. Samples may also be collected in pre-preserved ambers already containing HCl. Following collection and the addition of acid, the sample must be cooled to 4°C.

9.4 Soil and sediment samples must be cooled to 4°C immediately after collection.

9.5 A chain of custody form must accompany all aqueous, soil and sediment samples, documenting the time and date of sampling and any preservative additions.

9.6 Aqueous, soil and/or sediment samples must be extracted within 14 days of collection. If for whatever reason aqueous samples were not preserved at the time of collection, they must be extracted within 7 days of collection. Both aqueous and soil/sediment extracts must be analyzed within 40 days of extraction.

9.7 A summary of sample collection, preservation, and holding times is provided in Table 3. Additional information can also be found in SOP 64.

10 QUALITY CONTROL

10.1 General Requirements and Recommendations

10.1.1 Hexane or methylene chloride solvent blanks should be run after samples suspected of being highly contaminated to determine if sample carryover has occurred.

10.1.2 At a minimum, for each analytical batch (up to 20 samples), a laboratory Method Blank, Laboratory Control Sample (Water or Soil), sample duplicate, matrix spike/matrix spike duplicate must be analyzed. For analytical batches with more than 10 samples, the analysis of an additional mid-range calibration check standard is recommended. The blank and spiked samples must be carried through all the stages of the sample preparation and measurement process.

10.1.3 The recommended sequence of analysis is as follows:

10.1.3.1 Calibration Standards (initial) or mid-range Calibration Check Verification Standard (i.e. daily check of initial calibration)

10.1.3.2 Continuing Calibration Blank (a zero standard with the same matrix as the calibration standards)

10.1.3.3 Laboratory Method Blank

10.1.3.4 Laboratory Control Sample

10.1.3.5 Samples

10.1.3.6 Sample Duplicate (if there is not enough sample to extract for a sample duplicate, a laboratory control sample duplicate may be used)

10.1.3.7 Matrix Spike

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10.1.3.8 Matrix Spike Duplicate (if there is not enough sample to extract for a matrix spike duplicate, a laboratory control sample duplicate may be used)

10.1.3.9 Mid-range Calibration Check Verification Standard (also recommended after every 10 samples).

10.1.3.10 Continuing Calibration Blank (also recommended after every 10 samples).

10.1.4 It is recommended that a system of control charts be developed to plot surrogate standard recoveries as a function of time. When surrogate recovery from a sample, blank, or QC sample is less than 50% or more than 150%, check calculations to locate possible errors, the fortifying solution for degradation, and changes in instrument performance. If the cause cannot be determined, the analyst may reanalyze the sample extract, report the surrogate values as outside acceptance limits or, if additional sample is available, re-extract and reanalyze the sample.

10.2 Minimum Instrument QC

10.2.1 The instrument must be able to achieve adequate separation and resolution of peaks of interest.

10.2.1.1 The n-octane (n-C8) and toluene peaks must be adequately resolved from the solvent front of the chromatographic run.

10.2.1.2 The surrogates COD and OTP must be adequately resolved from any individual components in the Aliphatic Hydrocarbon and Aromatic Hydrocarbon standards.

10.2.2 Retention time windows must be established for each hydrocarbon range of interest each time a new GC column is installed and must be verified and/or adjusted on a daily basis.

10.2.3 Calibration curves must be developed based upon the analysis of calibration standards prepared at a minimum of five concentration levels. The linearity of calibration or response factors may be assumed if the percent relative standard deviation (%RSD) over the working range of the curve is less than or equal to 20%. Alternatively, if linear regression analysis is used for quantitation, the correlation coefficient (r) must be at least 0.99. The percent difference (%D) of the response for any hydrocarbon range from the predicted response may not vary by more than ± 20 %.

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10.3 Fractionation

To demonstrate the capability of properly fractionating aliphatic and aromatic hydrocarbons in a sample, the analyst must first prepare and analyze the Fractionation Check Solution specified in Section 8.4.

10.3.1 Separate 1 ml of the fractionation check solution by the procedure outlined in Section 13.2.

10.3.2 For each analyte within the Fractionation Check Solution, the mean accuracy, expressed as a percentage of the true value, must be between 70 and 130%.

10.4 Ongoing Method QC Demonstrations

10.4.1 Each sample and blank must be spiked with the surrogate spiking solution. The required surrogate recovery is 60-140%.

10.4.2 At a minimum, with every batch of 20 samples or less, the lab must analyze the following:

10.4.2.1 **Calibration Check Standard:** A mid-range calibration standard, prepared from the same stock standard solution used to develop the calibration curve, must be analyzed prior to sample analysis. This is used to verify the calibration state of the instrument. For large analytical batches that contain more than 10 samples, the analysis of an additional mid-range calibration check standard is recommended after the analysis of the tenth sample. If the percent difference of any compound within a calibration check standard varies from the predicted response by more than 20%, a new calibration curve must be prepared.

10.4.2.2 **Laboratory Method Blank:** A water or soil laboratory method blank is prepared by fortifying a reagent water or clean sodium sulfate blank with a known amount of the surrogate spiking solution. Peaks within the retention time windows of any hydrocarbon ranges of interest may not be present at or above the lowest calculated PQL for any sample within its batch. When determining the PQL of soil method blanks, incorporate the lowest percent solids value found for any sample within its batch in the calculation.

10.4.2.3 **Laboratory Control Sample:** A water or soil component spike is prepared by fortifying a reagent water or clean sodium sulfate blank with a known amount of the matrix spiking solution. The spike recovery must be between 70 and 130 % and if these values cannot be obtained, the analyst must identify and correct the problem before analyses can continue.

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10.4.2.4 **Sample Duplicates:** Sample duplicates may be laboratory duplicates or field duplicates and the RPD of the duplicate should not exceed ±25%. The lack of sample homogeneity may contribute to the RPD values exceeding this value. Should the values exceed 25%, the analyst must report that occurrence.

10.4.2.5 **Matrix Spike/Matrix Spike Duplicate:** Matrix spike and matrix spike duplicates are used to determine if there are any matrix interferences. The spike recovery must be between 70 and 130% with the matrix spike duplicate being no more than ±30% from the matrix spike. If these values cannot be obtained, presence of a matrix interference may be present and the occurrence must be reported.

10.5 If any of the performance standards specified in Section 10.4 are not met, the problem should be corrected before further samples are analyzed. Exceptions to this are duplicate sample RPD's, due to sample inhomogeneity, may exceed the allowable limits. Any samples run between the last calibration check standard that meet the criteria and one that does not must be re-analyzed. If this is not possible, then the data must be reported as an "estimated concentration".

11 INITIAL DEMONSTRATION OF PERFORMANCE

11.1 Initial and Periodic Method QC Demonstrations

The following must be conducted as an initial demonstration of laboratory capability prior to the analysis of any samples. Subsequent to this initial demonstration, additional evaluations of this nature should be conducted on a periodic basis, in response to changes in instrumentation or operations and/or in response to confirmed or suspected systems, method, or operational problems.

11.1.1 Accuracy and precision

11.1.1.1 To demonstrate initial laboratory capability, analyze a minimum of four replicate reagent water and/or sodium sulfate blanks spiked with the calibration compounds for each range of interest at a concentration that falls in the calibration range.

11.1.1.2 Extract and analyze each replicate according to the procedures described in Section 13 and Section 14.

11.1.1.3 Calculate the measured concentrations of each range in all replicates, the mean accuracy (as a percentage of the true value) for each compound, and the precision (as %RSD) of the measurements for each compound.

11.1.1.4 For each compound, the mean accuracy, expressed as a percentage of the true value, should be between 70 and 130 %. For each compound, the %RSD must be ≤ 20%.

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11.2 Method Detection Limits

11.2.1 For additional information, reference SOP 53.

12 CALIBRATION AND STANDARDIZATION

12.1 Calibration

12.1.1 Calibrate the GC system using the external standard procedure.

12.1.2 Prepare Aromatic and Aliphatic Hydrocarbon calibration standards at eight concentration levels. Do this by adding variable volumes of the spiking solutions along with variable volumes of surrogate solution for each concentration level. A separate calibration is made for Aliphatic and Aromatic with Aliphatic in hexane and Aromatic in methylene chloride. Refer to Table 6 and Table 7 for calibration charts.

12.1.3 Establish a collective calibration curve or factor for each hydrocarbon range of interest. Inject each calibration standard using the technique that introduces the actual samples into the gas chromatograph (e.g., 1 to 2 µL injections). To calculate the collective CF for C8-C10, >C12-C12, >C12-C16, >C16-C21 and C21-C34 Aromatic Hydrocarbons, tabulate the summation of all peak areas of the calibration compounds in that range (e.g. C8-C10, toluene and 1,2,4-trimethylbenzene or >C10-C12, naphthalene) against the total mass injected. Although a forced baseline projection is required for samples and blanks, the analyst is allowed to integrate only the area of the calibration compound(s) to generate the calibration factors. The analytical software will calculate the calibration factor (CF) at each concentration. The response of the detector can be considered linear if the percent relative standard deviation (%RSD) is equal to or less than 20%. In that case, the average CF can be used in place of a calibration curve. Calculate the Aliphatic Hydrocarbon collective CF in the same manner using the aliphatic standards.

12.1.4 At a minimum, verify the working calibration curve or calibration factor at the beginning of each working day and after the final analysis of that day, or after every 20 samples, whichever is more frequent, by the injection of a mid-level calibration standard. This is used to verify instrument performance and linearity. If the percent difference for any range varies from the predicted response by more than ± 20 %, a new calibration curve must be prepared.

12.1.5 The concentrations of hydrocarbon ranges are calculated from a calibration curve using a linear regression analysis employed by the analytical software.

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13 PROCEDURE

13.1 Water Sample Preparation

13.1.1 Measure 400 mL of sample. For blanks and laboratory control samples, measure out 400 mL of tap water into a 500 mL amber bottle.

13.1.2 Add 1mL 1:1 H_2SO_4, then check the pH of the sample with wide-range pH paper to verify the pH is less than 2. Note the pH and adjust as needed if pH has not been reached.

13.1.3 Add surrogate to all samples, blanks, laboratory control sample and matrix spike/matrix spike duplicates. Add the aromatic and aliphatic spiking standards to the laboratory control sample and matrix spike/matrix spike duplicates.

13.1.4 Add 50 mL Methylene Chloride to each bottle and then place on bottle roller for 12-18 hours to extract.

13.1.5 After sufficient time has passed for extraction on the roller, remove ambers and pour contents into cleaned separatory funnels, rinse bottles with additional Methylene Chloride (20 ml) and add to funnel, then collect the solvent layer into labeled 40-mL vials.

13.1.6 Refer to SOP 33 for additional information on bottle roller method.

13.1.7 Once collected, dry the solvent extract using approximately 5g (or as needed depending on emulsion from sample) of sodium sulfate. Shake and/or vortex each vial with the sodium sulfate to ensure even distribution of the drying agent. Proceed to the concentration step in 13.3.

13.2 Soil Sample Preparation

13.2.1 Weigh 5 g of each sample into 40 mL VOAs and dry the samples with sodium sulfate.

13.2.2 Add surrogate to all samples, blanks, laboratory control sample and matrix spike/matrix spike duplicates. Add the aromatic and aliphatic spiking standards to the laboratory control sample and matrix spike/matrix spike duplicates.

13.2.3 Add 20 mL methylene chloride to each sample

13.2.4 Vortex each sample until solvent moves through the entire matrix

13.2.5 Sonicate for 5 minutes and let the samples rest for 15 minutes. Then, sonicate again for 5 minutes.

13.2.6 Refer to SOP 38 for additional information on sonication extraction method.

13.2.7 Proceed to the concentration step in 13.3.

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13.3 Concentration – Both Soil and Water

13.3.1 Transfer solvent from the vial(s) into a cleaned Buchi collection tube that has been washed with soapy water and solvent rinsed with acetone and methylene chloride.

13.3.2 The methylene chloride solvent used to extract the sample will be solvent transferred into hexane with a final volume of 1 mL. The entire extract after the hexane transfer has occurred will be fractionated following steps outlined in section 13.4. If the sample is to be diluted at this point, ensure an accurate final volume is reached and recorded.

13.3.2.1 In cases where the solvent could not concentrate to 1 mL due to matrix, record the final volume it reached on the bench sheet.

13.3.2.2 In cases where the extract is highly viscous or there are concerns the matrix will interfere with separation, the analyst may make a dilution at this stage before the extract to the silica gel column. Record this dilution on the bench sheet and add the dilution factor to Omega when processing the run.

13.3.3 Refer to SOP 34 for additional information on solvent transfer from methylene chloride to hexane.

13.3.4 The solvents collected after the completion of the aromatic and aliphatic fractionation will be concentrated to a final volume of 1 mL using the Buchi.

13.3.5 Once aliphatic and aromatic solvent aliquots have been concentrated, transfer into a 2 mL auto sampler vial and seal with Teflon snap caps.

13.4 Sample Separation

13.4.1 Alliance Technical Group uses a fractionation apparatus to separate the aliphatic and aromatic ranges in sample extracts. In the event the apparatus may not be used, refer to section 13.4.3 for manual setup of columns and separation procedure.

13.4.2 EZ-EPH Separation

13.4.2.1 The apparatus has two main stages. The first stage is for priming the pre-packed silica columns and the second stage is for the separation of the aliphatic and aromatic fractions.

13.4.2.2 Set up the apparatus by placing uncapped and labeled collection vials into the provided rack and connecting the lines to both the waste container and the vacuum pump. Keep in mind that the aliphatic collection vials will be 40mL while the aromatic collection vials will be 60mL.

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13.4.2.3 Take the column stopcocks and female manifold adapters and place them into a clean 150 mL glass beaker. Add ACS-grade acetone into the beaker and cover with a piece of aluminum foil. Sonicate the beaker for ~5 minutes to clean the stopcocks and manifold adapters. Pour acetone from beaker into solvent waste containers and let the stopcocks and manifold adapters dry.

13.4.2.4 Place the pre-packed silica columns onto the singular priming manifold by attaching the stopcocks onto the male end of the column and then placing the male end of the stopcock into the manifold. Place an empty syringe vial into the female end of the column; this will be used to deliver the sample and extraction solvents into the column. Ensure that the stopcocks are in the closed position and that the vacuum valve on the apparatus is set to the priming manifold position (arrow will point toward the priming manifold).

13.4.2.5 To prime the columns for fractionation, place 10mL of hexane into each syringe vial. Turn on the vacuum pump. The vacuum pressure should be 8-10 inch Hg; if it is not, use the vacuum relief valve located at the end of the manifold to adjust it to the necessary pressure. Once the desired pressure has been achieved, open the stopcocks and elute the hexane through. Make sure to keep the columns wet by closing the stopcocks as soon as the syringe vials become empty.

13.4.2.6 Once the column conditioning is complete, turn the vacuum pump off and wait for the pressure to drop to zero. Once there is no more vacuum, move your column assembly to the collection manifold in the spaces above the aliphatic collection vials. Place the columns onto the collection manifold by inserting the column assembly into the acetone-rinsed female adapters in the manifold. For the parts of the manifold not in use, make sure that there are plugs put in place, otherwise a vacuum will not be achieved.

13.4.2.7 Check the stopcocks on the column assembly to ensure they are in the closed position. Pipette entire sample into the syringe vials according to the collection vials placed beneath the collection manifold. Rinse vial with a small amount of hexane to ensure quantitative transfer. Turn the vacuum valve so that the arrow is pointing towards the collection manifold. Turn on the vacuum pump and check to make sure the pressure is 8-10 inch Hg. If it is not, adjust it with the relief valve to the desired pressure. Open the stopcocks one sample at a time and elute the samples onto the column. Make sure to keep the columns wet by closing the stopcocks as soon as the syringe vials become empty.

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13.4.2.8 Once the sample is on the column, add 20mL of pentane to each syringe vial and elute into the collection vials. Remember to keep the column wet by closing the stopcocks as soon as the syringe vials have become empty.

13.4.2.9 When the aliphatic fractions are completely collected, turn the vacuum pump off and wait for the pressure to drop to zero. When there is no longer any vacuum, move the column assembly over to the priming manifold. Remove the collection manifold lid and carefully remove the aliphatic collection vials and place the caps back on. Place the manifold lid back onto the collection chamber and move the female manifold adapters to the spaces above the aromatic collection vials. Make sure to move the plugs over to the aliphatic portion of the manifold to ensure vacuum during extraction of the aromatic fractions.

13.4.2.10 Add 35mL of methylene chloride to the syringe vials and double check that the arrow on the vacuum valve is facing the collection manifold. Adjust the pressure if needed and then open the stopcocks to begin eluting the methylene chloride through onto the column. Elute the columns to dryness. Once the process is complete, turn off the vacuum pump.

13.4.2.11 Once the pressure has dropped to zero, remove the column assemblies and manifold lid. It is important to wait for the pressure to drop to zero before opening to prevent any loss of sample. Carefully remove the collection vials and place the caps back on. Place sample syringe vials into soapy water and let them soak before placing in drying rack. Throw away used silica gel columns. Repeat procedure with new silica columns for additional samples.

13.4.3 Column Packing and Separation (to be used in place of EZ-EPH method if necessary)

13.4.3.1 Upon completion of initial solvent transfer of samples into hexane, set up a glass column stand equipped with prepped glass columns for separation. To prepare columns for separation, place a tightly compressed cotton ball near the narrow tip of the column and add approximately 125 mm or fill half of the glass column with silica gel. To ensure that the silica gel is correctly packed into the column, lightly tap the side of the column to get the silica gel to pack down more tightly. After completion, carefully add 1 gram of sodium sulfate to the top of the silica gel to keep the silica gel in place and provide a level top for the separation column.

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13.4.3.2 Once columns are properly packed, condition the column with approximately 30 mL of hexane. This can be pushed through the column by applying a light pressure of nitrogen. Stop once the hexane is pushed down to the top of the sodium sulfate level.

13.4.3.3 When the column has been conditioned with hexane, place a labeled 40-mL collection vial under the opening of the column. Using a disposable glass pipet, transfer a 1 mL aliquot of the solvent transferred sample onto the sodium sulfate layer of the column.

13.4.3.4 Once the sample is on the column, assist the collection of the aliphatic portion by slowly adding 40 mL of pentane to the column. Be sure not to rush the aliphatic pentane collection due to the risk of aromatic collection. If the pentane used in the aliphatic collection is rushed, it will be likely that the aromatic compounds can be collected with the aliphatic compounds. This can negatively affect sample accuracy later in sample analysis.

13.4.3.5 When the pentane has completely run through the column, cap the collected aliphatic aliquot and place the labeled 40-mL aromatic collection vial below the same glass chromatograph column. Very carefully add 40 mL of methylene chloride, taking care not to disturb the sodium sulfate layer and silica gel, to collect the aromatic aliquot of the sample. For this step, the use of light nitrogen pressure is allowed. Be sure that the pressure being used does not blow the methylene chloride through the column faster than a steady drip. If the nitrogen produces a firm stream, it is likely that a low representation of aromatic recovery will be present upon analysis.

13.4.3.6 After the completion of the aromatic extraction, continue the separation steps with each sample, using a newly packed column each time until all samples are separated into both aliphatic and aromatic sample portions.

13.4.4 Buchi operation for concentration of aliphatic and aromatic compounds differ from that of initial solvent concentration. For aliphatic collection in pentane, only other aliphatic samples can be inserted into the Buchi chassis because of differences in solvent concentration rates between methylene chloride and pentane. Such is also the case for the aromatic collections.

13.4.5 Upon concentration in the Buchi evaporation apparatus to a final volume of 1 mL, transfer to the corresponding labeled 2 mL auto sampler vials and seal with Teflon crimp caps. (It is helpful to use different colored caps on the auto sampler vials to differentiate between aliphatic and aromatic samples.)

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14 DATA ANALYSIS AND CALCULATION

14.1 Analyze all laboratory method blanks and QC samples under the same conditions as that used for samples. If chromatographic responses exceed the linear range of the system, dilute the extract(s) and re-analyze.

14.2 Determination of Percent Moisture

14.2.1 Report soil and sediment sample results on a dry-weight basis. Refer to SOP 54 for additional information of percent moisture procedures.

14.3 GC Conditions

14.3.1 Refer to Table 4 for suggested gas chromatographic conditions.

14.4 Retention Time Windows

14.4.1 Before establishing windows, make sure the GC system is within optimum operating conditions. Inject a solution containing all marker compounds and surrogates under standard operating conditions.

14.4.2 EPH retention time (Rt) windows for all fractions (carbon ranges and hydrocarbon types) except the C8 through C10 are defined as beginning 0.1 minutes after the Rt of the beginning marker compound and ending 0.1 minutes after the Rt of the ending marker compound. Since the first fraction for both the aliphatics and aromatics includes the beginning marker compounds, the Rt windows for them are defined as beginning 0.1 minutes before the Rt of the beginning marker compound and ends 0.1 minutes after the ending marker compound. EPH marker compounds and windows are summarized in Table 5.

14.5 GC Analysis

14.5.1 Samples are analyzed in a set referred to as an analysis sequence. The sequence begins with instrument calibration, or verification of calibration, followed by sample extracts interspersed with blanks and QC samples. The analytical sequence must end with an acceptable verification calibration standard. If the ending calibration standard is not acceptable, all samples analyzed after the last acceptable calibration verification must be re-analyzed. If, for whatever reason, re-analysis is not possible, then the data for those samples must be qualified as an “estimate”.

14.5.2 Confirm the established retention time windows for each hydrocarbon range daily. Use the absolute retention time for each analyte as the midpoint of the window for that day. The daily retention time window equals the midpoint ± three times the standard deviation.

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14.5.2.1 Validation of GC system qualitative performance must be accomplished by the analysis of standards within the analysis sequence. If any of the standards fall outside their daily retention time window, the system is out of control. In such cases, the cause of the problem must be determined and corrected.

14.5.3 When quantifying a peak area by external calibration, the aliphatic and aromatic carbon ranges must be integrated from the baseline (i.e. must include the unresolved complex mixture "hump" areas).

14.6 Sample Analysis

14.6.1 Aliphatic Fraction

14.6.1.1 It is not necessary to identify or quantitate individual aliphatic compounds within the noted ranges below.

14.6.1.2 C8-C10: Determine the total area count for all peaks eluting 0.1 minutes before the retention time for Octane to 0.1 minutes after the retention time for Decane.

14.6.1.3 C10-C12: Determine the total area count for all peaks eluting 0.1 minutes after the retention time for Decane to 0.1 minutes after the retention time for Dodecane.

14.6.1.4 C12-C16: Determine the total area count for all peaks eluting 0.1 minutes after the retention time for Dodecane to 0.1 minutes after the retention time for Hexadecane.

14.6.1.5 C16-C21: Determine the total area count for all peaks eluting 0.1 minutes after the retention time for Hexadecane to 0.1 minutes after the retention time for Heneicosane.

14.6.1.6 C21-C34: Determine the total area count for all peaks eluting 0.1 minutes after the retention time for Heneicosane to 0.1 minutes after the retention time for Tetratriacontane.

14.6.1.7 Surrogate: Determine the peak area count for the surrogate chloro-octadecane and subtract this value from the collective area count value within the appropriate hydrocarbon range(s).

14.6.1.8 Calculate the concentrations of each carbon range with the GC software.

14.6.1.9 The term "all peak areas" must include any unresolved envelope of peaks which elute within the retention time windows listed above and below for the aliphatic and aromatic fractions.

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14.6.2 Aromatic Fraction

14.6.2.1 It is not necessary to identify or quantitate individual aromatic compounds within the noted ranges below.

14.6.2.2 C8-C10: Determine the total area count for all peaks eluting 0.1 minutes after the retention time for Toluene to 0.1 minutes after the retention time for 1,2,3-Trimethylbenzene.

14.6.2.3 C10-C12: Determine the total area count for all peaks eluting 0.1 minutes after the retention time for 1,2,3-Trimethylbenzene to 0.1 minutes after the retention time for Naphthalene.

14.6.2.4 C12-C16: Determine the total area count for all peaks eluting 0.1 minutes after the retention time for Naphthalene to 0.1 minutes after the retention time for Acenaphthene.

14.6.2.5 C16-C21: Determine the total area count for all peaks eluting 0.1 minutes after the retention time for Acenaphthene to 0.1 minutes after the retention time for Pyrene.

14.6.2.6 C21-C34: Determine the total area count for all peaks eluting 0.1 minutes after the retention time for Pyrene to 0.1 minutes after the retention time for Benzo(g,h,i)perylene.

14.6.2.7 Surrogate: Determine the peak area count for the surrogate ortho-terphenyl and subtract this value from the collective area count value within the appropriate hydrocarbon range(s).

14.6.2.8 Calculate the concentrations of each carbon range with the GC software.

15 METHOD PERFORMANCE, DATA REVIEW AND ACCEPTANCE CRITERIA

15.1 See the Omega LIMS for current acceptance criteria, quantitation limits and supporting documentation.

15.2 The holding time for EPH Water is 14 days. The laboratory has set this to 7 days to circumvent missing holding times. The analyst/data reviewer are required to check the hold time against sample receipt to remove unnecessary holding time flags (H).

16 POLLUTION PREVENTION AND WASTE MANAGEMENT

16.1 Prior to disposal, all residual solvent from extraction vials, collection vials, and auto sampler vials are vented in a laboratory fume hood.

16.2 Any solvent waste collected should be collected in solvent waste containers and disposed of through the appropriate services.

16.3 Once vials have been completely evaporated, they may be thrown away in the proper waste receptacle.

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17 REFERENCES

17.1 Washington State Department of Ecology. (1997, June). ***Analytical Methods for Petroleum Hydrocarbons***. Publication No. ECY 97-602.

18 CHANGES FROM LAST REVISION

18.1 FAI either removed from sentences or updated to Alliance Technical Group.

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19 TABLES

Table 1. Aromatic Hydrocarbon Standard

Equivalent Carbon Number	Compound
7.6	Toluene
10.1	1,23-Trimethylbenzene
11.7	Naphthalene
15.5	Acenaphthene
Surrogate	Ortho-Terphenyl
20.8	Pyrene
34.01	Benzo(g,h,i)Perylene

Table 2. Aliphatic Hydrocarbon Standard

Equivalent Carbon Number	Compound
8	Octane
10	Decane
12	Dodecane
16	Hexadecane
Surrogate	1-Chloro-octadecane
21	Heneicosane
34	Tetratriacontane

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Table 3. Holding Times and Preservatives for EPH Samples

Matrix	Container	Preservation	Holding Time
Aqueous Samples	1-Liter or 500-mL amber glass bottle with Teflon-lined screw cap	Add 1:1 HCl if not sampled in pre-preserved amber; cool to 4°C	Preserved/Unpreserved samples must be extracted within 14 days and extracts analyzed within 40 days.
Soil/Sediment Samples	4-oz. (120 mL) wide mouth glass jar with Teflon-lined screw cap	Cool to 4°C	Samples must be extracted within 14 days and extracts analyzed within 40 days.

Table 4. Suggested Gas Chromatographic Conditions

Component	Conditions
Oven Program	Set oven temperature to 50°C for 2 minutes, then 8°C/min to 320°C and hold for 10 minutes.
Sample/auto sampler injection volume	0.5-2 µL
Gas Flows	Helium or Hydrogen
Helium carrier gas flow	1-2 mL/min
Air	400 mL/min
Hydrogen	35 mL/min
Make-up gas flow	30 mL/min
FID Temperature	310-320°C
Injection Port Temperature	290-300°C
GC Mode	Split 1:50
Column Head Pressure	15 psi at 50°C
Linear Velocity	50 cm/sec

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Table 5. EPH Marker Compounds

Range/Hydrocarbon Standard	Beginning Marker Compound	Ending Marker Compound
C8-C10 Aliphatic Hydrocarbons	Just before n-octane	Just after n-decane
C10-C12 Aliphatic Hydrocarbon	Just after n-decane	Just after n-dodecane
C12-C16 Aliphatic Hydrocarbons	Just after n-dodecane	Just after n-hexadecane
C16-C21 Aliphatic Hydrocarbons	Just after n-hexadecane	Just after n-heneicosane
C21-C34 Aliphatic Hydrocarbons	Just after n-heneicosane	Just after n-tetratriacontane
C8-C10 Aromatic Hydrocarbons	Just before toluene	Just after 1,2,3-trimethylbenzene
C10-C12 Aromatic Hydrocarbon	Just after 1,2,3-trimethylbenzene	Just after naphthalene
C12-C16 Aromatic Hydrocarbons	Just after naphthalene	Just after acenaphthene
C16-C21 Aromatic Hydrocarbons	Just after acenaphthene	Just after pyrene
C21-C34 Aromatic Hydrocarbons	Just after pyrene	Just after benzo(g,h,i)perylene

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Table 6. Aliphatic Calibration Chart

Spike Concentration (ppm)	Surrogate Concentration (ppm)	Spike (µL)	Surrogate (µL)	Volume Removed (µL)	Final Volume (µL)	Comments
10	4	2	1	3	1000	
20	8	4	2	6	1000	
50	20	10	5	15	1000	
100	40	20	10	30	1000	
200	100	40	25	65	1000	
500	-	10	-	10	100	*Use Insert
1000	-	20	-	20	100	*Use Insert
2000	-	40	-	40	100	*Use Insert
ICB	40	-	10	10	1000	
ICV (100)	40	10 (Second Source)	10	20	1000	

Table 7. Aromatic Calibration Chart

Spike Concentration (ppm)	Surrogate Concentration (ppm)	Spike (µL)	Surrogate (µL)	Volume Removed (µL)	Final Volume (µL)	Comments
10	4	2	1	3	1000	
20	8	4	2	6	1000	
50	20	10	5	15	1000	
100	40	20	10	30	1000	
200	100	40	25	65	1000	
500	-	10	-	10	100	*Use Insert
1000	-	20	-	20	100	*Use Insert
2000	-	40	-	40	100	*Use Insert
ICB	40	-	10	10	1000	
ICV (100)	40	10 (Second Source)	10	20	1000	

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20 EPH Prep Guide – Soil Extraction

Batch Includes: MB, LCS, DUP, MS, MSD, and Samples (Up to 20 per Batch)

Soil Extraction Procedure:

1. Weigh out 5 g of each sample into 40 mL VOAs and dry the samples with sodium sulfate
2. Add 50 µL of surrogate to the batch then add 50 µL of aliphatic spike and 50 µL of aromatic spike to applicable QC
3. Add 20 mL of DCM to the batch
4. Vortex each sample until solvent moves through entire matrix
5. Sonicate samples for 5 minutes and let samples rest for 15 minutes
6. After 15 minutes of rest, vortex samples and sonicate again for 5 minutes
7. Transfer samples from 40 mL VOAs into Buchi tubes. After removing all the solvent from each sample, add 5 mL of DCM to each soil matrix to capture any analyte remaining and add that rinse to Buchi tubes
8. Concentrate samples down to ~1 mL DCM on Buchi. Then, add 10 mL of Hexane, adjust Buchi settings to perform a solvent transfer from DCM to hexane, blow samples down to exactly 1 mL final volume*. Samples are now in Hexane and ready to be separated
9. Prepare VOAs for capturing aliphatic and aromatic portions of samples during separation
10. Place 40 mL VOA labeled “Aliphatic” under column. Prime the column with 10 mL hexane
11. Let hexane move through the column and fully soak it. Watch for when the meniscus of the hexane volume reaches the top of the column, then stop the flow. Do not let any of the column dry out
12. Add the sample** to the column and rinse vial with Hexane, add rinse to column
13. Let sample soak through the top of the column. After all sample goes through the top of the column, add 20 mL of pentane
14. Collect all the pentane into the VOA. Once all the pentane has moved through the column, stop the flow and switch the collection VOA to a 40 mL VOA labeled “Aromatics”
15. Add 35 mL of DCM to column
16. Collect the solvent for the aromatic portion of the sample
17. Concentrate the samples on the Buchi to a final volume of 1 mL. For concentrating the aliphatic portion, blow off the pentane, then switch Buchi settings for hexane.

* If sample won’t concentrate to 1 mL, record the final volume it reached on the bench sheet
**If extract is highly viscous or there is reason to believe the matrix will interfere with separation, dilute before separating. Record dilution and add to DF column in analytical run.

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21 EPH Prep Guide – Water Extraction

Batch Includes: MB, LCS, DUP, MS, MSD, and Samples (Up to 20 per batch)

Water Extraction Procedure:

1. Weigh out 400 mL of each sample. For QC samples, use 400 mL of tap water
2. Acidify samples, then check the pH with a pH strip to ensure the pH ≤ 2
3. Set up autosampler vials with at least 0.5 mL acetone for each sample and QC. Add 50 µL surrogate to each vial. Add 50 µL each of aliphatic and aromatic spike to the vials for the LCS, MS, and MSD
4. Transfer each aliquot of acetone with spike to its corresponding sample. Rinse the autosampler vial twice with water from the sample
5. Add 50 mL of DCM and set on bottle roller to extract overnight
6. After extraction, pour up samples into separatory funnels and collect the DCM from each sample into 40 mL VOAs.
7. After collecting solvent, add 20 mL DCM & shake out for 1 minute. Collect DCM into VOAs
8. Transfer solvent from 40 mL VOAs into Buchi tubes
9. Concentrate samples down to ~1 mL on Buchi, then add 10 mL of Hexane, adjust Buchi settings to perform a solvent transfer from DCM to Hexane, blow samples down to exactly 1 mL final volume. Samples are now in Hexane and ready to be separated
10. Prepare VOAs for capturing aliphatic and aromatic portions of samples during separation
11. Place 40 mL VOA labeled “Aliphatic” under column. Prime the column with 10 mL hexane
12. Let hexane move through the column and fully soak it. Watch for when the meniscus of the hexane volume reaches the top of the column, then stop the flow. Do not let any of the column dry out
13. Add all the sample to the column and rinse vial with hexane, add rinse to column
14. Let sample soak through the top of the column. After all sample goes through the top of the column, add 20 mL of pentane
15. Collect all the pentane into the VOA. Once all the pentane has moved through the column, stop the flow and switch the collection VOA to a 40 mL VOA labeled “Aromatics”
16. Add 35 mL of DCM to column
18. Concentrate the samples on the Buchi, final volume is 1 mL. For concentrating the aliphatic portion, blow off the pentane first, then switch Buchi settings for hexane.

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Volatile Petroleum Hydrocarbons (VPH)

Method NWTPH-VPH

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1.0 SCOPE AND APPLICATION

1.1 This method is designed to measure the collective concentrations of volatile aliphatic and aromatic petroleum hydrocarbons in water and soil. The carbon ranges used throughout this document are given in equivalent carbon (EC) numbers which are related to the boiling point of a chemical normalized to the boiling point of the n-alkanes, and its retention time in a boiling point gas chromatographic (GC) column. Volatile aliphatic hydrocarbons are collectively quantitated within four ranges: C5 through C6, >C6 through C8, >C8 through C10 and >C10 through C12. Volatile aromatic hydrocarbons are collectively quantitated within the C8 through C10, >C10 through C12, and >C12 through C13 ranges. These aliphatic and aromatic hydrocarbon ranges correspond to a boiling point range between approximately 36°C and 220°C.

1.2 This method is also designed to measure the individual concentrations of benzene, toluene, ethylbenzene, xylenes, and methyl tert butyl ether (MTBE) in water and soil.

1.3 Petroleum products suitable for evaluation by this method include gasoline, mineral spirits, and certain petroleum naphthas. This method, in and of itself, is not suitable for the evaluation of samples contaminated with kerosene, jet fuel, heating oils, lubricating oils, or other petroleum products which contain a significant percentage of hydrocarbons larger than C10. When samples are known or suspected to contain petroleum products containing significant concentration of hydrocarbons >C10, the Extractable Petroleum Hydrocarbon (EPH) method should also be employed to fully evaluate the hydrocarbons present.

1.4 This method is based on a purge-and-trap, gas chromatography (GC) procedure. This method should be used by, or under the supervision of, analysts experienced in the use of purge-and-trap systems and gas chromatographs. The analysts should be skilled in the interpretation of gas chromatograms and their use as a quantitative tool.

1.5 Like all GC procedures, this method is subject to a "false positive" bias in the reporting of targeted analytes, in that non-petroleum compounds eluting or co-eluting within a specified retention time window may be falsely identified and/or quantitated with the respective carbon ranges. Confirmatory analysis by a GC/MS, EPA Method 8260, or other suitable procedures are recommended in cases where significant concentrations of non-hydrocarbon compounds are known or suspected. If the results of these analyses lead to identification and quantitation of non-petroleum compounds, the analyst may subtract those values from the affected carbon ranges as long as the identities and quantities of subtracted compounds are provided in the analytical report.

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2.0 SUMMARY OF METHOD

2.1 Samples are analyzed using purge-and-trap sample concentration. The gas chromatograph is temperature-programmed to facilitate separation of organic compounds. Detection is achieved by a photo-ionization detector (PID) and flame ionization detector (FID) in series. Quantitation is based on comparing the PID and FID detector response of a sample to a standard comprised of aromatic and aliphatic hydrocarbons. The PID chromatogram is used to determine the individual concentrations of targeted analytes (BTEX/MTBE) and collective concentration of aromatic hydrocarbons within the C8 through C10, C10 through C12 and C12 through C13 ranges. The FID chromatogram is used to determine the collective concentration of aliphatic hydrocarbons within the C5 through C6, C6 through C8, C8 through C10 and C10 through C12 ranges. To avoid double counting of the aromatic contribution to the aliphatic ranges, the PID concentrations are subtracted from the FID concentrations to yield the aliphatic ranges values.

2.2 This method is suitable for the analysis of waters, soils, and sediments. Water samples may be analyzed directly for volatile petroleum hydrocarbons by purge-and-trap concentration and gas chromatography. Soil samples are dispersed in methanol to dissolve the volatile organic constituents and a portion of the methanol is analyzed by purge-and-trap GC (EPA method 5035).

3.0 DEFINITIONS

3.1 **Volatile Petroleum Hydrocarbons (VPH) –** All hydrocarbon compounds eluting just prior to n-pentane through 1-methylnaphthalene. VPH ranges are comprised of C5 through C6, >C6 through C8, >C8 through C10 and >C10 through C12 Aliphatic Hydrocarbons, as well as >C8 through C10, >C10 through C12 and >C12 through C13 Aromatic Hydrocarbons as well as benzene and toluene. VPH concentration data are reported as the aggregate concentrations of the aliphatic and aromatic hydrocarbon ranges and as selected targeted analytes.

3.2 **C5 through C6 Aliphatic Hydrocarbons** – All aliphatic hydrocarbon compounds which elute on the FID chromatogram from (and including) n-pentane through n-hexane.

3.3 **C6 through C8 Aliphatic Hydrocarbons** – All aliphatic hydrocarbons which elute on the FID chromatogram after n-hexane through n-octane.

3.4 **C8 through C10 Aliphatic Hydrocarbons** – All aliphatic hydrocarbon compounds which elute on the FID chromatogram after n-octane through n-decane

3.5 **C10 through C12 Aliphatic Hydrocarbons** – All aliphatic hydrocarbons which elute on the FID chromatogram after n-decane through n-dodecane.

3.6 **C8 through C10 Aromatic Hydrocarbons** – All hydrocarbon compounds which elute on the PID chromatogram after toluene through 1,2,3-trimethylbenzene.

3.7 **C10 through C12 Aromatic Hydrocarbons** – All hydrocarbons which elute on the PID chromatogram after 1,2,3- trimethylbenzene through naphthalene.

3.8 **C12 through C13 Aromatic Hydrocarbons** – All hydrocarbons which elute on the PID chromatogram after naphthalene through 1-methylnaphthalene. This is a hybrid range which is designed to acquire the methylnaphthalenes associated with petroleum products like gasoline and is only used when VPH is run without an accompanying EPH method request.

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3.9 **Targeted VPH Analytes** – Benzene, toluene, ethylbenzene, m&p, o-xylenes, MTBE, and naphthalene.

3.10 **Volatile Petroleum Hydrocarbon (VPH) Component Standard** – A multi-component mixture of the aliphatic and aromatic compounds analyzed (Appendix A). The compounds comprising the VPH Component Standard are used to (a) define the individual retention times and chromatographic response factors for each of the Targeted VPH Analytes, (b) define and establish the windows for the collective aliphatic and aromatic hydrocarbon ranges of interest, and (c) determine average chromatographic response factors that can in turn be used to calculate the collective concentration of hydrocarbons within these ranges.

3.11 **Analytical Batch** – A group of samples with similar matrices which are processed as a unit. An analytical batch may contain up to 20 samples.

3.12 **Calibration Standards** – A series of standard solutions prepared from dilutions of a stock standard solution, containing known concentrations of each analyte and surrogate compound of interest.

3.13 **Calibration Check Standard** – A calibration standard used to check the calibration state of an instrument. The calibration check standard is prepared from the same stock solution as calibration standards and is generally one of the mid-level range calibration standard dilutions.

4.0 INTERFERENCES

4.1 Samples can become contaminated by diffusion of volatile organics through the sample container septum during shipment and storage. Trip blanks prepared from reagent water should be carried through sampling and subsequent storage and handling to serve as a check on such contamination.

4.2 Contamination by carryover can occur whenever high-level and low-level samples are sequentially analyzed. To reduce carryover, the sample syringe and/or purging device should be rinsed between samples with reagent water or solvent. The trap and other parts of the system are also subject to contamination, therefore, frequent bake-out and purging of the entire system may be required. A screening step is recommended to protect analytical instrumentation. Whenever an unusually concentrated sample is encountered, it should be followed by the analysis of a solvent blank to check for cross-contamination.

4.3 Certain organic compounds not associated with releases of petroleum products, including chlorinated solvents, ketones, and ethers, will be quantitated as Volatile Petroleum Hydrocarbons. Some samples may require additional analytical procedures to be employed, such as GC/MS, to document the presence and quantity of such compounds.

4.4 The response selectivity of a photo-ionization detector (PID) is used in this method to differentiate aromatic hydrocarbons from aliphatic hydrocarbons. All compounds eluting on the PID chromatogram after toluene are identified by the method as aromatic hydrocarbons. This will lead to an overestimation of aromatic hydrocarbons within samples, as certain aliphatic compounds will elicit a response on the PID, particularly unsaturated compounds such as alkenes. The significance and implications of this overestimation will vary from sample to sample and, where less conservative data are desired, additional actions should be considered to minimize the detection of non-aromatic compounds, such as the use of a lower energy PID lamp or GC/MS.

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5.0 APPARATUS AND MATERIALS

5.1 The following glassware is used for this method:

5.1.1 VOC Vials: 40-mL VOC vials with Teflon/ silicone septa for soils; 40-mL VOC vials with Teflon/silicone septa for waters.

5.1.2 Volumetric flasks: 10-mL, 50-mL, 100-mL, and 1,000-mL with a ground-glass stopper.

5.1.3 Disposal pipets: Pasteur.

5.2 Analytical balance: A top-loading balance capable of weighing to the nearest 0.1 g must be used for weighing soil samples.

5.3 Autosampler: The autosampler in use is a purge and trap system, capable of injecting 10 mL of sample, as well as surrogate solution into the sparge tube.

5.4 Gas Chromatography

5.4.1 Gas Chromatograph: Agilent 8890 gas chromatograph (GC) with an OI Corporation Photon Ionization Detector (PID) and Flame Ionization Detector (HD) in parallel. Data acquisition is performed using a Agilent Masshunter Integrator, capable of acquiring two analog signals in parallel.

5.4.2 Columns.

5.4.2.1 Recommended column: 105M x 0.53 mm I.D. Restek RTX 502.2, 3.0 micron film thickness, or equivalent.

5.4.2.2 Other columns, such as a 60 M x 0.53 mm J&W DB-5, may be used.

5.4.2.3 Capillary columns are required to achieve necessary resolution. The column must be capable of resolving typical gasoline components. It must also resolve ethylbenzene from m/p-xylene.

5.4.3 Detectors: The method utilizes a Photo-ionization Detector (PID) in series with a Flame Ionization Detector (FID); the PID first in the series. The method is based upon the use of a 10.0 eV PID lamp, although lower energy lamps are permissible in order to minimize PID response to aliphatic compounds.

5.5 Purge-and-trap: A system of purging volatiles from samples and trapping them in a trap column. After sparging, the trap is flash heated and volatiles are transferred to the analytical column. The sample is then transferred, and the trap is baked to remove high boiling point material. The purge and trap electronically controls all times and temperatures for reproducibility. Tubing and valve blocks for transfer of the sample from the trap to the analytical column are heated.

5.5.1.1 .

5.6 Microsyringes: 1-µL, 5-µL, 10-µL, 25-µL, 100-µL, 250-µL, 500-µL, and 1,000-µL.

5.7 Spatula: Stainless steel.

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6.0 REAGENTS AND STANDARDS

6.1 Reagents

6.1.1 Reagent Water: organic free water (ASTM Type I reagent grade water).

6.1.2 Solvent: methanol; purge and trap grade or equivalent. Store away from other solvents.

6.2 Stock Standard Solutions

6.2.1 Stock standard solutions are purchased from a reputable source as certified reference material.

6.3 Primary Dilution Standard

6.3.1 Using the stock standard solution, prepare primary dilution standards in methanol, as needed. The primary dilution standard should be prepared at 1000µg/mL (Appendix B). These standards should be stored with minimal headspace, at -10°C to -20°, and should be checked frequently for signs of degradation or evaporation. The analyst is allowed to prepare separate surrogate and VPH analyte standards.

The primary dilution standards should be replaced at least monthly.

6.4 VPH Calibration Standards

6.4.1 Rapidly inject the methanol-based standard into the water in the expanded area of a filled 100-mL volumetric flask. Remove the needle quickly after injection. VPH calibration levels are outlined in Appendix B.

6.4.2 Mix aqueous standards by inverting the flask three times. Avoid further agitation.

6.5 Surrogate Standard

6.5.1 The analyst must monitor both the performance of the analytical system and the effectiveness of the method in dealing with sample matrices by spiking each sample, blank, and matrix spike with a surrogate standard. The surrogate standard is also added to the VPH calibration standard solutions.

6.5.2 FAI currently uses a certified purchased surrogate solution containing 2,5-dibromotoluene. A solution of 50 µg/mL is made in methanol and added automatically to each sample by the auto sampler.

6.6 Matrix Spiking Solution

FAI currently uses a certified purchased VPH standard solution as a spiking solution. No further dilution is necessary as the standard is purchased at a concentration of 1000 µg/mL. Spiking concentrations are outlined in Appendix B.

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7.0 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

7.1 Aqueous Samples.

7.1.1 Aqueous samples should be collected in duplicate (or the number of vials directed by the laboratory) without agitation and without headspace in contaminant-free amber glass VOC vials with Teflon-lined septa screw caps. Samples should be acidified to a pH < 2.0 at the time of collection. Samples must be cooled to 4°C immediately after collection.

7.1.2 Acid preserved aqueous samples must be analyzed within 14 days of collection. Aqueous samples which, for whatever reason, have not received acid preservation must be analyzed within 7 days of collection. If an unpreserved sample was analyzed more than 7 days from collection the data must be reported as an "estimate quantity".

7.2 Soil Samples

7.2.1 Soil samples must be collected in a manner that minimizes sample handling and agitation. Samples must be cooled to 4°C immediately after collection.

7.2.2 Samples for VPH analysis should be collected in 40 ml VOA vials containing 5 ml of methanol. These vials should be pre-weighed so an accurate mass of the soil sample can be obtained.

7.2.3 Soil samples must be analyzed within 14 days of collection to avoid qualification.

8.0 PROCEDURE

8.1 Sample Preparation and Screening

8.1.1 It is recommended that samples known or suspected to have extremely high levels of volatile petroleum hydrocarbons be screened prior to analysis in order to establish the appropriate volume/mass to be used for analysis. Purge and trap and GC conditions are outlined in Appendix C.

8.1.2 Soil samples that are collected in jars:

8.1.2.1 Weigh 5 grams of sample into a tared 5mL methanol VOA vial.

8.1.2.2 Record the weight on the prep bench sheet.

8.1.2.3 This extraction procedure does not follow EPA 5035B preparation procedures.

8.1.3 Soil samples that are collected in pre-weighed methanol VOAs:

8.1.3.1 Pre-extracted sample containers are weighed prior to analysis.

8.1.3.2 Sample weights are recorded on the prep bench sheet and the Omega LIMS.

8.1.3.3 860µL of methanol are extracted from the sample vial and added to a VOA vial filled part way with water. Once the sample is added, fill to volume with DI, ensuring that there is no headspace in the vial.

8.1.3.4 Please refer to SOP37 for more detailed soil prep information.

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8.2 Sample Sparging

8.2.1 Once soil samples are extracted, they are sparged in the same manner as water samples.

8.2.2 Place the batch of VOAs into the autosampler tray. Use the autosampler software to create a sequence and carry out the analysis. Surrogate is added to the samples by the autosampler.

8.2.3 After the purge time is complete the trapped volatiles are automatically transferred to the analytical column.

8.2.4 Dilution: If the sample needs to be diluted, use Grade A volumetric glassware. Invert gently to avoid aeration of the sample while mixing and record the dilution in the LIMS. Alternatively, the analyst may dilute directly into a 40mL VOA vial as outlined in SOP36.

8.3 Determination of Percent Moisture.

8.3.1 Soil and sediment results must be reported on a dry-weight basis. The determination of percent moisture is outlined in SOP 54.

8.3.1

8.3.1 Retention Time Windows

8.3.2 Before establishing retention time windows, it is recommended that the GC system is within optimum operating conditions.

8.3.3 The laboratory should verify retention time windows whenever a new GC column is installed.

8.3.4 VPH retention time (RT) windows are defined as beginning 0.1 minutes after the RT of the beginning marker compound and ending 0.1 minutes after the RT of the ending marker compound. The exception to this is the C5 through C6 aliphatic hydrocarbon range, were its RT window is define as beginning 0.1 minutes prior to the beginning marker compound and ending 0.1 minutes after the ending marker compound. VPH marker compounds and windows are summarized in Appendix D.

8.4 Calibration Procedure

8.4.1.1

8.4.1.1 Prepare VPH Calibration Standards at a minimum of five concentration levels as outlined in Appendix B.

8.4.1.2 **Individual target analytes:** MTBE, Benzene, Toluene, Ethyl Benzene, m,p-xylene, o-xylene, 1,2,3-trimethylbenzene, naphthalene and 1-methylnaphthalene are all quantified using peak area on the PID signal.

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8.4.1.2.1 For each target analyte tabulate peak height or area responses against the mass injected to generate a calibration curve. Alternatively, the ratio of the response to the amount injected, defined as the calibration factor (CF), may be calculated for method analytes. If the percent relative standard deviation (%RSD) of the calibration factor is equal to or less than 20 % over the working range for all analytes of interest, linearity through the origin can be assumed, and the average calibration factor can be used in place of a calibration curve.

8.4.1.3 **Surrogate:** 2,5-dibromotoluene is quantified using peak area from the PID signal.

8.4.1.4 **Aromatic Hydrocarbon Ranges:** These ranges are integrated using spectrum summation on the PID signal, and the area obtained is compared to the total mass injected to define a calibration response factor.

- C8-C10:
  - Integration on the PID signal begins after toluene, ends after 1,2,3-trimethylbenzene
  - Range contains 4 target compounds (toluene, Ethylbenzene, m,p-xylene (double concentration) and o-xylene)
  - Calibration response factor is calculated using the summated area over the range.
- C10-C12:
  - Integration on the PID signal begins after 1,2,3-trimethylbenzene, ends after naphthalene
  - Range contains 1 target compound (naphthalene)
  - Calibration response factor is calculated using the summated area over the range.
- C12-C13:
  - Integration on the PID signal begins after naphthalene, ends after 1-methylnaphthalene
  - Range contains 1 target compound (1-methylnaphthalene) and 1 surrogate (2,5-dibromotoluene)
  - Calibration response factor is calculated using the summated area over the range, with the area from the surrogate being subtracted out.

8.4.1.5 **Aliphatic Hydrocarbon Ranges**: These ranges require the subtraction of the aromatic concentration (PID signal) from the total concentration (FID signal) over the same retention time window, to calculate to aliphatic concentration. These ranges are integrated using spectrum summation, and the area obtained is compared to the total mass injected to define a calibration response factor. Separate calibrations and ‘compounds’ will be set up in the software to generate concentrations for both signals over each range. The subtraction of the concentrations will be handled by an excel spreadsheet macro prior to data import into the Omega LIMS.

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- C5-C6:
  - Total:
    - Integration on the FID signal begins before pentane, ends after hexane
    - Range has 3 compounds (pentane, MTBE, hexane)
    - Calibration response factor is calculated using the summated area over the range.
  - Subtracted:
    - Integration on the PID signal begins before pentane, ends after hexane
    - Range contains 1 compound (MTBE)
    - Calibration response factor is calculated using the summated area over the range.
- C6-C8:
  - Total:
    - Integration on the FID signal begins after hexane, ends after octane
    - Range contains 3 compounds (benzene, toluene, octane)
    - Calibration response factor is calculated using the summated area over the range.
  - Subtracted:
    - Integration on the PID signal begins after hexane, ends after octane
    - Range contains 2 compounds (Benzene and Toluene)
    - Calibration response factor is calculated using the summated area over the range.
- C8-C10:
  - Total:
    - Integration on the FID signal begins after octane, ends after decane
    - Range contains 4 compounds (ethylbenzene, m,p-xylene (double concentration), o-xylene, decane)
    - Calibration response factor is calculated using the summated area over the range.
  - Subtracted:
    - Integration on the PID signal begins after octane, ends after decane
    - Range contains 3 compounds (ethylbenzene, m,p-xylene (double concentration), o-xylene)
    - Calibration response factor is calculated using the summated area over the range.

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- C10-C12:
  - Total:
    - Integration on the FID signal begins after decane, ends after dodecane
    - Range contains 2 compounds (1,2,3-trimethylbenzene, dodecane)
    - Calibration response factor is calculated using the summated area over the range.
  - Subtracted:
    - Integration on the PID signal begins after decane, ends after dodecane
    - Range contains 1 compound (1,2,3-trimethylbenzene)
    - Calibration response factor is calculated using the summated area over the range.

8.4.1.6 The concentration of specific analytes or hydrocarbon ranges may also be calculated from the calibration curve by linear regression, provided that the correlation coefficient (r^2) is at least 0.99 and the % D for any targeted analyte must not vary from the predicted response by more than +/- 15%, nor any hydrocarbon range standard from its predicted response by more than +/- 20%.

8.4.1.7 At a minimum, the working calibration curve or calibration factor must be verified on each working day, and after every 20 samples, by the injection of a mid-level calibration standard to verify instrument performance and linearity. If the percent difference (%D) for any targeted analyte response varies from the predicted response by more than ± 15 %, as determined, a new calibration curve must be prepared for that analyte, or the data must be flagged to indicate the bias. Similarly, if the percent difference of the carbon range compound response varies from the predicted response by more than ± 20 %, a new calibration curve must be prepared or the data must be flagged to indicate the bias.

8.5 Sample Analysis

8.5.1 Samples are analyzed in a set referred to as an analysis sequence. The sequence begins with instrument calibration or a calibration verification (CCV) followed by samples interspersed with blanks and QC samples. The analytical sequence ends must end with an acceptable calibration verification. If the final calibration verification is not acceptable, then all samples analyzed after the last acceptable calibration verification must either be reanalyzed or if this is not possible, then the data associated with those samples must be qualified.

8.5.2 Establishing daily retention time windows for each analyte is recommended. Use the absolute retention time for each analyte as the midpoint of the window for that day.

8.5.2.1 Tentative identification of an analyte occurs when a peak from a sample falls within the retention time window. In cases where interferences are suspected, confirmation on a second dissimilar GC column or by GC/MS analysis may be necessary.

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8.5.2.2 Validation of GC system qualitative performance must be accomplished by the analysis of standards, generally mid-level, within the analysis sequence. If any of the standards fall outside their daily retention time window, the system is out of control. In such cases, the cause of the problem must be determined and corrected.

8.5.3 If the response for Targeted VPH Analytes exceeds the linear range of the system, dilute the sample and reanalyze.

8.5.4 If detection of targeted analyte peaks are prevented by the presence of interferences, additional analytical techniques, e.g. GC/MS, are recommended.

8.5.5 Peak area and carbon range area quantification/integration must be from baseline (i.e. forced baseline projection which must include the unresolved complex mixture "hump" areas). The exception to this is the C5 through C6 Aliphatic Hydrocarbon range which, due to the use of capillary columns shorter than 100 meters and/or the purging of methanol volumes greater than 20 uL, may experience a lack of complete resolution between C5 (n-pentane) and methanol. In this event, the analyst is allowed to use tangential skim integration, or other suitable integration techniques, to integrate n-pentane, and subsequent hydrocarbons within the C5-C6 aliphatic range if it/they appear(s) on the trailing edge of the methanol solvent peak.

8.6 External Standard Calculations

The concentration of targeted analytes and hydrocarbon ranges in a sample may be determined by calculating the amount of analyte or hydrocarbon range purged, from the peak response, using the calibration curve or the calibration factor.

8.6.1 Peak areas measured from blanks may not be subtracted from sample peak areas.

9.0 QUALITY CONTROL

9.1 General Requirements and Recommendations

9.1.1 Each laboratory that uses this method should operate a formal quality control program. The minimum requirements of this program consist of an initial demonstration of laboratory capability and an ongoing analysis of spiked samples to evaluate and document the quality of data. The laboratory must maintain records to document the quality of the data generated. Ongoing data quality checks are compared with established performance criteria to determine if the results of analyses meet the performance standards for the method.

9.1.2 Cleanout samples should be run after samples suspected of being highly contaminated to determine if sample carryover has occurred. If cleanout samples are not run after highly contaminated samples, those samples following contaminated samples should be re-analyzed to verify detections.

9.1.3 At a minimum, for each analytical batch (up to 20 samples), a Method Blank (MB), Laboratory Control Sample (LCS), Matrix Spike/Matrix Spike Duplicate (MS/MSD), and sample duplicate should be analyzed. For analytical batches with more than 10 samples, the analysis of an additional mid-range calibration check standard is recommended. The blank and spiked samples must be carried through all stages of the sample preparation and measurement process.

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9.1.4 While it is recommended that the n-pentane (C5) peak be adequately resolved from the methanol solvent on the FID chromatogram, the analyst is allowed to follow the guidance as outlined in 9.9.5. Coelution of the m- and p- xylene isomers is permissible. Any surrogates used must be adequately resolved from individual compounds in the VPH Component Standard.

9.2 Initial and Continuing Demonstrations of Capability

9.2.1 Initial demonstration of laboratory capability (IDC) is required for new analysts or instrumentation, prior to the analysis of any samples. Subsequent to this initial demonstration, additional evaluations of this nature should be conducted on a periodic basis, in response to changes in instrumentation or operations, and/or in response to confirmed or suspected systems, method, or operational problems.

9.2.2 Further IDC information may be found in SOP59.

9.3 Petroleum Reference Standard

9.3.1 As an optional demonstration of the validity and relevance of VPH calibration, analyze a reagent water and/or clean sand blank spiked with a known concentration of a neat gasoline product.

9.3.1.1 Fortify a reagent water and/or clean sand blank with 5 µL and/or 0.5 mL of the Petroleum Standard Spiking Solution, respectively. Purge and analyze in accordance with the procedures outlined in Section 8.0.

9.3.1.2 Calculate the total concentration of all petroleum hydrocarbons within the Aliphatic Hydrocarbon ranges using the FID chromatogram. Add these values together. Do not subtract the concentration of Targeted VPH analytes.

9.3.1.3 The calculated concentration is expected to be within 30% ± the known concentration of Petroleum Standard in the reagent water or sand blank.

9.4 Ongoing Analytical Batch QC Demonstrations

9.4.1 Each sample, blank, and matrix spike must be spiked with the surrogate spiking solution. Required surrogate recovery is 60% to 140%.

9.4.2 Continuing Calibration Verification (CCV**)**

9.4.2.1 A mid-range calibration standard, prepared from the same stock standard solution used to develop the calibration curve, must be analyzed prior to sample analysis to verify the calibration state of the instrument. For large analytical batches that contain more than 10 samples, the analysis of an additional mid-range calibration check standard is recommended after the analysis of the tenth sample. If the percent difference (% D) of any analyte and range within the calibration check standard varies from the predicted response by more than15% and 20%, respectively, a new calibration curve must be prepared for that analyte.

9.4.3 Method Blank (MB)

9.4.3.1 A method blank is analyzed with each analytical batch. It is used to help determine method performance and detect background contamination and is subjected to the same preparation as analytical samples.

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9.4.4 Laboratory Control Sample (LCS)

9.4.4.1 One LCS is required per analytical batch. An LCS is a blank sample matrix spiked with a known concentration of analytes. The spike recovery must be between 70-130%. If these recoveries cannot be obtained, the analyst should identify and correct the problem and re-analyze the batch. If the batch cannot be re-analyzed, the samples must be qualified.

9.4.4.2 If there is insufficient volume to analyze a Duplicate and MS/MSD, and LCSD may be analyzed instead. The %RPD should be within 20% of the LCS.

9.4.4.3 If there is no preparation involved when making an LCS compared to a CCV, the CCV can stand in place of the LCS.

9.4.5 Duplicate

9.4.5.1 At least one sample duplicate must be analyzed per analytical batch. The RPD of duplicate samples should not exceed +/- 25%. The lack of sample homogeneity may contribute to RPD's for duplicates which exceed this value. Should the values exceed 25%, the analyst must report that occurrence.

9.4.6 Matrix Spike and Matrix Spike Duplicate

9.4.6.1 One MS/MSD pair will be analyzed per analytical batch. The purpose of the MS/MSD are to determine whether the sample matrix contributes bias to the analytical results. The background concentrations of the analytes in the sample matrix must be determined in a separate aliquot and the measured values in the MS/MSD corrected for background concentrations. The corrected concentrations of each analyte within the matrix spiking solution should be within 70 - 130% of the true value. Should the values determined exceed this range, the analyst must report that occurrence.

9.4.7 If any of the performance standards specified in Section 9.4 are not met, the problem must be corrected before further samples are analyzed. Exceptions to this are duplicate samples RPD's and high recoveries for MS/MSD's which, due to sample non-homogeneity may exceed the allowable limits. Any samples run between the last calibration check standard that meets the criteria and one that does not must be rerun. If this is not possible, that data must be reported as an "estimated concentration".

10.0 METHOD PERFORMANCE

10.1 Method Detection Limits

10.1.1 The method detection limit (MDL) is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the value is above zero. The MDL actually achieved in a given analysis will vary depending on instrument sensitivity and matrix effects.

10.1.2 Further detailed information regarding MDLs and reporting limits may be found in SOP53.

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11.0 POLLUTION PREVENTION AND WASTE MANAGEMENT

11.1 Aqueous sample waste is placed in large 55-gallon steel drums where the waste is purged with a large pump. Waste samples are collected and analyzed to ensure sample waste can be properly disposed of.

11.2 Soil samples that contain hazardous concentrations of contaminants are cataloged and disposed of by a licensed disposal company.

11.3 Calibration standards are obtained in dilute solutions to minimize their risk.

11.4 All sample and reagent waste generated in this procedure must be segregated and disposed of according to the FAI hazardous waste procedures.

11.5 Please refer to SOP61 for more information on FAI waste management procedures.

12.0 REFERENCES

12.1 Washington State Department of Ecology, ***Analytical Methods for Petroleum Hydrocarbons*** Publication ECY 97-602 June 1997

12.2 Closed-System Purge and Trap Extraction for Volatile Organics in Soil and Waste Samples, EPA 5035A, July 2002.

12.3 Purge and Trap for Aqueous Samples, EPA 5030B Revision 2, December 1996.

13.0 Appendices

13.1 Appendix A: VPH Component Standard with Surrogate

13.2 Appendix B: VPH Calibration and Spiking Information, Calibration Bench sheet

13.3 Appendix C: Recommended Purge & Trap and GC Operating Conditions

13.4 Appendix D: VPH Marker Compounds

13.5 Appendix E: Example Chromatograms

14.0 Changes Since Last Revision

14.1 Logo Update.

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14.1 Appendix A: VPH Component Standard with Surrogates

Compound	Equivalent Carbon Number
n-Pentane	5.0
n-Hexane	6.0
Methyl tert butyl ether	N/A
Benzene	6.5
Toluene	7.6
n-Octane	8.0
Ethylbenzene	8.5
m- & p- Xylene	8.6
o-Xylene	8.8
1,2,3,-Trimethylbenzene	10.1
n-Decane	10.0
Naphthalene	11.7
n-Dodecane	12.0
1-Methylnaphthalene	13.0
2,5-dibromotoluene (surrogate)	N/A

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Appendix B: VPH Calibration Prep sheet and Spiking Information

Expected Values on Instrument (ppb)											
		MDLs			Calibration						
Aliphatic Raw/Sub	**CCV/LCS/MS/MSD**	**MDL (5)**	**MDL (10)**	**MDL (20)**	**Level 1**	**Level 2**	**Level 3**	**Level 4**	**Level 5**	**Level 6**	**Level 7**
Raw C5-C6 Aliphatic Hydrocarbons	600	15	30	60	30	60	150	300	600	1500	3000
Raw C6-C8 Aliphatic Hydrocarbons	600	15	30	60	30	60	150	300	600	1500	3000
Raw C8-C10 Aliphatic Hydrocarbons	1000	25	50	100	50	100	250	500	1000	2500	5000
Raw C10-C12 Aliphatic Hydrocarbons	400	10	20	40	20	40	100	200	400	1000	2000
SUB C5-C6 Aliphatic Hydrocarbons PID	200	5	10	20	10	20	50	100	200	500	1000
SUB C6-C8 Aliphatic Hydrocarbons PID	400	10	20	40	20	40	100	200	400	1000	2000
SUB C8-C10 Aliphatic Hydrocarbons PID	800	20	40	80	40	80	200	400	800	2000	4000
SUB C10-C12 Aliphatic Hydrocarbons PID	200	5	10	20	10	20	50	100	200	500	1000
Aromatic											
VPH: Aromatic Hydrocarbon (C8-C10)	1000	25	50	100	50	100	250	500	1000	2500	5000
VPH: Aromatic Hydrocarbon (C10-C12)	200	5	10	20	10	20	50	100	200	500	1000
VPH: Aromatic Hydrocarbon (C12-C13)	200	5	10	20	10	20	50	100	200	500	1000
Aliphatic Calculations											
VPH: Aliphatic Hydrocarbon (C5-C6)	400	10	20	40	20	40	100	200	400	1000	2000
VPH: Aliphatic Hydrocarbon (C6-C8)	200	5	10	20	10	20	50	100	200	500	1000
VPH: Aliphatic Hydrocarbon (C8-C10)	200	5	10	20	10	20	50	100	200	500	1000
VPH: Aliphatic Hydrocarbon (C10-C12)	200	5	10	20	10	20	50	100	200	500	1000
Individual Target Analytes											
Benzene	200	5	10	20	10	20	50	100	200	500	1000
Toluene	200	5	10	20	10	20	50	100	200	500	1000
Ethylbenzene	200	5	10	20	10	20	50	100	200	500	1000
m,p-Xylene	400	10	20	40	20	40	100	200	400	1000	2000
o-Xylene	200	5	10	20	10	20	50	100	200	500	1000
Naphthalene	200	5	10	20	10	20	50	100	200	500	1000
tert-Butyl Methyl Ether	200	5	10	20	10	20	50	100	200	500	1000

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VPH Calibration

Date: _____

Analyst: _____

Cal	ICV
VPH Standard:	VPH Standard:

IS/Surrogate _____

Cal Level	Spike Conc. (ppb)	VPH Cal Spike (uL)	VPH ICV Spike (uL)	Final Vol. (mL)	Comments
1	10	0.50	--	50	
2	20	1.00	--	50	
3	50	2.50	--	50	
4	100	5.00	--	50	
5	200	10.00	--	50	
6	500	25.00	--	50	
7	1000	50.00	--	50	
	ICV (200 ppb)	--	10.00	50	

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Appendix C: Recommended Purge & Trap and GC Operating Conditions

Purge and Trap Conditions

Variable Name	Value
Valve Oven Temp	140°C
Transfer Line Temp	140°C
Sample Mount Temp	90°C
Water Heater Temp	90°C
Sample Vial Temp	20°C
Sample Equilibrate Time	0.00 min
Soil Valve Temp	50°C
Standby Flow	10 mL/min
Purge Ready Temp	40°C
Condensate Ready Temp	45°C
Presweep Time	0.25 min
Prime Sample Fill Volume	3.0 mL
Sample Volume	5.0 mL
Sweep Sample Time	0.25 min
Sweep Sample Flow	100 mL/min
Sparge Vessel Heater	Off
Sparge Vessel Temp	20°C
Prepurge Time	0.00 min
Prepurge Flow	0 mL/min
Purge Time	11.00 min
Purge Flow	40 mL/min
Purge Temp	20°C
Condensate Purge Temp	20°C
Dry Purge Time	0.00 min
Dry Purge Flow	100 mL/min
Dry Purge Temp	20°C

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GC Operating Conditions

D:\GC-29\Acquisition Methods\VPH.M
Tue Jun 13 12:50:50 2023

Control Information	
Sample Inlet	: GC
Injection Source	: Manual
No Sample Prep method has been assigned to this method.	
GC	
GC Summary	
Run Time	33.333 min
Post Run Time	0 min
Oven	
Temperature	
Setpoint	On
(Initial)	45 °C
Hold Time	1 min
Post Run	40 °C
Program	
#1 Rate	3 °C/min
#1 Value	100 °C
#1 Hold Time	0 min
#2 Rate	20 °C/min
#2 Value	230 °C
#2 Hold Time	7.5 min
Equilibration Time	0.1 min
Max Temperature	300 °C
Maximum Temperature Override	Disabled
Slow Fan	Disabled
Front SS Inlet He	
Mode	Split
Heater	On 250 °C
Pressure	On 15 psi
Total Flow	On 21.884 mL/min
Septum Purge Flow	On 3 mL/min
Pre-Run Flow Test	On
Pre-Run Flow Test Action on Failure	Continue
Gas Saver	Off
Split Ratio	10 :1
Split Flow	17.167 mL/min
Liner	A Liner has not been selected.
Column	
Column #1	
Flow	
Setpoint	On
(Initial)	1.7167 mL/min
Post Run	1 mL/min
Column Information	Agilent Technol 123-1064: UST246914H
DB-1	
Temperature Range	-60 °C–300 °C (300 °C)

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Dimensions	60 m x 320 µm x 3 µm
Column lock	Unlocked
In	Front SS Inlet He
Out	Front Detector FID
(Initial)	45 °C
Pressure	15 psi
Flow	1.7167 mL/min
Average Velocity	25.147 cm/sec
Holdup Time	3.9766 min
Control Mode	Constant Flow
Column Outlet Pressure	0 psi
Front Detector FID	
Makeup	N2
Heater	On 250 °C
H2 Flow	On 45 mL/min
Air Flow	On 190 mL/min
Makeup Flow	On 20 mL/min
Carrier Gas Flow Correction	Constant Makeup and Fuel Flow
Flame	On
Aux Detector CP FID Detector	
Makeup	He
Electrometer	Off
Detector Evaluation	
Perform Detector Evaluation Test	Off
Signal Selected	Signal #1: Front Signal (FID) {50 Hz}
Checkout Sample	FID
Valve 6	
Switching Valve	Off
Signals	
Signal #1: Front Signal	
Description	Front Signal
Details	Front Signal (FID)
Save	On
Data Rate	50 Hz
Signal #2: Aux Signal	
Description	Aux Signal
Details	Aux Signal (CP FID Detector)
Save	On
Data Rate	50 Hz

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Appendix D: VPH Marker Compounds

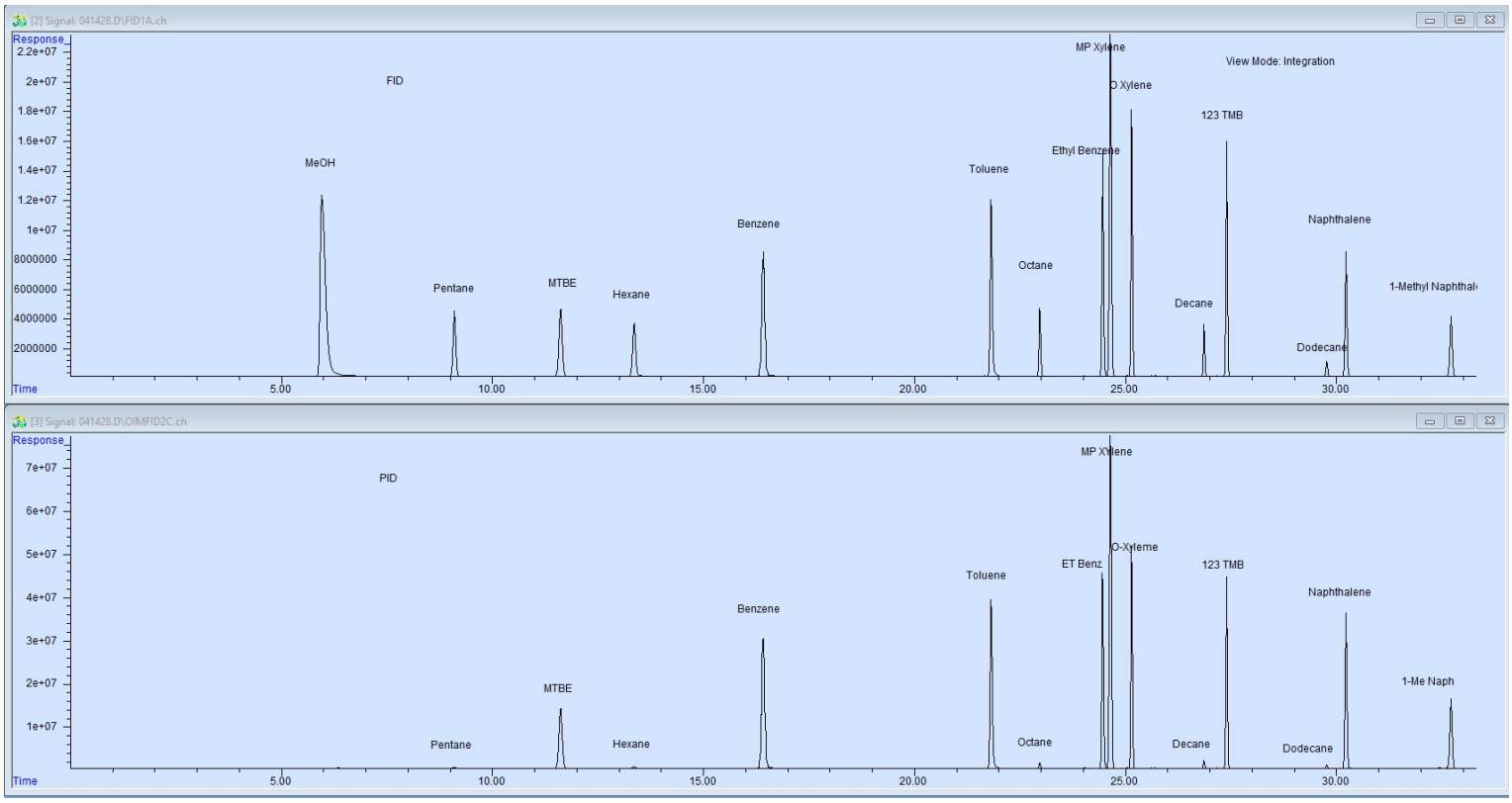
Hydrocarbon Range	Beginning Marker Compound	Ending Marker Compound
C5-C6 Aliphatic Hydrocarbons (FID)	just before n-Pentane	just after n-Hexane
C6-C8 Aliphatic Hydrocarbons (FID)	just after n-Hexane	just after n-Octane
C8-C10 Aliphatic Hydrocarbons (FID)	just after n-Octane	just after n-Decane
C10-C12 Aliphatic Hydrocarbons (FID)	just after n-Decane	just after n-Dodecane
C8-C10 Aromatic Hydrocarbons (PID)	just after Toluene	just after 1,2,3-Trimethylbenzene
C10-C12 Aromatic Hydrocarbons (PID)	just after 1,2,3-Trimethylbenzene	just after Naphthalene
C12-C13 Aromatic Hydrocarbons (PID)	just after Naphthalene	just after 1-Methylnaphthalene

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Appendix E: Example Chromatography



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EPA Method 8260C/D & 624.1 - Volatile Organic Compounds/Mass Spectrometry

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v3.01	March 24, 2025	Logo update – Montrell Givens

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1. SCOPE AND APPLICATION

1.1 Methods 8260 and 624.1 are used to determine volatile organic compounds and total volatile hydrocarbons (TVH) with boiling points below 200°C and are insoluble, or slightly soluble in water in a variety of solid, liquid, and waste matrices. Volatile water-soluble compounds can be included in this analytical technique. However, for more soluble compounds, quantitation limits are approximately ten times or higher because of poor purging efficiency. Such compounds include low-molecular-weight halogenated hydrocarbons, aromatics, ketones, nitriles, acetates, acrylates, ethers, and sulfides. Methods 8260 and 624 are prepared by EPA Method 5035 and 5030. These methods are applicable to nearly all types of samples, regardless of water content, including various air sampling trapping media, ground and surface water, aqueous sludges, caustic liquors, acid liquors, waste solvents, oily wastes, mousses, tars, fibrous wastes, polymeric emulsions, filter cakes, spent carbons, spent catalysts, soils, and sediments. Air samples supplied in Tedlar bags may also be analyzed by this method.

1.2 Method 624.1 is only applicable to municipal and industrial wastewater analyses. The requirements for Method 8260 fulfill all requirements for Method 624.1, unless otherwise specified.

1.3 Water, Air, and TCLP samples are analyzed by purge and trap (Method 5030B) in conjunction with GC/MS separation and detection.

1.4 Procedures for non-aqueous sample analysis are dependent on sample concentrations and the field sampling/preservation method employed prior to receipt of the sample at the laboratory. Soil samples are analyzed by purge and trap (Method 5035 or 5030) in conjunction with GC/MS separation and detection.

1.5 The Limit of Quantification (LOQ) of Method 8260 for an individual compound is dependent on the choice of sample preparation/introduction method. No matter which instrument is used, LOQs will be proportionately higher for sample extracts and samples that require dilution or when a reduced sample size is used to avoid saturation of the detector.

1.6 This method is restricted to use by, or under the supervision of, analysts experienced in the use of gas chromatograph/mass spectrometers, and skilled in the interpretation of mass spectra and their use as a quantitative tool.

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1.7 The following compounds may be determined by this method:

ANALYTE	CAS #
1,1,1,2-Tetrachloroethane	630-20-6
1,1,1-Trichloroethane	71-55-6
1,1,2,2-Tetrachloroethane	79-34-5
1,1,2-Trichloroethane	79-00-5
1,1-Dichloroethane	75-34-3
1,1-Dichloroethene	75-35-4
1,1-Dichloropropene	563-58-6
1,2,3-Trichlorobenzene	87-61-6
1,2,3-Trichloropropane	96-18-4
1,2,4-Trichlorobenzene	120-82-1
1,2,4-Trimethylbenzene	95-63-6
1,2-Dibromo-3-chloropropane	96-12-8
1,2-Dibromoethane	106-93-4
1,2-Dichlorobenzene	95-50-1
1,2-Dichloroethane	107-06-2
1,2-Dichloropropane	78-87-5
1,3,5-Trimethylbenzene	108-67-8
1,3-Dichlorobenzene	541-73-1
1,3-Dichloropropane	142-28-9

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1,4-Dichlorobenzene	106-46-7
1,4-Dioxane	123-91-1
2,2-Dichloropropane	594-20-7
2-Butanone (MEK)	78-93-3
2-Chloroethyl vinyl ether	110-75-8
2-Chlorotoluene	95-49-8
2-Hexanone	591-78-6
2-Nitropropane	79-46-9
4-Chlorotoluene	106-43-4
4-Methyl-2-pentanone (MIBK)	108-10-1
Acetone	67-64-1
Acetonitrile	75-05-8
Acrolein (Propenal)	107-02-8
Acrylonitrile	107-13-1
Allyl chloride	107-05-1
t-Amyl methyl ether (TAME)	994-05-8
Benzene	71-43-2
Bromobenzene	108-86-1
Bromochloromethane	74-97-5
Bromodichloromethane	75-27-4
Bromoform	75-25-2
Bromomethane	74-83-9

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t-Butyl alcohol	75-65-0
Carbon disulfide	75-15-0
Carbon tetrachloride	56-23-5
Chlorobenzene	108-90-7
Chloroethane	75-00-3
Chloroform	67-66-3
Chloromethane	74-87-3
cis-1,2-Dichloroethene	156-59-2
cis-1,3-Dichloropropene	10061-01-5
Dibromochloromethane	124-48-1
Dibromomethane	74-95-3
Dichlorodifluoromethane	75-71-8
Diethyl ether (Ethyl ether)	60-29-7
Diisopropyl ether (DIPE)	108-20-3
Ethyl acetate	141-78-6
Ethyl methacrylate	97-63-2
Ethyl t-butyl ether (ETBE)	637-92-3
Ethylbenzene	100-41-4
Hexachlorobutadiene	87-68-3
Hexane	110-54-3
Iodomethane	74-88-4

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Isopropylbenzene	98-82-8
Methacrylonitrile	126-98-7
Methyl methacrylate	80-62-6
Methylene chloride	75-09-2
Methyl-t-butyl ether	1634-04-4
m-Xylene	108-38-3
Naphthalene	91-20-3
n-Butylbenzene	104-51-8
n-Propylbenzene	103-65-1
o-Xylene	95-47-6
Pentachloroethane	76-01-7
p-Isopropyltoluene	99-87-6
Propionitrile (Ethyl cyanide)	107-12-0
p-Xylene	106-42-3
sec-Butylbenzene	135-98-8
Styrene	100-42-5
tert-Butylbenzene	98-06-6
Tetrachloroethene	127-18-4
Tetrahydrofuran	109-99-9
Toluene	108-88-3
Total Volatile Hydrocarbons (as gasoline)	86290-81-5
trans-1,2-Dichloroethene	156-60-5
trans-1,3-Dichloropropene	10061-02-6

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trans-1,4-Dichloro-2-butene	110-57-6
Trichloroethene	79-01-6
Trichlorofluoromethane	75-69-4
Vinyl acetate	108-05-4
Vinyl chloride	75-01-4

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2. SUMMARY OF METHOD

2.1 The volatile compounds are introduced into the gas chromatograph by the purge-and-trap method for aqueous samples or by direct injection. For aqueous and methanol preserved soil samples, an inert gas is purged through a portion of the aqueous or aqueous soluble phase at ambient temperature, and the volatile components are efficiently transferred from the aqueous phase to the vapor phase. The vapor is swept through a sorbent trap where volatile compounds are adsorbed. After the purging is complete, the trap is heated and back flushed with inert gas to desorb the components directly to a capillary column. The column is temperature-programmed to separate the analytes, which are then detected with a mass spectrometer (MS) interfaced to the gas chromatograph (GC).

2.2 Analytes eluted from the capillary column are introduced into the mass spectrometer via a direct connection. Identification of target analytes is accomplished by comparing their mass spectra with the electron impact (or electron impact-like) spectra of authentic standards. Quantitation is accomplished by comparing the response of at least one major (quantitation) ion relative to an internal library (for identification) using at least a five-point calibration curve.

2.3 Soil samples are analyzed based upon analyte concentration and the sampling/preservation technique employed outlined in SOP VOA weights for Method 5035.

2.4 Low-level soil samples are either sampled directly into a 40 mL VOA vial containing preservative in the field, or subsampled into a 40 mL VOA vial at the laboratory. Organic-free reagent water with surrogates and internal standards are added to the 40 mL VOA vial with the soil sample. The sample is heated and purged directly in the vial.

2.5 High level soil samples and waste samples that are preserved with methanol or extracted into methanol are analyzed by introducing a portion of the methanol extract into a 40 mL vial with reagent water and purged.

2.6 Note: Subsampling into 40 mL VOA vial from a jar is not compliant with EPA prep method 5035

2.7 For air samples, a portion of the sample is withdrawn from a Tedlar bag and introduced into a purge vessel containing 10 mL of reagent water. Analysis is conducted in the same manner that water samples are analyzed.

2.8 A measured amount of surrogate is added to each sample prior to analysis to allow evaluation of method performance for that sample matrix.

2.9 Quality control samples (MB, LCS, LCSD, and MS/MSD or MS and DUP pairs) are analyzed along with the samples to determine the precision and accuracy of the procedure during sample processing.

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3. DEFINITIONS

3.1 Common definitions may be found in the Quality Assurance Manual.

3.2 Standard Curve - A plot of known analyte standard concentrations versus the instrument response to the analyte. Calibration standards are prepared by successively diluting a standard solution to produce working standards covering the working range of the instrument. Standards are prepared at the frequency specified in section 9.0 of this SOP. Calibration standards are applicable to organic and inorganic chemical analyses, and should be prepared using the same type of acid or solvent, at the same concentration, as the samples following sample preparation.

3.3 Surrogate - An organic compound similar in chemical composition and behavior to the target analyte(s) in the analytical process, however is not normally found in environmental samples.

3.4 Trip Blank - A sample of analyte-free media taken from the laboratory to the sampling site and returned to the laboratory unopened. Trip Blanks are used to document contamination in volatile organic samples attributable to shipping and field handling procedures.

4. INTERFERENCES

4.1 Solvents, reagents, glassware, and other sample processing hardware may yield artifacts and/or interferences into sample analysis. Through the analysis of Method Blanks, all of these materials are demonstrated to be free from interferences under the conditions of analysis. Specific selection of reagents and purification of solvents by distillation in all-glass systems may be necessary.

4.2 Major contaminant sources are volatile materials in the laboratory (including Methylene Chloride), and impurities in the inert purging gas and the sorbent trap. The use of non-polytetrafluoroethylene (PTFE) thread sealants, plastic tubing, or flow controllers with rubber components are avoided, as such materials out-gas organic compounds (which may become concentrated in the trap during the purge operation). Analysis of calibration and reagent blanks provide information about the presence of contaminants.

4.3 Contamination may occur when a sample containing low concentrations of volatile organic compounds is analyzed immediately after a sample containing high concentrations of volatile organic compounds. A technique to prevent this problem is to rinse the purging apparatus and sample syringes with at least one portion of organic-free reagent water between samples. After the analysis of a sample containing high concentrations of volatile organic compounds, one or more blanks will be analyzed to check for cross-contamination. If the sample immediately following the high concentration sample does not contain the volatile organic compounds present in the high-level sample, freedom from contamination has been established.

4.4 Screening of the samples (especially for soil and waste samples) prior to purge-and-trap GC/MS analysis is recommended to prevent contamination of the system.

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4.5 Many analytes exhibit low purging efficiencies from a 10-mL sample. This often results in significant amounts of these analytes remaining in the sample purge vessel after analysis. After removal of the sample aliquot that was purged, and rinsing the purge vessel with organic-free water, the empty vessel may be subjected to a heated purge cycle prior to the analysis of another sample in the same purge vessel. This will reduce sample-to-sample carryover.

4.6 Samples can be contaminated by diffusion of volatile organics (particularly Methylene chloride and fluorocarbons) through the septum seal of the sample container into the sample during shipment and storage. A trip blank prepared from organic-free reagent water and carried through the sampling, handling, and storage process serves as a check on such contamination.

4.7 Sample storage and analytical areas where volatile analyses are performed are completely free of chlorinated solvents and isolated from all atmospheric sources of methylene chloride. All gas lines are made of copper to prevent diffusion of chlorinated solvents into the system. These isolation measures for the volatiles area are taken to prevent results containing random background levels of compounds of analytical interest.

5. SAFETY

5.1 All samples received for analysis should be considered hazardous and handled accordingly.

5.2 Some of the reagents and standards used in this method are hazardous. Before using this method, individuals who are unfamiliar with the hazards associated with these chemicals should refer to the safety data sheets (SDS) available in the laboratory.

5.3 It is the responsibility of the analyst to review and understand laboratory safety policies and procedures prior to performing any procedures outlined in this SOP.

6. EQUIPMENT AND SUPPLIES

6.1 Purge and trap device performs three functions - the sample purger, the trap, and the desorber.

6.1.1 EST Analytical Encon Evolution purge and trap concentrator with an EST Analytical Centurion autosampler for solid and aqueous samples - Described in Methods 5030 and 5035, utilizing a Vocarb K trap. Autosampler is fitted with a 10-mL sample loop.

6.1.2 Tekmar Atomx/XYZ purge and trap concentrator with built in autosampler for solid and aqueous samples – Described in methods 5030 and 5035 utilizing a U-Shaped Tenax trap.

6.1.3 The Desorb function is provided by the Encon Evolution and Tekmar Atomx/XYZ. The trap is heated rapidly to at least 200°C and desorbed into the gas chromatograph.

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6.2 Agilent 5890 Series II Gas chromatography with a 5972 mass spectrometer, Agilent 7890 with a 5975 MS, and an Agilent 7820 with a 5977MS and Chemstation or MassHunter data system.

6.2.1 Gas Chromatograph - An analytical system complete with a temperature-programmable gas chromatograph suitable for split injections with appropriate interface for sample introduction device. The system includes all required accessories, including syringes, analytical columns, and gases.

6.2.2 The GC is equipped with variable constant differential flow controllers so that the column flow rate remains constant throughout desorption and temperature program operation.

6.2.3 The capillary column is directly coupled to the source.

6.2.4 Gas chromatographic columns:

6.2.5 Recommended Column - 20 m x 0.18 mm ID capillary column coated with DB-624(J&W), 1.0-µm film thickness, or equivalent.

6.2.6 Mass spectrometer – capable of scanning from 35 to 300 amu every 2 sec or less, using 70 volts (nominal) electron energy in the electron impact ionization mode. The mass spectrometer is capable of producing a mass spectrum for 4 - Bromofluorobenzene (BFB), which meets all of the criteria in Table 1 when 25-50 ng of the GC/MS tuning standard (BFB) is injected through the GC. To ensure sufficient precision of mass spectral data, the desirable MS scan rate allows acquisition of at least five spectra while a sample component elutes from the GC.

6.2.7 GC/MS interface - direct coupling.

6.3 Data system - A computer system that controls the Mass Spectrometer, Fremont Analytical, Inc. uses Chemsation and MassHunter. The most recent version of the EPA/NIST Mass Spectral Library may also be installed

6.4 Microsyringes – 10-, -25, -50, 100-, -250, 1000-µL.

6.5 Eppindorf Pipettes – 1mL, 5mL, 10mL

6.6 Balance – Analytical, capable of weighing 0.0001g, and top loading, weighing 0.01g.

6.7 VOA Vials – 40 mL glass, manufacturer certified precleaned for samples, and also for use as a sparging vessel

6.8 Volumetric flasks, Class A, 10-mL, 50-mL, and 100-mL, with stoppers.

6.9 Spatula - Stainless steel.

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7. REAGENTS AND STANDARDS

7.1 Organic-free reagent water - All references to water in this method refer to organic-free reagent water. This water is produced using a double cartridge de-ionizing system which utilizes high quality well water.

7.2 Methanol, CH_3OH - Purge & Trap grade. Store apart from other solvents.

7.3 Hydrochloric Acid (1:1 v/v), HCL – Carefully add a measured volume of concentrated HCL to an equal volume of organic-free reagent water.

7.4 Stock Standard Solutions - A concentrated solution containing one or more method analytes or surrogate analytes, purchased from a reputable commercial source. Volatile standards should be stored at 0°C in the dark, and checked regularly for degradation. Purchased solutions expire on the manufacturers recommended date unless the quality can be verified against fresh standards for each additional use. It is recommended that stock standards must be replaced six months after the ampule opening date or sooner if comparison with calibration check standards indicate a problem.

7.5 Calibration/Continuing Calibration Verification/Spike Standard Solution: A solution of analytes prepared in the laboratory from stock standard solutions and diluted in purge-and-trap grade methanol, as needed to prepare working calibration solutions and other analyte solutions. It is recommended that primary dilution standards be replaced after six months or sooner if comparison with subsequent QC samples indicate a problem. Volatile standards should be stored at 0°C in the dark in 2 mL twist top amber vials.

7.5.1 Calibration/CCV/Spike standard solutions are added to aliquots of reagent water which are subsequently used to calibrate the instrument response with respect to analyte concentration. Calibration/CCV/Spike standard solutions are also used for required quality control samples.

7.5.2 Standards are compared to the initial calibration curve. Fresh standards will be opened or prepared if this comparison exceeds a 20% drift. Standards should be replaced after six months or as recommended by the standard manufacturer (unless the acceptability of the standard can be documented and recertified.

7.6 ICV Spike Solution: A second source solution of analytes purchased from a reputable source. Stock spike solutions are prepared in purge-and-trap methanol and contain all analytes of interest. Purchased solutions expire on the manufacturers recommended date unless the quality can be verified against fresh standards for each additional use. It is recommended that stock spike solutions are replaced six months after the ampule opening date or sooner if comparison with a working calibration standard indicates a problem. Volatile standards should be stored at 0°C in the dark.

7.6.1 The ICV spike solution is added to an aliquot of reagent water to verify the calibration curve.

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7.7 Surrogate standards - Recommended surrogates are toluene-d8, 4- bromofluorobenzene and dibromofluoromethane. A surrogate standard spiking solution is prepared in methanol from the stock at the appropriate concentration. Each sample undergoing GC/MS analysis is spiked with the surrogate spiking solution prior to analysis. Surrogates are added automatically by the autosampler.

7.8 Internal standards - Recommended internal standards are pentafluorobenzene, chlorobenzene-d5, and 1,4-dichlorobenzene-d4. Prepare internal standard stock standards in methanol. Area counts of internal standard peaks should be between 50-200% of the areas of the target analytes in the mid-point calibration analysis.

7.8.1 Internal standards may be prepared in the same working solutions as the surrogates being used.

7.9 4-Bromofluorobenzene (BFB) standard – A standard solution containing 20 ng/µL of BFB in methanol should be prepared.

7.9.1 Note: The surrogate standard solution contains a sufficient amount of BFB to do tune checks.

8. SAMPLE COLLECTION, PRESERVATION AND STORAGE

8.1 Sample Collection

8.1.1 Water samples are collected and stored in capped VOA vials, with minimum headspace at 4°C, in an area free of solvent fumes. The size of any bubble caused by degassing upon cooling the sample should not exceed 5-6 mm. When a bubble is present, the septum will be checked to ensure that a proper seal was made at the time of sampling. If the sample integrity is in question, the project manager is notified, and the sample will be flagged upon receipt.

8.1.1.1 It is recommended that 3-6 VOA vials are collected per sample to allow for Quality Control analyses.

8.1.2 Non-aqueous samples are collected according to one of the following methods:

8.1.2.1 Collected into tared 40 mL VOA vials containing sodium bisulfate or water preservative (low-level field preservation approach). It is recommended that 3-6 VOA vials are collected using this sampling methodl

8.1.2.2 Collected into tared 40 mL VOA vials containing methanol preservative (high-level field preservation approach). It is recommended that 2-3 VOA vials are collected using this sampling method.

8.1.2.3 Packed with no headspace into 2-4 oz wide mouth jar and capped with Teflon-lined screw caps, placed on ice, and extracted into methanol (or water or sodium bisulfate for low level tests) as soon as possible. Jar packing is no longer considered viable by Method 5035 and will be used as a last resort when other collection methods are not feasible. An analytical note is added to the report when this method of collection is used.

8.1.2.4 In all cases, a 4 or 8 oz soil sample jar should accompany each set of VOAs for further analyses and determination of soil moisture.

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8.2 Sample Preservation:

8.2.1 Water samples:

8.2.1.1 Aqueous samples may be preserved in either 1:1 HCl or be shipped unpreserved. Water samples received unpreserved have a shorter holding time of 7 days.

8.2.1.2 The pH must be <2 but may only be verified after the analysis occurs, in order to preserve the integrity of the sample. pH verifications can be found in the VOC lab.

8.2.1.3 When creating a bottle order and a client select list is known to include 2-chlorovinyl ether, styrene, and/or vinyl chloride, it is recommended that the laboratory provide clients with at least 1 unpreserved vial. This will be done on a project by project basis.

8.2.2 Soil Samples:

8.2.2.1 Soil samples for low-level analysis may be field-preserved by collecting approximately 5 g into tared VOA vials containing sodium bisulfate or water and a magnetic stir bar, and stored at 4°C until analysis. The preservative should be added to the vial prior to shipment to the field and should be present in the vial prior to adding the sample.

8.2.2.2 Soils samples for high-level analysis may be field-preserved by collecting approximately 5 g into tared VOA vials containing methanol, and stored at 4°C until analysis. The preservative should be added to the vial prior to shipment to the field and should be present in the vial prior to adding the sample.

8.2.2.3 If soil samples are received unpreserved, the appropriate preserve must be added within 48 hours of collection.

8.3 Holding Times:

8.3.1 Samples should be maintained at 4 °C and out of direct light from sampling through analysis.

8.3.2 Water samples must be analyzed within 14 days of collection (if preserved) or 7 days (if not preserved to pH $\leq$2).

8.3.3 The maximum holding time for soil and non-aqueous waste samples from time of collection to analysis is 14 days.

8.3.3.1 Low level soil samples preserved with water must be analyzed within 48 hours or frozen, to extend the holding time to 14 days.

8.4 Sample Handling:

8.4.1 It is important that samples, sample containers, and methanol be stored away from all sources of contamination (such as gasoline, exhaust fumes, etc.). All samples must be stored at 4°C $\pm$ 2°C.

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8.4.2 Samples collected for volatile compound analysis are stored separately from standards, samples expected to contain significantly different concentrations of volatile compounds, or samples being analyzed for other parameters which may interfere with volatile determination (such as semi-volatiles).

9. CALIBRATION AND ANALYSIS PROCEDURE

9.1 Purge-and-trap - This procedure includes purge-and-trap for aqueous samples (Method 5030) and purge-and-trap for solid samples (Method 5035). The purge-and-trap of aqueous and solid samples are performed at ambient temperature.

9.1.1 Fremont Analytical, Inc. recommended purge and trap conditions can be found in Appendix C.

9.1.2 Fremont Analytical, Inc. recommended chromatographic conditions can be found in appendix C.

9.2 Sample introduction and purging: Aqueous samples

9.2.1 It is recommended that all samples and standard solutions be allowed to warm to ambient temperature before analysis.

9.2.2 Aqueous samples are punctured by the automated sampler and transferred to fill the sample loop. The automated sampler adds internal standard and surrogate compounds to the sample in the sample loop then transfers the sample into the purge vessel.

9.3 Sample introduction and Purging: Soil samples with sodium bisulfate or water preserve:

9.3.1 Remove the sample vial from storage and allow it to warm to room temperature. Shake the vial gently to ensure that the contents move freely and stirring will be effective.

9.3.2 Without disturbing the hermetic seal on the sample vial, the automated sampler adds 5-mL of organic-free reagent water, the internal standards, and the surrogate compounds

9.3.3 While the sample is being agitated with the magnetic stirring bar, purge the sample with nitrogen at a suggested flow rate of 40-mL/min for 14 minutes. The purged analytes are allowed to flow out of the vial through a transfer line (glass-lined), and into the trap.

9.4 Sample introduction and purging: Soil samples with methanol preserve:

9.4.1 An aliquot of sample (typically 1 mL, for a 1:50 methanol to water ratio) is transferred into a 50-mL volumetric flask and brought to volume with organic-free reagent water. The flask decanted into a 40-mL vial to be run as an aqueous sample.

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9.4.2 Alternatively, the analyst may prepare the sample directly into a 40-mL vial. In order to do so, the analyst must first weigh the amount of water it takes to fill a 40-mL vial and calculate the amount of methanol it would take to maintain the appropriate methanol to water ratio.

9.4.2.1 It has been determined that a 40-mL vial actually holds 43-mL of water, resulting in a conversion factor of 0.86. Therefore, for a 1:50 methanol to water ratio for example, the analyst should fill the vial part way with DI water, add 860-µL (1ml x 0.86 = 860 µL) of sample into the water, then fill the vial the rest of the way, making sure there is no headspace in the vial.

9.4.2.2 One vial from each lot of 40-mL vials received by FAI will be weighed to make sure that 43-mL is the actual volume of 40- mL VOA vials. This will be logged on FASVR.

9.5 Sample introduction and purging: Air Samples

9.5.1 A blank water vial is loaded onto the autosampler. The autosampler draws up 10mL of water and automatically adds surrogate and internal standard.

9.5.2 While the water is purging, 2-50cc aliquots of air sample are withdrawn from the sample tedlar bag and introduced into the purge vessel.

9.5.3 Once the sample is loaded, the analysis is conducted in the same manner as a water sample.

9.6 Initial calibration:

9.6.1 Establish the GC/MS operating conditions, using the following as guidance:

Mass Range	35-280 amu
Scan time	0.6-2 sec/scan
Source temperature	250°C

9.6.2 The GC/MS system will be hardware-tuned to meet the criteria in Appendix E for a 25-50 ng purging of 4-bromofluorobenzene. Analyses will not begin until these criteria are met. Use the BFB mass intensity criteria in Appendix E as tuning acceptance criteria.

9.6.2.1 NOTE: All subsequent standards, samples, MS/MSDs, LCSs, and blanks associated with a BFB analysis must use identical mass spectrometer instrument conditions with the exception of batches analyzed in SIM. BFB may be analyzed in scan mode when samples are analyzed in SIM.

9.6.2.2 BFB tune checks are required prior to ICALs when running EPA 8260D. BFB tune checks are required every 12 hours when running EPA 8260C and EPA 624.1.

9.6.3 Set up the sample introduction system as outlined in the method of choice. A different calibration curve may be necessary for each method because of the differences in conditions and equipment. A set of at least five different calibration standards is necessary.

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9.6.4 A set of at least five calibration standards containing the method analytes is needed for linear calibration or average response factor (RF). Quadratic curve fits require six or more standards. One calibration standard should contain each analyte at a concentration at or below the required reporting limit for that compound; the other calibration standards should contain analytes at concentrations that define the range of the method. The purging efficiency for 10 mL of water is greater than for 25 mL. Therefore, develop the standard curve with whichever volume of sample that will be analyzed. To prepare a calibration standard:

9.6.4.1 Add an appropriate volume of primary dilution standard solution to an aliquot of organic-free reagent water in a volumetric flask. Use a micro syringe and rapidly inject the alcoholic standard into the expanded area of the filled volumetric flask underneath the surface of the reagent water. Remove the needle as quickly as possible after injection and dilute to the volume mark with additional reagent water.

9.6.4.2 Mix by inverting the flask sufficiently to achieve the desired dissolution (however, excessive mixing could result in the loss of gaseous standards). Aqueous standards are not stable and should be prepared daily.

9.6.4.3 Transfer the calibration standard to a 40mL vial, and seal it. Place the sample vial in the autosampler rack according to the manufacturer's instructions. Without disturbing the hermetic seal on the sample vial, a specific sample volume is withdrawn and placed into the purging vessel, along with the addition of internal standards and surrogate compounds using an automated sampler. Recommended calibration levels can be found in Appendix B.

9.6.4.4 All target analytes for a particular analysis are included in the initial calibration and calibration verification standard(s). Fremont Analytical, Inc. does not report quantitative results for target analytes not included in the calibration standard(s).

9.7 The Chemstation and MassHunter software tabulates the area response of the characteristic ions against the concentration for each target analyte and each internal standard. The software calculates response factors (RF) for each target analyte relative to one of the internal standards. The internal standard selected for the calculation of the RF for a target analyte will be the internal standard that has a retention time closest to the analyte being measured.

9.7.1 The mean response factor and the relative standard deviation (RSD) of the response factors for each target analyte is calculated. The RSD should be less than or equal to 20% for each target analyte. Alternatively, the correlation coefficients (r^2) should be greater than or equal to 0.990.

9.7.1.1 To meet requirements for DoD projects, the RSD must be less than or equal to 15% or the correlation coefficient must be greater than or equal to 0.990.

9.7.1.2 For EPA 624.1, r^2 must be greater than or equal to 0.920 when weighted inversely proportional to the concentration.

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9.7.2 It is also recommended that a minimum response factor for the most common target analytes be demonstrated for each individual calibration level as a means to ensure that these compounds are behaving as expected. In addition, meeting the minimum response factor criteria for the lowest calibration standard is critical in establishing and demonstrating the desired sensitivity.

9.7.3 Due to the large number of compounds that may be analyzed by this method, some compounds will fail to meet this criterion. For these occasions, it is acknowledged that the failing compounds may not be critical to the specific project and therefore they may be used as qualified data or estimated values for screening purposes. The analyst should also strive to place more emphasis on meeting the calibration criteria for those compounds that are critical project compounds, rather than meeting the criteria for those less important compounds.

9.7.4 If more than 10% of the compounds included with the initial calibration exceed 20% of the RSD limit and do not meet the minimum correlation coefficient (0.99) for alternative curve fits, then the chromatographic system is considered too imprecise for analysis to begin. Perform maintenance on the GCMS and/or the purge and trap system, and repeat calibration.

9.7.5 The method of linear regression analysis has the potential for significant bias to the lower portion of the calibration curve, while the relative percent difference and quadratic methods of calibration do not have this potential bias.

9.7.6 When using linear regression models, it is recommended that the calibration points be recalculated using the final calibration curve. The low point of the calibration should recalculate $\pm$ 50% of the standard's true concentration and the subsequent points of the calibration should recalculate $\pm$ 30% of the standard's true concentration.

9.8 Evaluation of retention times: the relative retention time (RRT) of each target analyte in each calibration standard should agree with 0.06 RRT units. Late-eluting target analytes typically have much better agreement.

9.9 The initial calibration curve should be verified (ICV) immediately after performing the standard analyses using a second source standard (prepared using standards different from the calibration standards), and spiked into organic-free reagent water with a concentration at the midpoint of the initial calibration range.

9.9.1 The acceptance limits for this initial calibration verification analysis are 70-130%. Quantitative sample analyses should not proceed for those analytes that fail the second source standard initial calibration verification. However, analyses may continue for those analytes that fail the criteria with an understanding these results could be used for screening purposes and would be considered estimated values.

9.9.2 To meet requirements for DoD projects, the ICV limits will be set to 80-120%.

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9.10 GC/MS calibration verification - Calibration verification steps that are performed at the beginning of each 12-hour analytical shift.

9.10.1 The calibration curve for each compound of interest will be verified once every 12 hours prior to sample analysis, using the introduction technique used for samples. This is accomplished by analyzing a calibration standard (containing all the compounds for quantitation) at a concentration near the midpoint concentration for the calibrating range of the GC/MS. The results from the calibration standard analysis will meet the verification acceptance criteria outlined in section 9.15.

9.10.2 A Method Blank or instrument blank should be analyzed after the calibration standard, or at any other time during the analytical shift, to ensure that the total system (introduction device, transfer lines and GC/MS system) is free of contaminants. If the Method Blank indicates contamination above the reporting limit, then it may be appropriate to analyze a solvent blank to demonstrate that the contamination is not a result of carryover from standards or samples. Corrective action will be taken to identify the source of the contamination.

9.11 Calibration verification standard criteria:

9.11.1 Each of the most common target analytes in the calibration verification standard should meet the minimum response factor. This criterion is particularly important when the common target analytes are also critical project-required compounds. This is the same check that is applied during the initial calibration. See Appendix D for a list of minimum response factors for each target analyte.

9.11.2 If the minimum response factors are not met, the system should be evaluated, and corrective action should be taken before sample analysis begins. Possible problems include standard mixture degradation, injection port inlet contamination, contamination at the front end of the analytical column, active sites in the analytical column, trap, or chromatographic system, and problems with the moisture control system.

9.11.3 If the percent difference or percent drift for a compound is less than or equal to 20%, then the initial calibration for that compound is assumed to be valid. Due to the large number of compounds that may be analyzed by this method, some compounds will fail to meet this criterion. Increased emphasis shall be placed on meeting the CCV criteria for those compounds that are critical to client data quality objectives. If the criterion is not met for more than 20% of the compounds included in the initial calibration (or more than 20% of those compounds that shall be reported), then corrective action must be taken. However, with the exception of samples governed by DOD requirements, in cases where compounds fail, they may still be reported as non-detects if it can be demonstrated that there was adequate sensitivity to detect the compound at the applicable quantitation limit. In this way, high-biased non-detects may be reported without qualification, as it is thereby demonstrated that any material present would be overestimated. For situations when the failed compound is detected, the concentrations must be qualified and reported as estimated values.

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9.11.4 Alternatively, in cases where compounds fail, two consecutive CCVs may be run immediately after the failing CCV. If those two CCVs pass for the analytes that failed, the analytical run may be deemed adequate and a re-analysis will not be necessary.

9.11.5 For method 624.1, the CCV is compared to acceptance criteria outlined in Appendix H. If there are failures, it is recommended that the LCS be reanalyzed. If that is not possible, samples must be qualified. If the LCS is reanalyzed but still fails for select analytes, it may indicate a problem with the instrumentation.

9.11.6 Problems similar to those listed under initial calibration could affect the ability to pass the calibration verification standard analysis. If the problem cannot be corrected by the other measures, a new initial calibration must be generated. The calibration verification criteria must be met before sample analysis begins.

9.12 Internal standard retention time - The retention times of the internal standards in the calibration verification standard must be evaluated immediately after or during data acquisition. If the retention time for any internal standard changes by more than 30 seconds from the mid-point standard level of the most recent initial calibration sequence, then the chromatographic system must be inspected for malfunctions and corrections must be made, as required. When corrections are made, reanalysis of samples analyzed while the system was malfunctioning is required.

9.13 Internal standard response - If the EICP (extracted ion current profile) area for any of the internal standards in the calibration verification standard changes by a factor of two (-50% to + 200%) from that in the mid-point standard level of the most recent initial calibration sequence, the mass spectrometer must be inspected for malfunctions and corrections must be made, as appropriate. When corrections are made, reanalysis of samples analyzed while the system was malfunctioning is required.

9.14 GC-MS analysis of water samples:

9.14.1 All samples and standard solutions must be allowed to warm to ambient temperature before analysis.

9.14.2 It is highly recommended that the sample be screened to minimize contamination of the GC/MS system from unexpectedly high concentrations of organic compounds. Sample screening is particularly important when Method 8260 is used to achieve low detection levels.

9.14.3 The process of taking an aliquot destroys the validity of the remaining volume of an aqueous sample for future analysis. Therefore, if only one VOA vial is provided to the laboratory, the analyst will prepare two aliquots for analysis at this time, to protect against possible loss of sample integrity. This second sample is maintained only until such time when the analyst has determined that the first sample has been analyzed properly.

9.14.4 Place the sample vial in the instrument's autosampler rack according to the manufacturer's instructions. Without disturbing the hermetic seal on the sample vial, a specific sample volume is withdrawn and placed into the purging vessel, along with the addition of internal standard and surrogate compounds using an automated sampler.

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9.14.5 The following procedure may be used to dilute aqueous samples for analysis of volatiles.

9.14.5.1 Dilutions are made in volumetric flasks (10- to 100-mL). Select the volumetric flask that will allow for the necessary dilution. Intermediate dilution steps may be necessary for extremely large dilutions.

9.14.5.2 Calculate the approximate volume of organic-free reagent water to be added to the volumetric flask, and add slightly less than this quantity of organic-free reagent water to the flask.

9.14.5.3 Inject the appropriate volume of the original sample from the syringe into the flask underneath the reagent water surface. Aliquots of less than 1 mL are not recommended. Dilute the sample to the mark with organic-free reagent water. Cap the flask, invert, and shake three times. Repeat this procedure for additional dilutions.

9.14.5.4 Fill a 40mL VOA vial with the contents of the dilution extract.

9.14.5.5 Alternatively, the analyst may prepare a dilution directly into a 40mL VOA vial as described in FAI SOP for EPA 5030B.

9.15 Compositing aqueous samples prior to GC/MS analysis:

9.15.1 Pour into a beaker and stir until homogenized.

9.15.2 Allow to mix and pour the sample into a 40 mL VOA vial.

9.15.3 Follow sample introduction, purging, and desorption steps described in the method.

9.15.4 It is important to note that compositing VOC samples is not ideal due to the potential volatilization of target analytes.

9.16 Sediment/soil and waste samples:

9.16.1 Low-concentration method: This is designed for samples containing individual purgeable compounds. It is limited to sediment/soil samples and waste that is of a similar consistency (granular and porous). The low-concentration method is based on purging a heated sediment/soil sample mixed with organic-free reagent water containing the surrogate and internal standards. Analyze all blanks and standards under the same conditions as the samples.

9.16.1.1 Use a 5 g sample.

9.16.1.2 The sample (for volatile organics) consists of the entire contents of the sample container which should have come pre-preserved with sodium bisulfate or water. If the sample arrived unpreserved, weigh the soil and preserve immediately.

9.16.1.3 Determine the percent dry weight of the soil/sediment sample by following the procedures outlined in FAI SOP for Percent Moisture. Concentrations of individual analytes are reported relative to the dry weight of sample.

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9.16.1.4 Proceed with the analysis by placing the sample vial in the instrument carousel according to the manufacturer's instructions. Without disturbing the hermetic seal on the sample vial, a specific volume of reagent water is introduced into the purging vessel, along with the addition of internal standard and surrogate compounds using an automated sampler. The sample is then purged under heated conditions before being desorbed onto the GC column.

9.16.2 High-concentration method: This method is based on extracting the sediment/soil with methanol, as described in section 9.4.3 and SOP VOA Weights for Method 5035 and SOP Purge and Trap for Aqueous Samples by EPA Method 5030B. A waste sample is either extracted or diluted, depending on its solubility in methanol. An aliquot of the extract is added to organic-free reagent water and is then treated as if it were a water sample. This is purged at ambient temperature before being desorbed onto the GC column.

9.17 If the initial analysis of the sample or a dilution of the sample has a concentration of any analyte that exceeds the initial calibration range, the sample must be reanalyzed at a higher dilution.

9.18 When ions from a compound in the sample saturate the detector, this analysis must be followed by the analysis of an organic-free reagent water blank. If the blank analysis is not free of interferences, then the system is considered contaminated. Sample analysis may not resume until the blank analysis has demonstrated to be free of interferences.

9.19 All dilutions will keep the response of the major constituents (previously saturated peaks) in the upper half of the linear range of the curve.

9.20 The use of selected ion monitoring (SIM) is acceptable for applications requiring quantitation limits below the normal range of electron impact mass spectrometry. However, SIM may provide a lesser degree of confidence in the compound identification, since less mass spectral information available. Using the primary ion for quantitation and secondary ions for confirmation, set up the collection groups based on their retention times. Selected ions are nominal ions and most compounds have small mass defect, usually less than 0.2 amu, in their spectra. These mass defects should be used in the acquisition table. The dwell time may be manually calculated or automatically calculated by the laboratory's GC/MS software. The total scan time should be less than 1,000 msec and produce at least 5 to 10 scans per chromatographic peak.

9.21 Analyte Identification:

9.21.1 The qualitative identification of each compound determined by this method is based on retention time, and on comparison of the sample mass spectrum, after background correction, with characteristic ions in a reference mass spectrum. The reference mass spectrum must be generated by the laboratory using the conditions of this method. The characteristic ions from the reference mass spectrum may be defined to be the three ions of greatest relative intensity, or any ions over 30% relative intensity (if less than three such ions occur in the reference spectrum). Compounds are identified as present when these criteria are met.

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9.21.2 The intensities of the characteristic ions of a compound maximize in the same scan or within one scan of each other. Selection of a peak by a data system target compound search routine, where the search is based on the presence of a target chromatographic peak (containing ions specific for the target compound at a compound-specific retention time) will be accepted as meeting the criteria.

9.21.3 The relative retention time (RRT) of the sample component is within ±0.06 RRT units of the RRT of the standard component.

9.21.4 The relative intensities of the characteristic ions agree within 30% of the relative intensities of these ions in the reference spectrum. (Example: For an ion with an abundance of 50% in the reference spectrum, the corresponding abundance in a sample spectrum can range between 20% and 80%.)

9.21.5 Structural isomers that produce very similar mass spectra will be identified as individual isomers if they have sufficiently different GC retention times. Sufficient GC resolution is achieved if the height of the valley between two isomer peaks is less than 25% of the sum of the two peak heights. Otherwise, structural isomers are identified as isomeric pairs. The resolution should be verified on the mid- point concentration of the initial calibration as well as the laboratory designated continuing calibration verification level if closely eluting isomers are to be reported.

9.21.6 Identification is hampered when sample components are not resolved chromatographically and produce mass spectra containing ions contributed by more than one analyte. When gas chromatographic peaks obviously represent more than one sample component (i.e. a broadened peak with shoulders or a valley between two or more maxima), appropriate selection of analyte spectra and background spectra is important.

9.21.7 Examination of extracted ion current profiles of appropriate ions can aid in the selection of spectra, and in qualitative identification of compounds. When analytes coelute (i.e. only one chromatographic peak is apparent), the identification criteria may be met, but each analyte spectrum will contain extraneous ions contributed by the coeluting compound.

9.21.8 For samples containing components not associated with the calibration standards, a library search may be made for the purpose of tentative identification. The necessity to perform this type of identification will be determined by analyses being conducted. Data system library search routines will not use normalization routines that would misrepresent the library or unknown spectra when compared to each other.

9.21.9 The experience of the analyst performing GC/MS analyses is invaluable to the success of the methods. Each day that analysis is performed, the calibration verification standard should be evaluated to determine if the chromatographic system is operating properly. Questions that should be asked are: “Do the peaks look normal?” “Is the response obtained comparable to the response from previous calibrations?” Careful examination of the standard chromatogram can indicate whether the column is still performing acceptably, the injector is leaking, the injector septum needs replacing, etc.

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9.22 Quantitative analysis:

9.22.1 Once a compound has been identified, the quantitation of that compound will be based on the integrated abundance of the primary characteristic ion. The internal standard used will be the one nearest to the retention time of that of a given analyte.

9.22.2 It is highly recommended to use the integration produced by the software if the integration is correct, as the software should produce more consistent integrations. However, when the software does not produce proper integrations due to improper baseline selection, the corrected peak is missed, a coelution is integrated, or a peak is partially integrated, etc. manual integrations are necessary. The analyst is responsible for ensuring that the integration is correct whether performed by the software or done manually.

9.22.3 Manual integrations should not be substituted for proper maintenance of the instrument or setup of the method (e.g. retention times updates, integration parameter files, etc.). The analyst should seek to minimize manual integration by properly maintaining the instrument, updating retention times, and configuring peak integration parameters.

9.22.4 DoD requires complete, before and after documentation of all manual integrations.

10. QUALITY CONTROL

10.1 DoD specific criteria can be found in Appendix I.

10.2 Quality control procedures necessary to evaluate the GC system operation include evaluation of retention time windows, calibration verification, and chromatographic analysis of samples.

10.3 The GC/MS must pass the recommended BFB criteria (outlined in Appendix E) prior to the initial calibration. These tune checks are then uploaded to the Omega LIMS system in the appropriate analytical run.

10.4 There must be an initial calibration of the GC/MS system. In addition, the initial calibration curve should be verified immediately after performing the standard analysis using a source other than the calibration standards (ICV) spiked into organic-free reagent water. The acceptance limits for the ICV analysis are 70 – 130% (80-120% for DOD accredited projects; control charted LCSs for 624.1 projects). Qualitative sample analyses should proceed for those analytes that fail the second source standard initial calibration verification. Analyses may continue for those analytes that fail the criteria with an understanding these results could be used for screening purposes and would be considered estimated values.

10.5 The GC/MS system must meet the calibration verification acceptance criteria (Section 9.15), every 12 hours. CCVs get imported with the samples in its corresponding batch into the 'Analytical Run' section of the Omega LIMS system.

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10.6 Method blanks:

10.6.1 The MB is prepared and analyzed at a minimum frequency of 1 per 5% of samples in a batch (1 per batch up to 20 samples) or each day that samples are prepared and analyzed, whichever is more often. An aliquot of reagent water or other blank matrix is prepared exactly as a sample. The MB is used to determine if method analytes or other interferences are present in the laboratory environment. If interferences are present greater than the lower reporting limit or regulatory limit, then the batch of samples and QC samples must be re-extracted and/or re-analyzed after determining the source of the interference and correcting it.

10.6.2 Blank subtracting is not acceptable except when running EPA 624.1 and it is explicitly requested by a regulating authority or permit to do so. If it is not requested, then it remains unacceptable for method 624.1

10.7 Analytical Duplicates:

10.7.1 A duplicate aliquot of an environmental sample that is analyzed exactly like the original sample. Its purpose is to determine the precision, or reproducibility, of the method on the specific sample matrix. The %RSD should be <30%.

10.7.2 A minimum of one Analytical Duplicate analysis is prepared each day an analysis is performed for each sample matrix analyzed. An Analytical Duplicate analysis is performed for every batch of 20 samples analyzed.

10.7.3 The relative percent difference (RPD) for an Analytical Duplicate analysis is calculated as follows:

$$\%RPD = \frac{2 * |AD_1 - AD_2|}{(AD_1 + AD_2)} * 100$$

Where:

%RPD= Relative percent difference for an analytical duplicate
AD_1 = First Analytical Duplicate concentration result
AD_2 = Second Analytical Duplicate concentration result

10.8 The Laboratory Control Sample (LCS) should be included with each analytical batch at a minimum frequency of 1 per 5% of samples (1 per up to 20 samples). The LCS consists of an aliquot of clean (control) matrix similar to the sample matrix and of the same weight or volume. The LCS is spiked with the same analytes, and at the same concentrations as the matrix spike when appropriate. When the results of the matrix spike analysis indicate a potential problem due to the sample matrix itself, the LCS results are used to verify that the laboratory can perform the analysis in a clean matrix. Also note the LCS for water sample matrices is prepared in organic-free reagent water similar to the CCV standard. In these situations, a single analysis can be used for both the LCS and continuing calibration verification.

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10.8.1 Recoveries for target analytes in the LCS must fall within the control limits specified in LIMS. If recoveries are not within control limits, then the LCS is re-analyzed. If the recoveries are still not within control limits after re-analysis, then the associated batch of samples and QC samples must be re-analyzed after determining the source of the problem and correcting it. Alternatively, the data must be reported with a QC failure where the data is flagged and a case narrative is written to explain the failure.

10.8.2 NOTE: Laboratory control limits, on a matrix-by-matrix basis, should be updated at least semi-annually by assessing recent data sets, determining the mean recovery, and applying ±3SD (3 x standard deviation). The ideal recovery is 100%, with a range from 70% to 130%. Current control limits are specified in LIMS.

10.8.3 Recovery for the LCS is calculated using the formula:

$$LCS\% = \frac{LCS_R}{LCS_A} * 100$$

Where:

LCS% = Laboratory Control Sample percent recovery

LCS_R = Laboratory Control Sample analytical result

LCS_A = Laboratory Control Sample actual result

10.9 Matrix Spike/Matrix Spiked Duplicate

10.9.1 The MS/MSD pair should be prepared and analyzed at a frequency equivalent to 5% of samples analyzed (i.e. 1 MS/MSD pair per 20 samples) for each matrix. Duplicate aliquots of an environmental sample to which known quantities of target analytes from the primary dilution standard are added in the laboratory are prepared and analyzed exactly like a sample.

10.9.1.1 For method 624.1, it is up to the discretion of the sampler to determine which samples are to be spiked. If it is not specified the laboratory will choose an MS/MSD pair arbitrarily.

10.9.2 When insufficient sample is available to create a MS/MSD pair for a given sample batch, an MS and DUP should be analyzed, otherwise analyze a LCS/LCSD pair.

10.9.3 If an MS is being run on a TCLP sample, the spike must be added after the sample has been filtered.

10.9.4 The purpose of the MS/MSD is two-fold: a) to determine whether the sample matrix contributes bias to the analytical results (as measured by the recoveries for the analytes added to the MS/MSD), and b) to measure the precision, or reproducibility of the method as it applies to the individual sample (as measured by the relative percent difference between the MS and MSD recoveries).

10.9.4.1 The background concentration of the analytes in the sample matrix must be determined in a separate aliquot and the measured values in the MS/MSD corrected for background concentrations.

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10.9.5 Recoveries for, and relative percent differences (RPDs) between, the target analytes in the MS/MSD should fall within the control limits specified in LIMS. If the recovery or RPD of any analyte falls outside the expected range and the LCS for that analyte is shown to be within control limits, then the recovery or precision problem for that sample is judged to be matrix-related, not system related.

10.9.6 Spike recoveries are calculated using the formulas:

$$MS\% = \frac{SR - R}{SA} * 100$$

$$MS\% = \frac{SDR - R}{SA} * 100$$

Where:

MS = Matrix Spike percent recovery

MSD = Matrix Spike Duplicate percent recovery

SR = Spike sample result

DR = Spike duplicate sample result

SA = Spike added

R = Sample result (do not use an averaged value)

10.9.7 The RPD is calculated using the total concentration of the analyte in the MS/MSD samples. RPD is calculated as follows:

$$\%RPD = \frac{2 * |MS_R - MSD_R|}{(MS_R + MSD_R)} * 100$$

Where:

MS_R = Matrix Spike concentration result

MSD_R = Matrix Spike duplicate concentration result

RPD = Relative percent difference

10.9.8 The RPD is a positive value

10.9.9 Acceptable RPD is 30%.

10.10 Surrogate

10.10.1 Surrogate recoveries are calculated for all samples and QC samples. Calculated surrogate recovery for each environmental sample and QC sample must fall within the control limits specified in LIMS or corrective action is required.

10.10.2 When surrogate recovery is outside established laboratory control limits, check (1) calculations to locate possible errors, (2) spiking solutions for degradation, (3) contamination, (4) hydrocarbon interference, and (5) instrument performance. If those steps do not reveal the cause of the problem, reanalyze the sample.

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10.10.3 If sample reanalysis meets the surrogate recovery criteria, report only data for the reanalysis. If the reanalyzed sample continues to fail the recovery criteria, report all data for that sample as suspect and that there may be a matrix effect.

10.10.4 Surrogate limits, on a matrix-by-matrix basis, should be updated at least semi-annually by assessing recent data. Current control limits are specified in LIMS.

10.10.5 Surrogates are added to all standards, Method Blanks, Laboratory Control Samples, Analytical Duplicates, Matrix Spike, Matrix Spike Duplicate, External Quality Control samples, Internal Quality Control samples, and all samples.

10.10.6 Recovery for the Surrogates are calculated using the formula:

$$SURR\% = \frac{SURR_R}{SURR_A} * 100$$

Where:

SURR% = Surrogate Compound percent recovery

$SURR_R$ = Surrogate Compound analytical result

$SURR_A$ = Surrogate Compound actual value

10.11 QC data is presented to the client as part of the sample report on a separate page entitled QA/QC.

10.12 Analysis of Refrigerator Blanks

10.12.1 Fremont Analytical, Inc. ensures no cross contamination occurs between samples stored in the VOC refrigerator through the storage and analysis of Refrigerator Blanks.

10.12.2 Refrigerator Blanks are VOAs prepared by filling the VOA with DI water. Once prepared, these VOAs are marked as 'Fridge Blanks' with the date that it was made and stored in the VOC refrigerator and the walk-in refrigerator with the rest of the samples. This should be done and replaced every two weeks once the old one is removed for analyzing.

10.12.3 Refrigerator Blanks are processed and analyzed approximately every two weeks (+/- 2 days). Data is analyzed and utilized to verify no cross contamination occurring from samples stored in close proximity of one another in the VOC refrigerator and the walk-in refrigerator.

10.12.4 The individual responsible for the running of and processing of Refrigerator Blanks is the analyst responsible for the VOC department. Other individuals knowledgeable in the running and processing of VOCs, who have completed an IDC (Sec.10.4) may also run and process refrigerator blanks if asked to do so by the lead analyst of the VOC department.

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10.12.5 Refrigerator Blanks will be analyzed for the normal list of analytes that Fremont Analytical, Inc. offers to select for in samples. Values for each analyte shall be beneath the MDL and thus appear as a 'Non-Detect' (N.D.) or 'Below Calibration' on the data package sheet, If values higher than those specified are observed, a second refrigerator blank should be run to verify the high value of the analyte. If this second value matches is near the first value (+/- 30% of the initial value) and is still above the MDL, contamination can be assumed to have occurred.

10.12.6 All records of refrigerator blanks will be stored in the Omega LIM system.

10.13 External Performance Evaluation Samples:

10.13.1 Fremont Analytical, Inc. maintains laboratory certification status through satisfactory analysis of unknown Performance Evaluation (PE) samples for organic and inorganic contaminants.

10.13.2 A Performance Evaluation Sample, prepared from an EPA or other certified solution, is analyzed twice a year. These samples have unknown true values at the time of analysis. The acceptability of results is determined by the supplier and a report is returned to the laboratory after results are received from all participating laboratories.

10.13.3 All Performance Evaluation samples are treated in the same manner as client samples, with the exception of storage area (please refer to SOP SM- SAMPLOG).

11. METHOD PERFORMANCE

11.1 Method Detection Limit (MDL) Study:

11.1.1 The MDL study demonstrates the laboratory's ability to generate acceptable data with accuracy and precision, and should be performed for each analyte and matrix prior to analyzing any samples, and then at least annually thereafter.

11.1.2 LOD and LOQ verifications will be completed quarterly.

11.1.3 The procedure for MDL/LOD/LOQ studies, including their data quality objectives may be found in FAI SOP Procedure for Generation and Submission of MDLs, LODs, and LOQs.

11.1.4 Due to the large number of analytes to be determined, it is probable that more than one concentration will be required to determine the MDL, LOD, and LOQ for all analytes.

11.1.5 Current MDL, LOD, and LOQ values are kept in the OMEGA Laboratory Management system and on FASVR.

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11.2 Initial demonstration of capability - Each laboratory analyst that is trained to run this method must demonstrate initial proficiency with each sample preparation and determinative method combination it utilizes by generation data of acceptable accuracy and precision for target analytes in a clean matrix:

11.2.1 Prepare and analyze at least four LCSs spiked with target analytes at the midpoint calibration level for each compound.

11.2.2 Acceptance criteria and a more detailed procedural description may be found in FAI SOP Training and Proficiency of Methods.

11.3 The list of analytes routinely reported and their associated reporting limits are listed in LIMS Omega.

11.4 Only FAI employees who have been properly trained and have the required experience shall perform this method.

12. POLLUTION PREVENTION

12.1 Aqueous sample waste is placed in large 55-gallon steel drums where the waste is purged with a large pump. Waste samples are collected and analyzed to ensure sample waste can be properly disposed of. Please refer to SOP QA-Waste Disposal.

12.2 Soil samples that contain hazardous concentrations of contaminants are cataloged and disposed of by a licensed disposal company.

13. WASTE MANAGEMENT

13.1 Calibration standards are obtained in dilute solutions to minimize their risk.

13.2 All sample and reagent waste generated in this procedure must be segregated and disposed of according to the FAI hazardous waste procedures. Please refer to SOP QA-Waste Disposal.

14. REFERENCES

14.1 SW846, Method 8260D, Revision 4, February, 2017.

14.2 SW846, Method 8260C, Revision 3, August, 2006.

14.3 SW846, Method 8000D, Revision 5, March 2018.

14.4 2009 NELAC Standard, September 8, 2009.

14.5 EPA Method 624.1-Purgables, December, 2016.

14.6 Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.4, 2017.

14.7 2017 Methods Update Rule, August 28, 2017.

14.8 2017 Methods Update Rule Frequently Asked Questions, https://www.epa.gov/cwa-methods/2017-methods-update-rule-frequent-questions

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15. APPENDICES

15.1 Appendix A: Characteristic Masses (M/Z) for Purgeable Organic Compounds

15.2 Appendix B: Recommended Standard Volumes and Concentrations

15.3 Appendix C: Recommended Instrument Operating Parameters Method 8260

15.4 Appendix D: Recommended Minimum Response Factors

15.5 Appendix E: Bromofluorobenzene Criteria

15.6 Appendix F: Sample Loading Guide

15.7 Appendix G: Changing Internal Standards

15.8 Appendix H: EPA 624.1 Specific Quality Control Limits

15.9 Appendix I: DoD Requirements from QSM 5.4 Appendix B

16. CHANGES SINCE LAST REVISION

16.1 Logo Update.

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Appendix A: Characteristic Masses (M/Z) for Purgeable Organic Compounds

Analyte	Primary Characteristic Ion	Secondary Characteristic Ion(s)
Acetone	43	58
Acetonitrile	41	40, 39
Acrolein (Propenal)	56	55, 58
Acrylonitrile	53	52, 51
Allyl chloride	76	41, 39, 78
Benzene	78	-
Bromobenzene	156	77, 158
Bromochloromethane	128	49, 130
Bromodichloromethane	83	85, 127
Bromoform	173	175, 254
Bromomethane	94	96
2-Butanone (MEK)	43	72
n-Butylbenzene	91	92, 134
sec-Butylbenzene	105	134
tert-Butylbenzene	119	91, 134
Carbon disulfide	76	78
Carbon tetrachloride	117	119
Chlorobenzene	112	77, 114
Chloroethane	64	66
2-Chloroethylvinyl ether	63	65, 106
Chloroform	83	85
Chloromethane	50	52
2-Chlorotoluene	91	126
4-Chlorotoluene	91	126
1,2-Dibromo-3-chloropropane	75	155, 157
Dibromochloromethane	129	127
1,2-Dibromoethane	107	109, 188
Dibromomethane	93	95, 174
1,2-Dichlorobenzene	146	111, 148
1,3-Dichlorobenzene	146	111, 148
1,4-Dichlorobenzene	146	111, 148
trans-1,4-Dichloro-2-butene	53	88, 75
Dichlorodifluoromethane	85	87
1,1-Dichloroethane	63	65, 83
1,2-Dichloroethane	62	98
1,1-Dichloroethene	96	61, 63
cis-1,2-Dichloroethene	96	61, 98
trans-1,2-Dichloroethene	96	61, 98
1,2-Dichloropropane	63	112
1,3-Dichloropropane	76	78

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Analyte	Primary Characteristic Ion	Secondary Characteristic Ion(s)
2,2-Dichloropropane	77	97
1,1-Dichloropropene	75	110, 77
cis-1,3-Dichloropropene	75	77, 39
trans-1,3-Dichloropropene	75	77, 39
Diethyl ether (ethyl ether)	74	45, 59
1,4-Dioxane	58	88, 57, 43
Ethyl acetate	61	43, 45, 88
Ethylbenzene	91	106
Ethyl methacrylate	69	41, 99, 86, 114
Hexachlorobutadiene	225	223, 227
Hexane	57	41, 86
2-Hexanone	43	58, 57, 100
Iodomethane	142	127, 141
Isopropylbenzene	105	120
p-Isopropyltoluene	119	134, 91
Methylene chloride	84	86, 49
Methacrylonitrile	41	67, 39, 52, 66
Methyl-t-butyl ether (MTBE)	73	57
Methyl methacrylate	69	41, 100, 39
4-Methyl-2-pentanone (MIBK)	43	58, 85, 100
Naphthalene	128	-
2-Nitropropane	39	41, 46
Pentachloroethane	167	130, 132, 165, 169
n-Propylbenzene	91	120
Propionitrile (ethyl cyanide)	54	52, 55, 40
Styrene	104	78
1,1,1,2-Tetrachloroethane	131	133, 119
1,1,2,2-Tetrachloroethane	83	131, 85
Tetrachloroethene	164	129, 131, 166
Tetrahydrofuran	42	41, 72
Toluene	92	91
1,2,3-Trichlorobenzene	180	182, 145
1,2,4-Trichlorobenzene	180	182, 145
1,1,1-Trichloroethane	97	99, 61
1,1,2-Trichloroethane	83	97, 85
Trichloroethene	95	97, 130, 132
Trichlorofluoromethane	101	103, 105
1,1,2-Trichlorotrifluoroethane (Freon 113)	101	151, 153, 103
1,2,3-Trichloropropane	75	77
1,2,4-Trimethylbenzene	105	120
1,3,5-Trimethylbenzene	105	120
Vinyl acetate	43	86
Vinyl chloride	62	64
o-Xylene	106	91

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Analyte	Primary Characteristic Ion	Secondary Characteristic Ion(s)
m-Xylene	106	91
p-Xylene	106	91
Internal Standards /Surrogates		
1,2-Dichloroethane-d4 (SS)	102	-
4-Bromofluorobenzene (SS)	95	174, 176
Dibromofluoromethane (SS)	113	-
Toluene-d8 (SS)	98	-
Fluorobenzene (IS)	114	-
Chlorobenzene-d5 (IS)	117	-
1,4-Dichlorobenzene-d4 (IS)	152	-
Pentafluorobenzene-d4 (IS)	168	

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Appendix B: Recommended Standard Volumes and Concentrations

	25µg/mL Internal Std + Surrogate for a 5mL/10mL/25 mL Sparge Sample	20µg/mL SCAN Calibration Std spike volume in 50mL DI	20µg/mL SIM Calibration Std spike volume in 50mL DI	2000µg/mL 1,4-Dioxane SIM Calibration Std spike volume in 50mL DI	20µg/mL Calibration Std spike volume for a 5mL low level soil calibration
MB	10 µL	--	--	--	--
CCV/ICV *	10 µL	50 µL	12.5 µL	25 µL	12.5 µL
LCS/MS/ MSD	10 µL	50 µL/43 µL	12.5 µL/10.75 µL	25 µL/21.5 µL	12.5 µL/10.75 µL
TCLP MS/MSD	10 µL	50 µL	12.5 µL	25 µL	--
100 ppb	10 µL	--	--	--	25 µL
50 ppb	10 µL	--	--	--	12.5 µL
40 ppb	10 µL	100 µL	--	--	--
20 ppb	10 µL	50 µL	--	--	5 µL
10 ppb	10 µL	25 µL	25 µL	**2000ppb**: 50 µL	2.5 µL
5 ppb	10 µL	12.5 µL	12.5 µL	**1000ppb**: 25 µL	1.25 µL
2.0 ppb	10 µL	5 µL	5 µL	**400ppb**: 10 µL	0.5 µL
1.0 ppb	10 µL	2.5 µL	2.5 µL	**200ppb**: 5.0 µL	0.25 µL
0.5 ppb	10 µL	1.25 µL	1.25 µL	**100ppb**: 2.5 µL	10x of 5ppb calibration level of a standard 50mL sample
0.2 ppb	10 µL	.5 µL	.5 µL	**40ppb**: 1.0 µL	10x of 2ppb calibration level of a standard 50mL sample
0.1 ppb**	10 µL	--	10x of 1.0 ppb calibration level	**20ppb**: 10x of 200 ppb calibration level	--
0.01 ppb**	10 µL	--	100x of 1.0 ppb calibration level	**2ppb**: 100x of 200 ppb calibration level	--

*ICVs must be prepared using second source standards
**These concentration are used for SIM calibrations only

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Preparing Working Standards

Standard*	Starting Concentration (µg/mL)	Amount added to 10mL purge and trap grade MeOH**	Final Concentration (µg/mL)
Ketones	5000	100 µL	50
Acetate mix	2000	100 µL	20
Hexane	2000	100 µL	20
MTBE	2000	100 µL	20
8260 Cal Mix Revised	2000	100 µL	20
Gases	2000	100 µL	20
California Oxygenates	2000 (TBA at100000)	100 µL	20 (TBA at 100)

*Standards are purchased from Restek with the exception of Hexane, which is prepared in house.
**700 µL must be removed from 10mL of MeOH prior to the addition of standards, to account for the change in volume.
***ICV standards will be prepared in the same manner using second source primary standards

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Appendix C: Recommended Instrument Operating Parameters Method 8260

Analysis Method	8260D/NWTPH-GX	8260D/NWTPH-GX	8260D – SIM Mode	8260D – LL Soils
Instrument	HP5890 series II with 5972MS	Agilent 7820A with 5977E MS or 7890A with 5975C MS	Agilent 7820A with 5977E MS or 7890A with 5975C MS	Agilent 7820A with 5977E MS or 7890A with 5975C MS
Purge and Trap				
Trap Specification	Supelco #K for Encon	U-Shaped Tenax	U-Shaped Tenax	U-Shaped Tenax
Purge Gas	N	N	N	N
Purge Volume (mL)	10	10	25	5
Purge Gas Flow Rate (mL/min)	40	30	50	40
Purge Time (min)	11	11	14	11
Purge Temperature (°C)	45	20	20	20
Dry Purge Time (min)	1	2	2	2
Desorb Temperature (°C)	260	250	250	250
Desorb Time (min)	1	2	2	2
Bake Time (min)	9	5	9	2
Bake Temperature (°C)	265	260	280	280
GC Conditions				
GC Column	DB-624 ID, 20 M x 0.180mm x 1.0 um	DB-624 ID, 20m x 180 um x 1 um	DB-624 ID, 20m x 180 um x 1 um	DB-624 ID, 20m x 180 um x 1 um
Carrier Gas	He	He	He	He
Injector Temperature (°C)	240	200	200	200
Transfer Line Temperature (°C)	200	200	200	200
Carrier Gas (He) flow rate (mL/min)	0.653	0.700	0.7	0.7

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Temperature Program	50°C hold 3.5 min	35°C hold 4min	45°C hold 4 min	45°C hold 4 min
	20°C/min to 180°C	15°C/min to 200°C	15°C/min to 200°C	15°C/min to 200°C
	17°C/min to 205°C			

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Appendix D: Recommended Minimum Response Factors

Recommended Minimum Relative Response factor Criteria for Initial and Continuing Calibration Verification.	Recommended Minimal Response Factor (RF)	Typical Response Factor (RF)
Dichlorodifluoromethane	0.100	0.327
Chloromethane	0.100	0.537
Vinyl chloride	0.100	0.451
Bromomethane	0.100	0.255
Chloroethane	0.100	0.254
Trichlorofluoromethane	0.100	0.426
1,1-Dichloroethene	0.100	0.313
1,1,2-Trichloro-1,2,2-trifluoroethane	0.100	0.302
Acetone	0.100	0.151
Carbon disulfide	0.100	1.163
Methyl Acetate	0.100	0.302
Methylene chloride	0.100	0.380
trans-1,2-Dichloroethene	0.100	0.351
cis-1,2-Dichloroethene	0.100	0.376
Methyl tert-Butyl Ether	0.100	0.847
1,1-Dichloroethane	0.200	0.655
2-Butanone	0.100	0.216
Chloroform	0.200	0.557
1,1,1-Trichloroethane	0.100	0.442
Cyclohexane	0.100	0.579
Carbon tetrachloride	0.100	0.353
Benzene	0.500	1.368
1,2-Dichloroethane	0.100	0.443
Trichloroethene	0.200	0.338
Methylcyclohexane	0.100	0.501
1,2-Dichloropropane	0.100	0.382
Bromodichloromethane	0.200	0.424
cis-1,3-Dichloropropene	0.200	0.537
trans-1,3-Dichloropropene	0.100	0.515
4-Methyl-2-pentanone	0.100	0.363
Toluene	0.400	1.577
1,1,2-Trichloroethane	0.100	0.518

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Tetrachloroethene	0.200	0.606
2-Hexanone	0.100	0.536
Dibromochloromethane	0.100	0.652
1,2-Dibromoethane	0.100	0.634
Chlorobenzene	0.500	1.733
Ethylbenzene	0.100	2.827
meta-/para-Xylene	0.100	1.080
ortho-Xylene	0.300	1.073
Styrene	0.300	1.916
Bromoform	0.100	0.413
Isopropylbenzene	0.100	2.271
1,1,2,2-Tetrachloroethane	0.300	0.782
1,3-Dichlorobenzene	0.600	1.408
1,4-Dichlorobenzene	0.500	1.427
1,2-Dichlorobenzene	0.400	1.332
1,2-Dibromo-3-chloropropane	0.050	0.129
1,2,4-Trichlorobenzene	0.200	0.806

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Appendix E: Bromofluorobenzene Criteria

EPA 8260D / 624.1

Target mass	Rel to mass	Lower Limit %	Upper Limit %
95	174	50	200
96	95	5	9
173	174	0	2
174	95	50	200
175	174	5	9
176	174	95	105
177	176	5	10

EPA 8260C

Target mass	Rel to mass	Lower Limit %	Upper Limit %
50	95	15	40
75	95	30	60
95	95	100	100
96	95	5	9
173	174	0	2
174	95	50	--
175	174	5	9
176	174	95	101
177	176	5	9

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Appendix F. Sample Loading Guide

GC-9

1. Start the Atomx software by opening the Windows menu and right clicking **Start Teklink Server (Administrator only)** and choosing **Run as Administrator.** Open the Atomx by clicking **Atomx Teklink** in the start menu. Connect to the Atomx listed, and when prompted, use the username Administrator and the password ABC123.
2. Open a new schedule by clicking New and selecting Schedule from the drop down menu. Choose the method to run on the autosampler (8260PH3DP for the scan 8260 VOC method and 25ml8260 for 8260 SIM method).
3. Add the appropriate amount of internal standard and surrogate mix by inputting the desired volume in the column correlating to the well with liquid in it. For GC-9 the internal standard/surrogate mix is normally kept in the first standard well; add **10** from the **STD 1** dropdown list. The dilution factor column should always read 1:1.
4. To fill the autosampler table with corresponding positions on the wheel, click on the vial column and type in the position number. Inputting a 0 will correspond to a reservoir blank. **It is recommended that you start a sequence with a reservoir or vial blank.** To add another row, highlight the line and press the down arrow on the keyboard, the program will automatically increment the sequence.
5. Once you are satisfied with your sequence press the **Save and Upload** key and save the sequence as today's date. Then **press Step** to move the autosampler into Purge Ready and then press Step to start sequence.
6. Next, create an acquisition sequence by opening the MassHunter Acquisition software. From the start menu **click the GC icon labeled Constance**. Click the sequence from the top bar, and choose **Use Quick Sequence Generator**. Change the data file to today's date [MMDD01]. Click OK. Change the Misc Info to the applicable test code in the next pop up box. Click OK again and the sequence table should pop up automatically.
7. Delete the first three Keyword Rows. To fill the table down, highlight the first row and drag downwards, right click and select **Repeat Row and Increment**. This will automatically increment the data file names. Change the sample name to correspond with respective sample running on the autosampler. The Method should remain **8260** (or whatever the current scan method is) for the entire sequence if you are running the normal SCAN 8260 method. If running 8260 SIM the method should be**8260SIM** (or whatever the current SIM method is). The **User Defined** column corresponds to the sample type in Omega (CCV, LCS, SAMP, etc.) and the **Comment** column corresponds to the test code. The Type, Multiplier Vial, and Level columns are not filled.
8. Ensure that the autosampler and GC lines correspond to each other and click OK. Save the sequence as today's date. Select Sequence from the top toolbar again and this time select **Position and Run.** Now, select the sample you wish to run (this is generally the cleanout) and click OK. Fill in the Operator name with your initials, and change the data output path to D:\GC-9\Data\[mmddyy]. Click **Run Sequence**

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GC-19

1. Start the Atomx software by opening the Windows menu and right clicking **Start Teklink Server (Administrator only)** and choosing **Run as Administrator.** Open the Atomx by clicking **Atomx Teklink** in the start menu. Connect to the Atomx listed, and when prompted, use the username Administrator and the password ABC123.
2. Open a new schedule by clicking New and selecting Schedule from the drop down menu. Choose the method to run on the autosampler (8260PH3DP for the scan 8260 VOC method and 25ml8260 for 8260 SIM method).
3. Add the appropriate amount of internal standard and surrogate mix by inputting the desired volume in the column correlating to the well with liquid in it. For GC-19 the internal standard/surrogate mix is normally kept in the first standard well; add **10** from the **STD 1** dropdown list. The dilution factor column should always read 1:1.
4. To fill the autosampler table with corresponding positions on the wheel, click on the vial column and type in the position number. Inputting a 0 will correspond to a reservoir blank. **It is recommended that you start a sequence with a reservoir or vial blank.** To add another row, highlight the line and press the down arrow on the keyboard, the program will automatically increment the sequence.
5. Once you are satisfied with your sequence press the **Save and Upload** key and save the sequence as today's date. Then **press Step** to move the autosampler into Purge Ready and then press Step to start sequence. Open the MassHunter Acquisition software. To create an acquisition sequence, select sequence from the top toolbar and edit the currently opened method, or load the default sequence file. If you are editing the currently open method be sure to save it before making any changes. Once you have the sequence table open, first change the data file number to today's date [mmdd01]. To add rows to the sequence table, manually click **Add Samples**. Enter the sample ID corresponding the respective autosampler position. The **Comment** column should correspond to the test code and the **User Defined** column corresponds to the Sample Type in Omega (CCV, LCS, SAMP, etc.).
6. Ensure that the autosampler and GC lines correspond to each other and, click OK. Select Sequence from the top toolbar again and save the sequence as today's date. Then select sequence from the toolbar and this time select **Position and Run.** Select the sample you wish to run first (which generally the cleanout. Then click "OK" Select "No" to "Process Keywords". Fill in the Operator name with your initials, and change the data output path to D:\GC-19\Data\[mmddyy]. Click **Run Sequence**.

GC-27

1. Start the Atomx software by opening the Windows menu and right clicking **Start Teklink Server (Administrator only)** and choosing **Run as Administrator.** Open the Atomx by clicking **Atomx Teklink** in the start menu. Connect to the Atomx listed, and when prompted, use the username Administrator and the password ABC123.
2. Open a new schedule by clicking New and selecting Schedule from the drop down menu. Choose the method to run on the autosampler (8260PH3DP for the scan 8260 VOC method and 25ml8260 for 8260 SIM method).
3. Add the appropriate amount of internal standard and surrogate mix by inputting the desired volume in the column correlating to the well with liquid in it. For GC-27 the internal standard/surrogate mix is normally kept in the first standard well; add **10** from the **STD 1** dropdown list. The dilution factor column should always read 1:1.

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4. To fill the autosampler table with corresponding positions on the wheel, click on the vial column and type in the position number. Inputting a 0 will correspond to a reservoir blank. **It is recommended that you start a sequence with a reservoir or vial blank.** To add another row, highlight the line and press the down arrow on the keyboard, the program will automatically increment the sequence.
5. Once you are satisfied with your sequence press the **Save and Upload** key and save the sequence as today's date. Then **press Step** to move the autosampler into Purge Ready and then press Step to start sequence.
6. Open the MassHunter Acquisition software. To create an acquisition sequence, select sequence from the top toolbar and edit the currently opened method, or load the default sequence file. If you are editing the currently open method be sure to save it before making any changes. Once you have the sequence table open, first change the data file number to today's date [mmdd01]. To add rows to the sequence table, manually click **Add Samples**. Enter the sample ID corresponding the respective autosampler position. The **Comment** column should correspond to the test code and the **User Defined** column corresponds to the Sample Type in Omega (CCV, LCS, SAMP, etc.).
7. Ensure that the autosampler and GC lines correspond to each other and, click OK. Hit Sequence from the top toolbar again and save the sequence as today's date. Then select sequence from the toolbar and this time select **Position and Run.** Now, select the sample you wish to run first (generally this is the cleanout). Then click "OK" Select "No" to "Process Keywords". Fill in the Operator name with your initials, and change the data output path to D:\GC-27\Data\[mmddyy]. Click **Run Sequence**.

GC-11 (archived)

1. The EST Centurion Autosampler controls GC-11. If it's shut off for some reason, the power switch is behind the machine on the right hand side, if you're facing the window. The login password is ESTAnalytical if you should need it. To edit the sequence table, on the left hand side of the Home screen, click the third tile from the top, a sequence table should pop up.
2. To add samples, input a start vial position, number of vials you're adding and change the method to reflect the correct internal standard vial and correct volume (usually 10 uL). Once you have added the correct number of vials, you will probably need to add cleanouts interspersed within the sequence. To do so, select the sample you wish to insert a cleanout before. For example, if you want to add a cleanout before the sample in slot 5, highlight vial 5. Next, change the number in the # of blanks column to however many cleanouts needed. Then, click insert again. This should replace the highlighted row with a new row including the cleanouts. **BE CAREFUL!!** The editor will replace whichever row is highlighted. The autosampler will sabotage your table and you will have to do everything over if you are not careful. Additionally, double check the method and verify it has not changed when a new row is inserted.
3. If you need to run something immediately, the priority button will run a row immediately next. However, if the currently running row has 6 cleanouts running before the sample, the autosampler will finish that row before proceeding to the new priority row.
4. To start the sequence, push the tile second from the top that resembles a recycle circle. This should bring you to the home screen. Select start, do not add a start delay, do not clear run log, and press Start Sequence one final time. Make sure the concentrator is taken off economy mode; the autosampler will not being if the concentrator is in economy mode.

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5. Next, type the acquisition table on the computer attached to the GC. Open GC_MS Instrument #1, click on **Sequence** from the toolbar and click on **Use Quick Sequence Generator**. Change the data file to today's date [MMDD01]. Click OK. Change the Misc Info to the applicable test code in the next pop up box. Click OK again and the sequence table should pop up automatically.
6. Delete the Keyword rows, change the sample name to correspond to the sample being analyzed. Always use method **8260**. The misc information box should contain the omega sample type as well as test code using the 'five space' rule before the test code. To add a row, click repeat while highlighting a row already typed. This will automatically increment the vial number and data number. If for some reason a row needs to be inserted into the middle of the sequence, to avoid retyping each data file number, add -1 to the end of the data file (so 110803 will become 110803-1). This prevents any data from being overwritten.
7. Once the sequence checks out, click OK. Save the sequence as today's date. Then select sequence from the toolbar and this time select Position and Run. Now, select the sample you wish to run first, which should probably be a cleanout because you haven't forgotten to run a cleanout first. Fill in the Operator name with your initials, and change the data output path to C:\GC-11\Data\[mmddyy]. Click Run Sequence, not just OK. The GC should start, and it will automatically begin to acquire data when the sample has finished its autosampling.

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Appendix G. Changing Internal Standards.

GC-9, GC-19, GC-27 (Tekmar Atomx/XYZ)

1. Click on **"Tools" → "Prime/Change Standards"** → Choose which standard(s) you wish to change.
    a. The Surrogate/Internal Standard mix is usually in Position 1.
2. Follow the prompt in the "**Instrument Status"** pane. When it says you are able to remove the vessels, do so.
3. Empty the contents and rinse them out a couple of times with clean methanol.
4. Add 150mL of Purge and Trap Grade Methanol to the empty ampules. Remove 300µl from each. Add 150µl of the current internal standard and 150µl of the current surrogate into each ampule. Carefully mix. Record the new standards in Omega and label the vessels with a description of its contents (include the Omega number and the concentration)
5. Re-attach the vessels then click "**Step"**. The Atomx will now prime the standards.
6. To prime the standards again, click on **"Tools" → "Prime/Change Standards".** This time, instead of changing the standards, just press **"Step"**.
7. Run a few cleanouts to really make sure your system is primed and ready to go.
8. Recalibrate.

GC-11 (EST Centurion) -- ARCHIVED

1. Turn off the Nitrogen. If you are facing the instrument, the toggle switch will is located in the back of the instrument on the left hand side. Wait a few moments for the system to vent.
2. On the Centurion screen, go to the Diagnostics page (the tool icon), then click on **"Manual Functions"→ "Internal Standards"→ "Front Park"**. This will bring the water needle to the front of the autosampler tray.
3. Use the wrench (found in the syringe box) to **CAREFULLY** remove the ampules. If care is not taken, these will break! Very little force is required to undo the nuts.
4. Once the ampules have been removed, empty the contents and rinse a couple times with clean methanol.
5. Add 5mL of Purge and Trap Grade Methanol to the empty ampules. Remove 100µl from each. Add 50µl of the current internal standard and 50µl of the current surrogate into each ampule. Carefully mix. Record the new standards in Omega and label the vessels with a description of its contents (include the Omega number and the concentration)
6. One at a time, **CAREFULLY** re-attach the ampules back onto the centurion. They only need to be finger tight with approximately an extra quarter turn.
7. On the Diagnostics page, click on **"Manual Functions"→ "Internal Standards"→ "Rear Park"**. This will bring the water needle to its home position in the back of the autosampler tray.
8. Turn the Nitrogen back on… **DON'T FORGET TO TURN THE NITROGEN BACK ON.**

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9. On the Diagnostics page, click on **"Manual Functions"→ "Internal Standards"→ "Prime"**. Highlight both internal standards then click **"Prime".** Prime the internal standards 3 times.
10. Run a few cleanouts to really make sure your system is primed and ready to go.
11. Recalibrate

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Appendix H. EPA 624.1 Specific Quality Control Limits

Analyte	LCS Range (%)	MS/MSD Range (%)	%RPD for MS/MSD
Acrolein	60-140	40-160	60
Acrylonitrile	60-140	40-160	60
Benzene	65-135	37-151	61
Bromodichloromethane	65-135	35-155	56
Bromoform	70-130	45-169	42
Bromomethane	15-185	D-242	61
Carbon Tetrachloride	70-130	70-140	51
Chlorobenzene	65-135	37-160	53
Chloroethane	40-160	14-230	78
2-Chloroethylvinyl ether	D-225	D-305	71
Chloroform	70-135	51-138	54
Chloromethane	D-205	D-273	60
Dibromochloromethane	70-135	53-149	50
1,2-Dichlorobenzene	65-135	18-190	57
1,3-Dichlorobenzene	70-130	59-156	43
1,4-Dichlorobenzene	65-135	18-180	57
1,1-Dichloroethane	70-130	59-155	40
1,2-Dichloroethane	70-130	49-155	49
1,1-Dichloroethene	50-150	D-234	32
trans-1,2-Dichloroethene	70-130	54-156	45
1,2-Dichloropropane	35-165	D-210	55
cis-1,3-Dichloropropane	25-175	D-227	58
trans-1,3-Dichloropropene	50-150	17-183	86
Ethylbenzene	60-140	37-162	63
Methylene Chloride	60-140	D-221	28
1,1,2,2-Tetrachloroethane	60-140	46-157	61
Tetrachloroethane	70-130	64-148	39
Toluene	70-130	47-150	41
1,1,1-Trichloroethane	70-130	52-162	36
1,1,2-Trichloroethane	70-130	52-150	45
Trichloroethene	65-135	70-157	48
Trichlorofluoromethane	50-150	17-181	84
Vinyl Chloride	5-195	D-251	66

*D = Detected; Result must be greater than zero
**For analytes not listed above, FAI will use the limits for 8260 as quality control criteria (LCS/MS/MSD: Control charts. RPD: 30%.).
***When a sufficient number of CCV/LCSs/MS/MSDs have been run (at least 20), %recoveries maybe control charted. However, if in-house control limits are wider than the limits listed in Appendix H, Appendix H limits must be used.
***Surrogates may be control charted when there are at least 20 representative samples run for this method. Until this occurs, the default surrogate recovery limits will be set at 60-140%.

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Appendix I. DoD Specific Quality Control Requirements, QSM 5.4 Appendix B

Organic Analysis by Gas Chromatography/Mass Spectrometry (GC/MS) in SCAN MODE					
QC Check	**Minimum Frequency**	**Acceptance Criteria**	**Corrective Action**	**Flagging Criteria**	**Comments**
Tune Check	Prior to ICAL and prior to each 12-hour period of sample analysis.	Specific ion abundance criteria of BFB or DFTPP from method.	Retune instrument and verify.	Flagging is not appropriate.	No samples shall be analyzed without a valid tune.
Initial calibration (ICAL) for all analytes (including surrogates)	At instrument set-up and after ICV or CCV failure, prior to sample analysis.	Each analyte must meet one of the three options below: Option 1: RSD for each analyte ≤ 15% Option 2: linear least squares regression for each analyte: $r^2 \geq 0.99$; *(continued next page)*	Correct problem then repeat ICAL.	Flagging is not appropriate.	Minimum 5 levels for linear and 6 levels for quadratic. No samples shall be analyzed until ICAL has passed.
Initial calibration (ICAL) for all analytes (including surrogates) *(Continued)*		Option 3: non-linear least squares regression (quadratic) for each analyte: $r^2 \geq 0.99$.			If the specific version of a method requires additional evaluation (e.g., RFs or low calibration standard analysis and recovery criteria) these additional requirements must also be met.

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QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Retention Time window position establishment	Once per ICAL and at the beginning of the analytical sequence.	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	NA.	NA.	Calculated for each analyte and surrogate.
Evaluation of Relative Retention Times (RRT)	With each sample.	RRT of each reported analyte within ± 0.06 RRT units.	Correct problem, then rerun ICAL.	NA.	After maintenance is performed which may affect retention times, RRTs may be updated based on the daily CCV. RRTs shall be compared with the most recently updated RRTs.
Initial Calibration Verification (ICV)	Once after each ICAL, analysis of a second source standard prior to sample analysis.	All reported analytes within ± 20% of true value.	Correct problem. Rerun ICV. If that fails, repeat ICAL.	Flagging is not appropriate.	No samples shall be analyzed until calibration has been verified with a second source.

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QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Continuing Calibration Verification (CCV)	Daily before sample analysis; after every 12 hours of analysis time; and at the end of the analytical batch run.	All reported analytes and surrogates within ± 20% of true value. All reported analytes and surrogates within ± 50% for end of analytical batch CCV.	Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails or if two consecutive CCVs cannot be run, perform corrective action(s) and repeat CCV and all associated samples since last successful CCV. Alternately, recalibrate if necessary; then reanalyze all associated samples since the last acceptable CCV.	If reanalysis cannot be performed, data must be qualified and explained in the Case Narrative. Apply Q-flag to all results for the specific analyte(s) in all samples since last acceptable calibration verification.	Results may not be reported without valid CCVs. Flagging is only appropriate in cases where the samples cannot be reanalyzed. If the specific version of a method requires additional evaluation (e.g., average RFs) these additional requirements must also be met.
Internal Standards (IS)	Every field sample, standard, and QC sample.	Retention time within ± 10 seconds from retention time of the midpoint standard in the ICAL; EICP area within – 50% to +100% of ICAL midpoint standard. On days when ICAL is not performed, the daily initial CCV can be used.	Inspect mass spectrometer and GC for malfunctions and correct problem. Reanalysis of samples analyzed while system was malfunctioning is mandatory.	If corrective action fails in field samples, data must be qualified and explained in the Case Narrative. Apply Q-flag to analytes associated with the noncompliant IS. Flagging is not appropriate for failed standards.	NA.

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QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Method Blank (MB)	One per preparatory batch.	No analytes detected > ½ LOQ or > 1/10th the amount measured in any sample or 1/10th the regulatory limit, whichever is greater. Common contaminants must not be detected > LOQ.	Correct problem. If required, reprep and reanalyze MB and all QC samples and field samples processed with the contaminated blank.	If reanalysis cannot be performed, data must be qualified and explained in the Case Narrative. Apply B-flag to all results for the specific analyte(s) in all samples in the associated preparatory batch.	Results may not be reported without a valid Method Blank. Flagging is only appropriate in cases where the samples cannot be reanalyzed.
Laboratory Control Sample (LCS)	One per preparatory batch.	A laboratory must use the QSM Appendix C Limits for batch control if project limits are not specified. If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes if sufficient sample material is available.	If reanalysis cannot be performed, data must be qualified and explained in the Case Narrative. Apply Q-flag to specific analyte(s) in all samples in the associated preparatory batch.	Must contain all surrogates and all analytes to be reported. Results may not be reported without a valid LCS. Flagging is only appropriate in cases where the samples cannot be reanalyzed.
Matrix Spike (MS)	One per preparatory batch.	A laboratory must use the QSM Appendix C Limits for batch control if project limits are not specified. If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified.	Examine the project-specific requirements. Contact the client as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met and explain in the Case Narrative.	Must contain all surrogates and all analytes to be reported. For matrix evaluation only. If MS results are outside the limits, the data shall be evaluated to determine the source(s) of difference, i.e., matrix effect or analytical error.

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QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Matrix Spike Duplicate (MSD) or Matrix Duplicate (MD)	One per preparatory batch.	A laboratory must use the QSM Appendix C Limits for batch control if project limits are not specified. If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified. MSD or MD: RPD of all analytes ≤ 20% (between MS and MSD or sample and MD).	Examine the project-specific requirements. Contact the client as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met and explain in the Case Narrative.	MSD: Must contain all surrogates and all analytes to be reported. The data shall be evaluated to determine the source of difference. For Sample/MD: RPD criteria only apply to analytes whose concentration in the sample is greater than or equal to the LOQ.
Surrogate Spike	All field and QC samples.	QC acceptance criteria specified by the project if available; otherwise use QSM Appendix C limits or in-house LCS limits if analyte(s) are not listed.	Correct problem, then reprep and reanalyze all failed samples for all surrogates in the associated preparatory batch if sufficient sample material is available. If obvious chromatographic interference is present, reanalysis may not be necessary, but the client must be notified prior to reporting data and the failures must be discussed in the Case Narrative.	Apply Q-flag to all associated analytes if acceptance criteria are not met and explain in the Case Narrative.	Alternative surrogates are recommended when there is obvious chromatographic interference.

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Semivolatile Organic Compounds by Gas Chromatography / Mass Spectrometry (GC/MS) EPA Method 8270E & EPA 625.1

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1. SCOPE AND APPLICATION

1.1. Method 8270E and Method 625.1 are used to determine the concentration of semi-volatile organic compounds in extracts prepared from soil, sediments, solid/waste, activated carbon traps, and wastewater samples. Compounds that can be determined by this method are found in Table 1.

1.2. Note: Method 625.1 is only applicable to municipal and industrial wastewater analyses. The requirements for Method 8270 fulfill all requirements for Method 625.1, unless otherwise specified..

1.3. Method 8270E and Method 625.1 can be used to quantitate most neutral, acidic, and basic organic compounds that are soluble in methylene chloride and capable of being eluted (without derivatization) as sharp peaks from a gas chromatographic fused-silica capillary column coated with a slightly polar silicone stationary phase. Such compounds include polynuclear aromatic hydrocarbons (PAH), chlorinated hydrocarbons and pesticides, phthalate esters, nitrosamines, haloethers, aldehydes, ethers, chlorinated herbicides, aromatic nitro compounds, and phenols, including nitrophenols. See Table 1 for a list of compounds and their characteristic ions that have been evaluated. In most cases, Method 8270 / Method 625.1 is not appropriate for the quantitation of multicomponent analytes, e.g. Toxaphene, Chlordane, etc., because of limited sensitivity for those analytes.

1.4. The following compounds may require special treatment when being determined by this method:

1.4.1. Hexachlorocyclopentadiene is subject to thermal decomposition in the inlet of the gas chromatograph, chemical reaction in acetone solution, and photochemical decomposition.

1.4.2. Benzidine may be subject to oxidative losses during solvent concentration.

1.4.3. N-nitrosodimethylamine is difficult to separate from the solvent peak under the chromatographic conditions described.

1.4.4. Pentachlorophenol, 2,4-dinitrophenol, 4-nitrophenol, 4,6-dinitro-2-methylphenol, 4-chloro-3-methylphenol, are subject to erratic chromatographic behavior, especially if the GC system is contaminated with high boiling material.

1.5. Limits of Quantitation, Detection, and MDLs can be found in the Omega LIMS system.

1.6. This method is restricted to use by or under the supervision of analysts experienced in the use of gas chromatograph/mass spectrometers and skilled in the interpretation of mass spectra. Each analyst must demonstrate the ability to generate acceptable results with this method.

2. SUMMARY OF METHOD

2.1. The semi-volatile compounds are introduced into the GC/MS by injecting the sample extract into an Agilent Gas Chromatograph (GC) with a narrow-bore fused-silica capillary column. The GC column is temperature-programmed to separate the analytes, which are then detected with a mass spectrometer (MS) connected to the gas chromatograph.

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2.2. Analytes eluted from the capillary column are introduced into the mass spectrometer via direct connection. Identification of target analytes is accomplished by comparing their mass spectra with the electron impact (or electron impact-like) spectra of authentic standards.

2.3. Quantitation is accomplished by comparing the response of a major (quantitation) ion relative to an internal standard using a minimum of five-point calibration curve.

2.4. The method includes specific calibration and quality control steps that supersede the general requirements provided in Method 8000.

3. DEFINITIONS

3.1. Batch - A group of samples behaving similarly with respect to the sampling or the employed testing procedures, and are processed as a unit. For QC purposes, if the number of samples in a group is greater than 20, then each group of 20 samples or less will all be handled as a separate batch.

3.2. Continuing Calibration Verification (CCV) – Standard run to verify the latest calibration, prior to sample analysis.

3.3. Initial Calibration Verification (ICV) – Second source calibration verification standard, run immediately following a calibration.

3.4. Reagent Water - Water that has been generated by any method achieving performance specifications for ASTM Type II water. For organic analyses, see the definition of organic-free reagent water.

3.5. Standard Curve - A plot of concentrations of known analyte standards versus instrument response to the analyte. Calibration standards are prepared by successively diluting a standard solution to produce working standards covering the range of the instrument. Standards should be prepared at the frequency specified in the appropriate section. Calibration standards are prepared using the same type of acid or solvent, and at the same concentrations as samples during preparation.

3.6. Free acid: The chemical state of an herbicide analyte as it is requested to be tested. This form of the compound is less stable when subjected to the high temperatures in the GC.

3.7. Methyl ester: A free acid herbicide has a methyl group attached to its structure during the derivatization step and becomes the methyl ester form. This form has increased stability during the analysis.

4. INTEFERENCES

4.1. Raw GC/MS data from all blanks, samples, and spikes must be evaluated for interference. Determine if the source of interference is in the preparation and/or cleanup of the samples and take corrective action to eliminate the problem.

4.2. Contamination by carryover can occur whenever high-concentration and low-concentration samples are sequentially analyzed. To reduce carryover, the sample syringe must be rinsed with solvent between sample injections. Whenever an unusually concentrated sample is encountered, it should be followed by the analysis of solvent to check for cross-contamination.

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4.3. In the presence of samples containing residual chlorine, phenol-d6 has been known to react to form chlorinated phenolic compounds that are not detected as the original spiked surrogate. Sample preservation precautions should be used when residual chlorine is known to be present in order to minimize degradation of deuterated phenols or any other susceptible target analyte.

5. SAFETY

5.1. Each chemical used in this method should be regarded as a potential health hazard and exposure to these compounds should be minimized by good laboratory practices. Normal accepted laboratory safety practices should be followed during reagent preparation and instrument operation. Always wear safety glasses or full-face shield for eye protection and gloves when working with these reagents. Before using this method, individuals who are unfamiliar with the hazards associated with these chemicals should refer to the material safety data sheets (MSDS).

5.2. Solvents are harmful through inhalation and skin contact. Steps should be taken to minimize inhalation of solvent vapors by doing all chemistry in a well- ventilated hood.

6. EQUIPMENT AND SUPPLIES

6.1. Gas chromatograph: An analytical system (Agilent 7890, or equivalent) complete with a temperature-programmable gas chromatograph suitable for split/splitless injection and all required accessories, including syringes, analytical columns, and gases. The capillary column should be directly coupled to the source.

6.2. Column: 20 m x 0.18 mm ID, 0.36 um film thickness silicone-coated fused-silica capillary column (Phenomenex ZB-5, J&W Scientific DB-5-MS, Restek XTI-5 or equivalent).

6.3. Mass-spectrometer: capable of scanning from 45 to 580 amu every 1 sec or less, using 70 volts (nominal) electron energy in the electron impact ionization mode. The mass-spectrometer must be capable of producing a mass spectrum for Decafluorotriphenylphosphine (DFTPP) which meets the criteria in Table 4 when 1 µL of the GC/MS tuning standard is injected through the GC (50 ng of DFTPP).

6.4. GC/MS Interface: Any GC-to-MS interface may be used that gives acceptable calibration points at 25 ng per injection for each compound of interest and achieves acceptable tuning performance criteria. For a narrow-bore capillary column, the interface is usually capillary-direct into the mass spectrometer source.

6.5. Balance: Analytical, capable of weighing 0.0001 g.

6.6. Bottles: glass vials with polytetrafluoroethylene (PTFE)-lined screw caps or crimp tops.

7. REAGENTS AND STANDARDS

7.1. Reagent grade organic chemicals shall be used in all tests. Other grades can be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

7.2. Organic-free reagent water: All references to water in this method refer to organic-free reagent water (also called deionized-(DI) water).

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7.3. Stock standard solutions (1000 mg/L): Standard solutions can be prepared from pure standard materials or purchased as certified solutions.

7.3.1. Commercially prepared stock standards may be used at any concentration if they are certified by the manufacturer or by an independent source.

7.3.2. Transfer the stock standard solutions into bottles with PTFE-lined screw caps. Store, protected from light, at –10°C or less or as recommended by the standard manufacturer. Stock standard solutions should be checked frequently for signs of degradation or evaporation, especially just prior to preparing calibration standards from them.

7.3.3. Stock standard solutions should be replaced after 1 year or sooner, if comparison with quality control check samples indicates a problem

7.3.4. It is recommended that nitrosamine compounds be placed together in a separate calibration mix and not combined with other calibration mixes. When using a premixed certified standard, consult the manufacturer's instructions for additional guidance.

7.3.5. Herbicide Analytes

7.3.5.1. Both free-acid and methyl ester versions of certified reference materials are purchased from a vendor with appropriate credentials. The methyl ester standards are used for CCVs and calibrations, while the free-acid standards are added to sample batches for QC.

7.4. Internal standard solutions: The internal standards recommended are:

7.4.1. 1,4-dichlorobenzene-d4

7.4.2. Naphthalene-d8

7.4.3. Acenaphthene-d10

7.4.4. Phenanthrene-d10

7.4.5. Chrysene-d12

7.4.6. Perylene-d12

7.4.7. Herbicide Internal Standard

7.4.7.1. The compound 4,4'-dibromooctafluorobiphenyl (DBOB) is used as an internal standard and is purchased from a vendor with appropriate credentials.

7.5. Premixed certified solutions are stored according to the manufacturer's documented holding time and storage temperature recommendations (Restek).

7.5.1. Area counts of the internal standard peaks should be between 50-200% of the area of the target analytes in the mid-point calibration analysis.

7.6. GC/MS tuning standard: A methylene chloride solution from Restek, containing 1000 µg/mL of decafluorotriphenylphosphine (DFTPP) should be stored at – 10°C or less when not in use. If a more sensitive mass spectrometer is employed to achieve lower detection levels, a more dilute tuning solution may be necessary.

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7.6.1. Dilutions should be made from this stock standard in methylene chloride of a concentration so that upon injection, 25-50 ng of DFTPP is introduced on the column. These dilute solutions should be analyzed after each tuning of the mass spectrometer and each day before sample analysis begins.

7.7. Calibration standards: A minimum of five calibration standards should be prepared at five different concentrations (Table 3). At least one of the calibration standards should correspond to a sample concentration at or below that necessary to meet the data quality objectives of the project. The remaining standards should correspond to the range of concentrations found in actual samples but should not exceed the working range of the GC/MS system. Each standard should contain each analyte for detection by this method. The laboratory shall not report a quantitative result for a target analyte that was not included in the calibration standard(s).

7.7.1. Each calibration standard should be spiked with internal standard solution prior to analysis. All standards should be stored at –10°C or less, and should be freshly prepared once a year, or sooner if check standards indicate a problem.

7.7.2. The calibration verification standard (CCV) should be prepared weekly and stored at 4°C. When using premixed certified solutions, store according to the manufacturer's documented holding time and storage temperature recommendations.

7.8. Surrogate standards - The recommended surrogates are:

7.8.1. Phenol-d6

7.8.2. 2-fluorophenol

7.8.3. 2,4,6-tribromophenol

7.8.4. Nitrobenzene-d5

7.8.5. 2-fluorobiphenyl

7.8.6. p-Terphenyl-d14

7.8.7. Herbicide Surrogates

7.8.7.1. The compound 2,4-Dichlorophenylacetic acid (DCAA) is used as a surrogate to monitor the performance of the extraction. It is purchased from a vendor with appropriate credentials.

7.8.8. Surrogate standard check: Determine what the appropriate concentration should be for the blank extracts after all extraction, cleanup, and concentration steps. Inject this concentration into the GC/MS to determine recovery of surrogate standards. It is recommended that this check be done whenever a new surrogate spiking solution is prepared.

7.9. Matrix spike and laboratory control standards: Purchased as a certified standard.The same standard may be used as the laboratory control standard (LCS).

7.9.1. Matrix Spike Check: Determine what concentration should be in the spiked extracts after all extraction, cleanup, and concentration steps. Inject this concentration into the GC/MS to determine recovery. It is recommended that this check be done whenever a new matrix spiking solution is prepared.

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8. SAMPLE COLLECTION, PRESERVATION, SHIPMENT AND STORAGE

8.1. Sample Collection

8.1.1. Soil samples should be collected in 4-8oz glass jars.

8.1.2. Water samples should be collected in 1 L glass amber bottles.

8.2. Sample Shipment

8.2.1. Samples should be received at the laboratory as soon as possible after sampling due to holding time requirements.

8.3. Sample Preservation

8.3.1. Sample extracts should be stored at 4°C away from light.

8.3.2. Water samples will not be acid preserved.

8.4. Holding Times

8.4.1. The maximum holding time for samples from time of collection to extraction is 7 days for water samples and 14 days for soil samples.

8.4.2. The maximum holding time for extracts from date of extraction to date of analysis is 40 days.

9. QUALITY CONTROL

9.1. Department of Defense (DoD) Quality Control Requirements

9.1.1. See Tables 14 and 15 for quality control requirements taken from DoD Quality Service Manual (QSM) Appendix B.

9.2. Quality control procedures to ensure the proper operation of the various sample preparation and/or sample introduction techniques can be found in EPA Method 3500. Method validation for EPA 625.1 is satisfied by EPA method 8270E, unless otherwise stated.

9.3. Quality control procedures necessary to evaluate the GC system operation include calibration verification and chromatographic analysis of samples.

9.4. The GC/MS system must be tuned to meet the DFTPP criteria listed in Table 4. For EPA 625.1, tune checks must occur every 12 hours. For EPA 8270E, tune checks must occur prior to each calibration.

9.5. There must be an initial calibration of the GC/MS system.

9.6. The GC/MS system must meet the calibration verification acceptance criteria every 12 hours.

9.7. Before processing any samples, the analyst should demonstrate, through the analysis of a method blank that interferences from the analytical system, glassware, and reagents are under control. Each time a set of samples is analyzed or there is a change in reagents, a method blank should be analyzed as a safeguard against chronic laboratory contamination. The blanks should be carried through all stages of sample preparation and measurement.

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9.7.1. Blanks are generally considered to be acceptable if target analyte concentrations are less than one half the LOQ or are less than project-specific requirements. Blanks may contain analyte concentrations greater than acceptance limits if the associated samples in the batch are unaffected (i.e., targets are not present in samples or sample concentrations/responses are ≥10X the blank). Other criteria may be used depending on the needs of the project.

9.7.2. If an analyte of interest is found in a sample in the batch near a concentration confirmed in the blank, the presence and/or concentration of that analyte should be considered suspect and may require qualification. Contaminants in the blank should meet most or all of the qualitative identifiers in Sec. 13.1 to be considered a detection. Samples may require re-extraction and/or reanalysis if the blanks do not meet laboratory established or project-specific criteria. Re-extraction and/or re-analysis is not necessary if the analyte concentration falls well below the action or regulatory limit or if the analyte is deemed not important for the project.

9.7.3. Blank subtracting is not acceptable except when running EPA 625.1 unless it is explicitly requested by a regulating authority or permit to do so. If it is not requested, blank subtraction remains unacceptable for method 625.1.

9.8. Documenting the effect of the matrix should include the analysis of at least one matrix spike (MS) and one duplicate, unspiked sample, or one matrix spike/matrix spike duplicate pair. The decision on whether to prepare and analyze duplicate samples or a matrix spike/matrix spike duplicate (MS/MSD) must be based on knowledge of the samples in the sample batch. If samples are expected to contain target analytes, then use one matrix spike and a duplicate analysis of an unspiked field sample. If samples are not expected to contain target analytes, use a matrix spike and matrix spike duplicate pair. Current control limits can be found in the Omega LIMS.

9.8.1. Control limits for EPA 625.1 can be found in Table 13 and in Omega.

9.8.2. Control limits for DoD projects are found in Appendix C of the DoD QSM. DoD test codes will reflect these limits. For analytes that are not listed in the QSM, the lab will use in house control charts.

9.9. A Laboratory Control Sample (LCS) should be included with each analytical batch. The LCS consists of an aliquot of a clean (control) matrix similar to the sample matrix and of the same weight or volume. The LCS is spiked with the same target analytes at the same concentrations as the matrix spike. When the results of the matrix spike analysis indicate a potential problem due to the sample matrix itself, the LCS results are used to verify that the laboratory can perform the analysis in a clean matrix. Current control limits can be found in the Omega LIMS.

9.9.1. Control limits for EPA 625.1 can be found in Table 13 and in Omega.

9.9.2. Control limits for DoD projects are found in Appendix C of the DoD QSM. DoD test codes will reflect these limits. For analytes that are not listed in the QSM, the lab will use in house control charts.

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9.10. Surrogates are added to all standards, method blanks, laboratory control samples, analytical duplicates, matrix spike, matrix spike duplicate, external quality control samples, internal quality control samples, and all samples

9.10.1. Surrogate recoveries: The laboratory must evaluate surrogate recovery data from individual samples versus the surrogate control limits developed by the laboratory. Current control limits can be found in the Omega LIMS.

9.10.2. Control limits for DoD projects are found in Appendix C of the DoD QSM. DoD test codes will reflect these limits. For analytes that are not listed in the QSM, the lab will use in house control charts.

9.11. Analytical Duplicate

9.11.1. Duplicate analyses are preferentially carried out on samples containing contamination five times above the reporting limit. Duplicate analyses should not exceed established the QC limits documented in the Omega LIMS.

9.11.2. Relative Percent Difference (RPD) values are calculated using sample and duplicate concentrations from samples with concentrations greater than five times the detection limit.

10. INITIAL DEMONSTRATION OF PERFORMANCE

10.1. Each laboratory must demonstrate initial proficiency with each determinative method combination it utilized by generating data of acceptable accuracy and precision for target analytes in a clean matrix.

10.2. Analysts should prepare four replicate Laboratory Control Samples (LCS) for a given matrix and analyze them with a valid calibration.

10.3. Calculate the average and standard deviation of the four recoveries of the analytes in each of the four LCSs analyzed.

10.4. A more detailed description of the IDC procedure is outlined in SOP59.

11. CALIBRATION AND STANDARDIZATION

11.1. Preparation of Calibration Standards

11.1.1. Prepare calibration standards at a minimum of five concentration levels for each analyte of interest, and surrogate compounds by diluting appropriate volumes of a primary dilution standard solution that contains all analytes of interest and the surrogate. The lowest standard should represent analyte concentrations at or below the required reporting limit. For a list of calibration levels see Table 3. The remaining standards should bracket the analyte concentrations expected in the sample extracts and should define the working range of the detector.

11.1.2. Add 10 µL of the 200 µg/mL internal standard solution to a 1.0 mL aliquot of each calibration standard prior to analysis.

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11.2. GC/MS Tuning

11.2.1. The GC/MS system must be hardware-tuned using a 50 ng injection of DFTPP. The criteria listed in Table 4 must be met for DFTPP before beginning an initial calibration.

11.2.2. Three or more scans of the DFTPP peak (e.g. the peak apex scan and the scans immediately preceding and following the apex) are acquired and averaged. Background subtraction is required, and must be accomplished using a single scan acquired no more than 20 scans prior to the elution of DFTPP. The background subtraction should be designed only to eliminate column bleed or instrument background ions. Do not subtract part of the DFTPP peak.

11.2.3. Use the DFTPP mass intensity criteria in Table 4 as tuning acceptance criteria. Alternatively, other documented tuning criteria may be used (e.g. CLP, Method 525, or manufacturer's instructions), provided that method performance is not adversely affected. All subsequent standards, samples, MS/MSDs, and blanks associated with a DFTPP analysis must use the identical mass spectrometer instrument conditions.

11.2.4. The GC/MS tuning standard solution should also be used to assess GC column performance and injection port inertness. Benzidine and pentachlorophenol should be present at their normal responses, and no peak tailing should be visible. The tailing factor for benzidine should be < 2 and the tailing factor for pentachlorophenol should be < 2. Degradation of DDT to DDE and DDD should not exceed 20%. Use the following equation to calculate DDT breakdown:

$$\%degrade\ of\ 4{,}4'DDT = \frac{DDE + DDD}{DDT + DDD + DDE} \times 100$$

11.2.5. Structural isomers that produce very similar mass spectra should be identified as individual isomers if they have sufficiently different GC retention times. Sufficient GC resolution is achieved if the height of the valley between two isomer peaks is less than 50% of the average of the two peak heights. Otherwise, structural isomers are identified as isomeric pairs. Diastereomeric pairs (e.g., Aramite and Isosafrol) that may be separable by the GC should be identified, quantitated and reported as the sum of both compounds by the GC.

11.2.6. If poor chromatography is noted, the injection port may require cleaning or replacement of Inlet liner/septa. It may also be necessary to break off the first 6-12 in. of the capillary column and replace the injection port liner. The use of a guard column between the injection port and the analytical column may help prolong analytical column performance.

11.3. Internal Standards

11.3.1. Use the base peak ion from the specific internal standard as the primary ion for quantitation (see Table 1). If interferences are noted, use the next most intense ion as the quantitation ion (i.e. for 1,4-dichlorobenzene-d4, use 152 m/z for quantitation).

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11.4. Instrument Calibration

11.4.1. Analyze 1 µL of each calibration standard (containing internal standards) and tabulate the area of the primary characteristic ion against concentration for each target analyte (as indicated in Table 1). The injection volume must be the same for all standards and sample extracts. If a low level calibration is being performed, inject 2 µL for all calibration standards and extracts. If samples are extracted as, and require low level limits, they must be analyzed and quantitated under the methods that are maintained as low level.

11.4.2. A set of at least five calibration standards is necessary to evaluate the %RSD of the response factors (RFs). A minimum of 5 calibration points is required to construct a linear calibration curve, and a minimum of 6 points are required for non-linear curves.

11.4.3. Calculate response factors (RFs) for each target analyte relative to one of the internal standards.

11.4.4. Calculate the mean RF and the relative standard deviation (RSD) of the RFs for each target analyte. The RSD should be less than or equal to 20% for each target analyte (15% for DoD projects run in Scan mode).

11.4.5. If the RSD of any target analyte is 20% or less, then the relative RF is assumed to be constant over the calibration range, and the average relative RF may be used for quantitation.

11.4.6. If the RSD of any target analyte is greater than 20% (15% for DoD projects run in Scan mode), then the RF results from the analysis of standards are used to prepare a calibration curve for that compound. The calibration curve for each compound being analyzed must meet a requirement of $r^2 \leq 0.990$ for curve-fit. A linear regression may be used when 5 or more calibration points are analyzed. A quadratic curve may be used when 6 or more calibration points are analyzed. It may be appropriate to use a weighted regression (1/x or $1/x^2$) to account for potential bias at the low end of a calibration curve.

11.4.6.1. For EPA 625.1, RSD must be less than 35%. If using a regression curve, r^2 must be greater than or equal to 0.920 when weighted inversely proportional to the concentration.

11.4.7. For analytes in the calibration using a linear regression model, it is recommended that the low point of the calibration curve is re-calculated against the new calibration. It is not necessary to re-analyze the low calibration point; rather re-calculate the concentrations as if it were an unknown sample. The re-calculated concentration of the low calibration point should be within 50% of the standard's true concentration, with the rest of the points being within 30%. Any analytes which do not pass the re-fitting criteria and are being reported should be considered estimated if their concentration is at or near the concentration of the low calibration point.

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11.4.8. It is also required that a minimum response factor for the most common target analytes, as noted in Table 4, be demonstrated for each individual calibration level as a means to ensure that these compounds are behaving as expected. Meeting the minimum response factor criteria for the lowest calibration standard is critical in establishing and demonstrating the desired sensitivity. See Table 12 for a list of recommended minimum response factors (RFs).

11.4.9. When the RSD exceeds 20%, the plotting and visual inspection of a calibration curve can be a useful diagnostic tool. The inspection may indicate analytical problems, including errors in standard preparation, the presence of active sites in the chromatographic system, analytes that exhibit poor chromatographic behavior, etc.

11.4.10. Verify the calibration using a second source initial calibration verification (ICV) that is of a different lot number than the calibration standard and has not been through prep. The analytes in the ICV must have a recovery of 70%-130% (80%-120% for projects that require DoD criteria). If that criterion is not met, the standard may be immediately reanalyzed using a fresh standard. If the results do not verify the calibration curve, a new curve must be prepared. Samples analyzed in association with the failed ICV must be reanalyzed.

11.4.11. After the calibration has been processed, update the expected ion ratios for the analytes in the calibration based on the calibration midpoint.

11.5. Continuing Calibration Verification (CCV)

11.5.1. Calibration verification consists of three steps that are performed at the beginning of each 12-hour analytical shift.

11.5.2. Prior to the analysis of samples or calibration standards, inject 50 ng of the DFTPP standard into the GC/MS system. The resultant mass spectrum for DFTPP must meet the criteria given in Table 4 before sample analysis begins.

11.5.2.1. These criteria must be demonstrated each 12-hour shift during which samples are analyzed for 8270D, 625.1, or DoD analysis.

11.5.3. The continuing calibration for each compound of interest should be verified once every 12 hours prior to sample analysis, using the introduction technique and conditions used for samples. This is accomplished by analyzing a calibration standard at a concentration near the midpoint concentration for the calibrated range of the GC/MS. Acceptance criteria for non DoD samples is 80% of target analytes must pass 80%-120% from the true value.

11.5.3.1. For DoD projects, all target analytes must pass 80%-120%.

11.5.3.2. For EPA 625.1, the CCV will be prepared with a second source standard.

11.5.3.3. EPA 625.1 specific CCV limits can be found in Table 13.

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11.5.4. A calibration blank (CCB) may be analyzed after the calibration standard, or at any other time during the analytical shift, to ensure that the total system (introduction device, transfer lines and GC/MS system) is free of contaminants. If the CCB indicates contamination, then it may be appropriate to analyze a solvent blank to demonstrate that the contamination is not a result of carryover from standards or samples.

11.5.5. The retention times of the internal standards in the calibration verification standard must be evaluated immediately after, or during data acquisition. If the retention time for any internal standard changes by more than 30 seconds from that in the mid-point standard level of the most recent initial calibration sequence, then the chromatographic system must be inspected for malfunctions and corrections must be made, as required. When corrections are made, reanalysis of samples analyzed while the system was malfunctioning is required.

11.5.6. If the response for any of the internal standards in the calibration verification standard changes by a factor of two (- 50% to +100%) from that in the mid-point standard level of the most recent initial calibration sequence, the mass spectrometer must be inspected for malfunctions and corrections must be made. When corrections are made, reanalysis of samples analyzed while the system was malfunctioning is required.

11.5.7. Some maintenance procedures are so likely to affect the instrument response that recalibration is automatically required, regardless of the ability to meet the calibration verification acceptance criteria. These procedures include: changing, replacing, or reversing the column, and/or cleaning or replacing the source in the MS detector. Whenever such procedures are performed, the analyst must perform a new initial calibration that meets the requirements. Altering or replacing the GC column will also require that the retention time windows be re-determined.

11.5.8. The accuracy of calibration standards used are routinely verified by ensuring that the sample spiking solution used for creating quality control samples at the sample preparation stage are from a second source. Calibration standards should be periodically verified by analyzing a standard or PE sample prepared from reference material obtained from an independent source.

11.5.9. Should any of the calibration verification checks described above fail to meet the specified criteria, then it is necessary to re-calibrate the instrument by performing a new initial calibration.

11.5.9.1. EPA 625.1 allows for a second CCV for the analytes that failed in the first CCV. If the second CCV passes for those analytes that failed, the system is deemed acceptable. If they do not, maintenance and/or recalibration will be necessary.

11.5.9.2. DoD projects allow for two consecutive passing CCVs to be run to account for CCV failures. If both fails, maintenance and/or recalibration will be necessary.

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12. PROCEDURE

12.1. Sample Preparation

12.1.1. EPA method 3510C is used for aqueous samples, and EPA method 3550C is used for solid/soil samples. For herbicide extraction, see Herbicide Prep SOP94.

12.2. Instrument Set-up

12.2.1. Prepare the GC/MS for analysis according to the recommended parameters outlined below:

Scan Parameters

Mass Range	48-580 amu
Scan Time	0.5 sec/scan
Initial Temperature	40°C hold for 2.5 minutes
Temperature Program	40-320°C at 25°C/min
Final Temperature	320°C hold for 3 minutes
Injector Temperature	270°C
Transfer Line Temperature	325°C
Injector Type	Pulsed splitless
Injection Volume	1 µL (2 µL for low levels)
Carrier Gas	Helium at 49.021 cm/sec (1.0ml.min)

Selective Ion Monitoring (SIM) Parameters

Mass Range	Specific for each analyte (See Table 7)
Scan Time	0.5 sec/scan
Initial Temperature	40°C hold for 2.5 minutes
Temperature Program	40-320°C at 25°C/min
Final Temperature	320°C hold for 3 minutes
Injector Temperature	270°C
Transfer Line Temperature	325°C
Injector Type	Pulsed splitless
Injection Volume	1 µL
Carrier Gas	Helium at 49.021 cm/sec (1.0ml.min)

12.2.2. Other GC/MS conditions may be used if the QC requirements of this section are met.

12.3. Allow the sample extract to warm to room temperature. Just prior to analysis, add the internal standard solution to the 1-mL concentrated sample extract obtained from sample preparation.

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12.4. Inject a 1 µL aliquot of the sample extract into the GC/MS system using the same operating conditions that were used for the calibration. The injection volume must be the same volume used for the calibration standards.

12.5. If the response for any quantitation ion exceeds the initial calibration range of the GC/MS system, the sample extract must be diluted and reanalyzed. Additional internal standard must be added to the diluted extract to maintain the same concentration as in the calibration standards.

12.6. If the response for any of the internal standards in the samples changes by a factor of two, (-50% to + 100%) from that in the daily CCV, the mass spectrometer must be inspected for malfunctions and corrections must be made. When corrections are made, re-analysis of samples analyzed while the system was malfunctioning is required. DoD samples require the internal check to be done against the mid-point of the most recent initial calibration.

12.7. Instrument Standby

12.7.1. Upon completion of analyses, the GC/MS system should be left on with the "Standby" method loaded. In "Standby," the gas saver parameters are optimized to save carrier gas and the oven is cooled to room temperature to preserve the GC column.

13. DATA ANALYSIS AND CALCULATIONS

13.1. Qualitative Analysis

13.1.1. The qualitative identification of compounds determined by this method is based on retention time and on comparison of the sample mass spectrum, after background correction, with characteristic ions in a reference mass spectrum. Qualitative method validation for EPA 625.1 is satisfied by EPA method 8270E. The laboratory using the conditions of this method must generate the reference mass spectrum. The characteristic ions from the reference mass spectrum are defined as the three ions of greatest relative intensity, or any ions over 30% relative intensity, if less than three such ions occur in the reference spectrum. Compounds are identified when the following criteria are met.

13.1.2. The intensities of the characteristic ions of a compound must maximize in the same scan or within one scan of each other. Selection of a peak by a data system target compound search routine, where the search is based on the presence of a target chromatographic peak containing ions specific for the target compound at a compound-specific retention time, will be accepted as meeting this criterion.

13.1.3. The RRT of the sample component is within ± 0.06 RRT units of the RRT of the standard component.

13.1.4. The relative intensities of the characteristic ions agree within 30% of the relative intensities of these ions in the reference spectrum. (Example: For an ion with an abundance of 50% in the reference spectrum, the corresponding abundance in a sample spectrum can range between 20% and 80%).

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13.1.5. Identification is hampered when sample components are not resolved chromatographically and produce mass spectra-containing ions contributed by more than one analyte. When gas chromatographic peaks obviously represent more than one sample component (i.e., a broadened peak with shoulder(s) or a valley between two or more maxims), appropriate selection of analyte spectra and a background spectrum is important.

13.1.6. Examination of extracted ion current profiles of appropriate ions can aid in the selection of spectra and in qualitative identification of compounds. When analytes co-elute (i.e., only one chromatographic peak is apparent), the identification criteria may be met, but each analyte spectrum will contain extraneous ions contributed by the coeluting compound.

13.1.6.1. The software will generate a Q-Value to aid in the identification of the target compound based on the ratios of the primary and secondary ions, as compared to their ratios in the calibration.

13.1.7. For samples containing components not associated with the calibration standards, a library search may be made for the purpose of tentative identification. The necessity to perform this type of identification will be determined by the purpose of the analyses being conducted.

13.1.8. Once a compound has been identified, the quantitation of that compound will be based on the integrated abundance of the primary characteristic ion from the EICP.

13.2. Calculations

13.2.1. Calculations for batch QC can be found in the FAI. QA Manual.

13.2.2. Due to the calibration being made with methyl ester versions of the herbicide analytes, use the equation below to convert the extract concentration of the methyl ester analyte into the equivalent concentration of the requested free acid analyte. Appendix A contains the relevant molecular weights of the different forms of herbicides.

C_{ME} = Extract Methyl Ester Concentration as determined by instrument

C_{FA} = Extract Free Acid Concentration equivalent based on conversion

MW_{FA} = Molecular weight of free acid analyte

MW_{ME} = Molecular weight of methyl ester analyte

$$C_{FA} = C_{ME} \times \left(\frac{MW_{FA}}{MW_{ME}}\right)$$

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13.3. Typical Analytical Sequence:

13.3.1. Reagent Blank/Instrument Blank

13.3.2. Initial calibration (IC) – If necessary

13.3.3. Initial Calibration Verification (ICV)/Continuing Calibration Verification (CCV) meets acceptance limits.

13.3.4. Method Blank

13.3.5. Laboratory Control Sample

13.3.6. Matrix spike, spike duplicate analyses, run immediately after sample.

13.3.7. 20 Sample Maximum

13.3.8. Closing CCV

14. METHOD PERFORMANCE, DATA REVIEW, AND ACCEPTANCE CRITERIA

14.1. Method Detection Limits, Limits of Detection, Limits of Quantitation, Practical Quantitation Limits

14.1.1. Procedures to determine method performance are described in SOP53.

14.1.2. The list of routinely reported analytes and their associated reporting limits are listed in the Omega LIMS.

14.1.3. Only ATG Seattle employees who have been properly trained and have the required experience shall perform this method.

14.2. Data should be reviewed by the analyst and the department manager prior to submittal to the project managers.

14.3. Out of Control Results:

14.3.1. LCS: See the 8270/625 test codes in Omega LIMS for current control charted LCS spike recovery acceptance limits.

14.3.1.1. An LCS with percent recovery outside the control limit is re-analyzed. If the recovery is still outside the limit the batch is marked for re-extraction if possible. If an out of control recovery persists, the analytical system error is corrected before the analysis continues. If the data needs to be reported with an out of control LCS, the data is flagged and a case narrative is written. Possible cases where this might happen are rush sample or samples with limited volume. If the LCS percent recovery is high and the associated samples are non-detect, re-analysis or re-extraction may not be necessary.

14.3.2. Duplicates: See the 8270/625 test codes in Omega LIMS for current RPD acceptance limits.

14.3.2.1. Analytical Duplicates with RPD outside the control limit may be re-analyzed. If the difference is still outside the limit the duplicates may be re-extracted and re-analyzed. If an out of control difference persists the data is flagged and a case narrative is written.

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14.3.3. Surrogates: See the 8270/625 test codes in Omega LIMS for current control charted surrogate recovery acceptance limits.

14.3.3.1. Samples with surrogate recoveries outside the control limit may be re- analyzed. If surrogate recovery is still outside of limits the sample may be re-extracted and re-analyzed. Samples exhibiting obvious matrix interference as seen in the sample chromatogram may not need to be re-extracted. Narration describing the matrix effect is sufficient.

14.3.4. MS/MSDs: See the 8270/625 test codes in Omega LIMS for current control charted MS/MSD recovery acceptance limits.

14.3.4.1. Samples with MS/MSD recoveries outside the control limit may be re-analyzed. If MS/MSD recovery is still outside of limits, the sample may be re-extracted and re-analyzed. Samples exhibiting obvious matrix interference as seen in the sample chromatogram may not need to be re-extracted. Narration describing the matrix effect is sufficient.

15. POLLITION PREVENTION AND WASTE MANAGEMENT

15.1. All client samples that are below discharge limits are disposed of in the general waste drums as outlined in SOP*61.*Those that exceed the limits are introduced into the hazardous waste stream. In extreme circumstances, or if requested, the samples are sent back to the client.

16. REFERENCES

16.1. EPA Method 8270D, Revision 5, July 2014

16.2. EPA Method 8270E, Revision 6, February 2017

16.3. EPA Method 625.1, December 2016.

16.4. SW846, Method 8000D, Revision 5, March 2018.

16.5. 2016 NELAC Standard.

16.6. Department of Defense (DoD) Quality Systems Manual, v5.4, 2021.

17. TABLES

17.1. Table 1: Recommended Characteristic Ions for Semi Volatile Compounds

17.2. Table 2: Recommended Quantitation Limits (Scan SVOC)

17.3. Table 3: Typical Calibration Concentrations (Scan)

17.4. Table 4: DFTPP Key Ions and Ion Abundance Criteria

17.5. Table 5: Preparing B/N Surrogate Solution

17.6. Table 6: Preparing Semi-volatile Calibration Standards

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17.7. Table 7: Characteristic Ions for PAH, Organophosphorus (OP) Pesticides, and PCBs – SIM Analysis
17.8. Table 8: Example SIM Assignments and Parameters-PAH
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17.10. Table 10 Recommended Quantitation Limits (SIM PAH)
17.11. Table 11: Typical Calibration Concentrations (SIM)
17.12. Table 12: Recommended Minimum Response Factor Criteria
17.13. Table 13: EPA 625.1 Specific Quality Control Limits
17.14. Table 14: DoD Specific Quality Control Requirements for GC/MS by Scan mode.
17.15. Table 15: DoD Specific Quality Control Requirements for GC/MS by SIM mode.

18. APPENDICES

18.1. APPENDIX A: Analyzing and Reporting Low Level Analyses
18.2. APPENDIX B: Methyl Ester to Free Acid Herbicide Mass Conversion Chart.

19. CHANGES FROM LAST REVISION

19.1. Added language about analyzing herbicides using this method.
19.2. Added guidance to update ion ratios with each calibration.
19.3. Added a discussion of Q Values in the Data Analysis and Calculations section

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TABLE 1: RECOMMENDED CHARACTERISTIC IONS FOR SEMIVOLATILE COMPOUNDS

Component	MZ
1,2,4-Trichlorobenzene	180, 182, 145
1,2-Dichlorobenzene	146, 148, 111
1,2-Dinitrobenzene	168, 50, 63
1,3-Dichlorobenzene	146, 148, 111
1,3-Dinitrobenzene	168, 75, 76
1,4-Dichlorobenzene	146, 148, 111
1,4-Dinitrobenzene	75, 76, 168
1-Methylnaphthalene	142, 141, 115
2,3,4,6-Tetrachlorophenol	232, 131, 230, 166, 234, 168
2,3,5,6-Tetrachlorophenol	232, 230, 234
2,4,5-Trichlorophenol	196, 198, 97, 132, 99
2,4,6-Trichlorophenol	196, 198, 200
2,4-Dichlorophenol	162, 164, 98
2,4-Dimethylphenol	122, 107, 121
2,4-Dinitrophenol	184, 63, 154
2,4-Dinitrotoluene	165, 89, 91
2,6-Dinitrotoluene	165, 68, 89
2-Chloronaphthalene	162, 127, 164
2-Chlorophenol	128, 64, 130
2-Methylnaphthalene	142, 141, 115
2-Methylphenol (o-cresol)	107, 108, 77, 79, 80
2-Nitroaniline	65, 92, 138
2-Nitrophenol	139, 109, 65
3-Methylphenol (p-cresol)	107, 108, 77, 79, 80
3-Nitroaniline	138, 108, 92
4,6-Dinitro-2-methylphenol	198, 51, 105
4-Bromophenyl phenyl ether	248, 250, 141

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Component	MZ
4-Chloro-3-Methylphenol	107, 144, 142
4-Chloroaniline	127, 129, 92
4-Chlorophenyl phenyl ether	204, 206, 141
4-Methylphenol (p-cresol)	107, 108, 77, 79, 80
4-Nitroaniline	62, 138, 108
4-Nitrophenol	139, 109, 55
Acenaphthene	154, 153, 152
Acenaphthylene	152, 151, 153
Aniline	93, 65, 66
Anthracene	178, 176, 179
Azobenzene	77, 105, 182
Benzo(a)anthracene	228, 229, 226
Benzo(a)pyrene	252, 253, 125
Benzo(b)fluoranthene	252, 253, 125
Benzo(g,h,i)perylene	276, 138, 277
Benzo(j,k)fluoranthene	252, 253, 125
Benzo(k)fluoranthene	252, 253, 125
Benzoic Acid	105, 122, 77
Benzyl Alcohol	108, 77, 79
Benzyl Butyl Phthalate	149, 91, 206
Bis(2-chloroethoxy)methane	93, 95, 123
Bis(2-chloroethyl)ether	93, 63, 95
Bis(2-ethylhexyl)phthalate	149, 167, 279
Bis(2-Ethylhexyl)adipate	129, 112, 70
Carbazole	167, 166, 168
Chrysene	228, 226, 229
Dibenz(a,h)anthracene	276, 139, 279
Dibenzofuran	168, 139, 169
Diethyl phthalate	149, 177, 150
Dimethyl phthalate	163, 194, 164

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Component	MZ
Di-n-butyl phthalate	149, 150, 104
Di-n-octyl phthalate	149, 167 43
Diphenylamine	169, 168, 167
Fluoranthene	202, 101, 203
Fluorene	166, 165, 167
Hexachlorobenzene	284, 142, 249
Hexachlorobutadiene	225, 223, 227
Hexachlorocyclopentadiene	237, 235, 272
Hexachloroethane	117, 201, 199
Indeno(1,2,3-cd)pyrene	276, 138, 227
Isophrone	82, 54, 138
Naphthalene	128, 129, 127
Nitrobenzene	77, 123, 65
N-nitrosodimethylamine	42, 74
N-nitrosodipropylamine	70, 42, 101, 130
Pentachlorophenol	266, 264, 268
Phenanthrene	178, 179, 176
Phenol	94, 65, 66
Pyrene	202, 200, 203
Pyridine	52, 79

Surrogate	MZ
2-Fluorophenol	112, 64
Phenol-d6	99, 42, 71
Nitrobenzene-d5	82, 128, 54
2-Fluorobiphenyl	172, 171
2,4,6-Tribromophenol	330, 332, 141
4-Terphenyl-d14	244, 122, 212

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Internal Standard	MZ
1,4-Dichlorobenzene-d4	150, 152, 115
Naphthalene-d8	136, 68
Acenaphthene-d10	164, 162, 160
Phenanthrene	188, 94, 80
Chrysene-d12	240, 120
Perylene-d12	264, 260, 265

TABLE 2: RECOMMENDED QUANTITATION LIMITS (SCAN SVOC)

Matrix	Quantitation Limits
Soil/Sediment	0.08-0.50 mg/kg
Water	0.1-5 µg/L

TABLE 3: TYPICAL CALIBRATION CONCENTRATIONS (Scan SVOC)

Level #	Concentration (µg/L)
1	10
2	20
3	40
4	100
5	200
6	500
7	750
8	1000
9	2000
10	5000

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TABLE 4: DFTPP KEY IONS AND ION ABUNDANCE CRITERIA

8270D

Mass	Ion Abundance Criteria
51	30-60% of mass 198
68	<2% of mass 69
70	<2% of mass 69
127	40-60% of mass 198
197	<1% of mass 198
198	Base peak, 100% relative abundance
199	5-9% of mass 198
275	10-30% of mass 198
365	>1% of mass 198
441	Present but less than mass 443
442	>40% of mass 198
443	17-23% of mass 442

8270E

Mass	Ion Abundance Criteria
68	<2% of m/z 69
69	Present
70	<2% of m/z 69
197	<2% of m/z 198
198	Base peak or present
199	5-9% of m/z 198
365	>1% of Base Peak
441	<150% of m/z 443
442	Base peak or present
443	15-24% of m/z 442

TABLE 5: PREPARING 8270 SURROGATE STANDARD IN METHYLENE CHLORIDE

Surrogate Stock	Stock Spiking Solution Concentration	Amount of Stock Added	Final Volume	Final Working Standard Concentration
B/N Surrogate	5,000 µg/mL	300 µL	3 mL	500 µg/mL
Acid Surrogate	7,500 µg/mL	400 µL	3 mL	1000 µg/mL

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TABLE 6: PREPARING SEMIVOLAITILE CALIBRATION STANDARDS

Spike Conc. (ppb)	BN/Acid Surr Conc. (ppb)	2° Spike (uL)	8270 Surr (uL)	Internal Standard (uL)	Remove (uL)	Final Vol. (mL)
10	10/5	1	--	10	11	1
20	20/10	2	--	10	12	1
40	40/20	4	--	10	14	1
100	100/50	10	--	10	20	1
200	200/100	20	--	10	30	1
500	500/250	40	--	10	60	1
750	750/375	75	--	10	85	1
1000	1000/500	100	--	10	110	1
2000	2000/1000	200	--	10	210	1
5000	5000/2500	500	--	10	510	1
ICB	1000/500		1	10	11	1
ICV (1000 ppb)	1000/500	100 (2° SS)	--	10	110	1

	Mega Mix (uL)	2,4-DNP (uL)	Benzoic Acid (uL)	8270 Surr (uL)	Final Volume (mL)
2° Intermediate (cal)	100	100	100	100	10
2° Intermediate (SS)	50	50	50	50	5

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TABLE 7: RECOMMENDED CHARACTERISTIC IONS FOR PAH AND HERBICIDE - SIM ANALYSIS

PAH plus extended

Component	Quant Ion	Quant Ion 1	Quant Ion 2
1-Methylnaphthalene	142	141	115
2-Chloronaphthalene	162	127	164
2-Methylnaphthalene	142	141	115
Acenaphthene	152	151	153
Acenaphthylene	153	152	154
Anthracene	178	179	176
Benz(a)anthracene	228	229	226
Benzo(a)pyrene	252	253	125
Benzo(b)fluoranthene	252	253	125
Benzo(g,h,i)perylene	276	138	277
Benzo(j,k)fluoranthene	252	253	125
Benzo(k)fluoranthene	252	253	125
Benzyl Butyl phthalate	149	91	206
Bis(2-ethylhexyl)phthalate	149	167	279
Carbazole	167	166	168
Chrysene	228	226	229
Di-n-butyl phthalate	149	150	104
Di-n-octyl phthalate	149	167	279
Dibenz(a,h)anthracene	278	139	279
Dibenzofuran	168	139	169
Diethyl phthalate	149	177	150
Dimethyl phthalate	163	194	164
Fluoranthene	202	101	203
Fluorene	166	165	167
Indeno(1,2,3-cd)pyrene	276	138	227
Naphthalene	128	129	127
Pentachlorophenol	266	264	268
Phenanthrene	178	179	176
Pyrene	202	200	203

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PAH

Internal Standard	Quant Ion	Quant Ion 1	Quant Ion 2
1,4-Dichlorobenzene-d4	152	150	115
Naphthalene-d8	136	65	--
Acenaphthene-d10	164	162	160
Phenanthrene-d10	188	94	80
Chrysene-d12	240	120	236
Perylene-d12	164	260	265
Surrogate	**Quant Ion**	**Quant Ion 1**	**Quant Ion 2**
2-Fluorophenol	112	--	--
Phenol-d6	99	--	--
Nitrobenzene-d5	82	--	--
2-Fluorobiphenyl	172	--	--
Terphenyl-d4	244	--	--
Tetrachloro-m-xylene (PCB)	207	209	244
Decachlorobiphenyl (PCB)	498	178	214

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Herbicides

Component	Quant Ion	Quant Ion 1	Quant Ion 2
Dalapon ME	97	59	99
3,5-Dichlorobenzoic	173	175	204
4-Nitroanisole	153	77	92
2,4-D ME	199	175	45
Dicamba ME	203	205	188
Picloram ME	198	196	197
Pentachloranisole	280	265	237
Chloramben ME	188	219	190
2,4,5-TP ME	196	198	59
2,4,5-T ME	233	235	45
2,4-DB ME	101	59	41
Dinoseb ME	225	195	177
Bentazon ME	212	105	133
Dichloroprop ME	162	164	189
Acifluorfen ME	375	75	223
MCPP ME	169	142	228
MCPA ME	141	214	77

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TABLE 8: EXAMPLE SIM ASSIGNMENTS AND PARAMETERS – PAH

Component	Time	Dwell	Ions
Group 1	0	30	112, 64, 92
Group 2	9	30	99, 71, 281
Group 3	10	30	150, 152, 115
Group 4	12	30	82, 54, 128
Group 5	14	30	136, 68, 127, 128, 129
Group 6	15.8	30	172, 171, 170
Group 7	16	30	141, 142, 115, 172
Group 8	17.95	30	152, 151, 153
Group 9	18	30	160, 162, 164, 152, 153
Group 10	19	30	165, 166
Group 11	19.9	30	188, 178, 268, 266, 270
Group 12	23.8	30	100, 202, 100, 101, 244
Group 13	26	30	288, 240, 120, 236, 226, 229
Group 14	28.65	30	252, 253, 129, 260, 264
Group 15	28.81	30	252, 253, 264, 250, 126
Group 16	31.8	30	276, 278, 138, 139, 279

*Times will vary for each new SIM program

TABLE 9: EXAMPLE SIM ASSIGNMENTS AND PARAMETERS – OP PESTICIDES

Component	Time	Dwell	Ions
Group 1	4.29	30	109, 79, 185
Group 2	6.124	30	127, 192, 109
Group 3	6.964	30	99, 179, 263
Group 4	7.414	30	88, 99, 87, 158, 109, 127, 322, 75
Group 5	8.253	30	179, 88, 137, 97, 152
Group 6	8.711	30	109, 285, 173, 97, 278, 97, 109
Group 7	9.481	30	57, 329, 209, 109
Group 8	9.883	30	43, 113, 63, 267
Group 9	10.166	30	293, 322, 308, 156, 141
Group 10	10.657	30	77, 325, 326
Group 11	10.933	30	157, 169, 141, 63
Group 12	11.236	30	160, 132, 77, 104
Group 13	11.648	30	362, 109, 266, 97

*Times will vary for each new SIM program

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TABLE 10: RECOMMENDED QUANTITATION LIMITS (SIM PAH)

Matrix	Quantitation Limits
Soil/Sediment	0.05 mg/kg
Water	0.1 µg/L

TABLE 11: TYPICAL CALIBRATION CONCENTRATIONS (SIM)

PAH

Level	Concentration (µg/L)
1	10
2	20
3	40
4	100
5	200
6	500
7	750
8	1000
9	2000
10	5000

Herbicides

Level	Concentration (µg/L)
1	10
2	20
3	50
4	100
5	200
6	400
7	1000
8	2000

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TABLE 12: RECOMMENDED MINIMUM RESPONSE FACTOR CRITERA FOR INITIAL AND CONTINUING CALIBRATION VERIFICATION FOR SVOCS USING THE SUGGESTED IONS FROM TABLE 1

Semivolatile Compound	Minimum Response Factor (RF)
2,2'-Oxybis-(1-chloropropane)	0.01
2,3,4,6-Tetrachlorophenol	0.01
2,4,5-Trichlorophenol	0.2
2,4,6-Trichlorophenol	0.2
2,4-Dichlorophenol	0.2
2,4-Dimethylphenol	0.2
2,4-Dinitrophenol	0.01
2,4-Dinitrotoluene	0.2
2,6-Dinitrotoluene	0.2
2-Chloronaphthalene	0.8
2-Chlorophenol	0.8
2-Methylnaphthalene	0.4
2-Nitroaniline	0.01
2-Nitrophenol	0.1
3-Nitroaniline	0.01
4,6-Dinitro-2-methylphenol	0.01
4-Bromophenyl phenyl ether	0.1
4-Chloro-3-Methylphenol	0.2
4-Chloroaniline	0.01
4-Chlorophenyl phenyl ether	0.4
4-Nitroaniline	0.01
4-Nitrophenol	0.01
Acenaphthene	0.9
Acenaphthylene	0.9
Anthracene	0.7
Benzo(a)anthracene	0.8
Benzo(a)pyrene	0.7
Benzo(b)fluoranthene	0.7
Benzo(g,h,i)perylene	0.5
Benzo(j,k)fluoranthene	0.7
Benzo(k)fluoranthene	0.7
Benzyl Butyl Phthalate	0.01

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Semivolatile Compound	Minimum Response Factor (RF)
Bis(2-chloroethoxy)methane	0.3
Bis(2-chloroethyl)ether	0.7
Bis(2-ethylhexyl)phthalate	0.01
Carbazole	0.01
Chrysene	0.7
Dibenz(a,h)anthracene	0.4
Dibenzofuran	0.8
Diethyl phthalate	0.01
Dimethyl phthalate	0.01
Di-n-butyl phthalate	0.01
Di-n-octyl phthalate	0.01
Diphenylamine	0.01
Fluoranthene	0.6
Fluorene	0.9
Hexachlorobenzene	0.1
Hexachlorobutadiene	0.01
Hexachlorocyclopentadiene	0.05
Hexachloroethane	0.3
Indeno(1,2,3-cd)pyrene	0.5
Isophrone	0.4
Naphthalene	0.7
Nitrobenzene	0.2
N-Nitrosodiphenylamine	0.01
N-nitrosodipropylamine	0.5
Pentachlorophenol	0.05
Phenanthrene	0.7
Phenol	0.8
Pyrene	0.6

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TABLE 13: EPA 625.1 Specific Control Limits

Analyte	CCV Range (%)	LCS/MS/MSD Range (%)	%RPD for MS/MSD
1,2,4-Trichlorobenzene	61-130	44-142	50
2,4,6-Trichlorophenol	69-130	37-144	58
2,4-Dichlorophenol	64-130	39-135	50
2,4-Dimethylphenol	58-130	32-120	58
2,4-Dinitrophenol	39-173	D-191	132
2,4-Dinitrotoluene	53-130	39-139	42
2,6-Dinitrotoluene	68-137	50-158	48
2-Chloronaphthalene	70-130	60-120	24
2-Chlorophenol	55-130	23-134	61
2-Nitrophenol	61-163	29-182	55
4-Bromophenyl phenyl ether	70-130	53-127	43
4-Chloro-3-Methylphenol	68-130	22-147	73
4-Nitrophenol	35-130	D-132	131
Acenaphthene	70-130	47-145	48
Acenaphthylene	60-130	33-145	74
Anthracene	58-130	27-133	66
Benzo(a)anthracene	42-133	33-143	53
Benzo(a)pyrene	32-148	17-163	72
Benzo(b)fluoranthene	42-140	24-159	71
Benzo(g,h,i)perylene	13-195	d-219	97
Benzo(j,k)fluoranthene	25-146	11-162	63
Benzo(k)fluoranthene	25-146	11-162	63
Benzyl Butyl Phthalate	43-140	D-152	60
Bis(2-chloroethoxy)methane	52-164	33-184	54
Bis(2-chloroethyl)ether	52-130	12-158	108
Bis(2-ethylhexyl)phthalate	43-137	8-158	82
Chrysene	44-140	17-168	87
Dibenz(a,h)anthracene	13-200	D-227	126
Diethyl phthalate	47-130	D-120	100

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Analyte	CCV Range (%)	LCS/MS/MSD Range (%)	%RPD for MS/MSD
Dimethyl phthalate	50-130	D-120	183
Di-n-butyl phthalate	52-130	1-120	47
Di-n-octyl phthalate	21-132	4-146	69
Fluoranthene	47-130	26-137	66
Fluorene	70-130	59-121	38
Hexachlorobenzene	38-142	D-152	55
Hexachlorobutadiene	68-130	24-120	62
Hexachlorocyclopentadiene	68-130	24-120	62
Hexachloroethane	55-130	40-120	52
Indeno(1,2,3-cd)pyrene	13-151	D-171	99
Isophrone	52-180	21-196	93
Naphthalene	70-130	21-133	65
Nitrobenzene	54-158	35-180	62
N-nitrosodi-n-propylamine	59-170	D-230	87
Pentachlorophenol	42-152	14-176	86
Phenanthrene	67-130	54-120	39
Phenol	48-130	5-120	64
Pyrene	70-130	52-120	49

*LCS/MS/MSD & %RPD limits may be control charted when there are at least 20 representative samples run for this method. However, if in-house control limits are wider than the limits listed in Table 14, Table 14 limits must be used.
**For analytes not listed above, FAI will use the limits for 8270 as quality control criteria (CCV: 80-120%; RPD: 30%, LCS/MS/MSD: Control charts).
***Surrogates may be control charted when there are at least 20 representative samples run for this method. Until this occurs, the default surrogate recovery limits will be set at 60-140%.
D = Detected; result must be greater than zero

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TABLE 14: DoD SPECIFIC QUALITY CONTROL REQUIREMENTS FOR GC/MS IN SCAN MODE (From QSM 5.4)

Organic Analysis by Gas Chromatography/Mass Spectrometry (GC/MS) in SCAN MODE					
QC Check	**Minimum Frequency**	**Acceptance Criteria**	**Corrective Action**	**Flagging Criteria**	**Comments**
Tune Check	Prior to ICAL and prior to each 12-hour period of sample analysis.	Specific ion abundance criteria of BFB or DFTPP from method.	Retune instrument and verify.	Flagging is not appropriate.	No samples shall be analyzed without a valid tune.
Performance Check (Method 8270 only)	At the beginning of each 12-hour period, prior to analysis of samples.	Degradation ≤ 20% for DDT. Benzidine and pentachlorophenol shall be present at their normal responses and shall not exceed a tailing factor of 2.	Correct problem, then repeat performance checks.	Flagging is not appropriate.	No samples shall be analyzed until performance check is within criteria. The DDT breakdown and Benzidine/ Pentachlorophenol tailing factors are considered overall system checks to evaluate injector port inertness and column performance and are required regardless of the reported analyte list.
Initial calibration (ICAL) for all analytes (including surrogates)	At instrument set-up and after ICV or CCV failure, prior to sample analysis.	Each analyte must meet one of the three options below: Option 1: RSD for each analyte ≤ 15% Option 2: linear least squares regression for each analyte: $r^2 \geq 0.99$; *(continued next page)*	Correct problem then repeat ICAL.	Flagging is not appropriate.	Minimum 5 levels for linear and 6 levels for quadratic. No samples shall be analyzed until ICAL has passed.

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QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Initial calibration (ICAL) for all analytes (including surrogates) *(Continued)*		Option 3: non-linear least squares regression (quadratic) for each analyte: $r^2 \geq 0.99$.			If the specific version of a method requires additional evaluation (e.g., RFs or low calibration standard analysis and recovery criteria) these additional requirements must also be met.
Retention Time window position establishment	Once per ICAL and at the beginning of the analytical sequence.	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	NA.	NA.	Calculated for each analyte and surrogate.
Evaluation of Relative Retention Times (RRT)	With each sample.	RRT of each reported analyte within ± 0.06 RRT units.	Correct problem, then rerun ICAL.	NA.	After maintenance is performed which may affect retention times, RRTs may be updated based on the daily CCV. RRTs shall be compared with the most recently updated RRTs.
Initial Calibration Verification (ICV)	Once after each ICAL, analysis of a second source standard prior to sample analysis.	All reported analytes within ± 20% of true value.	Correct problem. Rerun ICV. If that fails, repeat ICAL.	Flagging is not appropriate.	No samples shall be analyzed until calibration has been verified with a second source.

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QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Continuing Calibration Verification (CCV)	Daily before sample analysis; after every 12 hours of analysis time; and at the end of the analytical batch run.	All reported analytes and surrogates within ± 20% of true value. All reported analytes and surrogates within ± 50% for end of analytical batch CCV.	Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails or if two consecutive CCVs cannot be run, perform corrective action(s) and repeat CCV and all associated samples since last successful CCV. Alternately, recalibrate if necessary; then reanalyze all associated samples since the last acceptable CCV.	If reanalysis cannot be performed, data must be qualified and explained in the Case Narrative. Apply Q-flag to all results for the specific analyte(s) in all samples since last acceptable calibration verification.	Results may not be reported without valid CCVs. Flagging is only appropriate in cases where the samples cannot be reanalyzed. If the specific version of a method requires additional evaluation (e.g., average RFs) these additional requirements must also be met.
Internal Standards (IS)	Every field sample, standard, and QC sample.	Retention time within ± 10 seconds from retention time of the midpoint standard in the ICAL; EICP area within – 50% to +100% of ICAL midpoint standard. On days when ICAL is not performed, the daily initial CCV can be used.	Inspect mass spectrometer and GC for malfunctions and correct problem. Reanalysis of samples analyzed while system was malfunctioning is mandatory.	If corrective action fails in field samples, data must be qualified and explained in the Case Narrative. Apply Q-flag to analytes associated with the noncompliant IS. Flagging is not appropriate for failed standards.	NA.

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QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Method Blank (MB)	One per preparatory batch.	No analytes detected > ½ LOQ or > 1/10th the amount measured in any sample or 1/10th the regulatory limit, whichever is greater. Common contaminants must not be detected > LOQ.	Correct problem. If required, reprep and reanalyze MB and all QC samples and field samples processed with the contaminated blank.	If reanalysis cannot be performed, data must be qualified and explained in the Case Narrative. Apply B-flag to all results for the specific analyte(s) in all samples in the associated preparatory batch.	Results may not be reported without a valid Method Blank. Flagging is only appropriate in cases where the samples cannot be reanalyzed.
Laboratory Control Sample (LCS)	One per preparatory batch.	A laboratory must use the QSM Appendix C Limits for batch control if project limits are not specified. If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes if sufficient sample material is available.	If reanalysis cannot be performed, data must be qualified and explained in the Case Narrative. Apply Q-flag to specific analyte(s) in all samples in the associated preparatory batch.	Must contain all surrogates and all analytes to be reported. Results may not be reported without a valid LCS. Flagging is only appropriate in cases where the samples cannot be reanalyzed.
Matrix Spike (MS)	One per preparatory batch.	A laboratory must use the QSM Appendix C Limits for batch control if project limits are not specified. If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified.	Examine the project specific requirements. Contact the client as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met and explain in the Case Narrative.	Must contain all surrogates and all analytes to be reported. For matrix evaluation only. If MS results are outside the limits, the data shall be evaluated to determine the source(s) of difference, i.e., matrix effect or analytical error.

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QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Matrix Spike Duplicate (MSD) or Matrix Duplicate (MD)	One per preparatory batch.	A laboratory must use the QSM Appendix C Limits for batch control if project limits are not specified. If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified. MSD or MD: RPD of all analytes ≤ 20% (between MS and MSD or sample and MD).	Examine the project specific requirements. Contact the client as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met and explain in the Case Narrative.	MSD: Must contain all surrogates and all analytes to be reported. The data shall be evaluated to determine the source of difference. For Sample/MD: RPD criteria only apply to analytes whose concentration in the sample is greater than or equal to the LOQ.
Surrogate Spike	All field and QC samples.	QC acceptance criteria specified by the project if available; otherwise use QSM Appendix C limits or in-house LCS limits if analyte(s) are not listed.	Correct problem, then reprep and reanalyze all failed samples for all surrogates in the associated preparatory batch if sufficient sample material is available. If obvious chromatographic interference is present, reanalysis may not be necessary, but the client must be notified prior to reporting data and the failures must be discussed in the Case Narrative.	Apply Q-flag to all associated analytes if acceptance criteria are not met and explain in the Case Narrative.	Alternative surrogates are recommended when there is obvious chromatographic interference.

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20. TABLE 15: DoD SPECIFIC QUALITY CONTROL REQUIREMENTS FOR GC/MS IN SIM MODE (From QSM 5.4)

Organic Semi-Volatile Analysis by GC/MS in SIM Mode					
QC Check	**Minimum Frequency**	**Acceptance Criteria**	**Corrective Action**	**Flagging Criteria**	**Comments**
Tune Check	Prior to ICAL and prior to each 12-hour period of sample analysis.	Specific ion abundance criteria of DFTPP from method 8270. Tune check can be acquired as a full scan.	Retune instrument and verify.	Flagging is not appropriate.	No samples shall be analyzed without a valid tune. In addition to the full scan tune check, optimization for the analytes of interest is recommended.
Deuterated Monitoring Compounds (DMCs) (surrogates)	All field and QC samples.	PAH analysis: DMCs required for polyaromatic hydrocarbon (PAH) target analytes: fluoranthene-d_{10} and 2methylnaphthalene-d_{10}. Minimum RRF for PAH DMCs: 0.40. All DMCs: Requires 50-150% recovery until in-house limits can be established.	Correct problem, and then reprep and reanalyze all samples with failing DMCs if sufficient sample material is available. If obvious chromatographic interference is present, reanalysis may not be necessary, but the client must be notified prior to reporting data and the failures must be discussed in the Case Narrative.	Apply Q-flag to all associated samples and analytes if acceptance criteria are not met and explain in the Case Narrative.	For non-PAH target analytes, other DMCs with similar chemistry must be assigned. Laboratories may use the same extract for full scan and SIM analysis if the SIM-specific DMCs are added prior to extraction.

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QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Performance Checks	At the beginning of each 12-hour period, prior to analysis of samples.	Degradation ≤ 20% for DDT.	Correct problem, then repeat performance checks.	Flagging is not appropriate.	No samples shall be analyzed until the performance checks are within criteria. DDT breakdown and tailing factors are considered overall measures of port inertness and column performance and are required checks for SIM operation. DDT breakdown and tailing factor checks can be acquired as a full scan.
Initial Calibration (ICAL) for all analytes	At instrument set-up, prior to sample analysis.	Each analyte must meet one of the following options: RSD for each analyte ≤ 20% [If pentachlorophenol is a target analyte, an RSD of ≤ 40% allowed] **or** Linear least squares regression for each analyte: $r^2 \geq 0.99$.	Correct problem then repeat ICAL.	Flagging is not appropriate.	Minimum 5 levels required for ICAL with one calibration point at the same concentration as the daily CCV. No samples shall be analyzed until ICAL has passed.
Retention Time window position establishment	Once per ICAL and at the beginning of the analytical sequence.	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	NA.	NA.	Calculated for each analyte.

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QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Evaluation of Relative Retention Times (RRT)	With each sample.	RRT of each reported analyte within ± 0.06 RRT units of the mean RRT of the calibration standards. RRTs may be updated based on the daily CCV.	Correct problem, then rerun ICAL.	NA.	RRTs shall be compared with the most recently updated RRTs. Characteristic ions must maximize in the same scan or within one scan of each other. After any maintenance is performed which could affect retention times, RRTs may be updated based on the daily CCV.
Initial Calibration Verification (ICV)	Once after each ICAL, analysis of a second source standard prior to sample analysis.	All reported analytes within ± 20% of true value. If pentachlorophenol is a target analyte, a %D from true value of ± 50% is allowed.	Correct problem. Rerun ICV. If that fails, repeat ICAL.	Flagging is not appropriate.	No samples shall be analyzed until calibration has been verified with a second source.

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QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Continuing Calibration Verification (CCV)	Daily before sample analysis; after every 12 hours of analysis time; and at the end of the analytical batch run.	Concentration the same as the mid-point calibration standard (or lower). All reported analytes within ± 20% of true value. If pentachlorophenol is a target analyte, a %D from true value of ± 50% is allowed. All reported analytes within ± 50% for end of analytical batch CCV.	Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails or if two consecutive CCVs cannot be run, perform corrective action(s) until a passing CCV is attained, and then reanalyze all associated samples since last acceptable CCV. Alternatively, perform an ICAL (including appropriate instrument QC) if necessary; then reanalyze all associated samples since the last acceptable CCV.	If reanalysis cannot be performed, data must be qualified and explained in the Case Narrative. Apply Q-flag to all results for the specific analyte(s) in all samples since last acceptable calibration verification.	Results may not be reported without valid CCVs. Flagging is only appropriate in cases where the samples cannot be reanalyzed. If the specific version of a method requires additional evaluation (e.g., average RFs), these additional requirements must also be met.

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QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Internal Standards (IS)	Every field sample, Standards, blanks, and QC sample.	Retention time within ± 10 seconds from retention time of the midpoint standard in the ICAL; EICP area within -50% to +100% of ICAL midpoint standard. On days when ICAL is not performed, the initial CCV is used.	Inspect mass spectrometer and GC for malfunctions and correct problem. Reanalysis of samples analyzed while system was malfunctioning is mandatory.	If corrective action fails in field samples, data must be qualified and explained in the Case Narrative. Apply Q-flag to analytes associated with the non-compliant IS. Flagging is not appropriate for failed standards.	Internal Standard is spiked no greater than 0.40 ng/µL concentration. According to the EPA Contract Laboratory Program Statement of Work (CLP SOW), this is the concentration of internal standard specified for SIM analysis. The SOW indicates calibration standards range from 0.10 to 1.0 ng/µL, so 0.40 ng/µL is mid- range. 1, 4dichlorobenzene-d4 is ignored for SIM.
Method Blank (MB)	One per preparation batch, prior to analysis of any field samples.	No analytes detected > ½ LOQ or > 1/10th the amount measured in any sample or 1/10th the regulatory limit, whichever is greater.	Conduct investigation to determine the source of the contamination and take appropriate corrective actions. Correct problem. If required, reprep and reanalyze MB and all QC samples and field samples processed with the contaminated blank.	If reanalysis cannot be performed, data must be qualified and explained in the Case Narrative. Apply B-flag to all results for the specific analyte(s) in all samples in the associated analytical batch.	Laboratories may use the same extract for full scan and SIM analysis provided the applicable DMCs and IS are spiked at the appropriate concentrations. Results may not be reported without a valid Method Blank. Flagging is only appropriate in cases where the samples cannot be reanalyzed.

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QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Laboratory Control Sample (LCS)	One per preparation batch.	A laboratory must use the QSM Appendix C Limits (8270 SIM) for batch control if project specific limits are not specified. If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified.	Correct problem, and then reanalyze the LCS and all samples in the associated analytical batch for failed analytes if sufficient sample material is available.	If reanalysis cannot be performed, data must be qualified and explained in the Case Narrative. Apply Q-flag to specific analyte(s) in all samples in the associated analytical batch.	Must contain all analytes to be reported. Results may not be reported without a valid LCS. Flagging is only appropriate in cases where the samples cannot be reanalyzed.
Matrix Spike (MS)	One per preparation batch.	A laboratory must use the QSM Appendix C Limits (8270 SIM) for batch control if project specific limits are not specified. If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified.	Examine the project specific requirements. Contact the client as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply the J-flag if acceptance criteria are not met and explain in the Case Narrative.	Must contain all analytes to be reported spiked at concentrations appropriate for SIM analysis. For matrix evaluation only. If MS results are outside the limits, the data shall be evaluated to determine the source(s) of difference (i.e., matrix effect or analytical error).
Matrix Spike Duplicate (MSD) or Matrix Duplicate (MD)	One per preparation batch.	A laboratory must use the QSM Appendix C Limits (8270 SIM) for batch control if project specific limits are not specified. If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified. MSD or MD: RPD of all analytes ≤ 40% (between MS and	Examine the project specific requirements. Contact the client as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply the J-flag if acceptance criteria are not met and explain in the Case Narrative.	The MSD must contain all analytes to be reported spiked at concentrations appropriate for SIM analysis. All data must be evaluated to determine the source of difference. For Sample/MD: RPD criteria only apply to analytes whose concentration in the sample is greater than or equal to the LOQ.

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		MSD or sample and MD).			
QC Check	**Minimum Frequency**	**Acceptance Criteria**	**Corrective Action**	**Flagging Criteria**	**Comments**
Characteristic ions for MS confirmation	Minimum 3 ions.	The relative intensities of the characteristic ions of target analytes agree within 30% of the relative intensities in the reference spectrum and the relative intensities must be > 0. Confirmation requires S/N ratio of ≥ 3 for each quant and confirmation ion.	No data can be reported without MS confirmation.	NA.	Need 3 structurally significant ions that are logical fragments – not isotopic clusters. Internal standard and DMC can use fewer than 3 ions.

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APPENDIX A: Analyzing and Reporting Low Level Analyses

1. Test Codes:

The actions required are for the following test codes:

- O-PAH-W-SIM-625-LL
- O-PAH-W-SIM-LL
- O-PCB-W-LL
- O-PCB-W-LL-608
- Any future test code where the Method Detection Limit does not meet clean-up and action level requirements

2. Quality Control (QC Types) Required

An additional QC spike sample will be added to the analytical batch for verification/demonstration of capability to quantitate compound at the desired level. The QC Type sample that shall be selected is "LOQ" indicating ***Limit of Quantitation.***

2.1 All tests codes noted shall have a 0.01ppb spike added to the extraction batch.

2.2 The spikes will be extracted and analyzed like all batch QC and laboratory samples.

2.3 The additional spike will be brought into Omega as a LOQ QC Type sample in order to demonstrate the sensitivity of the analytical system at this level.

2.3.1 This LOQ QC sample shall be included in the analytical report to the client.

2.3.2 The LOQ QC sample must recover spiked analytes between 50-150% to allow unqualified quantitation below the test's standard LOQ. The spiked analytes in the LOQ QC sample must also have a signal-to-noise above 3 to verify samples that are non-detect at the level of the LOQ QC sample.

2.3.3 The signal-to-noise report shall be attached to the analytical run for reference. It is not necessary to distribute with the final report

2.3.3 While it is highly preferable that both %recovery (%Rec) and signal-to-noise (S/N) checks pass, there are some scenarios where failing results may be acceptable. In the chart below, the results of the LOQ QC Sample checks are shown in the columns and the scenarios for detections in client samples are shown in the rows. "Good" means the result may be reported without qualification. "Fail" means the LOQ QC Sample and/or client sample must be re-run or qualified. "Requires Approval" means the QA Manager or delegate must approve before results are reported without qualification, as they represent situations that require additional scrutiny.

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For Each Analyte:		Results of LOQ QC Sample				
Analyte Detection in Sample		%Rec Passes, S/N Passes	%Rec Fails High, S/N Passes	%Rec Fails Low, S/N Passes	%Rec Passes, S/N Fails	%Rec Fails, S/N Fails
	> Standard LOQ	Good	Good	Good	Good	Good
	< Standard LOQ, > Standard LOD	Good	Fail	Fail	Requires Approval	Fail
	< Standard LOD, > LL LOQ Spike	Good	Fail	Fail	Fail	Fail
	Non-Detect	Good	Good	Requires Approval	Fail	Fail

The Standard LOQ and LOD refer to the LOQ and LOD of the standard version of the test. For example, the standard version of O-PCB-W-LL is O-PCB-W.

2.3.4 Some of these scenarios include:

- *Spike Recovery is above 150%, Analyte not detected, S/N > 3:* If the analyte is not detected, then the results shall be reported without qualification
- *Spike Recovery is above 150%, Analyte not detected, S/N < 3:* The failed signal-to-noise check shows we cannot determine that the analyte is non-detect at this level, so it must be re-run or qualified.
- *Spike Recovery is above 150% - Analyte Detection, Any S/N*: If the analyte is detected above the Low Level PQL, the results shall be qualified with a S accompanied with the S narrative. The report shall be distributed as a preliminary report. The samples should be re-extracted and re-analyzed.

  Note: If the spiked LOQ sample is observed with a low recovery, the LOQ should be immediately re-analyzed to see if the recoveries come into range (similar to a re-analysis of a CCV). If the calibration window has passed, then the LOQ can be analyzed on subsequent days as long as the opening CCV for the respective analyte passed criteria.
- *Spike Recovery is above 150% - Analyte Detection is above standard, non-low level PQL, Any S/N*: If the analyte is detected AND the detection is >standard/non-low level PQL AND the LCS and CCV recovery for that analyte is within range, then the report can be distributed as final. The LCS and CCV must pass.

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Example

Analyte	LOQ (0.01) Spike Result	LOQ (0.01) Signal-to-Noise	LL PQL	Standard PQL	LL Test Results
Benzo (a) Pyrene	48%	2.2	0.01	0.1	**0.25**

LCS and CCV must pass spike recovery

Since the detection is greater than the Standard PQL the data does not need to be qualified as long as the LCS and CCV pass.

- *Spike Recovery is below 50%:* If the analyte spike recovery is below 50%, then the samples shall be re-extracted and re-analyzed.

  Note: If the spiked LOQ sample is observed with a low recovery, the LOQ should be immediately re-analyzed to see if the recoveries come into range (similar to a re-analysis of a CCV). If the calibration window has passed, then the LOQ can be analyzed on subsequent days as long as the opening CCV for the respective analyte passed criteria.
  Note 2: It may be possible to report a non-detect with a low-failing %Rec test if the S/N test passes. This requires additional scrutiny of these results, so QA approval is required.

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APPENDIX B: Methyl Ester to Free Acid Herbicide Mass Conversion Chart.

Methyl Ester to Free Acid Conversion Information			
	Acid	Methyl Ester	Conversion
Free Acid Herbicide	**M.W.**	**M.W.**	**Factor**
Dalapon	143.97	157.00	0.917
3,5-Dichlorobenzoic acid	191.01	204.95	0.932
4-Nitrophenol	139.11	153.20	0.908
2,4-D	221.04	235.15	0.94
Dicamba	221.04	249.20	0.887
Picloram	241.04	256.43	0.94
Pentachlorophenol	266.34	280.36	0.95
Chloramben	206.02	220.11	0.936
2,4,5-TP (Silvex)	269.51	283.40	0.951
2,4,5-T	255.48	269.49	0.948
2,4-DB	249.09	263.03	0.947
Dinoseb	240.22	254.20	0.945
Bentazon	240.28	254.26	0.945
Dichloroprop	234.01	239.03	0.979
Acifluorfen	361.66	375.56	0.963
MCPP	214.65	228.59	0.939
MCPA	200.62	214.57	0.935

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Volatile Organic Compounds in Air by Gas Chromatography/Mass Spectrometry by EPA Method TO-15

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v2.4	November 5, 2020	Edits/Revisions – W.Chang
v2.5	May 19, 2021	Edits/Revisions – M. Schimelfenig
v2.6	May 17, 2022	Updated to QSM Version 5.4 – A. Kegley
v2.7	January 27, 2023	Edits/Revisions – M. Schimelfenig
v2.8	August 2024	Edits/Revisions – M. Schimelfenig
v2.9	December 2024	Edits and Revisions – Lily B.

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1. SCOPE AND APPLICATION

1.1. This method documents the analytical procedures used at Alliance Technical Group for measuring subsets of volatile organic compounds (VOCs), volatile sulfur and siloxane compounds, and Air-Phase Petroleum Hydrocarbons (APH). VOCs are defined here as organic compounds with a vapor pressure greater than 10^{-1} Torr, at 25°C and 760 mm Hg.

1.2. The analytes that are covered by this SOP may be found in Appendix A.

2. SUMMARY OF METHOD

2.1. Samples are taken by the introduction of air into sampling equipment provided by the laboratory.

2.1.1. Canisters (1L, 1.4L or 6L) are sent to clients in an evacuated state. These may be used for sub-atmospheric and pressurized sampling methods. Clients may require extra equipment such as pumps or flow regulators, depending on the type of sampling being employed.

2.1.2. Samples may also be collected in Tedlar® bags or high-pressure cylinders.

2.2. Upon receipt by the laboratory, canister pressures are documented to ensure there is enough sample volume to run the requested analyses.

2.3. Samples are analyzed by Gas Chromatograph-Mass Spectrometer (GC-MS) after going through a preconcentrating step that may or may not use cryogen focusing.

2.3.1. During the preconcetration, a certain volume of sample is focused onto a two trap-module system, where analytes of interest are concentrated in preparation to be loaded on to the GC column.

2.3.2. When the sample is desorbed onto the GC column, analytes are separated into their individual ions to be read by the MS. Their fragmentation patterns may then be analyzed in order to identify compounds of interest in the sample.

3. DEFINITIONS

3.1. Common definitions can be found in the Quality Assurance Manual

3.2. Gauge – Tool to measure pressure with reference to the surrounding atmospheric pressure usually expressed in psi and Hg. Zero gauge pressure is equal to atmospheric (barometric) pressure.

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3.3. Method Blank - An analyte-free matrix (Nitrogen) carried through the complete analytical procedure and is used to document contamination resulting from the analytical process. For a Method Blank to be acceptable for use with accompanying samples, the blank concentration of any analyte of concern should not be higher than the highest of either: (1) the method limit, (2) five percent of the regulatory limit for that analyte, or (3) ten percent of the measured concentration in the sample.

3.4. Nominal Injection Volume – The volume at which your analytical method is set so that reporting limits are not affected. For example, if you have a canister with 20ppb of standard and your nominal injection volume is 250cc, when you run 250cc of your 20ppb standard, the instrument output value is 20ppbv. Nominal injection volumes may be changed as long as calibrations are adjusted accordingly.

4. INTEFERENCES

4.1. Very volatile compounds, such as chloromethane and vinyl chloride can display peak broadening and co-elution with other species if the compounds are not delivered to the GC column in a small volume of carrier gas. Refocusing of the sample after collection on the primary trap, either on a separate focusing trap or at the head of the gas chromatographic column, mitigates this problem.

4.2. Interferences in canister samples may result from improper use or from contamination of: (1) the canisters due to poor manufacturing practices, (2) the canister cleaning apparatus, and (3) the sampling or analytical system. Attention to the following details will help to minimize the possibility of contamination of canisters.

4.2.1. Canisters should be manufactured using high quality welding and cleaning techniques, and new canisters should be filled with humidified nitrogen and then analyzed, after “aging” for 24 hours, to determine cleanliness. The cleaning apparatus, sampling system, and analytical system should be assembled of clean, high quality components and each system should be shown to be free of contamination.

4.3. Canisters should be stored in a contaminant-free location and should be sealed during shipment to prevent leakage and minimize any compromise of the sample.

4.3.1. Impurities in the calibration dilution gas (if applicable) and carrier gas, organic compounds out-gassing from the system components ahead of the trap, and solvent vapors in the laboratory account for the majority of contamination problems. The analytical system must be demonstrated to be free from contamination under the conditions of the analysis by running humidified nitrogen blanks. The use of non-chromatographic grade stainless steel tubing, non-PTFE thread sealants, or flow controllers with Buna-N rubber components should be avoided.

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4.4. Significant contamination of the analytical equipment can occur whenever samples containing high VOC concentrations are analyzed. This in turn can result in carryover contamination in subsequent analyses. Whenever a high concentration (>25 ppbv of a trace species) sample is encountered, it should be followed by an analysis of humid nitrogen to check for carry-over contamination.

4.5. Samples in High Pressure Cylinders exceeding 25psia can have inconsistent reproducibility due to the decreasing pressure as sample is released in each subsequent injection. When possible, samples with such high pressures should be off-gassed in a hood until they reach a lower, but still positive, pressure.

5. SAFETY

5.1. All samples received for analysis should be considered hazardous and handled accordingly.

5.2. Some reagents and standards used in this method are hazardous. Before using this method, individuals who are unfamiliar with the hazards associated with these chemicals should refer to the material safety data sheets (SDS) available in the laboratory.

5.3. It is the responsibility of the analyst to review and understand laboratory safety policies prior to performing any procedures outlined in this SOP.

6. EQUIPMENT AND SUPPLIES

6.1. Sampling Equipment – FAI does not perform sampling but may supply sampling equipment to clients.

6.1.1. Sampling Inlet Line/Sample Manifold: Stainless steel tubing to connect the sampler to the sample inlet.

6.1.2. Sample Canister: Leak-free stainless steel pressure vessels of desired volume (e.g., 1.4L, 6L), with valve and specially prepared interior surfaces.

6.1.3. High Pressure Cylinder: Leak-free Sulfinert high pressure vessels that hold 500cc and are equipped with a needle valve.

6.1.4. Tedlar® Bag: Gas sampling bags

6.1.5. Stainless Steel Vacuum/Pressure Gauges: Capable of measuring vacuum (–100 to 0 kPa or 0 to - 30 in Hg) and pressure (0–206 kPa or 0–30 psig) in the sampling system and a Gauges should be tested, clean, and leak tight.

6.1.6. Flow Controllers: Capable of maintaining a constant flow rate over a sampling period of up to 24 hours and under conditions of changing temperature (20–40°C) and humidity.

6.1.7. Particulate Matter Filter: 2-Fm sintered stainless steel in-line filter.

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6.1.8. Chromatographic Grade Stainless Steel Tubing and Fittings: For interconnections. All such materials in contact with sample, analyte, and support gases prior to analysis should be chromatographic grade stainless steel or equivalent.

6.1.9. Fixed Orifice: May be used in lieu of the electronic flow controller for grab samples or short duration time-integrated samples.

6.2. Analytical Apparatus

6.2.1. Autosampler System: Entech 7650-M and 7016A or equivalent, with a capacity for holding multiple canisters and Tedlar® bags.

6.2.2. Preconcentrator system: Entech 7200 and 7200CTS, or equivalent.

6.2.2.1. A multiple module trapping system that focuses target analytes to be transferred to the GC-MS.

6.2.2.1.1. The Entech 7200 traps analytes onto modules using cryogenic focusing methods that are controlled by solenoid valves.

6.2.2.1.2. The Entech 7200CTS traps analytes onto capillary column modules and does not require cryogenic focusing.

6.2.2.2. Volume is controlled using an Electronic Volume Controller which accurately measures volume going through the system.

6.2.2.3. Silonite-D tubing is outfitted throughout the preconcentrator to create an inert flow path to the GC.

6.3. Gas Chromatography/Mass Spectroscopy (GC-MS) System

6.3.1. Gas chromatograph such as an Agilent 7890 or equivalent, that is able to be interfaced directly to the preconcentrator. GCs must be capable of temperature programming. All GC carrier gas lines should be constructed from stainless steel or copper tubing.

6.3.2. GC columns should be 60meter x 0.32 mmID x 1.0 micron for systems running with preconcentrators capable of cryogen focusing. For cryogen-less systems, GC columns should be 60 meters x 0.32mmID x 2.0 (or 1.8) micron.

6.3.3. A mass spectrometer such as an Agilent 5975, 5977, or equivalent with metal quadrupoles that is capable of scanning from 25 to 300 amu every 1 second or less, utilizing 70 volts (nominal) electron energy in the electron impact ionization mode, and producing a mass spectrum which meets all of the instrument performance acceptance criteria when 50ng or less of *p*-bromofluorobenzene (BFB) is analyzed.

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6.3.4. GC to MS Interface: A gas chromatograph to mass spectrometer interface that gives acceptable calibration points for each of the analytes of interest and can be used to achieve all acceptable performance criteria may be used. This interface is typically a direct interface between the capillary column and the MS.

6.3.5. Data System- Agilent Chemstation, Masshunter, or equivalent: This computer system is interfaced to the mass spectrometer and must allow the continuous acquisition and storage, on machine readable media, of all mass spectra obtained throughout the duration of the chromatographic program. The computer has software that allows searching any GC/MS data file for ions of a specified mass and plotting such ion abundances versus time or scan number.

6.3.6. Off-line Data Storage Device: Alliance Technical Group Data Archives. An offline data storage device which is capable of rapid recording and retrieval of data and must be suitable for long-term, offline data storage is required for this method.

6.4. Support Equipment

6.4.1. Canister Cleaning System: Entech 3100D, or equivalent

6.4.1.1. System capable of cleaning multiple canisters at once using cycles of evacuations, heat, and pressurization.

6.4.2. Dynamic Diluter System: Entech 4700, or equivalent

6.4.2.1. System that allows for the dilution of samples and the preparation of calibration standards.

6.4.3. Flow Regulator calibration system: Entech Flow Professor, or equivalent.

6.4.3.1. System that allows for the accurate calibration of flow regulators, set to desired flow rates and sampling times based on client need.

7. REAGENTS AND STANDARDS

7.1. Neat Materials or manufacturer certified solutions/mixtures. The must be NIST certified and traceable. Certificates of analysis must be retained to track traceability and expiration.

7.1.1. Secondary dilutions standards are created from manufactured or neat materials to be used as working spiking standards.

7.1.2. TO-15 and APH working standards are prepared on the Dynamic Diluter.

7.1.3. Siloxane standards are prepared from neat materials (Appendix F).

7.1.4. Sulfur standards are prepared by diluting certified mixtures (Appendix F).

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7.2. Helium: Ultra-high purity grade to be used as the GC carrier gas and a flush gas in preconcentrators.

7.3. Nitrogen: Ultra-high purity grade to be used as the preconcentrator backflush and inject gas. This is also used to make dilutions and standards.

7.4. Liquid Nitrogen: Used for cryogen focusing on the preconcentrator.

7.5. Deionized Water: Reagent grade laboratory water used as a humidifier in canisters and in canister cleaning systems.

8. SAMPLE COLLECTION, SHIPMENT AND STORAGE

8.1. Sample collection is not applicable to this SOP

8.2. Clean canisters, flow regulators, and/or high pressure cylinders should be packaged for shipping, with extra care taken to prevent any damage to the equipment.

8.3. Samples are stored in the air lab, isolated from organic solvents to prevent in-lab contamination.

9. QUALITY CONTROL

9.1. To be compliant with TO-15, the following three criteria must be met:

9.1.1. The method detection limit (MDL) for VOC analytes must be $\leq$ 0.5ppbv

9.1.2. Replicate precision must be within 25%

9.1.3. Laboratory control samples must be within 30% true value. These samples should be spiked at concentrations normally expected in contaminated ambient air. FAI spikes these samples at or around the mid-point of the calibration.

9.2. Department of Defense (DoD) Quality Control Requirements

9.2.1. See Appendix G for quality control requirements taken from Quality Service Manual (QSM) 5.4, Appendix B.

9.3. Initial Demonstration of Capability (IDC)

9.3.1. Each laboratory must demonstrate initial proficiency with each determinative method combination it utilized by generating data of acceptable accuracy and precision for target analytes in a clean matrix.

9.3.2. Analysts should prepare four replicate Laboratory Control Samples (LCS) for a given matrix and analyze them with a valid calibration.

9.3.3. Calculate the average and standard deviation of the four recoveries of the analytes in each of the four LCSs analyzed.

9.3.4. A more detailed description of the IDC procedure is outlined in SOP 59, *QA_Training and Proficiency of Methods*.

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9.4. BFB Checks

9.4.1. A BFB tune check must be run every 24 hours to verify that the MS is compliant with the criteria outlined in Appendix B.

9.4.2. If the BFB tune check is not compliant, the MS should be re-tuned to meet the criteria.

9.5. Initial Calibration Verification (ICV)

9.5.1. After running an initial calibration, the calibration must be verified using a second source standard.

9.5.2. The calibration is verified if $\geq$ 80% of the analytes are within $\pm$ 30% of the true value.

9.5.2.1. For DoD projects, all analytes must pass the ICV.

9.5.3. If the ICV does not pass, one more ICV may be run and must pass. If it does not, the problem should be identified, and the system should be recalibrated.

9.6. Calibration Checks (LCS)

9.6.1. Prior to running samples, the calibration must be verified by running a calibration check (LCS)

9.6.2. LCSs will be run once every 24 hours.

9.6.3. LCSs must pass within 30% of their true value.

9.6.3.1. If greater than 20% of the target analytes do not pass within the set acceptance criteria, two consecutive LCSs may be run and must pass for the analysis to continue. If they do not, the analysis should halt, and the GC-MS system should be inspected and re-calibrated.

9.6.3.2. If less than 20% of the target analytes do not pass, analysis may proceed but reported data may be qualified.

9.6.4. For DoD projects, an LCS is required at the end of an analytical run.

9.6.4.1. Closing LCSs must pass within 30% of their true value.

9.7. Method Blanks (MB)

9.7.1. Prior to running samples, and following the LCS, a method blank will be run to demonstrate that the analytical system is free of contamination.

9.7.2. MBs will be run once every 24 hours.

9.7.3. MBs are made in an unused certified canister and is pressurized with humidified nitrogen. The injected aliquot must contain the same amount of internal standard/surrogate that is added to each sample.

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9.7.4. Blanks are generally considered to be acceptable if target analyte concentrations are less than 3-times the MDL. If blanks show detections but samples do not or samples have detections but are 10x higher than the blank concentration, the data may still be deemed usable.

9.8. Sample Replicates (REP)

9.8.1. Sample replicates will be run once per analytical batch

9.8.2. Relative percent difference (%RPD) must fall within 25%

9.8.3. If there is not enough sample volume to run a sample replicate, an LCS/LCSD pair may be substituted.

9.9. Surrogates

9.9.1. Surrogates are added to all samples, MB, LCSs, and calibrations

9.9.2. Surrogate recoveries are a check on system performance for the duration of an analytical run.

9.9.3. FAI uses 4-Bromofluorobenzene (BFB) as a surrogate.

9.9.4. Surrogate recovery must fall within 30% of the true value.

9.10. Internal Standards (IS)

9.10.1. Internal Standards are added to all samples, MB, LCSs, and calibrations.

9.10.2. The retention time for each internal standard must be within ± 20 seconds of the mean retention time of the internal standard in the most recent, valid calibration.

9.10.3. The area response for any internal standard may not change by more than ± 40% between the sample and the most recent valid continuing calibration verification (CCV). The CCV must pass within ± 40% of the midpoint of the calibration.

9.10.4. If the IS in any sample or QC fails, the system should be inspected for malfunctions and samples should be re-analyzed. If samples cannot be reanalyzed, the reported date must be flagged.

10. CALIBRATION AND STANDARDIZATION

10.1. Each GC/MS system must be calibrated at a minimum five concentrations that span the monitoring range of interest in an initial calibration sequence to determine instrument sensitivity and the linearity of GC/MS response for the target compounds. Recommended calibration concentrations are found in Appendix C.

10.1.1. One of the calibration points from the initial calibration curve should be at the same concentration as the daily calibration standard

10.1.2. The calibration must be verified with a blank sample (ICB) and a second source midpoint calibration standard, which will be the ICV.

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10.2. Each GC/MS system must be recalibrated following corrective action (e.g., ion source cleaning or repair, column replacement, etc.) which may change or affect the initial calibration criteria or if the daily calibration acceptance criteria have not been met.

10.3. Technical Acceptance Criteria for the Initial Calibration.

10.3.1. The calculated %RSD for the Relative Response Factor for each compound in the calibration table must be less than 30% with at most two exceptions up to a limit of 40%.

10.3.1.1. Alternatively, the linear least squares regression or the quadratic regression for each analyte will demonstrate $r^2 \geq 0.990$.

10.3.2. The Relative Retention Time (RRT) for each target compound at each calibration level must be within 0.06 RRT units of the mean RRT for the compound.

10.3.3. For each internal standard, the area response of each calibration level must be within 40% of the mean area response over the initial calibration range.

10.3.4. The retention time shift for each of the internal standards at each calibration level must be within 20 s of the mean retention time over the initial calibration range for each internal standard.

10.3.5. See Section 10.5 for ICV acceptance criteria.

10.4. Criteria: If the initial calibration technical acceptance criteria are not met, inspect the system for problems. It may be necessary to clean the ion source, change the column, or take other corrective actions to meet the initial calibration technical acceptance criteria.

10.5. Initial calibration acceptance criteria must be met before any field samples, performance evaluation (PE) samples, or blanks are analyzed.

11. PROCEDURE

11.1. Prior to the analysis of samples and blanks but after tuning criteria have been met, the initial calibration of each GC/MS system must be routinely checked by analyzing a daily calibration standard (LCS) to ensure that the instrument continues to remain under control

11.1.1. The LCS must be run once every 24 hours and should be at a mid-point level of the calibration. The LCS must pass the acceptance criteria outlined in Section 10.6 before samples may be loaded.

11.1.2. A Method blank will be run once every 24 hours following the LCS.

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11.2. Once the GC/MS system has been verified, samples may be loaded. It is recommended that samples get screened prior to running an analytical sequence. If dilutions or lower volume injections are necessary, it is recommended that dilutions are run prior to a higher injection volume, to prevent carry over or contamination issues. The preparation of dilutions is outlined in Appendix E.

11.3. The nominal volumes of each analysis are listed in the table below. If more volume is injected, the reporting limit will be lowered. If less volume is injected, the reporting limit will be raised.

Analysis	Nominal Injection Volume
APH	200cc
Sulfur	100cc
Siloxane	25cc
SIMSCAN	200cc

11.4. At least one replicate will be run in each analytical run. If there is limited volume, an LCS/LCSD may be substituted.

11.5. When running samples for sulfur analysis or samples that are in Tedlar® Bags, analysts should check their runs as soon as possible so they can re-analyze samples if necessary and still remain within hold time.

11.6. Recommended Analytical Sequence

11.6.1. BFB Tune Check

11.6.2. LCS (May be multiple, depending on the analyses being run)

11.6.3. LCSD (if necessary)

11.6.4. MB

11.6.5. Lower volume injections/Dilutions (if necessary)

11.6.6. Samples (with one Rep)

11.6.7. Closing LCS (for DoD projects only)

11.7. Recommended instrument parameters for the Preconcentrator and GC/MS systems can be found in Appendix D.

12. DATA ANALYSIS AND CALCULATIONS

12.1. Qualitative identification of target analytes is determined based on retention times and the comparison of the sample compound's characteristic ions with the characteristic ions in a reference mass spectrum.

12.1.1. Recommended characteristic ions for each compound covered in this SOP may be found in Appendix A.

12.1.2. Typically, characteristic ions are chosen because they are the ions with the greatest intensity of the entire mass spectrum of a compound.

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12.1.3. Identification may be hampered when sample components are not resolved chromatographically (ex. Co-elution or interference). Determination of whether or not the peak in question represents a target compound or a non-target compound is based on analyst experience.

12.1.4. For APH calculations, the analyst should subtract out the abundance of non-APH compounds from the respective APH ranges. Some of the non-APH compounds that should be subtracted out can be found in appendix H.

12.2. The integration for target analyte ranges are outlined in the table below:

Range	Start	End
Gasoline Range Organics (GRO)	Before Hexane	After Naphthalene
Total Volatile Organic Compounds	Before Propylene	After 1,2,4-Trichlorobenzene
APH Aliphatic C_5-C_8	Before Isopentane	Right before Nonane
APH Aliphatic C_9-C_{12}	Before Nonane	Just after Dodecane
APH Aromatic C_9-C_{10}	Just after o-Xylene	Just before Naphthalene

12.3. Analyte concentration is calculated using the raw area count of the peak and the calibration curve equation generated in the initial calibration.

12.3.1. Analyte concentration determination is typically achieved in the data processing software. It may also be determined by the calculation below:

$$C = \frac{A_X C_{IS} DF}{A_{IS} \overline{RRF}}$$

Where:
C = Compound Concentration, ppbv
A_X = Area of the primary characteristic ion for the target compound
A_{IS} = Area of the primary characteristic ion for the corresponding internal standard
C_{IS} = Concentration of the internal standard spiking mixture, ppbv
RRF = Mean relative response factor from the initial calibration
DF = Dilution factor. If not dilutions factor, DF = 1

12.4. Percent recovery (%R) for the Surrogate, LCS, and ICV spikes are calculated using the following:

$$\%R = \frac{R_R}{R_A} \times 100$$

Where:
%R = Percent Recovery
R_R = Raw analytical result
R_A = Actual spiked value

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12.5. Percent Reproducibility (%RPD) for Replicates or LCSDs are calculated using the following:

$$\%RPD = \frac{|R_1 - R_2|}{1/2(R_1 + R_2)} \times 100$$

Where:
R_1 = Sample analysis result
R_2 = Duplicate analysis result

12.6. Calculation of Percent Recovery (%R) for MS samples

12.6.1. This only applies to sulfur analysis by ASTM D5504 upon client request

$$\%R = \frac{(SS_R - S_R)}{S_A} \times 100$$

Where:
%R = Percent recovery
SS_R = Spiked sample result
S_R = Sample result (concentration in sample)
S_A = True value of spike added

13. METHOD PERFORMANCE AND DATA REVIEW

13.1. Method Detection Limits, Limits of Detection, Limits of Quantitation, Practical Quantitation Limits

13.1.1. Procedures to determine method performance are described in SOP *QA_ MDL Submission*

13.1.2. The list of routinely reported analytes and their associated reporting limits are listed in the Omega LIM system.

13.2. Only Alliance Technical Group employees who have been properly trained and have the required experience shall perform this method.

13.3. Data should be reviewed by the analyst and the department manager prior to submittal to the project managers.

14. POLLUTION PREVENTION AND WASTE MANAGEMENT

14.1. This procedure produces minimal waste. Samples may be disposed of in hoods or well-ventilated areas.

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15. REFERENCES

15.1. Compendium Method TO-15: Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially-Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry (GC/MS), Second Edition, 1999.

15.2. Standard Test Method for Determination in Natural Gas and Gaseous Fuels by Gas Chromatography and Chemiluminescence, ASTM D5504, 2012.

15.3. Method for Determination of Air-Phase Petroleum Hydrocarbons, Massachusetts Department of Environmental Protection, Revision 1, 2009.

15.4. Department of Defense (DoD) Quality Systems Manual, v5.4, 2021.

16. APPENDICES

16.1. Appendix A: Analytes and Their Characteristic Ions

16.2. Appendix B: BFB Tune Check Criteria

16.3. Appendix C: Recommended Calibration Levels

16.4. Appendix D: Recommended Operation Parameters

16.5. Appendix E: Making Dilutions and Calculating Dilution Factors

16.6. Appendix F: Preparing Sulfur and Siloxane Standards

16.7. Appendix G: DoD QSM 5.4 Appendix B: Quality Control Requirements

16.8. Appendix H: List of Common Non-APH Compounds That Elute Within the APH Method Ranges

17. CHANGES FROM LAST REVISION

17.1. Removal of Section 3 Deviations from Method.

17.2. Removal of references to ASTM D5504.

17.3. Updated nominal injection volumes in 11.3.

17.4. Update language regarding CCV in Internal Standard section point 9.10.3

17.5. Update to Appendix C: Recommended Calibration Levels.

17.6. Update to Appendix F: Preparing Sulfur and Siloxane Standards in Preparing Sulfur Standard section for point 1.6 and 1.7.

17.7. Added subsection 4.5 about samples in high pressure cylinders.

17.8. Minor grammatical changes.

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Appendix A: Analytes and Their Recommended Characteristic Ions

VOC Compounds

Sample Name	CAS #	1° quant Ion	2°, 3°, 4° quant Ions
Acetone	67-64-1	43	58
Acrolein	107-02-8	56	55
Allyl Chloride	107-05-1	39	41, 71
Benzene	71-43-2	78	77, 52, 51
Benzyl Chloride	100-44-7	91	126, 65, 128
Bromoform	75-25-2	173	174, 93
Bromomethane	74-83-9	94	96, 93
1,3-Butadiene	106-99-0	54	53, 50, 52
Butane	106-97-8	43	41, 39
tert-Butanol	75-65-0	59	41, 43, 57
2-Butanone (MEK)	78-93-3	72	57
Carbon Disulfide	75-15-0	76	78, 44
Carbon Tetrachloride	56-23-5	117	119, 121, 82
Chlorobenzene	108-90-7	112	77, 114, 51
Chloroethane	75-00-3	64	66, 49
Chloroform	67-66-3	83	85, 87
Chloromethane	74-87-3	50	52, 48
2-Chlorotoluene	95-49-8	126	96, 89, 128
Cumene	98-82-8	105	120, 77, 79
Cyclohexane	110-82-7	56	55, 69, 84
Dibromochloromethane	124-48-1	129	127, 131
1,2-Dibromoethane	106-93-4	107	109, 188, 81
Dichlorodifluoromethane	75-71-8	85	87, 101
Dichlorotetrafluoroethane	76-14-2	85	87, 135, 137
1,2-Dichlorobenzene	95-50-1	146	111, 148, 75
1,3-Dichlorobenzene	541-73-1	146	111, 148, 75
1,4-Dichlorobenzene	106-46-1	146	150, 148, 75

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VOC Compounds Cont.

Sample Name	CAS #	1° quant Ion	2°, 3°, 4° quant Ions
1,1-Dichloroethane	75-34-3	63	85, 65, 83
1,2-Dichloroethane	107-06-2	62	98, 49, 64
1,1-Dichloroethene	75-35-4	96	61, 63, 98
cis-1,2-Dichloroethene	156-59-2	96	61, 98, 63
trans-1,2-Dichloroethene	156-60-5	96	61, 98, 100
1,2-Dichloropropane	78-87-5	63	112, 62, 76
cis-1,3-Dichloropropylene	10061-01-5	75	77, 110, 112
trans-1,3-Dichloropropylene	10061-02-6	75	77, 110, 112
1,4-Dioxane	123-91-1	88	58, 57
4-Ethyltoluene	622-96-8	105	120, 106, 91
Ethanol	64-17-5	45	46, 43
Ethyl Acetate	141-78-6	61	70, 88
Ethylbenzene	100-41-4	91	105, 51, 92
Heptane	142-82-5	57	71, 100, 56
Hexane	110-54-3	57	56, 86
Hexachlorobutadiene	87-68-3	190	227, 223
2-Hexanone	591-78-6	58	57, 100, 85
Isooctane	540-84-2	57	56
4-Methyl-2-Pentanone	108-10-1	58	57, 100, 85
Methylene Chloride	75-09-2	84	86, 88, 49
Methyl Methacrylate	80-62-6	69	99, 100
Naphthalene	91-20-3	128	129, 127, 51
Nonane	111-84-2	57	56, 58, 71
Pentane	109-66-0	43	41, 42, 39
2-Propanol	67-63-0	45	43, 59
n-Propylbenzene	103-65-1	120	78, 105, 121
Propylene	115-07-1	41	42
Styrene	100-42-5	104	103, 78, 77

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VOC Compounds cont.

Sample Name	CAS #	1° quant Ion	2°, 3°, 4° quant Ions
tert-Butyl Methyl Ether (MTBE)	1634-04-4	73	57
1,1,2,2-Tetrachloroethane	79-34-5	83	85, 95, 60
Tetrachloroethene	127-18	166	164, 129, 131
Tetrahydrofuran	109-99-9	72	71
Toluene	108-88-3	91	92, 65, 89
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	101	151, 103, 153
1,1,1-Trichloroethane	71-55-6	97	99, 61, 117
1,1,2-Trichloroethane	79-00-5	97	83, 99, 85
Trichloroethene	79-01-6	95	130, 132, 97
Trichlorofluoromethane	75-69-4	101	105, 103, 66
1,2,4-Trichlorobenzene	120-82-1	180	182, 145, 109
1,2,4-Trimethylbenzene	95-63-6	105	120, 119, 77
1,3,5-Trimethylbenzene	108-67-8	105	120, 119, 77
Vinyl Acetate	108-05-4	86	57
Vinyl Bromide	593-60-2	106	108, 81, 79
Vinyl Chloride	75-01-4	62	64, 63, 47
o-Xylene	95-47-6	91	106, 105, 77
m&p-Xylenes	108-38-3, 106-42-3	91	106, 105, 77

Sulfur Compounds

Sample Name	CAS #	1° quant Ion	2°, 3°, 4° quant Ions
n-Butyl Mercaptan	109-79-5	56	90, 61, 57
t-Butyl Mercaptan	75-66-1	57	75, 90, 55
Carbon Disulfide	75-15-0	76	78, 44
Carbonyl Sulfide	463-58-1	60	62, 32
Diethyl Disulfide	110-81-6	122	66, 94, 79
Dimethyl Disulfide	624-92-0	94	79, 61, 64
Dimethyl Sulfide	75-18-3	62	47, 45, 46

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Sulfur Compound cont.

Sample Name	CAS #	1° quant Ion	2°, 3°, 4° quant Ions
2,5-Dimethylthiophene	638-02-8	111	112, 97, 113
Ethyl Mercaptan	75-08-1	62	45, 47
Ethyl Methyl Sulfide	624-89-5	61	76, 48, 47
2-Ethylthiophene	872-55-9	97	112, 111, 98
Hydrogen Sulfide	7783-06-4	34	33, 32, 36
Isobutyl Mercaptan	513-44-0	41	90, 56
Isopropyl Mercaptan	75-33-2	76	61, 59
Methyl Mercaptan	74-93-1	47	48, 45
3-Methylthiophene	616-44-4	97	98, 99
n-Propyl Mercaptan	107-03-9	76	61, 48
Sulfur Dioxide	7446-09-5	64	48, 32
Tetrahydrothiophene	110-01-0	60	88, 87, 59
Thiophene	110-02-1	84	58, 45, 39

Siloxane Compounds

Sample Name	CAS #	1° Quant Ion	2°, 3°, 4° Quant Ions
Pentamethyldisiloxane	1438-82-0	133	73, 147
Hexamethyldisiloxane (MM)	107-46-0	147	73, 148
Hexamethylcyclotrisiloxane (D3)	541-05-9	207	96, 133, 208
Octamethyltrisiloxane (MDM)	107-51-7	221	73, 222
Octamethylcyclotetrasiloxane (D4)	556-67-2	281	282, 193
Decamethyltetrasiloxane (MD2M)	141-62-8	207	295, 85, 191
Decamethylcyclopentasiloxane (D5)	541-02-6	73	267, 268
Dodecamethylpentasiloxane (L5)	141-63-9	147	73, 281
Dodecamethylcyclohexasiloxane(D6)	540-97-6	147	281, 73

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APH Compounds

Sample Name	CAS #	1° Quant Ion	2°, 3°, 4° Quant Ions
Benzene	71-43-2	78	77, 52, 51
1,3-Butadiene	106-99-0	54	53, 50, 52
n-Butylcyclohexane	1678-93-9	83	55, 82, 140
Cyclohexane	110-82-7	56	55, 69, 84
Decane	124-18-5	57	71, 85, 56
2,3-Dimethylheptane	3074-71-3	84	85, 71
2,3-Dimethylpentane	565-59-3	56	57, 71
n-Dodecane	112-40-3	57	71, 85
Ethylbenzene	110-41-4	91	106, 51, 92
Heptane	142-82-5	57	71, 100
n-Hexane	110-54-3	57	56, 86
Isopentane	78-78-4	43	42, 57, 41
Isopropylbenzene	98-82-8	105	120, 91, 77
4-Isopropyltoluene	99-87-6	119	134
1-Methyl-3-Ethylbenzene	620-14-4	105	120, 91, 77
Naphthalene	91-20-3	128	129, 127, 51
Nonane	111-84-2	57	85, 71
Octane	111-65-9	57	85. 71. 56
tert-Butyl Methyl Ether (MTBE)	1634-04-04	73	57
Toluene	108-88-3	91	92, 65, 89
1,2,3-Trimethylbenzene	526-73-8	105	120, 77, 91
1,3,5-Trimethylbenzene	108-67-8	105	120, 91, 77
m&p-Xylenes	108-38-3, 106-42-3	91	106, 105, 77
o-Xylene	95-47-6	91	106, 105, 77
n-Undecane	1120-21-4	57	85, 71, 56

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Appendix B: BFB Tune Check Criteria

Mass	Ion Abundance Criteria
50	8.0 to 40.0 Percent of m/z 95
75	30.0 to 66.0 Percent of m/z 95
95	Base Peak, 100 Percent Relative Abundance
96	5.0 to 9.0 Percent of m/z 95
173	Less than 2.0 Percent of m/z 174
174	50.0 to 120.0 Percent of m/z 95
175	4.0 to 9.0 Percent of m/z 174
176	93.0 to 101.0 Percent of m/z 174
177	5.0 to 9.0 Percent of m/z 176

All ion abundances must be normalized to m/z 95, the nominal base peak, even though the ion abundance of m/z 174 may be up to 120 percent that of m/z 95.

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Appendix C: Recommended Calibration Levels

VOC SIMSCAN Calibration

Level	Calibration Point*	Calibration Standard	Injected Volume of Standard	Injected Volume of 20ppbv Internal Standard/Surrogate
1	0.005ppbv	0.2ppbv	5cc	50cc
2	0.01ppbv	0.2ppbv	10cc	50cc
3	0.05ppbv	0.2ppbv	50cc	50cc
4	0.15ppbv	0.2ppbv	150cc	50cc
5	0.5ppbv	2ppbv	50cc	50cc
6	1.0ppbv	2ppbv	100cc	50cc
7	2.0ppbv	2ppbv	200cc	50cc
8	5.0ppbv	20ppbv	50cc	50cc
9	10.0ppbv	20ppbv	100cc	50cc
10	20.0ppbv	20ppbv	200cc	50cc
	ICB	--	--	50cc
	ICV at 2ppbv	2ppbv	200cc	50cc
	LCS at 2ppbv	2ppbv	200cc	50cc

*For m&p-Xylenes, concentration points are 2x what are listed in the table.

APH Calibration-Single Analytes by SIMCAN

Level	Calibration Point	Calibration Standard	Injected Volume of Standard	Injected Volume of 20ppbv Internal Standard/Surrogate
1	0.2ppbv	2ppbv	20cc	50cc
2	0.5ppbv	2ppbv	50cc	50cc
3	1.0ppbv	2ppbv	100cc	50cc
4	1.5ppbv	2ppbv	150cc	50cc
5	2.0ppbv	2ppbv	200cc	50cc
6	3.0ppbv	20ppbv	30cc	50cc
7	5.0ppbv	20ppbv	50cc	50cc
8	10.0ppbv	20ppbv	100cc	50cc
9	20.0ppbv	20ppbv	200cc	50cc
	ICB	--	--	50cc
	LCS at 2.0ppbv	2ppbv	200cc	50cc

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APH Carbon-Range Concentrations

	Aliphatic C5-8	Aliphatic C9-12	Aromatic C9-10
1	1.2ppbv	1.2ppbv	1.0ppbv
2	3.0ppbv	3.0ppbv	2.5ppbv
3	6.0ppbv	6.0ppbv	5.0ppbv
4	9.0ppbv	9.0ppbv	7.5ppbv
5	12.0ppbv	12.0ppbv	10.0ppbv
6	18.0ppbv	18.0ppbv	15.0ppbv
7	30.0ppbv	30.0ppbv	25.0ppbv
8	60.0ppbv	60.0ppbv	50.0ppbv
9	120.0ppbv	120.0ppbv	100.0ppbv
ICB			
ICV	12.0ppbv	12.0ppbv	10.0ppbv
LCS	12.0ppbv	12.0ppbv	10.0ppbv

Siloxane Calibration

Level	Calibration Point	Calibration Standard	Injected Volume of Standard	Injected Volume of 20ppbv Internal Standard/Surrogate
1	5.0ppbv	25ppbv	5cc	50cc
2	10.0ppbv	25ppbv	10cc	50cc
3	15.0ppbv	25ppbv	15cc	50cc
4	25.0ppbv	25ppbv	25cc	50cc
5	50.0ppbv	25ppbv	50cc	50cc
6	75.0ppbv	25ppbv	75cc	50cc
7	100.0ppbv	25ppbv	100cc	50cc
8	150.0ppbv	25ppbv	150cc	50cc
9	250.0ppbv	25ppbv	250cc	50cc
	ICB	--	--	50cc
	ICV at 25ppbv	25ppbv	25cc	50cc
	LCS at 50ppbv	25ppbv	25cc	50cc

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Sulfur Calibrations

*Working sulfur standards are concentrations of 100 ppbv, dilute the stock sulfur standard accordingly.

Sulfur

Level	Calibration Point	Calibration Standard	Injected Volume of Standard	Injected Volume of 20ppbv Internal Standard/Surrogate
1	10.0ppbv	100ppbv	10cc	50cc
2	25.0ppbv	100ppbv	25cc	50cc
3	50.0ppbv	100ppbv	50cc	50cc
4	75.0ppbv	100ppbv	75cc	50cc
5	100.0ppbv	100ppbv	100cc	50cc
6	150.0ppbv	100ppbv	150cc	50cc
7	250.0ppbv	100ppbv	250cc	50cc
LCS	100.0ppbv	100ppbv	100cc	50cc

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Appendix D: Recommended Operating Parameters

Preconcentrator System - Cryogen

Temperatures								
	Trap Temp	M1 Preheat	M1 to M2	M3 precool	M2 Preheat	M2 to M3	Inject	Bakeout
Mod 1	-50°C	10°C	10°C					150°C
Mod 1 Bulkhead	40°C		60°C					150°C
Mod 2	-50°C		-50°C		-50°C	220°C		220°C
Mod 2 Bulkhead	40°C				40°C			150°C
Mod 3				-170°C		-150°C	80°C	
Rotary Valve Plate	80°C							80°C
Sample Transfer Line	80°C							
GC Transfer Line	100°C							
Gripper Temp	80°C			Wait on Step 1: Yes				
7650 Sample Transfer Line	80°C			Wait on Step 1: Yes				
Oven	30°C			Wait on Step 1: No				
7650 Loop	80°C			Wait on Step 1: Yes				
7650 Junction	80°C			Wait on Step 1: No				
Transfer line from 7650 to 7200	80°C			Wait on Step 1: Yes				
Transfer line from Tree	Sample: 30°C			Rotary Valve: 80°C			Transfer Line: 80°C	
Events								
Heated analysis?	No							
Sample Preheat	0.0 min							
M3 Focusing	2.5 min							
Inject Time	0.8 min							
System Bake	10.0min							
Post Injection Delay	32.0 min							
M3 Bake Time (Step 3)	5.0 min							
M3 Bake Time (Step 13)	0.0 min							
M3 Cool Delay (Step 15)	0.3 min							
More M2 M3	0.0 min							
Internal Std Preflush	10 sec							
Cal Std Preflush	10 sec							
Sample Preflush	10 sec							
Swp/Prg Gas Preflush	10 sec							
Post injection focuser bake	No							
Volume								
Trap Flush	75 cc							
M1 to M2 Volume	50 cc							
Int. Std. Trapping	60 cc/min							
Cal Std. Trapping	60 cc/min							
Sample Trapping	60 cc/min							
Flush	60 cc/min							
M1 to M2 Transfer	10 cc/min							

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Preconcentrator System – Cryogen - Siloxane

Temperatures								
	Trap Temp	M1 Preheat	M1 to M2	M3 precool	M2 Preheat	M2 to M3	Inject	Bakeout
Mod 1	140°C	10°C	140°C					150°C
Mod 1 Bulkhead	40°C		60°C					150°C
Mod 2	35°C		35°C		35°C	230°C		220°C
Mod 2 Bulkhead	40°C				40°C			150°C
Mod 3				40°C		40°C	80°C	
Rotary Valve Plate	80°C							80°C

Sample Transfer Line	80°C		
GC Transfer Line	100°C		
Gripper Temp	80°C	Wait on Step 1: Yes	
7650 Sample Transfer Line	80°C	Wait on Step 1: Yes	
Oven	30°C	Wait on Step 1: No	
7650 Loop	80°C	Wait on Step 1: Yes	
7650 Junction	80°C	Wait on Step 1: No	
Transfer line from 7650 to 7200	80°C	Wait on Step 1: Yes	
Transfer line from Tree	Sample: 30°C	Rotary Valve: 80°C	Transfer Line: 80°C

Events	
Heated analysis?	No
Sample Preheat	0.0 min
M3 Focusing	3.5 min
Inject Time	0.8 min
System Bake	10.0min
Post Injection Delay	32.0 min
M3 Bake Time (Step 3)	3.0 min
M3 Bake Time (Step 13)	0.0 min
M3 Cool Delay (Step 15)	0.3 min
More M2 M3	0.0 min
Internal Std Preflush	10 sec
Cal Std Preflush	10 sec
Sample Preflush	10 sec
Swp/Prg Gas Preflush	10 sec
Post injection focuser bake	No

Volume	
Trap Flush	75 cc
M1 to M2 Volume	50 cc
Int. Std. Trapping	60 cc/min
Cal Std. Trapping	60 cc/min
Sample Trapping	100 cc/min
Flush	100 cc/min
M1 to M2 Transfer	10 cc/min

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Preconcentrator System – Cryogenless

Temperatures						
	Trap Temp	M1 Preheat	M1 to M2	M2 Preheat	Inject	Bakeout
Mod 1	35°C	80°C	120°C			130°C
Mod 1 Bulkhead	150°C	150°	150°C	150°C		150°C
Mod 2	32°C		32°C	200°C	200°C	180°C
Mod 2 Bulkhead	150°C			150°C	150°C	150°C
Rotary Valve Plate	150°C	150°C	150°C	150°C		150°C
Sample Transfer Line	80°C					
GC Transfer Line	150°C					
Gripper Temp	120°C		Wait on Step 1: Yes			
7650 Sample Transfer Line	150°C		Wait on Step 1: Yes			
Oven	30°C		Wait on Step 1: No			
7650 Loop	120°C		Wait on Step 1: Yes			
Transfer line from 7650 to 7200	150°C		Wait on Step 1: Yes			
Transfer line from Tree	Sample: 30°C		Rotary Valve: 80°C		Transfer Line: 80°C	
Events						
Heated Analysis?	No					
Preheat Hold	0.2 min					
Inject Time	0.8 min					
M1M2 Bake	14.0min					
Post Injection Delay	20.0 min					
Internal Std Preflush	5 sec					
Cal Std Preflush	5 sec					
Sample Preflush	5 sec					
Swp/Prg Gas Preflush	5 sec					
Pre M1 Gas Flush	15 sec					
Volume						
Cal Std + Samp ≤ 150cc	50 cc					
Cal Std + Samp >150cc	30 cc					
M1 Cool Purge	15 cc					
M1 to M2 Volume	25cc					
Int. Std. Trapping	20 cc/min					
Cal Std. Trapping	20 cc/min					
Sample Trapping	20 cc/min					
Flush	20 cc/min					
M1 to M2 Transfer	10 cc/min					

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GC/MS System (with Cryogen System)

GC Column	60 m x 230 µm x 3 µm		
Carrier Gas	He		
Injector Temperature	125°C		
Transfer Line Temperature	250°C		
Oven	35°C		
Carrier Gas flow rate	1.5 mL/min		
Inlet Mode	Splitless		
Total Flow	56.5 ml/min		
Septum Purge Flow	5 ml/min		
Purge Flow to Split Vent	50 mL/mi at 32.5min		
Temperature Program	35°C	6 °C/min to 95°C	Hold: 0min
		10 °C/min to 140°C	Hold: 0min
		15°C/min to 220°C	Hold 5.7 min

GC/MS System (with Cryogenless System)

GC Column	60 m x 320 µm x 1.8 µm		
Carrier Gas	He		
Injector Temperature	125°C		
Transfer Line Temperature	190°C		
Oven	35°C		
Carrier Gas flow rate	1.5 mL/min		
Inlet Mode	Split (20:1)		
Total Flow	26 ml/min		
Septum Purge Flow	5 ml/min		
Temperature Program	35°C	6 °C/min to 95°C	Hold: 0min
		10 °C/min to 140°C	Hold: 0min
		15°C/min to 220°C	Hold 5.17 min

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Appendix E: Making Dilutions and Calculating Dilution Factors

1. Use the results of the original analysis to determine the approximate dilution factor required to get the largest analyte peak within the initial calibration range.
2. The dilution factor chosen should keep the response of the largest analyte peak for a target compound in the upper half of the initial calibration range of the instrument.
3. **Procedure for Diluting Samples in Tedlar Bags:**

   3.1. Obtain a clean, empty Tedlar bag and fill with 1 L of nitrogen. Set the Dynamic Dilutor to the Diluent line and open valve >50%, fill the Tedlar bag to the appropriate volume, determined by the analyst.

      3.1.1. Remove the appropriate volume from the Tedlar filled with nitrogen using an airtight syringe.

      3.1.2. Remove the same volume from the Tedlar containing the sample using an airtight syringe. Inject the sample aliquot into the Tedlar filled with nitrogen.

4. **Calculating the Dilution Factor:**

   4.1. The dilution factor is calculated by the following equation:

$$DF = \frac{Vf}{Vi}$$

Where:
DF = Dilution factor
Vf = Final volume (typically 1L)
Vi = Volume of the sample injected into the nitrogen-filled Tedlar

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Appendix F: Preparing Sulfur and Siloxane Standards

1. Preparing Sulfur Standard
   1.1. Use a rough pump to evacuate the Tedlar labeled Sulfur Stock.
   1.2. Attach a flow regulator on to the desired standard cylinder. This can usually be found already attached to one of the cylinders or in the air lab.
   1.3. Attach the evacuated bag to the flow regulator. Open the bag and then open the cylinder.
   1.4. Immediately close the cylinder after opening. The flow regulator will have built up pressure and will continue filling the bag to an acceptable amount.
   1.5. Fill a secondary Tedlar bag labeled 'Sulfur LCS' with nitrogen using the dynamic diluter.
   1.6. Dilute the sulfur standard appropriately to get a 100 ppbv standard in the bag labeled Sulfur LCS.
   1.7. Load the Tedlar bag onto the autosampler and run calibration as listed.
2. Preparing Siloxane Standard
   2.1. Grab the SILOX canister and evacuate below 50 mtorr using the canister cleaning oven.
   2.2. When the canister is evacuated, and closed, unscrew the compression fitting and humidify the canister by adding 60 µL of DI water.
   2.3. Screw the quick connect back onto the canister, open up the valve to allow the water to enter the canister.
   2.4. Switch the quick connect for a nut that has a septum in it to spike through.
   2.5. Sonicate the siloxane stock solution, which should be kept in a freezer, for 20 minutes.
   2.6. Rinse a 10 µL syringe with methanol. When the siloxane solution is finished sonicating, invert a few times then open the valve of the canister. Then, using the syringe inject 6.2 µL through the septa. This should result in a 25 ppbv concentration of all siloxane species in the bag.
   2.7. Flush the dynamic diluter with nitrogen before using.
   2.8. Use the dynamic diluter to add nitrogen to the canister to pressurize to 30PSIA.
   2.9. Let the standard canister sit for 24 hours before using.
   2.10. Keep in mind that the siloxane standard has a lot of DCM and will often cause lots of carry over issues. Many cleanouts will be needed after running a siloxane LCS if samples are being analyzed for DCM afterwards.

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3. Preparing Siloxane Standard from Neat Material

   3.1. Neat materials are diluted into 50mL of Methylene Chloride to achieve a final concentration of 4.08 µmol/mL.

   3.2. When preparing a new standard, record all actual weights on a bench sheet. The bench sheet must then be attached to the new standard ID in Omega.

   3.3. The desired masses of each siloxane species are shown below alongside the other categories that should be on the bench sheet

ID	Omega#	Desired Mass (mg)	Actual Mass (mg)
Pentamethyldisiloxane		30.3	
Hexamethyldisiloxane		33.2	
Hexamethylcyclotrisiloxane		45.5	
Octamethyltrisiloxane		48.4	
Octamethylcyclotetrasiloxane		60.7	
Decamethyltetrasiloxane		63.5	
Decamethylcyclopentasiloxane		75.8	
Dodecamethylpentasiloxane		78.6	
Dodecamethylcyclohexasiloxane		90.9	

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Appendix G: DoD QSM 5.4 Appendix B: QC Requirements

Table B-21. GC/MS Analysis of Air Samples					
QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Canister Cleanliness Check	Batch certified by cleaning batch.	No reported analytes detected > ½ LOQ for indoor air samples (6Ls). ½ LOQ or ½ the WA State CLARC limits for Acrolein	Repeat cleaning of canister and recertify.	Flagging is not appropriate.	Applicable only when laboratory supplies sampling canisters to client. For accreditation purposes, the laboratory must have the ability (procedures in place) to certify each canister. If the project uses the DoD/DOE QSM to define their requirements, then individual cans must be certified.
Tune Check	Prior to ICAL and prior to each 24-hour period of sample analysis.	Specific ion abundance criteria of BFB from method.	Retune instrument and verify.	Flagging is not appropriate.	No samples shall be analyzed without a valid tune.
Initial Calibration (ICAL) for all analytes	At instrument set-up, prior to sample analysis.	Calculated RSD for the RRF of each target analyte in the calibration must be less than 30%; or Linear least squares regression for each analyte: r2 ≥ 0.99; or Non-linear least squares regression (quadratic) for each analyte: r2 ≥ 0.99.	Correct problem, then repeat ICAL.	Flagging is not appropriate.	Minimum 5 levels for linear and 6 levels for quadratic with one calibration point at the same concentration as the daily CCV. The lowest calibration standard concentration at or below the LOQ. No samples shall be analyzed until ICAL has passed.
Retention Time window position establishment	Once per ICAL and at the beginning of the analytical sequence.	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	NA.	NA.	Calculated for each analyte.

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QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Evaluation of Relative Retention Times (RRT)	With each sample.	RRT of each reported analyte within ± 0.06 RRT units of the mean RRT of the calibration standards. RRTs may be updated based on the daily CCV.	Correct problem, then rerun ICAL.	NA.	RRTs shall be compared with the most recently updated RRTs. After maintenance is performed which may affect retention times, RRTs may be updated based on the daily CCV.
Initial Calibration Verification (ICV)	Once after each ICAL, analysis of a second source standard prior to sample analysis.	All reported analytes within ± 30% of true value.	Correct problem. Rerun ICV. If that fails, repeat ICAL.	Flagging is not appropriate.	No samples shall be analyzed until calibration has been verified with a second source.
Continuing Calibration Verification (CCV)	Daily before sample analysis; after every 24 hours of analysis time; and at the end of the analytical batch run.	Concentration the same as the mid-point calibration standard (or lower). All reported analytes within ± 30% of true value.	Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails or if two consecutive CCVs cannot be run, perform corrective action(s) until a passing CCV is attained, and then reanalyze all associated samples since last acceptable CCV. Alternatively, perform an ICAL (including appropriate instrument QC) if necessary; then reanalyze all associated samples since the last acceptable CCV.	If reanalysis cannot be performed, data must be qualified and explained in the Case Narrative. Apply Q-flag to all results for the specific analyte(s) in all samples since last acceptable calibration verification.	Results may not be reported without valid CCVs. Flagging is only appropriate in cases where the samples cannot be reanalyzed. If the specific version of a method requires additional evaluation (e.g., average RFs), these additional requirements must also be met.

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QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Internal Standards (IS)	Every field sample, standards, blanks, and QC sample.	**ICAL Standards** The area response for each internal standard must be within 40% of the mean area response of the calibration standards for each internal standard. The retention time shift for each internal standard at each calibration level must be within 20 seconds of the mean retention time of the calibration standards for each internal standard. **Field Samples, Blanks & QC** RT of each IS must be within +/-0.33 minutes of the most recent initial calibration.	Inspect mass spectrometer and GC for malfunctions and correct problem. Reanalysis of samples analyzed while system was malfunctioning is mandatory.	If corrective action fails in field samples, data must be qualified and explained in the Case Narrative. Apply Q-flag to analytes associated with the noncompliant IS. Flagging is not appropriate for failed standards.	Must include at a minimum bromochloromethane, Chlorobenzene-d5, and 1, 4-difluorobenzene.
Method Blank (MB)	One per analytical batch (after the first CCV), prior to analysis of any field samples.	No analytes detected <½ LOQ or < 1/10th the amount measured in any sample or 1/10th the regulatory limit, whichever is greater. Common contaminants must not be detected > LOQ.	Conduct investigation to determine the source of the contamination and take appropriate corrective actions. Rerun MB and all associated samples. If required, reprep and reanalyze MB and all QC samples and field samples processed with the contaminated blank.	If reanalysis cannot be performed, data must be qualified and explained in the Case Narrative. Apply B-flag to all results for the specific analyte(s) in all samples in the associated analytical batch. Flagging is only appropriate in cases where the samples cannot be reanalyzed.	The MB is a certified clean canister of the same type as the sample that has not left the laboratory. The blank has been pressurized with humidified zero air and carried through the same analytical procedures as a field sample. Results may not be reported without a valid MB. If a TIC search is required for any samples, then a TIC search is also required for the associated Method Blank.

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QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Laboratory Control Sample (LCS)/ LCS Replicate	One pair per analytical batch.	One canister standard is analyzed two times in the analytical run. A laboratory must use the QSM Appendix C Limits for batch control if project specific limits are not specified. If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified. RPD between the LCS and LCS Replicate for each target analyte must be < 30%.	Correct problem, and then reanalyze the LCS and all samples in the associated analytical batch for failed analytes if sufficient sample material is available.	If reanalysis cannot be performed, data must be qualified and explained in the Case Narrative. Apply Q-flag to specific analyte(s) in all samples in the associated analytical batch.	Must contain all analytes to be reported. Results may not be reported without a valid LCS. Flagging is only appropriate in cases where the samples cannot be reanalyzed. If the daily CCV is prepared in a canister, then the initial and closing CCVs can serve as the LCS and LCS Replicate as well. Both the CCV and LCS acceptance criteria would apply.

Appendix H: List of Common Non-APH Compounds Eluting Within APH Ranges

Hydrocarbon Range	Potential Non-APH Compounds
C_5-C_8 Aliphatic Hydrocarbons	Acetone may co-elute/interfere with isopentane. Isopropyl alcohol, methyl ethyl ketone, trichloroethene, tetrachloroethene, tetrahydrofuran, hexanal, 1-butanol, hexamethysiloxane.
C_9-C_{12} Aliphatic Hydrocarbons	Terpenes (e.g., a-pinene, d-limonene), phenol, benzaldehyde, n-chain aldehydes, 2-ethyl-1-hexanol, siloxanes, dichlorobenzenes
C_9-C_{10} Aromatic Hydrocarbons	Siloxanes, a-pinene, d-limonene may slightly interfere is present at high concentrations (contribute to the area of ions 120/134)

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Trace Elements in Water and Wastes by Inductively Coupled Plasma – Mass Spectrometry (ICP-MS)

EPA Method 200.8

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1 PURPOSE

1.1 This method provides procedures for determination of total and dissolved elements in ground waters, surface waters, drinking water, and wastewaters by inductively coupled plasma – mass spectrometry (ICP-MS).

2 SCOPE

2.1 This method is applicable to the following elements:

Analyte	Symbol	Chemical Abstract Services Registry Number
Aluminum	Al	7429-90-5
Antimony	Sb	7440-36-0
Arsenic	As	7440-38-2
Barium	Ba	7440-39-3
Beryllium	Be	7440-41-7
Cadmium	Cd	7440-43-9
Chromium	Cr	7440-47-3
Cobalt	Co	7440-48-4
Copper	Cu	7440-50-8
Lead	Pb	7439-92-1
Manganese	Mn	7439-96-5
Mercury	Hg	7439-97-6
Molybdenum	Mo	7439-98-7
Nickel	Ni	7440-02-0
Selenium	Se	7782-49-2
Silver	Ag	7440-22-4
Thallium	Tl	7440-28-0
Vanadium	V	7440-62-2
Zinc	Zn	7440-66-6

Method detection limits (MDLs) and linear working ranges are dependent on the sample matrix.

2.2 ATG Seattle. also provides analysis for the following elements under 200.8 at the client's request.

Analyte	Symbol	Chemical Abstract Services Registry Number
Boron	B	7440-42-8
Calcium	Ca	7440-70-2
Iron	Fe	7439-89-6
Magnesium	Mg	7439-96-5
Phosphorus	P	7440-14-0
Potassium	K	7440-09-7
Sodium	Na	7440-23-5
Strontium	Sr	7440-24-6
Tin	Sn	7440-31-5
Titanium	Ti	7440-32-6

2.3 For reference where this method is approved for use in compliance monitoring programs [e.g., Clean Water Act (NPDES) or Safe Drinking Water Act (SDWA)] consult both the appropriate sections of the Code of Federal Regulation (40 CFR Part 136 Table 1B for NPDES, and Part 141 § 141.23 for drinking water), and the latest Federal Register announcements.

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2.4 Dissolved elements are determined after suitable filtration (0.45 microns) and acid preservation. In order to reduce potential interferences, dissolved solids should not exceed 0.2% (w/v).

2.5 This method is approved for the determination of certain metal and metalloid contaminants in drinking water. Samples may be analyzed directly by pneumatic nebulization without acid digestion if the samples have been properly preserved with acid and have turbidity of <1 NTU.

2.6 For the determination of total recoverable analytes in aqueous samples a digestion/extraction is required prior to analysis when the elements are not in solution (e.g., aqueous samples that may contain particulate and suspended solids). Aqueous samples containing suspended or particulate material ≥1% (w/v) should be extracted as a solid type sample.

2.7 The total recoverable sample digestion procedure given in this method is suitable for the determination of silver in aqueous samples containing concentrations up to 0.1 mg/L. If the concentration of silver is suspected or known to be above 0.1 mg/L, a smaller, well mixed aliquot of sample should be used until the silver concentration is below 0.1mg/L.

2.8 The total recoverable sample digestion procedure given in this method will solubilize and hold in solution only minimal concentrations of barium in the presence of free sulfate. For the analysis of barium in samples having varying and unknown concentrations of sulfate, analysis should be completed as soon as possible after sample preparation.

2.9 Toxicity characteristic leaching procedure (TCLP) samples are prepared and analyzed following method 200.8. However, they are spiked in the same manner as solid samples as described in SOP 31 for metals by EPA 6020.

2.10 Sample being analyzed for Hardness by SM 2340B are prepared and analyzed by EPA 200.8. Hardness calculations may be found in Appendix V.

2.11 This method should be used by analysts experienced in the use of inductively coupled plasma – mass spectrometry (ICP-MS), the interpretation of spectral and matrix interferences and procedures for their correction.

3 DEFINITIONS

3.1 For more information about quality control definitions please reference the QA Manual. Contained in this section are definitions specific to this method

3.2 **Dissolved Analyte** - The concentration of analyte in an aqueous sample that will pass through a 0.45-µm membrane filter assembly before sample acidification.

3.3 **Internal Standard** - Pure analyte(s) added to a sample, extract, or standard solution in known amounts and used to measure the relative responses of other method analytes that are components of the same sample or solution. The internal standard must be an analyte that is not a sample component.

3.4 **Linear Dynamic Range (LDR)** - The concentration range over which the instrument response for each analyte is linear.

3.5 **Initial Calibration Verification (ICV)** - A solution of method analytes of known concentrations. The ICV is obtained from a source external to the laboratory and different from the source of calibration standards. It is used to check calibration performance.

3.6 **Total Recoverable Analyte** - The concentration of analyte determined either by "direct analysis" of an unfiltered acid preserved drinking water sample with turbidity of <1 NTU (11.2.1), or by analysis of the solution extract of a solid sample or an unfiltered aqueous sample following digestion by refluxing with hot dilute mineral acid(s) as specified in the method. The digested samples are reported as 200.8 total recoverable metals.

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3.7 **Tuning Solution** - A solution that is used to determine acceptable instrument performance before calibration and sample analyses. It is purchased commercially.

3.8 **Continuing Calibration Verification (CCV)** – A solution of one or more method analytes, internal standards, or other test substances used to evaluate the ongoing performance of the instrument system with respect to a defined set of criteria.

4 SUMMARY OF METHOD

4.1 An aliquot of a well-mixed, homogeneous aqueous sample is accurately measured for sample processing. For total recoverable analysis of an aqueous sample containing undissolved material, analytes are first solubilized by gentle refluxing with nitric and hydrochloric acids. After cooling, the sample is brought to volume, mixed and may be filtered before analysis. For the determination of dissolved analytes in a filtered aqueous sample aliquot, or for the "direct analysis" total recoverable determination of analytes in drinking water where sample turbidity is <1 NTU, the sample is made ready for analysis by the appropriate addition of nitric and hydrochloric acid, and then diluted to a predetermined volume and mixed before analysis.

4.2 This SOP describes the multi-element determination of trace elements by ICP-MS. Sample material in solution is introduced by pneumatic nebulization into a radiofrequency plasma where energy transfer processes cause desolvation, atomization and ionization. The ions are extracted from the plasma through a differentially pumped vacuum interface and separated on the basis of their mass-to-charge ratio by a quadrupole mass spectrometer having a minimum resolution capability of 1 amu peak width at 5% peak height. The ions transmitted through the quadrupole are detected by an electron multiplier and the ion information processed by a data handling system. Interferences relating to the technique must be recognized and corrected for. Such corrections must include compensation for isobaric elemental interferences and interferences from polyatomic ions derived from the plasma gas, reagents, or sample matrix. Instrumental drift as well as suppressions or enhancements of instrument response caused by the sample matrix must be corrected for by the use of internal standards.

5 RESPONSIBILITIES

5.1 It is the responsibility of the analyst performing this analysis to read and be familiar with the procedures and requirements of this SOP prior to reporting environmental sample results. It is also the responsibility of the analyst to review and adhere to all laboratory safety policies applicable to this procedure.

5.2 It is the responsibility of the operator (analyst) to ensure that all steps involved in sample analysis, after the completion of sample preparation, conform to the standards outlined in this SOP. Any deviations from this procedure must be approved by the Laboratory Manager (before analysis) and documented including discussion of reasoning for deviation.

5.3 The operator responsibilities also include maintenance of the instrument such as cleaning and replacing parts when indicated by the manufacturer's guidelines and instrument performance.

6 REQUIREMENTS

6.1 Inductively Coupled Plasma – Mass Spectrometer Instrument capable of scanning the mass range 5 - 250 amu with a minimum resolution capability of 1 amu peak width at 5% peak height. Instrument may be fitted with a conventional or extended dynamic range detection system.

6.1.1 **Note:** When electron multiplier detector is being used, precautions should be taken, where necessary, to prevent exposure to high ion flux. Otherwise, changes in instrument response or damage to the multiplier may result.

6.1.2 Radio-frequency generator compliant with FCC regulations.

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6.1.3 Argon gas supply - High purity grade (99.99%). Liquid argon is used as the source of argon for the instrument.

6.1.4 A variable-speed peristaltic pump is required for solution delivery to the nebulizer.

6.1.5 A mass-flow controller on the nebulizer gas supply is required.

6.2 Analytical balance, with capability to measure to 0.1 mg, for use in weighing solids and preparing standards.

6.3 A temperature adjustable block digester capable of maintaining a temperature of 95°C and equipped with 50 mL digestion tubes.

6.4 Labware

6.4.1 Volumetric flasks, graduated cylinders, funnels, polypropylene tubes

6.4.2 Assorted calibrated pipettes.

6.5 Reagents

6.5.1 Nitric acid, concentrated

6.5.1.1 Nitric acid (2% v/v) - Add 20 mL concentrated HNO_3 to about 800 mL of DIH_2O and dilute to 1 L.

6.5.2 Hydrochloric acid, concentrated

6.5.2.1 Hydrochloric acid (1+1) - Add 250 mL concentrated hydrochloric acid to 200 mL of DIH_2O and dilute to 500 mL.

6.5.3 Reagent water – All references to reagent water refer to DI water (DIH_2O).

6.5.4 Acidified reagent water

6.5.4.1 Reagent water with a final concentration of 2% nitric acid and 0.4% hydrochloric acid.

6.5.4.2 Preparation example: If making a liter, add 20 mL conc. nitric acid and 8 mL 1:1 hydrochloric acid to around 800 ml of reagent water, then bring to final volume of 1 L. Can be scaled to meet container needs.

6.5.5 Multi-element Stock Standard Solutions – Care must be taken in the preparation of multi-element stock standards that the elements are compatible and stable. The following stocks standards are purchased commercially.

6.5.5.1 EAL-STD-1D – calibration standard

6.5.5.2 EAL-STD-2 – calibration standard

6.5.5.3 EAL-STD-3 – calibration standard

6.5.5.4 EAL-CCV-1D – secondary source for calibration verification

6.5.5.5 EAL-CCV-2 – secondary source for calibration verification.

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6.6 Calibration Standards – Calibration standards are prepared by serial dilution of the multi-element stock standard solutions. Table 2 lists the calibration standards, elements, and concentrations.

6.6.1 Calibration points 1-4 are made by diluting calibration point 5: Cal 1 is a 200X, Cal 2 is a 100X, Cal 3 is a 20X, and Cal 4 is a 4X. This can be done on the instrument (auto-dilutor) or by hand.

6.6.2 Cal 5 – Dilute 1 mL of EAL-STD-1D, 1 mL of EAL-STD-3, 10 mL EAL-STD-2 to 1000 mL, and 0.25 mL of 10 ppm Hg standard. Maintain 2% HNO_3 and 0.4% HCl concentration in final solution.

6.6.3 Cal 6 – Dilute 0.5 mL of EAL-STD-1D, 0.5 mL EAL-STD-3, 6.25 mL of EAL-STD-2, and 2 mL of 500 ppb Hg standard to 250 mL. Maintain 2% HNO_3 and 0.4% HCl concentration in final solution.

6.6.4 Cal 7 – Dilute 1.25 mL of EAL-STD-1D, 1.25 mL EAL-STD-3, 12.5 mL EAL-STD-2, and 2.5 mL of 500 ppb Hg standard to 250 mL. Maintain 2% HNO_3 and 0.4% HCl concentration in final solution.

6.7 Internal Standards Stock Solution – Internal standard stock solution includes Lithium (Li), Scandium (Sc), Terbium (Tb), Yttrium (Y), Indium (In), Bismuth (Bi), and Holmium (Ho). Each of the elements is at a concentration of 10 µg/mL. It is purchased commercially.

6.8 Blanks – Three types of blanks are required for this method. A calibration blank is used to establish the analytical calibration curve, the method blank (or LRB) is used to assess possible contamination from the sample preparation procedure and to assess spectral background, and the rinse blank is used to flush the instrument between samples in order to reduce memory interferences.

6.8.1 Calibration Blank (CB) – Acidified reagent water (2% HNO3, 0.4% HCl).

6.8.2 MB – Must contain all the reagents in the same volumes as used in processing the samples. The MB must be carried through the same entire preparation scheme as the samples including digestion, when applicable.

6.8.3 Rinse Blank – Consists of 5% (v/v) nitric acid and 0.5 % (v/v) HCl in DIH_2O.

6.9 . Metals Water Spike: 2.5mL of EAL-STD-1, 2.5mL of EAL-STD-3, and 1mL of nitric acid brought up to 50mL with reagent water.

6.10 Tuning Solution – This solution is used for instrument tuning and mass calibration and resolution before analysis. It is purchased commercially.

6.11 Initial Calibration Verification (ICV) – The ICV should be obtained from a source outside the laboratory. A commercially purchased solution is used as second source to verify the calibration daily. This stock standard is diluted and used for the initial and continuing calibration verification. To prepare the ICV, dilute 5 mL of EAL-CCV-1D and 5 mL of EAL-CCV-2 in a final volume of 50 mL with Acidified reagent water.

6.12 Internal Standard Solution – A stock internal standard solution is purchased commercially. The stock solution is prepared by diluting 1 mL of stock standard solution and 1 mL Gold (Au) to a final volume of 500 mL with 2% HNO_3.

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7 SAMPLE COLLECTION, PRESERVATION AND STORAGE

7.1 Before the collection of an aqueous sample, consideration should be given to the type of data required, (i.e., dissolved or total recoverable), so that appropriate preservation and pretreatment steps can be taken. The pH of all aqueous samples **must** be tested immediately before aliquoting for processing or "direct analysis" to ensure the sample has been properly preserved. If properly acid preserved, the sample can be held up to 6 months before analysis.

7.2 For the determination of dissolved elements, the sample must be filtered through a 0.45 µm membrane filter at the time of collection or as soon thereafter as practically possible. Acidify the filtrate with concentrated nitric acid immediately following filtration to pH<2.

7.3 For the determination of total recoverable elements in aqueous samples, samples are **not** filtered, but acidified with concentrated nitric acid to pH<2. Preservation should be done at the time of collection, however, to avoid the hazards of strong acids in the field, transport restrictions, and possible contamination it is recommended that the samples be returned to the laboratory within two weeks of collection and acid preserved upon receipt in the laboratory. Following acidification, the sample should be mixed, held for 16 hours, and then verified to be pH <2 before withdrawing an aliquot for processing or "direct analysis". If for some reason, such as high alkalinity, the sample pH is verified to be >2, more acid must be added and the sample held for an additional 16 hours until verified to be pH<2.

7.3.1 **Note**: When the nature of the sample is either unknown or known to be hazardous, acidification should be done in a fume hood.

8 PROCEDURE

***Note: The optional decision to dilute samples is up to the discretion of the analyst providing that reporting limits reflect these dilutions*.**

8.1 Aqueous Sample Preparation – Dissolved Analytes and Drinking Water (<1 NTU)

8.1.1 **For Dissolved Analytes only**: If the sample was not filtered in the field, filter through a 0.45-µm membrane filter. Acidify the filtrate with concentrated nitric acid immediately following filtration to achieve a pH<2.

8.1.1.1 **Note:** If a precipitate is formed during acidification, transport, or storage, the sample aliquot must be treated using the procedure in Section 8.2 before analysis.

8.1.2 Transfer an aliquot of the filtered, acid preserved water (Dissolved Analyte, nominally 10mL, less if preparing at a dilution), or 10mL of the drinking water sample with turbidity <1 NTU (Drinking water) into a 10-mL polypropylene tube.

8.1.2.1 With each sample batch, prepare a MB by transferring an appropriate aliquot of acidified reagent water into a 10-mL polypropylene tube.

8.1.2.2 With each sample batch, prepare an LCS by pipetting 0.2 mL of Metals Water Spike (from section 6.9) and 0.1mL of EAL-STD-2 into a 10-mL polypropylene tube containing an appropriate aliquot (depending on analysis) of acidified reagent water.

8.1.2.3 A minimum of 10% (i.e. **1 per 10 samples**) of the samples shall be spiked with a known amount of analyte to evaluate the potential for matrix effects. To an aliquot of the respective sample, spike 0.2 mL of Metals Water Spike and 0.1 mL of EAL-STD-2.

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8.1.2.4 Each batch should contain a sample to evaluate reproducibility. This may be a sample duplicate (DUP), matrix spike duplicate (MSD) or laboratory control sample duplicate (LCSD).

8.1.3 If using less than 10 mL of sample, bring to a volume of 10 mL with acidified reagent water

8.1.4 The sample is now ready for analysis

8.2 Aqueous Sample Preparation – Total Recoverable Analytes [M-200.8-T]

8.2.1 Transfer a 50 mL aliquot from a well-mixed, acid preserved sample to a 50 mL polypropylene tube.

8.2.1.1 With each sample batch, prepare a MB by transferring 50 mL of acidified reagent water (2% HNO_3, 0.4% HCl) into a 50-mL polypropylene tube.

8.2.1.2 With each sample batch, prepare an LCS by pipetting 1 mL of Metals Water Spike and 0.5 mL of EAL-STD-2 into a 50-mL polypropylene tube and bringing to a final volume of 50ml with acidified reagent water (2% HNO_3, 0.4% HCl).

8.2.1.3 A minimum of 10% of the samples shall be spiked with a known amount of analyte to evaluate the potential for matrix effects. To a separate aliquot of each sample chosen for a matrix spike, spike 1 mL of the Metals Water Spike and 0.5 mL of EAL-STD-2. Bring to a final volume of 50 mL with the sample.

8.2.1.4 Each batch should contain a sample to evaluate reproducibility. This may be a sample duplicate (DUP), matrix spike duplicate (MSD) or laboratory control sample duplicate (LCSD).

8.2.2 Add 0.5 mL of concentrated Nitric Acid and 0.5 mL of (1+1) Hydrochloric Acid to each polypropylene tube.

8.2.3 Samples should be placed in a hot block preheated to 95 °C and digested for at least 2.5 hours in order to reduce volume to no less than 10 mL. DO NOT ALLOW TO BOIL. The rate of evaporation will increase as the volume decreases, so care must be taken not to allow the sample either to boil or reduce below the intended volume

8.2.4 Allow the tube to cool. Quantitatively return the digested sample to 50 mL final volume with reagent water. Cap, and mix.

8.2.5 Allow undissolved material to settle, or centrifuge, or, if necessary, filter the sample prior to analysis to avoid clogging the nebulizer. Filtering increases risk of contamination, so use care and judgement prior to and during this process.

8.2.6 Analyze the sample as soon as possible after preparation, diluting as necessary to mitigate matrix effects such as chloride concentration, dissolved solids, or non-target analytes.

8.3 Aqueous Sample Preparation – Phosphorus Analysis

8.3.1 Transfer 10 mL of unpreserved sample into a 10-mL polypropylene tube.

8.3.1.1 With each sample batch, prepare a MB by transferring 10 mL of acidified reagent water into a 10-mL polypropylene tube.

8.3.1.2 With each sample batch, prepare an LCS by pipetting 0.1 mL of EAL-STD-2 into a 10-mL polypropylene tube containing 10 mL acidified reagent water.

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8.3.1.3 A minimum of 10% (i.e. **1 per 10 samples**) of the samples shall be spiked with a known amount of analyte to evaluate the potential for matrix effects. To separate aliquots of each sample chosen for a matrix spike, spike 0.1 mL of EAL-STD-2. This results in a MS/MSD pair to determine matrix effects and reproducibility.

8.3.1.4 Each batch should contain a sample to evaluate reproducibility. This may be a sample duplicate (DUP), matrix spike duplicate (MSD) or laboratory control sample duplicate (LCSD).

8.3.2 Bring to a volume of 10 mL with acidified reagent water.

8.3.3 The sample is now ready for analysis

8.4 Instrument set-up

8.4.1 Initiate proper operating configuration of instrument and data system. Allow a period of no less than 30 minutes for the instrument to warm up. After at least 30 minutes, conduct a mass calibration and resolution check, if needed, and a Daily Performance Check. Table 1 shows acceptable operating conditions:

Table 1: Acceptable Operating Conditions for ICP-MS

Daily Performance Check		**Mass Calibration and Resolution**	
^{9}Be Sensitivity	>2,000 cps	Mass Calibration	0.05 amu
^{24}Mg Sensitivity	>15,000 cps	Target Accuracy	0.1 amu
^{115}In Sensitivity	>40,000 cps	Peak Height	5%
^{238}U Sensitivity	>30,000 cps	Target Resolution	0.7 amu
Precision	<5%		
Ce^{++}/Ce	<0.05		
CeO/Ce	<0.03		
Background	<5		

8.5 Calibration and Standardization

8.5.1 Internal Standardization – Internal standardization must be used in all analyses to correct for instrument drift and physical interferences. For full mass range scans, a minimum of three internal standards must be used. Internal standards must be present in all samples, standards, and blanks at identical levels. This may be achieved by mixing the internal standard solution prior to nebulization using a second channel of the peristaltic pump and a mixing T-fitting. The concentration of the internal standard should be sufficiently high that good precision is obtained in the measurement of the isotope used for data correction and to minimize the possibility of correction errors if the internal standard is naturally present in the sample. ^{6}Li, ^{45}Sc, ^{115}In, ^{103}Rh, ^{159}Tb, and ^{165}Ho are used as internal standards.

8.5.2 Calibration – The instrument must be calibrated for the analytes to be determined using the calibration blank and calibration standards Cal 1 through Cal 8. As a minimum, three replicate integrations are required for data acquisition. Use the average of the integrations for instrument calibration and data reporting. The rinse blank should be used to flush the system between solution changes for blanks, standards, and samples. Allow sufficient rinse time to remove traces of the previous sample. Solutions should be aspirated for 30 seconds before the acquisition of data to allow equilibrium to be established

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8.5.2.1 The analyst is permitted to drop points from the calibration as long as they are on the top or bottom end. Dropping mid-points is not allowed. If a low point is dropped, it may affect the reporting limit. If a high point is dropped, it will affect the level at which a dilution would become necessary.

8.5.3 Establish instrument software run procedures for quantitative analysis. For all sample analyses, a minimum of three replicate integrations are required for data acquisition. Use the average of the integrations for data reporting.

8.6 Analysis

8.6.1 All masses which might affect data quality must be monitored during the analytical run. That information should be used to correct the data for identified interferences.

8.6.2 During the analysis of samples, the laboratory must comply with the required quality control. Only for the determination of dissolved analytes or the “direct analysis” of drinking water with turbidity of <1 NTU is the sample digestion step not required.

8.6.3 Samples having concentrations higher than the established linear dynamic range should be diluted into range and reanalyzed. The sample should first be analyzed for the trace elements in the sample, protecting the detector from the high concentration elements, if necessary, by the selection of appropriate scanning windows. The sample should then be diluted for the determination of the remaining elements. Alternatively, the dynamic range may be adjusted by selecting an alternative isotope of lower natural abundance, provided quality control data for that isotope have been established. The dynamic range must not be adjusted by altering instrument conditions to an uncharacterized state.

8.6.4 Drinking water samples must only be analyzed with the instrument in standard mode. KED or DRC modes are not allowed for drinking waters tested via 200.8.

8.7 Instrument shutdown

8.7.1 Shutdown the instrument with the proper shutdown parameters according to the instrument manufacturer’s instructions.

9 INTERFERENCES

9.1 Several interference sources may cause inaccuracies in the determination of trace elements by ICP-MS. These are:

9.1.1 Isobaric elemental interferences – Caused by isotopes of different elements which form singly or doubly charged ions of the same nominal mass-to-charge ratio and which cannot be resolved by the mass spectrometer in use. All elements determined by this method have, at a minimum, one isotope free of isobaric elemental interference. Of the analytical isotopes recommended for use with this method only molybdenum-98 (ruthenium) and selenium-82 (krypton) have isobaric elemental interferences. If alternative analytical isotopes having higher natural abundance are selected in order to achieve greater sensitivity, an isobaric interference may occur. All data obtained under such conditions must be corrected by measuring the signal from another isotope of the interfering element and subtracting the appropriate signal ratio from the isotope of interest. It should be noted that such corrections will only be as accurate as the accuracy of the isotope ratio used in the elemental equation for data calculations. Relevant isotope ratios should be established before the application of any corrections.

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9.1.2 Abundance sensitivity – Is a property defining the degree to which the wings of a mass peak contribute to adjacent masses. The abundance sensitivity is affected by ion energy and quadrupole operating pressure. Wing overlap interferences may result when a small ion peak is being measured adjacent to a large one. The potential for these interferences should be recognized and the spectrometer resolution adjusted to minimize them.

9.1.3 Isobaric polyatomic ion interferences – Are caused by ions consisting of more than one atom which have the same nominal mass-to-charge ratio as the isotope of interest, and which cannot be resolved by the mass spectrometer in use. These ions are commonly formed in the plasma or interface system from support gases or sample components. Such interferences must be recognized, and when they cannot be avoided by the selection of alternative analytical isotopes, appropriate corrections must be made to the data. Equations for the correction of data should be established at the time of the analytical run sequence as the polyatomic ion interferences will be highly dependent on the sample matrix and chosen instrument conditions. In particular, the common 82Kr interference that affects the determination of both arsenic and selenium, can be greatly reduced with the use of high purity krypton free argon.

9.1.4 Physical Interferences – Are associated with the physical processes, which govern the transport of sample into the plasma, sample conversion processes in the plasma, and the transmission of ions through the plasma-mass spectrometer interface. These interferences may result in differences between instrument responses for the sample and the calibration standards. Physical interferences may occur in the transfer of solution to the nebulizer transport to the plasma (e. g., surface tension), or during excitation and ionization processes within the plasma itself. High levels of dissolved solids in the sample may contribute deposits of material on the extraction and/or skimmer cones reducing the effective diameter of the orifices and therefore ion transmission. Dissolved solids levels not exceeding 0.2% (w/v) have been recommended to reduce such effects. Internal standardization may be effectively used to compensate for many physical interference effects. Internal standards ideally should have similar analytical behavior to the elements being determined.

9.1.5 Memory interferences – Result when isotopes of elements in a previous sample contribute to the signals measured in a new sample. Memory effects can result from sample deposition on the sampler and skimmer cones, and from the buildup of sample material in the plasma torch and spray chamber. The site where these effects occur is dependent on the element and can be minimized by flushing the system with a rinse blank between samples. The possibility of memory interferences should be recognized within an analytical run. Memory interferences may be assessed within an analytical run by using a minimum of three replicate integrations for data acquisition. If the integrated signal values drop consecutively, the analyst should be alerted to the possibility of a memory effect and should examine the analyte concentration in the previous sample to identify if this was high. If memory interference is suspected, the sample should be reanalyzed.

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10 QUALITY CONTROL

10.1 Linear calibration ranges – Linear calibration ranges are primarily detector limited. The upper limit of the linear calibration range should be established for each analyte by determining the signal responses from a minimum of three different concentration standards, one of which is close to the upper limit of the linear range. Care should be taken to avoid potential damage to the detector during this process. The linear calibration range, which may be used for the analysis of samples, should be judged by the analyst from the resulting data. The upper LDR limit should be an observed signal no more than 10% below the level extrapolated from lower standards. Determined sample analyte concentrations that are greater than 90% of the determined upper LDR limit must be diluted and reanalyzed. The LDRs should be verified whenever, in the judgment of the analyst, a change in analytical performance caused by either a change in instrument hardware or operating conditions would dictate.

10.2 Quality control sample (QCS)/ICV – When beginning the use of this method, on a quarterly basis or as required to meet data-quality needs, verify the calibration standards and acceptable instrument performance with the preparation and analyses of a QCS (ICV). To verify the calibration standards, the QCS must be within ±10% of its true value.

10.2.1 For DOD analyses only, an additional low level CCV (DETL or LLCCV) check must be performed to measure read back at the low end of the calibration. It must fall within ±20% of the true value.

10.3 Continuing Calibration Verification (CCV) – Use the same prepared solution as the ICV. A CCV/CCB pair should be run after every 10 samples and at the end of a sequence. The CCV must recover within ±10% of its true value. If the CCV recovers outside of this criteria for analytes of interest, the instrument must be recalibrated. If the CCV recovers outside of ±15%, then the bracket of samples since the last passing (w/in ±10%) CCV must also be reanalyzed following the recalibration or qualified appropriately. The analyst may use the responses from the CCV to recalibrate the instrument; however, the calibration must be verified prior to continuing sample analysis.

10.4 Batch Quality Control Requirements

10.4.1 Method Blank (MB): Detections in the method blank must be < 10% of the detection in a sample, or < 2.2X the MDL, whichever is greater. If the detections are above those criteria, correct the contamination, establish a clean blank, and reanalyze fresh aliquots of the samples affected.

10.4.2 Laboratory Control Sample (LCS): recovery limit of ±15%.

10.4.3 Matrix Spike and Matrix Spike Duplicate (MS/MSD): recovery limit of ±30%.

10.4.4 Relative Percent Difference for Sample Duplicate (DUP) and MSD should be ≤30%.

10.5 Internal standards responses – The absolute response of any one internal standard must not deviate more than 60 - 125% of the original response in the calibration blank. If deviations greater than these are observed, flush the instrument with the rinse blank and monitor the responses in the calibration blank. If the responses of the internal standards are now within the limit, take a fresh aliquot of the sample, dilute by a further factor of five and reanalyze. Continue diluting by a factor of five until internal standards are within the acceptable limit.

10.6 Initial demonstration of capability (IDC) – See SOP 59.

10.7 Method Detection Limit (MDL) Study – See SOP 53.

10.8 For DoD Requirements see Department of Defense QSM in Omega. Specific requirements for metals from Appendix B of the QSM may be found in the Appendices of this SOP in Table 3

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11 DATA ANALYSIS AND CALCULATIONS

11.1 Sample data should be reported in units of µg/L for aqueous samples. Do not report element concentrations below the determined MDL.

11.2 Data values should be corrected for instrument drift or sample matrix induced interferences by the application of internal standardization. Corrections for characterized spectral interferences should be applied to the data. Chloride interference corrections should be made on all samples, regardless of the addition of hydrochloric acid, as the chloride ion is a common constituent of environmental samples.

11.3 If an element has more than one monitored isotope, examination of the concentration calculated for each isotope, or the isotope ratios, will provide useful information for the analyst in detecting a possible spectral interference. Consideration should therefore be given to both primary and secondary isotopes in the evaluation of the element concentration. In some cases, secondary isotopes may be less sensitive or more prone to interferences than the primary recommended isotopes, therefore differences between the results do not necessarily indicate a problem with data calculated for the primary isotopes.

12 RECORD KEEPING

12.1 Raw data is maintained on site for a minimum of 5 years.

12.2 All analytical batches are available in LIMS Omega.

13 SAFETY

13.1 The toxicity or carcinogenicity of reagents used in this method have not been fully established. Each chemical should be regarded as a potential health hazard and exposure to these compounds should be as low as reasonably achievable. Each laboratory is responsible for maintaining a current awareness file of OSHA regulations regarding the safe handling of the chemicals specified in this method. A reference file of material data handling sheets should also be available to all personnel involved in the chemical analysis. Specifically, concentrated nitric and hydrochloric acids present various hazards and are moderately toxic and extremely irritating to skin and mucus membranes. Use these reagents in a fume hood whenever possible and if eye or skin contact occurs, flush with large volumes of water. Always wear safety glasses or a shield for eye protection, protective clothing and observe proper mixing when working with these reagents.

13.2 The acidification of samples containing reactive materials may result in the release of toxic gases, such as cyanides or sulfides. Acidification of samples should be done in a fume hood.

13.3 Analytical plasma sources emit radiofrequency radiation in addition to intense UV radiation. Suitable precautions should be taken to protect personnel from such hazards. The inductively coupled plasma should only be viewed with proper eye protection from UV emissions.

13.4 It is the responsibility of the user of this method to comply with relevant disposal and waste regulations.

13.5 Samples received for analysis should be considered hazardous and handled accordingly. In addition, some of the reagents and standards used in this method are hazardous. Before using this method, individuals who are unfamiliar with the hazards associated with these chemicals should refer to the safety data sheets (SDS).

14 METHOD PERFORMANCE

14.1 Only employees who have been properly trained and have the required experience shall perform this method.

14.2 Please refer to SOPs 53 and 59 for more information.

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15 WASTE AND HAZARDOUS MATERIALS

15.1 All client samples that are below discharge limits are disposed of in the general waste drums. Those that exceed the limits are introduced into the hazardous waste stream. In extreme circumstances they are sent back to the client. Instrument waste is disposed of in the general waste drums. Expired standards are disposed of in either the general waste drums or the hazardous waste stream depending on concentration.

15.2 Please refer to SOP 61 for more information.

16 REFERENCES

16.1 Code of Federal Regulations 40, Ch. 1, Pt. 136 Appendix B.

16.2 Method 200.8: Determination of Trace Elements in Waters and Wastes by Inductively Coupled Plasma – Mass Spectrometry, Rev 5.4.

17 TABLES AND APPENDICES

17.1 Table 1: Calibration Standards

17.2 Table 2: ICP-MS MASS TABLE

17.3 Appendix I: Preparation of Dissolved Analytes in Water for EPA 200.8

17.4 Appendix II: Preparation of Drinking Waters for EPA 200.8

17.5 Appendix III: Preparation of Total Analyte Waters for EPA 200.8

17.6 Appendix IV: Preparation of Phosphorus Waters for EPA 200.8

17.7 Appendix V: Calculations for Hardness – SM 2340B

17.8 Table 3: Appendix B Requirements from QSM Version 5.4

18 CHANGES SINCE LAST REVISION

18.1 Logo and branding updates.

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Table 1: Calibration Standards

Element	Calibration Standard ug/L						
	Cal 1	**Cal 2**	**Cal 3**	**Cal 4**	**Cal 5**	**Cal 6**	**Cal 7**
Antimony	0.025	0.05	0.25	1.25	5.0	10.0	25.0
Arsenic	0.5	1.0	5.0	25.0	100	200	500
Barium	0.5	1.0	5.0	25.0	100	200	500
Beryllium	0.025	0.05	0.25	1.25	5.0	10.0	25.0
Cadmium	0.025	0.05	0.25	1.25	5.0	10.0	25.0
Chromium	0.5	1.0	5.0	25.0	100	200	500
Cobalt	0.5	1.0	5.0	25.0	100	200	500
Copper	0.5	1.0	5.0	25.0	100	200	500
Lead	0.25	0.5	2.5	12.5	50.0	100	250
Manganese	0.5	1.0	5.0	25.0	100	200	500
Mercury	0.0125	0.025	0.125	0.625	2.5	4.0	5.0
Molybdenum	0.5	1.0	5.0	25.0	100	200	500
Nickel	0.5	1.0	5.0	25.0	100	200	500
Selenium	0.05	0.1	0.5	2.5	10.0	20.0	50.0
Silver	0.025	0.05	0.25	1.25	5.0	10.0	25.0
Strontium	0.5	1.0	5.0	25.0	100	200	500
Thallium	0.0125	0.025	0.125	0.625	2.5	5.0	12.5
Tin	0.5	1.0	5.0	25.0	100	200	500
Titanium	0.5	1.0	5.0	25.0	100	200	500
Uranium	0.5	1.0	5.0	25.0	100	200	500
Vanadium	0.5	1.0	5.0	25.0	100	200	500
Zinc	0.5	1.0	5.0	25.0	100	200	500
Aluminum	5.0*	10.0	50.0*	250	1000	2500	5000
Boron	2.5*	5.0	25.0*	125	500	1250	2500
Calcium	5.0*	10.0	50.0*	250	1000	2500	5000
Iron	5.0*	10.0	50.0*	250	1000	2500	5000
Magnesium	5.0*	10.0	50.0*	250	1000	2500	5000
Phosphorous	5.0*	10.0	50.0*	250	1000	2500	5000
Potassium	5.0*	10.0	50.0*	250	1000	2500	5000
Sodium	5.0*	10.0	50.0*	250	1000	2500	5000

*Note: While EAL-STD-2 is present in calibration standards 1 and 3 due to it already being added in calibration standard 5, these two points are not used in the calibration curves for the elements in EAL-STD-2.

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Table 2: ICP-MS Mass Table

Analyte	Mass
Aluminum	27
Antimony	121
Arsenic	75, (77, 88)
Barium	137
Beryllium	9
Boron	11
Cadmium	111, (108)
Calcium	44
Chromium	52
Cobalt	29
Copper	63, 65
Iron	57
Lead	(206, 207), 208
Magnesium	24
Manganese	55
Mercury	201
Molybdenum	95
Nickel	60
Phosphorus	31
Potassium	39
Selenium	82
Silver	107
Sodium	23
Strontium	88
Thallium	205
Tin	118
Titanium	47
Uranium	238
Vanadium	51
Zinc	66

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Appendix: Quick Preparation Guides

Appendix I:
Preparation of Dissolved Analytes in Water for EPA 200.8

1. In a 10-mL tube add ~5 mL of acidified reagent water for MBLK and LCS. Spike **0.2 mL of Metals Water Spike** and **0.1 mL of EAL-STD-2** into LCS tube. Bring up to 10 mL with acidified reagent water.
2. Spike **0.2 mL of the Metals Water Spike** and **0.1 mL of EAL-STD-2** into MS and MSD tubes (two identical aliquots of the same sample). Bring up to 10 mL volume with parent sample. Note: the method requires 1 MS per 10 samples.
3. For samples, in a 10-mL tube add 10 mL of filtered and preserved sample.

Appendix II:
Preparation of Drinking Waters for EPA 200.8

1. Check samples to ensure turbidity is <1 NTU. Record sample turbidity on prep bench sheet.
    i. If turbidity is >1 NTU, sample must be digested.
2. In a 10-mL tube add 5 mL acidified reagent water for the MB and LCS. Spike **0.2 mL of the Metals Water Spike** and **0.1 mL of EAL-STD-2** into LCS tube. Bring up to 10 mL with acidified reagent water.
3. Spike **0.2 mL of the Metals Water Spike** and **0.1 mL of EAL-STD-2** into MS and MSD tubes (two identical aliquots of the same sample). Bring up to 10 mL volume with parent sample. Note: the method requires 1 MS per 10 samples.
4. For samples, in a 10-mL tube add 10 mL preserved sample.

Appendix III:
Preparation of Total Analyte Waters for EPA 200.8 [M-200.8-T]

1. Samples: In a 50-mL polypropylene tube add 50 mL of sample.
2. MB: In a 50-mL polypropylene tube add some acidified reagent water.
3. LCS: In a 50-mL polypropylene tube add some acidified reagent water. Spike **1 mL of the Metals Water Spike** and **0.5 mL of EAL-STD-2** into LCS tube. Bring up to 50 ml with acidified reagent water.
4. MS/MSD: Add 50mL of sample to two polypropylene tubes. Spike **1 mL of the Metals Water Spike** and **0.5 mL of EAL-STD-2** into each tube. Bring up to 50 ml with sample. Note: the method requires 1 MS per 10 samples.
5. Add **0.5mL concentrated HNO_3 and 0.5 mL 1:1 HCl** to each polypropylene tube
6. Place 50-mL tubes in Hot Block and digest for a minimum of 2.5 hours. Do not allow samples to boil. This should concentrate the sample to no less than 10mL.
7. Remove samples from Hot Block and allow to **COOL**.
8. Bring up to **50** mL with DIH_2O, filtering if necessary.

Appendix IV:
Preparation of Phosphorus Waters for EPA 200.8

1. In a 10-mL tube add 5 mL of acidified reagent water for MBLK and LCS. Spike 0.1 mL of EAL-STD-2 into LCS tube. Bring up to 10-mL with acidified reagent water.
2. Spike 0.1 mL of EAL-STD-2 into MS and MSD tubes (two identical aliquots of the same sample). Bring up to 10 mL volume with parent sample. Note: the method requires 1 MS per 10 samples.
3. For samples, in a 10-mL tube add 10 mL of unpreserved sample.

Appendix V:
CALCULATIONS FOR HARDNESS – SM 2340B

The hardness, mg equivalent $CaCO_3$/L is calculated by determining the concentration of both Ca and Mg and using the following equations:

Total Hardness
mg equivalent $CaCO_3$/L = 2.497 [Ca, mg/L] + 4.118 [Mg, mg/L]

Calcium Hardness
mg equivalent $CaCO_3$/L = 2.497 [Ca, mg/L]

Magnesium Hardness
mg equivalent $MgCO_3$/L = 4.118 [Mg, mg/L]

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Table 3: DoD/DOE Quality Control Requirements for Inductively Coupled Plasma/Mass Spectrometry (from QSM 5.4)

Trace Metals Analysis by Inductively Coupled Plasma/Mass Spectrometry (ICP/MS)					
QC Check	**Minimum Frequency**	**Acceptance Criteria**	**Corrective Action**	**Flagging Criteria**	**Comments**
Linear Dynamic Range (LDR) or High-Level Check Standard	At initial set-up and checked every 6 months with a high standard at the upper limit of the range.	Within ± 10% of true value.	Dilute samples within the calibration range or reestablish/verify the LDR.	Flagging is not appropriate.	Data cannot be reported above the calibration range without an established/passing high level check standard.
Tuning	Prior to ICAL.	Mass calibration ≤ 0.1 amu from the true value; Resolution < 0.9 amu full width at 10% peak height.	Retune instrument and verify.	Flagging is not appropriate.	No samples shall be analyzed without a valid tune.
Initial Calibration (ICAL) for All Analytes	Daily ICAL prior to sample analysis.	If more than one calibration standard is used, $r^2 \geq 0.99$.	Correct problem, then repeat ICAL.	Flagging is not appropriate.	Minimum one high standard and a Calibration Blank. No samples shall be analyzed until ICAL has passed.
Initial Calibration Verification (ICV)	Once after each ICAL, analysis of a second source standard prior to sample analysis.	All reported analytes within ± 10% of true value.	Correct problem. Rerun ICV. If that fails, repeat ICAL.	Flagging is not appropriate.	No samples shall be analyzed until calibration has been verified with a second source.

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QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Continuing Calibration Verification (CCV)	After every 10 field samples and at the end of the analysis sequence.	All reported analytes within ± 10% of the true value.	Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails or if two consecutive CCVs cannot be run, perform corrective action(s) and repeat CCV and all associated samples since last successful CCV. Alternately, recalibrate if necessary; then reanalyze all associated samples since the last acceptable CCV.	If reanalysis cannot be performed, data must be qualified and explained in the Case Narrative. Apply Q-flag to all results for the specific analyte(s) in all samples since the last acceptable CCV.	Results may not be reported without valid CCVs. Flagging is only appropriate in cases where the samples cannot be reanalyzed.

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QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Low-Level Calibration Check Standard (LLCCV)	Daily.	All reported analytes within ± 20% of the true value.	Correct problem and repeat ICAL.	Flagging is not appropriate.	No samples shall be analyzed without a valid Low-Level Calibration Check Standard (LLCCV). LLCCV should be less than or equal to the LOQ. If the concentration of the lowest calibration standard is less than or equal to the LOQ, the lowest standard may be re-quantified against the calibration curve as LLCCV. Otherwise, a separate standard must be analyzed as the LLCCV prior to the analysis of any samples.

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QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Internal Standards (IS)	Every field sample, standard and QC sample.	IS intensity in the samples within 30-120% of intensity of the IS in the ICAL blank.	If recoveries are acceptable for QC samples, but not field samples, the field samples may be considered to suffer from a matrix effect. Reanalyze sample at 5-fold dilutions until criteria is met. For failed QC samples, correct problem and rerun all associated failed field samples.	Flagging is not appropriate.	Samples suffering from matrix effect should be diluted until criteria are met, or an alternate IS should be selected.

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QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Method Blank (MB)	One per preparatory batch.	The absolute values of all analytes must be < ½ LOQ or < 1/10th the amount measured in any sample.	Correct problem. If required, re-prep and reanalyze MB and all QC samples and field samples processed with the contaminated blank.	If reanalysis cannot be performed, data must be qualified and explained in the Case Narrative. Apply B-flag to all results for the specific analyte(s) in all samples in the associated preparatory batch.	Results may not be reported without a valid Method Blank. Non-detects associated with positive blank infractions may be reported. Sample results > 10X the LOQ associated with negative blanks may be reported. Flagging is only appropriate in cases where the samples cannot be reanalyzed.

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QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Initial and Continuing Calibration Blank (ICB/CCB)	Immediately after the ICV and immediately after every CCV.	The absolute values of all analytes must be < ½ LOQ or < 1/10th the amount measured in any sample.	ICB: Correct problem and repeat ICV/ICB analysis. If that fails, rerun ICAL. All samples following the last acceptable Calibration Blank must be reanalyzed. CCBs may not be reanalyzed without reanalysis of the associated samples and CCV(s).	Flagging is not appropriate.	Results may not be reported without valid Calibration Blanks. Non-detects associated with positive blank infractions may be reported. Sample results > 10X the LOQ associated with negative blanks may be reported. For CCB, failures due to carryover may not require an ICAL.
Interference Check Solutions (ICS) (also called Spectral Interference Checks)	After ICAL and prior to sample analysis.	ICS-A: Absolute value of concentration for all non-spiked project analytes <1/2 LOQ (unless they are a verified trace impurity from one of the spiked analytes); ICS-AB: Within ± 20% of true value.	Terminate analysis, locate and correct problem, reanalyze ICS, reanalyze all samples.	If corrective action fails, apply Q-flag to all results for specific analyte(s) in all samples associated with the failed ICS.	All analytes must be within the LDR. ICS-AB is not needed if instrument can read negative responses.

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QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Laboratory Control Sample (LCS)	One per preparatory batch.	A laboratory must use the QSM Appendix C Limits for batch control if project limits are not specified. If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified.	Correct problem, then re-prep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes if sufficient sample material is available.	If reanalysis cannot be performed, data must be qualified and explained in the Case Narrative. Apply Q-flag to specific analyte(s) in all samples in the associated preparatory batch.	Must contain all reported analytes. Results may not be reported without a valid LCS. Flagging is only appropriate in cases where the samples cannot be reanalyzed.
Matrix Spike (MS)	One per preparatory batch.	A laboratory must use the QSM Appendix C Limits for batch control if project limits are not specified. If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified.	Examine the project specific requirements. Contact the client as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met and explain in the Case Narrative.	For matrix evaluation only. If MS results are outside the limits, the data shall be evaluated to determine the source(s) of difference (i.e., matrix effect or analytical error).

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QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria
Matrix Spike Duplicate (MSD) or Matrix Duplicate (MD)	One per preparatory batch.	A laboratory must use the QSM Appendix C Limits for batch control if project limits are not specified. If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified. MSD or MD: RPD of all analytes ≤ 20% (between MS and MSD or sample and MD).	Examine the project specific requirements. Contact the client as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met and explain in the Case Narrative.
Dilution Test	One per preparatory batch if MS or MSD fails.	Five-fold dilution must agree within ± 10% of the original measurement.	No specific CA unless required by the project.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met and explain in the Case Narrative.
Post Digestion Spike (PDS) Addition	One per preparatory batch if MS or MSD fails (using the same sample as used for the MS/MSD if possible).	Recovery within 80-120%.	No specific CA unless required by the project.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met and explain in the Case Narrative.
Method of Standard Additions (MSA)	When dilution or post digestion spike fails and if the required by project.	NA.	NA.	NA.

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SOP Proprietary Information

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Determination of Metals by Inductively Coupled Plasma – Mass Spectrometry (ICP-MS) EPA Method 6020B

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1. PURPOSE

1.1 Inductively coupled plasma-mass spectrometry (ICP-MS) is used to determine sub-µg/L concentrations of large numbers of elements in water samples and waste extracts or digests. When dissolved constituents are required, samples must be filtered and acid-preserved prior to analysis. No digestion is required prior to analysis for dissolved elements in water samples. An acid digestion prior to filtration and analysis is required in groundwater, aqueous, soil, sludge, sediment, and industrial and other solid waste samples for which total (acid-leachable) elements are required (refer to EPA Method 3010A and EPA Method 3050B for Fremont Analytical, Inc.)

2. SCOPE

2.1 ICP-MS is applied to the determination of over sixty elements in various matrices. Analytes for which the EPA has demonstrated the acceptability of Method 6020 are listed below. Fremont Analytical, Inc. provides analysis of these EPA-approved elements.

Element	CAS #
Aluminum	7429-90-5
Antimony	7440-36-0
Arsenic	7440-38-2
Barium	7440-39-3
Beryllium	7440-41-7
Cadmium	7440-43-9
Calcium	7440-70-2
Chromium	7440-47-3
Cobalt	7440-48-4
Copper	7440-50-8
Iron	7439-89-6
Lead	7439-92-1
Magnesium	7439-95-4
Manganese	7439-96-5
Mercury	7439-97-6
Nickel	7440-02-0
Potassium	7440-09-7
Selenium	7782-49-2
Silver	7440-22-4
Sodium	7440-23-5
Thallium	7440-28-0
Vanadium	7440-62-2
Zinc	7440-66-6

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2.2 Fremont Analytical, Inc. also uses 6020 for the analysis of:

Element	CAS #
Phosphorus	7723-14-0
Boron	7440-42-8
Strontium	7440-24-6
Molybdenum	7439-98-7
Tin	7440-31-5
Titanium	7440-32-6

2.3 If Method 6020 is used to determine any analyte not listed, it is the responsibility of the analyst to demonstrate the accuracy and precision of the method for the sample to be analyzed. The analyst is always required to monitor potential sources of interference and take appropriate action to ensure data of known quality. Other elements and matrices may be analyzed by this method if performance is demonstrated for the analyte of interest, in the matrices of interest, and at the concentration levels of interest, in the same manner as previously listed elements and matrices.

2.4 Use of this method should be relegated to analysts who are knowledgeable in the recognition and correction of spectral, chemical, and physical interferences in ICP-MS.

2.5 An appropriate internal standard is required for each analyte determined by ICP-MS. Recommended internal standards are ^{6}Li, ^{45}Sc, ^{89}Y, ^{103}Rh, ^{115}In, ^{159}Tb, ^{165}Ho, and ^{209}Bi. FAI uses ^{6}Li, ^{45}Sc, ^{103}Rh, ^{115}In, ^{159}Tb, and ^{165}Ho. For the Agilent ICP-MS, FAI uses ^{6}Li, ^{45}Sc, ^{73}Ge, ^{89}Y, ^{115}Tb, and ^{209}Bi.

3. DEFINITIONS

3.1 For more information about quality control definitions please reference the QA Manual. Definitions in this section are specific to this method.

3.2 *Post Digestion Spike (PDS)* – An aliquot of sample spiked with a known concentration of target analyte(s). The spiking occurs after sample preparation. A post digest spike is used to document the bias of a method in a given sample matrix.

3.3 *Serial Dilution (DIL)* – A 1:5 dilution of another sample in the batch that was prepared normally.

3.4 *Acidified Reagent Water* – DI water solution with 2% nitric acid and 0.5% hydrochloric acid. This is used for various dilutions throughout the procedure. To make, add 80 mL concentrated nitric acid and 20 mL concentrated hydrochloric acid to 4L of DI water. This recipe can be scaled to fit any desired container.

4. SUMMARY OF METHOD

4.1 Prior to analysis, samples, requiring total (“acid-leachable”) values, must be digested using appropriate sample preparation methods.

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4.2 Method 6020 describes the multi-elemental determination of analytes by ICP-MS in environmental samples. The method measures ions produced by a radio frequency inductively coupled plasma. Analyte species in liquid are nebulized and the resulting aerosol is transported by argon gas into a plasma torch. Ions produced by high temperatures are entrained in the plasma gas and introduced (by means of an interface) into a mass spectrometer. They are then sorted according to their mass-to-charge ratios and quantified with a channel electron multiplier. Interferences must be assessed and valid corrections applied, or the data must instead be flagged to indicate problems. Interference correction must include compensation for background ions contributed by the plasma gas, reagents, and constituents of the sample matrix.

5. RESPONSIBILITIES

5.1 The responsibilities of the operator (analyst) include maintenance of the instrument (such as cleaning and replacing parts when indicated by the manufacturer's guidelines) and instrument set up which includes Torch Axis, Standard Lenses Tune, HW Settings : Resolution/Axis, and Performance Report to test the Agilent 7850 hardware along with the US EPA Tune Check Report.

5.2 The analyst is responsible for setting up an auto sampler table and running sequence (where QC requirements are set) for the samples to be analyzed. The analyst is also responsible for monitoring the run. Check all QC and samples to see that they meet the criteria of this SOP and make corrections to the instrument (recalibration) or to the samples (dilution) as needed.

6. REQUIREMENTS

6.1 Inductively coupled plasma-mass spectrometer (ICP-MS): Perkin-Elmer Nexion 300D, Agilent 7850, or equivalent.

6.2 Argon gas supply: high-purity grade (99.99%).

6.3 Acids used in the preparation of standards and for sample processing must be of high purity. Redistilled acids are recommended because of the high sensitivity of the ICP-MS. Nitric acid at less than or equal to 2% (v/v) is required for the ICP-MS to minimize damage to the interface, and to minimize isobaric molecular-ion interferences with the analytes. An increased number of molecular-ion interferences are observed when hydrochloric and sulfuric acids are used. Concentrations of Antimony and Silver between 50-500 µg/L require 1% (v/v) HCl for stability. For concentrations above 500 µg/L Silver, additional HCl is needed. Consequently, accuracy of analytes requiring significant chloride molecular ion corrections (such as Arsenic and Vanadium) will degrade. Fremont Analytical, Inc. uses concentrations of Ag and Sb smaller than 50 µg/L for all calibration and check standards.

6.4 Reagent water: All references to water in the SOP refer to DI water unless otherwise specified.

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6.5 Multi-element stock solutions are purchased for both calibration and QC standards.

6.5.1 EAL-STD-1D – calibration standard

6.5.2 EAL-STD-2 – calibration standard

6.5.3 EAL-STD-3 – calibration standard

6.5.4 EAL-CCV-1D – secondary source for calibration verification

6.5.5 EAL-CCV-2 – secondary source for calibration verification.

6.6 Calibration Standards – Calibration standards are prepared by serial dilution of the multi-element stock standard solutions. Table 2 lists the calibration standards, elements, and concentrations.

6.6.1 Calibration points 1-4 are made by diluting calibration point 5: Cal 1 is a 200X, Cal 2 is a 100X, Cal 3 is a 20X, and Cal 4 is a 4X. This can be done on the instrument (auto-dilutor) or by hand.

6.6.2 Cal 5 – Dilute 1 mL of EAL-STD-1D, 1 mL of EAL-STD-3, 10 mL EAL-STD-2 to 1000 mL, and 0.25 mL of 10 ppm Hg standard. Maintain 2% HNO_3 and 0.4% HCl concentration in final solution.

6.6.3 Cal 6 – Dilute 0.5 mL of EAL-STD-1D, 0.5 mL EAL-STD-3, 6.25 mL of EAL-STD-2, and 2 mL of 500 ppb Hg standard to 250 mL. Maintain 2% HNO_3 and 0.4% HCl concentration in final solution.

6.6.4 Cal 7 – Dilute 1.25 mL of EAL-STD-1D, 1.25 mL EAL-STD-3, 12.5 mL EAL-STD-2, and 2.5 mL of 500 ppb Hg standard to 250 mL. Maintain 2% HNO_3 and 0.4% HCl concentration in final solution.

6.7 Calibration standard solutions contain a suitable concentration of appropriate internal standard for each analyte when analyzed. Internal standards are added inline at the time of analysis using an autosampler. In most instances, an internal standard should be no more than 50 amu removed from the analyte, however in certain cases this may not always be true. Internal standards used include ^{6}Li, ^{45}Sc, ^{72}Ge, ^{115}In, and ^{159}Tb.. Prior to preparing mixed standards, the multi-element solutions are analyzed to determine possible spectral interferences or the presence of impurities. This is done by the standard's manufacturer. All standards come with Certificates of Analysis, and are retained on file.

6.7.1 Care must be taken when preparing mixed standards to ensure that the elements are compatible and stable. Transfer mixed standard solutions to poly bottles for storage. Fresh mixed standards are prepared as needed (please note that concentrations can change with H_2O loss). Calibration standards are initially verified using a quality control standard

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6.8 Blanks: Three types of blanks are required for the analysis: calibration blanks (used in establishing the calibration curve), preparation blanks, (used to monitor for possible contamination resulting from the sample preparation procedure), and rinse blanks (used to flush the system between all samples and standards).

6.8.1 Calibration blanks consist of identical concentrations of acid used in preparing the final dilution of calibrating solutions (acidified reagent water).

6.8.2 Preparation (or reagent) blanks must be carried through the complete preparation procedure and contain identical volumes of reagents as the sample solutions.

6.8.3 Rinse blanks consist of 5% HNO_3 in reagent water. Prepare a sufficient quantity to flush the system between standards and samples.

6.9 Interference check solutions (ICSs) are prepared to contain known concentrations of interfering elements demonstrating the magnitude of interference, and provide an adequate test of any corrections.

6.9.1 Chloride in the ICS provides means to evaluate software corrections for chloride-related interferences (such as $^{35}Cl^{16}O^{+}$ on $^{51}V^{+}$ and $^{40}Ar^{35}Cl^{+}$ on $^{75}As^{+}$). Iron is used to demonstrate the adequate resolution of the spectrometer in the determination of manganese.

6.9.2 Molybdenum serves to indicate oxide effects on cadmium isotopes. Other components are present to evaluate the ability of the measurement system to correct for various molecular-ion isobaric interferences. The ICS is used to verify that interference levels are corrected by the data system within quality control limits.

6.9.3 NOTE: The final ICS solution concentrations are intended to evaluate corrections for known interferences on only the analytes in Section 2. If Method 6020 is used to determine an element not listed in Section 2, it is the responsibility of the analyst to modify the ICS solutions or prepare an alternative ICS solution to allow adequate verification of correction of interferences on the unlisted element.

6.9.4 The ICSA solution must be prepared from ultra-pure reagents. The solution used is Inorganic Ventures: 6020ICS-9A. This standard is obtained commercially.

6.9.4.1 Working ICS Solutions--Working solution is prepared daily by diluting 6020ICS-9A by 100 using acidified reagent water (i.e. ICSA: 0.1 mL of 6020ICS-9A into 10)

6.10 The quality control standard is the initial calibration verification solution (ICV) prepared in the same acid matrix as calibration standards. This solution is an independent standard (second source) near the midpoint of the linear range, and at a concentration other than that used for the instrument calibration.

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6.11 Mass spectrometer tuning solution: a solution containing elements representing all mass regions of interest (1 µg/L of Be, Ce, Fe, In, Li, Mg, Pb, and U). A mass spectrometer tuning solution must be prepared to verify the resolution and mass calibration of the instrument are within required specifications. This solution is also used to verify that the instrument has reached thermal stability. Alternatively, a tuning solution may be purchased from a reputable vendor.

7. SAMPLE COLLECTION

7.1 Fremont Analytical, Inc. personnel do not collect samples. SW-846 required handling information for storage, preservation, holding times, and containers are employed. Analysts create prepared sample batches using metals preparation procedures (3010 and 3050). The batches are prepared with a method blank, LCS, and spikes, as required by preparation SOPs.

8. PROCEDURE

8.1 Instrument set-up:

8.1.1 Turn on instrument and allow to stabilize for at least 30 minutes.

8.1.2 Run the instrument start-up tasks. These must be run daily to make sure the operating conditions are acceptable. Ensure that all criteria are passing prior to starting analysis.

8.2 Analysis

8.2.1 Calibrate the instrument for the analytes of interest, using the calibration blank and at least one initial calibration standard. Recommended isotopes for analytes are provided in Appendix A. Masses used by FAI are provided in Appendix B.. Use the average of at least three integrations for both calibration and sample analyses. Requirements for a single point calibration are as follows:

8.2.1.1 ICV: Immediately after the calibration has been established, it must be verified and documented for every analyte by the analysis of the calibration verification solution. An ICV must be prepared from a source other than that used for primary calibration. It should be prepared at a concentration near the midpoint of the calibration. The ICV must recover within 90-110% of expected values.

8.2.1.2 Low-level Verification: The LLCV should be prepared from the same source as the ICAL at or below the LLOQ. It should quantitate within 80-120% of the true value.

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8.2.1.3 Mid-Level Verification: The MLCV should be prepared from the same source as the ICAL at the midpoint of the ICAL. It should quantitate within 90-110% of the true value.

8.2.1.4 ICB: The Calibration Blank is reanalyzed after the ICV, and must not contain analytes of interest above 1/2 the LLOQ.

8.2.2 Alternatively, the calibration curve may be prepared with a minimum of a calibration blank and three non-zero standards effectively bracketing the desired sample concentration range. For all multi-point calibration scenarios, the lowest non-zero standard concentration should be considered the lower limit of quantitation. Requirements for a multiple-point calibration are as follows:

8.2.2.1 To be considered acceptable, the calibration curve should have a calibration coefficient (R^2) of 0.990 or greater. The extreme upper and lower calibration points may be removed from the multi-point curve (as long as three non-zero points remain) such that the linear range is narrowed and the non-linear upper and/or lower portions are removed.

8.2.2.2 ICV: Immediately after the calibration has been established, it must be verified and documented for every analyte by the analysis of the calibration verification solution. An ICV must be prepared from a source other than that used for primary calibration. It should be prepared at a concentration near the midpoint of the calibration. The ICV must recover within 90-110% of expected values.

8.2.2.3 Low-Level Readback: The lowest calibration point should re-quantitate to within 80-120% of the true value.

8.2.2.4 Mid-Level Readback: The middle calibration point should re-quantitate to within 90-110% of the true value.

Note: To readback standards listed above, the analyst should enter the instrument software. In the “Data” window, change the “Read Type” column for the appropriate standards and reprocess these samples into the CSV. Import them under LLCV and MLCV as appropriate in Omega.

8.2.2.5 ICB: The Calibration Blank is reanalyzed after the ICV, and must not contain analytes of interest above 1/2 the LLOQ.

8.2.3 The linear dynamic range (LDR) establishes the highest concentration that may be reported without dilution the sample. An LDR standard at the upper limit should be prepared, analyzed, and quantitated against the normal calibration curve daily. This may occur at any point in the run. The calculated value should be within 10% (±10%) of the true value. If an LDR is not run, the highest standard in the calibration becomes the linear dynamic range.

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8.3 Instrument shutdown

8.3.1 When sample analysis is complete, turn off the plasma and release the pump tubing.The Agilent software also has an auto shutoff feature for the plasma.

8.4 Interferences

8.4.1 Isobaric elemental interferences in ICP-MS are caused by isotopes of different elements forming atomic ions with the same nominal mass-to-charge ratio (m/z). Although this type of interference is uncommon, it is not easily corrected, and samples exhibiting a significant problem of this type could require resolution improvement, matrix separation, or analysis using another verified and documented isotope, or use of another method.

8.4.2 Isobaric molecular and doubly charged ion interferences in ICP-MS are caused by ions consisting of more than one atom or charge, respectively. Most isobaric interferences that could affect ICP-MS determinations have been identified in the method and referenced literature.

8.4.3 Physical interferences are associated with the sample nebulization and transport processes as well as with ion-transmission efficiencies. Nebulization and transport processes can be affected if a matrix component causes a change in surface tension or viscosity. Changes in matrix composition can cause significant signal suppression or enhancement. Dissolved solids can deposit on the nebulizer tip of a pneumatic nebulizer and on the interface skimmers (reducing the orifice size and the instrument performance). When intolerable physical interferences are present in a sample, a significant suppression of the internal standard signals (to less than 30% of the signals in the first calibration standard) will be observed. Dilution of the sample fivefold (1+4) will usually eliminate the problem. FAI allows for an internal standard suppression of up to 60%, instead of the EPA 6020B method listed 30%, before dilution.

8.4.4 Memory interferences or carry-over can occur when there are large concentration differences between samples or standards, which are analyzed sequentially. Sample deposition on the sampler and skimmer cones, spray chamber design, and the type of nebulizer affect the extent of the memory interferences, which are observed. The rinse period between samples must be long enough to eliminate significant memory interference.

8.4.5 Along with correction equations, collision cell mode, using helium as a cell gas, is used to reduce isobaric elemental and molecular interferences.

9. QUALITY CONTROL

9.1 All quality control data are maintained and available for easy reference or inspection.

9.2 DoD specific requirements are found in Table 1.

9.3 Initial demonstration of capability (IDC) – See FAI SOP 59.

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9.4 Method Detection Limit (MDL) Study – See FAI SOP 53,

9.5 LOD and LOQ: Verifications will be completed quarterly.

9.6 LLOQ: The laboratory should establish the LLOQ as the lowest point of quantitation which, in most cases, is the lowest concentration in the calibration curve. The LLOQ is initially verified by the analysis of at least 7 replicate samples, spiked at the LLOQ and processed through all preparation and analysis steps of the method. The mean recovery and relative standard deviation of these samples provide an initial statement of precision and accuracy at the LLOQ. In most cases the mean recovery should be +/- 35% of the true value and RSD should be < 20%.

9.6.1 Ongoing LLOQ verification, at a minimum, is on a quarterly basis to validate quantitation capability at low analyte concentration levels. This verification should be accomplished with clean reagent water. Optimally, the LLOQ should be less than the desired regulatory action levels based on the stated project-specific requirements.

9.7 The intensities of all internal standards must be monitored for every analysis. If the intensity of any internal standard in a sample falls below 30% of the intensity (or above 120% for DOD analyses only) of that internal standard in the initial calibration standard, a significant matrix effect must be suspected. Under these conditions, the detection limit has degraded and the correction ability of the internal standardization technique becomes questionable. The following procedure is followed: First, make sure the instrument has not just drifted by observing the internal standard intensities in the nearest clean matrix (calibration blank). If the low internal standard intensities are also seen in the nearest calibration blank, terminate the analysis, correct the problem, recalibrate, verify the new calibration, and reanalyze the affected samples. If drift has not occurred, matrix effects need to be removed by dilution of the affected sample. The sample must be diluted fivefold (1 + 4) and reanalyzed with the addition of appropriate amounts of internal standards. If the first dilution does not eliminate the problem, this procedure must be repeated until the internal standard intensities rise above the 60%. Reported results must be corrected for all dilutions.

9.8 Dilution test (serial dilution): If the analyte concentration is within the linear dynamic range of the instrument and sufficiently high (minimally, a factor of at least 100 times greater than the concentration in the reagent blank), an analysis of a fivefold (1+4) dilution must agree within ±20% of the original determination. If not, an interference effect must be suspected. One dilution test must be included for each 20 samples (or less) of each matrix in a batch. This is coded as the DIL sample in the prep batch.

9.9 Post-digestion spike addition (PDS): An analyte spike added to a portion of a prepared sample, or its dilution, should be recovered to within ±25% of the known value or within the laboratory derived acceptance criteria. The spike addition should be based on the indigenous concentration of each element of interest in the sample.

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9.10 A laboratory control sample (LCS) should be analyzed for each analyte using the same sample preparations, analytical methods, and QA/QC procedures employed for the test samples. One LCS should be prepared and analyzed for each sample batch at a minimum frequency of one LCS for each 20 samples or less. Acceptance criteria for LCS is ±20%. An LCSD may be appropriate when there is not enough sample for a DUP/MS/MSD. It will have the same acceptance criteria as an LCS and must have an RPD≤20%.

9.11 Concurrent analyses of standard reference materials (SRMs) containing known amounts of analytes in the media of interest are recommended and may be used as an LCS. For solid SRMs, 80 - 120% accuracy may not be achievable and the manufacturer's established acceptance criterion should be used for soil SRMs.

9.12 Check the instrument calibration during analysis by analyzing appropriate quality control solutions as follows:

9.12.1 Verify the calibration at a frequency of every 10 analytical samples with the continuing calibration verification (CCV) and the continuing calibration blank (CCB). A CCV and CCB must bracket each set of up to 10 analytical samples. The ICV and ICB may count as the opening CCV and CCB for the first set of samples directly after the calibration.

9.12.2 The results of the CCV must recover within ±10% of the expected value. If not, terminate the analysis, correct the problem, and recalibrate the instrument. Any sample associated with an out-of-control opening or closing CCV must be reanalyzed.

9.12.3 The results of the calibration blank must be less than the LLOQ for each analyte of interest (less than 1/2 the LLOQ for DOD). If this is not the case, the reason for the out-of-control condition must be found and corrected, and affected samples must be reanalyzed.

9.12.4 Verify the magnitude of elemental and molecular-ion isobaric interferences and the adequacy of any corrections at the beginning of each run and every 12 hours. Do this by analyzing the interference check solution 6020ICS-9A. Results for the unspiked elements in the ICS solution should be less than 2 times the LLOQ. Note that it may not be possible to obtain ICS spiking solutions that are completely free of the unspiked elements. If the presence and concentration of an unspiked element can be confirmed via vendor documentation and/or determination of multiple isotopes of the element in the correct ratios, the concentration actually present may be subtracted from the determined value prior to comparing to the LLOQ limits.. Refer to Section 8.4 for a discussion on interferences and potential solutions to those interferences if additional guidance is needed.

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9.13 Duplicate spiked samples (MS and MSD) are to be prepared and analyzed with each batch. Calculate the percent recovery and RPD. The data of MS/MSD is flagged if the resulting recovery is not within ±25% of the spiked value. A control limit of ±20% for the RPD shall be used.

9.14 A Method Blank (also known as an LRB) must be prepared with each batch. Method blanks must recover target analytes at < ½ of the level of the LLOQ for the analyte. If this requirement is not met, corrective action must be taken or the affected samples qualified appropriately.

10. DATA ANALYSIS AND CALCULATIONS

10.1 The quantitative values shall be reported in appropriate units, such as micrograms per liter (µg/L) for aqueous samples and milligrams per kilogram (mg/kg) for solid samples. If dilutions were performed, the appropriate corrections must be applied to the sample values.

10.2 Calculations must include appropriate interference corrections and internal-standard normalization.

11. RECORD KEEPING

11.1 Raw data is maintained on site for a minimum of 5 years.

11.2 All analytical batches are available in LIMS Omega.

12. SAFETY

12.1 Samples received for analysis should be considered hazardous and handled accordingly. In addition, some of the reagents and standards used in this method are hazardous. Before using this method, individuals who are unfamiliar with the hazards associated with these chemicals should refer to the Material Safety Data Sheets (MSDS).

13. METHOD PERFORMANCE

13.1 Only Fremont Analytical, Inc. employees who have been properly trained and have the required experience shall perform this method.

14. WASTE AND POLLUTION CONTROL

14.1 All client samples that are below discharge limits are disposed of in the general waste drums. Those that exceed the limits are introduced into the hazardous waste stream. In extreme circumstances, or if requested, samples are sent back to the client. Instrument waste is disposed of in the general waste drums. Expired standards are disposed of in either the general waste drums or the hazardous waste stream depending on concentration and analyte make-up.

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15. CHANGES SINCE LAST REVISION

15.1 Minor grammatical edits

15.2 Changed concentration of HCl in acidified reagent water from 0.4% to 0.5%

15.3 Updated startup procedure to reflect Agilent software

15.4 Updated calibration standards and preparation process

15.5 Updated internal standards

15.6 Updated ICSA procedures and passing requirements

15.7 Removed specific requirements for the NexION 300 and updated to the Agilent 7850 where appropriate

15.8 Updated Table 2 to reflect current calibration level and analyte list

16. REFERENCES

16.1 SW846, Method 6020B, Revision 1, February 2007.

16.2 2016 NELAC Standard, Revision 2.1

16.3 Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.4, 2021.

17. APPENDICES, TABLES, ETC.

17.1 Appendix A: Recommended Isotopes for Selected Elements

17.2 Appendix B: Masses used by Fremont Analytical, Inc.

17.3 Table 1: DoD/DOE QSM 5.4 Quality Control Requirements for Trace Metals Analysis by Inductively Coupled Plasma/Mass Spectrometry

17.4 Table 2: Calibration Levels

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Appendix A: Recommended Isotopes for Selected Elements

Element of interest	Mass
Aluminum	**27**
Antimony	121, 123
Arsenic	75
Barium	138, 137, 136, 135, 134
Beryllium	9
Bismuth (IS)	209
Cadmium	114, 112, 111, 110, 113, 116, 106
Calcium (I)	42, 43, 44, 46, 48
Chlorine (I)	35, 37, (77, 82) a
Chromium	52, 53, 50, 54
Cobalt	59
Copper	63, 65
Holmium (IS)	165
Indium (IS)	115, 113
Iron (I)	56, 54, 57, 58
Lanthanum (I)	139
Lead	208, 207, 206, 204
Lithium (IS)	6 , 7 b
Magnesium (I)	24, 25, 26
Manganese	55
Mercury	202, 200, 199, 201
Molybdenum (I)	98, 96, 92, 97, 94, (108) a
Nickel	58, 60, 62, 61, 64
Potassium (I)	39
Rhodium (IS)	103
Scandium (IS)	45
Selenium	80, 78, 82, 76, 77, 74
Silver	107, 109
Sodium (I)	23
Terbium (IS)	159
Thallium	205, 203
Vanadium	51, 50
Tin (I)	120, 118
Yttrium (IS)	89
Zinc	64, 66, 68, 67, 70

NOTE: Method 6020 is recommended for only those analytes listed in Table 1. Other elements are included in this table because they are potential interferants (labeled I) in the determination of recommended analytes, or because they are commonly used internal standards (labeled IS). Isotopes are listed in descending order of natural abundance.

a. These masses are also useful for interference correction.

b. The Internal standard must be enriched in the 6Li isotope. This minimizes interference from indigenous lithium.

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Appendix B: Masses Used by Fremont Analytical, Inc.

Element	Mass
Li	6
Be	9
B	11
Na	23
Mg	24, 25
Al	27
P	31
K	39
Ca	44
Sc	45
Ti	47
V	51
Cr	52
Mn	55
Fe	57
Co	59
Ni	60
Cu	63
Cu	65
Zn	66
As	75
Se	78, 82
Sr	88
Mo	97, 98
Ag	107, 109
Cd	111
In	115
Sn	118
Sb	121, 123
Ba	137, 138
Tb	159
Ho	165
Hg	201
Tl	205
(Pb)	206
(Pb)	207
Pb	208
U	238

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Table 1: DoD/DOE Quality Control Requirements for Inductively Coupled Plasma/Mass Spectrometry (from QSM 5.4)

Trace Metals Analysis by Inductively Coupled Plasma/Mass Spectrometry (ICP/MS)					
QC Check	**Minimum Frequency**	**Acceptance Criteria**	**Corrective Action**	**Flagging Criteria**	**Comments**
Linear Dynamic Range (LDR) or High-Level Check Standard	At initial set-up and checked every 6 months with a high standard at the upper limit of the range.	Within ± 10% of true value.	Dilute samples within the calibration range or reestablish/verify the LDR.	Flagging is not appropriate.	Data cannot be reported above the calibration range without an established/passing high level check standard.
Tuning	Prior to ICAL.	Mass calibration ≤ 0.1 amu from the true value; Resolution < 0.9 amu full width at 10% peak height.	Retune instrument and verify.	Flagging is not appropriate.	No samples shall be analyzed without a valid tune.
Initial Calibration (ICAL) for All Analytes	Daily ICAL prior to sample analysis.	If more than one calibration standard is used, $r^2 \geq 0.99$.	Correct problem, then repeat ICAL.	Flagging is not appropriate.	Minimum one high standard and a Calibration Blank. No samples shall be analyzed until ICAL has passed.
Initial Calibration Verification (ICV)	Once after each ICAL, analysis of a second source standard prior to sample analysis.	All reported analytes within ± 10% of true value.	Correct problem. Rerun ICV. If that fails, repeat ICAL.	Flagging is not appropriate.	No samples shall be analyzed until calibration has been verified with a second source.

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QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Continuing Calibration Verification (CCV)	After every 10 field samples and at the end of the analysis sequence.	All reported analytes within ± 10% of the true value.	Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails or if two consecutive CCVs cannot be run, perform corrective action(s) and repeat CCV and all associated samples since last successful CCV. Alternately, recalibrate if necessary; then reanalyze all associated samples since the last acceptable CCV.	If reanalysis cannot be performed, data must be qualified and explained in the Case Narrative. Apply Q-flag to all results for the specific analyte(s) in all samples since the last acceptable CCV.	Results may not be reported without valid CCVs. Flagging is only appropriate in cases where the samples cannot be reanalyzed.

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QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Low-Level Calibration Check Standard (LLCCV)	Daily.	All reported analytes within ± 20% of the true value.	Correct problem and repeat ICAL.	Flagging is not appropriate.	No samples shall be analyzed without a valid Low-Level Calibration Check Standard (LLCCV). LLCCV should be less than or equal to the LOQ. If the concentration of the lowest calibration standard is less than or equal to the LOQ, the lowest standard may be re-quantified against the calibration curve as LLCCV. Otherwise, a separate standard must be analyzed as the LLCCV prior to the analysis of any samples.

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QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Internal Standards (IS)	Every field sample, standard and QC sample.	IS intensity in the samples within 30-120% of intensity of the IS in the ICAL blank.	If recoveries are acceptable for QC samples, but not field samples, the field samples may be considered to suffer from a matrix effect. Reanalyze sample at 5-fold dilutions until criteria is met. For failed QC samples, correct problem and rerun all associated failed field samples.	Flagging is not appropriate.	Samples suffering from matrix effect should be diluted until criteria are met, or an alternate IS should be selected.

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QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Method Blank (MB)	One per preparatory batch.	The absolute values of all analytes must be < ½ LOQ or < 1/10th the amount measured in any sample.	Correct problem. If required, re-prep and reanalyze MB and all QC samples and field samples processed with the contaminated blank.	If reanalysis cannot be performed, data must be qualified and explained in the Case Narrative. Apply B-flag to all results for the specific analyte(s) in all samples in the associated preparatory batch.	Results may not be reported without a valid Method Blank. Non-detects associated with positive blank infractions may be reported. Sample results > 10X the LOQ associated with negative blanks may be reported. Flagging is only appropriate in cases where the samples cannot be reanalyzed.

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QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Initial and Continuing Calibration Blank (ICB/CCB)	Immediately after the ICV and immediately after every CCV.	The absolute values of all analytes must be < ½ LOQ or < 1/10th the amount measured in any sample.	ICB: Correct problem and repeat ICV/ICB analysis. If that fails, rerun ICAL. All samples following the last acceptable Calibration Blank must be reanalyzed. CCBs may not be reanalyzed without reanalysis of the associated samples and CCV(s).	Flagging is not appropriate.	Results may not be reported without valid Calibration Blanks. Non-detects associated with positive blank infractions may be reported. Sample results > 10X the LOQ associated with negative blanks may be reported. For CCB, failures due to carryover may not require an ICAL.
Interference Check Solutions (ICS) (also called Spectral Interference Checks)	After ICAL and prior to sample analysis.	ICS-A: Absolute value of concentration for all non-spiked project analytes <1/2 LOQ (unless they are a verified trace impurity from one of the spiked analytes); ICS-AB: Within ± 20% of true value.	Terminate analysis, locate and correct problem, reanalyze ICS, reanalyze all samples.	If corrective action fails, apply Q-flag to all results for specific analyte(s) in all samples associated with the failed ICS.	All analytes must be within the LDR. ICS-AB is not needed if instrument can read negative responses.

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QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Laboratory Control Sample (LCS)	One per preparatory batch.	A laboratory must use the QSM Appendix C Limits for batch control if project limits are not specified. If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified.	Correct problem, then re-prep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes if sufficient sample material is available.	If reanalysis cannot be performed, data must be qualified and explained in the Case Narrative. Apply Q-flag to specific analyte(s) in all samples in the associated preparatory batch.	Must contain all reported analytes. Results may not be reported without a valid LCS. Flagging is only appropriate in cases where the samples cannot be reanalyzed.
Matrix Spike (MS)	One per preparatory batch.	A laboratory must use the QSM Appendix C Limits for batch control if project limits are not specified. If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified.	Examine the project specific requirements. Contact the client as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met and explain in the Case Narrative.	For matrix evaluation only. If MS results are outside the limits, the data shall be evaluated to determine the source(s) of difference (i.e., matrix effect or analytical error).

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QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Matrix Spike Duplicate (MSD) or Matrix Duplicate (MD)	One per preparatory batch.	A laboratory must use the DoD/DOE QSM Appendix C Limits for batch control if project limits are not specified. If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified. MSD or MD: RPD of all analytes ≤ 20% (between MS and MSD or sample and MD).	Examine the project specific requirements. Contact the client as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met and explain in the Case Narrative.	The data shall be evaluated to determine the source of difference. For Sample/MD: RPD criteria only apply to analytes whose concentrations in the sample is greater than or equal to the LOQ.
Dilution Test	One per preparatory batch if MS or MSD fails.	Five-fold dilution must agree within ± 10% of the original measurement.	No specific CA unless required by the project.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met and explain in the Case Narrative.	Only applicable for samples with concentrations > 50 X LOQ (prior to dilution). Use along with MS/MSD or PDS data to confirm matrix effects.
Post Digestion Spike (PDS) Addition	One per preparatory batch if MS or MSD fails (using the same sample as used for the MS/MSD if possible).	Recovery within 80-120%.	No specific CA unless required by the project.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met and explain in the Case Narrative.	Criteria apply for samples with concentrations < 50 X LOQ prior to dilution.
Method of Standard Additions (MSA)	When dilution or post digestion spike fails and if the required by project.	NA.	NA.	NA.	Document use of MSA in the Case Narrative.

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Table 2: Calibration Standards

Element	Calibration Standard ug/L							
	Cal 1	Cal 2	Cal 3	Cal 4	Cal 5	Cal 6	Cal 7	
Aluminum	5	10	50	250	1000	2500	5000	
Antimony	0.025	0.05	0.25	1.25	5.0	10.0	25.0	
Arsenic	0.5	1.0	5.0	25.0	100.0	200.	500	
Barium	0.5	1.0	5.0	25.0	100.0	200.	500	
Beryllium	0.025	0.05	0.25	1.25	5.0	10.0	25.0	
Boron	2.5	5	25	125	500	1250	2500	
Cadmium	0.025	0.05	0.25	1.25	5.0	10.0	25.0	
Calcium	5	10	50	250	1000	2500	5000	
Chromium	0.5	1.0	5.0	25.0	100.0	200.0	500	
Cobalt	0.5	1.0	5.0	25.0	100.0	200.0	500	
Copper	0.5	1.0	5.0	25.0	100.0	200.0	500	
Iron	5	10	50	250	1000	2500	5000	
Lead	0.25	0.5	2.5	12.5	50	100	250	
Magnesium	5	10	50	250	1000	2500	5000	
Manganese	0.5	1.0	5.0	25.0	100.0	200.0	500	
Mercury	0.0125	0.025	0.125	0.625	2.5	4.0	5.0	
Molybdenum	0.5	1.0	5.0	25.0	100.0	200.0	500	
Nickel	0.5	1.0	5.0	25.0	100.0	200.0	500	
Phosphorous	5	10	50	250	1000	2500	5000	
Potassium	5	10	50	250	1000	2500	5000	
Selenium	0.05	0.1	0.5	2.5	10.0	20.0	50.0	
Silver	0.025	0.05	0.25	1.25	5.0	10.0	25	
Sodium	5	10	50	250	1000	2500	5000	
Strontium	0.5	1.0	5.0	25.0	100.0	200.0	500	
Thallium	0.0125	0.025	0.125	0.625	2.5	5.0	12.5	
Tin	0.5	1.0	5.0	25.0	100.0	200.0	500	
Titanium	0.5	1.0	5.0	25.0	100.0	200.0	500	
Uranium	0.5	1.0	5.0	25.0	100.0	200.	500	
Vanadium	0.5	1.0	5.0	25.0	100.0	200.	500	
Zinc	0.5	1.0	5.0	25.0	100.0	200.	500	

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Appendix B

Chain-of-Custody Forms

Air Chain of Custody Record & Laboratory Services Agreement

Alliance TECHNICAL GROUP

3600 Fremont Ave N.
Seattle, WA 98103
Tel: 206-352-3790

Date: **Page:** **of:**

Laboratory Project No (Internal):

Project Name:

Special Remarks:

Client: **Project No:**

Address: **Location:**

City, State, Zip: **Collected by:**

Telephone: **Reports to (PM):**

Disposal: Samples will be disposed of one week after report is submitted unless otherwise requested. ☐ Retain volume (specify above) ☐ Return to client

Fax: **Email (PM):**

	Sample Name	Canister / Flow Reg Serial #	Sample Type (Matrix) *	Container Type **	Expected Fill Time / Flow Rate	Sample Start Date & Time	Field Initial Sample Pressure (" Hg)	Sample End Date & Time	Field Final Sample Pressure (" Hg)	Analysis: Full list VOCs TO15	Select VOCs TO15 ***	APH TO15	Siloxanes TO15	Sulfur TO15	Major Gases 3C	Helium 3C Mod	VOCs 8260	GX/BTEX 8260		Comments
1		Canister / Flow Reg.				Date / Time	Pressure	Date / Time	Pressure											
2		Canister / Flow Reg.				Date / Time	Pressure	Date / Time	Pressure											
3		Canister / Flow Reg.				Date / Time	Pressure	Date / Time	Pressure											
4		Canister / Flow Reg.				Date / Time	Pressure	Date / Time	Pressure											
5		Canister / Flow Reg.				Date / Time	Pressure	Date / Time	Pressure											

* Matrix Codes: AA = Ambient Air OA = Outdoor Air IA = Indoor Air S = Subslab / Soil Gas SVE = SVE RNG = Biogas / Landfill / Digester

** Container Codes: BV = 1 Liter Bottle Vac 6L = 6L Canister 1L = 1L Canister CYL = High Pressure Cylinder F = Filter S = Sorbent Tube TB = Tedlar Bag

*** Select one: ☐ BTEXN & APH ☐ PCE & Breakdown ☐ Other, specify in comments

Turn-Around Time:

☐ Standard ☐ Next Day

☐ 3 Day ☐ Same Day

☐ 2 Day _____ *specify*

I represent that I am authorized to enter into this Agreement with Alliance Technical Group LLC on behalf of the Client named above, that I have verified Client's agreement to each of the terms on the front and backside of this Agreement.

Relinquished (Signature)	Print Name	Date/Time	Received (Signature)	Print Name	Date/Time
x			x		
Relinquished (Signature)	Print Name	Date/Time	Received (Signature)	Print Name	Date/Time
x			x		

SAMPLE RECEIVING. Laboratory hours are from 8:00am to 6:00pm – Monday through Friday. Turn-around times for samples received after 4:00pm begin on the following business day.

TURN-AROUND TIMES. Standard turn-around is 5 business days from the date of sample receipt for most analyses. For many analyses we offer expedited turn-around times, including:
• 3 Day (50% surcharge) • 2 Day (75% surcharge) • Next Day (100% surcharge) • Same Day – Call for availability and pricing
Expedited turn-around and/or specific data delivery requirements should be coordinated in advance. Samples received near the end of their holding time may incur an expedited analysis surcharge whether or not expedited report delivery is requested.

SAMPLE DISPOSAL. Alliance Technical Group LLC (Alliance) archives samples for 30 days after issuing the analytical report or after receiving Client instructions to suspend or terminate the project. After 30 days, Alliance disposes of all sample volume in accordance with all governing regulations and laboratory best practices. Clients wishing to reclaim sample volume must request storage beyond the standard 30 days or arrange to retrieve the volume before the scheduled disposal. A $5.00 fee per sample accrues monthly for storage requested beyond 30 days. Alliance reserves the right to charge a disposal fee (not to exceed $25.00/sample) for samples requiring special packaging and labeling as Hazardous Materials. “Hazardous Materials” include, but are not limited to, substances of any kind that are potentially poisonous, toxic, radioactive, explosive, or flammable, that contain biohazards or high levels of trace metals, or that pose any risk to persons or the environment through handling or disposal.

PAYMENT. All invoices are sent directly to the client contact provided. For clients with approved credit, payment terms are net 30 days from the date of the invoice. All overdue balances are subject to a 1.5% interest and service charge per month from the due date of the invoice. Third party billing will not be approved without a signed statement from the named party that acknowledges and accepts payment responsibility. In the event that payment is not received within 60 days of the invoice date, Alliance may, at its option, terminate all duties without liability to the Client or others. All data produced by Alliance is the property of Alliance until all associated costs are paid. Clients suspending or terminating a project may be charged for services already performed whether or not analytical data is available or provided.

CONFIDENTIALITY. Alliance maintains the confidentiality of all Client data. No information regarding clients’ names, sites, projects, or data will be released without direct, written authorization from the Project Manager designated on this COC Record or other authorized representative of the client company. All data and reports provided to the Client by Alliance are specifically for the use of the Client. Reports are intended to be considered in their entirety. Alliance is not responsible for the use or misuse of any portion of data or a report by the Client or third parties.

COMPLETE AGREEMENT, MODIFICATION, WAIVER, ENFORCEABILITY. This Agreement, including the parts incorporated herein by reference, is the complete agreement of the parties with regard to services of Alliance. No modification or amendment to this Agreement shall be valid unless in writing and signed by an authorized representative of each party. This Agreement is binding on each party's heirs, successors, and assigns. If any provision of this Agreement is held invalid, illegal, or unenforceable, then the remaining provisions shall remain in effect and may be reformed and enforced by the court. Failure to require performance of any term of this Agreement shall not be deemed a waiver of the right to enforce any term of this Agreement.

JURISDICTION AND VENUE. This Agreement shall be interpreted according to the laws of the State of Washington. Alliance and Client agree to submit to the jurisdiction and venue of state and federal courts in Seattle, Washington.

LIMITED WARRANTY. Alliance warrants only that it will perform services using analytical methodologies with published test methods according to industry standards. If circumstances require analytic practices for which standards do not exist, Alliance warrants only that its services will be in accordance with standard scientific procedures and good laboratory practices. ALLIANCE MAKES NO OTHER WARRANTIES AND DISCLAIMS ALL OTHER EXPRESS OR IMPLIED WARRANTIES. ALLIANCE MAKES NO REPRESENTATIONS OR WARRANTIES REGARDING THE FITNESS OF THE DATA IN ITS REPORTS FOR ANY PARTICULAR USE OR PURPOSE.

LIMITATIONS ON ALLIANCE'S LIABILITY. Alliance shall not be liable to Client for any of the following types of damages or losses arising out of this Agreement: incidental damages, indirect damages, consequential damages, lost profits, or tort damages. CLIENT'S SOLE REMEDY SHALL BE A REFUND OF THE APPLICABLE PAYMENT TO ALLIANCE. ALLIANCE SHALL HAVE NO LIABILITY OR OBLIGATIONS EXCEPT AS STATED HEREIN.

TIME LIMITATIONS ON ACTIONS AGAINST ALLIANCE. No legal action arising out of any service provided by Alliance under this Agreement may be brought against Alliance more than one year after Alliance has performed the service that is the subject of the legal action, regardless of whether the parties have agreed to arbitration. For the purposes of this Agreement, each Chain of Custody Record and Laboratory Services Agreement form submitted constitutes a unique set of services.

NOTICES. Client(s) shall inspect completed data packages and notify Alliance of any defects or nonconformity within thirty (30) days of receipt. Remittance of payment for services or failure to provide timely notification of defects shall be considered acceptance of such services, except as to latent defects which reasonable and timely examination would not have revealed.

Chain of Custody Record & Laboratory Services Agreement

Alliance TECHNICAL GROUP
3600 Fremont Ave N.
Seattle, WA 98103
Tel: 206-352-3790

Date: **Page:** **of:** ***Laboratory Project No (internal):***

Project Name: Special Remarks:

Client: **Project No:**

Address: **Collected by:**

City, State, Zip: **Location:**

Telephone: **Report To (PM):** Disposal: Samples will be disposed in 30 days unless otherwise requested. ☐ Retain volume (specify above) ☐ Return to client

Email(s):

Sample Name	Sample Date	Sample Time	Sample Type (Matrix)*	# of Cont.	VOCs (EPA 8260 / 624)	BTEX	Gasoline Range Organics (GX)	Hydrocarbon Identification (HCID)	Diesel/Heavy Oil Range Organics (DX)	SVOCs (EPA 8270 / 625)	PAHs (EPA 8270 - SIM)	PCBs (EPA 8082 / 608)	Metals** (EPA 6020 / 200.8)	Total (T) | Dissolved (D)	Anions (IC)***	EDB (8011)				Comments
1																				
2																				
3																				
4																				
5																				
6																				
7																				
8																				
9																				
10																				

***Matrix:** A = Air, AQ = Aqueous, B = Bulk, O = Other, P = Product, S = Soil, SD = Sediment, SL = Solid, W = Water, DW = Drinking Water, GW = Ground Water, SW = Storm Water, WW = Waste Water

****Metals (Circle):** MTCA-5 RCRA-8 Priority Pollutants TAL *Individual:* Ag Al As B Ba Be Ca Cd Co Cr Cu Fe Hg K Mg Mn Mo Na Ni Pb Sb Se Sr Sn Ti Tl V Zn

*****Anions (Circle):** Nitrate Nitrite Chloride Sulfate Bromide O-Phosphate Fluoride Nitrate+Nitrite

Turn-around Time:
☐ Standard ☐ Next Day
☐ 3 Day ☐ Same Day
☐ 2 Day _____ (specify)

I represent that I am authorized to enter into this Agreement with Alliance Technical Group LLC on behalf of the Client named above, that I have verified Client's agreement to each of the terms on the front and backside of this Agreement.

Relinquished (Signature)	Print Name	Date/Time	Received (Signature)	Print Name	Date/Time
x			x		
Relinquished (Signature)	Print Name	Date/Time	Received (Signature)	Print Name	Date/Time
x			x		

SAMPLE RECEIVING. The laboratory hours are from 8:00am to 6:30pm – Monday through Friday. Sample receiving hours are between 8:00am and 4:00pm – Monday through Friday. Turnaround times for samples received after 4:00pm will begin on the following business day.

TURNAROUND TIMES. Standard turnaround is 5 business days from the date of sample receipt for most sample analyses. For many analyses we can offer expedited turnaround, including:

- 3 Day (50% surcharge)
- 2 Day (75% surcharge)
- Next Day (100% Surcharge)
- Same Day Service – Call for Quote.

Expedited turnaround and/or specific data delivery requirements should be coordinated with the lab in advance. Samples received by Alliance Technical Group LLC (Alliance) near the end of a holding time period may incur an expedited analysis surcharge.

SAMPLE DISPOSAL. Alliance Technical Group will archive samples for 30 days. Afterwards Alliance will dispose of the samples appropriately. Clients should contact Alliance to retrieve their samples before disposal and/or arrange for storage beyond the standard 30 days. A $5.00 monthly fee, per sample, will be applied for storage beyond 30 days.

Certain hazardous samples, and/ or samples placed on hold, may be returned to the client upon completion of the project. Alliance reserves the right to charge a disposal fee (not to exceed $25.00/sample) for samples requiring special packaging and labeling as Hazardous Materials. "Hazardous Materials" include, but are not limited to, substances of any kind which are potentially poisonous, toxic, radioactive, explosive, flammable, contain biohazards, high levels of trace metals, or pose any risk to persons or the environment, through handling or disposal.

PAYMENT. All invoices are sent directly to the client. For clients with approved credit, payment terms are net 30 days from the date of the invoice. All overdue payments are subject to 1.5% interest and service charge per month from the due date of the invoice. Billing of a third party will not be accepted without a signed statement which acknowledges and accepts payment responsibility. In the event that payment is not received within 60 days following the invoice date, Alliance may, at its option, terminate all duties without liability to the Client or others. All data produced by Alliance is the property of Alliance until all fees are paid.

Clients choosing to suspend or terminate a project should contact Alliance. Those clients suspending or terminating a project will be charged for services already rendered and all samples associated with that project number will be held for the standard 30 days unless otherwise directed (please see "Sample Disposal" above for the guidelines and fees associated with longer storage). Alliance is not liable for the storage of samples past 30 days if the client does not contact the laboratory to make arrangements. Clients should contact the laboratory to resume suspended or terminated projects.

CONFIDENTIALITY. Alliance maintains the confidentiality of all analytical data. No information regarding projects of analytical data will be released without direct authorization from our clients. All data and results provided to the client by Alliance are specifically for the use of the client. Alliance is not responsible for the use of data and results by the client or third parties. Results are intended to be considered in their entirety and Alliance is not responsible for the misuse of any portion of the results.

COMPLETE AGREEMENT, MODIFICATION, WAIVER, ENFORCEABILITY. This Agreement, including the parts incorporated herein by reference, is the complete agreement of the parties with regardto services of Alliance. No modification or amendment to this Agreement shall be valid unless in writing and signed by an authorized representative of each party. This Agreement is binding on each party's heirs, successors, and assigns. If any provision of this Agreement is held invalid, illegal, or unenforceable, then the remaining provisions shall remain in effect and may be reformed and enforced by the court. Failure to require performance of any term of this Agreement shall not be deemed a waiver of the right to enforce any term of this Agreement.

JURISDICTION AND VENUE. This Agreement shall be interpreted according to the laws of the State of Washington. Alliance and Client agree to submit to the jurisdiction and venue of state and federal courts in Seattle, Washington.

LIMITED WARRANTY. Alliance warrants only that it will perform services using analytical methodologies with published test methods according to industry standards. If circumstances require analytic practices for which standards do not exist, Alliance warrants only that its services will be in accordance with standard scientific procedures and good laboratory practices. **ALLIANCE MAKES NO OTHER WARRANTIES AND DISCLAIMS ALL OTHER EXPRESS OR IMPLIED WARRANTIES.** ALLIANCE **MAKES NO REPRESENTATIONS OR WARRANTIES REGARDING THE FITNESS OF THE DATE IN ITS LAB REPORTS FOR ANY PARTICULAR USE OR PURPOSE.**

LIMITATIONS ON ALLIANCE'S **LIABILITY.** Alliance shall not be liable to Client for any of the following types of damages or losses arising out of this agreement: incidental damages, indirect damages, consequential damages, lost profits, or tort damages. **CLIENT'S SOLE REMEDY SHALL BE A REFUND OF THE APPLICABLE PAYMENT TO** ALLIANCE**.** ALLIANCE **SHALL HAVE NO LIABILITY OR OBLIGATIONS EXCEPT AS STATED HEREIN.**

TIME LIMITATIONS ON ACTIONS AGAINST ALLIANCE**.** No legal action arising out of any service provided by Alliance under this Agreement may be brought against Alliance more than one year after Alliance has completed the service that is the subject of the legal action, regardless of whether the parties have agreed to arbitration.

NOTICES. Client(s) shall inspect completed data packages and notify Alliance of any defects or nonconformity within thirty (30) days of receipt. Failure to provide timely notification or provide payment for services shall be considered acceptance of such services, except as to latent defects which reasonable and timely examination would not have revealed.

Appendix E

Health and Safety Plan

Health and Safety Plan

Remedial Investigation, Love's Travel Stop #413, 1512 HWY 97, Ellensburg, Washington 98926

Prepared for

Chris Weldon
Love's Travel Stops and Country Stores
10601 North Pennsylvania Avenue
Oklahoma City, OK 73120

Prepared by

Terraphase Engineering Inc.
2105 South C Street
Tacoma, Washington 98402

June 16, 2025

Project Number W053.001.003

terraphase engineering

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Appendix D Driving Directions to Nearest Urgent Care or Hospital

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Acronyms and Abbreviations

ANSI	American National Standards Institute
APR	Air-Purifying Respirator
ASTM	American Society for Testing and Materials
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
CFR	Code of Federal Regulations
Client	Love's Travel Stops and Country Stores
COPC	Chemicals of Potential Concern
CUL	Clean-Up Level
dBA	Decibels
Ecology	Washington State Department of Ecology
^{o}F	Degrees Fahrenheit
HASP	Health and Safety Plan
Love's	Love's Travel Stops and Country Stores
MTCA	Model Toxics Control Act
OSHA	Occupational Safety and Health Administration
PID	Photoionization Detector
PPE	Personal Protective Equipment
ppm	Parts per Million
QA/QC	quality assurance and quality control
Site	Love's Travel Stops Store No. 413 at 1512 Highway 97 in Ellensburg, Washington
SVOCs	semi-volatile organic compounds
SPF	Sun Protective Factor
SSHO	Site Safety and Health Officer
Terraphase	Terraphase Engineering, Inc.
TPH	total petroleum hydrocarbons
TPH-d	diesel-range total petroleum hydrocarbons
TPH-g	gasoline-range total petroleum hydrocarbons
TPH-o	oil-range total petroleum hydrocarbons
UV	Ultraviolet
VOC	Volatile Organic Compounds
WAUNC	Washington Utility Notification Center

Signatures

This section provides a detailed listing of the individuals responsible for drafting, reviewing, implementing, and approving this HASP.

Plan Prepared By:

Adrienne Venegas, RG, Senior Staff II Geologist | Date

Project Manager:

John F. Hildenbrand, Principal Environmental Scientist | Date

Corporate Health & Safety Officer Approval:

Daren Roth, Associate H&S Director | Date

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1 Introduction

Terraphase Engineering Inc. (Terraphase) has prepared this Health and Safety Plan (HASP) for remedial investigation activities at the Love's Travel Stops Store No. 413 at 1512 Highway 97 in Ellensburg, Washington (the "Site"; Figure 1). The work is being completed on behalf Love's Travel Stops and Country Stores (Love's) ("the Client"). The Site is listed on Washington State Department of Ecology (Ecology) Confirmed and Suspected Contaminated Sites List and the Leaking Underground Storage Tank Cleanup Site database (ID 5649) and has Ecology Facility/Site ID 18911356. The Site has operated as a fueling facility with underground storage tanks (USTs) since 1982 and is currently developed as a truck stop, with large parking areas, a commercial truck fueling island, an auto fueling island, a commercial truck oil-change and tire center, truck scales, and a travel center that includes a convenience store, a Subway restaurant, bathrooms, and showers.

This document constitutes the HASP, which is central to the safety and health program for the project. This document is considered a living document and can be amended as needed. A hardcopy of this HASP will remain on Site at all times during the field investigation activities.

1.1 Field Work Activities

The scope of remedial investigative activities at the Site was prepared to further assess the nature and extent of contamination and develop the best alternatives for Site cleanup. The scope of work includes the following field work activities:

- Drilling and Groundwater, Soil, and Soil Vapor Sampling: Terraphase will oversee a subcontractor who will complete soil boring/drilling for soil sampling, groundwater sampling, and installing groundwater monitoring and soil vapor wells.

  Eleven soil borings will be advanced using a track-mounted direct-push drilling rig at select locations to collect soil samples at varying depths. Groundwater samples will be collected from temporary wells installed within six of the eleven boreholes. Continuous soil samples from borings will be logged, screened for contaminants using visual observations and a photoionization detector (PID). Soil and groundwater samples will be analyzed for gasoline- and diesel-range total petroleum hydrocarbons (TPH-g and TPH-d, respectively), Model Toxics Control Act (MTCA) volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), and lead.

  Three groundwater monitoring wells will be installed using hollow stem auger drilling methods. The groundwater monitoring wells will be sampled quarterly.

  Three soil vapor wells will be installed using a hand auger at select locations to collect soil vapor samples. The soil vapor samples will be analyzed for aliphatic and aromatic TPH, MTCA VOCs, naphthalene, helium, and oxygen.

- Indoor Air and Sub-Slab Soil Vapor Sampling: Terraphase will collect four collocated indoor air samples and sub-slab soil vapor samples from existing sub-slab soil vapor pins within the travel center building. One outdoor air sample will be collected to assess ambient air quality. Indoor air,

outdoor air, and soil vapor samples will be analyzed for aliphatic and aromatic TPH, MTCA VOCs, and naphthalene.

- Sediment and Surface Water Sampling: Terraphase will collect three collocated sediment and surface water samples – one at the discharge point from the bioswale and two at points upstream and downstream of the discharge within Reecer Creek. Sediment and surface water samples will be analyzed for TPH-d, TPH-g, oil-range TPH (TPH-o), MTCA VOCs, and PAHs.
- Excavation: If soil excavation is selected as a remedial action, Terraphase will oversee a subcontractor who will excavate remaining contaminated soils, where identified. Confirmation soil samples will be collected from the excavator bucket using hand tools and screened for contaminants using visual observations and a PID. Excavated soils will be stockpiled on Site or directly loaded from the excavation into contractor provided trucks for off-site transportation and disposal. The extent of the excavation will be based on previous soil sampling and analytical results, and evidence of contamination during excavation activities.

  During excavation activities, Terraphase will collect confirmatory samples from the excavator buckets. Excavation activities will continue until the results of the post-excavation soil sampling activities document those soils with chemical concentrations above the corresponding MTCA Method A CUL have been removed. Should soil excavation be selected as a remedial action, this HASP will be revised to more thoroughly discuss the proposed actions, and associated hazards and mitigation measures.

1.2 Corporate Policy

Safety should take the highest priority in any Terraphase project; as evident in Terraphase's corporate motto "Safety First." It is Terraphase's policy that its personnel and its sub-contractor(s) on Site shall assume full responsibility and liability for compliance with all applicable Federal, State and local regulations pertaining to work practices, hauling, disposal, and protection of workers, visitors to the Site, and persons occupying areas adjacent to the Site. Terraphase's hard-earned reputation as a successful consulting company directly correlates to our high standards for safety during our projects. The goal for safety is no illness or injuries with zero lost work days due to work conditions.

1.3 Purpose and Regulatory Compliance

The HASP covers each of the required elements as specified in 29 Code of Federal Regulations (CFR) 1910.120, and WAC 296-843. When combined with the Terraphase Health and Safety Program, this Site-specific plan meets all applicable regulatory requirements. This HASP will be made available to all personnel and subcontractors involved for this project. The HASP has been reviewed by the Corporate Health and Safety Officer. By signing the documentation form provided with this plan (Attachment 2), project workers also certify their agreement to comply with the HASP. For subcontractors, this HASP represents minimum safety procedures. Subcontractors are responsible for their own HASP and safety protocols while present on-Site or conducting work for this project. Both Terraphase and its subcontractors are independently responsible for the health and safety of their own employees on the project.

2 Site Background

The 7.67-acre Site is approximately 290 feet northeast of the intersection between the Interstate 90 business spur and US Route 97. Based on aerial photographs, the Site has operated as a fueling facility with USTs since 1982. Construction of the Site's fueling facility in 1982 is consistent with the listed installation date of the initial USTS at the Site based on available UST records. A small (approximately 500 square feet) canopy is visible north of the building. The commercial truck fueling canopy is visible in aerial photographs from 1990. The auto fueling canopy is visible in aerial photographs from 2000. A smaller building, likely used for commercial truck maintenance, is visible at the northern portion of the Site in aerial photographs from 2000 to 2015. Construction of the existing larger commercial truck oil change and tire change center is visible in an aerial photograph from 2019. The commercial truck fueling canopy moved to the east in 2023.

Ecology UST records indicate that the Site operated as Steve's Auto Truck Stop and Grocery, owned by PBC Properties, until at least August 1993, as Pilot Travel Center 389 from at least October 1996 through April 2010, and as Love's Travel Stop #413 from at least October 2010 to present. Records indicate the following timeline of Site USTs. New rows are depicted when records indicate a change from the previous record:

Date	Tank 1 Single Wall Steel	Tank 2 Single Wall Steel	Tank 3 Single Wall Steel	Tank 4 Single Wall Steel	Tank 5 Double Wall Fiberglass	Tank 6 Double Wall Fiberglass	Tank 7 Double Wall Fiberglass
1982	10,000+* leaded gas	10,000* unleaded gas	10,000** unleaded gas	10,000* diesel	-	-	-
1992	12,000 regular unleaded	12,000 unleaded	10,000** premium unleaded	20,000 diesel (Single Wall Steel)			
1996	Cathodic Protection Installed on Tanks 1-4						
2008	10,000 premium unleaded	12,000 diesel	12,000 regular unleaded	20,000 diesel	20,000 diesel		
2012	10,000 premium unleaded	12,000 diesel	12,000 regular unleaded	20,000 diesel	20,000 diesel	20,000 diesel	12,000 DEF
2016-present	10,000 premium unleaded	12,000 biodiesel	12,000 regular unleaded	20,000 diesel	20,000 diesel	20,000 diesel	12,000 DEF

All listed capacities are in gallons.

* Listed capacities are likely incorrect based on subsequent records indicating tank volumes as listed in 1992 with installation dates of 1982.

** Although designated tank 3 in early UST records, this is likely the currently designated Tank 1 based on listed capacity.

Several environmental investigations and remedial actions have been performed at the Site between 1995 and 2023, respectively, following reported releases. Additional details are provided in the Work Plan (Terraphase 2025). In summary, the following contaminants of potential concern (COPCs) are identified at the Site based on their detection in one or more sampled media:

- Total petroleum hydrocarbons (TPH), including gasoline-range, diesel-range, and oil-range TPH (TPH-g, TPH-d, and TPH-o, respectively).
- Benzene, toluene, ethylbenzene, and xylenes (BTEX)
- Polycyclic aromatic hydrocarbons (PAHs), including naphthalene
- Lead

3 Hazards

Hazards that could be encountered include chemical hazards, environmental hazards, biological hazards, and/or physical hazards. The sub-categories of these four types of hazards are explained in further detail below.

3.1 Chemical Hazards

Chemical hazards may be encountered during the field activities to be conducted at the Site. These hazards may be encountered through inhalation, absorption (dermal contact), or ingestion. Based on previous exploration activities at the site, COPCs for the Site include TPH, VOCs (BTEX), PAHs (primarily naphthalene), and lead.

3.1.1 Absorption and Ingestion Risk

The anticipated concentrations of contaminants of potential concern (COPCs) in soil and groundwater are such that the absorption and ingestion risk can be minimized by proper personal hygiene and use of personal protective equipment (PPE). The PPE requirements are discussed further in Section 8. If work is anticipated in areas where one or more of the COPCs exceed acceptable risk-based screening levels; the work practices, engineering controls, and required PPE will be assessed and modified as necessary in an addendum to this HASP.

3.1.2 Inhalation Risk

3.1.2.1 Petroleum Hydrocarbons and Associated Volatile Organic Compounds

Inhalation risk associated with petroleum hydrocarbons and associated volatile organic compounds is possible when disturbing the subsurface (e.g., excavation activities). During the periods of field activities when the subsurface is disturbed, real-time air monitoring of the worker breathing zone will be conducted. Air monitoring is discussed further in Section 9. If field personnel experience short-term health effects such as headaches, nausea, or eye and respiratory irritation that are often associated with these compounds, they will take a break to relieve symptoms and further assess the risk to other personnel in the immediate area.

3.1.2.2 Silica Dust

Silica dust may be generated during coring, drilling, or excavation of the paved parking lot, roadway, or sidewalk surface. The Occupational Safety and Health Administration (OSHA) recommends engineering controls be implemented during all concrete coring/demolition to minimize inhalation risk to field personnel from silica dust in accordance with 29 CFR 1926.1153.

Silica dust may be generated during the coring or drilling of concrete, and during demolition activities involving silica-containing materials (including the demolition of the parking lot surface). The following

engineering controls are required, in accordance with Table 1 in 29 CFR 1926.1153, to substantially reduce the potential for exposure from silica dust.

- Core saws will be equipped with an integrated water delivery system with water flow rates sufficient to minimize the release of visible dust. The resulting slurry will be cleaned up (most likely with a wet/dry vacuum) to prevent the slurry from drying and releasing silica dust into the air.
- When using a handheld drill (e.g., rotary hammer, hammer drill, etc.), a vacuum dust collection system (e.g., hammer drill collection attachment) will be used to reduce exposure to silica dust. The vacuum must provide adequate airflow to remove dust at the drilling point and be equipped with a HEPA filter.
- Heavy equipment operators must operate equipment from within an enclosed cab.
- When employees outside of the cab are engaged in the task, apply water and/or dust suppressants as necessary to minimize dust emissions.

3.2 Environmental Hazards

Ellensburg, Washington is located within the Eastern Washington Columbia Plateau, which has a semi-arid climate. This climate is characterized by hot, dry summers and cool, relatively dry winters. The average annual precipitation is approximately 9 inches and the average annual snowfall is approximately 28 inches. In the summer, high temperatures average 84 degrees Fahrenheit (^{o}F), and low temperatures average 54^{o}F. In the winter, high temperatures average 35^{o}F, and low temperatures average 21^{o}F.

3.2.1 Heat Stress

Heat stress is caused by a number of interacting factors, including environmental conditions, clothing, workload, etc., as well as the physical and conditioning characteristics of the individual. All employees must be informed of the importance of adequate rest, acclimation, and proper diet in the prevention of heat stress disorders.

Heat stress monitoring and work rest cycle implementation must commence when the ambient temperatures exceed 80°F. The Site Safety and Health Officer (SSHO), project manager, and/or task manager should monitor the anticipated high temperatures prior to the start of work, as well and monitor real-time temperatures during the work day using a reputable website (i.e., http://www.weather.gov/) or on-Site weather station.

The following control measures can be used to help control heat stress:

- Site workers will be encouraged to drink plenty of water and electrolyte replacement fluids throughout the day. Potable water must be provided at the jobsite in sufficient quantities (at least one quart per employee per hour for the entire shift).
- Onsite drinking water will be kept cool (below the ambient temperature, but not so cool that it causes discomfort).
- A work regimen that will provide adequate rest periods for cooling down will be established, and based on the work activities, level of PPE, and anticipated daily temperatures.

- All personnel will be advised of the dangers and symptoms of heat stroke, heat exhaustion, and heat cramps.
- Cooling devices (i.e. cooling vests) should be used when personnel must wear impermeable clothing in conditions of extreme heat (>95°F).
- Employees should be instructed to monitor themselves and co-workers for signs of heat stress and to take additional breaks as necessary. If an employee is working alone in hot weather, the PM/TM should schedule regular check-ins with the employee.
- A shaded rest area must be available near the job site. The site workers will either utilize natural shade (i.e. building structures, trees, etc.), or temporary a shade structure will be erected. The shaded area must be large enough to accommodate the number of employees on rest or recovery periods. The interior of cars or trucks are not considered shade unless the vehicles are air conditioned or kept from heating up in the sun in some other way.
- All breaks should take place in the shaded rest area and the employees must not be assigned to other tasks during breaks.
- Employees must remove impermeable garments during rest periods. This includes white Tyvek-type garments.

Employees shall be allowed and encouraged to take a preventative cool-down rest in the shade at a time when they feel the need to do so to protect themselves from overheating. Such access to shade shall be permitted at all times. An individual employee who takes a preventative cool-down rest (A) shall be monitored and asked if he or she is experiencing symptoms of heat illness; (B) shall be encouraged to remain in the shade; and (C) shall not be ordered back to work until any signs or symptoms of heat illness have abated, but in no event less than 5 minutes in addition to the time needed to access the shade.

When wearing protective clothing that decreases ventilation (i.e., poly Tyvek suits), a work schedule will be established that will provide sufficient rest periods for cooling down (at least ten minutes when workers feel the need to do so), even when temperatures are below 80°F. When wearing this clothing, field staff are required to take a cool-down rest break at least once every two hours. The staff must exit the exclusion zone and completely remove their protective clothing and respirators prior to the start of the rest break. Only light duty work can be completed during the rest break (i.e. paperwork, meetings, etc.).

High Heat Procedures will be implemented in accordance with The Washington State Department of Labor & Industries (L&I) WAC 296-62-095 through 09560. L&I adopted updates to Outdoor Heat Exposure rules to prevent heat-related illness and reduce traumatic injuries associated with heat exposure (June 27, 2023). Under the adopted rules:

(1) Requirements are year-round, in effect whenever workers are exposed to outdoor heat.
(2) Outdoor temperature action levels are: - Non-breathable clothing: 52°F- All other clothing: 80°F
(3) Employers must encourage and allow employees to take preventative cool-down rest periods at or above outdoor temperature action levels.

(4) Shade, or other sufficient means for cooling down, must be provided any time employees are exposed to heat at or above action levels.- There must be enough shade for all employees on a meal or rest period to sit fully in the shade, and it must be located close to where employees are working.

(5) Drinking water must be suitably cool in temperature. Current rules require sufficient quantities for each worker to drink at least a quart per hour at the applicable action level.

(6) Close observation for 14 consecutive days is required for employees not acclimatized to the heat, including new employees, those returning from absences, and all workers during a heat wave.

- Heat waves are days when heat will be at or above the action levels and at least 10°F higher than the five-day average highs.

- Close observation is defined as regular communication with employees working alone, such as by radio or cellular phone; a mandatory buddy system; or other effective means of observation.

(7) At or above 90°F, a 10-minute cool-down rest period every two hours and close observation to help identify employees showing signs and symptoms of heat-related illness is mandatory.

(8) At or above 100°F, the cool-down rest periods must be 15 minutes every hour. These can be taken at the same time with any meal or rest period under wage and hour laws and must be paid unless taken during a meal period. In order to ensure public safety in crisis or disaster situations, an exemption was added excluding emergency response operations from mandatory cool-down rest periods when restoring or maintaining critical infrastructure at risk.

(9) Ensuring that effective communication by voice, observation, or electronic means is maintained so that employees at the work site can contact a supervisor when necessary. An electronic device, such as a cell phone or text messaging device, may be used for this purpose only if reception in the area is reliable.

(10) Observing employees for alertness and signs or symptoms of heat illness. The employer shall ensure effective employee observation/monitoring by implementing one or more of the following:

A. Supervisor or designee observation of 20 or fewer employees, or
B. Mandatory buddy system, or
C. Regular communication with sole employee such as by radio or cellular phone, or
D. Other effective means of observation.

(11) Designating one or more employees on each worksite as authorized to call for emergency medical services, and allowing other employees to call for emergency services when no designated employee is available.

(12) Reminding employees throughout the work shift to drink plenty of water.

Pre-shift meetings before the commencement of work to review the high heat procedures, encourage employees to drink plenty of water, and remind employees of their right to take a cool-down rest when necessary

3.2.2 Hypothermia

Hypothermia can result from abnormal cooling of the core body temperature. It is caused by exposure to a cold environment and wind-chill. Wetness or water immersion can also play a significant role. Typical warning signs of hypothermia include fatigue, weakness, lack of coordination, apathy, and drowsiness. A confused state is a key symptom of hypothermia. Shivering and pallor are usually absent, and the face may appear puffy and pink. Body temperatures below 90°F require immediate treatment to restore temperature to normal. Current medical practice recommends slow re-warming as treatment for hypothermia, followed by professional medical care. This can be accomplished by moving the person into a sheltered area and wrapping with blankets in a warm room. In emergency situations, where body temperature falls below 90°F and heated shelter is not available, use a sleeping bag, blankets, and body heat from another individual to help restore normal body temperature.

3.2.3 Ultraviolet (UV) Radiation (Sunlight)

Moderate to high potential for overexposure to UV light exists for field personnel. To prevent erythema (sunburn), workers will be provided Sun Protection Factor (SPF) 30 or greater sunscreen to apply to areas not covered with clothing or PPE. Workers will be encouraged to seek shade whenever possible.

3.2.4 Rain/Thunder/Lightning

Monitor local weather through available media or a weather radio. Although not as frequent, electrical storms can potentially be very hazardous to field personnel. During lightning and thunderstorms, the following is necessary:

- Equipment shutdown;
- Seek shelter in a building or vehicle; and
- Await further instruction from Project Leader.

A 30-minute STAND DOWN period is required after encountering Lightning or Thunder in order to allow the storm to pass.

3.3 Physical Hazards

Physical hazards discussed under this section include traffic hazards, underground and overhead utilities, drill rigs, machinery and moving parts, electrical hazards, confined space entry, noise, slips, trips, and falls, motor vehicle and heavy equipment operation, and ergonomic hazards.

3.3.1 Underground and Overhead Utilities

Reasonable efforts will be made to identify the location(s) of underground utilities (e.g., pipes, electrical conductors, fuel lines, and water and sewer lines) before mechanized soil intrusive work is performed. The state underground utility notification authority, Washington Utility Notification Center (WAUNC, 811), will be notified at least 48 hours prior to starting field activities (not including the day of notification). WAUNC in turn will notify representatives of the utility companies who will mark the

location of underground services entering the property. Additionally, a local private utility locator will mark the locations of underground private utilities in the vicinity of the proposed locations. WAUNC and private utility markings will be noted prior to drilling to prevent damage to utility lines.

All locations will be investigated with a hand auger or air knife prior to drilling to confirm the location is free of underground utilities. If fill is present and the hand auger cannot be advanced through fill materials due to the presence of subsurface debris (i.e., dense gravel fill, concrete, brick, etc.), augering will be suspended and drilling will commence.

The Project Manager is responsible for ensuring that underground utility locations are identified prior to the commencement of any subsurface activities. Resources include site plans, utility companies, and regional utility locating services. The proper utility company personnel should certify the deactivation of utilities, and the certification should be retained in the permanent log.

In accordance with 29 CFR 1926.651 (Excavations), an excavation shall not commence until:

- The excavation area has been marked by the excavator; and
- The excavator has received a positive response from all known owner/operators of subsurface installations within the boundaries of the proposed project; those responses confirm that the owner/operators have located their installations, and those responses either advise the excavator of those locations or advise the excavator that the owner/operator does not operate a subsurface installation that would be affected by the proposed excavation.

Only qualified persons shall perform subsurface installation locating activities.

When excavation or boring operations approach the approximate location of subsurface installations, the exact location of the installations shall be determined by safe and acceptable means that will prevent damage to the subsurface installation.

While the excavation is open, subsurface installations shall be protected, supported, or removed as necessary to safeguard employees.

An excavator discovering or causing damages to a subsurface installation shall immediately notify the facility owner/operator or contact the Regional Notification Center to obtain subsurface installation operator contact information immediately after which the excavator shall notify the facility operator. All breaks, leaks, nicks, dents, gouges, grooves, or other damages to an installation's lines, conduits, coatings or cathodic protection shall be reported to the subsurface installation operator.

If a utility strike presents an immediate danger to the work crew or general public (i.e., electrical, gas, high pressure water line), then the crew should evacuate to a safe distance, contact 911 immediately, and cordon off the area to prevent public access.

All utility strikes should be reported out to the Project Manager and/or SSHO as soon as it is safe to do so, and then a plan will be made for reporting to the utility company and client. If a utility strike does occur refer to the accident reporting requirements in Section 7.

Prior to mechanized excavation, the following techniques will be employed to determine the location of subsurface structures:

- contracting the services of a qualified private utility locator, and
- subsurface testing (i.e., hand augering, potholing, air-knife) to the expected depth of probable utilities, when feasible (not less than 5 feet below ground surface)

If utilities cannot be located and/or if unlocated utilities are suspected to be present, subsurface activities (i.e., borings, excavation) should not be conducted prior to confirming the location(s) or absence of underground utilities.

Excavation, drilling, crane, or similar operations adjacent to overhead lines shall not be initiated until operations are coordinated with the utility officials. Operations adjacent to overhead lines are prohibited unless one of the following conditions is satisfied:

- Power has been shut off and positive means (e.g. lockout/tagout) have been taken to prevent lines from being energized. Wherever possible, the SSHO will observe power shut off and place a lock and tag on the switch. In all cases utility company personnel shall certify in writing to the Project Manager or SSHO the deactivation of overhead utilities, and the certification retained in the project files. The Site Manager or SSHO must also attempt to verify power shut off by checking that power is no longer available to the affected building or equipment.
- Equipment, or any part of the equipment, cannot come within the following minimum clearance from energized overhead lines:
- Equipment, or any part of the equipment, cannot come within the following minimum clearance from energized overhead lines (please note that Terraphase recommends that 10 feet be added to the minimum required clearances presented below):

Power Lines Nominal System (kv)	Minimum Required Clearance
0-50	10 feet
50- 200	15 feet
200-350	20 feet
350-500	25 feet
500-750	35 feet
750-1000	45 feet
Over 1000	as established by the utility owner/operator or registered professional engineer who is a qualified person with respect to electrical power transmission and distribution

3.3.2 Excavators/Drill Rigs/Heavy Machinery

The operator of the excavator, drill rig, or other heavy machinery will comply with the precautions specified in the above section. In addition, the following precautions should be observed whenever a drill rig, excavator, trackhoe, backhoe, bulldozer, or similar in use:

- Workers must not wear loose clothing, nor leave long hair, boot laces, or jacket ties uncontrolled while operating moving equipment;

- Hard hats, hearing protection, safety footwear, and eye protections must be worn at all times;
- Prior to the start of daily operations, the excavator/heavy machinery operator should inspect the machinery carefully to be sure that it is suitable for the day's work;
- The machinery operator will ensure that there is adequate lighting on the rig to enable the job to be performed safely;
- The machinery must be equipped with an operable kill switch and personnel must be aware of restarting procedures;
- All fittings, connections, and hydraulic hoses must be of a standard to operate in a safe manner;
- Repairs and service must not be attempted while rotary machinery is running; and
- If electrical storms can be seen or heard, excavation operations will be shut down until it is deemed safe by the SSHO.

3.3.3 Machinery/Moving Parts

Drilling and vacuum equipment may have various motors, booms, and other equipment. These present a general physical hazard from moving parts. Personnel will stand clear of machinery at all times unless specific instructions are given by the trained operator, or other person in authority. Steel toed shoes or boots will be worn at all times when on the Site. When possible, appropriate guards will be in place during equipment use. Field personnel should be careful to keep loose clothing, hands, and feet away from vacuum hose inlets.

3.3.4 Hand and Power Tools

Use of power tools presents potential physical hazards (e.g., pinch points, electrical hazards, flying debris, and struck-by/caught-between hazards) to personnel operating them. The following safety rules must be implemented:

- Inspect tools frequently for defects. Turn in all tools which are burred, mushroomed, have split or loose handles, have worn or sprung jaws, have exposed wires, or are generally unsafe.
- Use hand tools properly and for their intended use only.
- Do not to operate power tools, machinery, or equipment without proper training or supervision.
- Do not operate equipment unless all guards and other protective devices are properly secured and correctly adjusted.
- Keep cords of electrical equipment coiled when not in use.
- When using electrical equipment, position its power cord to avoid its being run over by vehicles or equipment.
- Turn off, and if possible unplug, machinery before cleaning, oiling, adjusting, or repairing unless the equipment is designed or fitted with safeguards to protect the person performing the work.
- Do not wear loose or frayed clothing, dangling ties, finger rings, etc. when operating or working near moving machinery or other mechanical sources of entanglement.
- Do not lift or lower portable electric tools by means of a power cord; use a handline.

- Never throw tools, equipment, or material up or down from one working level to another; always use a handline. Do not disconnect air hoses at compressors until hose line has been bled.

3.3.5 Electrical Hazards

In order to prevent accidents caused by electrical shock, field personnel will inspect electrical equipment being used (e.g., power tools, electrical cords) on a daily basis for evidence of frayed or loose connections.

3.3.6 Lock-out/Tag-out

Lock-out/Tag-out procedures should be used on any pieces of equipment being worked on by field personnel. The only exception to this is equipment with a plug, which can be unplugged and remain in control of the worker. Proper lock-out/tag-out includes the identification and isolation of hazardous energy. The energy sources must be locked out so that only the worker(s) has the key to release the isolation point. Stored energy (e.g., air or water pressure) must also be released prior to conducting work on the equipment. If necessary, all provisions of the OSHA standard as stated in 29 CFR 1910.147 will be followed for controlling hazardous energy or locking out or tagging out electrical and utility hazards.

3.3.7 Confined Spaces

Confined space entry is not anticipated for this project. Terraphase field personnel will not enter any confined space without specific approval of the Project Manager. Subcontractors may need to conduct permit-required confined space entries and should notify Terraphase Project Leader prior to the entry.

If confined space entries are conducted, they will be in accordance with the subcontractor's confined space entry program. An attendant will be stationed above the confined space while the entrant(s) are in the confined space. A full-body harness with emergency retrieval equipment or another means of egress (e.g., ladder) shall be in use if necessary and if the confined space is greater than 6 feet deep.

Before conducting any work inside a confined space (e.g., tank), the personnel will conduct a visual inspection of the area from the opening to identify any hazards before proceeding. Gas measuring devices will be utilized to detect any presence of harmful or dangerous atmospheres. Any floating or rotating machinery that are in the confined space are turned off and locked out prior to beginning any work.

3.3.8 Noise

Appropriate hearing protection (ear muffs or ear plugs with a noise reduction rating of at least 20 decibels [dBA]) will be used if individuals work near high-noise generating equipment (> 85 dBA). Determination of the need for hearing protection will be made by the Project Leader and follow the Terraphase Hearing Conservation program document and 29 CFR 1910.95. The determination will be based on historical area noise surveys for similar tasks. If recent representative data is not available for specific noise producing equipment/tasks, then area noise surveys will be conducted. Personal noise

dosimetry will also be conducted if area noise surveys indicate that employees may be exposed to noise in excess of 85 dBA over an 8-hour time-weighted average (8-hour TWA).

3.3.9 Slips, Trips, and Falls

Slips, trips, and falls are a leading cause of injury on construction and remediation worksites. Water and slime collect on horizontal surfaces and stairs, posing a potential hazard. Proper housekeeping is the key to preventing injuries of this nature. To minimize potential for injuries, the following measures will be implemented:

- Site areas around open manholes, excavations, trenches, etc. will be kept clean and orderly.
- All potential trip and fall hazards will be clearly marked, modified to reduce the hazard, or engineered in a configuration to eliminate the hazard (if possible).
- All floors and stair treads will be kept clean of water, oil, and polymer.
- All hoses will be coiled and stored out of the way when not in use.
- There will be no running on the Site.
- If work is to be completed along the flanks of water features (rivers, lakes, settling ponds, etc.), the following measures will be implemented. All potential trip, slip, and fall hazards will be clearly marked, modified to reduce the hazard, or engineered in a configuration to eliminate the hazard (if possible).
- Movement along the shoreline or within the water will be done slowly and carefully, carrying the minimum of equipment and maintaining one hand free at all times to aid in balance and bracing.
- A stick or pole should also be used to assess the depth of soft sediments near the surface and the ability of the sediment to support the weight of the sampler, especially in areas that appear to be saturated during the majority of the year.
- Beware of icy conditions and take alternate walking paths if necessary.

As with all field work sites, caution will be exercised to prevent slips on rain slick surfaces, stepping on sharp objects, etc. Work will not be performed on elevated platforms without fall protection.

Before conducting any work adjacent (such as opening, measuring water level, etc.) to an underground storage tank access area (e.g. manhole), the personnel will conduct a visual inspection of the area from the opening to identify any trip/slip hazards. Personnel, who are within 10 feet of the opening, will use full body harness and a self-retracting lifeline with fall arrestor. The fall protection system will be tied into a suitable anchor (e.g. tree, truck, etc.) that allows for work to be conducted around the underground storage tank opening. The access cover shall be completely closed and bolted to the frame (if bolts are present) prior to the fall protection system being removed.

3.3.10 Heavy Equipment Operation

Physical hazards can arise from loading and off-loading heavy equipment from tractor-trailers and locating equipment to designated areas of use. Hazards will be mitigated by personnel avoiding close proximity to moving equipment and immovable objects.

Belts and rotating parts have the ability to injure, crush, or amputate body parts and limbs. Personnel will avoid contact with any moving part. Any loose items will be removed before working around moving or rotating equipment. Any moving parts that can be guarded will have an appropriate machine guard installed. Equipment will not be operated without the proper guards in place. Repairs/adjustments will be done with the equipment stopped and locked out as appropriate.

The following measures will be implemented for heavy equipment operation:

- The minimum required work uniform for all field personnel (e.g., Level D protection) shall be general work clothes, steel-toed construction boots American National Standards Institute (ANSI) approved, safety goggles or glasses, work gloves, high visibility vest, hearing protection, and a hard hat (ANSI approved).
- Adequate workspace shall be maintained during equipment operation.
- Equipment shall be inspected for proper working condition prior to use.
- Field personnel shall only approach operating equipment from the operator's angle of view, and only after making eye contact with the equipment operator.
- A 10-foot perimeter will be maintained around all active equipment as a "Danger Zone".
- Only trained and qualified persons shall operate individual equipment.

On-Site haulage or earth-moving vehicles subject to the requirements of OSHA 1926.602 will have a functional audible alarm in compliance with the referenced standard. In addition, the warning sound shall be of such magnitude that it will normally be audible from a distance of 200 feet and will sound immediately on backing. In congested areas or areas with high ambient noise which may obscure the audible alarm, a signaler, in clear view of the operator, shall direct the backing operation.

3.3.11 Excavation Hazards

If hazardous atmospheres are suspected, the atmosphere in any trench or excavation more than 4 feet deep must be monitored in accordance with 29 CFR 1926.651. In addition, a means of egress from excavations (such as a stairway, ladder, ramp, or other safe means of egress) shall be in excavations or trench greater than 4 feet. However, if excavations will extend beyond 5 feet deep, personnel are prohibited from entering a trench or excavation that is deeper than 5 feet without the excavation being properly shored, sloped, or benched in accordance with 29 CFR 1926 Subpart P App B. If personnel are required to enter a trench or excavation that is deeper than 5 feet, the contractor who created the excavation must make the following provisions prior to entry:

- If hazardous atmospheres are suspected, the atmosphere in any trench or excavation must be monitored;
- Adequate shoring, sloping, or benching techniques must be employed;
- Adequate means of employee access and egress must be utilized and will be located within 25 feet of the work area;
- The contractor's trained competent person must inspect the trench or excavation on a daily basis, before work commences, and on an as-needed basis throughout the day; and

- All provisions of this regulation must be complied with when working in a trench or excavation that is deeper than 5 feet at the deepest point. Adequate protection shall be provided by placing and keeping excavated soils, rock, and equipment a minimum of 2 feet back from the edge of each excavation.

3.3.12 Motor Vehicle Operation

Employees may be exposed to vehicle accident hazards associated with the operation of vehicles during the project. To control these hazards, the following safety requirements will be strictly enforced:

- Seat belts shall be worn anytime a vehicle is in motion, regardless of speed or distance to be traveled. Seat belt requirements also apply to the operation of backhoe and other construction equipment;
- The basic speed law shall be followed at all times; and
- Vehicles shall never be operated at a speed that is not safe for the conditions (i.e., road surface, traffic, visibility, weather, etc.).

3.3.13 Traffic Hazards

Most of the work will occur near the center of the site near public access, entrance ways, and potentially within the public rights-of-way along Highway 97. Site traffic may consist of pedestrians, small vehicles, and large trucks. The following procedures should be implemented to minimize the hazards from site traffic:

- The traffic control plan prepared for the work and will include active flagging services, if required.
- Park work vehicle between on-coming traffic and work zone to the extent feasible.
- Demarcate the work zone with high visibility traffic cones.
- Wear high visibility vest.
- Follow all laws regarding pedestrian crossing of streets.
- Traffic considerations should be made to minimize driver frustration and confusion.
- Provide as much barrier between work area and traffic lanes as practicable.
- When possible, employees should not walk between the traffic cones and the active lane of traffic.
- Equipment and supplies should be unloaded from the back of the vehicle or the sidewalk side of the vehicle to minimize the potential to travel in the active traffic lane.

A common hazard on high traffic sites is being struck by a moving vehicle. Every project is to be planned and organized to ensure vehicles, machines and equipment are not operated in reverse or are operated in reverse as little as possible. All heavy equipment must be equipped with an automatic audible alarm that signals when they are being operated in reverse.

3.3.14 Illumination

Proper illumination is important in the prevention of slips, trips, and falls. It is anticipated that work will be conducted during daylight hours and not within any structures that do not have proper illumination. Therefore, no additional illumination will be required. If Site activities are to occur during non-traditional hours (i.e., night-time), or inside a building without proper illumination, portable illumination will be provided to ensure that all walkways and workspaces are properly illuminated to the OSHA 1910.120(m) standard. Portable illumination will be provided in the form of light towers to properly illuminate the required areas. Additionally, portable flashlights and headlamps can also be utilized by site workers to illuminate their general work vicinity if more illumination is desired.

3.3.15 Ergonomic Hazards

The initial Site safety briefing given to all workers prior to the start of the project will cover the basics of ergonomics and focus on the following topics:

- Ergonomic injuries – their prevalence, causes, and significance
- Proper lifting procedures and planning all lifts
- Proper posture when standing, operating a motor vehicle or heavy equipment
- Avoiding overexertion
- Awareness of repetitive task and the hazards that they can pose

3.4 Biological Hazards

This section provides health and safety precautions against potential biological agents that might be encountered by field personnel during field activities. The biological hazards that may be encountered include: microbiological agents, insects and wild animals.

3.4.1 Arthropods – Insects, Ticks, and Spiders

Nearly all work sites may contain ticks, venomous spiders, chiggers, and venomous insects. The most common venomous spiders in the area are the Black widow spider and the Hobo spider. Black widow spiders typically have globose, shiny abdomens that are predominantly black with red markings (although some may be pale or have lateral stripes), with moderately long, slender legs. These spiders are nocturnal and build a three-dimensional tangled web, often with a conical tent of dense silk in a corner where the spider hides during the day. Hobo spiders are dark brown with distinct pattern of yellow markings on their abdomen. Unlike many other similar looking spiders, they do not have dark bands on their legs. The body of an adult hobo is moderately large, about a half to three-quarters of an inch. To minimize exposure to venomous spiders, field personnel should wear long sleeves and pants, boots, a hat, and work gloves if they need to move stored material or debris at the site to avoid spider bites.

3.4.2 Vermin

Feral cats, skunks, rats, mice, squirrels and rabbits may be carriers of disease. Although the interaction with vermin are unlikely, it is always possible for vermin to be present in office and warehouse spaces, especially mice and rats. If vermin are identified in work areas, the Project Leader shall be immediately notified. Bites will be immediately reported and medical care obtained. Infections may occur in humans associated with activities that bring humans into contact with rodents, rodent saliva, or rodent excreta. Disturbing rodent-infested areas may bring humans into contact with the etiologic agents causing infections.

Transmission of disease may occur through broken skin, contact with conjunctivae, ingestion of contaminated food or water, or inhalation of aerosols. Personal hygiene practices, such as frequent hand washing, will help prevent rodent-borne diseases as well as using caution in areas likely to be occupied by vermin.

Workers will be advised that if a fever or respiratory illness develops within 45 days of the potential exposure, they should seek medical attention and inform the physician of potential Hantavirus exposure. All precautions will be made to ensure Hantavirus exposure is eliminated in the field. Rodent-borne diseases, including Hantavirus, result in severe respiratory distress and plague.

4 Roles and Responsibilities

The following section describes the roles and responsibilities of the personnel involved with the project. The roles and levels of authority are presented in the schematic in Section 4.4 below. Appendix A has a list of contact names and phone numbers related to this project.

4.1 Project Manager

The project manager has the responsibilities to:

- staff the project with qualified personnel (including proper training and certifications);
- ensure proper documentation is being collected and maintained;
- provide adequate resources and equipment to field personnel;
- monitor the performance of field activities; and
- ensure company policy is in compliance with all applicable regulations.

4.2 Project Leader

The project leader will serve as the SSHO and will report to the Project Manager. The project leader has the responsibilities to:

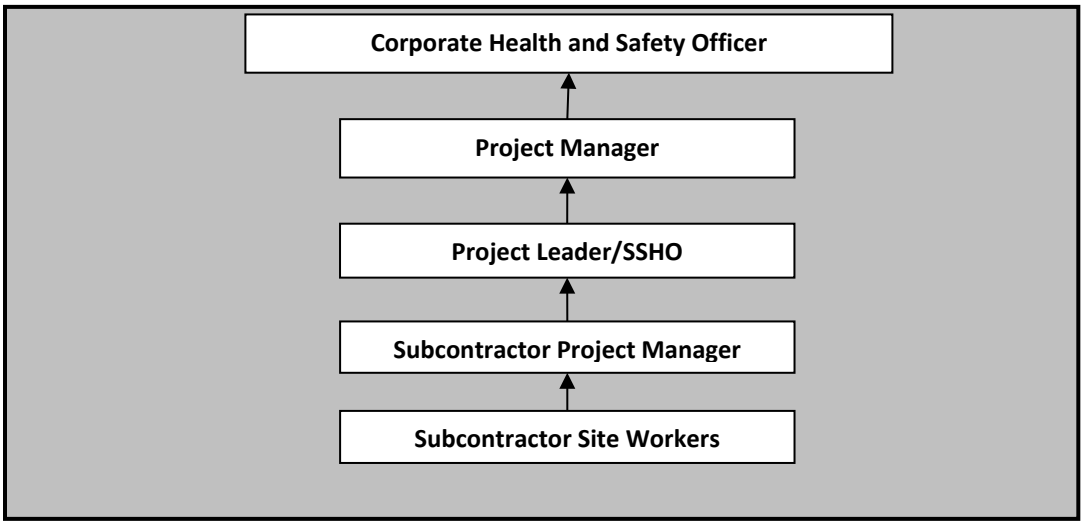
- act as the liaison between field personnel and the subcontractor(s);
- lead the daily and weekly safety meetings;
- ensure the HASP is being followed;
- provide adequate resources and equipment to field personnel; and
- monitor the performance of field activities.

4.3 Subcontractor(s)

Terraphase is responsible for the oversight and implementation of the project safety program. Each subcontractor will be required to designate one individual to work directly with and under the authority of the SSHO to ensure safety responsibilities are being met. Coordination and control of work flow will be achieved through frequent meetings (formal and informal) and job Site inspection. The designated subcontractor safety designee (subcontractor project manager) must be granted stop work authority over persons from their company.

Subcontractor control and coordination will be through the chain of command identified in Section 4.4 below. Although each subcontractor is ultimately responsible for the performance and actions of their employees, the SSHO has the authority to take action when a violation of safety guidelines is in question.

4.4 Chain of Command



4.5 Training

Field personnel engaged in project operations that potentially expose them to hazardous wastes, hazardous substances, or any combination of hazardous wastes or hazardous substances shall have satisfied the requirements of 29 CFR Part 1910.120 through completion of:

- Initial 40-hour HAZWOPER training, and
- Annual 8-hour HAZWOPER refresher training current within one year.

4.5.1 General Site-Specific Training

All potential field personnel will review this HASP before commencing work which will serve as Site-specific training. The SSHO will review the HASP before field operations begin and the SSHO, or designee, will conduct daily tailgate safety meetings (i.e., pre-entry briefings) to bring up appropriate health and safety concerns and discuss any changes in field conditions. The SSHO will conduct additional pre-entry briefings with entrants to the Site who are not present for the tailgate safety meeting. Field personnel will certify their review by signing a HASP acknowledgement form (Appendix B). Social distancing practices should be observed during all Site meetings.

Any additional Site-specific safety concerns such as, noise, heat illness prevention, or lock-out/tag-out will be addressed by the Project Manager and the SSHO will be provided with proper Site-specific training with accordance with any OSHA regulations prior to the start of the project, as applicable.

4.5.2 First Aid/CPR

Medical assistance is in near proximity to the Site, and therefore, per 29 CFR 1910.151, a designated first aid provider is not required. Personnel trained in first aid/CPR and bloodborne pathogens (29 CFR 1910.151 and 1910.1030) may administer first aid and CPR if needed.

4.5.3 Respiratory Protection

It is not anticipated that project personnel will need to utilize respiratory protective equipment. However, all on-site personnel will provide their own appropriate mask style and filter type for the specific tasks. All personnel donning respirators will be fit tested prior commencing work. On-Site workers will have successfully completed respiratory protection training in accordance with the requirements of OSHA 1910.134 should it be necessary.

5 Personal Hygiene and Sanitation Facilities

The following personal hygiene requirements will be observed:

- Water Supply: a water supply meeting the following requirements will be utilized:
  - Potable Water: an adequate supply of potable water will be available for field personnel consumption. Potable water will be provided in the form of water bottles, canteens, or water coolers by the SSHO. Potable water containers will be properly identified in order to distinguish them from non-potable water sources.
  - Non-Potable Water: non-potable water may be used for hand washing and cleaning activities. Non-potable water will not be used for drinking purposes. All containers of non-potable water will be marked with a label stating: “Non-Potable Water; Not Intended for Drinking Water Consumption.”
- Toilet Facilities: the on-site travel center restrooms

6 Safety Meetings

All workers permitted access to the Site will receive a Site orientation briefing and a review of pertinent aspects of the project and HASP before the start of work. Personnel will sign a form (Appendix B) documenting they have had an opportunity to review the HASP, understand the requirements, and agree willfully to adhere to the safety aspects of the plan.

The Site orientation briefing will include the following aspects:

- Key personnel and responsibilities
- Site hazards (known and potential)
- PPE requirements
- Emergency procedures (including signals, evacuation locations, and what constitutes an emergency)
- Location and route to the nearest medical facility
- Incident reporting procedures

Meetings typically last no less than 10 minutes in time and attendance will be documented. Daily informal safety meeting will be conducted each morning before work commences. Daily meeting attendance will be documented. Sign in sheets for the safety meetings are included in Appendix C.

Personnel are encouraged to immediately report any unsafe work conditions or work practices observed to the SSHO.

7 Accident Reporting

Workers are required to immediately report all accidents, incidents, near-miss incidents, injuries, illnesses and injuries requiring first-aid (no matter how trivial) to their supervisor and/or the SSHO.

In the event of a worker injury or illness, the SSHO must be notified, who will in turn immediately report the incident to the Project Manager to assist with the coordination of required medical assistance and related workers compensation case management follow-up.

Should an incident such as a serious injury (requiring hospitalization), explosion, fire, or a spill or release of toxic materials occur, during the project, the SSHO will immediately report the incident to the project manager and appropriate government agencies. The written report must include the following information:

- Name, organization, telephone number, and location of the contractor
- Name and title of the person(s) reporting the incident
- Date and time of the incident
- Location of the incident
- Approximate chronological summary of details occurring before and at the time of the incident
- Cause of incident (if immediately known)
- Casualty information (fatalities or disabling injuries)
- Details of any existing chemical hazard or contamination
- Estimated property damage (if applicable)
- Nature of the damage and effect on the contract
- Actions taken to preserve safety and security
- Other damages or injuries sustained
- Witness statements

If a utility strike does occur, report this to the Project Manager and utility operator as soon as it is safe to do so. The contact info for potential utility operators near the Site are available in the One-Call ticket which will be included in Appendix E once it has been submitted.

8 Personal Protective Equipment

PPE in the form of protective footwear and appropriate work clothing are required for all field activities. PPE for specific field activities is listed below.

All Field Activities:

- Boots – chemical resistant, steel (or equivalent) toe and shank (ASTM F2412-18 and F2413-18, Safety Toe Footwear Classification 75). Boots shall be equipped with deep traction sole.
- Work clothing (e.g., long pants)
- Safety Vests (Yellow or orange with reflective strips)
- Safety Glasses (ANSI Z87.1)

Drilling and Excavation Operations:

- Hard Hat (ANSI Z89.1-2014 Type 1 Class E and G; when heavy equipment, drill rigs, or other overhead hazards are present)
- Hearing Protection (foam inserts)
- Gloves - Chemical (Nitrile)
- Work Gloves (Leather or equivalent) – for activities that require more resilient gloves

Soil Sampling:

- Gloves – Chemical (nitrile)
- Work Gloves (Leather or equivalent) – if splitting cores or other activities that require more resilient gloves

If necessary:

- Safety Face Shield (splash hazard)
- Tyvek® suit or similar coverall (splash hazard)
- Rubber boots or over boots (wet conditions or if wet boot decontamination is necessary)

PPE offers a high degree of protection, yet the equipment must be maintained and inspected on a regular basis to ensure its effectiveness. Hard hats should be discarded if cracked. Boots should be maintained (use waterproofing if necessary) to prevent injuries, disease (from wet conditions) and insect/snake bites.

Employees required to wear PPE will be trained to know at least the following:

- When PPE is necessary.
- What PPE is necessary.
- How to properly put on, take off, adjust and wear the PPE.
- The limitations of the PPE.
- Proper care, maintenance, useful life and disposal of PPE.

Changes in the workplace or in the type of required PPE that make prior training obsolete may require additional training or retraining of employees.

If air monitoring exceeds action levels identified in Section 9.0, work will be modified to reduce vapors. If air monitoring indicates that an upgrade to level C PPE is necessary, Level C includes the PPE specified above plus the NIOSH-approved half- or full-face air-purifying respirator (APR) equipped with the appropriate filter cartridges for organic vapors. Personnel will be fit-tested for the specific make and model respirator that will be used. Note: safety glasses or goggles are not required when wearing a full-face APR.

8.1 Respirator Cartridge Change-out Schedule

The respirator cartridge change-out schedule includes the following:

- Particulate (i.e., P-100, HEPA) – Cartridge to be changed out whenever the employee detects an increase in breathing resistance. This will occur as the filter becomes loaded with particulate matter.
- Sorbent (i.e., organic vapor) – Cartridge to be changed out at the end of each day's use or whenever the employee detects an abnormal odor or other indicator.

9 Air Monitoring

Air monitoring will be conducted during intrusive activities as the potential exists to contact soil, soil vapor or groundwater impacted with VOCs. The work environment will be monitored using a photoionization detector (PID) and gas detection tubes, as needed.

9.1 Direct Reading Instruments

9.1.1 Photoionization Detector

A PID with a 10.6 electron volt (eV) lamp will be used to determine the presence and concentration of organic vapor. Contaminants such as VOCs are detectable with a PID, but a PID will not identify which VOCs are present. Air monitoring and actions will be implemented identified in 10.2 below.

9.1.2 Gas Detection Tubes (Benzene)

Gas detection tubes will be used to determine if benzene is present in the work environment. Gas detection tubes specific to benzene with a detection level of at least 0.5 ppm will be used. Air monitoring and action levels will be implemented as identified in 9.2 below.

9.2 Monitoring Strategy

Inhalation is one of the primary routes of exposure for VOCs and SVOCs. The following approach to air monitoring was selected based on site conditions and background information presented in Section 2.

9.2.1 Total Organic Vapor Monitoring

During intrusive and remediation activities, VOCs could potentially become airborne and result in exposure to employees. When intrusive activities are being conducted or when known or suspected contaminated soils or groundwater are encountered, total organic vapors will be monitored with a PID or a similar device. **Total organic vapor readings will be taken in the breathing zone approximately once per half hour, or more frequently as site conditions warrant.**

If the PID detects total organic vapors at concentrations greater than 1 ppm sustained for at least 1 minute, a real-time measurement of benzene will be taken with a gas detection tube. If the gas detection tube reading is non-detect for benzene, the PID action level shall be 10 ppm.

If the PID detects total organic vapors at concentrations greater than 10 parts per million (ppm), then sustained for at least 1 minute, additional controls will be implemented to prevent exposure. If possible, all personnel will evacuate the area and wait for vapors to dissipate to levels below 10 ppm before resuming work. If personnel must remain in an area where vapors above 5 ppm are present, air-purifying respirators will be worn to identify the source of the vapors and implement engineering controls (i.e. blower fans) to reduce VOCs to below occupational exposure limits. If the PID readings exceed 100 ppm sustained (for greater than 1 minute), all work will be stopped and the project manager

notified. Work may not resume until airborne total organic vapors readings are recorded below 50 ppm. On-Site personnel wearing C Level PPE should try to identify the source of the contaminants once readings fall to below 100 ppm.

9.2.2 Draeger Tubes (Benzene)

In the event that PID readings exceed 1 ppm for a sustained 1-minute period, a gas detection tube reading will be taken for benzene. The gas detection tube will have a detection limit of 0.5 ppm or lower. Readings shall be taken at least twice per day during the first instance of a sustained PID reading of 1 ppm or higher for a sustained 1-minute period, and periodically throughout the day as needed as site conditions and locations change. At a minimum, additional gas detection tube readings shall be taken when respiratory protection is required to verify benzene is not present, or at least not present at a concentration that exceeds the protection factor of the respiratory protection being used.

Chemicals of Potential Concern (COPCs)		
Direct Reading Instrument Action Levels for Area Monitoring and Breathing Zone Monitoring		
Monitored Parameter	**Action Level**	**Response to Action Level**
VOCs in the work area will be monitored using a PID and gas detection tubes or other benzene specific meter.	≥ 1 ppm continuous reading in the breathing zone for 1 minute	The SSHO should: Take a real-time reading with a benzene Draeger tube (or equivalent) with a detection level of 0.5 ppm or lower. • If the benzene sample confirms that benzene concentrations are non-detect (i.e. below 0.5 ppm), work may continue. • If the benzene sample detects the presence of benzene, STOP WORK, and contact the Terraphase Project Manager and Safety Officer to develop and plan to proceed safely. • Work with Subcontractor to determine if additional ventilation can be provided in the work area to maintain levels to less than 1 ppm

Chemicals of Potential Concern (COPCs)		
Direct Reading Instrument Action Levels for Area Monitoring and Breathing Zone Monitoring		
Monitored Parameter	**Action Level**	**Response to Action Level**
	≥ 10 ppm continuous reading in the breathing zone for 1 minute	The SSHO should: • Stop work • Don Level C (HEPA/OV cartridges) to identify source of airborne contamination. • Initiate vapor suppression measures or other engineering controls where (e.g. work upwind, blower fan) to maintain levels to less than 10 ppm • Take a real-time reading with a benzene Draeger tube (or equivalent) with a detection level of 0.5 ppm or lower. • If the benzene sample confirms that benzene concentrations are non-detect (i.e. below 0.5 ppm), work may continue. • If the benzene sample detects the presence of benzene, STOP WORK and contact the Terraphase Project Manager and Safety Officer
	≥ 100 ppm continuous reading in the breathing zone for 1 minute	• Stop work • Contact Project Manager if VOC levels cannot be controlled to less than 100 ppm total

The Site action levels were derived using the following regulatory exposure limits:

Compound	CF	OSHA		ACGIH	
		PEL	STEL	TLV	TLV-STEL
Benzene	0.47	1	5	0.5	2.5
Naphthalene	0.42	10	--	10	--

Concentrations presented in parts per million (ppm)

CF = PID correction factor for a 10.6eV lamp

PEL = permissible exposure limit, 8-hour time weighted average

STEL = short term exposure limit, 15-minute

TLV = threshold limit value, 8-hour time weighted average

ACGIH = American Conference of Governmental Industrial Hygienists

9.3 Quality Assurance/Quality Control

Adherence to a proper quality assurance and quality control (QA/QC) plan is essential for a meaningful air sampling effort. The major concerns of a QA/QC plan are calibration of equipment and document control.

9.3.1 Calibration and Maintenance Procedures

All direct reading instruments will be calibrated daily before work and checked against calibration gas at the end of the day. Calibration records will be kept that detail date, time span, gas or other standard, and the name of the person performing the calibration. The calibration gas for the PID is isobutylene. The SSHO will ensure that the instrument is kept clean and will follow manufacturer's directions for keeping the lamp clean. The SSHO will perform no other maintenance procedures unless approved by the Project Manager.

9.3.2 Documentation

Strict adherence to document and data control procedures is essential for good QA/QC. Data and calibration records must be accounted for and retrievable at all times. Types of documents that are essential include notes, logbooks, maps, data sheets, and reports. These must be placed in the project files. Copies of all field data reports and personal sampling records will be sent to the project manager for review.

Documentation of employee exposure monitoring results must be made available and maintained in compliance with 29 CFR 1910.1020.

10 Decontamination of Personnel and Equipment

Despite protective procedures, personnel and equipment may come in contact with potentially hazardous compounds while performing work tasks. If so, decontamination must occur using an Alconox or TSP wash (or other effective means), followed by a rinse with clean water. Standard decontamination procedures for levels C and D are as follows:

- equipment drop
- boot cover and outer glove wash and rinse
- boot cover and outer glove removal
- suit wash and rinse
- suit removal
- safety boot wash and rinse
- inner glove wash and rinse
- respirator removal
- inner glove removal
- field wash of hands and face

Workers should employ only applicable steps in accordance with level of PPE worn and extent of contamination present. The SSHO shall maintain adequate quantities of clean water to be used for personal decontamination (i.e., field wash of hands and face) whenever a suitable washing facility is not located in the immediate vicinity of the work area. Disposable items will be disposed of in an appropriate container. Wash and rinse water generated from decontamination activities will be handled and disposed of properly. Non-disposable items may need to be sanitized before reuse. Each Site worker is responsible for the maintenance, decontamination, and sanitizing of his/her own PPE.

Used equipment may be decontaminated as follows:

- An Alconox or TSP and water solution will be used to wash the equipment.
- The equipment will then be rinsed with clean water.

Each person must follow these procedures to reduce the potential for transferring chemically affected materials off Site.

11 Medical Surveillance

Any field personnel engaged in project operations that expose them to hazardous wastes, hazardous substances, or any combination of hazardous wastes or hazardous substances shall be participants in a Medical Surveillance program that meet the OSHA requirements. These persons must be medically evaluated and cleared for use of respiratory protection devices and protective clothing for working with hazardous materials by the examining physicians. The medical clearance shall be current within one year through at least the last day of field operations. The applicable requirements under the OSHA standards for HAZWOPER and Respiratory Protection Program will be observed. Current copies of training certificates and statements of medical program participation for all Terraphase personnel are maintained by the Terraphase headquarters office.

12 First Aid and Medical Treatment

All persons on site must report any near-miss incident, accident, injury, or illness to the SSHO. A trained site first aid provider will provide first aid. Injuries and illnesses requiring medical treatment must be documented. The SSHO must conduct an accident investigation as soon as emergency conditions no longer exist and first aid and/or medical treatment have been completed. All necessary reports must be completed and submitted to the Project Manager within 24 hours after the incident.

For non-emergency work-related injuries, staff should contact WorkCare at (888) 449-7787 for telephonic injury/illness assessment and treatment advice. If treatment beyond first aid is required, the injured should be transported to the nearest medical facility off-site. If the injured is not ambulatory or shows any sign of not being in a comfortable and stable condition for transport, then an ambulance/paramedics should be summoned. If there is any doubt as to the injured worker's condition, it is best to let the local paramedic or ambulance service examine and transport the worker.
The closest medical facility with 24-hour emergency services is the KVH Hospital, as described below. A map of the driving directions is included in Appendix D.

Nearby Hospital:
KVH Hospital
603 S Chestnut St,
Ellensburg, WA 98926
509-962-9841

Directions to Hospital (from Site Entrance):

10 min (3.7 miles)

via W University Way

Fastest route, the usual traffic

Love's Travel Stop
1512 US-97, Ellensburg, WA 98926

Head southwest toward US-97 S

157 ft

Turn left onto US-97 S

194 ft

At the traffic circle, take the 3rd exit onto 90BL/W University Way



Continue to follow W University Way

2.7 mi

Turn right onto N Chestnut St

0.8 mi

Turn right

167 ft

Turn left

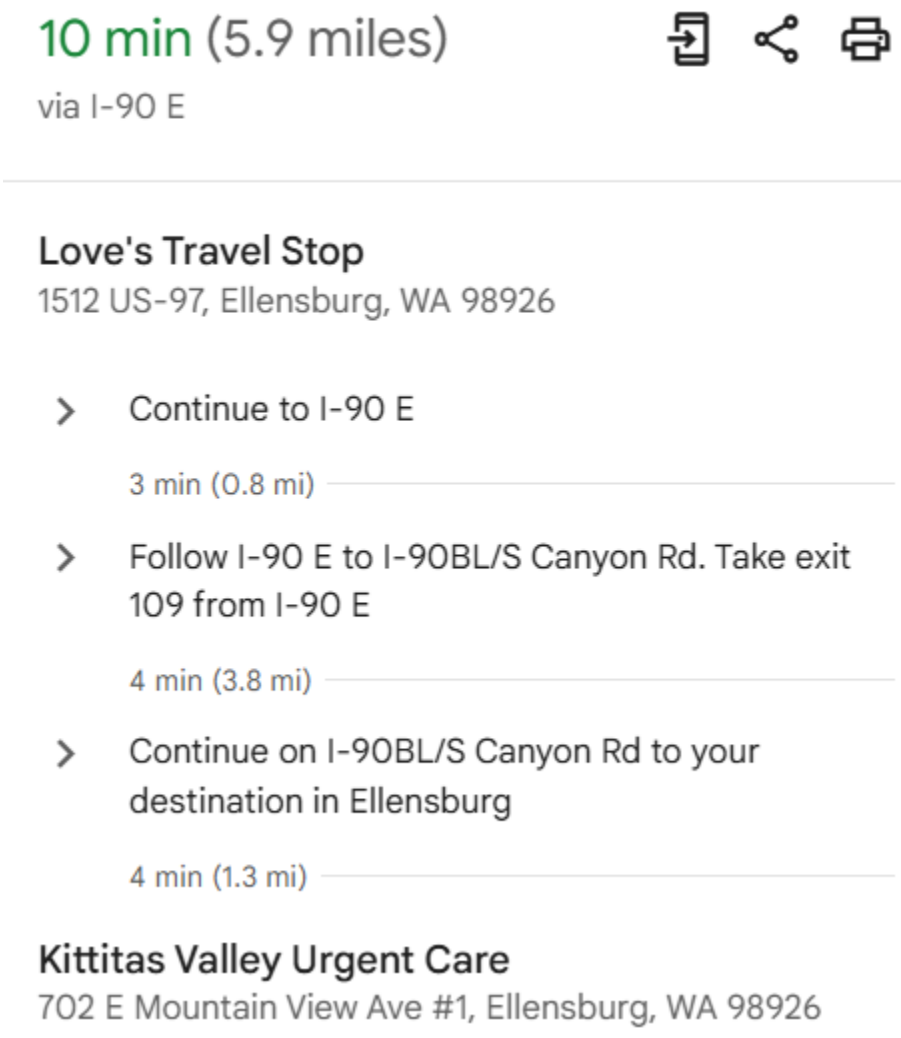
Destination will be on the right

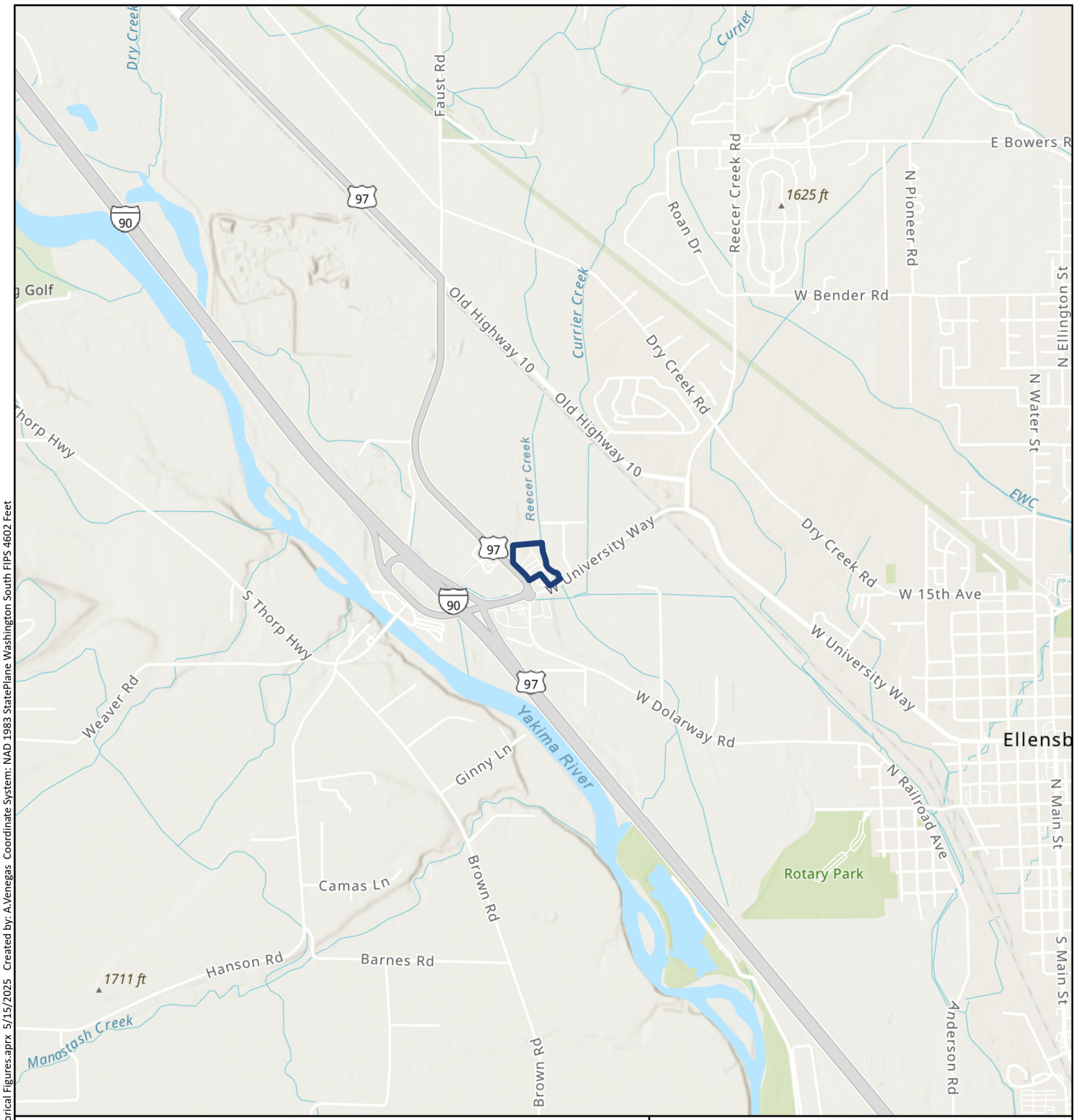
46 ft

KVH Hospital : Emergency Room
603 S Chestnut St, Ellensburg, WA 98926

Nearby Urgent Care:
Kittitas Valley Urgent Care
702 E Mountain View Ave #1,
Ellensburg, WA 98926
509-968-5273

Directions to Urgent Care (from Site Entrance):





0 1,250 2,500 5,000 Feet

1 inch = 2,500 feet

N

Legend

Site Boundary

Imagery Source: ESRI World Topographic Map

SAFETY FIRST	CLIENT: Love's Travel Stops	**Site Location**
terraphase engineering	PROJECT: Love's Travel Stop #413 1512 HWY 97, Ellensburg, WA	
	PROJECT NUMBER: W053.001.003	**FIGURE 1**

File: N:\GIS\Prj\W053_Loves Ellensburg\.001\Pro Project\Historical Figures.aprx 5/15/2025 Created by: A.Venegas Coordinate System: NAD 1983 StatePlane Washington South FIPS 4602 Feet

Appendix A

Contact Names and Phone Numbers

Emergency Contacts

Emergency Contacts

Emergency Services (Police/Fire Department/Ambulance):	911
KVH Hospital:	(509) 962-9841
Kittitas Valley Urgent Care:	(509) 968-5273
WorkCare 24-hour Telehealth Service:	(888) 449-7787
National Response Center:	(800) 424-8802
Poison Control Center:	(800) 876-4766 or (800) 222-1222
CHEMTREC:	(800) 424-9300

Terraphase

Tacoma Office Number:	(253) 475-7711
Corporate Health and Safety Officer: Office Number: Cell Number:	Daren Roth (925) 444-0555 x38 (925) 719-5496
Project Manager: Office Number: Cell Number:	Max Wills (425) 488-0599 (206) 550-7215
Project Leaders/SSHO: Office Number: Cell Number:	Kari Thomas (253) 475-7711 (541) 915-3452

Contractors

Locator (TBD):	(XXX) XXX-XXXX
Driller (TBD):	(XXX) XXX-XXXX
Excavator (TBD):	(XXX) XXX-XXXX

Appendix B

HASP Review and Acceptance Form

HASP Review and Acceptance Form

All field personnel working on the Site must be familiar with the HASP. By signing below, you confirm you have read, understand, and agree to abide by the HASP. Any questions regarding health and safety on this Site may be directed to either the Project Leader/SSHO or Project Manager.

Name	Company	Date

Appendix C

Safety Meeting Sign-in Sheets

Safety Meeting Sign-In Sheet

Conducted By:

Date:

Topics Discussed:

Concerns/Problems/Hazards:

Meeting Attendees

Name	Company

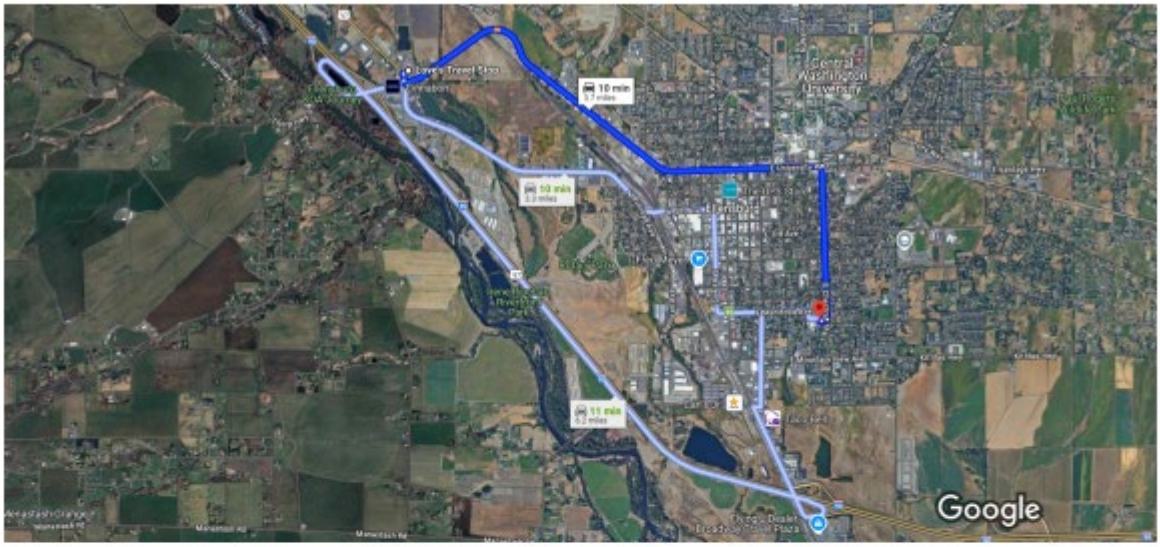
Appendix D

Driving Directions to Nearest Urgent Care or Hospital

Directions to Hospital: KVH Hospital (603 S Chestnut St, Ellensburg, WA 98926)

Google Maps

Love's Travel Stop, 1512 US-97, Ellensburg, WA 98926 to KVH Hospital : Emergency Room, 603 S Chestnut St, Ellensburg, WA 98926 — Drive 3.7 miles, 10 min



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Love's Travel Stop
1512 US-97, Ellensburg, WA 98926

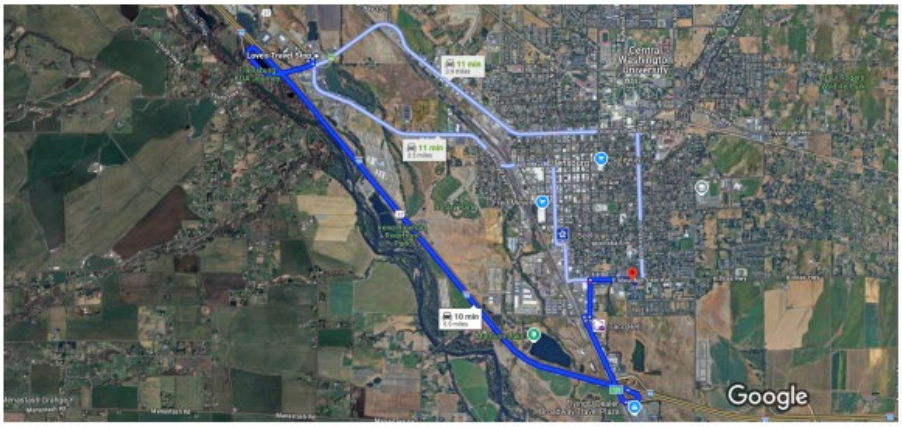
1. Head southwest toward US-97 S
   157 ft
2. Turn left onto US-97 S
   194 ft
3. At the traffic circle, take the 3rd exit onto I-90BL/W University Way
   Continue to follow W University Way
   2.7 mi
4. Turn right onto N Chestnut St
   0.8 mi
5. Turn right
   167 ft
6. Turn left
   Destination will be on the right
   46 ft

KVH Hospital : Emergency Room
603 S Chestnut St, Ellensburg, WA 98926

Directions to Clinic: Kittitas Valley Urgent Care (702 E Mountain View Ave #1, Ellensburg, WA 98926)

Google Maps

Love's Travel Stop, 1512 US-97, Ellensburg, WA 98926 to Kittitas Valley Urgent Care, 702 E Mountain View Ave #1, Ellensburg, WA 98926 — Drive 5.9 miles, 10 min



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Love's Travel Stop
1512 US-97, Ellensburg, WA 98926

Continue to I-90 E

3 min (0.8 mi)

1. Head southwest toward US-97 S

157 ft

2. Turn left onto US-97 S

194 ft

3. At the traffic circle, take the 1st exit onto I-90BL

0.7 mi

Follow I-90 E to I-90BL/S Canyon Rd. Take exit 109 from I-90 E

4 min (3.8 mi)

4. Merge onto I-90 E

3.6 mi

5. Take exit 109 for Canyon Road

0.2 mi

Continue on I-90BL/S Canyon Rd to your destination in Ellensburg

4 min (1.3 mi)

6. At the traffic circle, take the 1st exit onto I-90BL/S Canyon Rd

0.7 mi

7. Turn right onto E Umptanum Rd

220 ft

8. Turn left onto Ruby St

0.3 mi

9. Turn right onto E Mountain View Ave

0.3 mi

10. Turn right
Destination will be on the right

112 ft

Kittitas Valley Urgent Care
702 E Mountain View Ave #1, Ellensburg, WA 98926

Appendix E

Utility Locate Ticket and Utility Contact Info