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January 26, 2023

Ms. Denise Kirkpatrick
Hazardous Materials Section Supervisor
Montana Department of Environmental Quality
Waste Management Bureau
P.O. Box 200901
Helena, MT 59620-0901

RE: AOC-16 Interim Measure 3rd Quarter 2023 Monitoring Report No. 7

Submitted via Montana File Transfer Service with Hard Copy to follow

Dear Ms. Kirkpatrick,

Please find attached Calumet Montana Refining LLC's (CMR) AOC-16 Interim Measure (IM) 3rd Quarter 2023 Monitoring Report (QMR) No. 7 for review and approval. The report documents the operations, maintenance, and monitoring activities completed for the dual phase extraction (DPE) remediation system, passive treatment trench, and light non-aqueous phase liquid (LNAPL) recovery trench between July 2023 and September 2023. In addition, this report presents an evaluation of AOC-16 IM remediation system performance during this period and discusses continued system optimization and monitoring activities.

Please contact me at your earliest convenience if you have any questions.

Sincerely,

Michael Gipson

Mike Gipson
Environmental Specialist

cc: Joe Dauner - CMR

Attachments: AOC-16 Interim Measure 3rd Quarter 2023 Monitoring Report No.7

AOC-16 INTERIM MEASURE 3RD QUARTER 2023 MONITORING REPORT NO. 7

CALUMET MONTANA REFINING, LLC
GREAT FALLS, MONTANA

January 25, 2024

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ACRONYMNS AND ABBREVIATIONS

AOC-16	Area of Concern-16
BOD	biochemical oxygen demand
BTEX	benzene, toluene, ethylbenzene, and xylene
CMR	Calumet Montana Refining, LLC
COC	constituent of concern
DEQ-7 HHS	Montana Department of Environmental Quality-7 Human Health Standards
DO	dissolved oxygen
DPE	dual-phase extraction
EPH	extractable petroleum hydrocarbon
gpm	gallons per minute
IM	Interim Measures
in-Hg	inches of mercury
LEL	lower explosive limit
LNAPL	light non-aqueous phase liquid
µg/L	microgram per liter
MDEQ	Montana Department of Environmental Quality
mg/L	milligrams per liter
mL/min	milliliters per minute
MS/MSD	matrix spike/matrix spike duplicate
mV	millivolts
NTu	nephelometric turbidity unit
OM&M	operations, maintenance, and monitoring
ORP	oxidation reduction potential
Pace	Pace Analytical Services, LLC
PID	photoionization detector
PLC	programmable logic controller
PRT	primary recovery trench
PTT	passive treatment trench
QAPP	Quality Assurance Project Plan
QA/QC	quality assurance/quality control
QMR	Quarterly Monitoring Report
RBSL	Risk-Based Screening Levels
RCRA	Resource Conservation Recovery Act
RFI	RCRA Facility Investigation
Ramboll	Ramboll Americas Engineering Solutions, Inc.
ROI	radius of influence
SCFM	standard cubic per minute
SRCO	Self-Recuperative Catalytic Oxidizer
SVOC	semi-volatile organic compound
TPH	total petroleum hydrocarbons
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound
VPH	volatile petroleum hydrocarbon
WWTP	wastewater treatment plant

SIGNATORY PAGE

I certify under penalty of law that this document and all attachments were prepared under my direct supervision according to a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Signature: 

Name: Carlos Centurion

Title: VP/Plant Manager – Calumet Montana Refining, LLC

Date: 1/24/24

EXECUTIVE SUMMARY

Ramboll Americas Engineering Solutions, Inc. (Ramboll), on behalf of Calumet Montana Refining, LLC (CMR), has prepared this Area of Concern-16 (AOC-16) Interim Measure (IM) 3rd Quarter 2023 Monitoring Report (QMR) No. 7 to summarize the operations of the AOC-16 Dual Phase Extraction (DPE) system and the Passive Treatment Trench (PTT). This QMR has been prepared in accordance with Section 6.2 of the Operations Maintenance and Monitoring (OM&M) Plan for the AOC-16 IM.

During the 3rd quarter of 2023, the DPE system operated approximately 23% of the available time. The DPE system extracted and discharged approximately 33,975 gallons of total fluids to CMR's wastewater treatment plant (WWTP). During this reporting period the DPE system also removed approximately 4.2 pounds of petroleum vapor. It also removed approximately 0.8 pound of volatile organic compounds (VOCs), 1.8 pounds of semi-volatile organic compounds (SVOCs), 10.4 pounds of volatile petroleum hydrocarbons (VPH), and 511 pounds of extractable petroleum hydrocarbons (EPH) in the form of liquid effluent. Initial mass removal rates indicate that the DPE system is accomplishing the AOC-16 IM objectives of recovering free phase Light Non-Aqueous Phase Liquid (LNAPL) mass and reducing the LNAPL within the vadose and saturated zone soil matrix. Due to reductions in contaminant mass recovery compared to previous quarters and reduced flows and manifold vacuums, optimization efforts were conducted to rebalance flow and increase mass recovery.

Quarterly groundwater sampling was conducted at the PTT performance monitoring wells on September 20, 2023. Sampling was conducted at upgradient well MW-41S, PTT well MW-106, and downgradient compliance well MW-105. Samples collected from these monitoring wells were analyzed for petroleum constituents of concern (COCs) – VOCs, SVOCs, VPH, and EPH. Samples from PTT well MW-106 was also analyzed for biodegradation parameters.

The monitoring well upgradient of the passive treatment trench (MW-41S) reported benzene concentrations exceeding the DEQ-7 Human Health Standards – Groundwater (DEQ-7 HHS) and the Risk-Based Screening Levels (RBSLs) of 5 µg/L. Benzene was not detected from monitoring well MW-106 installed within the trench. Monitoring well MW-105 installed downgradient of the passive treatment trench reported benzene at 85 µg/L exceeding the DEQ-7 HHS and RBSL of 5 µg/L. Within the trench (MW-106), TPH and C5-C8 Aliphatics were at concentrations of 533 µg/L and 495 µg/L, respectively. The C5-C8 Aliphatics concentration was below the RBSL of 650 µg/L. Downgradient of the PTT (MW-105), the TPH concentration was 2,910 ug/L with a C5-C8 Aliphatic concentration of 1580 µg/L, exceeding the RBSL of 650 µg/L. Concentrations of contaminants of concern at the downgradient well MW-105 appear decreasing with time with some seasonal variability.

OM&M of the IM will continue to document the performance of the IM's and will include periodic performance reporting to the Montana Department of Environmental Quality (MDEQ) to ensure the IM objectives are continuing to be met. Further investigation/evaluation at the AOC-16 Truck Rack Source Area will be completed as part of the upcoming Resource Conservation Recovery Act (RCRA) Facility Investigation (RFI) activities. The results from the RFI and ongoing IM performance monitoring will be evaluated in the Corrective Measures Study to determine if operational modifications are necessary or if a request to the MDEQ to cease recovery and place the DPE system in standby mode is warranted.

1. INTRODUCTION

Ramboll Americas Engineering Solutions, Inc. (Ramboll), on behalf of Calumet Montana Refining, LLC (CMR), has prepared this Area of Concern-16 (AOC-16) Interim Measure (IM) Quarterly Monitoring Report (QMR) No. 7 for the Calumet Great Falls Montana Refining facility located at 1900 10th Street NE, Great Falls, Montana to summarize the third quarter of operations in 2023 (July 1 through September 30, 2023) for the AOC-16 IM remedy selected to address petroleum releases at AOC-16.

The CMR refinery is comprised of 82.7 acres of industrial/refinery operations and office buildings. The refinery produces gasoline, middle distillates, and asphalt for distribution in Washington, Montana, Idaho, and Alberta, Canada. AOC-16, referred to as the "Gasoline and Light Oil Loading Rack" or "truck loading rack," is located within an approximately 7.6-acre parcel to the east of the active refinery and is owned by CMR (Figure 1).

Activities were completed in accordance with the Corrective Action Order on Consent issued to Montana Refining Company, Inc. by the Montana Department of Environmental Quality (MDEQ) to govern the performance of Resource Conservation Recovery Act (RCRA) corrective action activities at the site. In 2016, petroleum related vapors were detected in an offsite residential property along 11th Street NE. The MDEQ issued an IM letter on October 11, 2016, directing CMR to address imminent threats to human health and/or the environment stemming from petroleum release near CMR's Loading Rack (MDEQ, 2016). Immediate action consisting of relocating and filling an existing sanitary sewer to prevent migration of contaminants was undertaken. Between 2016 and 2019, in coordination with the MDEQ, investigation activities were undertaken, and alternative remedies were evaluated to address the petroleum release near the Loading Rack. Ultimately, an IM remedy approach was recommended consisting of dual-phase extraction (DPE) in the existing primary recovery trench (PRT) in the Truck Rack Area and Light non-aqueous phase liquid (LNAPL) recovery and a passive treatment trench (PTT) just north of North River Road.

Construction of the AOC-16 IM remedies commenced in July 2021 and were completed in October 2021 as documented in the *AOC-16 Interim Measures AOC-16 IM Construction Documentation Report* (CMR, 2022a). Construction activities included the installation of following IM remedies:

- DPE remediation system in the Truck Rack Area, and
- LNAPL recovery trench and PTT utilizing colloidal activated carbon at an area along North River Road.

Commissioning of the AOC-16 IM was conducted from October 2021 through December 2021 and routine operations of the DPE system commenced on January 1, 2022. A 25-foot LNAPL recovery trench extension was completed between July 25, 2022 and July 29, 2022. Documentation of the extension construction activities were provided in the *AOC-16 IM Construction Documentation Report Addendum 1* (CMR, 2022b).

Corrective action remedial goals were developed as part of the AOC-16 Interim Measures Evaluation Report (CMR, 2019) to protect human health and the environment. The AOC-16 IM goals specific to each treatment area include:

- Truck Rack Area (DPE System)
  - Recover free phase LNAPL mass present in the area south of the Truck Rack to stabilize the LNAPL plume.
  - Reduce LNAPL within the vadose and saturated zone soil matrix to stabilize the dissolved phase plume.
- North River Road Area (LNAPL recovery trench and PTT)
  - Mitigate dissolved phase groundwater impacts migrating from the Truck Rack Area towards the Missouri River.

This AOC-16 IM 3rd Quarter 2023 Monitoring Report No. 7 summarizes the sampling results, operations, and performance monitoring data that were gathered for the AOC-16 IM from July 1, 2023 through September 30, 2023, and presents: 1) system runtime for the DPE System; 2) DPE system operational data; 3) identification of operational problems, the length of any shutdowns, and a summary of actions taken to rectify or prevent these problems; 4) influent vapor and liquid sampling results and estimated contaminant mass removal rates for the DPE system; 5) fluid levels, including LNAPL thickness measurements in the LNAPL recovery trench upgradient of the PTT; and 6) groundwater concentrations of constituents of concern (COC) in the PTT point of compliance well (MW-105) and PTT well (MW-106). The activities outlined in this report were performed in accordance with the Operations, Maintenance, and Monitoring (OM&M) Plan (CMR, 2021b).

2. DPE SYSTEM OPERATIONS SUMMARY

2.1 System Runtime

During the period of July 1, 2023 through September 30, 2023, the DPE system was in operation approximately 23% of the time and extracted and discharged approximately 33,975 gallons of total fluids to CMR's wastewater treatment plan (WWTP). Table 1 provides a summary of operations during this reporting period. A summary of the routine and non-routine system shutdowns is discussed below.

2.1.1 Planned Shutdowns for Routine and Corrective Maintenance

Brief shutdowns of the DPE system were performed to conduct maintenance activities, including filter replacement and level switch cleaning, monthly preventative maintenance, and inspection of equipment.

2.1.2 Non-Routine/Unplanned Shutdowns

A summary of the non-routine system shutdowns for this reporting period is discussed below:

- The system shut down on July 20, 2023 following a pump transfer delay and knock out tank high level alarm. Troubleshooting indicated that the transfer pump was unable to transfer liquid due to capacity issues in the facilities' sewer discharge piping system.
- The system was restarted on August 10, 2023 and immediately experienced a "differential pressure" and "high temperature" alarms. The SRCO (self-recuperating catalytic oxidizer) thermal oxidizer reactor chamber temperature reached approximately 1,600 degrees Fahrenheit (°F) which is well above the designed operating temperature. After allowing the system to cool, the reactor chamber was opened and inspected. The catalyst module was found to be damaged by high temperature and in need of replacement prior to continued operation. Additional cleaning of internal piping and troubleshooting the cause of the SRCO failure was needed before the system could be restarted. It was determined that the cause of the SRCO failure was carryover of liquid NAPL from the knock-out tank into the SRCO unit. Additional troubleshooting of the cause of liquid carryover is also being investigated before the system can be restarted.[1]

2.2 System Operation and Monitoring

DPE system performance monitoring and sampling were conducted in accordance with the OM&M Plan (CMR, 2021b and CMR, 2021c) to document system operation effectiveness. It included monitoring of operations data, periodic vapor and effluent sampling to document contaminant mass recovery, monitoring well gauging, and sub-surface vacuum measurements. These parameters are discussed in the following sections.

2.2.1 DPE Influent and Effluent Sampling Results

Monitoring of contaminant mass removal is the primary metric for optimizing DPE system performance and gauging the AOC-16 IM objective of free-phase LNAPL mass recovery and LNAPL plume stabilization.

[1] The system was restarted in the fourth quarter of 2023 following troubleshooting and repairs. The system was initially restarted on October 11, 2023 running to October 21, 2023; however, additional issues with the demister filter in the knockout tank were identified. Following replacement of the demister filter, the system was restarted on December 6, 2023.

Vapor

Vapor/air extraction flow rates were continuously monitored and recorded by the system programmable logic controller (PLC) and influent vapor sampling was periodically conducted to evaluate mass removal.

The concentrations of volatile organic compound (VOCs) in the vapor phase were measured periodically on each DPE influent line (DPE-1 through DPE-8) using a photoionization detector (PID) to measure relative vapor concentrations from each DPE well. PID measurements were also collected from sample port SP-301 on the inlet side of the blowers. PID measurements from the DPE wells and SP-301 port are summarized on Figures 2A and 2B. PID readings at all wells have dropped from greater than 400 parts per million (ppm) upon startup in October 2021 to less than 200 ppm in the third quarter of 2023. The highest PID reading during the reporting period was recorded at DPE-6 (151 ppm) on July 11, 2023.

Vapor samples were collected in July 2023 from SP-301. The sample was submitted to Pace National Laboratory located in Mount Juliet, Tennessee. The sample was analyzed for VOCs by the United States Environmental Protection Agency (USEPA) Method TO-15. Analytical results for detected compounds from the influent vapor samples are summarized in Table 2. Laboratory reports are included in Appendix A1. Historical analytical results and mass removal are included in Appendix B.

Concentrations of benzene, toluene, ethylbenzene, and xylene (BTEX), n-hexane, and n-heptane in effluent vapor over time are shown on Figure 3. These compounds were selected to evaluate vapor effluent concentration trends as their concentrations were the highest as compared to other VOCs during the start-up sampling. Concentration during the 3rd quarter of 2023 of BTEX, n-hexane, and n-heptane are approximately three to four orders of magnitude less than the concentrations at startup in October 2021. However, concentrations of BTEX increased approximately one order of magnitude between second quarter 2023 and third quarter 2023 while n-hexane and n-heptane concentrations appear relatively stable. For example, benzene concentrations decreased from 3,330,000 µg/m^3 in October 2021 to 138,000 µg/m^3 in December 2022 to 206 µg/m^3 in May 2023 before rebounding to 3,550 µg/m^3 in July 2023. However, N-hexane concentrations have decreased from 7,840,000 µg/m^3 in October 2021 to 169,000 µg/m^3 in December 2022 to 9,200 µg/m^3 to 15,700 µg/m^3 in July 2023.

As described in the AOC-16 Interim Measure 2nd Quarter 2023 Monitoring Report No. 6 (CMR, 2023), flow balancing was performed at the end the second quarter. The valves at DPE-6 and DPE-8 were determined to be producing higher flow rates of vapor compared to the other wells, which is likely due to subsurface variability. The high flow rates at these wells result in the overall system vacuum being reduced to a level that is less effective for liquid extraction. The manual valves at DPE-6 and DPE-8 were closed approximately 75% to reduce flow at these locations and increase recovery at other wellheads. It is likely that the rebound between second and third quarter 2023 are due to these flow adjustments. Concentration trends in the DPE system influent are decreasing which is likely due to reduced volatile mass in the subsurface. However, continued flow balancing is recommended to maximize VOC recovery.

The combination of vapor flow rates, system runtime, and vapor VOC concentrations were used to calculate the mass of contaminants removed. During the reporting period, the DPE system removed approximately 4.2 pounds of VOCs in the vapor phase as shown on Figure 4. As noted above, influent vapor concentrations (Table 2 and Figure 3) have dropped one to two orders of magnitude between the 4th quarter of 2022 and the 3rd quarter of 2023.

The post-catalyst outlet temperature on the Recuperative Catalytic Oxidizer (SRCO) unit also serves as a continuous relative indicator of contaminant mass with higher temperatures corresponding to relatively greater contaminant mass (Figure 5). Prior to January 2023 as shown in previous Quarterly Monitoring Reports, the post-catalyst process air temperature consistently exceeded 800 degrees F. During the first quarter of 2023 as noted in the AOC-16 Interim Measure 1st Quarter 2023 Monitoring Report No. 5 (CMR, 2023), the post-catalyst process air temperature during operation dropped below 700 degrees F during the first quarter of 2023 indicating reduced mass loading to the SRCO unit. However, as noted on Figure 5, the post-catalyst temperature has remained above 700 degrees F during the third quarter of 2023 indicating that the flow balancing appears to have increased mass loading which is corroborated by the analytical data collected.

Influent VOC concentrations as measured through vapor VOC sampling, PID readings at individual wells, and post-catalyst outlet temperature have decreased with time. Flow balancing appears to have increased contaminant recovery during the third quarter of 2023. Continued flow balancing is recommended including maximizing drawdown throughout the trench to influence the residual contamination in the zone of water table fluctuation.

Liquid

Effluent samples of groundwater were collected from the discharge side of the transfer pump in July 2023 and submitted to Pace located in West Columbia, South Carolina for analysis of VOCs and semi-volatile organic compounds (SVOCs). Samples were submitted to the Pace National Laboratory located in Mount Juliet, Tennessee for analysis of volatile petroleum hydrocarbons (VPH), and extractable petroleum hydrocarbons (EPHs). Analytical results from the effluent sampling are summarized in Table 3. Laboratory reports are included in Appendix A2. Historical analytical results and mass removal estimates are included in Appendix C.

The combination of fluid recoveries and contaminant concentrations were used to calculate the mass of contaminants removed in the dissolved phase. In the dissolved phase during the reporting period, the DPE system removed approximately 0.8 pounds of VOCs, 1.8 pounds of SVOCs, 10.4 pounds of VPH, and 511 pounds of EPH. In the third quarter of 2023, there appears to be a spike in mass recovery of EPH. This may be due to a shift in recovery to heavier end compounds or may be attributable to variations in sampling from event to event. Further monitoring of this trend is recommended.

Separate phase LNAPL recovery is not quantified. Total fluids (combined LNAPL and water) in the effluent are pumped to the refinery's on-site WWTP where oil-water separation occurs. However, visual observations of LNAPL in the DPE system knockout tank (T-23100) sight glass serve as a qualitative indicator of LNAPL recovery. One to two inches of LNAPL was observed within the knock-out tank sight glass. Qualitatively, the amount of LNAPL observed in the sight glass is lower than in previous quarters.

As shown on Figure 4, total VOC, SVOC, VPH, and EPH mass removed in the vapor and dissolved phase since DPE system startup in October 2021 and through September 30, 2023, is calculated to be approximately 2,901 pounds, 13.8 pounds, 215 pounds, and 2,429 pounds, respectively.

2.2.2 Groundwater Elevations

Monitoring wells in AOC-16 area (MW-22, MW-41S, MW-41D, MW-53, MW-57, MW-59S, MW-59D, MW-63, MW-64, MW-102, MW-103, MW-104, MW-105, and MW-106) were gauged monthly. The

depth to water and if observed, separate-phase LNAPL thickness measurements, were recorded. These measurements are presented in Table 4. Groundwater contours are provided on Figure 6. Groundwater elevations in September 2023 were approximately 1 to 2 feet higher than in June 2023.

2.2.4 Overall System Performance and Optimization

This section compares the primary design parameters to the observed/measured values during the reporting period to evaluate the system performance. These parameters are discussed in detail in following sections and summarized in Table 1.

Liquid Extraction Rate

The average design flow rate for the DPE system is between 0.25 gallons per minute (gpm) during steady-state operation and 21 gpm during rainfall events. The combination of fluid recoveries and system run time was used to calculate liquid flow rate during the reporting period. The DPE system extracted fluids at an average rate of 1.14 gpm which is within the design flow rate.

Vapor Influent Flow Rate and Applied Vacuum

The design vapor influent flow rate and applied vacuum are 200 standard cubic per minute (SCFM) and 17 inches of mercury (in-Hg), respectively. System flow rate and system vacuum at the header during the reporting period are shown on Figure 7. The vacuum exceeded 12 in-Hg in July slightly below the design vacuum of 17 in-Hg. Flows in July 2023 approached 100 SCFM. Some of the lower vapor flows may be attributable to higher liquid flow rates during these time periods. Note that clogging/fouling has been identified in the blowers so there is the potential for clogging of well screens and piping that may result in reduced system flows and should be inspected in the near term.

SRCO Performance Monitoring

The SRCO has a design destruction efficiency of 99% per manufacturer's specifications. To show compliance with the air permit, the SRCO pre- and post-catalyst process air temperature is monitored. The pre-catalyst process air temperature must be greater than 650°F to ensure a destruction efficiency of 99%. The SRCO temperature monitoring results during the reporting period is shown on Figure 5. As shown on Figure 5, the pre-catalyst process air temperature was above 650°F while the system was in operation.

During operation, the system was determined to be functioning as designed. DPE system optimization will be conducted, as needed, based on DPE well vapor concentrations, mass removal, and liquid extraction rates. Troubleshooting to understand the cause of the liquid carryover and SRCO failure is needed before operation can be resumed[2].

[2] The system was restarted in the fourth quarter of 2023 following troubleshooting and repairs. The system was initially restarted on October 11, 2023 running to October 21, 2023; however, additional issues with the demister filter in the knockout tank were identified. Following replacement of the demister filter, the system was restarted on December 6, 2023.

3. LNAPL RECOVERY TRENCH AND PTT

3.1 LNAPL Monitoring

The 11 original LNAPL collection wells located in the LNAPL recovery trench and 6 additional LNAPL trench extension collection wells were gauged monthly throughout this reporting period (Figure 1). Fluid levels collected from the LNAPL wells are summarized in Table 5 and on Figure 8. In July 2023, 0.02 feet of LNAPL was identified at LNAPL-6, and LNAPL was not identified at any other wells. LNAPL was not observed to be present in LNAPL-6 in August or September 2023.

3.1.1 Passive LNAPL Skimmer Installation

Passive LNAPL skimmers are deployed in eight recovery wells: LNAPL-2, LNAPL-4, LNAPL-5, LNAPL-6, LNAPL-7, LNAPL-8, LNAPL-10, and LNAPL-11. Passive skimmers are drained periodically and the liquid volume recovered at each location is recorded. During the reporting period, LNAPL was not identified in the skimmers which is consistent with the limited thicknesses observed in the wells so no LNAPL was recovered from the trench.

Given the continued observed LNAPL thickness in the LNAPL recovery trench (varying from 0 to 0.02 feet during this quarter) passive recovery program will be continued.

3.2 Groundwater Monitoring

The primary goal of the PTT is to mitigate dissolved phase groundwater impacts from migrating towards the Missouri River. Quarterly groundwater sampling was conducted on September 19 and 20, 2023, at upgradient well MW-41S, PTT well MW-106, and compliance well MW-105 (Figure 1).

3.2.1 Monitoring Well Sampling

The three wells were purged dry on September 19, 2023. The wells recharged over a 24-hour period and a groundwater sample was collected on September 20 2023. During the purging of each well, field measurements were collected for water quality parameters, including dissolved oxygen (DO), pH, specific conductance, temperature, turbidity, and oxidation reduction potential (ORP). The field measurements were recorded every 5 minutes during well purging. The physical and chemical field measurements collected when purging the monitoring wells are summarized in the groundwater sampling logs in Appendix D.

After all the samples were collected, they were sealed, labeled, and placed on ice, pending delivery under chain-of-custody procedures to Pace located in West Columbia, South Carolina. The groundwater samples were analyzed for VOCs (via USEPA Method SW8260D), SVOCs (via USEPA Method SW 8270D) by the Pace South Carolina Laboratory. Samples for analysis of MDEQ VPH (via Method MDEQ VPH), and MDEQ EPH (via Method MDEQ EPH) were analyzed by the Pace National Laboratory located in Mount Juliet, Tennessee.

The wells did not yield enough volume to facilitate the collection of field duplicate samples or a matrix spike/matrix spike duplicate (MS/MSD) sample. One trip blank was submitted along with each laboratory cooler for quality assurance/quality control (QA/QC) purposes. Methods and procedures for collecting, handling, and analyzing samples are provided in the Quality Assurance Project Plan (QAPP) (CMR, 2018). Treatment and disposal of purge water generated during monitoring well sampling was handled consistent with existing project procedures.

3.2.2 Groundwater Analytical Results – September 2023

The groundwater analytical results for detected compounds from the September 2023 sampling event are provided in Table 6. Previous quarterly groundwater sampling results from October 2021, March 2022, June 2022, August 2022, March 2023, and June 2023 are also provided in Table 6 for comparison purposes. Analytical compounds that met or exceeded the respective MDEQ -7 HHS (May 2017) and/or MDEQ Tier 1 Groundwater Risk-Based Screening Levels (RBSLs) are bolded and/or shaded, respectively, for reference. Laboratory reports are included in Appendix A3.

The following subsections provide a summary of the analytical parameters detected in the monitoring wells in September 2023 and compare those detections to the DEQ-7 HHS in groundwater and RBSLs.

VOCs

Of the VOCs detected during the September2023 groundwater sampling event at AOC-16, only benzene was detected above its respective groundwater screening standard.[3]

The monitoring well upgradient of the passive treatment trench (MW-41S) reported benzene at 470 micrograms per liter (µg/L) exceeding the DEQ-7 HHS and RBSL of 5 µg/L. Benzene was not detected from the location (MW-106) installed within the trench. The monitoring well (MW-105) installed downgradient of the passive treatment trench reported benzene at 85 µg/L exceeding the DEQ-7 HHS and RBSL of 5 µg/L.

SVOCs

In September 2023, no SVOCs were detected at concentrations exceeding the DEQ-7 HHS or the RBSLs.

TPH, VPH, and EPH

The upgradient monitoring well (MW-41S) had detectable concentrations of total petroleum hydrocarbons (TPH) via method MTDEQ VPH of 5,570 µg/L with a C5-C8 Aliphatic concentration of 842 µg/L which exceeds the RBSL of 650 µg/L. Within the trench (MW-106), TPH[4] and C5-C8 Aliphatics were detected at concentrations of 533 µg/L and 495 µg/L, respectively. The C5-C8 Aliphatics concentration was below the RBSL of 650 µg/L. Downgradient of the PTT (MW-105), the TPH concentration was 2,910 ug/L with a C5-C8 Aliphatic concentration of 1580 µg/L, exceeding the RBSL of 650 µg/L.

3.2.3 Evaluation of Concentration Trends Over Time

To evaluate concentration trends over time, the concentrations of benzene and TPH were plotted for each of the three passive treatment trench monitoring wells. Baseline sampling data from June 2020 through October 2021 are included on Figures 9A through 9C along with post-remediation data. This historical data was previously reported in the 2020/2021 Annual Groundwater Sampling Summary Report (CMR, 2021a) and Construction Documentation Report (CMR, 2022a). Benzene and C5-C8 Aliphatics were selected as indicator compounds because they were the two compounds that exceed DEQ-7 HHSs and/or RBSLs during the baseline sampling event in October 2021. While there are no DEQ-7 HHSs and RBSLs for TPH, TPH represents a range of hydrocarbons and serves as an overall indicator of contaminant loading to the PTT.

[3] All VOC results reported in this section are from USEPA Method 8260B.

[4] TPH analyzed using Method MTDEQ VPH.

The benzene, C5-C8 Aliphatics and TPH sampling results at upgradient well MW-41S showed the following changes between October 2021 and September 2023:

- Benzene decreased from 1,900 µg/L in October 2021 to 470 µg/L in September 2023.
- TPH has remained relatively consistent with some variability between sampling events with a maximum value of 9,800 µg/L in June 2022 and a minimum value of 3,100 µg/L in March 2022.
- C5-C8 Aliphatic have remained relatively consistent between sampling events with a minimum value of 1,500 µg/L in October 2021 and a maximum value of 3,090 µg/L in March 2023.

The benzene, C5-C8 Aliphatics and TPH sampling results at well MW-106 located in the PTT showed the following changes between October 2021 and September 2023:

- Benzene has not been detected during any sampling events.
- TPH had not been detected between October 2021 and June 2022, but was detected at concentration of 189 µg/L in August 2022, 108 µg/L in December 2022, 108 µg/L in June 2023, and 533 µg/L in September 2023.
- C5-C8 Aliphatic had not been detected between October 2021 and June 2022, but was detected in August 2022 a concentration of 153 µg/L, in December 2022 at a concentration of 80 µg/L, in June 2023 at a concentration of 85.9 µg/L and in September 2023 at a concentration of 495 µg/L. Detected results remain less than the RBSL of 650 µg/L.

The benzene, C5-C8 Aliphatics, and TPH sampling results at well MW-105 located downgradient of the PTT showed the following changes between October 2021 and September 2023:

- Benzene has decreased from 250 µg/L in October 2021 to 85 µg/L in March 2023. Trends generally are decreasing with time since the installation of the PTT with some variability between sampling events. Trends may indicate that concentrations are higher in summer/fall months than in winter months but further data collection and analysis is needed to verify this trend.
- TPH appears variable with a maximum concentration of 1,900 µg/L in October 2021 and a minimum concentration 284 µg/L in March 2023. Trends may indicate that concentrations are higher in summer months than in winter months, but further data collection and analysis is needed to verify this trend.
- C5-C8 Aliphatics appear variable with a maximum concentration of 1,800 µg/L in February 2021 and a minimum concentration 63.9 µg/L December 2022. Trends may indicate that concentrations are higher in summer months than in winter months, but further data collection and analysis is needed to verify this trend.
- Trends may indicate that concentrations are higher in summer months than in winter months but further data collection and analysis is needed to verify this trend.

Analytical results from groundwater samples collected from monitoring wells located up-gradient, down-gradient and from within the PTT indicate that the concentration of dissolved phase petroleum COCs decreased across the PTT initially meeting the goal of the PTT to mitigate the dissolved phase groundwater impacts from migrating from the Truck Rack to the Missouri River. Concentrations of COCs appear to be fluctuating with time at the down-gradient compliance point. Initial trends may indicate that there is some seasonable variability in concentrations at downgradient well MW-105, but further data collection and analysis is needed to verify this trend.

Biodegradation Parameters

Field parameters including pH, conductivity, turbidity, ORP, and dissolved oxygen are provided in Table 7. Low dissolved oxygen (generally less than 0.5 mg/L) and low or negative ORP values serve as indicators of the presence of reducing conditions. The lower the ORP and DO, the greater the potential for a reducing and anaerobic environment. At the PTT well (MW-106), ORP remained low and constant (ranging between -127 and 47 millivolts [mV]) and DO was not detected indicative of a slightly reducing to slightly oxidizing condition. In the down gradient well (MW-105), ORP has been close to zero ranging between -107 and 144 mV indicative of both reducing and oxidizing conditions.

4. CONCLUSION AND RECOMMENDATIONS

During this reporting period from July 1, 2023 through September 30, 2023, the DPE system operated approximately 23% of the available time. A non-routine system shutdown occurred during this period due to capacity issues in the facilities' sewer discharge piping system that prohibited the transfer pump to transfer liquid to the sewer. Additionally, a SRCO system failure occurred because of carryover of liquid NAPL from the knock-out tank into the SRCO unit, which resulted in damage to the SRCO catalyst module. During this reporting period, the DPE system extracted and discharged approximately 33,975 gallons of total fluids to CMR's WWTP while in operation.

DPE System Performance

Initial mass removal rates indicate that the DPE system in the Truck Rack Area is meeting the AOC-16 IM goals of recovering free phase LNAPL mass and reducing the LNAPL within the vadose and saturated zone soil matrix.

During the reporting period, the DPE system removed approximately 4.2 pounds of VOCs in the vapor phase, and 0.8 pounds of VOCs, 1.8 pounds of SVOCs, 10.4 pounds of VPH, and 511 pounds of EPH in the liquid phase. Total VOC, SVOC, VPH, and EPH mass removed in the vapor and dissolved phase since DPE system startup in October 2021 and through September 30, 2023, is calculated to be approximately 2,901 pounds, 13.8 pounds, 215 pounds, and 2,429 pounds, respectively. Total influent vapor VOC concentrations were approximately 3 to 4 orders of magnitude lower than during startup during this quarter. Reductions in contaminant mass recovery may be due to a combination of the submerged DPE wells, reduced manifold vacuum, seasonal fate and transport mechanisms, and reduced contaminant mass present.

The pre-catalyst SRCO temperature remained greater than 650°F while in operation indicating at least 99% destruction efficiency of the extracted petroleum vapors prior to being discharged to the atmosphere.

During operation, maintenance activities will be performed and documented to ensure optimal performance of the system. DPE system optimization will be performed based on trench liquid elevations, DPE well vapor concentrations, mass removal, and liquid extraction rates.

Ongoing maintenance issues with liquid carryover from the knockout tank need to be resolved before the system can continue operation[5].

LNAPL Trench Performance

The LNAPL trench installed upgradient of the PTT is successfully recovering and preventing the migration of LNAPL into the PTT.

For more effective LNAPL recovery, CMR deployed passive skimmer in the LNAPL recovery wells with measurable LNAPL in February 2022. LNAPL thicknesses in LNAPL recovery wells were generally lower

[5] The system was restarted in the fourth quarter of 2023 following troubleshooting and repairs. The system was initially restarted on October 11, 2023 running to October 21, 2023; however, additional issues with the demister filter in the knockout tank were identified. Following replacement of the demister filter, the system was restarted on December 6, 2023.

than previous reporting periods with a maximum thickness of 0.02 feet observed at LNAPL-6. No LNAPL was recovered from the trench via passive skimmers during the reporting period. As this was the first reporting period with limited LNAPL recovery from the trench, continued monitoring and passive recovery are recommended.

PTT Performance

Analytical results from groundwater samples collected from monitoring wells located up-gradient, down-gradient and from within the PTT indicate that the concentration of dissolved phase petroleum COCs decreased across the PTT initially meeting the goal of mitigating the dissolved phase groundwater impacts from migrating from the Truck Rack to the Missouri River. Concentration trends are decreasing at downgradient performance monitoring well MW-105 with some seasonable variability.

OM&M of the interim measures will continue to document the performance of the IM's and will include periodic performance reporting to the MDEQ to ensure the IM objectives are being met. Further investigation/evaluation of the petroleum impacts at the AOC-16 Truck Rack Area will be completed as part of the upcoming RCRA RFI activities. The results from the RFI and ongoing IM performance monitoring will be evaluated to determine if operational modifications are necessary or if a request to the MDEQ to cease recovery and place the DPE system in standby mode is warranted.

5. REFERENCES

CMR. 2018. Quality Assurance Project Plan (QAPP), Calumet Montana Refinery. November.

CMR. 2021a. 2020/2021 Annual Groundwater Sampling Summary Report. June.

CMR. 2021b. AOC-16 Interim Measure Operations, Maintenance, and Monitoring Plan. October.

CMR. 2021c. AOC-16 Interim Measure Self-Recuperative Catalytic Oxidizer Operations, Maintenance, and Monitoring Plan. October.

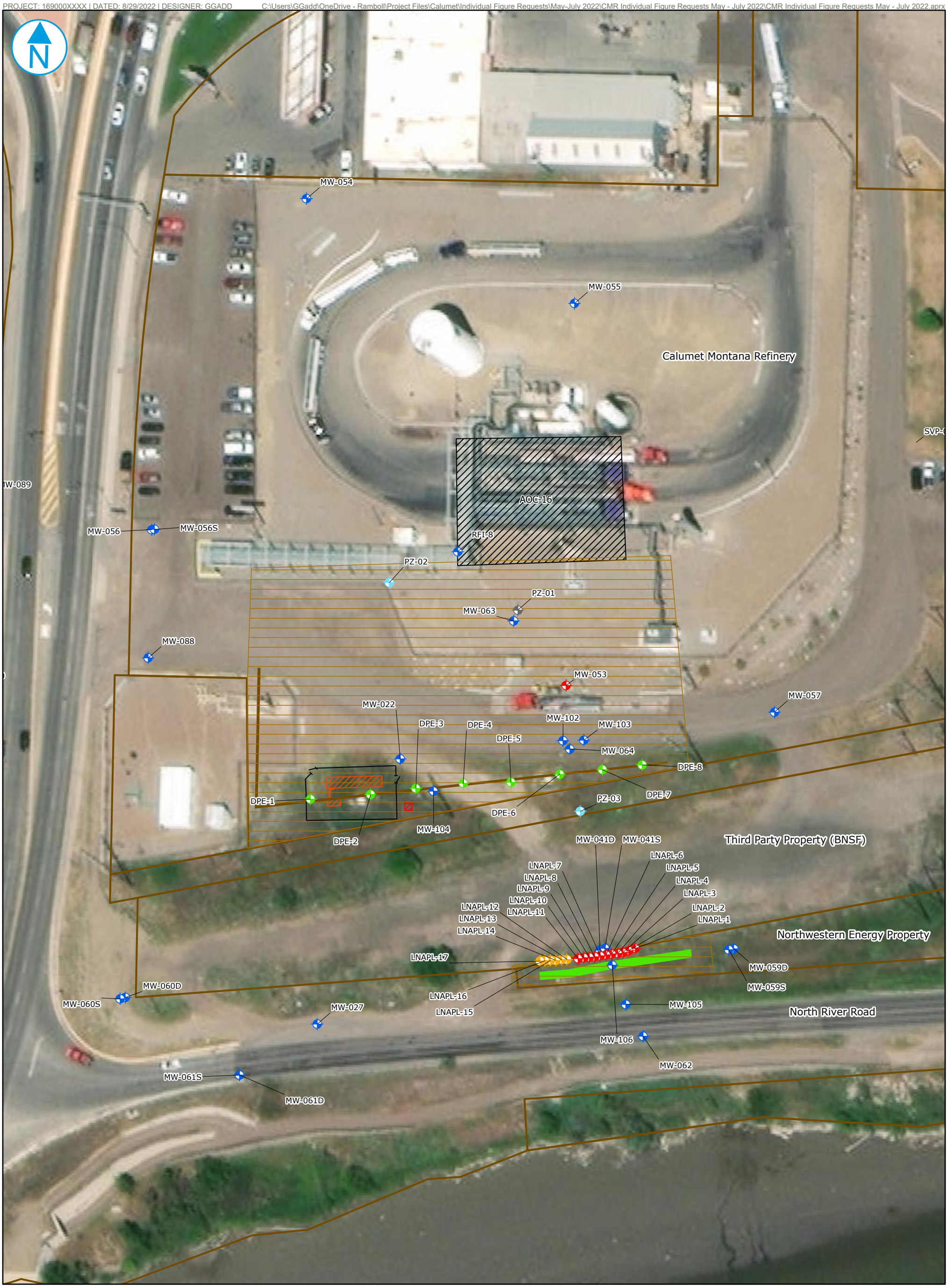
CMR. 2022a. AOC-16 IM Construction Documentation Report. March.

CMR. 2022b. AOC-16 IM Construction Documentation Report Addendum 1. October.

CMR. 2023. AOC-16 Interim Measures Quarterly Monitoring Report No. 6. November 10.

MDEQ. 2016. Immediate Interim Measures Petroleum Release Near CMR's Loading Rack. October 11.

FIGURES



LNAPL Recovery Well - Installed 2022
LNAPL Recovery Well - Installed 2021
DPE Recovery Well - Installed 2021
Abandoned Well
Piezometer
Monitoring Well
DPE Fence

Property Line
Corrective Action
Passive Recovery Trench
Primary Recovery Trench
DPE - CATOX Unit
DPE Transformer
AOC

0 25 50 100 Feet

AOC 16 SITE LAYOUT

FIGURE 01

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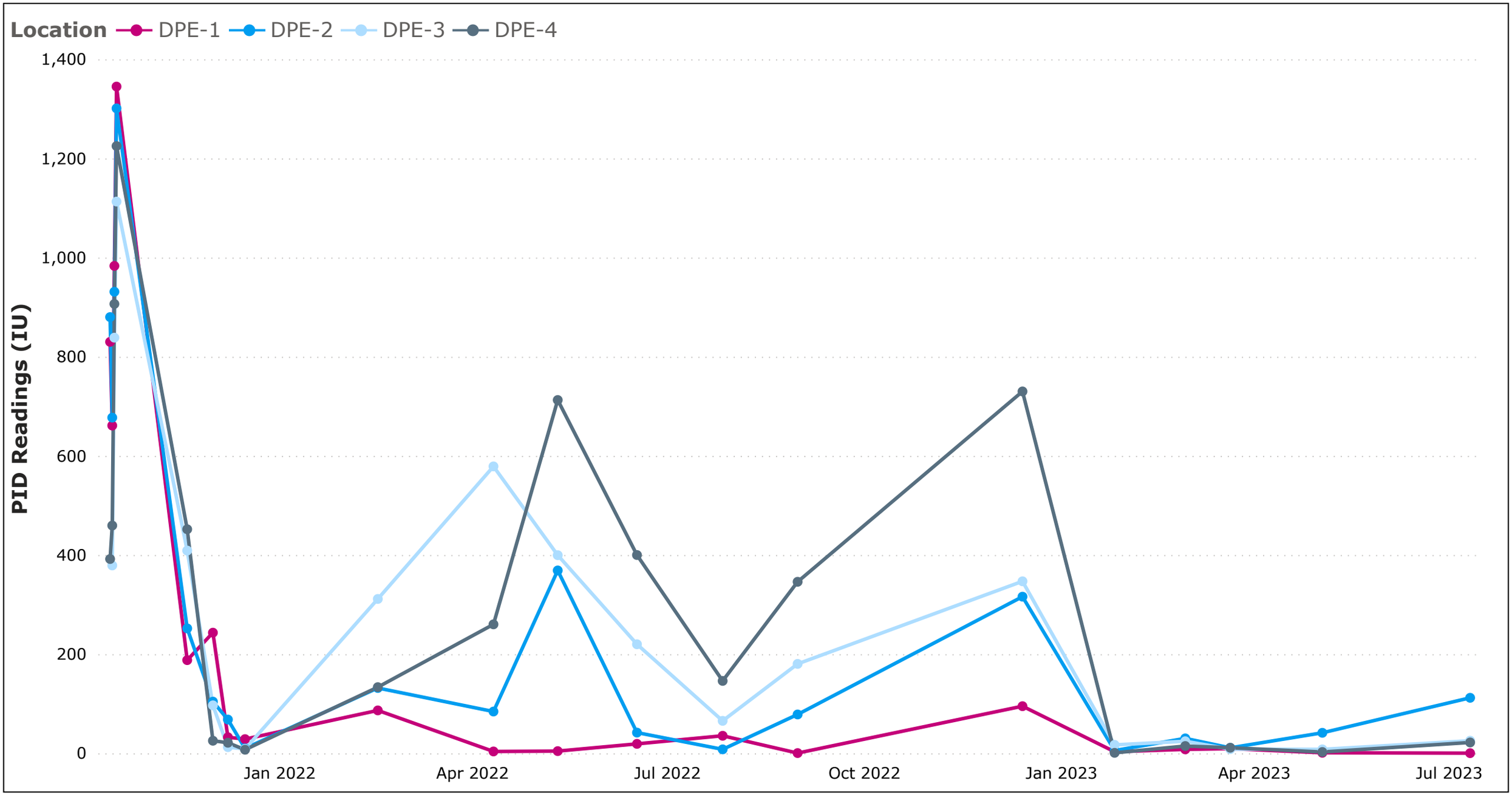
A RAMBOLL COMPANY

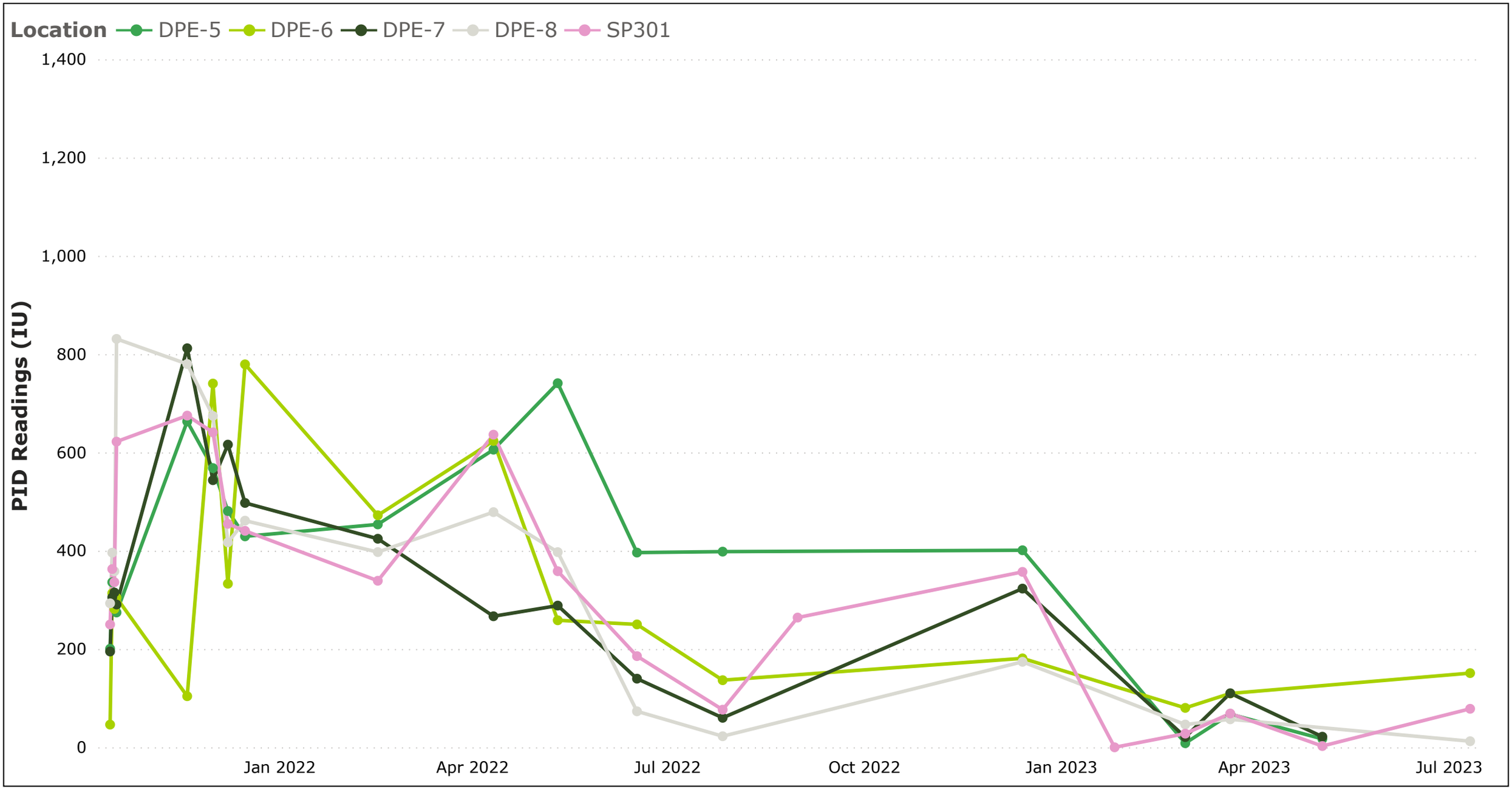
Calumet Montana Refining, LLC
1900 10th Street Northeast
Great Falls, Montana

Figure 2A: DPE system Influent Vapor PID Readings (DPE-1 through DPE-4)



Notes:
IU: Instrument Units
PID: photoionization detector

Figure 2B: DPE system Influent Vapor PID Readings (DPE-5 through DPE-8 and SP-301)



Notes:
IU: Instrument Units
PID: photoionization detector

SP-301 represents combined vapor sample from all 8 DPE wells.

PID measurements were not recored in July 2023 at DPE-5 and DPE-7 due to water flooding the sampling lines.

Figure 3: DPE System Influent Vapor Concentration Trend

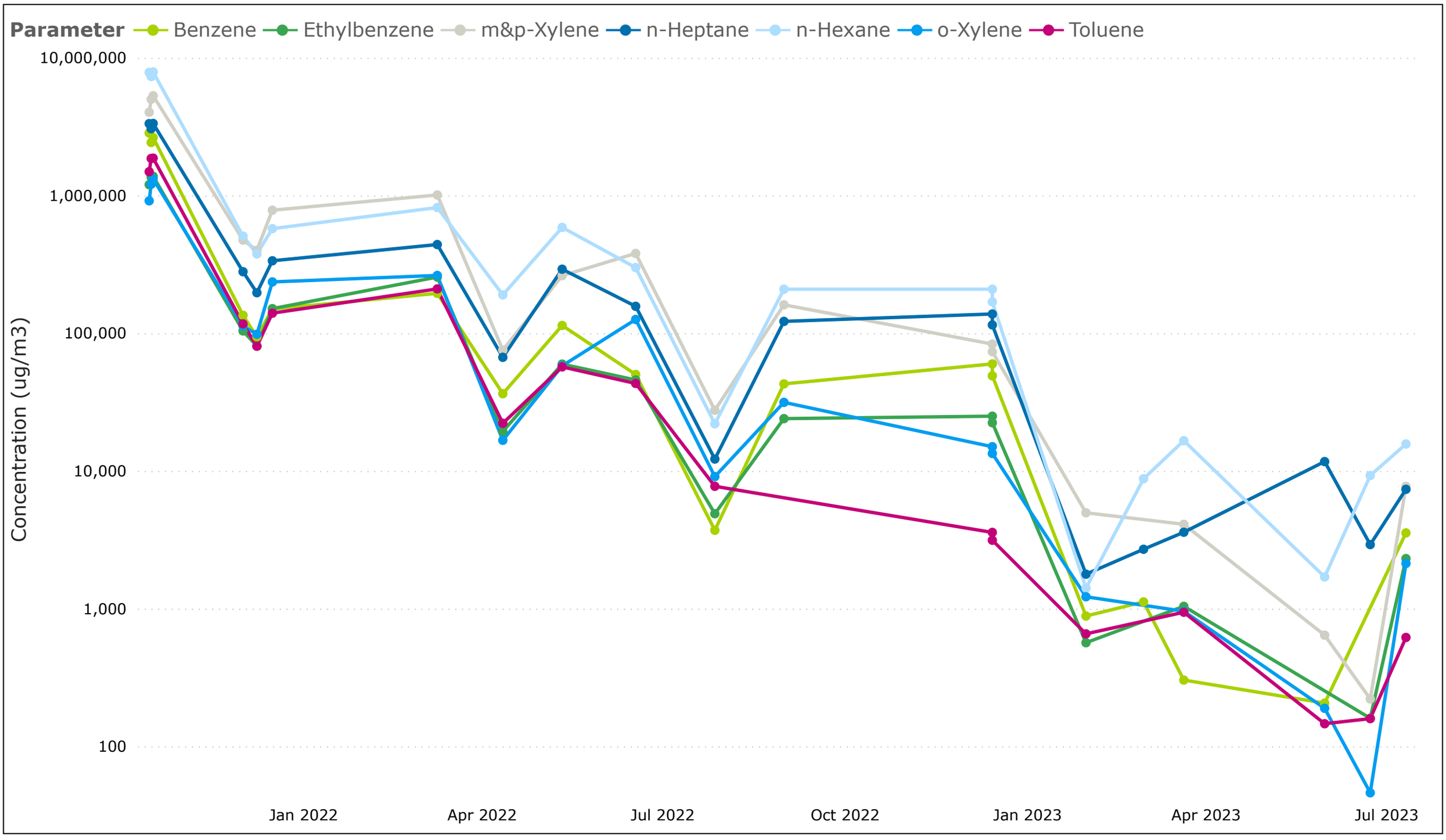
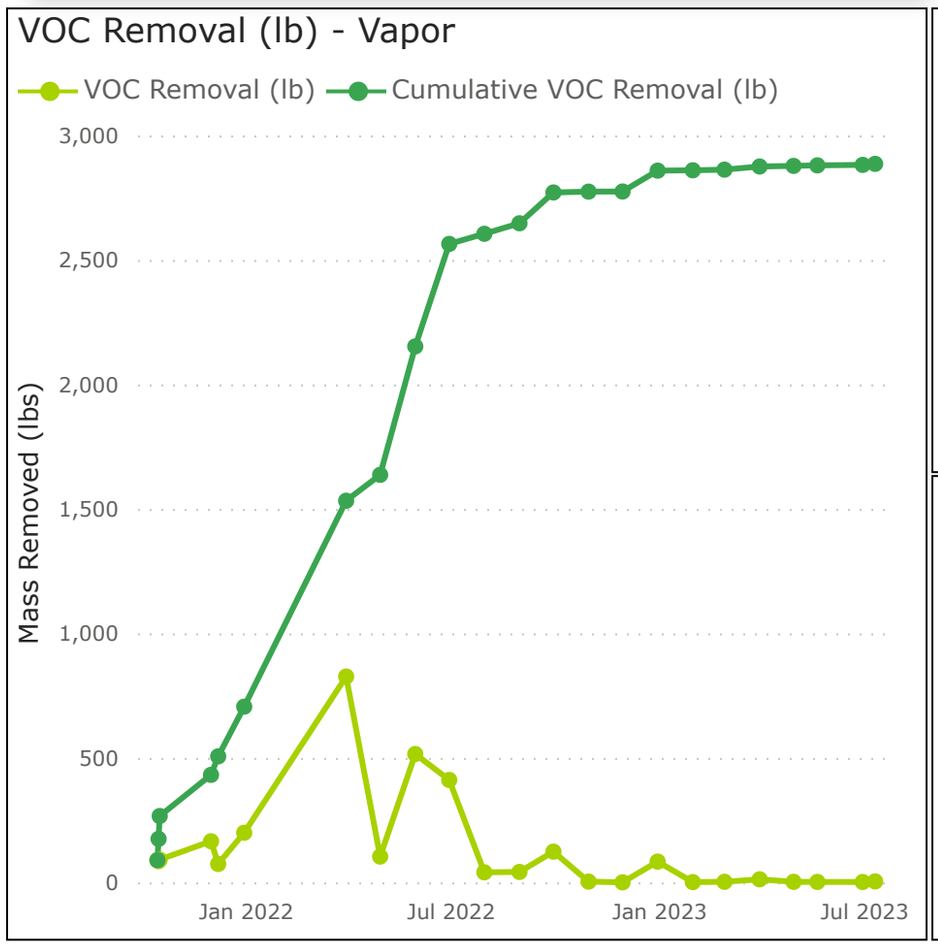
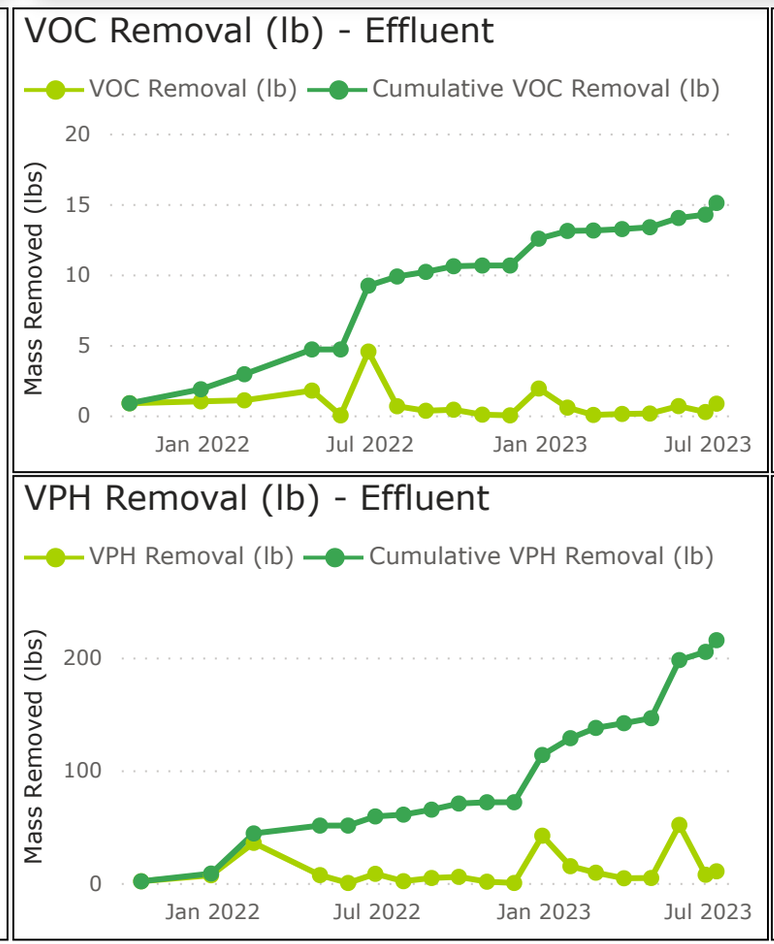


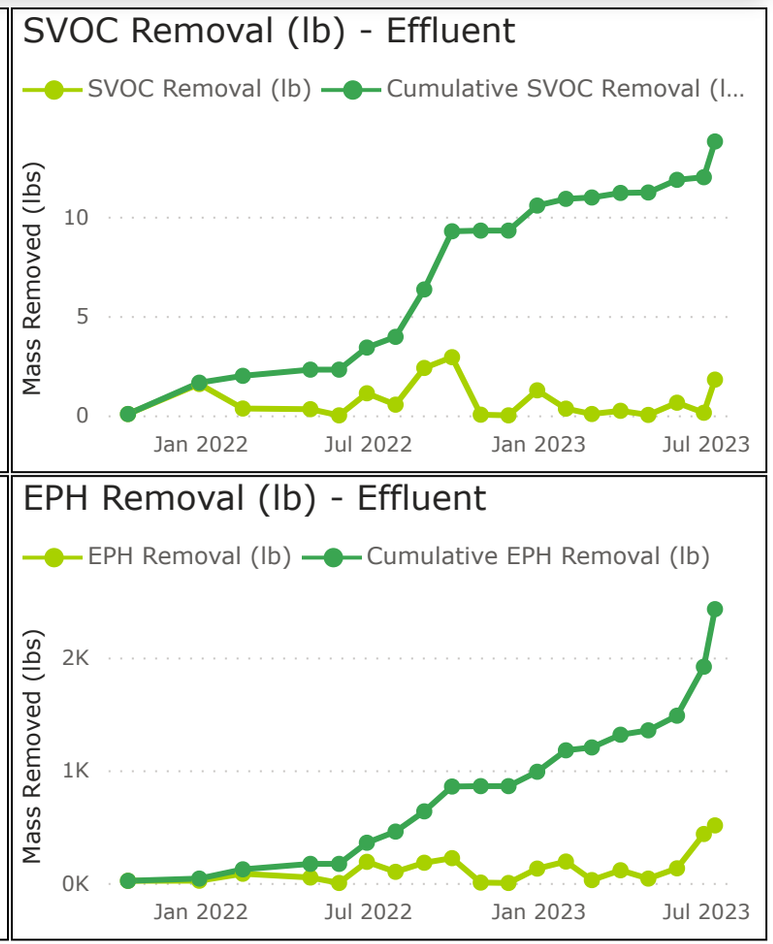
Figure 4: Vapor and Liquid Effluent Mass Removal

Vapor Mass Removal



Liquid Effluent Mass Removal



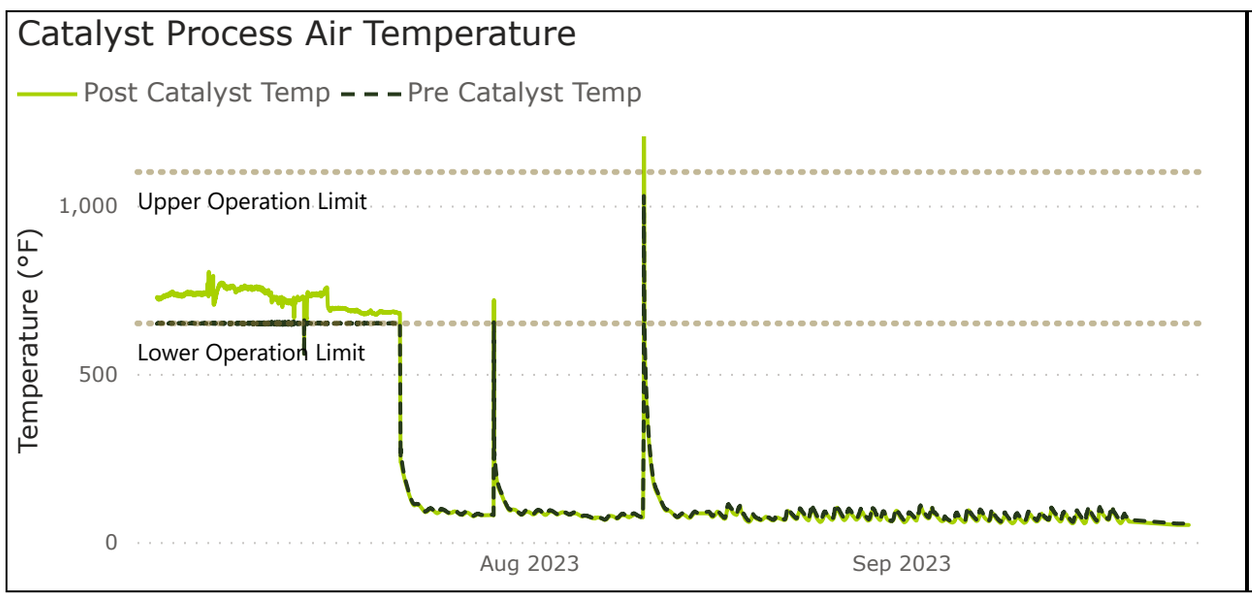


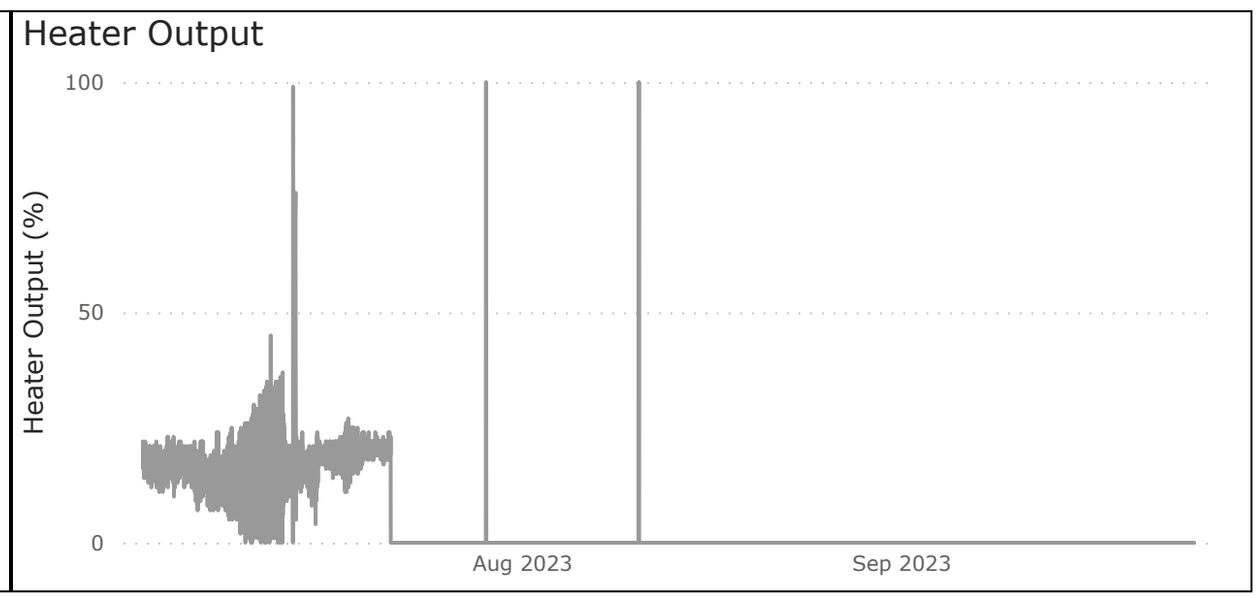
Total VOCs Removed (lbs)	Total SVOCs Removed (lbs)	Total VPHs Removed (lbs)	Total EPHs Removed (lbs)
2,901	13.8	215	2,429

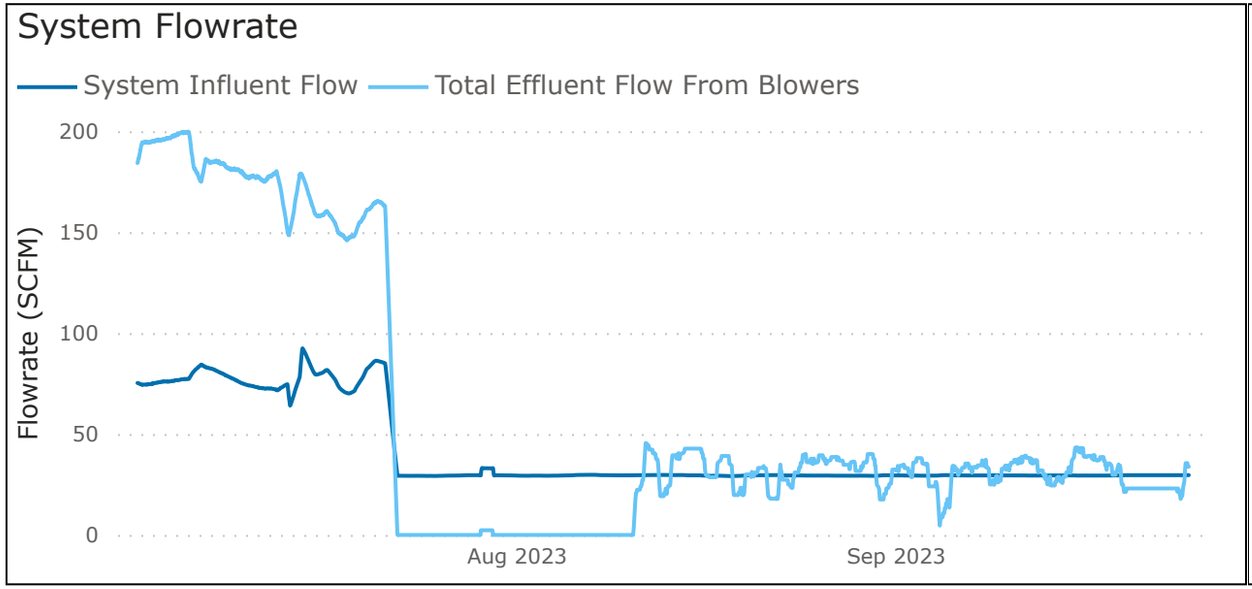
Notes:

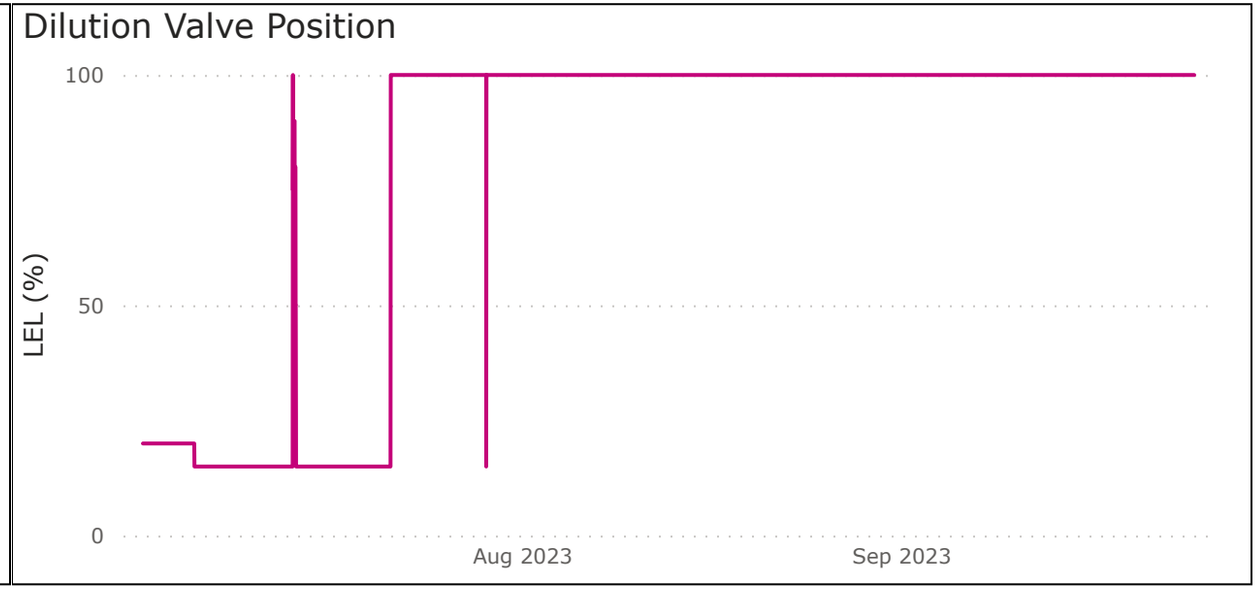
- Vapor samples were collected from SP-301. The combination of vapor flow rates, system runtime, and vapor VOC concentrations were used to calculate the mass of contaminants removed.
- Liquid effluent samples were collected from the discharge side of the transfer pump (SP-200). The combination of fluid recoveries and contaminant concentrations were used to calculate the mass of contaminants removed.

Figure 5: SRCO Operational Parameters





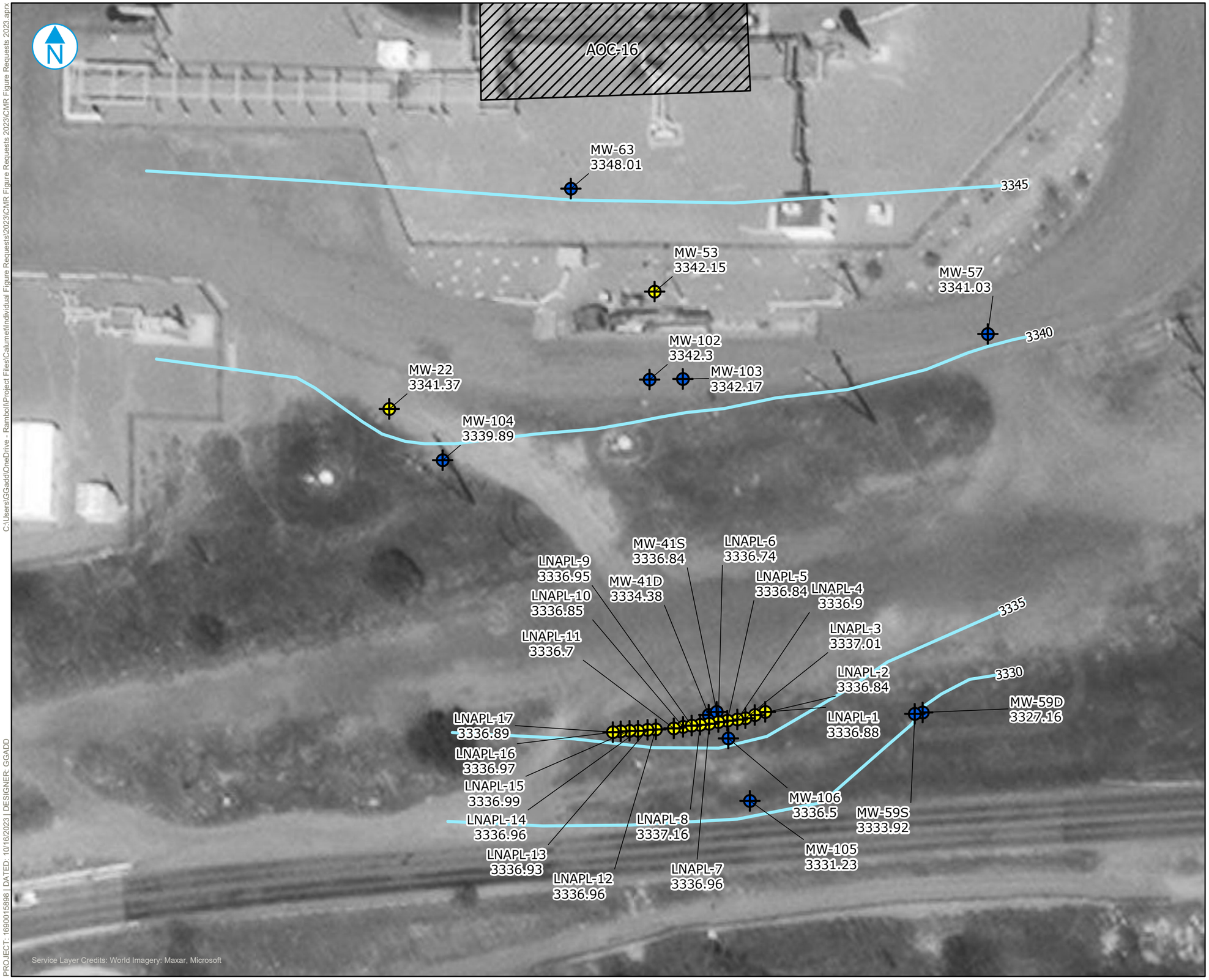




Notes:

- Post-catalyst process air temperature is based on TT-23702 reading.
- System flow is from FT-23401 (prior to dilution). Total Flow from blowers is based on readings from FT-23405 and FT-2306.
- Heater Output is based on H-2303 and H-2304 readings.
- Heater Output represents % energy supplied by CATOX to maintain catalyst temperature.
- Dilution valve position represents FV23702 valve position (% open).
- DPE system was operational during the period from July 1, 2023 to July 20, 2023 and was not operational from July 21, 2023 to September 30 (through the end of this reporting period) due to issues with the transfer pump and SRCO system

7/1/2023 9/30/2023



Monitoring Well
Recovery Well
Groundwater Contours (5 ft)

0 50 100 Feet

Notes
1) Measurements collected on September 9, 2023
2) The shallow most screen interval at well cluster MW-41S/D was used to generate the potentiometric surface contour map (i.e. MW-41S)

GROUNDWATER CONTOURS - SEPTEMBER 2023

Calumet Montana Refining, LLC
1900 10th Street Northeast
Great Falls, Montana

FIGURE 06

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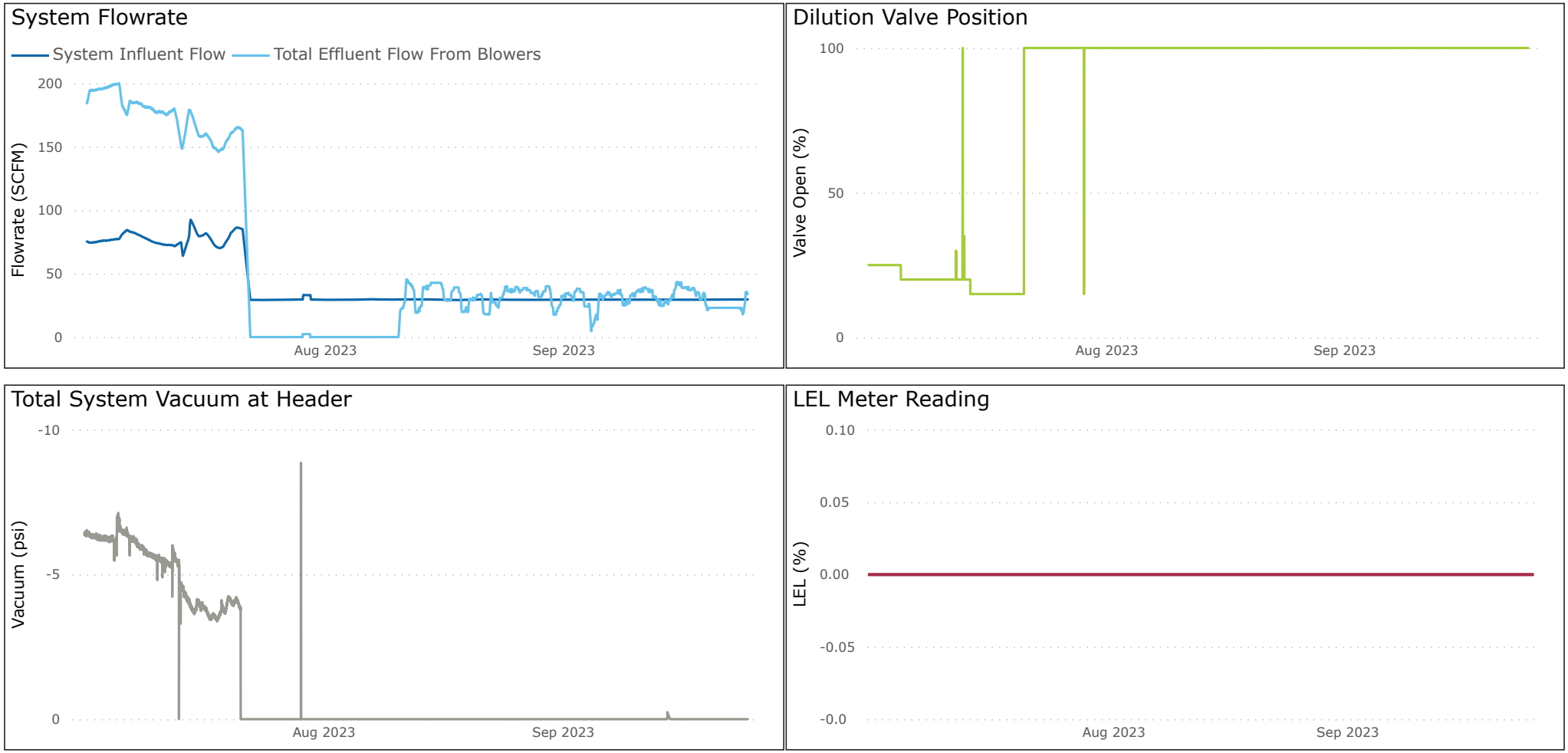
RAMBOLL

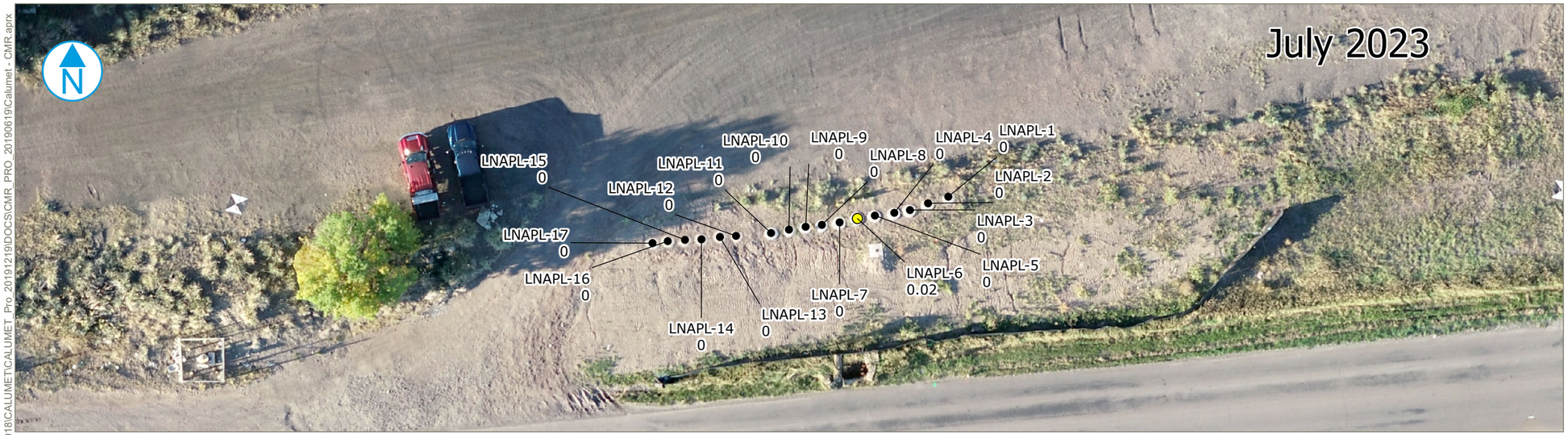
Figure 7: DPE System Operational Parameters

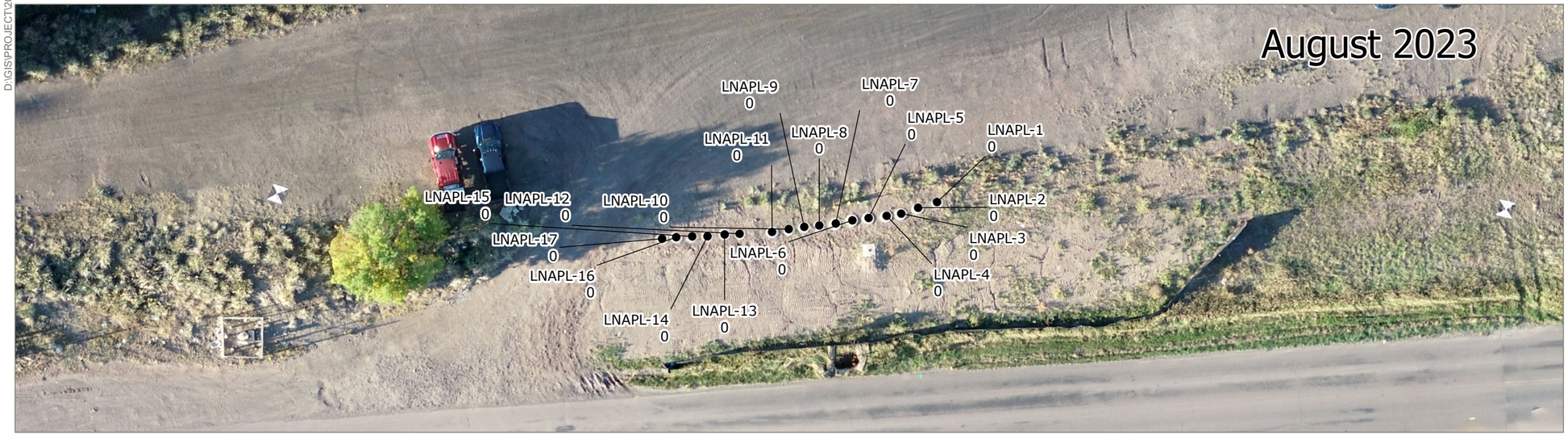


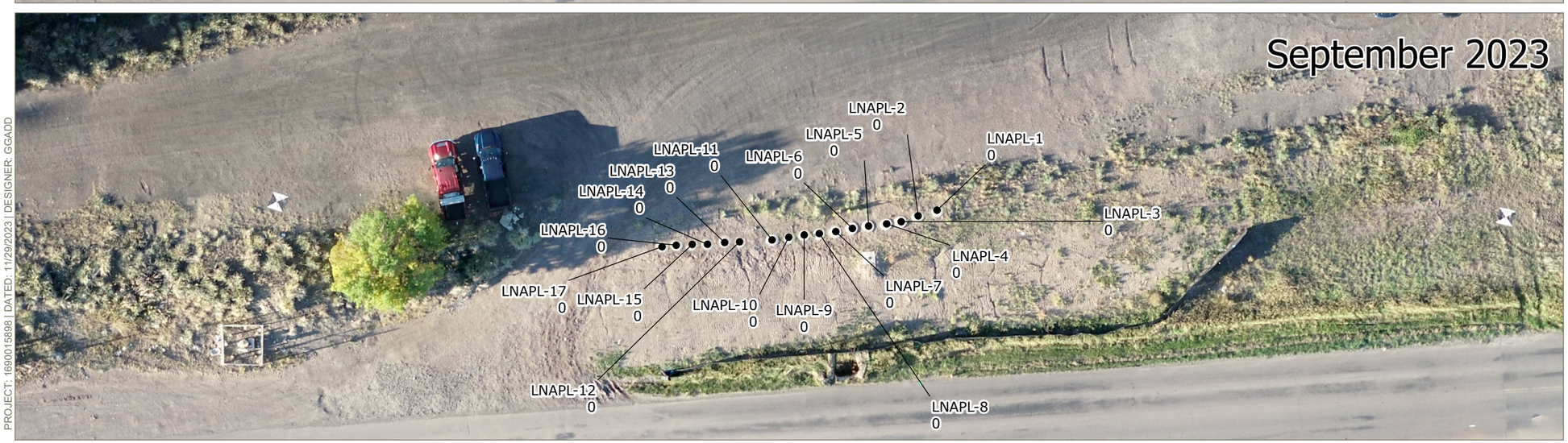
7/1/2023 9/30/2023

Notes:

- System flow is from FT-23401 (prior to dilution). Total Flow from blowers is based on readings from FT-23405 and FT-2306.
- Dilution valve position represents FV23904 valve position (% open).
- Total System Vacuum is measured at PT23623.
- LEL meter readings are from AT23904 LEL meter. LEL meter readings are not available from 1/1/2022 - 1/20/2022 due to LEL meter malfunction.
- DPE system was operational during the period from July 1, 2023 to July 20, 2023 and was not operational from July 21, 2023 to September 30 (through the end of this reporting period) due to issues with the transfer pump and SRCO system.







LNAPL Thickness (ft)
- 0.0
- 0.0 - 0.25
- 0.25 - 0.50
- 0.50 - 0.75

0 30 60 Feet

MAXIMUM LNAPL THICKNESS
LNAPL RECOVERY WELLS
Q3 2023

Calumet Montana Refining, LLC
1900 10th Street Northeast
Great Falls, Montana

FIGURE 08

RAMBOLL US CORPORATION
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RAMBOLL

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PROJECT: 1690015898 | DATED: 11/29/2023 | DESIGNER: GGADD

Figure 9A: Groundwater Concentration Trend Graph - Benzene

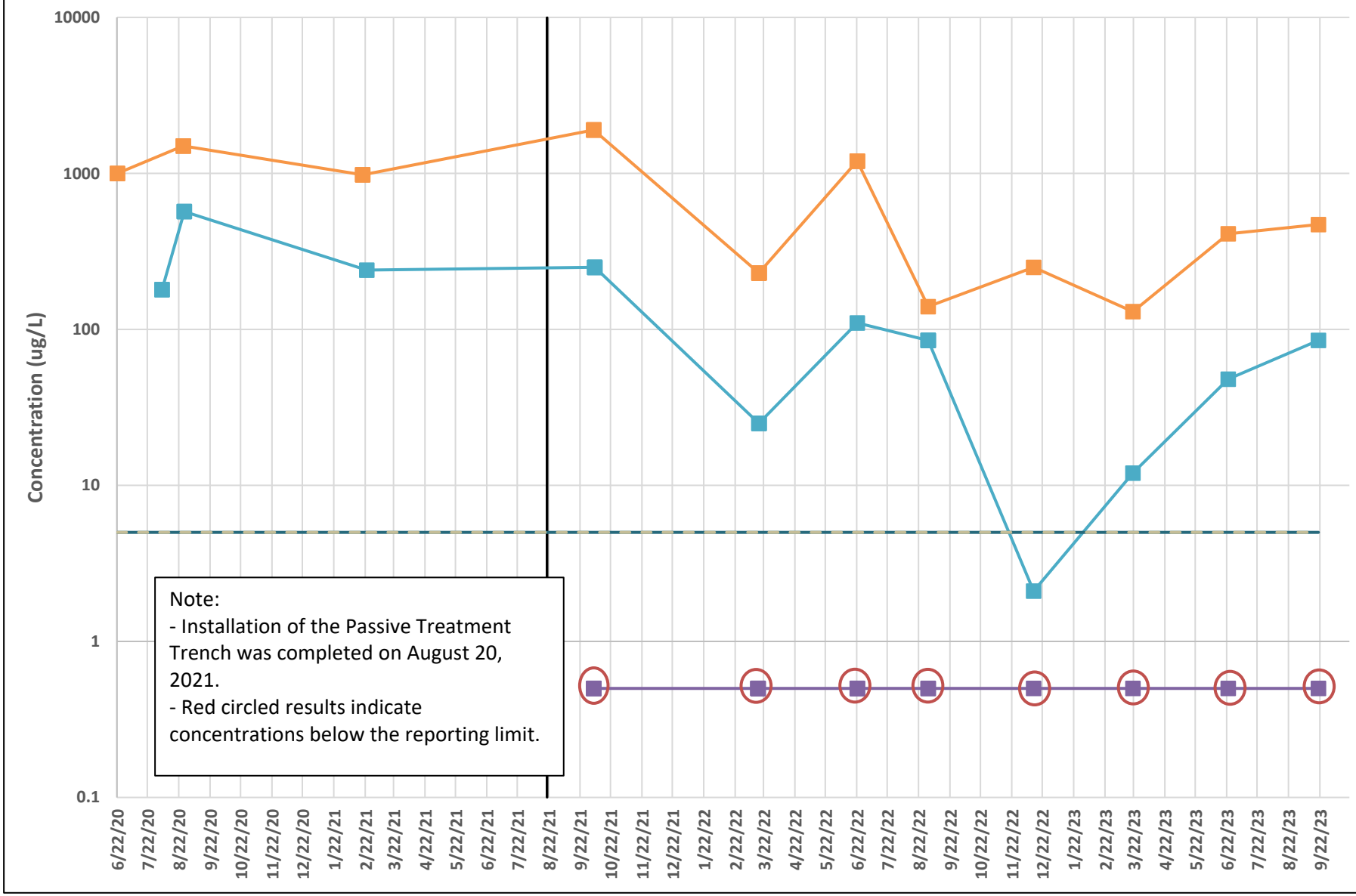


Figure 9B: Groundwater Concentration Trend Graph - C5-C8 Aliphatics

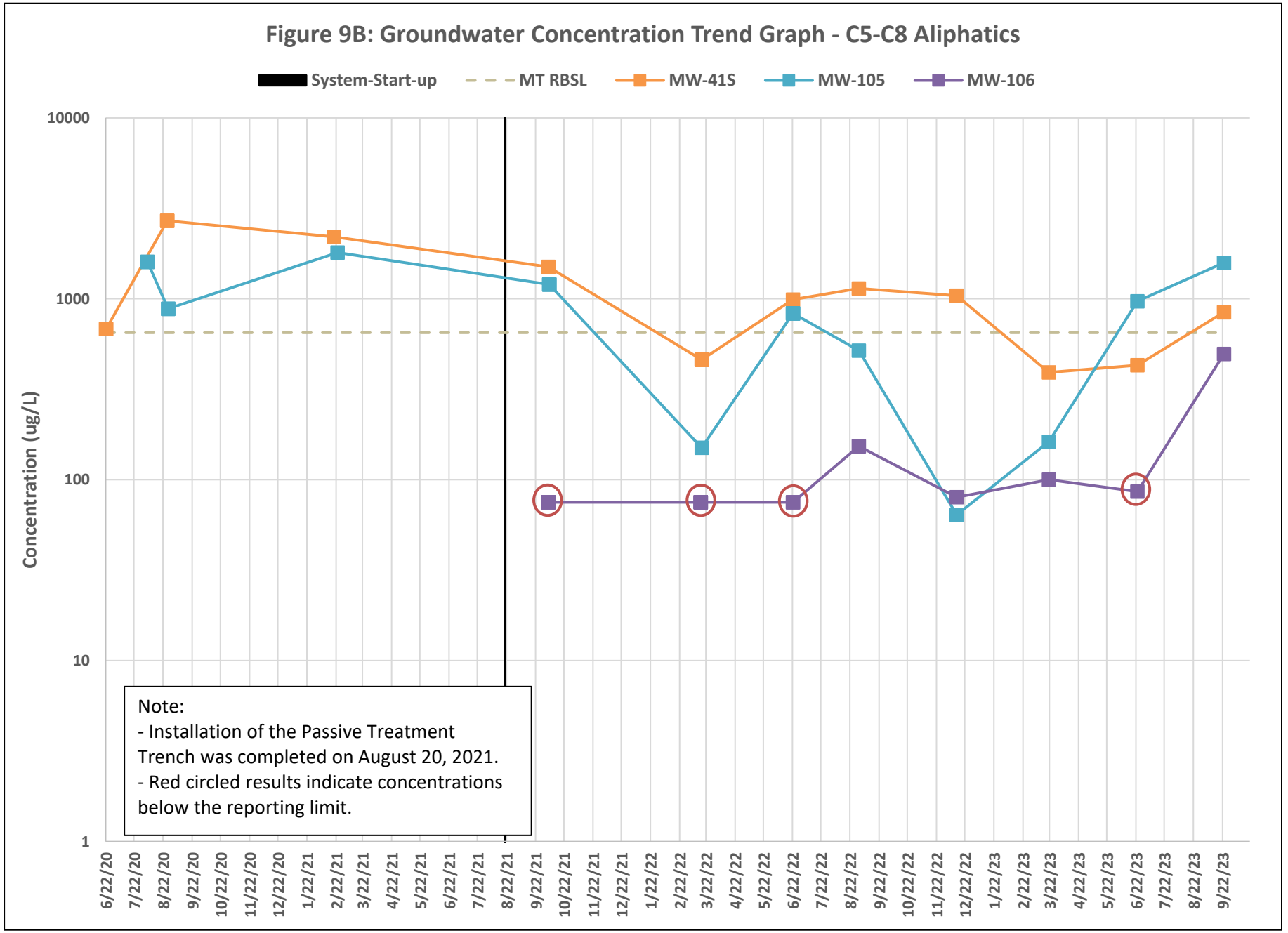
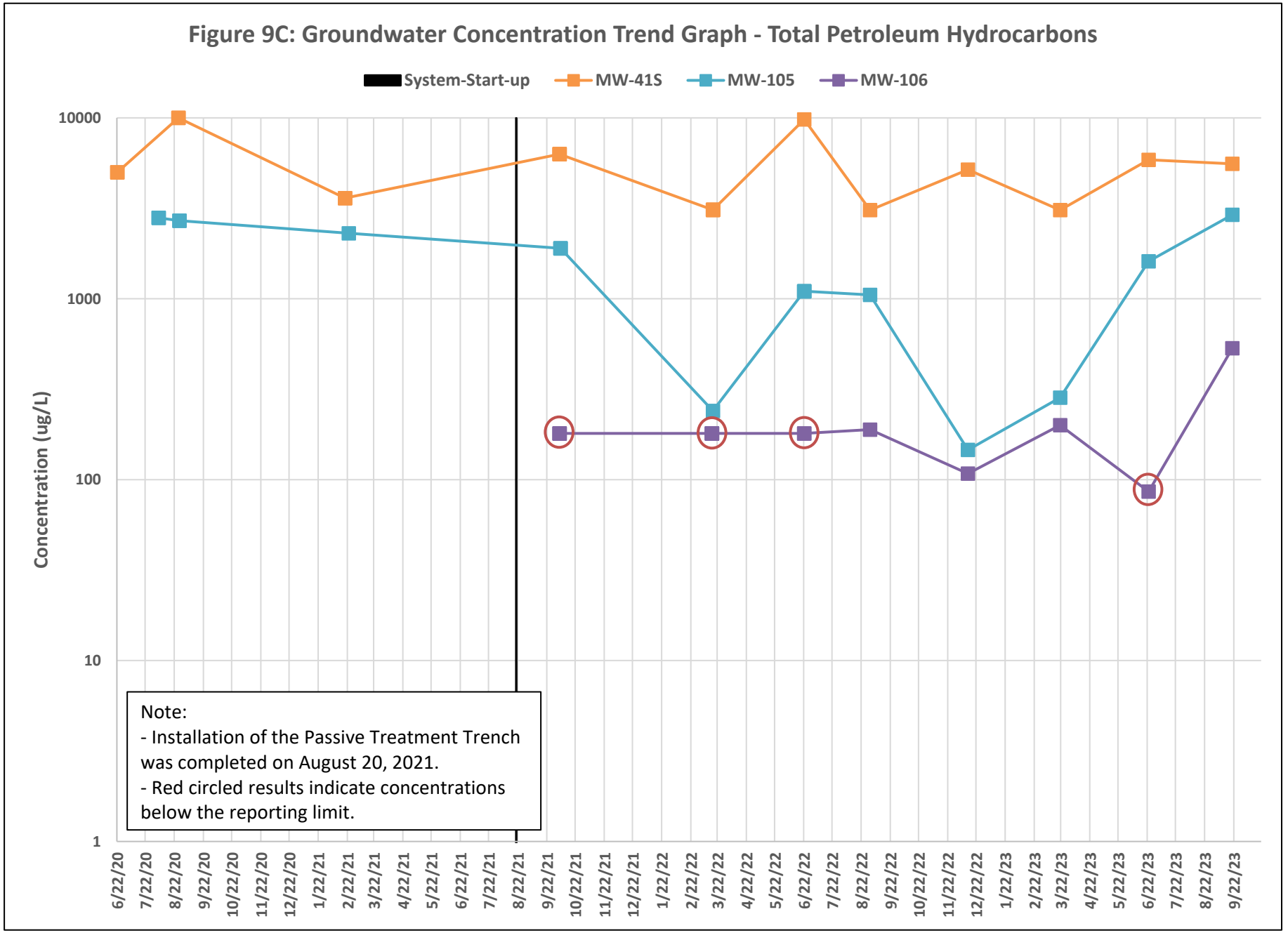


Figure 9C: Groundwater Concentration Trend Graph - Total Petroleum Hydrocarbons



TABLES

Table 1
DPE System Operational Data
Calumet Montana Refining, LLC - Great Falls, Montana

Operational Period	Percent Operational[a]	System Flowrate[b] (SCFM)	Average System Vacuum at Header[c] (in-Hg)	Liquid Extraction Rate (gpm)	Total Fluids Discharged During the Operational Period (gallons)	Total Water Discharged Since Start-up[d] (gallons)	Average Post-Catalyst Process Air Temperature When System is Operational[e] (°F)
Design Values	**--**	**200**	**17**	**0.25 to 21**	**--**	**--**	**>650**
July 1 - 31, 2023	65%	63	7.1	1.14	33,086	435,486	722
August 1 - 31, 2023	0%	0.0	0.0	0.00	889		NA
September 1 - 30, 2023	0%	0.0	0.0	0.00	0		NA
July 1, 2023 - September 30, 2023	**23%**	**63**	**7.1**	**1.14**	**33,975**		**722**

Notes:
a. Percent operational is calculated using the system run-time hours (as logged by the system PLC) divided by the number of available operational hours in the time period.
b. System flow is from FT-23401 (prior to dilution).
c. Total System Vacuum is measured at PT23623.
d. Commissioning and start-up testing of the DPE system commenced on October 14, 2021.
e. Post-catalyst process air temperature is based on TT-23702 reading.

Abbreviations:
in-Hg = inches of mercury
gpm = gallons per minute
scfm = standard cubic feet per minute

Table 2
Summary of Analytical Results and Contaminant Mass Removal - Vapor
Calumet Montana Refining, LLC - Great Falls, Montana

Location	SP301
Ramboll Sample ID	CMR-SP301-110723
Sample Date	7/11/2023
Average Blower Flow (scfm)[1]	78
Period Operational Time (hrs)[2]	310
Notes	

VOCs	CAS No.	Result (ug/m^3)	Mass (lb)
1,1,1-Trichloroethane	71-55-6	22 U	0.00
1,1,2,2-Tetrachloroethane	79-34-5	28 U	0.00
1,1,2-Trichloroethane	79-00-5	22 U	0.00
1,1,2-Trichlorotrifluoroethane	76-13-1	31 U	0.00
1,1-Dichloroethane	75-34-3	16 U	0.00
1,1-Dichloroethene	75-35-4	16 U	0.00
1,2,4-Trichlorobenzene	120-82-1	93 U	0.00
1,2,4-Trimethylbenzene	95-63-6	638	0.06
1,2-Dibromoethane (EDB)	106-93-4	31 U	0.00
1,2-Dichlorobenzene	95-50-1	24 U	0.00
1,2-Dichloroethane	107-06-2	16 U	0.00
1,2-Dichloropropane	78-87-5	19 U	0.00
1,3,5-Trimethylbenzene	108-67-8	408	0.04
1,3-Butadiene	106-99-0	89 U	0.00
1,3-Dichlorobenzene	541-73-1	24 U	0.00
1,4-Dichlorobenzene	106-46-7	24 U	0.00
2-Butanone (MEK)	78-93-3	74 U	0.00
2-Hexanone	591-78-6	102 U	0.00
2-Propanol	67-63-0	62 U	0.00
4-Ethyltoluene	622-96-8	287	0.03
4-Methyl-2-pentanone (MIBK)	108-10-1	102 U	0.00
Acetone	67-64-1	59 U	0.00
Benzene	71-43-2	3,550	0.32
Benzyl chloride	100-44-7	21 U	0.00
Bromodichloromethane	75-27-4	27 U	0.00
Bromoform	75-25-2	124 U	0.00
Bromomethane	74-83-9	16 U	0.00
Carbon disulfide	75-15-0	12 U	0.00
Carbon tetrachloride	56-23-5	25 U	0.00
Chlorobenzene	108-90-7	19 U	0.00
Chloroethane	75-00-3	11 U	0.00
Chloroform	67-66-3	20 U	0.00
Chloromethane	74-87-3	8 U	0.00
cis-1,2-Dichloroethene	156-59-2	16 U	0.00
cis-1,3-Dichloropropene	10061-01-5	18 U	0.00
Cyclohexane	110-82-7	6,100	0.55
Dibromochloromethane	124-48-1	34 U	0.00
Dichlorodifluoromethane	75-71-8	20 U	0.00
Dichlorotetrafluoroethane	76-14-2	28 U	0.00
Ethanol	64-17-5	94 U	0.00
Ethyl acetate	141-78-6	-- --	--
Ethylbenzene	100-41-4	2,310	0.21
Hexachloro-1,3-butadiene	87-68-3	135 U	0.00
m&p-Xylene	179601-23-1	7,720	0.70
Methylene Chloride	75-09-2	14 U	0.00
Methyl-tert-butyl ether	1634-04-4	14 U	0.00
Naphthalene	91-20-3	66 U	0.00
n-Heptane	142-82-5	7,360	0.66
n-Hexane	110-54-3	15,700	1.42
o-Xylene	95-47-6	2,130	0.19
Propylene	115-07-1	43 U	0.00
Styrene	100-42-5	17 U	0.00
Tetrachloroethene	127-18-4	27 U	0.00
Tetrahydrofuran	109-99-9	12 U	0.00
Toluene	108-88-3	618	0.06
trans-1,2-Dichloroethene	156-60-5	16 U	0.00
trans-1,3-Dichloropropene	10061-02-6	18 U	0.00
Trichloroethene	79-01-6	21 U	0.00

Table 2
Summary of Analytical Results and Contaminant Mass Removal - Vapor
Calumet Montana Refining, LLC - Great Falls, Montana

	Location	**SP301**	
	Ramboll Sample ID	**CMR-SP301-110723**	
	Sample Date	**7/11/2023**	
	Average Blower Flow (scfm)[1]	**78**	
	Period Operational Time (hrs)[2]	**310**	
	Notes		
VOCs	**CAS No.**	**Result (ug/m^3)**	**Mass (lb)**
Trichlorofluoromethane	75-69-4	23 U	0.00
Vinyl acetate	108-05-4	14 U	0.00
Vinyl chloride	75-01-4	10 U	0.00
Total VOCs	--	--	4.22
Period Total VOC Mass Removed (lbs)		**4.2**	
Cumulative Total VOC Mass Removed (lbs)[4]		**2,886**	

Notes:

1. Blower flowrate is continuously recorded by the system PLC. Average blower flowrate during the period is used for the calculations
2. Operational time represents system runtime (in hour) for the month during with the sample was taken.
3. Historical analytical results and mass recoveries are included in Appendix B.
4. Cumulative Total VOC Mass Removed represents total mass removed since system start-up (October 2021).

U: The analyte was not detected in the sample at the estimated detection limit

VOCs : Volatile Organic Compounds

ug/m^3 : micrograms per cubic meter

Sample Calculation

$$\boldsymbol{Mass\ Removed\ (lb) = 340000\ \frac{ug}{m^3} \times 10^{-6}\ \frac{g}{ug} \times \frac{1}{453.6}\ \frac{lb}{g} \times 41\ \frac{ft^3}{min} \times 0.02832\ \frac{m^3}{ft^3} \times 26\ hr \times 60\ \frac{min}{hr}}$$

Table 3
Summary of Analytical Results and Contaminant Mass Removal - Liquid
Calumet Montana Refining, LLC - Great Falls, Montana

	Location	**SP200**	
	Ramboll Sample ID	**CMR-SP200-110723**	
	Sample Date	**7/11/2023**	
	Effluent Volume (L)*	**125,244**	
	Notes		
Analyte	**CAS No.**	**Result (ug/L)**	**Mass (lb)**
VOCs			
1,1,1-TRICHLOROETHANE	71-55-6	ND	--
1,1,2,2-TETRACHLOROETHANE	79-34-5	21	0.01
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	76-13-1	ND	--
1,1,2-TRICHLOROETHANE	79-00-5	ND	--
1,1-DICHLOROETHANE	75-34-3	ND	--
1,1-DICHLOROETHENE	75-35-4	ND	--
1,2,3-TRICHLOROBENZENE	87-61-6	ND	--
1,2,4-TRICHLOROBENZENE	120-82-1	ND	--
1,2-DIBROMO-3-CHLOROPROPANE	96-12-8	ND	--
1,2-DIBROMOETHANE	106-93-4	ND	--
1,2-DICHLOROBENZENE	95-50-1	ND	--
1,2-DICHLOROETHANE	107-06-2	ND	--
1,2-DICHLOROPROPANE	78-87-5	ND	--
1,3-DICHLOROBENZENE	541-73-1	ND	--
1,4-DICHLOROBENZENE	106-46-7	ND	--
1,4-DIOXANE	123-91-1	ND	--
2-BUTANONE	78-93-3	ND	--
2-HEXANONE	591-78-6	ND	--
4-METHYL-2-PENTANONE	108-10-1	ND	--
ACETONE	67-64-1	ND	--
BENZENE	71-43-2	53	0.01
BROMOCHLOROMETHANE	74-97-5	ND	--
BROMODICHLOROMETHANE	75-27-4	ND	--
BROMOFORM	75-25-2	ND	--
BROMOMETHANE	74-83-9	ND	--
CARBON DISULFIDE	75-15-0	ND	--
CARBON TETRACHLORIDE	56-23-5	ND	--
CHLOROBENZENE	108-90-7	ND	--
CHLOROETHANE	75-00-3	ND	--
CHLOROFORM	67-66-3	ND	--
CHLOROMETHANE	74-87-3	ND	--
CIS-1,2-DICHLOROETHENE	156-59-2	ND	--
CIS-1,3-DICHLOROPROPENE	10061-01-5	ND	--
CUMENE	98-82-8	37	0.01
CYCLOHEXANE	110-82-7	28	0.01
DIBROMOCHLOROMETHANE	124-48-1	ND	--
DICHLORODIFLUOROMETHANE	75-71-8	ND	--
ETHYL BENZENE	100-41-4	300	0.08
M,P-XYLENE	179601-23-1	1,500	0.41
METHYL ACETATE	79-20-9	ND	--
METHYL TERT-BUTYL ETHER	1634-04-4	ND	--
METHYLCYCLOHEXANE	108-87-2	35	0.01
METHYLENE CHLORIDE	75-09-2	ND	--
NAPHTHALENE	91-20-3	430	0.12
ORTHO-XYLENE	95-47-6	550	0.15
STYRENE	100-42-5	17	0.00
TETRACHLOROETHENE	127-18-4	ND	--
TOLUENE	108-88-3	29	0.01
TRANS-1,2-DICHLOROETHENE	156-60-5	ND	--
TRANS-1,3-DICHLOROPROPENE	10061-02-6	ND	--
TRICHLOROETHENE	79-01-6	ND	--
TRICHLOROFLUOROMETHANE	75-69-4	ND	--
VINYL CHLORIDE	75-01-4	ND	--
XYLENES (TOTAL)	1330-20-7	--	--
Total VOCs	--	--	**0.83**
Period Total VOC Mass Removed (lbs)		**0.8**	
Cumulative Total VOC Mass Removed (lbs)		**15.1**	
SVOCs			
1,2,4,5-TETRACHLOROBENZENE	95-94-3	--	--
1,2,4-TRICHLOROBENZENE	120-82-1	--	--
1,2-DICHLOROBENZENE	95-50-1	--	--
1,3-DICHLOROBENZENE	541-73-1	--	--
1,4-DICHLOROBENZENE	106-46-7	--	--

Table 3
Summary of Analytical Results and Contaminant Mass Removal - Liquid
Calumet Montana Refining, LLC - Great Falls, Montana

	Location	SP200	
	Ramboll Sample ID	CMR-SP200-110723	
	Sample Date	7/11/2023	
	Effluent Volume (L)*	125,244	
	Notes		
Analyte	**CAS No.**	**Result (ug/L)**	**Mass (lb)**
2,2'-OXYBIS(1-CHLOROPROPANE)	108-60-1	ND	--
2,3,4,6-TETRACHLOROPHENOL	58-90-2	--	--
2,4,5-TRICHLOROPHENOL	95-95-4	ND	--
2,4,6-TRICHLOROPHENOL	88-06-2	ND	--
2,4-DICHLOROPHENOL	120-83-2	ND	--
2,4-DIMETHYLPHENOL	105-67-9	ND	--
2,4-DINITROPHENOL	51-28-5	ND	--
2,4-DINITROTOLUENE	121-14-2	ND	--
2,6-DINITROTOLUENE	606-20-2	ND	--
2-CHLORONAPHTHALENE	91-58-7	ND	--
2-CHLOROPHENOL	95-57-8	ND	--
2-METHYLNAPHTHALENE	91-57-6	4,000	1.10
2-METHYLPHENOL	95-48-7	ND	--
2-NITROANILINE	88-74-4	ND	--
2-NITROPHENOL	88-75-5	ND	--
3,3'-DICHLOROBENZIDINE	91-94-1	ND	--
3-NITROANILINE	99-09-2	ND	--
4,6-DINITRO-2-METHYLPHENOL	534-52-1	ND	--
4-BROMOPHENYL-PHENYL ETHER	101-55-3	ND	--
4-CHLORO-3-METHYLPHENOL	59-50-7	ND	--
4-CHLOROPHENYL-PHENYL ETHER	7005-72-3	ND	--
4-METHYLPHENOL	106-44-5	ND	--
4-NITROANILINE	100-01-6	ND	--
4-NITROPHENOL	100-02-7	ND	--
ACENAPHTHENE	83-32-9	ND	--
ACENAPHTHYLENE	208-96-8	ND	--
ANTHRACENE	120-12-7	ND	--
BENZO(A)ANTHRACENE	56-55-3	ND	--
BENZO(A)PYRENE	50-32-8	ND	--
BENZO(B)FLUORANTHENE	205-99-2	ND	--
BENZO(G,H,I)PERYLENE	191-24-2	ND	--
BENZO(K)FLUORANTHENE	207-08-9	ND	--
BIS(2-CHLOROETHOXY)METHANE	111-91-1	ND	--
BIS(2-CHLOROETHYL) ETHER	111-44-4	ND	--
BIS(2-ETHYLHEXYL)PHTHALATE	117-81-7	ND	--
BUTYLBENZYLPHTHALATE	85-68-7	ND	--
CARBAZOLE	86-74-8	ND	--
CHRYSENE	218-01-9	ND	--
DIBENZ(A,H)ANTHRACENE	53-70-3	ND	--
DIBENZOFURAN	132-64-9	ND	--
DIETHYLPHTHALATE	84-66-2	ND	--
DIMETHYLPHTHALATE	131-11-3	ND	--
DI-N-BUTYLPHTHALATE	84-74-2	ND	--
DI-N-OCTYLPHTHALATE	117-84-0	ND	--
FLUORANTHENE	206-44-0	ND	--
FLUORENE	86-73-7	ND	--
HEXACHLOROBENZENE	118-74-1	ND	--
HEXACHLOROBUTADIENE	87-68-3	ND	--
HEXACHLOROCYCLOPENTADIENE	77-47-4	ND	--
HEXACHLOROETHANE	67-72-1	ND	--
INDENO(1,2,3-CD)PYRENE	193-39-5	ND	--
ISOPHORONE	78-59-1	ND	--
NAPHTHALENE	91-20-3	2,100	0.58
NITROBENZENE	98-95-3	ND	--
N-NITROSO-DI-N-PROPYLAMINE	621-64-7	ND	--
N-NITROSODIPHENYLAMINE	86-30-6	ND	--
PENTACHLOROPHENOL	87-86-5	ND	--
PHENANTHRENE	85-01-8	350	0.10
PHENOL	108-95-2	ND	--
PYRENE	129-00-0	67	0.02
Total SVOCs	--	--	**1.80**
Period Total SVOC Mass Removed (lbs)		**1.8**	
Cumulative Total VOC Mass Removed (lbs)		**13.8**	

Table 3
Summary of Analytical Results and Contaminant Mass Removal - Liquid
Calumet Montana Refining, LLC - Great Falls, Montana

	Location	**SP200**	
	Ramboll Sample ID	**CMR-SP200-110723**	
	Sample Date	**7/11/2023**	
	Effluent Volume (L)*	**125,244**	
	Notes		
Analyte	**CAS No.**	**Result (ug/L)**	**Mass (lb)**
EPH			
C11 THROUGH C22 AROMATIC HYDROCARBONS	AROMATIC11-22A	331,000	91.39
C19 THROUGH C36 ALIPHATIC HYDROCARBONS	ALIPHATIC19-36U	285,000	78.69
C9 THROUGH C18 ALIPHATIC HYDROCARBONS	ALIPHATIC09-18U	1,190,000	328.57
TOTAL EXTRACTABLE HYDROCARBON (POST FRACTIONATION)	68334-30-5	1,810,000	499.76
TOTAL EXTRACTABLE HYDROCARBON	68334-30-5E	1,850,000	510.81
Total EPHs	--	--	**510.81**
Period Total EPH Mass Removed (lbs)		**510.8**	
Cumulative Total EPH Mass Removed (lbs)		**2429.4**	
VPH			
C5 THROUGH C8 ALIPHATIC HYDROCARBONS (ADJUSTED)	C05-C08-ALIP-J	2,160	0.60
C9 THROUGH C12 ALIPHATIC HYDROCARBONS (ADJUSTED)	C09-C12-ALIP-J	12,300	3.40
C5-C8 ALIPHATICS (UNADJUSTED)	C05-C08-ALIP-U	2,160	0.60
C9 THROUGH C10 AROMATIC HYDROCARBONS (UNADJUSTED)	C09-C10-AROM-U	17,800	4.91
C9 THROUGH C12 ALIPHATIC HYDROCARBONS (UNADJUSTED)	C09-C12-ALIP-U	17,500	4.83
TOTAL PETROLEUM HYDROCARBONS	TPH	37,500	10.35
Total VPHss	--	--	**10.35**
Period Total VPH Mass Removed (lbs)		**10.4**	
Cumulative Total VPH Mass Removed (lbs)		**215.4**	

Notes:
*Effluent volumes represent volume extracted during the month which the sample was taken.
1. Historical analytical results and mass recoveries are included in Appendix B.
2. Cumulative Total VOC Mass Removed represents total mass removed since system start-up (October 2021).
Sample Calculation

$$\boldsymbol{Mass\ Removed\ (lb)} = \mathbf{1800}\ \frac{\boldsymbol{ug}}{\boldsymbol{L}} \times \mathbf{10^{-6}}\ \frac{\boldsymbol{g}}{\boldsymbol{ug}} \times \frac{\mathbf{1}}{\mathbf{453.6}}\ \frac{\boldsymbol{lb}}{\boldsymbol{g}} \times \mathbf{21138}\ \boldsymbol{L}$$

Abbreviations:

EPH : Extractable Petroleum Hydrocarbon
ND : Non Detect
SVOCs : Semi-volatile Organic Compounds
ug/L : micrograms per liter
VOCs : Volatile Organic Compounds
VPH : Volatile Petroleum Hydrocarbons

Table 4
Fluid Level Measurements at AOC-16 Area
Calumet Montana Refining, LLC - Great Falls, Montana

Location	Date	DTP (ft BTOC)	DTW (ft BTOC)	LNAPL Thickness (ft)
MW-22	9/29/2021	--	7.12	--
MW-22	10/14/2021	--	7.26	--
MW-22	1/10/2023	--	8.89	--
MW-22	5/31/2023	--	8.01	--
MW-22	6/19/2023	--	6.67	--
MW-22	7/10/2023	--	7.87	--
MW-22	8/19/2023	--	8.49	--
MW-22	9/19/2023	--	7.16	--
MW-41D	8/27/2021	--	11.07	--
MW-41D	9/29/2021	--	10.83	--
MW-41D	10/15/2021	--	10.78	--
MW-41D	12/2/2021	--	10.65	--
MW-41D	1/3/2022	--	10.62	--
MW-41D	2/8/2022	--	10.70	--
MW-41D	2/8/2022	--	10.70	--
MW-41D	3/11/2022	--	10.76	--
MW-41D	4/11/2022	--	10.79	--
MW-41D	6/8/2022	--	10.95	--
MW-41D	7/27/2022	--	10.90	--
MW-41D	9/1/2022	--	10.94	--
MW-41D	1/10/2023	--	10.54	--
MW-41D	3/22/2023	--	10.60	--
MW-41D	5/31/2023	--	10.39	--
MW-41D	6/19/2023	--	10.22	--
MW-41D	7/10/2023	--	10.12	--
MW-41D	8/19/2023	--	10.52	--
MW-41D	9/19/2023	--	10.07	--
MW-41S	8/27/2021	--	8.25	--
MW-41S	9/29/2021	7.85	7.89	0.04
MW-41S	10/5/2021	7.78	7.81	0.03
MW-41S	10/15/2021	--	8.06	--
MW-41S	12/2/2021	--	7.90	--
MW-41S	1/3/2022	--	7.97	--
MW-41S	2/8/2022	--	8.13	--
MW-41S	3/11/2022	--	8.18	--
MW-41S	4/11/2022	--	8.55	--
MW-41S	6/8/2022	--	7.86	--
MW-41S	7/27/2022	--	7.99	--
MW-41S	9/1/2022	--	8.16	--
MW-41S	1/10/2023	--	7.52	--
MW-41S	3/22/2023	--	7.48	--
MW-41S	5/31/2023	--	6.51	--
MW-41S	6/19/2023	--	5.74	--
MW-41S	7/10/2023	--	6.41	--
MW-41S	8/19/2023	--	7.00	--
MW-41S	9/19/2023	--	7.40	--
MW-53	9/29/2021	7.90	8.49	0.59
MW-53	10/14/2021	--	8.26	--
MW-53	11/9/2021	8.54	8.59	0.05
MW-53	12/2/2021	8.83	8.88	0.06
MW-53	1/3/2022	--	9.32	--
MW-53	2/8/2022	9.31	9.32	0.00
MW-53	2/8/2022	9.31	9.32	0.01
MW-53	3/11/2022	9.43	9.44	0.01
MW-53	4/11/2022	--	9.38	--
MW-53	6/8/2022	9.08	10.03	0.95
MW-53	6/8/2022	9.08	10.03	0.95
MW-53	7/27/2022	--	10.23	--
MW-53	9/1/2022	--	9.59	--
MW-53	1/10/2023	--	8.53	--
MW-53	3/22/2023	--	9.00	--
MW-53	5/31/2023	9.36	9.41	0.05
MW-53	6/19/2023	7.99	8.10	0.11
MW-53	7/10/2023	8.50	8.52	0.02
MW-53	8/19/2023	9.20	9.22	0.02
MW-53	9/19/2023	--	7.85	--

Table 4
Fluid Level Measurements at AOC-16 Area
Calumet Montana Refining, LLC - Great Falls, Montana

Location	Date	DTP (ft BTOC)	DTW (ft BTOC)	LNAPL Thickness (ft)
MW-57	9/29/2021	--	10.29	--
MW-57	10/14/2021	--	10.51	--
MW-57	12/2/2021	--	11.10	--
MW-57	1/3/2022	--	11.27	--
MW-57	2/8/2022	--	11.23	--
MW-57	3/11/2022	--	11.19	--
MW-57	4/11/2022	--	11.06	--
MW-57	6/8/2022	--	10.25	--
MW-57	7/27/2022	--	10.17	--
MW-57	9/1/2022	--	10.07	--
MW-57	1/10/2023	--	9.79	--
MW-57	3/22/2023	--	10.14	--
MW-57	5/31/2023	--	8.62	--
MW-57	6/19/2023	--	7.54	--
MW-57	7/10/2023	--	6.35	--
MW-57	8/19/2023	--	9.02	--
MW-57	9/19/2023	--	10.08	--
MW-59D	9/29/2021	--	12.14	--
MW-59D	10/14/2021	--	12.06	--
MW-59D	12/2/2021	--	12.31	--
MW-59D	2/8/2022	--	12.49	--
MW-59D	2/8/2022	--	12.49	--
MW-59D	3/11/2022	--	12.54	--
MW-59D	4/11/2022	--	12.73	--
MW-59D	6/8/2022	--	12.53	--
MW-59D	7/27/2022	--	12.59	--
MW-59D	9/1/2022	--	12.59	--
MW-59D	1/10/2023	--	12.21	--
MW-59D	3/22/2023	--	12.48	--
MW-59D	5/31/2023	--	13.08	--
MW-59D	6/19/2023	--	12.80	--
MW-59D	7/10/2023	--	12.89	--
MW-59D	8/19/2023	--	13.23	--
MW-59D	9/19/2023	--	13.00	--
MW-59S	9/29/2021	--	6.23	--
MW-59S	10/14/2021	--	6.22	--
MW-59S	12/2/2021	--	6.28	--
MW-59S	2/8/2022	--	6.32	--
MW-59S	3/11/2022	--	6.31	--
MW-59S	4/11/2022	--	6.31	--
MW-59S	6/8/2022	--	6.28	--
MW-59S	7/27/2022	--	6.24	--
MW-59S	9/1/2022	--	6.22	--
MW-59S	1/10/2023	--	6.23	--
MW-59S	3/22/2023	--	6.22	--
MW-59S	5/31/2023	--	6.11	--
MW-59S	6/19/2023	--	4.97	--
MW-59S	7/10/2023	--	6.08	--
MW-59S	8/19/2023	--	6.19	--
MW-59S	9/19/2023	--	6.22	--
MW-63	9/29/2021	--	6.30	--
MW-63	10/14/2021	--	6.40	--
MW-63	11/4/2021	--	6.60	--
MW-63	2/8/2022	--	7.13	--
MW-63	3/11/2022	--	7.23	--
MW-63	4/11/2022	--	7.30	--
MW-63	6/8/2022	--	7.06	--
MW-63	7/27/2022	--	6.68	--
MW-63	9/1/2022	--	6.64	--
MW-63	1/10/2023	--	6.34	--
MW-63	3/22/2023	--	6.48	--
MW-63	5/31/2023	--	5.50	--
MW-63	6/19/2023	--	4.99	--
MW-63	7/10/2023	--	5.09	--
MW-63	8/19/2023	--	5.70	--
MW-63	9/19/2023	--	5.01	--

Table 4
Fluid Level Measurements at AOC-16 Area
Calumet Montana Refining, LLC - Great Falls, Montana

Location	Date	DTP (ft BTOC)	DTW (ft BTOC)	LNAPL Thickness (ft)
MW-64	9/29/2021	--	7.76	--
MW-64	10/14/2021	--	8.40	--
MW-64	11/4/2021	--	8.72	--
MW-64	12/2/2021	9.04	9.11	0.07
MW-64	1/3/2022	9.45	10.36	0.91
MW-64	2/8/2022	9.26	10.81	1.55
MW-64	3/11/2022	9.55	10.66	1.11
MW-64	4/11/2022	10.11	10.59	0.48
MW-64	6/8/2022	10.41	10.46	0.06
MW-64	7/27/2022	10.21	10.23	0.02
MW-64	9/1/2022	--	8.97	--
MW-64	1/10/2023	--	8.75	--
MW-64	5/31/2023	--		--
MW-64	6/19/2023	--		--
MW-64	7/10/2023	--	--	--
MW-64	8/19/2023	--	--	--
MW-64	9/19/2023	--	--	--
MW-102	9/29/2021	7.98	8.59	0.61
MW-102	10/14/2021	8.25	8.82	0.57
MW-102	11/4/2021	--	9.02	--
MW-102	12/2/2021	--	8.97	--
MW-102	1/3/2022	9.29	9.33	0.04
MW-102	2/8/2022	--	9.50	--
MW-102	2/8/2022	--	9.50	--
MW-102	3/11/2022	--	10.07	--
MW-102	4/11/2022	--	10.08	--
MW-102	6/8/2022	--	10.22	--
MW-102	7/27/2022	9.99	10.02	0.03
MW-102	9/1/2022	--	8.98	--
MW-102	1/10/2023	--	8.82	--
MW-102	3/22/2023	--	9.96	--
MW-102	5/31/2023	--	8.42	--
MW-102	6/19/2023	--	8.00	--
MW-102	7/10/2023	--	8.15	--
MW-102	8/19/2023	--	8.60	--
MW-102	9/19/2023	--	7.60	--
MW-103	9/29/2021	--	8.04	--
MW-103	10/14/2021	--	8.35	--
MW-103	11/4/2021	--	8.77	--
MW-103	12/2/2021	--	9.32	--
MW-103	1/3/2022	--	9.66	--
MW-103	2/8/2022	--	9.61	--
MW-103	3/11/2022	--	9.87	--
MW-103	4/11/2022	--	9.87	--
MW-103	6/8/2022	--	9.79	--
MW-103	7/27/2022	--	9.66	--
MW-103	9/1/2022	--	9.12	--
MW-103	1/10/2023	--	8.81	--
MW-103	3/22/2023	--	9.60	--
MW-103	5/31/2023	--	8.53	--
MW-103	6/19/2023	--	8.09	--
MW-103	7/10/2023	--	5.80	--
MW-103	8/19/2023	--	6.20	--
MW-103	9/19/2023	--	7.88	--

Table 4
Fluid Level Measurements at AOC-16 Area
Calumet Montana Refining, LLC - Great Falls, Montana

Location	Date	DTP (ft BTOC)	DTW (ft BTOC)	LNAPL Thickness (ft)
MW-104	9/29/2021	6	6.25	0.25
MW-104	10/15/2021	6.1	6.23	0.13
MW-104	12/2/2021	6.62	6.79	0.17
MW-104	1/3/2022	6.75	7.02	0.27
MW-104	2/8/2022	6.83	7.16	0.33
MW-104	2/8/2022	6.83	7.16	0.33
MW-104	3/11/2022	7.13	7.57	0.44
MW-104	4/11/2022	7.38	7.81	0.43
MW-104	6/8/2022	7.86	7.86	0.00
MW-104	7/27/2022	--		--
MW-104	9/1/2022	7.72	7.82	0.10
MW-104	1/10/2023	--	7.37	--
MW-104	3/22/2023	--	6.89	--
MW-104	5/31/2023	--	6.61	--
MW-104	6/19/2023	--	5.79	--
MW-104	7/10/2023	--	5.80	--
MW-104	8/19/2023	--	6.22	--
MW-104	9/19/2023	--	5.96	--
MW-105	9/29/2021	--	5.58	--
MW-105	10/14/2021	--	8.97	--
MW-105	12/2/2021	--	6.67	--
MW-105	1/3/2022	--	5.63	--
MW-105	2/8/2022	--	5.89	--
MW-105	2/8/2022	--	5.92	--
MW-105	3/11/2022	--	5.85	--
MW-105	4/11/2022	--	8.01	--
MW-105	6/8/2022	--	6.06	--
MW-105	7/27/2022	--	6.63	--
MW-105	9/1/2022	--	4.89	--
MW-105	1/10/2023	--	7.50	--
MW-105	3/22/2023	--	5.59	--
MW-105	5/31/2023	--	5.39	--
MW-105	6/19/2023	--	2.94	--
MW-105	7/10/2023	--	8.41	--
MW-105	8/19/2023	--	8.87	--
MW-105	9/19/2023	--	5.39	--
MW-106	9/29/2021	--	6.14	--
MW-106	10/14/2021	--	5.83	--
MW-106	10/20/2021	--	5.71	--
MW-106	11/9/2021	--	5.48	--
MW-106	12/2/2021	--	5.70	--
MW-106	1/3/2022	--	6.19	--
MW-106	2/8/2022	--	5.92	--
MW-106	2/8/2022	--	5.84	--
MW-106	3/11/2022	--	5.80	--
MW-106	4/11/2022	--	5.70	--
MW-106	6/8/2022	--	5.03	--
MW-106	7/27/2022	--	5.40	--
MW-106	9/1/2022	--	5.83	--
MW-106	1/10/2023	--	4.62	--
MW-106	3/22/2023	--	4.60	--
MW-106	5/31/2023	--	3.51	--
MW-106	6/19/2023	--	2.95	--
MW-106	7/10/2023	--	4.81	--
MW-106	8/19/2023	--	4.40	--
MW-106	9/19/2023	--	4.59	--

Notes:

DTP	Depth to Product
DTW	Depth to Water
ft BTOC	Below Top of Casing
LNAPL	light non-aqueous phase liquid
NA	Reading not collected
--	LNAPL was not present

Table 5
Fluid Level Measurements at LNAPL Wells
Calumet Montana Refining, LLC - Great Falls, Montana

Location	Date	DTP (ft BTOC)	DTW (ft BTOC)	LNAPL Thickness (ft)	Fluid Recovery (gal)
LNAPL-1	8/27/2021	--	8.23	--	--
LNAPL-1	9/30/2021	--	6.55	--	--
LNAPL-1	10/5/2021	--	6.44	--	--
LNAPL-1	10/12/2021	--	6.37	--	--
LNAPL-1	10/19/2021	--	6.31	--	--
LNAPL-1	11/9/2021	--	6.24	--	--
LNAPL-1	11/18/2021	--	6.30	--	--
LNAPL-1	12/2/2021	--	6.36	--	--
LNAPL-1	1/3/2022	--	6.50	--	--
LNAPL-1	2/8/2022	--	6.72	--	--
LNAPL-1	5/15/2022	--	5.90	--	--
LNAPL-1	5/22/2022	--	5.90	--	--
LNAPL-1	5/29/2022	--	5.90	--	--
LNAPL-1	6/5/2022	--	5.88	--	--
LNAPL-1	6/12/2022	--	5.90	--	--
LNAPL-1	6/19/2022	--	6.00	--	--
LNAPL-1	6/26/2022	--	6.00	--	--
LNAPL-1	7/3/2022	--	5.46	--	--
LNAPL-1	7/10/2022	--	5.56	--	--
LNAPL-1	7/17/2022	--	5.60	--	--
LNAPL-1	7/31/2022	--	5.92	--	--
LNAPL-1	8/7/2022	--	6.87	--	--
LNAPL-1	8/14/2022	7.00	7.03	0.03	--
LNAPL-1	9/4/2022	--	6.80	--	--
LNAPL-1	9/10/2022	6.80	6.81	0.01	--
LNAPL-1	9/18/2022	7.35	7.37	0.02	--
LNAPL-1	9/25/2022	6.97	7.00	0.03	--
LNAPL-1	10/2/2022	6.58	6.83	0.25	--
LNAPL-1	10/9/2022	6.47	6.92	0.45	--
LNAPL-1	11/14/2022	--	6.22	--	--
LNAPL-1	12/6/2022	--	6.10	--	--
LNAPL-1	2/26/2023	--	5.62	--	--
LNAPL-1	3/5/2023	--	5.98	--	--
LNAPL-1	3/23/2023	--	5.57	--	--
LNAPL-1	4/2/2023	5.58	5.60	0.02	--
LNAPL-1	5/31/2023	--	4.60	--	--
LNAPL-1	6/19/2023	--	3.95	--	--
LNAPL-1	7/10/2023	--	4.48	--	--
LNAPL-1	8/19/2023	--	5.19	--	--
LNAPL-1	9/19/2023	--	5.52	--	--
LNAPL-2	8/27/2021	--	8.18	--	--
LNAPL-2	9/30/2021	--	6.42	--	--
LNAPL-2	10/5/2021	--	6.30	--	--
LNAPL-2	10/12/2021	--	6.22	--	--
LNAPL-2	10/19/2021	--	6.15	--	--
LNAPL-2	11/9/2021	--	6.09	--	--
LNAPL-2	11/18/2021	--	6.15	--	--
LNAPL-2	12/2/2021	--	6.22	--	--
LNAPL-2	1/3/2022	--	6.35	--	--
LNAPL-2	2/8/2022	--	6.57	--	--
LNAPL-2	5/15/2022	--	6.00	--	--
LNAPL-2	5/22/2022	--	5.73	--	--
LNAPL-2	5/29/2022	--	5.75	--	--
LNAPL-2	6/5/2022	--	5.73	--	0.5
LNAPL-2	6/12/2022	--	5.73	--	--
LNAPL-2	6/19/2022	--	5.85	--	0.5
LNAPL-2	6/26/2022	--	5.60	--	--
LNAPL-2	7/3/2022	--	5.42	--	0.8
LNAPL-2	7/10/2022	--	5.55	--	0.6
LNAPL-2	7/17/2022	--	5.41	--	0.7
LNAPL-2	7/31/2022	--	5.70	--	--
LNAPL-2	8/7/2022	--	6.82	--	--
LNAPL-2	8/14/2022	6.91	6.95	0.04	--
LNAPL-2	9/4/2022	6.78	6.79	0.01	0.8
LNAPL-2	9/10/2022	6.62	6.73	0.11	0.8
LNAPL-2	9/18/2022	7.12	7.22	0.1	0.3
LNAPL-2	9/25/2022	--	6.60	--	0.5
LNAPL-2	10/2/2022	6.61	6.70	0.09	0.7
LNAPL-2	10/9/2022	6.30	6.76	0.46	0.5
LNAPL-2	11/14/2022	--	6.07	--	0.5

Table 5
Fluid Level Measurements at LNAPL Wells
Calumet Montana Refining, LLC - Great Falls, Montana

Location	Date	DTP (ft BTOC)	DTW (ft BTOC)	LNAPL Thickness (ft)	Fluid Recovery (gal)
LNAPL-2	12/6/2022	--	5.95	--	0.3
LNAPL-2	2/26/2023	--	5.40	--	--
LNAPL-2	3/5/2023	--	5.96	--	--
LNAPL-2	3/23/2023	--	5.62	--	--
LNAPL-2	4/2/2023	5.54	5.55	0.01	--
LNAPL-2	5/31/2023	--	4.45	--	--
LNAPL-2	6/19/2023	3.77	3.78	0.01	--
LNAPL-2	7/10/2023	--	4.32	--	--
LNAPL-2	8/19/2023	--	5.21	--	--
LNAPL-2	9/19/2023	--	5.35	--	--
LNAPL-3	8/27/2021	--	8.11	--	--
LNAPL-3	9/30/2021	--	6.45	--	--
LNAPL-3	10/5/2021	--	6.31	--	--
LNAPL-3	10/12/2021	--	6.24	--	--
LNAPL-3	10/19/2021	--	6.18	--	--
LNAPL-3	11/9/2021	--	6.10	--	--
LNAPL-3	11/18/2021	--	6.17	--	--
LNAPL-3	12/2/2021	--	6.24	--	--
LNAPL-3	1/3/2022	--	6.38	--	--
LNAPL-3	2/8/2022	--	6.58	--	--
LNAPL-3	5/15/2022	--	5.76	--	--
LNAPL-3	5/22/2022	--	5.74	--	--
LNAPL-3	5/29/2022	--	5.80	--	--
LNAPL-3	6/5/2022	--	5.71	--	--
LNAPL-3	6/12/2022	--	5.78	--	--
LNAPL-3	6/19/2022	--	5.87	--	--
LNAPL-3	6/26/2022	--	5.45	--	--
LNAPL-3	7/3/2022	--	5.31	--	--
LNAPL-3	7/10/2022	--	5.40	--	--
LNAPL-3	7/17/2022	--	5.15	--	--
LNAPL-3	7/31/2022	--	5.80	--	--
LNAPL-3	8/7/2022	--	6.72	--	--
LNAPL-3	8/14/2022	6.71	6.74	0.03	--
LNAPL-3	9/4/2022	--	6.69	--	--
LNAPL-3	9/10/2022	--	6.67	--	--
LNAPL-3	9/18/2022	7.42	7.45	0.03	--
LNAPL-3	9/25/2022	6.74	6.81	0.07	--
LNAPL-3	10/2/2022	6.50	6.58	0.08	--
LNAPL-3	10/9/2022	6.39	6.93	0.54	--
LNAPL-3	11/14/2022	6.08	6.10	0.02	--
LNAPL-3	12/6/2022	5.97	6.00	0.03	--
LNAPL-3	12/11/2022	6.36	6.58	0.22	--
LNAPL-3	12/18/2022	5.86	5.88	0.02	--
LNAPL-3	2/26/2023	5.48	5.49	0.01	--
LNAPL-3	3/5/2023	--	5.97	--	--
LNAPL-3	3/23/2023	--	5.61	--	--
LNAPL-3	4/2/2023	5.39	5.42	0.03	--
LNAPL-3	5/31/2023	--	4.45	--	--
LNAPL-3	6/19/2023	--	3.78	--	--
LNAPL-3	7/10/2023	--	4.28	--	--
LNAPL-3	8/19/2023	--	5.08	--	--
LNAPL-3	9/19/2023	--	5.36	--	--
LNAPL-4	8/27/2021	--	8.15	--	--
LNAPL-4	9/30/2021	--	6.46	--	--
LNAPL-4	10/5/2021	--	6.31	--	--
LNAPL-4	10/12/2021	--	6.24	--	--
LNAPL-4	10/19/2021	--	6.18	--	--
LNAPL-4	11/9/2021	--	6.11	--	--
LNAPL-4	11/18/2021	--	6.18	--	--
LNAPL-4	12/2/2021	--	6.25	--	--
LNAPL-4	1/3/2022	--	6.40	--	--
LNAPL-4	2/8/2022	--	6.59	--	--
LNAPL-4	5/15/2022	--	6.10	--	--
LNAPL-4	5/22/2022	--	5.74	--	--
LNAPL-4	5/29/2022	--	5.90	--	--
LNAPL-4	6/5/2022	--	5.85	--	1.0
LNAPL-4	6/12/2022	--	5.90	--	0.8
LNAPL-4	6/19/2022	5.87	5.89	0.02	0.8
LNAPL-4	6/26/2022	--	5.55	--	--
LNAPL-4	7/3/2022	--	5.42	--	0.8

Table 5
Fluid Level Measurements at LNAPL Wells
Calumet Montana Refining, LLC - Great Falls, Montana

Location	Date	DTP (ft BTOC)	DTW (ft BTOC)	LNAPL Thickness (ft)	Fluid Recovery (gal)
LNAPL-4	7/10/2022	--	5.50	--	0.7
LNAPL-4	7/17/2022	5.45	5.48	0.03	0.5
LNAPL-4	7/31/2022	5.80	5.82	0.02	0.8
LNAPL-4	8/7/2022	--	6.79	--	0.7
LNAPL-4	8/14/2022	6.81	6.85	0.04	--
LNAPL-4	9/4/2022	6.63	6.88	0.25	0.2
LNAPL-4	9/10/2022	6.64	6.81	0.17	--
LNAPL-4	9/18/2022	7.48	7.52	0.04	0.1
LNAPL-4	9/25/2022	--	6.87	--	0.5
LNAPL-4	10/2/2022	6.70	7.05	0.35	0.7
LNAPL-4	10/9/2022	6.36	6.69	0.33	0.8
LNAPL-4	11/14/2022	6.08	6.27	0.19	0.8
LNAPL-4	12/6/2022	5.96	6.03	0.07	0.5
LNAPL-4	12/11/2022	6.43	6.66	0.23	--
LNAPL-4	12/18/2022	5.91	5.92	0.01	--
LNAPL-4	12/25/2022	5.96	5.99	0.03	0.5
LNAPL-4	1/15/2023	5.80	5.82	0.02	1.0
LNAPL-4	1/22/2023	5.88	5.92	0.04	0.6
LNAPL-4	1/30/2023	--	5.39	--	0.6
LNAPL-4	2/5/2023	5.62	5.71	0.09	0.5
LNAPL-4	2/12/2023	5.49	5.51	0.02	1.0
LNAPL-4	2/18/2023	--	5.71	--	0.7
LNAPL-4	2/26/2023	5.49	5.50	0.01	0.1
LNAPL-4	3/5/2023	5.84	5.87	0.03	0.3
LNAPL-4	3/12/2023	--	5.82	--	1.0
LNAPL-4	3/19/2023	--	5.61	--	0.3
LNAPL-4	3/23/2023	--	5.62	--	0.0
LNAPL-4	4/2/2023	5.50	5.51	0.01	0.0
LNAPL-4	4/30/2023	4.30	4.40	0.10	0.0
LNAPL-4	5/31/2023	--	4.41	--	--
LNAPL-4	6/19/2023	--	3.79	--	--
LNAPL-4	7/10/2023	--	4.35	--	--
LNAPL-4	8/19/2023	--	5.09	--	--
LNAPL-4	9/19/2023	--	5.35	--	--
LNAPL-5	8/27/2021	--	8.15	--	--
LNAPL-5	9/30/2021	--	6.49	--	--
LNAPL-5	10/5/2021	--	6.35	--	--
LNAPL-5	10/12/2021	--	6.28	--	--
LNAPL-5	10/19/2021	--	6.22	--	--
LNAPL-5	11/9/2021	--	6.14	--	--
LNAPL-5	11/18/2021	--	6.20	--	--
LNAPL-5	12/2/2021	6.28	6.30	0.02	--
LNAPL-5	12/15/2021	6.32	6.64	0.32	--
LNAPL-5	1/3/2022	6.37	6.78	0.41	--
LNAPL-5	2/8/2022	6.56	7.01	0.45	--
LNAPL-5	3/7/2022	6.60	7.30	0.70	--
LNAPL-5	4/11/2022	6.64	7.32	0.68	--
LNAPL-5	5/15/2022	5.90	5.92	0.02	0.5
LNAPL-5	5/22/2022	--	5.78	--	--
LNAPL-5	5/29/2022	--	5.85	--	--
LNAPL-5	6/5/2022	--	5.81	--	0.5
LNAPL-5	6/12/2022	5.79	5.81	0.02	0.5
LNAPL-5	6/19/2022	5.90	5.93	0.03	0.5
LNAPL-5	6/26/2022	5.45	5.50	0.05	--
LNAPL-5	7/3/2022	--	5.50	--	0.8
LNAPL-5	7/10/2022	--	5.60	--	0.7
LNAPL-5	7/17/2022	5.48	5.49	0.01	0.7
LNAPL-5	7/31/2022	--	5.93	--	0.5
LNAPL-5	8/7/2022	6.78	6.82	0.04	0.8
LNAPL-5	8/14/2022	--		--	--
LNAPL-5	9/4/2022	6.75	7.45	0.70	0.7
LNAPL-5	9/10/2022	6.65	7.45	0.80	0.8
LNAPL-5	9/18/2022	7.00	7.14	0.14	0.1
LNAPL-5	9/25/2022	--	6.49	--	1.0
LNAPL-5	10/2/2022	6.80	7.08	0.28	0.6
LNAPL-5	10/9/2022	6.39	6.75	0.36	0.8
LNAPL-5	11/14/2022	6.12	6.14	0.02	0.8
LNAPL-5	12/6/2022	--	6.02	--	0.5
LNAPL-5	12/25/2022	--	5.98	--	0.5
LNAPL-5	1/15/2023	--	5.93	--	--

Table 5
Fluid Level Measurements at LNAPL Wells
Calumet Montana Refining, LLC - Great Falls, Montana

Location	Date	DTP (ft BTOC)	DTW (ft BTOC)	LNAPL Thickness (ft)	Fluid Recovery (gal)
LNAPL-5	1/22/2023	5.90	5.91	0.01	0.8
LNAPL-5	1/30/2023	5.39	5.41	0.02	--
LNAPL-5	2/5/2023	--	5.76	--	--
LNAPL-5	2/12/2023	5.53	5.54	0.01	1.0
LNAPL-5	2/18/2023	5.74	5.77	0.03	0.7
LNAPL-5	2/26/2023	5.51	5.53	0.02	--
LNAPL-5	3/5/2023	--	5.95	--	--
LNAPL-5	3/12/2023	5.76	5.78	0.02	--
LNAPL-5	3/19/2023	--	5.71	--	0.3
LNAPL-5	3/23/2023	--	5.60	--	--
LNAPL-5	4/2/2023	--	5.48	--	--
LNAPL-5	4/30/2023	4.20	4.30	0.10	--
LNAPL-5	5/31/2023	--	4.41	--	--
LNAPL-5	6/19/2023	--	3.82	--	--
LNAPL-5	7/10/2023	--	4.32	--	--
LNAPL-5	8/19/2023	--	5.11	--	--
LNAPL-5	9/19/2023	--	5.42	--	--
LNAPL-6	8/27/2021	--	8.13	--	--
LNAPL-6	9/30/2021	--	6.61	--	--
LNAPL-6	10/5/2021	--	6.47	--	--
LNAPL-6	10/12/2021	--	6.40	--	--
LNAPL-6	10/19/2021	--	6.33	--	--
LNAPL-6	11/9/2021	--	6.27	--	--
LNAPL-6	11/18/2021	--	6.24	--	--
LNAPL-6	12/2/2021	--	6.41	--	--
LNAPL-6	12/15/2021	--	6.50	--	--
LNAPL-6	1/3/2022	--	6.56	--	--
LNAPL-6	2/8/2022	--	6.78	--	--
LNAPL-6	5/15/2022	5.94	5.95	0.01	--
LNAPL-6	5/22/2022	--	5.93	--	--
LNAPL-6	5/29/2022	--	5.75	--	--
LNAPL-6	6/5/2022	--	5.92	--	--
LNAPL-6	6/12/2022	--	5.93	--	--
LNAPL-6	6/19/2022	--	6.04	--	--
LNAPL-6	6/26/2022	5.45	5.50	0.05	--
LNAPL-6	7/3/2022	5.46	5.48	0.02	--
LNAPL-6	7/10/2022	--	5.61	--	--
LNAPL-6	7/17/2022	5.60	5.61	0.01	--
LNAPL-6	7/31/2022	--	5.92	--	--
LNAPL-6	8/7/2022	6.89	6.91	0.02	0.8
LNAPL-6	8/14/2022	6.90	6.94	0.04	--
LNAPL-6	9/4/2022	6.85	6.88	0.03	--
LNAPL-6	9/10/2022	6.85	6.89	0.04	--
LNAPL-6	9/18/2022	--	7.38	--	--
LNAPL-6	9/25/2022	6.92	7.00	0.08	--
LNAPL-6	10/2/2022	6.68	6.73	0.05	--
LNAPL-6	10/9/2022	6.53	6.85	0.32	--
LNAPL-6	11/14/2022	--	6.25	--	--
LNAPL-6	12/6/2022	--	6.13	--	--
LNAPL-6	12/25/2022	--	6.13	--	--
LNAPL-6	1/15/2023	--	5.97	--	--
LNAPL-6	1/22/2023	--	5.99	--	--
LNAPL-6	1/30/2023	--	5.45	--	--
LNAPL-6	2/5/2023	--	5.53	--	--
LNAPL-6	2/12/2023	--	5.75	--	--
LNAPL-6	2/18/2023	--	5.76	--	--
LNAPL-6	2/26/2023	--	5.65	--	--
LNAPL-6	3/5/2023	5.84	5.87	0.03	0.3
LNAPL-6	3/19/2023	--	5.90	--	--
LNAPL-6	3/23/2023	--	5.64	--	--
LNAPL-6	4/2/2023	5.41	5.45	0.04	--
LNAPL-6	4/30/2023	4.40	4.45	0.05	--
LNAPL-6	5/31/2023	--	4.60	--	--
LNAPL-6	6/19/2023	--	3.83	--	--
LNAPL-6	7/10/2023	4.45	4.47	0.02	--
LNAPL-6	8/19/2023	--	5.22	--	--
LNAPL-6	9/19/2023	--	5.53	--	--
LNAPL-7	8/27/2021	--	8.14	--	--
LNAPL-7	9/30/2021	--	6.42	--	--
LNAPL-7	10/5/2021	--	6.29	--	--

Table 5
Fluid Level Measurements at LNAPL Wells
Calumet Montana Refining, LLC - Great Falls, Montana

Location	Date	DTP (ft BTOC)	DTW (ft BTOC)	LNAPL Thickness (ft)	Fluid Recovery (gal)
LNAPL-7	10/12/2021	--	6.22	--	--
LNAPL-7	10/19/2021	--	6.16	--	--
LNAPL-7	11/9/2021	5.98	5.99	0.01	--
LNAPL-7	11/18/2021	6.18	6.58	0.40	--
LNAPL-7	12/2/2021	6.18	6.58	0.40	--
LNAPL-7	12/15/2021	6.28	6.65	0.38	--
LNAPL-7	1/3/2022	6.32	6.77	0.45	--
LNAPL-7	2/8/2022	6.58	6.75	0.17	--
LNAPL-7	3/7/2022	6.57	7.18	0.61	--
LNAPL-7	4/11/2022	6.53	7.26	0.73	--
LNAPL-7	5/15/2022	5.90	5.91	0.01	0.9
LNAPL-7	5/22/2022	5.73	5.74	0.01	--
LNAPL-7	5/29/2022	--	5.70	--	--
LNAPL-7	6/5/2022	--	5.80	--	0.5
LNAPL-7	6/12/2022	--	5.96	--	0.6
LNAPL-7	6/19/2022	5.85	5.87	0.02	1.0
LNAPL-7	6/26/2022	5.40	5.45	0.05	--
LNAPL-7	7/3/2022	--	5.50	--	0.3
LNAPL-7	7/10/2022	--	5.67	--	0.6
LNAPL-7	7/17/2022	--	5.45	--	0.7
LNAPL-7	7/31/2022	--	5.90	--	0.6
LNAPL-7	8/7/2022	6.89	6.95	0.06	--
LNAPL-7	8/14/2022	7.05	7.08	0.03	--
LNAPL-7	9/4/2022	6.75	7.45	0.70	0.3
LNAPL-7	9/10/2022	6.64	7.41	0.77	0.5
LNAPL-7	9/18/2022	6.99	7.11	0.12	0.3
LNAPL-7	9/25/2022	--	6.51	--	0.5
LNAPL-7	10/2/2022	6.75	7.02	0.27	0.5
LNAPL-7	10/9/2022	6.33	6.66	0.33	0.8
LNAPL-7	11/14/2022	6.08	6.10	0.02	0.8
LNAPL-7	12/6/2022	--	5.95	--	1.0
LNAPL-7	12/25/2022	5.93	5.94	0.01	0.8
LNAPL-7	1/15/2023	--	5.38	--	1.0
LNAPL-7	1/22/2023	5.88	5.90	0.02	0.7
LNAPL-7	1/30/2023	--	5.43	--	0.8
LNAPL-7	2/12/2023	--	5.50	--	1.0
LNAPL-7	2/18/2023	--	5.55	--	0.1
LNAPL-7	2/26/2023	--	5.46	--	0.1
LNAPL-7	3/5/2023	5.74	5.76	0.02	0.2
LNAPL-7	3/12/2023	--	5.92	--	1.0
LNAPL-7	3/19/2023	--	5.52	--	0.3
LNAPL-7	3/23/2023	--	5.63	--	--
LNAPL-7	4/2/2023	5.43	5.45	0.02	--
LNAPL-7	4/30/2023	4.50	4.55	0.05	--
LNAPL-7	5/31/2023	--	4.41	--	--
LNAPL-7	6/19/2023	--	3.72	--	--
LNAPL-7	7/10/2023	--	4.25	--	--
LNAPL-7	8/19/2023	--	5.10	--	--
LNAPL-7	9/19/2023	--	5.35	--	--
LNAPL-8	8/27/2021	--	8.10	--	--
LNAPL-8	9/30/2021	--	6.30	--	--
LNAPL-8	10/5/2021	--	6.20	--	--
LNAPL-8	10/12/2021	--	6.11	--	--
LNAPL-8	10/19/2021	--	6.05	--	--
LNAPL-8	11/9/2021	5.88	5.90	0.02	--
LNAPL-8	11/18/2021	6.08	6.43	0.35	--
LNAPL-8	12/2/2021	6.08	6.46	0.38	--
LNAPL-8	12/15/2021	6.18	6.55	0.37	--
LNAPL-8	1/3/2022	6.28	6.37	0.09	--
LNAPL-8	2/8/2022	6.50	6.59	0.09	--
LNAPL-8	2/25/2022	6.47	6.98	0.51	--
LNAPL-8	3/7/2022	6.45	7.10	0.65	--
LNAPL-8	4/11/2022	6.46	7.07	0.61	--
LNAPL-8	5/15/2022	5.82	5.83	0.01	0.6
LNAPL-8	5/22/2022	--	5.65	--	--
LNAPL-8	5/29/2022	5.75	5.80	0.05	--
LNAPL-8	6/5/2022	5.75	5.76	0.01	0.3
LNAPL-8	6/12/2022	--	5.96	--	0.8
LNAPL-8	6/19/2022	5.77	5.80	0.03	--
LNAPL-8	6/26/2022	--	5.40	--	--

Table 5
Fluid Level Measurements at LNAPL Wells
Calumet Montana Refining, LLC - Great Falls, Montana

Location	Date	DTP (ft BTOC)	DTW (ft BTOC)	LNAPL Thickness (ft)	Fluid Recovery (gal)
LNAPL-8	7/3/2022	--	5.67	--	0.8
LNAPL-8	7/10/2022	--	5.61	--	0.4
LNAPL-8	7/17/2022	--	5.33	--	0.3
LNAPL-8	7/31/2022	--	5.92	--	0.8
LNAPL-8	8/7/2022	6.84	6.88	0.04	0.1
LNAPL-8	8/14/2022	7.21	7.25	0.04	--
LNAPL-8	9/4/2022	6.68	7.25	0.57	--
LNAPL-8	9/10/2022	6.38	7.17	0.79	--
LNAPL-8	9/18/2022	--	6.98	--	--
LNAPL-8	9/25/2022	--	6.28	--	1.0
LNAPL-8	10/2/2022	6.69	6.96	0.27	0.8
LNAPL-8	10/9/2022	6.24	6.57	0.33	0.5
LNAPL-8	11/14/2022	--	6.10	--	0.8
LNAPL-8	12/6/2022	--	5.86	--	1.0
LNAPL-8	12/25/2022	--	5.84	--	0.5
LNAPL-8	1/15/2023	--	5.74	--	--
LNAPL-8	1/22/2023	5.88	5.90	0.02	0.6
LNAPL-8	1/30/2023	--	5.40	--	--
LNAPL-8	2/5/2023	--	5.60	--	0.5
LNAPL-8	2/12/2023	--	5.44	--	--
LNAPL-8	2/18/2023	--	5.43	--	0.8
LNAPL-8	2/26/2023	5.37	5.38	0.01	--
LNAPL-8	3/5/2023	5.82	5.84	0.02	0.2
LNAPL-8	3/12/2023	5.83	5.84	0.01	--
LNAPL-8	3/19/2023	--	5.52	--	0.3
LNAPL-8	3/23/2023	5.43	5.44	0.01	--
LNAPL-8	4/2/2023	5.46	5.47	0.01	--
LNAPL-8	4/30/2023	4.30	4.40	0.10	--
LNAPL-8	5/31/2023	--	4.31	--	--
LNAPL-8	6/19/2023	--	3.63	--	--
LNAPL-8	7/10/2023	--	4.17	--	--
LNAPL-8	8/19/2023	--	4.95	--	--
LNAPL-8	9/19/2023	--	5.30	--	--
LNAPL-9	8/27/2021	--	8.09	--	--
LNAPL-9	9/30/2021	--	6.33	--	--
LNAPL-9	10/5/2021	--	6.23	--	--
LNAPL-9	10/12/2021	--	6.16	--	--
LNAPL-9	10/19/2021	6.11	6.12	0.01	--
LNAPL-9	10/22/2021	--	6.12	--	--
LNAPL-9	10/25/2021	--	6.09	--	--
LNAPL-9	10/28/2021	--	6.10	--	--
LNAPL-9	11/4/2021	--	6.15	--	--
LNAPL-9	11/9/2021	6.05	6.09	0.04	--
LNAPL-9	11/18/2021	6.17	6.20	0.04	--
LNAPL-9	12/2/2021	6.17	6.31	0.14	--
LNAPL-9	12/15/2021	6.27	6.40	0.13	--
LNAPL-9	1/3/2022	--	6.42	--	--
LNAPL-9	2/8/2022	--	6.56	--	--
LNAPL-9	5/15/2022	--	5.71	--	--
LNAPL-9	5/22/2022	--	5.70	--	--
LNAPL-9	5/29/2022	--	5.70	--	--
LNAPL-9	6/5/2022	--	5.76	--	--
LNAPL-9	6/12/2022	--	5.72	--	--
LNAPL-9	6/19/2022	5.80	5.82	0.02	--
LNAPL-9	6/26/2022	--	5.40	--	--
LNAPL-9	7/3/2022	--	5.29	--	--
LNAPL-9	7/10/2022	--	5.39	--	--
LNAPL-9	7/17/2022	5.34	5.36	0.02	--
LNAPL-9	7/31/2022	--	5.70	--	--
LNAPL-9	8/7/2022	6.68	6.72	0.04	--
LNAPL-9	8/14/2022	7.70	7.75	0.05	--
LNAPL-9	9/4/2022	6.62	6.76	0.14	--
LNAPL-9	9/10/2022	6.60	6.80	0.20	--
LNAPL-9	9/18/2022	--	6.83	--	--
LNAPL-9	9/25/2022	--	6.67	--	--
LNAPL-9	10/2/2022	6.45	6.75	0.30	--
LNAPL-9	10/9/2022	6.30	6.62	0.32	--
LNAPL-9	11/14/2022	--	6.04	--	--
LNAPL-9	12/6/2022	--	5.91	--	--
LNAPL-9	2/5/2023	--	5.62	0.50	--

Table 5
Fluid Level Measurements at LNAPL Wells
Calumet Montana Refining, LLC - Great Falls, Montana

Location	Date	DTP (ft BTOC)	DTW (ft BTOC)	LNAPL Thickness (ft)	Fluid Recovery (gal)
LNAPL-9	2/26/2023	--	5.42	--	--
LNAPL-9	3/5/2023	--	5.86	--	--
LNAPL-9	3/23/2023	--	5.45	--	--
LNAPL-9	4/2/2023	5.55	5.58	0.03	--
LNAPL-9	5/31/2023	--	4.36	--	--
LNAPL-9	6/19/2023	--	3.66	--	--
LNAPL-9	7/10/2023	--	3.25	--	--
LNAPL-9	8/19/2023	--	5.00	--	--
LNAPL-9	9/19/2023	--	5.30	--	--
LNAPL-10	8/27/2021	--	8.11	--	--
LNAPL-10	9/30/2021	6.31	6.36	0.05	--
LNAPL-10	10/5/2021	6.14	6.59	0.45	--
LNAPL-10	10/12/2021	6.15	6.64	0.49	--
LNAPL-10	10/14/2021	6.05	6.49	0.44	--
LNAPL-10	10/19/2021	6.05	6.42	0.37	--
LNAPL-10	10/20/2021	6.04	6.22	0.18	--
LNAPL-10	10/21/2021	6.15	6.23	0.08	--
LNAPL-10	10/22/2021	6.09	6.18	0.09	--
LNAPL-10	10/25/2021	6.02	6.18	0.16	--
LNAPL-10	10/28/2021	6.05	6.28	0.23	--
LNAPL-10	11/4/2021	5.98	6.26	0.28	--
LNAPL-10	11/9/2021	6.04	6.35	0.31	--
LNAPL-10	11/18/2021	6.08	6.45	0.38	--
LNAPL-10	12/2/2021	6.09	6.62	0.53	--
LNAPL-10	12/15/2021	6.19	6.64	0.45	--
LNAPL-10	1/3/2022	6.24	6.75	0.51	--
LNAPL-10	2/8/2022	6.47	7.05	0.59	--
LNAPL-10	2/25/2022	6.43	7.33	0.90	--
LNAPL-10	3/7/2022	6.47	7.10	0.63	--
LNAPL-10	4/11/2022	6.52	7.19	0.67	--
LNAPL-10	5/15/2022	5.90	5.91	0.01	1.0
LNAPL-10	5/22/2022	5.69	5.70	0.01	--
LNAPL-10	5/29/2022	5.62	5.65	0.03	--
LNAPL-10	6/5/2022	--	5.89	--	1.0
LNAPL-10	6/12/2022	6.00	6.03	0.03	0.8
LNAPL-10	6/19/2022	5.76	6.00	0.24	0.8
LNAPL-10	6/26/2022	--	5.35	--	--
LNAPL-10	7/3/2022	5.45	5.48	0.03	0.8
LNAPL-10	7/10/2022	5.62	5.63	0.01	0.6
LNAPL-10	7/17/2022	5.37	5.39	0.02	0.7
LNAPL-10	7/31/2022	6.00	6.01	0.01	0.8
LNAPL-10	8/7/2022	6.91	7.15	0.24	0.6
LNAPL-10	8/14/2022	7.61	7.80	0.19	--
LNAPL-10	9/4/2022	6.70	7.30	0.60	0.4
LNAPL-10	9/10/2022	6.51	7.21	0.70	0.8
LNAPL-10	9/18/2022	7.08	7.18	0.10	0.3
LNAPL-10	9/25/2022	--	6.34	--	0.5
LNAPL-10	10/2/2022	6.88	7.09	0.21	0.6
LNAPL-10	10/9/2022	6.30	6.61	0.31	0.8
LNAPL-10	11/14/2022	--	6.10	--	0.5
LNAPL-10	12/6/2022	--	5.96	--	1.0
LNAPL-10	12/25/2022	--	5.90	--	0.3
LNAPL-10	1/15/2023	--	5.72	--	1.0
LNAPL-10	1/22/2023	--	5.94	--	0.3
LNAPL-10	1/30/2023	--	5.44	--	0.4
LNAPL-10	2/12/2023	5.60	5.62	0.02	1.0
LNAPL-10	2/18/2023	--	5.47	--	0.7
LNAPL-10	2/26/2023	5.41	5.42	0.01	0.3
LNAPL-10	3/5/2023	--	5.80	--	--
LNAPL-10	3/12/2023	--	5.71	--	1.0
LNAPL-10	3/19/2023	--	5.52	--	0.3
LNAPL-10	3/23/2023	--	5.40	--	--
LNAPL-10	4/2/2023	5.60	5.62	0.02	--
LNAPL-10	4/30/2023	4.30	4.35	0.05	--
LNAPL-10	5/31/2023	--	4.35	--	--
LNAPL-10	6/19/2023	--	3.65	--	--
LNAPL-10	7/10/2023	--	4.19	--	--
LNAPL-10	8/19/2023	--	4.95	--	--
LNAPL-10	9/19/2023	--	5.30	--	--
LNAPL-11	8/27/2021	--	8.20	--	--

Table 5
Fluid Level Measurements at LNAPL Wells
Calumet Montana Refining, LLC - Great Falls, Montana

Location	Date	DTP (ft BTOC)	DTW (ft BTOC)	LNAPL Thickness (ft)	Fluid Recovery (gal)
LNAPL-11	9/30/2021	--	6.52	--	--
LNAPL-11	10/5/2021	6.29	6.30	0.01	--
LNAPL-11	10/12/2021	--	6.34	--	--
LNAPL-11	10/19/2021	6.22	6.63	0.41	--
LNAPL-11	10/20/2021	6.32	6.35	0.03	--
LNAPL-11	10/21/2021	6.40	6.41	0.01	--
LNAPL-11	10/22/2021	--	6.30	--	--
LNAPL-11	10/25/2021	6.22	6.25	0.03	--
LNAPL-11	10/28/2021	6.25	6.38	0.13	--
LNAPL-11	11/4/2021	6.20	6.40	0.20	--
LNAPL-11	11/9/2021	6.21	6.45	0.24	--
LNAPL-11	11/18/2021	6.26	6.53	0.27	--
LNAPL-11	12/2/2021	6.28	6.68	0.40	--
LNAPL-11	12/15/2021	6.38	6.78	0.41	--
LNAPL-11	1/3/2022	6.42	6.88	0.46	--
LNAPL-11	2/8/2022	6.73	7.29	0.56	--
LNAPL-11	2/25/2022	6.61	7.39	0.78	--
LNAPL-11	3/7/2022	6.63	7.43	0.80	--
LNAPL-11	4/11/2022	6.70	7.43	0.73	--
LNAPL-11	5/15/2022	6.12	6.50	0.38	0.5
LNAPL-11	5/22/2022	--	5.86	--	--
LNAPL-11	5/29/2022	--	5.90	--	--
LNAPL-11	6/5/2022	--	6.09	--	1.0
LNAPL-11	6/12/2022	6.21	6.25	0.04	0.5
LNAPL-11	6/19/2022	5.94	6.18	0.24	0.8
LNAPL-11	6/26/2022	--	5.50	--	--
LNAPL-11	7/3/2022	5.56	5.58	0.02	0.9
LNAPL-11	7/10/2022	--	5.83	--	1.0
LNAPL-11	7/17/2022	5.55	5.57	0.02	0.7
LNAPL-11	7/31/2022	6.10	6.20	0.10	0.5
LNAPL-11	8/7/2022	7.15	7.16	0.01	0.7
LNAPL-11	8/14/2022	7.82	7.86	0.04	--
LNAPL-11	9/4/2022	7.19	7.60	0.41	0.7
LNAPL-11	9/10/2022	6.58	7.20	0.62	0.8
LNAPL-11	9/18/2022	7.34	7.38	0.04	0.1
LNAPL-11	9/25/2022	--	6.56	--	0.5
LNAPL-11	10/2/2022	7.21	7.34	0.13	0.7
LNAPL-11	10/9/2022	6.46	6.76	0.30	0.5
LNAPL-11	11/14/2022	--	6.10	--	0.5
LNAPL-11	12/6/2022	--	6.03	--	0.8
LNAPL-11	12/25/2022	--	6.06	--	0.3
LNAPL-11	1/15/2023	--	5.89	--	--
LNAPL-11	1/22/2023	--	6.07	--	0.4
LNAPL-11	1/30/2023	5.56	5.58	0.02	0.5
LNAPL-11	2/12/2023	5.60	5.62	0.02	1.0
LNAPL-11	2/18/2023	5.62	5.65	0.03	0.5
LNAPL-11	2/26/2023	5.58	5.60	0.02	--
LNAPL-11	3/5/2023	--	5.77	--	--
LNAPL-11	3/12/2023	--	5.83	--	--
LNAPL-11	3/19/2023	--	5.63	--	0.3
LNAPL-11	3/23/2023	--	5.49	--	--
LNAPL-11	4/2/2023	5.55	5.56	0.01	--
LNAPL-11	4/30/2023	4.30	4.35	0.05	--
LNAPL-11	5/31/2023	--	4.51	--	--
LNAPL-11	6/19/2023	--	3.81	--	--
LNAPL-11	7/30/2023	--	4.34	--	--
LNAPL-11	8/19/2023	--	5.12	--	--
LNAPL-11	9/19/2023	--	5.50	--	--
LNAPL-12	8/14/2022	--	6.92	--	--
LNAPL-12	8/20/2022	--	6.81	--	--
LNAPL-12	9/4/2022	--	6.71	--	--
LNAPL-12	9/10/2022	--	6.71	--	--
LNAPL-12	9/18/2022	--	6.95	--	--
LNAPL-12	9/25/2022	--	6.85	--	--
LNAPL-12	10/2/2022	--	6.64	--	--
LNAPL-12	10/9/2022	--	6.52	--	--
LNAPL-12	11/14/2022	--	6.12	--	--
LNAPL-12	12/6/2022	--	6.01	--	--
LNAPL-12	2/26/2023	--	5.59	--	--
LNAPL-12	3/5/2023	--	5.81	--	--

Table 5
Fluid Level Measurements at LNAPL Wells
Calumet Montana Refining, LLC - Great Falls, Montana

Location	Date	DTP (ft BTOC)	DTW (ft BTOC)	LNAPL Thickness (ft)	Fluid Recovery (gal)
LNAPL-12	3/23/2023	--	5.67	--	--
LNAPL-12	4/2/2023	5.60	5.61	0.01	--
LNAPL-12	5/31/2023	--	4.45	--	--
LNAPL-12	6/19/2023	--	3.75	--	--
LNAPL-12	7/10/2023	--	4.39	--	--
LNAPL-12	8/19/2023	--	5.14	--	--
LNAPL-12	9/19/2023	--	5.48	--	--
LNAPL-13	8/14/2022	--	6.88	--	--
LNAPL-13	8/20/2022	--	6.82	--	--
LNAPL-13	9/4/2022	--	6.69	--	--
LNAPL-13	9/10/2022	--	6.70	--	--
LNAPL-13	9/18/2022	--	6.83	--	--
LNAPL-13	9/25/2022	--	6.81	--	--
LNAPL-13	10/2/2022	--	6.62	--	--
LNAPL-13	10/9/2022	--	6.52	--	--
LNAPL-13	11/14/2022	--	6.11	--	--
LNAPL-13	12/6/2022	--	5.98	--	--
LNAPL-13	2/26/2023	--	5.57	--	--
LNAPL-13	3/5/2023	--	5.78	--	--
LNAPL-13	3/23/2023	--	5.54	--	--
LNAPL-13	4/2/2023	5.52	5.56	0.04	--
LNAPL-13	5/31/2023	--	4.45	--	--
LNAPL-13	6/19/2023	--	3.75	--	--
LNAPL-13	7/10/2023	--	4.39	--	--
LNAPL-13	8/19/2023	--	5.15	--	--
LNAPL-13	9/19/2023	--	5.48	--	--
LNAPL-14	8/14/2022	--	6.93	--	--
LNAPL-14	8/20/2022	--	6.85	--	--
LNAPL-14	9/4/2022	--	6.74	--	--
LNAPL-14	9/10/2022	--	6.73	--	--
LNAPL-14	9/18/2022	--	7.13	--	--
LNAPL-14	9/25/2022	--	7.02	--	--
LNAPL-14	10/2/2022	--	6.66	--	--
LNAPL-14	10/9/2022	--	6.55	--	--
LNAPL-14	11/14/2022	--	6.15	--	--
LNAPL-14	12/6/2022	--	6.04	--	--
LNAPL-14	2/26/2023	--	5.62	--	--
LNAPL-14	3/5/2023	--	5.80	--	--
LNAPL-14	3/23/2023	--	5.50	--	--
LNAPL-14	4/2/2023	5.58	5.60	0.02	--
LNAPL-14	5/31/2023	--	4.48	--	--
LNAPL-14	6/19/2023	--	3.75	--	--
LNAPL-14	7/10/2023	--	4.43	--	--
LNAPL-14	8/19/2023	--	5.19	--	--
LNAPL-14	9/19/2023	--	5.47	--	--
LNAPL-15	8/14/2022	--	6.93	--	--
LNAPL-15	8/20/2022	--	6.82	--	--
LNAPL-15	9/4/2022	--	6.73	--	--
LNAPL-15	9/10/2022	--	6.72	--	--
LNAPL-15	9/18/2022	--	7.24	--	--
LNAPL-15	9/25/2022	--	6.84	--	--
LNAPL-15	10/2/2022	--	6.65	--	--
LNAPL-15	10/9/2022	--	6.53	--	--
LNAPL-15	11/14/2022	--	6.14	--	--
LNAPL-15	12/6/2022	--	5.99	--	--
LNAPL-15	2/26/2023	--	5.60	--	--
LNAPL-15	3/5/2023	--	5.77	--	--
LNAPL-15	3/23/2023	--	5.49	--	--
LNAPL-15	4/2/2023	5.51	5.55	0.04	--
LNAPL-15	5/31/2023	--	4.45	--	--
LNAPL-15	6/19/2023	--	3.73	--	--
LNAPL-15	7/10/2023	--	4.41	--	--
LNAPL-15	8/19/2023	--	5.22	--	--
LNAPL-15	9/19/2023	--	5.42	--	--
LNAPL-16	8/14/2022	--	6.92	--	--
LNAPL-16	8/20/2022	--	6.83	--	--
LNAPL-16	9/4/2022	--	6.72	--	--
LNAPL-16	9/10/2022	--	6.72	--	--
LNAPL-16	9/18/2022	--	6.91	--	--
LNAPL-16	9/25/2022	--	6.83	--	--

Table 5
Fluid Level Measurements at LNAPL Wells
Calumet Montana Refining, LLC - Great Falls, Montana

Location	Date	DTP (ft BTOC)	DTW (ft BTOC)	LNAPL Thickness (ft)	Fluid Recovery (gal)
LNAPL-16	10/2/2022	--	6.66	--	--
LNAPL-16	10/9/2022	--	6.52	--	--
LNAPL-16	11/14/2022	--	6.12	--	--
LNAPL-16	12/6/2022	--	5.97	--	--
LNAPL-16	2/26/2023	--	5.60	--	--
LNAPL-16	3/5/2023	--	5.82	--	--
LNAPL-16	3/23/2023	--	5.45	--	--
LNAPL-16	4/2/2023	5.50	5.51	0.01	--
LNAPL-16	5/31/2023	--	4.47	--	--
LNAPL-16	6/19/2023	--	3.73	--	--
LNAPL-16	7/10/2023	--	4.40	--	--
LNAPL-16	8/19/2023	--	5.22	--	--
LNAPL-16	9/19/2023	--	5.44	--	--
LNAPL-17	8/14/2022	--	6.90	--	--
LNAPL-17	8/20/2022	--	6.79	--	--
LNAPL-17	9/4/2022	--	3.73	--	--
LNAPL-17	9/10/2022	--	6.67	--	--
LNAPL-17	9/18/2022	--	6.87	--	--
LNAPL-17	9/25/2022	--	6.95	--	--
LNAPL-17	10/2/2022	--	6.62	--	--
LNAPL-17	10/9/2022	--	6.51	--	--
LNAPL-17	11/14/2022	--	6.10	--	--
LNAPL-17	12/6/2022	--	6.02	--	--
LNAPL-17	12/11/2022	--	6.02	--	--
LNAPL-17	2/26/2023	--	5.57	--	--
LNAPL-17	3/5/2023	--	5.75	--	--
LNAPL-17	3/23/2023	--	6.63	--	--
LNAPL-17	4/2/2023	5.52	5.55	0.03	--
LNAPL-17	5/31/2023	--	4.42	--	--
LNAPL-17	6/19/2023	--	3.64	--	--
LNAPL-17	7/10/2023	--	4.39	--	--
LNAPL-17	8/19/2023	--	5.19	--	--
LNAPL-17	9/19/2023	--	5.50	--	--

Notes:

DTP	Depth to Product
DTW	Depth to Water
ft BTOC	Below Top of Casing
LNAPL	light non-aqueous phase liquid
NA	Reading not collected
--	LNAPL was not present/No LNAPL Recovery

Table 6
Summary of Groundwater Analytical Results - Petroleum COCs
Calumet Montana Refining, LLC - Great Falls, Montana

Location			MW-041S	MW-041S	MW-041S	MW-041S	MW-041S	MW-041S	MW-041S	MW-041S
Field Sample ID	Montana DEQ-7 Human Health Standards - Groundwater	Montana DEQ Tier 1 Groundwater RBSLs	CMR-MW41S-211005	CMR-MW141S-220317	MW41S-GW-220622	CMR-MW41S-220831	CMR-MW-41S-221213-L1569525	CMR-MW-415-230321	CMR-MW-41S-270623	R-MW-41S-092023
Lab Sample ID(s)			WJ08015-001	XC21009-002	XF23073-001	L1533605-03; XI01059-003	L1569525-03; XL14017-003	YC22023-003	YF29005-005	YI21013-003
Sample Method			Low Flow	Low Flow	Low Flow	Low Flow	Low Flow	Low Flow	Low Flow	Low Flow
Sample Date			10/5/2021	3/17/2022	6/22/2022	8/31/2022	12/13/2022	3/21/2023	6/27/2023	9/20/2023
Comments										
VOC										
Acetone			U (80)	76 (20)	HU (80)	88 (4)	35 J (20)	U (20)	40 H (4)	U (200)
Benzene	5	5	**1900 (8)**	**230 (2)**	**1200 H (8)**	**140 (0.4)**	**250 (2)**	**130 (0.4)**	**410 (2)**	**470 (20)**
Bromoform	80		U (8)	U (2)	HU (8)	U (0.4)	U (2)	U (0.4)	U (2)	U (20)
2-Butanone			U (40)	28 J (10)	HU (40)	16 (2)	14 J (10)	U (2)	18 H (2)	U (100)
Carbon Disulfide			U (8)	U (2)	HU (8)	4.2 (0.4)	U (2)	U (0.4)	U (2)	U (20)
Chloroform	70		U (8)	U (2)	HU (8)	U (0.4)	U (2)	U (0.4)	U (2)	U (20)
Chloromethane	600		U (8)	U (2)	HU (8)	U (0.4)	U (2)	U (0.4)	U (2)	U (20)
Cumene			14 (8)	U (2)	16 H (8)	0.57 (0.4)	U (2)	0.55 (0.4)	5.6 (2)	U (20)
Cyclohexane			110 (8)	15 (2)	22 H (8)	27 (0.4)	33 (2)	18 (2)	17 (2)	45 (20)
cis-1,2-Dichloroethene	70		U (8)	U (2)	HU (8)	0.48 J (0.4)	U (2)	U (0.4)	U (2)	U (20)
Ethyl Benzene	700	700	450 (8)	15 (2)	410 H (8)	21 (0.4)	50 (2)	16 (0.4)	150 (2)	170 (20)
4-Methyl-2-pentanone			U (40)	U (10)	HU (40)	2.4 J (2)	U (10)	U (2)	U (10)	U (100)
Methylcyclohexane			57 J (8)	9.4 J (2)	12 (8)	18 (0.4)	34 (2)	12 (0.4)	15 J (2)	33 J (20)
Methylene Chloride	5		U (8)	U (2)	HU (8)	U (0.4)	U (2)	U (0.4)	U (2)	U (20)
Naphthalene	100	100	35 (8)	31 (2)	77 H (8)	3.4 (0.4)	27 (2)	18 (0.4)	35 (2)	30 (20)
Toluene	1000	1000	270 (8)	44 (2)	180 H (8)	11 (0.4)	9.5 (2)	2.2 (0.4)	3.4 (2)	U (20)
1,1,2-Trichloroethane	3		U (8)	U (2)	HU (8)	U (0.4)	U (2)	U (0.4)	U (2)	U (20)
m,p-xylene			640 (8)	580 (2)	2000 H (8)	150 (0.4)	730 (2)	320 (2)	470 (2)	590 (20)
ortho-xylene	10000		200 (8)	300 (2)	750 H (8)	67 (0.4)	300 (2)	150 (2)	150 (2)	200 (20)
Xylenes (total)	10000	10000	840 (8)	870 (2)	2700 H (8)	220 (0.4)	1000 (2)	460 (2)	630 (2)	790 (20)
SVOC										
Acenaphthene	70	70	U (0.2)	U (0.8)	U (2)	U (0.04)	U (0.8)	U (0.8)	0.34 J (0.2)	0.65 J (0.2)
Benzo(a)anthracene	0.5	0.5	U (0.2)	U (0.8)	U (2)	U (0.04)	U (0.8)	U (0.8)	U (0.2)	U (0.2)
Benzo(a)pyrene	0.05	0.05	U (0.35)	U (1.4)	U (3.5)	U (0.04)	U (0.8)	U (0.8)	U (0.2)	U (0.2)
Benzo(b)fluoranthene	0.5	0.5	U (0.2)	U (0.8)	U (2)	U (0.04)	U (0.8)	U (0.8)	U (0.2)	U (0.2)
Benzo(g,h,i)perylene			U (0.2)	U (0.8)	U (2)	U (0.04)	U (0.8)	U (0.8)	U (0.2)	U (0.2)
bis(2-Ethylhexyl)phthalate	6		U (5)	U (40)	U (100)	3.8 BJ (1.5)	U (30)	U (30)	U (7.5)	U (7.5)
Chrysene	50	50	U (0.15)	U (0.6)	U (1.5)	U (0.04)	U (0.8)	U (0.8)	U (0.2)	U (0.2)
Diethylphthalate	600		U (2.5)	U (10)	U (25)	U (0.19)	U (3.8)	U (3.8)	U (0.95)	U (0.95)
2,4-Dimethylphenol	100		U (2.4)	**160 (9.6)**	36 J (24)	U (0.15)	**100 (3)**	60 (3)	8.3 (0.75)	75 (0.75)
Di-n-butylphthalate	20		U (2.5)	U (10)	U (25)	U (0.42)	U (8.4)	U (8.4)	U (2.1)	U (2.1)
Fluoranthene	20	20	U (0.5)	U (2)	U (5)	U (0.04)	U (0.8)	U (0.8)	U (0.2)	U (0.2)
Fluorene	50	50	0.63 BJ (0.15)	U (0.6)	2.3 J (1.5)	U (0.04)	U (0.8)	1.2 (0.8)	0.67 J (0.2)	1.4 (0.2)
Indeno(1,2,3-cd)pyrene	0.5	0.5	U (0.2)	U (0.8)	U (2)	U (0.04)	U (0.8)	U (0.8)	U (0.2)	U (0.2)
1-Methylnaphthalene		11	--	--	--	0.065 J (0.04)	12 (0.8)	14 (0.8)	10 (0.2)	7.3 (0.2)
2-Methylnaphthalene		36	1.7 B (0.2)	7.7 (0.8)	33 (2)	0.11 J (0.04)	6.7 (0.8)	11 (0.8)	12 (0.2)	0.74 J (0.2)
2-Methylphenol			U (1.1)	U (4.2)	U (11)	U (0.21)	U (4.2)	U (4.2)	U (1.1)	U (1.1)
Naphthalene	100	100	15 B (0.25)	18 (1)	60 (2.5)	U (0.04)	19 (0.8)	11 (0.8)	15 (0.2)	6.9 (0.2)
Phenanthrene			U (0.3)	U (1.2)	U (3)	U (0.04)	U (0.8)	U (0.8)	0.42 J (0.2)	U (0.2)
Phenol	4000		5.6 (2.5)	15 J (10)	U (25)	U (0.19)	9.1 J (3.8)	U (3.8)	U (0.95)	15 (0.95)
MTDEQ VPH										
C5-C8 Aliphatics (Unadjusted)			--	--	--	1460 (33.3)	1050 (33.3)	516 (100)	850 (167)	1310 (33.3)
C5-C8 Aliphatics		650	1500 (150)	460 J (150)	990 (150)	1140 (33.3)	1040 (33.3)	392 (100)	429 J (167)	842 (33.3)
C9-C12 Aliphatics (Unadjusted)			--	--	--	1200 (33.3)	2060 (33.3)	1330 (100)	3100 (167)	2510 (33.3)
C9-C12 Aliphatics		1400	370 J (150)	730 J (150)	710 J (150)	625 (33.3)	405 (33.3)	456 (100)	U (167)	844 (33.3)
C9-C10 Aromatics (Unadjusted)			--	--	--	530 (33.3)	1570 (33.3)	1240 (500)	1910 (167)	1750 (33.3)
C9-C10 Aromatics		1100	990 (50)	810 (50)	3100 (50)	--	--	--	--	--
Volatile Petroleum Hydrocarbons			6300 (350)	3100 (350)	9800 (350)	3190 (66.7)	5170 (66.7)	3090 (1000)	5860 (333)	5570 (66.7)
MTDEQ EPH										
C19-C36 Aliphatics		1000	--	--	U (100)	--	--	--	--	--
C11-C22 Aromatics		1100	--	--	4000 (100)	--	375 (200)	506 (666)	425 J (200)	397 J (200)
C11-C22 Aromatics (unadjusted)			--	--	--	--	375 (200)	506 (666)	425 J (200)	397 J (200)
TPH (Unadjusted)			--	--	--	--	375 (200)	506 (666)	425 J (200)	397 J (200)
TPH (adjusted)			--	--	--	--	375 (200)	506 (666)	425 J (200)	397 J (200)
Petroleum Hydrocarbons (Extractable)			--	--	5700 (2000)	5560 (500)	--	5640 (333)	5490 (100	5560 (100)
Extractable Petroleum Hydrocarbons (Frac)			--	--	5000 B (100)	--	4460 Q (100)	--		

Notes:

1 All concentrations are presented in ug/L (ppb) except where otherwise noted.

2 Only compounds with at least one detection are shown.

3 Concentrations that exceed the Montana DEQ-7 Human Health Standards - Groundwater are **boldfaced**.

4 Concentrations that exceed the Montana DEQ Tier 1 Groundwater RBSLs are underlined.

Abbreviations:

U -- Not Detected.
J -- Estimated Concentration.
B -- Blank Contamination.
( ) -- Detection Limit.
-- -- Not Analyzed.

Table 6
Summary of Groundwater Analytical Results - Petroleum COCs
Calumet Montana Refining, LLC - Great Falls, Montana

Location			MW-105	MW-105	MW-105	MW-105	MW-105	MW-105	MW-105	MW-105	MW-105	MW-105	MW-105
Field Sample ID	Montana DEQ-7 Human Health Standards - Groundwater	Montana DEQ Tier 1 Groundwater RBSLs	CMR-MW105-08052020	CMR-MW105-200827	CMR-MW105-210223	CMR-MW105S-211006	CMR-MW105-220317	MW105-GW-220622	CMR-MW105-220831	CMR-MW-105-221213-L1569525	CMR-MW-105-230321	CMR-MW-105-270623	CMR-MW-105-092023
Lab Sample ID(s)			VH07016-001	VH28044-018	WB25040-009	WJ08015-002	XC21009-003	XF23073-003	L1533605-01; XI01059-001	L1569525-01; XL14017-001	YC22023-001	YF29005-003	YI21013-001
Sample Method			Low Flow	Low Flow	Low Flow	Low Flow	Low Flow	Low Flow	Low Flow	Low Flow	Low Flow	Low Flow	Low Flow
Sample Date			8/5/2020	8/27/2020	2/23/2021	10/6/2021	3/17/2022	6/22/2022	8/31/2022	12/13/2022	3/21/2023	6/27/2023	9/20/2023
Comments													
VOC													
Acetone			110 (4)	43 J (40)	65 J (40)	58 H (20)	6.8 J (4)	U (4)	77 (4)	8 J (4)	U (4)	21 H (4)	U (200)
Benzene	5	5	**180 (0.4)**	**570 (4)**	**240 (4)**	**250 H (2)**	**25 (0.4)**	**110 (0.4)**	**85 (0.4)**	2.1 (0.4)	**12 (0.4)**	**48 (0.4)**	**85 (20)**
Bromoform	80		U (0.4)	U (4)	U (4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (20)
2-Butanone			15 (2)	U (20)	U (20)	17 (2)	U (2)	3 J (2)	U (2)	U (2)	U (2)	3.2 J (2)	U (100)
Carbon Disulfide			0.56 (0.4)	U (4)	U (4)	HU (2)	U (0.4)	1.4 (0.4)	0.55 (0.4)	5.8 (0.4)	U (0.4)	U (0.4)	U (20)
Chloroform	70		U (0.4)	U (4)	U (4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (20)
Chloromethane	600		29 (0.4)	U (4)	U (4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	1.5 (0.4)	U (20)
Cumene			4.6 (0.4)	5.4 (4)	5.5 (4)	2.4 (0.4)	U (0.4)	2.9 (0.4)	0.67 (0.4)	U (0.4)	U (0.4)	0.72 (0.4)	U (20)
Cyclohexane			59 (0.4)	55 J (4)	70 (4)	59 (0.4)	3 (0.4)	50 (0.4)	26 (0.4)	3.4 (0.4)	6.6 (0.4)	9.4 H (0.4)	96 (20)
cis-1,2-Dichloroethene	70		U (0.4)	U (4)	U (4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (20)
Ethyl Benzene	700	700	240 (2)	320 (4)	160 (4)	150 (0.4)	20 (0.4)	200 (0.4)	120 (0.4)	7.9 (0.4)	21 (0.4)	15 (0.4)	570 (20)
4-Methyl-2-pentanone			U (2)	U (20)	U (20)	U (2)	U (2)	U (2)	U (2)	U (2)	U (2)	U (2)	U (100)
Methylcyclohexane			26 (0.4)	17 J (4)	37 J (4)	25 (0.4)	0.85 J (0.4)	14 (0.4)	8.1 (0.4)	0.91 J (0.4)	1.7 (0.4)	3.8 J (0.4)	28 J (20)
Methylene Chloride	5		U (0.4)	U (4)	U (4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (20)
Naphthalene	100	100	9.4 (0.4)	9.1 (4)	12 (4)	8.5 (0.4)	0.86 (0.4)	4.9 (0.4)	4.9 (0.4)	U (0.4)	0.57 (0.4)	1.5 (0.4)	U (20)
Toluene	1000	1000	25 (0.4)	42 (4)	15 (4)	14 (0.4)	2 (0.4)	12 (0.4)	9.9 (0.4)	U (0.4)	1.5 (0.4)	2.2 (0.4)	20 J (20)
1,1,2-Trichloroethane	3		U (0.4)	U (4)	U (4)	U (0.4)	U (0.4)	U (0.4)	0.51 (0.4)	U (0.4)	U (0.4)	U (0.4)	U (20)
m,p-xylene			250 (2)	260 (4)	55 (4)	41 (0.4)	6.7 (0.4)	28 (0.4)	12 (0.4)	0.57 (0.4)	3.6 (0.4)	4.7 (0.4)	U (20)
ortho-xylene	10000		16 (0.4)	20 (4)	5.7 (4)	3.8 (0.4)	2.3 (0.4)	3.9 (0.4)	3.9 (0.4)	0.44 J (0.4)	0.57 (0.4)	1.2 (0.4)	U (20)
Xylenes (total)	10000	10000	290 (0.4)	280 (4)	61 (4)	45 (0.4)	9 (0.4)	31 (0.4)	16 (0.4)	1 (0.4)	4.1 (0.4)	5.9 (0.4)	U (20)
SVOC													
Acenaphthene	70	70	--	U (0.2)	0.065 J (0.04)	U (0.4)	U (0.04)	U (0.25)	U (0.8)	U (0.2)	U (0.2)	U (0.2)	U (0.2)
Benzo(a)anthracene	0.5	0.5	--	U (0.2)	U (0.04)	U (0.4)	U (0.04)	U (0.25)	U (0.8)	U (0.2)	U (0.2)	U (0.2)	U (0.2)
Benzo(a)pyrene	0.05	0.05	--	U (0.35)	U (0.07)	U (0.7)	U (0.07)	U (0.44)	U (0.8)	U (0.2)	U (0.2)	U (0.2)	U (0.2)
Benzo(b)fluoranthene	0.5	0.5	--	U (0.2)	U (0.04)	U (0.4)	U (0.04)	U (0.25)	U (0.8)	U (0.2)	U (0.2)	U (0.2)	U (0.2)
Benzo(g,h,i)perylene			--	U (0.2)	U (0.04)	U (0.4)	U (0.04)	U (0.25)	U (0.8)	U (0.2)	U (0.2)	U (0.2)	U (0.2)
bis(2-Ethylhexyl)phthalate	6		--	U (2.5)	U (0.5)	U (20)	U (2)	U (13)	U (30)	U (7.5)	U (7.5)	U (7.5)	U (7.5)
Chrysene	50	50	--	U (0.15)	U (0.03)	U (0.3)	U (0.03)	U (0.19)	U (0.8)	U (0.2)	U (0.2)	U (0.2)	U (0.2)
Diethylphthalate	600		--	U (2.5)	U (0.5)	U (5)	U (0.5)	U (3.1)	U (3.8)	U (0.95)	U (0.95)	U (0.95)	U (0.95)
2,4-Dimethylphenol	100		--	U (2.4)	1.1 (0.48)	U (4.8)	0.63 J (0.48)	U (3)	37 (3)	U (0.75)	U (0.75)	U (0.75)	31 (0.75)
Di-n-butylphthalate	20		--	U (2.5)	U (0.5)	U (5)	U (0.5)	U (3.1)	U (8.4)	U (2.1)	U (2.1)	U (2.1)	U (2.1)
Fluoranthene	20	20	--	U (0.5)	U (0.1)	U (1)	U (0.1)	U (0.63)	U (0.8)	U (0.2)	U (0.2)	U (0.2)	U (0.2)
Fluorene	50	50	--	U (0.15)	0.15 J (0.03)	U (0.3)	U (0.03)	U (0.19)	U (0.8)	U (0.2)	U (0.2)	U (0.2)	U (0.2)
Indeno(1,2,3-cd)pyrene	0.5	0.5	--	U (0.2)	U (0.04)	U (0.4)	U (0.04)	U (0.25)	U (0.8)	U (0.2)	U (0.2)	U (0.2)	U (0.2)
1-Methylnaphthalene		11	--	--	--	--	--	--	1.3 J (0.8)	U (0.2)	U (0.2)	0.73 J (0.2)	4 (0.2)
2-Methylnaphthalene		36	--	0.77 J (0.2)	2.4 (0.04)	U (0.4)	U (0.04)	U (0.25)	1.9 J (0.8)	U (0.2)	U (0.2)	0.31 J (0.2)	0.29 J (0.2)
2-Methylphenol			--	U (1.1)	0.24 J (0.21)	U (2.1)	U (0.21)	U (1.3)	U (4.2)	U (1.1)	U (1.1)	U (1.1)	U (1.1)
Naphthalene	100	100	--	6.6 (0.25)	6.1 (0.05)	3.1 (0.5)	0.42 (0.05)	2.1 (0.31)	1.5 J (0.8)	U (0.2)	0.23 (0.2)	0.91 (0.2)	4 (0.2)
Phenanthrene			--	U (0.3)	0.088 J (0.06)	U (0.6)	U (0.06)	U (0.38)	U (0.8)	U (0.2)	U (0.2)	U (0.2)	U (0.2)
Phenol	4000		--	U (2.5)	3.4 (0.5)	U (5)	U (0.5)	U (3.1)	U (3.8)	U (0.95)	U (0.95)	1.2 J (0.95)	3.3 J (0.95)
MTDEQ VPH													
C5-C8 Aliphatics (Unadjusted)			--	--	--	--	--	--	650 (33.3)	63.9 J (33.3)	178 (100)	1050 (33.3)	1580 (33.3)
C5-C8 Aliphatics		650	1600 (15)	880 (75)	1800 (75)	1200 (75)	150 (15)	830 (15)	517 (33.3)	63.9 J (33.3)	162 (100)	969 (33.3)	1490 (33.3)
C9-C12 Aliphatics (Unadjusted)			--	--	--	--	--	--	240 B (33.3)	U (33.3)	106 (100)	377 (33.3)	955 (33.3)
C9-C12 Aliphatics		1400	180 (15)	200 J (75)	210 J (75)	130 (15)	21 J (15)	37 J (15)	140 B (33.3)	U (33.3)	67.5 (100)	117 (33.3)	396 (33.3)
C9-C10 Aromatics (Unadjusted)			--	--	--	--	--	--	158 (33.3)	51 J (33.3)	U (100)	185 (33.3)	375 (33.3)
C9-C10 Aromatics		1100	530 (5)	650 (25)	350 (25)	300 (5)	52 (5)	150 (5)	--	--	--		
Volatile Petroleum Hydrocarbons			2800 (35)	2700 (180)	2300 (180)	1900 (180)	240 (35)	1100 (35)	1050 (66.7)	146 J (66.7)	284 (200)	1610 (66.7)	2910 (66.7)
MTDEQ EPH													
C19-C36 Aliphatics		1000	--	740 (480)	--	--	--	--	--	--	--		
C11-C22 Aromatics		1100	--	U (480)	--	--	--	--	--	--	U (600)	U (200)	U (200)
C11-C22 Aromatics (unadjusted)			--	--	--	--	--	--	--	--	U (600)	U (200)	U (200)
TPH (Unadjusted)			--	--	--	--	--	--	--	--	U (600)	U (200)	U (200)
TPH (adjusted)			--	--	--	--	--	--	--	--	U (600)	U (600)	U (600)
Petroleum Hydrocarbons (Extractable)			--	1900 (950)	470 (240)	--	--	--	--	--	374 (300)	638 (100)	17000
Extractable Petroleum Hydrocarbons (Frac)			--	880 J (480)	--	--	--	--	--	--	--		

Notes:

1 All concentrations are presented in ug/L (ppb) except where otherwise noted.

2 Only compounds with at least one detection are shown.

3 Concentrations that exceed the Montana DEQ-7 Human Health Standards - Groundwater are **boldfaced**.

4 Concentrations that exceed the Montana DEQ Tier 1 Groundwater RBSLs are underlined.

Abbreviations:

U -- Not Detected.
J -- Estimated Concentration.
B -- Blank Contamination.
( ) -- Detection Limit.
-- -- Not Analyzed.

Table 6
Summary of Groundwater Analytical Results - Petroleum COCs
Calumet Montana Refining, LLC - Great Falls, Montana

Location			MW-106	MW-106	MW-106	MW-106	MW-106	MW-106	MW-106	MW-106	MW-106	MW-106
Field Sample ID	Montana DEQ-7 Human Health Standards - Groundwater	Montana DEQ Tier 1 Groundwater RBSLs	CMR-MW106-211005	CMR-MW106-220316	MW106-GW-220622	CMR-MW106-220831	CMR-MW-106-221213-L1569525	CMR-DS1-221213	CMR-MW-106-230321	CMR-DUP-1-230321	CMR-MW-106-280623	CMR-MW-106-092023
Lab Sample ID(s)			WJ08009-001	XC21009-001	XF23073-002	L1533605-02; XI01059-002	L1569525-02; XL14017-002	XL14017-004	YC22023-002	YC22023-004	YF29005-001	YI21013-002
Sample Method			Low Flow	Low Flow	Low Flow	Low Flow	Low Flow	Low Flow	Low Flow	Low Flow	Low Flow	Low Flow
Sample Date			10/5/2021	3/16/2022	6/22/2022	8/31/2022	12/13/2022	12/13/2022	3/21/2023	3/21/2023	6/28/2023	9/20/2023
Comments								Field Duplicate		Field Duplicate		
VOC												
Acetone			6.9 J (4)	U (4)	U (4)	U (4)	14 (4)	12 (4)	U (4)	U (4)	U (4)	13 (4)
Benzene	5	5	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)
Bromoform	80		U (0.4)	U (0.4)	U (0.4)	U (0.4)	0.96 (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)
2-Butanone			U (2)	U (2)	U (2)	U (2)	U (2)	U (2)	U (2)	U (2)	U (2)	U (2)
Carbon Disulfide			U (0.4)	U (0.4)	U (0.4)	U (0.4)	4.2 (0.4)	3.2 (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)
Chloroform	70		U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)
Chloromethane	600		U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)
Cumene			U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)
Cyclohexane			U (0.4)	U (0.4)	U (0.4)	7.2 (0.4)	2.8 (0.4)	2.6 (0.4)	U (0.4)	U (0.4)	U (0.4)	1.7 (0.4)
cis-1,2-Dichloroethene	70		U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)
Ethyl Benzene	700	700	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)
4-Methyl-2-pentanone			U (2)	U (2)	U (2)	U (2)	U (2)	U (2)	U (2)	U (2)	U (2)	3.8 J (2)
Methylcyclohexane			U (0.4)	U (0.4)	U (0.4)	1.7 J (0.4)	1 J (0.4)	1.1 J (0.4)	U (0.4)	U (0.4)	U (0.4)	0.5 J (0.4)
Methylene Chloride	5		0.47 J (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	0.49 J (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)
Naphthalene	100	100	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)
Toluene	1000	1000	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)
1,1,2-Trichloroethane	3		U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)
m,p-xylene			U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)
ortho-xylene	10000		U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)
Xylenes (total)	10000	10000	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)	U (0.4)
SVOC												
Acenaphthene	70	70	U (0.04)	U (0.04)	U (0.2)	U (0.04)	U (0.2)	--	U (0.2)	--	U (0.2)	U (0.2)
Benzo(a)anthracene	0.5	0.5	U (0.04)	0.084 J (0.04)	U (0.2)	U (0.04)	U (0.2)	--	U (0.2)	--	U (0.2)	U (0.2)
Benzo(a)pyrene	0.05	0.05	U (0.07)	**0.17 J (0.07)**	U (0.35)	U (0.04)	U (0.2)	--	U (0.2)	--	U (0.2)	U (0.2)
Benzo(b)fluoranthene	0.5	0.5	U (0.04)	0.2 (0.04)	U (0.2)	U (0.04)	U (0.2)	--	U (0.2)	--	U (0.2)	U (0.2)
Benzo(g,h,i)perylene			U (0.04)	0.12 J (0.04)	U (0.2)	U (0.04)	U (0.2)	--	U (0.2)	--	U (0.2)	U (0.2)
bis(2-Ethylhexyl)phthalate	6		U (1)	U (2)	U (10)	2 BJ (1.5)	U (7.5)	--	U (7.5)	--	U (7.5)	U (7.5)
Chrysene	50	50	U (0.03)	0.042 J (0.03)	U (0.15)	U (0.04)	U (0.2)	--	U (0.2)	--	U (0.2)	U (0.2)
Diethylphthalate	600		U (0.5)	U (0.5)	U (2.5)	0.21 J (0.19)	U (0.95)	--	U (0.95)	--	U (0.95)	U (0.95)
2,4-Dimethylphenol	100		U (0.48)	U (0.48)	U (2.4)	U (0.15)	U (0.75)	--	U (0.75)	--	U (0.75)	U (0.75)
Di-n-butylphthalate	20		U (0.5)	U (0.5)	U (2.5)	U (0.42)	U (2.1)	--	U (2.1)	--	U (2.1)	U (2.1)
Fluoranthene	20	20	U (0.1)	0.16 J (0.1)	U (0.5)	U (0.04)	U (0.2)	--	U (0.2)	--	U (0.2)	U (0.2)
Fluorene	50	50	U (0.03)	U (0.03)	U (0.15)	U (0.04)	U (0.2)	--	U (0.2)	--	U (0.2)	U (0.2)
Indeno(1,2,3-cd)pyrene	0.5	0.5	U (0.04)	0.15 J (0.04)	U (0.2)	U (0.04)	U (0.2)	--	U (0.2)	--	U (0.2)	U (0.2)
1-Methylnaphthalene		11	--	--	--	0.061 J (0.04)	U (0.2)	--	U (0.2)	--	U (0.2)	U (0.2)
2-Methylnaphthalene		36	0.044 BJ (0.04)	U (0.04)	U (0.2)	0.1 J (0.04)	U (0.2)	--	U (0.2)	--	U (0.2)	U (0.2)
2-Methylphenol			U (0.21)	U (0.21)	U (1.1)	U (0.21)	U (1.1)	--	U (1.1)	--	U (1.1)	U (1.1)
Naphthalene	100	100	U (0.05)	U (0.05)	U (0.25)	0.045 J (0.04)	U (0.2)	--	U (0.2)	--	U (0.2)	U (0.2)
Phenanthrene			U (0.06)	U (0.06)	U (0.3)	U (0.04)	U (0.2)	--	U (0.2)	--	U (0.2)	U (0.2)
Phenol	4000		U (0.5)	U (0.5)	U (2.5)	U (0.19)	U (0.95)	--	U (0.95)	--	U (0.95)	U (0.95)
MTDEQ VPH												
C5-C8 Aliphatics (Unadjusted)			--	--	--	153 (33.3)	80 J (33.3)	--	U (100)	--	85.9 J (33.3)	495 (33.3)
C5-C8 Aliphatics		650	U (15)	U (15)	U (15)	153 (33.3)	80 J (33.3)	--	U (100)	--	85.9 J (33.3)	495 (33.3)
C9-C12 Aliphatics (Unadjusted)			--	--	--	36 (33.3)	U (33.3)	--	U (100)	--	U (33.3)	U (33.3)
C9-C12 Aliphatics		1400	U (15)	U (15)	U (15)	36 (33.3)	U (33.3)	--	U (100)	--	U (33.3)	U (33.3)
C9-C10 Aromatics (Unadjusted)			--	--	--	U (33.3)	U (33.3)	--	U (100)	--	U (33.3)	38.4 (33.3)
C9-C10 Aromatics		1100	U (5)	U (5)	U (5)	--	--	--	--	--	--	--
Volatile Petroleum Hydrocarbons			U (35)	U (35)	U (35)	189 J (66.7)	108 J (66.7)	--	U (200)	--	108 J (66.7)	533 (66.7)
MTDEQ EPH												
C19-C36 Aliphatics		1000	--	--	U (100)	--	--	--	--	--	--	--
C11-C22 Aromatics		1100	--	--	U (100)	--	U (200)	--	U (666)	--	U (200)	U (200)
C11-C22 Aromatics (unadjusted)			--	--	--	--	U (200)	--	U (666)	--	U (200)	U (200)
TPH (Unadjusted)			--	--	--	--	U (200)	--	U (666)	--	U (200)	U (200)
TPH (adjusted)			--	--	--	--	U (200)	--	U (666)	--	U (200)	U (200)
Petroleum Hydrocarbons (Extractable)			U (200)	U (200)	U (200)	U (100)	--	--	U (333)	--	1650 (100)	843 (100)
Extractable Petroleum Hydrocarbons (Frac)			--	--	U (100)	--	U (100)	--	--	--	--	

Notes:

1 All concentrations are presented in ug/L (ppb) except where otherwise noted.

2 Only compounds with at least one detection are shown.

3 Concentrations that exceed the Montana DEQ-7 Human Health Standards - Groundwater are **boldfaced**.

4 Concentrations that exceed the Montana DEQ Tier 1 Groundwater RBSLs are underlined.

Abbreviations:

U -- Not Detected.
J -- Estimated Concentration.
B -- Blank Contamination.
( ) -- Detection Limit.
-- -- Not Analyzed.

Table 7
Summary of Groundwater Analytical Results - Field Parameters
Calumet Montana Refining, LLC - Great Falls, Montana

Location	MW-041S	MW-041S	MW-041S	MW-041S	MW-041S	MW-041S	MW-041S	MW-041S
Field Sample ID	CMR-MW41S-211005	CMR-MW141S-220317	MW41S-GW-220622	CMR-MW41S-220831	CMR-MW-41S-221213	CMR-MW-41S-230321	CMR-MW-41S-230627	CMR-MW-41S-092023
Sample Method	Low Flow	Low Flow	Low Flow	Low Flow	Low Flow	Low Flow	Low Flow	Low Flow
Sample Date	10/5/2021	3/17/2022	6/22/2022	8/31/2022	12/13/2022	3/21/2023	6/27/2023	9/20/2023
FIELD PARAMETERS								
Specific Conductivity (Field Analysis)	1.26	0.00	1.40	1.40	1.76	1.22	0.00	1.38
Dissolved Oxygen	0.00	5.65	2.99	0.00	8.56	0.76	8.16	0.00
Oxidation Reduction Potential	-93	-40	-123	-127	-139	-149	-26	-147
pH (Field Analysis)	7.22	5.32	7	6.34	7.17	7.24	6.22	7.18
Turbidity (Field Parameters)	0.8	221.0	55	1.7	78.0	19.0	664.0	26

Location	MW-105	MW-105	MW-105	MW-105	MW-105	MW-105	MW-105	MW-105
Field Sample ID	CMR-MW105S-211006	CMR-MW105-220317	MW105-GW-220622	CMR-MW105-220831	CMR-MW-105-221213	CMR-MW-105-230321	CMR-MW-105-230627	CMR-MW-105-092023
Sample Method	Low Flow	Low Flow	Low Flow	Low Flow	Low Flow	Low Flow	Low Flow	Low Flow
Sample Date	10/6/2021	3/17/2022	6/22/2022	8/31/2022	12/13/2022	3/21/2023	6/27/2023	9/20/2023
FIELD PARAMETERS								
Specific Conductivity (Field Analysis)	1.99	1.98	2.16	2.19	2.25	2.16	0.00	---
Dissolved Oxygen	0.00	0.00	1.81	0.00	0.00	4.20	8.25	6.31
Oxidation Reduction Potential	-107	-81	-113	-53	49	121	144	98
pH (Field Analysis)	7.57	7.36	7.31	6.10	7.14	7.32	6.30	7.12
Turbidity (Field Parameters)	2.7	0	12.9	0	139	0	369	---

Location	MW-106	MW-106	MW-106	MW-106	MW-106	MW-106	MW-106	MW-106
Field Sample ID	CMR-MW106-211005	CMR-MW106-220316	MW106-GW-220622	CMR-MW106-220831	CMR-MW-106-221213	CMR-MW-106-230321	CMR-MW-106-230628	CMR-MW-106-092023
Sample Method	Low Flow	Low Flow	Low Flow	Low Flow	Low Flow	Low Flow	Low Flow	Low Flow
Sample Date	10/5/2021	3/16/2022	6/22/2022	8/31/2022	12/13/2022	3/21/2023	6/28/2023	9/20/2023
FIELD PARAMETERS								
Specific Conductivity (Field Analysis)	6.91	2.01	2.35	2.28	2.29	2.09	0.00	2.18
Dissolved Oxygen	0.00	0.02	0.85	0.00	8.16	2.90	9.03	0.00
Oxidation Reduction Potential	13	14	17	34	31	39	47	-127
pH (Field Analysis)	8.07	7.50	7.27	6.57	7.54	7.23	6.74	7.35
Turbidity (Field Parameters)	3.1	0	101	423	90	0	519	159

Abbreviations:
NTU -- Nephelometric Turbidity unit,
mg/L -- milligram per liter
mS/cm -- millisiemens per centimeter
mV -- millivolt

APPENDIX A
LABORATORY ANALYTICAL REPORTS

A1: Dual-Phase Extraction Vapor Analytical Results

A2: Dual-Phase Extraction Effluent Liquid Analytical Results

A3: Passive Treatment Trench Groundwater Analytical Results

APPENDIX A
LABORATORY ANALYTICAL REPORTS

A1: Dual-Phase Extraction Vapor Analytical Results

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A3: Passive Treatment Trench Groundwater Analytical Results

APPENDIX A1

DUAL-PHASE EXTRACTION VAPOR ANALYTICAL RESULTS

Pace Project Number L1634467

ANALYTICAL REPORT

July 24, 2023

Ramboll - Chicago, IL

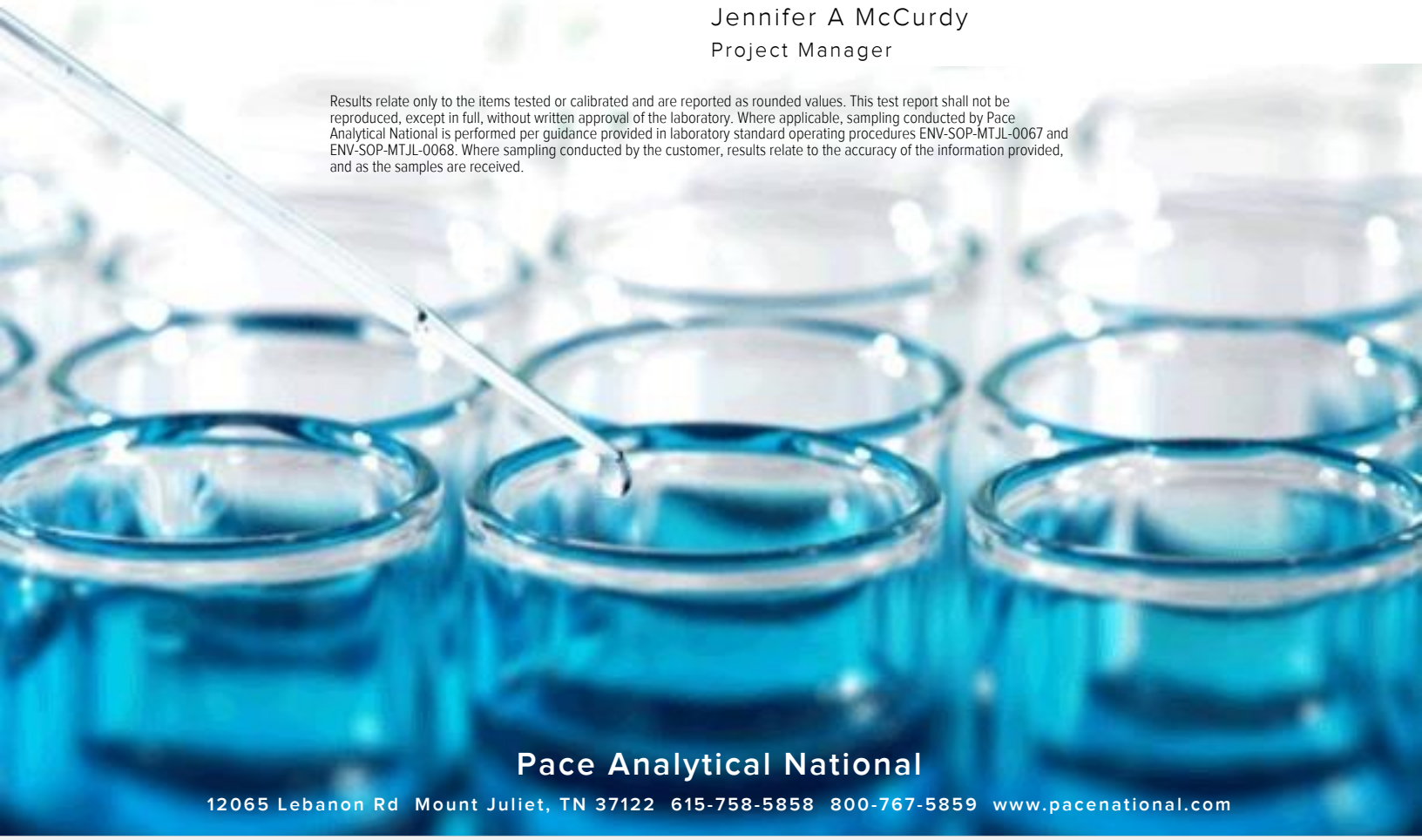
Sample Delivery Group:	L1634467
Samples Received:	07/12/2023
Project Number:	1690029636-002 AOC-1
Description:	Calumet Refinery

Report To:

Ruta Deshpande
333 West Wacker Drive
Suite 2700
Chicago, IL 60606

Entire Report Reviewed By:

Jennifer A McCurdy
Project Manager



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

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SAMPLE SUMMARY

CMR-SP301-110723 L1634467-01 Air

Collected by: Eric Poissant
Collected date/time: 07/11/23 14:20
Received date/time: 07/12/23 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Volatile Organic Compounds (MS) by Method TO-15	WG2095467	20	07/15/23 22:15	07/15/23 22:15	DBB	Mt. Juliet, TN
Volatile Organic Compounds (MS) by Method TO-15	WG2099193	500	07/21/23 14:10	07/21/23 14:10	DAH	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.

Jennifer A McCurdy
Project Manager

Volatile Organic Compounds (MS) by Method TO-15

Analyte	CAS #	Mol. Wt.	RDL1 ppbv	RDL2 ug/m3	Result ppbv	Result ug/m3	Qualifier	Dilution	Batch
Acetone	67-64-1	58.10	25.0	59.4	ND	ND		20	WG2095467
Allyl chloride	107-05-1	76.53	4.00	12.5	ND	ND		20	WG2095467
Benzene	71-43-2	78.10	4.00	12.8	1110	3550		20	WG2095467
Benzyl Chloride	100-44-7	127	4.00	20.8	ND	ND		20	WG2095467
Bromodichloromethane	75-27-4	164	4.00	26.8	ND	ND		20	WG2095467
Bromoform	75-25-2	253	12.0	124	ND	ND		20	WG2095467
Bromomethane	74-83-9	94.90	4.00	15.5	ND	ND		20	WG2095467
1,3-Butadiene	106-99-0	54.10	40.0	88.5	ND	ND		20	WG2095467
Carbon disulfide	75-15-0	76.10	4.00	12.4	ND	ND		20	WG2095467
Carbon tetrachloride	56-23-5	154	4.00	25.2	ND	ND		20	WG2095467
Chlorobenzene	108-90-7	113	4.00	18.5	ND	ND		20	WG2095467
Chloroethane	75-00-3	64.50	4.00	10.6	ND	ND		20	WG2095467
Chloroform	67-66-3	119	4.00	19.5	ND	ND		20	WG2095467
Chloromethane	74-87-3	50.50	4.00	8.26	ND	ND		20	WG2095467
2-Chlorotoluene	95-49-8	126	4.00	20.6	ND	ND		20	WG2095467
Cyclohexane	110-82-7	84.20	4.00	13.8	1770	6100		20	WG2095467
Dibromochloromethane	124-48-1	208	4.00	34.0	ND	ND		20	WG2095467
1,2-Dibromoethane	106-93-4	188	4.00	30.8	ND	ND		20	WG2095467
1,2-Dichlorobenzene	95-50-1	147	4.00	24.0	ND	ND		20	WG2095467
1,3-Dichlorobenzene	541-73-1	147	4.00	24.0	ND	ND		20	WG2095467
1,4-Dichlorobenzene	106-46-7	147	4.00	24.0	ND	ND		20	WG2095467
1,2-Dichloroethane	107-06-2	99	4.00	16.2	ND	ND		20	WG2095467
1,1-Dichloroethane	75-34-3	98	4.00	16.0	ND	ND		20	WG2095467
1,1-Dichloroethene	75-35-4	96.90	4.00	15.9	ND	ND		20	WG2095467
cis-1,2-Dichloroethene	156-59-2	96.90	4.00	15.9	ND	ND		20	WG2095467
trans-1,2-Dichloroethene	156-60-5	96.90	4.00	15.9	ND	ND		20	WG2095467
1,2-Dichloropropane	78-87-5	113	4.00	18.5	ND	ND		20	WG2095467
cis-1,3-Dichloropropene	10061-01-5	111	4.00	18.2	ND	ND		20	WG2095467
trans-1,3-Dichloropropene	10061-02-6	111	4.00	18.2	ND	ND		20	WG2095467
1,4-Dioxane	123-91-1	88.10	4.00	14.4	ND	ND		20	WG2095467
Ethanol	64-17-5	46.10	50.0	94.3	ND	ND		20	WG2095467
Ethylbenzene	100-41-4	106	4.00	17.3	533	2310		20	WG2095467
4-Ethyltoluene	622-96-8	120	4.00	19.6	58.4	287		20	WG2095467
Trichlorofluoromethane	75-69-4	137.40	4.00	22.5	ND	ND		20	WG2095467
Dichlorodifluoromethane	75-71-8	120.92	4.00	19.8	ND	ND		20	WG2095467
1,1,2-Trichlorotrifluoroethane	76-13-1	187.40	4.00	30.7	ND	ND		20	WG2095467
1,2-Dichlorotetrafluoroethane	76-14-2	171	4.00	28.0	ND	ND		20	WG2095467
Heptane	142-82-5	100	4.00	16.4	1800	7360		20	WG2095467
Hexachloro-1,3-butadiene	87-68-3	261	12.6	135	ND	ND		20	WG2095467
n-Hexane	110-54-3	86.20	315	1110	4460	15700		500	WG2099193
Isopropylbenzene	98-82-8	120.20	4.00	19.7	22.9	113		20	WG2095467
Methylene Chloride	75-09-2	84.90	4.00	13.9	ND	ND		20	WG2095467
Methyl Butyl Ketone	591-78-6	100	25.0	102	ND	ND		20	WG2095467
2-Butanone (MEK)	78-93-3	72.10	25.0	73.7	ND	ND		20	WG2095467
4-Methyl-2-pentanone (MIBK)	108-10-1	100.10	25.0	102	ND	ND		20	WG2095467
Methyl methacrylate	80-62-6	100.12	4.00	16.4	ND	ND		20	WG2095467
MTBE	1634-04-4	88.10	4.00	14.4	ND	ND		20	WG2095467
Naphthalene	91-20-3	128	12.6	66.0	ND	ND		20	WG2095467
2-Propanol	67-63-0	60.10	25.0	61.5	ND	ND		20	WG2095467
Propene	115-07-1	42.10	25.0	43.0	ND	ND		20	WG2095467
Styrene	100-42-5	104	4.00	17.0	ND	ND		20	WG2095467
1,1,2,2-Tetrachloroethane	79-34-5	168	4.00	27.5	ND	ND		20	WG2095467
Tetrachloroethylene	127-18-4	166	4.00	27.2	ND	ND		20	WG2095467
Tetrahydrofuran	109-99-9	72.10	4.00	11.8	ND	ND		20	WG2095467
Toluene	108-88-3	92.10	10.0	37.7	164	618		20	WG2095467
1,2,4-Trichlorobenzene	120-82-1	181	12.6	93.3	ND	ND		20	WG2095467

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

Volatile Organic Compounds (MS) by Method TO-15

Analyte	CAS #	Mol. Wt.	RDL1 ppbv	RDL2 ug/m3	Result ppbv	Result ug/m3	Qualifier	Dilution	Batch
1,1,1-Trichloroethane	71-55-6	133	4.00	21.8	ND	ND		20	WG2095467
1,1,2-Trichloroethane	79-00-5	133	4.00	21.8	ND	ND		20	WG2095467
Trichloroethylene	79-01-6	131	4.00	21.4	ND	ND		20	WG2095467
1,2,4-Trimethylbenzene	95-63-6	120	4.00	19.6	130	638		20	WG2095467
1,3,5-Trimethylbenzene	108-67-8	120	4.00	19.6	83.1	408		20	WG2095467
2,2,4-Trimethylpentane	540-84-1	114.22	100	467	9850	46000		500	WG2099193
Vinyl chloride	75-01-4	62.50	4.00	10.2	ND	ND		20	WG2095467
Vinyl Bromide	593-60-2	106.95	4.00	17.5	ND	ND		20	WG2095467
Vinyl acetate	108-05-4	86.10	4.00	14.1	ND	ND		20	WG2095467
Xylenes, Total	1330-20-7	106.16	12.0	52.1	2270	9860		20	WG2095467
m&p-Xylene	1330-20-7	106	8.00	34.7	1780	7720		20	WG2095467
o-Xylene	95-47-6	106	4.00	17.3	491	2130		20	WG2095467
(S) 1,4-Bromofluorobenzene	*460-00-4*	*175*	*60.0-140*		*105*				WG2095467
(S) 1,4-Bromofluorobenzene	*460-00-4*	*175*	*60.0-140*		*101*				WG2099193

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

Method Blank (MB)

(MB) R3949087-3 07/15/23 12:55

Analyte	MB Result ppbv	MB Qualifier	MB MDL ppbv	MB RDL ppbv
Acetone	U		0.584	1.25
Allyl chloride	U		0.114	0.200
Benzene	U		0.0715	0.200
Benzyl Chloride	U		0.0598	0.200
Bromodichloromethane	U		0.0702	0.200
Bromoform	U		0.0732	0.600
Bromomethane	U		0.0982	0.200
1,3-Butadiene	U		0.104	2.00
Carbon disulfide	U		0.102	0.200
Carbon tetrachloride	U		0.0732	0.200
Chlorobenzene	U		0.0832	0.200
Chloroethane	U		0.0996	0.200
Chloroform	U		0.0717	0.200
Chloromethane	U		0.103	0.200
2-Chlorotoluene	U		0.0828	0.200
Cyclohexane	U		0.0753	0.200
Dibromochloromethane	U		0.0727	0.200
1,2-Dibromoethane	U		0.0721	0.200
1,2-Dichlorobenzene	U		0.128	0.200
1,3-Dichlorobenzene	U		0.182	0.200
1,4-Dichlorobenzene	U		0.0557	0.200
1,2-Dichloroethane	U		0.0700	0.200
1,1-Dichloroethane	U		0.0723	0.200
1,1-Dichloroethene	U		0.0762	0.200
cis-1,2-Dichloroethene	U		0.0784	0.200
trans-1,2-Dichloroethene	U		0.0673	0.200
1,2-Dichloropropane	U		0.0760	0.200
cis-1,3-Dichloropropene	U		0.0689	0.200
trans-1,3-Dichloropropene	U		0.0728	0.200
1,4-Dioxane	U		0.0833	0.200
Ethanol	U		0.265	2.50
Ethylbenzene	U		0.0835	0.200
4-Ethyltoluene	U		0.0783	0.200
Trichlorofluoromethane	U		0.0819	0.200
Dichlorodifluoromethane	U		0.137	0.200
1,1,2-Trichlorotrifluoroethane	U		0.0793	0.200
1,2-Dichlorotetrafluoroethane	U		0.0890	0.200
Heptane	U		0.104	0.200
Hexachloro-1,3-butadiene	U		0.105	0.630
Isopropylbenzene	U		0.0777	0.200

Method Blank (MB)

(MB) R3949087-3 07/15/23 12:55

Analyte	MB Result ppbv	MB Qualifier	MB MDL ppbv	MB RDL ppbv
Methylene Chloride	U		0.0979	0.200
Methyl Butyl Ketone	U		0.133	1.25
2-Butanone (MEK)	U		0.0814	1.25
4-Methyl-2-pentanone (MIBK)	U		0.0765	1.25
Methyl methacrylate	U		0.0876	0.200
MTBE	U		0.0647	0.200
Naphthalene	0.604	J	0.350	0.630
2-Propanol	U		0.264	1.25
Propene	U		0.0932	1.25
Styrene	U		0.0788	0.200
1,1,2,2-Tetrachloroethane	U		0.0743	0.200
Tetrachloroethylene	U		0.0814	0.200
Tetrahydrofuran	U		0.0734	0.200
Toluene	U		0.0870	0.500
1,2,4-Trichlorobenzene	U		0.148	0.630
1,1,1-Trichloroethane	U		0.0736	0.200
1,1,2-Trichloroethane	U		0.0775	0.200
Trichloroethylene	U		0.0680	0.200
1,2,4-Trimethylbenzene	U		0.0764	0.200
1,3,5-Trimethylbenzene	U		0.0779	0.200
Vinyl chloride	U		0.0949	0.200
Vinyl Bromide	U		0.0852	0.200
Vinyl acetate	U		0.116	0.200
Xylenes, Total	U		0.135	0.600
m&p-Xylene	U		0.135	0.400
o-Xylene	U		0.0828	0.200
(S) 1,4-Bromofluorobenzene	*98.6*			*60.0-140*

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

(LCS) R3949087-1 07/15/23 10:33 • (LCSD) R3949087-2 07/15/23 11:03

Analyte	Spike Amount ppbv	LCS Result ppbv	LCSD Result ppbv	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Acetone	3.75	3.30	3.24	88.0	86.4	70.0-130			1.83	25
Allyl chloride	3.75	3.38	3.37	90.1	89.9	70.0-130			0.296	25
Benzene	3.75	3.57	3.61	95.2	96.3	70.0-130			1.11	25
Benzyl Chloride	3.75	3.27	3.28	87.2	87.5	70.0-152			0.305	25
Bromodichloromethane	3.75	3.37	3.44	89.9	91.7	70.0-130			2.06	25
Bromoform	3.75	3.17	3.20	84.5	85.3	70.0-130			0.942	25

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

(LCS) R3949087-1 07/15/23 10:33 • (LCSD) R3949087-2 07/15/23 11:03

Analyte	Spike Amount ppbv	LCS Result ppbv	LCSD Result ppbv	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Bromomethane	3.75	3.48	3.50	92.8	93.3	70.0-130			0.573	25
1,3-Butadiene	3.75	3.16	3.20	84.3	85.3	70.0-130			1.26	25
Carbon disulfide	3.75	3.42	3.45	91.2	92.0	70.0-130			0.873	25
Carbon tetrachloride	3.75	3.42	3.47	91.2	92.5	70.0-130			1.45	25
Chlorobenzene	3.75	3.44	3.53	91.7	94.1	70.0-130			2.58	25
Chloroethane	3.75	3.47	3.40	92.5	90.7	70.0-130			2.04	25
Chloroform	3.75	3.61	3.66	96.3	97.6	70.0-130			1.38	25
Chloromethane	3.75	3.38	3.41	90.1	90.9	70.0-130			0.884	25
2-Chlorotoluene	3.75	3.90	3.97	104	106	70.0-130			1.78	25
Cyclohexane	3.75	3.82	3.84	102	102	70.0-130			0.522	25
Dibromochloromethane	3.75	3.29	3.34	87.7	89.1	70.0-130			1.51	25
1,2-Dibromoethane	3.75	3.48	3.47	92.8	92.5	70.0-130			0.288	25
1,2-Dichlorobenzene	3.75	3.59	3.64	95.7	97.1	70.0-130			1.38	25
1,3-Dichlorobenzene	3.75	3.67	3.71	97.9	98.9	70.0-130			1.08	25
1,4-Dichlorobenzene	3.75	3.71	3.80	98.9	101	70.0-130			2.40	25
1,2-Dichloroethane	3.75	3.56	3.63	94.9	96.8	70.0-130			1.95	25
1,1-Dichloroethane	3.75	3.56	3.60	94.9	96.0	70.0-130			1.12	25
1,1-Dichloroethene	3.75	3.48	3.47	92.8	92.5	70.0-130			0.288	25
cis-1,2-Dichloroethene	3.75	3.78	3.84	101	102	70.0-130			1.57	25
trans-1,2-Dichloroethene	3.75	3.38	3.42	90.1	91.2	70.0-130			1.18	25
1,2-Dichloropropane	3.75	3.46	3.48	92.3	92.8	70.0-130			0.576	25
cis-1,3-Dichloropropene	3.75	3.43	3.48	91.5	92.8	70.0-130			1.45	25
trans-1,3-Dichloropropene	3.75	3.37	3.41	89.9	90.9	70.0-130			1.18	25
1,4-Dioxane	3.75	3.88	4.03	103	107	70.0-140			3.79	25
Ethanol	3.75	3.57	3.62	95.2	96.5	55.0-148			1.39	25
Ethylbenzene	3.75	4.01	4.09	107	109	70.0-130			1.98	25
4-Ethyltoluene	3.75	4.21	4.32	112	115	70.0-130			2.58	25
Trichlorofluoromethane	3.75	3.37	3.42	89.9	91.2	70.0-130			1.47	25
Dichlorodifluoromethane	3.75	3.42	3.41	91.2	90.9	64.0-139			0.293	25
1,1,2-Trichlorotrifluoroethane	3.75	3.40	3.45	90.7	92.0	70.0-130			1.46	25
1,2-Dichlorotetrafluoroethane	3.75	3.44	3.43	91.7	91.5	70.0-130			0.291	25
Heptane	3.75	3.85	3.86	103	103	70.0-130			0.259	25
Hexachloro-1,3-butadiene	3.75	3.34	3.36	89.1	89.6	70.0-151			0.597	25
Isopropylbenzene	3.75	3.84	3.93	102	105	70.0-130			2.32	25
Methylene Chloride	3.75	3.41	3.39	90.9	90.4	70.0-130			0.588	25
Methyl Butyl Ketone	3.75	4.41	4.60	118	123	70.0-149			4.22	25
2-Butanone (MEK)	3.75	3.88	3.91	103	104	70.0-130			0.770	25
4-Methyl-2-pentanone (MIBK)	3.75	4.19	4.22	112	113	70.0-139			0.713	25
Methyl methacrylate	3.75	4.02	4.07	107	109	70.0-130			1.24	25
MTBE	3.75	3.78	3.80	101	101	70.0-130			0.528	25

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

(LCS) R3949087-1 07/15/23 10:33 • (LCSD) R3949087-2 07/15/23 11:03

Analyte	Spike Amount ppbv	LCS Result ppbv	LCSD Result ppbv	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Naphthalene	3.75	3.90	3.90	104	104	70.0-159			0.000	25
2-Propanol	3.75	3.53	3.56	94.1	94.9	70.0-139			0.846	25
Propene	3.75	3.58	3.58	95.5	95.5	64.0-144			0.000	25
Styrene	3.75	4.36	4.40	116	117	70.0-130			0.913	25
1,1,2,2-Tetrachloroethane	3.75	3.50	3.61	93.3	96.3	70.0-130			3.09	25
Tetrachloroethylene	3.75	3.40	3.49	90.7	93.1	70.0-130			2.61	25
Tetrahydrofuran	3.75	3.94	3.98	105	106	70.0-137			1.01	25
Toluene	3.75	3.70	3.80	98.7	101	70.0-130			2.67	25
1,2,4-Trichlorobenzene	3.75	3.56	3.56	94.9	94.9	70.0-160			0.000	25
1,1,1-Trichloroethane	3.75	3.51	3.51	93.6	93.6	70.0-130			0.000	25
1,1,2-Trichloroethane	3.75	3.45	3.45	92.0	92.0	70.0-130			0.000	25
Trichloroethylene	3.75	3.54	3.59	94.4	95.7	70.0-130			1.40	25
1,2,4-Trimethylbenzene	3.75	4.41	4.48	118	119	70.0-130			1.57	25
1,3,5-Trimethylbenzene	3.75	4.11	4.19	110	112	70.0-130			1.93	25
Vinyl chloride	3.75	3.42	3.40	91.2	90.7	70.0-130			0.587	25
Vinyl Bromide	3.75	3.44	3.43	91.7	91.5	70.0-130			0.291	25
Vinyl acetate	3.75	3.79	3.78	101	101	70.0-130			0.264	25
Xylenes, Total	11.3	12.4	12.6	110	112	70.0-130			1.60	25
m&p-Xylene	7.50	8.30	8.42	111	112	70.0-130			1.44	25
o-Xylene	3.75	4.07	4.17	109	111	70.0-130			2.43	25
(S) 1,4-Bromofluorobenzene				*101*	*100*	*60.0-140*				

Method Blank (MB)

(MB) R3951432-3 07/21/23 09:26

Analyte	MB Result ppbv	MB Qualifier	MB MDL ppbv	MB RDL ppbv
n-Hexane	U		0.206	0.630
2,2,4-Trimethylpentane	U		0.133	0.200
(S) 1,4-Bromofluorobenzene	*98.8*			*60.0-140*

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

(LCS) R3951432-1 07/21/23 08:10 • (LCSD) R3951432-2 07/21/23 08:49

Analyte	Spike Amount ppbv	LCS Result ppbv	LCSD Result ppbv	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
n-Hexane	3.75	4.40	4.43	117	118	70.0-130			0.679	25
2,2,4-Trimethylpentane	3.75	4.41	4.49	118	120	70.0-130			1.80	25
(S) 1,4-Bromofluorobenzene				*102*	*101*	*60.0-140*				

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.
ND	Not detected at the Reporting Limit (or MDL where applicable).
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.
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
J	The identification of the analyte is acceptable; the reported value is an estimate.

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:
Ramboll - Chicago, IL

333 West Wacker Drive

Suite 2700

Billing Information:
Ruta Deshpande
333 West Wacker Drive

Suite 2700
Chicago, IL 60606

Report To:
Ruta Deshpande / Mike Gibson

Email To:
rdeshpande@ramboll.com

Project Description: Calumet Refinery

City/State Collected: Great Falls MT

Please Circle: PT MT CT ET

Phone:
312-288-3854

Client Project #
1690029636-002 AOC-1

Lab Project #
RAMBOLLCIL-169002963

Collected by (print):
Eric Forssell

Site/Facility ID #

P.O. #

Collected by (signature):
E Forssell

Rush? (Lab MUST Be Notified)
___ Same Day ___ Three Day
___ Next Day ___ Five Day
___ Two Day

Date Results Needed

Sample ID	Can #	Flow Cont. #	Collection Date	Collection Time	Canister Pressure/Vacuum Initial	Canister Pressure/Vacuum Final
CMR-SB01-110723	22127	9527	7/11/23	1400	7/11/23	1420

Analysis

TO-15 Summa				Rem./Contaminant	Sample # (lab only)
X					-01

Chain of Custody Page ___ of ___

Pace
PEOPLE ADVANCING SCIENCE

MT JULIET, TN

12065 Lebanon Road Mt Juliet, TN 37122
Phone: 615-758-5858 Alt: 800-767-5859
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 # L1634467
F212

Acctnum: **RAMBOLLCIL**
Template: **T224808**
Prelogin: **P980900**
PM: **3828 - Jennifer A McCurdy**
PB: CSL 07/13/23
Shipped Via: **FedEx Ground**

Sample Receipt Checklist

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

Remarks:

Relinquished by : (Signature) E Forssell Ramboll	Date: 7/11/23	Time: 1500	Samples returned via: __ UPS X FedEx __ Courier __ _____	Tracking #	Hold #
Relinquished by : (Signature)	Date:	Time:	Received by: (Signature) FedEX	Date: Time:	Condition: (lab use only) OK
Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)	Date: Time:	COC Seal Intact: ___Y ___N ✓NA
			Received for lab by: (Signature) Edward Wilson	Date: 7/12 Time: 0845	NCF:

APPENDIX A2

DUAL-PHASE EXTRACTION EFFLUENT LIQUID ANALYTICAL RESULTS

Pace Lot Number YG12014

Report of Analysis

Ramboll US Corporation
333 West Wacker Drive
Suite 2700
Chicago, IL 60606
Attention: Ruta Deshpande

Project Name: Calumet (CMR) AOC16

Project Number: 1690029636-001

Lot Number:**YG12014**

Date Completed:08/03/2023

08/03/2023 10:20 AM
Approved and released by:
Project Manager II: **Edward Barnett**

The electronic signature above is the equivalent of a handwritten signature.

Pace Analytical Services, LLC (*formerly Shealy Environmental Services, Inc.*)
106 Vantage Point Drive West Columbia, SC 29172
Tel: 803-791-9700 Fax: 803-791-9111 www.pacelabs.com

Case Narrative
Ramboll US Corporation
Lot Number: YG12014

This Report of Analysis contains the analytical result(s) for the sample(s) listed on the Sample Summary following this Case Narrative. The sample receiving date is documented in the header information associated with each sample.

All results listed in this report relate only to the samples that are contained within this report. Where sampling is conducted by the client, results relate to the accuracy of the information provided, and as the samples are received.

Sample receipt, sample analysis, and data review have been performed in accordance with the most current approved The NELAC Institute (TNI) standards, the Pace Analytical Services, LLC ("Pace") Laboratory Quality Manual, standard operating procedures (SOPs), and Pace policies. Any exceptions to the TNI standards, the Laboratory Quality Manual, SOPs or policies are qualified on the results page or discussed below.

Pace is a TNI accredited laboratory; however, the following analyses are currently not listed on our TNI scope of accreditation: Drinking Water: VOC (excluding BTEX, MTBE, Naphthalene, & 1,2-dichloroethane) EPA 524.2, E. coli and Total coliforms SM 9223 B-2004, Solid Chemical Material: TOC Walkley-Black, Biological Tissue: All, Non-Potable Water: SGT-HEM EPA 1664B, Silica EPA 200.7, Boron, Calcium, Silicon, Strontium EPA 200.8, Bicarbonate, Carbonate, and Hydroxide Alkalinity SM 2320 B-2011, SM 9221 C E-2006 & SM 9222D-2006, Strontium SW-846 6010D, VOC SM 6200 B-2011, Fecal Coliform Colilert-18, PFAS by Isotope Dilution SOP.

Pace is a DoD/DoE and TNI accredited laboratory; however, Pace is not accredited for PFAS Direct Aqueous Injection or Method D8421.

If you have any questions regarding this report, please contact the Pace Project Manager listed on the cover page.

VOCs

The laboratory control sample (LCS) for analytical batch 80243 exceeded acceptance criteria for the following analyte: Acetone. This analyte was biased high and was not detected in the sample affected: YG12014-001.

YG12014-001 (CMR-SP200-110723) (Run 1) (Analysis Batch 80243) Full list VOCs

SVOCs

Sample Y12014-001 has been analyzed at a dilution. Dilutions may cause a surrogate(s) to recover outside of method criteria. No corrective action is required as it is known that dilutions of 5X and greater may impact surrogate recoveries. The associated compounds have been qualified with a “Q” accordingly.

Subcontracted Results

EPH and VPH were subcontracted to Pace National for analysis. The results are included after the Pace West Columbia report of analysis.

Sample Summary
Ramboll US Corporation
Lot Number: YG12014
Project Name: Calumet (CMR) AOC16
Project Number: 1690029636-001

Sample Number	Sample ID	Matrix	Date Sampled	Date Received
001	CMR-SP200-110723	Aqueous	07/11/2023 1300	07/12/2023

(1 sample)

Detection Summary
Ramboll US Corporation
Lot Number: YG12014
Project Name: Calumet (CMR) AOC16
Project Number: 1690029636-001

Sample	Sample ID	Matrix	Parameter	Method	Result	Q	Units	Page
001	CMR-SP200-110723	Aqueous	Benzene	8260D	53		ug/L	5
001	CMR-SP200-110723	Aqueous	Cyclohexane	8260D	28		ug/L	5
001	CMR-SP200-110723	Aqueous	Ethylbenzene	8260D	300		ug/L	5
001	CMR-SP200-110723	Aqueous	Isopropylbenzene	8260D	37		ug/L	5
001	CMR-SP200-110723	Aqueous	Methylcyclohexane	8260D	35	J	ug/L	5
001	CMR-SP200-110723	Aqueous	Naphthalene	8260D	430	S	ug/L	5
001	CMR-SP200-110723	Aqueous	Styrene	8260D	17		ug/L	5
001	CMR-SP200-110723	Aqueous	1,1,2,2-Tetrachloroethane	8260D	21		ug/L	5
001	CMR-SP200-110723	Aqueous	Toluene	8260D	29		ug/L	5
001	CMR-SP200-110723	Aqueous	Xylenes (total)	8260D	2100		ug/L	6
001	CMR-SP200-110723	Aqueous	m+p - Xylenes	8260D	1500		ug/L	6
001	CMR-SP200-110723	Aqueous	o - Xylenes	8260D	550		ug/L	6
001	CMR-SP200-110723	Aqueous	1,1'-Biphenyl	8270E	730	QS	ug/L	7
001	CMR-SP200-110723	Aqueous	1-Methylnaphthalene	8270E	2100	QS	ug/L	8
001	CMR-SP200-110723	Aqueous	2-Methylnaphthalene	8270E	4000	QS	ug/L	8
001	CMR-SP200-110723	Aqueous	Naphthalene	8270E	2100	QS	ug/L	8
001	CMR-SP200-110723	Aqueous	Phenanthrene	8270E	350	QS	ug/L	8
001	CMR-SP200-110723	Aqueous	Pyrene	8270E	67	QS	ug/L	8

(18 detections)

Volatile Organic Compounds by GC/MS

Client: **Ramboll US Corporation** Laboratory ID: **YG12014-001**

Description: **CMR-SP200-110723** Matrix: **Aqueous**

Date Sampled: **07/11/2023 1300** Project Name: **Calumet (CMR) AOC16**

Date Received: **07/12/2023** Project Number: **1690029636-001**

Run	Prep Method	Analytical Method	Dilution	Analysis Date	Analyst	Prep Date	Batch
1	5030B	8260D	20	07/18/2023 1905	AMR2		80243

Parameter	CAS Number	Analytical Method	Result	Q	LOQ	DL	Units	Run
Acetone	67-64-1	8260D	ND	L	200	80	ug/L	1
Benzene	**71-43-2**	**8260D**	**53**		**10**	**8.0**	**ug/L**	**1**
Bromochloromethane	74-97-5	8260D	ND		10	8.0	ug/L	1
Bromodichloromethane	75-27-4	8260D	ND		10	8.0	ug/L	1
Bromoform	75-25-2	8260D	ND		10	8.0	ug/L	1
Bromomethane (Methyl bromide)	74-83-9	8260D	ND		10	8.0	ug/L	1
2-Butanone (MEK)	78-93-3	8260D	ND		200	40	ug/L	1
Carbon disulfide	75-15-0	8260D	ND		10	8.0	ug/L	1
Carbon tetrachloride	56-23-5	8260D	ND		10	8.0	ug/L	1
Chlorobenzene	108-90-7	8260D	ND		10	8.0	ug/L	1
Chloroethane	75-00-3	8260D	ND		10	8.0	ug/L	1
Chloroform	67-66-3	8260D	ND		10	8.0	ug/L	1
Chloromethane (Methyl chloride)	74-87-3	8260D	ND		10	8.0	ug/L	1
Cyclohexane	**110-82-7**	**8260D**	**28**		**10**	**8.0**	**ug/L**	**1**
1,2-Dibromo-3-chloropropane (DBCP)	96-12-8	8260D	ND		10	8.0	ug/L	1
Dibromochloromethane	124-48-1	8260D	ND		10	8.0	ug/L	1
1,2-Dibromoethane (EDB)	106-93-4	8260D	ND		10	8.0	ug/L	1
1,2-Dichlorobenzene	95-50-1	8260D	ND		10	8.0	ug/L	1
1,3-Dichlorobenzene	541-73-1	8260D	ND		10	8.0	ug/L	1
1,4-Dichlorobenzene	106-46-7	8260D	ND		10	8.0	ug/L	1
Dichlorodifluoromethane	75-71-8	8260D	ND		10	8.0	ug/L	1
1,1-Dichloroethane	75-34-3	8260D	ND		10	8.0	ug/L	1
1,2-Dichloroethane	107-06-2	8260D	ND		10	8.0	ug/L	1
1,1-Dichloroethene	75-35-4	8260D	ND		10	8.0	ug/L	1
cis-1,2-Dichloroethene	156-59-2	8260D	ND		10	8.0	ug/L	1
trans-1,2-Dichloroethene	156-60-5	8260D	ND		10	8.0	ug/L	1
1,2-Dichloropropane	78-87-5	8260D	ND		10	8.0	ug/L	1
cis-1,3-Dichloropropene	10061-01-5	8260D	ND		10	8.0	ug/L	1
trans-1,3-Dichloropropene	10061-02-6	8260D	ND		10	8.0	ug/L	1
1,4-Dioxane	123-91-1	8260D	ND	S	400	270	ug/L	1
Ethylbenzene	**100-41-4**	**8260D**	**300**		**10**	**8.0**	**ug/L**	**1**
2-Hexanone	591-78-6	8260D	ND		200	40	ug/L	1
Isopropylbenzene	**98-82-8**	**8260D**	**37**		**10**	**8.0**	**ug/L**	**1**
Methyl acetate	79-20-9	8260D	ND		20	8.0	ug/L	1
Methyl tertiary butyl ether (MTBE)	1634-04-4	8260D	ND		10	8.0	ug/L	1
4-Methyl-2-pentanone	108-10-1	8260D	ND		200	40	ug/L	1
Methylcyclohexane	**108-87-2**	**8260D**	**35**	**J**	**100**	**8.0**	**ug/L**	**1**
Methylene chloride	75-09-2	8260D	ND		10	8.0	ug/L	1
Naphthalene	**91-20-3**	**8260D**	**430**	**S**	**10**	**8.0**	**ug/L**	**1**
Styrene	**100-42-5**	**8260D**	**17**		**10**	**8.2**	**ug/L**	**1**
1,1,2,2-Tetrachloroethane	**79-34-5**	**8260D**	**21**		**10**	**8.0**	**ug/L**	**1**
Tetrachloroethene	127-18-4	8260D	ND		10	8.0	ug/L	1
Toluene	**108-88-3**	**8260D**	**29**		**10**	**8.0**	**ug/L**	**1**
1,1,2-Trichloro-1,2,2-Trifluoroethane	76-13-1	8260D	ND		20	8.4	ug/L	1

LOQ = Limit of Quantitation
B = Detected in the method blank
E = Quantitation of compound exceeded the calibration range
DL = Detection Limit
Q = Surrogate failure
ND = Not detected at or above the DL
N = Recovery is out of criteria
P = The RPD between two GC columns exceeds 40%
J = Estimated result < LOQ and ≥ DL
L = LCS/LCSD failure
H = Out of holding time
W = Reported on wet weight basis
S = MS/MSD failure

Pace Analytical Services, LLC *(formerly Shealy Environmental Services, Inc.)*
106 Vantage Point Drive West Columbia, SC 29172 (803) 791-9700 Fax (803) 791-9111 www.pacelabs.com

Volatile Organic Compounds by GC/MS

Client: **Ramboll US Corporation** Laboratory ID: **YG12014-001**

Description: **CMR-SP200-110723** Matrix: **Aqueous**

Date Sampled: **07/11/2023 1300** Project Name: **Calumet (CMR) AOC16**

Date Received: **07/12/2023** Project Number: **1690029636-001**

Run	Prep Method	Analytical Method	Dilution	Analysis Date	Analyst	Prep Date	Batch
1	5030B	8260D	20	07/18/2023 1905	AMR2		80243

Parameter	CAS Number	Analytical Method	Result	Q	LOQ	DL	Units	Run
1,2,3-Trichlorobenzene	87-61-6	8260D	ND		10	8.0	ug/L	1
1,2,4-Trichlorobenzene	120-82-1	8260D	ND		10	8.0	ug/L	1
1,1,1-Trichloroethane	71-55-6	8260D	ND		10	8.0	ug/L	1
1,1,2-Trichloroethane	79-00-5	8260D	ND		10	8.0	ug/L	1
Trichloroethene	79-01-6	8260D	ND		10	8.0	ug/L	1
Trichlorofluoromethane	75-69-4	8260D	ND		10	8.0	ug/L	1
Vinyl chloride	75-01-4	8260D	ND	S	10	8.0	ug/L	1
Xylenes (total)	**1330-20-7**	**8260D**	**2100**		**20**	**8.0**	**ug/L**	**1**
m+p - Xylenes	**179601-23-1**	**8260D**	**1500**		**10**	**8.0**	**ug/L**	**1**
o - Xylenes	**95-47-6**	**8260D**	**550**		**10**	**8.0**	**ug/L**	**1**

Surrogate	Q	Run 1 % Recovery	Acceptance Limits
Bromofluorobenzene		105	70-130
1,2-Dichloroethane-d4		83	70-130
Toluene-d8		92	70-130

LOQ = Limit of Quantitation
ND = Not detected at or above the DL
H = Out of holding time
B = Detected in the method blank
N = Recovery is out of criteria
W = Reported on wet weight basis
E = Quantitation of compound exceeded the calibration range
P = The RPD between two GC columns exceeds 40%
DL = Detection Limit
J = Estimated result < LOQ and ≥ DL
Q = Surrogate failure
L = LCS/LCSD failure
S = MS/MSD failure

Pace Analytical Services, LLC *(formerly Shealy Environmental Services, Inc.)*
106 Vantage Point Drive West Columbia, SC 29172 (803) 791-9700 Fax (803) 791-9111 www.pacelabs.com

Semivolatile Organic Compounds by GC/MS

Client: **Ramboll US Corporation** Laboratory ID: **YG12014-001**

Description: **CMR-SP200-110723** Matrix: **Aqueous**

Date Sampled: **07/11/2023 1300** Project Name: **Calumet (CMR) AOC16**

Date Received: **07/12/2023** Project Number: **1690029636-001**

Run	Prep Method	Analytical Method	Dilution	Analysis Date	Analyst	Prep Date	Batch
1	3520C	8270E	200	07/28/2023 1513	JCG	07/17/2023 1452	80106

Parameter	CAS Number	Analytical Method	Result	Q	LOQ	DL	Units	Run
Acenaphthene	83-32-9	8270E	ND	QS	32	8.0	ug/L	1
Acenaphthylene	208-96-8	8270E	ND	QS	32	8.0	ug/L	1
Acetophenone	98-86-2	8270E	ND	QS	160	46	ug/L	1
Anthracene	120-12-7	8270E	ND	QS	32	8.0	ug/L	1
Atrazine	1912-24-9	8270E	ND	QS	160	40	ug/L	1
Benzaldehyde	100-52-7	8270E	ND	QS	800	54	ug/L	1
Benzo(a)anthracene	56-55-3	8270E	ND	QS	32	8.0	ug/L	1
Benzo(a)pyrene	50-32-8	8270E	ND	QS	32	8.0	ug/L	1
Benzo(b)fluoranthene	205-99-2	8270E	ND	QS	32	8.0	ug/L	1
Benzo(g,h,i)perylene	191-24-2	8270E	ND	QS	32	8.0	ug/L	1
Benzo(k)fluoranthene	207-08-9	8270E	ND	QS	32	8.0	ug/L	1
1,1'-Biphenyl	**92-52-4**	**8270E**	**730**	**QS**	**160**	**42**	**ug/L**	**1**
4-Bromophenyl phenyl ether	101-55-3	8270E	ND	QS	160	30	ug/L	1
Butyl benzyl phthalate	85-68-7	8270E	ND	QS	800	42	ug/L	1
Caprolactam	105-60-2	8270E	ND	QS	800	140	ug/L	1
Carbazole	86-74-8	8270E	ND	QS	160	8.0	ug/L	1
bis (2-Chloro-1-methylethyl) ether	108-60-1	8270E	ND	QS	160	34	ug/L	1
4-Chloro-3-methyl phenol	59-50-7	8270E	ND	QS	160	52	ug/L	1
4-Chloroaniline	106-47-8	8270E	ND	QS	160	26	ug/L	1
bis(2-Chloroethoxy)methane	111-91-1	8270E	ND	QS	160	12	ug/L	1
bis(2-Chloroethyl)ether	111-44-4	8270E	ND	QS	160	32	ug/L	1
2-Chloronaphthalene	91-58-7	8270E	ND	QS	160	30	ug/L	1
2-Chlorophenol	95-57-8	8270E	ND	QS	160	30	ug/L	1
4-Chlorophenyl phenyl ether	7005-72-3	8270E	ND	QS	160	32	ug/L	1
Chrysene	218-01-9	8270E	ND	QS	32	8.0	ug/L	1
Dibenzo(a,h)anthracene	53-70-3	8270E	ND	QS	32	8.0	ug/L	1
Dibenzofuran	132-64-9	8270E	ND	QS	160	32	ug/L	1
3,3'-Dichlorobenzidine	91-94-1	8270E	ND	QS	800	160	ug/L	1
2,4-Dichlorophenol	120-83-2	8270E	ND	QS	160	38	ug/L	1
Diethylphthalate	84-66-2	8270E	ND	QS	800	38	ug/L	1
Dimethyl phthalate	131-11-3	8270E	ND	QS	800	36	ug/L	1
2,4-Dimethylphenol	105-67-9	8270E	ND	QS	160	30	ug/L	1
Di-n-butyl phthalate	84-74-2	8270E	ND	QS	800	84	ug/L	1
4,6-Dinitro-2-methylphenol	534-52-1	8270E	ND	QS	800	180	ug/L	1
2,4-Dinitrophenol	51-28-5	8270E	ND	QS	800	260	ug/L	1
2,4-Dinitrotoluene	121-14-2	8270E	ND	QS	320	72	ug/L	1
2,6-Dinitrotoluene	606-20-2	8270E	ND	QS	320	68	ug/L	1
Di-n-octylphthalate	117-84-0	8270E	ND	QS	800	96	ug/L	1
bis(2-Ethylhexyl)phthalate	117-81-7	8270E	ND	QS	800	300	ug/L	1
Fluoranthene	206-44-0	8270E	ND	QS	32	8.0	ug/L	1
Fluorene	86-73-7	8270E	ND	QS	32	8.0	ug/L	1
Hexachlorobenzene	118-74-1	8270E	ND	QS	160	30	ug/L	1
Hexachlorobutadiene	87-68-3	8270E	ND	QS	160	34	ug/L	1
Hexachlorocyclopentadiene	77-47-4	8270E	ND	QS	800	220	ug/L	1

LOQ = Limit of Quantitation
B = Detected in the method blank
E = Quantitation of compound exceeded the calibration range
DL = Detection Limit
Q = Surrogate failure
ND = Not detected at or above the DL
N = Recovery is out of criteria
P = The RPD between two GC columns exceeds 40%
J = Estimated result < LOQ and ≥ DL
L = LCS/LCSD failure
H = Out of holding time
W = Reported on wet weight basis
S = MS/MSD failure

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Semivolatile Organic Compounds by GC/MS

Client: **Ramboll US Corporation** Laboratory ID: **YG12014-001**

Description: **CMR-SP200-110723** Matrix: **Aqueous**

Date Sampled: **07/11/2023 1300** Project Name: **Calumet (CMR) AOC16**

Date Received: **07/12/2023** Project Number: **1690029636-001**

Run	Prep Method	Analytical Method	Dilution	Analysis Date	Analyst	Prep Date	Batch
1	3520C	8270E	200	07/28/2023 1513	JCG	07/17/2023 1452	80106

Parameter	CAS Number	Analytical Method	Result	Q	LOQ	DL	Units	Run
Hexachloroethane	67-72-1	8270E	ND	QS	160	34	ug/L	1
Indeno(1,2,3-c,d)pyrene	193-39-5	8270E	ND	QS	32	8.0	ug/L	1
Isophorone	78-59-1	8270E	ND	QS	160	44	ug/L	1
1-Methylnaphthalene	**90-12-0**	**8270E**	**2100**	**QS**	**32**	**8.0**	**ug/L**	**1**
2-Methylnaphthalene	**91-57-6**	**8270E**	**4000**	**QS**	**32**	**8.0**	**ug/L**	**1**
2-Methylphenol	95-48-7	8270E	ND	QS	160	42	ug/L	1
3+4-Methylphenol	106-44-5	8270E	ND	QS	320	92	ug/L	1
Naphthalene	**91-20-3**	**8270E**	**2100**	**QS**	**32**	**8.0**	**ug/L**	**1**
2-Nitroaniline	88-74-4	8270E	ND	QS	320	130	ug/L	1
3-Nitroaniline	99-09-2	8270E	ND	QS	320	30	ug/L	1
4-Nitroaniline	100-01-6	8270E	ND	QS	320	260	ug/L	1
Nitrobenzene	98-95-3	8270E	ND	QS	160	34	ug/L	1
2-Nitrophenol	88-75-5	8270E	ND	QS	320	88	ug/L	1
4-Nitrophenol	100-02-7	8270E	ND	QS	800	420	ug/L	1
N-Nitrosodi-n-propylamine	621-64-7	8270E	ND	QS	160	56	ug/L	1
N-Nitrosodiphenylamine (Diphenylamine)	86-30-6	8270E	ND	QS	160	100	ug/L	1
Pentachlorophenol	87-86-5	8270E	ND	QS	800	270	ug/L	1
Phenanthrene	**85-01-8**	**8270E**	**350**	**QS**	**32**	**8.0**	**ug/L**	**1**
Phenol	108-95-2	8270E	ND	QS	160	38	ug/L	1
Pyrene	**129-00-0**	**8270E**	**67**	**QS**	**32**	**8.0**	**ug/L**	**1**
2,4,5-Trichlorophenol	95-95-4	8270E	ND	QS	160	38	ug/L	1
2,4,6-Trichlorophenol	88-06-2	8270E	ND	QS	160	44	ug/L	1

Surrogate	Q	Run 1 % Recovery	Acceptance Limits
2-Fluorobiphenyl	N	0.00	37-129
2-Fluorophenol		64	24-127
Nitrobenzene-d5	N	2520	38-127
Phenol-d5	N	1050	28-128
Terphenyl-d14		130	10-148
2,4,6-Tribromophenol	N	0.00	35-144

LOQ = Limit of Quantitation
B = Detected in the method blank
E = Quantitation of compound exceeded the calibration range
DL = Detection Limit
Q = Surrogate failure
ND = Not detected at or above the DL
N = Recovery is out of criteria
P = The RPD between two GC columns exceeds 40%
J = Estimated result < LOQ and ≥ DL
L = LCS/LCSD failure
H = Out of holding time
W = Reported on wet weight basis
S = MS/MSD failure

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QC Summary

Volatile Organic Compounds by GC/MS - MB

Sample ID: YQ80243-001
Batch: 80243
Analytical Method: 8260D

Matrix: Aqueous
Prep Method: 5030B

Parameter	Result	Q	Dil	LOQ	DL	Units	Analysis Date
Acetone	ND		1	10	4.0	ug/L	07/18/2023 1132
Benzene	ND		1	0.50	0.40	ug/L	07/18/2023 1132
Bromochloromethane	ND		1	0.50	0.40	ug/L	07/18/2023 1132
Bromodichloromethane	ND		1	0.50	0.40	ug/L	07/18/2023 1132
Bromoform	ND		1	0.50	0.40	ug/L	07/18/2023 1132
Bromomethane (Methyl bromide)	ND		1	0.50	0.40	ug/L	07/18/2023 1132
2-Butanone (MEK)	ND		1	10	2.0	ug/L	07/18/2023 1132
Carbon disulfide	ND		1	0.50	0.40	ug/L	07/18/2023 1132
Carbon tetrachloride	ND		1	0.50	0.40	ug/L	07/18/2023 1132
Chlorobenzene	ND		1	0.50	0.40	ug/L	07/18/2023 1132
Chloroethane	ND		1	0.50	0.40	ug/L	07/18/2023 1132
Chloroform	ND		1	0.50	0.40	ug/L	07/18/2023 1132
Chloromethane (Methyl chloride)	ND		1	0.50	0.40	ug/L	07/18/2023 1132
Cyclohexane	ND		1	0.50	0.40	ug/L	07/18/2023 1132
1,2-Dibromo-3-chloropropane (DBCP)	ND		1	0.50	0.40	ug/L	07/18/2023 1132
Dibromochloromethane	ND		1	0.50	0.40	ug/L	07/18/2023 1132
1,2-Dibromoethane (EDB)	ND		1	0.50	0.40	ug/L	07/18/2023 1132
1,2-Dichlorobenzene	ND		1	0.50	0.40	ug/L	07/18/2023 1132
1,3-Dichlorobenzene	ND		1	0.50	0.40	ug/L	07/18/2023 1132
1,4-Dichlorobenzene	ND		1	0.50	0.40	ug/L	07/18/2023 1132
Dichlorodifluoromethane	ND		1	0.50	0.40	ug/L	07/18/2023 1132
1,1-Dichloroethane	ND		1	0.50	0.40	ug/L	07/18/2023 1132
1,2-Dichloroethane	ND		1	0.50	0.40	ug/L	07/18/2023 1132
1,1-Dichloroethene	ND		1	0.50	0.40	ug/L	07/18/2023 1132
cis-1,2-Dichloroethene	ND		1	0.50	0.40	ug/L	07/18/2023 1132
trans-1,2-Dichloroethene	ND		1	0.50	0.40	ug/L	07/18/2023 1132
1,2-Dichloropropane	ND		1	0.50	0.40	ug/L	07/18/2023 1132
cis-1,3-Dichloropropene	ND		1	0.50	0.40	ug/L	07/18/2023 1132
trans-1,3-Dichloropropene	ND		1	0.50	0.40	ug/L	07/18/2023 1132
1,4-Dioxane	ND		1	20	13	ug/L	07/18/2023 1132
Ethylbenzene	ND		1	0.50	0.40	ug/L	07/18/2023 1132
2-Hexanone	ND		1	10	2.0	ug/L	07/18/2023 1132
Isopropylbenzene	ND		1	0.50	0.40	ug/L	07/18/2023 1132
Methyl acetate	ND		1	1.0	0.40	ug/L	07/18/2023 1132
Methyl tertiary butyl ether (MTBE)	ND		1	0.50	0.40	ug/L	07/18/2023 1132
4-Methyl-2-pentanone	ND		1	10	2.0	ug/L	07/18/2023 1132
Methylcyclohexane	ND		1	5.0	0.40	ug/L	07/18/2023 1132
Methylene chloride	ND		1	0.50	0.40	ug/L	07/18/2023 1132
Naphthalene	ND		1	0.50	0.40	ug/L	07/18/2023 1132
Styrene	ND		1	0.50	0.41	ug/L	07/18/2023 1132
1,1,2,2-Tetrachloroethane	ND		1	0.50	0.40	ug/L	07/18/2023 1132
Tetrachloroethene	ND		1	0.50	0.40	ug/L	07/18/2023 1132
Toluene	ND		1	0.50	0.40	ug/L	07/18/2023 1132
1,1,2-Trichloro-1,2,2-Trifluoroethane	ND		1	1.0	0.42	ug/L	07/18/2023 1132

LOQ = Limit of Quantitation
DL = Detection Limit
ND = Not detected at or above the DL
J = Estimated result < LOQ and ≥ DL
* = RSD is out of criteria
N = Recovery is out of criteria
P = The RPD between two GC columns exceeds 40%
+ = RPD is out of criteria

Note: Calculations are performed before rounding to avoid round-off errors in calculated results

Volatile Organic Compounds by GC/MS - MB

Sample ID: YQ80243-001
Batch: 80243
Analytical Method: 8260D
Matrix: Aqueous
Prep Method: 5030B

Parameter	Result	Q	Dil	LOQ	DL	Units	Analysis Date
1,2,3-Trichlorobenzene	ND		1	0.50	0.40	ug/L	07/18/2023 1132
1,2,4-Trichlorobenzene	ND		1	0.50	0.40	ug/L	07/18/2023 1132
1,1,1-Trichloroethane	ND		1	0.50	0.40	ug/L	07/18/2023 1132
1,1,2-Trichloroethane	ND		1	0.50	0.40	ug/L	07/18/2023 1132
Trichloroethene	ND		1	0.50	0.40	ug/L	07/18/2023 1132
Trichlorofluoromethane	ND		1	0.50	0.40	ug/L	07/18/2023 1132
Vinyl chloride	ND		1	0.50	0.40	ug/L	07/18/2023 1132
Xylenes (total)	ND		1	1.0	0.40	ug/L	07/18/2023 1132
m+p - Xylenes	ND		1	0.50	0.40	ug/L	07/18/2023 1132
o - Xylenes	ND		1	0.50	0.40	ug/L	07/18/2023 1132

Surrogate	Q	% Rec	Acceptance Limit
Bromofluorobenzene		102	70-130
1,2-Dichloroethane-d4		84	70-130
Toluene-d8		94	70-130

LOQ = Limit of Quantitation
DL = Detection Limit
ND = Not detected at or above the DL
J = Estimated result < LOQ and ≥ DL
* = RSD is out of criteria
N = Recovery is out of criteria
P = The RPD between two GC columns exceeds 40%
+ = RPD is out of criteria

Note: Calculations are performed before rounding to avoid round-off errors in calculated results

Volatile Organic Compounds by GC/MS - LCS

Sample ID: YQ80243-002
Batch: 80243
Analytical Method: 8260D

Matrix: Aqueous
Prep Method: 5030B

Parameter	Spike Amount (ug/L)	Result (ug/L)	Q	Dil	% Rec	%Rec Limit	Analysis Date
Acetone	100	170	N	1	165	60-140	07/18/2023 0958
Benzene	50	46		1	91	70-130	07/18/2023 0958
Bromochloromethane	50	45		1	89	70-130	07/18/2023 0958
Bromodichloromethane	50	47		1	95	70-130	07/18/2023 0958
Bromoform	50	53		1	105	70-130	07/18/2023 0958
Bromomethane (Methyl bromide)	50	48		1	95	70-130	07/18/2023 0958
2-Butanone (MEK)	100	130		1	127	70-130	07/18/2023 0958
Carbon disulfide	50	48		1	96	70-130	07/18/2023 0958
Carbon tetrachloride	50	46		1	91	70-130	07/18/2023 0958
Chlorobenzene	50	47		1	95	70-130	07/18/2023 0958
Chloroethane	50	49		1	97	70-130	07/18/2023 0958
Chloroform	50	43		1	86	70-130	07/18/2023 0958
Chloromethane (Methyl chloride)	50	53		1	107	60-140	07/18/2023 0958
Cyclohexane	50	44		1	87	70-130	07/18/2023 0958
1,2-Dibromo-3-chloropropane (DBCP)	50	58		1	115	70-130	07/18/2023 0958
Dibromochloromethane	50	56		1	113	70-130	07/18/2023 0958
1,2-Dibromoethane (EDB)	50	50		1	100	70-130	07/18/2023 0958
1,2-Dichlorobenzene	50	48		1	97	70-130	07/18/2023 0958
1,3-Dichlorobenzene	50	50		1	99	70-130	07/18/2023 0958
1,4-Dichlorobenzene	50	47		1	94	70-130	07/18/2023 0958
Dichlorodifluoromethane	50	49		1	98	60-140	07/18/2023 0958
1,1-Dichloroethane	50	43		1	86	70-130	07/18/2023 0958
1,2-Dichloroethane	50	45		1	89	70-130	07/18/2023 0958
1,1-Dichloroethene	50	48		1	96	70-130	07/18/2023 0958
cis-1,2-Dichloroethene	50	44		1	89	70-130	07/18/2023 0958
trans-1,2-Dichloroethene	50	45		1	89	70-130	07/18/2023 0958
1,2-Dichloropropane	50	46		1	91	70-130	07/18/2023 0958
cis-1,3-Dichloropropene	50	42		1	85	70-130	07/18/2023 0958
trans-1,3-Dichloropropene	50	50		1	101	70-130	07/18/2023 0958
1,4-Dioxane	500	470		1	95	60-140	07/18/2023 0958
Ethylbenzene	50	50		1	100	70-130	07/18/2023 0958
2-Hexanone	100	110		1	111	70-130	07/18/2023 0958
Isopropylbenzene	50	53		1	107	70-130	07/18/2023 0958
Methyl acetate	50	47		1	94	70-130	07/18/2023 0958
Methyl tertiary butyl ether (MTBE)	50	44		1	89	70-130	07/18/2023 0958
4-Methyl-2-pentanone	100	95		1	95	70-130	07/18/2023 0958
Methylcyclohexane	50	43		1	87	70-130	07/18/2023 0958
Methylene chloride	50	42		1	84	70-130	07/18/2023 0958
Naphthalene	50	60		1	119	70-130	07/18/2023 0958
Styrene	50	53		1	107	70-130	07/18/2023 0958
1,1,2,2-Tetrachloroethane	50	48		1	97	70-130	07/18/2023 0958
Tetrachloroethene	50	51		1	101	70-130	07/18/2023 0958
Toluene	50	51		1	102	70-130	07/18/2023 0958
1,1,2-Trichloro-1,2,2-Trifluoroethane	50	48		1	96	70-130	07/18/2023 0958

LOQ = Limit of Quantitation
DL = Detection Limit
ND = Not detected at or above the DL
J = Estimated result < LOQ and ≥ DL
* = RSD is out of criteria
N = Recovery is out of criteria
P = The RPD between two GC columns exceeds 40%
+ = RPD is out of criteria

Note: Calculations are performed before rounding to avoid round-off errors in calculated results

Volatile Organic Compounds by GC/MS - LCS

Sample ID: YQ80243-002
Batch: 80243
Analytical Method: 8260D
Matrix: Aqueous
Prep Method: 5030B

Parameter	Spike Amount (ug/L)	Result (ug/L)	Q	Dil	% Rec	%Rec Limit	Analysis Date
1,2,3-Trichlorobenzene	50	55		1	111	70-130	07/18/2023 0958
1,2,4-Trichlorobenzene	50	57		1	113	70-130	07/18/2023 0958
1,1,1-Trichloroethane	50	45		1	89	70-130	07/18/2023 0958
1,1,2-Trichloroethane	50	49		1	98	70-130	07/18/2023 0958
Trichloroethene	50	46		1	92	70-130	07/18/2023 0958
Trichlorofluoromethane	50	50		1	99	70-130	07/18/2023 0958
Vinyl chloride	50	60		1	120	70-130	07/18/2023 0958
Xylenes (total)	100	100		1	102	70-130	07/18/2023 0958
m+p - Xylenes	50	51		1	102	70-130	07/18/2023 0958
o - Xylenes	50	51		1	103	70-130	07/18/2023 0958

Surrogate	Q	% Rec	Acceptance Limit
Bromofluorobenzene		95	70-130
1,2-Dichloroethane-d4		78	70-130
Toluene-d8		92	70-130

LOQ = Limit of Quantitation
DL = Detection Limit
ND = Not detected at or above the DL
J = Estimated result < LOQ and ≥ DL
* = RSD is out of criteria
N = Recovery is out of criteria
P = The RPD between two GC columns exceeds 40%
+ = RPD is out of criteria

Note: Calculations are performed before rounding to avoid round-off errors in calculated results

Volatile Organic Compounds by GC/MS - MS

Sample ID: YG12014-001MS
Batch: 80243
Analytical Method: 8260D

Matrix: Aqueous
Prep Method: 5030B

Parameter	Sample Amount (ug/L)	Spike Amount (ug/L)	Result (ug/L)	Q	Dil	% Rec	%Rec Limit	Analysis Date
Acetone	ND	2000	1300		20	65	60-140	07/18/2023 1928
Benzene	53	1000	1100		20	100	70-130	07/18/2023 1928
Bromochloromethane	ND	1000	950		20	95	70-130	07/18/2023 1928
Bromodichloromethane	ND	1000	990		20	99	70-130	07/18/2023 1928
Bromoform	ND	1000	930		20	93	70-130	07/18/2023 1928
Bromomethane (Methyl bromide)	ND	1000	1100		20	109	70-130	07/18/2023 1928
2-Butanone (MEK)	ND	2000	1700		20	85	70-130	07/18/2023 1928
Carbon disulfide	ND	1000	1100		20	108	70-130	07/18/2023 1928
Carbon tetrachloride	ND	1000	1000		20	101	70-130	07/18/2023 1928
Chlorobenzene	ND	1000	1000		20	102	70-130	07/18/2023 1928
Chloroethane	ND	1000	1000		20	102	70-130	07/18/2023 1928
Chloroform	ND	1000	960		20	96	70-130	07/18/2023 1928
Chloromethane (Methyl chloride)	ND	1000	1200		20	119	60-140	07/18/2023 1928
Cyclohexane	28	1000	1000		20	99	70-130	07/18/2023 1928
1,2-Dibromo-3-chloropropane (DBCP)	ND	1000	1100		20	113	70-130	07/18/2023 1928
Dibromochloromethane	ND	1000	1100		20	109	70-130	07/18/2023 1928
1,2-Dibromoethane (EDB)	ND	1000	1000		20	103	70-130	07/18/2023 1928
1,2-Dichlorobenzene	ND	1000	1000		20	102	70-130	07/18/2023 1928
1,3-Dichlorobenzene	ND	1000	1000		20	104	70-130	07/18/2023 1928
1,4-Dichlorobenzene	ND	1000	980		20	98	70-130	07/18/2023 1928
Dichlorodifluoromethane	ND	1000	1000		20	101	60-140	07/18/2023 1928
1,1-Dichloroethane	ND	1000	980		20	98	70-130	07/18/2023 1928
1,2-Dichloroethane	ND	1000	980		20	98	70-130	07/18/2023 1928
1,1-Dichloroethene	ND	1000	1100		20	114	70-130	07/18/2023 1928
cis-1,2-Dichloroethene	ND	1000	970		20	97	70-130	07/18/2023 1928
trans-1,2-Dichloroethene	ND	1000	1000		20	103	70-130	07/18/2023 1928
1,2-Dichloropropane	ND	1000	980		20	98	70-130	07/18/2023 1928
cis-1,3-Dichloropropene	ND	1000	840		20	84	70-130	07/18/2023 1928
trans-1,3-Dichloropropene	ND	1000	1000		20	102	70-130	07/18/2023 1928
1,4-Dioxane	ND	10000	5500	N	20	55	60-140	07/18/2023 1928
Ethylbenzene	300	1000	1400		20	110	70-130	07/18/2023 1928
2-Hexanone	ND	2000	2100		20	103	70-130	07/18/2023 1928
Isopropylbenzene	37	1000	1100		20	109	70-130	07/18/2023 1928
Methyl acetate	ND	1000	830		20	83	70-130	07/18/2023 1928
Methyl tertiary butyl ether (MTBE)	ND	1000	890		20	89	70-130	07/18/2023 1928
4-Methyl-2-pentanone	ND	2000	1800		20	92	70-130	07/18/2023 1928
Methylcyclohexane	35	1000	900		20	87	70-130	07/18/2023 1928
Methylene chloride	ND	1000	930		20	93	70-130	07/18/2023 1928
Naphthalene	430	1000	1800	N	20	134	70-130	07/18/2023 1928
Styrene	17	1000	1200		20	114	70-130	07/18/2023 1928
1,1,2,2-Tetrachloroethane	21	1000	1000		20	98	70-130	07/18/2023 1928
Tetrachloroethene	ND	1000	1100		20	109	70-130	07/18/2023 1928
Toluene	29	1000	1100		20	111	70-130	07/18/2023 1928
1,1,2-Trichloro-1,2,2-Trifluoroethane	ND	1000	1100		20	112	70-130	07/18/2023 1928

LOQ = Limit of Quantitation
DL = Detection Limit
ND = Not detected at or above the DL
J = Estimated result < LOQ and ≥ DL
* = RSD is out of criteria
N = Recovery is out of criteria
P = The RPD between two GC columns exceeds 40%
+ = RPD is out of criteria

Note: Calculations are performed before rounding to avoid round-off errors in calculated results

Volatile Organic Compounds by GC/MS - MS

Sample ID: YG12014-001MS
Batch: 80243
Analytical Method: 8260D

Matrix: Aqueous
Prep Method: 5030B

Parameter	Sample Amount (ug/L)	Spike Amount (ug/L)	Result (ug/L)	Q	Dil	% Rec	%Rec Limit	Analysis Date
1,2,3-Trichlorobenzene	ND	1000	1100		20	114	70-130	07/18/2023 1928
1,2,4-Trichlorobenzene	ND	1000	1100		20	112	70-130	07/18/2023 1928
1,1,1-Trichloroethane	ND	1000	1000		20	103	70-130	07/18/2023 1928
1,1,2-Trichloroethane	ND	1000	1000		20	101	70-130	07/18/2023 1928
Trichloroethene	ND	1000	1000		20	105	70-130	07/18/2023 1928
Trichlorofluoromethane	ND	1000	1100		20	107	70-130	07/18/2023 1928
Vinyl chloride	ND	1000	1400	N	20	138	70-130	07/18/2023 1928
Xylenes (total)	2100	2000	4300		20	112	70-130	07/18/2023 1928
m+p - Xylenes	1500	1000	2700		20	114	70-130	07/18/2023 1928
o - Xylenes	550	1000	1700		20	110	70-130	07/18/2023 1928

Surrogate	Q	% Rec	Acceptance Limit
Bromofluorobenzene		109	70-130
1,2-Dichloroethane-d4		87	70-130
Toluene-d8		104	70-130

LOQ = Limit of Quantitation
DL = Detection Limit
ND = Not detected at or above the DL
J = Estimated result < LOQ and ≥ DL
* = RSD is out of criteria
N = Recovery is out of criteria
P = The RPD between two GC columns exceeds 40%
+ = RPD is out of criteria

Note: Calculations are performed before rounding to avoid round-off errors in calculated results

Volatile Organic Compounds by GC/MS - MSD

Sample ID: YG12014-001MD
Batch: 80243
Analytical Method: 8260D
Matrix: Aqueous
Prep Method: 5030B

Parameter	Sample Amount (ug/L)	Spike Amount (ug/L)	Result (ug/L)	Q	Dil	% Rec	% RPD	%Rec Limit	% RPD Limit	Analysis Date
Acetone	ND	2000	1600	+	20	80	21	60-140	20	07/18/2023 1951
Benzene	53	1000	1100		20	104	2.9	70-130	20	07/18/2023 1951
Bromochloromethane	ND	1000	970		20	97	1.4	70-130	20	07/18/2023 1951
Bromodichloromethane	ND	1000	1000		20	102	2.9	70-130	20	07/18/2023 1951
Bromoform	ND	1000	920		20	92	1.8	70-130	20	07/18/2023 1951
Bromomethane (Methyl bromide)	ND	1000	1100		20	111	1.4	70-130	20	07/18/2023 1951
2-Butanone (MEK)	ND	2000	2000		20	98	14	70-130	20	07/18/2023 1951
Carbon disulfide	ND	1000	1100		20	108	0.85	70-130	20	07/18/2023 1951
Carbon tetrachloride	ND	1000	1000		20	104	3.4	70-130	20	07/18/2023 1951
Chlorobenzene	ND	1000	1000		20	101	1.1	70-130	20	07/18/2023 1951
Chloroethane	ND	1000	1000		20	105	2.7	70-130	20	07/18/2023 1951
Chloroform	ND	1000	990		20	99	3.2	70-130	20	07/18/2023 1951
Chloromethane (Methyl chloride)	ND	1000	1300		20	128	7.7	60-140	20	07/18/2023 1951
Cyclohexane	28	1000	1100		20	107	8.0	70-130	20	07/18/2023 1951
1,2-Dibromo-3-chloropropane (DBCP)	ND	1000	1200		20	124	9.2	70-130	20	07/18/2023 1951
Dibromochloromethane	ND	1000	1100		20	112	2.6	70-130	20	07/18/2023 1951
1,2-Dibromoethane (EDB)	ND	1000	1000		20	104	1.4	70-130	20	07/18/2023 1951
1,2-Dichlorobenzene	ND	1000	1000		20	103	0.79	70-130	20	07/18/2023 1951
1,3-Dichlorobenzene	ND	1000	1000		20	104	0.47	70-130	20	07/18/2023 1951
1,4-Dichlorobenzene	ND	1000	980		20	98	0.75	70-130	20	07/18/2023 1951
Dichlorodifluoromethane	ND	1000	1000		20	105	3.9	60-140	20	07/18/2023 1951
1,1-Dichloroethane	ND	1000	1000		20	103	5.1	70-130	20	07/18/2023 1951
1,2-Dichloroethane	ND	1000	1000		20	100	2.7	70-130	20	07/18/2023 1951
1,1-Dichloroethene	ND	1000	1100		20	113	1.4	70-130	20	07/18/2023 1951
cis-1,2-Dichloroethene	ND	1000	1000		20	103	5.4	70-130	20	07/18/2023 1951
trans-1,2-Dichloroethene	ND	1000	1000		20	104	1.3	70-130	20	07/18/2023 1951
1,2-Dichloropropane	ND	1000	1000		20	100	2.5	70-130	20	07/18/2023 1951
cis-1,3-Dichloropropene	ND	1000	870		20	87	3.1	70-130	20	07/18/2023 1951
trans-1,3-Dichloropropene	ND	1000	1100		20	106	4.0	70-130	20	07/18/2023 1951
1,4-Dioxane	ND	10000	6200		20	62	12	60-140	20	07/18/2023 1951
Ethylbenzene	300	1000	1400		20	113	2.2	70-130	20	07/18/2023 1951
2-Hexanone	ND	2000	2300		20	113	9.0	70-130	20	07/18/2023 1951
Isopropylbenzene	37	1000	1100		20	109	0.30	70-130	20	07/18/2023 1951
Methyl acetate	ND	1000	920		20	92	9.7	70-130	20	07/18/2023 1951
Methyl tertiary butyl ether (MTBE)	ND	1000	950		20	95	6.1	70-130	20	07/18/2023 1951
4-Methyl-2-pentanone	ND	2000	2000		20	101	9.4	70-130	20	07/18/2023 1951
Methylcyclohexane	35	1000	900		20	86	0.94	70-130	20	07/18/2023 1951
Methylene chloride	ND	1000	940		20	94	0.67	70-130	20	07/18/2023 1951
Naphthalene	430	1000	1900	N	20	143	5.3	70-130	20	07/18/2023 1951
Styrene	17	1000	1100		20	111	2.8	70-130	20	07/18/2023 1951
1,1,2,2-Tetrachloroethane	21	1000	1100		20	105	6.8	70-130	20	07/18/2023 1951
Tetrachloroethene	ND	1000	1100		20	107	1.6	70-130	20	07/18/2023 1951
Toluene	29	1000	1100		20	111	0.12	70-130	20	07/18/2023 1951
1,1,2-Trichloro-1,2,2-Trifluoroethane	ND	1000	1100		20	111	0.41	70-130	20	07/18/2023 1951

LOQ = Limit of Quantitation
DL = Detection Limit
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* = RSD is out of criteria
N = Recovery is out of criteria
P = The RPD between two GC columns exceeds 40%
+ = RPD is out of criteria

Note: Calculations are performed before rounding to avoid round-off errors in calculated results

Volatile Organic Compounds by GC/MS - MSD

Sample ID: YG12014-001MD
Batch: 80243
Analytical Method: 8260D
Matrix: Aqueous
Prep Method: 5030B

Parameter	Sample Amount (ug/L)	Spike Amount (ug/L)	Result (ug/L)	Q	Dil	% Rec	% RPD	%Rec Limit	% RPD Limit	Analysis Date
1,2,3-Trichlorobenzene	ND	1000	1100		20	113	0.36	70-130	20	07/18/2023 1951
1,2,4-Trichlorobenzene	ND	1000	1100		20	112	0.053	70-130	20	07/18/2023 1951
1,1,1-Trichloroethane	ND	1000	1100		20	106	3.2	70-130	20	07/18/2023 1951
1,1,2-Trichloroethane	ND	1000	1000		20	105	3.2	70-130	20	07/18/2023 1951
Trichloroethene	ND	1000	1000		20	103	1.6	70-130	20	07/18/2023 1951
Trichlorofluoromethane	ND	1000	1100		20	109	1.9	70-130	20	07/18/2023 1951
Vinyl chloride	ND	1000	1500	N	20	151	9.1	70-130	20	07/18/2023 1951
Xylenes (total)	2100	2000	4500		20	121	3.9	70-130	20	07/18/2023 1951
m+p - Xylenes	1500	1000	2800		20	126	4.5	70-130	20	07/18/2023 1951
o - Xylenes	550	1000	1700		20	115	3.0	70-130	20	07/18/2023 1951

Surrogate	Q	% Rec	Acceptance Limit
Bromofluorobenzene		108	70-130
1,2-Dichloroethane-d4		90	70-130
Toluene-d8		106	70-130

LOQ = Limit of Quantitation
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ND = Not detected at or above the DL
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Note: Calculations are performed before rounding to avoid round-off errors in calculated results

Semivolatile Organic Compounds by GC/MS - MB

Sample ID: YQ80106-001
Batch: 80106
Analytical Method: 8270E
Matrix: Aqueous
Prep Method: 3520C
Prep Date: 07/17/2023 1452

Parameter	Result	Q	Dil	LOQ	DL	Units	Analysis Date
Acenaphthene	ND		1	0.16	0.040	ug/L	07/28/2023 1233
Acenaphthylene	ND		1	0.16	0.040	ug/L	07/28/2023 1233
Acetophenone	ND		1	0.80	0.23	ug/L	07/28/2023 1233
Anthracene	ND		1	0.16	0.040	ug/L	07/28/2023 1233
Atrazine	ND		1	0.80	0.20	ug/L	07/28/2023 1233
Benzaldehyde	ND		1	4.0	0.27	ug/L	07/28/2023 1233
Benzo(a)anthracene	ND		1	0.16	0.040	ug/L	07/28/2023 1233
Benzo(a)pyrene	ND		1	0.16	0.040	ug/L	07/28/2023 1233
Benzo(b)fluoranthene	ND		1	0.16	0.040	ug/L	07/28/2023 1233
Benzo(g,h,i)perylene	ND		1	0.16	0.040	ug/L	07/28/2023 1233
Benzo(k)fluoranthene	ND		1	0.16	0.040	ug/L	07/28/2023 1233
1,1'-Biphenyl	ND		1	0.80	0.21	ug/L	07/28/2023 1233
4-Bromophenyl phenyl ether	ND		1	0.80	0.15	ug/L	07/28/2023 1233
Butyl benzyl phthalate	ND		1	4.0	0.21	ug/L	07/28/2023 1233
Caprolactam	**0.72**	**J**	**1**	**4.0**	**0.71**	**ug/L**	**07/28/2023 1233**
Carbazole	ND		1	0.80	0.040	ug/L	07/28/2023 1233
bis (2-Chloro-1-methylethyl) ether	ND		1	0.80	0.17	ug/L	07/28/2023 1233
4-Chloro-3-methyl phenol	ND		1	0.80	0.26	ug/L	07/28/2023 1233
4-Chloroaniline	ND		1	0.80	0.13	ug/L	07/28/2023 1233
bis(2-Chloroethoxy)methane	ND		1	0.80	0.060	ug/L	07/28/2023 1233
bis(2-Chloroethyl)ether	ND		1	0.80	0.16	ug/L	07/28/2023 1233
2-Chloronaphthalene	ND		1	0.80	0.15	ug/L	07/28/2023 1233
2-Chlorophenol	ND		1	0.80	0.15	ug/L	07/28/2023 1233
4-Chlorophenyl phenyl ether	ND		1	0.80	0.16	ug/L	07/28/2023 1233
Chrysene	ND		1	0.16	0.040	ug/L	07/28/2023 1233
Dibenzo(a,h)anthracene	ND		1	0.16	0.040	ug/L	07/28/2023 1233
Dibenzofuran	ND		1	0.80	0.16	ug/L	07/28/2023 1233
3,3'-Dichlorobenzidine	ND		1	4.0	0.81	ug/L	07/28/2023 1233
2,4-Dichlorophenol	ND		1	0.80	0.19	ug/L	07/28/2023 1233
Diethylphthalate	ND		1	4.0	0.19	ug/L	07/28/2023 1233
Dimethyl phthalate	ND		1	4.0	0.18	ug/L	07/28/2023 1233
2,4-Dimethylphenol	ND		1	0.80	0.15	ug/L	07/28/2023 1233
Di-n-butyl phthalate	**0.84**	**J**	**1**	**4.0**	**0.42**	**ug/L**	**07/28/2023 1233**
4,6-Dinitro-2-methylphenol	ND		1	4.0	0.89	ug/L	07/28/2023 1233
2,4-Dinitrophenol	ND		1	4.0	1.3	ug/L	07/28/2023 1233
2,4-Dinitrotoluene	ND		1	1.6	0.36	ug/L	07/28/2023 1233
2,6-Dinitrotoluene	ND		1	1.6	0.34	ug/L	07/28/2023 1233
Di-n-octylphthalate	ND		1	4.0	0.48	ug/L	07/28/2023 1233
bis(2-Ethylhexyl)phthalate	ND		1	4.0	1.5	ug/L	07/28/2023 1233
Fluoranthene	ND		1	0.16	0.040	ug/L	07/28/2023 1233
Fluorene	ND		1	0.16	0.040	ug/L	07/28/2023 1233
Hexachlorobenzene	ND		1	0.80	0.15	ug/L	07/28/2023 1233
Hexachlorobutadiene	ND		1	0.80	0.17	ug/L	07/28/2023 1233
Hexachlorocyclopentadiene	ND		1	4.0	1.1	ug/L	07/28/2023 1233

LOQ = Limit of Quantitation
DL = Detection Limit
ND = Not detected at or above the DL
J = Estimated result < LOQ and ≥ DL
* = RSD is out of criteria
N = Recovery is out of criteria
P = The RPD between two GC columns exceeds 40%
+ = RPD is out of criteria

Note: Calculations are performed before rounding to avoid round-off errors in calculated results

Semivolatile Organic Compounds by GC/MS - MB

Sample ID: YQ80106-001
Batch: 80106
Analytical Method: 8270E
Matrix: Aqueous
Prep Method: 3520C
Prep Date: 07/17/2023 1452

Parameter	Result	Q	Dil	LOQ	DL	Units	Analysis Date
Hexachloroethane	ND		1	0.80	0.17	ug/L	07/28/2023 1233
Indeno(1,2,3-c,d)pyrene	ND		1	0.16	0.040	ug/L	07/28/2023 1233
Isophorone	ND		1	0.80	0.22	ug/L	07/28/2023 1233
1-Methylnaphthalene	ND		1	0.16	0.040	ug/L	07/28/2023 1233
2-Methylnaphthalene	ND		1	0.16	0.040	ug/L	07/28/2023 1233
2-Methylphenol	ND		1	0.80	0.21	ug/L	07/28/2023 1233
3+4-Methylphenol	ND		1	1.6	0.46	ug/L	07/28/2023 1233
Naphthalene	ND		1	0.16	0.040	ug/L	07/28/2023 1233
2-Nitroaniline	ND		1	1.6	0.66	ug/L	07/28/2023 1233
3-Nitroaniline	ND		1	1.6	0.15	ug/L	07/28/2023 1233
4-Nitroaniline	ND		1	1.6	1.3	ug/L	07/28/2023 1233
Nitrobenzene	ND		1	0.80	0.17	ug/L	07/28/2023 1233
2-Nitrophenol	ND		1	1.6	0.44	ug/L	07/28/2023 1233
4-Nitrophenol	ND		1	4.0	2.1	ug/L	07/28/2023 1233
N-Nitrosodi-n-propylamine	ND		1	0.80	0.28	ug/L	07/28/2023 1233
N-Nitrosodiphenylamine (Diphenylamine)	ND		1	0.80	0.50	ug/L	07/28/2023 1233
Pentachlorophenol	ND		1	4.0	1.3	ug/L	07/28/2023 1233
Phenanthrene	ND		1	0.16	0.040	ug/L	07/28/2023 1233
Phenol	ND		1	0.80	0.19	ug/L	07/28/2023 1233
Pyrene	ND		1	0.16	0.040	ug/L	07/28/2023 1233
2,4,5-Trichlorophenol	ND		1	0.80	0.19	ug/L	07/28/2023 1233
2,4,6-Trichlorophenol	ND		1	0.80	0.22	ug/L	07/28/2023 1233

Surrogate	Q	% Rec	Acceptance Limit
2-Fluorobiphenyl		75	37-129
2-Fluorophenol		47	24-127
Nitrobenzene-d5		75	38-127
Phenol-d5		58	28-128
Terphenyl-d14		109	10-148
2,4,6-Tribromophenol		88	35-144

LOQ = Limit of Quantitation
DL = Detection Limit
ND = Not detected at or above the DL
J = Estimated result < LOQ and ≥ DL
* = RSD is out of criteria
N = Recovery is out of criteria
P = The RPD between two GC columns exceeds 40%
+ = RPD is out of criteria

Note: Calculations are performed before rounding to avoid round-off errors in calculated results

Semivolatile Organic Compounds by GC/MS - LCS

Sample ID: YQ80106-002
Batch: 80106
Analytical Method: 8270E
Matrix: Aqueous
Prep Method: 3520C
Prep Date: 07/17/2023 1452

Parameter	Spike Amount (ug/L)	Result (ug/L)	Q	Dil	% Rec	%Rec Limit	Analysis Date
Acenaphthene	8.0	5.5		1	69	30-122	07/28/2023 1259
Acenaphthylene	8.0	6.0		1	75	30-130	07/28/2023 1259
Acetophenone	8.0	6.2		1	77	52-125	07/28/2023 1259
Anthracene	8.0	6.3		1	78	30-123	07/28/2023 1259
Atrazine	8.0	5.6		1	70	25-121	07/28/2023 1259
Benzaldehyde	8.0	5.0		1	63	20-115	07/28/2023 1259
Benzo(a)anthracene	8.0	6.9		1	86	40-125	07/28/2023 1259
Benzo(a)pyrene	8.0	5.8		1	73	40-128	07/28/2023 1259
Benzo(b)fluoranthene	8.0	7.1		1	88	30-130	07/28/2023 1259
Benzo(g,h,i)perylene	8.0	7.3		1	91	30-130	07/28/2023 1259
Benzo(k)fluoranthene	8.0	5.7		1	72	30-130	07/28/2023 1259
1,1'-Biphenyl	8.0	5.2		1	65	42-120	07/28/2023 1259
4-Bromophenyl phenyl ether	8.0	6.0		1	76	30-124	07/28/2023 1259
Butyl benzyl phthalate	8.0	7.4		1	93	54-135	07/28/2023 1259
Caprolactam	8.0	6.8		1	85	44-152	07/28/2023 1259
Carbazole	8.0	6.2		1	77	45-101	07/28/2023 1259
bis (2-Chloro-1-methylethyl) ether	8.0	6.3		1	79	42-124	07/28/2023 1259
4-Chloro-3-methyl phenol	8.0	6.3		1	79	30-123	07/28/2023 1259
4-Chloroaniline	8.0	3.1		1	38	12-157	07/28/2023 1259
bis(2-Chloroethoxy)methane	8.0	5.8		1	73	44-127	07/28/2023 1259
bis(2-Chloroethyl)ether	8.0	5.5		1	68	46-120	07/28/2023 1259
2-Chloronaphthalene	8.0	5.2		1	64	46-100	07/28/2023 1259
2-Chlorophenol	8.0	5.4		1	67	50-117	07/28/2023 1259
4-Chlorophenyl phenyl ether	8.0	5.8		1	72	30-121	07/28/2023 1259
Chrysene	8.0	6.7		1	84	30-130	07/28/2023 1259
Dibenzo(a,h)anthracene	8.0	5.6		1	70	30-130	07/28/2023 1259
Dibenzofuran	8.0	5.9		1	73	30-118	07/28/2023 1259
3,3'-Dichlorobenzidine	8.0	1.8		1	23	10-126	07/28/2023 1259
2,4-Dichlorophenol	8.0	5.6		1	70	30-121	07/28/2023 1259
Diethylphthalate	8.0	6.6		1	83	40-125	07/28/2023 1259
Dimethyl phthalate	8.0	6.6		1	82	40-127	07/28/2023 1259
2,4-Dimethylphenol	8.0	6.6		1	82	20-125	07/28/2023 1259
Di-n-butyl phthalate	8.0	7.9		1	99	40-127	07/28/2023 1259
4,6-Dinitro-2-methylphenol	8.0	5.3		1	66	56-128	07/28/2023 1259
2,4-Dinitrophenol	16	9.5		1	59	11-126	07/28/2023 1259
2,4-Dinitrotoluene	8.0	6.2		1	77	59-127	07/28/2023 1259
2,6-Dinitrotoluene	8.0	6.3		1	79	59-126	07/28/2023 1259
Di-n-octylphthalate	8.0	6.6		1	83	50-136	07/28/2023 1259
bis(2-Ethylhexyl)phthalate	8.0	9.2		1	116	56-128	07/28/2023 1259
Fluoranthene	8.0	6.6		1	82	40-128	07/28/2023 1259
Fluorene	8.0	6.0		1	75	30-124	07/28/2023 1259
Hexachlorobenzene	8.0	6.6		1	82	30-125	07/28/2023 1259
Hexachlorobutadiene	8.0	4.4		1	56	24-110	07/28/2023 1259
Hexachlorocyclopentadiene	40	18		1	45	16-96	07/28/2023 1259

LOQ = Limit of Quantitation
DL = Detection Limit
ND = Not detected at or above the DL
J = Estimated result < LOQ and ≥ DL
* = RSD is out of criteria
N = Recovery is out of criteria
P = The RPD between two GC columns exceeds 40%
+ = RPD is out of criteria

Note: Calculations are performed before rounding to avoid round-off errors in calculated results

Semivolatile Organic Compounds by GC/MS - LCS

Sample ID: YQ80106-002
Batch: 80106
Analytical Method: 8270E
Matrix: Aqueous
Prep Method: 3520C
Prep Date: 07/17/2023 1452

Parameter	Spike Amount (ug/L)	Result (ug/L)	Q	Dil	% Rec	%Rec Limit	Analysis Date
Hexachloroethane	8.0	4.3		1	54	31-110	07/28/2023 1259
Indeno(1,2,3-c,d)pyrene	8.0	5.8		1	72	30-130	07/28/2023 1259
Isophorone	8.0	6.5		1	82	57-123	07/28/2023 1259
1-Methylnaphthalene	8.0	5.2		1	65	42-126	07/28/2023 1259
2-Methylnaphthalene	8.0	5.5		1	68	40-132	07/28/2023 1259
2-Methylphenol	8.0	7.6		1	95	56-119	07/28/2023 1259
3+4-Methylphenol	8.0	5.8		1	72	53-119	07/28/2023 1259
Naphthalene	8.0	5.2		1	64	30-130	07/28/2023 1259
2-Nitroaniline	8.0	5.1		1	64	60-124	07/28/2023 1259
3-Nitroaniline	8.0	3.6		1	45	43-123	07/28/2023 1259
4-Nitroaniline	8.0	4.3		1	53	30-135	07/28/2023 1259
Nitrobenzene	8.0	5.8		1	72	51-122	07/28/2023 1259
2-Nitrophenol	8.0	5.3		1	67	51-118	07/28/2023 1259
4-Nitrophenol	16	11		1	71	53-130	07/28/2023 1259
N-Nitrosodi-n-propylamine	8.0	6.6		1	83	54-127	07/28/2023 1259
N-Nitrosodiphenylamine (Diphenylamine)	8.0	5.8		1	73	30-123	07/28/2023 1259
Pentachlorophenol	16	9.8		1	61	42-131	07/28/2023 1259
Phenanthrene	8.0	6.1		1	76	40-123	07/28/2023 1259
Phenol	8.0	5.7		1	71	49-117	07/28/2023 1259
Pyrene	8.0	7.0		1	88	40-126	07/28/2023 1259
2,4,5-Trichlorophenol	8.0	5.1		1	64	30-123	07/28/2023 1259
2,4,6-Trichlorophenol	8.0	5.8		1	72	30-125	07/28/2023 1259

Surrogate	Q	% Rec	Acceptance Limit
2-Fluorobiphenyl		64	37-129
2-Fluorophenol		54	24-127
Nitrobenzene-d5		66	38-127
Phenol-d5		64	28-128
Terphenyl-d14		88	10-148
2,4,6-Tribromophenol		77	35-144

LOQ = Limit of Quantitation
DL = Detection Limit
ND = Not detected at or above the DL
J = Estimated result < LOQ and ≥ DL
* = RSD is out of criteria
N = Recovery is out of criteria
P = The RPD between two GC columns exceeds 40%
+ = RPD is out of criteria

Note: Calculations are performed before rounding to avoid round-off errors in calculated results

Semivolatile Organic Compounds by GC/MS - MS

Sample ID: YG12014-001MS
Batch: 80106
Analytical Method: 8270E
Matrix: Aqueous
Prep Method: 3520C
Prep Date: 07/17/2023 1452

Parameter	Sample Amount (ug/L)	Spike Amount (ug/L)	Result (ug/L)	Q	Dil	% Rec	%Rec Limit	Analysis Date
Acenaphthene	ND	8.0	57	N	200	715	30-122	07/28/2023 1539
Acenaphthylene	ND	8.0	38	N	200	475	30-130	07/28/2023 1539
Acetophenone	ND	8.0	3200	N	200	39800	52-125	07/28/2023 1539
Anthracene	ND	8.0	97	N	200	1210	30-123	07/28/2023 1539
Atrazine	ND	8.0	160	N	200	1990	25-121	07/28/2023 1539
Benzaldehyde	ND	8.0	450	N	200	5670	20-115	07/28/2023 1539
Benzo(a)anthracene	ND	8.0	16	N	200	206	40-125	07/28/2023 1539
Benzo(a)pyrene	ND	8.0	36	N	200	451	40-128	07/28/2023 1539
Benzo(b)fluoranthene	ND	8.0	28	N	200	345	30-130	07/28/2023 1539
Benzo(g,h,i)perylene	ND	8.0	ND	N	200	0.00	30-130	07/28/2023 1539
Benzo(k)fluoranthene	ND	8.0	35	N	200	439	30-130	07/28/2023 1539
1,1'-Biphenyl	730	8.0	380	N	200	-4310	42-120	07/28/2023 1539
4-Bromophenyl phenyl ether	ND	8.0	37	N	200	468	30-124	07/28/2023 1539
Butyl benzyl phthalate	ND	8.0	110	N	200	1350	54-135	07/28/2023 1539
Caprolactam	ND	8.0	210	N	200	2660	44-152	07/28/2023 1539
Carbazole	ND	8.0	41	N	200	509	45-101	07/28/2023 1539
bis (2-Chloro-1-methylethyl) ether	ND	8.0	ND	N	200	0.00	42-124	07/28/2023 1539
4-Chloro-3-methyl phenol	ND	8.0	190	N	200	2340	30-123	07/28/2023 1539
4-Chloroaniline	ND	8.0	670	N	200	8400	30-130	07/28/2023 1539
bis(2-Chloroethoxy)methane	ND	8.0	67	N	200	838	44-127	07/28/2023 1539
bis(2-Chloroethyl)ether	ND	8.0	250	N	200	3140	46-120	07/28/2023 1539
2-Chloronaphthalene	ND	8.0	40	N	200	500	46-100	07/28/2023 1539
2-Chlorophenol	ND	8.0	53	N	200	657	50-117	07/28/2023 1539
4-Chlorophenyl phenyl ether	ND	8.0	73	N	200	907	30-121	07/28/2023 1539
Chrysene	ND	8.0	12	N	200	145	30-130	07/28/2023 1539
Dibenzo(a,h)anthracene	ND	8.0	ND	N	200	0.00	30-130	07/28/2023 1539
Dibenzofuran	ND	8.0	120	N	200	1480	30-118	07/28/2023 1539
3,3'-Dichlorobenzidine	ND	8.0	ND	N	200	0.00	10-126	07/28/2023 1539
2,4-Dichlorophenol	ND	8.0	220	N	200	2770	30-121	07/28/2023 1539
Diethylphthalate	ND	8.0	120	N	200	1440	40-125	07/28/2023 1539
Dimethyl phthalate	ND	8.0	62	N	200	780	40-127	07/28/2023 1539
2,4-Dimethylphenol	ND	8.0	340	N	200	4240	20-125	07/28/2023 1539
Di-n-butyl phthalate	ND	8.0	ND	N	200	0.00	40-127	07/28/2023 1539
4,6-Dinitro-2-methylphenol	ND	8.0	260	N	200	3200	56-128	07/28/2023 1539
2,4-Dinitrophenol	ND	16	860	N	200	5390	30-130	07/28/2023 1539
2,4-Dinitrotoluene	ND	8.0	310	N	200	3900	59-127	07/28/2023 1539
2,6-Dinitrotoluene	ND	8.0	300	N	200	3710	59-126	07/28/2023 1539
Di-n-octylphthalate	ND	8.0	290	N	200	3650	50-136	07/28/2023 1539
bis(2-Ethylhexyl)phthalate	ND	8.0	140	N	200	1750	56-128	07/28/2023 1539
Fluoranthene	ND	8.0	13	N	200	164	40-128	07/28/2023 1539
Fluorene	ND	8.0	140	N	200	1720	30-124	07/28/2023 1539
Hexachlorobenzene	ND	8.0	ND	N	200	0.00	30-125	07/28/2023 1539
Hexachlorobutadiene	ND	8.0	ND	N	200	0.00	30-130	07/28/2023 1539
Hexachlorocyclopentadiene	ND	40	ND	N	200	0.00	16-96	07/28/2023 1539

LOQ = Limit of Quantitation
DL = Detection Limit
ND = Not detected at or above the DL
J = Estimated result < LOQ and ≥ DL
* = RSD is out of criteria
N = Recovery is out of criteria
P = The RPD between two GC columns exceeds 40%
+ = RPD is out of criteria

Note: Calculations are performed before rounding to avoid round-off errors in calculated results

Semivolatile Organic Compounds by GC/MS - MS

Sample ID: YG12014-001MS
Batch: 80106
Analytical Method: 8270E
Matrix: Aqueous
Prep Method: 3520C
Prep Date: 07/17/2023 1452

Parameter	Sample Amount (ug/L)	Spike Amount (ug/L)	Result (ug/L)	Q	Dil	% Rec	%Rec Limit	Analysis Date
Hexachloroethane	ND	8.0	3500	N	200	43500	31-110	07/28/2023 1539
Indeno(1,2,3-c,d)pyrene	ND	8.0	35	N	200	437	30-130	07/28/2023 1539
Isophorone	ND	8.0	410	N	200	5100	57-123	07/28/2023 1539
1-Methylnaphthalene	2100	8.0	1300	N	200	-9140	42-126	07/28/2023 1539
2-Methylnaphthalene	4000	8.0	2300	N	200	-20400	40-132	07/28/2023 1539
2-Methylphenol	ND	8.0	38	N	200	473	56-119	07/28/2023 1539
3+4-Methylphenol	ND	8.0	50	N	200	623	53-119	07/28/2023 1539
Naphthalene	2100	8.0	1200	N	200	-11700	30-130	07/28/2023 1539
2-Nitroaniline	ND	8.0	120	N	200	1470	60-124	07/28/2023 1539
3-Nitroaniline	ND	8.0	320	N	200	4050	43-123	07/28/2023 1539
4-Nitroaniline	ND	8.0	200	N	200	2560	30-135	07/28/2023 1539
Nitrobenzene	ND	8.0	150	N	200	1920	51-122	07/28/2023 1539
2-Nitrophenol	ND	8.0	290	N	200	3620	51-118	07/28/2023 1539
4-Nitrophenol	ND	16	1400	N	200	8500	53-130	07/28/2023 1539
N-Nitrosodi-n-propylamine	ND	8.0	86	N	200	1080	54-127	07/28/2023 1539
N-Nitrosodiphenylamine (Diphenylamine)	ND	8.0	370	N	200	4620	30-123	07/28/2023 1539
Pentachlorophenol	ND	16	540	N	200	3360	42-131	07/28/2023 1539
Phenanthrene	350	8.0	190	N	200	-1950	40-123	07/28/2023 1539
Phenol	ND	8.0	34	N	200	427	49-117	07/28/2023 1539
Pyrene	67	8.0	43	N	200	-296	40-126	07/28/2023 1539
2,4,5-Trichlorophenol	ND	8.0	210	N	200	2590	30-123	07/28/2023 1539
2,4,6-Trichlorophenol	ND	8.0	63	N	200	785	30-125	07/28/2023 1539

Surrogate	Q	% Rec	Acceptance Limit
2-Fluorobiphenyl	N	180	37-129
2-Fluorophenol		78	24-127
Nitrobenzene-d5	N	1190	38-127
Phenol-d5	N	776	28-128
Terphenyl-d14		135	10-148
2,4,6-Tribromophenol	N	1400	35-144

LOQ = Limit of Quantitation
DL = Detection Limit
ND = Not detected at or above the DL
J = Estimated result < LOQ and ≥ DL
* = RSD is out of criteria
N = Recovery is out of criteria
P = The RPD between two GC columns exceeds 40%
+ = RPD is out of criteria

Note: Calculations are performed before rounding to avoid round-off errors in calculated results

Semivolatile Organic Compounds by GC/MS - MSD

Sample ID: YG12014-001MD
Batch: 80106
Analytical Method: 8270E
Matrix: Aqueous
Prep Method: 3520C
Prep Date: 07/17/2023 1452

Parameter	Sample Amount (ug/L)	Spike Amount (ug/L)	Result (ug/L)	Q	Dil	% Rec	% RPD	%Rec Limit	% RPD Limit	Analysis Date
Acenaphthene	ND	8.0	52	N	200	649	9.7	30-122	40	07/28/2023 1605
Acenaphthylene	ND	8.0	39	N	200	486	2.3	30-130	40	07/28/2023 1605
Acetophenone	ND	8.0	2700	N	200	33400	18	52-125	40	07/28/2023 1605
Anthracene	ND	8.0	78	N	200	977	21	30-123	40	07/28/2023 1605
Atrazine	ND	8.0	120	N	200	1510	27	25-121	40	07/28/2023 1605
Benzaldehyde	ND	8.0	380	N	200	4770	17	20-115	40	07/28/2023 1605
Benzo(a)anthracene	ND	8.0	15	N	200	191	7.3	40-125	40	07/28/2023 1605
Benzo(a)pyrene	ND	8.0	39	N	200	485	7.5	40-128	40	07/28/2023 1605
Benzo(b)fluoranthene	ND	8.0	28	N	200	356	3.1	30-130	40	07/28/2023 1605
Benzo(g,h,i)perylene	ND	8.0	ND	N	200	0.00	0.00	30-130	40	07/28/2023 1605
Benzo(k)fluoranthene	ND	8.0	34	N	200	428	2.5	30-130	40	07/28/2023 1605
1,1'-Biphenyl	730	8.0	310	N	200	-5260	22	42-120	40	07/28/2023 1605
4-Bromophenyl phenyl ether	ND	8.0	41	N	200	517	9.9	30-124	40	07/28/2023 1605
Butyl benzyl phthalate	ND	8.0	110	N	200	1390	2.8	54-135	40	07/28/2023 1605
Caprolactam	ND	8.0	230	N	200	2880	8.0	44-152	40	07/28/2023 1605
Carbazole	ND	8.0	34	N	200	428	17	45-101	40	07/28/2023 1605
bis (2-Chloro-1-methylethyl) ether	ND	8.0	ND	N	200	0.00	0.00	42-124	40	07/28/2023 1605
4-Chloro-3-methyl phenol	ND	8.0	160	N	200	2020	15	30-123	40	07/28/2023 1605
4-Chloroaniline	ND	8.0	590	N	200	7320	14	30-130	40	07/28/2023 1605
bis(2-Chloroethoxy)methane	ND	8.0	57	N	200	710	16	44-127	40	07/28/2023 1605
bis(2-Chloroethyl)ether	ND	8.0	210	N	200	2680	16	46-120	40	07/28/2023 1605
2-Chloronaphthalene	ND	8.0	41	N	200	507	1.4	46-100	40	07/28/2023 1605
2-Chlorophenol	ND	8.0	35	N	200	443	39	50-117	40	07/28/2023 1605
4-Chlorophenyl phenyl ether	ND	8.0	51	N	200	635	35	30-121	40	07/28/2023 1605
Chrysene	ND	8.0	8.7		200	109	29	30-130	40	07/28/2023 1605
Dibenzo(a,h)anthracene	ND	8.0	ND	N	200	0.00	0.00	30-130	40	07/28/2023 1605
Dibenzofuran	ND	8.0	120	N	200	1460	1.0	30-118	40	07/28/2023 1605
3,3'-Dichlorobenzidine	ND	8.0	ND	N	200	0.00	0.00	10-126	40	07/28/2023 1605
2,4-Dichlorophenol	ND	8.0	160	N	200	1980	33	30-121	40	07/28/2023 1605
Diethylphthalate	ND	8.0	46	N,+	200	575	86	40-125	40	07/28/2023 1605
Dimethyl phthalate	ND	8.0	42	N	200	519	40	40-127	40	07/28/2023 1605
2,4-Dimethylphenol	ND	8.0	140	N,+	200	1730	84	20-125	40	07/28/2023 1605
Di-n-butyl phthalate	ND	8.0	ND	N	200	0.00	0.00	40-127	40	07/28/2023 1605
4,6-Dinitro-2-methylphenol	ND	8.0	270	N	200	3370	5.2	56-128	40	07/28/2023 1605
2,4-Dinitrophenol	ND	16	890	N	200	5550	2.8	30-130	40	07/28/2023 1605
2,4-Dinitrotoluene	ND	8.0	220	N	200	2730	35	59-127	40	07/28/2023 1605
2,6-Dinitrotoluene	ND	8.0	250	N	200	3100	18	59-126	40	07/28/2023 1605
Di-n-octylphthalate	ND	8.0	290	N	200	3660	0.36	50-136	40	07/28/2023 1605
bis(2-Ethylhexyl)phthalate	ND	8.0	140	N	200	1710	2.4	56-128	40	07/28/2023 1605
Fluoranthene	ND	8.0	12	N	200	151	8.5	40-128	40	07/28/2023 1605
Fluorene	ND	8.0	110	N	200	1430	18	30-124	40	07/28/2023 1605
Hexachlorobenzene	ND	8.0	ND	N	200	0.00	0.00	30-125	40	07/28/2023 1605
Hexachlorobutadiene	ND	8.0	ND	N	200	0.00	0.00	30-130	40	07/28/2023 1605
Hexachlorocyclopentadiene	ND	40	ND	N	200	0.00	0.00	16-96	40	07/28/2023 1605

LOQ = Limit of Quantitation
DL = Detection Limit
ND = Not detected at or above the DL
J = Estimated result < LOQ and ≥ DL
* = RSD is out of criteria
N = Recovery is out of criteria
P = The RPD between two GC columns exceeds 40%
+ = RPD is out of criteria

Note: Calculations are performed before rounding to avoid round-off errors in calculated results

Semivolatile Organic Compounds by GC/MS - MSD

Sample ID: YG12014-001MD
Batch: 80106
Analytical Method: 8270E
Matrix: Aqueous
Prep Method: 3520C
Prep Date: 07/17/2023 1452

Parameter	Sample Amount (ug/L)	Spike Amount (ug/L)	Result (ug/L)	Q	Dil	% Rec	% RPD	%Rec Limit	% RPD Limit	Analysis Date
Hexachloroethane	ND	8.0	ND	N,+	200	0.00	200	31-110	40	07/28/2023 1605
Indeno(1,2,3-c,d)pyrene	ND	8.0	35	N	200	434	0.64	30-130	40	07/28/2023 1605
Isophorone	ND	8.0	330	N	200	4090	22	57-123	40	07/28/2023 1605
1-Methylnaphthalene	2100	8.0	1100	N	200	-11700	16	42-126	40	07/28/2023 1605
2-Methylnaphthalene	4000	8.0	2000	N	200	-25000	17	40-132	40	07/28/2023 1605
2-Methylphenol	ND	8.0	38	N	200	472	0.28	56-119	40	07/28/2023 1605
3+4-Methylphenol	ND	8.0	39	N	200	485	25	53-119	40	07/28/2023 1605
Naphthalene	2100	8.0	1000	N	200	-14000	17	30-130	40	07/28/2023 1605
2-Nitroaniline	ND	8.0	130	N	200	1600	8.1	60-124	40	07/28/2023 1605
3-Nitroaniline	ND	8.0	250	N	200	3160	25	43-123	40	07/28/2023 1605
4-Nitroaniline	ND	8.0	280	N	200	3560	33	30-135	40	07/28/2023 1605
Nitrobenzene	ND	8.0	130	N	200	1620	17	51-122	40	07/28/2023 1605
2-Nitrophenol	ND	8.0	250	N	200	3110	15	51-118	40	07/28/2023 1605
4-Nitrophenol	ND	16	1100	N	200	7080	18	53-130	40	07/28/2023 1605
N-Nitrosodi-n-propylamine	ND	8.0	91	N	200	1140	5.9	54-127	40	07/28/2023 1605
N-Nitrosodiphenylamine (Diphenylamine)	ND	8.0	270	N	200	3370	31	30-123	40	07/28/2023 1605
Pentachlorophenol	ND	16	390	N	200	2460	31	42-131	40	07/28/2023 1605
Phenanthrene	350	8.0	150	N	200	-2440	23	40-123	40	07/28/2023 1605
Phenol	ND	8.0	ND	N,+	200	0.00	200	49-117	40	07/28/2023 1605
Pyrene	67	8.0	41	N	200	-321	4.7	40-126	40	07/28/2023 1605
2,4,5-Trichlorophenol	ND	8.0	160	N	200	1950	28	30-123	40	07/28/2023 1605
2,4,6-Trichlorophenol	ND	8.0	280	N,+	200	3540	130	30-125	40	07/28/2023 1605

Surrogate	Q	% Rec	Acceptance Limit
2-Fluorobiphenyl	N	380	37-129
2-Fluorophenol		71	24-127
Nitrobenzene-d5	N	1050	38-127
Phenol-d5	N	539	28-128
Terphenyl-d14		115	10-148
2,4,6-Tribromophenol	N	1440	35-144

LOQ = Limit of Quantitation
DL = Detection Limit
ND = Not detected at or above the DL
J = Estimated result < LOQ and ≥ DL
* = RSD is out of criteria
N = Recovery is out of criteria
P = The RPD between two GC columns exceeds 40%
+ = RPD is out of criteria

Note: Calculations are performed before rounding to avoid round-off errors in calculated results

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Chain of Custody
and
Miscellaneous Documents

PACE ANALYTICAL SERVICES, LLC

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www.pacelabs.com

Pace Analytical®

Number 149563

Client: Calumet Refining LLC	Report to Contact: Mike Gibson - CMR Ruta Humboldt	Telephone No. / E-mail: 513-641-8677	Quote No.
Address: 807 3rd St. N W	Sampler's Signature: x [signature]	Analysis (Attach list if more space is needed)	Page 1 of 1
City: Great Falls; State: MT; Zip Code: 59404	Printed Name: Eric Poissant		YG12014
Project Name: Calumet Refinery			STB2
Project No.: 1690029636-001	P.O. No.		

Sample ID / Description (Containers for each sample may be combined on one line.)	Collection Date(s)	Collection Time (Military)	G=Grab C=Composite	Matrix: Aqueous	Matrix: Solid	Matrix: Non-Aqueous	Unpres.	H2SO4	HNO3	HCl	NaOH	5035 Kit	Field Filtered	VOCs	SVOCs	VPH	EPH					Remarks / Cooler I.D.
CMR-SP200-110723	7/11/23	1330	G	X			X			X				X	X	X	X					

Turn Around Time Required (Prior lab approval required for expedited TAT.) ☑ Standard ☐ Rush (Specify)	Sample Disposal ☐ Return to Client ☐ Disposal by Lab	Possible Hazard Identification ☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison ☐ Unknown		QC Requirements (Specify)	
1. Relinquished by [signature]	Date 7/11/23	Time 1500	1. Received by Fed EX	Date	Time
2. Relinquished by	Date	Time	2. Received by	Date	Time
3. Relinquished by	Date	Time	3. Received by	Date	Time
4. Relinquished by fedex	Date 7.12.23	Time 930	4. Laboratory received by [signature]	Date 7.12.23	Time 930

Note: All samples are retained for four weeks from receipt unless other arrangements are made.

LAB USE ONLY
Received on Ice (Circle) (Yes) No Ice Pack | Receipt Temp. 4.9 °C | Temp Blank ☐ Y ☑ N

DISTRIBUTION: WHITE & YELLOW-Return to laboratory with Sample(s); PINK-Field/Client Copy

Document Number: ME003N2-01

DC#_Title: ENV-FRM-WCOL-0286 v02_Samples Receipt Checklist (SRC)
Effective Date: 8/2/2022

Sample Receipt Checklist (SRC)

Client: ARCADIS Cooler Inspected by/date: KDRW / 07/12/2023 Lot #: YG12014

Means of receipt: ☐ Pace ☐ Client ☐ UPS ☑ FedEx ☐ Other: ____

☐ Yes	☑ No		1. Were custody seals present on the cooler?
☐ Yes	☐ No	☑ NA	2. If custody seals were present, were they intact and unbroken?

pH Strip ID: NA Chlorine Strip ID: NA Tested by: NA

Original temperature upon receipt / Derived (Corrected) temperature upon receipt %Solid Snap-Cup ID: NA

4.9 / 4.9 °C NA / NA °C NA / NA °C NA / NA °C

Method: ☐ Temperature Blank ☑ Against Bottles IR Gun ID: 8 IR Gun Correction Factor: 0 °C

Method of coolant: ☑ Wet Ice ☐ Ice Packs ☐ Dry Ice ☐ None

☑ Yes	☐ No	☐ NA	3. Were all coolers received at or below 6.0°C? If no, was Project Manager notified? PM was Notified by: phone / email / face-to-face (circle one).
☑ Yes	☐ No	☐ NA	4. Is the commercial courier's packing slip attached to this form?
☑ Yes	☐ No		5. Were proper custody procedures (relinquished/received) followed?
☑ Yes	☐ No		6. Were sample IDs listed on the COC and all sample containers?
☑ Yes	☐ No		7. Was collection date & time listed on the COC and all sample containers?
☑ Yes	☐ No		8. Did all container label information (ID, date, time) agree with the COC?
☑ Yes	☐ No		9. Were tests to be performed listed on the COC?
☑ Yes	☐ No		10. Did all samples arrive in the proper containers for each test and/or in good condition (unbroken, lids on, etc.)? ____
☑ Yes	☐ No		11. Was adequate sample volume available?
☑ Yes	☐ No		12. Were all samples received within ½ the holding time or 48 hours, whichever comes first?
☑ Yes	☐ No		13. Were all samples containers accounted for? (No missing/excess)
☑ Yes	☐ No	☐ NA	14. Were VOA, 8015C and RSK-175 samples free of bubbles >"pea-size" (¼"or 6mm in diameter) in any of the VOA vials?
☐ Yes	☐ No	☑ NA	15. Were all DRO/metals/nutrient samples received at a pH of < 2?
☐ Yes	☐ No	☑ NA	16. Were all cyanide samples received at a pH > 12 and sulfide samples received at a pH > 9?
☐ Yes	☐ No	☑ NA	17. Were all applicable NH_3/TKN/cyanide/phenol/625.1/608.3 (< 0.5mg/L) samples free of residual chlorine?
☐ Yes	☑ No	☐ NA	18. Was the quote number listed on the container label? If yes, Quote # NA

Sample Preservation (Must be completed for any sample(s) incorrectly preserved or with headspace.)

Sample(s) NA were received incorrectly preserved and were adjusted accordingly in sample receiving with NA mL of circle one: H2SO4, HNO3, HCl, NaOH using SR # NA. ☐
Time of preservation NA. If more than one preservative is needed, please note in the comments below.

Sample(s) ____ were received with bubbles >6 mm in diameter.

Samples(s) NA were received with TRC > 0.5 mg/L (If #19 is *no*) and were adjusted accordingly in sample receiving with sodium thiosulfate ($Na_2S_2O_3$) with Unique ID: NA.

Comments:

Qualtrax ID: 56360

ANALYTICAL REPORT

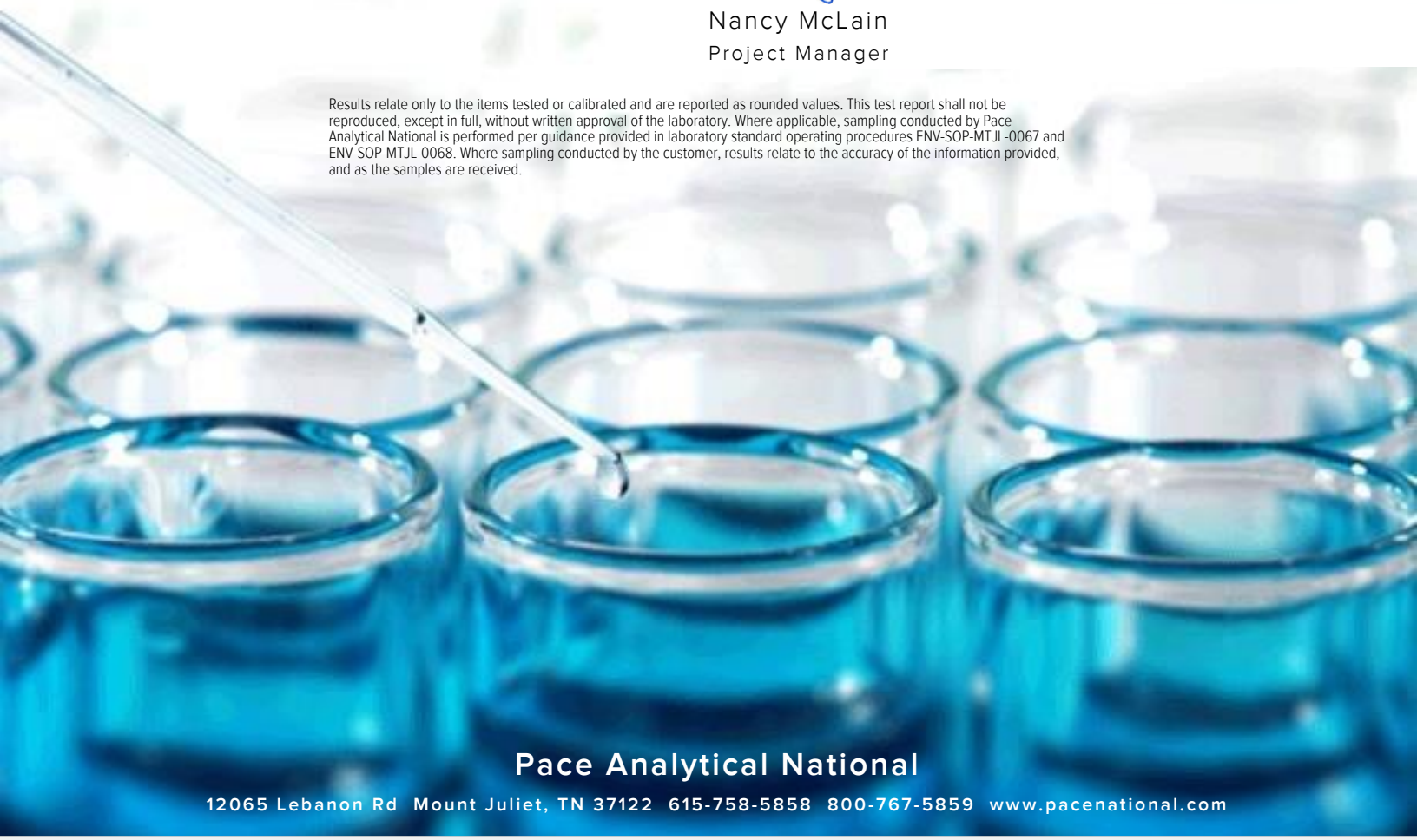
August 03, 2023

Pace Analytical - West Columbia, SC

Sample Delivery Group:	L1634988
Samples Received:	07/13/2023
Project Number:	YG12014
Description:	Calumet CMR AOC16
Site:	001
Report To:	Edward T. Barnett 106 Vantage Point Dr. West Columbia, SC 29172

Entire Report Reviewed By:

Nancy McLain
Project Manager



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

TABLE OF CONTENTS

CMR-SP200-110723 L1634988-01 GW

Collected by	Collected date/time	Received date/time
	07/11/23 13:00	07/13/23 09:00

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Volatile Petroleum Hydrocarbons by Method MTDEQ VPH	WG2104952	50	08/02/23 15:09	08/02/23 15:09	NCC	Mt. Juliet, TN
TPH by Method MTDEQ EPH	WG2094617	151	07/17/23 05:40	07/18/23 18:42	JSS	Mt. Juliet, TN
TPH by Method MTDEQ EPH	WG2096288	151	07/17/23 05:40	07/27/23 06:51	DMG	Mt. Juliet, TN
TPH by Method MTDEQ EPH	WG2096288	60.6	07/17/23 05:40	07/19/23 21:04	HLJ	Mt. Juliet, TN
TPH by Method MTDEQ EPH	WG2096288	757	07/17/23 05:40	07/27/23 09:35	DMG	Mt. Juliet, TN

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.

Nancy McLain
Project Manager

Project Narrative

Due to multiple preparation procedures, calculated analytes are not reported in the quality control samples for EPH and VPH Methods.

Volatile Petroleum Hydrocarbons by Method MTDEQ VPH

Analyte	Result ug/l	Qualifier	MDL ug/l	RDL ug/l	Dilution	Analysis date / time	Batch
Unadjusted C5-C8 Aliphatics	2160	J Q	1670	5000	50	08/02/2023 15:09	WG2104952
Unadjusted C9-C12 Aliphatics	17500	Q	1670	5000	50	08/02/2023 15:09	WG2104952
Unadjusted C9-C10 Aromatics	17800	Q	1670	5000	50	08/02/2023 15:09	WG2104952
Adjusted C5-C8 Aliphatics	2160	J Q	1670	5000	50	08/02/2023 15:09	WG2104952
Adjusted C9-C12 Aliphatics	12300	Q	1670	5000	50	08/02/2023 15:09	WG2104952
Total VPH	37500	Q	3340	10000	50	08/02/2023 15:09	WG2104952
Total Purgeable Hydrocarbons C5-C12	49000	Q	3340	10000	50	08/02/2023 15:09	WG2104952
(S) 2,5-Dibromotoluene(FID)	*74.4*			*70.0-130*		*08/02/2023 15:09*	WG2104952
(S) 2,5-Dibromotoluene(PID)	*83.5*			*70.0-130*		*08/02/2023 15:09*	WG2104952

TPH by Method MTDEQ EPH

Analyte	Result ug/l	Qualifier	MDL ug/l	RDL ug/l	Dilution	Analysis date / time	Batch
EPH Screen	1850000		15100	45300	151	07/18/2023 18:42	WG2094617
Unadjusted C9-C18 Aliphatics	1190000		151000	454000	757	07/27/2023 09:35	WG2096288
Unadjusted C19-C36 Aliphatics	285000		30200	90600	151	07/27/2023 06:51	WG2096288
Unadjusted C11-C22 Aromatics	346000		12100	36400	60.6	07/19/2023 21:04	WG2096288
Unadjusted Total Petroleum Hydrocarbons	1820000		151000	454000	757	07/27/2023 09:35	WG2096288
Adjusted C11-C22 Aromatics	331000		12100	36400	60.6	07/19/2023 21:04	WG2096288
Adjusted Total Petroleum Hydrocarbons	1810000		151000	454000	757	07/27/2023 09:35	WG2096288
(S) o-Terphenyl	*0.000*	J7		*40.0-140*		*07/18/2023 18:42*	WG2094617
(S) o-Terphenyl	*86.9*	J7		*40.0-140*		*07/19/2023 21:04*	WG2096288
(S) 1-Chloro-octadecane	*0.000*	J7		*40.0-140*		*07/27/2023 06:51*	WG2096288
(S) 1-Chloro-octadecane	*0.000*	J7		*40.0-140*		*07/27/2023 09:35*	WG2096288
(S) 2-Fluorobiphenyl	*3160*	J7		*40.0-140*		*07/19/2023 21:04*	WG2096288
(S) 2-Bromonaphthalene	*4320*	J7		*40.0-140*		*07/19/2023 21:04*	WG2096288

Sample Narrative:

L1634988-01 WG2096288: Dilution and surrogate failure due to matrix interference.

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

Method Blank (MB)

(MB) R3955687-3 08/01/23 22:30

Analyte	MB Result ug/l	MB Qualifier	MB MDL ug/l	MB RDL ug/l
Unadjusted C5-C8 Aliphatics	U		33.3	100
Unadjusted C9-C12 Aliphatics	U		33.3	100
Unadjusted C9-C10 Aromatics	U		33.3	100
Adjusted C5-C8 Aliphatics	U		33.3	100
Adjusted C9-C12 Aliphatics	U		33.3	100
Total VPH	U		66.7	200
Total Purgeable Hydrocarbons C5-C12	U		66.7	200
(S) 2,5-Dibromotoluene(FID)	*94.5*			*70.0-130*
(S) 2,5-Dibromotoluene(PID)	*96.8*			*70.0-130*

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

(LCS) R3955687-1 08/01/23 19:41 • (LCSD) R3955687-2 08/01/23 20:15

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 %
Unadjusted C5-C8 Aliphatics	1200	1200	1090	100	90.8	70.0-130			9.61	50
Unadjusted C9-C12 Aliphatics	1400	1310	1140	93.6	81.4	70.0-130			13.9	50
Unadjusted C9-C10 Aromatics	200	190	166	95.0	83.0	70.0-130			13.5	50
Total VPH	2800	2700	2400	96.4	85.7	70.0-130			11.8	50
Total Purgeable Hydrocarbons C5-C12	2800	2860	2540	102	90.7	70.0-130			11.9	50
(S) 2,5-Dibromotoluene(FID)				*130*	*101*	*70.0-130*				
(S) 2,5-Dibromotoluene(PID)				*130*	*104*	*70.0-130*				

L1635366-03 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1635366-03 08/02/23 08:10 • (MS) R3955687-4 08/02/23 16:16 • (MSD) R3955687-5 08/02/23 17:24

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 %
Unadjusted C5-C8 Aliphatics	6000	U	4690	5150	78.2	85.8	5	70.0-130			9.35	50
Unadjusted C9-C12 Aliphatics	7000	U	5340	6120	76.3	87.4	5	70.0-130			13.6	50
Unadjusted C9-C10 Aromatics	1000	U	763	872	76.3	87.2	5	70.0-130			13.3	50
Total VPH	14000	U	10800	12100	77.1	86.4	5	70.0-130			11.4	50
Total Purgeable Hydrocarbons C5-C12	14000	U	11400	12900	81.4	92.1	5	70.0-130			12.3	50
(S) 2,5-Dibromotoluene(FID)					*77.7*	*81.6*		*70.0-130*				
(S) 2,5-Dibromotoluene(PID)					*82.1*	*86.1*		*70.0-130*				

Sample Narrative:

L1635366-03 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1635366-03 08/02/23 08:10 • (MS) R3955687-4 08/02/23 16:16 • (MSD) R3955687-5 08/02/23 17:24

	Spike Amount	Original Result	MS Result	MSD Result	MS Rec.	MSD Rec.	Dilution	Rec. Limits	MS Qualifier	MSD Qualifier	RPD	RPD Limits
Analyte	ug/l	ug/l	ug/l	ug/l	%	%		%			%	%

OS: Lowest possible dilution due to sample foaming.

Method Blank (MB)

(MB) R3949933-1 07/18/23 12:53

Analyte	MB Result	MB Qualifier	MB MDL	MB RDL
	ug/l		ug/l	ug/l
EPH Screen	U		100	300
(S) o-Terphenyl	*100*			*40.0-140*

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

(LCS) R3949933-2 07/18/23 13:07 • (LCSD) R3949933-3 07/18/23 13:20

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	%	%	%			%	%
EPH Screen	3100	2560	2610	82.6	84.2	40.0-140			1.93	25
(S) o-Terphenyl				*107*	*105*	*40.0-140*				

L1635366-03 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1635366-03 07/18/23 14:01 • (MS) R3949933-4 07/18/23 14:14 • (MSD) R3949933-5 07/18/23 14:28

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	%	%		%			%	%
EPH Screen	2950	U	2530	2290	85.8	77.6	1	40.0-140			9.96	50
(S) o-Terphenyl					*80.3*	*72.5*		*40.0-140*				

Method Blank (MB)

(MB) R3949995-1 07/18/23 12:54

Analyte	MB Result ug/l	MB Qualifier	MB MDL ug/l	MB RDL ug/l
Unadjusted C9-C18 Aliphatics	U		200	600
Unadjusted C19-C36 Aliphatics	U		200	600
(S) 1-Chloro-octadecane	*62.5*			*40.0-140*

Method Blank (MB)

(MB) R3949995-6 07/19/23 00:04

Analyte	MB Result ug/l	MB Qualifier	MB MDL ug/l	MB RDL ug/l
Unadjusted C11-C22 Aromatics	U		200	600
(S) o-Terphenyl	*67.6*			*40.0-140*
(S) 2-Fluorobiphenyl	*77.3*			*40.0-140*
(S) 2-Bromonaphthalene	*76.9*			*40.0-140*

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

(LCS) R3949995-2 07/18/23 13:18 • (LCSD) R3949995-3 07/18/23 13:40

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 %
Unadjusted C9-C18 Aliphatics	600	435	411	72.5	68.5	40.0-140			5.67	25
Unadjusted C19-C36 Aliphatics	800	671	664	83.9	83.0	40.0-140			1.05	25
(S) 1-Chloro-octadecane				*68.0*	*64.4*	*40.0-140*				

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

(LCS) R3949995-7 07/19/23 00:27 • (LCSD) R3949995-8 07/19/23 00:49

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 %
Unadjusted C11-C22 Aromatics	1700	1420	1320	83.5	77.6	40.0-140			7.30	25
(S) o-Terphenyl				*76.0*	*71.1*	*40.0-140*				
(S) 2-Fluorobiphenyl				*82.6*	*82.2*	*40.0-140*				
(S) 2-Bromonaphthalene				*80.5*	*81.9*	*40.0-140*				

L1635366-03 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1635366-03 07/18/23 17:01 • (MS) R3949995-4 07/18/23 17:23 • (MSD) R3949995-5 07/18/23 17:45

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 %
Unadjusted C9-C18 Aliphatics	570	U	484	369	84.9	64.7	1	40.0-140			27.0	50
Unadjusted C19-C36 Aliphatics	760	U	703	523	92.5	68.8	1	40.0-140			29.4	50
(S) 1-Chloro-octadecane					*47.0*	*29.1*		*40.0-140*		J2		

Sample Narrative:

OS: Surrogate failure due to matrix interference during extraction procedure.

L1635366-03 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1635366-03 07/19/23 04:09 • (MS) R3949995-9 07/19/23 04:31 • (MSD) R3949995-10 07/19/23 04:53

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 %
Unadjusted C11-C22 Aromatics	1620	U	1380	1120	85.2	69.1	1	40.0-140			20.8	50
(S) o-Terphenyl					*70.0*	*55.5*		*40.0-140*				
(S) 2-Fluorobiphenyl					*86.3*	*85.0*		*40.0-140*				
(S) 2-Bromonaphthalene					*85.7*	*83.2*		*40.0-140*				

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
J	The identification of the analyte is acceptable; the reported value is an estimate.
J2	Surrogate recovery limits have been exceeded; values are outside lower control limits.
J7	Surrogate recovery cannot be used for control limit evaluation due to dilution.
Q	Sample was prepared and/or analyzed past holding time as defined in the method. Concentrations should be considered minimum values.

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.

Chain of Custody

C029

Pace Analytical
www.pacelabs.com

Workorder: YG12014 Workorder Name: Calumet CMR AOC16 Owner Received Date: 7/12/2023 Results Requested By: 7/24/2023

Report To:	Subcontract To:
Edward T. Barnett	Project # YG12014
Pace Analytical	
106 Vantage Point Drive	Pace National
Columbia SC, 29223	
803-509-8398	
Edward.Barnett@pacelabs.com	

L1634988

Item	Sample ID	Sample Type	Collect Date/Time	Lab ID	Matrix	Preserved Containers					Requested Analysis: MA EPH	Requested Analysis: MA VPH	LAB USE ONLY
1	CMR-SP200-110723	grab	07/11/23 @ 1300	YG12014-001	AQ						X	X	-01
													Environ
													EQUIS
													EDD
													Needed

Transfers	Released By	Date/Time	Reveived By	Date/Time	Comments
1	[signature]	7/12/23 1900	GRACE BARRON	7.13.23 0900	For all samples - MA EPH and MA VPH Level 2 with J/MDLs screen + fractionated analysis
2					
3					

Cooler Temperature on Receipt 3.8 °C	Custody Seal Y or N	Received on Ice Y or N	Sample Intact Y or N

***In order to maintain client confidentiality, location/name of the sampling site, sampler's name and signature may not be provided on this COC
This chain of custody is considered complete as is since this information is available in the owner laboratory.

Friday, June 17, 2016 11:01:34 AM FMT-ALL-C-002rev.00 24March2009 Page 1 of 1

Sample Receipt Checklist
COC Seal Present/Intact: X Y N If Applicable
COC Signed/Accurate: Y N VOA Zero Headspace: Y N
Bottles arrive intact: Y N Pres.Correct/Check: Y N
Correct bottles used: Y N GBAG 3.8+0=3.8
Sufficient volume sent: Y N
RAD Screen <0.5 mR/hr: X Y N 16633470 3560

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Ship to :
Pace National

Phone

INTER_LABORATORY WORK ORDER # YG12014
(To be complete by sending lab)

Sending Project No:	Calumet
Receiving Project No:	
Check Box for Consolidated Invoice:	x
Date Prepared:	12-Jul
REQUESTED COMPLETION DATE:	24-Jul

Sending Region	IR77-SC	Sending Project Mgr.	Eddie Barnett
Receiving Region	Pace National	External Client	Ramboll
State of Sample Origin	MT	Q	LV2 w / Js

All questions should be addressed to sending project manager. L1634988

Requested Reportable Units: ug/L or mg/kg Report Wet or Dry Weight? dry Cert Needed: MI

WORK REQUESTED						
Method Description	Container Type	Quantity of containers	Preservative	Quantity of Samples	Unit Price	Amount
MT VPH	40mL	2	HCL	1	65	65
MT EPH	1L	1	HCL	1	90	90
					TOTAL	155

Special Requirements: Environ EQUIS EDD Needed

Receiving Reqion Department	Acctg. Code	Totals from above	Revenue Allocation	
			Receiving Region (80%)	Client Services Dept. Sending Region (20%)
		65	52	13
		90	72	18
* Custom Revenue Allocation		TOTAL	124	31

FOR ANALYTICAL WORK COMPLETED THIS SECTION ALSO

Chain of Custody Included: [x] Yes [ ] No Return Samples to Sending Reguion: [ ] Yes [x] No

Matrix: [ ] Soil [ ] Water [ ] Air [ ] Other (identity) _____

CONFIRMATION OF WORK COMPLETED

Date Completed: _____ Receiving Project Manager: _____

Original sent to the receiving lab - Copy kept at the sending lab.

When work completed: Original sent to the ABM at the receiving laboratory. Copies are made to corporate as needed.

APPENDIX A3

PASSIVE TREATMENT TRENCH GROUNDWATER ANALYTICAL RESULTS

Pace Lot Number YI21013

Report of Analysis

Ramboll US Corporation
333 West Wacker Drive
Suite 2700
Chicago, IL 60606
Attention: Ruta Deshpande

Project Name: Calumet Refinery GW Sampling

Project Number: 1690029636-001

Lot Number:**YI21013**

Date Completed:10/17/2023

10/17/2023 10:08 AM
Approved and released by:
Project Manager II: **Edward Barnett**

The electronic signature above is the equivalent of a handwritten signature.

Pace Analytical Services, LLC (*formerly Shealy Environmental Services, Inc.*)
106 Vantage Point Drive West Columbia, SC 29172
Tel: 803-791-9700 Fax: 803-791-9111 www.pacelabs.com

Case Narrative
Ramboll US Corporation
Lot Number: YI21013

This Report of Analysis contains the analytical result(s) for the sample(s) listed on the Sample Summary following this Case Narrative. The sample receiving date is documented in the header information associated with each sample.

All results listed in this report relate only to the samples that are contained within this report. Where sampling is conducted by the client, results relate to the accuracy of the information provided, and as the samples are received.

Sample receipt, sample analysis, and data review have been performed in accordance with the most current approved The NELAC Institute (TNI) standards, the Pace Analytical Services, LLC ("Pace") Laboratory Quality Manual, standard operating procedures (SOPs), and Pace policies. Any exceptions to the TNI standards, the Laboratory Quality Manual, SOPs or policies are qualified on the results page or discussed below.

Pace is a TNI accredited laboratory; however, the following analyses are currently not listed on our TNI scope of accreditation: Drinking Water: VOC (excluding BTEX, MTBE, Naphthalene, & 1,2-dichloroethane) EPA 524.2, E. coli and Total coliforms SM 9223 B-2004, Solid Chemical Material: TOC Walkley-Black, Biological Tissue: All, Non-Potable Water: SGT-HEM EPA 1664B, Silica EPA 200.7, Boron, Calcium, Silicon, Strontium EPA 200.8, Bicarbonate, Carbonate, and Hydroxide Alkalinity SM 2320 B-2011, SM 9221 C E-2006 & SM 9222D-2006, Strontium SW-846 6010D, VOC SM 6200 B-2011, Fecal Coliform Colilert-18, PFAS by Isotope Dilution SOP.

If you have any questions regarding this report, please contact the Pace Project Manager listed on the cover page.

SVOCs

The following sampless diluted due to the nature of the sample matrix: YI21013-001, YI21013-002, YI21013-003. The LOQ has been elevated to reflect the dilution.

YI21013-001 (CMR-MW-105-092023) (Run 1) (Analysis Batch 86422) (Prep Batch 85897)
YI21013-002 (CMR-MW-106-092023) (Run 1) (Analysis Batch 86422) (Prep Batch 85897)
YI21013-003 (CMR-MW-41S-092023) (Run 1) (Analysis Batch 86422) (Prep Batch 85897)

Due to the large number of spiked analytes, there is a high probability that one or more analytes will recover outside acceptance limits. The laboratory's SOP allows for 10% of analytes to recover marginally outside criteria. The following analyte recovered marginally outside LCS/LCSD criteria: 2,4 Dimethylphenol.

YI21013-001 (CMR-MW-105-092023) (Run 1) (Analysis Batch 86422) (Prep Batch 85897)
YI21013-002 (CMR-MW-106-092023) (Run 1) (Analysis Batch 86422) (Prep Batch 85897)
YI21013-003 (CMR-MW-41S-092023) (Run 1) (Analysis Batch 86422) (Prep Batch 85897)

VOCs

Samples YI21013-001, YI21013-002, YI21013-003 were analyzed on an instrument that was not calibrated for 1,4-Dioxane. 1,4-Dioxane was in the initial calibration standards. Since its calibration curve did not meet acceptance criteria, the calibration was not used. 1,4-Dioxane was also in the daily calibration verification standard and LOQ standard. Since 1,4-Dioxane was not detected in the samples, per client's permission the data has been reported.

YI21013-001 (CMR-MW-105-092023) (Run 1) (Analysis Batch 86531)
YI21013-002 (CMR-MW-106-092023) (Run 1) (Analysis Batch 86531)
YI21013-003 (CMR-MW-41S-092023) (Run 1) (Analysis Batch 86531)

Subcontracted Results

EPH and VPH were subcontracted to Pace National for analysis. The results are included after the Pace West Columbia report of analysis.

Sample Summary

Ramboll US Corporation

Lot Number: YI21013

Project Name: Calumet Refinery GW Sampling

Project Number: 1690029636-001

Sample Number	Sample ID	Matrix	Date Sampled	Date Received
001	CMR-MW-105-092023	Aqueous	09/20/2023 0925	09/21/2023
002	CMR-MW-106-092023	Aqueous	09/20/2023 0955	09/21/2023
003	CMR-MW-41S-092023	Aqueous	09/20/2023 1020	09/21/2023

(3 samples)

Detection Summary

Ramboll US Corporation

Lot Number: YI21013

Project Name: Calumet Refinery GW Sampling

Project Number: 1690029636-001

Sample	Sample ID	Matrix	Parameter	Method	Result	Q	Units	Page
001	CMR-MW-105-092023	Aqueous	Benzene	8260D	85		ug/L	6
001	CMR-MW-105-092023	Aqueous	Cyclohexane	8260D	96		ug/L	6
001	CMR-MW-105-092023	Aqueous	Ethylbenzene	8260D	570		ug/L	6
001	CMR-MW-105-092023	Aqueous	Methylcyclohexane	8260D	28	J	ug/L	6
001	CMR-MW-105-092023	Aqueous	Toluene	8260D	20	J	ug/L	6
001	CMR-MW-105-092023	Aqueous	2,4-Dimethylphenol	8270E	31	L	ug/L	8
001	CMR-MW-105-092023	Aqueous	1-Methylnaphthalene	8270E	4.0		ug/L	9
001	CMR-MW-105-092023	Aqueous	2-Methylnaphthalene	8270E	0.29	J	ug/L	9
001	CMR-MW-105-092023	Aqueous	Naphthalene	8270E	4.0		ug/L	9
001	CMR-MW-105-092023	Aqueous	Phenol	8270E	3.3	J	ug/L	9
002	CMR-MW-106-092023	Aqueous	Acetone	8260D	13		ug/L	10
002	CMR-MW-106-092023	Aqueous	Cyclohexane	8260D	1.7		ug/L	10
002	CMR-MW-106-092023	Aqueous	4-Methyl-2-pentanone	8260D	3.8	J	ug/L	10
002	CMR-MW-106-092023	Aqueous	Methylcyclohexane	8260D	0.50	J	ug/L	10
003	CMR-MW-41S-092023	Aqueous	Benzene	8260D	470		ug/L	14
003	CMR-MW-41S-092023	Aqueous	Cyclohexane	8260D	45		ug/L	14
003	CMR-MW-41S-092023	Aqueous	Ethylbenzene	8260D	170		ug/L	14
003	CMR-MW-41S-092023	Aqueous	Methylcyclohexane	8260D	33	J	ug/L	14
003	CMR-MW-41S-092023	Aqueous	Naphthalene	8260D	30		ug/L	14
003	CMR-MW-41S-092023	Aqueous	Xylenes (total)	8260D	790		ug/L	15
003	CMR-MW-41S-092023	Aqueous	m+p - Xylenes	8260D	590		ug/L	15
003	CMR-MW-41S-092023	Aqueous	o - Xylenes	8260D	200		ug/L	15
003	CMR-MW-41S-092023	Aqueous	Acenaphthene	8270E	0.65	JQ	ug/L	16
003	CMR-MW-41S-092023	Aqueous	2,4-Dimethylphenol	8270E	75	QL	ug/L	16
003	CMR-MW-41S-092023	Aqueous	Fluorene	8270E	1.4	Q	ug/L	16
003	CMR-MW-41S-092023	Aqueous	1-Methylnaphthalene	8270E	7.3	Q	ug/L	17
003	CMR-MW-41S-092023	Aqueous	2-Methylnaphthalene	8270E	0.74	JQ	ug/L	17
003	CMR-MW-41S-092023	Aqueous	Naphthalene	8270E	6.9	Q	ug/L	17
003	CMR-MW-41S-092023	Aqueous	Phenol	8270E	15	Q	ug/L	17

(29 detections)

Volatile Organic Compounds by GC/MS

Client: Ramboll US Corporation | Laboratory ID: YI21013-001
Description: CMR-MW-105-092023 | Matrix: Aqueous
Date Sampled: 09/20/2023 0925 | Project Name: Calumet Refinery GW
Date Received: 09/21/2023 | Project Number: 1690029636-001

Run	Prep Method	Analytical Method	Dilution	Analysis Date	Analyst	Prep Date	Batch
1	5030B	8260D	50	10/04/2023 1704	CCO		86531

Parameter	CAS Number	Analytical Method	Result	Q	LOQ	DL	Units	Run
Acetone	67-64-1	8260D	ND		500	200	ug/L	1
Benzene	71-43-2	8260D	85		25	20	ug/L	1
Bromochloromethane	74-97-5	8260D	ND		25	20	ug/L	1
Bromodichloromethane	75-27-4	8260D	ND		25	20	ug/L	1
Bromoform	75-25-2	8260D	ND		25	20	ug/L	1
Bromomethane (Methyl bromide)	74-83-9	8260D	ND		25	20	ug/L	1
2-Butanone (MEK)	78-93-3	8260D	ND		500	100	ug/L	1
Carbon disulfide	75-15-0	8260D	ND		25	20	ug/L	1
Carbon tetrachloride	56-23-5	8260D	ND		25	20	ug/L	1
Chlorobenzene	108-90-7	8260D	ND		25	20	ug/L	1
Chloroethane	75-00-3	8260D	ND		25	20	ug/L	1
Chloroform	67-66-3	8260D	ND		25	20	ug/L	1
Chloromethane (Methyl chloride)	74-87-3	8260D	ND		25	20	ug/L	1
Cyclohexane	110-82-7	8260D	96		25	20	ug/L	1
1,2-Dibromo-3-chloropropane (DBCP)	96-12-8	8260D	ND		25	20	ug/L	1
Dibromochloromethane	124-48-1	8260D	ND		25	20	ug/L	1
1,2-Dibromoethane (EDB)	106-93-4	8260D	ND		25	20	ug/L	1
1,2-Dichlorobenzene	95-50-1	8260D	ND		25	20	ug/L	1
1,3-Dichlorobenzene	541-73-1	8260D	ND		25	20	ug/L	1
1,4-Dichlorobenzene	106-46-7	8260D	ND		25	20	ug/L	1
Dichlorodifluoromethane	75-71-8	8260D	ND		25	20	ug/L	1
1,1-Dichloroethane	75-34-3	8260D	ND		25	20	ug/L	1
1,2-Dichloroethane	107-06-2	8260D	ND		25	20	ug/L	1
1,1-Dichloroethene	75-35-4	8260D	ND		25	20	ug/L	1
cis-1,2-Dichloroethene	156-59-2	8260D	ND		25	20	ug/L	1
trans-1,2-Dichloroethene	156-60-5	8260D	ND		25	20	ug/L	1
1,2-Dichloropropane	78-87-5	8260D	ND		25	20	ug/L	1
cis-1,3-Dichloropropene	10061-01-5	8260D	ND		25	20	ug/L	1
trans-1,3-Dichloropropene	10061-02-6	8260D	ND		25	20	ug/L	1
1,4-Dioxane	123-91-1	8260D	ND	L	1000	670	ug/L	1
Ethylbenzene	100-41-4	8260D	570		25	20	ug/L	1
2-Hexanone	591-78-6	8260D	ND		500	100	ug/L	1
Isopropylbenzene	98-82-8	8260D	ND		25	20	ug/L	1
Methyl acetate	79-20-9	8260D	ND		50	20	ug/L	1
Methyl tertiary butyl ether (MTBE)	1634-04-4	8260D	ND		25	20	ug/L	1
4-Methyl-2-pentanone	108-10-1	8260D	ND		500	100	ug/L	1
Methylcyclohexane	108-87-2	8260D	28	J	250	20	ug/L	1
Methylene chloride	75-09-2	8260D	ND		25	20	ug/L	1
Naphthalene	91-20-3	8260D	ND		25	20	ug/L	1
Styrene	100-42-5	8260D	ND		25	21	ug/L	1
1,1,2,2-Tetrachloroethane	79-34-5	8260D	ND		25	20	ug/L	1
Tetrachloroethene	127-18-4	8260D	ND		25	20	ug/L	1
Toluene	108-88-3	8260D	20	J	25	20	ug/L	1
1,1,2-Trichloro-1,2,2-Trifluoroethane	76-13-1	8260D	ND		50	21	ug/L	1

LOQ = Limit of Quantitation
ND = Not detected at or above the DL
H = Out of holding time
B = Detected in the method blank
N = Recovery is out of criteria
W = Reported on wet weight basis
E = Quantitation of compound exceeded the calibration range
P = The RPD between two GC columns exceeds 40%
DL = Detection Limit
J = Estimated result < LOQ and ≥ DL
Q = Surrogate failure
L = LCS/LCSD failure
S = MS/MSD failure

Volatile Organic Compounds by GC/MS

Client: Ramboll US Corporation
Laboratory ID: YI21013-001
Description: CMR-MW-105-092023
Matrix: Aqueous
Date Sampled: 09/20/2023 0925
Project Name: Calumet Refinery GW
Date Received: 09/21/2023
Project Number: 1690029636-001

Run	Prep Method	Analytical Method	Dilution	Analysis Date	Analyst	Prep Date	Batch
1	5030B	8260D	50	10/04/2023 1704	CCO		86531

Parameter	CAS Number	Analytical Method	Result	Q	LOQ	DL	Units	Run
1,2,3-Trichlorobenzene	87-61-6	8260D	ND		25	20	ug/L	1
1,2,4-Trichlorobenzene	120-82-1	8260D	ND		25	20	ug/L	1
1,1,1-Trichloroethane	71-55-6	8260D	ND		25	20	ug/L	1
1,1,2-Trichloroethane	79-00-5	8260D	ND		25	20	ug/L	1
Trichloroethene	79-01-6	8260D	ND		25	20	ug/L	1
Trichlorofluoromethane	75-69-4	8260D	ND		25	20	ug/L	1
Vinyl chloride	75-01-4	8260D	ND		25	20	ug/L	1
Xylenes (total)	1330-20-7	8260D	ND		50	20	ug/L	1
m+p - Xylenes	179601-23-1	8260D	ND		25	20	ug/L	1
o - Xylenes	95-47-6	8260D	ND		25	20	ug/L	1

Surrogate	Q	Run 1 % Recovery	Acceptance Limits
Bromofluorobenzene		99	70-130
1,2-Dichloroethane-d4		105	70-130
Toluene-d8		98	70-130

LOQ = Limit of Quantitation
ND = Not detected at or above the DL
H = Out of holding time
B = Detected in the method blank
N = Recovery is out of criteria
W = Reported on wet weight basis
E = Quantitation of compound exceeded the calibration range
P = The RPD between two GC columns exceeds 40%
DL = Detection Limit
J = Estimated result < LOQ and ≥ DL
Q = Surrogate failure
L = LCS/LCSD failure
S = MS/MSD failure

Pace Analytical Services, LLC *(formerly Shealy Environmental Services, Inc.)*
106 Vantage Point Drive West Columbia, SC 29172 (803) 791-9700 Fax (803) 791-9111 www.pacelabs.com

Semivolatile Organic Compounds by GC/MS

Client: Ramboll US Corporation | Laboratory ID: YI21013-001
Description: CMR-MW-105-092023 | Matrix: Aqueous
Date Sampled: 09/20/2023 0925 | Project Name: Calumet Refinery GW
Date Received: 09/21/2023 | Project Number: 1690029636-001

Run	Prep Method	Analytical Method	Dilution	Analysis Date	Analyst	Prep Date	Batch
1	3520C	8270E	5	10/03/2023 1526	JCG	09/27/2023 1348	85897

Parameter	CAS Number	Analytical Method	Result	Q	LOQ	DL	Units	Run
Acenaphthene	83-32-9	8270E	ND		0.80	0.20	ug/L	1
Acenaphthylene	208-96-8	8270E	ND		0.80	0.20	ug/L	1
Acetophenone	98-86-2	8270E	ND		4.0	1.2	ug/L	1
Anthracene	120-12-7	8270E	ND		0.80	0.20	ug/L	1
Atrazine	1912-24-9	8270E	ND		4.0	1.0	ug/L	1
Benzaldehyde	100-52-7	8270E	ND		20	1.4	ug/L	1
Benzo(a)anthracene	56-55-3	8270E	ND		0.80	0.20	ug/L	1
Benzo(a)pyrene	50-32-8	8270E	ND		0.80	0.20	ug/L	1
Benzo(b)fluoranthene	205-99-2	8270E	ND		0.80	0.20	ug/L	1
Benzo(g,h,i)perylene	191-24-2	8270E	ND		0.80	0.20	ug/L	1
Benzo(k)fluoranthene	207-08-9	8270E	ND		0.80	0.20	ug/L	1
1,1'-Biphenyl	92-52-4	8270E	ND		4.0	1.1	ug/L	1
4-Bromophenyl phenyl ether	101-55-3	8270E	ND		4.0	0.75	ug/L	1
Butyl benzyl phthalate	85-68-7	8270E	ND		20	1.1	ug/L	1
Caprolactam	105-60-2	8270E	ND		20	3.6	ug/L	1
Carbazole	86-74-8	8270E	ND		4.0	0.20	ug/L	1
bis (2-Chloro-1-methylethyl) ether	108-60-1	8270E	ND		4.0	0.85	ug/L	1
4-Chloro-3-methyl phenol	59-50-7	8270E	ND		4.0	1.3	ug/L	1
4-Chloroaniline	106-47-8	8270E	ND		4.0	0.65	ug/L	1
bis(2-Chloroethoxy)methane	111-91-1	8270E	ND		4.0	0.30	ug/L	1
bis(2-Chloroethyl)ether	111-44-4	8270E	ND		4.0	0.80	ug/L	1
2-Chloronaphthalene	91-58-7	8270E	ND		4.0	0.75	ug/L	1
2-Chlorophenol	95-57-8	8270E	ND		4.0	0.75	ug/L	1
4-Chlorophenyl phenyl ether	7005-72-3	8270E	ND		4.0	0.80	ug/L	1
Chrysene	218-01-9	8270E	ND		0.80	0.20	ug/L	1
Dibenzo(a,h)anthracene	53-70-3	8270E	ND		0.80	0.20	ug/L	1
Dibenzofuran	132-64-9	8270E	ND		4.0	0.80	ug/L	1
3,3'-Dichlorobenzidine	91-94-1	8270E	ND		20	4.1	ug/L	1
2,4-Dichlorophenol	120-83-2	8270E	ND		4.0	0.95	ug/L	1
Diethylphthalate	84-66-2	8270E	ND		20	0.95	ug/L	1
Dimethyl phthalate	131-11-3	8270E	ND		20	0.90	ug/L	1
2,4-Dimethylphenol	105-67-9	8270E	31	L	4.0	0.75	ug/L	1
Di-n-butyl phthalate	84-74-2	8270E	ND		20	2.1	ug/L	1
4,6-Dinitro-2-methylphenol	534-52-1	8270E	ND		20	4.5	ug/L	1
2,4-Dinitrophenol	51-28-5	8270E	ND		20	6.6	ug/L	1
2,4-Dinitrotoluene	121-14-2	8270E	ND		8.0	1.8	ug/L	1
2,6-Dinitrotoluene	606-20-2	8270E	ND		8.0	1.7	ug/L	1
Di-n-octylphthalate	117-84-0	8270E	ND		20	2.4	ug/L	1
bis(2-Ethylhexyl)phthalate	117-81-7	8270E	ND		20	7.5	ug/L	1
Fluoranthene	206-44-0	8270E	ND		0.80	0.20	ug/L	1
Fluorene	86-73-7	8270E	ND		0.80	0.20	ug/L	1
Hexachlorobenzene	118-74-1	8270E	ND		4.0	0.75	ug/L	1
Hexachlorobutadiene	87-68-3	8270E	ND		4.0	0.85	ug/L	1
Hexachlorocyclopentadiene	77-47-4	8270E	ND		20	5.5	ug/L	1

LOQ = Limit of Quantitation | B = Detected in the method blank | E = Quantitation of compound exceeded the calibration range | DL = Detection Limit | Q = Surrogate failure
ND = Not detected at or above the DL | N = Recovery is out of criteria | P = The RPD between two GC columns exceeds 40% | J = Estimated result < LOQ and ≥ DL | L = LCS/LCSD failure
H = Out of holding time | W = Reported on wet weight basis | S = MS/MSD failure

Semivolatile Organic Compounds by GC/MS

Client: Ramboll US Corporation | Laboratory ID: YI21013-001
Description: CMR-MW-105-092023 | Matrix: Aqueous
Date Sampled: 09/20/2023 0925 | Project Name: Calumet Refinery GW
Date Received: 09/21/2023 | Project Number: 1690029636-001

Run	Prep Method	Analytical Method	Dilution	Analysis Date	Analyst	Prep Date	Batch
1	3520C	8270E	5	10/03/2023 1526	JCG	09/27/2023 1348	85897

Parameter	CAS Number	Analytical Method	Result	Q	LOQ	DL	Units	Run
Hexachloroethane	67-72-1	8270E	ND		4.0	0.85	ug/L	1
Indeno(1,2,3-c,d)pyrene	193-39-5	8270E	ND		0.80	0.20	ug/L	1
Isophorone	78-59-1	8270E	ND		4.0	1.1	ug/L	1
1-Methylnaphthalene	90-12-0	8270E	4.0		0.80	0.20	ug/L	1
2-Methylnaphthalene	91-57-6	8270E	0.29	J	0.80	0.20	ug/L	1
2-Methylphenol	95-48-7	8270E	ND		4.0	1.1	ug/L	1
3+4-Methylphenol	106-44-5	8270E	ND		8.0	2.3	ug/L	1
Naphthalene	91-20-3	8270E	4.0		0.80	0.20	ug/L	1
2-Nitroaniline	88-74-4	8270E	ND		8.0	3.3	ug/L	1
3-Nitroaniline	99-09-2	8270E	ND		8.0	0.75	ug/L	1
4-Nitroaniline	100-01-6	8270E	ND		8.0	6.6	ug/L	1
Nitrobenzene	98-95-3	8270E	ND		4.0	0.85	ug/L	1
2-Nitrophenol	88-75-5	8270E	ND		8.0	2.2	ug/L	1
4-Nitrophenol	100-02-7	8270E	ND		20	10	ug/L	1
N-Nitrosodi-n-propylamine	621-64-7	8270E	ND		4.0	1.4	ug/L	1
N-Nitrosodiphenylamine (Diphenylamine)	86-30-6	8270E	ND		4.0	2.5	ug/L	1
Pentachlorophenol	87-86-5	8270E	ND		20	6.7	ug/L	1
Phenanthrene	85-01-8	8270E	ND		0.80	0.20	ug/L	1
Phenol	108-95-2	8270E	3.3	J	4.0	0.95	ug/L	1
Pyrene	129-00-0	8270E	ND		0.80	0.20	ug/L	1
2,4,5-Trichlorophenol	95-95-4	8270E	ND		4.0	0.95	ug/L	1
2,4,6-Trichlorophenol	88-06-2	8270E	ND		4.0	1.1	ug/L	1

Surrogate	Q	Run 1 % Recovery	Acceptance Limits
2-Fluorobiphenyl		77	37-129
2-Fluorophenol		36	24-127
Nitrobenzene-d5		75	38-127
Phenol-d5		42	28-128
Terphenyl-d14		80	10-148
2,4,6-Tribromophenol		90	35-144

LOQ = Limit of Quantitation
ND = Not detected at or above the DL
H = Out of holding time
B = Detected in the method blank
N = Recovery is out of criteria
W = Reported on wet weight basis
E = Quantitation of compound exceeded the calibration range
P = The RPD between two GC columns exceeds 40%
DL = Detection Limit
J = Estimated result < LOQ and ≥ DL
Q = Surrogate failure
L = LCS/LCSD failure
S = MS/MSD failure

Volatile Organic Compounds by GC/MS

Client: Ramboll US Corporation
Laboratory ID: YI21013-002
Description: CMR-MW-106-092023
Matrix: Aqueous
Date Sampled: 09/20/2023 0955
Project Name: Calumet Refinery GW
Date Received: 09/21/2023
Project Number: 1690029636-001

Run	Prep Method	Analytical Method	Dilution	Analysis Date	Analyst	Prep Date	Batch
1	5030B	8260D	1	10/04/2023 1109	CCO		86531

Parameter	CAS Number	Analytical Method	Result	Q	LOQ	DL	Units	Run
Acetone	67-64-1	8260D	13		10	4.0	ug/L	1
Benzene	71-43-2	8260D	ND		0.50	0.40	ug/L	1
Bromochloromethane	74-97-5	8260D	ND		0.50	0.40	ug/L	1
Bromodichloromethane	75-27-4	8260D	ND		0.50	0.40	ug/L	1
Bromoform	75-25-2	8260D	ND		0.50	0.40	ug/L	1
Bromomethane (Methyl bromide)	74-83-9	8260D	ND		0.50	0.40	ug/L	1
2-Butanone (MEK)	78-93-3	8260D	ND		10	2.0	ug/L	1
Carbon disulfide	75-15-0	8260D	ND		0.50	0.40	ug/L	1
Carbon tetrachloride	56-23-5	8260D	ND		0.50	0.40	ug/L	1
Chlorobenzene	108-90-7	8260D	ND		0.50	0.40	ug/L	1
Chloroethane	75-00-3	8260D	ND		0.50	0.40	ug/L	1
Chloroform	67-66-3	8260D	ND		0.50	0.40	ug/L	1
Chloromethane (Methyl chloride)	74-87-3	8260D	ND		0.50	0.40	ug/L	1
Cyclohexane	110-82-7	8260D	1.7		0.50	0.40	ug/L	1
1,2-Dibromo-3-chloropropane (DBCP)	96-12-8	8260D	ND		0.50	0.40	ug/L	1
Dibromochloromethane	124-48-1	8260D	ND		0.50	0.40	ug/L	1
1,2-Dibromoethane (EDB)	106-93-4	8260D	ND		0.50	0.40	ug/L	1
1,2-Dichlorobenzene	95-50-1	8260D	ND		0.50	0.40	ug/L	1
1,3-Dichlorobenzene	541-73-1	8260D	ND		0.50	0.40	ug/L	1
1,4-Dichlorobenzene	106-46-7	8260D	ND		0.50	0.40	ug/L	1
Dichlorodifluoromethane	75-71-8	8260D	ND		0.50	0.40	ug/L	1
1,1-Dichloroethane	75-34-3	8260D	ND		0.50	0.40	ug/L	1
1,2-Dichloroethane	107-06-2	8260D	ND		0.50	0.40	ug/L	1
1,1-Dichloroethene	75-35-4	8260D	ND		0.50	0.40	ug/L	1
cis-1,2-Dichloroethene	156-59-2	8260D	ND		0.50	0.40	ug/L	1
trans-1,2-Dichloroethene	156-60-5	8260D	ND		0.50	0.40	ug/L	1
1,2-Dichloropropane	78-87-5	8260D	ND		0.50	0.40	ug/L	1
cis-1,3-Dichloropropene	10061-01-5	8260D	ND		0.50	0.40	ug/L	1
trans-1,3-Dichloropropene	10061-02-6	8260D	ND		0.50	0.40	ug/L	1
1,4-Dioxane	123-91-1	8260D	ND	L	20	13	ug/L	1
Ethylbenzene	100-41-4	8260D	ND		0.50	0.40	ug/L	1
2-Hexanone	591-78-6	8260D	ND		10	2.0	ug/L	1
Isopropylbenzene	98-82-8	8260D	ND		0.50	0.40	ug/L	1
Methyl acetate	79-20-9	8260D	ND		1.0	0.40	ug/L	1
Methyl tertiary butyl ether (MTBE)	1634-04-4	8260D	ND		0.50	0.40	ug/L	1
4-Methyl-2-pentanone	108-10-1	8260D	3.8	J	10	2.0	ug/L	1
Methylcyclohexane	108-87-2	8260D	0.50	J	5.0	0.40	ug/L	1
Methylene chloride	75-09-2	8260D	ND		0.50	0.40	ug/L	1
Naphthalene	91-20-3	8260D	ND		0.50	0.40	ug/L	1
Styrene	100-42-5	8260D	ND		0.50	0.41	ug/L	1
1,1,2,2-Tetrachloroethane	79-34-5	8260D	ND		0.50	0.40	ug/L	1
Tetrachloroethene	127-18-4	8260D	ND		0.50	0.40	ug/L	1
Toluene	108-88-3	8260D	ND		0.50	0.40	ug/L	1
1,1,2-Trichloro-1,2,2-Trifluoroethane	76-13-1	8260D	ND		1.0	0.42	ug/L	1

LOQ = Limit of Quantitation
B = Detected in the method blank
E = Quantitation of compound exceeded the calibration range
DL = Detection Limit
Q = Surrogate failure
ND = Not detected at or above the DL
N = Recovery is out of criteria
P = The RPD between two GC columns exceeds 40%
J = Estimated result < LOQ and ≥ DL
L = LCS/LCSD failure
H = Out of holding time
W = Reported on wet weight basis
S = MS/MSD failure

Volatile Organic Compounds by GC/MS

Client: Ramboll US Corporation
Laboratory ID: YI21013-002
Description: CMR-MW-106-092023
Matrix: Aqueous
Date Sampled: 09/20/2023 0955
Project Name: Calumet Refinery GW
Date Received: 09/21/2023
Project Number: 1690029636-001

Run	Prep Method	Analytical Method	Dilution	Analysis Date	Analyst	Prep Date	Batch
1	5030B	8260D	1	10/04/2023 1109	CCO		86531

Parameter	CAS Number	Analytical Method	Result	Q	LOQ	DL	Units	Run
1,2,3-Trichlorobenzene	87-61-6	8260D	ND		0.50	0.40	ug/L	1
1,2,4-Trichlorobenzene	120-82-1	8260D	ND		0.50	0.40	ug/L	1
1,1,1-Trichloroethane	71-55-6	8260D	ND		0.50	0.40	ug/L	1
1,1,2-Trichloroethane	79-00-5	8260D	ND		0.50	0.40	ug/L	1
Trichloroethene	79-01-6	8260D	ND		0.50	0.40	ug/L	1
Trichlorofluoromethane	75-69-4	8260D	ND		0.50	0.40	ug/L	1
Vinyl chloride	75-01-4	8260D	ND		0.50	0.40	ug/L	1
Xylenes (total)	1330-20-7	8260D	ND		1.0	0.40	ug/L	1
m+p - Xylenes	179601-23-1	8260D	ND		0.50	0.40	ug/L	1
o - Xylenes	95-47-6	8260D	ND		0.50	0.40	ug/L	1

Surrogate	Q	Run 1 % Recovery	Acceptance Limits
Bromofluorobenzene		108	70-130
1,2-Dichloroethane-d4		114	70-130
Toluene-d8		105	70-130

LOQ = Limit of Quantitation
ND = Not detected at or above the DL
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Semivolatile Organic Compounds by GC/MS

Client: Ramboll US Corporation | Laboratory ID: YI21013-002
Description: CMR-MW-106-092023 | Matrix: Aqueous
Date Sampled: 09/20/2023 0955 | Project Name: Calumet Refinery GW
Date Received: 09/21/2023 | Project Number: 1690029636-001

Run	Prep Method	Analytical Method	Dilution	Analysis Date	Analyst	Prep Date	Batch
1	3520C	8270E	5	10/03/2023 1550	JCG	09/27/2023 1348	85897

Parameter	CAS Number	Analytical Method	Result	Q	LOQ	DL	Units	Run
Acenaphthene	83-32-9	8270E	ND		0.80	0.20	ug/L	1
Acenaphthylene	208-96-8	8270E	ND		0.80	0.20	ug/L	1
Acetophenone	98-86-2	8270E	ND		4.0	1.2	ug/L	1
Anthracene	120-12-7	8270E	ND		0.80	0.20	ug/L	1
Atrazine	1912-24-9	8270E	ND		4.0	1.0	ug/L	1
Benzaldehyde	100-52-7	8270E	ND		20	1.4	ug/L	1
Benzo(a)anthracene	56-55-3	8270E	ND		0.80	0.20	ug/L	1
Benzo(a)pyrene	50-32-8	8270E	ND		0.80	0.20	ug/L	1
Benzo(b)fluoranthene	205-99-2	8270E	ND		0.80	0.20	ug/L	1
Benzo(g,h,i)perylene	191-24-2	8270E	ND		0.80	0.20	ug/L	1
Benzo(k)fluoranthene	207-08-9	8270E	ND		0.80	0.20	ug/L	1
1,1'-Biphenyl	92-52-4	8270E	ND		4.0	1.1	ug/L	1
4-Bromophenyl phenyl ether	101-55-3	8270E	ND		4.0	0.75	ug/L	1
Butyl benzyl phthalate	85-68-7	8270E	ND		20	1.1	ug/L	1
Caprolactam	105-60-2	8270E	ND		20	3.6	ug/L	1
Carbazole	86-74-8	8270E	ND		4.0	0.20	ug/L	1
bis (2-Chloro-1-methylethyl) ether	108-60-1	8270E	ND		4.0	0.85	ug/L	1
4-Chloro-3-methyl phenol	59-50-7	8270E	ND		4.0	1.3	ug/L	1
4-Chloroaniline	106-47-8	8270E	ND		4.0	0.65	ug/L	1
bis(2-Chloroethoxy)methane	111-91-1	8270E	ND		4.0	0.30	ug/L	1
bis(2-Chloroethyl)ether	111-44-4	8270E	ND		4.0	0.80	ug/L	1
2-Chloronaphthalene	91-58-7	8270E	ND		4.0	0.75	ug/L	1
2-Chlorophenol	95-57-8	8270E	ND		4.0	0.75	ug/L	1
4-Chlorophenyl phenyl ether	7005-72-3	8270E	ND		4.0	0.80	ug/L	1
Chrysene	218-01-9	8270E	ND		0.80	0.20	ug/L	1
Dibenzo(a,h)anthracene	53-70-3	8270E	ND		0.80	0.20	ug/L	1
Dibenzofuran	132-64-9	8270E	ND		4.0	0.80	ug/L	1
3,3'-Dichlorobenzidine	91-94-1	8270E	ND		20	4.1	ug/L	1
2,4-Dichlorophenol	120-83-2	8270E	ND		4.0	0.95	ug/L	1
Diethylphthalate	84-66-2	8270E	ND		20	0.95	ug/L	1
Dimethyl phthalate	131-11-3	8270E	ND		20	0.90	ug/L	1
2,4-Dimethylphenol	105-67-9	8270E	ND	L	4.0	0.75	ug/L	1
Di-n-butyl phthalate	84-74-2	8270E	ND		20	2.1	ug/L	1
4,6-Dinitro-2-methylphenol	534-52-1	8270E	ND		20	4.5	ug/L	1
2,4-Dinitrophenol	51-28-5	8270E	ND		20	6.6	ug/L	1
2,4-Dinitrotoluene	121-14-2	8270E	ND		8.0	1.8	ug/L	1
2,6-Dinitrotoluene	606-20-2	8270E	ND		8.0	1.7	ug/L	1
Di-n-octylphthalate	117-84-0	8270E	ND		20	2.4	ug/L	1
bis(2-Ethylhexyl)phthalate	117-81-7	8270E	ND		20	7.5	ug/L	1
Fluoranthene	206-44-0	8270E	ND		0.80	0.20	ug/L	1
Fluorene	86-73-7	8270E	ND		0.80	0.20	ug/L	1
Hexachlorobenzene	118-74-1	8270E	ND		4.0	0.75	ug/L	1
Hexachlorobutadiene	87-68-3	8270E	ND		4.0	0.85	ug/L	1
Hexachlorocyclopentadiene	77-47-4	8270E	ND		20	5.5	ug/L	1

LOQ = Limit of Quantitation
ND = Not detected at or above the DL
H = Out of holding time
B = Detected in the method blank
N = Recovery is out of criteria
W = Reported on wet weight basis
E = Quantitation of compound exceeded the calibration range
P = The RPD between two GC columns exceeds 40%
DL = Detection Limit
J = Estimated result < LOQ and ≥ DL
Q = Surrogate failure
L = LCS/LCSD failure
S = MS/MSD failure

Semivolatile Organic Compounds by GC/MS

Client: Ramboll US Corporation | Laboratory ID: YI21013-002
Description: CMR-MW-106-092023 | Matrix: Aqueous
Date Sampled: 09/20/2023 0955 | Project Name: Calumet Refinery GW
Date Received: 09/21/2023 | Project Number: 1690029636-001

Run	Prep Method	Analytical Method	Dilution	Analysis Date	Analyst	Prep Date	Batch
1	3520C	8270E	5	10/03/2023 1550	JCG	09/27/2023 1348	85897

Parameter	CAS Number	Analytical Method	Result	Q	LOQ	DL	Units	Run
Hexachloroethane	67-72-1	8270E	ND		4.0	0.85	ug/L	1
Indeno(1,2,3-c,d)pyrene	193-39-5	8270E	ND		0.80	0.20	ug/L	1
Isophorone	78-59-1	8270E	ND		4.0	1.1	ug/L	1
1-Methylnaphthalene	90-12-0	8270E	ND		0.80	0.20	ug/L	1
2-Methylnaphthalene	91-57-6	8270E	ND		0.80	0.20	ug/L	1
2-Methylphenol	95-48-7	8270E	ND		4.0	1.1	ug/L	1
3+4-Methylphenol	106-44-5	8270E	ND		8.0	2.3	ug/L	1
Naphthalene	91-20-3	8270E	ND		0.80	0.20	ug/L	1
2-Nitroaniline	88-74-4	8270E	ND		8.0	3.3	ug/L	1
3-Nitroaniline	99-09-2	8270E	ND		8.0	0.75	ug/L	1
4-Nitroaniline	100-01-6	8270E	ND		8.0	6.6	ug/L	1
Nitrobenzene	98-95-3	8270E	ND		4.0	0.85	ug/L	1
2-Nitrophenol	88-75-5	8270E	ND		8.0	2.2	ug/L	1
4-Nitrophenol	100-02-7	8270E	ND		20	10	ug/L	1
N-Nitrosodi-n-propylamine	621-64-7	8270E	ND		4.0	1.4	ug/L	1
N-Nitrosodiphenylamine (Diphenylamine)	86-30-6	8270E	ND		4.0	2.5	ug/L	1
Pentachlorophenol	87-86-5	8270E	ND		20	6.7	ug/L	1
Phenanthrene	85-01-8	8270E	ND		0.80	0.20	ug/L	1
Phenol	108-95-2	8270E	ND		4.0	0.95	ug/L	1
Pyrene	129-00-0	8270E	ND		0.80	0.20	ug/L	1
2,4,5-Trichlorophenol	95-95-4	8270E	ND		4.0	0.95	ug/L	1
2,4,6-Trichlorophenol	88-06-2	8270E	ND		4.0	1.1	ug/L	1

Surrogate	Q	Run 1 % Recovery	Acceptance Limits
2-Fluorobiphenyl		81	37-129
2-Fluorophenol		50	24-127
Nitrobenzene-d5		80	38-127
Phenol-d5		64	28-128
Terphenyl-d14		55	10-148
2,4,6-Tribromophenol		87	35-144

LOQ = Limit of Quantitation
ND = Not detected at or above the DL
H = Out of holding time
B = Detected in the method blank
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E = Quantitation of compound exceeded the calibration range
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DL = Detection Limit
J = Estimated result < LOQ and ≥ DL
Q = Surrogate failure
L = LCS/LCSD failure
S = MS/MSD failure

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Volatile Organic Compounds by GC/MS

Client: Ramboll US Corporation | Laboratory ID: YI21013-003
Description: CMR-MW-41S-092023 | Matrix: Aqueous
Date Sampled: 09/20/2023 1020 | Project Name: Calumet Refinery GW
Date Received: 09/21/2023 | Project Number: 1690029636-001

Run	Prep Method	Analytical Method	Dilution	Analysis Date	Analyst	Prep Date	Batch
1	5030B	8260D	50	10/04/2023 1729	CCO		86531

Parameter	CAS Number	Analytical Method	Result	Q	LOQ	DL	Units	Run
Acetone	67-64-1	8260D	ND		500	200	ug/L	1
Benzene	71-43-2	8260D	470		25	20	ug/L	1
Bromochloromethane	74-97-5	8260D	ND		25	20	ug/L	1
Bromodichloromethane	75-27-4	8260D	ND		25	20	ug/L	1
Bromoform	75-25-2	8260D	ND		25	20	ug/L	1
Bromomethane (Methyl bromide)	74-83-9	8260D	ND		25	20	ug/L	1
2-Butanone (MEK)	78-93-3	8260D	ND		500	100	ug/L	1
Carbon disulfide	75-15-0	8260D	ND		25	20	ug/L	1
Carbon tetrachloride	56-23-5	8260D	ND		25	20	ug/L	1
Chlorobenzene	108-90-7	8260D	ND		25	20	ug/L	1
Chloroethane	75-00-3	8260D	ND		25	20	ug/L	1
Chloroform	67-66-3	8260D	ND		25	20	ug/L	1
Chloromethane (Methyl chloride)	74-87-3	8260D	ND		25	20	ug/L	1
Cyclohexane	110-82-7	8260D	45		25	20	ug/L	1
1,2-Dibromo-3-chloropropane (DBCP)	96-12-8	8260D	ND		25	20	ug/L	1
Dibromochloromethane	124-48-1	8260D	ND		25	20	ug/L	1
1,2-Dibromoethane (EDB)	106-93-4	8260D	ND		25	20	ug/L	1
1,2-Dichlorobenzene	95-50-1	8260D	ND		25	20	ug/L	1
1,3-Dichlorobenzene	541-73-1	8260D	ND		25	20	ug/L	1
1,4-Dichlorobenzene	106-46-7	8260D	ND		25	20	ug/L	1
Dichlorodifluoromethane	75-71-8	8260D	ND		25	20	ug/L	1
1,1-Dichloroethane	75-34-3	8260D	ND		25	20	ug/L	1
1,2-Dichloroethane	107-06-2	8260D	ND		25	20	ug/L	1
1,1-Dichloroethene	75-35-4	8260D	ND		25	20	ug/L	1
cis-1,2-Dichloroethene	156-59-2	8260D	ND		25	20	ug/L	1
trans-1,2-Dichloroethene	156-60-5	8260D	ND		25	20	ug/L	1
1,2-Dichloropropane	78-87-5	8260D	ND		25	20	ug/L	1
cis-1,3-Dichloropropene	10061-01-5	8260D	ND		25	20	ug/L	1
trans-1,3-Dichloropropene	10061-02-6	8260D	ND		25	20	ug/L	1
1,4-Dioxane	123-91-1	8260D	ND	L	1000	670	ug/L	1
Ethylbenzene	100-41-4	8260D	170		25	20	ug/L	1
2-Hexanone	591-78-6	8260D	ND		500	100	ug/L	1
Isopropylbenzene	98-82-8	8260D	ND		25	20	ug/L	1
Methyl acetate	79-20-9	8260D	ND		50	20	ug/L	1
Methyl tertiary butyl ether (MTBE)	1634-04-4	8260D	ND		25	20	ug/L	1
4-Methyl-2-pentanone	108-10-1	8260D	ND		500	100	ug/L	1
Methylcyclohexane	108-87-2	8260D	33	J	250	20	ug/L	1
Methylene chloride	75-09-2	8260D	ND		25	20	ug/L	1
Naphthalene	91-20-3	8260D	30		25	20	ug/L	1
Styrene	100-42-5	8260D	ND		25	21	ug/L	1
1,1,2,2-Tetrachloroethane	79-34-5	8260D	ND		25	20	ug/L	1
Tetrachloroethene	127-18-4	8260D	ND		25	20	ug/L	1
Toluene	108-88-3	8260D	ND		25	20	ug/L	1
1,1,2-Trichloro-1,2,2-Trifluoroethane	76-13-1	8260D	ND		50	21	ug/L	1

LOQ = Limit of Quantitation
B = Detected in the method blank
E = Quantitation of compound exceeded the calibration range
DL = Detection Limit
Q = Surrogate failure
ND = Not detected at or above the DL
N = Recovery is out of criteria
P = The RPD between two GC columns exceeds 40%
J = Estimated result < LOQ and ≥ DL
L = LCS/LCSD failure
H = Out of holding time
W = Reported on wet weight basis
S = MS/MSD failure

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Volatile Organic Compounds by GC/MS

Client: Ramboll US Corporation
Laboratory ID: YI21013-003
Description: CMR-MW-41S-092023
Matrix: Aqueous
Date Sampled: 09/20/2023 1020
Project Name: Calumet Refinery GW
Date Received: 09/21/2023
Project Number: 1690029636-001

Run	Prep Method	Analytical Method	Dilution	Analysis Date	Analyst	Prep Date	Batch
1	5030B	8260D	50	10/04/2023 1729	CCO		86531

Parameter	CAS Number	Analytical Method	Result	Q	LOQ	DL	Units	Run
1,2,3-Trichlorobenzene	87-61-6	8260D	ND		25	20	ug/L	1
1,2,4-Trichlorobenzene	120-82-1	8260D	ND		25	20	ug/L	1
1,1,1-Trichloroethane	71-55-6	8260D	ND		25	20	ug/L	1
1,1,2-Trichloroethane	79-00-5	8260D	ND		25	20	ug/L	1
Trichloroethene	79-01-6	8260D	ND		25	20	ug/L	1
Trichlorofluoromethane	75-69-4	8260D	ND		25	20	ug/L	1
Vinyl chloride	75-01-4	8260D	ND		25	20	ug/L	1
Xylenes (total)	1330-20-7	8260D	790		50	20	ug/L	1
m+p - Xylenes	179601-23-1	8260D	590		25	20	ug/L	1
o - Xylenes	95-47-6	8260D	200		25	20	ug/L	1

Surrogate	Q	Run 1 % Recovery	Acceptance Limits
Bromofluorobenzene		105	70-130
1,2-Dichloroethane-d4		112	70-130
Toluene-d8		104	70-130

LOQ = Limit of Quantitation
ND = Not detected at or above the DL
H = Out of holding time
B = Detected in the method blank
N = Recovery is out of criteria
W = Reported on wet weight basis
E = Quantitation of compound exceeded the calibration range
P = The RPD between two GC columns exceeds 40%
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Semivolatile Organic Compounds by GC/MS

Client: Ramboll US Corporation | Laboratory ID: YI21013-003
Description: CMR-MW-41S-092023 | Matrix: Aqueous
Date Sampled: 09/20/2023 1020 | Project Name: Calumet Refinery GW
Date Received: 09/21/2023 | Project Number: 1690029636-001

Run	Prep Method	Analytical Method	Dilution	Analysis Date	Analyst	Prep Date	Batch
1	3520C	8270E	5	10/03/2023 1613	JCG	09/27/2023 1348	85897

Parameter	CAS Number	Analytical Method	Result	Q	LOQ	DL	Units	Run
Acenaphthene	83-32-9	8270E	0.65	JQ	0.80	0.20	ug/L	1
Acenaphthylene	208-96-8	8270E	ND	Q	0.80	0.20	ug/L	1
Acetophenone	98-86-2	8270E	ND	Q	4.0	1.2	ug/L	1
Anthracene	120-12-7	8270E	ND	Q	0.80	0.20	ug/L	1
Atrazine	1912-24-9	8270E	ND	Q	4.0	1.0	ug/L	1
Benzaldehyde	100-52-7	8270E	ND	Q	20	1.4	ug/L	1
Benzo(a)anthracene	56-55-3	8270E	ND	Q	0.80	0.20	ug/L	1
Benzo(a)pyrene	50-32-8	8270E	ND	Q	0.80	0.20	ug/L	1
Benzo(b)fluoranthene	205-99-2	8270E	ND	Q	0.80	0.20	ug/L	1
Benzo(g,h,i)perylene	191-24-2	8270E	ND	Q	0.80	0.20	ug/L	1
Benzo(k)fluoranthene	207-08-9	8270E	ND	Q	0.80	0.20	ug/L	1
1,1'-Biphenyl	92-52-4	8270E	ND	Q	4.0	1.1	ug/L	1
4-Bromophenyl phenyl ether	101-55-3	8270E	ND	Q	4.0	0.75	ug/L	1
Butyl benzyl phthalate	85-68-7	8270E	ND	Q	20	1.1	ug/L	1
Caprolactam	105-60-2	8270E	ND	Q	20	3.6	ug/L	1
Carbazole	86-74-8	8270E	ND	Q	4.0	0.20	ug/L	1
bis (2-Chloro-1-methylethyl) ether	108-60-1	8270E	ND	Q	4.0	0.85	ug/L	1
4-Chloro-3-methyl phenol	59-50-7	8270E	ND	Q	4.0	1.3	ug/L	1
4-Chloroaniline	106-47-8	8270E	ND	Q	4.0	0.65	ug/L	1
bis(2-Chloroethoxy)methane	111-91-1	8270E	ND	Q	4.0	0.30	ug/L	1
bis(2-Chloroethyl)ether	111-44-4	8270E	ND	Q	4.0	0.80	ug/L	1
2-Chloronaphthalene	91-58-7	8270E	ND	Q	4.0	0.75	ug/L	1
2-Chlorophenol	95-57-8	8270E	ND	Q	4.0	0.75	ug/L	1
4-Chlorophenyl phenyl ether	7005-72-3	8270E	ND	Q	4.0	0.80	ug/L	1
Chrysene	218-01-9	8270E	ND	Q	0.80	0.20	ug/L	1
Dibenzo(a,h)anthracene	53-70-3	8270E	ND	Q	0.80	0.20	ug/L	1
Dibenzofuran	132-64-9	8270E	ND	Q	4.0	0.80	ug/L	1
3,3'-Dichlorobenzidine	91-94-1	8270E	ND	Q	20	4.1	ug/L	1
2,4-Dichlorophenol	120-83-2	8270E	ND	Q	4.0	0.95	ug/L	1
Diethylphthalate	84-66-2	8270E	ND	Q	20	0.95	ug/L	1
Dimethyl phthalate	131-11-3	8270E	ND	Q	20	0.90	ug/L	1
2,4-Dimethylphenol	105-67-9	8270E	75	QL	4.0	0.75	ug/L	1
Di-n-butyl phthalate	84-74-2	8270E	ND	Q	20	2.1	ug/L	1
4,6-Dinitro-2-methylphenol	534-52-1	8270E	ND	Q	20	4.5	ug/L	1
2,4-Dinitrophenol	51-28-5	8270E	ND	Q	20	6.6	ug/L	1
2,4-Dinitrotoluene	121-14-2	8270E	ND	Q	8.0	1.8	ug/L	1
2,6-Dinitrotoluene	606-20-2	8270E	ND	Q	8.0	1.7	ug/L	1
Di-n-octylphthalate	117-84-0	8270E	ND	Q	20	2.4	ug/L	1
bis(2-Ethylhexyl)phthalate	117-81-7	8270E	ND	Q	20	7.5	ug/L	1
Fluoranthene	206-44-0	8270E	ND	Q	0.80	0.20	ug/L	1
Fluorene	86-73-7	8270E	1.4	Q	0.80	0.20	ug/L	1
Hexachlorobenzene	118-74-1	8270E	ND	Q	4.0	0.75	ug/L	1
Hexachlorobutadiene	87-68-3	8270E	ND	Q	4.0	0.85	ug/L	1
Hexachlorocyclopentadiene	77-47-4	8270E	ND	Q	20	5.5	ug/L	1

LOQ = Limit of Quantitation
ND = Not detected at or above the DL
H = Out of holding time
B = Detected in the method blank
N = Recovery is out of criteria
W = Reported on wet weight basis
E = Quantitation of compound exceeded the calibration range
P = The RPD between two GC columns exceeds 40%
DL = Detection Limit
J = Estimated result < LOQ and ≥ DL
Q = Surrogate failure
L = LCS/LCSD failure
S = MS/MSD failure

Semivolatile Organic Compounds by GC/MS

Client: Ramboll US Corporation | Laboratory ID: YI21013-003
Description: CMR-MW-41S-092023 | Matrix: Aqueous
Date Sampled: 09/20/2023 1020 | Project Name: Calumet Refinery GW
Date Received: 09/21/2023 | Project Number: 1690029636-001

Run	Prep Method	Analytical Method	Dilution	Analysis Date	Analyst	Prep Date	Batch
1	3520C	8270E	5	10/03/2023 1613	JCG	09/27/2023 1348	85897

Parameter	CAS Number	Analytical Method	Result	Q	LOQ	DL	Units	Run
Hexachloroethane	67-72-1	8270E	ND	Q	4.0	0.85	ug/L	1
Indeno(1,2,3-c,d)pyrene	193-39-5	8270E	ND	Q	0.80	0.20	ug/L	1
Isophorone	78-59-1	8270E	ND	Q	4.0	1.1	ug/L	1
1-Methylnaphthalene	90-12-0	8270E	7.3	Q	0.80	0.20	ug/L	1
2-Methylnaphthalene	91-57-6	8270E	0.74	JQ	0.80	0.20	ug/L	1
2-Methylphenol	95-48-7	8270E	ND	Q	4.0	1.1	ug/L	1
3+4-Methylphenol	106-44-5	8270E	ND	Q	8.0	2.3	ug/L	1
Naphthalene	91-20-3	8270E	6.9	Q	0.80	0.20	ug/L	1
2-Nitroaniline	88-74-4	8270E	ND	Q	8.0	3.3	ug/L	1
3-Nitroaniline	99-09-2	8270E	ND	Q	8.0	0.75	ug/L	1
4-Nitroaniline	100-01-6	8270E	ND	Q	8.0	6.6	ug/L	1
Nitrobenzene	98-95-3	8270E	ND	Q	4.0	0.85	ug/L	1
2-Nitrophenol	88-75-5	8270E	ND	Q	8.0	2.2	ug/L	1
4-Nitrophenol	100-02-7	8270E	ND	Q	20	10	ug/L	1
N-Nitrosodi-n-propylamine	621-64-7	8270E	ND	Q	4.0	1.4	ug/L	1
N-Nitrosodiphenylamine (Diphenylamine)	86-30-6	8270E	ND	Q	4.0	2.5	ug/L	1
Pentachlorophenol	87-86-5	8270E	ND	Q	20	6.7	ug/L	1
Phenanthrene	85-01-8	8270E	ND	Q	0.80	0.20	ug/L	1
Phenol	108-95-2	8270E	15	Q	4.0	0.95	ug/L	1
Pyrene	129-00-0	8270E	ND	Q	0.80	0.20	ug/L	1
2,4,5-Trichlorophenol	95-95-4	8270E	ND	Q	4.0	0.95	ug/L	1
2,4,6-Trichlorophenol	88-06-2	8270E	ND	Q	4.0	1.1	ug/L	1

Surrogate	Q	Run 1 % Recovery	Acceptance Limits
2-Fluorobiphenyl		64	37-129
2-Fluorophenol	N	17	24-127
Nitrobenzene-d5	N	142	38-127
Phenol-d5		56	28-128
Terphenyl-d14		56	10-148
2,4,6-Tribromophenol		99	35-144

LOQ = Limit of Quantitation
ND = Not detected at or above the DL
H = Out of holding time
B = Detected in the method blank
N = Recovery is out of criteria
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E = Quantitation of compound exceeded the calibration range
P = The RPD between two GC columns exceeds 40%
DL = Detection Limit
J = Estimated result < LOQ and ≥ DL
Q = Surrogate failure
L = LCS/LCSD failure
S = MS/MSD failure

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QC Summary

Volatile Organic Compounds by GC/MS - MB

Sample ID: YQ86531-001
Batch: 86531
Analytical Method: 8260D

Matrix: Aqueous
Prep Method: 5030B

Parameter	Result	Q	Dil	LOQ	DL	Units	Analysis Date
Acetone	ND		1	10	4.0	ug/L	10/04/2023 0940
Benzene	ND		1	0.50	0.40	ug/L	10/04/2023 0940
Bromochloromethane	ND		1	0.50	0.40	ug/L	10/04/2023 0940
Bromodichloromethane	ND		1	0.50	0.40	ug/L	10/04/2023 0940
Bromoform	ND		1	0.50	0.40	ug/L	10/04/2023 0940
Bromomethane (Methyl bromide)	ND		1	0.50	0.40	ug/L	10/04/2023 0940
2-Butanone (MEK)	ND		1	10	2.0	ug/L	10/04/2023 0940
Carbon disulfide	ND		1	0.50	0.40	ug/L	10/04/2023 0940
Carbon tetrachloride	ND		1	0.50	0.40	ug/L	10/04/2023 0940
Chlorobenzene	ND		1	0.50	0.40	ug/L	10/04/2023 0940
Chloroethane	ND		1	0.50	0.40	ug/L	10/04/2023 0940
Chloroform	ND		1	0.50	0.40	ug/L	10/04/2023 0940
Chloromethane (Methyl chloride)	ND		1	0.50	0.40	ug/L	10/04/2023 0940
Cyclohexane	ND		1	0.50	0.40	ug/L	10/04/2023 0940
1,2-Dibromo-3-chloropropane (DBCP)	ND		1	0.50	0.40	ug/L	10/04/2023 0940
Dibromochloromethane	ND		1	0.50	0.40	ug/L	10/04/2023 0940
1,2-Dibromoethane (EDB)	ND		1	0.50	0.40	ug/L	10/04/2023 0940
1,2-Dichlorobenzene	ND		1	0.50	0.40	ug/L	10/04/2023 0940
1,3-Dichlorobenzene	ND		1	0.50	0.40	ug/L	10/04/2023 0940
1,4-Dichlorobenzene	ND		1	0.50	0.40	ug/L	10/04/2023 0940
Dichlorodifluoromethane	ND		1	0.50	0.40	ug/L	10/04/2023 0940
1,1-Dichloroethane	ND		1	0.50	0.40	ug/L	10/04/2023 0940
1,2-Dichloroethane	ND		1	0.50	0.40	ug/L	10/04/2023 0940
1,1-Dichloroethene	ND		1	0.50	0.40	ug/L	10/04/2023 0940
cis-1,2-Dichloroethene	ND		1	0.50	0.40	ug/L	10/04/2023 0940
trans-1,2-Dichloroethene	ND		1	0.50	0.40	ug/L	10/04/2023 0940
1,2-Dichloropropane	ND		1	0.50	0.40	ug/L	10/04/2023 0940
cis-1,3-Dichloropropene	ND		1	0.50	0.40	ug/L	10/04/2023 0940
trans-1,3-Dichloropropene	ND		1	0.50	0.40	ug/L	10/04/2023 0940
1,4-Dioxane	ND		1	20	13	ug/L	10/04/2023 0940
Ethylbenzene	ND		1	0.50	0.40	ug/L	10/04/2023 0940
2-Hexanone	ND		1	10	2.0	ug/L	10/04/2023 0940
Isopropylbenzene	ND		1	0.50	0.40	ug/L	10/04/2023 0940
Methyl acetate	ND		1	1.0	0.40	ug/L	10/04/2023 0940
Methyl tertiary butyl ether (MTBE)	ND		1	0.50	0.40	ug/L	10/04/2023 0940
4-Methyl-2-pentanone	ND		1	10	2.0	ug/L	10/04/2023 0940
Methylcyclohexane	ND		1	5.0	0.40	ug/L	10/04/2023 0940
Methylene chloride	ND		1	0.50	0.40	ug/L	10/04/2023 0940
Naphthalene	ND		1	0.50	0.40	ug/L	10/04/2023 0940
Styrene	ND		1	0.50	0.41	ug/L	10/04/2023 0940
1,1,2,2-Tetrachloroethane	ND		1	0.50	0.40	ug/L	10/04/2023 0940
Tetrachloroethene	ND		1	0.50	0.40	ug/L	10/04/2023 0940
Toluene	ND		1	0.50	0.40	ug/L	10/04/2023 0940
1,1,2-Trichloro-1,2,2-Trifluoroethane	ND		1	1.0	0.42	ug/L	10/04/2023 0940

LOQ = Limit of Quantitation
DL = Detection Limit
ND = Not detected at or above the DL
J = Estimated result < LOQ and ≥ DL
* = RSD is out of criteria
N = Recovery is out of criteria
P = The RPD between two GC columns exceeds 40%
+ = RPD is out of criteria

Note: Calculations are performed before rounding to avoid round-off errors in calculated results

Volatile Organic Compounds by GC/MS - MB

Sample ID: YQ86531-001
Batch: 86531
Analytical Method: 8260D

Matrix: Aqueous
Prep Method: 5030B

Parameter	Result	Q	Dil	LOQ	DL	Units	Analysis Date
1,2,3-Trichlorobenzene	ND		1	0.50	0.40	ug/L	10/04/2023 0940
1,2,4-Trichlorobenzene	ND		1	0.50	0.40	ug/L	10/04/2023 0940
1,1,1-Trichloroethane	ND		1	0.50	0.40	ug/L	10/04/2023 0940
1,1,2-Trichloroethane	ND		1	0.50	0.40	ug/L	10/04/2023 0940
Trichloroethene	ND		1	0.50	0.40	ug/L	10/04/2023 0940
Trichlorofluoromethane	ND		1	0.50	0.40	ug/L	10/04/2023 0940
Vinyl chloride	ND		1	0.50	0.40	ug/L	10/04/2023 0940
Xylenes (total)	ND		1	1.0	0.40	ug/L	10/04/2023 0940
m+p - Xylenes	ND		1	0.50	0.40	ug/L	10/04/2023 0940
o - Xylenes	ND		1	0.50	0.40	ug/L	10/04/2023 0940

Surrogate	Q	% Rec	Acceptance Limit
Bromofluorobenzene		104	70-130
1,2-Dichloroethane-d4		116	70-130
Toluene-d8		105	70-130

LOQ = Limit of Quantitation
DL = Detection Limit
ND = Not detected at or above the DL
J = Estimated result < LOQ and ≥ DL
* = RSD is out of criteria
N = Recovery is out of criteria
P = The RPD between two GC columns exceeds 40%
+ = RPD is out of criteria

Note: Calculations are performed before rounding to avoid round-off errors in calculated results

Volatile Organic Compounds by GC/MS - LCS

Sample ID: YQ86531-002
Batch: 86531
Analytical Method: 8260D

Matrix: Aqueous
Prep Method: 5030B

Parameter	Spike Amount (ug/L)	Result (ug/L)	Q	Dil	% Rec	%Rec Limit	Analysis Date
Acetone	100	87		1	87	60-140	10/04/2023 0806
Benzene	50	54		1	108	70-130	10/04/2023 0806
Bromochloromethane	50	54		1	108	70-130	10/04/2023 0806
Bromodichloromethane	50	57		1	115	70-130	10/04/2023 0806
Bromoform	50	47		1	95	70-130	10/04/2023 0806
Bromomethane (Methyl bromide)	50	56		1	111	70-130	10/04/2023 0806
2-Butanone (MEK)	100	110		1	112	70-130	10/04/2023 0806
Carbon disulfide	50	56		1	112	70-130	10/04/2023 0806
Carbon tetrachloride	50	57		1	114	70-130	10/04/2023 0806
Chlorobenzene	50	53		1	106	70-130	10/04/2023 0806
Chloroethane	50	54		1	109	70-130	10/04/2023 0806
Chloroform	50	57		1	115	70-130	10/04/2023 0806
Chloromethane (Methyl chloride)	50	60		1	120	60-140	10/04/2023 0806
Cyclohexane	50	57		1	113	70-130	10/04/2023 0806
1,2-Dibromo-3-chloropropane (DBCP)	50	50		1	100	70-130	10/04/2023 0806
Dibromochloromethane	50	56		1	112	70-130	10/04/2023 0806
1,2-Dibromoethane (EDB)	50	55		1	110	70-130	10/04/2023 0806
1,2-Dichlorobenzene	50	51		1	103	70-130	10/04/2023 0806
1,3-Dichlorobenzene	50	53		1	106	70-130	10/04/2023 0806
1,4-Dichlorobenzene	50	52		1	104	70-130	10/04/2023 0806
Dichlorodifluoromethane	50	65		1	130	60-140	10/04/2023 0806
1,1-Dichloroethane	50	57		1	113	70-130	10/04/2023 0806
1,2-Dichloroethane	50	57		1	114	70-130	10/04/2023 0806
1,1-Dichloroethene	50	58		1	116	70-130	10/04/2023 0806
cis-1,2-Dichloroethene	50	57		1	113	70-130	10/04/2023 0806
trans-1,2-Dichloroethene	50	57		1	115	70-130	10/04/2023 0806
1,2-Dichloropropane	50	54		1	107	70-130	10/04/2023 0806
cis-1,3-Dichloropropene	50	59		1	119	70-130	10/04/2023 0806
trans-1,3-Dichloropropene	50	49		1	98	70-130	10/04/2023 0806
1,4-Dioxane	500	ND	N	1	0.00	60-140	10/04/2023 0806
Ethylbenzene	50	55		1	109	70-130	10/04/2023 0806
2-Hexanone	100	120		1	117	70-130	10/04/2023 0806
Isopropylbenzene	50	55		1	110	70-130	10/04/2023 0806
Methyl acetate	50	54		1	108	70-130	10/04/2023 0806
Methyl tertiary butyl ether (MTBE)	50	49		1	99	70-130	10/04/2023 0806
4-Methyl-2-pentanone	100	110		1	111	70-130	10/04/2023 0806
Methylcyclohexane	50	56		1	113	70-130	10/04/2023 0806
Methylene chloride	50	51		1	102	70-130	10/04/2023 0806
Naphthalene	50	47		1	93	70-130	10/04/2023 0806
Styrene	50	55		1	110	70-130	10/04/2023 0806
1,1,2,2-Tetrachloroethane	50	51		1	102	70-130	10/04/2023 0806
Tetrachloroethene	50	54		1	108	70-130	10/04/2023 0806
Toluene	50	54		1	108	70-130	10/04/2023 0806
1,1,2-Trichloro-1,2,2-Trifluoroethane	50	57		1	113	70-130	10/04/2023 0806

LOQ = Limit of Quantitation
DL = Detection Limit
ND = Not detected at or above the DL
J = Estimated result < LOQ and ≥ DL
* = RSD is out of criteria
N = Recovery is out of criteria
P = The RPD between two GC columns exceeds 40%
+ = RPD is out of criteria

Note: Calculations are performed before rounding to avoid round-off errors in calculated results

Volatile Organic Compounds by GC/MS - LCS

Sample ID: YQ86531-002
Batch: 86531
Analytical Method: 8260D

Matrix: Aqueous
Prep Method: 5030B

Parameter	Spike Amount (ug/L)	Result (ug/L)	Q	Dil	% Rec	%Rec Limit	Analysis Date
1,2,3-Trichlorobenzene	50	43		1	87	70-130	10/04/2023 0806
1,2,4-Trichlorobenzene	50	47		1	94	70-130	10/04/2023 0806
1,1,1-Trichloroethane	50	58		1	116	70-130	10/04/2023 0806
1,1,2-Trichloroethane	50	54		1	109	70-130	10/04/2023 0806
Trichloroethene	50	56		1	111	70-130	10/04/2023 0806
Trichlorofluoromethane	50	59		1	119	70-130	10/04/2023 0806
Vinyl chloride	50	61		1	121	70-130	10/04/2023 0806
Xylenes (total)	100	110		1	110	70-130	10/04/2023 0806
m+p - Xylenes	50	55		1	111	70-130	10/04/2023 0806
o - Xylenes	50	55		1	110	70-130	10/04/2023 0806

Surrogate	Q	% Rec	Acceptance Limit
Bromofluorobenzene		104	70-130
1,2-Dichloroethane-d4		106	70-130
Toluene-d8		101	70-130

LOQ = Limit of Quantitation
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P = The RPD between two GC columns exceeds 40%
+ = RPD is out of criteria

Note: Calculations are performed before rounding to avoid round-off errors in calculated results

Semivolatile Organic Compounds by GC/MS - MB

Sample ID: YQ85897-001
Batch: 85897
Analytical Method: 8270E

Matrix: Aqueous
Prep Method: 3520C
Prep Date: 09/27/2023 1348

Parameter	Result	Q	Dil	LOQ	DL	Units	Analysis Date
Acenaphthene	ND		1	0.16	0.040	ug/L	10/03/2023 1305
Acenaphthylene	ND		1	0.16	0.040	ug/L	10/03/2023 1305
Acetophenone	ND		1	0.80	0.23	ug/L	10/03/2023 1305
Anthracene	ND		1	0.16	0.040	ug/L	10/03/2023 1305
Atrazine	ND		1	0.80	0.20	ug/L	10/03/2023 1305
Benzaldehyde	ND		1	4.0	0.27	ug/L	10/03/2023 1305
Benzo(a)anthracene	ND		1	0.16	0.040	ug/L	10/03/2023 1305
Benzo(a)pyrene	ND		1	0.16	0.040	ug/L	10/03/2023 1305
Benzo(b)fluoranthene	ND		1	0.16	0.040	ug/L	10/03/2023 1305
Benzo(g,h,i)perylene	ND		1	0.16	0.040	ug/L	10/03/2023 1305
Benzo(k)fluoranthene	ND		1	0.16	0.040	ug/L	10/03/2023 1305
1,1'-Biphenyl	ND		1	0.80	0.21	ug/L	10/03/2023 1305
4-Bromophenyl phenyl ether	ND		1	0.80	0.15	ug/L	10/03/2023 1305
Butyl benzyl phthalate	ND		1	4.0	0.21	ug/L	10/03/2023 1305
Caprolactam	ND		1	4.0	0.71	ug/L	10/03/2023 1305
Carbazole	ND		1	0.80	0.040	ug/L	10/03/2023 1305
bis (2-Chloro-1-methylethyl) ether	ND		1	0.80	0.17	ug/L	10/03/2023 1305
4-Chloro-3-methyl phenol	ND		1	0.80	0.26	ug/L	10/03/2023 1305
4-Chloroaniline	ND		1	0.80	0.13	ug/L	10/03/2023 1305
bis(2-Chloroethoxy)methane	ND		1	0.80	0.060	ug/L	10/03/2023 1305
bis(2-Chloroethyl)ether	ND		1	0.80	0.16	ug/L	10/03/2023 1305
2-Chloronaphthalene	ND		1	0.80	0.15	ug/L	10/03/2023 1305
2-Chlorophenol	ND		1	0.80	0.15	ug/L	10/03/2023 1305
4-Chlorophenyl phenyl ether	ND		1	0.80	0.16	ug/L	10/03/2023 1305
Chrysene	ND		1	0.16	0.040	ug/L	10/03/2023 1305
Dibenzo(a,h)anthracene	ND		1	0.16	0.040	ug/L	10/03/2023 1305
Dibenzofuran	ND		1	0.80	0.16	ug/L	10/03/2023 1305
3,3'-Dichlorobenzidine	ND		1	4.0	0.81	ug/L	10/03/2023 1305
2,4-Dichlorophenol	ND		1	0.80	0.19	ug/L	10/03/2023 1305
Diethylphthalate	ND		1	4.0	0.19	ug/L	10/03/2023 1305
Dimethyl phthalate	ND		1	4.0	0.18	ug/L	10/03/2023 1305
2,4-Dimethylphenol	ND		1	0.80	0.15	ug/L	10/03/2023 1305
Di-n-butyl phthalate	ND		1	4.0	0.42	ug/L	10/03/2023 1305
4,6-Dinitro-2-methylphenol	ND		1	4.0	0.89	ug/L	10/03/2023 1305
2,4-Dinitrophenol	ND		1	4.0	1.3	ug/L	10/03/2023 1305
2,4-Dinitrotoluene	ND		1	1.6	0.36	ug/L	10/03/2023 1305
2,6-Dinitrotoluene	ND		1	1.6	0.34	ug/L	10/03/2023 1305
Di-n-octylphthalate	ND		1	4.0	0.48	ug/L	10/03/2023 1305
bis(2-Ethylhexyl)phthalate	ND		1	4.0	1.5	ug/L	10/03/2023 1305
Fluoranthene	ND		1	0.16	0.040	ug/L	10/03/2023 1305
Fluorene	ND		1	0.16	0.040	ug/L	10/03/2023 1305
Hexachlorobenzene	ND		1	0.80	0.15	ug/L	10/03/2023 1305
Hexachlorobutadiene	ND		1	0.80	0.17	ug/L	10/03/2023 1305
Hexachlorocyclopentadiene	ND		1	4.0	1.1	ug/L	10/03/2023 1305

LOQ = Limit of Quantitation
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* = RSD is out of criteria
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P = The RPD between two GC columns exceeds 40%
+ = RPD is out of criteria

Note: Calculations are performed before rounding to avoid round-off errors in calculated results

Semivolatile Organic Compounds by GC/MS - MB

Sample ID: YQ85897-001
Batch: 85897
Analytical Method: 8270E

Matrix: Aqueous
Prep Method: 3520C
Prep Date: 09/27/2023 1348

Parameter	Result	Q	Dil	LOQ	DL	Units	Analysis Date
Hexachloroethane	ND		1	0.80	0.17	ug/L	10/03/2023 1305
Indeno(1,2,3-c,d)pyrene	ND		1	0.16	0.040	ug/L	10/03/2023 1305
Isophorone	ND		1	0.80	0.22	ug/L	10/03/2023 1305
1-Methylnaphthalene	ND		1	0.16	0.040	ug/L	10/03/2023 1305
2-Methylnaphthalene	ND		1	0.16	0.040	ug/L	10/03/2023 1305
2-Methylphenol	ND		1	0.80	0.21	ug/L	10/03/2023 1305
3+4-Methylphenol	ND		1	1.6	0.46	ug/L	10/03/2023 1305
Naphthalene	ND		1	0.16	0.040	ug/L	10/03/2023 1305
2-Nitroaniline	ND		1	1.6	0.66	ug/L	10/03/2023 1305
3-Nitroaniline	ND		1	1.6	0.15	ug/L	10/03/2023 1305
4-Nitroaniline	ND		1	1.6	1.3	ug/L	10/03/2023 1305
Nitrobenzene	ND		1	0.80	0.17	ug/L	10/03/2023 1305
2-Nitrophenol	ND		1	1.6	0.44	ug/L	10/03/2023 1305
4-Nitrophenol	ND		1	4.0	2.1	ug/L	10/03/2023 1305
N-Nitrosodi-n-propylamine	ND		1	0.80	0.28	ug/L	10/03/2023 1305
N-Nitrosodiphenylamine (Diphenylamine)	ND		1	0.80	0.50	ug/L	10/03/2023 1305
Pentachlorophenol	ND		1	4.0	1.3	ug/L	10/03/2023 1305
Phenanthrene	ND		1	0.16	0.040	ug/L	10/03/2023 1305
Phenol	ND		1	0.80	0.19	ug/L	10/03/2023 1305
Pyrene	ND		1	0.16	0.040	ug/L	10/03/2023 1305
2,4,5-Trichlorophenol	ND		1	0.80	0.19	ug/L	10/03/2023 1305
2,4,6-Trichlorophenol	ND		1	0.80	0.22	ug/L	10/03/2023 1305

Surrogate	Q	% Rec	Acceptance Limit
2-Fluorobiphenyl		67	37-129
2-Fluorophenol		52	24-127
Nitrobenzene-d5		91	38-127
Phenol-d5		55	28-128
Terphenyl-d14		105	10-148
2,4,6-Tribromophenol		81	35-144

LOQ = Limit of Quantitation
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+ = RPD is out of criteria

Note: Calculations are performed before rounding to avoid round-off errors in calculated results

Semivolatile Organic Compounds by GC/MS - LCS

Sample ID: YQ85897-002
Batch: 85897
Analytical Method: 8270E

Matrix: Aqueous
Prep Method: 3520C
Prep Date: 09/27/2023 1348

Parameter	Spike Amount (ug/L)	Result (ug/L)	Q	Dil	% Rec	%Rec Limit	Analysis Date
Acenaphthene	8.0	6.6		1	83	30-122	10/03/2023 1328
Acenaphthylene	8.0	6.9		1	86	30-130	10/03/2023 1328
Acetophenone	8.0	6.4		1	80	52-125	10/03/2023 1328
Anthracene	8.0	7.4		1	93	30-123	10/03/2023 1328
Atrazine	8.0	7.0		1	87	25-121	10/03/2023 1328
Benzaldehyde	8.0	6.4		1	79	20-115	10/03/2023 1328
Benzo(a)anthracene	8.0	5.4		1	68	40-125	10/03/2023 1328
Benzo(a)pyrene	8.0	7.0		1	87	40-128	10/03/2023 1328
Benzo(b)fluoranthene	8.0	5.1		1	64	30-130	10/03/2023 1328
Benzo(g,h,i)perylene	8.0	6.4		1	80	30-130	10/03/2023 1328
Benzo(k)fluoranthene	8.0	8.0		1	100	30-130	10/03/2023 1328
1,1'-Biphenyl	8.0	6.6		1	83	42-120	10/03/2023 1328
4-Bromophenyl phenyl ether	8.0	7.0		1	88	30-124	10/03/2023 1328
Butyl benzyl phthalate	8.0	6.7		1	84	54-135	10/03/2023 1328
Caprolactam	8.0	6.8		1	85	44-152	10/03/2023 1328
Carbazole	8.0	7.2		1	91	45-101	10/03/2023 1328
bis (2-Chloro-1-methylethyl) ether	8.0	8.8		1	111	42-124	10/03/2023 1328
4-Chloro-3-methyl phenol	8.0	7.9		1	99	30-123	10/03/2023 1328
4-Chloroaniline	8.0	3.7		1	46	12-157	10/03/2023 1328
bis(2-Chloroethoxy)methane	8.0	7.7		1	97	44-127	10/03/2023 1328
bis(2-Chloroethyl)ether	8.0	7.7		1	96	46-120	10/03/2023 1328
2-Chloronaphthalene	8.0	6.4		1	80	46-100	10/03/2023 1328
2-Chlorophenol	8.0	6.0		1	75	50-117	10/03/2023 1328
4-Chlorophenyl phenyl ether	8.0	6.2		1	78	30-121	10/03/2023 1328
Chrysene	8.0	6.6		1	82	30-130	10/03/2023 1328
Dibenzo(a,h)anthracene	8.0	6.5		1	82	30-130	10/03/2023 1328
Dibenzofuran	8.0	6.2		1	77	30-118	10/03/2023 1328
3,3'-Dichlorobenzidine	8.0	2.4		1	30	10-126	10/03/2023 1328
2,4-Dichlorophenol	8.0	6.2		1	78	30-121	10/03/2023 1328
Diethylphthalate	8.0	7.6		1	95	40-125	10/03/2023 1328
Dimethyl phthalate	8.0	7.5		1	94	40-127	10/03/2023 1328
2,4-Dimethylphenol	8.0	11	N	1	133	20-125	10/03/2023 1328
Di-n-butyl phthalate	8.0	8.6		1	107	40-127	10/03/2023 1328
4,6-Dinitro-2-methylphenol	8.0	9.0		1	112	56-128	10/03/2023 1328
2,4-Dinitrophenol	16	13		1	82	11-126	10/03/2023 1328
2,4-Dinitrotoluene	8.0	7.2		1	90	59-127	10/03/2023 1328
2,6-Dinitrotoluene	8.0	8.0		1	100	59-126	10/03/2023 1328
Di-n-octylphthalate	8.0	8.2		1	102	50-136	10/03/2023 1328
bis(2-Ethylhexyl)phthalate	8.0	7.6		1	95	56-128	10/03/2023 1328
Fluoranthene	8.0	7.0		1	87	40-128	10/03/2023 1328
Fluorene	8.0	6.3		1	79	30-124	10/03/2023 1328
Hexachlorobenzene	8.0	7.1		1	89	30-125	10/03/2023 1328
Hexachlorobutadiene	8.0	5.8		1	73	24-110	10/03/2023 1328
Hexachlorocyclopentadiene	40	18		1	45	16-96	10/03/2023 1328

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Semivolatile Organic Compounds by GC/MS - LCS

Sample ID: YQ85897-002
Batch: 85897
Analytical Method: 8270E

Matrix: Aqueous
Prep Method: 3520C
Prep Date: 09/27/2023 1348

Parameter	Spike Amount (ug/L)	Result (ug/L)	Q	Dil	% Rec	%Rec Limit	Analysis Date
Hexachloroethane	8.0	6.7		1	84	31-110	10/03/2023 1328
Indeno(1,2,3-c,d)pyrene	8.0	6.2		1	78	30-130	10/03/2023 1328
Isophorone	8.0	8.5		1	106	57-123	10/03/2023 1328
1-Methylnaphthalene	8.0	6.3		1	79	42-126	10/03/2023 1328
2-Methylnaphthalene	8.0	6.5		1	81	40-132	10/03/2023 1328
2-Methylphenol	8.0	7.3		1	91	56-119	10/03/2023 1328
3+4-Methylphenol	8.0	6.9		1	86	53-119	10/03/2023 1328
Naphthalene	8.0	6.2		1	78	30-130	10/03/2023 1328
2-Nitroaniline	8.0	6.8		1	85	60-124	10/03/2023 1328
3-Nitroaniline	8.0	3.4		1	43	43-123	10/03/2023 1328
4-Nitroaniline	8.0	6.2		1	78	30-135	10/03/2023 1328
Nitrobenzene	8.0	7.9		1	98	51-122	10/03/2023 1328
2-Nitrophenol	8.0	7.3		1	91	51-118	10/03/2023 1328
4-Nitrophenol	16	14		1	85	53-130	10/03/2023 1328
N-Nitrosodi-n-propylamine	8.0	8.6		1	108	54-127	10/03/2023 1328
N-Nitrosodiphenylamine (Diphenylamine)	8.0	6.2		1	77	30-123	10/03/2023 1328
Pentachlorophenol	16	14		1	91	42-131	10/03/2023 1328
Phenanthrene	8.0	6.6		1	82	40-123	10/03/2023 1328
Phenol	8.0	6.2		1	78	49-117	10/03/2023 1328
Pyrene	8.0	6.8		1	85	40-126	10/03/2023 1328
2,4,5-Trichlorophenol	8.0	6.5		1	81	30-123	10/03/2023 1328
2,4,6-Trichlorophenol	8.0	6.6		1	83	30-125	10/03/2023 1328

Surrogate	Q	% Rec	Acceptance Limit
2-Fluorobiphenyl		71	37-129
2-Fluorophenol		67	24-127
Nitrobenzene-d5		91	38-127
Phenol-d5		73	28-128
Terphenyl-d14		84	10-148
2,4,6-Tribromophenol		89	35-144

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Chain of Custody

and

Miscellaneous Documents

Pace Analytical®

PACE ANALYTICAL SERVICES, LLC
106 Vantage Point Drive • West Columbia, SC 29172
Telephone No. 803-791-9700 Fax No. 803-791-9111
www.pacelabs.com

Number 149546

Client: Ramboll / Calumet
Address: 600 Smelter Avenue
City: Great Falls State: MT Zip Code: 59404
Project Name: Calumet Refinery Montana
Project No.: 1690029636-001
Report to Contact: Mike Gibson / Ruta / Abby Small
Sampler's Signature: x [signature]
Printed Name: Eric Poissant
Telephone No. / E-mail:
Quote No.:
Page 1 of 1
Y121013

Sample ID / Description (Containers for each sample may be combined on one line.)	Collection Date(s)	Collection Time (Military)	G=Grab C=Composite	Matrix: Aqueous	Solid	Non-Aqueous	Unpres	H2SO4	HNO3	HCl	NaOH	Na2S2O3	Field Filtered	VOC	SVOC	EPH	VPH	Remarks / Cooler I.D.
CMR-MW-105-092023	9/20/23	925	G	X			X			X				X	X	X	X	
CMR-MW-106-092023	↓	955	G	X			X			X				X	X	X	X	
CMR-MW-415-092023	↓	1020	G	X			X			X				X	X	X	X	

Turn Around Time Required (Prior lab approval required for expedited TAT.) ☑ Standard ☐ Rush (Specify)
Sample Disposal ☐ Return to Client ☑ Disposal by Lab
Possible Hazard Identification ☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison ☐ Unknown
QC Requirements (Specify)

Relinquished by	Date	Time	Received by	Date	Time
1. [signature]	9-20-23	1100	1.		
2.			2.		
3.			3.		
4. FedEx	9/21/23	1000	4. Laboratory received by: [signature]	9/21/23	1000

Note: All samples are retained for four weeks from receipt unless other arrangements are made.

LAB USE ONLY Received on ice (Circle) (Yes) No Ice Pack Receipt Temp. 3.7 °C Temp Blank ☑ Y ☐ N

DISTRIBUTION: WHITE & YELLOW-Return to laboratory with Sample(s), PINK-Field/Client Copy

Document Number: ME003N2-01

DC#_Title: ENV-FRM-WCOL-0286 v02_Samples Receipt Checklist (SRC)
Effective Date: 8/2/2022

Sample Receipt Checklist (SRC)

Client: RAMBOLL Cooler Inspected by/date: BRS2 / 09/21/23 Lot #: YT21013

Means of receipt: ☐ Pace ☐ Client ☐ UPS ☑ FedEx ☐ Other:

☐ Yes	☑ No		1. Were custody seals present on the cooler?
☐ Yes	☐ No	☑ NA	2. If custody seals were present, were they intact and unbroken?

pH Strip ID: NA Chlorine Strip ID: NA Tested by: NA

Original temperature upon receipt / Derived (Corrected) temperature upon receipt %Solid Snap-Cup ID: NA

3.7 / 3.7 °C NA / NA °C NA / NA °C NA / NA °C

Method: ☑ Temperature Blank ☐ Against Bottles IR Gun ID: 8 IR Gun Correction Factor: 0 °C

Method of coolant: ☑ Wet Ice ☐ Ice Packs ☐ Dry Ice ☐ None

☑ Yes	☐ No	☐ NA	3. Were all coolers received at or below 6.0°C? If no, was Project Manager notified? PM was Notified by: phone / email / face-to-face (circle one).
☑ Yes	☐ No	☐ NA	4. Is the commercial courier's packing slip attached to this form?
☑ Yes	☐ No		5. Were proper custody procedures (relinquished/received) followed?
☑ Yes	☐ No		6. Were sample IDs listed on the COC and all sample containers?
☑ Yes	☐ No		7. Was collection date & time listed on the COC and all sample containers?
☑ Yes	☐ No		8. Did all container label information (ID, date, time) agree with the COC?
☑ Yes	☐ No		9. Were tests to be performed listed on the COC?
☑ Yes	☐ No		10. Did all samples arrive in the proper containers for each test and/or in good condition (unbroken, lids on, etc.)?
☑ Yes	☐ No		11. Was adequate sample volume available?
☑ Yes	☐ No		12. Were all samples received within ½ the holding time or 48 hours, whichever comes first?
☑ Yes	☐ No		13. Were all samples containers accounted for? (No missing/excess)
☑ Yes	☐ No	☐ NA	14. Were VOA, 8015C and RSK-175 samples free of bubbles >"pea-size" (¼" or 6mm in diameter) in any of the VOA vials?
☐ Yes	☐ No	☑ NA	15. Were all DRO/metals/nutrient samples received at a pH of < 2?
☐ Yes	☐ No	☑ NA	16. Were all cyanide samples received at a pH > 12 and sulfide samples received at a pH > 9?
☐ Yes	☐ No	☑ NA	17. Were all applicable NH_3/TKN/cyanide/phenol/625.1/608.3 (< 0.5mg/L) samples free of residual chlorine?
☐ Yes	☑ No	☐ NA	18. Was the quote number listed on the container label? If yes, Quote #

Sample Preservation (Must be completed for any sample(s) incorrectly preserved or with headspace.)

Sample(s) NA were received incorrectly preserved and were adjusted accordingly in sample receiving with NA mL of circle one: H_2SO_4, HNO_3, HCl, NaOH using SR # NA. Time of preservation NA. If more than one preservative is needed, please note in the comments below.

Sample(s) NA were received with bubbles >6 mm in diameter.

Samples(s) NA were received with TRC > 0.5 mg/L (If #19 is *no*) and were adjusted accordingly in sample receiving with sodium thiosulfate ($Na_2S_2O_3$) with Unique ID: NA.

Comments:

ANALYTICAL REPORT

October 17, 2023

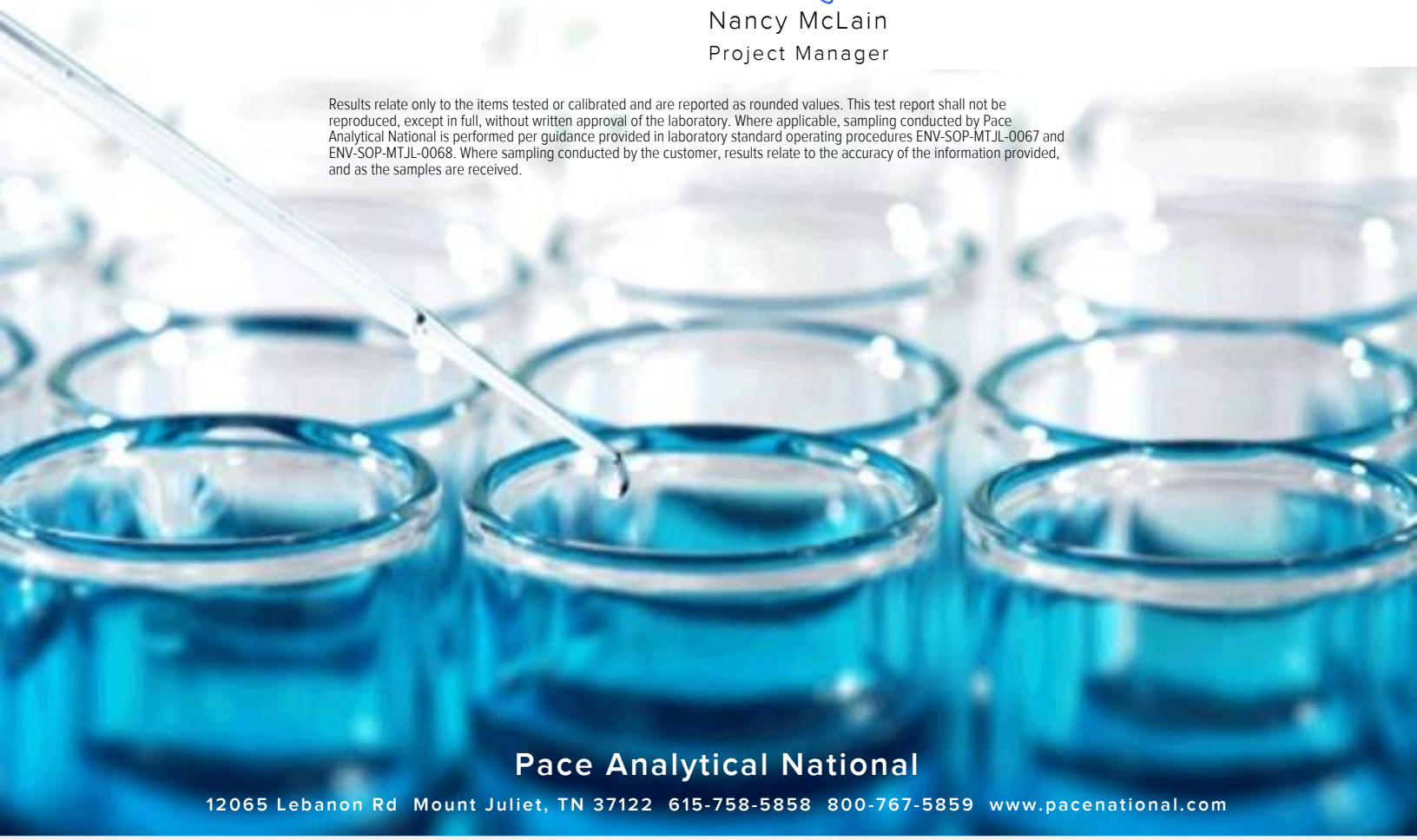
Revised Report

Pace Analytical - West Columbia, SC

Sample Delivery Group:	L1658629
Samples Received:	09/22/2023
Project Number:	YI21013
Description:	Calumet Refinery GW Sam
Site:	001
Report To:	Edward T. Barnett 106 Vantage Point Dr. West Columbia, SC 29172

Entire Report Reviewed By:

Nancy McLain
Project Manager



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

TABLE OF CONTENTS

CMR-MW-105-092023 L1658629-01 GW

Collected by	Collected date/time	Received date/time
	09/20/23 09:25	09/22/23 09:00

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Volatile Petroleum Hydrocarbons by Method MTDEQ VPH	WG2141605	1	09/30/23 13:29	09/30/23 13:29	JHH	Mt. Juliet, TN
TPH by Method MTDEQ EPH	WG2136410	1	09/26/23 10:07	09/28/23 20:30	JAS	Mt. Juliet, TN
TPH by Method MTDEQ EPH	WG2140640	1	09/26/23 10:07	09/28/23 18:18	JDG	Mt. Juliet, TN
TPH by Method MTDEQ EPH	WG2140640	1	09/26/23 10:07	09/28/23 19:31	JDG	Mt. Juliet, TN

CMR-MW-106-092023 L1658629-02 GW

Collected by	Collected date/time	Received date/time
	09/20/23 09:55	09/22/23 09:00

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Volatile Petroleum Hydrocarbons by Method MTDEQ VPH	WG2141605	1	09/30/23 14:03	09/30/23 14:03	JHH	Mt. Juliet, TN
TPH by Method MTDEQ EPH	WG2136410	1	09/26/23 10:07	09/28/23 20:45	JAS	Mt. Juliet, TN
TPH by Method MTDEQ EPH	WG2140640	1	09/26/23 10:07	09/28/23 18:42	JDG	Mt. Juliet, TN
TPH by Method MTDEQ EPH	WG2140640	1	09/26/23 10:07	09/28/23 19:55	JDG	Mt. Juliet, TN

CMR-MW-41S-092023 L1658629-03 GW

Collected by	Collected date/time	Received date/time
	09/20/23 10:20	09/22/23 09:00

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst	Location
Volatile Petroleum Hydrocarbons by Method MTDEQ VPH	WG2141605	1	09/30/23 14:37	09/30/23 14:37	JHH	Mt. Juliet, TN
TPH by Method MTDEQ EPH	WG2136410	1	09/26/23 10:07	09/28/23 20:59	JAS	Mt. Juliet, TN
TPH by Method MTDEQ EPH	WG2140640	1	09/26/23 10:07	09/28/23 19:07	JDG	Mt. Juliet, TN
TPH by Method MTDEQ EPH	WG2140640	1	09/26/23 10:07	09/28/23 20:19	JDG	Mt. Juliet, TN

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.

Nancy McLain
Project Manager

Report Revision History

Level II Report - Version 1: 10/02/23 13:58

Project Narrative

Due to multiple preparation procedures, calculated analytes are not reported in the quality control samples for EPH and VPH Methods.

Sample Delivery Group (SDG) Narrative

The following analysis were performed from an unpreserved, insufficiently or inadequately preserved sample.

Lab Sample ID	Project Sample ID	Method
L1658629-02	CMR-MW-106-092023	MTDEQ EPH

Volatile Petroleum Hydrocarbons by Method MTDEQ VPH

Analyte	Result ug/l	Qualifier	MDL ug/l	RDL ug/l	Dilution	Analysis date / time	Batch
Unadjusted C5-C8 Aliphatics	1580		33.3	100	1	09/30/2023 13:29	WG2141605
Unadjusted C9-C12 Aliphatics	955		33.3	100	1	09/30/2023 13:29	WG2141605
Unadjusted C9-C10 Aromatics	375		33.3	100	1	09/30/2023 13:29	WG2141605
Adjusted C5-C8 Aliphatics	1490		33.3	100	1	09/30/2023 13:29	WG2141605
Adjusted C9-C12 Aliphatics	396		33.3	100	1	09/30/2023 13:29	WG2141605
Total VPH	2910		66.7	200	1	09/30/2023 13:29	WG2141605
Total Purgeable Hydrocarbons C5-C12	2880		66.7	200	1	09/30/2023 13:29	WG2141605
(S) 2,5-Dibromotoluene(FID)	*104*			*70.0-130*		*09/30/2023 13:29*	WG2141605
(S) 2,5-Dibromotoluene(PID)	*102*			*70.0-130*		*09/30/2023 13:29*	WG2141605

TPH by Method MTDEQ EPH

Analyte	Result ug/l	Qualifier	MDL ug/l	RDL ug/l	Dilution	Analysis date / time	Batch
EPH Screen	843		100	300	1	09/28/2023 20:30	WG2136410
Unadjusted C9-C18 Aliphatics	U		200	600	1	09/28/2023 18:18	WG2140640
Unadjusted C19-C36 Aliphatics	U		200	600	1	09/28/2023 18:18	WG2140640
Unadjusted C11-C22 Aromatics	U		200	600	1	09/28/2023 19:31	WG2140640
Unadjusted Total Petroleum Hydrocarbons	U		200	600	1	09/28/2023 18:18	WG2140640
Adjusted C11-C22 Aromatics	U		200	600	1	09/28/2023 19:31	WG2140640
Adjusted Total Petroleum Hydrocarbons	U		200	600	1	09/28/2023 18:18	WG2140640
(S) o-Terphenyl	*82.2*			*40.0-140*		*09/28/2023 20:30*	WG2136410
(S) o-Terphenyl	*55.8*			*40.0-140*		*09/28/2023 19:31*	WG2140640
(S) 1-Chloro-octadecane	*35.4*	J2		*40.0-140*		*09/28/2023 18:18*	WG2140640
(S) 2-Fluorobiphenyl	*75.8*			*40.0-140*		*09/28/2023 19:31*	WG2140640
(S) 2-Bromonaphthalene	*78.1*			*40.0-140*		*09/28/2023 19:31*	WG2140640

Sample Narrative:

L1658629-01 WG2140640: Surrogate failure due to matrix interference during extraction procedure.

Volatile Petroleum Hydrocarbons by Method MTDEQ VPH

Analyte	Result ug/l	Qualifier	MDL ug/l	RDL ug/l	Dilution	Analysis date / time	Batch
Unadjusted C5-C8 Aliphatics	495		33.3	100	1	09/30/2023 14:03	WG2141605
Unadjusted C9-C12 Aliphatics	U		33.3	100	1	09/30/2023 14:03	WG2141605
Unadjusted C9-C10 Aromatics	38.4	J	33.3	100	1	09/30/2023 14:03	WG2141605
Adjusted C5-C8 Aliphatics	495		33.3	100	1	09/30/2023 14:03	WG2141605
Adjusted C9-C12 Aliphatics	U		33.3	100	1	09/30/2023 14:03	WG2141605
Total VPH	533		66.7	200	1	09/30/2023 14:03	WG2141605
Total Purgeable Hydrocarbons C5-C12	533		66.7	200	1	09/30/2023 14:03	WG2141605
(S) 2,5-Dibromotoluene(FID)	*108*			*70.0-130*		*09/30/2023 14:03*	WG2141605
(S) 2,5-Dibromotoluene(PID)	*107*			*70.0-130*		*09/30/2023 14:03*	WG2141605

TPH by Method MTDEQ EPH

Analyte	Result ug/l	Qualifier	MDL ug/l	RDL ug/l	Dilution	Analysis date / time	Batch
EPH Screen	17000		100	300	1	09/28/2023 20:45	WG2136410
Unadjusted C9-C18 Aliphatics	U		200	600	1	09/28/2023 18:42	WG2140640
Unadjusted C19-C36 Aliphatics	U		200	600	1	09/28/2023 18:42	WG2140640
Unadjusted C11-C22 Aromatics	U		200	600	1	09/28/2023 19:55	WG2140640
Unadjusted Total Petroleum Hydrocarbons	U		200	600	1	09/28/2023 18:42	WG2140640
Adjusted C11-C22 Aromatics	U		200	600	1	09/28/2023 19:55	WG2140640
Adjusted Total Petroleum Hydrocarbons	U		200	600	1	09/28/2023 18:42	WG2140640
(S) o-Terphenyl	*68.5*			*40.0-140*		*09/28/2023 20:45*	WG2136410
(S) o-Terphenyl	*47.8*			*40.0-140*		*09/28/2023 19:55*	WG2140640
(S) 1-Chloro-octadecane	*30.5*	J2		*40.0-140*		*09/28/2023 18:42*	WG2140640
(S) 2-Fluorobiphenyl	*76.4*			*40.0-140*		*09/28/2023 19:55*	WG2140640
(S) 2-Bromonaphthalene	*77.7*			*40.0-140*		*09/28/2023 19:55*	WG2140640

Sample Narrative:

L1658629-02 WG2140640: Surrogate failure due to matrix interference during extraction procedure.

Volatile Petroleum Hydrocarbons by Method MTDEQ VPH

Analyte	Result ug/l	Qualifier	MDL ug/l	RDL ug/l	Dilution	Analysis date / time	Batch
Unadjusted C5-C8 Aliphatics	1310		33.3	100	1	09/30/2023 14:37	WG2141605
Unadjusted C9-C12 Aliphatics	2510		33.3	100	1	09/30/2023 14:37	WG2141605
Unadjusted C9-C10 Aromatics	1750		33.3	100	1	09/30/2023 14:37	WG2141605
Adjusted C5-C8 Aliphatics	842		33.3	100	1	09/30/2023 14:37	WG2141605
Adjusted C9-C12 Aliphatics	844		33.3	100	1	09/30/2023 14:37	WG2141605
Total VPH	5570		66.7	200	1	09/30/2023 14:37	WG2141605
Total Purgeable Hydrocarbons C5-C12	6010		66.7	200	1	09/30/2023 14:37	WG2141605
(S) 2,5-Dibromotoluene(FID)	*115*			*70.0-130*		*09/30/2023 14:37*	WG2141605
(S) 2,5-Dibromotoluene(PID)	*105*			*70.0-130*		*09/30/2023 14:37*	WG2141605

TPH by Method MTDEQ EPH

Analyte	Result ug/l	Qualifier	MDL ug/l	RDL ug/l	Dilution	Analysis date / time	Batch
EPH Screen	5660		100	300	1	09/28/2023 20:59	WG2136410
Unadjusted C9-C18 Aliphatics	U		200	600	1	09/28/2023 19:07	WG2140640
Unadjusted C19-C36 Aliphatics	U		200	600	1	09/28/2023 19:07	WG2140640
Unadjusted C11-C22 Aromatics	397	J	200	600	1	09/28/2023 20:19	WG2140640
Unadjusted Total Petroleum Hydrocarbons	397	J	200	600	1	09/28/2023 19:07	WG2140640
Adjusted C11-C22 Aromatics	397	J	200	600	1	09/28/2023 20:19	WG2140640
Adjusted Total Petroleum Hydrocarbons	397	J	200	600	1	09/28/2023 19:07	WG2140640
(S) o-Terphenyl	*85.8*			*40.0-140*		*09/28/2023 20:59*	WG2136410
(S) o-Terphenyl	*60.5*			*40.0-140*		*09/28/2023 20:19*	WG2140640
(S) 1-Chloro-octadecane	*37.1*	J2		*40.0-140*		*09/28/2023 19:07*	WG2140640
(S) 2-Fluorobiphenyl	*76.8*			*40.0-140*		*09/28/2023 20:19*	WG2140640
(S) 2-Bromonaphthalene	*76.4*			*40.0-140*		*09/28/2023 20:19*	WG2140640

Sample Narrative:

L1658629-03 WG2140640: Surrogate failure due to matrix interference during extraction procedure.

Method Blank (MB)

(MB) R3980497-3 09/30/23 06:40

Analyte	MB Result ug/l	MB Qualifier	MB MDL ug/l	MB RDL ug/l
Unadjusted C5-C8 Aliphatics	U		33.3	100
Unadjusted C9-C12 Aliphatics	U		33.3	100
Unadjusted C9-C10 Aromatics	U		33.3	100
Adjusted C5-C8 Aliphatics	U		33.3	100
Adjusted C9-C12 Aliphatics	U		33.3	100
Total VPH	U		66.7	200
Total Purgeable Hydrocarbons C5-C12	U		66.7	200
(S) 2,5-Dibromotoluene(FID)	*88.1*			*70.0-130*
(S) 2,5-Dibromotoluene(PID)	*90.1*			*70.0-130*

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

(LCS) R3980497-1 09/30/23 01:05 • (LCSD) R3980497-2 09/30/23 01:39

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 %
Unadjusted C5-C8 Aliphatics	1200	964	965	80.3	80.4	70.0-130			0.104	50
Unadjusted C9-C12 Aliphatics	1400	1360	1350	97.1	96.4	70.0-130			0.738	50
Unadjusted C9-C10 Aromatics	200	229	227	115	114	70.0-130			0.877	50
Total VPH	2800	2550	2540	91.1	90.7	70.0-130			0.393	50
Total Purgeable Hydrocarbons C5-C12	2800	2680	2660	95.7	95.0	70.0-130			0.749	50
(S) 2,5-Dibromotoluene(FID)				*97.2*	*93.7*	*70.0-130*				
(S) 2,5-Dibromotoluene(PID)				*96.0*	*92.8*	*70.0-130*				

Method Blank (MB)

(MB) R3979627-1 09/28/23 16:53

Analyte	MB Result ug/l	MB Qualifier	MB MDL ug/l	MB RDL ug/l
EPH Screen	U		100	300
(S) o-Terphenyl	*105*			*40.0-140*

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

(LCS) R3979627-2 09/28/23 17:07 • (LCSD) R3979627-3 09/28/23 17:22

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 %
EPH Screen	3100	2770	3020	89.4	97.4	40.0-140			8.64	25
(S) o-Terphenyl				*109*	*112*	*40.0-140*				

Method Blank (MB)

(MB) R3979483-1 09/28/23 15:53

Analyte	MB Result	MB Qualifier	MB MDL	MB RDL
	ug/l		ug/l	ug/l
Unadjusted C9-C18 Aliphatics	U		200	600
Unadjusted C19-C36 Aliphatics	U		200	600
(S) 1-Chloro-octadecane	*69.5*			*40.0-140*

Method Blank (MB)

(MB) R3979483-4 09/28/23 17:06

Analyte	MB Result	MB Qualifier	MB MDL	MB RDL
	ug/l		ug/l	ug/l
Unadjusted C11-C22 Aromatics	U		200	600
(S) o-Terphenyl	*74.1*			*40.0-140*
(S) 2-Fluorobiphenyl	*77.9*			*40.0-140*
(S) 2-Bromonaphthalene	*79.1*			*40.0-140*

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

(LCS) R3979483-2 09/28/23 16:17 • (LCSD) R3979483-3 09/28/23 16:41

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	%	%	%			%	%
Unadjusted C9-C18 Aliphatics	600	313	304	52.2	50.7	40.0-140			2.92	25
Unadjusted C19-C36 Aliphatics	800	675	650	84.4	81.2	40.0-140			3.77	25
(S) 1-Chloro-octadecane				*69.5*	*66.6*	*40.0-140*				

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

(LCS) R3979483-5 09/28/23 17:30 • (LCSD) R3979483-6 09/28/23 17:54

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	%	%	%			%	%
Unadjusted C11-C22 Aromatics	1700	1310	1340	77.1	78.8	40.0-140			2.26	25
(S) o-Terphenyl				*73.8*	*73.9*	*40.0-140*				
(S) 2-Fluorobiphenyl				*77.6*	*79.5*	*40.0-140*				
(S) 2-Bromonaphthalene				*78.3*	*80.2*	*40.0-140*				

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.
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
J	The identification of the analyte is acceptable; the reported value is an estimate.
J2	Surrogate recovery limits have been exceeded; values are outside lower control limits.

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.

E113

Chain of Custody

Pace Analytical®
www.pacelabs.com

Workorder: YI21013 Workorder Name: Calumet Refinery GW Sam Owner Received Date: 9/21/2023 Results Requested By: 10/3/2023

Report To:	Subcontract To:
Edward T. Barnett	Project # YI21013
Pace Analytical	
106 Vantage Point Drive	Pace National
Columbia SC, 29223	
803-509-8398	
Edward.Barnett@pacelabs.com	

Requested Analysis

L1658629

Item	Sample ID	Sample Type	Collect Date/Time	Lab ID	Matrix	Preserved Containers					MA EPH	MA VPH	LAB USE ONLY
1	CMR-MW-105-092023	grab	09/20/23 @ 0925	YI21013-001	AQ						X	X	-01
2	CMR-MW-106-092023	grab	09/20/23 @ 0955	YI21013-002	AQ						X	X	-02
3	CMR-MW-41S-092023	grab	09/20/23 @ 1020	YI21013-003	AQ						X	X	-03
													Environ EQUIS EDD Needed

Transfers	Released By	Date/Time	Received By	Date/Time	Comments
1	Kayun Mears	9/21/23 1900	Hanna Mvechina	09/22 0900	For all samples - MA EPH and MA VPH Level 2 with J/MDLs screen + fractionated analysis
2					
3					

Cooler Temperature on Receipt ______ °C	Custody Seal Y or N	Received on Ice Y or N	Sample Intact Y or N

***In order to maintain client confidentiality, location/name of the sampling site, sampler's name and signature may not be provided on this COC
This chain of custody is considered complete as is since this information is available in the owner laboratory.

Friday, June 17, 2016 11:01:34 … C-002rev.00 24March2009 Page 1 of 1

Sample Receipt Checklist
COC Seal Present/Intact: ✓Y __N   If Applicable
COC Signed/Accurate: ✓Y __N   VOA Zero Headspace: ✓Y __N
Bottles arrive intact: ✓Y __N   Pres.Correct/Check: __Y __N
Correct bottles used: ✓Y __N
Sufficient volume sent: ✓Y __N
RAD Screen <0.5 mR/hr: ✓Y __N

5.3+0=5.3

L1658629

Pace Analytical
www.pacelabs.com

Ship to :
Pace National

Phone

INTER_LABORATORY WORK ORDER # YI21013

(To be complete by sending lab)

Sending Project No:	Calumet
Receiving Project No:	
Check Box for Consolidated Invoice:	x
Date Prepared:	21-Sep
REQUESTED COMPLETION DATE:	3-Oct

Sending Region	IR77-SC	Sending Project Mgr.	Eddie Barnett
Receiving Region	Pace National	External Client	Ramboll
State of Sample Origin	MT	Q	LV2 w / Js

All questions should be addressed to sending project manager.

Requested Reportable Units: ug/L or mg/kg Report Wet or Dry Weight? dry Cert Needed: MI

WORK REQUESTED						
Method Description	Container Type	Quantity of containers	Preservative	Quantity of Samples	Unit Price	Amount
MT VPH	40mL	2	HCL	3	65	195
MT EPH	1L	2	HCL	3	90	270
					TOTAL	465

Special Requirements: Environ EQUIS EDD Needed

Receiving Reqion Department	Acctg. Code	Totals from above	Revenue Allocation	
			Receiving Region (80%)	Client Services Dept. Sending Region (20%)
		195	156	39
		270	216	54
* Custom Revenue Allocation		TOTAL	372	93

FOR ANALYTICAL WORK COMPLETED THIS SECTION ALSO

Chain of Custody Included: [x] Yes [ ] No Return Samples to Sending Reguion: [ ] Yes [x] No

Matrix: [ ] Soil [ ] Water [ ] Air [ ] Other (identity) _____

CONFIRMATION OF WORK COMPLETED

Date Completed: _____ Receiving Project Manager: _____

Original sent to the receiving lab - Copy kept at the sending lab.

When work completed: Original sent to the ABM at the receiving laboratory. Copies are made to corporate as needed.

APPENDIX B

HISTORICAL ANALYTICAL RESULTS AND CONTAMINANT MASS REMOVAL - VAPOR

Appendix B
Historical Analytical Results and Contaminant Mass Removal - Vapor
Calumet Montana Refining, LLC - Great Falls, Montana

Location		SP301		SP301		SP301	
Ramboll Sample ID		CMR-SP301-211015		CMR-SP301-211016		CMR-SP301-211017	
Sample Date		10/15/2021		10/16/2021		10/17/2021	
Blower Flow (scfm)		41		41		41	
Period Operational Time (hrs)		26		24		24	
Notes							
VOCs	**CAS No.**	**Result (ug/m³)**	**Mass (lb)**	**Result (ug/m³)**	**Mass (lb)**	**Result (ug/m³)**	**Mass (lb)**
1,1,1-Trichloroethane	71-55-6	18,100 U	0.00	18,600 U	0.00	19,600 U	0.00
1,1,2,2-Tetrachloroethane	79-34-5	22,800 U	0.00	23,400 U	0.00	24,700 U	0.00
1,1,2-Trichloroethane	79-00-5	9,040 U	0.00	9,290 U	0.00	9,800 U	0.00
1,1,2-Trichlorotrifluoroethane	76-13-1	25,400 U	0.00	26,100 U	0.00	27,600 U	0.00
1,1-Dichloroethane	75-34-3	13,400 U	0.00	13,800 U	0.00	14,500 U	0.00
1,1-Dichloroethene	75-35-4	13,100 U	0.00	13,500 U	0.00	14,200 U	0.00
1,2,4-Trichlorobenzene	120-82-1	123,000 U	0.00	126,000 U	0.00	133,000 U	0.00
1,2,4-Trimethylbenzene	95-63-6	340,000	1.36	471,000	1.73	562,000	2.07
1,2-Dibromoethane (EDB)	106-93-4	12,700 U	0.00	13,100 U	0.00	13,800 U	0.00
1,2-Dichlorobenzene	95-50-1	49,800 U	0.00	51,200 U	0.00	54,100 U	0.00
1,2-Dichloroethane	107-06-2	13,400 U	0.00	13,800 U	0.00	14,500 U	0.00
1,2-Dichloropropane	78-87-5	15,300 U	0.00	15,700 U	0.00	16,600 U	0.00
1,3,5-Trimethylbenzene	108-67-8	179,000	0.71	225,000	0.83	272,000	1.00
1,3-Butadiene	106-99-0	7,330 U	0.00	7,530 U	0.00	7,950 U	0.00
1,3-Dichlorobenzene	541-73-1	49,800 U	0.00	51,200 U	0.00	54,100 U	0.00
1,4-Dichlorobenzene	106-46-7	49,800 U	0.00	51,200 U	0.00	54,100 U	0.00
2-Butanone (MEK)	78-93-3	48,800 U	0.00	50,200 U	0.00	53,000 U	0.00
2-Hexanone	591-78-6	67,700 U	0.00	69,600 U	0.00	73,500 U	0.00
2-Propanol	67-63-0	40,700 U	0.00	41,900 U	0.00	44,200 U	0.00
4-Ethyltoluene	622-96-8	171,000	0.68	222,000	0.82	257,000	0.95
4-Methyl-2-pentanone (MIBK)	108-10-1	88,300	0.35	81,400	0.30	84,900	0.31
Acetone	67-64-1	98,300 U	0.00	101,000 U	0.00	107,000 U	0.00
Benzene	71-43-2	2,850,000 E	11.36	2,430,000 E	8.94	2,640,000 E	9.71
Benzyl chloride	100-44-7	42,800 U	0.00	44,000 U	0.00	46,500 U	0.00
Bromodichloromethane	75-27-4	22,100 U	0.00	22,800 U	0.00	24,000 U	0.00
Bromoform	75-25-2	85,500 U	0.00	87,900 U	0.00	92,700 U	0.00
Bromomethane	74-83-9	12,800 U	0.00	13,200 U	0.00	13,900 U	0.00
Carbon disulfide	75-15-0	10,300 U	0.00	10,600 U	0.00	11,200 U	0.00
Carbon tetrachloride	56-23-5	20,800 U	0.00	21,400 U	0.00	22,600 U	0.00
Chlorobenzene	108-90-7	15,200 U	0.00	15,700 U	0.00	16,500 U	0.00
Chloroethane	75-00-3	8,730 U	0.00	8,970 U	0.00	9,470 U	0.00
Chloroform	67-66-3	8,080 U	0.00	8,300 U	0.00	8,760 U	0.00
Chloromethane	74-87-3	6,840 U	0.00	7,030 U	0.00	7,420 U	0.00
cis-1,2-Dichloroethene	156-59-2	13,100 U	0.00	13,500 U	0.00	14,200 U	0.00
cis-1,3-Dichloropropene	10061-01-5	37,600 U	0.00	38,700 U	0.00	40,800 U	0.00
Cyclohexane	110-82-7	28,500 U	0.00	29,300 U	0.00	30,900 U	0.00
Dibromochloromethane	124-48-1	28,200 U	0.00	29,000 U	0.00	30,600 U	0.00
Dichlorodifluoromethane	75-71-8	16,400 U	0.00	16,900 U	0.00	17,800 U	0.00
Dichlorotetrafluoroethane	76-14-2	23,100 U	0.00	23,800 U	0.00	25,100 U	0.00
Ethanol	64-17-5	31,300 U	0.00	32,100 U	0.00	33,900 U	0.00
Ethyl acetate	141-78-6	11,900 U	0.00	12,300 U	0.00	12,900 U	0.00
Ethylbenzene	100-41-4	1,200,000	4.78	1,360,000	5.00	1,380,000	5.08
Hexachloro-1,3-butadiene	87-68-3	88,200 U	0.00	90,700 U	0.00	95,700 U	0.00
m&p-Xylene	179601-23-1	4,030,000	16.06	5,010,000	18.43	5,310,000	19.54
Methylene Chloride	75-09-2	57,500 U	0.00	59,100 U	0.00	62,400 U	0.00
Methyl-tert-butyl ether	1634-04-4	59,600 U	0.00	61,300 U	0.00	64,700 U	0.00
Naphthalene	91-20-3	43,300 U	0.00	44,500 U	0.00	47,000 U	0.00
n-Heptane	142-82-5	3,330,000 E	13.27	3,060,000 E	11.26	3,340,000 E	12.29
n-Hexane	110-54-3	7,840,000 E	31.25	7,320,000 E	26.93	7,900,000 E	29.07
o-Xylene	95-47-6	916,000	3.65	1,210,000	4.45	1,320,000	4.86
Propylene	115-07-1	14,200 U	0.00	14,600 U	0.00	15,500 U	0.00
Styrene	100-42-5	14,100 U	0.00	14,500 U	0.00	15,300 U	0.00
Tetrachloroethene	127-18-4	11,200 U	0.00	11,500 U	0.00	12,200 U	0.00
Tetrahydrofuran	109-99-9	9,770 U	0.00	10,000 U	0.00	10,600 U	0.00
Toluene	108-88-3	1,490,000	5.94	1,860,000	6.84	1,870,000	6.88
trans-1,2-Dichloroethene	156-60-5	13,100 U	0.00	13,500 U	0.00	14,200 U	0.00
trans-1,3-Dichloropropene	10061-02-6	37,600 U	0.00	38,700 U	0.00	40,800 U	0.00
Trichloroethene	79-01-6	17,800 U	0.00	18,300 U	0.00	19,300 U	0.00
Trichlorofluoromethane	75-69-4	18,600 U	0.00	19,100 U	0.00	20,100 U	0.00
Vinyl acetate	108-05-4	11,700 U	0.00	12,000 U	0.00	12,600 U	0.00
Vinyl chloride	75-01-4	4,230 U	0.00	4,350 U	0.00	4,590 U	0.00
Total VOCs	--	--	89.42	--	85.54	--	91.74
Period Total VOC Mass Removed (lbs)		**89.4**		**85.5**		**91.7**	
Cumulative Total VOC Mass Removed (lbs)		**89**		**175**		**267**	

Appendix B
Historical Analytical Results and Contaminant Mass Removal - Vapor
Calumet Montana Refining, LLC - Great Falls, Montana

Location		SP301		SP301		SP301	
Ramboll Sample ID		CMR-SP301-2		CMR-SP301-211201		CMR-SP301-211208	
Sample Date		11/19/2021		12/1/2021		12/8/2021	
Blower Flow (scfm)		41		56		65	
Period Operational Time (hrs)		--		283		144	
Notes							
VOCs	**CAS No.**	**Result (ug/m^3)**	**Mass (lb)**	**Result (ug/m^3)**	**Mass (lb)**	**Result (ug/m^3)**	**Mass (lb)**
1,1,1-Trichloroethane	71-55-6	158 R	0.00	9,290 U	0.00	9,800 U	0.00
1,1,2,2-Tetrachloroethane	79-34-5	199 R	0.00	11,700 U	0.00	12,400 U	0.00
1,1,2-Trichloroethane	79-00-5	79 R	0.00	4,650 U	0.00	4,900 U	0.00
1,1,2-Trichlorotrifluoroethane	76-13-1	222 R	0.00	13,100 U	0.00	13,800 U	0.00
1,1-Dichloroethane	75-34-3	117 R	0.00	6,890 U	0.00	7,270 U	0.00
1,1-Dichloroethene	75-35-4	115 R	0.00	6,750 U	0.00	7,120 U	0.00
1,2,4-Trichlorobenzene	120-82-1	1,070 R	0.00	63,100 U	0.00	66,600 U	0.00
1,2,4-Trimethylbenzene	95-63-6	7,720 R	0.00	49,600	2.95	50,300	1.76
1,2-Dibromoethane (EDB)	106-93-4	111 R	0.00	6,540 U	0.00	6,900 U	0.00
1,2-Dichlorobenzene	95-50-1	435 R	0.00	25,600 U	0.00	27,000 U	0.00
1,2-Dichloroethane	107-06-2	117 R	0.00	6,890 U	0.00	7,270 U	0.00
1,2-Dichloropropane	78-87-5	134 R	0.00	7,860 U	0.00	8,290 U	0.00
1,3,5-Trimethylbenzene	108-67-8	3,310 R	0.00	27,100	1.61	27,900	0.98
1,3-Butadiene	106-99-0	64 R	0.00	3,770 U	0.00	3,970 U	0.00
1,3-Dichlorobenzene	541-73-1	435 R	0.00	25,600 U	0.00	27,000 U	0.00
1,4-Dichlorobenzene	106-46-7	435 R	0.00	25,600 U	0.00	27,000 U	0.00
2-Butanone (MEK)	78-93-3	427 R	0.00	25,100 U	0.00	26,500 U	0.00
2-Hexanone	591-78-6	592 R	0.00	34,800 U	0.00	36,700 U	0.00
2-Propanol	67-63-0	356 R	0.00	20,900 U	0.00	22,100 U	0.00
4-Ethyltoluene	622-96-8	1,180 R	0.00	26,600	1.58	26,700	0.93
4-Methyl-2-pentanone (MIBK)	108-10-1	592 R	0.00	34,800 U	0.00	36,700 U	0.00
Acetone	67-64-1	859 R	0.00	50,600 U	0.00	53,300 U	0.00
Benzene	71-43-2	51 R	0.00	135,000	8.04	94,100	3.29
Benzyl chloride	100-44-7	374 R	0.00	22,000 U	0.00	23,200 U	0.00
Bromodichloromethane	75-27-4	193 R	0.00	11,400 U	0.00	12,000 U	0.00
Bromoform	75-25-2	747 R	0.00	43,900 U	0.00	46,400 U	0.00
Bromomethane	74-83-9	112 R	0.00	6,600 U	0.00	6,970 U	0.00
Carbon disulfide	75-15-0	90 R	0.00	5,300 U	0.00	5,590 U	0.00
Carbon tetrachloride	56-23-5	182 R	0.00	10,700 U	0.00	11,300 U	0.00
Chlorobenzene	108-90-7	133 R	0.00	7,840 U	0.00	8,270 U	0.00
Chloroethane	75-00-3	76 R	0.00	11,200 U	0.00	11,800 U	0.00
Chloroform	67-66-3	71 R	0.00	4,150 U	0.00	4,380 U	0.00
Chloromethane	74-87-3	60 R	0.00	3,520 U	0.00	3,710 U	0.00
cis-1,2-Dichloroethene	156-59-2	115 R	0.00	6,750 U	0.00	7,120 U	0.00
cis-1,3-Dichloropropene	10061-01-5	328 R	0.00	19,300 U	0.00	20,400 U	0.00
Cyclohexane	110-82-7	3,940 R	0.00	945,000	56.27	687,000	24.03
Dibromochloromethane	124-48-1	246 R	0.00	14,500 U	0.00	15,300 U	0.00
Dichlorodifluoromethane	75-71-8	144 R	0.00	8,450 U	0.00	8,920 U	0.00
Dichlorotetrafluoroethane	76-14-2	202 R	0.00	11,900 U	0.00	12,500 U	0.00
Ethanol	64-17-5	273 R	0.00	16,100 U	0.00	17,000 U	0.00
Ethyl acetate	141-78-6	104 R	0.00	6,140 U	0.00	6,470 U	0.00
Ethylbenzene	100-41-4	1,520 R	0.00	104,000	6.19	80,800	2.83
Hexachloro-1,3-butadiene	87-68-3	771 R	0.00	45,400 U	0.00	47,900 U	0.00
m&p-Xylene	179601-23-1	7,210 R	0.00	475,000	28.28	401,000	14.02
Methylene Chloride	75-09-2	502 R	0.00	29,600 U	0.00	31,200 U	0.00
Methyl-tert-butyl ether	1634-04-4	520 R	0.00	30,600 U	0.00	32,300 U	0.00
Naphthalene	91-20-3	378 R	0.00	44,600 U	0.00	47,100 U	0.00
n-Heptane	142-82-5	847 R	0.00	280,000	16.67	197,000	6.89
n-Hexane	110-54-3	274 R	0.00	507,000	30.19	377,000	13.19
o-Xylene	95-47-6	4,140 R	0.00	113,000	6.73	98,400	3.44
Propylene	115-07-1	124 R	0.00	7,320 U	0.00	7,730 U	0.00
Styrene	100-42-5	308 R	0.00	7,250 U	0.00	7,650 U	0.00
Tetrachloroethene	127-18-4	98 R	0.00	5,770 U	0.00	6,090 U	0.00
Tetrahydrofuran	109-99-9	85 R	0.00	5,020 U	0.00	5,300 U	0.00
Toluene	108-88-3	352 R	0.00	117,000	6.97	80,500	2.82
trans-1,2-Dichloroethene	156-60-5	115 R	0.00	6,750 U	0.00	7,120 U	0.00
trans-1,3-Dichloropropene	10061-02-6	328 R	0.00	19,300 U	0.00	20,400 U	0.00
Trichloroethene	79-01-6	78 R	0.00	4,570 U	0.00	4,820 U	0.00
Trichlorofluoromethane	75-69-4	162 R	0.00	9,540 U	0.00	10,100 U	0.00
Vinyl acetate	108-05-4	102 R	0.00	5,990 U	0.00	6,320 U	0.00
Vinyl chloride	75-01-4	37 R	0.00	4,350 U	0.00	4,590 U	0.00
Total VOCs	--	--	0.00	--	165.48	--	74.17
Period Total VOC Mass Removed (lbs)		**0.0**		**165.5**		**74.2**	
Cumulative Total VOC Mass Removed (lbs)		**267**		**432**		**506**	

Appendix B
Historical Analytical Results and Contaminant Mass Removal - Vapor
Calumet Montana Refining, LLC - Great Falls, Montana

Location		SP301		SP301		SP301	
Ramboll Sample ID		CMR-SP301-211216		CMR-SP301-220216		CMR-SP301-110309	
Sample Date		12/31/2021		2/16/2022		3/9/2022	
Blower Flow (scfm)		61		66		70	
Period Operational Time (hrs)		334		--		949	
Notes							
VOCs	**CAS No.**	**Result (ug/m^3)**	**Mass (lb)**	**Result (ug/m^3)**	**Mass (lb)**	**Result (ug/m^3)**	**Mass (lb)**
1,1,1-Trichloroethane	71-55-6	46,400 U	0.00	3 R	0.00	12,300 U	0.00
1,1,2,2-Tetrachloroethane	79-34-5	23,400 U	0.00	4 R	0.00	15,500 U	0.00
1,1,2-Trichloroethane	79-00-5	46,400 U	0.00	2 R	0.00	6,160 U	0.00
1,1,2-Trichlorotrifluoroethane	76-13-1	26,100 U	0.00	4 R	0.00	17,300 U	0.00
1,1-Dichloroethane	75-34-3	13,800 U	0.00	2 R	0.00	9,130 U	0.00
1,1-Dichloroethene	75-35-4	13,500 U	0.00	2 R	0.00	8,940 U	0.00
1,2,4-Trichlorobenzene	120-82-1	253,000 U	0.00	41 R	0.00	167,000 U	0.00
1,2,4-Trimethylbenzene	95-63-6	121,000	9.22	378 R	0.00	50,700	12.63
1,2-Dibromoethane (EDB)	106-93-4	26,200 U	0.00	2 R	0.00	8,670 U	0.00
1,2-Dichlorobenzene	95-50-1	51,200 U	0.00	8 R	0.00	34,000 U	0.00
1,2-Dichloroethane	107-06-2	13,800 U	0.00	2 R	0.00	9,130 U	0.00
1,2-Dichloropropane	78-87-5	39,300 U	0.00	3 R	0.00	10,400 U	0.00
1,3,5-Trimethylbenzene	108-67-8	75,900	5.79	218 R	0.00	43,300	10.79
1,3-Butadiene	106-99-0	7,530 U	0.00	1 R	0.00	4,990 U	0.00
1,3-Dichlorobenzene	541-73-1	51,200 U	0.00	8 R	0.00	34,000 U	0.00
1,4-Dichlorobenzene	106-46-7	102,000 U	0.00	8 R	0.00	34,000 U	0.00
2-Butanone (MEK)	78-93-3	50,200 U	0.00	16 R	0.00	33,300 U	0.00
2-Hexanone	591-78-6	69,600 U	0.00	11 R	0.00	46,200 U	0.00
2-Propanol	67-63-0	41,900 U	0.00	7 R	0.00	27,700 U	0.00
4-Ethyltoluene	622-96-8	51,900	3.96	41 R	0.00	32,200	8.02
4-Methyl-2-pentanone (MIBK)	108-10-1	69,600 U	0.00	11 R	0.00	46,200 U	0.00
Acetone	67-64-1	101,000 U	0.00	37 R	0.00	67,000 U	0.00
Benzene	71-43-2	150,000	11.44	4 R	0.00	195,000	48.57
Benzyl chloride	100-44-7	88,100 U	0.00	7 R	0.00	29,200 U	0.00
Bromodichloromethane	75-27-4	22,800 U	0.00	4 R	0.00	15,100 U	0.00
Bromoform	75-25-2	176,000 U	0.00	14 R	0.00	58,300 U	0.00
Bromomethane	74-83-9	13,200 U	0.00	2 R	0.00	8,760 U	0.00
Carbon disulfide	75-15-0	10,600 U	0.00	2 R	0.00	7,020 U	0.00
Carbon tetrachloride	56-23-5	21,400 U	0.00	4 R	0.00	14,200 U	0.00
Chlorobenzene	108-90-7	15,700 U	0.00	3 R	0.00	10,400 U	0.00
Chloroethane	75-00-3	8,970 U	0.00	2 R	0.00	5,950 U	0.00
Chloroform	67-66-3	8,300 U	0.00	1 R	0.00	5,500 U	0.00
Chloromethane	74-87-3	17,600 U	0.00	1 R	0.00	4,660 U	0.00
cis-1,2-Dichloroethene	156-59-2	13,500 U	0.00	2 R	0.00	8,940 U	0.00
cis-1,3-Dichloropropene	10061-01-5	38,700 U	0.00	6 R	0.00	25,600 U	0.00
Cyclohexane	110-82-7	29,300 U	0.00	5 R	0.00	19,400 U	0.00
Dibromochloromethane	124-48-1	29,000 U	0.00	5 R	0.00	19,200 U	0.00
Dichlorodifluoromethane	75-71-8	16,900 U	0.00	3 R	0.00	11,200 U	0.00
Dichlorotetrafluoroethane	76-14-2	23,800 U	0.00	4 R	0.00	15,800 U	0.00
Ethanol	64-17-5	32,100 U	0.00	8 R	0.00	21,300 U	0.00
Ethyl acetate	141-78-6	12,300 U	0.00	2 R	0.00	8,130 U	0.00
Ethylbenzene	100-41-4	151,000	11.51	29 R	0.00	256,000	63.76
Hexachloro-1,3-butadiene	87-68-3	90,700 U	0.00	15 R	0.00	60,100 U	0.00
m&p-Xylene	179601-23-1	783,000	59.70	186 R	0.00	1,010,000	251.57
Methylene Chloride	75-09-2	59,100 U	0.00	10 R	0.00	39,200 U	0.00
Methyl-tert-butyl ether	1634-04-4	61,300 U	0.00	10 R	0.00	40,600 U	0.00
Naphthalene	91-20-3	44,500 U	0.00	15 R	0.00	29,500 U	0.00
n-Heptane	142-82-5	336,000	25.62	19 R	0.00	441,000	109.84
n-Hexane	110-54-3	575,000	43.84	12 R	0.00	819,000	204.00
o-Xylene	95-47-6	236,000	17.99	148 R	0.00	263,000	65.51
Propylene	115-07-1	14,600 U	0.00	2 R	0.00	9,710 U	0.00
Styrene	100-42-5	14,500 U	0.00	6 R	0.00	9,610 U	0.00
Tetrachloroethene	127-18-4	11,500 U	0.00	2 R	0.00	7,650 U	0.00
Tetrahydrofuran	109-99-9	10,000 U	0.00	132 R	0.00	6,660 U	0.00
Toluene	108-88-3	140,000	10.67	13 R	0.00	210,000	52.31
trans-1,2-Dichloroethene	156-60-5	33,700 U	0.00	2 R	0.00	8,940 U	0.00
trans-1,3-Dichloropropene	10061-02-6	38,700 U	0.00	6 R	0.00	25,600 U	0.00
Trichloroethene	79-01-6	18,300 U	0.00	2 R	0.00	6,060 U	0.00
Trichlorofluoromethane	75-69-4	19,100 U	0.00	3 R	0.00	12,700 U	0.00
Vinyl acetate	108-05-4	12,000 U	0.00	2 R	0.00	7,950 U	0.00
Vinyl chloride	75-01-4	21,700 U	0.00	1 R	0.00	2,890 U	0.00
Total VOCs	--	--	199.73	--	0.00	--	826.99
Period Total VOC Mass Removed (lbs)		**199.7**		**0.0**		**827.0**	
Cumulative Total VOC Mass Removed (lbs)		**706**		**706**		**1,533**	

Appendix B
Historical Analytical Results and Contaminant Mass Removal - Vapor
Calumet Montana Refining, LLC - Great Falls, Montana

Location		SP301		SP301		SP301	
Ramboll Sample ID		CMR-SP301-2022411		CMR-SP301-220511		CMR-SP301-220617	
Sample Date		4/11/2022		5/11/2022		6/17/2022	
Blower Flow (scfm)		102		128		172	
Period Operational Time (hrs)		632		742		517	
Notes							
VOCs	**CAS No.**	**Result (ug/m^3)**	**Mass (lb)**	**Result (ug/m^3)**	**Mass (lb)**	**Result (ug/m^3)**	**Mass (lb)**
1,1,1-Trichloroethane	71-55-6	1,680 U	0.00	6,520 U	0.00	13,000 U	0.00
1,1,2,2-Tetrachloroethane	79-34-5	2,120 U	0.00	8,230 U	0.00	16,500 U	0.00
1,1,2-Trichloroethane	79-00-5	842 U	0.00	3,260 U	0.00	6,520 U	0.00
1,1,2-Trichlorotrifluoroethane	76-13-1	2,370 U	0.00	9,170 U	0.00	18,300 U	0.00
1,1-Dichloroethane	75-34-3	1,250 U	0.00	4,840 U	0.00	9,670 U	0.00
1,1-Dichloroethene	75-35-4	1,220 U	0.00	4,740 U	0.00	9,470 U	0.00
1,2,4-Trichlorobenzene	120-82-1	11,400 U	0.00	44,300 U	0.00	88,600 U	0.00
1,2,4-Trimethylbenzene	95-63-6	2,310	0.56	9,770	3.48	68,600	22.79
1,2-Dibromoethane (EDB)	106-93-4	1,180 U	0.00	4,590 U	0.00	9,180 U	0.00
1,2-Dichlorobenzene	95-50-1	4,640 U	0.00	18,000 U	0.00	36,000 U	0.00
1,2-Dichloroethane	107-06-2	1,250 U	0.00	4,840 U	0.00	9,670 U	0.00
1,2-Dichloropropane	78-87-5	1,420 U	0.00	5,520 U	0.00	11,000 U	0.00
1,3,5-Trimethylbenzene	108-67-8	2,090	0.50	10,000	3.56	55,200	18.34
1,3-Butadiene	106-99-0	683 U	0.00	2,640 U	0.00	5,290 U	0.00
1,3-Dichlorobenzene	541-73-1	4,640 U	0.00	18,000 U	0.00	36,000 U	0.00
1,4-Dichlorobenzene	106-46-7	4,640 U	0.00	18,000 U	0.00	36,000 U	0.00
2-Butanone (MEK)	78-93-3	4,550 U	0.00	17,600 U	0.00	35,300 U	0.00
2-Hexanone	591-78-6	6,310 U	0.00	24,400 U	0.00	48,900 U	0.00
2-Propanol	67-63-0	3,790 U	0.00	14,700 U	0.00	29,400 U	0.00
4-Ethyltoluene	622-96-8	3,790 U	0.00	14,700 U	0.00	29,400 U	0.00
4-Methyl-2-pentanone (MIBK)	108-10-1	6,310 U	0.00	24,400 U	0.00	48,900 U	0.00
Acetone	67-64-1	9,160 U	0.00	35,500 U	0.00	71,000 U	0.00
Benzene	71-43-2	36,400	8.77	114,000	40.58	50,200	16.68
Benzyl chloride	100-44-7	3,990 U	0.00	15,500 U	0.00	30,900 U	0.00
Bromodichloromethane	75-27-4	2,060 U	0.00	7,990 U	0.00	16,000 U	0.00
Bromoform	75-25-2	7,960 U	0.00	30,800 U	0.00	61,700 U	0.00
Bromomethane	74-83-9	1,200 U	0.00	4,640 U	0.00	9,270 U	0.00
Carbon disulfide	75-15-0	960 U	0.00	3,720 U	0.00	7,440 U	0.00
Carbon tetrachloride	56-23-5	1,940 U	0.00	7,520 U	0.00	15,000 U	0.00
Chlorobenzene	108-90-7	1,420 U	0.00	5,500 U	0.00	11,000 U	0.00
Chloroethane	75-00-3	813 U	0.00	7,880 U	0.00	6,300 U	0.00
Chloroform	67-66-3	752 U	0.00	2,910 U	0.00	5,830 U	0.00
Chloromethane	74-87-3	637 U	0.00	2,470 U	0.00	4,940 U	0.00
cis-1,2-Dichloroethene	156-59-2	1,220 U	0.00	4,740 U	0.00	9,470 U	0.00
cis-1,3-Dichloropropene	10061-01-5	3,500 U	0.00	13,600 U	0.00	27,100 U	0.00
Cyclohexane	110-82-7	2,650 U	0.00	10,300 U	0.00	20,600 U	0.00
Dibromochloromethane	124-48-1	2,620 U	0.00	10,200 U	0.00	20,300 U	0.00
Dichlorodifluoromethane	75-71-8	1,530 U	0.00	5,930 U	0.00	11,900 U	0.00
Dichlorotetrafluoroethane	76-14-2	2,150 U	0.00	8,340 U	0.00	16,700 U	0.00
Ethanol	64-17-5	2,910 U	0.00	11,300 U	0.00	22,600 U	0.00
Ethyl acetate	141-78-6	1,110 U	0.00	4,310 U	0.00	8,610 U	0.00
Ethylbenzene	100-41-4	19,400	4.68	59,700	21.25	45,800	15.22
Hexachloro-1,3-butadiene	87-68-3	8,220 U	0.00	31,800 U	0.00	63,700 U	0.00
m&p-Xylene	179601-23-1	75,500	18.20	262,000	93.25	380,000	126.25
Methylene Chloride	75-09-2	5,350 U	0.00	20,700 U	0.00	41,500 U	0.00
Methyl-tert-butyl ether	1634-04-4	5,550 U	0.00	21,500 U	0.00	43,000 U	0.00
Naphthalene	91-20-3	4,030 U	0.00	15,600 U	0.00	31,300 U	0.00
n-Heptane	142-82-5	66,900	16.12	292,000	103.93	157,000	52.16
n-Hexane	110-54-3	190,000	45.79	587,000	208.93	300,000	99.67
o-Xylene	95-47-6	16,700	4.02	58,000	20.64	126,000	41.86
Propylene	115-07-1	1,330 U	0.00	5,140 U	0.00	10,300 U	0.00
Styrene	100-42-5	1,310 U	0.00	5,090 U	0.00	10,200 U	0.00
Tetrachloroethene	127-18-4	1,050 U	0.00	4,050 U	0.00	13,000	4.32
Tetrahydrofuran	109-99-9	910 U	0.00	3,530 U	0.00	7,050 U	0.00
Toluene	108-88-3	22,200	5.35	57,000	20.29	43,200	14.35
trans-1,2-Dichloroethene	156-60-5	1,220 U	0.00	4,740 U	0.00	9,470 U	0.00
trans-1,3-Dichloropropene	10061-02-6	3,500 U	0.00	13,600 U	0.00	27,100 U	0.00
Trichloroethene	79-01-6	828 U	0.00	3,210 U	0.00	6,420 U	0.00
Trichlorofluoromethane	75-69-4	1,730 U	0.00	6,700 U	0.00	13,400 U	0.00
Vinyl acetate	108-05-4	1,090 U	0.00	4,210 U	0.00	8,410 U	0.00
Vinyl chloride	75-01-4	394 U	0.00	3,060 U	0.00	3,060 U	0.00
Total VOCs	--	--	103.99	--	515.90	--	411.66
Period Total VOC Mass Removed (lbs)		**104.0**		**515.9**		**411.7**	
Cumulative Total VOC Mass Removed (lbs)		**1,637**		**2,153**		**2,565**	

Appendix B
Historical Analytical Results and Contaminant Mass Removal - Vapor
Calumet Montana Refining, LLC - Great Falls, Montana

Location		SP301		SP301		SP301	
Ramboll Sample ID		CMR-SP301-220727		CMR-SP301-083122		CMR-SP301-083122	
Sample Date		7/27/2022		8/31/2022		9/30/2022[4]	
Blower Flow (scfm)		155		37		76	
Period Operational Time (hrs)		715		506		720	
Notes							
VOCs	**CAS No.**	**Result (ug/m^3)**	**Mass (lb)**	**Result (ug/m^3)**	**Mass (lb)**	**Result (ug/m^3)**	**Mass (lb)**
1,1,1-Trichloroethane	71-55-6	1,490 U	0.00	10,700 U	0.00	10,700 U	0.00
1,1,2,2-Tetrachloroethane	79-34-5	1,880 U	0.00	13,500 U	0.00	13,500 U	0.00
1,1,2-Trichloroethane	79-00-5	746 U	0.00	5,370 U	0.00	5,370 U	0.00
1,1,2-Trichlorotrifluoroethane	76-13-1	2,100 U	0.00	15,100 U	0.00	15,100 U	0.00
1,1-Dichloroethane	75-34-3	1,110 U	0.00	7,960 U	0.00	7,960 U	0.00
1,1-Dichloroethene	75-35-4	1,080 U	0.00	7,800 U	0.00	7,800 U	0.00
1,2,4-Trichlorobenzene	120-82-1	10,100 U	0.00	73,000 U	0.00	73,000 U	0.00
1,2,4-Trimethylbenzene	95-63-6	3,710	1.54	9,670 U	0.00	9,670 U	0.00
1,2-Dibromoethane (EDB)	106-93-4	1,050 U	0.00	7,560 U	0.00	7,560 U	0.00
1,2-Dichlorobenzene	95-50-1	4,110 U	0.00	29,600 U	0.00	29,600 U	0.00
1,2-Dichloroethane	107-06-2	1,110 U	0.00	7,960 U	0.00	7,960 U	0.00
1,2-Dichloropropane	78-87-5	1,260 U	0.00	9,090 U	0.00	9,090 U	0.00
1,3,5-Trimethylbenzene	108-67-8	2,610	1.08	10,100	0.71	10,100	2.08
1,3-Butadiene	106-99-0	605 U	0.00	4,350 U	0.00	4,350 U	0.00
1,3-Dichlorobenzene	541-73-1	4,110 U	0.00	29,600 U	0.00	29,600 U	0.00
1,4-Dichlorobenzene	106-46-7	4,110 U	0.00	29,600 U	0.00	29,600 U	0.00
2-Butanone (MEK)	78-93-3	4,030 U	0.00	29,000 U	0.00	29,000 U	0.00
2-Hexanone	591-78-6	5,590 U	0.00	40,300 U	0.00	40,300 U	0.00
2-Propanol	67-63-0	3,360 U	0.00	24,200 U	0.00	24,200 U	0.00
4-Ethyltoluene	622-96-8	3,360 U	0.00	24,200 U	0.00	24,200 U	0.00
4-Methyl-2-pentanone (MIBK)	108-10-1	5,590 U	0.00	40,300 U	0.00	40,300 U	0.00
Acetone	67-64-1	8,120 U	0.00	58,400 U	0.00	58,400 U	0.00
Benzene	71-43-2	3,710	1.54	42,900	3.02	42,900	8.84
Benzyl chloride	100-44-7	3,530 U	0.00	25,400 U	0.00	25,400 U	0.00
Bromodichloromethane	75-27-4	1,830 U	0.00	13,200 U	0.00	13,200 U	0.00
Bromoform	75-25-2	7,060 U	0.00	50,800 U	0.00	50,800 U	0.00
Bromomethane	74-83-9	1,060 U	0.00	7,630 U	0.00	7,630 U	0.00
Carbon disulfide	75-15-0	851 U	0.00	6,130 U	0.00	6,130 U	0.00
Carbon tetrachloride	56-23-5	1,720 U	0.00	12,400 U	0.00	12,400 U	0.00
Chlorobenzene	108-90-7	1,260 U	0.00	9,060 U	0.00	9,060 U	0.00
Chloroethane	75-00-3	720 U	0.00	5,190 U	0.00	5,190 U	0.00
Chloroform	67-66-3	667 U	0.00	4,800 U	0.00	4,800 U	0.00
Chloromethane	74-87-3	564 U	0.00	4,060 U	0.00	4,060 U	0.00
cis-1,2-Dichloroethene	156-59-2	1,080 U	0.00	7,800 U	0.00	7,800 U	0.00
cis-1,3-Dichloropropene	10061-01-5	3,100 U	0.00	22,400 U	0.00	22,400 U	0.00
Cyclohexane	110-82-7	2,350 U	0.00	16,900 U	0.00	16,900 U	0.00
Dibromochloromethane	124-48-1	2,330 U	0.00	16,700 U	0.00	16,700 U	0.00
Dichlorodifluoromethane	75-71-8	1,360 U	0.00	9,770 U	0.00	9,770 U	0.00
Dichlorotetrafluoroethane	76-14-2	1,910 U	0.00	13,700 U	0.00	13,700 U	0.00
Ethanol	64-17-5	2,580 U	0.00	18,600 U	0.00	18,600 U	0.00
Ethyl acetate	141-78-6	985 U	0.00	7,090 U	0.00	7,090 U	0.00
Ethylbenzene	100-41-4	4,890	2.03	24,000	1.69	24,000	4.94
Hexachloro-1,3-butadiene	87-68-3	7,280 U	0.00	52,400 U	0.00	52,400 U	0.00
m&p-Xylene	179601-23-1	27,600	11.44	161,000	11.33	161,000	33.17
Methylene Chloride	75-09-2	4,740 U	0.00	34,200 U	0.00	34,200 U	0.00
Methyl-tert-butyl ether	1634-04-4	4,920 U	0.00	35,400 U	0.00	35,400 U	0.00
Naphthalene	91-20-3	4,490	1.86	25,700 U	0.00	25,700 U	0.00
n-Heptane	142-82-5	12,200	5.06	122,000	8.58	122,000	25.14
n-Hexane	110-54-3	22,000	9.12	209,000	14.70	209,000	43.06
o-Xylene	95-47-6	9,100	3.77	31,500	2.22	31,500	6.49
Propylene	115-07-1	1,180 U	0.00	8,470 U	0.00	8,470 U	0.00
Styrene	100-42-5	1,160 U	0.00	8,380 U	0.00	8,380 U	0.00
Tetrachloroethene	127-18-4	926 U	0.00	6,670 U	0.00	6,670 U	0.00
Tetrahydrofuran	109-99-9	806 U	0.00	5,810 U	0.00	5,810 U	0.00
Toluene	108-88-3	7,740	3.21	7,410 U	0.00	7,410 U	0.00
trans-1,2-Dichloroethene	156-60-5	1,080 U	0.00	7,800 U	0.00	7,800 U	0.00
trans-1,3-Dichloropropene	10061-02-6	3,100 U	0.00	22,400 U	0.00	22,400 U	0.00
Trichloroethene	79-01-6	734 U	0.00	5,280 U	0.00	5,280 U	0.00
Trichlorofluoromethane	75-69-4	1,530 U	0.00	11,000 U	0.00	11,000 U	0.00
Vinyl acetate	108-05-4	2,400 U	0.00	17,300 U	0.00	17,300 U	0.00
Vinyl chloride	75-01-4	349 U	0.00	2,520 U	0.00	2,520 U	0.00
Total VOCs	--	--	40.64	--	42.25	--	123.72
Period Total VOC Mass Removed (lbs)		**40.6**		**42.2**		**123.7**	
Cumulative Total VOC Mass Removed (lbs)		**2,605**		**2,648**		**2,771**	

##

Appendix B
Historical Analytical Results and Contaminant Mass Removal - Vapor
Calumet Montana Refining, LLC - Great Falls, Montana

Location		SP301		SP301		SP301		SP301
Ramboll Sample ID		CMR-SP301-221214		CMR-SP301-221214		CMR-SP301-221214		CMR-DS3-221214
Sample Date		10/31/2022		11/30/2022		12/14/2022		12/14/2022
Blower Flow (scfm)		22		11		88		--
Period Operational Time (hrs)		75		20		469		--
Notes								Field Duplicate
VOCs	**CAS No.**	**Result (ug/m^3)**	**Mass (lb)**	**Result (ug/m^3)**	**Mass (lb)**	**Result (ug/m^3)**	**Mass (lb)**	**Result (ug/m^3)**
1,1,1-Trichloroethane	71-55-6	4,310 U	0.00	4,310 U	0.00	4,310 U	0.00	2,810 U
1,1,2,2-Tetrachloroethane	79-34-5	5,430 U	0.00	5,430 U	0.00	5,430 U	0.00	3,550 U
1,1,2-Trichloroethane	79-00-5	2,150 U	0.00	2,150 U	0.00	2,150 U	0.00	1,410 U
1,1,2-Trichlorotrifluoroethane	76-13-1	6,050 U	0.00	6,050 U	0.00	6,050 U	0.00	3,960 U
1,1-Dichloroethane	75-34-3	3,190 U	0.00	3,190 U	0.00	3,190 U	0.00	2,090 U
1,1-Dichloroethene	75-35-4	3,130 U	0.00	3,130 U	0.00	3,130 U	0.00	2,040 U
1,2,4-Trichlorobenzene	120-82-1	29,200 U	0.00	29,200 U	0.00	29,200 U	0.00	19,100 U
1,2,4-Trimethylbenzene	95-63-6	5,870	0.04	5,870	0.00	5,870	0.90	3,400
1,2-Dibromoethane (EDB)	106-93-4	3,030 U	0.00	3,030 U	0.00	3,030 U	0.00	1,980 U
1,2-Dichlorobenzene	95-50-1	11,900 U	0.00	11,900 U	0.00	11,900 U	0.00	7,760 U
1,2-Dichloroethane	107-06-2	3,190 U	0.00	3,190 U	0.00	3,190 U	0.00	2,090 U
1,2-Dichloropropane	78-87-5	3,640 U	0.00	3,640 U	0.00	3,640 U	0.00	2,380 U
1,3,5-Trimethylbenzene	108-67-8	5,060	0.03	5,060	0.00	5,060	0.78	3,240
1,3-Butadiene	106-99-0	1,750 U	0.00	1,750 U	0.00	1,750 U	0.00	1,140 U
1,3-Dichlorobenzene	541-73-1	11,900 U	0.00	11,900 U	0.00	11,900 U	0.00	7,760 U
1,4-Dichlorobenzene	106-46-7	11,900 U	0.00	11,900 U	0.00	11,900 U	0.00	7,760 U
2-Butanone (MEK)	78-93-3	11,600 U	0.00	11,600 U	0.00	11,600 U	0.00	7,610 U
2-Hexanone	591-78-6	16,100 U	0.00	16,100 U	0.00	16,100 U	0.00	10,500 U
2-Propanol	67-63-0	9,700 U	0.00	9,700 U	0.00	9,700 U	0.00	6,340 U
4-Ethyltoluene	622-96-8	9,700 U	0.00	9,700 U	0.00	9,700 U	0.00	6,340 U
4-Methyl-2-pentanone (MIBK)	108-10-1	16,100 U	0.00	16,100 U	0.00	16,100 U	0.00	10,500 U
Acetone	67-64-1	23,400 U	0.00	23,400 U	0.00	23,400 U	0.00	15,300 U
Benzene	71-43-2	59,900	0.37	59,900	0.05	59,900	9.21	49,100
Benzyl chloride	100-44-7	10,200 U	0.00	10,200 U	0.00	10,200 U	0.00	6,670 U
Bromodichloromethane	75-27-4	5,270 U	0.00	5,270 U	0.00	5,270 U	0.00	3,450 U
Bromoform	75-25-2	20,400 U	0.00	20,400 U	0.00	20,400 U	0.00	13,300 U
Bromomethane	74-83-9	3,060 U	0.00	3,060 U	0.00	3,060 U	0.00	2,000 U
Carbon disulfide	75-15-0	2,460 U	0.00	2,460 U	0.00	2,460 U	0.00	1,610 U
Carbon tetrachloride	56-23-5	4,960 U	0.00	4,960 U	0.00	4,960 U	0.00	3,250 U
Chlorobenzene	108-90-7	3,630 U	0.00	3,630 U	0.00	3,630 U	0.00	2,370 U
Chloroethane	75-00-3	2,080 U	0.00	2,080 U	0.00	2,080 U	0.00	1,360 U
Chloroform	67-66-3	1,920 U	0.00	1,920 U	0.00	1,920 U	0.00	1,260 U
Chloromethane	74-87-3	1,630 U	0.00	1,630 U	0.00	1,630 U	0.00	1,070 U
cis-1,2-Dichloroethene	156-59-2	3,130 U	0.00	3,130 U	0.00	3,130 U	0.00	2,040 U
cis-1,3-Dichloropropene	10061-01-5	8,960 U	0.00	8,960 U	0.00	8,960 U	0.00	5,860 U
Cyclohexane	110-82-7	6,790 U	0.00	6,790 U	0.00	6,790 U	0.00	4,440 U
Dibromochloromethane	124-48-1	6,710 U	0.00	6,710 U	0.00	6,710 U	0.00	4,390 U
Dichlorodifluoromethane	75-71-8	3,920 U	0.00	3,920 U	0.00	3,920 U	0.00	2,560 U
Dichlorotetrafluoroethane	76-14-2	5,510 U	0.00	5,510 U	0.00	5,510 U	0.00	3,600 U
Ethanol	64-17-5	7,450 U	0.00	7,450 U	0.00	7,450 U	0.00	4,870 U
Ethyl acetate	141-78-6	2,840 U	0.00	2,840 U	0.00	2,840 U	0.00	1,860 U
Ethylbenzene	100-41-4	25,000	0.16	25,000	0.02	25,000	3.85	22,400
Hexachloro-1,3-butadiene	87-68-3	21,000 U	0.00	21,000 U	0.00	21,000 U	0.00	13,700 U
m&p-Xylene	179601-23-1	83,500	0.52	83,500	0.07	83,500	12.84	73,500
Methylene Chloride	75-09-2	13,700 U	0.00	13,700 U	0.00	13,700 U	0.00	8,950 U
Methyl-tert-butyl ether	1634-04-4	14,200 U	0.00	14,200 U	0.00	14,200 U	0.00	9,280 U
Naphthalene	91-20-3	10,300 U	0.00	10,300 U	0.00	10,300 U	0.00	6,750 U
n-Heptane	142-82-5	138,000	0.86	138,000	0.11	138,000	21.23	115,000
n-Hexane	110-54-3	209,000	1.30	209,000	0.17	209,000	32.15	169,000
o-Xylene	95-47-6	15,000	0.09	15,000	0.01	15,000	2.31	13,400
Propylene	115-07-1	3,390 U	0.00	3,390 U	0.00	3,390 U	0.00	2,220 U
Styrene	100-42-5	3,360 U	0.00	3,360 U	0.00	3,360 U	0.00	2,200 U
Tetrachloroethene	127-18-4	2,670 U	0.00	2,670 U	0.00	2,670 U	0.00	1,750 U
Tetrahydrofuran	109-99-9	2,330 U	0.00	2,330 U	0.00	2,330 U	0.00	1,520 U
Toluene	108-88-3	3,580	0.02	3,580	0.00	3,580	0.55	3,140
trans-1,2-Dichloroethene	156-60-5	3,130 U	0.00	3,130 U	0.00	3,130 U	0.00	2,040 U
trans-1,3-Dichloropropene	10061-02-6	8,960 U	0.00	8,960 U	0.00	8,960 U	0.00	5,860 U
Trichloroethene	79-01-6	2,120 U	0.00	2,120 U	0.00	2,120 U	0.00	1,380 U
Trichlorofluoromethane	75-69-4	4,420 U	0.00	4,420 U	0.00	4,420 U	0.00	2,890 U
Vinyl acetate	108-05-4	2,780 U	0.00	2,780 U	0.00	2,780 U	0.00	1,820 U
Vinyl chloride	75-01-4	1,010 U	0.00	1,010 U	0.00	1,010 U	0.00	659 U
Total VOCs	--	--	3.40	--	0.45	--	83.81	--
Period Total VOC Mass Removed (lbs)		**3.4**		**0.4**		**83.8**		**--**
Cumulative Total VOC Mass Removed (lbs)		**2,775**		**2,775**		**2,859**		**--**

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Appendix B
Historical Analytical Results and Contaminant Mass Removal - Vapor
Calumet Montana Refining, LLC - Great Falls, Montana

Location		SP301		SP301		SP301	
Ramboll Sample ID		CMR-SP301-230130		CMR-SP301-230228		CMR-SP301-230321	
Sample Date		1/30/2023		2/28/2023		3/21/2023	
Blower Flow (scfm)		44		105		147	
Period Operational Time (hrs)		703		534		734	
Notes							
VOCs	**CAS No.**	**Result (ug/m^3)**	**Mass (lb)**	**Result (ug/m^3)**	**Mass (lb)**	**Result (ug/m^3)**	**Mass (lb)**
1,1,1-Trichloroethane	71-55-6	78 U	0.00	1,340 U	0.00	1 U	0.00
1,1,2,2-Tetrachloroethane	79-34-5	99 U	0.00	1,690 U	0.00	1 U	0.00
1,1,2-Trichloroethane	79-00-5	39 U	0.00	671 U	0.00	1 U	0.00
1,1,2-Trichlorotrifluoroethane	76-13-1	110 U	0.00	1,890 U	0.00	2 U	0.00
1,1-Dichloroethane	75-34-3	58 U	0.00	996 U	0.00	1 U	0.00
1,1-Dichloroethene	75-35-4	57 U	0.00	975 U	0.00	1 U	0.00
1,2,4-Trichlorobenzene	120-82-1	532 U	0.00	9,120 U	0.00	5 U	0.00
1,2,4-Trimethylbenzene	95-63-6	114	0.01	1,210 U	0.00	491 U	0.00
1,2-Dibromoethane (EDB)	106-93-4	55 U	0.00	945 U	0.00	2 U	0.00
1,2-Dichlorobenzene	95-50-1	216 U	0.00	3,700 U	0.00	1 U	0.00
1,2-Dichloroethane	107-06-2	58 U	0.00	996 U	0.00	1 U	0.00
1,2-Dichloropropane	78-87-5	66 U	0.00	1,140 U	0.00	1 U	0.00
1,3,5-Trimethylbenzene	108-67-8	144	0.02	1,210 U	0.00	388	0.16
1,3-Butadiene	106-99-0	32 U	0.00	544 U	0.00	4 U	0.00
1,3-Dichlorobenzene	541-73-1	216 U	0.00	3,700 U	0.00	1 U	0.00
1,4-Dichlorobenzene	106-46-7	216 U	0.00	3,700 U	0.00	1 U	0.00
2-Butanone (MEK)	78-93-3	212 U	0.00	3,630 U	0.00	4 U	0.00
2-Hexanone	591-78-6	293 U	0.00	5,030 U	0.00	5 U	0.00
2-Propanol	67-63-0	176 U	0.00	3,020 U	0.00	7	0.00
4-Ethyltoluene	622-96-8	176 U	0.00	3,020 U	0.00	205	0.08
4-Methyl-2-pentanone (MIBK)	108-10-1	293 U	0.00	5,030 U	0.00	5 U	0.00
Acetone	67-64-1	426 U	0.00	7,310 U	0.00	33	0.01
Benzene	71-43-2	884	0.10	1,120	0.24	303	0.12
Benzyl chloride	100-44-7	185 U	0.00	3,180 U	0.00	1 U	0.00
Bromodichloromethane	75-27-4	96 U	0.00	1,650 U	0.00	1 U	0.00
Bromoform	75-25-2	370 U	0.00	6,350 U	0.00	6 U	0.00
Bromomethane	74-83-9	56 U	0.00	954 U	0.00	1 U	0.00
Carbon disulfide	75-15-0	45 U	0.00	766 U	0.00	12	0.00
Carbon tetrachloride	56-23-5	90 U	0.00	1,550 U	0.00	1 U	0.00
Chlorobenzene	108-90-7	66 U	0.00	1,130 U	0.00	1 U	0.00
Chloroethane	75-00-3	38 U	0.00	648 U	0.00	1 U	0.00
Chloroform	67-66-3	35 U	0.00	600 U	0.00	1 U	0.00
Chloromethane	74-87-3	30 U	0.00	508 U	0.00	0 U	0.00
cis-1,2-Dichloroethene	156-59-2	57 U	0.00	975 U	0.00	1 U	0.00
cis-1,3-Dichloropropene	10061-01-5	163 U	0.00	2,790 U	0.00	1 U	0.00
Cyclohexane	110-82-7	123 U	0.00	2,120 U	0.00	8,020	3.24
Dibromochloromethane	124-48-1	122 U	0.00	2,090 U	0.00	2 U	0.00
Dichlorodifluoromethane	75-71-8	71 U	0.00	1,220 U	0.00	2	0.00
Dichlorotetrafluoroethane	76-14-2	100 U	0.00	1,720 U	0.00	1 U	0.00
Ethanol	64-17-5	212	0.02	2,320 U	0.00	35	0.01
Ethyl acetate	141-78-6	52 U	0.00	887 U	0.00	-- --	--
Ethylbenzene	100-41-4	566	0.07	1,070 U	0.00	1,040	0.42
Hexachloro-1,3-butadiene	87-68-3	382 U	0.00	6,560 U	0.00	7 U	0.00
m&p-Xylene	179601-23-1	4,970	0.57	2,140 U	0.00	-- --	--
Methylene Chloride	75-09-2	249 U	0.00	4,270 U	0.00	1 U	0.00
Methyl-tert-butyl ether	1634-04-4	258 U	0.00	4,430 U	0.00	1 U	0.00
Naphthalene	91-20-3	188 U	0.00	3,220 U	0.00	3 U	0.00
n-Heptane	142-82-5	1,780	0.21	2,700	0.57	3,590	1.45
n-Hexane	110-54-3	1,410	0.16	8,780	1.85	16,600	6.70
o-Xylene	95-47-6	1,220	0.14	1,070 U	0.00	958	0.39
Propylene	115-07-1	62 U	0.00	1,060 U	0.00	2 U	0.00
Styrene	100-42-5	61 U	0.00	1,050 U	0.00	1 U	0.00
Tetrachloroethene	127-18-4	49 U	0.00	833 U	0.00	1 U	0.00
Tetrahydrofuran	109-99-9	42 U	0.00	726 U	0.00	1 U	0.00
Toluene	108-88-3	656	0.08	927 U	0.00	942 U	0.00
trans-1,2-Dichloroethene	156-60-5	57 U	0.00	975 U	0.00	1 U	0.00
trans-1,3-Dichloropropene	10061-02-6	163 U	0.00	2,790 U	0.00	1 U	0.00
Trichloroethene	79-01-6	39 U	0.00	660 U	0.00	1 U	0.00
Trichlorofluoromethane	75-69-4	80 U	0.00	1,380 U	0.00	1 U	0.00
Vinyl acetate	108-05-4	51 U	0.00	866 U	0.00	1 U	0.00
Vinyl chloride	75-01-4	18 U	0.00	314 U	0.00	1 U	0.00
Total VOCs	--	--	1.38	--	2.65	--	12.59
Period Total VOC Mass Removed (lbs)		**1.4**		**2.7**		**12.6**	
Cumulative Total VOC Mass Removed (lbs)		**2,860**		**2,863**		**2,876**	

Appendix B
Historical Analytical Results and Contaminant Mass Removal - Vapor
Calumet Montana Refining, LLC - Great Falls, Montana

Location		SP301		SP301		SP301	
Ramboll Sample ID		CMR-SP301-230531		CMR-SP301-230531		CMR-SP301-290623	
Sample Date		4/30/2023		5/31/2023		6/29/2023	
Blower Flow (scfm)		81		75		70	
Period Operational Time (hrs)		533		510		449	
Notes							
VOCs	**CAS No.**	**Result (ug/m^3)**	**Mass (lb)**	**Result (ug/m^3)**	**Mass (lb)**	**Result (ug/m^3)**	**Mass (lb)**
1,1,1-Trichloroethane	71-55-6	1 U	0.00	1 U	0.00	1 U	0.00
1,1,2,2-Tetrachloroethane	79-34-5	275 U	0.00	275 U	0.00	1 U	0.00
1,1,2-Trichloroethane	79-00-5	1 U	0.00	1 U	0.00	1 U	0.00
1,1,2-Trichlorotrifluoroethane	76-13-1	2 U	0.00	2 U	0.00	2 U	0.00
1,1-Dichloroethane	75-34-3	1 U	0.00	1 U	0.00	1 U	0.00
1,1-Dichloroethene	75-35-4	1 U	0.00	1 U	0.00	1 U	0.00
1,2,4-Trichlorobenzene	120-82-1	933 U	0.00	933 U	0.00	5 U	0.00
1,2,4-Trimethylbenzene	95-63-6	196 U	0.00	196 U	0.00	4	0.00
1,2-Dibromoethane (EDB)	106-93-4	2 U	0.00	2 U	0.00	2 U	0.00
1,2-Dichlorobenzene	95-50-1	240 U	0.00	240 U	0.00	1 U	0.00
1,2-Dichloroethane	107-06-2	1 U	0.00	1 U	0.00	1 U	0.00
1,2-Dichloropropane	78-87-5	1 U	0.00	1 U	0.00	1 U	0.00
1,3,5-Trimethylbenzene	108-67-8	196 U	0.00	196 U	0.00	2	0.00
1,3-Butadiene	106-99-0	4 U	0.00	4 U	0.00	4 U	0.00
1,3-Dichlorobenzene	541-73-1	240 U	0.00	240 U	0.00	1 U	0.00
1,4-Dichlorobenzene	106-46-7	240 U	0.00	240 U	0.00	1 U	0.00
2-Butanone (MEK)	78-93-3	22	0.00	22	0.00	4 U	0.00
2-Hexanone	591-78-6	5 U	0.00	5 U	0.00	5 U	0.00
2-Propanol	67-63-0	13	0.00	13	0.00	3 U	0.00
4-Ethyltoluene	622-96-8	196 U	0.00	196 U	0.00	1 U	0.00
4-Methyl-2-pentanone (MIBK)	108-10-1	5 U	0.00	5 U	0.00	5 U	0.00
Acetone	67-64-1	3 U	0.00	3 U	0.00	3 U	0.00
Benzene	71-43-2	206	0.03	206	0.03	1 U	0.00
Benzyl chloride	100-44-7	208 U	0.00	208 U	0.00	1 U	0.00
Bromodichloromethane	75-27-4	1 U	0.00	1 U	0.00	1 U	0.00
Bromoform	75-25-2	1,240 U	0.00	1,240 U	0.00	6 U	0.00
Bromomethane	74-83-9	1 U	0.00	1 U	0.00	1 U	0.00
Carbon disulfide	75-15-0	6	0.00	6	0.00	1 U	0.00
Carbon tetrachloride	56-23-5	1 U	0.00	1 U	0.00	1 U	0.00
Chlorobenzene	108-90-7	1 U	0.00	1 U	0.00	1 U	0.00
Chloroethane	75-00-3	1 U	0.00	1 U	0.00	1 U	0.00
Chloroform	67-66-3	1 U	0.00	1 U	0.00	1 U	0.00
Chloromethane	74-87-3	0 U	0.00	0 U	0.00	1	0.00
cis-1,2-Dichloroethene	156-59-2	1 U	0.00	1 U	0.00	1 U	0.00
cis-1,3-Dichloropropene	10061-01-5	1 U	0.00	1 U	0.00	1 U	0.00
Cyclohexane	110-82-7	278	0.05	278	0.04	3,120	0.37
Dibromochloromethane	124-48-1	2 U	0.00	2 U	0.00	2 U	0.00
Dichlorodifluoromethane	75-71-8	3	0.00	3	0.00	2	0.00
Dichlorotetrafluoroethane	76-14-2	1 U	0.00	1 U	0.00	1 U	0.00
Ethanol	64-17-5	60	0.01	60	0.01	13	0.00
Ethyl acetate	141-78-6	-- --	--	-- --	--	-- --	--
Ethylbenzene	100-41-4	173 U	0.00	173 U	0.00	160	0.02
Hexachloro-1,3-butadiene	87-68-3	1,350 U	0.00	1,350 U	0.00	7 U	0.00
m&p-Xylene	179601-23-1	642	0.10	642	0.09	221	0.03
Methylene Chloride	75-09-2	1 U	0.00	1 U	0.00	1 U	0.00
Methyl-tert-butyl ether	1634-04-4	1 U	0.00	1 U	0.00	1 U	0.00
Naphthalene	91-20-3	660 U	0.00	660 U	0.00	3 U	0.00
n-Heptane	142-82-5	11,700	1.90	11,700	1.67	2,920	0.34
n-Hexane	110-54-3	1,700	0.28	1,700	0.24	9,270	1.09
o-Xylene	95-47-6	189	0.03	189	0.03	46	0.01
Propylene	115-07-1	27	0.00	27	0.00	15	0.00
Styrene	100-42-5	170 U	0.00	170 U	0.00	1 U	0.00
Tetrachloroethene	127-18-4	4	0.00	4	0.00	1 U	0.00
Tetrahydrofuran	109-99-9	1 U	0.00	1 U	0.00	1 U	0.00
Toluene	108-88-3	146	0.02	146	0.02	159	0.02
trans-1,2-Dichloroethene	156-60-5	1 U	0.00	1 U	0.00	1 U	0.00
trans-1,3-Dichloropropene	10061-02-6	1 U	0.00	1 U	0.00	1 U	0.00
Trichloroethene	79-01-6	1 U	0.00	1 U	0.00	1 U	0.00
Trichlorofluoromethane	75-69-4	1	0.00	1	0.00	1	0.00
Vinyl acetate	108-05-4	1 U	0.00	1 U	0.00	1 U	0.00
Vinyl chloride	75-01-4	1 U	0.00	1 U	0.00	1 U	0.00
Total VOCs	--	--	2.43	--	2.14	--	1.87
Period Total VOC Mass Removed (lbs)		**2.4**		**2.1**		**1.9**	
Cumulative Total VOC Mass Removed (lbs)		**2,878**		**2,880**		**2,882**	

Appendix B
Historical Analytical Results and Contaminant Mass Removal - Vapor
Calumet Montana Refining, LLC - Great Falls, Montana

	Location	**SP301**	
	Ramboll Sample ID	**CMR-SP301-110723**	
	Sample Date	**7/11/2023**	
	Blower Flow (scfm)	**78**	
	Period Operational Time (hrs)	**310**	
	Notes		
VOCs	**CAS No.**	**Result (ug/m^3)**	**Mass (lb)**
1,1,1-Trichloroethane	71-55-6	22 U	0.00
1,1,2,2-Tetrachloroethane	79-34-5	28 U	0.00
1,1,2-Trichloroethane	79-00-5	22 U	0.00
1,1,2-Trichlorotrifluoroethane	76-13-1	31 U	0.00
1,1-Dichloroethane	75-34-3	16 U	0.00
1,1-Dichloroethene	75-35-4	16 U	0.00
1,2,4-Trichlorobenzene	120-82-1	93 U	0.00
1,2,4-Trimethylbenzene	95-63-6	638	0.06
1,2-Dibromoethane (EDB)	106-93-4	31 U	0.00
1,2-Dichlorobenzene	95-50-1	24 U	0.00
1,2-Dichloroethane	107-06-2	16 U	0.00
1,2-Dichloropropane	78-87-5	19 U	0.00
1,3,5-Trimethylbenzene	108-67-8	408	0.04
1,3-Butadiene	106-99-0	89 U	0.00
1,3-Dichlorobenzene	541-73-1	24 U	0.00
1,4-Dichlorobenzene	106-46-7	24 U	0.00
2-Butanone (MEK)	78-93-3	74 U	0.00
2-Hexanone	591-78-6	102 U	0.00
2-Propanol	67-63-0	62 U	0.00
4-Ethyltoluene	622-96-8	287	0.03
4-Methyl-2-pentanone (MIBK)	108-10-1	102 U	0.00
Acetone	67-64-1	59 U	0.00
Benzene	71-43-2	3,550	0.32
Benzyl chloride	100-44-7	21 U	0.00
Bromodichloromethane	75-27-4	27 U	0.00
Bromoform	75-25-2	124 U	0.00
Bromomethane	74-83-9	16 U	0.00
Carbon disulfide	75-15-0	12 U	0.00
Carbon tetrachloride	56-23-5	25 U	0.00
Chlorobenzene	108-90-7	19 U	0.00
Chloroethane	75-00-3	11 U	0.00
Chloroform	67-66-3	20 U	0.00
Chloromethane	74-87-3	8 U	0.00
cis-1,2-Dichloroethene	156-59-2	16 U	0.00
cis-1,3-Dichloropropene	10061-01-5	18 U	0.00
Cyclohexane	110-82-7	6,100	0.55
Dibromochloromethane	124-48-1	34 U	0.00
Dichlorodifluoromethane	75-71-8	20 U	0.00
Dichlorotetrafluoroethane	76-14-2	28 U	0.00
Ethanol	64-17-5	94 U	0.00
Ethyl acetate	141-78-6	-- --	--
Ethylbenzene	100-41-4	2,310	0.21
Hexachloro-1,3-butadiene	87-68-3	135 U	0.00
m&p-Xylene	179601-23-1	7,720	0.70
Methylene Chloride	75-09-2	14 U	0.00
Methyl-tert-butyl ether	1634-04-4	14 U	0.00
Naphthalene	91-20-3	66 U	0.00
n-Heptane	142-82-5	7,360	0.66
n-Hexane	110-54-3	15,700	1.42
o-Xylene	95-47-6	2,130	0.19
Propylene	115-07-1	43 U	0.00
Styrene	100-42-5	17 U	0.00
Tetrachloroethene	127-18-4	27 U	0.00
Tetrahydrofuran	109-99-9	12 U	0.00
Toluene	108-88-3	618	0.06
trans-1,2-Dichloroethene	156-60-5	16 U	0.00
trans-1,3-Dichloropropene	10061-02-6	18 U	0.00
Trichloroethene	79-01-6	21 U	0.00
Trichlorofluoromethane	75-69-4	23 U	0.00
Vinyl acetate	108-05-4	14 U	0.00
Vinyl chloride	75-01-4	10 U	0.00
Total VOCs	--	--	4.22
Period Total VOC Mass Removed (lbs)		**4.2**	
Cumulative Total VOC Mass Removed (lbs)		**2,886**	

Appendix B
Summary of Analytical Results and Contaminant Mass Removal - Vapor
Calumet Montana Refining, LLC - Great Falls, Montana

1. Blower flowrate is continuously recorded by the system PLC. Average blower flowrate during the period is used for the calculations
2. Operational time during system start-up and comissioning (October, 2021 through December 2021) is the number of hours the system operated between each sampling event. Opertational time during the standard system opration (beginning January 2022) represents system runtime (in hour) for the month during with the sample was taken.
3. Results from November 19, 2021 and February 16, 2022 appear anomalously low as PID readings from these two events were consistent with PID readings from the other sampling events. Therfore, these results were rejected.
4. Sample was not collected during September 2022, therefore results from August 2022 were used for mass removal calculations.
5. Sample was not collected during October 2022 and November 2022, therefore results from December 2022 were used for mass removal calculations.
6. Sample collected for April 2023 was received by the lab outside the allowable vacuum range so sample was not analyzed; therefore results from May 2023 were used for mass removal calculations.
7. Samples were not collected in August and September 2023 due to system shutdown

E: Analyte concentration exceeded the calibration range. The reported result is estimated
R: Result rejected
U: The analyte was not detected in the sample at the estimated detection limit
VOCs : Volatile Organic Compounds
ug/m^3 : micrograms per cubic meter
Sample Calculation

$$\boldsymbol{Mass\ Removed\ (lb) = 340000\ \frac{ug}{m^3} \times\ 10^{-6}\ \frac{g}{ug}\ \times \frac{1}{453.6}\ \frac{lb}{g} \times 41\ \frac{ft^3}{min} \times 0.02832\ \frac{m^3}{ft^3} \times 26\ hr\ \times 60\ \frac{min}{hr}}$$

APPENDIX C

HISTORICAL ANALYTICAL RESULTS AND CONTAMINANT MASS REMOVAL - LIQUID

Appendix C
Historical Analytical Results and Contaminant Mass Removal - Liquid
Calumet Montana Refining, LLC - Great Falls, Montana

Location		SP200		SP200		SP200		SP200	
Ramboll Sample ID		CMR-SP200-211015		CMR-SP200-211208		CMR-SP200-220216		CMR-SP200-220411	
Sample Date		10/15/2021		12/8/2021		2/16/2022		4/11/2022	
Effluent Volume (L)*		21,138		43,176		80,754		137,543	
Notes									
Analyte	**CAS No.**	**Result (ug/L)**	**Mass (lb)**	**Result (ug/L)**	**Mass (lb)**	**Result (ug/L)**	**Mass (lb)**	**Result (ug/L)**	**Mass (lb)**
VOCs									
1,1,1-TRICHLOROETHANE	71-55-6	ND	--	ND	--	ND	--	ND	--
1,1,2,2-TETRACHLOROETHANE	79-34-5	ND	--	ND	--	ND	--	ND	--
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	76-13-1	ND	--	ND	--	ND	--	ND	--
1,1,2-TRICHLOROETHANE	79-00-5	ND	--	ND	--	ND	--	ND	--
1,1-DICHLOROETHANE	75-34-3	ND	--	ND	--	ND	--	ND	--
1,1-DICHLOROETHENE	75-35-4	ND	--	ND	--	ND	--	ND	--
1,2,3-TRICHLOROBENZENE	87-61-6	ND	--	ND	--	ND	--	ND	--
1,2,4-TRICHLOROBENZENE	120-82-1	ND	--	ND	--	ND	--	ND	--
1,2-DIBROMO-3-CHLOROPROPANE	96-12-8	ND	--	ND	--	ND	--	ND	--
1,2-DIBROMOETHANE	106-93-4	ND	--	ND	--	ND	--	ND	--
1,2-DICHLOROBENZENE	95-50-1	ND	--	ND	--	ND	--	ND	--
1,2-DICHLOROETHANE	107-06-2	ND	--	ND	--	ND	--	ND	--
1,2-DICHLOROPROPANE	78-87-5	ND	--	ND	--	ND	--	ND	--
1,3-DICHLOROBENZENE	541-73-1	ND	--	ND	--	ND	--	ND	--
1,4-DICHLOROBENZENE	106-46-7	ND	--	ND	--	ND	--	ND	--
1,4-DIOXANE	123-91-1	ND	--	ND	--	ND	--	ND	--
2-BUTANONE	78-93-3	ND	--	ND	--	ND	--	ND	--
2-HEXANONE	591-78-6	ND	--	ND	--	ND	--	ND	--
4-METHYL-2-PENTANONE	108-10-1	ND	--	ND	--	ND	--	ND	--
ACETONE	67-64-1	ND	--	ND	--	ND	--	ND	--
BENZENE	71-43-2	2,300	0.11	350	0.03	420	0.07	540	0.16
BROMOCHLOROMETHANE	74-97-5	ND	--	ND	--	ND	--	ND	--
BROMODICHLOROMETHANE	75-27-4	ND	--	ND	--	ND	--	ND	--
BROMOFORM	75-25-2	ND	--	ND	--	ND	--	ND	--
BROMOMETHANE	74-83-9	ND	--	ND	--	ND	--	ND	--
CARBON DISULFIDE	75-15-0	ND	--	ND	--	ND	--	ND	--
CARBON TETRACHLORIDE	56-23-5	ND	--	ND	--	ND	--	ND	--
CHLOROBENZENE	108-90-7	ND	--	ND	--	ND	--	ND	--
CHLOROETHANE	75-00-3	ND	--	ND	--	ND	--	ND	--
CHLOROFORM	67-66-3	ND	--	ND	--	ND	--	ND	--
CHLOROMETHANE	74-87-3	ND	--	ND	--	ND	--	ND	--
CIS-1,2-DICHLOROETHENE	156-59-2	ND	--	79	0.01	ND	--	ND	--
CIS-1,3-DICHLOROPROPENE	10061-01-5	ND	--	ND	--	ND	--	ND	--
CUMENE	98-82-8	ND	--	130	0.01	ND	--	ND	--
CYCLOHEXANE	110-82-7	160	0.01	72	0.01	ND	--	ND	--
DIBROMOCHLOROMETHANE	124-48-1	ND	--	ND	--	ND	--	ND	--
DICHLORODIFLUOROMETHANE	75-71-8	ND	--	ND	--	ND	--	ND	--
ETHYL BENZENE	100-41-4	1,100	0.05	730	0.07	450	0.08	590	0.18
M,P-XYLENE	179601-23-1	5,100	0.24	5,400	0.51	3,200	0.57	3,200	0.97
METHYL ACETATE	79-20-9	ND	--	ND	--	ND	--	ND	--
METHYL TERT-BUTYL ETHER	1634-04-4	ND	--	ND	--	ND	--	ND	--
METHYLCYCLOHEXANE	108-87-2	71	0.00	43	0.00	ND	--	ND	--
METHYLENE CHLORIDE	75-09-2	ND	--	ND	--	ND	--	ND	--
NAPHTHALENE	91-20-3	290	0.01	1,500	0.14	460	0.08	510	0.15
ORTHO-XYLENE	95-47-6	1,400	0.07	1,800	0.17	1,100	0.20	960	0.29
STYRENE	100-42-5	ND	--	ND	--	ND	--	ND	--
TETRACHLOROETHENE	127-18-4	ND	--	ND	--	ND	--	ND	--
TOLUENE	108-88-3	1,500	0.07	330	0.03	370	0.07	ND	--
TRANS-1,2-DICHLOROETHENE	156-60-5	ND	--	ND	--	ND	--	ND	--
TRANS-1,3-DICHLOROPROPENE	10061-02-6	ND	--	ND	--	ND	--	ND	--
TRICHLOROETHENE	79-01-6	ND	--	ND	--	ND	--	ND	--
TRICHLOROFLUOROMETHANE	75-69-4	ND	--	ND	--	ND	--	ND	--
VINYL CHLORIDE	75-01-4	ND	--	ND	--	ND	--	ND	--
XYLENES (TOTAL)	1330-20-7	6,500	0.30	--	--	--	--	--	--
Total VOCs	--	--	**0.86**	--	**0.99**	--	**1.07**	--	**1.76**
Period Total VOC Mass Removed (lbs)			**0.9**		**1.0**		**1.1**		**1.8**
Cumulative Total VOC Mass Removed (lbs)			**0.9**		**1.9**		**2.9**		**4.7**

Appendix C
Historical Analytical Results and Contaminant Mass Removal - Liquid
Calumet Montana Refining, LLC - Great Falls, Montana

Location		SP200		SP200		SP200		SP200	
Ramboll Sample ID		CMR-SP200-211015		CMR-SP200-211208		CMR-SP200-220216		CMR-SP200-220411	
Sample Date		10/15/2021		12/8/2021		2/16/2022		4/11/2022	
Effluent Volume (L)*		21,138		43,176		80,754		137,543	
Notes									
Analyte	**CAS No.**	**Result (ug/L)**	**Mass (lb)**	**Result (ug/L)**	**Mass (lb)**	**Result (ug/L)**	**Mass (lb)**	**Result (ug/L)**	**Mass (lb)**
SVOCs									
1,2,4,5-TETRACHLOROBENZENE	95-94-3	ND	--	ND	--	ND	--	ND	--
1,2,4-TRICHLOROBENZENE	120-82-1	ND	--	ND	--	ND	--	ND	--
1,2-DICHLOROBENZENE	95-50-1	ND	--	ND	--	ND	--	ND	--
1,3-DICHLOROBENZENE	541-73-1	ND	--	ND	--	ND	--	ND	--
1,4-DICHLOROBENZENE	106-46-7	ND	--	ND	--	ND	--	ND	--
2,2'-OXYBIS(1-CHLOROPROPANE)	108-60-1	ND	--	ND	--	ND	--	ND	--
2,3,4,6-TETRACHLOROPHENOL	58-90-2	ND	--	ND	--	ND	--	ND	--
2,4,5-TRICHLOROPHENOL	95-95-4	ND	--	ND	--	ND	--	ND	--
2,4,6-TRICHLOROPHENOL	88-06-2	ND	--	ND	--	ND	--	ND	--
2,4-DICHLOROPHENOL	120-83-2	ND	--	ND	--	ND	--	ND	--
2,4-DIMETHYLPHENOL	105-67-9	ND	--	ND	--	590	0.11	270	0.08
2,4-DINITROPHENOL	51-28-5	ND	--	ND	--	ND	--	ND	--
2,4-DINITROTOLUENE	121-14-2	ND	--	ND	--	ND	--	ND	--
2,6-DINITROTOLUENE	606-20-2	ND	--	ND	--	ND	--	ND	--
2-CHLORONAPHTHALENE	91-58-7	ND	--	ND	--	ND	--	ND	--
2-CHLOROPHENOL	95-57-8	ND	--	ND	--	ND	--	ND	--
2-METHYLNAPHTHALENE	91-57-6	710	0.03	9,700	0.92	710	0.13	340	0.10
2-METHYLPHENOL	95-48-7	ND	--	ND	--	ND	--	ND	--
2-NITROANILINE	88-74-4	ND	--	ND	--	ND	--	ND	--
2-NITROPHENOL	88-75-5	ND	--	ND	--	ND	--	ND	--
3,3'-DICHLOROBENZIDINE	91-94-1	ND	--	ND	--	ND	--	ND	--
3-NITROANILINE	99-09-2	ND	--	ND	--	ND	--	ND	--
4,6-DINITRO-2-METHYLPHENOL	534-52-1	ND	--	ND	--	ND	--	ND	--
4-BROMOPHENYL-PHENYL ETHER	101-55-3	ND	--	ND	--	ND	--	ND	--
4-CHLORO-3-METHYLPHENOL	59-50-7	ND	--	ND	--	ND	--	ND	--
4-CHLOROPHENYL-PHENYL ETHER	7005-72-3	ND	--	ND	--	ND	--	ND	--
4-METHYLPHENOL	106-44-5	ND	--	ND	--	ND	--	ND	--
4-NITROANILINE	100-01-6	ND	--	ND	--	ND	--	ND	--
4-NITROPHENOL	100-02-7	ND	--	ND	--	ND	--	ND	--
ACENAPHTHENE	83-32-9	ND	--	ND	--	14	0.00	ND	--
ACENAPHTHYLENE	208-96-8	38	0.00	ND	--	ND	--	ND	--
ANTHRACENE	120-12-7	ND	--	ND	--	ND	--	ND	--
BENZO(A)ANTHRACENE	56-55-3	ND	--	ND	--	ND	--	ND	--
BENZO(A)PYRENE	50-32-8	ND	--	ND	--	ND	--	ND	--
BENZO(B)FLUORANTHENE	205-99-2	ND	--	ND	--	ND	--	ND	--
BENZO(G,H,I)PERYLENE	191-24-2	ND	--	ND	--	ND	--	ND	--
BENZO(K)FLUORANTHENE	207-08-9	ND	--	ND	--	ND	--	ND	--
BIS(2-CHLOROETHOXY)METHANE	111-91-1	ND	--	ND	--	ND	--	ND	--
BIS(2-CHLOROETHYL) ETHER	111-44-4	ND	--	ND	--	ND	--	ND	--
BIS(2-ETHYLHEXYL)PHTHALATE	117-81-7	ND	--	ND	--	ND	--	ND	--
BUTYLBENZYLPHTHALATE	85-68-7	ND	--	ND	--	ND	--	ND	--
CARBAZOLE	86-74-8	ND	--	ND	--	ND	--	ND	--
CHRYSENE	218-01-9	ND	--	ND	--	ND	--	ND	--
DIBENZ(A,H)ANTHRACENE	53-70-3	ND	--	ND	--	ND	--	ND	--
DIBENZOFURAN	132-64-9	ND	--	ND	--	ND	--	ND	--
DIETHYLPHTHALATE	84-66-2	ND	--	ND	--	ND	--	ND	--
DIMETHYLPHTHALATE	131-11-3	ND	--	ND	--	ND	--	ND	--
DI-N-BUTYLPHTHALATE	84-74-2	ND	--	ND	--	ND	--	ND	--
DI-N-OCTYLPHTHALATE	117-84-0	ND	--	ND	--	ND	--	ND	--
FLUORANTHENE	206-44-0	ND	--	ND	--	ND	--	ND	--
FLUORENE	86-73-7	30	0.00	360	0.03	ND	--	13	0.00
HEXACHLOROBENZENE	118-74-1	ND	--	ND	--	ND	--	ND	--
HEXACHLOROBUTADIENE	87-68-3	ND	--	ND	--	ND	--	ND	--
HEXACHLOROCYCLOPENTADIENE	77-47-4	ND	--	ND	--	ND	--	ND	--
HEXACHLOROETHANE	67-72-1	ND	--	ND	--	ND	--	ND	--
INDENO(1,2,3-CD)PYRENE	193-39-5	ND	--	ND	--	ND	--	ND	--
ISOPHORONE	78-59-1	ND	--	ND	--	ND	--	ND	--
NAPHTHALENE	91-20-3	610	0.03	5,800	0.55	560	0.10	330	0.10
NITROBENZENE	98-95-3	ND	--	ND	--	ND	--	ND	--
N-NITROSO-DI-N-PROPYLAMINE	621-64-7	ND	--	ND	--	ND	--	ND	--
N-NITROSODIPHENYLAMINE	86-30-6	ND	--	ND	--	ND	--	ND	--
PENTACHLOROPHENOL	87-86-5	ND	--	ND	--	ND	--	ND	--
PHENANTHRENE	85-01-8	48	0.00	610	0.06	53	0.01	22	0.01
PHENOL	108-95-2	ND	--	ND	--	ND	--	47	0.01
PYRENE	129-00-0	12	0.00	110	0.01	7	0.00	3	0.00
Total SVOCs	--	--	**0.07**	--	**1.58**	--	**0.34**	--	**0.31**
Period Total SVOC Mass Removed (lbs)			**0.1**		**1.6**		**0.3**		**0.3**
Cumulative Total VOC Mass Removed (lbs)			**0.1**		**1.6**		**2.0**		**2.3**

Appendix C
Historical Analytical Results and Contaminant Mass Removal - Liquid
Calumet Montana Refining, LLC - Great Falls, Montana

Location		SP200		SP200		SP200		SP200	
Ramboll Sample ID		CMR-SP200-211015		CMR-SP200-211208		CMR-SP200-220216		CMR-SP200-220411	
Sample Date		10/15/2021		12/8/2021		2/16/2022		4/11/2022	
Effluent Volume (L)*		21,138		43,176		80,754		137,543	
Notes									
Analyte	**CAS No.**	**Result (ug/L)**	**Mass (lb)**	**Result (ug/L)**	**Mass (lb)**	**Result (ug/L)**	**Mass (lb)**	**Result (ug/L)**	**Mass (lb)**
EPH									
C11 THROUGH C22 AROMATIC HYDROCARBONS	C11-C22-AROM	89,000	4.15	32,000	3.05	81,000	14.42	56,000	16.98
C19 THROUGH C36 ALIPHATIC HYDROCARBONS	C19-C36-ALIP	50,000	2.33	28,000	2.67	55,000	9.79	17,000	5.15
C9 THROUGH C18 ALIPHATIC HYDROCARBONS	C09-C18-ALIP	190,000	8.85	130,000	12.37	320,000	56.97	87,000	26.38
TOTAL EXTRACTABLE HYDROCARBON (POST FRACTIONATION)	68334-30-5S	330,000	15.38	--	--	460,000	81.89	160,000	48.52
TOTAL EXTRACTABLE HYDROCARBON	68334-30-5E	410,000	19.11	210,000	19.99	460,000	81.89	160,000	48.52
Total EPHs	--	--	**19.11**	--	**19.99**	--	**81.89**	--	**48.52**
Period Total EPH Mass Removed (lbs)			**19.1**		**20.0**		**81.9**		**48.5**
Cumulative Total EPH Mass Removed (lbs)			**19.1**		**39.1**		**121.0**		**169.5**
VPH									
BENZENE	71-43-2	1,800	0.08	230	0.02	480	0.09	430	0.13
C5 THROUGH C8 ALIPHATIC HYDROCARBONS (ADJUSTED)	C05-C08-ALIP-J	3,900	0.18	2,600	0.25	12,000	2.14	1,500	0.45
C9 THROUGH C10 AROMATIC HYDROCARBONS	C09-C10-AROM	9,300	0.43	40,000	3.81	88,000	15.67	9,400	2.85
C9 THROUGH C12 ALIPHATIC HYDROCARBONS (ADJUSTED)	C09-C12-ALIP-J	9,400	0.44	26,000	2.47	130,000	23.14	6,800	2.06
ETHYL BENZENE	100-41-4	990	0.05	650	0.06	1,200	0.21	600	0.18
M,P-XYLENE	179601-23-1	4,100	0.19	4,100	0.39	5,900	1.05	3,200	0.97
METHYL TERT-BUTYL ETHER	1634-04-4	ND	--	ND	--	ND	--	ND	--
NAPHTHALENE	91-20-3	510	0.02	2,300	0.22	5,200	0.93	470	0.14
ORTHO-XYLENE	95-47-6	1,300	0.06	1,700	0.16	2,200	0.39	1,000	0.30
TOLUENE	108-88-3	1,100	0.05	300	0.03	530	0.09	300	0.09
TOTAL PETROLEUM HYDROCARBONS	TPH	32,000	1.49	72,000	6.85	200,000	35.61	23,000	6.97
Total VPHss	--	--	**1.49**	--	**6.85**	--	**35.61**	--	**6.97**
Period Total VPH Mass Removed (lbs)			**1.5**		**6.9**		**35.6**		**7.0**
Cumulative Total VPH Mass Removed (lbs)			**1.5**		**8.3**		**44.0**		**50.9**

Appendix C
Historical Analytical Results and Contaminant Mass Removal - Liquid
Calumet Montana Refining, LLC - Great Falls, Montana

Location		SP200		SP200		SP200		SP200	
Ramboll Sample ID		CMR-SP200-220517		CMR-SP200-220617		CMR-SP200-220727		CMR-SP200-220830	
Sample Date		5/17/2022		6/17/2022		7/27/2022		8/30/2022	
Effluent Volume (L)*		0		126,978		76,011		31,926	
Notes									
Analyte	**CAS No.**	**Result (ug/L)**	**Mass (lb)**	**Result (ug/L)**	**Mass (lb)**	**Result (ug/L)**	**Mass (lb)**	**Result (ug/L)**	**Mass (lb)**
VOCs									
1,1,1-TRICHLOROETHANE	71-55-6	ND R	--	ND	--	ND	--	ND	--
1,1,2,2-TETRACHLOROETHANE	79-34-5	ND R	--	ND	--	ND	--	ND	--
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	76-13-1	ND R	--	ND	--	ND	--	ND	--
1,1,2-TRICHLOROETHANE	79-00-5	ND R	--	ND	--	ND	--	ND	--
1,1-DICHLOROETHANE	75-34-3	ND R	--	ND	--	ND	--	ND	--
1,1-DICHLOROETHENE	75-35-4	ND R	--	ND	--	ND	--	ND	--
1,2,3-TRICHLOROBENZENE	87-61-6	ND R	--	ND	--	ND	--	ND	--
1,2,4-TRICHLOROBENZENE	120-82-1	ND R	--	ND	--	ND	--	ND	--
1,2-DIBROMO-3-CHLOROPROPANE	96-12-8	ND R	--	ND	--	ND	--	ND	--
1,2-DIBROMOETHANE	106-93-4	ND R	--	ND	--	ND	--	ND	--
1,2-DICHLOROBENZENE	95-50-1	ND R	--	ND	--	ND	--	ND	--
1,2-DICHLOROETHANE	107-06-2	ND R	--	ND	--	ND	--	ND	--
1,2-DICHLOROPROPANE	78-87-5	ND R	--	ND	--	ND	--	ND	--
1,3-DICHLOROBENZENE	541-73-1	ND R	--	ND	--	ND	--	ND	--
1,4-DICHLOROBENZENE	106-46-7	ND R	--	ND	--	ND	--	ND	--
1,4-DIOXANE	123-91-1	ND R	--	ND	--	ND	--	ND	--
2-BUTANONE	78-93-3	ND R	--	ND	--	ND	--	26	0.00
2-HEXANONE	591-78-6	ND R	--	ND	--	ND	--	ND	--
4-METHYL-2-PENTANONE	108-10-1	ND R	--	ND	--	ND	--	ND	--
ACETONE	67-64-1	ND R	--	100	0.03	ND	--	91	0.01
BENZENE	71-43-2	310 R	--	120	0.03	19	0.00	94	0.01
BROMOCHLOROMETHANE	74-97-5	ND R	--	ND	--	ND	--	ND	--
BROMODICHLOROMETHANE	75-27-4	ND R	--	ND	--	ND	--	ND	--
BROMOFORM	75-25-2	ND R	--	ND	--	ND	--	ND	--
BROMOMETHANE	74-83-9	ND R	--	ND	--	ND	--	ND	--
CARBON DISULFIDE	75-15-0	ND R	--	ND	--	ND	--	ND	--
CARBON TETRACHLORIDE	56-23-5	ND R	--	ND	--	ND	--	ND	--
CHLOROBENZENE	108-90-7	ND R	--	ND	--	ND	--	ND	--
CHLOROETHANE	75-00-3	ND R	--	ND	--	ND	--	0	0.00
CHLOROFORM	67-66-3	ND R	--	ND	--	ND	--	ND	--
CHLOROMETHANE	74-87-3	ND R	--	ND	--	ND	--	0	0.00
CIS-1,2-DICHLOROETHENE	156-59-2	ND R	--	ND	--	ND	--	ND	--
CIS-1,3-DICHLOROPROPENE	10061-01-5	ND R	--	ND	--	ND	--	ND	--
CUMENE	98-82-8	ND R	--	99	0.03	22	0.00	58	0.00
CYCLOHEXANE	110-82-7	ND R	--	320	0.09	49	0.01	170	0.01
DIBROMOCHLOROMETHANE	124-48-1	ND R	--	ND	--	ND	--	ND	--
DICHLORODIFLUOROMETHANE	75-71-8	ND R	--	ND	--	ND	--	ND	--
ETHYL BENZENE	100-41-4	340 R	--	660	0.18	95	0.02	330	0.02
M,P-XYLENE	179601-23-1	2,600 R	--	8,200	2.30	1,900	0.32	2,500	0.18
METHYL ACETATE	79-20-9	ND R	--	ND	--	ND	--	ND	--
METHYL TERT-BUTYL ETHER	1634-04-4	ND R	--	ND	--	ND	--	ND	--
METHYLCYCLOHEXANE	108-87-2	ND R	--	340	0.10	50	0.01	220	0.02
METHYLENE CHLORIDE	75-09-2	ND R	--	ND	--	ND	--	ND	--
NAPHTHALENE	91-20-3	280 R	--	3,200	0.90	960	0.16	350	0.02
ORTHO-XYLENE	95-47-6	800 R	--	2,900	0.81	740	0.12	780	0.05
STYRENE	100-42-5	ND R	--	ND	--	ND	--	ND	--
TETRACHLOROETHENE	127-18-4	ND R	--	ND	--	ND	--	ND	--
TOLUENE	108-88-3	170 R	--	240	0.07	34	0.01	24	0.00
TRANS-1,2-DICHLOROETHENE	156-60-5	ND R	--	ND	--	ND	--	ND	--
TRANS-1,3-DICHLOROPROPENE	10061-02-6	ND R	--	ND	--	ND	--	ND	--
TRICHLOROETHENE	79-01-6	ND R	--	ND	--	ND	--	ND	--
TRICHLOROFLUOROMETHANE	75-69-4	ND R	--	ND	--	ND	--	ND	--
VINYL CHLORIDE	75-01-4	ND R	--	ND	--	ND	--	ND	--
XYLENES (TOTAL)	1330-20-7	-- R	--	--	--	--	--	--	--
Total VOCs	--	--	**0.00**	--	**4.53**	--	**0.65**	--	**0.33**
Period Total VOC Mass Removed (lbs)		**0.0**		**4.5**		**0.6**		**0.3**	
Cumulative Total VOC Mass Removed (lbs)		**4.7**		**9.2**		**9.9**		**10.2**	

Appendix C
Historical Analytical Results and Contaminant Mass Removal - Liquid
Calumet Montana Refining, LLC - Great Falls, Montana

Location		SP200		SP200		SP200		SP200	
Ramboll Sample ID		CMR-SP200-220517		CMR-SP200-220617		CMR-SP200-220727		CMR-SP200-220830	
Sample Date		5/17/2022		6/17/2022		7/27/2022		8/30/2022	
Effluent Volume (L)*		0		126,978		76,011		31,926	
Notes									
Analyte	**CAS No.**	**Result (ug/L)**	**Mass (lb)**	**Result (ug/L)**	**Mass (lb)**	**Result (ug/L)**	**Mass (lb)**	**Result (ug/L)**	**Mass (lb)**
SVOCs									
1,2,4,5-TETRACHLOROBENZENE	95-94-3	ND R	--	ND	--	--	--	--	--
1,2,4-TRICHLOROBENZENE	120-82-1	ND R	--	ND	--	--	--	--	--
1,2-DICHLOROBENZENE	95-50-1	ND R	--	ND	--	--	--	--	--
1,3-DICHLOROBENZENE	541-73-1	ND R	--	ND	--	--	--	--	--
1,4-DICHLOROBENZENE	106-46-7	ND R	--	ND	--	--	--	--	--
2,2'-OXYBIS(1-CHLOROPROPANE)	108-60-1	ND R	--	ND	--	ND	--	ND	--
2,3,4,6-TETRACHLOROPHENOL	58-90-2	ND R	--	ND	--	--	--	--	--
2,4,5-TRICHLOROPHENOL	95-95-4	ND R	--	ND	--	ND	--	ND	--
2,4,6-TRICHLOROPHENOL	88-06-2	ND R	--	ND	--	ND	--	ND	--
2,4-DICHLOROPHENOL	120-83-2	ND R	--	ND	--	ND	--	ND	--
2,4-DIMETHYLPHENOL	105-67-9	ND R	--	ND	--	ND	--	ND	--
2,4-DINITROPHENOL	51-28-5	ND R	--	ND	--	ND	--	ND	--
2,4-DINITROTOLUENE	121-14-2	ND R	--	ND	--	ND	--	ND	--
2,6-DINITROTOLUENE	606-20-2	ND R	--	ND	--	ND	--	ND	--
2-CHLORONAPHTHALENE	91-58-7	ND R	--	ND	--	ND	--	ND	--
2-CHLOROPHENOL	95-57-8	ND R	--	ND	--	ND	--	ND	--
2-METHYLNAPHTHALENE	91-57-6	20,000 R	--	2,400	0.67	2,000	0.34	21,000	1.48
2-METHYLPHENOL	95-48-7	ND R	--	ND	--	ND	--	ND	--
2-NITROANILINE	88-74-4	ND R	--	ND	--	ND	--	ND	--
2-NITROPHENOL	88-75-5	ND R	--	ND	--	ND	--	ND	--
3,3'-DICHLOROBENZIDINE	91-94-1	ND R	--	ND	--	ND	--	ND	--
3-NITROANILINE	99-09-2	ND R	--	ND	--	ND	--	ND	--
4,6-DINITRO-2-METHYLPHENOL	534-52-1	ND R	--	ND	--	ND	--	ND	--
4-BROMOPHENYL-PHENYL ETHER	101-55-3	ND R	--	ND	--	ND	--	ND	--
4-CHLORO-3-METHYLPHENOL	59-50-7	ND R	--	ND	--	ND	--	ND	--
4-CHLOROPHENYL-PHENYL ETHER	7005-72-3	ND R	--	ND	--	ND	--	ND	--
4-METHYLPHENOL	106-44-5	ND R	--	ND	--	ND	--	ND	--
4-NITROANILINE	100-01-6	ND R	--	ND	--	ND	--	ND	--
4-NITROPHENOL	100-02-7	ND R	--	ND	--	ND	--	ND	--
ACENAPHTHENE	83-32-9	380 R	--	93	0.03	ND	--	ND	--
ACENAPHTHYLENE	208-96-8	ND R	--	ND	--	ND	--	ND	--
ANTHRACENE	120-12-7	ND R	--	ND	--	ND	--	ND	--
BENZO(A)ANTHRACENE	56-55-3	ND R	--	ND	--	ND	--	ND	--
BENZO(A)PYRENE	50-32-8	ND R	--	ND	--	ND	--	ND	--
BENZO(B)FLUORANTHENE	205-99-2	ND R	--	ND	--	ND	--	ND	--
BENZO(G,H,I)PERYLENE	191-24-2	ND R	--	ND	--	ND	--	ND	--
BENZO(K)FLUORANTHENE	207-08-9	ND R	--	ND	--	ND	--	ND	--
BIS(2-CHLOROETHOXY)METHANE	111-91-1	ND R	--	ND	--	ND	--	ND	--
BIS(2-CHLOROETHYL) ETHER	111-44-4	ND R	--	ND	--	ND	--	ND	--
BIS(2-ETHYLHEXYL)PHTHALATE	117-81-7	ND R	--	ND	--	ND	--	ND	--
BUTYLBENZYLPHTHALATE	85-68-7	ND R	--	ND	--	ND	--	ND	--
CARBAZOLE	86-74-8	ND R	--	ND	--	ND	--	ND	--
CHRYSENE	218-01-9	ND R	--	ND	--	ND	--	ND	--
DIBENZ(A,H)ANTHRACENE	53-70-3	ND R	--	ND	--	ND	--	ND	--
DIBENZOFURAN	132-64-9	ND R	--	ND	--	ND	--	ND	--
DIETHYLPHTHALATE	84-66-2	ND R	--	ND	--	ND	--	ND	--
DIMETHYLPHTHALATE	131-11-3	ND R	--	ND	--	ND	--	ND	--
DI-N-BUTYLPHTHALATE	84-74-2	ND R	--	ND	--	ND	--	ND	--
DI-N-OCTYLPHTHALATE	117-84-0	ND R	--	ND	--	ND	--	ND	--
FLUORANTHENE	206-44-0	ND R	--	ND	--	ND	--	ND	--
FLUORENE	86-73-7	910 R	--	130	0.04	110	0.02	1,100	0.08
HEXACHLOROBENZENE	118-74-1	ND R	--	ND	--	ND	--	ND	--
HEXACHLOROBUTADIENE	87-68-3	ND R	--	ND	--	ND	--	ND	--
HEXACHLOROCYCLOPENTADIENE	77-47-4	ND R	--	ND	--	ND	--	ND	--
HEXACHLOROETHANE	67-72-1	ND R	--	ND	--	ND	--	ND	--
INDENO(1,2,3-CD)PYRENE	193-39-5	ND R	--	ND	--	ND	--	ND	--
ISOPHORONE	78-59-1	ND R	--	ND	--	ND	--	ND	--
NAPHTHALENE	91-20-3	12,000 R	--	1,100	0.31	830	0.14	9,800	0.69
NITROBENZENE	98-95-3	ND R	--	ND	--	ND	--	ND	--
N-NITROSO-DI-N-PROPYLAMINE	621-64-7	ND R	--	ND	--	ND	--	ND	--
N-NITROSODIPHENYLAMINE	86-30-6	ND R	--	ND	--	ND	--	ND	--
PENTACHLOROPHENOL	87-86-5	ND R	--	ND	--	ND	--	ND	--
PHENANTHRENE	85-01-8	1,500 R	--	250	0.07	230	0.04	2,000	0.14
PHENOL	108-95-2	ND R	--	ND	--	ND	--	ND	--
PYRENE	129-00-0	230 R	--	ND	--	44	0.01	ND	--
Total SVOCs	--	--	**0.00**	--	**1.11**	--	**0.54**	--	**2.39**
Period Total SVOC Mass Removed (lbs)		**0.0**		**1.1**		**0.5**		**2.4**	
Cumulative Total VOC Mass Removed (lbs)		**2.5**		**3.4**		**4.0**		**6.3**	

Appendix C
Historical Analytical Results and Contaminant Mass Removal - Liquid
Calumet Montana Refining, LLC - Great Falls, Montana

Location		SP200		SP200		SP200		SP200	
Ramboll Sample ID		CMR-SP200-220517		CMR-SP200-220617		CMR-SP200-220727		CMR-SP200-220830	
Sample Date		5/17/2022		6/17/2022		7/27/2022		8/30/2022	
Effluent Volume (L)*		0		126,978		76,011		31,926	
Notes									
Analyte	**CAS No.**	**Result (ug/L)**	**Mass (lb)**	**Result (ug/L)**	**Mass (lb)**	**Result (ug/L)**	**Mass (lb)**	**Result (ug/L)**	**Mass (lb)**
EPH									
C11 THROUGH C22 AROMATIC HYDROCARBONS	C11-C22-AROM	740,000 R	--	530,000	148.36	120,000	20.11	--	--
C19 THROUGH C36 ALIPHATIC HYDROCARBONS	C19-C36-ALIP	660,000 R	--	37,000	10.36	80,000	13.41	--	--
C9 THROUGH C18 ALIPHATIC HYDROCARBONS	C09-C18-ALIP	3,700,000 R	--	240,000	67.18	340,000	56.97	--	--
TOTAL EXTRACTABLE HYDROCARBON (POST FRACTIONATION)	68334-30-5S	5,100,000 R	--	810,000	226.75	540,000	90.49	--	--
TOTAL EXTRACTABLE HYDROCARBON	68334-30-5E	5,900,000 R	--	670,000	187.56	590,000	98.87	2,550,000	179.48
Total EPHs	--	--	**0.00**	--	**187.56**	--	**98.87**	--	**179.48**
Period Total EPH Mass Removed (lbs)			**0.0**		**187.6**		**98.9**		**179.5**
Cumulative Total EPH Mass Removed (lbs)			**169.5**		**357.1**		**455.9**		**635.4**
VPH									
BENZENE	71-43-2	330 R	--	58	0.02	ND	--	--	--
C5 THROUGH C8 ALIPHATIC HYDROCARBONS (ADJUSTED)	C05-C08-ALIP-J	2,600 R	--	1,300	0.36	ND	--	2,860	0.20
C9 THROUGH C10 AROMATIC HYDROCARBONS	C09-C10-AROM	29,000 R	--	20,000	5.60	5,700	0.96	--	--
C9 THROUGH C12 ALIPHATIC HYDROCARBONS (ADJUSTED)	C09-C12-ALIP-J	28,000 R	--	8,600	2.41	4,300	0.72	29,500	2.08
ETHYL BENZENE	100-41-4	510 R	--	110	0.03	ND	--	--	--
M,P-XYLENE	179601-23-1	3,200 R	--	1,300	0.36	310	0.05	--	--
METHYL TERT-BUTYL ETHER	1634-04-4	ND R	--	ND	--	ND	--	--	--
NAPHTHALENE	91-20-3	1,600 R	--	1,300	0.36	550	0.09	--	--
ORTHO-XYLENE	95-47-6	1,100 R	--	550	0.15	160	0.03	--	--
TOLUENE	108-88-3	180 R	--	52	0.01	ND	--	--	--
TOTAL PETROLEUM HYDROCARBONS	TPH	56,000 R	--	29,000	8.12	9,500	1.59	62,800	4.42
Total VPHss	--	--	**0.00**	--	**8.12**	--	**1.59**	--	**4.42**
Period Total VPH Mass Removed (lbs)			**0.0**		**8.1**		**1.6**		**4.4**
Cumulative Total VPH Mass Removed (lbs)			**50.9**		**59.0**		**60.6**		**65.1**

Appendix C
Historical Analytical Results and Contaminant Mass Removal - Liquid
Calumet Montana Refining, LLC - Great Falls, Montana

Location		SP200		SP200		SP200		SP200		SP200
Ramboll Sample ID		CMR-SP200-220830		CMR-SP200-221214		CMR-SP200-221214		CMR-SP200-221214		CMR-DS2-
Sample Date		9/30/2022		10/31/2022		11/30/2022		12/14/2022		12/14/2022
Effluent Volume (L)*		39,179		4,319		17		159,877		--
Notes										Field Duplicate
Analyte	**CAS No.**	**Result (ug/L)**	**Mass (lb)**	**Result (ug/L)**	**Mass (lb)**	**Result (ug/L)**	**Mass (lb)**	**Result (ug/L)**	**Mass (lb)**	**Result (ug/L)**
VOCs										
1,1,1-TRICHLOROETHANE	71-55-6	ND	--	ND	--	ND	--	ND	--	ND
1,1,2,2-TETRACHLOROETHANE	79-34-5	ND	--	ND	--	ND	--	ND	--	ND
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	76-13-1	ND	--	ND	--	ND	--	ND	--	ND
1,1,2-TRICHLOROETHANE	79-00-5	ND	--	ND	--	ND	--	ND	--	ND
1,1-DICHLOROETHANE	75-34-3	ND	--	ND	--	ND	--	ND	--	ND
1,1-DICHLOROETHENE	75-35-4	ND	--	ND	--	ND	--	ND	--	ND
1,2,3-TRICHLOROBENZENE	87-61-6	ND	--	ND	--	ND	--	ND	--	ND
1,2,4-TRICHLOROBENZENE	120-82-1	ND	--	ND	--	ND	--	ND	--	ND
1,2-DIBROMO-3-CHLOROPROPANE	96-12-8	ND	--	ND	--	ND	--	ND	--	ND
1,2-DIBROMOETHANE	106-93-4	ND	--	ND	--	ND	--	ND	--	ND
1,2-DICHLOROBENZENE	95-50-1	ND	--	ND	--	ND	--	ND	--	ND
1,2-DICHLOROETHANE	107-06-2	ND	--	ND	--	ND	--	ND	--	ND
1,2-DICHLOROPROPANE	78-87-5	ND	--	ND	--	ND	--	ND	--	ND
1,3-DICHLOROBENZENE	541-73-1	ND	--	ND	--	ND	--	ND	--	ND
1,4-DICHLOROBENZENE	106-46-7	ND	--	ND	--	ND	--	ND	--	ND
1,4-DIOXANE	123-91-1	ND	--	ND	--	ND	--	ND	--	ND
2-BUTANONE	78-93-3	26	0.00	ND	--	ND	--	ND	--	ND
2-HEXANONE	591-78-6	ND	--	ND	--	ND	--	ND	--	ND
4-METHYL-2-PENTANONE	108-10-1	ND	--	ND	--	ND	--	ND	--	ND
ACETONE	67-64-1	91	0.01	ND	--	ND	--	ND	--	ND
BENZENE	71-43-2	94	0.01	200	0.00	200	0.00	200	0.07	180
BROMOCHLOROMETHANE	74-97-5	ND	--	ND	--	ND	--	ND	--	ND
BROMODICHLOROMETHANE	75-27-4	ND	--	ND	--	ND	--	ND	--	ND
BROMOFORM	75-25-2	ND	--	ND	--	ND	--	ND	--	ND
BROMOMETHANE	74-83-9	ND	--	ND	--	ND	--	ND	--	ND
CARBON DISULFIDE	75-15-0	ND	--	ND	--	ND	--	ND	--	ND
CARBON TETRACHLORIDE	56-23-5	ND	--	ND	--	ND	--	ND	--	ND
CHLOROBENZENE	108-90-7	ND	--	ND	--	ND	--	ND	--	ND
CHLOROETHANE	75-00-3	0	0.00	ND	--	ND	--	ND	--	ND
CHLOROFORM	67-66-3	ND	--	ND	--	ND	--	ND	--	ND
CHLOROMETHANE	74-87-3	0	0.00	ND	--	ND	--	ND	--	ND
CIS-1,2-DICHLOROETHENE	156-59-2	ND	--	ND	--	ND	--	ND	--	ND
CIS-1,3-DICHLOROPROPENE	10061-01-5	ND	--	ND	--	ND	--	ND	--	ND
CUMENE	98-82-8	58	0.01	81	0.00	81	0.00	81	0.03	21
CYCLOHEXANE	110-82-7	170	0.01	190	0.00	190	0.00	190	0.07	53
DIBROMOCHLOROMETHANE	124-48-1	ND	--	ND	--	ND	--	ND	--	ND
DICHLORODIFLUOROMETHANE	75-71-8	ND	--	ND	--	ND	--	ND	--	ND
ETHYL BENZENE	100-41-4	330	0.03	490	0.00	490	0.00	490	0.17	210
M,P-XYLENE	179601-23-1	2,500	0.22	2,700	0.03	2,700	0.00	2,700	0.95	1,000
METHYL ACETATE	79-20-9	ND	--	ND	--	ND	--	ND	--	ND
METHYL TERT-BUTYL ETHER	1634-04-4	ND	--	ND	--	ND	--	ND	--	ND
METHYLCYCLOHEXANE	108-87-2	220	0.02	240	0.00	240	0.00	240	0.08	52
METHYLENE CHLORIDE	75-09-2	ND	--	ND	--	ND	--	ND	--	ND
NAPHTHALENE	91-20-3	350	0.03	890	0.01	890	0.00	890	0.31	270
ORTHO-XYLENE	95-47-6	780	0.07	590	0.01	590	0.00	590	0.21	250
STYRENE	100-42-5	ND	--	ND	--	ND	--	ND	--	ND
TETRACHLOROETHENE	127-18-4	ND	--	ND	--	ND	--	ND	--	ND
TOLUENE	108-88-3	24	0.00	22	0.00	22	0.00	22	0.01	ND
TRANS-1,2-DICHLOROETHENE	156-60-5	ND	--	ND	--	ND	--	ND	--	ND
TRANS-1,3-DICHLOROPROPENE	10061-02-6	ND	--	ND	--	ND	--	ND	--	ND
TRICHLOROETHENE	79-01-6	ND	--	ND	--	ND	--	ND	--	ND
TRICHLOROFLUOROMETHANE	75-69-4	ND	--	ND	--	ND	--	ND	--	ND
VINYL CHLORIDE	75-01-4	ND	--	ND	--	ND	--	ND	--	ND
XYLENES (TOTAL)	1330-20-7	--	--	--	--	--	--	--	--	--
Total VOCs	--	--	**0.40**	--	**0.05**	--	**0.00**	--	**1.90**	--
Period Total VOC Mass Removed (lbs)		**0.4**		**0.1**		**0.0**		**1.9**		--
Cumulative Total VOC Mass Removed (lbs)		**10.6**		**10.6**		**10.6**		**12.5**		--

Appendix C
Historical Analytical Results and Contaminant Mass Removal - Liquid
Calumet Montana Refining, LLC - Great Falls, Montana

Location		SP200		SP200		SP200		SP200		SP200
Ramboll Sample ID		CMR-SP200-220830		CMR-SP200-221214		CMR-SP200-221214		CMR-SP200-221214		CMR-DS2-
Sample Date		9/30/2022		10/31/2022		11/30/2022		12/14/2022		12/14/2022
Effluent Volume (L)*		39,179		4,319		17		159,877		--
Notes										Field Duplicate
Analyte	**CAS No.**	**Result (ug/L)**	**Mass (lb)**	**Result (ug/L)**	**Mass (lb)**	**Result (ug/L)**	**Mass (lb)**	**Result (ug/L)**	**Mass (lb)**	**Result (ug/L)**
SVOCs										
1,2,4,5-TETRACHLOROBENZENE	95-94-3	--	--	--	--	--	--	--	--	--
1,2,4-TRICHLOROBENZENE	120-82-1	--	--	--	--	--	--	--	--	--
1,2-DICHLOROBENZENE	95-50-1	--	--	--	--	--	--	--	--	--
1,3-DICHLOROBENZENE	541-73-1	--	--	--	--	--	--	--	--	--
1,4-DICHLOROBENZENE	106-46-7	--	--	--	--	--	--	--	--	--
2,2'-OXYBIS(1-CHLOROPROPANE)	108-60-1	ND	--	ND	--	ND	--	ND	--	ND
2,3,4,6-TETRACHLOROPHENOL	58-90-2	--	--	--	--	--	--	--	--	--
2,4,5-TRICHLOROPHENOL	95-95-4	ND	--	ND	--	ND	--	ND	--	ND
2,4,6-TRICHLOROPHENOL	88-06-2	ND	--	ND	--	ND	--	ND	--	ND
2,4-DICHLOROPHENOL	120-83-2	ND	--	ND	--	ND	--	ND	--	ND
2,4-DIMETHYLPHENOL	105-67-9	ND	--	ND	--	ND	--	ND	--	ND
2,4-DINITROPHENOL	51-28-5	ND	--	ND	--	ND	--	ND	--	ND
2,4-DINITROTOLUENE	121-14-2	ND	--	ND	--	ND	--	ND	--	ND
2,6-DINITROTOLUENE	606-20-2	ND	--	ND	--	ND	--	ND	--	ND
2-CHLORONAPHTHALENE	91-58-7	ND	--	ND	--	ND	--	ND	--	ND
2-CHLOROPHENOL	95-57-8	ND	--	ND	--	ND	--	ND	--	ND
2-METHYLNAPHTHALENE	91-57-6	21,000	1.81	2,000	0.02	2,000	0.00	2,000	0.70	2,000
2-METHYLPHENOL	95-48-7	ND	--	ND	--	ND	--	ND	--	ND
2-NITROANILINE	88-74-4	ND	--	ND	--	ND	--	ND	--	ND
2-NITROPHENOL	88-75-5	ND	--	ND	--	ND	--	ND	--	ND
3,3'-DICHLOROBENZIDINE	91-94-1	ND	--	ND	--	ND	--	ND	--	ND
3-NITROANILINE	99-09-2	ND	--	ND	--	ND	--	ND	--	ND
4,6-DINITRO-2-METHYLPHENOL	534-52-1	ND	--	ND	--	ND	--	ND	--	ND
4-BROMOPHENYL-PHENYL ETHER	101-55-3	ND	--	ND	--	ND	--	ND	--	ND
4-CHLORO-3-METHYLPHENOL	59-50-7	ND	--	ND	--	ND	--	ND	--	ND
4-CHLOROPHENYL-PHENYL ETHER	7005-72-3	ND	--	ND	--	ND	--	ND	--	ND
4-METHYLPHENOL	106-44-5	ND	--	ND	--	ND	--	ND	--	ND
4-NITROANILINE	100-01-6	ND	--	ND	--	ND	--	ND	--	ND
4-NITROPHENOL	100-02-7	ND	--	ND	--	ND	--	ND	--	ND
ACENAPHTHENE	83-32-9	ND	--	51	0.00	51	0.00	51	0.02	ND
ACENAPHTHYLENE	208-96-8	ND	--	ND	--	ND	--	ND	--	ND
ANTHRACENE	120-12-7	ND	--	ND	--	ND	--	ND	--	ND
BENZO(A)ANTHRACENE	56-55-3	ND	--	ND	--	ND	--	ND	--	ND
BENZO(A)PYRENE	50-32-8	ND	--	ND	--	ND	--	ND	--	ND
BENZO(B)FLUORANTHENE	205-99-2	ND	--	ND	--	ND	--	ND	--	ND
BENZO(G,H,I)PERYLENE	191-24-2	ND	--	ND	--	ND	--	ND	--	ND
BENZO(K)FLUORANTHENE	207-08-9	ND	--	ND	--	ND	--	ND	--	ND
BIS(2-CHLOROETHOXY)METHANE	111-91-1	ND	--	ND	--	ND	--	ND	--	ND
BIS(2-CHLOROETHYL) ETHER	111-44-4	ND	--	ND	--	ND	--	ND	--	ND
BIS(2-ETHYLHEXYL)PHTHALATE	117-81-7	ND	--	ND	--	ND	--	ND	--	ND
BUTYLBENZYLPHTHALATE	85-68-7	ND	--	ND	--	ND	--	ND	--	ND
CARBAZOLE	86-74-8	ND	--	ND	--	ND	--	ND	--	ND
CHRYSENE	218-01-9	ND	--	ND	--	ND	--	ND	--	ND
DIBENZ(A,H)ANTHRACENE	53-70-3	ND	--	ND	--	ND	--	ND	--	ND
DIBENZOFURAN	132-64-9	ND	--	ND	--	ND	--	ND	--	ND
DIETHYLPHTHALATE	84-66-2	ND	--	ND	--	ND	--	ND	--	ND
DIMETHYLPHTHALATE	131-11-3	ND	--	ND	--	ND	--	ND	--	ND
DI-N-BUTYLPHTHALATE	84-74-2	ND	--	ND	--	ND	--	ND	--	ND
DI-N-OCTYLPHTHALATE	117-84-0	ND	--	ND	--	ND	--	ND	--	ND
FLUORANTHENE	206-44-0	ND	--	ND	--	ND	--	ND	--	ND
FLUORENE	86-73-7	1,100	0.10	170	0.00	170	0.00	170	0.06	110
HEXACHLOROBENZENE	118-74-1	ND	--	ND	--	ND	--	ND	--	ND
HEXACHLOROBUTADIENE	87-68-3	ND	--	ND	--	ND	--	ND	--	ND
HEXACHLOROCYCLOPENTADIENE	77-47-4	ND	--	ND	--	ND	--	ND	--	ND
HEXACHLOROETHANE	67-72-1	ND	--	ND	--	ND	--	ND	--	ND
INDENO(1,2,3-CD)PYRENE	193-39-5	ND	--	ND	--	ND	--	ND	--	ND
ISOPHORONE	78-59-1	ND	--	ND	--	ND	--	ND	--	ND
NAPHTHALENE	91-20-3	9,800	0.85	1,100	0.01	1,100	0.00	1,100	0.39	1,000
NITROBENZENE	98-95-3	ND	--	ND	--	ND	--	ND	--	ND
N-NITROSO-DI-N-PROPYLAMINE	621-64-7	ND	--	ND	--	ND	--	ND	--	ND
N-NITROSODIPHENYLAMINE	86-30-6	ND	--	ND	--	ND	--	ND	--	ND
PENTACHLOROPHENOL	87-86-5	ND	--	ND	--	ND	--	ND	--	ND
PHENANTHRENE	85-01-8	2,000	0.17	220	0.00	220	0.00	220	0.08	210
PHENOL	108-95-2	ND	--	ND	--	ND	--	ND	--	ND
PYRENE	129-00-0	ND	--	34	0.00	34	0.00	34	0.01	33
Total SVOCs	--	**--**	**2.93**	**--**	**0.03**	**--**	**0.00**	**--**	**1.26**	**--**
Period Total SVOC Mass Removed (lbs)		**2.9**		**0.0**		**0.0**		**1.3**		**--**
Cumulative Total VOC Mass Removed (lbs)		**9.3**		**9.3**		**9.3**		**10.6**		**--**

Appendix C
Historical Analytical Results and Contaminant Mass Removal - Liquid
Calumet Montana Refining, LLC - Great Falls, Montana

Location		SP200		SP200		SP200		SP200		SP200
Ramboll Sample ID		CMR-SP200-220830		CMR-SP200-221214		CMR-SP200-221214		CMR-SP200-221214		CMR-DS2-
Sample Date		9/30/2022		10/31/2022		11/30/2022		12/14/2022		12/14/2022
Effluent Volume (L)*		39,179		4,319		17		159,877		--
Notes										Field Duplicate
Analyte	**CAS No.**	**Result (ug/L)**	**Mass (lb)**	**Result (ug/L)**	**Mass (lb)**	**Result (ug/L)**	**Mass (lb)**	**Result (ug/L)**	**Mass (lb)**	**Result (ug/L)**
EPH										
C11 THROUGH C22 AROMATIC HYDROCARBONS	C11-C22-AROM	--	--	103,000	0.98	103,000	0.00	103,000	36.30	--
C19 THROUGH C36 ALIPHATIC HYDROCARBONS	C19-C36-ALIP	--	--	50,100	0.48	50,100	0.00	50,100	17.66	--
C9 THROUGH C18 ALIPHATIC HYDROCARBONS	C09-C18-ALIP	--	--	264,000	2.51	264,000	0.01	264,000	93.05	--
TOTAL EXTRACTABLE HYDROCARBON (POST FRACTIONATION)	68334-30-5S	--	--	417,000	3.97	417,000	0.02	417,000	146.98	--
TOTAL EXTRACTABLE HYDROCARBON	68334-30-5E	2,550,000	220.25	362,000	3.45	362,000	0.01	362,000	127.59	--
Total EPHs	--	**--**	**220.25**	**--**	**3.45**	**--**	**0.01**	**--**	**127.59**	**--**
Period Total EPH Mass Removed (lbs)		**220.3**		**3.4**		**0.0**		**127.6**		**--**
Cumulative Total EPH Mass Removed (lbs)		**855.7**		**859.1**		**859.1**		**986.7**		**--**
VPH										
BENZENE	71-43-2	--	--	--	--	--	--	--	--	--
C5 THROUGH C8 ALIPHATIC HYDROCARBONS (ADJUSTED)	C05-C08-ALIP-J	2,860	0.25	ND	--	ND	--	ND	--	7,480
C9 THROUGH C10 AROMATIC HYDROCARBONS	C09-C10-AROM	--	--	--	--	--	--	--	--	--
C9 THROUGH C12 ALIPHATIC HYDROCARBONS (ADJUSTED)	C09-C12-ALIP-J	29,500	2.55	42,500	0.40	42,500	0.00	42,500	14.98	65,500
ETHYL BENZENE	100-41-4	--	--	--	--	--	--	--	--	--
M,P-XYLENE	179601-23-1	--	--	--	--	--	--	--	--	--
METHYL TERT-BUTYL ETHER	1634-04-4	--	--	--	--	--	--	--	--	--
NAPHTHALENE	91-20-3	--	--	--	--	--	--	--	--	--
ORTHO-XYLENE	95-47-6	--	--	--	--	--	--	--	--	--
TOLUENE	108-88-3	--	--	--	--	--	--	--	--	--
TOTAL PETROLEUM HYDROCARBONS	TPH	62,800	5.42	119,000	1.13	119,000	0.00	119,000	41.94	163,000
Total VPHss	--	**--**	**5.42**	**--**	**1.13**	**--**	**0.00**	**--**	**41.94**	**--**
Period Total VPH Mass Removed (lbs)		**5.4**		**1.1**		**0.0**		**41.9**		**--**
Cumulative Total VPH Mass Removed (lbs)		**70.5**		**71.6**		**71.6**		**113.6**		**--**

Appendix C
Historical Analytical Results and Contaminant Mass Removal - Liquid
Calumet Montana Refining, LLC - Great Falls, Montana

Location		SP200		SP200		SP200		SP200	
Ramboll Sample ID		CMR-SP200-230126		CMR-SP200-230228		CMR-SP200-230321		CMR-SP200-230503	
Sample Date		1/26/2023		2/28/2023		3/21/2023		5/3/2023	
Effluent Volume (L)*		88,291		48,336		89,975		127,742	
Notes									
Analyte	**CAS No.**	**Result (ug/L)**	**Mass (lb)**	**Result (ug/L)**	**Mass (lb)**	**Result (ug/L)**	**Mass (lb)**	**Result (ug/L)**	**Mass (lb)**
VOCs									
1,1,1-TRICHLOROETHANE	71-55-6	ND	--	ND	--	ND	--	ND	--
1,1,2,2-TETRACHLOROETHANE	79-34-5	ND	--	ND	--	ND	--	1.9	0.00
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	76-13-1	ND	--	ND	--	ND	--	ND	--
1,1,2-TRICHLOROETHANE	79-00-5	ND	--	ND	--	ND	--	ND	--
1,1-DICHLOROETHANE	75-34-3	ND	--	ND	--	ND	--	ND	--
1,1-DICHLOROETHENE	75-35-4	ND	--	ND	--	ND	--	ND	--
1,2,3-TRICHLOROBENZENE	87-61-6	ND	--	ND	--	ND	--	ND	--
1,2,4-TRICHLOROBENZENE	120-82-1	ND	--	ND	--	ND	--	ND	--
1,2-DIBROMO-3-CHLOROPROPANE	96-12-8	ND	--	ND	--	ND	--	ND	--
1,2-DIBROMOETHANE	106-93-4	ND	--	ND	--	ND	--	ND	--
1,2-DICHLOROBENZENE	95-50-1	ND	--	ND	--	ND	--	ND	--
1,2-DICHLOROETHANE	107-06-2	ND	--	ND	--	ND	--	ND	--
1,2-DICHLOROPROPANE	78-87-5	ND	--	ND	--	ND	--	ND	--
1,3-DICHLOROBENZENE	541-73-1	ND	--	ND	--	ND	--	ND	--
1,4-DICHLOROBENZENE	106-46-7	ND	--	ND	--	ND	--	ND	--
1,4-DIOXANE	123-91-1	ND	--	ND	--	ND	--	ND	--
2-BUTANONE	78-93-3	ND	--	ND	--	ND	--	18	0.01
2-HEXANONE	591-78-6	ND	--	ND	--	ND	--	9.8	0.00
4-METHYL-2-PENTANONE	108-10-1	ND	--	ND	--	ND	--	5	0.00
ACETONE	67-64-1	40	0.01	ND	--	ND	--	45	0.01
BENZENE	71-43-2	23	0.00	6	0.00	21	0.00	90	0.03
BROMOCHLOROMETHANE	74-97-5	ND	--	ND	--	ND	--	ND	--
BROMODICHLOROMETHANE	75-27-4	ND	--	ND	--	ND	--	0	0.00
BROMOFORM	75-25-2	5	0.00	ND	--	ND	--	ND	--
BROMOMETHANE	74-83-9	ND	--	ND	--	ND	--	ND	--
CARBON DISULFIDE	75-15-0	ND	--	ND	--	ND	--	ND	--
CARBON TETRACHLORIDE	56-23-5	ND	--	ND	--	ND	--	ND	--
CHLOROBENZENE	108-90-7	ND	--	ND	--	ND	--	ND	--
CHLOROETHANE	75-00-3	ND	--	ND	--	ND	--	ND	--
CHLOROFORM	67-66-3	ND	--	ND	--	ND	--	ND	--
CHLOROMETHANE	74-87-3	ND	--	ND	--	ND	--	ND	--
CIS-1,2-DICHLOROETHENE	156-59-2	ND	--	ND	--	ND	--	ND	--
CIS-1,3-DICHLOROPROPENE	10061-01-5	ND	--	ND	--	ND	--	ND	--
CUMENE	98-82-8	15	0.00	ND	--	ND	--	3	0.00
CYCLOHEXANE	110-82-7	39	0.01	ND	--	ND	--	5	0.00
DIBROMOCHLOROMETHANE	124-48-1	ND	--	ND	--	ND	--	ND	--
DICHLORODIFLUOROMETHANE	75-71-8	ND	--	ND	--	ND	--	ND	--
ETHYL BENZENE	100-41-4	34	0.01	ND	--	37	0.01	29	0.01
M,P-XYLENE	179601-23-1	1,000	0.19	100	0.01	240	0.05	140	0.04
METHYL ACETATE	79-20-9	ND	--	ND	--	ND	--	ND	--
METHYL TERT-BUTYL ETHER	1634-04-4	ND	--	ND	--	ND	--	ND	--
METHYLCYCLOHEXANE	108-87-2	44	0.01	ND	--	ND	--	5	0.00
METHYLENE CHLORIDE	75-09-2	ND	--	ND	--	ND	--	ND	--
NAPHTHALENE	91-20-3	1,300	0.25	130	0.01	110	0.02	61	0.02
ORTHO-XYLENE	95-47-6	310	0.06	48	0.01	81	0.02	40	0.01
STYRENE	100-42-5	ND	--	ND	--	ND	--	1	0.00
TETRACHLOROETHENE	127-18-4	ND	--	ND	--	ND	--	ND	--
TOLUENE	108-88-3	15	0.00	ND	--	20	0.00	11	0.00
TRANS-1,2-DICHLOROETHENE	156-60-5	ND	--	ND	--	ND	--	ND	--
TRANS-1,3-DICHLOROPROPENE	10061-02-6	ND	--	ND	--	ND	--	ND	--
TRICHLOROETHENE	79-01-6	ND	--	ND	--	ND	--	ND	--
TRICHLOROFLUOROMETHANE	75-69-4	ND	--	ND	--	ND	--	ND	--
VINYL CHLORIDE	75-01-4	ND	--	ND	--	ND	--	ND	--
XYLENES (TOTAL)	1330-20-7	--	--	--	--	--	--	--	--
Total VOCs	--	**--**	**0.55**	**--**	**0.03**	**--**	**0.10**	**--**	**0.13**
Period Total VOC Mass Removed (lbs)		**0.5**		**0.03**		**0.10**		**0.13**	
Cumulative Total VOC Mass Removed (lbs)		**13.1**		**13.1**		**13.2**		**13.4**	

Appendix C
Historical Analytical Results and Contaminant Mass Removal - Liquid
Calumet Montana Refining, LLC - Great Falls, Montana

Location		SP200		SP200		SP200		SP200	
Ramboll Sample ID		CMR-SP200-230126		CMR-SP200-230228		CMR-SP200-230321		CMR-SP200-230503	
Sample Date		1/26/2023		2/28/2023		3/21/2023		5/3/2023	
Effluent Volume (L)*		88,291		48,336		89,975		127,742	
Notes									
Analyte	**CAS No.**	**Result (ug/L)**	**Mass (lb)**	**Result (ug/L)**	**Mass (lb)**	**Result (ug/L)**	**Mass (lb)**	**Result (ug/L)**	**Mass (lb)**
SVOCs									
1,2,4,5-TETRACHLOROBENZENE	95-94-3	--	--	--	--	--	--	--	--
1,2,4-TRICHLOROBENZENE	120-82-1	--	--	--	--	--	--	--	--
1,2-DICHLOROBENZENE	95-50-1	--	--	--	--	--	--	--	--
1,3-DICHLOROBENZENE	541-73-1	--	--	--	--	--	--	--	--
1,4-DICHLOROBENZENE	106-46-7	--	--	--	--	--	--	--	--
2,2'-OXYBIS(1-CHLOROPROPANE)	108-60-1	ND	--	ND	--	ND	--	ND	--
2,3,4,6-TETRACHLOROPHENOL	58-90-2	--	--	--	--	--	--	--	--
2,4,5-TRICHLOROPHENOL	95-95-4	ND	--	ND	--	ND	--	ND	--
2,4,6-TRICHLOROPHENOL	88-06-2	ND	--	ND	--	ND	--	ND	--
2,4-DICHLOROPHENOL	120-83-2	ND	--	ND	--	ND	--	ND	--
2,4-DIMETHYLPHENOL	105-67-9	ND	--	ND	--	450	0.09	ND	--
2,4-DINITROPHENOL	51-28-5	ND	--	ND	--	ND	--	ND	--
2,4-DINITROTOLUENE	121-14-2	ND	--	ND	--	ND	--	ND	--
2,6-DINITROTOLUENE	606-20-2	ND	--	ND	--	ND	--	ND	--
2-CHLORONAPHTHALENE	91-58-7	ND	--	ND	--	ND	--	ND	--
2-CHLOROPHENOL	95-57-8	ND	--	ND	--	ND	--	ND	--
2-METHYLNAPHTHALENE	91-57-6	1,100	0.21	390	0.04	440	0.09	ND	--
2-METHYLPHENOL	95-48-7	ND	--	ND	--	ND	--	ND	--
2-NITROANILINE	88-74-4	ND	--	ND	--	ND	--	ND	--
2-NITROPHENOL	88-75-5	ND	--	ND	--	ND	--	ND	--
3,3'-DICHLOROBENZIDINE	91-94-1	ND	--	ND	--	ND	--	ND	--
3-NITROANILINE	99-09-2	ND	--	ND	--	ND	--	ND	--
4,6-DINITRO-2-METHYLPHENOL	534-52-1	ND	--	ND	--	ND	--	ND	--
4-BROMOPHENYL-PHENYL ETHER	101-55-3	ND	--	ND	--	ND	--	ND	--
4-CHLORO-3-METHYLPHENOL	59-50-7	ND	--	ND	--	ND	--	ND	--
4-CHLOROPHENYL-PHENYL ETHER	7005-72-3	ND	--	ND	--	ND	--	ND	--
4-METHYLPHENOL	106-44-5	ND	--	ND	--	ND	--	22	0.01
4-NITROANILINE	100-01-6	ND	--	ND	--	ND	--	ND	--
4-NITROPHENOL	100-02-7	ND	--	ND	--	ND	--	ND	--
ACENAPHTHENE	83-32-9	ND	--	10	0.00	ND	--	ND	--
ACENAPHTHYLENE	208-96-8	ND	--	ND	--	ND	--	ND	--
ANTHRACENE	120-12-7	ND	--	ND	--	ND	--	ND	--
BENZO(A)ANTHRACENE	56-55-3	ND	--	ND	--	ND	--	ND	--
BENZO(A)PYRENE	50-32-8	ND	--	ND	--	ND	--	ND	--
BENZO(B)FLUORANTHENE	205-99-2	ND	--	ND	--	ND	--	ND	--
BENZO(G,H,I)PERYLENE	191-24-2	ND	--	ND	--	ND	--	ND	--
BENZO(K)FLUORANTHENE	207-08-9	ND	--	ND	--	ND	--	ND	--
BIS(2-CHLOROETHOXY)METHANE	111-91-1	ND	--	ND	--	ND	--	ND	--
BIS(2-CHLOROETHYL) ETHER	111-44-4	ND	--	ND	--	ND	--	ND	--
BIS(2-ETHYLHEXYL)PHTHALATE	117-81-7	ND	--	ND	--	ND	--	17	0.00
BUTYLBENZYLPHTHALATE	85-68-7	ND	--	ND	--	ND	--	ND	--
CARBAZOLE	86-74-8	ND	--	ND	--	ND	--	ND	--
CHRYSENE	218-01-9	ND	--	ND	--	ND	--	ND	--
DIBENZ(A,H)ANTHRACENE	53-70-3	ND	--	ND	--	ND	--	ND	--
DIBENZOFURAN	132-64-9	ND	--	ND	--	ND	--	ND	--
DIETHYLPHTHALATE	84-66-2	ND	--	ND	--	ND	--	ND	--
DIMETHYLPHTHALATE	131-11-3	ND	--	ND	--	ND	--	ND	--
DI-N-BUTYLPHTHALATE	84-74-2	ND	--	ND	--	ND	--	ND	--
DI-N-OCTYLPHTHALATE	117-84-0	ND	--	ND	--	ND	--	ND	--
FLUORANTHENE	206-44-0	14	0.00	ND	--	ND	--	ND	--
FLUORENE	86-73-7	ND	--	29	0.00	ND	--	ND	--
HEXACHLOROBENZENE	118-74-1	ND	--	ND	--	ND	--	ND	--
HEXACHLOROBUTADIENE	87-68-3	ND	--	ND	--	ND	--	ND	--
HEXACHLOROCYCLOPENTADIENE	77-47-4	ND	--	ND	--	ND	--	ND	--
HEXACHLOROETHANE	67-72-1	ND	--	ND	--	ND	--	ND	--
INDENO(1,2,3-CD)PYRENE	193-39-5	ND	--	ND	--	ND	--	ND	--
ISOPHORONE	78-59-1	ND	--	ND	--	ND	--	ND	--
NAPHTHALENE	91-20-3	460	0.09	160	0.02	220	0.04	ND	--
NITROBENZENE	98-95-3	ND	--	ND	--	ND	--	ND	--
N-NITROSO-DI-N-PROPYLAMINE	621-64-7	ND	--	ND	--	ND	--	ND	--
N-NITROSODIPHENYLAMINE	86-30-6	ND	--	ND	--	ND	--	25	0.01
PENTACHLOROPHENOL	87-86-5	ND	--	ND	--	ND	--	ND	--
PHENANTHRENE	85-01-8	130	0.03	45	0.00	40	0.01	ND	--
PHENOL	108-95-2	ND	--	ND	--	ND	--	12	0.00
PYRENE	129-00-0	32	0.01	8	0.00	9	0.00	3	0.00
Total SVOCs	--	--	**0.34**	--	**0.07**	--	**0.23**	--	**0.02**
Period Total SVOC Mass Removed (lbs)			**0.3**		**0.1**		**0.2**		**0.0**
Cumulative Total VOC Mass Removed (lbs)			**10.9**		**11.0**		**11.2**		**11.2**

Appendix C
Historical Analytical Results and Contaminant Mass Removal - Liquid
Calumet Montana Refining, LLC - Great Falls, Montana

Location		SP200		SP200		SP200		SP200	
Ramboll Sample ID		CMR-SP200-230126		CMR-SP200-230228		CMR-SP200-230321		CMR-SP200-230503	
Sample Date		1/26/2023		2/28/2023		3/21/2023		5/3/2023	
Effluent Volume (L)*		88,291		48,336		89,975		127,742	
Notes									
Analyte	**CAS No.**	**Result (ug/L)**	**Mass (lb)**	**Result (ug/L)**	**Mass (lb)**	**Result (ug/L)**	**Mass (lb)**	**Result (ug/L)**	**Mass (lb)**
EPH									
C11 THROUGH C22 AROMATIC HYDROCARBONS	C11-C22-AROM	209,000	40.68	49,500	5.27	92,500	18.35	22,300	6.28
C19 THROUGH C36 ALIPHATIC HYDROCARBONS	C19-C36-ALIP	--	--	--	--	--	--	--	--
C9 THROUGH C18 ALIPHATIC HYDROCARBONS	C09-C18-ALIP	--	--	--	--	--	--	--	--
TOTAL EXTRACTABLE HYDROCARBON (POST FRACTIONATION)	68334-30-5S	713,000	138.78	200,000	21.31	560,000	111.08	99,100	27.91
TOTAL EXTRACTABLE HYDROCARBON	68334-30-5E	977,000	190.17	240,000	25.57	569,000	112.87	138,000	38.86
Total EPHs	--	--	**190.17**	--	**25.57**	--	**112.87**	--	**38.86**
Period Total EPH Mass Removed (lbs)			**190.2**		**25.6**		**112.9**		**38.9**
Cumulative Total EPH Mass Removed (lbs)			**1176.9**		**1202.5**		**1315.3**		**1354.2**
VPH									
BENZENE	71-43-2	--	--	--	--	--	--	--	--
C5 THROUGH C8 ALIPHATIC HYDROCARBONS (ADJUSTED)	C05-C08-ALIP-J	1,690	0.33	ND	--	894	0.18	718	0.20
C9 THROUGH C10 AROMATIC HYDROCARBONS	C09-C10-AROM	--	--	--	--	--	--	--	--
C9 THROUGH C12 ALIPHATIC HYDROCARBONS (ADJUSTED)	C09-C12-ALIP-J	38,400	7.47	42,000	4.48	10,500	2.08	8,120	2.29
ETHYL BENZENE	100-41-4	--	--	--	--	--	--	--	--
M,P-XYLENE	179601-23-1	--	--	--	--	--	--	--	--
METHYL TERT-BUTYL ETHER	1634-04-4	--	--	--	--	--	--	--	--
NAPHTHALENE	91-20-3	--	--	--	--	--	--	--	--
ORTHO-XYLENE	95-47-6	--	--	--	--	--	--	--	--
TOLUENE	108-88-3	--	--	--	--	--	--	--	--
TOTAL PETROLEUM HYDROCARBONS	TPH	76,500	14.89	85,600	9.12	21,100	4.19	15,700	4.42
Total VPHss	--	--	**14.89**	--	**9.12**	--	**4.19**	--	**4.42**
Period Total VPH Mass Removed (lbs)			**14.9**		**9.1**		**4.2**		**4.4**
Cumulative Total VPH Mass Removed (lbs)			**128.4**		**137.6**		**141.8**		**146.2**

Appendix C
Historical Analytical Results and Contaminant Mass Removal - Liquid
Calumet Montana Refining, LLC - Great Falls, Montana

Location		SP200		SP200		SP200	
Ramboll Sample ID		CMR-SP200-230531		CMR-SP200-290623		CMR-SP200-110723	
Sample Date		5/31/2023		6/23/2023		7/11/2023	
Effluent Volume (L)*		151,878		306,490		125,244	
Notes							
Analyte	**CAS No.**	**Result (ug/L)**	**Mass (lb)**	**Result (ug/L)**	**Mass (lb)**	**Result (ug/L)**	**Mass (lb)**
VOCs							
1,1,1-TRICHLOROETHANE	71-55-6	ND	--	ND	--	ND	--
1,1,2,2-TETRACHLOROETHANE	79-34-5	ND	--	ND	--	21	0.01
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	76-13-1	ND	--	ND	--	ND	--
1,1,2-TRICHLOROETHANE	79-00-5	ND	--	ND	--	ND	--
1,1-DICHLOROETHANE	75-34-3	ND	--	ND	--	ND	--
1,1-DICHLOROETHENE	75-35-4	ND	--	ND	--	ND	--
1,2,3-TRICHLOROBENZENE	87-61-6	ND	--	ND	--	ND	--
1,2,4-TRICHLOROBENZENE	120-82-1	ND	--	ND	--	ND	--
1,2-DIBROMO-3-CHLOROPROPANE	96-12-8	ND	--	ND	--	ND	--
1,2-DIBROMOETHANE	106-93-4	ND	--	ND	--	ND	--
1,2-DICHLOROBENZENE	95-50-1	ND	--	ND	--	ND	--
1,2-DICHLOROETHANE	107-06-2	ND	--	ND	--	ND	--
1,2-DICHLOROPROPANE	78-87-5	ND	--	ND	--	ND	--
1,3-DICHLOROBENZENE	541-73-1	ND	--	ND	--	ND	--
1,4-DICHLOROBENZENE	106-46-7	ND	--	ND	--	ND	--
1,4-DIOXANE	123-91-1	ND	--	ND	--	ND	--
2-BUTANONE	78-93-3	ND	--	ND	--	ND	--
2-HEXANONE	591-78-6	ND	--	ND	--	ND	--
4-METHYL-2-PENTANONE	108-10-1	ND	--	ND	--	ND	--
ACETONE	67-64-1	ND	--	ND	--	ND	--
BENZENE	71-43-2	27	0.01	85	0.06	53	0.01
BROMOCHLOROMETHANE	74-97-5	ND	--	ND	--	ND	--
BROMODICHLOROMETHANE	75-27-4	ND	--	ND	--	ND	--
BROMOFORM	75-25-2	ND	--	ND	--	ND	--
BROMOMETHANE	74-83-9	ND	--	ND	--	ND	--
CARBON DISULFIDE	75-15-0	ND	--	ND	--	ND	--
CARBON TETRACHLORIDE	56-23-5	ND	--	ND	--	ND	--
CHLOROBENZENE	108-90-7	ND	--	ND	--	ND	--
CHLOROETHANE	75-00-3	ND	--	ND	--	ND	--
CHLOROFORM	67-66-3	ND	--	ND	--	ND	--
CHLOROMETHANE	74-87-3	ND	--	ND	--	ND	--
CIS-1,2-DICHLOROETHENE	156-59-2	ND	--	ND	--	ND	--
CIS-1,3-DICHLOROPROPENE	10061-01-5	ND	--	ND	--	ND	--
CUMENE	98-82-8	17	0.01	9	0.01	37	0.01
CYCLOHEXANE	110-82-7	16	0.01	ND	--	28	0.01
DIBROMOCHLOROMETHANE	124-48-1	ND	--	ND	--	ND	--
DICHLORODIFLUOROMETHANE	75-71-8	ND	--	ND	--	ND	--
ETHYL BENZENE	100-41-4	78	0.03	101	0.07	300	0.08
M,P-XYLENE	179601-23-1	770	0.26	--	--	1,500	0.41
METHYL ACETATE	79-20-9	ND	--	ND	--	ND	--
METHYL TERT-BUTYL ETHER	1634-04-4	ND	--	ND	--	ND	--
METHYLCYCLOHEXANE	108-87-2	19	0.01	ND	--	35	0.01
METHYLENE CHLORIDE	75-09-2	ND	--	ND	--	ND	--
NAPHTHALENE	91-20-3	760	0.25	--	--	430	0.12
ORTHO-XYLENE	95-47-6	270	0.09	157	0.11	550	0.15
STYRENE	100-42-5	ND	--	ND	--	17	0.00
TETRACHLOROETHENE	127-18-4	ND	--	ND	--	ND	--
TOLUENE	108-88-3	6	0.00	ND	--	29	0.01
TRANS-1,2-DICHLOROETHENE	156-60-5	ND	--	ND	--	ND	--
TRANS-1,3-DICHLOROPROPENE	10061-02-6	ND	--	ND	--	ND	--
TRICHLOROETHENE	79-01-6	ND	--	ND	--	ND	--
TRICHLOROFLUOROMETHANE	75-69-4	ND	--	ND	--	ND	--
VINYL CHLORIDE	75-01-4	ND	--	ND	--	ND	--
XYLENES (TOTAL)	1330-20-7	--	--	--	--	--	--
Total VOCs	--	--	**0.66**	--	**0.24**	--	**0.83**
Period Total VOC Mass Removed (lbs)			**0.66**		**0.24**		**0.83**
Cumulative Total VOC Mass Removed (lbs)			**14.0**		**14.2**		**15.1**

Appendix C
Historical Analytical Results and Contaminant Mass Removal - Liquid
Calumet Montana Refining, LLC - Great Falls, Montana

Location		SP200		SP200		SP200	
Ramboll Sample ID		CMR-SP200-230531		CMR-SP200-290623		CMR-SP200-110723	
Sample Date		5/31/2023		6/23/2023		7/11/2023	
Effluent Volume (L)*		151,878		306,490		125,244	
Notes							
Analyte	**CAS No.**	**Result (ug/L)**	**Mass (lb)**	**Result (ug/L)**	**Mass (lb)**	**Result (ug/L)**	**Mass (lb)**
SVOCs							
1,2,4,5-TETRACHLOROBENZENE	95-94-3	--	--	--	--	--	--
1,2,4-TRICHLOROBENZENE	120-82-1	--	--	--	--	--	--
1,2-DICHLOROBENZENE	95-50-1	--	--	--	--	--	--
1,3-DICHLOROBENZENE	541-73-1	--	--	--	--	--	--
1,4-DICHLOROBENZENE	106-46-7	--	--	--	--	--	--
2,2'-OXYBIS(1-CHLOROPROPANE)	108-60-1	ND	--	ND	--	ND	--
2,3,4,6-TETRACHLOROPHENOL	58-90-2	--	--	--	--	--	--
2,4,5-TRICHLOROPHENOL	95-95-4	ND	--	ND	--	ND	--
2,4,6-TRICHLOROPHENOL	88-06-2	ND	--	ND	--	ND	--
2,4-DICHLOROPHENOL	120-83-2	ND	--	ND	--	ND	--
2,4-DIMETHYLPHENOL	105-67-9	ND	--	28	0.02	ND	--
2,4-DINITROPHENOL	51-28-5	ND	--	ND	--	ND	--
2,4-DINITROTOLUENE	121-14-2	ND	--	ND	--	ND	--
2,6-DINITROTOLUENE	606-20-2	ND	--	ND	--	ND	--
2-CHLORONAPHTHALENE	91-58-7	ND	--	ND	--	ND	--
2-CHLOROPHENOL	95-57-8	ND	--	ND	--	ND	--
2-METHYLNAPHTHALENE	91-57-6	1,200	0.40	80	0.05	4,000	1.10
2-METHYLPHENOL	95-48-7	ND	--	ND	--	ND	--
2-NITROANILINE	88-74-4	ND	--	ND	--	ND	--
2-NITROPHENOL	88-75-5	ND	--	ND	--	ND	--
3,3'-DICHLOROBENZIDINE	91-94-1	ND	--	ND	--	ND	--
3-NITROANILINE	99-09-2	ND	--	ND	--	ND	--
4,6-DINITRO-2-METHYLPHENOL	534-52-1	ND	--	ND	--	ND	--
4-BROMOPHENYL-PHENYL ETHER	101-55-3	ND	--	ND	--	ND	--
4-CHLORO-3-METHYLPHENOL	59-50-7	ND	--	ND	--	ND	--
4-CHLOROPHENYL-PHENYL ETHER	7005-72-3	ND	--	ND	--	ND	--
4-METHYLPHENOL	106-44-5	ND	--	--	--	ND	--
4-NITROANILINE	100-01-6	ND	--	ND	--	ND	--
4-NITROPHENOL	100-02-7	ND	--	ND	--	ND	--
ACENAPHTHENE	83-32-9	ND	--	ND	--	ND	--
ACENAPHTHYLENE	208-96-8	ND	--	ND	--	ND	--
ANTHRACENE	120-12-7	ND	--	ND	--	ND	--
BENZO(A)ANTHRACENE	56-55-3	ND	--	ND	--	ND	--
BENZO(A)PYRENE	50-32-8	ND	--	ND	--	ND	--
BENZO(B)FLUORANTHENE	205-99-2	ND	--	ND	--	ND	--
BENZO(G,H,I)PERYLENE	191-24-2	ND	--	ND	--	ND	--
BENZO(K)FLUORANTHENE	207-08-9	ND	--	ND	--	ND	--
BIS(2-CHLOROETHOXY)METHANE	111-91-1	ND	--	ND	--	ND	--
BIS(2-CHLOROETHYL) ETHER	111-44-4	ND	--	ND	--	ND	--
BIS(2-ETHYLHEXYL)PHTHALATE	117-81-7	ND	--	ND	--	ND	--
BUTYLBENZYLPHTHALATE	85-68-7	ND	--	ND	--	ND	--
CARBAZOLE	86-74-8	ND	--	ND	--	ND	--
CHRYSENE	218-01-9	ND	--	ND	--	ND	--
DIBENZ(A,H)ANTHRACENE	53-70-3	ND	--	ND	--	ND	--
DIBENZOFURAN	132-64-9	ND	--	ND	--	ND	--
DIETHYLPHTHALATE	84-66-2	ND	--	ND	--	ND	--
DIMETHYLPHTHALATE	131-11-3	ND	--	ND	--	ND	--
DI-N-BUTYLPHTHALATE	84-74-2	ND	--	ND	--	ND	--
DI-N-OCTYLPHTHALATE	117-84-0	ND	--	ND	--	ND	--
FLUORANTHENE	206-44-0	ND	--	ND	--	ND	--
FLUORENE	86-73-7	ND	--	6	0.00	ND	--
HEXACHLOROBENZENE	118-74-1	ND	--	ND	--	ND	--
HEXACHLOROBUTADIENE	87-68-3	ND	--	ND	--	ND	--
HEXACHLOROCYCLOPENTADIENE	77-47-4	ND	--	ND	--	ND	--
HEXACHLOROETHANE	67-72-1	ND	--	ND	--	ND	--
INDENO(1,2,3-CD)PYRENE	193-39-5	ND	--	ND	--	ND	--
ISOPHORONE	78-59-1	ND	--	ND	--	ND	--
NAPHTHALENE	91-20-3	570	0.19	74	0.05	2,100	0.58
NITROBENZENE	98-95-3	ND	--	ND	--	ND	--
N-NITROSO-DI-N-PROPYLAMINE	621-64-7	ND	--	ND	--	ND	--
N-NITROSODIPHENYLAMINE	86-30-6	ND	--	ND	--	ND	--
PENTACHLOROPHENOL	87-86-5	ND	--	ND	--	ND	--
PHENANTHRENE	85-01-8	110	0.04	5	0.00	350	0.10
PHENOL	108-95-2	ND	--	ND	--	ND	--
PYRENE	129-00-0	22	0.01	1	0.00	67	0.02
Total SVOCs	--	**--**	**0.64**	**--**	**0.13**	**--**	**1.80**
Period Total SVOC Mass Removed (lbs)		**0.6**		**0.1**		**1.8**	
Cumulative Total VOC Mass Removed (lbs)		**11.9**		**12.0**		**13.8**	

Appendix C
Historical Analytical Results and Contaminant Mass Removal - Liquid
Calumet Montana Refining, LLC - Great Falls, Montana

Location		SP200		SP200		SP200	
Ramboll Sample ID		CMR-SP200-230531		CMR-SP200-290623		CMR-SP200-110723	
Sample Date		5/31/2023		6/23/2023		7/11/2023	
Effluent Volume (L)*		151,878		306,490		125,244	
Notes							
Analyte	**CAS No.**	**Result (ug/L)**	**Mass (lb)**	**Result (ug/L)**	**Mass (lb)**	**Result (ug/L)**	**Mass (lb)**
EPH							
C11 THROUGH C22 AROMATIC HYDROCARBONS	C11-C22-AROM	77,000	25.78	83,500	56.42	--	--
C19 THROUGH C36 ALIPHATIC HYDROCARBONS	C19-C36-ALIP	--	--	--	--	--	--
C9 THROUGH C18 ALIPHATIC HYDROCARBONS	C09-C18-ALIP	--	--	--	--	--	--
TOTAL EXTRACTABLE HYDROCARBON (POST FRACTIONATION)	68334-30-5S	348,000	116.52	354,000	239.19	--	--
TOTAL EXTRACTABLE HYDROCARBON	68334-30-5E	388,000	129.91	643,000	434.46	1,850,000	510.81
Total EPHs	--	**--**	**129.91**	**--**	**434.46**	**--**	**510.81**
Period Total EPH Mass Removed (lbs)			**129.9**		**434.5**		**510.8**
Cumulative Total EPH Mass Removed (lbs)			**1484.1**		**1918.6**		**2429.4**
VPH							
BENZENE	71-43-2	--	--	--	--	--	--
C5 THROUGH C8 ALIPHATIC HYDROCARBONS (ADJUSTED)	C05-C08-ALIP-J	3,690	1.24	ND	--	2,160	0.60
C9 THROUGH C10 AROMATIC HYDROCARBONS	C09-C10-AROM	--	--	--	--	--	--
C9 THROUGH C12 ALIPHATIC HYDROCARBONS (ADJUSTED)	C09-C12-ALIP-J	112,000	37.50	3,790	2.56	12,300	3.40
ETHYL BENZENE	100-41-4	--	--	--	--	--	--
M,P-XYLENE	179601-23-1	--	--	--	--	--	--
METHYL TERT-BUTYL ETHER	1634-04-4	--	--	--	--	--	--
NAPHTHALENE	91-20-3	--	--	--	--	--	--
ORTHO-XYLENE	95-47-6	--	--	--	--	--	--
TOLUENE	108-88-3	--	--	--	--	--	--
TOTAL PETROLEUM HYDROCARBONS	TPH	154,000	51.56	10,800	7.30	37,500	10.35
Total VPHss	--	**--**	**51.56**	**--**	**7.30**	**--**	**10.35**
Period Total VPH Mass Removed (lbs)			**51.6**		**7.3**		**10.4**
Cumulative Total VPH Mass Removed (lbs)			**197.7**		**205.0**		**215.4**

Appendix C
Summary of Analytical Results and Contaminant Mass Removal - Liquid
Calumet Montana Refining, LLC - Great Falls, Montana

Notes:

*Effluent volumes represent volume of groundwater extracted during the start-up (October 2021), commissioning (November 2021 - December 2021), and first quarter of standard operation (January 2022 - March 2022). Effluent volumes beginning April 2022 represent volume extracted during the month which the sample was taken.

1. Results from May 17, 2022 appear anomalously high and separate phase non-aqueous phase liquid was identified in the sampling jar; therefore, these results do not appear representative of dissolved phase concentrations and were rejected. Due to the rejected May 2022 results, the effluent volume associated with the April 2022 sampling event represents the volume recovered from April 1, 2022 - May 15, 2022 and effluent volume associated with the June 17, 2022 sampling event represents the volume recovered from May 16, 2022 through June 30, 2022.

2. Sample was not collected during September 2022, therefore results from August 2022 were used for mass removal calculations.

3. Sample was not collected during October 2022 and November 2022, therefore results from December 2022 were used for mass removal calculations.

4. April 2023 sample was collected on May 3, 2023

5. Samples were not collected during August and September 2023, therefore results from July 2023 were used for mass removal calculations

Sample Calculation

$$\boldsymbol{Mass\ Removed\ (lb) = 1800\ \frac{ug}{L} \times 10^{-6}\ \frac{g}{ug}\ \times \frac{1}{453.6}\ \frac{lb}{g} \times 21138\ L}$$

Abbreviations:

EPH : Extractable Petroleum Hydrocarbon
ND : Non Detect
SVOCs : Semi-volatile Organic Compounds
ug/L : micrograms per liter
VOCs : Volatile Organic Compounds
VPH : Volatile Petroleum Hydrocarbons

APPENDIX D
GROUNDWATER SAMPLING PURGE LOGS

Low Flow Groundwater Sampling Field Log

Monitoring Well - **MW-106**

Calumet Montana Refinery, LLC
Great Falls, Montana

Sampling Information

Date (MM/DD/YY) - **September 19, 2023**
Personnel - **Eric Poissant**
Weather - **Sunny 60F**
Sampling Device - **Geotech Peristaltic Pump**

Pump on - **11:35**
Pump off - **12:05**

Well Information

Well Casing PID - **--** ppm
Well Diameter - **2** inch
Screened Zone - **2 - 12** ft BGS

Measured Depth to Bottom - **12.30** ft BTOC
Depth to LNAPL - **--** ft BTOC
Depth to Water - **4.59** ft BTOC
Depth to Pump Intake - **11.5** ft BTOC

Well Evacuation Data

Stabilization Criteria			± 0.1 SU	± 3 %	± 10 % < 5 NTU	N/A	± 10 mV	± 10 % <0.5 mg/L	0.3 ft	
Time	**Vol.** L	**Rate** ml/min	**pH** Std	**Cond.** ms/cm	**Turb.** NTU	**Temp.** C	**ORP** mV	**DO** mg/L	**DTW** ft	**Appearance or Comments**
11:40	1.5	300	7.26	2.25	38.30	18.53	123	0.00		Clear
11:45	1.5	300	7.45	2.25	43.00	19.10	-127	0.00		Clear
11:50	1.5	300	7.37	2.25	61.30	19.94	-127	0.00		Clear
11:55	1.5	DRY	7.34	2.29	63.50	19.99	-122	0.00		Clear
12:00	1.5	300	7.36	2.23	90.30	19.69	-124	0.00		
12:05	1.5	300	7.35	2.18	159.00	19.48	-127	0.00		
		DRY								
		SAMPLE	7.35	2.18	159.00	19.48	-127.00	0.00		

Notes / Sample Information

Appearance at Start - **Clear**
Appearance After Purging - **Clear**

Sample ID - CMR-MW-106-092023
Sample Time - 9:55 9/20/2023

Total Volume Purged - **9.0** L
Purge Rate - **300** ml/min

Additional Sample -
Additional Sample ID -

Analysis - VOCs (8260);
VPH (Montana VPH);
SVOCs (8270);
EPH (Montana EPH)

Equipment Information

Multi-Gas Meter / PID # - **NA**
Water Quality Meter # - **Horiba**
Oil / Water Interface Probe # - **Heron**
Peristaltic Pump # - **GeoTech**

Notes **Purged Dry, sampled next day**

Low Flow Groundwater Sampling Field Log

Monitoring Well - **MW-41S**

Calumet Montana Refinery, LLC
Great Falls, Montana

Sampling Information

Date (MM/DD/YY) - **September 19, 2023**
Personnel - **Eric Poissant**
Weather - **Sunny 60F**
Sampling Device - **Geotech Peristaltic Pump**

Pump on - **12:10**
Pump off - **12:32**

Well Information

Well Casing PID - **--** ppm
Well Diameter - **2** inch
Screened Zone - **4 - 14** ft BGS

Measured Depth to Bottom - **16.70** ft BTOC
Depth to LNAPL - **--** ft BTOC
Depth to Water - **7.40** ft BTOC
Depth to Pump Intake - **14.0** ft BTOC

Well Evacuation Data

Stabilization Criteria			± 0.1 SU	± 3 %	± 10 % < 5 NTU	N/A	± 10 mV	± 10 % <0.5 mg/L	0.3 ft	
Time	**Vol.** L	**Rate** ml/min	**pH** Std	**Cond.** ms/cm	**Turb.** NTU	**Temp.** C	**ORP** mV	**DO** mg/L	**DTW** ft	**Appearance or Comments**
12:15	1.5	300	7.20	1.320	19.8	17.06	-143	0.00		Clear
12:20	1.5	300	7.07	1.250	19.2	18.33	-133	0.00		Clear
12:25	1.5	300	7.10	1.310	15.8	17.46	-137	0.00		Clear
12:30	1.5	300	7.13	1.370	25.6	16.59	-144	0.00		Clear
12:32	DRY	300	7.18	1.380	26.0	16.31	-147	0.00		Clear
	SAMPLE	300	7.18	1.380	26	16.31	-147	0.00		Clear

Notes / Sample Information

Appearance at Start - **Clear**
Appearance After Purging - **Clear**

Total Volume Purged - **6.6** L
Purge Rate - **300** ml/min

Analysis - VOCs (8260);
VPH (Montana VPH);
SVOCs (8270);
EPH (Montana EPH)

Sample ID - CMR-MW-41S-092023
Sample Time - 10:20 9/20/2023

Additional Sample -
Additional Sample ID -

Equipment Information

Multi-Gas Meter / PID # - **NA**
Water Quality Meter # - **Horiba**

Oil / Water Interface Probe # - **Heron**
Peristaltic Pump # - **GeoTech**

Notes **Purged dry - sampled next day**

Low Flow Groundwater Sampling Field Log

Monitoring Well - **MW-105**

Calumet Montana Refinery, LLC
Great Falls, Montana

Sampling Information

Date (MM/DD/YY) - **September 19, 2023**
Personnel - **Eric Poissant**
Weather - **Sunny 55F**
Sampling Device - **Geotech Peristaltic Pump**

Pump on - **9:45**
Pump off - **9:53**

Well Information

Well Casing PID - **--** ppm
Well Diameter - **2** inch
Screened Zone - **5 - 10** ft BGS

Measured Depth to Bottom - **9.91** ft BTOC
Depth to LNAPL - **--** ft BTOC
Depth to Water - **5.39** ft BTOC
Depth to Pump Intake - **9.0** ft BTOC

Well Evacuation Data

Stabilization Criteria			± 0.1 SU	± 3 %	± 10 % < 5 NTU	N/A	± 10 mV	± 10 % <0.5 mg/L	0.3 ft	
Time	**Vol.** L	**Rate** ml/min	**pH** Std	**Cond.** ms/cm	**Turb.** NTU	**Temp.** C	**ORP** mV	**DO** mg/L	**DTW** ft	**Appearance or Comments**
9:50	1.5	300	7.12	---	---	13.11	98	6.31	5.39	Clear
9:53	Dry									Connectivity problem
9:55	***SAMPLE***	300	7.12	---	---	13.11	98	6.31	5.39	Connectivity problem

Notes / Sample Information

Appearance at Start - **Clear**
Appearance After Purging - **Connectivity problems**

Total Volume Purged - **2.4** L
Purge Rate - **300** ml/min

Sample ID - CMR-MW-105-092023
Sample Time - 9:25 9/20/2023

Additional Sample -
Additional Sample ID -

Analysis - VOCs (8260); SVOCs (8270); VPH (Montana VPH); EPH (Montana EPH)

Equipment Information

Multi-Gas Meter / PID # - **NA**
Water Quality Meter # - **Horiba**

Oil / Water Interface Probe # - **Heron**
Peristaltic Pump # - **GeoTech**

Notes **Horiba flow though cell problem, Field parameters not accurate. Limited water and pumped dry.**
Purged dry - sampled next day

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