PacifiCorp and Union Oil Company of California

Light Nonaqueous Phase Liquid Assessment Report

Former Petroleum Terminal #0022 and Manufactured Gas Plant (MGP)

DEQ ECSI #1646
256 Marine Drive
Astoria, Oregon

August 22, 2023

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Acronyms and Abbreviations

Arcadis	Arcadis U.S., Inc.
ASTM	American Society for Testing and Materials
AROD	Amended Record of Decision
btoc	below top of casing
CH2M	CH2M Hill, Inc.
City	City of Astoria
CNFA	Conditional No Further Action
CSM	conceptual site model
DEQ	Oregon Department of Environmental Quality
TPH-DRO	total petroleum hydrocarbons as diesel range organics
ECSI	Environmental Cleanup Site Information
FS	Feasibility Study Report
TPH-GRO	total petroleum hydrocarbons as gasoline range organic
TPH-HRO	total petroleum hydrocarbons as residual range organics
IFT	interfacial tension
ITRC	Interstate Technology and Regulatory Council
LNAPL	light nonaqueous phase liquid
LOF	Locality of Facility
MFA	Maul Foster & Alongi, Inc
MGP	manufactured gas plant
NFA	No Further Action
NSZD	natural source zone depletion
PAH	Polycyclic aromatic hydrocarbon
RBC	Risk Based Concentrations
RI/FS	Remedial Investigation and Feasibility Study
ROD	Record of Decision
site	Former Petroleum Terminal #0022 and manufactured gas plant (MGP) located at 256 Marine Drive, Astoria, Oregon
SVOC	Semivolatile organic compound

TOC	total organic carbon
the Parties	PacifiCorp and Union Oil Company of California (Unocal)
TPH	total petroleum hydrocarbons
TPH-GRO	total petroleum hydrocarbons in the gasoline range
TPH-DRO	total petroleum hydrocarbons in the diesel range
TPH-HRO	total petroleum hydrocarbons in the heavy oil range
USEPA	United States Environmental Protection Agency
VOC	Volatile organic compound
Work Plan	LNAPL Assessment Work Plan

1 Introduction

On behalf of PacifiCorp and Union Oil Company of California (Unocal), collectively referred to as "the Parties," Arcadis U.S., Inc. (Arcadis) has prepared this Light Non-Aqueous Phase Liquid (LNAPL) Assessment Report (Report) for the Former Petroleum Terminal #0022 and manufactured gas plant (MGP) located at 256 Marine Drive, Astoria, Oregon (site; Figure 1). The Oregon Department of Environmental Quality (DEQ) assigned the Environmental Cleanup Site Information (ECSI) #1646 to the site.

The LNAPL Assessment Work Plan (Work Plan) was submitted to DEQ on January 26, 2023. The proposed scope of work includes additional evaluation of LNAPL plume stability; evaluation of the rate of natural source zone depletion (NSZD), and; assessing whether dissolved-phase constituents associated with LNAPL are present in groundwater and, if present, screen detected concentrations against DEQ's current human health risk based concentrations (RBCs) and ecological screening level values (SLVs) (Arcadis 2023). Oregon DEQ provided comments on the Work Plan on March 22, 2023 (DEQ 2023) in an email correspondence. Arcadis acknowledged Oregon DEQ's comments in an email correspondence on April 10, 2023 and proceeded with implementation of the Work Plan (Arcadis 2023).[1]

The objectives of this Report are to:

- Summarize the investigation activities conducted in accordance with the LNAPL Work Plan (Arcadis 2023).
- Evaluate results and present data analysis from the LNAPL and groundwater assessments.
- Provide conclusions and recommendations based on the analytical data collected as part of this investigation.

2 Site History

This section provides a description of the site and summarizes the site's environmental history including historical groundwater monitoring and upland LNAPL investigation results. The site's location is shown on Figure 1.

2.1 Site Description

Historically, the site was used as an MGP and a petroleum storage/distribution terminal. The MGP, which was owned and operated by Astoria Coal and Gas Company (a predecessor company of PacifiCorp), occupied the northeastern portion of the site between 1888 and 1921. By 1905, concurrent with MGP operations, Unocal operated a petroleum storage/distribution terminal (#0022) in the northwestern portion of the site. Operations had expanded to the southwestern portion of the Site by 1917. Unocal purchased the entire block by 1921 and operated this portion of the site from approximately 1927 to 1977. Unocal also had bulk fuel storage on the block immediately east of the site from 1921 to 1977. The Spokane, Portland, and Seattle Railway Company (later Burlington Northern Santa Fe Railroad) operated a rail line and siding north of the site in the late 1800s and 1900s. Currently, the City of Astoria (City) maintains the rail line and operates a passenger trolley.

[1] In response to the LNAPL Work Plan, DEQ requested the installation of a temporary piezometer north and downgradient of MW-12. The Parties provided limitations regarding the possible installation of a boring north of MW-12, including the proximity of MW-12 to the top of the riverbank, subsurface cobbles that would cause challenging drilling conditions, and increased turbidity created by rotary sonic drilling techniques preventing the collection of representative groundwater sample from a temporary piezometer. DEQ agreed that the collection of a groundwater sample from MW-15 would be more representative of groundwater downgradient of MW-12.

The site is divided into three areas:

- On-site upland (former MPG and petroleum storage/distribution terminal)
- Off-site upland, which includes upland areas north and northeast of the city block denoted as the site (and the location of the Upland LNAPL Hot Spot in monitoring well MW-12)
- Off-site in-water, which includes the intertidal zone of the Columbia River to the north of the site.

Collectively, the areas comprise the Locality of Facility (LOF) as shown on Figure 2. The on- and off-site upland areas are referred to as the upland areas in this Report.

The On-site upland portion of the site is currently paved and used as a parking lot. Some remnants of historical structures, including concrete foundations and on-grade concrete slabs, are present on the site. It is relatively flat, with a grade similar to that of the surrounding properties. The Off-site upland area is located in the City's Riverwalk, which consists of a multiuse path and trolley line.

2.2 Environmental History

This section presents the regulatory history for the areas of the site which have been remediated and where the Parties have requested a determination of conditional no further action (CNFA) from DEQ. It also provides a summary of actions taken to address upland LNAPL at MW-12, which is the current focus of ongoing investigation and remediation activities at the site.

2.2.1 Regulatory History

The site was placed on the Confirmed Release List and Inventory in 1995. PacifiCorp and Unocal entered into the Voluntary Cleanup Program as co-contributors in 1996 under a joint remediation agreement for the project. In October 1997, PacifiCorp entered a voluntary cleanup agreement with DEQ (DEQ No. WMCVC-NWR-97-06) as the performing party for on-site upland work solely for project logistics. Pursuant to the 1997 agreement, the Parties conducted a remedial investigation (RI; CH2M Hill, Inc. [CH2M] 2001) and risk assessment (RA; CH2M 2002) for the on-site upland area. Investigation results indicated that hazardous substances potentially associated with historical site operations were present beyond the property boundaries. In October 2002, the Parties entered into a voluntary cleanup agreement with DEQ (DEQ No. LQVC-NWR-02-12) to investigate the nature and extent of off-site impacts. A RI/RA for off-site upland and in-water areas of the site was submitted in 2008 (Maul Foster & Alongi, Inc. [MFA] 2008).

A Feasibility Study (FS) addressing both on-site and off-site areas was submitted in 2010, with the primary objective being remediation of upland offsite and in-water (intertidal) LNAPL "hot spots" (MFA 2010). In December 2011, DEQ issued a remedial action Record of Decision (ROD) for the LOF (DEQ 2011). DEQ amended the ROD (AROD; DEQ 2012) in May 2012 to incorporate responses to two sets of comments. The AROD selected *Upland Alternative 2: Capping, Institutional Controls, and Enhanced LNAPL Recovery* as the upland remedy, also referred to in this report as the LNAPL remedy. In June 2016, the Final Upland Cap Design (Arcadis 2016a) was completed.

In October and November 2018, the upland cap was constructed in accordance with Final Upland Cap Design (Arcadis 2016a) and the Construction Quality Assurance Project Plan (Arcadis 2016b). Site features and remediation footprints are shown on Figure 3.

The Draft Upland Cap Construction Completion Report was submitted to DEQ on February 25, 2019 (Arcadis 2019a). After addressing comments provided by DEQ on July 29, 2019, the Parties submitted a final Upland Construction Completion Report on August 23, 2019. DEQ approved the final report on August 23, 2019.

On May 31, 2019, Dalton Olmsted & Fuglevand (DOF) submitted three In-Water Area final design documents to DEQ including the Final Design Report, the Environmental Monitoring Plan, and the Construction Quality Assurance Plan. These design documents were revised in accordance with DEQ's letter dated April 25, 2019, Re: Approval In-Water Remediation Documents. DEQ approved the In-Water Area Final Design Documents in a January 7, 2020, letter. Off-site In-Water remedial activities as well as post-construction monitoring were conducted in August and September 2020. On November 12, 2020, DOF on behalf of the Parties, submitted the draft In-Water (intertidal) Construction Completion Report to the DEQ. On March 4, 2021, DEQ provided the Parties with comments on the In-Water (intertidal) Construction Completion Report (DEQ, 2021). The final report dated April 9, 2021, was submitted to DEQ on April 14, 2021 and approved by DEQ on January 25, 2022.

Following a verbal agreement between the Parties and DEQ in July 2022, PacifiCorp submitted the Request for Issuance of Conditional No Further Action (CFNA) on August 19, 2022. In the CNFA letter, the Parties requested DEQ provide conditional NFA determinations for the On-Site Upland and Off-Site In-Water (Intertidal) areas of the site which are currently capped. The CNFA letter did not request a conditional NFA for the Off-Site Upland area where the LNAPL in MW-12 is present (PacifiCorp 2022). The DEQ CNFA determination letter is pending at the time of this Report submittal.

2.2.2 Upland Light Non-Aqueous Phase Liquid History

LNAPL has historically been measured in monitoring wells MW-7, MW-11, MW-12, and MW-13, as indicated on Figure 4, with the greatest thicknesses measured in MW-12. LNAPL thickness has ranged from 0.01 feet (sheen; MW-7) on February 27, 2003, to 7.51 feet (MW-12) on October 18, 2022. LNAPL accumulation in MW-12 during remedy effectiveness monitoring is shown on Figure 5. The LNAPL observed in MW-12 has been characterized as a dark brown, oil-like substance identified as a degraded Bunker Crude, or similar intermediate fuel oil blend (MFA 2008). The product is composed of hydrocarbons with relatively high molecular weights and relatively low solubilities (MFA 2008). LNAPL near MW-12 is assumed to have been released as a result of the historical site operations more than 40 years ago. In 2008, MFA concluded that given the nature and age of release, no significant dissolved-phase plume is expected to develop in groundwater (MFA 2008).

LNAPL properties were characterized in the 2010 RI/FS (MFA 2010) and verified in the 2014 LNAPL Pilot Scale Study (Arcadis 2014). During both investigations, LNAPL was sampled and submitted for viscosity and specific gravity testing. The results of the 2014 study were consistent with and verified the results of the 2010 tests. LNAPL interfacial tension (IFT) and flash point were analyzed during the 2014 pilot study. LNAPL transmissivity tests were deployed in both investigations. In 2010, LNAPL transmissivity was determined to be approximately 0.01 square foot per day (ft^2/day; MFA 2010). In 2014, LNAPL transmissivity was determined to vary between 0.03 and 0.04 ft^2/day, consistent with the historical LNAPL transmissivity calculations made during the RI/FS (Arcadis 2014). Based on its high viscosity and low LNAPL transmissivity, LNAPL near MW-12 will not readily flow into the well and testing indicates low recoverability potential, as defined by the Interstate Technology Regulatory Council (ITRC 2009).

Removal of the weathered LNAPL has been performed at the site since November 2002, and approximately 71 gallons of LNAPL have been removed from monitoring wells to date. LNAPL assessments and removal activities have been documented in routine reports submitted to the DEQ between 2001 and 2023. Significant LNAPL

deliverables are summarized below. A detailed upland LNAPL history can be found in the 2023 LNAPL Work Plan (Arcadis 2023).

- *LNAPL Pilot Scale Study and Recoverability Report, October 2014*. In 2014, Arcadis submitted the LNAPL Pilot Scale Study and Recoverability Report to DEQ, summarizing the results of pilot studies for three LNAPL removal methods, LNAPL transmissivity results, and analytical results for LNAPL samples collected from MW-12. Analytical results indicated that LNAPL viscosity at MW-12 is at least 3,000 times more viscous than water (at 90 degrees Fahrenheit [^{o}F]); equivalent to 660 times more viscous than water at 104 ^{o}F), consistent with LNAPL analytical data collected during the RI. The report concluded that LNAPL mobility is limited by the high viscosity of the LNAPL. Based on field observations and low transmissivity estimates, the report concluded that LNAPL was near residual saturation and stable, with limited potential for recovery. Based on results of the pilot testing, manual removal using a hydrophobic absorbent product was selected as the remedial alternative for LNAPL near MW-12 (Arcadis 2014). An adaptive management approach was proposed consisting of the following elements:
  - Installation of monitoring well MW-15.
  - Implementation of a long-term water-level and LNAPL (if present) gauging program at monitoring wells MW-7, MW-11, MW-12, MW-13, and MW-15.
  - LNAPL recovery at monitoring wells in which LNAPL is observed using hydrophobic adsorbent socks, pumping, and/or bailing.
  - Evaluation of LNAPL recovery rates and thicknesses. Once recovery rates are stable or declining, discontinuation of LNAPL recovery and pre-closure monitoring to characterize LNAPL in site monitoring wells under steady-state conditions.
  - Once LNAPL thicknesses (if present) are declining or stable after 6 months of effectiveness monitoring without recovery, then remediation of the MW-12 LNAPL will be considered complete, and the Parties will request a No Further Action (NFA) determination for the site (Arcadis 2014).

  On November 12, 2014, the DEQ approved the proposed LNAPL recovery approach (DEQ 2014), and hydrophobic absorbent socks were deployed at monitoring wells MW-7, MW-11, MW-12, and MW-13.
- *Upland LNAPL Recovery Work Plan, February 2015.* In 2015, Arcadis submitted the Upland LNAPL Recovery Work Plan (Arcadis 2015a) proposing the installation of MW-15 to evaluate the presence or absence of LNAPL between well MW- 12 and the Columbia River, and (if present) to determine whether enhanced LNAPL recovery from MW-12 was warranted. The work plan was approved by the DEQ on February 26, 2015 (DEQ 2015a).
- *Final MW-15 Installation Field and Data Summary Report, September 2015.* In September 2015, Arcadis submitted a report documenting field activities and observations from the installation of MW-15. As described in the report, no LNAPL was observed at MW-15. A geotechnical sample was collected from the MW-15 borehole, and an updated LNAPL conceptual site model (CSM) was presented in the report based on site-specific soil properties. Results of laboratory measurements indicated that LNAPL near MW-12 would be unable to exert sufficient capillary pressure to overcome the soil entry pressure required for LNAPL to migrate beyond the previously wetted soil footprint. These data indicated that the LNAPL footprint was stable and not migrating, and that LNAPL releases to the Columbia River were not likely (Arcadis 2015). On September 15, 2015, the DEQ approved the Final MW-15 Installation Field and Data Summary Report (DEQ 2015).

- *Request to Conduct Upland LNAPL Hot Spot Pre-Closure Monitoring, Former Petroleum Terminal No. 0022 and Manufactured Gas Plant, 256 Marine Drive, Astoria, Oregon, Oregon DEQ ECSI No. 1646, July 2019.* In 2019, Arcadis provided an updated CSM for LNAPL in the vicinity of MW-12 and proposed the initiation of remedy effectiveness monitoring to evaluate the upland LNAPL Hot Spot for potential CNFA determination, after monitoring data demonstrated that LNAPL recharge had decreased compared to baseline conditions. The DEQ deferred the approval of this request until after the completion of the offsite in-water sediment cap to allow for additional monitoring to determine if LNAPL was observed seeping from the upland during in-water remediation activities (DEQ 2021a).
- On January 13, 2021, the DEQ approved the request to conduct upland remedy effectiveness monitoring and requested evaluation of dissolved phase constituents in MW-12 and MW-15 to confirm that constituents were not dissolving from LNAPL in MW-12 at concentrations exceeding DEQ screening values for potential excavation workers and ecological receptors along the shoreline (DEQ 2021a).
- On February 16, 2021, Arcadis responded to the DEQ's January letter, stating Arcadis and the Parties did not agree that additional analytical groundwater data from MW-12 and MW-15 were needed since no material changes to the CSM had occurred since the RI/RA report was approved by DEQ on September 18, 2008 (Arcadis 2021a). On March 31, 2021, DEQ responded to Arcadis' February letter, and stated that dissolved phase sampling was not required if the Parties did not wish to potentially remove the deed restrictions at the time (DEQ 2021b).
- *Upland LNAPL Hot Spot Remedy Effectiveness Monitoring Interim Data Summary (2021)* In 2021, Arcadis submitted the Upland LNAPL Hot Spot Remedy Effectiveness Monitoring Interim Data Summary. In the summary, Arcadis evaluated results of the remedy effectiveness monitoring conducted between February and September 2021 using the approach defined in the LNAPL Report (Arcadis 2014). Following removal of the absorbent sock from MW-12, LNAPL thicknesses recovered at a rate consistent with that measured during pilot testing (approximately 0.03 foot per day; Arcadis 2014) for one month, after which the recovery rate slowed (0.02 then to 0.01 foot per day), but did not achieve a steady state. Arcadis recommended extending remedy effectiveness monitoring through December 2021 to allow for 12 months of gauging to determine if a stable steady state LNAPL thickness in MW-12 would be achieved during that time period (Arcadis 2021). The DEQ verbally approved the proposed monitoring period extension in May 2021.
- The remedy effectiveness monitoring period was extended once more through December 2022. LNAPL continued to accumulate in MW-12 throughout the extended remedy effectiveness monitoring period at an average rate of 0.01 foot per day, reaching a thickness of 7.23 feet on September 13, 2022. Groundwater elevations within the well appear to fluctuate seasonally. Greater LNAPL thicknesses correlate with lower groundwater elevations indicating an intersection with residual LNAPL within the formation being allowed to accumulate within MW-12.. Steady state conditions were not achieved during this extended monitoring period as the LNAPL continues to accumulate within this well regardless of groundwater influence indicating that the MW-12 well is functioning as a high-conductivity collection point for LNAPL. On October 13, 2022,
- Arcadis requested and received DEQ approval to resume removal of LNAPL from MW-11 and MW-12 (DEQ 2022).

3 Investigation Activities

The Work Plan proposed to collect additional data to further evaluate the LNAPL in MW-12 to support continued discussion of the Hot Spot determination according to the adaptive management approach established in the

LNAPL Report and included: Additional evaluation of LNAPL plume stability; evaluation of the rate of NSZD, and; assessing whether dissolved-phase constituents associated with LNAPL are present in groundwater and, if present, screen detected concentrations against DEQ's current human health RBCs and ecological SLVs. (Arcadis 2022).

Arcadis completed investigation activities in general accordance with the Work Plan (Arcadis 2023). This section describes the activities completed, including:

- Measurement of natural source zone depletion (NSZD) parameters at monitoring well MW-12,
- LNAPL transmissivity testing at MW-12,
- Collection of representative LNAPL samples from MW-12 for fluid properties analysis (interfacial tension, viscosity, density) and geochemical analyses, and;
- Collection of representative groundwater samples from monitoring well MW-15.

3.1 Natural Source Zone Depletion Assessment

On May 30, 2023, Arcadis conducted soil gas screening at monitoring well MW-12 to qualitatively evaluate if NSZD is occurring. Prior to conducting soil gas screening, a vapor-tight fitting with a 0.25-inch-diameter valve and sample port was installed on the well casing of MW-12. A volume of one well casing (7,007.75 milliliters) of air was purged from MW-12 to stabilize screening parameters. Concentrations of volatile organic compound (VOCs) and fixed gases (methane, carbon dioxide, and oxygen) were measured and recorded using a calibrated photo ionization detector (PID) with a 10.6 electronvolt lamp for VOCs and a calibrated Landtec Gem5000 landfill gas meter for fixed gases. Field notes documenting the soil gas screening activities are provided in Appendix A.

3.2 Light Nonaqueous Phase Liquid Transmissivity Testing

In preparation for implementation of LNAPL transmissivity testing, routine LNAPL removal was not conducted at MW-12 between March 23, 2023 and May 29, 2023. On May 30, 2023 during approximate low tide conditions, Arcadis gauged monitoring well MW-12 and measured 3.03 feet of LNAPL, and a depth to water of 13.65 feet.

LNAPL baildown activities were initiated using a disposable bailer, in accordance with the Technical Guidance Instruction (TGI) for LNAPL Baildown Testing (Appendix B) and consistent with the Standard Guide for Estimation of LNAPL Transmissivity, E2856-13 (ASTM 2021). The LNAPL baildown tests were initiated by removing accumulated LNAPL from MW-12 to a zero thickness as quickly as possible; approximately 0.38 gallon of LNAPL was recovered from MW-12. This volume was less than the estimated total volume present in the well and filter pack (1.79 gallons) prior to initiating the test, indicating that LNAPL was not readily flowing into the well during purging. Immediately following removal, LNAPL and groundwater elevation gauging was initiated, and consisted of gauging the depth to water and depth to LNAPL at the following frequency:

- First 10 minutes: every minute
- 10-20 minutes: every 2 minutes
- 20-40 minutes: every 5 minutes
- 40-90 minutes: every 10-15 minutes

LNAPL thickness had reached 0.42 feet approximately 81 minutes into the test, after which no additional recharge to the well was measured. Gauging was terminated 135 minutes into the test. Initial recharge observed

immediately following purging was likely attributable to filter-pack drainage. These observations are consistent with historical recovery and gauging activities, which indicated that LNAPL has previously taken months to years to return to equilibrium or near-equilibrium accumulations.

Field notes documenting the LNAPL transmissivity test activities are provided in Appendix A. LNAPL baildown test logs are provided in Appendix C.

3.3 Light Nonaqueous Phase Liquid Characterization

Arcadis collected LNAPL samples from the LNAPL that was recovered from MW-12 during transmissivity testing activities on May 30, 2023. LNAPL samples were collected and submitted for fluid properties testing to evaluate whether the physical properties of LNAPL at MW-12 are consistent with previous characterization, and petroleum hydrocarbon geochemical testing to evaluate the chemical compounds present and potential soluble fraction of LNAPL currently accumulating in monitoring well MW-12.

Samples for fluid properties testing were collected in laboratory-provided bottles and placed in a cooler with ice. LNAPL samples were submitted to Pace Analytical, located in Mt. Juliet, Tennessee, an Oregon-accredited laboratory, under standard chain-of-custody protocol. LNAPL samples were analyzed for the following:

- LNAPL Density via ASTM International (ASTM) Method D4052.
- LNAPL Viscosity, ASTM Method D445.
- Interfacial Tension, ASTM Method D971.

Samples for petroleum hydrocarbon testing were collected in pre-preserved, laboratory-provided bottles and placed in a cooler with ice. LNAPL samples were submitted to Alpha Analytical, located in Mansfield, Massachusetts, an Oregon-accredited laboratory, under standard chain-of-custody protocol. LNAPL samples were analyzed for the following:

- VOCs via United States Environmental Protection Agency (USEPA) Method 8260.
- Polycyclic aromatic hydrocarbon (PAHs) via USEPA Method 8270.
- Whole Oil Fingerprint (C3-C44) via modified USEPA Method 8015D.

The laboratory analytical reports and chain-of-custody for the groundwater and LNAPL samples are provided in Appendix D.

3.4 Groundwater Monitoring Activities

On May 31, 2023, Arcadis completed groundwater monitoring activities (groundwater gauging and sampling) at monitoring well MW-15.

The groundwater sample was collected following standard low-flow purge methodology using a peristaltic pump. Field parameters including pH, temperature, electrical conductivity, turbidity, dissolved oxygen, and oxidation-reduction potential were collected during the purging process with a calibrated multiparameter water quality meter and a flow through cell. Field parameters were stabilized in accordance with Arcadis standard operating procedures prior to collecting samples. Groundwater monitoring field data sheets are provided in Appendix E.

The depth to water in MW-15 was measured at 10.30 feet below top of casing (btoc) (17.06 feet above North American Vertical Datum of 1988 [NAVD 88]) prior to beginning the low-flow purge.

Following stabilization, groundwater samples were collected in pre-preserved laboratory-provided bottles placed in a cooler with ice. Groundwater samples were submitted to Pace Analytical for the following:

- VOCs via USEPA 8260
- TPH-GRO via NWTPH-Gx
- TPH-DRO and TPH-HRO (with and without silica gel cleanup) via NWTPH-dx
- PAHs via USEPA Method 8270E
- General Chemistry parameters:
    - Ammonia (as Nitrogen) USEPA Method 350.1
    - Nitrate USEPA Method 353.3
    - Sulfate via UJSEOA Method 300.1
    - Total Organic Carbon (TOC) by USEPA Method 415.2
    - Total Suspended Solids by USEPA method 160.2
    - Hardness via USEPA Method 130.2

The laboratory analytical report and chain-of-custody documentation for the groundwater samples are provided in Appendix F.

3.5 Investigation-Derived Waste

LNAPL and purge water generated from related activities were contained in a U.S. Department of Transportation approved 55-gallon steel drum and disposed of at the Waste Management facility in Arlington, OR. The waste manifest is provided in Appendix G.

4 Results and Interpretations

The following sections present the results and analysis of data from the field activities discussed in Section 3.

4.1 Natural Source Zone Depletion Results

Results of soil gas monitoring conducted on May 30, 2023 are summarized in Inset Table 4-1.

Table 4-1. NSZD Field Parameter Measurements

Location	Methane (ppm)	Carbon Dioxide (volume percent)	Oxygen (volume percent)	VOCs (ppm)
Ambient Air[1]	1.7	0.035	20.9	--
MW-12	2,000	4.2	13.2	48.8
Implication of Well Condition Finding	Elevated methane indicates anerobic biodegradation in the LNAPL source zone is occurring.	Elevated carbon dioxide in the source zone indicates methane is being degraded via aerobic processes in the vadose zone.	Depleted oxygen confirms the carbon dioxide observed is the result of aerobic biodegradation which uses subsurface oxygen.	Presence of VOCs indicate a phase change is occurring within the LNAPL to a readily degradable state.

Notes:
ppm = part per million
-- = not available
[1] 2023. National Oceanic Atmospheric Administration. The Atmosphere. Accessed at: https://www.noaa.gov/jetstream/atmosphere. July 28.

The soil-gas monitoring results demonstrate that LNAPL-related impacts are present in the well, diffusive and advective soil gas transport processes are occurring, and soil-gas conditions are consistent with the occurrence of NSZD in the saturated and vadose zones. The presence of VOCs at 48.8 parts per million (ppm) in the soil-gas are an indication that LNAPL is present in the subsurface and phase change (volatilization) within the LNAPL mass is occurring. Volatilization transfers the LNAPL mass to the vapor phase where rapid biodegradation can occur. Additionally, the presence of VOCs and the depleted oxygen content (measured at 13.2% by volume, versus the 20.9% found in ambient atmospheric conditions) support the occurrence of diffusive and advective transport of soil-gas. Specifically, VOCs move from areas of high concentration to areas of lower concentration (in this case toward the ground surface), and atmospheric oxygen, used for aerobic biodegradation, moves from the ground surface to the LNAPL smear zone where biodegradation is occurring. Methane concentrations measured at 2,000 ppm in the soil-gas are well above typical ambient air conditions (1.7 ppm), and are generated by methanogenic degradation of LNAPL in the saturated and vadose zones. Then, bio-oxidation of methane depletes oxygen in the vadose zone, which was measured at 13.2% by volume in soil-gas as opposed to 20.9% in ambient air. This bio-oxidation process produces carbon dioxide that accumulates in the vadose zone and then transmitted to the ground surface by diffusive and advective flux. Additionally, carbon dioxide produced as mentioned above through aerobic hydrocarbon degradation and also as an end product of methanogenesis and aerobic methane oxidation, was observed at concentrations well above normal atmospheric concentrations (4.2% by volume as compared to 0.035% by volume in ambient air).

These results suggest NSZD is likely occurring at MW-12 through a combination of biodegradation in the saturated zone, and volatilization and biodegradation in the unsaturated zone. At locations where NSZD is not occurring, increased concentrations of methane, carbon dioxide, and depleted concentrations of oxygen would not be observed, and soil-gas composition would closely resemble ambient air conditions. Given the likely occurrence of NSZD, LNAPL and dissolved-phase COCs are likely to continue to degrade, and LNAPL will likely

become less mobile and less recoverable as the LNAPL saturation is reduced through time, given the existing conditions at MW-12.

4.2 Light Nonaqueous Phase Liquid Transmissivity Results

Results of LNAPL baildown testing at MW-12 were used to update the ongoing evaluation of LNAPL recoverability at the well. The analysis of the LNAPL baildown test data at MW-12 was initially planned to be completed using the American Petroleum Institute's (API) API LNAPL Transmissivity Workbook: A Tool for Baildown Test Analysis, User Guide (API Workbook; API 2016). However, because of the slow recharge rates observed in response to LNAPL removal from the well, and the resultant long timeframe required for LNAPL to recharge to a near-equilibrium condition following removal, the LNAPL baildown testing at MW-12 did not run until near-equilibrium conditions were achieved. Because of this condition, an alternate analysis approach was used. This approach, based on ASTM guidance for calculating LNAPL transmissivity from LNAPL skimming system data, can be used to calculate LNAPL transmissivity using data showing LNAPL recharge in response to an induced gradient (e.g., bailing), and is not dependent on later-time, near-equilibrium recharge data .

Analysis of the LNAPL recoverability test data was completed using Equation 16 from the ASTM guidance for estimation of LNAPL transmissivity (ASTM, 2013), which is a modified form of the commonly-used Thiem equation. Equation 16 is as follows:

$$T_n = Q_n \cdot \frac{\ln\left(R_{OI} / r_w\right)}{2 \cdot \pi \cdot s_n}$$

Where:

T_n = transmissivity, square feet per day (ft^2/day)

Q_n = measured LNAPL recovery rate, cubic feet per day ($feet^3$/day)

R_{OI} = radius of influence, feet

r_w = well radius, feet

s_n = LNAPL drawdown, feet

The radius of influence term "ln (R_{OI}/r_w)" was assumed to be 4.6 per ASTM guidance (ASTM, 2013). The completed Workbook for LNAPL is provided in Appendix C. The LNAPL drawdown induced over the test period was conservatively assumed to be 0.079 feet, calculated using equation 17 in ASTM E-2856 based on initial pre-test thickness (3.03 feet) and LNAPL density (0.97 grams per milliliter [g/mL]). This drawdown value should be considered an approximation but is likely to be similar to or smaller than the actual drawdown that would be calculated if the final LNAPL equilibrium recovery depth (in feet) was known. If LNAPL drawdown is underestimated, calculations would over-estimate LNAPL transmissivity and provide a conservative (high) bias in LNAPL transmissivity calculations.

The calculated LNAPL transmissivity at MW-12 is 0.09 ft2/day. This transmissivity value is consistent with previously calculated values of 0.01 to 0.04 ft^2/day for LNAPL in MW-12 (Arcadis 2014). These results are below the lower-bound of the range of values that the ITRC lists as typical endpoints for practical hydraulic LNAPL recovery (0.1 to 0.8 ft^2/day), below which LNAPL recovery via conventional hydraulic methods yields negligible

LNAPL mass reduction (ITRC 2009). Further, these calculated values support existing recovery and gauging data sets which indicate LNAPL recoverability is limited and LNAPL recharge to the well is very slow. As evidenced by previous efforts, LNAPL accumulation in the well can be controlled at near-zero thicknesses through installation and replacement of absorbent socks which represent an annual recovery rate of less than five gallons. For context, applicable literature (Lundegard and Johnson 2006; Sihota et al. 2011) and Arcadis' experience suggest that the magnitude of petroleum hydrocarbon LNAPL losses through NSZD, which were identified as part of this investigation effort, typically occur at a rate in the range of hundreds to thousands of gallons per acre per year.

Despite the very low transmissivity of LNAPL in MW-12, accumulation of LNAPL at thicknesses of over 7 feet was observed when the LNAPL was allowed to recover without removal for over approximately 18 months (Arcadis 2022). These observations suggest that although the LNAPL is not outwardly mobile, and has very low transmissivity, thicknesses of at least seven feet of LNAPL are likely to accumulate at MW-12 under stable steady-state conditions. Consistent with conditions estimated to occur at a critical LNAPL Thickness of 28 feet (Arcadis 2014), even when over 7 feet of LNAPL was observed in MW-12, there was no evidence of LNAPL migration to MW-15 or along the banks of the Columbia River (Arcadis 2021). These results are consistent with the findings of the RI (MFA 2008) and the LNAPL Pilot Test (Arcadis 2014).

4.3 Light Nonaqueous Phase Liquid Physical Properties Results

Results of laboratory analysis of LNAPL collected on May 30, 2023, are in Appendix D and tabulated in Inset Table 4-2, below, along with corollary results from similar testing in 2014 (Arcadis 2014).

Table 4-2. LNAPL Physical Properties Results 2014 and 2023

Date	LNAPL Density (g/cm^3)	LNAPL Viscosity[1] (cSt)	LNAPL Interfacial Tension (dynes/cm)
May 7, 2014	0.968	660	32.6
May 30, 2023	0.968	419.8	30.1

Notes:
[1] LNAPL viscosity was measured at 90 °F during 2014 analysis (Arcadis 2014) and 104 °F during 2023 analysis.
g/cm^3 = gram per cubic centimeter
cSt = centistokes
dynes/cm = dynes per centimeter

The 2023 LNAPL density, LNAPL viscosity, and LNAPL interfacial tension results have not changed significantly from the values measured in 2014.

4.4 Light Nonaqueous Phase Liquid and Groundwater Analytical Results

As proposed in the LNAPL Work Plan, a LNAPL sample was collected from MW-12 on May 30, 2023, and a groundwater sample was collected from MW-15 on May 31, 2023. Results of laboratory analysis of LNAPL collected from MW-12 are presented in Appendix D and summarized in Table 5 and 6. Results of groundwater

collected from MW-15 are presented in Appendix F and summarized in Tables 1 through 4.

Consistent with historical results, LNAPL from MW-12 contains high concentrations of VOCs including naphthalene, ethylbenzene, and xylenes. Semi-volatile organic compounds (SVOC) results were also high with significant concentrations of polycyclic aromatic hydrocarbons (PAHs). Compositions of VOCs and SVOCs are generally consistent with expected concentrations.

Groundwater analytical results from samples collected at MW-15 were compared to the following values:

- Risk-based concentrations (RBCs) for construction and excavation workers exposed to groundwater in an open excavation, which are provided in Appendix A to the DEQ document titled “Risk-Based Decision Making for the Remediation of Petroleum-Contaminated Sites” (DEQ 2003; RBC tables, updated 2018)

- Screening level values (SLVs) for Screening Ecological Risk Assessment for aquatic receptors in fresh surface water, which are provided in Table 2 of the DEQ document titled “Conducting Ecological Risk Assessment” (DEQ 2020)

Groundwater concentrations detected in samples collected from MW-15 did not exceed the applicable RBCs or SLVs. Gauging results suggest MW-15 is approximately 13 feet hydraulically cross-gradient with MW-12 and may be downgradient of LNAPL in the vicinity of MW-12. Characterization of groundwater from MW-15 indicates that dissolved phase COCs potentially migrating from LNAPL near MW-12 upgradient of MW-15 are not present at concentrations that exceed human health RBCs and ecological SLVs.

5 Conclusions and Recommendations

The investigation activities completed at the site are summarized below:

- Qualitative NSZD screening results demonstrate that ongoing degradation processes in the subsurface are occurring in the saturated and vadose zones near MW-12. LNAPL and dissolved-phase COCs will continue to degrade, and LNAPL will likely become less mobile and less recoverable as the LNAPL saturation is reduced through time via NSZD processes.
- LNAPL recoverability testing results indicate that the LNAPL transmissivity at MW-12 is consistent with previously calculated results at MW-12 (Arcadis 2014) and below the lower-bound of the range of values that the ITRC lists as typical endpoints for practical hydraulic LNAPL recovery (0.1 to 0.8 ft^2/day). These results support historical recovery efforts and gauging data which indicate that recovery volumes are limited and LNAPL recharge to the well takes weeks to months to occur.
- LNAPL physical properties support LNAPL stability for the mass present at MW-12, and that the potential for migration outside of the known footprint is limited.
- Groundwater analytical results from MW-15 do not exceed any applicable RBC or SLV indicating that LNAPL is not creating a dissolved-phase risk to human health or the environment adjacent to the Columbia River.

Based on the results of this assessment, the previous interpretations presented for the site are further validated and support the conclusion that LNAPL in monitoring well MW-12 is stable and that no further action is necessary. In recognition of the LNAPL accumulation within MW-12, ongoing annual LNAPL removal events will be conducted at the site. Upland Cap Inspection and Maintenance Reports will continue to be submitted on an annual basis and will include summaries of LNAPL removal activities, monitoring well gauging and shoreline

inspection observations. Due to this annual approach to ongoing field activities and reporting, the submission of semi-annual progress reports will be discontinued after the Second Semi-Annual 2023 Progress Report for the site. Pending DEQ's agreement on the annual field event schedule and reporting, the Parties will update section 3.3 of the Upland Cap Operation, Monitoring, and Maintenance Plan for the site to include the removal of accumulated LNAPL in MW-12 on an annual basis in coordination with upland and in-water cap inspections (Arcadis 2019b).

6 References

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Tables

Table 1
Groundwater Gauging and Analytical Results - Primary VOCs
Former Unocal/PacifiCorp Site
256 Marine Drive, Astoria, Oregon

Well ID	Date	TOC	DTW	LNAPL	GWE	TPH-GRO	TPH-DRO	TPH-DRO w/ SGC	TPH-HRO	TPH-HRO w/ SGC	Benzene	Toluene	Ethylbenzene	Total Xylenes	MTBE	EDB	EDC
Generic RBCs: Groundwater in Excavation			**Construction and Excavation Worker**			**14,000**	**>S**	**>S**	**>S**	**>S**	**1,800**	**220,000**	**4,500**	**23,000**	**63,000**	**27**	**630**
SLVs: Aquatic Receptors in Fresh Surface Water			**Aquatic Receptors**			**440**	**640**	**640**	**--**	**--**	**160**	**62**	**61**	**27**	**730**	**--**	**2,000**
MW-15	5/31/2023	12.00	10.30	--	1.70	<100	50.2 J	<110	<275	<275	<1.00	<1.00	<1.00	<3.00	<1.00	<1.00	<1.00

Notes:

1. Analytical results presented in micrograms per liter (µg/L).
2. **BOLD** and highlighted concentrations are greater than their respective RBC or SLV.
3. **BOLD** values are nondetect, less than the laboratory reprting detection limit (RL), but the RL is greater than the DEQ RBC or SLV.
4. RBCs are based on values presented in Appendix A of the Oregon DEQ's Risk-Based Decision Making for the Remediation of Petroleum-Contaminated Sites dated September 22, 2003 (updated May 2018 and June 2023).
5. SLVs are based on values presented in Table 2 of the DEQ document title "Conducting Ecological Risk Assessment" (September 2020).

Acronyms and Abbreviations:

-- = not applicable/not established
< = not detected at or greater than the laboratory reporting limit
> S = The groundwater RBC exceeds the solubility limit. Groundwater concentrations in excess of S indicate that free product may be present.
DEQ = Department of Environmental Quality
DTW = depth to water, in feet below TOC
GWE = groundwater elevation, in feet relative to arbitrary benchmark
LNAPL = light nonaqueous phase liquid, thickness in feet
RBCs = Risk-Based Concentrations
SGC = Silica-Gel Cleanup
SLVs = Screening Levels
TOC = top of casing, in feet relative to arbitrary benchmarks
TPH = total petroleum hydrocarbons
USEPA = United States Environmental Protection Agency

Qualifiers:

J = The identification of the analyte is acceptable; the reported value is an estimate.

Current Analytical Methods:

Samples analyzed by Method NWTPH-Gx:
TPH-GRO = total petroleum hydrocarbons as gasoline-range organics
Samples analyzed by NWTPH-Dx:
TPH-DRO = total petroleum hydrocarbons as diesel-range organics
TPH-HRO = total petroleum hydrocarbons as heavy-oil-range organics
Samples analyzed by USEPA Method 8260:
Benzene, toluene, ethylbenzene, and total xylenes
MTBE = methyl tertiary butyl ether
EDC = 1,2-dicholoroethane
Samples analyzed by USEPA Method 8011:
EDB = ethylene dibromide

Table 2
Groundwater Gauging and Analytical Results - Full Suite VOCs
Former Unocal/PacifiCorp Site
256 Marine Drive, Astoria, Oregon

ARCADIS

Well ID	Generic RBCs: Groundwater in Excavation	SLVs: Aquatic Receptors in Fresh Surface Water	MW-15
Date	Construction and Excavation Worker	Aquatic Receptors	5/31/2023
Acetone	--	1700	<50.0
Acrolein	--	3	**<50.0 C3**
Acrylonitrile	250	78	<10
Benzene	1800	160	<1.00
Bromobenzene	--	--	<1.00
Bromodichloromethane	--	--	<1.00
Bromoform	14000	230	<1.00
Bromomethane	1200	16	<5.00
n-Butylbenzene	--	--	<1.00
sec-Butylbenzene	--	--	<1.00
tert-Butylbenzene	--	--	<1.00
Carbon tetrachloride	1800	77	<1.00
Chlorobenzene	10000	25	<1.00
Chlorodibromomethane	610	320	<1.00
Chloroethane	2400000	--	<5.00
Chloroform	720	140	<2.50
Chloromethane	22000	--	<1.00
2-Chlorotoluene	--	--	<1.00
4-Chlorotoluene	--	--	<1.00
1,2-Dibromo-3-Chloropropane	--	--	<5.00
1,2-Dibromoethane	27	--	<1.00
Dibromomethane	--	--	<1.00
1,2-Dichlorobenzene	37000	23	<1.00
1,3-Dichlorobenzene	--	22	<1.00
1,4-Dichlorobenzene	1500	9.4	<1.00
Dichlorodifluoromethane	--	--	<5.00
1,1-Dichloroethane	10000	410	<1.00
1,2-Dichloroethane	630	2000	<1.00
1,1-Dichloroethene	44000	130	<1.00
cis-1,2-Dichloroethene	18000	--	<1.00
trans-1,2-Dichloroethene	180000	--	<1.00
1,2-Dichloropropane	--	520	<1.00
1,1-Dichloropropene	--	--	<1.00
1,3-Dichloropropane	--	1.7	<1.00
cis-1,3-Dichloropropene	--	1.7	<1.00
trans-1,3-Dichloropropene	--	1.7	<1.00
2,2-Dichloropropane	--	--	<1.00
Di-isopropyl ether	--	--	<1.00
Ethylbenzene	4500	61	<1.00
Hexachloro-1,3-butadiene	--	--	<1.00
Isopropylbenzene	51000	4.8	<1.00
p-Isopropyltoluene	--	--	<1.00
2-Butanone (MEK)	--	22000	<10.0
Methylene Chloride	--	1500	<5.00
4-Methyl-2-pentanone (MIBK)	--	170	<10.0
MTBE	63000	730	<1.00
Naphthalene	500	21	<5.00
n-Propylbenzene	--	--	<1.00
Styrene	170000	32	<1.00
1,1,1,2-Tetrachloroethane	--	85	<1.00
1,1,2,2-Tetrachloroethane	--	200	<1.00
1,1,2-Trichlorotrifluoroethane	--	--	<1.00
Tetrachloroethene	5600	--	<1.00
Toluene	220000	62	<1.00

Table 2
Groundwater Gauging and Analytical Results - Full Suite VOCs
Former Unocal/PacifiCorp Site
256 Marine Drive, Astoria, Oregon

Well ID	Generic RBCs: Groundwater in Excavation	SLVs: Aquatic Receptors in Fresh Surface Water	MW-15
Date	Construction and Excavation Worker	Aquatic Receptors	5/31/2023
1,2,3-Trichlorobenzene	--	8	<1.00
1,2,4-Trichlorobenzene	--	130	<1.00
1,1,1-Trichloroethane	1100000	76	<1.00
1,1,2-Trichloroethane	49	730	<1.00
Trichloroethene	430	220	<1.00
Trichlorofluoromethane	160000	--	<5.00
1,2,3-Trichloropropane	--	--	<2.50
1,2,4-Trimethylbenzene	6300	15	<1.00
1,2,3-Trimethylbenzene	--	--	<1.00
1,3,5-Trimethylbenzene	7500	26	<1.00
Vinyl chloride	960	930	<1.00
Total Xylenes	23000	27	<3.00
TPH-GRO	14000	440	<100
TPH-DRO	>S	640	50.2 J
TPH-DRO w/ SGC	>S	--	<110
TPH-HRO	>S	640	<275
TPH-HRO w/ SGC	>S	--	<275

Notes:

1. Analytical results presented in micrograms per liter (µg/L).
2. **BOLD** and highlighted concentrations are greater than their respective RBC or SLV.
3. **BOLD** values are nondetect, less than the laboratory reprting detection limit (RL), but the RL is greater than the DEQ RBC or SLV.
4. RBCs are based on values presented in Appendix A of the Oregon DEQ's Risk-Based Decision Making for the Remediation of Petroleum-Contaminated Sites dated September 22, 2003 (updated May 2018 and June 2023).
5. SLVs are based on values presented in Table 2 of the DEQ document title "Conducting Ecological Risk Assessment" (September 2020).

Acronyms and Abbreviations:

-- = not applicable/not established
< = not detected at or greater than the laboratory reporting limit
> S = The groundwater RBC exceeds the solubility limit. Groundwater concentrations in excess of S indicate that free product may be present.
DEQ = Department of Environmental Quality
DTW = depth to water, in feet below TOC
GWE = groundwater elevation, in feet relative to arbitrary benchmark
LNAPL = light nonaqueous phase liquid, thickness in feet
RBCs = Risk-Based Concentrations
SGC = silica gel celanup
SLV = Screening Level
TOC = top of casing, in feet relative to arbitrary benchmarks
TPH = total petroleum hydrocarbons
USEPA = United States Environmental Protection Agency

Qualifiers:

C3 = The reported concentration is an estimate. The continuing calibration standard associated with this data responded low. Method sensitivity check is acceptable

Current Analytical Methods:

Samples analyzed by Method NWTPH-Gx:
TPH-GRO = total petroleum hydrocarbons as gasoline-range organics
Samples analyzed by NWTPH-Dx:
TPH-DRO = total petroleum hydrocarbons as diesel-range organics
TPH-HRO = total petroleum hydrocarbons as heavy-oil-range organics
Samples analyzed by NWTPH-Dx w/ SGC:
TPH-DRO = total petroleum hydrocarbons as diesel-range organics
TPH-HRO = total petroleum hydrocarbons as heavy-oil-range organics
Samples analyzed by USEPA Method 8260:
Volatile organic compounds

Table 3
Select Groundwater Analytical Results - sVOCs
Former Unocal/PacifiCorp Site
256 Marine Drive, Astoria, Oregon

ARCADIS

Well ID	Date	Anthracene	Acenaphthene	Acenaphthylene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Phenanthrene	Pyrene	1-Methylnaphthalene	2-Methylnaphthalene	2-Chloronaphthalene
Generic RBCs: Groundwater in Excavation	**Construction and Excavation Worker**	**>S**	**>S**	**--**	**>S**	**>S**	**>S**	**--**	**>S**	**>S**	**>S**	**>S**	**>S**	**>S**	**500**	**--**	**>S**	**--**	**--**	**--**
SLVs: Aquatic Receptors in Fresh Surface Water	**Aquatic Receptors**	**0.02**	**15**	**13**	**4.7**	**0.06**	**2.6**	**0.012**	**0.06**	**4.7**	**0.012**	**0.8**	**19**	**0.012**	**21**	**2.3**	**4.6**	**6.1**	**4.7**	**--**
MW-15	5/31/2023	<0.0500	<0.0500	<0.0500	<0.0500	<0.0500	<0.0500	**<0.0500**	<0.0500	<0.0500	**<0.0500**	<0.100	<0.0500	**<0.0500**	<0.250	<0.0500	<0.0500	<0.250	<0.250	<0.250

Notes:

1. Analytical results presented in micrograms per liter (µg/L).
2. **BOLD** and highlighted concentrations are greater than their respective RBC or SLV.
3. **BOLD** values are nondetect, less than the laboratory reprting detection limit (RL), but the RL is greater than the DEQ RBC or SLV.
4. RBCs are based on values presented in Appendix A of the Oregon DEQ's Risk-Based Decision Making for the Remediation of Petroleum-Contaminated Sites dated September 22, 2003 (updated May 2018 and June 2023).
5. SLVs are based on values presented in Table 2 of the DEQ document title "Conducting Ecological Risk Assessment" (September 2020).

Acronyms and Abbreviations:

-- = not applicable/not established
< = not detected at or greater than the laboratory reporting limit
> S = The groundwater RBC exceeds the solubility limit. Groundwater concentrations in excess of S indicate that free product may be present.
DEQ = Department of Environmental Quality
NITI = no inhalation toxicityinformation
NV = this chemical is considered “nonvolatile” for purposes of the exposure calculations. A chemical is defined as nonvolatile if the Henry’s law constant is less than 1 x 10-5 atm/m3-mole and vapor pressure less than one mm mercury
RBCs = Risk-Based Concentrations
SLV = Screening Level
USEPA = United States Environmental Protection Agency

Current Analytical Methods:

Samples analyzed by USEPA Method 8270C:

- Anthracene
- Acenaphthene
- Acenaphthylene
- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(g,h,i)perylene
- Benzol(k)fluoranthene
- Chrysene
- Fluoranthene
- Fluorene
- Indeno(l,2,3-Cd)pyrene
- Naphthalene
- Phenanthrene
- Pyrene
- 1-Methylnaphthalene
- 2-Methylnaphthalene
- 2-Chloronaphthalene

Table 4
Select Groundwater Analytical Results - General Chemistry
Former Unocal/PacifiCorp Site
256 Marine Drive, Astoria, Oregon

Well ID	Date	Hardness as CaCO3	Suspended Solids	Nitrate	Sulfate	mmonia Nitroge	TOC	Calcium	Magnesium
SLVs: Aquatic Receptors in Fresh Surface Water	**Aquatic Receptors**	**--**	**--**	**--**	**--**	**1,900**	**--**	**120,000**	**82,000**
MW-15	5/31/2023	107,000	14,800	4,010 Q	34,000	<117	2,680	29,200	8,270

Notes:

1. Analytical results presented in micrograms per liter (µg/L).
2. **BOLD** and highlighted concentrations are greater than their respective SLV.
3. **BOLD** values are nondetect, less than the laboratory reprting detection limit (RL), but the RL is greater than the DEQ SLV.
4. SLVs are based on values presented in Table 2 of the DEQ document title "Conducting Ecological Risk Assessment" (September 2020).

Acronyms and Abbreviations:

-- = not applicable/not established
< = not detected at or greater than the laboratory reporting limit
DEQ = Department of Environmental Quality
SLV = Screening Level
USEPA = United States Environmental Protection Agency

Qaulifiers:

Q = Sample was prepared and/or analyzed past holding time as defined in the method. Concentrations should be considered minimum values.

Current Analytical Methods:

Samples analyzed by ASTM Method 2540 D-2015
  Suspended Solids
Samples analyzed by USEPA Method 300.0:
  Nitrate
  Sulfate
Samples analyzed by USEPA Method 350.1:
  Ammonia Nitrogen
Samples analyzed by USEPA Method 9060A:
  TOC = total organic carbon
Samples analyzed by USEPA Method 6010D:
  Calcium
  Magnesium

Table 5
LNAPL Analytical Results - Full Suite VOCs
Former Unocal/PacifiCorp Site
256 Marine Drive, Astoria, Oregon

Well ID	MW-12
Sample ID	**MW-12**
Date	5/31/2023
Acetone	<51,000
Acrolein	<2,800
Acrylonitrile	<5,900
Benzene	<850
Bromobenzene	<740
Bromochloromethane	<1,000
Bromodichloromethane	<560
Bromoform	<1,200
Bromomethane	<3,000
n-Butylbenzene	13,000
sec-Butylbenzene	29,000
tert-Butylbenzene	3,300 J
Carbon tetrachloride	<1,200
Chlorobenzene	<650
Chlorodibromomethane	--
Chloroethane	<2,300
Chloroform	<710
Chloromethane	<4,800
2-Chlorotoluene	<970
4-Chlorotoluene	<550
1,2-Dibromo-3-Chloropropane	<5,100
1,2-Dibromoethane	<1,400
Dibromomethane	<1,200
1,2-Dichlorobenzene	<730
1,3-Dichlorobenzene	<760
1,4-Dichlorobenzene	<870
Dichlorodifluoromethane	<4,700
1,1-Dichloroethane	<740
1,2-Dichloroethane	<1,300
1,1-Dichloroethene	<1,200
cis-1,2-Dichloroethene	<890
trans-1,2-Dichloroethene	<700
1,2-Dichloropropane	<640
1,1-Dichloropropene	<810
1,3-Dichloropropane	<850
cis-1,3-Dichloropropene	<810
trans-1,3-Dichloropropene	<1,400
2,2-Dichloropropane	<1,000
Di-isopropyl ether	--
Ethylbenzene	1,300 J
Hexachloro-1,3-butadiene	<860
Isopropylbenzene	9,900
p-Isopropyltoluene	830 J
2-Butanone (MEK)	<11,000
Methylene Chloride	<12,000

Table 5
LNAPL Analytical Results - Full Suite VOCs
Former Unocal/PacifiCorp Site
256 Marine Drive, Astoria, Oregon

Well ID	MW-12
4-Methyl-2-pentanone (MIBK)	<6,500
MTBE	<1,000
Naphthalene	53,000
n-Propylbenzene	2,900 J
Styrene	<1,000
1,1,1,2-Tetrachloroethane	<670
1,1,2,2-Tetrachloroethane	<850
1,1,2-Trichlorotrifluoroethane	--
Tetrachloroethene	<1,000
Toluene	<2,800
1,2,3-Trichlorobenzene	<1,600
1,2,4-Trichlorobenzene	<1,400
1,1,1-Trichloroethane	<850
1,1,2-Trichloroethane	<1,400
Trichloroethene	<700
Trichlorofluoromethane	<3,500
1,2,3-Trichloropropane	<650
1,2,4-Trimethylbenzene	7,400 J
1,2,3-Trimethylbenzene	<1.00
1,3,5-Trimethylbenzene	8,600 J
Vinyl chloride	<1,700
Total Xylenes	2,300 J

Notes:

1. Analytical results presented in micrograms per liter (µg/kg).

Acronyms and Abbreviations:

-- = not applicable/not established
< = not detected at or greater than the laboratory reporting limit
> S = The groundwater RBC exceeds the solubility limit. Groundwater concentrations in excess of S indicate that free product may b
DEQ = Department of Environmental Quality
DTW = depth to water, in feet below TOC
GWE = groundwater elevation, in feet relative to arbitrary benchmark
LNAPL = light nonaqueous phase liquid, thickness in feet
RBCs = Risk-Based Concentrations
SGC = silica gel celanup
TOC = top of casing, in feet relative to arbitrary benchmarks
TPH = total petroleum hydrocarbons
USEPA = United States Environmental Protection Agency

Qualifiers:

C3 = The reported concentration is an estimate. The continuing calibration standard associated with this data responded low. Methoc

Current Analytical Methods:

Samples analyzed by USEPA Method 8260:
Volatile organic compounds

Table 6
LNAPL Analytical Results - sVOCs
Former Unocal/PacifiCorp Site
256 Marine Drive, Astoria, Oregon

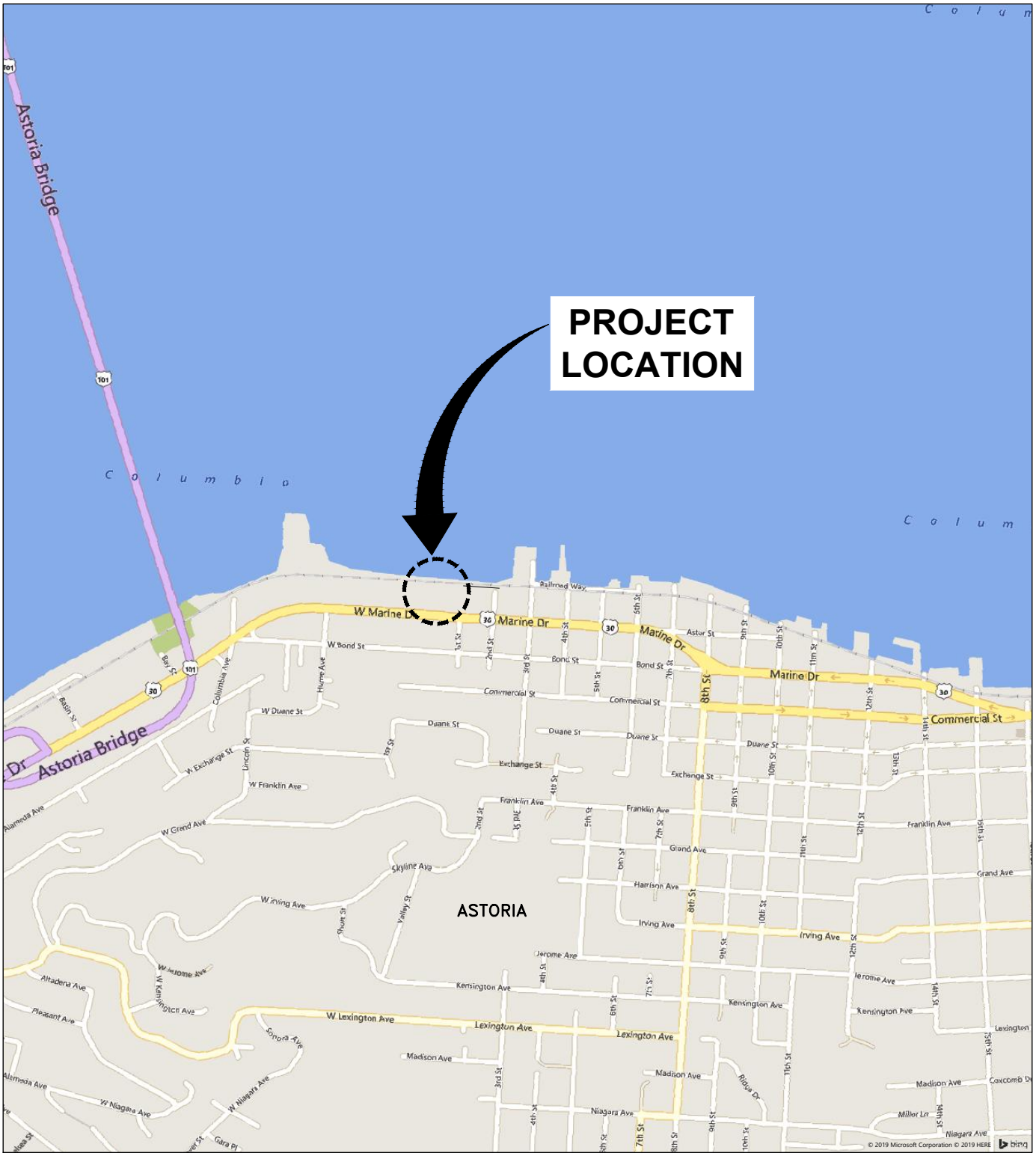
Well ID	Date	Anthracene	Acenaphthene	Acenaphthylene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Phenanthrene	Pyrene	1-Methylnaphthalene	2-Methylnaphthalene	2-Chloronaphthalene
MW-12	5/30/2023	248,000	501,000	37,200	133,000	79,500	51,600	40,500	59,600	107,000	10,400	383,000	450,000	40,400	36,300	630,000	242,000	--	--	--

Notes:
1. Analytical results presented in micrograms per liter (µg/kg).

Acronyms and Abbreviations:
-- = not applicable/not established
< = not detected at or greater than the laboratory reporting limit
USEPA = United States Environmental Protection Agency

Current Analytical Methods:
Samples analyzed by USEPA Method 8270C:
Anthracene
Acenaphthene
Acenaphthylene
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(g,h,i)perylene
Benzol(k)fluoranthene
Chrysene
Fluoranthene
Fluorene
Indeno(l,2,3-Cd)pyrene
Naphthalene
Phenanthrene
Pyrene
1-Methylnaphthalene
2-Methylnaphthalene
2-Chloronaphthalene

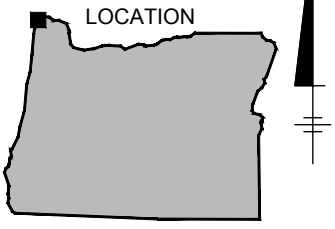
Figures



0 1000' 2000'

Approximate Scale: 1 in. = 1000 ft.

AREA LOCATION



OREGON

FORMER PETROLEUM TERMINAL #0022 AND
MANUFACTURED GAS PLAN (MGP) DEQ ECSI #1646
256 MARINE DRIVE, ASTORIA, OREGON

LNAPL ASSESSMENT REPORT

SITE LOCATION MAP

ARCADIS

FIGURE
1

CITY:SYR-NY DIV/GROUP: ENV/CAD DB: K.SARTORI PIC:/PM:/TM: M. SCHETTLER LYR:(Opt)ON=*;OFF=*REF*
C:\BIM\OneDrive - ARCADIS\BIM 360 Docs\ANA - CHEVRON CORPORATION\PACIFICORP_UNOCAL ASTORIA\2019\PO100006.000201-DWG\PC-0022&1646-Fig 1-Site Loc Map.dwg LAYOUT: 1 SAVED: 5/31/2019 3:18 PM ACADVER: 23.0S (LMS TECH) PAGESETUP: --- PLOTSTYLETABLE:
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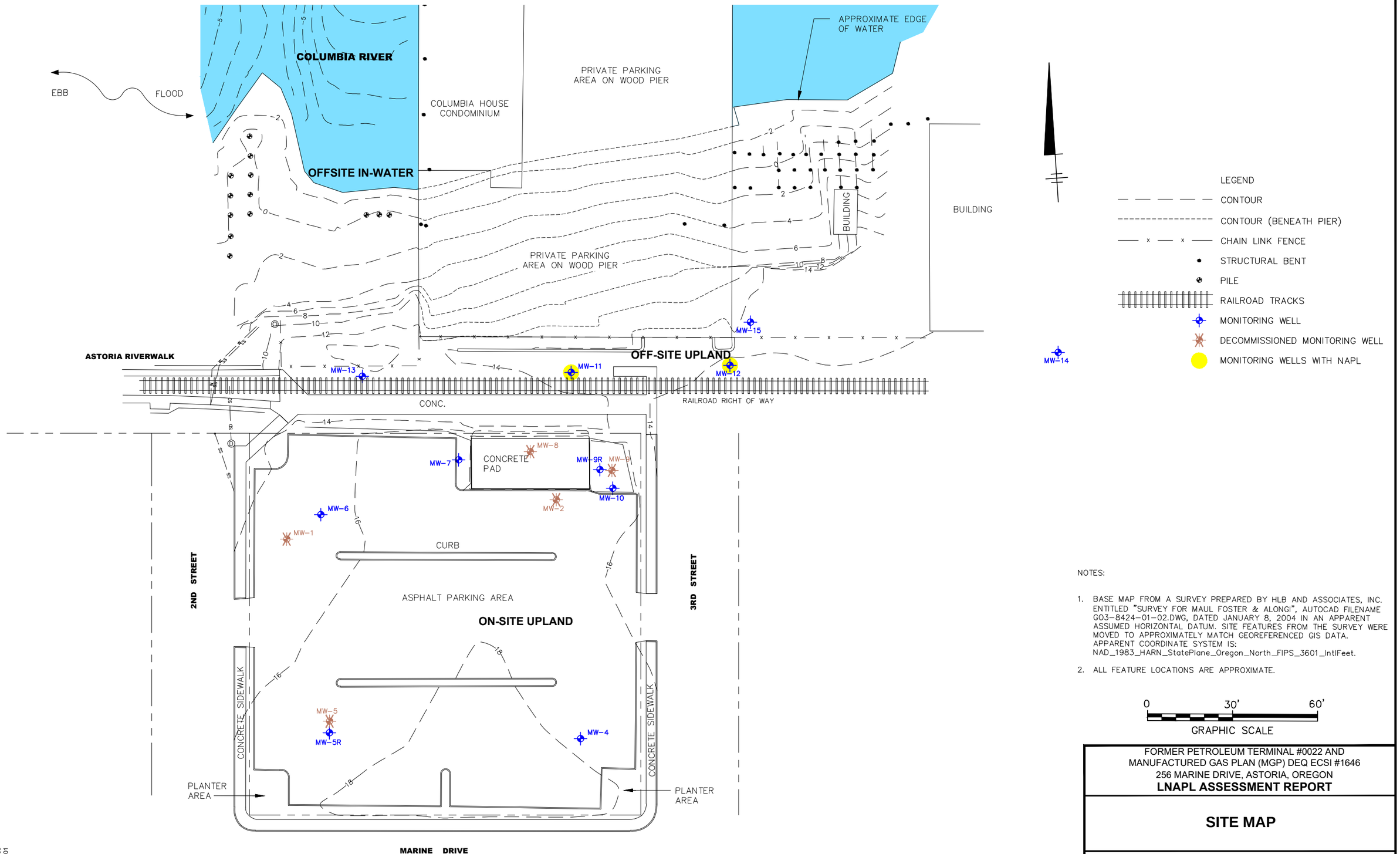
XREFS: IMAGES:
PC-0022&1646-TitleBlock-PAR



NOTES:

1. BASE MAP FROM A SURVEY PREPARED BY HLB AND ASSOCIATES, INC. ENTITLED "SURVEY FOR MAUL FOSTER & ALONGI", AUTOCAD FILENAME GO3-8424-01-02.DWG, DATED JANUARY 8, 2004 IN AN APPARENT ASSUMED HORIZONTAL DATUM. SITE FEATURES FROM THE SURVEY WERE MOVED TO APPROXIMATELY MATCH GEOREFERENCED GIS DATA. APPARENT COORDINATE SYSTEM IS: NAD_1983_HARN_StatePlane_Oregon_North_FIPS_3601_IntlFeet.
2. ALL FEATURE LOCATIONS ARE APPROXIMATE.

0 30' 60'

GRAPHIC SCALE

FORMER PETROLEUM TERMINAL #0022 AND
MANUFACTURED GAS PLAN (MGP) DEQ ECSI #1646
256 MARINE DRIVE, ASTORIA, OREGON

LNAPL ASSESSMENT REPORT

SITE MAP

ARCADIS

FIGURE 2

CITY:SYRACUSE-NY DIV/GROUP:ENVCAD DB:G.STEINBERGER LD:(Opt) PIC: PM:J.STARR TM:G.GUMMADI LYR:(Opt)ON=*;OFF=*REF*
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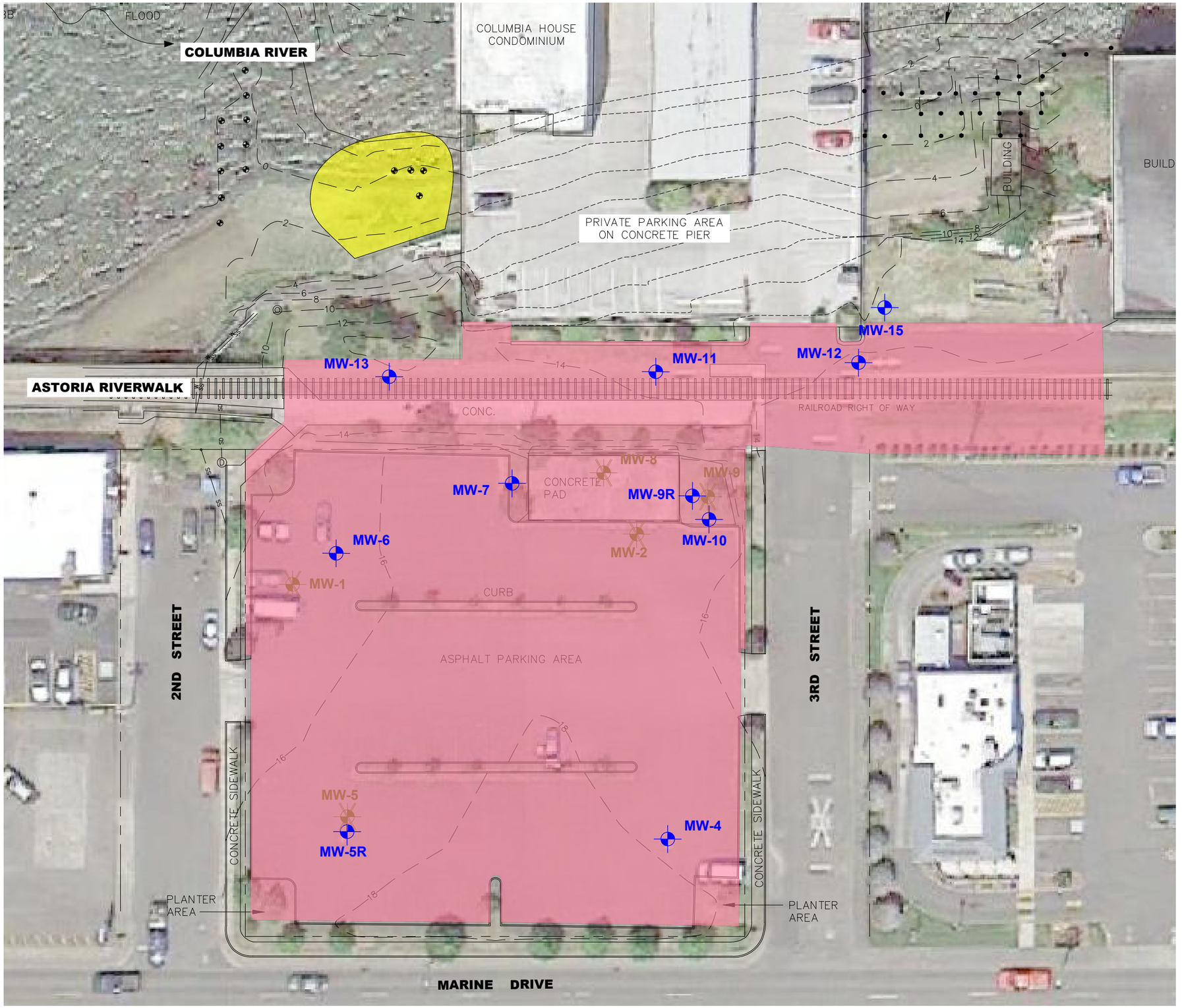
PO100006X01



LEGEND:

- CONTOUR
- CONTOUR (BENEATH PIER)
- PILE
- RAILROAD TRACKS
- MONITORING WELL
- DECOMMISSIONED MONITORING WELL
- UPLAND CAP (COMPLETED NOVEMBER 2018)
- SEDIMENT CAP (COMPLETED AUGUST 2020)

ABBREVIATIONS:

LNAPL = LIGHT NON-AQUEOUS PHASE LIQUID

NOTES:

1. BASE MAP INFORMATION FROM OTAK, INC. DATED 4/24/2014, AT A SCALE OF 1" = 30'.
2. APPARENT HORIZONTAL COORDINATE SYSTEM IS NORTH AMERICAN DATUM OF 1983 (NAD83). APPARENT VERTICAL COORDINATE SYSTEM IS NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).

0 20' 40'

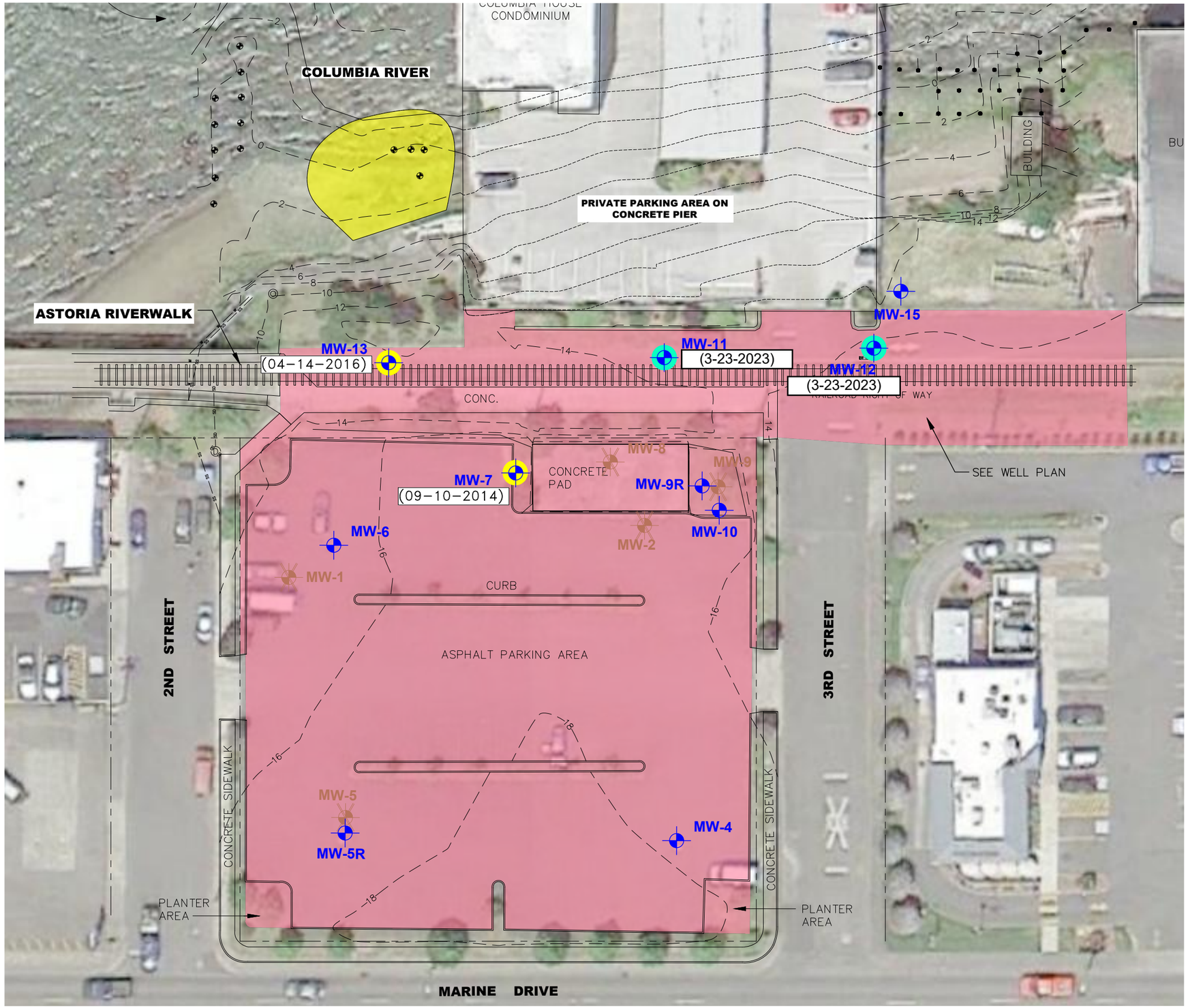
GRAPHIC SCALE

FORMER PETROLEUM TERMINAL #0022 AND
MANUFACTURED GAS PLANT DEQ ECSI #1646
256 MARINE DRIVE, ASTORIA, OREGON
LNAPL ASSESSMENT REPORT

SITE FEATURES AND REMEDIATION FOOTPRINTS

ARCADIS

FIGURE 3



LEGEND:

- CONTOUR
- CONTOUR (BENEATH PIER)
- PILE
- RAILROAD TRACKS
- MONITORING WELL
- DECOMMISSIONED MONITORING WELL
- WELLS WITH HISTORICAL LNAPL PRESENCE
- MONITORING WELL WITH NAPL
- (05-02-2019) DATE OF MOST RECENT LNAPL OBSERVATION
- UPLAND CAP (COMPLETED NOVEMBER 2018)
- SEDIMENT CAP (COMPLETED AUGUST 2020)

ABBREVIATIONS:

LNAPL = LIGHT NON-AQUEOUS PHASE LIQUID

NOTES:

1. BASE MAP INFORMATION FROM OTAK, INC. DATED 4/24/2014, AT A SCALE OF 1" = 30'.
2. APPARENT HORIZONTAL COORDINATE SYSTEM IS NORTH AMERICAN DATUM OF 1983 (NAD83). APPARENT VERTICAL COORDINATE SYSTEM IS NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).

0 20' 40'

GRAPHIC SCALE

FORMER PETROLEUM TERMINAL #0022 AND
MANUFACTURED GAS PLANT DEQ ECSI #1646
256 MARINE DRIVE, ASTORIA, OREGON
LNAPL ASSESSMENT REPORT

LNAPL OBSERVATIONS IN SITE MONITORING WELLS

ARCADIS

FIGURE 4

CITY:SYRACUSE-NY DIV/GROUP:ENVCAD DB:G.STEINBERGER, K.SARTORI PIC: /PM/ / TM: M. SCHETTLER LYR:(Opt)ON=*;OFF=*REF*
C:\BIM\OneDrive - ARCADIS\BIM 360 Docs\ANA - CHEVRON CORPORATION\PACIFICORP_UNOCAL ASTORIA\2019\PO100006.0002\01-DWG\PC-0022&1646-Fig 4-Site Features.dwg LAYOUT: 4 SAVED: 6/11/2019 2:54 PM ACADVER: 23.0S (LMS TECH) PAGESETUP: --- PLOTSTYLETABLE: ---
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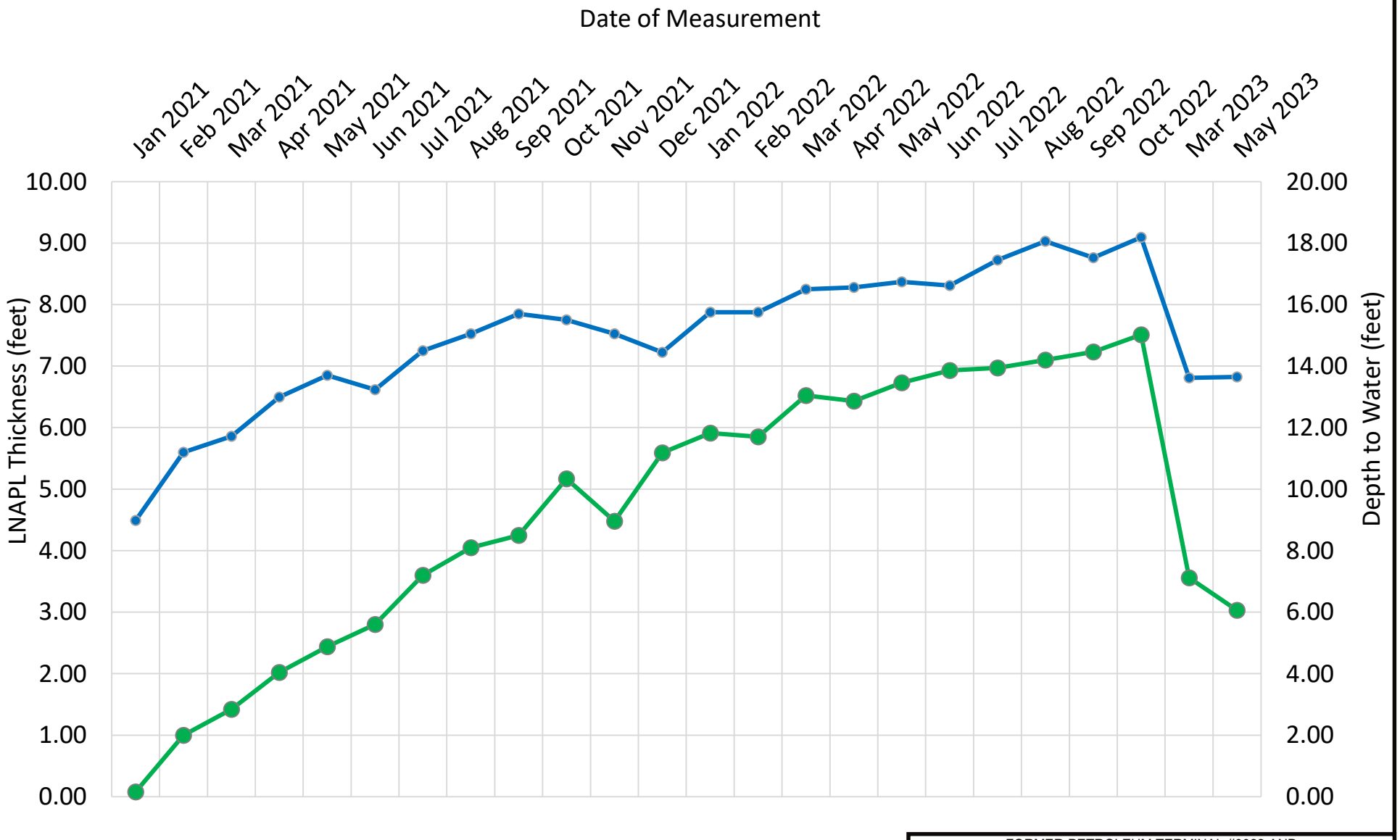


ABBREVIATIONS:

LNAPL = LIGHT NON-AQUEOUS PHASE LIQUID

FORMER PETROLEUM TERMINAL #0022 AND MANUFACTURED GAS PLANT DEQ ECSI #1646
256 MARINE DRIVE, ASTORIA, OREGON
LNAPL ASSESSMENT REPORT

LNAPL ACCUMULATION IN MW-12 DURING REMEDY EFFECTIVENESS MONITORING

ARCADIS

FIGURE
5

Appendix A

Field Notes

5/30/23

purpose: LNAPL sampling & GW sampling

personel: E. Joves & J. Bowers

WX: sunny 50-60's

07:48: staff onsite, don PPE
08:20: Tailgate, site walk
08:40 Start at MW-12 - NASZD testing
08:45: Take DTW + DTP readings
DTP = 10.62 DTW = 13.65
09:00: Take ambient air reading
09:15: Begin purge
10:00: Get cooler from store
10:30: Set up LNAPL baildown at MW-12
11:00: ACT environmental onsite for drum pickup
11:14: ACT offsite
11:28: 4L bailed from MW-12, All product removed
13:00 LNAPL samples taken
14:30 Lock gates, leave site

JB

MW-12
DTP = 10.62
DTW = 13.65

Empty casing = $(\pi(\frac{2.00}{2})^2 \times (DTP \cdot 12)) \times 16.387$
= 700 7.75mL

Ambient Air	MW-12 (post purge)
O_2: 20.9%	O_2: 13.2%
CO_2: 0%	CO_2: 4.2%
CH_4: 0%	CH_4: 0.2%
VOC: 0.0 ppm	VOC: 48.8 ppm

Baildown Test: 4L removed
0 min = 0'
30 min = 0.19'
60 min = 0.34'
90 min = ~~1.98'~~ 0.42

JB

76 5/31/2023

purpose: GW sampling @ MW-12S

personel: E. Joves & J Bowers

Wx: Sunny 60's

0700: Arrive at PDX office
0930: Arrive onsite
1000: sort sample bottles
1030: Begin purging MW-15
1200: Take samples from MW-15
1230: Fill out COCs, take waste samples
1245: Pack coolers for shipping
1305: Drive back to PDX
1500: Drop MW-15 pace samples off to courier
1600: unpack transite
1800: Take Alpha samples to FedEx

JB

LNAPL BAILDOWN TEST LOG

LNAPL Baildown Test Standard Operating Procedures

Site Name: Pacificorp **Test Well ID:** MW-12

Date and Time In: 05/30/2023 08:00 **Date and Time Out:** 05/30/2023 16:40

Personnel: Elijah Joves & Jaelyn Bowers **Weather:** Sunny

Well Construction Details			
Ground Surface Elevation (feet amsl)		Screen Slot Diameter (inches)	
Top of Casing Elevation (feet amsl)		Screen Slot Size (inches)	
Total Well Depth (feet)		Filter Pack Type	
Depth to Top of Screen (feet)		Depth to Bottom of Screen (feet)	
Well Casing Diameter (inches)	2	Borehole Diameter (inches)	

LNAPL Properties			
LNAPL Specific Yield, S_y :		LNAPL Density Ratio, ρ_r :	

Initial Test Conditions			
Static Depth to LNAPL (feet)	10.62	Test Date	5/30/2023
Static Depth to Water (feet)	13.65	Start Time	10:05
LNAPL Thickness (feet)	3.03	Initial LNAPL Volume in Well (gallons)	0.49

LNAPL Removal Information			
LNAPL Removal Method/Equipment	Bailer	Time LNAPL Removal Begins	10:39
Volume of LNAPL Removed (gallons)	0.38	Time LNAPL Removal is Completed	11:29
Volume of Groundwater Removed (gallons)	0.29	Time to Remove LNAPL (minutes)	50

Baildown Test Data

Date	Time	Elapsed Time (minutes)	Depth to LNAPL (feet)	Depth to Water (feet)	LNAPL Thickness (feet)	Observations
5/30/2023	11:30		10.30	10.30	0.00	
5/30/2023	11:32		10.30	10.32	0.02	
5/30/2023	11:33		10.30	10.35	0.05	
5/30/2023	11:35		10.30	10.39	0.09	
5/30/2023	11:36		10.30	10.40	0.10	

5/30/2023	11:38		10.30	10.43	0.13	
5/30/2023	11:40		10.30	10.43	0.13	
5/30/2023	11:42		10.30	10.44	0.14	
5/30/2023	11:44		10.30	10.44	0.14	
5/30/2023	11:46		10.30	10.45	0.15	
5/30/2023	11:48		10.30	10.46	0.16	
5/30/2023	11:50		10.30	10.47	0.17	
5/30/2023	11:55		10.30	10.49	0.19	
5/30/2023	12:00		10.30	10.53	0.23	
5/30/2023	12:05		10.30	10.55	0.25	
5/30/2023	12:10		10.30	10.57	0.27	
5/30/2023	12:15		10.30	10.59	0.29	
5/30/2023	12:20		10.30	10.62	0.32	
5/30/2023	12:25		10.30	10.64	0.34	
5/30/2023	12:30		10.28	10.62	0.34	
5/30/2023	12:40		10.28	10.68	0.40	
5/30/2023	12:50		10.28	10.70	0.42	
5/30/2023	13:00		10.28	10.70	0.42	
5/30/2023	13:15		10.28	10.70	0.42	
5/30/2023	13:30		10.28	10.70	0.42	
5/30/2023	13:45		10.28	10.70	0.42	

Appendix B

Technical Guidance Instruction - LNAPL Baildown Testing

TGI – LNAPL Baildown Testing

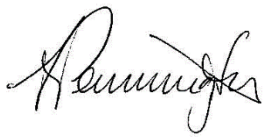
Rev: 5

Rev Date: December 22, 2021

Version Control

Issue	Revision No.	Date Issued	Page No.	Description	Reviewed By
	1			Initiated TGI	
	2			Technical and editorial revisions	
	3			Technical and editorial revisions	
	4	May 26, 2017	All	Updates to procedure and simplification of text	Andy Pennington
	5	December 22, 2021		Updated references and language for digital forms	A. Pennington

Approval Signatures

Prepared by:		12/22/2021
	Colleen O. Barton (Preparer)	Date
Reviewed by:		12/22/2021
	Andy Pennington (Subject Matter Expert)	Date

1 Introduction

This technical guidance instruction (TGI) document discusses uniform procedures for conducting rising-head light non-aqueous phase liquid (LNAPL) baildown tests to evaluate LNAPL transmissivity in the subsurface at a specific well location. The data generated from the LNAPL baildown tests can be used, along with other site data, to evaluate LNAPL mobility and recoverability at a site. This TGI describes the equipment, field procedures, materials, and documentation procedures necessary to determine LNAPL conductivity. The details within this TGI should be used in conjunction with project work plans.

2 Intended Use and Responsibilities

This document describes general and/or specific procedures, methods, actions, steps, and considerations to be used and observed by Arcadis staff when performing work, tasks, or actions under the scope and relevancy of this document. This document may describe expectations, requirements, guidance, recommendations, and/or instructions pertinent to the service, work task, or activity it covers.

It is the responsibility of the Arcadis Certified Project Manager (CPM) to provide this document to the persons conducting services that fall under the scope and purpose of this procedure, instruction, and/or guidance. The Arcadis CPM will also ensure that the persons conducting the work falling under this document are appropriately trained and familiar with its content. The persons conducting the work under this document are required to meet the minimum competency requirements outlined herein, and inquire to the CPM regarding any questions, misunderstanding, or discrepancy related to the work under this document.

This document is not considered to be all inclusive nor does it apply to all projects. It is the CPM's responsibility to determine the proper scope and personnel required for each project. There may be project- and/or client- and/or state-specific requirements that may be more or less stringent than what is described herein. The CPM is responsible for informing Arcadis and/or Subcontractor personnel of omissions and/or deviations from this document that may be required for the project. In turn, project staff are required to inform the CPM if or when there is a deviation or omission from work performed as compared to what is described herein.

In following this document to execute the scope of work for a project, it may be necessary for staff to make professional judgment decisions to meet the project's scope of work based upon site conditions, staffing expertise, regulation-specific requirements, health and safety concerns, etc. Staff are required to consult with the CPM when or if a deviation or omission from this document is required that has not already been previously approved by the CPM. Upon approval by the CPM, the staff can perform the deviation or omission as confirmed by the CPM.

3 Scope and Application

This TGI applies to task orders and projects associated with Arcadis. This TGI may be modified, as required, depending on site-specific conditions, equipment limitations or limitations imposed by the procedure. The ultimate procedure employed will be documented in the appropriate project work plans or reports. If changes to the testing procedures are required due to unanticipated field conditions, the changes will be discussed with the project manager as soon as practicable and documented in the project report.

4 Personnel Qualifications

Arcadis field sampling personnel qualified to conduct LNAPL baildown testing will have sufficient "hands- on" experience necessary to operate field equipment, safely handle LNAPL-contaminated materials, and collect accurate field data. Training requirements for conducting LNAPL baildown tests include reviewing this TGI and other applicable TGIs and/or guidance documents, training in using an oil/water interface probe and other equipment used during the testing, and health and safety training. It is helpful to have two field sampling personnel to perform the test. One person can collect the data and the other can record and review the data.

Arcadis field sampling personnel will have completed current company-required health and safety training (e.g., 40-hour Hazardous Waste Operations training, site-specific training, first aid and cardiopulmonary resuscitation (CPR) training), as needed.

5 Equipment List

Equipment and materials used for conducting LNAPL baildown tests may include, but are not limited to, the following:

- appropriate personal protective equipment (PPE), as specified in the site Health and Safety Plan (HASP)
- equipment decontamination supplies
- air monitoring equipment (such as a PID or LEL meter), according to the requirements of the HASP
- oil-water interface probe (see Arcadis TGI: Water Level Measurement)
- oil absorbent pads
- stopwatch
- rope
- clean disposable bailers preferably with product recovery cups (e.g., Superbailer™ manufactured by EON Products)
- peristaltic pump with polyethylene tubing and flexible silicone tubing
- Spill Buddy pump
- plastic buckets with lids (graduated with volume markings)
- plastic beakers or graduated cylinders (appropriately sized for anticipated NAPL/water recovery volume)
- calculator
- field log forms for recording measurements (API Baildown Test Analysis Spreadsheet or *digital FieldNow® – LNAPL Baildown Test Log*)
- Field tablet with applicable FieldNow® applications (daily logs, LNAPL Baildown Test, etc.) OR Field Laptop with API Baildown Test Analysis Spreadsheet.

6 Cautions

Wells containing LNAPL for baildown testing should be selected based on project-specific objectives and a review of historical site data. It is good practice to select several baildown test wells to bracket the range of observed

historical apparent LNAPL thickness measurements, geologic conditions, and LNAPL mobility/ recoverability conditions across a given area. A minimum equilibrium in-well LNAPL thickness of 0.5 feet is recommended for selection of wells for LNAPL baildown testing (ASTM 2013). Additional guidelines for selecting appropriate wells for LNAPL baildown testing include:

- Select wells located near both the interior and exterior portions of the LNAPL plume(s)
- Select wells located in a variety of geologic materials, if feasible
- Consider the position of wells relative to groundwater and LNAPL flow direction
- Consider the potential of wells to exhibit different equilibrated apparent LNAPL thicknesses
- Select wells which contain different types of LNAPL, if present
- Review site history and select wells with slow recovery for testing at the beginning of the field activities.

In addition, if active remediation activities are underway (or have been recently completed) in the vicinity of proposed test wells, these areas may not be representative of static subsurface conditions. Tests should be conducted, if possible, during conditions representative of typical static fluid levels.

“Background” fluid level measurements can be periodically collected at wells not tested to track any changes in ambient groundwater elevation during baildown testing. Collection of background fluid level measurements is strongly recommended if ambient water levels at the site are expected to fluctuate significantly over the course of baildown testing. One or more data-logging pressure transducers can also be used to record background fluid level measurements during testing, reducing the field effort associated with collection of background data.

If higher LNAPL recovery rates are expected, larger diameter wells (4- to 6-inch-diameter casings) are generally preferred. The increased area of the wellbore seepage face for larger diameter wells will provide information that is applicable to a larger, more representative volume of aquifer material. However, if the expected recovery rate is low, smaller diameter wells are often preferred because the volume of the borehole is smaller relative to the formation recovery capacity. Further discussion on accounting for the well filter pack is presented in *A Protocol for Performing Field Tasks and Follow-up Analytical Evaluation for LNAPL Transmissivity using Well Baildown Procedures (Beckett and Lyverse, 2002).*

Arcadis project personnel should confirm that the test wells have been properly developed. Incomplete well development results in underestimates of LNAPL transmissivity. See the Arcadis TGI titled *Monitoring Well Development for additional details.*

Arcadis field personnel must verify that the air/LNAPL and LNAPL/groundwater interfaces occur within the screen interval. At a minimum, the piezometric head elevation in the well should occur below the top of the screen.

Arcadis project personnel will choose the most appropriate technique to evacuate the LNAPL from the well. A recovery of 90%+ of the total calculated LNAPL volume should be targeted with as little groundwater recovery as possible. These techniques include:

- **Manual bailer** — A 1¾-inch-diameter bailer should be used for 2-inch-diameter wells. For 4-inch- diameter wells, a 3-inch-diameter bailer can be used for LNAPL recovery. The use of product recovery cups, which attach to the bottom of the bailer and maximize the surface area for LNAPL recovery, is highly recommended. Some bailers (for example, the Superbailer™, manufactured by EON Products, Inc.) have this feature built-in. This will allow for more efficient LNAPL removal and more accurate recovery measurements.
- **Pumping** — LNAPL removal can be accomplished by using an oil-specific skimmer pump, submersible pump, or peristaltic pump that operates at a pumping rate which exceeds the LNAPL recharge capacity. Keep

in mind that peristaltic pumps, because they rely on creation of a vacuum to drive fluid movement, are typically limited to lifting fluids at head differences of 25 to 30 feet or less. It is also desirable to choose a pump capable of rapidly removing LNAPL from the well; as such, larger-diameter tubing or higher-capacity peristaltic pumps may be helpful.

The intake tubing for a peristaltic pump can be fastened to the tip portion of an interface probe using plastic cable ties; the tubing intake should be placed just above the sensors at the tip of the interface probe. This arrangement allows the field personnel operating the pump to keep the tubing within the LNAPL layer as much as possible, assess the rate at which the LNAPL thickness in the well is dropping, and minimize water recovery.

The “Spill Buddy” pump manufactured by Clean Earth Technology, functions similarly, combining a submersible pump and interface probe. Submersible pumps used for baildown testing should be evaluated relative to the potential ignition hazards associated with the LNAPL.

To increase LNAPL removal rates at large-diameter wells, a combination of removal methods (such as simultaneous manual bailing and pumping) may be employed.

Data collection is generally conducted manually using an interface probe. Before performing an LNAPL baildown test, allow monitoring well fluid levels to equilibrate with atmospheric pressure.

Tests at wells that are expected to exhibit slower recovery should be initiated at the beginning of the field event, if possible. Arcadis recommends taking LNAPL measurements initially in one-minute intervals and then adjusting the frequency of measurements thereafter, based on site-specific conditions. Ideally, the frequency of measurements should be sufficient to document recovery of in-well LNAPL thickness at intervals of approximately 5 percent of the initial thickness. For example, if the initial (pre-test) LNAPL thickness is 3 feet, fluid level measurements should be recorded each time the in-well thickness increases by 0.15 feet. However, it is much more important to accurately record fluid levels and actual measurement times than to match an idealized measurement frequency.

The following measurement schedule can be used as a general guide and adjusted in the field based on observed recovery rates. Note that this schedule will likely result in collection of more data points than suggested by the idealized frequency described earlier.

- First 10 minutes: every minute
- 10-20 minutes: every 2 minutes
- 20-40 minutes: every 5 minutes
- 40-90 minutes: every 10-15 minutes
- 90 minutes to 4 hours: every half hour to 1 hour depending on recovery rate
- 4 hours + : every 4-6 hours or as practical and depending on recovery rate

Measurements should continue until the in-well thickness has stabilized to a static level or until recovery of over 90 percent of the initial thickness is observed (whichever occurs first). Generally, stabilization of in-well thickness is indicated by a constant in-well thickness over one-quarter to one- half of a log cycle (e.g., stable thickness over a period of 100 to 500 minutes after test initiation, with a log cycle being 100 to 1000 minutes) (ASTM 2013).

The rate of LNAPL recovery will usually slow over time. Once the rate of recovery is slow enough, a new baildown test can be initiated at another location, returning to take periodic measurements at the initial test well. For wells with unknown or slow recovery rates, tests should be initiated earlier in the day so that monitoring can be conducted for several hours. Continue this process as long as it is viable based on soil characteristics, field logistics, well locations and data collection needs. Real-time examination of the data curves is the best indicator of data sufficiency. A plot of the change in LNAPL thickness over time may exhibit up to three theoretical segments:

1. initial steep segment that could reflect filter pack drainage
2. main production segment where the formation LNAPL gradient to the wells controls recovery
3. third segment where the diminishing formation LNAPL gradient produces a flatter recovery curve

Repeatedly introducing the oil-water interface indicator may alter the fluid-level measurements. Avoid splashing the probe into the water table or lowering the probe too far beyond the LNAPL-water interface depth. Avoid introducing surface soil or other material into the monitoring well by staging downhole equipment on a clean and dry working surface.

If observed LNAPL recovery rates during the baildown test are very slow, the data can be reviewed to evaluate whether continued data collection beyond one day is warranted. The benefits of additional data collection may be minimal for cases where data do not support identification of a discrete LNAPL transmissivity result, and LNAPL transmissivity is estimated to be less than approximately 0.1 square feet per day.

Two to three baildown tests are highly recommended at each location. Multiple separate testing events may be desirable if slow recovery rates are expected or encountered during testing.

7 Health and Safety Considerations

Field personnel should review a Job Safety Analysis (JSA) for LNAPL baildown tests and revise it as necessary. The following health and safety issues must be considered when conducting LNAPL baildown tests:

- Air monitoring should be conducted in accordance with the HASP, and readings will be compared to action levels established in the HASP to identify appropriate action.
- Appropriate PPE must be worn to avoid contact with LNAPL during the baildown test. Large outer gloves, goggles or a face shield, and chemical-protective clothing (Tyvek) should be considered if extensive contact with LNAPL is likely.
- LNAPL and LNAPL-contaminated materials generated during the baildown test must be properly managed in accordance with facility requirements and applicable regulatory requirements.
- The flammability of the LNAPL should be evaluated prior to field activities. If the LNAPL represents a flammability or ignition hazard, appropriate precautions should be taken to prevent accumulation of vapors, remove ignition sources, or both. Particular attention should be paid to static-electricity-related hazards.

8 Procedure

Specific procedures for conducting LNAPL baildown tests are presented below:

1. Prior to conducting a baildown test, it is recommended that field personnel verify the fluid levels in the well are stable and in equilibrium. This can be done by comparing fluid levels measured recently (e.g., 8 to 24 hours before the initiation of the test) to fluid levels measured at the start of the test.

2. Prepare a log within the "Baildown test form" tab of the API spreadsheet or with the *FieldNow® – LNAPL Baildown Test Log*. Identify site, well number, date and time on the LNAPL Baildown Test Form/FieldNow® log, along with other appropriate LNAPL baildown testing information, including the well casing and LNAPL density ratio (ratio of LNAPL density to water density). Recovery data will be entered in the "Baildown Test Form" tab in the pale-yellow areas with text stating "Enter Data Here" in red, bold text while the *FieldNow® – LNAPL Baildown Test Log* includes blank fields to populate.

3. If feasible, calculate the volume of LNAPL within the well within the filter pack (multiplying the volume of the filter pack located between the air-NAPL interface and NAPL-water interfaces by a specific yield of 0.175). The volume of NAPL removed during test initiation should ideally be near the combined volume of NAPL in the well and NAPL in the filter pack. *The FieldNow® – LNAPL Baildown Test Log* will automatically calculate the LNAPL volumes based on the well information entered initially.

4. Place clean plastic sheeting and several oil absorbent pads on the ground next to the well.

5. Set up any air monitoring equipment in accordance with the site HASP and JSA.

6. Unlock and open the monitoring well cover while standing upwind from the well.

7. Before beginning the baildown testing, measure and record static fluid levels using the oil/ water interface probe (i.e., depth to LNAPL and depth to groundwater) and document the fluid levels in the Baildown Test Form tab of the API spreadsheet/*FieldNow® – LNAPL Baildown Test Log*. By entering the well casing diameter and initial depth to LNAPL (cell D30) and depth to water (cell E30), the initial LNAPL thickness and volume in the well will be automatically calculated in the API spreadsheet. Likewise, LNAPL thicknesses will auto-populate in the *FieldNow® – LNAPL Baildown Test Log*. Gauge fluid levels periodically for 5 to 10 minutes to monitor changes in head. Do not begin the test until the well has equilibrated. Ideally, one person will be responsible for lowering the bailer into the well and recording time intervals in the log, and another person will be responsible for lowering the interface probe into the well and measuring and communicating fluid level measurements to the person recording information in the log.

8. To begin baildown testing, slowly lower the bailer or equivalent into the well until the bottom end of it is just below the LNAPL-water interface. If using a pump, lower the tubing intake to just below the LNAPL/air interface. Record the time that LNAPL removal will begin.

9. Evacuate LNAPL from the well by gently bailing, pumping, or by other means as described in Section IV above while minimizing water production. Attempt to remove LNAPL from the well as quickly as possible while removing as little water as possible. LNAPL removal from the well should occur in less than one-hundredth of the total length of the test. If LNAPL removal requires a relatively long time (over 15 minutes) or if a large volume of LNAPL is removed (over 5 gallons), record intermediate measurements of time, LNAPL volume, and water volume during the removal event. The volume of water removed should be

small relative to the volume of LNAPL removed. If more than 500 mL of water is removed, consider contacting NAPL Focus Area TKI staff to discuss whether continuation of the test is worthwhile.

10. Record the time at which LNAPL removal is complete (or LNAPL is removed to the maximum practical extent) as the test start time. Begin measuring the elapsed time, starting with this point. Monitor depth to LNAPL and depth to water at the appropriate intervals, as discussed above. Measure fluid levels to the nearest hundredth of a foot with the oil-water interface probe and record, along with the corresponding time reading in minutes and seconds.

11. Transfer the LNAPL and groundwater evacuated from the well into an appropriately sized beaker, graduated cylinder, or graduated bucket. Record the volumes of LNAPL and groundwater removed in the API spreadsheet/FieldNow® log. If an LNAPL/water emulsion was formed during fluid recovery, allow time for LNAPL/water separation, and make note of the observed emulsification.

12. Use the *FieldNow® – LNAPL Baildown Test Log* or the API spreadsheet "Baildown Test Form" tab to record DTW and DTP data.

13. The API spreadsheet "Baildown Test Form" tab can be used to observe the results graphically. As you enter data in the API Spreadsheet, it is plotted on the recovery curve in the "B&R Type Curve" tab. The data should reside between two of the fit curves on this graph. Using the API Spreadsheet, one can determine the lower transmissivity (T) fit curve the data set is fitting. For example, if the data for a given test is graphed between T= 1 ft^2/day and T= 2 ft^2/day, then estimate the T as 1 ft^2/day. On the "Baildown Test Form, locate the **Guidelines for Test Length** in columns I and J and determine roughly how long data should be collected. The estimated time and curves change with casing diameter and LNAPL density ratio; therefore, it is important to enter this information prior to the test. Typical guidelines for test length from the API Spreadsheet are included below for reference. Useful results can still be obtained from baildown tests that are shorter than these recommended timeframes -- for example, a test with two hours of monitoring and minimal LNAPL recharge may be adequate to establish that LNAPL transmissivity values are qualitatively low, or below a certain threshold metric. Test length and monitoring should be evaluated in the context of data quality objectives for the test.

Guidelines for Test Length

Transmissivity (ft^2/day)	Estimated Time of Test (min)
10	19
5	37
2	93
1	187
0.5	374
0.2	935
0.1	1870

14. A target recovery of 90% should be achieved in the well before a test if completed. Two to eight hours of data collection is usually sufficient. If less than 80% recovery is achieved on Day 1, then readings should be taken on Day 2. Daily review of data by the project team and NAPL Focus Area TKI contact is

recommended to ensure tests are being implemented properly and to aid in determining when to terminate tests.

15. Place all LNAPL and groundwater collected during the test into an appropriate container for waste management.
16. Decontaminate the oil-water interface probe.
17. Secure the monitoring well prior to leaving by replacing the well cap and/or cover and locking it.

9 Waste Management

Rinse water, PPE and other waste materials generated during equipment decontamination should be placed in appropriate containers and labeled. Containerized waste will be disposed of in a manner consistent with appropriate waste management procedures for investigation-derived waste.

10 Data Recording and Management

Digital data collection is the Arcadis standard using available FieldNow® applications that enable real-time, paperless data collection, entry, and automated reporting. Paper forms should only be used as backup to FieldNow® digital data collection and/or as necessary to collect data not captured by available FieldNow® applications. The Field Now® digital form applications follow a standardized approach, correlate to most TGIs and are available to all projects accessible with a PC or capable mobile device. Once the digital forms are saved within FieldNow®, the data is instantly available for review on a web interface. This facilitates review by project management team members and SMEs enabling error or anomalous data detection for correction while the staff are still in the field. Continual improvements of FieldNow® applications are ongoing, and revisions are made as necessary in response to feedback from users and subject matter experts.

Arcadis field sampling personnel will record data using either the digital field form available through the FieldNow® Application titled *FieldNow® – LNAPL Baildown Test Log* or the API spreadsheet (provided by TKI staff). All information relevant to the test data beyond the items identified in the FieldNow® application/API spreadsheet tool will be recorded using the daily logs. Field equipment decontamination activities and waste management activities will be recorded in the daily logs. Records generated as a result of implementing this TGI will be controlled and maintained in the project record files in accordance with client-specific requirements.

11 Quality Assurance

Arcadis field personnel should review the data set collected during the LNAPL baildown test in the field to determine whether or not the data are reasonable given site-specific conditions. For example, if the data indicates that LNAPL recovery is very rapid in a very low-permeability soil type, this may indicate that there are problems with the data set. If the data are questionable, field equipment should be checked to confirm it is working properly. If unexpected results are observed, completion of at least one additional test at the same well is strongly recommended. Duplicate and triplicate LNAPL baildown tests may be conducted to improve confidence in test results, assuming water levels and apparent LNAPL thicknesses have returned to static conditions.

Any issues that may affect the data (such as equipment problems, major precipitation events, or unusual site-specific conditions) should be recorded in the daily logs so that analysts can consider those issues when processing the data.

12 References

ASTM International. 2013. Standard Guide for Estimation of LNAPL Transmissivity. ASTM Standard E2856

- 13. ASTM International, West Conshohocken, Pennsylvania.

Beckett, G.D. and Lyverse, M.A. 2002. *A Protocol for Performing Field Tasks and Follow-up Analytical Evaluation for LNAPL Transmissivity using Well Baildown Procedures, August 2002.*

Lundy, D. and Parcher, M. 2007. *Assessment of LNAPL Volume, Mobility and Recoverability for Recovery Systems: Design and Risk-Based Corrective Action. National Ground Water Association Short Course, November 2007.*

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Appendix C

LNAPL Workbook

Theim Equation Solution for Upper-Bound Estimation of LNAPL Transmissivity (Unconfined Conditions)

Well Designation:	MW-12
Date:	30-May-23

Initial LNAPL thickness in well, b_n (ft):	3.03
LNAPL-water density ratio, ρ_r:	0.97
Initial LNAPL thickness observed during test (ft):	0.40
Initial theoretical skimming drawdown, s_n (ft):	0.079
Final LNAPL thickness observed during test (ft):	0.42
Final theoretical skimming drawdown, s_n (ft):	0.078
Geometric mean of theoretical LNAPL drawdowns, s_n (ft):	0.079
Time between initial and final thickness observations (min):	65
Well casing diameter (in):	2
Observed LNAPL recharge rate, Q_n (ft^3/d):	9.67E-03
$\ln(R_{oi}/r_w)$ (assumption per ASTM E-2856):	4.6

LNAPL Transmissivity, T_n (ft^2/d):	**0.09**

$$T_n = \frac{Q_n \ln(\frac{R_{oi}}{r_w})}{2\pi s_n}$$

$$s_{n\_unconfined} = b_n(1 - \rho_r)$$

Appendix D

LNAPL Laboratory Report and Chain-of-Custody Documentation

ANALYTICAL REPORT

Lab Number:	L2330819
Client:	Arcadis US, Inc. 830 NE Holladay Street Suite 109 Portland, OR 97232
ATTN:	Grace Boyd
Phone:	(503) 785-9389
Project Name:	PACIFICORP
Project Number:	30167230.00005
Report Date:	06/23/23

Certifications & Approvals: MA (M-MA030), NH NELAP (2062), CT (PH-0825), DoD (L2474), FL (E87814), IL (200081), IN (C-MA-04), KY (KY98046), LA (85084), ME (MA00030), MD (350), MI (99110) , NJ (MA015), NY (11627), NC (685), OH (CL106), OR (MA-0262), PA (68-02089), RI (LAO00299), TX (T104704419), VT (VT-0015), VA (460194), WA (C954), US Army Corps of Engineers, USDA (Permit #525-23-107-88708), USFWS (Permit #206964).

320 Forbes Boulevard, Mansfield, MA 02048-1806
508-822-9300 (Fax) 508-822-3288 800-624-9220 - www.alphalab.com

Project Name: PACIFICORP
Project Number: 30167230.00005

Lab Number: L2330819
Report Date: 06/23/23

Alpha Sample ID	Client ID	Matrix	Sample Location	Collection Date/Time	Receive Date
L2330819-01	MW-12	OIL	ASTORIA, OR	05/30/23 14:30	06/02/23

Project Name:	PACIFICORP	**Lab Number:**	L2330819
Project Number:	30167230.00005	**Report Date:**	06/23/23

Case Narrative

The samples were received in accordance with the Chain of Custody and no significant deviations were encountered during the preparation or analysis unless otherwise noted. Sample Receipt, Container Information, and the Chain of Custody are located at the back of the report.

Results contained within this report relate only to the samples submitted under this Alpha Lab Number and meet NELAP requirements for all NELAP accredited parameters unless otherwise noted in the following narrative. The data presented in this report is organized by parameter (i.e. VOC, SVOC, etc.). Sample specific Quality Control data (i.e. Surrogate Spike Recovery) is reported at the end of the target analyte list for each individual sample, followed by the Laboratory Batch Quality Control at the end of each parameter. Tentatively Identified Compounds (TICs), if requested, are reported for compounds identified to be present and are not part of the method/program Target Compound List, even if only a subset of the TCL are being reported. If a sample was re-analyzed or re-extracted due to a required quality control corrective action and if both sets of data are reported, the Laboratory ID of the re-analysis or re-extraction is designated with an "R" or "RE", respectively.

When multiple Batch Quality Control elements are reported (e.g. more than one LCS), the associated samples for each element are noted in the grey shaded header line of each data table. Any Laboratory Batch, Sample Specific % recovery or RPD value that is outside the listed Acceptance Criteria is bolded in the report. In reference to questions H (CAM) or 4 (RCP) when "NO" is checked, the performance criteria for CAM and RCP methods allow for some quality control failures to occur and still be within method compliance. In these instances, the specific failure is not narrated but noted in the associated QC Outlier Summary Report, located directly after the Case Narrative. QC information is also incorporated in the Data Usability Assessment table (Format 11) of our Data Merger tool, where it can be reviewed in conjunction with the sample result, associated regulatory criteria and any associated data usability implications.

Soil/sediments, solids and tissues are reported on a dry weight basis unless otherwise noted. Definitions of all data qualifiers and acronyms used in this report are provided in the Glossary located at the back of the report.

HOLD POLICY - For samples submitted on hold, Alpha's policy is to hold samples (with the exception of Air canisters) free of charge for 21 calendar days from the date the project is completed. After 21 calendar days, we will dispose of all samples submitted including those put on hold unless you have contacted your Alpha Project Manager and made arrangements for Alpha to continue to hold the samples. Air canisters will be disposed after 3 business days from the date the project is completed.

Please contact Project Management at 800-624-9220 with any questions.

Project Name:	PACIFICORP	**Lab Number:**	L2330819
Project Number:	30167230.00005	**Report Date:**	06/23/23

Case Narrative (continued)

Report Submission

All non-detect (ND) or estimated concentrations (J-qualified) have been quantitated to the limit noted in the MDL column.

Sample Receipt

L2330819-01: The collection date and time on the chain of custody was 30-MAY-23 13:00; however, the collection date/time on the container label was 30-MAY-23 14:30. At the client's request, the collection date/time is reported as 30-MAY-23 14:30.

Volatile Organics

L2330819-01D: The surrogate recovery is outside the acceptance criteria for 4-bromofluorobenzene (147%); however, the sample was not re-analyzed due to coelution with an obvious interference. A copy of the chromatogram is included as an attachment to this report.

L2330819-01D: The sample has elevated detection limits due to the dilution required by the elevated concentrations of non-target compounds in the sample.

The WG1795310-5 Method Blank, associated with L2330819-01D, has a concentration above the reporting limit for bromomethane. Since the associated sample concentrations are either greater than 10x the blank concentration or non-detect to the RL for this target analyte, no corrective action is required. Any results detected below the reporting limit are qualified with a "B".

PAHs by SIM

L2330819-01D: The sample has elevated detection limits due to the dilution required by the sample matrix.

L2330819-01D: The surrogate recoveries are outside the acceptance criteria for 2-methylnaphthalene-d10 (190%); however, the sample was not re-extracted due to coelution with obvious interferences.

I, the undersigned, attest under the pains and penalties of perjury that, to the best of my knowledge and belief and based upon my personal inquiry of those responsible for providing the information contained in this analytical report, such information is accurate and complete. This certificate of analysis is not complete unless this page accompanies any and all pages of this report.

Authorized Signature: Susan E O'Neil Susan O' Neil

Title: Technical Director/Representative Date: 06/23/23

ORGANICS

VOLATILES

Project Name: PACIFICORP **Lab Number:** L2330819

Project Number: 30167230.00005 **Report Date:** 06/23/23

SAMPLE RESULTS

Lab ID: L2330819-01 D
Client ID: MW-12
Sample Location: ASTORIA, OR

Date Collected: 05/30/23 14:30
Date Received: 06/02/23
Field Prep: Not Specified

Sample Depth:
Matrix: Oil
Analytical Method: 1,8260D
Analytical Date: 06/22/23 23:16
Analyst: JIC
Percent Solids: Results reported on an 'AS RECEIVED' basis.

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatile Organics by GC/MS - Westborough Lab						
Methylene chloride	ND		ug/kg	26000	12000	10
1,1-Dichloroethane	ND		ug/kg	5100	740	10
Chloroform	ND		ug/kg	7600	710	10
Carbon tetrachloride	ND		ug/kg	5100	1200	10
1,2-Dichloropropane	ND		ug/kg	5100	640	10
Dibromochloromethane	ND		ug/kg	5100	710	10
1,1,2-Trichloroethane	ND		ug/kg	5100	1400	10
Tetrachloroethene	ND		ug/kg	2600	1000	10
Chlorobenzene	ND		ug/kg	2600	650	10
Trichlorofluoromethane	ND		ug/kg	20000	3500	10
1,2-Dichloroethane	ND		ug/kg	5100	1300	10
1,1,1-Trichloroethane	ND		ug/kg	2600	850	10
Bromodichloromethane	ND		ug/kg	2600	560	10
trans-1,3-Dichloropropene	ND		ug/kg	5100	1400	10
cis-1,3-Dichloropropene	ND		ug/kg	2600	810	10
1,3-Dichloropropene, Total	ND		ug/kg	2600	810	10
1,1-Dichloropropene	ND		ug/kg	2600	810	10
Bromoform	ND		ug/kg	20000	1200	10
1,1,2,2-Tetrachloroethane	ND		ug/kg	2600	850	10
Benzene	ND		ug/kg	2600	850	10
Toluene	ND		ug/kg	5100	2800	10
Ethylbenzene	1300	J	ug/kg	5100	720	10
Chloromethane	ND		ug/kg	20000	4800	10
Bromomethane	ND		ug/kg	10000	3000	10
Vinyl chloride	ND		ug/kg	5100	1700	10
Chloroethane	ND		ug/kg	10000	2300	10
1,1-Dichloroethene	ND		ug/kg	5100	1200	10
trans-1,2-Dichloroethene	ND		ug/kg	7600	700	10

Project Name: PACIFICORP **Lab Number:** L2330819

Project Number: 30167230.00005 **Report Date:** 06/23/23

SAMPLE RESULTS

Lab ID: L2330819-01 D
Client ID: MW-12
Sample Location: ASTORIA, OR

Date Collected: 05/30/23 14:30
Date Received: 06/02/23
Field Prep: Not Specified

Sample Depth:

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatile Organics by GC/MS - Westborough Lab						
Trichloroethene	ND		ug/kg	2600	700	10
1,2-Dichlorobenzene	ND		ug/kg	10000	730	10
1,3-Dichlorobenzene	ND		ug/kg	10000	760	10
1,4-Dichlorobenzene	ND		ug/kg	10000	870	10
Methyl tert butyl ether	ND		ug/kg	10000	1000	10
p/m-Xylene	ND		ug/kg	10000	2800	10
o-Xylene	2300	J	ug/kg	5100	1500	10
Xylenes, Total	2300	J	ug/kg	5100	1500	10
cis-1,2-Dichloroethene	ND		ug/kg	5100	890	10
1,2-Dichloroethene, Total	ND		ug/kg	5100	700	10
Dibromomethane	ND		ug/kg	10000	1200	10
1,4-Dichlorobutane	ND		ug/kg	51000	1200	10
1,2,3-Trichloropropane	ND		ug/kg	10000	650	10
Styrene	ND		ug/kg	5100	1000	10
Dichlorodifluoromethane	ND		ug/kg	51000	4700	10
Acetone	ND		ug/kg	130000	51000	10
Carbon disulfide	ND		ug/kg	51000	23000	10
2-Butanone	ND		ug/kg	51000	11000	10
Vinyl acetate	ND		ug/kg	51000	11000	10
4-Methyl-2-pentanone	ND		ug/kg	51000	6500	10
2-Hexanone	ND		ug/kg	51000	6000	10
Ethyl methacrylate	ND		ug/kg	51000	8100	10
Acrylonitrile	ND		ug/kg	20000	5900	10
Bromochloromethane	ND		ug/kg	10000	1000	10
Tetrahydrofuran	ND		ug/kg	20000	8100	10
2,2-Dichloropropane	ND		ug/kg	10000	1000	10
1,2-Dibromoethane	ND		ug/kg	5100	1400	10
1,3-Dichloropropane	ND		ug/kg	10000	850	10
1,1,1,2-Tetrachloroethane	ND		ug/kg	2600	670	10
Bromobenzene	ND		ug/kg	10000	740	10
n-Butylbenzene	13000		ug/kg	5100	850	10
sec-Butylbenzene	29000		ug/kg	5100	740	10
tert-Butylbenzene	3300	J	ug/kg	10000	600	10
o-Chlorotoluene	ND		ug/kg	10000	970	10
p-Chlorotoluene	ND		ug/kg	10000	550	10
1,2-Dibromo-3-chloropropane	ND		ug/kg	15000	5100	10
Hexachlorobutadiene	ND		ug/kg	20000	860	10

Project Name: PACIFICORP **Lab Number:** L2330819

Project Number: 30167230.00005 **Report Date:** 06/23/23

SAMPLE RESULTS

Lab ID: L2330819-01 D Date Collected: 05/30/23 14:30

Client ID: MW-12 Date Received: 06/02/23

Sample Location: ASTORIA, OR Field Prep: Not Specified

Sample Depth:

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatile Organics by GC/MS - Westborough Lab						
Isopropylbenzene	9900		ug/kg	5100	560	10
p-Isopropyltoluene	830	J	ug/kg	5100	560	10
Naphthalene	53000		ug/kg	20000	3300	10
n-Propylbenzene	2900	J	ug/kg	5100	870	10
1,2,3-Trichlorobenzene	ND		ug/kg	10000	1600	10
1,2,4-Trichlorobenzene	ND		ug/kg	10000	1400	10
1,3,5-Trimethylbenzene	8600	J	ug/kg	10000	980	10
1,2,4-Trimethylbenzene	7400	J	ug/kg	10000	1700	10
trans-1,4-Dichloro-2-butene	ND		ug/kg	26000	7200	10
Ethyl ether	ND		ug/kg	10000	1700	10

Surrogate	% Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	90		70-130
Toluene-d8	106		70-130
4-Bromofluorobenzene	**147**	Q	70-130
Dibromofluoromethane	86		70-130

Project Name: PACIFICORP
Project Number: 30167230.00005
Lab Number: L2330819
Report Date: 06/23/23

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8260D
Analytical Date: 06/22/23 14:13
Analyst: AJK

Parameter	Result	Qualifier	Units	RL	MDL
Volatile Organics by GC/MS - Westborough Lab for sample(s): 01 Batch: WG1795310-5					
Methylene chloride	ND		ug/kg	2500	1100
1,1-Dichloroethane	ND		ug/kg	500	72.
Chloroform	ND		ug/kg	750	70.
Carbon tetrachloride	ND		ug/kg	500	120
1,2-Dichloropropane	ND		ug/kg	500	62.
Dibromochloromethane	ND		ug/kg	500	70.
1,1,2-Trichloroethane	ND		ug/kg	500	130
2-Chloroethylvinyl ether	ND		ug/kg	10000	820
Tetrachloroethene	ND		ug/kg	250	98.
Chlorobenzene	ND		ug/kg	250	64.
Trichlorofluoromethane	ND		ug/kg	2000	350
1,2-Dichloroethane	ND		ug/kg	500	130
1,1,1-Trichloroethane	ND		ug/kg	250	84.
Bromodichloromethane	ND		ug/kg	250	54.
trans-1,3-Dichloropropene	ND		ug/kg	500	140
cis-1,3-Dichloropropene	ND		ug/kg	250	79.
1,3-Dichloropropene, Total	ND		ug/kg	250	79.
1,1-Dichloropropene	ND		ug/kg	250	80.
Bromoform	ND		ug/kg	2000	120
1,1,2,2-Tetrachloroethane	ND		ug/kg	250	83.
Benzene	ND		ug/kg	250	83.
Toluene	ND		ug/kg	500	270
Ethylbenzene	ND		ug/kg	500	70.
Chloromethane	ND		ug/kg	2000	470
Bromomethane	1000		ug/kg	1000	290
Vinyl chloride	ND		ug/kg	500	170
Chloroethane	ND		ug/kg	1000	230
1,1-Dichloroethene	ND		ug/kg	500	120
trans-1,2-Dichloroethene	ND		ug/kg	750	68.

Project Name: PACIFICORP **Lab Number:** L2330819

Project Number: 30167230.00005 **Report Date:** 06/23/23

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8260D
Analytical Date: 06/22/23 14:13
Analyst: AJK

Parameter	Result	Qualifier	Units	RL	MDL
Volatile Organics by GC/MS - Westborough Lab for sample(s): 01 Batch: WG1795310-5					
Trichloroethene	ND		ug/kg	250	68.
1,2-Dichlorobenzene	ND		ug/kg	1000	72.
1,3-Dichlorobenzene	ND		ug/kg	1000	74.
1,4-Dichlorobenzene	ND		ug/kg	1000	86.
Methyl tert butyl ether	ND		ug/kg	1000	100
p/m-Xylene	ND		ug/kg	1000	280
o-Xylene	ND		ug/kg	500	140
Xylenes, Total	ND		ug/kg	500	140
cis-1,2-Dichloroethene	ND		ug/kg	500	88.
1,2-Dichloroethene, Total	ND		ug/kg	500	68.
Dibromomethane	ND		ug/kg	1000	120
1,4-Dichlorobutane	ND		ug/kg	5000	110
1,2,3-Trichloropropane	ND		ug/kg	1000	64.
Styrene	ND		ug/kg	500	98.
Dichlorodifluoromethane	ND		ug/kg	5000	460
Acetone	ND		ug/kg	12000	5000
Carbon disulfide	ND		ug/kg	5000	2300
2-Butanone	ND		ug/kg	5000	1100
Vinyl acetate	ND		ug/kg	5000	1100
4-Methyl-2-pentanone	ND		ug/kg	5000	640
2-Hexanone	ND		ug/kg	5000	590
Ethyl methacrylate	ND		ug/kg	5000	790
Acrolein	ND		ug/kg	12000	2800
Acrylonitrile	ND		ug/kg	2000	580
Bromochloromethane	ND		ug/kg	1000	100
Tetrahydrofuran	ND		ug/kg	2000	800
2,2-Dichloropropane	ND		ug/kg	1000	100
1,2-Dibromoethane	ND		ug/kg	500	140
1,3-Dichloropropane	ND		ug/kg	1000	84.

Project Name: PACIFICORP **Lab Number:** L2330819

Project Number: 30167230.00005 **Report Date:** 06/23/23

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8260D
Analytical Date: 06/22/23 14:13
Analyst: AJK

Parameter	Result	Qualifier	Units	RL	MDL
Volatile Organics by GC/MS - Westborough Lab for sample(s): 01 Batch: WG1795310-5					
1,1,1,2-Tetrachloroethane	ND		ug/kg	250	66.
Bromobenzene	ND		ug/kg	1000	72.
n-Butylbenzene	ND		ug/kg	500	84.
sec-Butylbenzene	ND		ug/kg	500	73.
tert-Butylbenzene	ND		ug/kg	1000	59.
1,3,5-Trichlorobenzene	ND		ug/kg	1000	86.
o-Chlorotoluene	ND		ug/kg	1000	96.
p-Chlorotoluene	ND		ug/kg	1000	54.
1,2-Dibromo-3-chloropropane	ND		ug/kg	1500	500
Hexachlorobutadiene	ND		ug/kg	2000	84.
Isopropylbenzene	ND		ug/kg	500	54.
p-Isopropyltoluene	ND		ug/kg	500	54.
Naphthalene	ND		ug/kg	2000	320
n-Propylbenzene	ND		ug/kg	500	86.
1,2,3-Trichlorobenzene	ND		ug/kg	1000	160
1,2,4-Trichlorobenzene	ND		ug/kg	1000	140
1,3,5-Trimethylbenzene	ND		ug/kg	1000	96.
1,2,4-Trimethylbenzene	ND		ug/kg	1000	170
trans-1,4-Dichloro-2-butene	ND		ug/kg	2500	710
Halothane	ND		ug/kg	5000	90.
Ethyl ether	ND		ug/kg	1000	170
Methyl Acetate	ND		ug/kg	2000	480
Ethyl Acetate	ND		ug/kg	5000	600
Isopropyl Ether	ND		ug/kg	1000	110
Cyclohexane	ND		ug/kg	5000	270
Tert-Butyl Alcohol	ND		ug/kg	10000	2600
Ethyl-Tert-Butyl-Ether	ND		ug/kg	1000	64.
Tertiary-Amyl Methyl Ether	ND		ug/kg	1000	88.
1,4-Dioxane	ND		ug/kg	40000	18000

Project Name: PACIFICORP
Project Number: 30167230.00005
Lab Number: L2330819
Report Date: 06/23/23

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8260D
Analytical Date: 06/22/23 14:13
Analyst: AJK

Parameter	Result	Qualifier	Units	RL	MDL
Volatile Organics by GC/MS - Westborough Lab for sample(s): 01 Batch: WG1795310-5					
1,1,2-Trichloro-1,2,2-Trifluoroethane	ND		ug/kg	2000	350

Surrogate	%Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	98		70-130
Toluene-d8	101		70-130
4-Bromofluorobenzene	100		70-130
Dibromofluoromethane	90		70-130

Lab Control Sample Analysis
Batch Quality Control

Project Name: PACIFICORP
Project Number: 30167230.00005

Lab Number: L2330819
Report Date: 06/23/23

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Volatile Organics by GC/MS - Westborough Lab Associated sample(s): 01 Batch: WG1795310-3 WG1795310-4								
Methylene chloride	88		90		70-130	2		30
1,1-Dichloroethane	97		96		70-130	1		30
Chloroform	91		94		70-130	3		30
Carbon tetrachloride	100		103		70-130	3		30
1,2-Dichloropropane	93		95		70-130	2		30
Dibromochloromethane	92		96		70-130	4		30
1,1,2-Trichloroethane	100		103		70-130	3		30
2-Chloroethylvinyl ether	95		96		70-130	1		30
Tetrachloroethene	113		115		70-130	2		30
Chlorobenzene	103		106		70-130	3		30
Trichlorofluoromethane	105		108		70-139	3		30
1,2-Dichloroethane	89		93		70-130	4		30
1,1,1-Trichloroethane	97		100		70-130	3		30
Bromodichloromethane	88		91		70-130	3		30
trans-1,3-Dichloropropene	98		101		70-130	3		30
cis-1,3-Dichloropropene	93		97		70-130	4		30
1,1-Dichloropropene	105		108		70-130	3		30
Bromoform	75		78		70-130	4		30
1,1,2,2-Tetrachloroethane	100		99		70-130	1		30
Benzene	96		98		70-130	2		30
Toluene	103		106		70-130	3		30
Ethylbenzene	104		106		70-130	2		30
Chloromethane	92		93		52-130	1		30

Lab Control Sample Analysis

Batch Quality Control

Project Name: PACIFICORP

Project Number: 30167230.00005

Lab Number: L2330819

Report Date: 06/23/23

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Volatile Organics by GC/MS - Westborough Lab Associated sample(s): 01 Batch: WG1795310-3 WG1795310-4								
Bromomethane	89		95		57-147	7		30
Vinyl chloride	101		105		67-130	4		30
Chloroethane	97		100		50-151	3		30
1,1-Dichloroethene	99		101		65-135	2		30
trans-1,2-Dichloroethene	97		99		70-130	2		30
Trichloroethene	97		101		70-130	4		30
1,2-Dichlorobenzene	102		106		70-130	4		30
1,3-Dichlorobenzene	109		110		70-130	1		30
1,4-Dichlorobenzene	107		109		70-130	2		30
Methyl tert butyl ether	90		94		66-130	4		30
p/m-Xylene	106		110		70-130	4		30
o-Xylene	106		109		70-130	3		30
cis-1,2-Dichloroethene	92		96		70-130	4		30
Dibromomethane	90		93		70-130	3		30
1,4-Dichlorobutane	98		99		70-130	1		30
1,2,3-Trichloropropane	97		99		68-130	2		30
Styrene	105		107		70-130	2		30
Dichlorodifluoromethane	99		102		30-146	3		30
Acetone	86		86		54-140	0		30
Carbon disulfide	94		97		59-130	3		30
2-Butanone	84		83		70-130	1		30
Vinyl acetate	109		103		70-130	6		30
4-Methyl-2-pentanone	96		97		70-130	1		30

Lab Control Sample Analysis
Batch Quality Control

Project Name: PACIFICORP
Project Number: 30167230.00005

Lab Number: L2330819
Report Date: 06/23/23

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Volatile Organics by GC/MS - Westborough Lab Associated sample(s): 01 Batch: WG1795310-3 WG1795310-4								
2-Hexanone	94		95		70-130	1		30
Ethyl methacrylate	98		100		70-130	2		30
Acrolein	99		99		70-130	0		30
Acrylonitrile	95		92		70-130	3		30
Bromochloromethane	90		95		70-130	5		30
Tetrahydrofuran	84		82		66-130	2		30
2,2-Dichloropropane	97		98		70-130	1		30
1,2-Dibromoethane	100		105		70-130	5		30
1,3-Dichloropropane	99		103		69-130	4		30
1,1,1,2-Tetrachloroethane	98		100		70-130	2		30
Bromobenzene	102		105		70-130	3		30
n-Butylbenzene	123		125		70-130	2		30
sec-Butylbenzene	112		115		70-130	3		30
tert-Butylbenzene	108		111		70-130	3		30
1,3,5-Trichlorobenzene	116		118		70-139	2		30
o-Chlorotoluene	106		109		70-130	3		30
p-Chlorotoluene	108		111		70-130	3		30
1,2-Dibromo-3-chloropropane	81		83		68-130	2		30
Hexachlorobutadiene	114		116		67-130	2		30
Isopropylbenzene	108		110		70-130	2		30
p-Isopropyltoluene	114		116		70-130	2		30
Naphthalene	101		103		70-130	2		30
n-Propylbenzene	113		115		70-130	2		30

Lab Control Sample Analysis

Batch Quality Control

Project Name: PACIFICORP
Project Number: 30167230.00005

Lab Number: L2330819
Report Date: 06/23/23

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Volatile Organics by GC/MS - Westborough Lab Associated sample(s): 01 Batch: WG1795310-3 WG1795310-4								
1,2,3-Trichlorobenzene	105		109		70-130	4		30
1,2,4-Trichlorobenzene	114		116		70-130	2		30
1,3,5-Trimethylbenzene	108		110		70-130	2		30
1,2,4-Trimethylbenzene	108		111		70-130	3		30
trans-1,4-Dichloro-2-butene	100		101		70-130	1		30
Halothane	99		101		70-130	2		20
Ethyl ether	94		95		67-130	1		30
Methyl Acetate	87		88		65-130	1		30
Ethyl Acetate	91		93		70-130	2		30
Isopropyl Ether	98		93		66-130	5		30
Cyclohexane	106		109		70-130	3		30
Tert-Butyl Alcohol	86		82		70-130	5		30
Ethyl-Tert-Butyl-Ether	93		95		70-130	2		30
Tertiary-Amyl Methyl Ether	92		94		70-130	2		30
1,4-Dioxane	84		86		65-136	2		30
1,1,2-Trichloro-1,2,2-Trifluoroethane	108		111		70-130	3		30

Surrogate	LCS %Recovery	Qual	LCSD %Recovery	Qual	Acceptance Criteria
1,2-Dichloroethane-d4	92		94		70-130
Toluene-d8	102		102		70-130
4-Bromofluorobenzene	100		102		70-130
Dibromofluoromethane	93		94		70-130

SEMIVOLATILES

Project Name: PACIFICORP
Project Number: 30167230.00005
Lab Number: L2330819
Report Date: 06/23/23

SAMPLE RESULTS

Lab ID: L2330819-01 D
Client ID: MW-12
Sample Location: ASTORIA, OR

Date Collected: 05/30/23 14:30
Date Received: 06/02/23
Field Prep: Not Specified

Sample Depth:
Matrix: Oil
Analytical Method: 1,8270E-SIM
Analytical Date: 06/21/23 22:07
Analyst: CNC
Percent Solids:

Extraction Method: EPA 3580A
Extraction Date: 06/12/23 09:51

Results reported on an 'AS RECEIVED' basis.

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
PAHs by GC/MS-SIM - Mansfield Lab						
Naphthalene	36300		ug/kg	5000	1960	50
Acenaphthylene	37200		ug/kg	5000	1960	50
Acenaphthene	501000		ug/kg	5000	1940	50
Fluorene	450000		ug/kg	5000	2950	50
Phenanthrene	630000		ug/kg	5000	3220	50
Anthracene	248000		ug/kg	5000	3420	50
Fluoranthene	383000		ug/kg	5000	2300	50
Pyrene	242000		ug/kg	5000	2760	50
Benz(a)anthracene	133000		ug/kg	5000	2460	50
Chrysene	107000		ug/kg	5000	1810	50
Benzo(b)fluoranthene	51600		ug/kg	5000	2390	50
Benzo(k)fluoranthene	59600		ug/kg	5000	1430	50
Benzo(a)pyrene	79500		ug/kg	5000	1450	50
Indeno(1,2,3-cd)pyrene	40400		ug/kg	5000	1420	50
Dibenz(a,h)anthracene	10400		ug/kg	5000	2960	50
Benzo(g,h,i)perylene	40500		ug/kg	5000	3220	50

Surrogate	% Recovery	Qualifier	Acceptance Criteria
2-Methylnaphthalene-d10	**190**	Q	30-130
Pyrene-d10	96		30-130
Benzo(b)fluoranthene-d12	86		30-130

Project Name: PACIFICORP
Project Number: 30167230.00005
Lab Number: L2330819
Report Date: 06/23/23

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8270E-SIM
Analytical Date: 06/21/23 13:50
Analyst: CNC

Extraction Method: EPA 3580A
Extraction Date: 06/12/23 09:51

Parameter	Result	Qualifier	Units	RL	MDL
PAHs by GC/MS-SIM - Mansfield Lab for sample(s): 01 Batch: WG1790050-1					
Naphthalene	ND		ug/kg	100	39.2
Acenaphthylene	ND		ug/kg	100	39.2
Acenaphthene	ND		ug/kg	100	38.9
Fluorene	ND		ug/kg	100	59.1
Phenanthrene	ND		ug/kg	100	64.4
Anthracene	ND		ug/kg	100	68.4
Fluoranthene	ND		ug/kg	100	46.1
Pyrene	ND		ug/kg	100	55.2
Benz(a)anthracene	ND		ug/kg	100	49.2
Chrysene	ND		ug/kg	100	36.3
Benzo(b)fluoranthene	ND		ug/kg	100	47.9
Benzo(k)fluoranthene	ND		ug/kg	100	28.7
Benzo(a)pyrene	ND		ug/kg	100	29.0
Indeno(1,2,3-cd)pyrene	ND		ug/kg	100	28.5
Dibenz(a,h)anthracene	ND		ug/kg	100	59.3
Benzo(g,h,i)perylene	ND		ug/kg	100	64.4

Surrogate	%Recovery	Qualifier	Acceptance Criteria
2-Methylnaphthalene-d10	104		30-130
Pyrene-d10	103		30-130
Benzo(b)fluoranthene-d12	108		30-130

Lab Control Sample Analysis
Batch Quality Control

Project Name: PACIFICORP
Project Number: 30167230.00005

Lab Number: L2330819
Report Date: 06/23/23

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
PAHs by GC/MS-SIM - Mansfield Lab Associated sample(s): 01 Batch: WG1790050-2 WG1790050-3								
Naphthalene	96		100		40-140	4		30
Acenaphthylene	89		91		40-140	2		30
Acenaphthene	89		92		40-140	3		30
Fluorene	98		102		40-140	4		30
Phenanthrene	114		96		40-140	17		30
Anthracene	70		96		40-140	**31**	Q	30
Fluoranthene	99		103		40-140	4		30
Pyrene	90		92		40-140	2		30
Benz(a)anthracene	133		108		40-140	21		30
Chrysene	70		95		40-140	30		30
Benzo(b)fluoranthene	136		123		40-140	10		30
Benzo(k)fluoranthene	69		92		40-140	29		30
Benzo(a)pyrene	68		94		40-140	**32**	Q	30
Indeno(1,2,3-cd)pyrene	129		126		40-140	2		30
Dibenz(a,h)anthracene	111		118		40-140	6		30
Benzo(g,h,i)perylene	126		132		40-140	5		30

Surrogate	LCS %Recovery	Qual	LCSD %Recovery	Qual	Acceptance Criteria
2-Methylnaphthalene-d10	99		102		30-130
Pyrene-d10	97		98		30-130
Benzo(b)fluoranthene-d12	102		105		30-130

PETROLEUM HYDROCARBONS

Project Name: PACIFICORP
Project Number: 30167230.00005
Lab Number: L2330819
Report Date: 06/23/23

SAMPLE RESULTS

Lab ID: L2330819-01
Client ID: MW-12
Sample Location: ASTORIA, OR

Date Collected: 05/30/23 14:30
Date Received: 06/02/23
Field Prep: Not Specified

Sample Depth:
Matrix: Oil
Analytical Method: 1,8015D(M)
Analytical Date: 06/23/09 00:00
Analyst: DMP
Percent Solids:

Extraction Method: NA

Results reported on an 'AS RECEIVED' basis.

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Whole Oil Analysis - Mansfield Lab						
Refer To Case Narrative/Chromatograms			-	-	1.00	1

Project Name: PACIFICORP
Project Number: 30167230.00005

Lab Number: L2330819
Report Date: 06/23/23

Sample Receipt and Container Information

Were project specific reporting limits specified? YES

Cooler Information

Cooler	Custody Seal
NA	Present/Intact

Container Information

Container ID	Container Type	Cooler	Initial pH	Final pH	Temp deg C	Pres	Seal	Frozen Date/Time	Analysis(*)
L2330819-01A	Vial unpreserved 20ml hard-cap	NA	NA			Y	Present/Intact		A2-WHOLEOIL(365),A2-PAH-8270SIM(14)
L2330819-01B	Vial unpreserved 20ml hard-cap	NA	NA			Y	Present/Intact		8260(14)
L2330819-01B9	Vial MeOH preserved split	NA	NA			Y	Absent		8260(14)

*Values in parentheses indicate holding time in days

Project Name:	PACIFICORP	**Lab Number:**	L2330819
Project Number:	30167230.00005	**Report Date:**	06/23/23

GLOSSARY

Acronyms

DL	- Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the limit of quantitation (LOQ). The DL includes any adjustments from dilutions, concentrations or moisture content, where applicable. (DoD report formats only.)
EDL	- Estimated Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The EDL includes any adjustments from dilutions, concentrations or moisture content, where applicable. The use of EDLs is specific to the analysis of PAHs using Solid-Phase Microextraction (SPME).
EMPC	- Estimated Maximum Possible Concentration: The concentration that results from the signal present at the retention time of an analyte when the ions meet all of the identification criteria except the ion abundance ratio criteria. An EMPC is a worst-case estimate of the concentration.
EPA	- Environmental Protection Agency.
LCS	- Laboratory Control Sample: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.
LCSD	- Laboratory Control Sample Duplicate: Refer to LCS.
LFB	- Laboratory Fortified Blank: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.
LOD	- Limit of Detection: This value represents the level to which a target analyte can reliably be detected for a specific analyte in a specific matrix by a specific method. The LOD includes any adjustments from dilutions, concentrations or moisture content, where applicable. (DoD report formats only.)
LOQ	- Limit of Quantitation: The value at which an instrument can accurately measure an analyte at a specific concentration. The LOQ includes any adjustments from dilutions, concentrations or moisture content, where applicable. (DoD report formats only.) Limit of Quantitation: The value at which an instrument can accurately measure an analyte at a specific concentration. The LOQ includes any adjustments from dilutions, concentrations or moisture content, where applicable. (DoD report formats only.)
MDL	- Method Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The MDL includes any adjustments from dilutions, concentrations or moisture content, where applicable.
MS	- Matrix Spike Sample: A sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available. For Method 332.0, the spike recovery is calculated using the native concentration, including estimated values.
MSD	- Matrix Spike Sample Duplicate: Refer to MS.
NA	- Not Applicable.
NC	- Not Calculated: Term is utilized when one or more of the results utilized in the calculation are non-detect at the parameter's reporting unit.
NDPA/DPA	- N-Nitrosodiphenylamine/Diphenylamine.
NI	- Not Ignitable.
NP	- Non-Plastic: Term is utilized for the analysis of Atterberg Limits in soil.
NR	- No Results: Term is utilized when 'No Target Compounds Requested' is reported for the analysis of Volatile or Semivolatile Organic TIC only requests.
RL	- Reporting Limit: The value at which an instrument can accurately measure an analyte at a specific concentration. The RL includes any adjustments from dilutions, concentrations or moisture content, where applicable.
RPD	- Relative Percent Difference: The results from matrix and/or matrix spike duplicates are primarily designed to assess the precision of analytical results in a given matrix and are expressed as relative percent difference (RPD). Values which are less than five times the reporting limit for any individual parameter are evaluated by utilizing the absolute difference between the values; although the RPD value will be provided in the report.
SRM	- Standard Reference Material: A reference sample of a known or certified value that is of the same or similar matrix as the associated field samples.
STLP	- Semi-dynamic Tank Leaching Procedure per EPA Method 1315.
TEF	- Toxic Equivalency Factors: The values assigned to each dioxin and furan to evaluate their toxicity relative to 2,3,7,8-TCDD.
TEQ	- Toxic Equivalent: The measure of a sample's toxicity derived by multiplying each dioxin and furan by its corresponding TEF and then summing the resulting values.
TIC	- Tentatively Identified Compound: A compound that has been identified to be present and is not part of the target compound list (TCL) for the method and/or program. All TICs are qualitatively identified and reported as estimated concentrations.

Report Format: DU Report with 'J' Qualifiers

Project Name:	PACIFICORP	**Lab Number:**	L2330819
Project Number:	30167230.00005	**Report Date:**	06/23/23

Footnotes

1 - The reference for this analyte should be considered modified since this analyte is absent from the target analyte list of the original method.

Terms

Analytical Method: Both the document from which the method originates and the analytical reference method. (Example: EPA 8260B is shown as 1,8260B.) The codes for the reference method documents are provided in the References section of the Addendum.

Chlordane: The target compound Chlordane (CAS No. 57-74-9) is reported for GC ECD analyses. Per EPA,this compound "refers to a mixture of chlordane isomers, other chlorinated hydrocarbons and numerous other components." (Reference: USEPA Toxicological Review of Chlordane, In Support of Summary Information on the Integrated Risk Information System (IRIS), December 1997.)

Difference: With respect to Total Oxidizable Precursor (TOP) Assay analysis, the difference is defined as the Post-Treatment value minus the Pre-Treatment value.

Final pH: As it pertains to Sample Receipt & Container Information section of the report, Final pH reflects pH of container determined after adjustment at the laboratory, if applicable. If no adjustment required, value reflects Initial pH.

Frozen Date/Time: With respect to Volatile Organics in soil, Frozen Date/Time reflects the date/time at which associated Reagent Water-preserved vials were initially frozen. Note: If frozen date/time is beyond 48 hours from sample collection, value will be reflected in 'bold'.

Gasoline Range Organics (GRO): Gasoline Range Organics (GRO) results include all chromatographic peaks eluting from Methyl tert butyl ether through Naphthalene, with the exception of GRO analysis in support of State of Ohio programs, which includes all chromatographic peaks eluting from Hexane through Dodecane.

Initial pH: As it pertains to Sample Receipt & Container Information section of the report, Initial pH reflects pH of container determined upon receipt, if applicable.

PAH Total: With respect to Alkylated PAH analyses, the 'PAHs, Total' result is defined as the summation of results for all or a subset of the following compounds: Naphthalene, C1-C4 Naphthalenes, 2-Methylnaphthalene, 1-Methylnaphthalene, Biphenyl, Acenaphthylene, Acenaphthene, Fluorene, C1-C3 Fluorenes, Phenanthrene, C1-C4 Phenanthrenes/Anthracenes, Anthracene, Fluoranthene, Pyrene, C1-C4 Fluoranthenes/Pyrenes, Benz(a)anthracene, Chrysene, C1-C4 Chrysenes, Benzo(b)fluoranthene, Benzo(j)+(k)fluoranthene, Benzo(e)pyrene, Benzo(a)pyrene, Perylene, Indeno(1,2,3-cd)pyrene, Dibenz(ah)+(ac)anthracene, Benzo(g,h,i)perylene. If a 'Total' result is requested, the results of its individual components will also be reported.

PFAS Total: With respect to PFAS analyses, the 'PFAS, Total (5)' result is defined as the summation of results for: PFHpA, PFHxS, PFOA, PFNA and PFOS. In addition, the 'PFAS, Total (6)' result is defined as the summation of results for: PFHpA, PFHxS, PFOA, PFNA, PFDA and PFOS. For MassDEP DW compliance analysis only, the 'PFAS, Total (6)' result is defined as the summation of results at or above the RL. Note: If a 'Total' result is requested, the results of its individual components will also be reported.

Total: With respect to Organic analyses, a 'Total' result is defined as the summation of results for individual isomers or Aroclors. If a 'Total' result is requested, the results of its individual components will also be reported. This is applicable to 'Total' results for methods 8260, 8081 and 8082.

Data Qualifiers

A - Spectra identified as "Aldol Condensates" are byproducts of the extraction/concentration procedures when acetone is introduced in the process.

B - The analyte was detected above the reporting limit in the associated method blank. Flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For MCP-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For DOD-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank AND the analyte was detected above one-half the reporting limit (or above the reporting limit for common lab contaminants) in the associated method blank. For NJ-Air-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte above the reporting limit. For NJ-related projects (excluding Air), flag only applies to associated field samples that have detectable concentrations of the analyte, which was detected above the reporting limit in the associated method blank or above five times the reporting limit for common lab contaminants (Phthalates, Acetone, Methylene Chloride, 2-Butanone).

C - Co-elution: The target analyte co-elutes with a known lab standard (i.e. surrogate, internal standards, etc.) for co-extracted analyses.

D - Concentration of analyte was quantified from diluted analysis. Flag only applies to field samples that have detectable concentrations of the analyte.

E - Concentration of analyte exceeds the range of the calibration curve and/or linear range of the instrument.

F - The ratio of quantifier ion response to qualifier ion response falls outside of the laboratory criteria. Results are considered to be an estimated maximum concentration.

G - The concentration may be biased high due to matrix interferences (i.e, co-elution) with non-target compound(s). The result should be considered estimated.

H - The analysis of pH was performed beyond the regulatory-required holding time of 15 minutes from the time of sample collection.

I - The lower value for the two columns has been reported due to obvious interference.

J - Estimated value. The Target analyte concentration is below the quantitation limit (RL), but above the Method Detection Limit (MDL) or Estimated Detection Limit (EDL) for SPME-related analyses. This represents an estimated concentration for Tentatively

Report Format: DU Report with 'J' Qualifiers

Project Name:	PACIFICORP	**Lab Number:**	L2330819
Project Number:	30167230.00005	**Report Date:**	06/23/23

Data Qualifiers

Identified Compounds (TICs).

M - Reporting Limit (RL) exceeds the MCP CAM Reporting Limit for this analyte.

ND - Not detected at the method detection limit (MDL) for the sample, or estimated detection limit (EDL) for SPME-related analyses.

NJ - Presumptive evidence of compound. This represents an estimated concentration for Tentatively Identified Compounds (TICs), where the identification is based on a mass spectral library search.

P - The RPD between the results for the two columns exceeds the method-specified criteria.

Q - The quality control sample exceeds the associated acceptance criteria. For DOD-related projects, LCS and/or Continuing Calibration Standard exceedences are also qualified on all associated sample results. Note: This flag is not applicable for matrix spike recoveries when the sample concentration is greater than 4x the spike added or for batch duplicate RPD when the sample concentrations are less than 5x the RL. (Metals only.)

R - Analytical results are from sample re-analysis.

RE - Analytical results are from sample re-extraction.

S - Analytical results are from modified screening analysis.

V - The surrogate associated with this target analyte has a recovery outside the QC acceptance limits. (Applicable to MassDEP DW Compliance samples only.)

Z - The batch matrix spike and/or duplicate associated with this target analyte has a recovery/RPD outside the QC acceptance limits. (Applicable to MassDEP DW Compliance samples only.)

Project Name:	PACIFICORP	**Lab Number:**	L2330819
Project Number:	30167230.00005	**Report Date:**	06/23/23

REFERENCES

1 Test Methods for Evaluating Solid Waste: Physical/Chemical Methods. EPA SW-846. Third Edition. Updates I - VI, 2018.

LIMITATION OF LIABILITIES

Alpha Analytical performs services with reasonable care and diligence normal to the analytical testing laboratory industry. In the event of an error, the sole and exclusive responsibility of Alpha Analytical shall be to re-perform the work at it's own expense. In no event shall Alpha Analytical be held liable for any incidental, consequential or special damages, including but not limited to, damages in any way connected with the use of, interpretation of, information or analysis provided by Alpha Analytical.

We strongly urge our clients to comply with EPA protocol regarding sample volume, preservation, cooling, containers, sampling procedures, holding time and splitting of samples in the field.

Certification Information

The following analytes are not included in our Primary NELAP Scope of Accreditation:

Westborough Facility
EPA 624.1: m/p-xylene, o-xylene, Naphthalene
EPA 625.1: alpha-Terpineol
EPA 8260D: NPW: 1,2,4,5-Tetramethylbenzene; 4-Ethyltoluene, Azobenzene; SCM: Iodomethane (methyl iodide), 1,2,4,5-Tetramethylbenzene; 4-Ethyltoluene.
EPA 8270E: NPW: Dimethylnaphthalene,1,4-Diphenylhydrazine, alpha-Terpineol; SCM: Dimethylnaphthalene,1,4-Diphenylhydrazine.
SM4500: NPW: Amenable Cyanide; SCM: Total Phosphorus, TKN, NO2, NO3.

Mansfield Facility
SM 2540D: TSS.
EPA TO-15: Halothane, 2,4,4-Trimethyl-2-pentene, 2,4,4-Trimethyl-1-pentene, Thiophene, 2-Methylthiophene, 3-Methylthiophene, 2-Ethylthiophene, 1,2,3-Trimethylbenzene, Indan, Indene, 1,2,4,5-Tetramethylbenzene, Benzothiophene, 1-Methylnaphthalene.
Biological Tissue Matrix: EPA 3050B

The following analytes are included in our Massachusetts DEP Scope of Accreditation

Westborough Facility:

Drinking Water
EPA 300.0: Chloride, Nitrate-N, Fluoride, Sulfate; **EPA 353.2**: Nitrate-N, Nitrite-N; **SM4500NO3-F**: Nitrate-N, Nitrite-N; **SM4500F-C, SM4500CN-CE, EPA 180.1, SM2130B, SM4500Cl-D, SM2320B, SM2540C, SM4500H-B, SM4500NO2-B**
EPA 524.2: THMs and VOCs; **EPA 504.1:** EDB, DBCP.
Microbiology: **SM9215B; SM9223-P/A, SM9223B-Colilert-QT,SM9222D**.

Non-Potable Water
SM4500H,B, EPA 120.1, SM2510B, SM2540C, SM2320B, SM4500CL-E, SM4500F-BC, SM4500NH3-BH: Ammonia-N and Kjeldahl-N, **EPA 350.1**: Ammonia-N, **LACHAT 10-107-06-1-B**: Ammonia-N, **EPA 351.1, SM4500NO3-F, EPA 353.2**: Nitrate-N**, SM4500P-E, SM4500P-B, E, SM4500SO4-E, SM5220D, EPA 410.4, SM5210B, SM5310C, SM4500CL-D, EPA 1664, EPA 420.1, SM4500-CN-CE, SM2540D, EPA 300: Chloride, Sulfate, Nitrate.**
EPA 624.1: Volatile Halocarbons & Aromatics,
EPA 608.3: Chlordane, Toxaphene, Aldrin, alpha-BHC, beta-BHC, gamma-BHC, delta-BHC, Dieldrin, DDD, DDE, DDT, Endosulfan I, Endosulfan II, Endosulfan sulfate, Endrin, Endrin Aldehyde, Heptachlor, Heptachlor Epoxide, PCBs
EPA 625.1: SVOC (Acid/Base/Neutral Extractables).
Microbiology: **SM9223B-Colilert-QT; Enterolert-QT, SM9221E, EPA 1600, EPA 1603, SM9222D.**

Mansfield Facility:

Drinking Water
EPA 200.7: Al, Ba, Cd, Cr, Cu, Fe, Mn, Ni, Na, Ag, Ca, Zn. **EPA 200.8:** Al, Sb, As, Ba, Be, Cd, Cr, Cu, Pb, Mn, Ni, Se, Ag, TL, Zn. **EPA 245.1** Hg.
EPA 522, EPA 537.1.

Non-Potable Water
EPA 200.7: Al, Sb, As, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Mo, Ni, K, Se, Ag, Na, Sr, TL, Ti, V, Zn.
EPA 200.8: Al, Sb**,** As, Be, Cd, Cr, Cu, Fe, Pb, Mn, Ni, K, Se, Ag, Na, TL, Zn.
EPA 245.1 Hg.
SM2340B

For a complete listing of analytes and methods, please contact your Alpha Project Manager.

CHAIN OF CUSTODY

PAGE 1 OF 1

ALPHA ANALYTICAL

WESTBORO, MA TEL: 508-898-9220 FAX: 508-898-9193

MANSFIELD, MA TEL: 508-822-9300 FAX: 508-822-3288

Date Rec'd in Lab: 6/2/23

ALPHA Job #: L2330819

Client Information

Client: ARCADIS

Address: 830 NE Holladay St
Portland, OR 97232

Phone: 503-785-9389

Fax:

Email: grace.boyd@arcadis.com

❑ These samples have been previously analyzed by Alpha

Project Information

Project Name: PACIFICORP

Project Location: ASTORIA, OR

Project #: 30167230.00005

Project Manager: Grace Boyd

ALPHA Quote #:

Turn-Around Time

☒ Standard ❑ RUSH (only confirmed if pre-approved!)

Date Due: Time:

Report Information - Data Deliverables

❑ FAX ❑ EMAIL

❑ ADEx ❑ Add'l Deliverables

Billing Information

❑ Same as Client info PO #:

Regulatory Requirements/Report Limits

State /Fed Program	Criteria

Other Project Specific Requirements/Comments/Detection Limits:

ANALYSIS: VOC's 8260; PAH 8310; WHOLE OIL Fingerprint 8015D

SAMPLE HANDLING

Filtration
❑ Done
❑ Not needed
❑ Lab to do
Preservation
❑ Lab to do
(Please specify below)

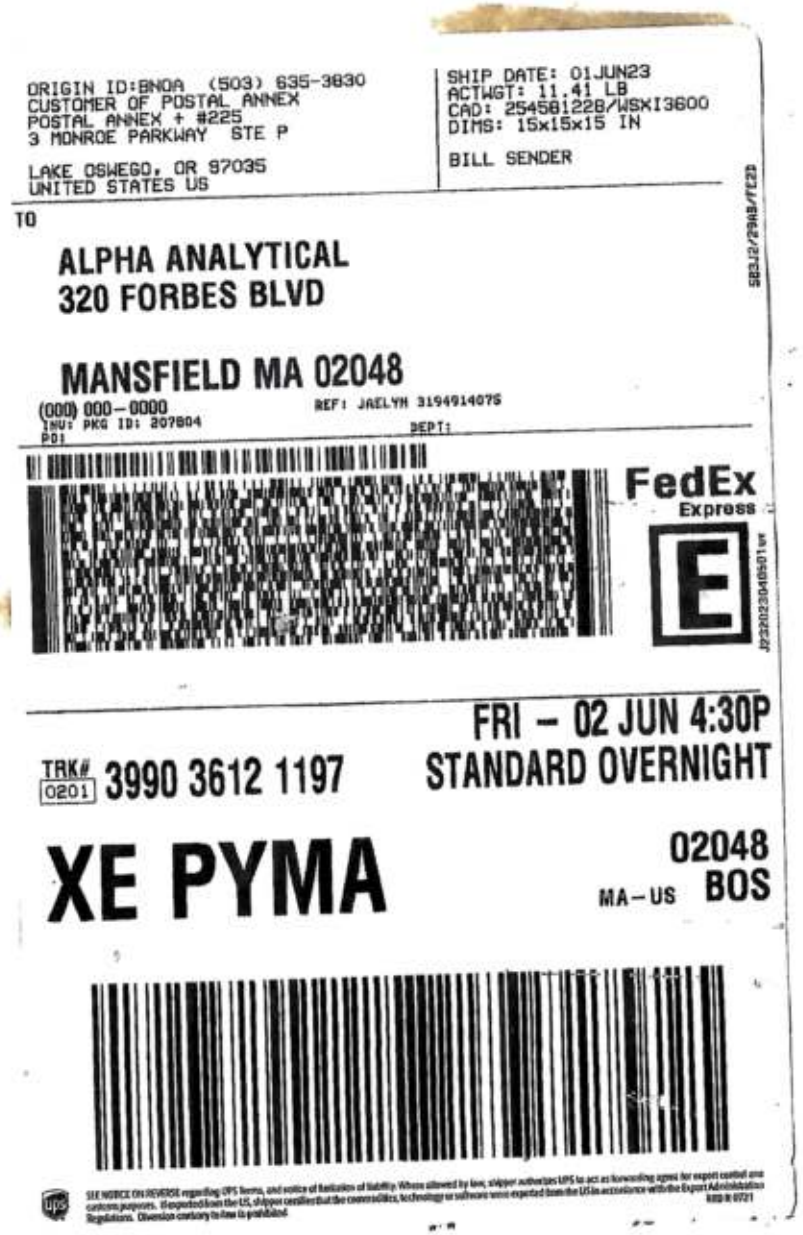
ALPHA Lab ID (Lab Use Only)	Sample ID	Collection Date	Collection Time	Sample Matrix	Sampler's Initials	Sample Specific Comments	TOTAL # BOTTLES
30819 -01	MW-12	5/30/23	1300	OIL	JB, ES		6

Container Type	VOA	VOA	VOA
Preservative	NP	NP	NP

Relinquished By:	Date/Time	Received By:	Date/Time
Fedex	6/1/23 10:09	Fedex	6/1/23 1009

Please print clearly, legibly and completely. Samples can not be logged in and turnaround time clock will not start until any ambiguities are resolved. All samples submitted are subject to Alpha's Terms and Conditions. See reverse side.

FORM NO: 01-01 (rev. 14-OCT-07)



ORIGIN ID:BNOA (503) 635-3830
CUSTOMER OF POSTAL ANNEX
POSTAL ANNEX + #225
3 MONROE PARKWAY STE P

LAKE OSWEGO, OR 97035
UNITED STATES US

SHIP DATE: 01JUN23
ACTWGT: 11.41 LB
CAD: 254581228/WSXI3600
DIMS: 15x15x15 IN

BILL SENDER

TO

ALPHA ANALYTICAL
320 FORBES BLVD

MANSFIELD MA 02048

(000) 000-0000
INV: PKG ID: 207804
PO:

REF: JAELYN 3194914075
DEPT:

FedEx
Express

FRI - 02 JUN 4:30P
STANDARD OVERNIGHT

TRK# 0201 3990 3612 1197

XE PYMA

02048
MA-US BOS

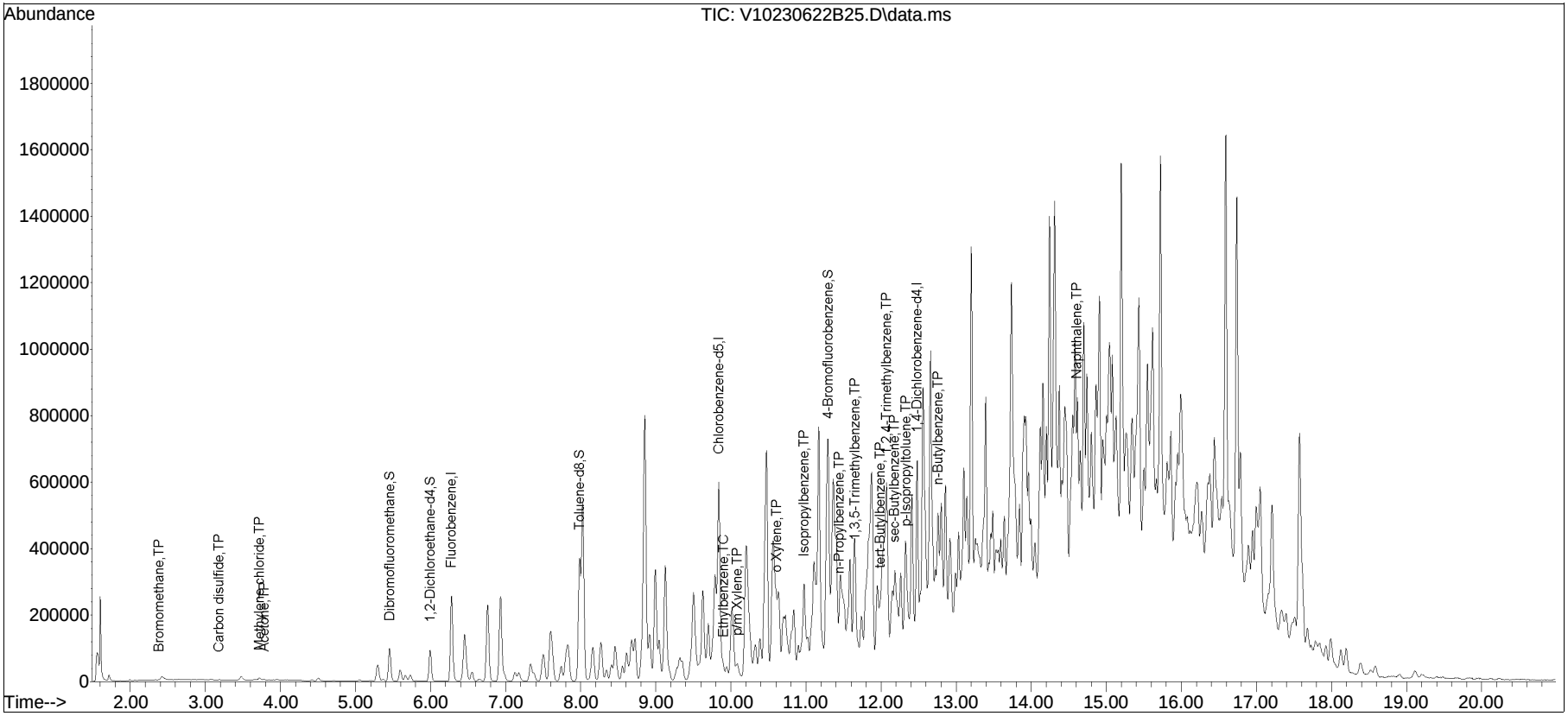
SEE NOTICE ON REVERSE regarding CPS liens, and notice of limitation of liability. Where allowed by law, shipper authorizes UPS to act as forwarding agent for export control and customs purposes. If shipment is from the US, shipper certifies that the commodities, technology or software were exported from the US in accordance with the Export Administration Regulations. Diversion contrary to law is prohibited.

Quantitation Report (QT Reviewed)

Data Path : K:\VOA110\2023\230622B\
Data File : V10230622B25.D
Acq On : 22 Jun 2023 11:16 pm
Operator : VOA110:JIC
Sample : L2330819-01D,31,0.98,10,0.01,,B9
Misc : WG1795310,ICAL20119
ALS Vial : 25 Sample Multiplier: 1

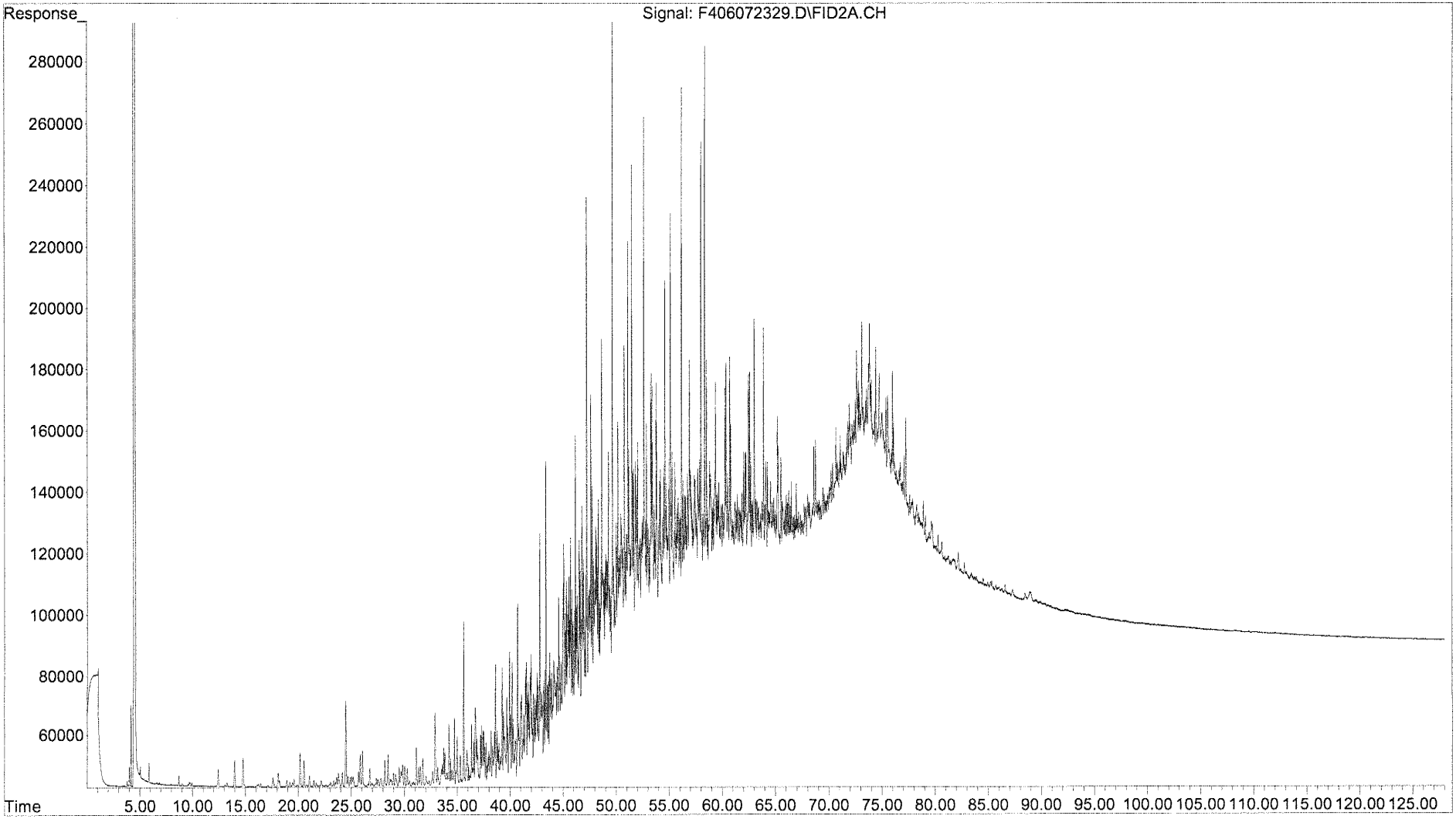
Quant Time: Jun 23 07:23:50 2023
Quant Method : K:\VOA110\2023\230622B\V110_230622A_8260.m
Quant Title : VOLATILES BY GC/MS
QLast Update : Thu Jun 22 09:59:23 2023
Response via : Initial Calibration

Sub List : 8260-Reg - Regular 826022B\V10230622B01.D•



Whole Oil by GC-FID Chromatograms

File :O:\Forensics\Data\PAH4\2023\JUN23\JUN07.SEC\F406072329.D
Operator : AC
Acquired : 09 Jun 2023 1:03 pm using AcqMethod WHOIL4A.M
Instrument : PAH 4
Sample Name: L2330819-01
Misc Info : dcm added
Vial Number: 65



Whole Oil Reference Oils

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File       :O:\Forensics\Data\PAH4\2023\JUN23\JUN07.SEC\F406072323.D
Operator   : AC
Acquired   : 08 Jun 2023    7:32 pm using AcqMethod WHOIL4A.M
Instrument :    PAH 4
Sample Name: C406072302R
Misc Info  : CC
Vial Number: 62
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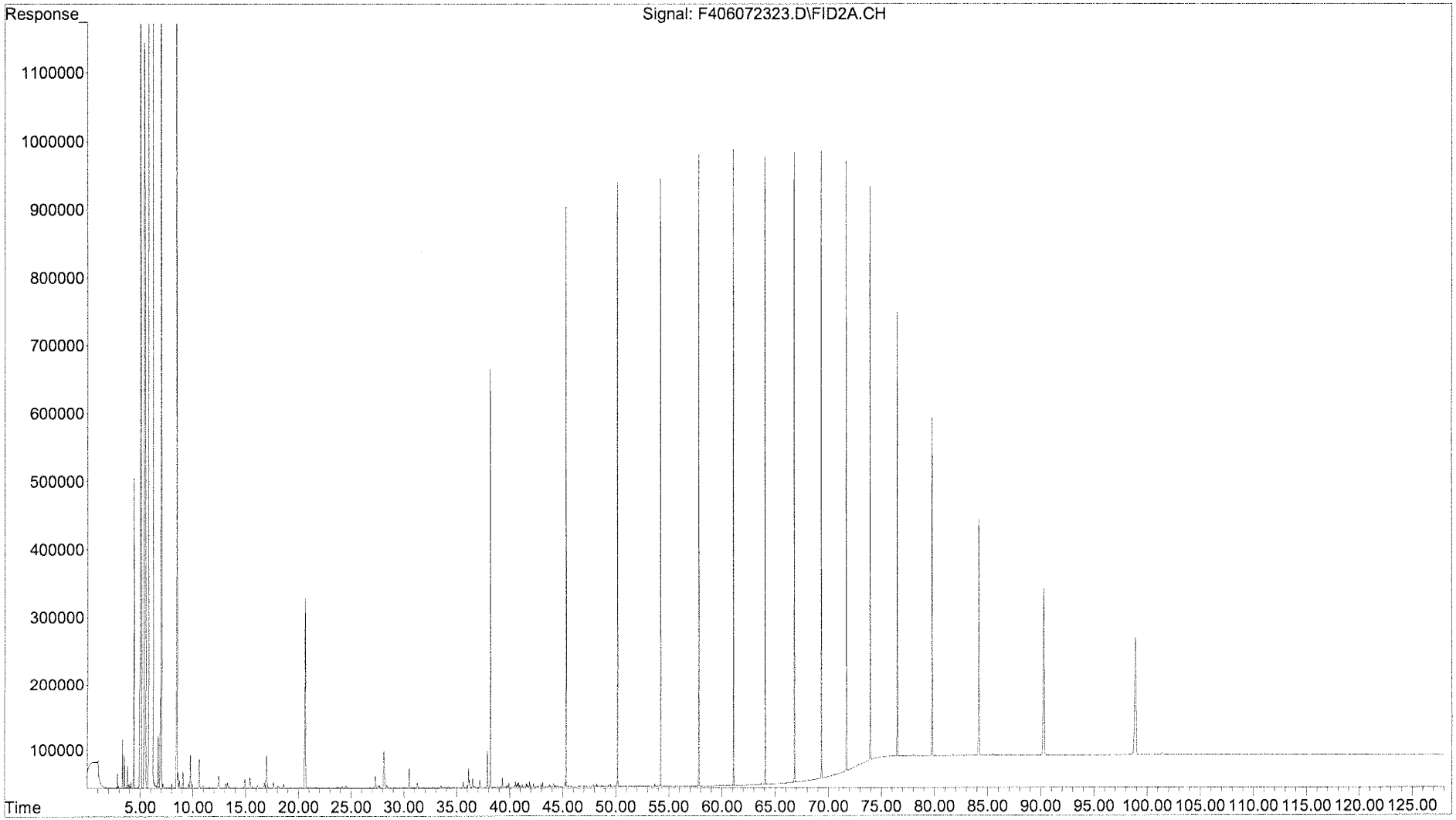

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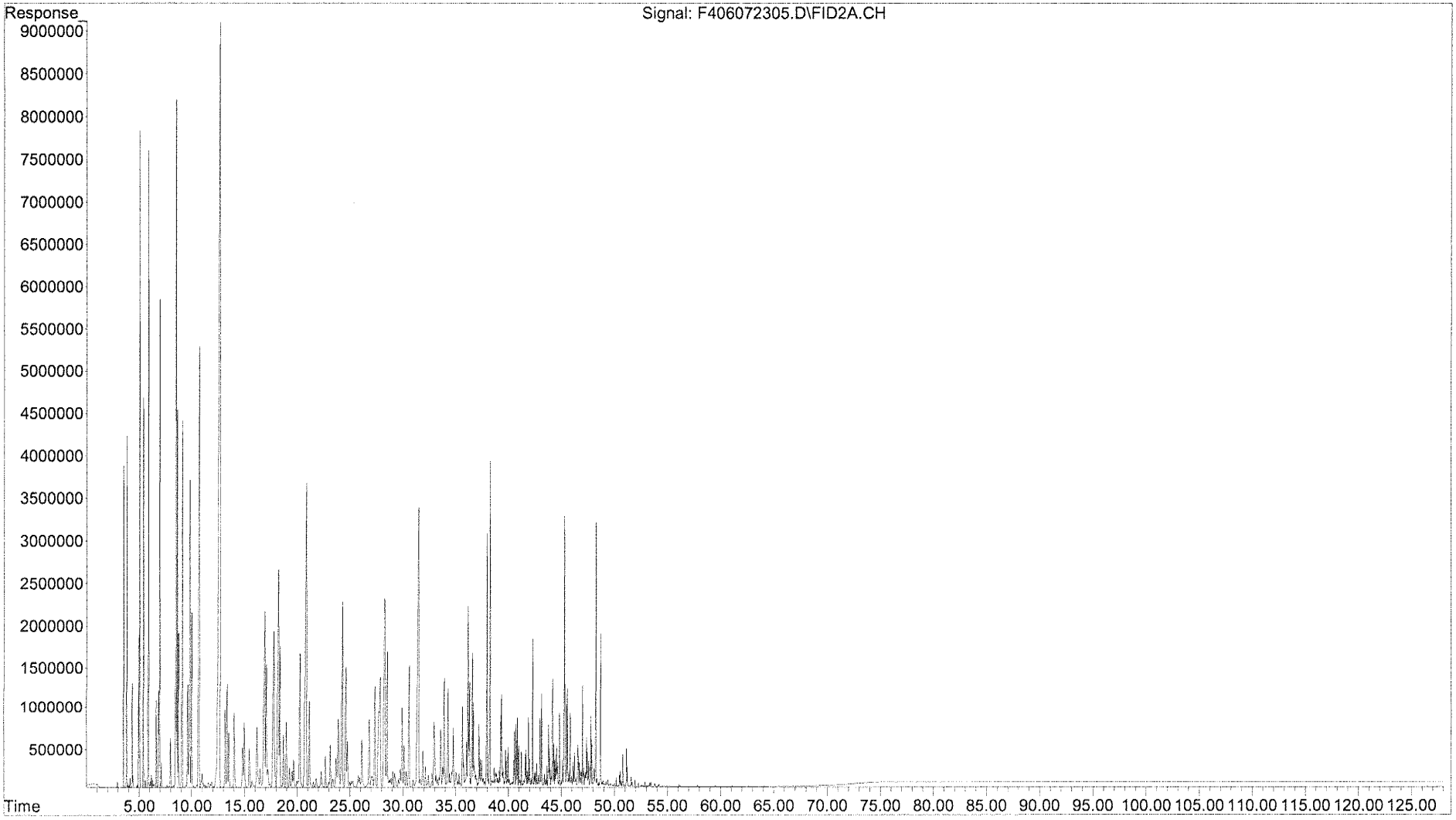
Operator : AC
Acquired : 07 Jun 2023 6:41 pm using AcqMethod WHOIL4A.M
Instrument : PAH 4
Sample Name: LD7406072301
Misc Info : F012605B
Vial Number: 53



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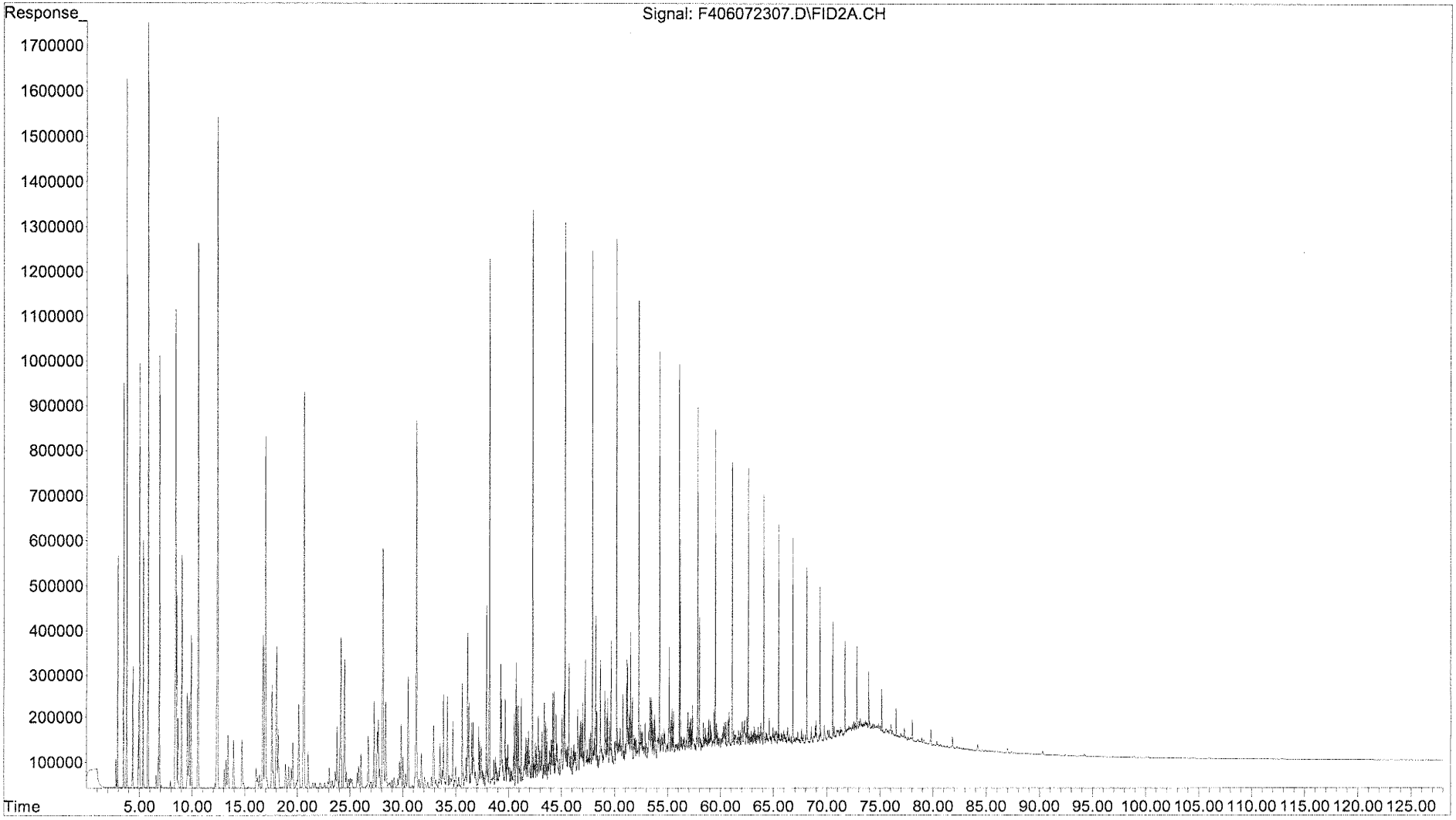
Acquired : 07 Jun 2023 9:15 pm using AcqMethod WHOIL4A.M
Instrument : PAH 4
Sample Name: ANS406072301
Misc Info : S210303G
Vial Number: 54



ANALYTICAL REPORT

June 20, 2023

ARCADIS - Portland, OR

Sample Delivery Group:	L1621658
Samples Received:	06/01/2023
Project Number:	30167230.00005
Description:	
Site:	PACIFICORP ASTORIA
Report To:	Grace Boyd 830 NE Holladay St. Suite 109 Portland, OR 97232

Entire Report Reviewed By:

Brian Ford

Project Manager

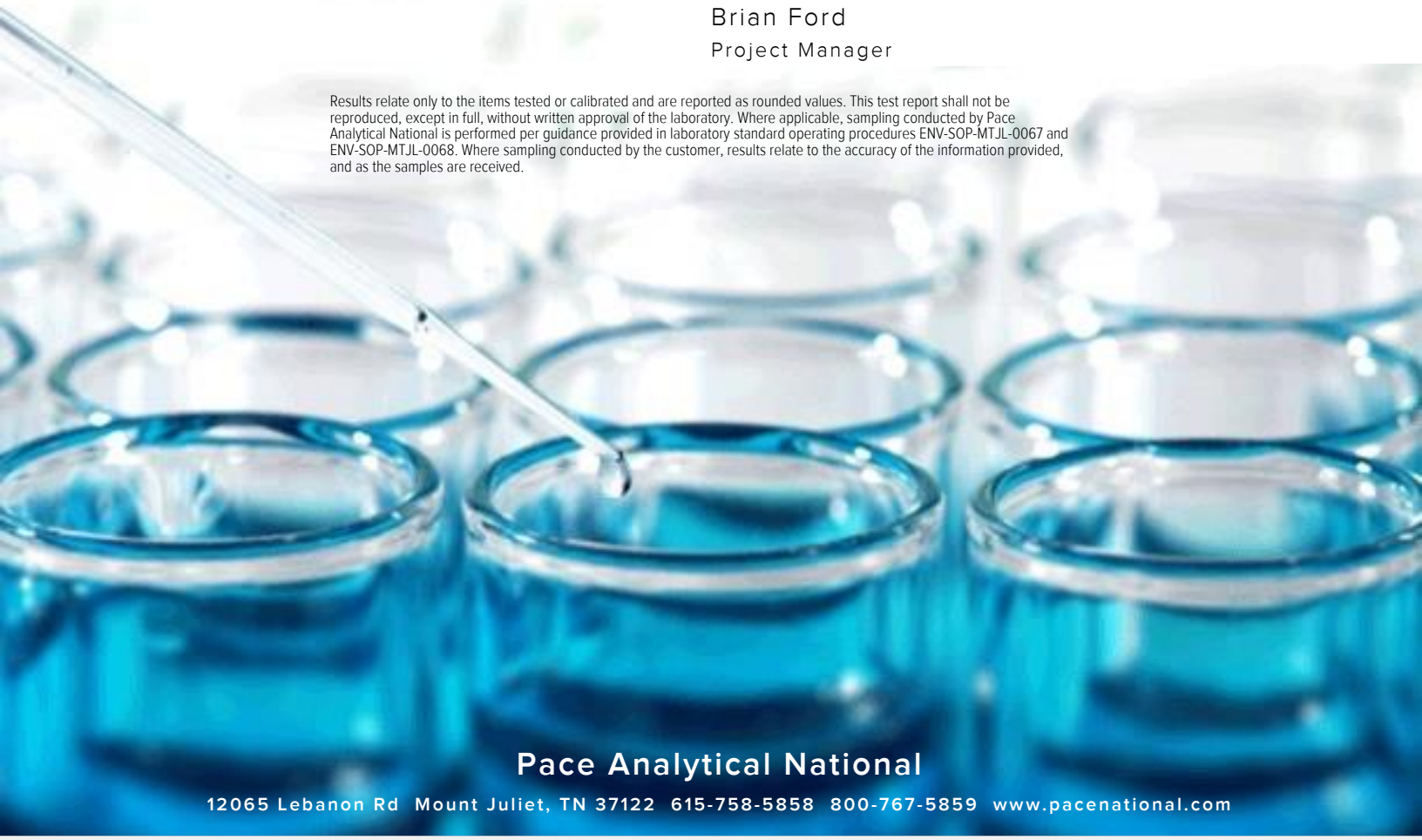


TABLE OF CONTENTS

SAMPLE SUMMARY

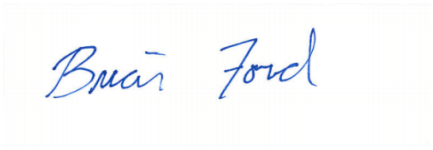
MW-12 L1621658-01 Solid

			Collected by	Collected date/time	Received date/time
				05/30/23 13:00	06/01/23 09:00

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Subcontracted Analyses	WG2069948	1	06/19/23 00:00	06/19/23 00:00	-	Subcontract

CASE NARRATIVE

All sample aliquots were received at the correct temperature, in the proper containers, with the appropriate preservatives, and within method specified holding times, unless qualified or notated within the report. Where applicable, all MDL (LOD) and RDL (LOQ) values reported for environmental samples have been corrected for the dilution factor used in the analysis. All Method and Batch Quality Control are within established criteria except where addressed in this case narrative, a non-conformance form or properly qualified within the sample results. By my digital signature below, I affirm to the best of my knowledge, all problems/anomalies observed by the laboratory as having the potential to affect the quality of the data have been identified by the laboratory, and no information or data have been knowingly withheld that would affect the quality of the data.



Brian Ford
Project Manager

Project Narrative

L1621658 -01 contains subout data that is included after the chain of custody.

GLOSSARY OF TERMS

Guide to Reading and Understanding Your Laboratory Report

The information below is designed to better explain the various terms used in your report of analytical results from the Laboratory. This is not intended as a comprehensive explanation, and if you have additional questions please contact your project representative.

Results Disclaimer - Information that may be provided by the customer, and contained within this report, include Permit Limits, Project Name, Sample ID, Sample Matrix, Sample Preservation, Field Blanks, Field Spikes, Field Duplicates, On-Site Data, Sampling Collection Dates/Times, and Sampling Location. Results relate to the accuracy of this information provided, and as the samples are received.

Abbreviations and Definitions

SDG	Sample Delivery Group.
Uncertainty (Radiochemistry)	Confidence level of 2 sigma.
Case Narrative (Cn)	A brief discussion about the included sample results, including a discussion of any non-conformances to protocol observed either at sample receipt by the laboratory from the field or during the analytical process. If present, there will be a section in the Case Narrative to discuss the meaning of any data qualifiers used in the report.
Quality Control Summary (Qc)	This section of the report includes the results of the laboratory quality control analyses required by procedure or analytical methods to assist in evaluating the validity of the results reported for your samples. These analyses are not being performed on your samples typically, but on laboratory generated material.
Sample Chain of Custody (Sc)	This is the document created in the field when your samples were initially collected. This is used to verify the time and date of collection, the person collecting the samples, and the analyses that the laboratory is requested to perform. This chain of custody also documents all persons (excluding commercial shippers) that have had control or possession of the samples from the time of collection until delivery to the laboratory for analysis.
Sample Results (Sr)	This section of your report will provide the results of all testing performed on your samples. These results are provided by sample ID and are separated by the analyses performed on each sample. The header line of each analysis section for each sample will provide the name and method number for the analysis reported.
Sample Summary (Ss)	This section of the Analytical Report defines the specific analyses performed for each sample ID, including the dates and times of preparation and/or analysis.

Qualifier Description

The remainder of this page intentionally left blank, there are no qualifiers applied to this SDG.

ACCREDITATIONS & LOCATIONS

Pace Analytical National 12065 Lebanon Rd Mount Juliet, TN 37122

Alabama	40660	Nebraska	NE-OS-15-05
Alaska	17-026	Nevada	TN000032021-1
Arizona	AZ0612	New Hampshire	2975
Arkansas	88-0469	New Jersey–NELAP	TN002
California	2932	New Mexico [1]	TN00003
Colorado	TN00003	New York	11742
Connecticut	PH-0197	North Carolina	Env375
Florida	E87487	North Carolina [1]	DW21704
Georgia	NELAP	North Carolina [3]	41
Georgia [1]	923	North Dakota	R-140
Idaho	TN00003	Ohio–VAP	CL0069
Illinois	200008	Oklahoma	9915
Indiana	C-TN-01	Oregon	TN200002
Iowa	364	Pennsylvania	68-02979
Kansas	E-10277	Rhode Island	LAO000356
Kentucky [1 6]	KY90010	South Carolina	84004002
Kentucky [2]	16	South Dakota	n/a
Louisiana	AI30792	Tennessee [1 4]	2006
Louisiana	LA018	Texas	T104704245-20-18
Maine	TN00003	Texas [5]	LAB0152
Maryland	324	Utah	TN000032021-11
Massachusetts	M-TN003	Vermont	VT2006
Michigan	9958	Virginia	110033
Minnesota	047-999-395	Washington	C847
Mississippi	TN00003	West Virginia	233
Missouri	340	Wisconsin	998093910
Montana	CERT0086	Wyoming	A2LA
A2LA – ISO 17025	1461.01	AIHA-LAP,LLC EMLAP	100789
A2LA – ISO 17025 [5]	1461.02	DOD	1461.01
Canada	1461.01	USDA	P330-15-00234
EPA–Crypto	TN00003		

[1] Drinking Water [2] Underground Storage Tanks [3] Aquatic Toxicity [4] Chemical/Microbiological [5] Mold [6] Wastewater n/a Accreditation not applicable

* Not all certifications held by the laboratory are applicable to the results reported in the attached report.

* Accreditation is only applicable to the test methods specified on each scope of accreditation held by Pace Analytical.

Company Name/Address:
ARCADIS - Portland, OR

830 NE Holladay St.
Suite 109
Portland, OR 97232

Billing Information:
Attn: Accounts Payable
630 Plaza Drive, Suite 600
Highlands Ranch, CO 80129

Pres Chk

Report to:
Grace Boyd

Email To:
Grace.Boyd@arcadis.com;Jaelyn.Bowers@arcad

Project Description:

City/State Collected: Astoria, OR

Please Circle: (PT) MT CT ET

Phone: **503-785-9405**

Client Project #
30167230.00005

Lab Project #
LFRPOR-PACIFICORP

Collected by (print):
Elijah Jones

Site/Facility ID #
PACIFICORP ASTORIA

P.O. #

Collected by (signature):

Immediately Packed on Ice N ___ Y X

Rush? (Lab MUST Be Notified)
___ Same Day ___ Five Day
___ Next Day ___ 5 Day (Rad Only)
___ Two Day ___ 10 Day (Rad Only)
___ Three Day

Quote #

Date Results Needed
STAT

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	DENSITY 40mlAmb-NoPres	TENSION 100ml Amb NoPres	TENSION 40mlAmb-NoPres	VISCOSITY 40mlAmb-NoPres	Remarks	Sample # (lab only)
MW-12	G	OIL		5/30/23	1300	7	X	X	X	6		-01

Chain of Custody Page 1 of 1

Pace
PEOPLE ADVANCING SCIENCE

MT JULIET, TN
12065 Lebanon Rd Mount Juliet, TN 37122
Submitting a sample via this chain of custody constitutes acknowledgment and acceptance of the Pace Terms and Conditions found at: https://info.pacelabs.com/hubfs/pas-standard-terms.pdf

SDG # L1621658

F046

Acctnum: **LFRPOR**
Template: **T230587**
Prelogin: **P1000069**
PM: **110 - Brian Ford**
PB:

Shipped Via:

* Matrix:
SS - Soil **AIR** - Air **F** - Filter
GW - Groundwater **B** - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other____

Remarks:

pH ____ Temp ____
Flow ____ Other ____

Samples returned via:
__ UPS V FedEx __ Courier ____

Tracking # 6295 1089 8023

Sample Receipt Checklist
COC Seal Present/Intact: NP Y N
COC Signed/Accurate: Y N
Bottles arrive intact: Y N
Correct bottles used: Y N
Sufficient volume sent: Y N
If Applicable
VOA Zero Headspace: Y N
Preservation Correct/Checked: Y N
RAD Screen <0.5 mR/hr: Y N

Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)	Trip Blank Received: Yes / No HCL / MeoH TBR	If preservation required by Login: Date/Time
	5/31/23	1505		0	
Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)	Temp: USA7 °C Bottles Received:	
	5/31/23	1600	FedEx	3.1+0=3.1 7	
Relinquished by : (Signature)	Date:	Time:	Received for lab by: (Signature)	Date:	Time:	Hold:	Condition: NCF / OK
				6/1/23	0900		

PADOR

Pace Analytical
Contact: Jimmy Huckaba
Address: Pace Analytical
12065 Lebanon Road
Mt. Juliet, TN 37122
Ph: 615.773.9775 Fax:
Email: MTJLSuboutTeam@pacelabs.com

FINAL REPORT
This report and the data within has completed QA/QC review

CLARK TESTING

Fuels & Lubrication Lab
1801 Route 51 South
Building 9
Jefferson Hills, PA 15025
Ph: 412-387-1001
Fax: 412-387-1028

Pace Analytical	**2019**	**Lube Supplier**	**Level 3**
Pace/Mt. Juliet, TN	Pace/Mt. Juliet, TN	Unknown	Make: UNKNOWN
L1621658-01 (MW-12)	L1621658-01 (MW-12)		Model: UNKNOWN
L1621658-01 (MW-12)	L1621658-01 (MW-12)	**Lube Type**	**Level 4**
	Client Sample# L1621658-01 (MW-12)	Unknown	Make: UNKNOWN
	PO# L1621658		Model: UNKNOWN
			Serial No: UNKNOWN

1	2	3	4	5
Normal		Abnormal		Critical

Tracking #	420774-1
Client Sample #	L1621658-01 (MW-12)
Sample Date	05/30/2023
Received Date	06/02/2023
Time on Oil	
Time on Unit	
Mach Cond	-
Lube Cond	-

General Diagnostic Notes

No additional notes

Digital Density at 15C

Test Code: D4052 / method: D4052

Sample Date		05/30/2023		
Result Date		06/19/2023	REF	
Tracking #		420774-1	LOWER	UPPER
Density	*g/cm3*	0.96746	-	-

Kinematic Viscosity - ASTM D445 40C - new

Test Code: VISC40 new / method: D445, SOP 0107

Sample Date		05/30/2023		
Result Date		06/19/2023	REF	
Tracking #		420774-1	LOWER	UPPER
Viscosity @40C	*cSt*	419.79	-	-

Oil/Water Interface, Interfacial Tension

Test Code: D971 / method: D971

Sample Date		05/30/2023		
Result Date		06/19/2023	REF	
Tracking #		420774-1	LOWER	UPPER
Result	*Dynes/centimeter*	30.08	-	-

Comments for section

D971 - Interfacial Tension performed with DI H2O as per client's request.

Authorized Signature

Final Approval:  Date: 06/19/2023

Pat Stockton

Results relate only to items tested.

Appendix E

Groundwater Monitoring Field Data Sheets

Groundwater Sampling Form

ARCADIS

Project Number	30167230	**Well ID**	MW-15			**Date**	05/31/2023
Project Name/Location	PACIFICORP/UNOCAL ASTORIA-LNAPL Recovery, Assessment, and Reporting	**Weather(°F)**					
Measuring Pt. Description	Top of Inner Casing	**MP Elevation**		**Casing Diameter (in)**	4	**Well Casing Material**	PVC
Static Water Level (ft-bmp)	10.30	**Total Depth (ft-bmp)**	25.6	**Water Column (ft)**	15.3	**Gallons in Well**	9.49
Purge Start	11:03	**Pump Intake (ft-bmp)**	17	**Purge Method**	Low-Flow	**Purge Equipment**	Peristaltic
Purge End	11:48	**Volumes Purged**	0.73	**Sample ID**	MW-15	**Sampled by**	Jaelyn Bowers
Sample Time	11:30	**Gallons Purged**	1.82	**Replicate/ Code No.**	NA	**Sample Type**	Grab

Time	Minutes Elapsed	Total Elapsed Minutes	Rate mL/min	Depth to Water (ft)	Gallons Purged	pH (standard units)	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temperature °C	Redox (mV)	Appearance	
												Color	Odor
11:03	0	0	300	10.30	0.00	11.36	0.502	38.3	2.71	13.15	73	--	--
11:06	3	3	300	10.30	0.24	10.75	0.485	38.6	1.72	13	77	--	--
11:09	3	6	300	10.30	0.24	10.01	0.482	36.2	1.5	12.94	93	--	--
11:12	3	9	300	10.30	0.24	9.8	0.482	37	0.93	12.91	94	--	--
11:15	3	12	300	10.30	0.24	9.58	0.483	37.1	7.9	12.91	101	--	--
11:18	3	15	300	10.30	0.24	9.36	0.482	34.9	0.84	12.97	104	--	--
11:21	3	18	300	10.30	0.24	9.22	0.473	35	0.97	12.95	106	--	--
11:23	2	20	300	10.30	0.24	9.24	0.475	35.4	0.99	12.99	104	--	--
11:26	3	23	300	10.30	0.24	9.26	0.475	36.2	1.02	13.04	102	Clear	None

Constituent Sampled	Container	Number	Preservative

Comments:

Well Casing Volume Conversion

Well diameter (inches) = gallons per foot

1 = 0.04; 1.5 = 0.09; 2.5 = 0.26; 3.5 = 0.50; 6 = 1.47
1.25 = 0.06; 2 = 0.16; 3 = 0.37; 4 = 0.65

Well Information

Well Location:	In locked gate area, directly to left of entrance	Well Locked at Arrival:	yes
Condition of Well:	Good condition	Well Locked at Departure:	yes
Well Completion:	Flush mount	Key Number To Well:	NA

ft-bmp = feet below measuring point
in = inches
ft = feet
mL/min = milliliters per minute

mS/cm = milliSiemens per centimeter
NTU = Nephelometric Turbidity Unit
mg/L = milligrams per liter

mV = millivolts
°F = degrees Fahrenheit
°C = degrees Celsius

Appendix F

Groundwater Laboratory Report and Chain-of-Custody Documentation

ANALYTICAL REPORT

June 20, 2023

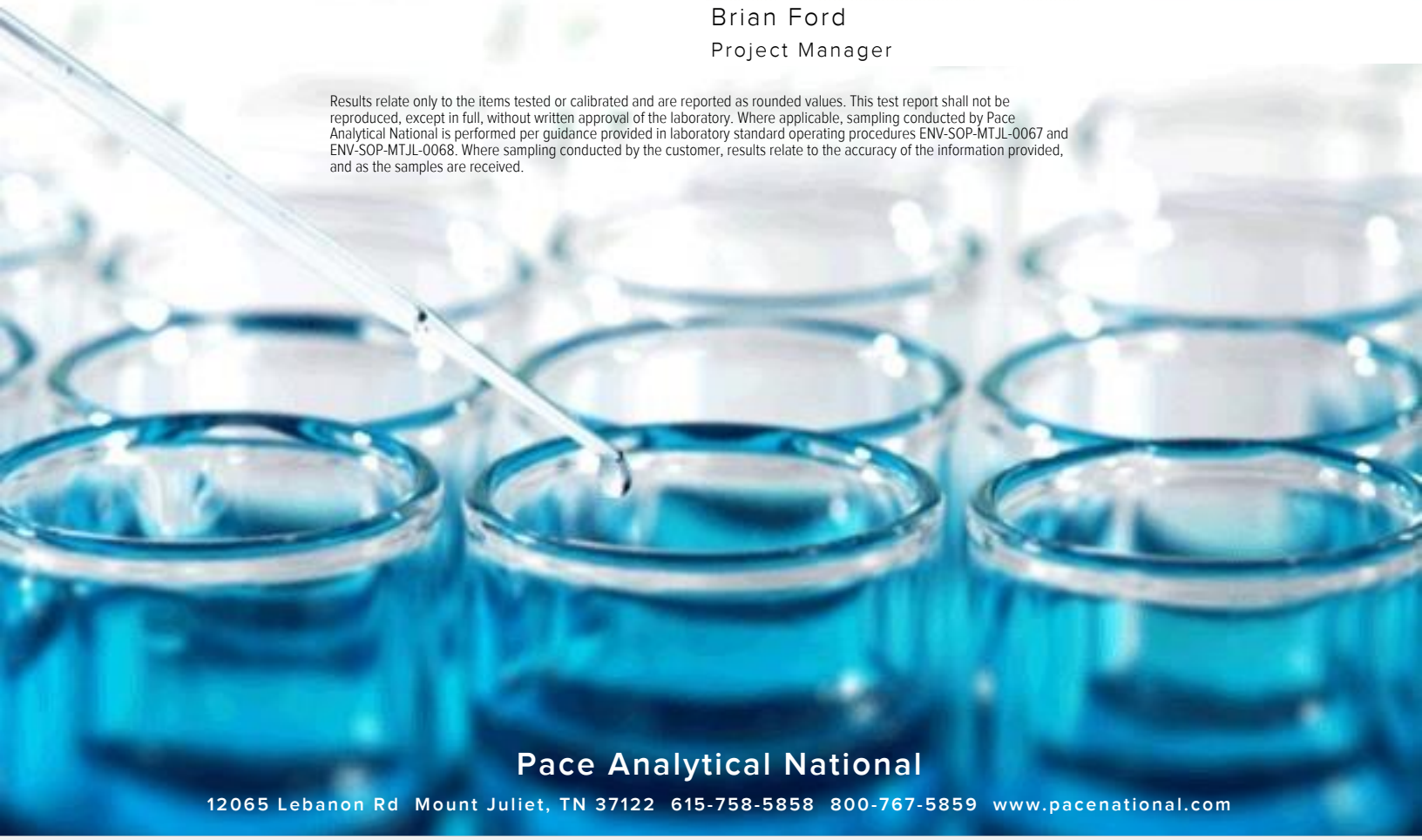
ARCADIS - Portland, OR

Sample Delivery Group:	L1621655
Samples Received:	06/01/2023
Project Number:	30167230.00005
Description:	
Site:	PACIFICORP ASTORIA
Report To:	Grace Boyd 830 NE Holladay St. Suite 109 Portland, OR 97232

Entire Report Reviewed By:

Brian Ford

Project Manager



Pace Analytical National

12065 Lebanon Rd Mount Juliet, TN 37122 615-758-5858 800-767-5859 www.pacenational.com

TABLE OF CONTENTS

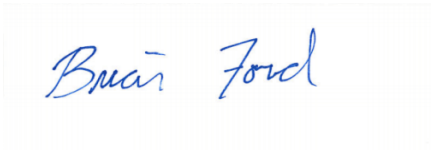
MW-15 L1621655-01 GW

Collected by	Collected date/time	Received date/time
	05/31/23 11:30	06/01/23 09:00

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Calculated Results	WG2070022	1	06/07/23 18:26	06/07/23 18:26	ZSA	Mt. Juliet, TN
Gravimetric Analysis by Method 2540 D-2015	WG2071667	1	06/05/23 10:48	06/05/23 10:50	MMF	Mt. Juliet, TN
Wet Chemistry by Method 300.0	WG2078957	1	06/17/23 02:07	06/17/23 02:07	GEB	Mt. Juliet, TN
Wet Chemistry by Method 350.1	WG2070654	1	06/03/23 18:53	06/03/23 18:53	AEC	Mt. Juliet, TN
Wet Chemistry by Method 9060A	WG2076048	1	06/17/23 16:14	06/17/23 16:14	AW	Mt. Juliet, TN
Metals (ICP) by Method 6010D	WG2070022	1	06/05/23 13:56	06/07/23 18:26	ZSA	Mt. Juliet, TN
Volatile Organic Compounds (GC) by Method NWTPHGX	WG2073774	1	06/08/23 14:35	06/08/23 14:35	DWR	Mt. Juliet, TN
Volatile Organic Compounds (GC/MS) by Method 8260D	WG2071986	1	06/05/23 22:31	06/05/23 22:31	JAH	Mt. Juliet, TN
Semi-Volatile Organic Compounds (GC) by Method NWTPHDX-NO SGT	WG2073474	1.1	06/08/23 06:54	06/09/23 18:24	HLJ	Mt. Juliet, TN
Semi-Volatile Organic Compounds (GC) by Method NWTPHDX-SGT	WG2072824	1.1	06/08/23 06:56	06/09/23 16:31	HLJ	Mt. Juliet, TN
Semi Volatile Organic Compounds (GC/MS) by Method 8270E-SIM	WG2071008	1	06/04/23 06:10	06/04/23 13:01	DLH	Mt. Juliet, TN

CASE NARRATIVE

All sample aliquots were received at the correct temperature, in the proper containers, with the appropriate preservatives, and within method specified holding times, unless qualified or notated within the report. Where applicable, all MDL (LOD) and RDL (LOQ) values reported for environmental samples have been corrected for the dilution factor used in the analysis. All Method and Batch Quality Control are within established criteria except where addressed in this case narrative, a non-conformance form or properly qualified within the sample results. By my digital signature below, I affirm to the best of my knowledge, all problems/anomalies observed by the laboratory as having the potential to affect the quality of the data have been identified by the laboratory, and no information or data have been knowingly withheld that would affect the quality of the data.



Brian Ford
Project Manager

Calculated Results

Analyte	Result ug/l	Qualifier	MDL ug/l	RDL ug/l	Dilution	Analysis date / time	Batch
Hardness (calculated) as CaCO3	107000		198	2500	1	06/07/2023 18:26	WG2070022

Gravimetric Analysis by Method 2540 D-2015

Analyte	Result ug/l	Qualifier	RDL ug/l	Dilution	Analysis date / time	Batch
Suspended Solids	14800		5000	1	06/05/2023 10:50	WG2071667

Wet Chemistry by Method 300.0

Analyte	Result ug/l	Qualifier	MDL ug/l	RDL ug/l	Dilution	Analysis date / time	Batch
Nitrate as (N)	4010	Q	48.0	100	1	06/17/2023 02:07	WG2078957
Sulfate	34000		594	5000	1	06/17/2023 02:07	WG2078957

Wet Chemistry by Method 350.1

Analyte	Result ug/l	Qualifier	MDL ug/l	RDL ug/l	Dilution	Analysis date / time	Batch
Ammonia Nitrogen	U		117	250	1	06/03/2023 18:53	WG2070654

Wet Chemistry by Method 9060A

Analyte	Result ug/l	Qualifier	MDL ug/l	RDL ug/l	Dilution	Analysis date / time	Batch
TOC (Total Organic Carbon)	2680		102	1000	1	06/17/2023 16:14	WG2076048

Metals (ICP) by Method 6010D

Analyte	Result ug/l	Qualifier	MDL ug/l	RDL ug/l	Dilution	Analysis date / time	Batch
Calcium	29200		79.3	1000	1	06/07/2023 18:26	WG2070022
Magnesium	8270		85.3	1000	1	06/07/2023 18:26	WG2070022

Volatile Organic Compounds (GC) by Method NWTPHGX

Analyte	Result ug/l	Qualifier	MDL ug/l	RDL ug/l	Dilution	Analysis date / time	Batch
Gasoline Range Organics-NWTPH	U		31.6	100	1	06/08/2023 14:35	WG2073774
(S) a,a,a-Trifluorotoluene(FID)	*114*			*78.0-120*		*06/08/2023 14:35*	WG2073774

Volatile Organic Compounds (GC/MS) by Method 8260D

Analyte	Result ug/l	Qualifier	MDL ug/l	RDL ug/l	Dilution	Analysis date / time	Batch
Acetone	U		11.3	50.0	1	06/05/2023 22:31	WG2071986
Acrolein	U	C3	2.54	50.0	1	06/05/2023 22:31	WG2071986
Acrylonitrile	U		0.671	10.0	1	06/05/2023 22:31	WG2071986
Benzene	U		0.0941	1.00	1	06/05/2023 22:31	WG2071986
Bromobenzene	U		0.118	1.00	1	06/05/2023 22:31	WG2071986
Bromodichloromethane	U		0.136	1.00	1	06/05/2023 22:31	WG2071986
Bromoform	U		0.129	1.00	1	06/05/2023 22:31	WG2071986
Bromomethane	U		0.605	5.00	1	06/05/2023 22:31	WG2071986
n-Butylbenzene	U		0.157	1.00	1	06/05/2023 22:31	WG2071986
sec-Butylbenzene	U		0.125	1.00	1	06/05/2023 22:31	WG2071986
tert-Butylbenzene	U		0.127	1.00	1	06/05/2023 22:31	WG2071986
Carbon tetrachloride	U		0.128	1.00	1	06/05/2023 22:31	WG2071986

Volatile Organic Compounds (GC/MS) by Method 8260D

Analyte	Result	Qualifier	MDL	RDL	Dilution	Analysis	Batch
	ug/l		ug/l	ug/l		date / time	
Chlorobenzene	U		0.116	1.00	1	06/05/2023 22:31	WG2071986
Chlorodibromomethane	U		0.140	1.00	1	06/05/2023 22:31	WG2071986
Chloroethane	U		0.192	5.00	1	06/05/2023 22:31	WG2071986
Chloroform	U		0.111	5.00	1	06/05/2023 22:31	WG2071986
Chloromethane	U		0.960	2.50	1	06/05/2023 22:31	WG2071986
2-Chlorotoluene	U		0.106	1.00	1	06/05/2023 22:31	WG2071986
4-Chlorotoluene	U		0.114	1.00	1	06/05/2023 22:31	WG2071986
1,2-Dibromo-3-Chloropropane	U		0.276	5.00	1	06/05/2023 22:31	WG2071986
1,2-Dibromoethane	U		0.126	1.00	1	06/05/2023 22:31	WG2071986
Dibromomethane	U		0.122	1.00	1	06/05/2023 22:31	WG2071986
1,2-Dichlorobenzene	U		0.107	1.00	1	06/05/2023 22:31	WG2071986
1,3-Dichlorobenzene	U		0.110	1.00	1	06/05/2023 22:31	WG2071986
1,4-Dichlorobenzene	U		0.120	1.00	1	06/05/2023 22:31	WG2071986
Dichlorodifluoromethane	U		0.374	5.00	1	06/05/2023 22:31	WG2071986
1,1-Dichloroethane	U		0.100	1.00	1	06/05/2023 22:31	WG2071986
1,2-Dichloroethane	U		0.0819	1.00	1	06/05/2023 22:31	WG2071986
1,1-Dichloroethene	U		0.188	1.00	1	06/05/2023 22:31	WG2071986
cis-1,2-Dichloroethene	U		0.126	1.00	1	06/05/2023 22:31	WG2071986
trans-1,2-Dichloroethene	U		0.149	1.00	1	06/05/2023 22:31	WG2071986
1,2-Dichloropropane	U		0.149	1.00	1	06/05/2023 22:31	WG2071986
1,1-Dichloropropene	U		0.142	1.00	1	06/05/2023 22:31	WG2071986
1,3-Dichloropropane	U		0.110	1.00	1	06/05/2023 22:31	WG2071986
cis-1,3-Dichloropropene	U		0.111	1.00	1	06/05/2023 22:31	WG2071986
trans-1,3-Dichloropropene	U		0.118	1.00	1	06/05/2023 22:31	WG2071986
2,2-Dichloropropane	U		0.161	1.00	1	06/05/2023 22:31	WG2071986
Di-isopropyl ether	U		0.105	1.00	1	06/05/2023 22:31	WG2071986
Ethylbenzene	U		0.137	1.00	1	06/05/2023 22:31	WG2071986
Hexachloro-1,3-butadiene	U		0.337	1.00	1	06/05/2023 22:31	WG2071986
Isopropylbenzene	U		0.105	1.00	1	06/05/2023 22:31	WG2071986
p-Isopropyltoluene	U		0.120	1.00	1	06/05/2023 22:31	WG2071986
2-Butanone (MEK)	U		1.19	10.0	1	06/05/2023 22:31	WG2071986
Methylene Chloride	U		0.430	5.00	1	06/05/2023 22:31	WG2071986
4-Methyl-2-pentanone (MIBK)	U		0.478	10.0	1	06/05/2023 22:31	WG2071986
Methyl tert-butyl ether	U		0.101	1.00	1	06/05/2023 22:31	WG2071986
Naphthalene	U		1.00	5.00	1	06/05/2023 22:31	WG2071986
n-Propylbenzene	U		0.0993	1.00	1	06/05/2023 22:31	WG2071986
Styrene	U		0.118	1.00	1	06/05/2023 22:31	WG2071986
1,1,1,2-Tetrachloroethane	U		0.147	1.00	1	06/05/2023 22:31	WG2071986
1,1,2,2-Tetrachloroethane	U		0.133	1.00	1	06/05/2023 22:31	WG2071986
1,1,2-Trichlorotrifluoroethane	U		0.180	1.00	1	06/05/2023 22:31	WG2071986
Tetrachloroethene	U		0.300	1.00	1	06/05/2023 22:31	WG2071986
Toluene	U		0.278	1.00	1	06/05/2023 22:31	WG2071986
1,2,3-Trichlorobenzene	U		0.230	1.00	1	06/05/2023 22:31	WG2071986
1,2,4-Trichlorobenzene	U		0.481	1.00	1	06/05/2023 22:31	WG2071986
1,1,1-Trichloroethane	U		0.149	1.00	1	06/05/2023 22:31	WG2071986
1,1,2-Trichloroethane	U		0.158	1.00	1	06/05/2023 22:31	WG2071986
Trichloroethene	U		0.190	1.00	1	06/05/2023 22:31	WG2071986
Trichlorofluoromethane	U		0.160	5.00	1	06/05/2023 22:31	WG2071986
1,2,3-Trichloropropane	U		0.237	2.50	1	06/05/2023 22:31	WG2071986
1,2,4-Trimethylbenzene	U		0.322	1.00	1	06/05/2023 22:31	WG2071986
1,2,3-Trimethylbenzene	U		0.104	1.00	1	06/05/2023 22:31	WG2071986
1,3,5-Trimethylbenzene	U		0.104	1.00	1	06/05/2023 22:31	WG2071986
Vinyl chloride	U		0.234	1.00	1	06/05/2023 22:31	WG2071986
Xylenes, Total	U		0.174	3.00	1	06/05/2023 22:31	WG2071986
(S) Toluene-d8	*115*			*80.0-120*		*06/05/2023 22:31*	WG2071986
(S) 4-Bromofluorobenzene	*94.3*			*77.0-126*		*06/05/2023 22:31*	WG2071986

Volatile Organic Compounds (GC/MS) by Method 8260D

Analyte	Result ug/l	Qualifier	MDL ug/l	RDL ug/l	Dilution	Analysis date / time	Batch
(S) 1,2-Dichloroethane-d4	*123*			*70.0-130*		*06/05/2023 22:31*	WG2071986

Semi-Volatile Organic Compounds (GC) by Method NWTPHDX-NO SGT

Analyte	Result ug/l	Qualifier	MDL ug/l	RDL ug/l	Dilution	Analysis date / time	Batch
Diesel Range Organics (DRO)	50.2	J	36.6	110	1.1	06/09/2023 18:24	WG2073474
Residual Range Organics (RRO)	U		91.6	275	1.1	06/09/2023 18:24	WG2073474
(S) o-Terphenyl	*99.5*			*31.0-160*		*06/09/2023 18:24*	WG2073474

Semi-Volatile Organic Compounds (GC) by Method NWTPHDX-SGT

Analyte	Result ug/l	Qualifier	MDL ug/l	RDL ug/l	Dilution	Analysis date / time	Batch
Diesel Range Organics (DRO)	U		36.7	110	1.1	06/09/2023 16:31	WG2072824
Residual Range Organics (RRO)	U		91.7	275	1.1	06/09/2023 16:31	WG2072824
(S) o-Terphenyl	*65.9*			*31.0-160*		*06/09/2023 16:31*	WG2072824

Semi Volatile Organic Compounds (GC/MS) by Method 8270E-SIM

Analyte	Result ug/l	Qualifier	MDL ug/l	RDL ug/l	Dilution	Analysis date / time	Batch
Anthracene	U		0.0190	0.0500	1	06/04/2023 13:01	WG2071008
Acenaphthene	U		0.0190	0.0500	1	06/04/2023 13:01	WG2071008
Acenaphthylene	U		0.0171	0.0500	1	06/04/2023 13:01	WG2071008
Benzo(a)anthracene	U		0.0203	0.0500	1	06/04/2023 13:01	WG2071008
Benzo(a)pyrene	U		0.0184	0.0500	1	06/04/2023 13:01	WG2071008
Benzo(b)fluoranthene	U		0.0168	0.0500	1	06/04/2023 13:01	WG2071008
Benzo(g,h,i)perylene	U		0.0184	0.0500	1	06/04/2023 13:01	WG2071008
Benzo(k)fluoranthene	U		0.0202	0.0500	1	06/04/2023 13:01	WG2071008
Chrysene	U		0.0179	0.0500	1	06/04/2023 13:01	WG2071008
Dibenz(a,h)anthracene	U		0.0160	0.0500	1	06/04/2023 13:01	WG2071008
Fluoranthene	U		0.0270	0.100	1	06/04/2023 13:01	WG2071008
Fluorene	U		0.0169	0.0500	1	06/04/2023 13:01	WG2071008
Indeno(1,2,3-cd)pyrene	U		0.0158	0.0500	1	06/04/2023 13:01	WG2071008
Naphthalene	U		0.0917	0.250	1	06/04/2023 13:01	WG2071008
Phenanthrene	U		0.0180	0.0500	1	06/04/2023 13:01	WG2071008
Pyrene	U		0.0169	0.0500	1	06/04/2023 13:01	WG2071008
1-Methylnaphthalene	U		0.0687	0.250	1	06/04/2023 13:01	WG2071008
2-Methylnaphthalene	U		0.0674	0.250	1	06/04/2023 13:01	WG2071008
2-Chloronaphthalene	U		0.0682	0.250	1	06/04/2023 13:01	WG2071008
(S) Nitrobenzene-d5	*124*			*31.0-160*		*06/04/2023 13:01*	WG2071008
(S) 2-Fluorobiphenyl	*114*			*48.0-148*		*06/04/2023 13:01*	WG2071008
(S) p-Terphenyl-d14	*113*			*37.0-146*		*06/04/2023 13:01*	WG2071008

Method Blank (MB)

(MB) R3933210-1 06/05/23 10:50

Analyte	MB Result ug/l	MB Qualifier	MB MDL ug/l	MB RDL ug/l
Suspended Solids	U		2500	2500

L1621630-01 Original Sample (OS) • Duplicate (DUP)

(OS) L1621630-01 06/05/23 10:50 • (DUP) R3933210-3 06/05/23 10:50

Analyte	Original Result ug/l	DUP Result ug/l	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Suspended Solids	63300	63300	1	0.000		5

L1621696-01 Original Sample (OS) • Duplicate (DUP)

(OS) L1621696-01 06/05/23 10:50 • (DUP) R3933210-4 06/05/23 10:50

Analyte	Original Result ug/l	DUP Result ug/l	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Suspended Solids	33300	38900	1	15.4	P1	5

Laboratory Control Sample (LCS)

(LCS) R3933210-2 06/05/23 10:50

Analyte	Spike Amount ug/l	LCS Result ug/l	LCS Rec. %	Rec. Limits %	LCS Qualifier
Suspended Solids	773000	696000	90.0	85.7-114	

Method Blank (MB)

(MB) R3938708-1 06/16/23 09:31

Analyte	MB Result ug/l	MB Qualifier	MB MDL ug/l	MB RDL ug/l
Nitrate as (N)	U		48.0	100
Sulfate	U		594	5000

L1621826-01 Original Sample (OS) • Duplicate (DUP)

(OS) L1621826-01 06/16/23 18:10 • (DUP) R3938708-3 06/16/23 18:25

Analyte	Original Result ug/l	DUP Result ug/l	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Nitrate as (N)	589	591	1	0.424		20
Sulfate	U	U	1	0.000		20

L1621655-01 Original Sample (OS) • Duplicate (DUP)

(OS) L1621655-01 06/17/23 02:07 • (DUP) R3938708-5 06/17/23 02:54

Analyte	Original Result ug/l	DUP Result ug/l	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Nitrate as (N)	4010	4000	1	0.237		20
Sulfate	34000	34000	1	0.0985		20

Laboratory Control Sample (LCS)

(LCS) R3938708-2 06/16/23 09:47

Analyte	Spike Amount ug/l	LCS Result ug/l	LCS Rec. %	Rec. Limits %	LCS Qualifier
Nitrate as (N)	8000	7980	99.7	90.0-110	
Sulfate	40000	40600	102	90.0-110	

L1621826-01 Original Sample (OS) • Matrix Spike (MS)

(OS) L1621826-01 06/16/23 18:10 • (MS) R3938708-4 06/16/23 18:41

Analyte	Spike Amount ug/l	Original Result ug/l	MS Result ug/l	MS Rec. %	Dilution	Rec. Limits %	MS Qualifier
Nitrate as (N)	5000	589	5550	99.2	1	80.0-120	
Sulfate	50000	U	49600	99.1	1	80.0-120	

L1621655-01 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1621655-01 06/17/23 02:07 • (MS) R3938708-6 06/17/23 03:15 • (MSD) R3938708-7 06/17/23 03:29

Analyte	Spike Amount ug/l	Original Result ug/l	MS Result ug/l	MSD Result ug/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Nitrate as (N)	5000	4010	8360	8390	86.9	87.6	1	80.0-120			0.385	20
Sulfate	50000	34000	80400	80900	92.9	93.8	1	80.0-120			0.533	20

Method Blank (MB)

(MB) R3932536-1 06/03/23 18:44

Analyte	MB Result ug/l	MB Qualifier	MB MDL ug/l	MB RDL ug/l
Ammonia Nitrogen	U		117	250

L1621650-02 Original Sample (OS) • Duplicate (DUP)

(OS) L1621650-02 06/03/23 18:47 • (DUP) R3932536-3 06/03/23 18:48

Analyte	Original Result ug/l	DUP Result ug/l	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Ammonia Nitrogen	U	U	1	0.000		10

L1621922-06 Original Sample (OS) • Duplicate (DUP)

(OS) L1621922-06 06/03/23 19:17 • (DUP) R3932536-5 06/03/23 19:23

Analyte	Original Result ug/l	DUP Result ug/l	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Ammonia Nitrogen	U	U	1	0.000		10

Laboratory Control Sample (LCS)

(LCS) R3932536-2 06/03/23 18:45

Analyte	Spike Amount ug/l	LCS Result ug/l	LCS Rec. %	Rec. Limits %	LCS Qualifier
Ammonia Nitrogen	7500	7400	98.7	90.0-110	

L1621650-02 Original Sample (OS) • Matrix Spike (MS)

(OS) L1621650-02 06/03/23 18:47 • (MS) R3932536-4 06/03/23 18:50

Analyte	Spike Amount ug/l	Original Result ug/l	MS Result ug/l	MS Rec. %	Dilution	Rec. Limits %	MS Qualifier
Ammonia Nitrogen	5000	U	5100	102	1	90.0-110	

L1621922-06 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1621922-06 06/03/23 19:17 • (MS) R3932536-6 06/03/23 19:24 • (MSD) R3932536-7 06/03/23 19:26

Analyte	Spike Amount ug/l	Original Result ug/l	MS Result ug/l	MSD Result ug/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Ammonia Nitrogen	5000	U	4900	4940	98.0	98.8	1	90.0-110			0.813	10

Method Blank (MB)

(MB) R3938144-2 06/17/23 13:45

Analyte	MB Result ug/l	MB Qualifier	MB MDL ug/l	MB RDL ug/l
TOC (Total Organic Carbon)	228	J	102	1000

L1621655-01 Original Sample (OS) • Duplicate (DUP)

(OS) L1621655-01 06/17/23 16:14 • (DUP) R3938144-5 06/17/23 16:30

Analyte	Original Result ug/l	DUP Result ug/l	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
TOC (Total Organic Carbon)	2680	2650	1	1.20		20

L1622003-01 Original Sample (OS) • Duplicate (DUP)

(OS) L1622003-01 06/17/23 19:37 • (DUP) R3938144-6 06/17/23 19:50

Analyte	Original Result ug/l	DUP Result ug/l	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
TOC (Total Organic Carbon)	702	731	1	4.12	J	20

Laboratory Control Sample (LCS)

(LCS) R3938144-1 06/17/23 13:33

Analyte	Spike Amount ug/l	LCS Result ug/l	LCS Rec. %	Rec. Limits %	LCS Qualifier
TOC (Total Organic Carbon)	25000	24600	98.5	85.0-115	

L1621213-04 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1621213-04 06/17/23 15:16 • (MS) R3938144-3 06/17/23 15:37 • (MSD) R3938144-4 06/17/23 15:58

Analyte	Spike Amount ug/l	Original Result ug/l	MS Result ug/l	MSD Result ug/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
TOC (Total Organic Carbon)	25000	U	24800	24600	99.3	98.3	1	80.0-120			1.01	20

L1625455-14 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1625455-14 06/17/23 23:09 • (MS) R3938144-7 06/17/23 23:29 • (MSD) R3938144-8 06/17/23 23:48

Analyte	Spike Amount ug/l	Original Result ug/l	MS Result ug/l	MSD Result ug/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
TOC (Total Organic Carbon)	25000	803	26000	25900	101	100	1	80.0-120			0.617	20

Method Blank (MB)

(MB) R3934039-1 06/07/23 17:46

Analyte	MB Result	MB Qualifier	MB MDL	MB RDL
	ug/l		ug/l	ug/l
Calcium	U		79.3	1000
Magnesium	U		85.3	1000

Laboratory Control Sample (LCS)

(LCS) R3934039-2 06/07/23 17:49

Analyte	Spike Amount	LCS Result	LCS Rec.	Rec. Limits	LCS Qualifier
	ug/l	ug/l	%	%	
Calcium	10000	9880	98.8	80.0-120	
Magnesium	10000	9310	93.1	80.0-120	

L1621691-01 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1621691-01 06/07/23 17:52 • (MS) R3934039-4 06/07/23 17:58 • (MSD) R3934039-5 06/07/23 18:01

Analyte	Spike Amount	Original Result	MS Result	MSD Result	MS Rec.	MSD Rec.	Dilution	Rec. Limits	MS Qualifier	MSD Qualifier	RPD	RPD Limits
	ug/l	ug/l	ug/l	ug/l	%	%		%			%	%
Calcium	10000	425000	427000	423000	22.6	0.000	1	75.0-125	E V	E V	0.935	20
Magnesium	10000	198000	205000	203000	61.1	46.4	1	75.0-125	V	V	0.719	20

Method Blank (MB)

(MB) R3934693-3 06/08/23 12:03

Analyte	MB Result ug/l	MB Qualifier	MB MDL ug/l	MB RDL ug/l
Gasoline Range Organics-NWTPH	U		31.6	100
(S) a,a,a-Trifluorotoluene(FID)	*114*			*78.0-120*

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3934693-1 06/08/23 10:38 • (LCSD) R3934693-2 06/08/23 11:19

Analyte	Spike Amount ug/l	LCS Result ug/l	LCSD Result ug/l	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Gasoline Range Organics-NWTPH	5500	5050	5930	91.8	108	70.0-124			16.0	20
(S) a,a,a-Trifluorotoluene(FID)				*110*	*108*	*78.0-120*				

L1622130-03 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1622130-03 06/08/23 18:14 • (MS) R3934693-4 06/08/23 20:03 • (MSD) R3934693-5 06/08/23 20:25

Analyte	Spike Amount ug/l	Original Result ug/l	MS Result ug/l	MSD Result ug/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Gasoline Range Organics-NWTPH	5500	49.9	4380	4590	78.7	82.5	1	10.0-155			4.68	21
(S) a,a,a-Trifluorotoluene(FID)					*107*	*107*		*78.0-120*				

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Method Blank (MB)

(MB) R3933734-2 06/05/23 17:35

Analyte	MB Result ug/l	MB Qualifier	MB MDL ug/l	MB RDL ug/l
Acetone	U		11.3	50.0
Acrolein	U		2.54	50.0
Acrylonitrile	U		0.671	10.0
Benzene	U		0.0941	1.00
Bromobenzene	U		0.118	1.00
Bromodichloromethane	U		0.136	1.00
Bromoform	U		0.129	1.00
Bromomethane	U		0.605	5.00
n-Butylbenzene	U		0.157	1.00
sec-Butylbenzene	U		0.125	1.00
tert-Butylbenzene	U		0.127	1.00
Carbon tetrachloride	U		0.128	1.00
Chlorobenzene	U		0.116	1.00
Chlorodibromomethane	U		0.140	1.00
Chloroethane	U		0.192	5.00
Chloroform	U		0.111	5.00
Chloromethane	U		0.960	2.50
2-Chlorotoluene	U		0.106	1.00
4-Chlorotoluene	U		0.114	1.00
1,2-Dibromo-3-Chloropropane	U		0.276	5.00
1,2-Dibromoethane	U		0.126	1.00
Dibromomethane	U		0.122	1.00
1,2-Dichlorobenzene	U		0.107	1.00
1,3-Dichlorobenzene	U		0.110	1.00
1,4-Dichlorobenzene	U		0.120	1.00
Dichlorodifluoromethane	U		0.374	5.00
1,1-Dichloroethane	U		0.100	1.00
1,2-Dichloroethane	U		0.0819	1.00
1,1-Dichloroethene	U		0.188	1.00
cis-1,2-Dichloroethene	U		0.126	1.00
trans-1,2-Dichloroethene	U		0.149	1.00
1,2-Dichloropropane	U		0.149	1.00
1,1-Dichloropropene	U		0.142	1.00
1,3-Dichloropropane	U		0.110	1.00
cis-1,3-Dichloropropene	U		0.111	1.00
trans-1,3-Dichloropropene	U		0.118	1.00
2,2-Dichloropropane	U		0.161	1.00
Di-isopropyl ether	U		0.105	1.00
Ethylbenzene	U		0.137	1.00
Hexachloro-1,3-butadiene	U		0.337	1.00

Method Blank (MB)

(MB) R3933734-2 06/05/23 17:35

Analyte	MB Result ug/l	MB Qualifier	MB MDL ug/l	MB RDL ug/l
Isopropylbenzene	U		0.105	1.00
p-Isopropyltoluene	U		0.120	1.00
2-Butanone (MEK)	U		1.19	10.0
Methylene Chloride	U		0.430	5.00
4-Methyl-2-pentanone (MIBK)	U		0.478	10.0
Methyl tert-butyl ether	U		0.101	1.00
Naphthalene	U		1.00	5.00
n-Propylbenzene	U		0.0993	1.00
Styrene	U		0.118	1.00
1,1,1,2-Tetrachloroethane	U		0.147	1.00
1,1,2,2-Tetrachloroethane	U		0.133	1.00
1,1,2-Trichlorotrifluoroethane	U		0.180	1.00
Tetrachloroethene	U		0.300	1.00
Toluene	U		0.278	1.00
1,2,3-Trichlorobenzene	U		0.230	1.00
1,2,4-Trichlorobenzene	U		0.481	1.00
1,1,1-Trichloroethane	U		0.149	1.00
1,1,2-Trichloroethane	U		0.158	1.00
Trichloroethene	U		0.190	1.00
Trichlorofluoromethane	U		0.160	5.00
1,2,3-Trichloropropane	U		0.237	2.50
1,2,4-Trimethylbenzene	U		0.322	1.00
1,2,3-Trimethylbenzene	U		0.104	1.00
1,3,5-Trimethylbenzene	U		0.104	1.00
Vinyl chloride	U		0.234	1.00
Xylenes, Total	U		0.174	3.00
(S) Toluene-d8	*112*			*80.0-120*
(S) 4-Bromofluorobenzene	*89.8*			*77.0-126*
(S) 1,2-Dichloroethane-d4	*123*			*70.0-130*

Laboratory Control Sample (LCS)

(LCS) R3933734-1 06/05/23 16:57

Analyte	Spike Amount ug/l	LCS Result ug/l	LCS Rec. %	Rec. Limits %	LCS Qualifier
Acetone	25.0	25.3	101	19.0-160	
Acrolein	25.0	2.63	10.5	10.0-160	
Acrylonitrile	25.0	29.2	117	55.0-149	
Benzene	5.00	5.72	114	70.0-123	

Laboratory Control Sample (LCS)

(LCS) R3933734-1 06/05/23 16:57

Analyte	Spike Amount ug/l	LCS Result ug/l	LCS Rec. %	Rec. Limits %	LCS Qualifier
Bromobenzene	5.00	5.69	114	73.0-121	
Bromodichloromethane	5.00	5.94	119	75.0-120	
Bromoform	5.00	5.85	117	68.0-132	
Bromomethane	5.00	4.01	80.2	10.0-160	
n-Butylbenzene	5.00	5.04	101	73.0-125	
sec-Butylbenzene	5.00	5.31	106	75.0-125	
tert-Butylbenzene	5.00	5.33	107	76.0-124	
Carbon tetrachloride	5.00	5.86	117	68.0-126	
Chlorobenzene	5.00	5.53	111	80.0-121	
Chlorodibromomethane	5.00	5.77	115	77.0-125	
Chloroethane	5.00	4.51	90.2	47.0-150	
Chloroform	5.00	5.56	111	73.0-120	
Chloromethane	5.00	6.01	120	41.0-142	
2-Chlorotoluene	5.00	5.57	111	76.0-123	
4-Chlorotoluene	5.00	5.56	111	75.0-122	
1,2-Dibromo-3-Chloropropane	5.00	5.46	109	58.0-134	
1,2-Dibromoethane	5.00	5.63	113	80.0-122	
Dibromomethane	5.00	5.84	117	80.0-120	
1,2-Dichlorobenzene	5.00	5.77	115	79.0-121	
1,3-Dichlorobenzene	5.00	5.88	118	79.0-120	
1,4-Dichlorobenzene	5.00	5.89	118	79.0-120	
Dichlorodifluoromethane	5.00	4.57	91.4	51.0-149	
1,1-Dichloroethane	5.00	5.72	114	70.0-126	
1,2-Dichloroethane	5.00	6.01	120	70.0-128	
1,1-Dichloroethene	5.00	4.85	97.0	71.0-124	
cis-1,2-Dichloroethene	5.00	5.25	105	73.0-120	
trans-1,2-Dichloroethene	5.00	5.25	105	73.0-120	
1,2-Dichloropropane	5.00	6.04	121	77.0-125	
1,1-Dichloropropene	5.00	5.37	107	74.0-126	
1,3-Dichloropropane	5.00	5.82	116	80.0-120	
cis-1,3-Dichloropropene	5.00	5.64	113	80.0-123	
trans-1,3-Dichloropropene	5.00	5.81	116	78.0-124	
2,2-Dichloropropane	5.00	5.18	104	58.0-130	
Di-isopropyl ether	5.00	6.31	126	58.0-138	
Ethylbenzene	5.00	5.26	105	79.0-123	
Hexachloro-1,3-butadiene	5.00	6.33	127	54.0-138	
Isopropylbenzene	5.00	5.10	102	76.0-127	
p-Isopropyltoluene	5.00	5.21	104	76.0-125	
2-Butanone (MEK)	25.0	30.7	123	44.0-160	
Methylene Chloride	5.00	5.12	102	67.0-120	

Laboratory Control Sample (LCS)

(LCS) R3933734-1 06/05/23 16:57

Analyte	Spike Amount ug/l	LCS Result ug/l	LCS Rec. %	Rec. Limits %	LCS Qualifier
4-Methyl-2-pentanone (MIBK)	25.0	33.8	135	68.0-142	
Methyl tert-butyl ether	5.00	4.57	91.4	68.0-125	
Naphthalene	5.00	4.87	97.4	54.0-135	
n-Propylbenzene	5.00	5.46	109	77.0-124	
Styrene	5.00	5.30	106	73.0-130	
1,1,1,2-Tetrachloroethane	5.00	5.63	113	75.0-125	
1,1,2,2-Tetrachloroethane	5.00	5.69	114	65.0-130	
1,1,2-Trichlorotrifluoroethane	5.00	5.45	109	69.0-132	
Tetrachloroethene	5.00	5.75	115	72.0-132	
Toluene	5.00	5.64	113	79.0-120	
1,2,3-Trichlorobenzene	5.00	5.50	110	50.0-138	
1,2,4-Trichlorobenzene	5.00	5.68	114	57.0-137	
1,1,1-Trichloroethane	5.00	5.51	110	73.0-124	
1,1,2-Trichloroethane	5.00	5.84	117	80.0-120	
Trichloroethene	5.00	5.60	112	78.0-124	
Trichlorofluoromethane	5.00	4.42	88.4	59.0-147	
1,2,3-Trichloropropane	5.00	6.18	124	73.0-130	
1,2,4-Trimethylbenzene	5.00	5.20	104	76.0-121	
1,2,3-Trimethylbenzene	5.00	5.26	105	77.0-120	
1,3,5-Trimethylbenzene	5.00	5.36	107	76.0-122	
Vinyl chloride	5.00	5.03	101	67.0-131	
Xylenes, Total	15.0	15.6	104	79.0-123	
(S) Toluene-d8			*113*	*80.0-120*	
(S) 4-Bromofluorobenzene			*96.1*	*77.0-126*	
(S) 1,2-Dichloroethane-d4			*122*	*70.0-130*	

Method Blank (MB)

(MB) R3935077-1 06/09/23 17:16

Analyte	MB Result	MB Qualifier	MB MDL	MB RDL
	ug/l		ug/l	ug/l
Diesel Range Organics (DRO)	U		33.3	100
Residual Range Organics (RRO)	U		83.3	250
(S) o-Terphenyl	*108*			*31.0-160*

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3935077-2 06/09/23 17:39 • (LCSD) R3935077-3 06/09/23 18:01

Analyte	Spike Amount	LCS Result	LCSD Result	LCS Rec.	LCSD Rec.	Rec. Limits	LCS Qualifier	LCSD Qualifier	RPD	RPD Limits
	ug/l	ug/l	ug/l	%	%	%			%	%
Diesel Range Organics (DRO)	1500	1310	1370	87.3	91.3	50.0-150			4.48	20
(S) o-Terphenyl				*115*	*115*	*31.0-160*				

Method Blank (MB)

(MB) R3935076-1 06/09/23 15:23

Analyte	MB Result ug/l	MB Qualifier	MB MDL ug/l	MB RDL ug/l
Diesel Range Organics (DRO)	U		33.3	100
Residual Range Organics (RRO)	U		83.3	250
(S) o-Terphenyl	*75.0*			*31.0-160*

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3935076-2 06/09/23 15:46 • (LCSD) R3935076-3 06/09/23 16:09

Analyte	Spike Amount ug/l	LCS Result ug/l	LCSD Result ug/l	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Diesel Range Organics (DRO)	1500	1040	1030	69.3	68.7	50.0-150			0.966	20
(S) o-Terphenyl				*90.0*	*92.5*	*31.0-160*				

Method Blank (MB)

(MB) R3932932-3 06/04/23 11:51

Analyte	MB Result ug/l	MB Qualifier	MB MDL ug/l	MB RDL ug/l
Anthracene	U		0.0190	0.0500
Acenaphthene	U		0.0190	0.0500
Acenaphthylene	U		0.0171	0.0500
Benzo(a)anthracene	U		0.0203	0.0500
Benzo(a)pyrene	U		0.0184	0.0500
Benzo(b)fluoranthene	U		0.0168	0.0500
Benzo(g,h,i)perylene	U		0.0184	0.0500
Benzo(k)fluoranthene	U		0.0202	0.0500
Chrysene	U		0.0179	0.0500
Dibenz(a,h)anthracene	U		0.0160	0.0500
Fluoranthene	U		0.0270	0.100
Fluorene	U		0.0169	0.0500
Indeno(1,2,3-cd)pyrene	U		0.0158	0.0500
Naphthalene	U		0.0917	0.250
Phenanthrene	U		0.0180	0.0500
Pyrene	U		0.0169	0.0500
1-Methylnaphthalene	U		0.0687	0.250
2-Methylnaphthalene	U		0.0674	0.250
2-Chloronaphthalene	U		0.0682	0.250
(S) Nitrobenzene-d5	*127*			*31.0-160*
(S) 2-Fluorobiphenyl	*116*			*48.0-148*
(S) p-Terphenyl-d14	*116*			*37.0-146*

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3932932-1 06/04/23 11:17 • (LCSD) R3932932-2 06/04/23 11:34

Analyte	Spike Amount ug/l	LCS Result ug/l	LCSD Result ug/l	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Anthracene	2.00	2.13	2.30	106	115	67.0-150			7.67	20
Acenaphthene	2.00	1.95	2.10	97.5	105	65.0-138			7.41	20
Acenaphthylene	2.00	2.19	2.38	109	119	66.0-140			8.32	20
Benzo(a)anthracene	2.00	2.30	2.47	115	123	61.0-140			7.13	20
Benzo(a)pyrene	2.00	2.17	2.32	108	116	60.0-143			6.68	20
Benzo(b)fluoranthene	2.00	1.97	2.15	98.5	107	58.0-141			8.74	20
Benzo(g,h,i)perylene	2.00	1.84	1.96	92.0	98.0	52.0-153			6.32	20
Benzo(k)fluoranthene	2.00	1.96	2.15	98.0	107	58.0-148			9.25	20
Chrysene	2.00	2.28	2.46	114	123	64.0-144			7.59	20
Dibenz(a,h)anthracene	2.00	2.06	2.17	103	108	52.0-155			5.20	20
Fluoranthene	2.00	2.27	2.46	114	123	69.0-153			8.03	20

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3932932-1 06/04/23 11:17 • (LCSD) R3932932-2 06/04/23 11:34

Analyte	Spike Amount ug/l	LCS Result ug/l	LCSD Result ug/l	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Fluorene	2.00	2.17	2.36	108	118	64.0-136			8.39	20
Indeno(1,2,3-cd)pyrene	2.00	2.21	2.35	111	117	54.0-153			6.14	20
Naphthalene	2.00	2.14	2.30	107	115	61.0-137			7.21	20
Phenanthrene	2.00	2.15	2.32	107	116	62.0-137			7.61	20
Pyrene	2.00	2.31	2.51	115	126	60.0-142			8.30	20
1-Methylnaphthalene	2.00	2.28	2.47	114	123	66.0-142			8.00	20
2-Methylnaphthalene	2.00	2.17	2.36	108	118	62.0-136			8.39	20
2-Chloronaphthalene	2.00	2.13	2.31	106	115	64.0-140			8.11	20
(S) Nitrobenzene-d5				*120*	*127*	*31.0-160*				
(S) 2-Fluorobiphenyl				*112*	*117*	*48.0-148*				
(S) p-Terphenyl-d14				*110*	*116*	*37.0-146*				

GLOSSARY OF TERMS

Guide to Reading and Understanding Your Laboratory Report

The information below is designed to better explain the various terms used in your report of analytical results from the Laboratory. This is not intended as a comprehensive explanation, and if you have additional questions please contact your project representative.

Results Disclaimer - Information that may be provided by the customer, and contained within this report, include Permit Limits, Project Name, Sample ID, Sample Matrix, Sample Preservation, Field Blanks, Field Spikes, Field Duplicates, On-Site Data, Sampling Collection Dates/Times, and Sampling Location. Results relate to the accuracy of this information provided, and as the samples are received.

Abbreviations and Definitions

MDL	Method Detection Limit.
RDL	Reported Detection Limit.
Rec.	Recovery.
RPD	Relative Percent Difference.
SDG	Sample Delivery Group.
(S)	Surrogate (Surrogate Standard) - Analytes added to every blank, sample, Laboratory Control Sample/Duplicate and Matrix Spike/Duplicate; used to evaluate analytical efficiency by measuring recovery. Surrogates are not expected to be detected in all environmental media.
U	Not detected at the Reporting Limit (or MDL where applicable).
Analyte	The name of the particular compound or analysis performed. Some Analyses and Methods will have multiple analytes reported.
Dilution	If the sample matrix contains an interfering material, the sample preparation volume or weight values differ from the standard, or if concentrations of analytes in the sample are higher than the highest limit of concentration that the laboratory can accurately report, the sample may be diluted for analysis. If a value different than 1 is used in this field, the result reported has already been corrected for this factor.
Limits	These are the target % recovery ranges or % difference value that the laboratory has historically determined as normal for the method and analyte being reported. Successful QC Sample analysis will target all analytes recovered or duplicated within these ranges.
Original Sample	The non-spiked sample in the prep batch used to determine the Relative Percent Difference (RPD) from a quality control sample. The Original Sample may not be included within the reported SDG.
Qualifier	This column provides a letter and/or number designation that corresponds to additional information concerning the result reported. If a Qualifier is present, a definition per Qualifier is provided within the Glossary and Definitions page and potentially a discussion of possible implications of the Qualifier in the Case Narrative if applicable.
Result	The actual analytical final result (corrected for any sample specific characteristics) reported for your sample. If there was no measurable result returned for a specific analyte, the result in this column may state “ND” (Not Detected) or “BDL” (Below Detectable Levels). The information in the results column should always be accompanied by either an MDL (Method Detection Limit) or RDL (Reporting Detection Limit) that defines the lowest value that the laboratory could detect or report for this analyte.
Uncertainty (Radiochemistry)	Confidence level of 2 sigma.
Case Narrative (Cn)	A brief discussion about the included sample results, including a discussion of any non-conformances to protocol observed either at sample receipt by the laboratory from the field or during the analytical process. If present, there will be a section in the Case Narrative to discuss the meaning of any data qualifiers used in the report.
Quality Control Summary (Qc)	This section of the report includes the results of the laboratory quality control analyses required by procedure or analytical methods to assist in evaluating the validity of the results reported for your samples. These analyses are not being performed on your samples typically, but on laboratory generated material.
Sample Chain of Custody (Sc)	This is the document created in the field when your samples were initially collected. This is used to verify the time and date of collection, the person collecting the samples, and the analyses that the laboratory is requested to perform. This chain of custody also documents all persons (excluding commercial shippers) that have had control or possession of the samples from the time of collection until delivery to the laboratory for analysis.
Sample Results (Sr)	This section of your report will provide the results of all testing performed on your samples. These results are provided by sample ID and are separated by the analyses performed on each sample. The header line of each analysis section for each sample will provide the name and method number for the analysis reported.
Sample Summary (Ss)	This section of the Analytical Report defines the specific analyses performed for each sample ID, including the dates and times of preparation and/or analysis.

Qualifier	Description
C3	The reported concentration is an estimate. The continuing calibration standard associated with this data responded low. Method sensitivity check is acceptable.
E	The analyte concentration exceeds the upper limit of the calibration range of the instrument established by the initial calibration (ICAL).
J	The identification of the analyte is acceptable; the reported value is an estimate.
P1	RPD value not applicable for sample concentrations less than 5 times the reporting limit.
Q	Sample was prepared and/or analyzed past holding time as defined in the method. Concentrations should be considered minimum values.
V	The sample concentration is too high to evaluate accurate spike recoveries.

ACCREDITATIONS & LOCATIONS

Pace Analytical National 12065 Lebanon Rd Mount Juliet, TN 37122

Alabama	40660	Nebraska	NE-OS-15-05
Alaska	17-026	Nevada	TN000032021-1
Arizona	AZ0612	New Hampshire	2975
Arkansas	88-0469	New Jersey–NELAP	TN002
California	2932	New Mexico [1]	TN00003
Colorado	TN00003	New York	11742
Connecticut	PH-0197	North Carolina	Env375
Florida	E87487	North Carolina [1]	DW21704
Georgia	NELAP	North Carolina [3]	41
Georgia [1]	923	North Dakota	R-140
Idaho	TN00003	Ohio–VAP	CL0069
Illinois	200008	Oklahoma	9915
Indiana	C-TN-01	Oregon	TN200002
Iowa	364	Pennsylvania	68-02979
Kansas	E-10277	Rhode Island	LAO000356
Kentucky [1 6]	KY90010	South Carolina	84004002
Kentucky [2]	16	South Dakota	n/a
Louisiana	AI30792	Tennessee [1 4]	2006
Louisiana	LA018	Texas	T104704245-20-18
Maine	TN00003	Texas [5]	LAB0152
Maryland	324	Utah	TN000032021-11
Massachusetts	M-TN003	Vermont	VT2006
Michigan	9958	Virginia	110033
Minnesota	047-999-395	Washington	C847
Mississippi	TN00003	West Virginia	233
Missouri	340	Wisconsin	998093910
Montana	CERT0086	Wyoming	A2LA
A2LA – ISO 17025	1461.01	AIHA-LAP,LLC EMLAP	100789
A2LA – ISO 17025 [5]	1461.02	DOD	1461.01
Canada	1461.01	USDA	P330-15-00234
EPA–Crypto	TN00003		

[1] Drinking Water [2] Underground Storage Tanks [3] Aquatic Toxicity [4] Chemical/Microbiological [5] Mold [6] Wastewater n/a Accreditation not applicable

* Not all certifications held by the laboratory are applicable to the results reported in the attached report.

* Accreditation is only applicable to the test methods specified on each scope of accreditation held by Pace Analytical.

Company Name/Address:
ARCADIS - Portland, OR

830 NE Holladay St.
Suite 109
Portland. OR 97232

Billing Information:
Attn: Accounts Payable
630 Plaza Drive, Suite 600
Highlands Ranch, CO 80129

Pres Chk

Report to:
Grace Boyd

Email To:
Grace.Boyd@arcadis.com;Jaelyn.Bowers@arcad

Project Description:

City/State Collected: ASTORIA, OR

Please Circle: (PT) MT CT ET

Phone: **503-785-9405**

Client Project #
30167230.00005

Lab Project #
LFRPOR-PACIFICORP

Collected by (print):
ELIJAH JONES

Site/Facility ID #
PACIFICORP ASTORIA

P.O. #

Collected by (signature):

Immediately Packed on Ice N___ Y X

Rush? (Lab MUST Be Notified)
___ Same Day ___ Five Day
___ Next Day ___ 5 Day (Rad Only)
___ Two Day ___ 10 Day (Rad Only)
___ Three Day

Quote #

Date Results Needed
STAT

No. of Cntrs

Analysis / Container / Preservative

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	*NITRATE,SULFATE 300 125ml HDPE-NoPres	Hardness 250mlHDPE-HNO3	NH3 250mlHDPE-H2SO4	NWTPHDX no silica 100ml Amb-HCl	NWTPHDX w/ silica 100ml Amb-HCl	NWTPHGX 40mlAmb HCl	PAHs 8270SIM 40mlAmb-NoPres-WT	TOC 250mlAmb-HCl	TSS 1L-HDPE NoPres	VOCs 260 40mlAmb-HCl	Remarks	Sample # (lab only)
								L2	L2									
MW-15	G	GW		5/31/23	1130	16	X	X	X	X	X	X	X	X	X	X		-01
~~PACIFICO~~ (01)																		

Chain of Custody Page 1 of 1

Pace
PEOPLE ADVANCING SCIENCE

MT JULIET, TN

12065 Lebanon Rd Mount Juliet, TN 37122
Submitting a sample via this chain of custody constitutes acknowledgment and acceptance of the Pace Terms and Conditions found at: https://info.pacelabs.com/hubfs/pas-standard-terms.pdf

SDG # L621655

F045

Acctnum: **LFRPOR**
Template: **T230590**
Prelogin: **P1000082**
PM: **110 - Brian Ford**
PB:
Shipped Via:

PH-10BDH4321 TRC-2144141
CR6-220221V

* Matrix:
SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other_____

Remarks:*Nitrate has a 48 hour holding time.

pH _____ Temp _____
Flow _____ Other _____

Samples returned via:
__ UPS X FedEx __ Courier _____

Tracking # 6295 1089 8023

Sample Receipt Checklist

COC Seal Present/Intact:	NP	Y N
COC Signed/Accurate:		Y N
Bottles arrive intact:		Y N
Correct bottles used:		Y N
Sufficient volume sent:		Y N
If Applicable		
VOA Zero Headspace:		Y N
Preservation Correct/Checked:		Y N
RAD Screen <0.5 mR/hr:		Y N

	Date:	Time:		
Relinquished by : (Signature)	5/31/23	1505	Received by: (Signature)	Trip Blank Received: Yes / No HCL / MeoH TBR
Relinquished by : (Signature)	5/31/23	1600	Received by: (Signature) FedEx	Temp: NS47 °C 3.1 to 3.1 Bottles Received: 16
Relinquished by : (Signature)	Date:	Time:	Received for lab by: (Signature) (12)	Date: 5/1/23 Time: 0400

If preservation required by Login: Date/Time

Hold:

Condition: NCF / OK (0)

Appendix G

Waste Manifest

Please print or type.
(Form designed for use on elite (12-pitch) typewriter.)

NON-HAZARDOUS WASTE MANIFEST	1. Generator ID Number	2. Page 1 of	3. Emergency Response Phone	4. Waste Tracking Number
	VSQG	1	888-785-7225	450830/D547782

GENERATOR

5. Generator's Name and Mailing Address

PacifiCorp/Union Oil Company of California
830 NE Holladay Street Suite 109
Portland, OR 97201
Generator's Phone: 503-813-5036

Generator's Site Address (if different than mailing address)

PacifiCorp/Union Oil Company of California
256 Marine Drive
Astoria, OR 97103

6. Transporter 1 Company Name: Advanced Chemical Transport Inc./DBA ACTenviro — U.S. EPA ID Number: CAR000070540

7. Transporter 2 Company Name — U.S. EPA ID Number:

8. Designated Facility Name and Site Address

Chemical Waste Management of the Northwest (OR)
17629 Cedar Springs Lane
Arlington, OR 97812
Facility's Phone: 541-454-3220

U.S. EPA ID Number: ORD089452353

	9. Waste Shipping Name and Description	10. Containers No.	10. Containers Type	11. Total Quantity	12. Unit Wt./Vol.	
1.	Non-RCRA/Non-DOT Regulated Material Liquid (LNAPL AND PURGE WATER MIXTURE)	01	DM	70	P	
2.						
3.						
4.						

13. Special Handling Instructions and Additional Information

Project Number 450830 Document #: D547782

1) OR355390 PAC-01X55

14. GENERATOR'S CERTIFICATION: I certify the materials described above on this manifest are not subject to federal regulations for reporting proper disposal of Hazardous Waste.

Generator's/Offeror's Printed/Typed Name: (SOBO PacifiCorp) Andrew Jansma — Signature: andrewJansma — Month: 07 Day: 28 Year: 23

INT'L

15. International Shipments ☐ Import to U.S. ☐ Export from U.S. Port of entry/exit:

Transporter Signature (for exports only): Date leaving U.S.:

TRANSPORTER

16. Transporter Acknowledgment of Receipt of Materials

Transporter 1 Printed/Typed Name: Andrew Jansma — Signature: andrewJansma — Month: 07 Day: 28 Year: 23

Transporter 2 Printed/Typed Name — Signature — Month Day Year

DESIGNATED FACILITY

17. Discrepancy

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

Manifest Reference Number:

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

Facility's Phone:

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

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

Printed/Typed Name — Signature — Month Day Year

DESIGNATED FACILITY TO GENERATOR

Arcadis U.S., Inc.
830 NE Holladay Street
Portland
Oregon 97232
Phone: 503 220 8201
Fax:
www.arcadis.com