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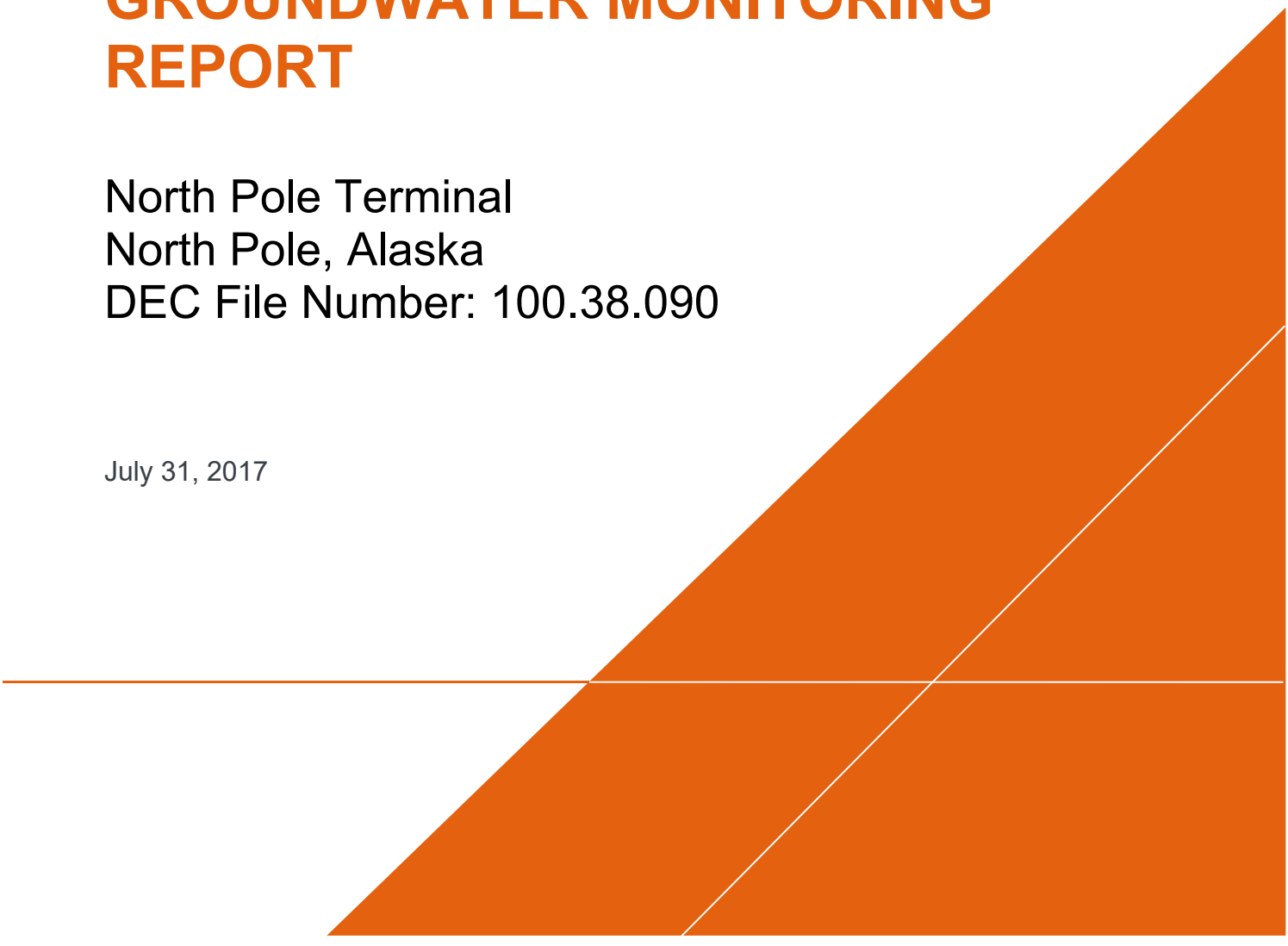
Flint Hills Resources Alaska, LLC

# FIRST SEMIANNUAL 2017 ONSITE GROUNDWATER MONITORING REPORT

North Pole Terminal
North Pole, Alaska
DEC File Number: 100.38.090

July 31, 2017



# FIRST SEMIANNUAL 2017 ONSITE GROUNDWATER MONITORING REPORT

North Pole Terminal
North Pole, Alaska
DEC File Number: 100.38.090

Genevieve Magdziuk
Environmental Engineer

Gina Withy
Project Engineer

Rebecca Andresen
Vice President

Prepared for:

Flint Hills Resources Alaska, LLC

Prepared by:

Arcadis U.S., Inc.
1100 Olive Way
Suite 800
Seattle
Washington 98101
Tel 206 325 5254
Fax 206 325 8218

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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AAC | Alaska Administrative Code |
| ADEC | Alaska Department of Environmental Conservation |
| APOC | alternative point of compliance |
| Arcadis | Arcadis U.S., Inc. |
| Barr | Barr Engineering Company |
| BTEX | benzene, toluene, ethylbenzene, and xylenes |
| bwt | below the water table |
| COC | constituent of concern |
| DRO | diesel-range organics |
| FHRA | Flint Hills Resources Alaska, LLC |
| $ft^2$/day | square foot per day |
| GAC East | original treatment system |
| GAC West | expanded groundwater recovery and treatment system |
| gpm | gallons per minute |
| GRO | gasoline-range organics |
| GRTS | groundwater remediation and treatment system |
| LNAPL | light nonaqueous phase liquid |
| LTM Plan | Long-Term Monitoring Plan – 2015 Update |
| OCP | Final Onsite Cleanup Plan |
| OMM Plan | Operations, Maintenance, and Monitoring Plan – 2015 Update |
| Onsite RSAP | Revised Onsite Sampling and Analysis Plan |
| Onsite SCR – 2013 | Onsite Site Characterization Report – 2013 Addendum |
| report | First Semiannual 2016 Onsite Groundwater Monitoring Report |
| reporting period | first and second quarters of 2017 |
| ROCP | Revised Onsite Cleanup Plan |
| SGP | South Gravel Pit |
| site | Flint Hills Resources Alaska, LLC North Pole Terminal, located on H and H Lane in North Pole, Alaska |
| SOP | standard operating procedure |
| SWI | Shannon & Wilson, Inc. |

| | |
|---|---|
| µg/L | micrograms per liter |

# 1 INTRODUCTION

On behalf of Flint Hills Resources Alaska, LLC (FHRA), Arcadis U.S., Inc. (Arcadis) prepared this First Semiannual 2017 Onsite Groundwater Monitoring Report (report) for the FHRA North Pole Terminal, located on H and H Lane in North Pole, Alaska (site). This report summarizes onsite field activities completed during the first and second quarters of 2017 (reporting period) as described in Section 3 and in Table 1-1.

The data, analyses, and conclusions presented in this report are the product of a collaborative effort among FHRA's consulting team members. The team includes qualified professionals in a variety of technical disciplines from three environmental consulting firms: Arcadis, Shannon & Wilson, Inc. (SWI), and Barr Engineering Company (Barr). FHRA engaged these consulting firms to perform various tasks for the project. Pursuant to 18 Alaska Administrative Code (AAC) 75.335(c)(1), this report was prepared and submitted by Qualified Environmental Professionals. Samples were collected and analyzed in accordance with 18 AAC 75.355(a). The sampling and analyses for this reporting period were completed in accordance with the following documents, which were prepared by Qualified Environmental Professionals and approved by the Alaska Department of Environmental Conservation (ADEC):

- Final Onsite Cleanup Plan (OCP; Arcadis 2014)
- Long-Term Monitoring Plan – 2015 Update (Arcadis 2015)
- Long-Term Monitoring Plan – 2016 Update (LTM Plan; Arcadis 2016)
- Operations, Maintenance, and Monitoring Plan – 2016 Update (OMM Plan; Barr 2016)
- Revised Onsite Sampling and Analysis Plan (Onsite RSAP; Arcadis 2017a, Appendix A)

The site, offsite area, and the site's physical setting are described in the conceptual site model, which was presented as Appendix A of the Onsite Site Characterization Report – 2013 Addendum (Onsite SCR – 2013; Arcadis 2013). The site is shown on Figure 1-1. Current site features are shown on Figure 1-2 and an onsite site plan is presented on Figure 1-3.

# 2 CURRENT GROUNDWATER MONITORING PROGRAM AND METHODS

Monitoring conducted during the reporting period was based on the following networks included in the LTM Plan (Arcadis 2016) and OMM Plan (Barr 2016):

- Groundwater elevation
- Light non-aqueous phase liquid (LNAPL) thickness and migration monitoring.
- Groundwater sampling and analysis of sulfolane
- Groundwater sampling and analysis of other constituents of concern (COCs; benzene, toluene, ethylbenzene, and xylenes [BTEX]; gasoline-range organics [GRO]; and diesel range organics [DRO]).

Additionally, baildown and LNAPL transmissivity testing was conducted based on the criteria described in the LTM Plan – 2015 Update (Arcadis 2015).

A Revised Onsite Cleanup Plan (ROCP; Arcadis 2017b) was submitted and approved by ADEC in February 2017. Under the ROCP (Arcadis 2017b), the groundwater remediation and treatment system (GRTS) will be shut down in third quarter 2017 and the updated sampling program defined under the ROCP will be implemented in third quarter (Arcadis 2017b).

Table 1-1 summarizes the field activities completed during the reporting period. Monitoring methods and well construction details are summarized in the RSAP (Arcadis 2017a). The following deviations from the LTM Plan (Arcadis 2016) were noted during the reporting period:

- Samples for sulfolane analysis were not collected from wells MW-115-15, MW-116-15, MW-178A-15, MW-178B-50, MW-179A-15, MW-179B-50, MW-336-15, MW-336-20, MW-336-35, MW-336-55, MW-337-20, MW-345-75, O-1, O-14, and O-20 during the reporting period because the wells were frozen.
- Wells MW-304-CMT-10 and S-39 were dry during the reporting period and were not sampled for sulfolane.
- Samples for BTEX, GRO, and DRO analyses were not collected from wells MW-115-15, MW-116-15, MW-138-20, MW-336-15, MW-336-20, and MW-337-20 during the reporting period because the wells were frozen.
- LNAPL was encountered in MW-138-20, MW-176A-15, MW-186A-15, MW-334-15, O-2, O-19, S-44, S-50, and S-51 during planned monitoring events within the reporting period; therefore, samples were not collected from these wells for BTEX, GRO, and DRO analyses.

# 3 GROUNDWATER MONITORING RESULTS

Groundwater impacts have been characterized and continue to be monitored through the analysis of water-level gauging data and groundwater samples collected from onsite monitoring wells. This section presents the results of water-level gauging and groundwater analyses of onsite well samples. Data are summarized in Tables 3-1 through 3-8.

Historical groundwater elevation and LNAPL thickness measurements, and BTEX, GRO, DRO, sulfolane, and geochemical analytical results are included as Appendix A. Analytical laboratory reports are included as Appendix B. A data quality evaluation including ADEC quality assurance (QA)/quality control checklists is included as Appendix C. Field data sheets are included as Appendix D.

## 3.1 Groundwater Elevation

Depth to water measurements were collected from monitoring wells on March 14 and 15, 2017 during first quarter 2017. Potentiometric maps are included for each monitoring zone: water table, 10 to 55 feet below the water table (bwt), 55 to 90 feet bwt, and 90 to 160 feet bwt (Figures 3-1 through 3-4). During the reporting period, the general direction of the horizontal hydraulic gradient was interpreted to be to the north-northwest, which is consistent with historical groundwater data. Groundwater elevations and horizontal hydraulic gradients were within the range of historical groundwater data.

Groundwater well field parameters and elevations are summarized in Tables 3-1 and 3-2, respectively. Groundwater elevation measurements collected as part of the hydraulic capture performance monitoring are presented in Section 5.1. Groundwater elevations near the GRTS are discussed in Section 5.1.

In addition to manual water-level measurements, automated measurements were collected with transducers from selected onsite wells and well nests. Data from the well nests were used to calculate horizontal hydraulic gradients and differences in groundwater elevations between wells screened at various depths within the suprapermafrost aquifer. Groundwater elevation hydrographs were prepared in accordance with the standard operating procedure (SOP; SWI 2013) using the most recent survey data. Error ranges, calculated in accordance with the method outlined in the SOP (SWI 2013), are shown on the well nest hydrographs presented in Appendix E. A detailed evaluation of transducer data and hydraulic gradients through 2013 is provided in Appendix 6-B of the Onsite SCR – 2013 (Arcadis 2013). Hydraulic gradients are further discussed in Section 6.

Measurements were recorded from gauging points located at the North Gravel Pit and South Gravel Pit (SGP) on March 14 and 15, 2017. Data are summarized in Table 3-2 and on Figures 3-1 through 3-4. Historical gauging data are summarized in Appendix A.

## 3.2 Light Nonaqueous Phase Liquid Monitoring Results

LNAPL migration observations and thickness measurements were collected from a network of monitoring, observation, and recovery wells screened across the water table according to the LTM Plan (Arcadis 2016). Additionally, LNAPL was gauged throughout the reporting period during monitoring events outside

of the LNAPL migration and thickness networks. A comprehensive LNAPL gauging table is presented in Appendix F.

### 3.2.1 Light Nonaqueous Phase Liquid Extent

Per the LTM Plan (Arcadis 2016), LNAPL migration observations were made from wells along the perimeter of the LNAPL plume. LNAPL was not observed in any of the LNAPL migration monitoring wells during the reporting period. Results are summarized in Table 3-3.

### 3.2.2 Light Nonaqueous Phase Liquid Thickness

Per the LTM Plan (Arcadis 2016), LNAPL thickness measurements were made from wells within the LNAPL thickness monitoring well network. These results are included in Table 3-4, and maximum thickness data measured during the reporting period are presented on Figures 3-5 and 3-6. Additionally, LNAPL was gauged during the following monitoring events throughout the quarter: groundwater elevation monitoring, groundwater sampling and field parameter collection, vertical gradient monitoring, hydraulic capture monitoring, and FHRA operator gauging. A comprehensive table including gauging data from each monitoring event conducted at the site during the reporting period is included in Appendix F.

LNAPL thickness measurements are similar to historical results. LNAPL recovery results are discussed in Section 4.3.

### 3.2.3 Transmissivity Testing

LNAPL baildown tests are conducted during periods when groundwater levels are at or near seasonal lows (water table minima), which have been historically observed in March and late October. LNAPL thickness was measured at greater than 0.5 foot in eight wells during the reporting period and a baildown test was completed at one well (O-27) during this reporting period. Transmissivity testing results for the reporting period are included in Table 3-5 and Appendix G.

### 3.2.4 Groundwater Extraction-Enhanced Light Nonaqueous Phase Liquid Recovery

FHRA calculated the LNAPL transmissivity for recovery wells R-21 and R-40 using remediation system data collected during the reporting period. LNAPL and groundwater drawdowns are required input values for the LNAPL transmissivity calculation. Two simplifying assumptions were made to facilitate the LNAPL transmissivity calculations:

- LNAPL drawdown used in the calculations was based on the observed thickness of LNAPL in the well during gauging and system data collection.
- Groundwater drawdown can be reasonably calculated for R-21 and R-40 by pairing the recovery well with a monitoring well outside the zone of capture.

LNAPL transmissivity results from the groundwater extraction-enhanced LNAPL recovery at R-21 and R-40 from January 2010 through June 2016 are included in Appendix H. Time series plots for groundwater extraction-enhanced LNAPL recovery at R-21 and R-40 over that period are included on Figures 3-7a and

3-7b, respectively. Appendices H-1 and H-2 include data analysis output for groundwater extraction-enhanced LNAPL recovery at R-21 and R-40, respectively.

LNAPL transmissivity could not be evaluated quantitatively at R-21 and R-40 using data collected over the first two quarters of 2017 due to limited LNAPL thickness and collection events. Qualitatively, a comparison can be made between this reporting period and the preceding periods during which recovery was conducted. In the first half of 2017, a total of 18.5 and 5.2 gallons of LNAPL were collected from R-21 and R-40, respectively. These rates have generally been consistent since early 2015. In comparison, historical recovery prior to 2015 over two quarters of system operation at the wells has ranged up to 1620 gallons at R-21, and more than 430 gallons at R-40. Given the decrease in recent LNAPL recovery volumes, current LNAPL transmissivity at these wells is expected to be within a range comparable to values estimated since early 2015, which were below the upper end of the recoverability criterion range. LNAPL transmissivity from 2012 through 2016 has been estimated to range from less than 0.1 $ft^2$/day to 0.4 $ft^2$/day at wells R-21 and R-40, which is less than the 0.8 $ft^2$/day upper limit of the recoverability criteria range and at or near the 0.1 $ft^2$/day lower limit indicating that continued hydraulic recovery of LNAPL since 2012 has not resulted in beneficial LNAPL mass reduction from the subsurface near the wells.

## 3.3 Onsite Monitoring Well Sampling

Onsite wells included in the other COC monitoring network in the LTM Plan (Arcadis 2016) were sampled for BTEX, GRO, and DRO during the reporting period. Results are summarized in Table 3-6. Figure 3-8 presents analytical results for benzene, including the inferred extent of the dissolved-phase benzene distribution within the suprapermafrost aquifer at the site.

Analyses for sulfolane were completed on groundwater samples collected from the wells identified in the LTM Plan (Arcadis 2016), including wells that are on a monthly performance monitoring schedule for the GRTS, as described in the OCP (Arcadis 2014). Sulfolane analytical results are summarized in Table 3-7 and on Figures 3-9 through 3-15, which show the inferred extent (based on current and past data) of the dissolved-phase sulfolane distribution at the water table, 10 to 55 feet bwt and 55 to 90 feet bwt, within the suprapermafrost aquifer at the site. In accordance with the updated sampling schedule (Arcadis 2016), no data were collected during second quarter 2017 at the 90 to 160 feet bwt interval.

Groundwater samples were collected from the alternative point of compliance (APOC) wells to evaluate the vertical distribution of sulfolane concentrations. Sample results collected from the APOC, which includes well clusters MW-301 through MW-306, MW-101-25A, MW-101-60, MW-141-20, and MW-143-20, are summarized in Table 3-7 and on Figures 3-9 through 3-15. Sulfolane concentrations for the APOC wells are also summarized in Table 3-8 and on Figures 3-16 and 3-17. Sulfolane concentrations continue to decline along the APOC, with the shallow data at the MW-304 well nest showing the highest residual concentrations. The MW-304 well nest is located near the historical longitudinal axis of the plume and, according to tracer studies, is likely influenced by dual-porosity characteristics (Arcadis 2013).

## 3.4 Statistical Analysis of Benzene and Sulfolane Data

A statistical and graphical evaluation of benzene and sulfolane concentration trends using a Mann-Kendall trend analysis is conducted semiannually during the first and third quarters at monitoring and

observation wells to evaluate plume migration and stability, remedial action effectiveness, and to identify relationships between concentrations, groundwater elevations, and flow directions. Use of the Monitoring and Remediation Optimization System for Mann-Kendall trend analysis was applied to groundwater monitoring data collected since 2006 from monitoring and observation wells. Wells with LNAPL were excluded from evaluation of the benzene statistical trend. Section 5.2 describes an additional evaluation of the sulfolane and benzene concentration trends for data collected from the performance monitoring network associated with the GRTS since 2011.

The analysis trends are expressed as probably increasing, increasing, probably decreasing, decreasing, stable, or no trend. Results of the Mann-Kendall trend analysis for the reporting period are presented in Tables 1 and 2 and on Figures 1A through 2D of Appendix I, and are summarized in the table below.

| Parameter Trend | First Quarter | |
|---|---|---|
| | Benzene | Sulfolane |
| Number of wells | 142 | 295 |
| All results nondetect[1] | 89 | 106 |
| Insufficient data points[1] | 6 | 10 |
| Probably decreasing | 0 | 11 |
| Decreasing | 9 | 100 |
| Probably increasing | 5 | 4 |
| Increasing | 0 | 7 |
| Stable | 8 | 29 |
| No trend | 25 | 28 |

**Note:**
[1]Wells with insufficient data points for the statistical analysis (less than four points), but with all results less than detection limits, are listed under “all results nondetect.”

The results of the trend analyses are discussed below.

### 3.4.1 Benzene Statistical Evaluation

No increasing benzene concentration trends were observed as a result of the Mann-Kendall trend analysis. The Mann-Kendall trend analysis indicated a probably increasing benzene concentration trend in wells MW-130-25, MW-134-20, MW-321-15, O-24, and R-46. However, based on a visual evaluation of the benzene time series plots included as Attachment 1 in Appendix I, concentrations appear to be decreasing in well R-46 since October 2014, remain relatively stable in well MW-134-20, and increasing in wells MW-130-25, MW-321-15, and O-24. Well R-46 is within the detectable benzene plume at the site and was actively pumped by the recovery system during the reporting period, which is likely influencing dissolved benzene concentrations at this location. Monitoring well MW-130-25 is within the detectable

benzene plume at the site, near the downgradient extent, and a decrease in concentrations has been noted beginning in first quarter 2016. MW-321-15 is within the detectable benzene plume at the site at the eastern extent. Well O-24 is within the detectable benzene plume at the site, near the downgradient extent. Some seasonal variation is evident in this well, and a decrease in concentrations was noted in first quarter 2017. MW-134-20 is on the eastern upgradient extent of the benzene plume and the last result had an estimated (J-flagged) benzene detection.

### 3.4.2 Sulfolane Statistical Evaluation

Using statistical approaches to evaluate groundwater monitoring data collected since 2006, increasing or probably increasing sulfolane concentration trends were indicated at 11 onsite monitoring wells (MW-179B-50, MW-304-96, MW-304-CMT-10, MW-321-65, MW-330-20, MW-345-55, MW-345-75, MW-348-65, O-27-65, S-21, and S-39). Of these, MW-304-96 is outside the detectable sulfolane plume and has not exhibited detections since third quarter 2013. Sulfolane results collected from monitoring well MW-321-65 have typically been nondetect; however, an estimated result greater than the laboratory detection limit but less than the laboratory quantification limit was detected during the last reporting period. Wells S-21 and MW-179B-50 are located upgradient or adjacent to the GRTS and are therefore influenced by the groundwater remediation effort; the last sulfolane results for these wells were also estimated (J-flagged) concentrations.

A visual observation of the concentration trend plots (Attachment 1 of Appendix I) show that concentrations at most locations with increasing Mann-Kendall trends are either stable or decreasing since October 2014. The exceptions include O-27-65 (which appears to have a seasonal variation), MW-304-CMT-10, MW-330-20, MW-345-55, and MW-345-75. Concentrations have remained less than 20 micrograms per liter (µg/L) in O-27-65, less than 25 µg/L in MW-345-75, and less than 40 µg/L in MW-345-55 and MW-304-CMT-10 since sampling began at these locations. MW-345-55 and MW-345-75 are located adjacent to recovery well R-43, which is likely influencing sulfolane concentrations at these locations. Although not reflected as an increasing trend by the Mann-Kendall analysis, an increase in sulfolane concentrations was noted in the fourth quarter 2016 and first quarter 2017 at MW-372-15.

## 3.5 Nonroutine Activities

During this reporting period, groundwater monitoring wells MW-177-90, MW-105-65, MW-105A-25, and MW-196-15 were decommissioned on June 21, 2017. ADEC previously concurred with the abandonment of these wells and they were decommissioned in accordance with ADEC Monitoring Well Guidance (ADEC 2013).

# 4 GROUNDWATER REMEDIATION AND TREATMENT SYSTEM RESULTS AND EVALUATION

This section discusses operating results for the existing GRTS for the reporting period. Ongoing remediation efforts at the site include groundwater recovery and treatment, and LNAPL recovery and recycling, as described in Sections 4.2 and 4.3, respectively. The GRTS layout is shown on Figure 4-1 and process flow diagram for the original treatment system (GAC East) is shown on Figure 4-2. The expanded groundwater recovery and treatment system (GAC West) and recovery wells R-47 and R-48 were shut down in 2016; therefore, operation is not discussed further in this report. A Revised Onsite Cleanup Plan (ROCP; Arcadis 2017b) was submitted and approved by ADEC in February 2017. Under the ROCP (Arcadis 2017b), the GRTS will be shut down in third quarter 2017.

## 4.1 Associated Permits

Treated groundwater from GAC East is discharged at the SGP in accordance with wastewater disposal permit 2005-DB0012 issued by ADEC (with subsequent ADEC-approved revisions). Groundwater withdrawal for the purpose of groundwater recovery and treatment is done in accordance with Temporary Water Use Authorization A2016-41 issued by the Alaska Department of Natural Resources.

## 4.2 Groundwater Recovery and Treatment

The average groundwater recovery rate for the GRTS was 345 gallons per minute (gpm) during the reporting period. This rate is consistent with target recovery rates for the GRTS established in the OMM Plan (Barr 2016). The average flow rates (when pumping) and total and percent runtimes for the reporting period are shown in the table below, along with the target flow rate for each well.

| Location | First and Second Quarter 2017 Average Flow Rate | Target Flow Range* | First and Second Quarter 2017 Runtime | Percent Runtime |
|---|---|---|---|---|
| R-21 | 40.5 gpm | 40 to 50 gpm | 4,329 hours | 99.7 |
| R-35R | 50.6 gpm | 50 to 65 gpm | 4,328 hours | 99.6 |
| R-40 | 16.8 gpm | See R-45 below | 4,329 hours | 99.7 |
| R-42 | 60.0 gpm | 60 to 85 gpm | 4,329 hours | 99.7 |
| R-43 | 60.7 gpm | 60 to 85 gpm | 4,329 hours | 99.6 |
| R-44 | 60.8 gpm | 60 to 70 gpm | 4,328 hours | 99.6 |
| R-45 | 34.1 gpm (with R-40, 50.9 gpm) | 50 to 65 gpm (combined with R-40) | 4,326 hours | 99.6 |
| R-46 | 30.1 gpm | 30 to 40 gpm | 4,327 hours | 99.6 |

**Note:**
* Target flow ranges as presented in the OMM Plan (Barr 2016).

Each of the recovery wells maintained a high runtime during the reporting period. Downtime for each recovery well is further discussed in Section 4.6.

### 4.2.1 Cumulative Groundwater Recovery

Table 4-1 summarizes the volume and rate of groundwater recovered monthly from 2009 through the end of the reporting period. Approximately 90,000,000 gallons of recovered groundwater were remediated during the reporting period.

### 4.2.2 Groundwater Treatment Performance Evaluation – GAC East

In accordance with the OCP (Arcadis 2014) and the wastewater disposal permit for GAC East, FHRA conducted monthly monitoring of the GAC East effluent during the reporting period. FHRA also conducted multiple additional monitoring events to evaluate performance of the treatment system. Results for the monthly and additional monitoring events are summarized in Tables 4-2a through 4-2d.

The sulfolane concentration measured in the GAC East final effluent was less than 15 µg/L and less than the detection limit during each monitoring event for the reporting period (Table 4-2a).

BTEX and semivolatile organic compound concentrations measured at the GAC East final effluent were less than the discharge limits for the system during each monitoring event (Tables 4-2b and 4-2c). Total organic carbon monitoring was performed to evaluate system operation; results are included in Table 4-2d. Analytical laboratory reports are provided in Appendix B.

No GAC media changeouts were completed during the reporting period.

## 4.3 Light Nonaqueous Phase Liquid Recovery Rates and Recycling

During the reporting period, FHRA performed LNAPL recovery via a skimmer system when adequate LNAPL was consistently present, and/or conducted manual recovery using a vacuum truck or portable LNAPL pump at the wells shown on Figure 4-1. LNAPL recovered from the skimmer systems and from manual recovery activities is stored onsite until it is recycled.

LNAPL recovery for the reporting period is summarized in Table 4-3; historical LNAPL recovery at the site since 1986 is summarized in Table 4-4. During the reporting period, 43.2 gallons of LNAPL were recovered. From 1986 to present, approximately 398,318 gallons of LNAPL have been recovered. LNAPL gauging data collected as part of the operations and maintenance of the LNAPL recovery efforts are included in Appendix F.

## 4.4 Benzene, Toluene, Ethylbenzene, and Xylenes Mass Capture

FHRA monitored the BTEX concentrations in recovered groundwater on a monthly (or more frequent) basis to calculate mass removal rates (Table 4-5). Based on the monitoring results, BTEX mass removal averaged 0.50 pound per day and totalled approximately 91 pounds during the reporting period.

## 4.5 Sulfolane Mass Capture

FHRA monitored the sulfolane concentration in recovered groundwater at each active recovery well; mass recovery rates for each well are summarized in Table 4-6 for GAC East. During the reporting period, the highest average mass recovery rate was measured in well R-21 (0.10 pound per day; Table 4-6). Well R-46 had no measurable recovery of sulfolane and is outside the sulfolane plume (Table 4-6.

Table 4-7 summarizes the overall sulfolane mass recovery for the groundwater recovery system. The rates were calculated from sulfolane concentrations measured monthly in the GRTS influent. Sulfolane mass removal averaged 0.22 pound per day and, based on the system runtime, totalled approximately 40 pounds during the reporting period.

## 4.6 Summary of Routine and Nonroutine Repairs, Changes, and Maintenance

The GRTS maintained a high runtime percentage as demonstrated at the individual recovery wells (Section 4.2.1). Periodic interim well rehabilitation of wells R-35R, R-43, R-44, R-45, and R-46 was completed during the reporting period. The interim well rehabilitation includes using the Hydropuls® tool to dislodge scale and biological growth. Pumps are not removed from the wells for the interim rehabilitation. The results of the efforts have indicated improvement in preventing excessive drawdown in the recovery wells. Step-drawdown tests are not being performed during the interim rehabilitation work.

Additional downtime for smaller maintenance events and changes at the individual recovery wells or treatment systems during the reporting period are summarized in Table 4-8.

As further described in Section 5, results of the hydraulic capture events and continued overall declines in concentration in the sulfolane and BTEX plumes north of the GRTS capture zone indicate the effectiveness of the GRTS during the reporting period and preceding quarters. Thus, operation of the GRTS is meeting its performance goals and limited downtime events in the reporting period fell within design expectations.

# 5 GROUNDWATER REMEDIATION AND TREATMENT SYSTEM PERFORMANCE MONITORING

This section discusses performance monitoring results for the GRTS, as defined in the OCP (Arcadis 2014), including two quarterly hydraulic capture events conducted during the first and second quarters of 2017.

## 5.1 Groundwater Capture Evaluation

Performance monitoring for the GRTS includes hydraulic capture monitoring (quarterly) and water quality assessment (quarterly to annually). Performance monitoring is conducted to confirm the continued effectiveness of the GRTS. Capture of the sulfolane and BTEX plumes was evaluated during the reporting period using groundwater elevation and groundwater quality data. Measured depth to water, calculated hydraulic heads, and capture zone estimates are presented in Appendix J.

The capture evaluation results indicate that operation of the GRTS at rates achieved throughout the reporting period were consistent with results presented in previous groundwater monitoring reports. Under the ROCP (Arcadis 2017b), the GRTS will be shut down in third quarter 2017. Appendix J provides additional detail regarding the capture zone evaluation.

## 5.2 Concentration Trend Evaluation

FHRA evaluates the concentration data for sulfolane (quarterly or semiannual sampling frequency) and benzene (semiannual or annual sampling frequency) to identify any recent trends that may be influenced by remediation measures and to evaluate the performance of the GRTS.

### 5.2.1 Sulfolane

Table 5-1 summarizes FHRA's interpretation of sulfolane concentration trends since 2010 at individual GRTS performance monitoring wells to identify the effects of enhanced groundwater remediation; wells are generally presented in the table from west to east. The performance monitoring wells identified in Table 5-1 are categorized based on location relative to the treatment zone; each area is summarized below:

- *Upgradient*. Sulfolane concentration trends for performance monitoring wells located upgradient from the GRTS treatment zone are generally decreasing or stable. It is likely that the upgradient locations are minimally influenced by operation of the GRTS; these trends are believed to primarily be the result of a decreasing stored sulfolane mass in upgradient source areas.
- *Within the treatment zone*. Sulfolane concentration trends for monitoring wells located within the treatment zone are decreasing or stable, with the following exceptions:
  - MW-345-55 and MW-345-75 have shown seasonal variation with an overall increase from 2013 through second quarter 2017, which may be the result of increased pumping in R-43 and subsequent altering of flow paths in the area prior to capture.

  - Sulfolane concentrations increased in MW-370-15 and MW-370-55 in 2016 following shutdown of adjacent recovery well R-48 in third quarter 2016, but decreased during the reporting period (Section 5.2.3). GAC West shutdown monitoring is further discussed in Section 5.2.3.

- *Downgradient*. Sulfolane concentration trends for monitoring wells located downgradient from the treatment zone are decreasing or stable, except MW-371-15. Concentrations have increased in MW-371-15, likely due to the shutdown of GAC West in the third quarter of 2016. GAC West shutdown monitoring is further discussed in Section 5.2.3.

In addition to the trends presented in Table 5-1, a low concentration zone remains immediately north (downgradient) of the GAC East recovery wells (Figures 3-13, 3-14, and 3-15). Overall downward trends in concentration (in many cases decreases of more than an order of magnitude to single-digit, J-flagged or non-detectable concentrations) and consistently declining mass flux at the APOC are consistent with the source controls and operation of the GRTS.

### 5.2.2 Benzene

Performance monitoring for benzene occurred during first quarter 2017, with the exceptions noted in Section 2. Table 5-2 summarizes FHRA's interpretation of benzene concentration trends since 2010 in individual performance monitoring wells to identify the effects of enhanced groundwater remediation, which are generally presented from west to east. The performance monitoring wells identified in Table 5-2 are categorized based on location relative to the treatment zone; each area is summarized below:

- *Upgradient*. Both of the monitoring wells located upgradient of the GRTS that were sampled during the reporting period have decreasing concentrations. Two wells were not sampled due to the presence of LNAPL. The other three upgradient wells (all of which were previously nondetect for benzene) were not scheduled for sampling during the reporting period.
- *Within the treatment zone*. The three monitoring wells located within the GRTS treatment zone that were sampled during the reporting period have decreasing or stable concentrations. Three of the 13 monitoring wells were not sampled due to the presence of LNAPL. Seven of the 13 treatment zone monitoring wells (all of which were previously nondetect for benzene during the most recent monitoring) were not scheduled for sampling during the reporting period.
- *Downgradient*. The four monitoring wells located downgradient of the GRTS treatment zone that were sampled during the reporting period have decreasing or stable concentrations. Eight of the 12 downgradient monitoring wells (all of which were previously nondetect for benzene during the most recent monitoring) were not scheduled for sampling during the reporting period.

### 5.2.3 GAC West Shutdown Monitoring

As discussed in the previous semiannual groundwater monitoring report (Arcadis 2017a), GAC West and recovery wells R-47 and R-48 were shut down on August 31, 2016. As requested by ADEC, the sulfolane monitoring frequency was increased at the following wells to evaluate contaminant rebound:

- MW-302-CMT-20: increase the monitoring frequency from semiannually to quarterly.

- MW-302-CMT-70: increase the monitoring frequency from annual to semiannually.
- MW-351-55 and MW-351-75: increase the monitoring frequency from semiannually to quarterly (MW-351-15 was already being monitored quarterly).
- MW-370-15 and MW-370-55: increase the monitoring frequency from semiannually to quarterly.

Table 5-3 presents the results of the increased sulfolane monitoring post-shutdown, plus additional downgradient wells monitored during the reporting period in accordance with the LTM Plan (Arcadis 2016). Sulfolane concentrations rebounded to expected concentrations near wells R-47 and R-48. Well MW-309-15, which is located adjacent to R-47, has rebounded to 32.2 µg/L. Well MW-370-15, which is located adjacent to R-48, rebounded to 34.8 µg/L and has since declined to 27.4 µg/L. The slow rebound of concentrations supports the conceptual site model and dual-porosity transport mechanisms. Well MW-371-15 is the only well downgradient of R-47 and R-48 that has rebounded to sulfolane concentrations greater than 20 µg/L, which was expected with GAC West shutdown. Other downgradient wells that have shown concentration rebound likely related to the GAC West shutdown but remaining less than 20 µg/L include: MW-101A-25, MW-302-CMT-10, MW-302-CMT-20, MW-302-CMT-30, and MW-351-15. These trends are consistent with post-shutdown expectations and with the dual-porosity mechanism retarding the transport of sulfolane (Arcadis 2013). For example, concentrations at the MW-302 nest are not expected to rebound to values greater than 30 µg/L. The trend noted above for MW-370-15 is also consistent with expectations that sulfolane concentration trends should exhibit decreasing trends after concentrations rebounded following GAC West system shutdown.

## 5.3 Transect Trend Evaluation

To further evaluate the effectiveness of the GRTS, sulfolane concentration trends were evaluated along three longitudinal transects parallel to the groundwater flow path (Figure 5-1). Transects A and B (Figures 5-2 and 5-3) comprise shallow wells (water table and 10 to 55 feet bwt); Transect C (Figure 5-4) comprises deeper wells (55 to 90 feet bwt).

The data presented on Figures 5-2 and 5-3 demonstrate that shallow sulfolane concentrations downgradient from the treatment zone are lower than concentrations upgradient from the treatment zone. In addition, these figures show that decreasing downgradient sulfolane concentrations correlate with increased pumping from the GRTS starting in 2010. Additionally, concentrations measured in deeper wells are decreasing or stable (Figure 5-4).

# 6 CONCLUSIONS

Groundwater monitoring and sampling events were conducted during this reporting period in accordance with the LTM Plans (Arcadis 2015 and Arcadis 2016), OMM Plan (Barr 2016) and Onsite RSAP (Arcadis 2017a). During the reporting period, the GRTS system was operated and monitored in accordance with the OCP (Arcadis 2014) and the OMM Plan (Barr 2016). This section summarizes conclusions based on results of the onsite field activities conducted during the reporting period:

- Groundwater monitoring data collected during the reporting period are consistent with data collected during recent quarters.
- The statistical analyses included in Appendix I show that sulfolane concentrations in 111 wells and benzene concentrations in nine wells across the plume are decreasing or probably decreasing, while sulfolane concentrations in 11 wells and benzene concentrations in five wells across the plume are increasing or probably increasing.
- Sulfolane concentrations and trends continue to decrease in the onsite areas near the downgradient site boundary.
- BTEX concentrations are consistent with historical detections and the core of the BTEX plume appears to be stable. BTEX concentrations continue to be limited to the developed area onsite.
- During the reporting period, the GRTS continued to capture and remediate sulfolane- and BTEX-impacted groundwater.
- Concentrations of sulfolane and BTEX in the downgradient portion of the plume adjacent to the capture zone continue to show an overall decline, thus indicating the effectiveness of the GRTS.

In accordance with the ROCP (Arcadis 2017b), the GRTS system will be shut down in third quarter 2017 and the updated sampling program as defined in the ROCP will be implemented in third quarter (Arcadis 2017b).

# 7 REFERENCES

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Arcadis 2017a. First Semiannual 2016 Onsite Groundwater Monitoring Report. North Pole Terminal, North Pole, Alaska. DEC File No. 100.38.090. January.

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# TABLES

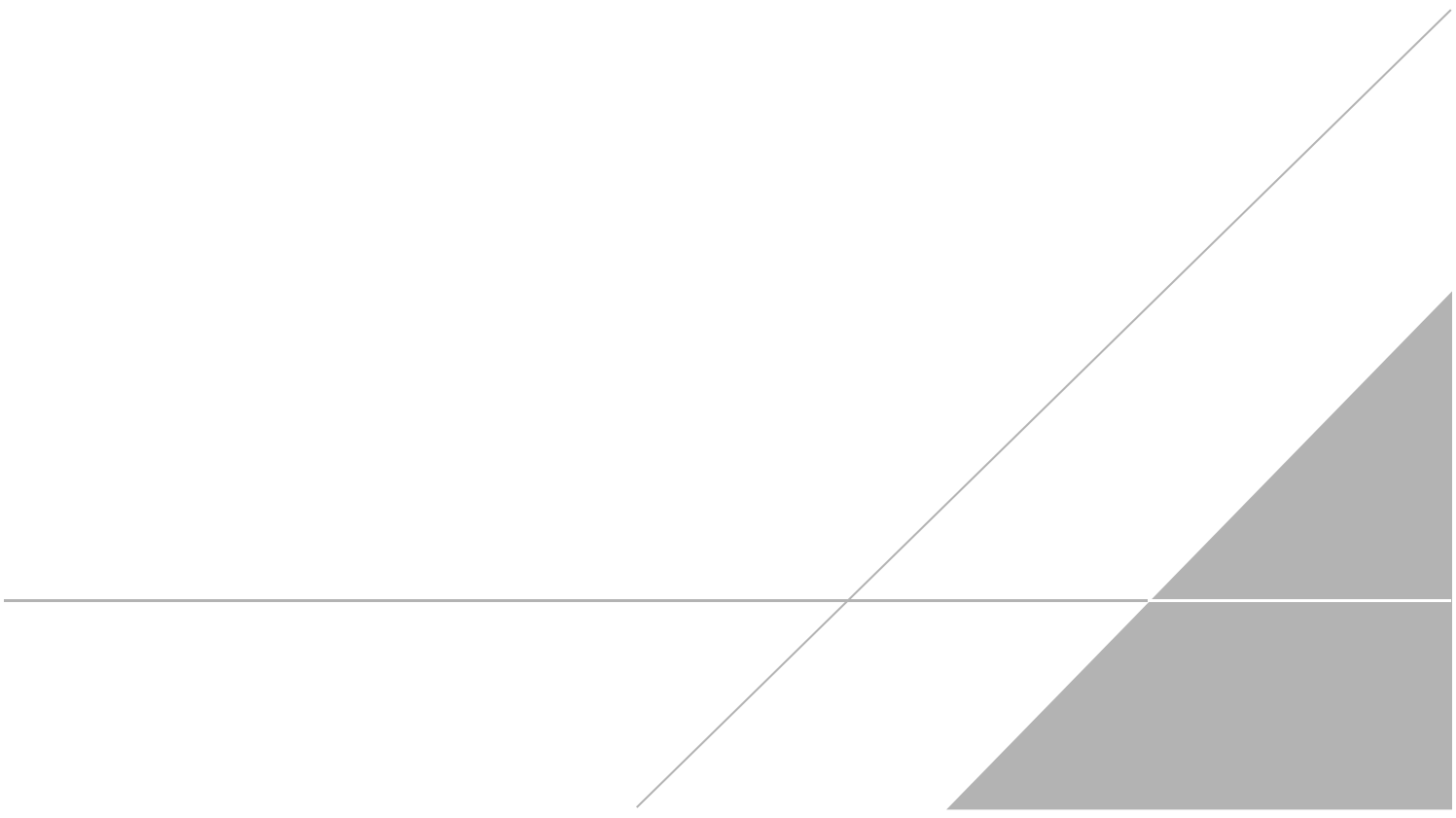


**Table 1-1**
**Field Activities**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Activity | Frequency |
|---|---|
| Groundwater Elevation Check | Semiannual |
| Data Loggers | Downloaded quarterly (hourly measurements) |
| LNAPL Migration Network Check | Monthly |
| LNAPL Thickness Network Check | Monthly |
| LNAPL Transmissivity Testing | Semiannual |
| Sulfolane Network Sampling | Throughout the reporting period |
| Other Constituents of Concern Network Sampling | Throughout First Quarter 2017<br>Frozen wells rechecked during Second Quarter 2017 |
| Contaminant Capture Performance Monitoring - Sulfolane Sampling | Throughout the reporting period |
| Groundwater Treatment System Sampling | Twice a month |
| Recovery Well Sampling | Monthly |
| Hydraulic Capture Performance Monitoring Network Groundwater Elevations | Quarterly |
| Interim Recovery Well Rehabilitation Services | Wells R-35R, R-43, R-44, R-45 and R-46 on three week frequency through February. R-45 and R-46 on three week frequency for remainder of reporting period. |
| Monitoring Well Repair and Maintenance | No major well repairs. Maintenance activities included cutting casings. |
| Wells Installed | None |
| Wells Developed | None |
| Initial Sulfolane/BTEX Sampling | None |

**General Notes:**
First Quarter 2017 activities were completed from January 1, 2017 through March 31, 2017.
Second Quarter 2017 activities were completed from April 1, 2017 through June 30, 2017.
Other Constituents of Concern includes BTEX, GRO, and DRO

**Acronyms and Abbreviations:**
BTEX= Benzene, Toluene, Ethylbenzene, and Xylenes
DRO = Diesel Range Organics
GRO = Gasoline Range Organics
LNAPL = Light Non-Aqueous Phase Liquid

**Table 3-1**
**Groundwater Well Field Parameters**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Well ID | Sample Name | Date | Analysis | Depth to Ice (feet) | Depth to Water (feet) | Depth to LNAPL (feet) | Temperature (°C) | Dissolved Oxygen (mg/L) | Conductivity (µS/cm) | pH | ORP (mV) | Water Clarity | Sample Collection Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MW-101A-25 | MW-101A-25 | 2/14/2017 | S | -- | 11.32 | -- | 4.8 | 0.82 | 225.6 | 7.42 | -36.3 | Clear | > 3 Well Volumes |
| MW-106-25 | MW-106-25 | 3/1/2017 | DRO, GRO, BTEX, PAH | -- | 14.44 | -- | 5.9 | 1.13 | 226.0 | 7.22 | 121.0 | Clear | > 3 Well Volumes |
| MW-110-20 | MW-110-20 | 2/16/2017 | S | -- | 11.11 | -- | 3.6 | 1.42 | 241.8 | 7.21 | -90.3 | Clear | > 3 Well Volumes |
| MW-110-20 | MW-110-20 | 4/10/2017 | S | -- | 11.13 | -- | 2.9 | 0.03 | 253.4 | 6.94 | 82.5 | Clear | > 3 Well Volumes |
| MW-113-15 | MW-113-15 | 2/27/2017 | S | -- | 9.98 | -- | 2.8 | 0.87 | 299.9 | 7.10 | 20.0 | Clear | Parameters Stabilized |
| MW-113-15 | MW-113-15 | 4/10/2017 | S | -- | 10.00 | -- | 2.5 | 0.76 | 316.3 | 7.13 | -77.4 | Clear | Parameters Stabilized |
| MW-115-15 | -- | 3/1/2017 | -- | 9.54 | -- | -- | No sample, well was frozen | | | | | | |
| MW-115-15 | -- | 4/13/2017 | -- | 9.65 | -- | -- | No sample, well was frozen | | | | | | |
| MW-115-15 | -- | 5/11/2017 | -- | 8.97 | 5.56 | -- | No sample, well was frozen | | | | | | |
| MW-116-15 | -- | 2/23/2017 | -- | 9.97 | -- | -- | No sample, well was frozen | | | | | | |
| MW-116-15 | -- | 4/11/2017 | -- | 9.98 | -- | -- | No sample, well was frozen | | | | | | |
| MW-116-15 | -- | 5/11/2017 | -- | 10.00 | 9.49 | -- | No sample, well was frozen | | | | | | |
| MW-125-25 | MW-125-25 | 2/24/2017 | S, BTEX, GRO, DRO | -- | 11.79 | -- | 4.4 | 0.23 | 249.8 | 7.23 | -137.8 | Clear | Parameters Stabilized |
| MW-125-25 | MW-125-25 | 4/11/2017 | S | -- | 11.75 | -- | 4.0 | 0.04 | 245.2 | 7.18 | -148.5 | Clear | Parameters Stabilized |
| MW-127-25 | MW-127-25 | 2/27/2017 | S | -- | 12.73 | -- | 3.9 | 0.48 | 232.3 | 7.06 | -58.6 | Clear | > 3 Well Volumes |
| MW-127-25 | MW-127-25 | 4/11/2017 | S | -- | 12.74 | -- | 3.8 | 0.43 | 231.6 | 7.07 | -75.7 | Clear | > 3 Well Volumes |
| MW-129-40 | MW-129-40 | 2/25/2017 | S | -- | 11.61 | -- | 4.3 | 0.15 | 224.1 | 7.10 | -20.5 | Clear | Parameters Stabilized |
| MW-130-25 | MW-130-25 | 2/24/2017 | S, BTEX, GRO, DRO | -- | 12.35 | -- | 3.7 | 0.14 | 288.3 | 6.66 | -136.8 | Slightly Turbid | Parameters Stabilized |
| MW-130-25 | MW-130-25 | 4/11/2017 | S | -- | 12.33 | -- | 3.0 | 0.09 | 303.2 | 6.63 | -161.2 | Clear | Parameters Stabilized |
| MW-135-20 | MW-135-20 | 2/24/2017 | S, BTEX, GRO, DRO | -- | 12.46 | -- | Product Well - no parameters collected | | | | | Clear with a slight amber hue | > 1 Well Volume |
| MW-136-20 | MW-136-20 | 2/24/2017 | S, BTEX, GRO, DRO | -- | 12.36 | -- | Product Well - no parameters collected | | | | | Not recorded | > 1 Well Volume |
| MW-138-20 | -- | 2/27/2017 | -- | 9.98 | -- | -- | No sample, well was frozen | | | | | | |
| MW-138-20 | MW-138-20 | 4/13/2017 | S | 9.99 | 5.38 | -- | Product Well - no parameters collected | | | | | Clear | > 1 Well Volume |
| MW-139-25 | MW-139-25 | 2/28/2017 | S, DRO, GRO, BTEX | -- | 13.23 | -- | 2.0 | 1.25 | 255.7 | 7.12 | -118.7 | Clear | > 3 Well Volumes |
| MW-139-25 | MW-139-25 | 4/10/2017 | S | -- | 13.25 | -- | 3.5 | 0.83 | 257.9 | 7.20 | -128.7 | Clear | Parameters Stabilized |
| MW-141-20 | MW-141-20 | 3/1/2017 | DRO, GRO, BTEX, PAH | -- | 9.13 | -- | 8.5 | 0.89 | 256.5 | 7.36 | -96.7 | Clear | > 3 Well Volumes |
| MW-142-20 | MW-142-20 | 2/16/2017 | S | -- | 11.95 | -- | 3.5 | 0.05 | 280.1 | 7.33 | -67.1 | Clear | Parameters Stabilized |
| MW-142-20 | MW-142-20 | 4/10/2017 | S | -- | 12.00 | -- | 3.3 | 0.79 | 279.7 | 7.35 | -122.2 | Clear | Parameters Stabilized |
| MW-142-65 | MW-142-65 | 2/28/2017 | S | -- | 9.32 | -- | 4.3 | 0.09 | 201.7 | 7.28 | -31.0 | Slightly turbid | Parameters Stabilized |
| MW-143-20 | MW-143-20 | 2/14/2017 | S | -- | 11.17 | -- | 3.3 | 1.50 | 223.7 | 7.22 | -1.1 | Clear | > 3 Well Volumes |
| MW-145-20 | MW-145-20 | 2/27/2017 | S | -- | 11.12 | -- | 3.7 | 0.18 | 390.7 | 6.80 | -8.1 | Clear | Parameters Stabilized |
| MW-148A-15 | MW-148A-15 | 2/13/2017 | S | -- | 10.13 | -- | 2.8 | 1.49 | 180.7 | 6.74 | 10.8 | Slightly Turbid | Parameters Stabilized |
| MW-148B-30 | MW-148B-30 | 2/13/2017 | S | -- | 10.35 | -- | 3.1 | 0.87 | 246.6 | 7.25 | -85.2 | Clear | Parameters Stabilized |
| MW-148C-55 | MW-148C-55 | 2/13/2017 | S | -- | 11.06 | -- | 3.5 | 0.86 | 220.8 | 7.34 | -63.1 | Clear | Parameters Stabilized |
| MW-148-80 | MW-148-80 | 2/13/2017 | S | -- | 10.42 | -- | 4.1 | 0.92 | 202.2 | 7.42 | -55.4 | Clear | Parameters Stabilized |
| MW-154A-75 | MW-154A-75 | 2/14/2017 | S | -- | 13.96 | -- | 4.7 | 0.16 | 205.5 | 7.26 | -80.0 | Clear | Parameters Stabilized |
| MW-154A-75 | MW-154A-75 | 4/10/2017 | S | -- | 14.02 | -- | 4.8 | 0.97 | 216.3 | 7.45 | -86.2 | Clear | Parameters Stabilized |
| MW-154B-95 | MW-154B-95 | 2/14/2017 | S | -- | 13.78 | -- | 4.6 | 0.09 | 172.4 | 7.40 | -211.6 | Clear | Parameters Stabilized |
| MW-154B-95 | MW-154B-95 | 4/10/2017 | S | -- | 13.85 | -- | 4.7 | 0.80 | 218.4 | 7.56 | -136.8 | Clear | Parameters Stabilized |
| MW-174-15 | MW-174-15 | 2/25/2017 | S | -- | 9.71 | -- | 3.6 | 2.44 | 236.5 | 7.38 | -70.0 | Clear | > 3 Well Volumes |
| MW-174A-50 | MW-174A-50 | 2/25/2017 | S | -- | 9.75 | -- | 5.8 | 1.04 | 222.0 | 7.54 | -110.5 | Clear | Parameters Stabilized |
| MW-175-90 | MW-175-90 | 2/24/2017 | S | -- | 12.25 | -- | 4.7 | 0.24 | 198.3 | 7.17 | -71.9 | Clear | Parameters Stabilized |
| MW-176A-15 | MW-176A-15 | 3/10/2017 | S | -- | 12.80 | 11.40 | Product Well - no parameters collected | | | | | Clear w/ sheen | > 1 Well Volume |
| MW-176A-15 | -- | 4/13/2017 | -- | 12.32 | -- | 11.55 | No sample, well was frozen | | | | | | |
| MW-176A-15 | -- | 5/11/2017 | -- | 12.29 | 12.29 | 11.51 | No sample, well was frozen | | | | | | |
| MW-178A-15 | -- | 2/24/2017 | -- | 10.78 | -- | -- | No sample, well was frozen | | | | | | |
| MW-178A-15 | -- | 4/11/2017 | -- | 10.77 | -- | -- | No sample, well was frozen | | | | | | |
| MW-178A-15 | -- | 5/12/2017 | -- | 11.49 | -- | -- | No sample, well was frozen | | | | | | |
| MW-178B-50 | -- | 2/24/2017 | -- | 10.30 | -- | -- | No sample, well was frozen | | | | | | |
| MW-178B-50 | -- | 4/11/2017 | -- | 10.34 | -- | -- | No sample, well was frozen | | | | | | |

**Table 3-1**
**Groundwater Well Field Parameters**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Well ID | Sample Name | Date | Analysis | Depth to Ice (feet) | Depth to Water (feet) | Depth to LNAPL (feet) | Temperature (°C) | Dissolved Oxygen (mg/L) | Conductivity (µS/cm) | pH | ORP (mV) | Water Clarity | Sample Collection Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MW-178B-50 | -- | 5/11/2017 | -- | 10.20 | -- | -- | No sample, well was frozen | | | | | | |
| MW-179A-15 | -- | 2/24/2017 | -- | 11.19 | -- | -- | No sample, well was frozen | | | | | | |
| MW-179A-15 | -- | 4/11/2017 | -- | 11.20 | -- | -- | No sample, well was frozen | | | | | | |
| MW-179A-15 | -- | 5/12/2017 | -- | 9.50 | -- | -- | No sample, well was frozen | | | | | | |
| MW-179B-50 | -- | 2/24/2017 | -- | 10.81 | -- | -- | No sample, well was frozen | | | | | | |
| MW-179B-50 | -- | 4/11/2017 | -- | 10.88 | -- | -- | No sample, well was frozen | | | | | | |
| MW-179B-50 | -- | 5/11/2017 | -- | 10.83 | -- | -- | No sample, well was frozen | | | | | | |
| MW-186A-15 | MW-186A-15 | 2/22/2017 | S | -- | 11.73 | 12.00 | Product Well - no parameters collected | | | | | Clear | > 1 Well Volume |
| MW-186A-15 | MW-186A-15 | 4/13/2017 | S | -- | 11.91 | 11.61 | Product Well - no parameters collected | | | | | Clear | > 1 Well Volume |
| MW-186B-60 | MW-186B-60 | 2/22/2017 | S | -- | 11.64 | -- | 4.1 | 0.14 | 204.0 | 7.32 | 82.8 | Clear | Parameters Stabilized |
| MW-186B-60 | MW-186B-60 | 4/11/2017 | S | -- | 11.57 | -- | 4.2 | 0.05 | 203.2 | 7.20 | -51.3 | Clear | Parameters Stabilized |
| MW-186E-75 | MW-186E-75 | 2/22/2017 | S | -- | 11.48 | -- | 4.1 | 0.18 | 204.0 | 7.35 | 51.8 | Clear | Parameters Stabilized |
| MW-186E-75 | MW-186E-75 | 4/13/2017 | S | -- | 11.36 | -- | 4.3 | 0.03 | 203.6 | 7.25 | 354.4 | Clear | Parameters Stabilized |
| MW-195A-15 | MW-195A-15 | 2/16/2017 | S | -- | 10.89 | -- | 3.5 | 1.60 | 350.1 | 6.81 | 72.3 | Clear | Parameters Stabilized |
| MW-195A-15 | MW-195A-15 | 4/10/2017 | S | -- | 10.93 | -- | 2.5 | 0.11 | 320.1 | 6.68 | 59.2 | Clear | Parameters Stabilized |
| MW-199-150 | MW-199-150 | 2/14/2017 | S | -- | 11.42 | -- | 4.5 | 0.30 | 188.6 | 7.05 | 76.0 | Clear | Parameters Stabilized |
| MW-301-60 | MW-301-60 | 2/14/2017 | S | -- | 9.01 | -- | 6.9 | 0.14 | 206.8 | 7.22 | -6.4 | Clear | Parameters Stabilized |
| MW-302-CMT-10 | MW-302-CMT-10 | 2/17/2017 | S | -- | 10.55 | -- | 2.3 | 1.80 | 208.7 | 7.21 | 46.6 | Clear | > 3 Well Volumes |
| MW-302-CMT-20 | MW-302-CMT-20 | 2/17/2017 | S | -- | 10.54 | -- | 3.9 | 2.32 | 219.7 | 7.42 | -11.2 | Clear | > 3 Well Volumes |
| MW-302-CMT-20 | MW-302-CMT-20 | 4/10/2017 | S | -- | 10.56 | -- | 4.4 | 2.29 | 219.2 | 7.32 | 9.8 | Clear | Parameters Stabilized |
| MW-302-CMT-30 | MW-302-CMT-30 | 2/17/2017 | S | -- | 10.54 | -- | 4.5 | 2.47 | 219.5 | 7.40 | 38.2 | Clear | > 3 Well Volumes |
| MW-302-70 | MW-302-70 | 2/14/2017 | S | -- | 9.47 | -- | 5.1 | 0.92 | 211.3 | 7.41 | -10.1 | Clear | Parameters Stabilized |
| MW-303-CMT-19 | MW-303-CMT-19 | 2/17/2017 | S | -- | 12.23 | -- | 3.0 | 1.26 | 227.3 | 7.36 | -74.4 | Clear | Parameters Stabilized |
| MW-303-CMT-29 | MW-303-CMT-29 | 2/17/2017 | S | -- | 12.24 | -- | 3.7 | 1.11 | 216.9 | 7.50 | -93.2 | Clear | Parameters Stabilized |
| MW-303-CMT-39 | MW-303-CMT-39 | 2/17/2017 | S | -- | 12.22 | -- | 3.9 | 2.43 | 213.9 | 7.47 | -86.5 | Clear | > 3 Well Volumes |
| MW-304-CMT-10 | -- | 2/16/2017 | -- | -- | -- | -- | No sample, well was dry | | | | | | |
| MW-304-CMT-10 | -- | 4/11/2017 | -- | -- | -- | -- | No sample, well was dry | | | | | | |
| MW-304-CMT-10 | -- | 5/11/2017 | -- | -- | -- | -- | No sample, well was dry | | | | | | |
| MW-304-15 | MW-304-15 | 2/13/2017 | S | -- | 13.11 | -- | 3.5 | 0.93 | 473.6 | 7.37 | -16.9 | Clear | > 3 Well Volumes |
| MW-304-15 | MW-304-15 | 4/10/2017 | S | -- | 13.19 | -- | 2.8 | 1.27 | 385.1 | 6.84 | -32.1 | Clear | > 3 Well Volumes |
| MW-304-CMT-20 | MW-304-CMT-20 | 2/16/2017 | S | -- | 13.77 | -- | 3.2 | 0.18 | 364.2 | 6.98 | 17.0 | Clear | Parameters Stabilized |
| MW-304-CMT-20 | MW-304-CMT-20 | 4/11/2017 | S | -- | 13.80 | -- | 3.9 | 1.02 | 388.6 | 6.96 | -36.5 | Clear | Parameters Stabilized |
| MW-304-CMT-30 | MW-304-CMT-30 | 2/16/2017 | S | -- | 13.79 | -- | 3.2 | 0.16 | 239.6 | 7.33 | 0.4 | Clear | Parameters Stabilized |
| MW-309-15 | MW-309-15 | 2/17/2017 | S | -- | 10.55 | -- | 2.7 | 2.08 | 260.0 | 7.23 | -12.4 | Clear | > 3 Well Volumes |
| MW-309-15 | MW-309-15 | 4/10/2017 | S | -- | 10.50 | -- | 2.1 | 0.09 | 246.6 | 7.11 | 148.4 | Clear | Parameters Stabilized |
| MW-309-66 | MW-309-66 | 2/17/2017 | S | -- | 10.78 | -- | 4.8 | 1.51 | 220.4 | 7.36 | -41.6 | Clear | Parameters Stabilized |
| MW-310-15 | MW-310-15 | 2/25/2017 | S | -- | 10.24 | -- | 4.0 | 1.03 | 340.1 | 6.79 | -54.8 | Clear | Parameters Stabilized |
| MW-321-15 | MW-321-15 | 2/28/2017 | S, BTEX, GRO, DRO | -- | 10.72 | -- | 2.9 | 1.07 | 319.3 | 7.18 | -145.2 | Clear | > 3 Well Volumes |
| MW-330-20 | MW-330-20 | 2/25/2017 | S | -- | 15.02 | -- | 5.1 | 0.97 | 296.5 | 6.88 | -24.9 | Clear | > 3 Well Volumes |
| MW-330-20 | MW-330-20 | 4/10/2017 | S | -- | 14.99 | -- | 4.8 | 0.09 | 281.3 | 6.78 | 148.3 | Clear | Parameters Stabilized |
| MW-334-15 | MW-334-15 | 2/27/2017 | S | -- | 12.97 | 12.83 | Product Well - no parameters collected | | | | | Turbid and petroleum odor | > 1 Well Volume |
| MW-334-15 | MW-334-15 | 4/12/2017 | S | -- | 13.52 | 12.67 | Product Well - no parameters collected | | | | | Clear | > 1 Well Volume |
| MW-334-65 | MW-334-65 | 2/24/2017 | S | -- | 11.43 | -- | 4.0 | 0.18 | 195.2 | 7.25 | -30.8 | Clear | Parameters Stabilized |
| MW-334-65 | MW-334-65 | 4/13/2017 | S | -- | 11.32 | -- | 4.2 | 0.01 | 200.1 | 7.20 | 347.9 | Clear | Parameters Stabilized |
| MW-336-15 | -- | 3/2/2017 | -- | 6.60 | -- | -- | No sample, well was frozen | | | | | | |
| MW-336-15 | -- | 4/13/2017 | -- | 6.58 | -- | -- | No sample, well was frozen | | | | | | |
| MW-336-15 | -- | 5/15/2017 | -- | 6.54 | 3.50 | -- | No sample, well was frozen | | | | | | |
| MW-336-20 | -- | 2/23/2017 | -- | 7.00 | -- | -- | No sample, well was frozen | | | | | | |
| MW-336-20 | -- | 4/11/2017 | -- | 7.02 | -- | -- | No sample, well was frozen | | | | | | |
| MW-336-20 | -- | 5/15/2017 | -- | 7.02 | -- | -- | No sample, well was frozen | | | | | | |

**Table 3-1**
**Groundwater Well Field Parameters**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Well ID | Sample Name | Date | Analysis | Depth to Ice (feet) | Depth to Water (feet) | Depth to LNAPL (feet) | Temperature (°C) | Dissolved Oxygen (mg/L) | Conductivity (µS/cm) | pH | ORP (mV) | Water Clarity | Sample Collection Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MW-336-35 | -- | 2/23/2017 | -- | 6.95 | -- | -- | No sample, well was frozen | | | | | | |
| MW-336-35 | -- | 4/11/2017 | -- | 6.96 | -- | -- | No sample, well was frozen | | | | | | |
| MW-336-35 | -- | 5/15/2017 | -- | 6.96 | -- | -- | No sample, well was frozen | | | | | | |
| MW-336-55 | -- | 2/23/2017 | -- | 6.27 | -- | -- | No sample, well was frozen | | | | | | |
| MW-336-55 | -- | 4/11/2017 | -- | 6.31 | -- | -- | No sample, well was frozen | | | | | | |
| MW-336-55 | -- | 5/15/2017 | -- | 6.31 | -- | -- | No sample, well was frozen | | | | | | |
| MW-337-20 | -- | 2/23/2017 | -- | 6.52 | -- | -- | No sample, well was frozen | | | | | | |
| MW-337-20 | -- | 4/11/2017 | -- | 6.54 | -- | -- | No sample, well was frozen | | | | | | |
| MW-337-20 | -- | 5/15/2017 | -- | 6.54 | -- | -- | No sample, well was frozen | | | | | | |
| MW-344-15 | MW-344-15 | 2/27/2017 | S | -- | 9.55 | -- | 2.5 | 1.20 | 176.2 | 6.90 | 134.0 | Clear | Parameters Stabilized |
| MW-344-15 | MW-344-15 | 4/11/2017 | S | -- | 9.56 | -- | 2.4 | 0.30 | 230.7 | 6.89 | 365.0 | Clear | > 3 Well Volumes |
| MW-344-55 | MW-344-55 | 2/28/2017 | S, DRO, GRO, BTEX | -- | 9.57 | -- | 4.2 | 0.77 | 215.8 | 7.43 | 18.4 | Clear | Parameters Stabilized |
| MW-344-55 | MW-344-55 | 4/11/2017 | S | -- | 9.57 | -- | 5.1 | 0.01 | 215.6 | 7.31 | 361.1 | Clear | Parameters Stabilized |
| MW-344-75 | MW-344-75 | 2/27/2017 | S | -- | 9.00 | -- | 4.7 | 0.70 | 205.6 | 7.44 | 92.2 | Clear | Parameters Stabilized |
| MW-345-15 | MW-345-15 | 2/13/2017 | S | -- | 11.65 | -- | 1.3 | 1.41 | 220.5 | 6.69 | -62.1 | Clear | > 3 Well Volumes |
| MW-345-15 | -- | 4/10/2017 | -- | 11.72 | -- | -- | No sample, well was frozen | | | | | | |
| MW-345-15 | -- | 5/11/2017 | -- | 11.69 | -- | -- | No sample, well was frozen | | | | | | |
| MW-345-55 | MW-345-55 | 2/14/2017 | S | -- | 11.67 | -- | 4.4 | 0.13 | 193.7 | 7.17 | -29.4 | Clear | Parameters Stabilized |
| MW-345-55 | -- | 4/10/2017 | -- | 11.77 | -- | -- | No sample, well was frozen | | | | | | |
| MW-345-55 | -- | 5/11/2017 | -- | 11.74 | -- | -- | No sample, well was frozen | | | | | | |
| MW-345-75 | -- | 2/13/2017 | -- | 11.25 | -- | -- | No sample, well was frozen | | | | | | |
| MW-345-75 | -- | 4/10/2017 | -- | 11.26 | -- | -- | No sample, well was frozen | | | | | | |
| MW-345-75 | -- | 5/11/2017 | -- | 11.27 | -- | -- | No sample, well was frozen | | | | | | |
| MW-348-15 | MW-348-15 | 3/10/2017 | S | -- | 8.30 | -- | Product Well - no parameters collected. | | | | | Not recorded | > 1 Well Volume |
| MW-348-65 | MW-348-65 | 2/27/2017 | S | -- | 8.16 | -- | 4.4 | 0.25 | 209.6 | 7.20 | -15.1 | Clear | Parameters Stabilized |
| MW-348-65 | MW-348-65 | 4/11/2017 | S | -- | 8.20 | -- | 4.6 | 0.67 | 216.7 | 7.42 | -43.2 | Clear | Parameters Stabilized |
| MW-351-15 | MW-351-15 | 1/25/2017 | S | -- | 9.25 | -- | 2.9 | 0.83 | 213.2 | 6.88 | 53.8 | Slightly Turbid | Parameters Stabilized |
| MW-351-15 | MW-351-15 | 4/10/2017 | S | -- | 9.37 | -- | 2.1 | 0.79 | 204.0 | 6.87 | 119.0 | Clear | Parameters Stabilized |
| MW-351-55 | MW-351-55 | 1/25/2017 | S | -- | 9.32 | -- | 5.7 | 0.30 | 226.3 | 7.28 | -15.7 | Clear | Parameters Stabilized |
| MW-351-55 | MW-351-55 | 4/10/2017 | S | -- | 9.44 | -- | 5.5 | 0.17 | 219.2 | 7.40 | -20.3 | Clear | Parameters Stabilized |
| MW-351-75 | MW-351-75 | 1/25/2017 | S | -- | 9.22 | -- | 5.7 | 0.27 | 212.5 | 7.29 | 27.2 | Clear | Parameters Stabilized |
| MW-351-75 | MW-351-75 | 4/11/2017 | S | -- | 9.35 | -- | 5.5 | 0.68 | 220.1 | 7.40 | 13.1 | Clear | Parameters Stabilized |
| MW-351-150 | MW-351-150 | 1/25/2017 | S | -- | 9.52 | -- | 4.7 | 0.36 | 195.8 | 7.31 | 58.9 | Clear | Parameters Stabilized |
| MW-354-15 | MW-354-15 | 2/28/2017 | S | -- | 11.07 | 11.05 | Product Well - no parameters collected | | | | | Clear | > 1 Well Volume |
| MW-354-35 | MW-354-35 | 2/24/2017 | S | -- | 11.56 | -- | 4.0 | 1.12 | 404.0 | 7.43 | -40.4 | Clear | Parameters Stabilized |
| MW-354-65 | MW-354-65 | 2/24/2017 | S | -- | 12.40 | -- | 4.0 | 1.02 | 333.4 | 7.44 | 47.3 | Clear | Parameters Stabilized |
| MW-355-15 | MW-355-15 | 2/27/2017 | S | -- | 12.50 | -- | 4.7 | 1.13 | 238.1 | 7.15 | 165.0 | Clear | Parameters Stabilized |
| MW-355-15 | MW-355-15 | 4/11/2017 | S | -- | 12.48 | -- | 3.7 | 0.11 | 224.4 | 6.89 | 329.1 | Clear | Parameters Stabilized |
| MW-355-55 | MW-355-55 | 2/27/2017 | S | -- | 12.30 | -- | 7.2 | 0.73 | 243.5 | 7.39 | 131.8 | Clear | Parameters Stabilized |
| MW-358-20 | MW-358-20 | 1/26/2017 | S | -- | 11.99 | -- | 4.2 | 0.46 | 237.1 | 6.95 | 12.8 | Clear | Parameters Stabilized |
| MW-358-40 | MW-358-40 | 1/26/2017 | S | -- | 12.02 | -- | 5.5 | 0.29 | 247.7 | 7.08 | 15.5 | Clear | Parameters Stabilized |
| MW-358-60 | MW-358-60 | 1/26/2017 | S | -- | 11.92 | -- | 5.6 | 0.26 | 221.8 | 7.28 | -15.6 | Clear | Parameters Stabilized |
| MW-359-15 | MW-359-15 | 1/26/2017 | S | -- | 11.62 | -- | 2.2 | 0.45 | 230.6 | 6.66 | 16.6 | Clear | Parameters Stabilized |
| MW-359-35 | MW-359-35 | 1/26/2017 | S | -- | 11.41 | -- | 3.9 | 0.30 | 234.9 | 7.25 | -32.3 | Clear | Parameters Stabilized |
| MW-359-60 | MW-359-60 | 1/26/2017 | S | -- | 11.45 | -- | 4.5 | 0.28 | 202.4 | 7.27 | -18.3 | Clear | Parameters Stabilized |
| MW-360-15 | MW-360-15 | 1/26/2017 | S | -- | 11.69 | -- | 2.8 | 0.40 | 262.1 | 6.79 | -89.8 | Clear | Parameters Stabilized |
| MW-360-35 | MW-360-35 | 1/26/2017 | S | -- | 11.50 | -- | 3.6 | 0.34 | 267.6 | 7.05 | -84.5 | Clear | Parameters Stabilized |
| MW-360-50 | MW-360-50 | 1/26/2017 | S | -- | 11.61 | -- | 3.6 | 0.36 | 259.7 | 7.03 | -65.1 | Clear | Parameters Stabilized |
| MW-361-15 | MW-361-15 | 2/23/2017 | S | -- | 10.48 | -- | 1.9 | 0.36 | 333.4 | 6.93 | 63.2 | Slightly turbid | Parameters Stabilized |
| MW-362-80 | MW-362-80 | 2/28/2017 | S | -- | 11.62 | -- | 6.5 | 0.12 | 225.8 | 7.25 | 25.7 | Clear | Parameters Stabilized |

**Table 3-1**
**Groundwater Well Field Parameters**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Well ID | Sample Name | Date | Analysis | Depth to Ice (feet) | Depth to Water (feet) | Depth to LNAPL (feet) | Temperature (°C) | Dissolved Oxygen (mg/L) | Conductivity (µS/cm) | pH | ORP (mV) | Water Clarity | Sample Collection Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MW-364-90 | MW-364-90 | 2/13/2017 | S | -- | 11.64 | -- | 4.1 | 1.17 | 200.9 | 7.34 | 74.0 | Clear | Parameters Stabilized |
| MW-369-16 | MW-369-16 | 2/25/2017 | S | -- | 13.70 | -- | 3.5 | 1.08 | 301.4 | 6.95 | -18.6 | Clear | Parameters Stabilized |
| MW-369-16 | MW-369-16 | 4/11/2017 | S | -- | 13.66 | -- | 3.6 | 0.06 | 279.0 | 6.85 | 319.4 | Clear | Parameters Stabilized |
| MW-369-55 | MW-369-55 | 2/25/2017 | S | -- | 13.94 | -- | 5.2 | 0.72 | 229.9 | 7.44 | -68.8 | Clear | Parameters Stabilized |
| MW-369-55 | MW-369-55 | 4/11/2017 | S | -- | 13.88 | -- | 5.7 | 0.01 | 227.5 | 7.32 | 336.3 | Clear | > 3 Well Volumes |
| MW-369-75 | MW-369-75 | 2/25/2017 | S | -- | 14.30 | -- | 5.7 | 0.77 | 227.9 | 7.43 | -50.0 | Clear | Parameters Stabilized |
| MW-370-15 | MW-370-15 | 2/17/2017 | S | -- | 10.77 | -- | 2.8 | 0.62 | 226.4 | 9.62 JH* | -88.3 | Clear | > 3 Well Volumes |
| MW-370-15 | MW-370-15 | 4/10/2017 | S | -- | 10.75 | -- | 2.2 | 0.01 | 219.8 | 7.20 | 104.8 | Clear | > 3 Well Volumes |
| MW-370-55 | MW-370-55 | 2/17/2017 | S | -- | 10.78 | -- | 5.1 | 0.62 | 224.0 | 11.04 JH* | -103.7 | Clear | > 3 Well Volumes |
| MW-370-55 | MW-370-55 | 4/10/2017 | S | -- | 10.77 | -- | 5.3 | 0.03 | 224.9 | 7.30 | 136.2 | Clear | Parameters Stabilized |
| MW-370-75 | MW-370-75 | 2/17/2017 | S | -- | 10.38 | -- | 5.4 | 0.61 | 208.6 | 11.88 JH* | -125.5 | Clear | > 3 Well Volumes |
| MW-371-15 | MW-371-15 | 2/14/2017 | S | -- | 11.99 | -- | 3.4 | 1.15 | 226.8 | 7.39 | -88.7 | Clear | Parameters Stabilized |
| MW-371-15 | MW-371-15 | 4/10/2017 | S | -- | 12.09 | -- | 2.8 | 1.11 | 212.4 | 7.26 | -70.4 | Clear | > 3 Well Volumes |
| MW-371-55 | MW-371-55 | 2/14/2017 | S | -- | 11.42 | -- | 5.1 | 0.97 | 220.7 | 7.43 | -44.2 | Clear | Parameters Stabilized |
| MW-371-75 | MW-371-75 | 2/14/2017 | S | -- | 11.79 | -- | 4.9 | 0.99 | 219.4 | 7.42 | -49.0 | Clear | Parameters Stabilized |
| MW-371-75 | MW-371-75 | 4/11/2017 | S | -- | 11.88 | -- | 5.1 | 0.66 | 224.1 | 7.42 | -50.5 | Clear | Parameters Stabilized |
| MW-371-125 | MW-371-125 | 2/14/2017 | S | -- | 11.87 | -- | 4.9 | 0.94 | 200.5 | 7.46 | -25.5 | Clear | Parameters Stabilized |
| MW-372-15 | MW-372-15 | 2/16/2017 | S | -- | 15.27 | -- | 5.5 | 0.14 | 452.1 | 6.94 | 51.9 | Clear | Parameters Stabilized |
| MW-372-15 | MW-372-15 | 4/11/2017 | S | -- | 15.28 | -- | 4.5 | 0.27 | 437.3 | 6.70 | 348.8 | Clear | Parameters Stabilized |
| MW-373-15 | MW-373-15 | 2/17/2017 | S | -- | 15.32 | -- | 3.8 | 1.48 | 228.6 | 8.30 | -16.3 | Clear | > 3 Well Volumes |
| MW-373-15 | MW-373-15 | 4/10/2017 | S | -- | 15.28 | -- | 2.7 | 0.76 | 212.7 | 6.90 | 157.2 | Clear | > 3 Well Volumes |
| O-1 | -- | 2/24/2017 | -- | 11.29 | -- | -- | No sample, well was frozen | | | | | | |
| O-1 | -- | 4/11/2017 | -- | 11.32 | -- | -- | No sample, well was frozen | | | | | | |
| O-1 | -- | 5/12/2017 | -- | 11.29 | 8.64 | -- | No sample, well was frozen | | | | | | |
| O-2 | O-2 | 2/24/2017 | S | -- | 13.17 | 12.98 | Product Well - no parameters collected | | | | | Sheen on sample | > 1 Well Volume |
| O-2 | O-2 | 4/12/2017 | S | -- | 12.93 | 12.91 | Product Well - no parameters collected | | | | | Clear | > 1 Well Volume |
| O-3 | O-3 | 2/27/2017 | S | -- | 13.63 | -- | 3.0 | 0.30 | 604.0 | 6.89 | -67.4 | Clear with silt | > 3 Well Volumes |
| O-4 | O-4 | 2/28/2017 | S, BTEX, GRO, DRO | -- | 12.43 | -- | 1.9 | 1.72 | 210.3 | 6.91 | 34.7 | Clear | Parameters Stabilized |
| O-4 | O-4 | 4/10/2017 | S | -- | 12.42 | -- | 2.9 | 1.70 | 217.2 | 6.73 | 1.5 | Clear | Parameters Stabilized |
| O-5 | O-5 | 2/28/2017 | S, BTEX, GRO, DRO | -- | 11.42 | -- | 2.9 | 0.23 | 301.5 | 7.13 | -102.2 | Clear | Parameters Stabilized |
| O-5 | O-5 | 4/10/2017 | S | -- | 11.49 | -- | 2.6 | 0.84 | 300.6 | 7.38 | -124.7 | Clear | Parameters Stabilized |
| O-5-65 | O-5-65 | 2/28/2017 | S | -- | 11.26 | -- | 4.5 | 0.25 | 209.1 | 7.26 | -11.9 | Clear | Parameters Stabilized |
| O-5-65 | O-5-65 | 4/10/2017 | S | -- | 12.00 | -- | 4.9 | 0.70 | 219.8 | 7.46 | -64.8 | Clear | Parameters Stabilized |
| O-6 | O-6 | 2/27/2017 | S | -- | 10.36 | -- | 2.4 | 0.27 | 254.7 | 6.75 | -4.8 | Turbid | Parameters Stabilized |
| O-6 | O-6 | 4/11/2017 | S | -- | 10.45 | -- | 2.7 | 0.84 | 256.1 | 6.92 | -30.6 | Clear | Parameters Stabilized |
| O-12 | O-12 | 2/25/2017 | S, BTEX, GRO, DRO | -- | 12.21 | -- | 4.0 | 0.28 | 246.2 | 7.00 | -113.3 | Clear | Parameters Stabilized |
| O-12 | O-12 | 4/11/2017 | S | -- | 12.14 | -- | 3.3 | 0.12 | 234.1 | 6.94 | -163.7 | Clear | Parameters Stabilized |
| O-12-65 | O-12-65 | 2/25/2017 | S | -- | 12.65 | -- | 4.2 | 0.17 | 201.1 | 7.26 | 9.7 | Clear | Parameters Stabilized |
| O-14 | -- | 2/23/2017 | -- | 8.64 | -- | -- | No sample, well was frozen | | | | | | |
| O-14 | -- | 5/15/2017 | -- | 8.82 | 4.30 | -- | No sample, well was frozen | | | | | | |
| O-19 | O-19 | 2/22/2017 | S | -- | 12.00 | Sheen | Product Well - no parameters collected | | | | | Clear | > 1 Well Volume |
| O-19 | O-19 | 4/12/2017 | S | -- | 11.94 | -- | Product Well - no parameters collected | | | | | Clear | > 1 Well Volume |
| O-19-55 | O-19-55 | 2/22/2017 | S | -- | 11.90 | -- | 4.0 | 0.35 | 203.0 | 7.26 | 45.3 | Clear | Parameters Stabilized |
| O-19-55 | O-19-55 | 4/11/2017 | S | -- | 11.97 | -- | 4.2 | 0.07 | 203.9 | 7.22 | -30.2 | Clear | Parameters Stabilized |
| O-19-90 | O-19-90 | 2/22/2017 | S | -- | 11.49 | -- | 4.2 | 0.15 | 203.0 | 7.33 | 58.5 | Clear | Parameters Stabilized |
| O-19-90 | O-19-90 | 4/13/2017 | S | -- | 11.27 | -- | 4.3 | 0.03 | 201.7 | 7.16 | 340.1 | Clear | Parameters Stabilized |
| O-20 | -- | 2/24/2017 | -- | 11.44 | -- | -- | No sample, well was frozen | | | | | | |
| O-20 | -- | 4/11/2017 | -- | 11.49 | -- | -- | No sample, well was frozen | | | | | | |
| O-20 | -- | 5/12/2017 | -- | 11.43 | 6.70 | -- | No sample, well was frozen | | | | | | |
| O-24 | O-24 | 2/25/2017 | S, BTEX, GRO, DRO | -- | 12.81 | -- | 3.7 | 0.21 | 285.0 | 6.75 | -88.1 | Clear | Parameters Stabilized |

**Table 3-1**
**Groundwater Well Field Parameters**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Well ID | Sample Name | Date | Analysis | Depth to Ice (feet) | Depth to Water (feet) | Depth to LNAPL (feet) | Temperature (°C) | Dissolved Oxygen (mg/L) | Conductivity (µS/cm) | pH | ORP (mV) | Water Clarity | Sample Collection Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| O-24-65 | O-24-65 | 2/25/2017 | S | -- | 12.95 | -- | 4.2 | 0.21 | 202.1 | 7.25 | 48.0 | Clear | Parameters Stabilized |
| O-26 | O-26 | 2/24/2017 | S | -- | 12.89 | -- | 3.8 | 0.16 | 312.9 | 7.13 | -94.9 | Clear | Parameters Stabilized |
| O-26 | O-26 | 4/11/2017 | S | -- | 12.89 | -- | 3.0 | 0.19 | 283.0 | 7.07 | -94.2 | Clear | Parameters Stabilized |
| O-26-65 | O-26-65 | 2/24/2017 | S | -- | 12.51 | -- | 4.4 | 0.13 | 199.2 | 7.24 | -13.7 | Clear | Parameters Stabilized |
| O-27 | O-27 | 2/17/2017 | S | -- | 13.32 | 12.71 | Product Well - no parameters collected | | | | | Clear w/ sheen | > 1 Well Volume |
| O-27 | O-27 | 4/12/2017 | S | -- | 12.81 | 12.77 | Product Well - no parameters collected | | | | | Clear | > 1 Well Volume |
| O-27-65 | O-27-65 | 2/16/2017 | S | -- | 13.26 | -- | 4.5 | 0.07 | 202.6 | 7.34 | 137.7 | Clear | Parameters Stabilized |
| O-27-65 | O-27-65 | 4/10/2017 | S | -- | 13.28 | -- | 4.9 | 0.71 | 221.7 | 7.46 | -65.5 | Clear | Parameters Stabilized |
| O-31 | O-31 | 2/24/2017 | S | -- | 12.25 | 11.84 | Product Well - no parameters collected | | | | | Clear w/ sheen | > 1 Well Volume |
| O-32 | O-32 | 2/23/2017 | S | -- | 12.35 | -- | Product Well - no parameters collected | | | | | Translucent amber color | > 1 Well Volume |
| O-33 | O-33 | 2/23/2017 | S | -- | 12.21 | 11.84 | Product Well - no parameters collected | | | | | Sheen observed in purge water | > 1 Well Volume |
| O-34 | O-34 | 3/10/2017 | S | -- | 11.17 | 11.16 | Product Well - no parameters collected | | | | | Clear w/ sheen | > 1 Well Volume |
| R-32R | R-32R | 2/23/2017 | S | -- | 12.22 | 11.32 | Product Well - no parameters collected | | | | | Clear, some sand in sample | > 1 Well Volume |
| S-21 | S-21 | 2/28/2017 | S | -- | 12.53 | 12.35 | Product Well - no parameters collected | | | | | Clear, heavy sheen in purge water | > 1 Well Volume |
| S-39 | -- | 2/23/2017 | -- | -- | 11.34 | 10.46 | No sample, well was purged dry | | | | | | |
| S-39 | S-39 | 4/13/2017 | S | -- | 10.72 | 10.46 | Product Well - no parameters collected. | | | | | Not recorded | > 1 Well Volume |
| S-41R | S-41R | 2/23/2017 | S | -- | 11.03 | -- | 2.7 | 0.21 | 457.1 | 6.92 | -135.3 | Clear | > 3 Well Volumes |
| S-43 | S-43 | 2/27/2017 | S, BTEX, GRO, DRO | -- | 11.58 | -- | Product Well - no parameters collected | | | | | Clear w/ sheen | > 1 Well Volume |
| S-43 | S-43 | 4/12/2017 | S | -- | 11.57 | -- | Product Well - no parameters collected | | | | | Clear | > 1 Well Volume |
| S-44 | -- | 2/24/2017 | -- | -- | 10.74 | 10.52 | No sample, product present - only analytes requested are BTEX, GRO, DRO | | | | | | |
| S-50 | S-50 | 2/27/2017 | S | -- | 12.17 | 12.00 | Product Well - no parameters collected | | | | | Clear w/ sheen | > 1 Well Volume |
| S-51 | S-51 | 2/27/2017 | S, BTEX, GRO, DRO | -- | 11.42 | 11.39 | Product Well - no parameters collected | | | | | Clear, petroleum odor | > 1 Well Volume |
| S-51 | S-51 | 4/12/2017 | S | -- | 11.26 | -- | Product Well - no parameters collected | | | | | Clear | > 1 Well Volume |

**General Notes:**
First Quarter 2017 represents January 1, 2017 through March 31, 2017.
Second Quarter 2017 represents April 1, 2017 through June 16, 2017.
MW-148 nest is located offsite near the property boundary, but is being monitored and reported as part of the onsite groundwater monitoring program.
**Acronyms and Abbreviations:**
-- = not applicable
> = greater than
BTEX = benzene, toluene, ethylbenzene, xylenes
°C = degrees Celsius
CMT = continuous multichannel tubing
DRO = diesel range organics
GRO = gasoline range organics
JH* = Estimated concentration, biased high, due to QC failures. Flag applied by Shannon & Wilson, Inc.
LNAPL = light-nonaqueous-phase liquid
mg/L = milligrams per liter
mV = millivolts
MW = monitoring well
ORP = oxidation-reduction potential
PAH = Polycyclic Aromatic Hydrocarbons
S = sulfolane
µS/cm = microsiemens per centimeter

**Table 3-2**
**Groundwater Elevation, Surface Water Elevation, and Depth to LNAPL Monitoring Results**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Well ID | Zone | Date | Riser Elevation (MSL feet) | Depth to LNAPL (feet) | Depth to Water (feet) | Corrected Water Table Elevation (MSL feet) | Notes |
|---|---|---|---|---|---|---|---|
| MW-101-60 | 10-55 | 3/15/2017 | 494.27 | - | 10.55 | 483.72 | |
| MW-102-70 | 55-90 | 3/14/2017 | 496.15 | - | 12.51 | 483.64 | |
| MW-104-65 | 10-55 | 3/14/2017 | 496.04 | - | 12.24 | 483.80 | |
| MW-105A-25 | 10-55 | 3/15/2017 | 499.19 | - | 11.90 | 487.29 | |
| MW-105-65 | 10-55 | 3/15/2017 | 497.63 | - | 10.28 | 487.35 | |
| MW-106-25 | 10-55 | 3/14/2017 | 499.58 | - | 14.44 | 485.14 | |
| MW-109-15 | Water Table | 3/14/2017 | 495.16 | - | 9.34 | 485.82 | |
| MW-110-20 | Water Table | 3/14/2017 | 496.58 | - | 11.16 | 485.42 | |
| MW-110-65 | 10-55 | 3/14/2017 | 496.53 | - | 11.25 | 485.28 | |
| MW-113-15 | Water Table | 3/14/2017 | 494.24 | - | 10.01 | 484.23 | |
| MW-125-25 | 10-55 | 3/14/2017 | 496.21 | - | 11.80 | 484.41 | |
| MW-129-40 | 10-55 | 3/14/2017 | 496.07 | - | 11.62 | 484.45 | |
| MW-130-25 | 10-55 | 3/14/2017 | 496.98 | - | 12.37 | 484.61 | |
| MW-133-20 | Water Table | 3/15/2017 | 498.38 | - | 13.08 | 485.30 | |
| MW-135-20 | Water Table | 3/14/2017 | 496.92 | Sheen | 12.46 | 484.46 | |
| MW-140-25 | 10-55 | 3/14/2017 | 494.88 | - | 10.94 | 483.94 | |
| MW-141-20 | Water Table | 3/14/2017 | 492.72 | - | 9.17 | 483.55 | |
| MW-144A-25 | 10-55 | 3/14/2017 | 495.31 | - | 11.10 | 484.21 | |
| MW-144BR-90 | 55-90 | 3/14/2017 | 495.02 | - | 10.81 | 484.21 | |
| MW-145-20 | Water Table | 3/14/2017 | 495.64 | - | 11.18 | 484.46 | |
| MW-146A-15 | Water Table | 3/14/2017 | 495.19 | - | 11.41 | 483.78 | |
| MW-148A-15 | Water Table | 3/14/2017 | 493.33 | - | 10.41 | 482.92 | |
| MW-148C-55 | 10-55 | 3/14/2017 | 493.38 | - | 11.16 | 482.22 | |
| MW-148-80 | 55-90 | 3/14/2017 | 493.49 | - | 10.48 | 483.01 | |
| MW-148-100 | 55-90 | 3/14/2017 | 493.21 | - | 10.29 | 482.92 | |
| MW-148D-150 | 90-160 | 3/14/2017 | 493.00 | - | 10.09 | 482.91 | |
| MW-149A-15 | Water Table | 3/14/2017 | 493.67 | - | 10.81 | 482.86 | |
| MW-154A-75 | 55-90 | 3/14/2017 | 498.10 | - | 14.03 | 484.07 | |
| MW-173A-15 | Water Table | 3/14/2017 | 496.20 | - | 12.08 | 484.12 | |
| MW-173B-150 | 90-160 | 3/14/2017 | 496.41 | - | 12.14 | 484.27 | |
| MW-174-15 | Water Table | 3/14/2017 | 494.52 | - | 9.73 | 484.79 | |
| MW-174A-50 | 10-55 | 3/14/2017 | 494.57 | - | 9.75 | 484.82 | |
| MW-174B-90 | 55-90 | 3/14/2017 | 493.52 | - | 8.75 | 484.77 | |

**Table 3-2**
**Groundwater Elevation, Surface Water Elevation, and Depth to LNAPL Monitoring Results**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Well ID | Zone | Date | Riser Elevation (MSL feet) | Depth to LNAPL (feet) | Depth to Water (feet) | Corrected Water Table Elevation (MSL feet) | Notes |
|---|---|---|---|---|---|---|---|
| MW-175-90 | 55-90 | 3/14/2017 | 497.04 | - | 12.27 | 484.77 | |
| MW-176A-15 | Water Table | 3/15/2017 | 497.17 | 11.40 | Frozen | — | Depth to ice = 12.10 feet |
| MW-176B-50 | 10-55 | 3/15/2017 | 497.00 | - | Frozen | — | Depth to ice = 11.35 feet |
| MW-176C-90 | 55-90 | 3/15/2017 | 496.86 | - | Frozen | — | Depth to ice = 11.20 feet |
| MW-180B-50 | 10-55 | 3/14/2017 | 496.88 | - | 10.83 | 486.05 | |
| MW-180C-90 | 55-90 | 3/14/2017 | 497.07 | - | 11.04 | 486.03 | |
| MW-186A-15 | Water Table | 3/14/2017 | 495.94 | 11.72 | 12.06 | 484.16 | |
| MW-186B-60 | 10-55 | 3/14/2017 | 495.97 | - | 11.90 | 484.07 | |
| MW-186E-75 | 55-90 | 3/14/2017 | 495.85 | - | 11.47 | 484.38 | |
| MW-186D-135 | 90-160 | 3/14/2017 | 495.82 | - | 11.30 | 484.52 | |
| MW-192A-15 | Water Table | 3/14/2017 | 496.25 | - | 9.72 | 486.53 | |
| MW-192B-55 | 10-55 | 3/14/2017 | 495.66 | - | 9.00 | 486.66 | |
| MW-195A-15 | Water Table | 3/14/2017 | 496.49 | - | 10.97 | 485.52 | |
| MW-195B-150 | 90-160 | 3/14/2017 | 496.14 | - | 10.89 | 485.25 | |
| MW-197A-65 | 10-55 | 3/14/2017 | 495.37 | - | 10.81 | 484.56 | |
| MW-198-150 | 90-160 | 3/15/2017 | 493.33 | - | 7.59 | 485.74 | |
| MW-199-150 | 90-160 | 3/14/2017 | 495.91 | - | 11.48 | 484.43 | |
| MW-300-150 | 90-160 | 3/14/2017 | 496.02 | - | 10.21 | 485.81 | |
| MW-301-CMT-10 | Water Table | 3/15/2017 | 492.79 | - | 9.30 | 483.49 | |
| MW-301-60 | 10-55 | 3/15/2017 | 492.75 | - | 9.08 | 483.67 | |
| MW-301-70 | 55-90 | 3/15/2017 | 492.49 | - | 8.79 | 483.70 | |
| MW-302-CMT-10 | Water Table | 3/15/2017 | 494.16 | - | 10.60 | 483.56 | |
| MW-302-CMT-50 | 10-55 | 3/15/2017 | 494.16 | - | 10.60 | 483.56 | |
| MW-302-80 | 55-90 | 3/15/2017 | 493.46 | - | 9.78 | 483.68 | |
| MW-302-110 | 90-160 | 3/15/2017 | 493.65 | - | 9.98 | 483.67 | |
| MW-303-CMT-9 | Water Table | 3/15/2017 | 495.67 | - | 12.28 | 483.39 | |
| MW-303-CMT-59 | 10-55 | 3/15/2017 | 495.67 | - | 12.29 | 483.38 | |
| MW-303-80 | 55-90 | 3/15/2017 | 491.83 | - | 8.19 | 483.64 | |
| MW-303-130 | 90-160 | 3/15/2017 | 495.12 | - | 11.37 | 483.75 | |
| MW-304-CMT-10 | Water Table | 3/14/2017 | 497.56 | - | Dry | — | Well was dry. Depth to bottom not recorded. |
| MW-304-CMT-60 | 10-55 | 3/14/2017 | 497.56 | - | 13.80 | 483.76 | |
| MW-304-80 | 55-90 | 3/14/2017 | 496.74 | - | 12.90 | 483.84 | |
| MW-304-125 | 90-160 | 3/14/2017 | 497.29 | - | 13.47 | 483.82 | |

**Table 3-2**
**Groundwater Elevation, Surface Water Elevation, and Depth to LNAPL Monitoring Results**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Well ID | Zone | Date | Riser Elevation (MSL feet) | Depth to LNAPL (feet) | Depth to Water (feet) | Corrected Water Table Elevation (MSL feet) | Notes |
|---|---|---|---|---|---|---|---|
| MW-305-CMT-18 | Water Table | 3/14/2017 | 496.34 | - | 12.80 | 483.54 | |
| MW-305-CMT-58 | 10-55 | 3/14/2017 | 496.34 | - | 12.70 | 483.64 | |
| MW-305-80 | 55-90 | 3/14/2017 | 495.37 | - | 11.70 | 483.67 | |
| MW-305-100 | 55-90 | 3/14/2017 | 495.72 | - | 12.04 | 483.68 | |
| MW-306-CMT-10 | Water Table | 3/14/2017 | 496.87 | - | 13.35 | 483.52 | |
| MW-306-CMT-60 | 10-55 | 3/14/2017 | 496.87 | - | 13.30 | 483.57 | |
| MW-306-80 | 55-90 | 3/14/2017 | 496.52 | - | 12.93 | 483.59 | |
| MW-306-150 | 90-160 | 3/14/2017 | 496.03 | - | 12.47 | 483.56 | |
| MW-307-150 | 90-160 | 3/14/2017 | 495.44 | - | 10.71 | 484.73 | |
| MW-309-15 | Water Table | 3/14/2017 | 494.78 | - | 10.57 | 484.21 | |
| MW-309-66 | 10-55 | 3/14/2017 | 495.06 | - | 10.80 | 484.26 | |
| MW-310-15 | Water Table | 3/14/2017 | 494.38 | - | 10.28 | 484.10 | |
| MW-310-65 | 10-55 | 3/14/2017 | 494.00 | - | 9.99 | 484.01 | |
| MW-310-110 | 90-160 | 3/14/2017 | 494.27 | - | 9.97 | 484.30 | |
| MW-321-15 | Water Table | 3/14/2017 | 495.87 | - | 10.78 | 485.09 | |
| MW-330-20 | Water Table | 3/14/2017 | 500.08 | - | 15.03 | 485.05 | |
| MW-330-65 | 10-55 | 3/14/2017 | 499.87 | - | 14.84 | 485.03 | |
| MW-334-15 | Water Table | 3/14/2017 | 496.95 | 12.84 | 13.10 | 484.06 | |
| MW-334-85 | 55-90 | 3/14/2017 | 496.10 | - | 11.66 | 484.44 | |
| MW-336-20 | Water Table | 3/14/2017 | 493.33 | — | — | — | Well was inaccessible due to demolition debris. Well was frozen on 2-23-17. |
| MW-336-55 | 10-55 | 3/14/2017 | 493.31 | — | — | — | Well was inaccessible due to demolition debris. Well was frozen on 2-23-17. |
| MW-355-15 | Water Table | 3/14/2017 | 497.67 | - | 12.54 | 485.13 | |
| MW-355-55 | 10-55 | 3/14/2017 | 497.50 | - | 12.35 | 485.15 | |
| MW-358-20 | Water Table | 3/15/2017 | 495.47 | - | 12.11 | 483.36 | |
| MW-358-40 | 10-55 | 3/15/2017 | 495.56 | - | 12.19 | 483.37 | |
| MW-358-60 | 10-55 | 3/15/2017 | 495.43 | - | 12.08 | 483.35 | |
| MW-358-150 | 90-160 | 3/15/2017 | 495.49 | - | 11.97 | 483.52 | |
| MW-359-15 | Water Table | 3/15/2017 | 495.13 | - | 11.78 | 483.35 | |
| MW-359-60 | 10-55 | 3/15/2017 | 495.01 | - | 11.60 | 483.41 | |
| MW-359-80 | 55-90 | 3/15/2017 | 495.25 | - | 11.66 | 483.59 | |
| MW-360-15 | Water Table | 3/15/2017 | 494.98 | - | 11.83 | 483.15 | |

**Table 3-2**
**Groundwater Elevation, Surface Water Elevation, and Depth to LNAPL Monitoring Results**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Well ID | Zone | Date | Riser Elevation (MSL feet) | Depth to LNAPL (feet) | Depth to Water (feet) | Corrected Water Table Elevation (MSL feet) | Notes |
|---|---|---|---|---|---|---|---|
| MW-360-50 | 10-55 | 3/15/2017 | 494.89 | - | 11.80 | 483.09 | |
| MW-360-80 | 55-90 | 3/15/2017 | 494.81 | - | 11.62 | 483.19 | |
| MW-360-150 | 90-160 | 3/15/2017 | 494.68 | - | 11.38 | 483.30 | |
| MW-361-15 | Water Table | 3/15/2017 | 496.95 | - | Frozen | — | Depth to ice = 10.52 feet |
| MW-362-15 | Water Table | 3/15/2017 | 495.33 | - | 11.88 | 483.45 | |
| MW-362-50 | 10-55 | 3/15/2017 | 495.08 | - | 11.53 | 483.55 | |
| MW-362-80 | 55-90 | 3/15/2017 | 495.09 | - | 11.59 | 483.50 | |
| MW-362-150 | 90-160 | 3/15/2017 | 495.37 | - | 11.92 | 483.45 | |
| MW-363-15 | Water Table | 3/14/2017 | 494.73 | - | 11.88 | 482.85 | |
| MW-364-15 | Water Table | 3/14/2017 | 493.91 | - | 11.07 | 482.84 | |
| MW-364-65 | 10-55 | 3/14/2017 | 494.06 | - | 10.95 | 483.11 | |
| MW-364-90 | 55-90 | 3/14/2017 | 494.71 | - | 11.72 | 482.99 | |
| MW-364-150 | 90-160 | 3/14/2017 | 494.35 | - | 11.24 | 483.11 | |
| MW-365-15 | Water Table | 3/15/2017 | 494.11 | - | 8.01 | 486.10 | |
| MW-372-15 | Water Table | 3/14/2017 | 500.37 | - | 15.35 | 485.02 | |
| MW-373-15 | Water Table | 3/14/2017 | 500.70 | - | 15.35 | 485.35 | |
| North Gravel Pit | Surface Water | 3/14/2017 | 492.78 | - | 9.78 | 483.00 | |
| O-14 | Water Table | 3/14/2017 | 494.93 | — | — | — | Unable to locate well. Well was frozen on 2-23-17. |
| South Gravel Pit** | Surface Water | 3/14/2017 | 481.62 | - | -10.28 | 491.9 | Depth of water observed on 12 foot staff gauge. |

**General Notes:**

** The South Gravel Pit measurement is the depth of water as read from a 12 foot staff gauge in the pond. The 12 foot mark on the gauge is at an elevation of 493.62 MSL feet, as surveyed on October 10, 2016.

MW-148 nest is located offsite near the property boundary, but is being monitored and reported as part of the onsite groundwater monitoring program.

**Acronyms and Abbreviations:**

- = a water sounder was used. The well was not checked with an interface probe for the presence of LNAPL.

— = not measured or incalculable

LNAPL = Light Non-Aqueous Phase Liquid

MSL = mean sea level

Sheen = an interface prove was used. A measurable thickness of LNAPL was not present but LNAPL was observed visually

**Table 3-3**
**LNAPL Migration Monitoring**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Well ID | Date | Event | Month | Top of Riser Elevation (MSL feet) | Depth to LNAPL (feet) | Depth to Water (feet) | LNAPL Thickness (feet) | Water Table Elevation (feet MSL) | Notes |
|---|---|---|---|---|---|---|---|---|---|
| MW-139-25 | 3/1/2017 | Annual | March | 497.29 | No LNAPL | 13.26 | 0.00 | 484.03 | |
| MW-142-20 | 3/1/2017 | Annual | March | 495.84 | No LNAPL | 12.00 | 0.00 | 483.84 | |
| MW-178A-15 | 3/1/2017 | Annual | March | 496.50 | No LNAPL | Frozen | 0.00 | — | Ice at 10.75 feet btoc |
| MW-180A-15 | 3/1/2017 | Annual | March | 497.42 | No LNAPL | 11.39 | 0.00 | 486.03 | |
| O-3 | 3/1/2017 | Annual | March | 498.07 | No LNAPL | 13.70 | 0.00 | 484.37 | |
| O-3 | 6/6/2017 | Quarterly | June | 498.07 | No LNAPL | 13.65 | 0.00 | 484.42 | |
| O-4 | 3/1/2017 | Annual | March | 496.56 | No LNAPL | 12.45 | 0.00 | 484.11 | |
| O-4 | 6/6/2017 | Quarterly | June | 496.57 | No LNAPL | 12.47 | 0.00 | 484.10 | |
| O-5 | 3/1/2017 | Annual | March | 495.75 | No LNAPL | 11.50 | 0.00 | 484.25 | |
| O-8 | 3/1/2017 | Annual | March | 496.76 | No LNAPL | 11.03 | 0.00 | 485.73 | |
| O-12 | 3/1/2017 | Annual | March | 496.35 | No LNAPL | 12.20 | 0.00 | 484.15 | |
| O-12 | 6/6/2017 | Quarterly | June | 496.39 | No LNAPL | 12.21 | 0.00 | 484.18 | |
| O-16 | 3/2/2017 | Annual | March | 493.24 | No LNAPL | 7.50 | 0.00 | 485.74 | |
| O-17 | 3/2/2017 | Annual | March | 493.44 | No LNAPL | 8.46 | 0.00 | 484.98 | |
| O-18 | 3/2/2017 | Annual | March | 492.88 | No LNAPL | 7.68 | 0.00 | 485.20 | |
| O-20 | 3/1/2017 | Annual | March | 497.43 | No LNAPL | Frozen | 0.00 | — | Ice at 11.59 feet btoc |
| O-23 | 3/1/2017 | Annual | March | 495.86 | No LNAPL | 11.24 | 0.00 | 484.62 | |
| O-24 | 3/1/2017 | Annual | March | 497.11 | No LNAPL | 12.87 | 0.00 | 484.24 | |
| O-24 | 6/6/2017 | Quarterly | June | 497.09 | No LNAPL | 12.81 | 0.00 | 484.28 | |
| O-25 | 3/1/2017 | Annual | March | 497.81 | No LNAPL | 13.74 | 0.00 | 484.07 | |
| O-25 | 6/6/2017 | Quarterly | June | 497.81 | No LNAPL | 13.68 | 0.00 | 484.13 | |
| O-26 | 3/1/2017 | Annual | March | 496.94 | No LNAPL | 12.94 | 0.00 | 484.00 | |
| O-26 | 6/6/2017 | Quarterly | June | 496.94 | No LNAPL | 12.89 | 0.00 | 484.05 | |
| O-29 | 3/1/2017 | Annual | March | 498.65 | No LNAPL | 13.38 | 0.00 | 485.27 | |
| O-30 | 3/1/2017 | Annual | March | 498.01 | No LNAPL | 12.33 | 0.00 | 485.68 | |
| R-42 | 1/24/2017 | Monthly | January | 493.28 | No LNAPL | 9.77 | 0.00 | 483.51 | |
| R-42 | 2/8/2017 | Monthly | February | 493.28 | No LNAPL | 9.85 | 0.00 | 483.50 | |
| R-42 | 3/1/2017 | Annual | March | 493.28 | No LNAPL | 9.90 | 0.00 | 483.38 | |
| R-42 | 4/18/2017 | Monthly | April | 493.28 | No LNAPL | 9.76 | 0.00 | 483.52 | |
| R-42 | 5/25/2017 | Monthly | May | 493.28 | No LNAPL | 9.64 | 0.00 | 483.64 | |
| R-42 | 6/6/2017 | Quarterly | June | 493.28 | No LNAPL | 10.04 | 0.00 | 483.24 | |
| R-43 | 1/24/2017 | Monthly | January | 495.44 | No LNAPL | 28.97 | 0.00 | 466.47 | |
| R-43 | 2/8/2017 | Monthly | February | 495.44 | No LNAPL | 29.75 | 0.00 | 465.76 | |
| R-43 | 3/1/2017 | Annual | March | 495.44 | No LNAPL | 28.97 | 0.00 | 466.47 | |

**Table 3-3**
**LNAPL Migration Monitoring**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Well ID | Date | Event | Month | Top of Riser Elevation (MSL feet) | Depth to LNAPL (feet) | Depth to Water (feet) | LNAPL Thickness (feet) | Water Table Elevation (feet MSL) | Notes |
|---|---|---|---|---|---|---|---|---|---|
| R-43 | 4/18/2017 | Monthly | April | 495.44 | No LNAPL | 29.10 | 0.00 | 466.34 | |
| R-43 | 5/25/2017 | Monthly | May | 495.44 | No LNAPL | 28.91 | 0.00 | 466.53 | Heavy biofoul/oxidation observed on probe |
| R-43 | 6/6/2017 | Quarterly | June | 495.44 | No LNAPL | 29.12 | 0.00 | 466.32 | |
| R-46 | 1/24/2017 | Monthly | January | 496.05 | No LNAPL | 24.62 | 0.00 | 471.43 | |
| R-46 | 2/8/2017 | Monthly | February | 496.05 | No LNAPL | 24.64 | 0.00 | 471.48 | |
| R-46 | 3/2/2017 | Annual | March | 496.05 | No LNAPL | 23.01 | 0.00 | 473.04 | |
| R-46 | 4/18/2017 | Monthly | April | 496.05 | No LNAPL | 24.98 | 0.00 | 471.07 | |
| R-46 | 5/25/2017 | Monthly | May | 496.05 | No LNAPL | 25.04 | 0.00 | 471.01 | Light biofoul/oxidation observed on probe |
| R-46 | 6/6/2017 | Quarterly | June | 496.05 | No LNAPL | 25.11 | 0.00 | 470.94 | |

**General Notes:**
Only monitoring wells scheduled for sampling per Table 3-2 of the Long Term Monitoring Plan - 2016 Update are shown here (Arcadis. 2016. Long-Term Monitoring Plan – 2016 Update. December). A comprehensive LNAPL gauging table is included in Appendix F.

**Acronyms and Abbreviations:**
— = not measured or incalculable
btoc = below top of casing
LNAPL = Light Non-Aqueous Phase Liquid
MSL = mean sea level
No LNAPL = an interface probe was used to measure depth to water, LNAPL was not observed

**Table 3-4**
**LNAPL Thickness Monitoring**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Well ID | Date | Event | Month | Top of Riser Elevation (MSL feet) | Depth to LNAPL (feet) | Depth to Water (feet) | LNAPL Thickness (feet) | Water Table Elevation (feet MSL) | Notes |
|---|---|---|---|---|---|---|---|---|---|
| MW-115-15 | 3/1/2017 | Annual | March | 495.85 | 9.62 | Frozen | 0.01 | — | Ice at 9.63 feet btoc |
| MW-135-20 | 3/1/2017 | Annual | March | 496.92 | No LNAPL | 12.44 | 0.00 | 484.48 | |
| MW-136-20 | 3/1/2017 | Annual | March | 496.88 | Sheen | 12.36 | Sheen | 484.52 | |
| MW-138-20 | 3/1/2017 | Annual | March | 496.34 | Sheen | Frozen | Sheen | — | Ice at 9.99 feet btoc |
| MW-138-20 | 6/6/2017 | Quarterly | June | 496.34 | Sheen | Frozen | Sheen | — | DTW = 8.30 feet btoc.<br>Depth to ice not recorded. |
| MW-176A-15 | 3/2/2017 | Annual | March | 497.17 | 11.29 | 13.26 | 1.97 | 485.51 | |
| MW-176A-15 | 6/6/2017 | Quarterly | June | 497.17 | 11.37 | Frozen | 0.91 | — | Ice at 12.28 feet btoc |
| MW-186A-15 | 3/1/2017 | Annual | March | 495.94 | 11.71 | 11.97 | 0.26 | 484.18 | |
| MW-334-15 | 1/24/2017 | Monthly | January | 496.95 | Sheen | 12.76 | Sheen | 484.19 | |
| MW-334-15 | 2/8/2017 | Monthly | February | 496.95 | Sheen | 12.81 | Sheen | 484.21 | |
| MW-334-15 | 3/1/2017 | Annual | March | 496.95 | 12.94 | 12.99 | 0.05 | 484.00 | |
| MW-334-15 | 4/18/2017 | Monthly | April | 496.95 | 12.55 | 13.43 | 0.88 | 484.22 | |
| MW-334-15 | 5/25/2017 | Monthly | May | 496.95 | Sheen | 12.50 | Sheen | 484.45 | Skimmer pump removed for measurement and replaced. |
| MW-334-15 | 6/6/2017 | Quarterly | June | 497.01 | 12.79 | 13.23 | 0.44 | 484.13 | |
| MW-336-15 | 3/2/2017 | Annual | March | 492.91 | No LNAPL | Frozen | 0.00 | — | Ice at 6.60 feet btoc |
| MW-348-15 | 3/1/2017 | Annual | March | 493.85 | No LNAPL | 8.25 | 0.00 | 485.60 | |
| MW-354-15 | 3/1/2017 | Annual | March | 496.35 | 11.03 | 11.04 | 0.01 | 485.32 | |
| MW-366-15 | 3/2/2017 | Annual | March | 493.55 | 7.39 | 7.43 | 0.04 | 486.15 | |
| MW-366-15 | 6/6/2017 | Quarterly | June | 493.55 | 7.48 | 7.68 | 0.20 | 486.03 | |
| O-2 | 3/1/2017 | Annual | March | 497.15 | 12.95 | 13.12 | 0.17 | 484.17 | |
| O-2 | 6/6/2017 | Quarterly | June | 497.15 | 12.95 | 13.21 | 0.26 | 484.15 | |
| O-9 | 3/1/2017 | Annual | March | 497.36 | 12.06 | 12.08 | 0.02 | 485.30 | |
| O-10 | 3/1/2017 | Annual | March | 496.70 | 11.48 | 11.51 | 0.03 | 485.21 | |
| O-10 | 6/6/2017 | Quarterly | June | 496.70 | 11.40 | 11.44 | 0.04 | 485.29 | |
| O-11 | 3/1/2017 | Annual | March | 497.91 | 13.76 | 13.79 | 0.03 | 484.14 | |
| O-11 | 6/6/2017 | Quarterly | June | 497.92 | 13.76 | 13.81 | 0.05 | 484.15 | |
| O-13 | 3/1/2017 | Annual | March | 495.40 | 11.17 | 11.27 | 0.10 | 484.21 | |
| O-13 | 6/6/2017 | Quarterly | June | 495.41 | 11.16 | 11.17 | 0.01 | 484.25 | |
| O-19 | 3/1/2017 | Annual | March | 496.60 | Sheen | 11.98 | Sheen | 484.62 | |
| O-19 | 6/6/2017 | Quarterly | June | 496.63 | No LNAPL | 12.00 | 0.00 | 484.63 | |
| O-21 | 3/1/2017 | Annual | March | 493.13 | 6.81 | Frozen | 0.86 | — | Ice at 7.67 feet btoc |

**Table 3-4**
**LNAPL Thickness Monitoring**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Well ID | Date | Event | Month | Top of Riser Elevation (MSL feet) | Depth to LNAPL (feet) | Depth to Water (feet) | LNAPL Thickness (feet) | Water Table Elevation (feet MSL) | Notes |
|---|---|---|---|---|---|---|---|---|---|
| O-21 | 6/6/2017 | Quarterly | June | 493.13 | Sheen | Frozen | Sheen | — | DTW = 6.90 feet btoc.<br>Ice at 7.07 feet btoc. |
| O-27 | 3/1/2017 | Annual | March | 496.94 | 12.73 | 13.31 | 0.58 | 484.11 | |
| O-27 | 6/6/2017 | Quarterly | June | 496.94 | 12.80 | 13.04 | 0.24 | 484.10 | |
| O-31 | 3/1/2017 | Annual | March | 496.14 | 11.82 | 12.21 | 0.39 | 484.24 | |
| O-31 | 6/6/2017 | Quarterly | June | 496.14 | 11.82 | 12.21 | 0.39 | 484.24 | |
| O-32 | 3/1/2017 | Annual | March | 496.50 | No LNAPL | 12.33 | 0.00 | 484.17 | |
| O-33 | 3/1/2017 | Annual | March | 496.62 | 11.85 | 12.20 | 0.35 | 484.70 | |
| O-33 | 6/6/2017 | Quarterly | June | 496.62 | 11.90 | 12.08 | 0.18 | 484.68 | |
| O-34 | 3/2/2017 | Annual | March | 496.43 | 11.14 | 11.15 | 0.01 | 485.29 | |
| O-34 | 6/6/2017 | Quarterly | June | 496.43 | 11.15 | 11.16 | 0.01 | 485.28 | |
| O-35 | 3/1/2017 | Annual | March | 497.16 | 11.48 | 11.50 | 0.02 | 485.68 | |
| O-36 | 3/1/2017 | Annual | March | 496.52 | No LNAPL | 11.60 | 0.00 | 484.92 | |
| O-37 | 3/1/2017 | Annual | March | 496.54 | 11.50 | 11.51 | 0.01 | 485.04 | |
| O-38 | 3/1/2017 | Annual | March | 496.89 | Sheen | 11.50 | Sheen | 485.39 | |
| O-38 | 6/6/2017 | Quarterly | June | 496.89 | 11.53 | 11.58 | 0.05 | 485.35 | |
| R-14A | 3/1/2017 | Annual | March | 494.15 | No LNAPL | 9.98 | 0.00 | 484.17 | |
| R-18 | 3/1/2017 | Annual | March | 499.96 | 14.99 | 15.04 | 0.05 | 484.96 | |
| R-18 | 6/6/2017 | Quarterly | June | 500.00 | Sheen | 15.04 | Sheen | 484.96 | |
| R-20R | 3/1/2017 | Annual | March | 498.80 | 13.42 | 13.52 | 0.10 | 485.36 | |
| R-20R | 6/6/2017 | Quarterly | June | 498.80 | 13.35 | 14.10 | 0.75 | 485.31 | |
| R-21 | 1/24/2017 | Monthly | January | 495.54 | 12.65 | 12.98 | 0.33 | 482.83 | |
| R-21 | 2/8/2017 | Monthly | February | 495.54 | 12.68 | 12.80 | 0.12 | 482.91 | |
| R-21 | 3/1/2017 | Annual | March | 495.54 | 12.81 | 12.83 | 0.02 | 482.73 | |
| R-21 | 4/18/2017 | Monthly | April | 495.54 | 12.74 | 12.88 | 0.14 | 482.77 | |
| R-21 | 5/25/2017 | Monthly | May | 495.54 | 12.48 | 12.87 | 0.39 | 482.99 | |
| R-21 | 6/6/2017 | Quarterly | June | 495.54 | 12.99 | 13.24 | 0.25 | 482.50 | |
| R-22 | 3/1/2017 | Annual | March | 495.58 | Sheen | 11.43 | Sheen | 484.15 | |
| R-32 | 3/2/2017 | Annual | March | 494.30 | 9.12 | 9.20 | 0.08 | 485.17 | |
| R-32 | 6/6/2017 | Quarterly | June | 494.30 | 9.11 | 9.33 | 0.22 | 485.15 | |
| R-32R | 3/2/2017 | Annual | March | 496.59 | 11.30 | 12.35 | 1.05 | 485.08 | |
| R-32R | 6/6/2017 | Quarterly | June | 496.59 | 11.38 | 11.94 | 0.56 | 485.10 | |
| R-33 | 3/2/2017 | Annual | March | 495.83 | 9.94 | Frozen | 0.05 | — | Ice at 9.99 feet btoc |
| R-34 | 3/2/2017 | Annual | March | 495.18 | Sheen | 10.07 | Sheen | 485.11 | |

**Table 3-4**
**LNAPL Thickness Monitoring**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Well ID | Date | Event | Month | Top of Riser Elevation (MSL feet) | Depth to LNAPL (feet) | Depth to Water (feet) | LNAPL Thickness (feet) | Water Table Elevation (feet MSL) | Notes |
|---|---|---|---|---|---|---|---|---|---|
| R-34 | 6/6/2017 | Quarterly | June | 495.18 | No LNAPL | 10.10 | 0.00 | 485.08 | |
| R-35R | 1/24/2017 | Monthly | January | 494.14 | No LNAPL | 20.88 | 0.00 | 473.26 | |
| R-35R | 2/8/2017 | Monthly | February | 494.14 | No LNAPL | 21.75 | 0.00 | 472.46 | |
| R-35R | 3/1/2017 | Annual | March | 494.14 | No LNAPL | 22.90 | 0.00 | 471.24 | |
| R-35R | 4/18/2017 | Monthly | April | 494.14 | No LNAPL | 23.20 | 0.00 | 470.94 | |
| R-35R | 5/25/2017 | Monthly | May | 494.14 | No LNAPL | 22.75 | 0.00 | 471.39 | |
| R-35R | 6/6/2017 | Quarterly | June | 494.14 | No LNAPL | 24.90 | 0.00 | 469.24 | |
| R-39 | 3/2/2017 | Annual | March | 495.05 | No LNAPL | 10.87 | 0.00 | 484.18 | |
| R-40 | 1/24/2017 | Monthly | January | 494.48 | 15.79 | 15.91 | 0.12 | 478.67 | |
| R-40 | 2/8/2017 | Monthly | February | 494.48 | 15.11 | 15.26 | 0.15 | 479.41 | |
| R-40 | 3/1/2017 | Annual | March | 494.48 | 15.51 | 15.65 | 0.14 | 478.95 | |
| R-40 | 4/18/2017 | Monthly | April | 494.48 | 15.16 | 15.25 | 0.09 | 479.30 | |
| R-40 | 5/25/2017 | Monthly | May | 494.48 | 14.91 | 15.01 | 0.10 | 479.55 | |
| R-40 | 6/6/2017 | Quarterly | June | 494.48 | 15.16 | 15.37 | 0.21 | 479.28 | |
| R-44 | 1/24/2017 | Monthly | January | 496.20 | No LNAPL | 21.80 | 0.00 | 474.40 | |
| R-44 | 2/8/2017 | Monthly | February | 496.20 | Sheen | 22.13 | Sheen | 474.14 | |
| R-44 | 3/1/2017 | Annual | March | 496.20 | Sheen | 22.55 | Sheen | 473.65 | |
| R-44 | 4/18/2017 | Monthly | April | 496.20 | No LNAPL | 23.44 | 0.00 | 472.76 | Flowrate not recorded.<br>Scaly sheen observed. |
| R-44 | 5/25/2017 | Monthly | May | 496.20 | Sheen | 25.09 | Sheen | 471.11 | Heavy biofoul/oxidation observed on probe. |
| R-44 | 6/6/2017 | Quarterly | June | 496.20 | No LNAPL | 25.95 | 0.00 | 470.25 | |
| R-45 | 1/24/2017 | Monthly | January | 495.78 | No LNAPL | 27.46 | 0.00 | 468.32 | |
| R-45 | 2/8/2017 | Monthly | February | 495.78 | No LNAPL | 26.76 | 0.00 | 469.09 | |
| R-45 | 3/1/2017 | Annual | March | 495.78 | No LNAPL | 27.74 | 0.00 | 468.04 | |
| R-45 | 4/18/2017 | Monthly | April | 495.78 | Sheen | 27.97 | Sheen | 467.81 | |
| R-45 | 5/25/2017 | Monthly | May | 495.78 | No LNAPL | 23.10 | 0.00 | 472.68 | |
| R-45 | 6/6/2017 | Quarterly | June | 495.78 | No LNAPL | 24.97 | 0.00 | 470.81 | |
| S-21 | 3/1/2017 | Annual | March | 497.25 | 12.35 | 12.51 | 0.16 | 484.87 | |
| S-21 | 6/6/2017 | Quarterly | June | 497.25 | 12.42 | 12.52 | 0.10 | 484.81 | |
| S-22 | 3/1/2017 | Annual | March | 496.85 | 11.33 | 12.09 | 0.76 | 485.38 | |
| S-22 | 6/6/2017 | Quarterly | June | 496.85 | 11.37 | 12.11 | 0.74 | 485.35 | |
| S-32 | 3/1/2017 | Annual | March | 495.77 | No LNAPL | 11.12 | 0.00 | 484.65 | |
| S-39 | 3/1/2017 | Annual | March | 494.03 | 10.45 | 11.28 | 0.83 | 483.42 | |

**Table 3-4**
**LNAPL Thickness Monitoring**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Well ID | Date | Event | Month | Top of Riser Elevation (MSL feet) | Depth to LNAPL (feet) | Depth to Water (feet) | LNAPL Thickness (feet) | Water Table Elevation (feet MSL) | Notes |
|---|---|---|---|---|---|---|---|---|---|
| S-39 | 6/6/2017 | Quarterly | June | 494.08 | 10.42 | 10.81 | 0.39 | 483.59 | |
| S-43 | 3/2/2017 | Annual | March | 496.27 | No LNAPL | 11.54 | 0.00 | 484.73 | |
| S-44 | 3/1/2017 | Annual | March | 495.00 | 10.49 | 10.73 | 0.24 | 484.46 | |
| S-44 | 6/6/2017 | Quarterly | June | 495.05 | 10.52 | 10.65 | 0.13 | 484.50 | |
| S-50 | 3/1/2017 | Annual | March | 496.67 | 12.02 | 12.18 | 0.16 | 484.62 | |
| S-50 | 6/6/2017 | Quarterly | June | 496.71 | 12.06 | 12.17 | 0.11 | 484.63 | |
| S-51 | 3/1/2017 | Annual | March | 495.92 | 11.39 | 11.48 | 0.09 | 484.51 | |
| S-51 | 6/6/2017 | Quarterly | June | 495.95 | 11.41 | 11.56 | 0.15 | 484.51 | |

**General Notes:**

Only monitoring wells scheduled for sampling per Table 3-3 of the Long Term Monitoring Plan - 2016 Update are shown here (Arcadis. 2016. Long-Term Monitoring Plan – 2016 Update. December). A comprehensive LNAPL gauging table is included in Appendix F.

**Acronyms and Abbreviations:**

— not measured or incalculable
btoc = below top of casing
DTW = Depth to Water
LNAPL = Light Non-Aqueous Phase Liquid
MSL = mean sea level
No LNAPL = an interface probe was used to measure depth to water, LNAPL was not observed
Sheen = LNAPL thickness was less than 0.01' and was not detected with an air/product/water interface probe, product was detected visually

**Table 3-5**
**LNAPL Baildown Test Results**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Well ID | Date | Time Cut (minutes) | Initial LNAPL Thickness (feet) | Test Duration (minutes) | Final LNAPL Thickness (feet) | Percent Recovery | LNAPL Transmissivity ($feet^2$/day) |
|---|---|---|---|---|---|---|---|
| | | | | | | | Bouwer & Rice |
| O-27 | 3/10/2017 | 0 | 0.64 | 1376 | 0.22 | 34% | 0.03 |

**General Notes:**

**Bold** Exceeds 0.8 $feet^2$/day upper criterion range to produce sufficient LNAPL recoverability (ITRC. 2009. Evaluating LNAPL Remedial Technologies for Achieving Project Goals. LNAPL-2. Washington, D.C.: Interstate Technology & Regulatory Council, LNAPLs Team. www.itrcweb.org.)

**Acronyms and Abbreviations:**

LNAPL = light nonaqueous phase liquid

**Table 3-6**
**Constituents of Concern (BTEX, GRO, and DRO) Analytical Results**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Well ID | Zone | Sample Name | Dup | Date | Benzene (µg/L) | Toluene (µg/L) | Ethylbenzene (µg/L) | o-Xylene (µg/L) | P & M -Xylene (µg/L) | Total Xylenes (µg/L) | Gasoline Range Organics (mg/L) | Diesel Range Organics (mg/L) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MW-106-25 | 10-55 | MW-106-25 | | 3/1/2017 | <0.200 | <0.500 | <0.500 | <0.500 | <1.00 | <1.50 | <0.0500 | <0.313 | |
| MW-115-15 | Water Table | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | Well frozen, no sample collected |
| MW-115-15 | Water Table | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | Frozen well, no sample collected; scheduled for Q1, revisited in Q2 due to frozen status. |
| MW-116-15 | Water Table | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | Well frozen, no sample collected |
| MW-116-15 | Water Table | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | Frozen well, no sample collected; scheduled for Q1, revisited in Q2 due to frozen status. |
| MW-125-25 | 10-55 | MW-125-25 | | 2/24/2017 | <0.200 | <0.500 | <0.500 | <0.500 | <1.00 | <1.50 | <0.0500 | <0.566B* | |
| MW-130-25 | 10-55 | MW-130-25 | | 2/24/2017 | 205 | 30.3 | 31.8 | 36.1 | 230 | 266 | 1.52JH* | 4.09 | |
| MW-135-20 | Water Table | MW-135-20 | | 2/24/2017 | 1570 | 1020 | 1520 | 2430 | 5850 | 8280 | 23.0 | 2.47 | |
| MW-136-20 | Water Table | MW-136-20 | | 2/24/2017 | 417 | 311 | 328 | 517 | 1450 | 1970 | 6.47 | <0.734B* | |
| MW-138-20 | Water Table | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | Well frozen, no sample collected |
| MW-138-20 | Water Table | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | Product present, no sample collected |
| MW-139-25 | 10-55 | MW-139-25 | | 2/28/2017 | 4.70 | <0.500 | 2.67 | <0.500 | 13.9 | 13.9 | 0.118JH* | 0.509J | |
| MW-141-20 | Water Table | MW-141-20 | | 3/1/2017 | <0.200 | <0.500 | <0.500 | <0.500 | <1.00 | <1.50 | <0.0500 | <0.306 | |
| MW-176A-15 | Water Table | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | Product present, no sample collected |
| MW-186A-15 | Water Table | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | Product present, no sample collected |
| MW-321-15 | Water Table | MW-321-15 | | 2/28/2017 | 155 | <0.500 | <0.500 | <0.500 | 6.75 | 6.75 | 0.389 | 0.373J | |
| MW-321-15 | Water Table | MW-421-15 | DUP | 2/28/2017 | 175 | 0.320J | <0.500 | <0.500 | 8.02 | 8.02 | 0.431 | 0.315J | |
| MW-334-15 | Water Table | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | Product present, no sample collected |
| MW-336-15 | Water Table | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | Well frozen, no sample collected |
| MW-336-15 | Water Table | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | Frozen well, no sample collected; scheduled for Q1, revisited in Q2 due to frozen status. |
| MW-336-20 | Water Table | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | Well frozen, no sample collected |
| MW-336-20 | Water Table | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | Frozen well, no sample collected; scheduled for Q1, revisited in Q2 due to frozen status. |
| MW-337-20 | Water Table | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | Well frozen, no sample collected |
| MW-337-20 | Water Table | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | Frozen well, no sample collected; scheduled for Q1, revisited in Q2 due to frozen status. |
| MW-344-55 | 10-55 | MW-344-55 | | 2/28/2017 | <0.200 | <0.500 | <0.500 | <0.500 | <1.00 | <1.50 | <0.0500 | <0.283 | |
| MW-344-55 | 10-55 | MW-444-55 | DUP | 2/28/2017 | <0.200 | <0.500 | <0.500 | <0.500 | <1.00 | <1.50 | <0.0500 | <0.294 | |
| O-2 | Water Table | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | Product present, no sample collected |
| O-4 | Water Table | O-4 | | 2/28/2017 | <0.200 | <0.500 | <0.500 | <0.500 | <1.00 | <1.50 | <0.0500 | <0.294 | |
| O-5 | Water Table | O-5 | | 2/28/2017 | <0.200 | <0.500 | <0.500 | <0.500 | <1.00 | <1.50 | 0.0418J | 0.387J | |
| O-12 | Water Table | O-12 | | 2/25/2017 | 3.01 | <0.500 | 0.322J | <0.500 | 0.965J | <1.50 | <0.100B* | <0.588B* | |
| O-19 | Water Table | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | Product present, no sample collected |
| O-24 | Water Table | O-24 | | 2/25/2017 | 10.3 | <0.500 | <0.500 | <0.500 | <1.00 | <1.50 | <0.100B* | <0.615B* | |
| R-21 | Water Table | R-21 | | 1/5/2017 | 55.8 | 6.50J | 15.6 | 23.6 | 135 | 159 | -- | -- | |
| R-21 | Water Table | R-121 | DUP | 1/5/2017 | 61.4 | 6.90J | 17.5 | 26.7 | 152 | 179 | -- | -- | |
| R-21 | Water Table | R-21 | | 2/1/2017 | 53.3 | 9.00J | 19.4 | 26.1 | 146 | 172 | -- | -- | |
| R-21 | Water Table | R-121 | DUP | 2/1/2017 | 48.6 | 9.00J | 18.8 | 26.8 | 145 | 172 | -- | -- | |
| R-21 | Water Table | R-21 | | 3/1/2017 | 46.6 | 44.8 | 72.2 | 121 | 468 | 589 | -- | -- | |
| R-21 | Water Table | R-121 | DUP | 3/1/2017 | 49.1 | 46.0 | 74.2 | 125 | 479 | 604 | -- | -- | |
| R-21 | Water Table | R-21 | | 4/5/2017 | 35.3 | 12.8 | 19.7 | 40.7 | 169 | 210 | -- | -- | |
| R-21 | Water Table | R-121 | DUP | 4/5/2017 | 36.0 | 12.9 | 19.6 | 41.9 | 172 | 214 | -- | -- | |
| R-21 | Water Table | R-21 | | 5/3/2017 | 40.6 | 21.9 | 20.0 | 30.2 | 143 | 173 | -- | -- | |
| R-21 | Water Table | R-121 | DUP | 5/3/2017 | 39.9 | 22.6 | 20.5 | 30.7 | 144 | 175 | -- | -- | |
| R-21 | Water Table | R-21 | | 6/6/2017 | 42.0 | 15.5J* | 20.1 | 31.8J* | 136J* | 167J* | -- | -- | |
| R-21 | Water Table | R-121 | DUP | 6/6/2017 | 36.8 | 11.4J* | 15.0 | 19.8J* | 99.3J* | 119J* | -- | -- | |

**Table 3-6**
**Constituents of Concern (BTEX, GRO, and DRO) Analytical Results**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Well ID | Zone | Sample Name | Dup | Date | Benzene (µg/L) | Toluene (µg/L) | Ethylbenzene (µg/L) | o-Xylene (µg/L) | P & M -Xylene (µg/L) | Total Xylenes (µg/L) | Gasoline Range Organics (mg/L) | Diesel Range Organics (mg/L) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R-35R | Water Table | R-35R | | 1/5/2017 | 29.2 | 2.64 | 16.8 | 5.24 | 59.9 | 65.1 | -- | -- | |
| R-35R | Water Table | R-35R | | 2/1/2017 | 22.3 | 1.86 | 12.4 | 3.75 | 45.3 | 49.0 | -- | -- | |
| R-35R | Water Table | R-35R | | 3/1/2017 | 19.5 | 1.38 | 11.4 | 3.39 | 41.7 | 45.1 | -- | -- | |
| R-35R | Water Table | R-35R | | 4/5/2017 | 14.8 | 1.37 | 9.07 | 2.17 | 34.2 | 36.4 | -- | -- | |
| R-35R | Water Table | R-35R | | 5/3/2017 | 16.1 | 1.93 | 12.4 | 2.83 | 40.5 | 43.3 | -- | -- | |
| R-35R | Water Table | R-35R | | 6/6/2017 | 17.0 | 4.44 | 10.3 | 2.83 | 34.9 | 37.7 | -- | -- | |
| R-40 | Water Table | R-40 | | 1/5/2017 | 98.1 | 81.0 | 65.2 | 54.8 | 214 | 269 | -- | -- | |
| R-40 | Water Table | R-40 | | 2/1/2017 | 93.6 | 80.7 | 58.6 | 49.6 | 188 | 238 | -- | -- | |
| R-40 | Water Table | R-40 | | 3/1/2017 | 69.8 | 61.6 | 45.7 | 41.9 | 152 | 194 | -- | -- | |
| R-40 | Water Table | R-40 | | 4/5/2017 | 65.6 | 61.2 | 46.9 | 43.8 | 160 | 204 | -- | -- | |
| R-40 | Water Table | R-40 | | 5/3/2017 | 70.4 | 97.7 | 51.1 | 71.5 | 212 | 283 | -- | -- | |
| R-40 | Water Table | R-40 | | 6/6/2017 | 82.3 | 102 | 56.0 | 77.6 | 195 | 273 | -- | -- | |
| R-42 | Water Table | R-42 | | 1/5/2017 | <0.200 | <0.500 | <0.500 | <0.500 | <1.00 | <1.50 | -- | -- | |
| R-42 | Water Table | R-42 | | 2/1/2017 | <0.200 | <0.500 | <0.500 | <0.500 | <1.00 | <1.50 | -- | -- | |
| R-42 | Water Table | R-42 | | 3/1/2017 | <0.200 | <0.500 | <0.500 | <0.500 | <1.00 | <1.50 | -- | -- | |
| R-42 | Water Table | R-42 | | 4/5/2017 | <0.200 | <0.500 | <0.500 | <0.500 | <1.00 | <1.50 | -- | -- | |
| R-42 | Water Table | R-42 | | 5/3/2017 | <0.200 | <0.500 | <0.500 | <0.500 | <1.00 | <1.50 | -- | -- | |
| R-42 | Water Table | R-42 | | 6/6/2017 | <0.200 | 0.400J | <0.500 | <0.500 | <1.00 | <1.50 | -- | -- | |
| R-43 | Water Table | R-43 | | 1/5/2017 | 43.7 | 7.99 | 5.27 | 8.07 | 22.8 | 30.9 | -- | -- | |
| R-43 | Water Table | R-43 | | 2/1/2017 | 33.2 | 5.28 | 3.65 | 5.54 | 15.2 | 20.8 | -- | -- | |
| R-43 | Water Table | R-43 | | 3/1/2017 | 37.0 | 7.58 | 4.65 | 7.78 | 21.1 | 28.9 | -- | -- | |
| R-43 | Water Table | R-43 | | 4/5/2017 | 29.2 | 6.69 | 3.45 | 6.31 | 16.6 | 22.9 | -- | -- | |
| R-43 | Water Table | R-43 | | 5/3/2017 | 28.5 | 8.11 | 3.78 | 6.96 | 17.8 | 24.8 | -- | -- | |
| R-43 | Water Table | R-43 | | 6/6/2017 | 32.8 | 9.04 | 5.18 | 9.02 | 21.1 | 30.1 | -- | -- | |
| R-44 | Water Table | R-44 | | 1/5/2017 | 1.85 | <0.500 | <0.500 | <0.500 | 1.20J | 1.20J | -- | -- | |
| R-44 | Water Table | R-44 | | 2/1/2017 | 1.54 | <0.500 | <0.500 | <0.500 | 0.790J | <1.50 | -- | -- | |
| R-44 | Water Table | R-44 | | 3/1/2017 | 1.26 | <0.500 | <0.500 | <0.500 | 1.17J | 1.17J | -- | -- | |
| R-44 | Water Table | R-44 | | 4/5/2017 | 1.54 | <0.500 | <0.500 | <0.500 | 0.820J | <1.50 | -- | -- | |
| R-44 | Water Table | R-44 | | 5/3/2017 | 1.26 | <0.500 | 0.420J | <0.500 | 2.07 | 2.07J | -- | -- | |
| R-44 | Water Table | R-44 | | 6/6/2017 | 1.78 | <0.500 | 1.46 | 0.670J | 4.70 | 5.37 | -- | -- | |
| R-45 | Water Table | R-45 | | 1/5/2017 | 110 | 91.9 | 52.9 | 98.1 | 232 | 330 | -- | -- | |
| R-45 | Water Table | R-45 | | 2/1/2017 | 87.6 | 58.5 | 34.4 | 58.4 | 146 | 205 | -- | -- | |
| R-45 | Water Table | R-45 | | 3/1/2017 | 73.8 | 51.1 | 34.0 | 61.6 | 149 | 211 | -- | -- | |
| R-45 | Water Table | R-45 | | 4/5/2017 | 60.6 | 39.6 | 27.5 | 51.7 | 130 | 182 | -- | -- | |
| R-45 | Water Table | R-45 | | 5/3/2017 | 50.0 | 35.3 | 23.3 | 34.9 | 90.3 | 125 | -- | -- | |
| R-45 | Water Table | R-45 | | 6/6/2017 | 94.4 | 47.3 | 24.2 | 45.3 | 96.3 | 142 | -- | -- | |
| R-46 | Water Table | R-46 | | 1/5/2017 | 49.8 | 61.0 | 21.6 | 40.2 | 152 | 192 | -- | -- | |
| R-46 | Water Table | R-46 | | 2/1/2017 | 37.8 | 46.2 | 14.8 | 30.2 | 116 | 146 | -- | -- | |
| R-46 | Water Table | R-46 | | 3/1/2017 | 39.8 | 48.8 | 20.3 | 41.4 | 158 | 200 | -- | -- | |
| R-46 | Water Table | R-46 | | 4/5/2017 | 27.6 | 30.0 | 13.4 | 28.0 | 110 | 138 | -- | -- | |
| R-46 | Water Table | R-46 | | 5/3/2017 | 27.7 | 29.8 | 15.1 | 29.9 | 113 | 143 | -- | -- | |
| R-46 | Water Table | R-46 | | 6/6/2017 | 27.4 | 39.6 | 18.1 | 30.7 | 106 | 137 | -- | -- | |
| S-43 | Water Table | S-43 | | 2/27/2017 | 106 | <0.500 | 12.3 | <0.500 | 366 | 366 | 2.30JH* | 0.827 | |
| S-43 | Water Table | S-143 | DUP | 2/27/2017 | 102 | <0.500 | 11.3 | <0.500 | 346 | 346 | 2.56JH* | 0.630 | |
| S-44 | Water Table | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | Product present, no sample collected |

**Table 3-6**
**Constituents of Concern (BTEX, GRO, and DRO) Analytical Results**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Well ID | Zone | Sample Name | Dup | Date | Benzene (µg/L) | Toluene (µg/L) | Ethylbenzene (µg/L) | o-Xylene (µg/L) | P & M -Xylene (µg/L) | Total Xylenes (µg/L) | Gasoline Range Organics (mg/L) | Diesel Range Organics (mg/L) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S-50 | Water Table | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | Product present, no sample collected |
| S-51 | Water Table | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | Product present, no sample collected |

**General Notes:**
First Quarter 2017 represents January 5, 2017 through March 1, 2017.
Second Quarter 2017 represents April 5, 2017 through June 6, 2017.
Samples were analyzed for BTEX by EPA method SW8260B, for GRO by Alaska Method AK101, and for DRO by Alaska Method AK102.
Frozen or dry wells were checked and remained frozen or dry during both quarters unless analytical results are listed.
Total xylenes are calculated by Shannon & Wilson, Inc. as the sum of o-, p- and m-xylenes
**Acronyms and Abbreviations:**
--- = information not provided, sample was not collected, refer to the comments for details
< = not detected, limit of detection (LOD) listed, except where noted below; flag applied by laboratory
BTEX = benzene, ethylbenzene, toluene, xylenes
DRO = diesel range organics
DUP = field duplicate sample
GRO = gasoline range organics
J = estimated concentration, detected above the detection limit (DL) and below the limit of quantitation (LOQ); flag applied by laboratory.
JH* = result is considered estimated, biased high, due to QC failures; flag applied by Shannon & Wilson, Inc.
mg/L = milligrams per liter
UB* = Result is considered not detected at the limit of quantitation (LOQ) or reported concentration (higher value), due to contamination identified in a blank QC sample. Flag is reported as <...B*. Flag applied by Shannon & Wilson, Inc.
µg/L = micrograms per liter

**Table 3-7**
**Onsite Sulfolane Analytical Results**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Well ID | Zone | Sample Name | Dup | Date | Sulfolane (µg/L) | Comments |
|---|---|---|---|---|---|---|
| MW-101A-25 | 10-55 | MW-101A-25 | | 2/14/2017 | 10.3 | |
| MW-101A-25 | 10-55 | MW-201A-25 | DUP | 2/14/2017 | 9.67J | |
| MW-110-20 | Water Table | MW-110-20 | | 2/16/2017 | 69.2 | |
| MW-110-20 | Water Table | MW-110-20 | | 4/10/2017 | 62.2 | |
| MW-110-20 | Water Table | MW-210-20 | DUP | 4/10/2017 | 56.9 | |
| MW-113-15 | Water Table | MW-113-15 | | 2/27/2017 | 30.2 | |
| MW-113-15 | Water Table | MW-113-15 | | 4/10/2017 | 26.8 | |
| MW-115-15 | Water Table | -- | | -- | -- | Frozen well, no sample collected |
| MW-115-15 | Water Table | -- | | -- | -- | Frozen well, no sample collected; scheduled for Q1, revisited in Q2 due to frozen status. |
| MW-116-15 | Water Table | -- | | -- | -- | Frozen well, no sample collected |
| MW-116-15 | Water Table | -- | | -- | -- | Frozen well, no sample collected; scheduled for Q1, revisited in Q2 due to frozen status. |
| MW-125-25 | 10-55 | MW-125-25 | | 2/24/2017 | <5.10 | |
| MW-125-25 | 10-55 | MW-125-25 | | 4/11/2017 | <5.55J* | |
| MW-127-25 | 10-55 | MW-127-25 | | 2/27/2017 | <5.20 | |
| MW-127-25 | 10-55 | MW-227-25 | DUP | 2/27/2017 | <5.05 | |
| MW-127-25 | 10-55 | MW-127-25 | | 4/11/2017 | <5.40 | |
| MW-129-40 | 10-55 | MW-129-40 | | 2/25/2017 | <5.50 | |
| MW-130-25 | 10-55 | MW-130-25 | | 2/24/2017 | 204J* | |
| MW-130-25 | 10-55 | MW-130-25 | | 4/11/2017 | 181 | |
| MW-135-20 | Water Table | MW-135-20 | | 2/24/2017 | <5.40 | |
| MW-138-20 | Water Table | -- | | -- | -- | Frozen well, no sample collected |
| MW-138-20 | Water Table | MW-138-20 | | 4/13/2017 | 16900JL* | |
| MW-139-25 | 10-55 | MW-139-25 | | 2/28/2017 | 27.7 | |
| MW-139-25 | 10-55 | MW-139-25 | | 4/10/2017 | 27.6 | |
| MW-142-20 | Water Table | MW-142-20 | | 2/16/2017 | 18.4 | |
| MW-142-20 | Water Table | MW-242-20 | DUP | 2/16/2017 | 17.1 | |
| MW-142-20 | Water Table | MW-142-20 | | 4/10/2017 | 17.6 | |
| MW-142-65 | 10-55 | MW-142-65 | | 2/28/2017 | 7.23J | |
| MW-143-20 | Water Table | MW-143-20 | | 2/14/2017 | 8.88J | |
| MW-145-20 | Water Table | MW-145-20 | | 2/27/2017 | <5.40 | |
| MW-148A-15 | Water Table | MW-148A-15 | | 2/13/2017 | 20.6 | |
| MW-148B-30 | 10-55 | MW-148B-30 | | 2/13/2017 | 13.7 | |
| MW-148C-55 | 10-55 | MW-148C-55 | | 2/13/2017 | 8.79J | |
| MW-148C-55 | 10-55 | MW-248C-55 | DUP | 2/13/2017 | 9.78J | |
| MW-148-80 | 55-90 | MW-148-80 | | 2/13/2017 | <5.10 | |
| MW-154A-75 | 55-90 | MW-154A-75 | | 2/14/2017 | 11.2J | |
| MW-154A-75 | 55-90 | MW-154A-75 | | 4/10/2017 | 10.8 | |
| MW-154B-95 | 55-90 | MW-154B-95 | | 2/14/2017 | 20.0 | |
| MW-154B-95 | 55-90 | MW-154B-95 | | 4/10/2017 | 14.9 | |
| MW-174-15 | Water Table | MW-174-15 | | 2/25/2017 | 12.1 | |
| MW-174A-50 | 10-55 | MW-174A-50 | | 2/25/2017 | <5.30 | |
| MW-175-90 | 55-90 | MW-175-90 | | 2/24/2017 | <5.05 | |
| MW-176A-15 | Water Table | MW-176A-15 | | 3/10/2017 | 1720 | |
| MW-176A-15 | Water Table | -- | | -- | -- | Frozen well, no sample collected |
| MW-178A-15 | Water Table | -- | | -- | -- | Frozen well, no sample collected |
| MW-178A-15 | Water Table | -- | | -- | -- | Frozen well, no sample collected; scheduled for Q1, revisited in Q2 due to frozen status. |
| MW-178B-50 | 10-55 | -- | | -- | -- | Frozen well, no sample collected |
| MW-178B-50 | 10-55 | -- | | -- | -- | Frozen well, no sample collected |
| MW-179A-15 | Water Table | -- | | -- | -- | Frozen well, no sample collected |
| MW-179A-15 | Water Table | -- | | -- | -- | Frozen well, no sample collected; scheduled for Q1, revisited in Q2 due to frozen status. |
| MW-179B-50 | 10-55 | -- | | -- | -- | Frozen well, no sample collected |
| MW-179B-50 | 10-55 | -- | | -- | -- | Frozen well, no sample collected; scheduled for Q1, revisited in Q2 due to frozen status. |
| MW-186A-15 | Water Table | MW-186A-15 | | 2/22/2017 | 187 | |
| MW-186A-15 | Water Table | MW-186A-15 | | 4/13/2017 | 182 | |
| MW-186B-60 | 10-55 | MW-186B-60 | | 2/22/2017 | 15.9 | |
| MW-186B-60 | 10-55 | MW-286B-60 | DUP | 2/22/2017 | 16.2 | |

**Table 3-7**
**Onsite Sulfolane Analytical Results**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Well ID | Zone | Sample Name | Dup | Date | Sulfolane (µg/L) | Comments |
|---|---|---|---|---|---|---|
| MW-186B-60 | 10-55 | MW-186B-60 | | 4/11/2017 | 13.3 | |
| MW-186E-75 | 55-90 | MW-186E-75 | | 2/22/2017 | 7.80J | |
| MW-186E-75 | 55-90 | MW-186E-75 | | 4/13/2017 | 5.93J | |
| MW-186E-75 | 55-90 | MW-286E-75 | DUP | 4/13/2017 | 6.93J | |
| MW-195A-15 | Water Table | MW-195A-15 | | 2/16/2017 | 170 | |
| MW-195A-15 | Water Table | MW-195A-15 | | 4/10/2017 | 134 | |
| MW-199-150 | 90-160 | MW-199-150 | | 2/14/2017 | <5.50 | |
| MW-301-60 | 10-55 | MW-301-60 | | 2/14/2017 | <5.95 | |
| MW-302-CMT-10 | Water Table | MW-302-CMT-10 | | 2/17/2017 | 5.82J | |
| MW-302-CMT-20 | Water Table | MW-302-CMT-20 | | 2/17/2017 | 9.99J | |
| MW-302-CMT-20 | Water Table | MW-302-CMT-20 | | 4/10/2017 | 10.7J | |
| MW-302-CMT-30 | 10-55 | MW-302-CMT-30 | | 2/17/2017 | 6.97J | |
| MW-302-70 | 55-90 | MW-302-70 | | 2/14/2017 | 4.50J | |
| MW-303-CMT-19 | Water Table | MW-303-CMT-19 | | 2/17/2017 | 8.40J | |
| MW-303-CMT-29 | 10-55 | MW-303-CMT-29 | | 2/17/2017 | 5.68J | |
| MW-303-CMT-39 | 10-55 | MW-303-CMT-39 | | 2/17/2017 | 5.14J* | |
| MW-304-CMT-10 | Water Table | -- | | -- | -- | Well was dry, no sample collected |
| MW-304-CMT-10 | Water Table | -- | | -- | -- | Well was dry, no sample collected; scheduled for Q1, revisited in Q2 due to dry status. |
| MW-304-15 | Water Table | MW-304-15 | | 2/13/2017 | 12.0 | |
| MW-304-15 | Water Table | MW-404-15 | DUP | 2/13/2017 | 12.8 | |
| MW-304-15 | Water Table | MW-304-15 | | 4/10/2017 | 8.09J | |
| MW-304-15 | Water Table | MW-404-15 | DUP | 4/10/2017 | 7.65J | |
| MW-304-CMT-20 | Water Table | MW-304-CMT-20 | | 2/16/2017 | 22.0 | |
| MW-304-CMT-20 | Water Table | MW-304-CMT-20 | | 4/11/2017 | 12.5 | |
| MW-304-CMT-30 | 10-55 | MW-304-CMT-30 | | 2/16/2017 | <6.00 | |
| MW-309-15 | Water Table | MW-309-15 | | 2/17/2017 | 31.0 | |
| MW-309-15 | Water Table | MW-309-15 | | 4/10/2017 | 32.2 | |
| MW-309-66 | 10-55 | MW-309-66 | | 2/17/2017 | 6.85J | |
| MW-310-15 | Water Table | MW-310-15 | | 2/25/2017 | 200 | |
| MW-321-15 | Water Table | MW-321-15 | | 2/28/2017 | 36.2 | |
| MW-330-20 | Water Table | MW-330-20 | | 2/25/2017 | 766 | |
| MW-330-20 | Water Table | MW-430-20 | DUP | 2/25/2017 | 780 | |
| MW-330-20 | Water Table | MW-330-20 | | 4/10/2017 | 677 | |
| MW-334-15 | Water Table | MW-334-15 | | 2/27/2017 | 71.9JL* | |
| MW-334-15 | Water Table | MW-334-15 | | 4/12/2017 | 45.6 | |
| MW-334-65 | 10-55 | MW-334-65 | | 2/24/2017 | <5.10 | |
| MW-334-65 | 10-55 | MW-334-65 | | 4/13/2017 | <5.10 | |
| MW-336-15 | Water Table | -- | | -- | -- | Frozen well, no sample collected |
| MW-336-15 | Water Table | -- | | -- | -- | Frozen well, no sample collected |
| MW-336-20 | Water Table | -- | | -- | -- | Frozen well, no sample collected |
| MW-336-20 | Water Table | -- | | -- | -- | Frozen well, no sample collected |
| MW-336-35 | 10-55 | -- | | -- | -- | Frozen well, no sample collected |
| MW-336-35 | 10-55 | -- | | -- | -- | Frozen well, no sample collected |
| MW-336-55 | 10-55 | -- | | -- | -- | Frozen well, no sample collected |
| MW-336-55 | 10-55 | -- | | -- | -- | Frozen well, no sample collected; scheduled for Q1, revisited in Q2 due to frozen status. |
| MW-337-20 | Water Table | -- | | -- | -- | Frozen well, no sample collected |
| MW-337-20 | Water Table | -- | | -- | -- | Frozen well, no sample collected |
| MW-344-15 | Water Table | MW-344-15 | | 2/27/2017 | 45.9 | |
| MW-344-15 | Water Table | MW-444-15 | DUP | 2/27/2017 | 45.3 | |
| MW-344-15 | Water Table | MW-344-15 | | 4/11/2017 | 49.9 | |
| MW-344-55 | 10-55 | MW-344-55 | | 2/28/2017 | <5.30 | |
| MW-344-55 | 10-55 | MW-344-55 | | 4/11/2017 | 4.80J | |
| MW-344-75 | 55-90 | MW-344-75 | | 2/27/2017 | <5.10 | |
| MW-345-15 | Water Table | MW-345-15 | | 2/13/2017 | 8.10J | |
| MW-345-15 | Water Table | -- | | -- | -- | Frozen well, no sample collected |
| MW-345-55 | 10-55 | MW-345-55 | | 2/14/2017 | 32.1 | |
| MW-345-55 | 10-55 | MW-445-55 | DUP | 2/14/2017 | 31.6 | |
| MW-345-55 | 10-55 | -- | | -- | -- | Frozen well, no sample collected |
| MW-345-75 | 55-90 | -- | | -- | -- | Frozen well, no sample collected |

**Table 3-7**
**Onsite Sulfolane Analytical Results**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Well ID | Zone | Sample Name | Dup | Date | Sulfolane (µg/L) | Comments |
|---|---|---|---|---|---|---|
| MW-345-75 | 55-90 | -- | | -- | -- | Frozen well, no sample collected |
| MW-348-15 | Water Table | MW-348-15 | | 3/10/2017 | 988 | |
| MW-348-65 | 10-55 | MW-348-65 | | 2/27/2017 | 9.83J | |
| MW-348-65 | 10-55 | MW-348-65 | | 4/11/2017 | 7.52J | |
| MW-351-15 | Water Table | MW-351-15 | | 1/25/2017 | 4.32J | |
| MW-351-15 | Water Table | MW-351-15 | | 4/10/2017 | 8.41J | |
| MW-351-55 | 10-55 | MW-351-55 | | 1/25/2017 | 6.06J | |
| MW-351-55 | 10-55 | MW-351-55 | | 4/10/2017 | 5.01J | |
| MW-351-75 | 55-90 | MW-351-75 | | 1/25/2017 | <5.10 | |
| MW-351-75 | 55-90 | MW-351-75 | | 4/11/2017 | <5.15 | |
| MW-351-150 | 90-160 | MW-351-150 | | 1/25/2017 | <5.05 | |
| MW-354-15 | Water Table | MW-354-15 | | 2/28/2017 | 341 | |
| MW-354-15 | Water Table | MW-454-15 | DUP | 2/28/2017 | 352 | |
| MW-354-35 | 10-55 | MW-354-35 | | 2/24/2017 | 444 | |
| MW-354-65 | 10-55 | MW-354-65 | | 2/24/2017 | <5.45 | |
| MW-355-15 | Water Table | MW-355-15 | | 2/27/2017 | <5.25 | |
| MW-355-15 | Water Table | MW-355-15 | | 4/11/2017 | <5.00 | |
| MW-355-55 | 10-55 | MW-355-55 | | 2/27/2017 | <5.10 | |
| MW-358-20 | Water Table | MW-358-20 | | 1/26/2017 | 4.68J | |
| MW-358-40 | 10-55 | MW-358-40 | | 1/26/2017 | 3.86J | |
| MW-358-60 | 10-55 | MW-358-60 | | 1/26/2017 | 3.85J | |
| MW-359-15 | Water Table | MW-359-15 | | 1/26/2017 | 8.34J | |
| MW-359-35 | 10-55 | MW-359-35 | | 1/26/2017 | 15.6 | |
| MW-359-35 | 10-55 | MW-459-35 | DUP | 1/26/2017 | 13.8 | |
| MW-359-60 | 10-55 | MW-359-60 | | 1/26/2017 | 7.37J | |
| MW-360-15 | Water Table | MW-360-15 | | 1/26/2017 | 3.76J | |
| MW-360-35 | 10-55 | MW-360-35 | | 1/26/2017 | 8.16J* | |
| MW-360-50 | 10-55 | MW-360-50 | | 1/26/2017 | 9.85J | |
| MW-361-15 | Water Table | MW-361-15 | | 2/23/2017 | <5.05 | |
| MW-361-15 | Water Table | MW-461-15 | DUP | 2/23/2017 | <5.10 | |
| MW-362-80 | 55-90 | MW-362-80 | | 2/28/2017 | <5.15 | |
| MW-364-90 | 55-90 | MW-364-90 | | 2/13/2017 | <5.15 | |
| MW-369-16 | Water Table | MW-369-16 | | 2/25/2017 | 92.6 | |
| MW-369-16 | Water Table | MW-469-16 | DUP | 2/25/2017 | 89.2 | |
| MW-369-16 | Water Table | MW-369-16 | | 4/11/2017 | 98.4 | |
| MW-369-55 | 10-55 | MW-369-55 | | 2/25/2017 | 17.0 | |
| MW-369-55 | 10-55 | MW-369-55 | | 4/11/2017 | 14.4 | |
| MW-369-75 | 55-90 | MW-369-75 | | 2/25/2017 | 6.29J | |
| MW-370-15 | Water Table | MW-370-15 | | 2/17/2017 | 29.4 | |
| MW-370-15 | Water Table | MW-370-15 | | 4/10/2017 | 27.4 | |
| MW-370-15 | Water Table | MW-470-15 | DUP | 4/10/2017 | 24.7 | |
| MW-370-55 | 10-55 | MW-370-55 | | 2/17/2017 | 9.36J | |
| MW-370-55 | 10-55 | MW-370-55 | | 4/10/2017 | 8.69J | |
| MW-370-75 | 55-90 | MW-370-75 | | 2/17/2017 | <5.15 | |
| MW-371-15 | Water Table | MW-371-15 | | 2/14/2017 | 24.8 | |
| MW-371-15 | Water Table | MW-371-15 | | 4/10/2017 | 19.4 | |
| MW-371-55 | 10-55 | MW-371-55 | | 2/14/2017 | 3.21J | |
| MW-371-75 | 55-90 | MW-371-75 | | 2/14/2017 | <5.10 | |
| MW-371-75 | 55-90 | MW-371-75 | | 4/11/2017 | <5.10 | |
| MW-371-125 | 90-160 | MW-371-125 | | 2/14/2017 | <5.15 | |
| MW-372-15 | Water Table | MW-372-15 | | 2/16/2017 | 930 | |
| MW-372-15 | Water Table | MW-472-15 | DUP | 2/16/2017 | 977 | |
| MW-372-15 | Water Table | MW-372-15 | | 4/11/2017 | 1060 | |
| MW-373-15 | Water Table | MW-373-15 | | 2/17/2017 | 9.01J | |
| MW-373-15 | Water Table | MW-373-15 | | 4/10/2017 | 4.69J | |
| O-1 | Water Table | -- | | -- | -- | Frozen well, no sample collected |
| O-1 | Water Table | -- | | -- | -- | Frozen well, no sample collected; scheduled for Q1, revisited in Q2 due to frozen status. |
| O-2 | Water Table | O-2 | | 2/24/2017 | 172 | |
| O-2 | Water Table | O-2 | | 4/12/2017 | 166 | |
| O-3 | Water Table | O-3 | | 2/27/2017 | <5.15 | |

**Table 3-7**
**Onsite Sulfolane Analytical Results**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Well ID | Zone | Sample Name | Dup | Date | Sulfolane (µg/L) | Comments |
|---|---|---|---|---|---|---|
| O-4 | Water Table | O-4 | | 2/28/2017 | 4.77J | |
| O-4 | Water Table | O-4 | | 4/10/2017 | 5.77J | |
| O-5 | Water Table | O-5 | | 2/28/2017 | 158J* | |
| O-5 | Water Table | O-5 | | 4/10/2017 | 154 | |
| O-5-65 | 10-55 | O-5-65 | | 2/28/2017 | 3.22J | |
| O-5-65 | 10-55 | O-205-65 | DUP | 2/28/2017 | 3.49J | |
| O-5-65 | 10-55 | O-5-65 | | 4/10/2017 | 3.79J | |
| O-5-65 | 10-55 | O-105-65 | DUP | 4/10/2017 | 3.67J | |
| O-6 | Water Table | O-6 | | 2/27/2017 | 14.7 | |
| O-6 | Water Table | O-6 | | 4/11/2017 | 15.9 | |
| O-12 | Water Table | O-12 | | 2/25/2017 | <5.40 | |
| O-12 | Water Table | O-12 | | 4/11/2017 | <5.55 | |
| O-12-65 | 10-55 | O-12-65 | | 2/25/2017 | <5.40 | |
| O-14 | Water Table | -- | | -- | -- | Frozen well, no sample collected |
| O-14 | Water Table | -- | | -- | -- | Frozen well, no sample collected; scheduled for Q1, revisited in Q2 due to frozen status. |
| O-19 | Water Table | O-19 | | 2/22/2017 | 428 | |
| O-19 | Water Table | O-19 | | 4/12/2017 | 395 | |
| O-19-55 | 10-55 | O-19-55 | | 2/22/2017 | 17.6 | |
| O-19-55 | 10-55 | O-19-55 | | 4/11/2017 | 13.3 | |
| O-19-90 | 55-90 | O-19-90 | | 2/22/2017 | <5.50 | |
| O-19-90 | 55-90 | O-19-90 | | 4/13/2017 | <5.05 | |
| O-20 | Water Table | -- | | -- | -- | Frozen well, no sample collected |
| O-20 | Water Table | -- | | -- | -- | Frozen well, no sample collected; scheduled for Q1, revisited in Q2 due to frozen status. |
| O-24 | Water Table | O-24 | | 2/25/2017 | <5.40 | |
| O-24-65 | 10-55 | O-24-65 | | 2/25/2017 | <5.20 | |
| O-26 | Water Table | O-26 | | 2/24/2017 | 15.3 | |
| O-26 | Water Table | O-26 | | 4/11/2017 | 13.8 | |
| O-26-65 | 10-55 | O-26-65 | | 2/24/2017 | <5.10 | |
| O-27 | Water Table | O-27 | | 2/17/2017 | 22.4 | |
| O-27 | Water Table | O-27 | | 4/12/2017 | 17.6 | |
| O-27-65 | 10-55 | O-27-65 | | 2/16/2017 | 9.76J | |
| O-27-65 | 10-55 | O-27-65 | | 4/10/2017 | 8.54J | |
| O-27-65 | 10-55 | O-127-65 | DUP | 4/10/2017 | 8.95J | |
| O-31 | Water Table | O-31 | | 2/24/2017 | 3.71J | |
| O-32 | Water Table | O-32 | | 2/23/2017 | 374 | |
| O-33 | Water Table | O-33 | | 2/23/2017 | 11.2 | |
| O-34 | Water Table | O-34 | | 3/10/2017 | 620 | |
| R-21 | Water Table | R-21 | | 1/5/2017 | 235J* | |
| R-21 | Water Table | R-121 | DUP | 1/5/2017 | 227J* | |
| R-21 | Water Table | R-21 | | 2/1/2017 | 223 | |
| R-21 | Water Table | R-121 | DUP | 2/1/2017 | 216 | |
| R-21 | Water Table | R-21 | | 3/1/2017 | 211JL* | |
| R-21 | Water Table | R-121 | DUP | 3/1/2017 | 207JL* | |
| R-21 | Water Table | R-21 | | 4/5/2017 | 204 | |
| R-21 | Water Table | R-121 | DUP | 4/5/2017 | 211 | |
| R-21 | Water Table | R-21 | | 5/3/2017 | 193 | |
| R-21 | Water Table | R-121 | DUP | 5/3/2017 | 194 | |
| R-21 | Water Table | R-21 | | 6/6/2017 | 184J* | |
| R-21 | Water Table | R-121 | DUP | 6/6/2017 | 173 | |
| R-32R | Water Table | R-32R | | 2/23/2017 | 570 | |
| R-35R | Water Table | R-35R | | 1/5/2017 | 36.1 | |
| R-35R | Water Table | R-35R | | 2/1/2017 | 35.0 | |
| R-35R | Water Table | R-35R | | 3/1/2017 | 33.7 | |
| R-35R | Water Table | R-35R | | 4/5/2017 | 32.0 | |
| R-35R | Water Table | R-35R | | 5/3/2017 | 30.2 | |
| R-35R | Water Table | R-35R | | 6/6/2017 | 23.1 | |
| R-40 | Water Table | R-40 | | 1/5/2017 | 23.0 | |
| R-40 | Water Table | R-40 | | 2/1/2017 | 20.2 | |
| R-40 | Water Table | R-40 | | 3/1/2017 | 22.6 | |

**Table 3-7**
**Onsite Sulfolane Analytical Results**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Well ID | Zone | Sample Name | Dup | Date | Sulfolane (µg/L) | Comments |
|---|---|---|---|---|---|---|
| R-40 | Water Table | R-40 | | 4/5/2017 | 21.0 | |
| R-40 | Water Table | R-40 | | 5/3/2017 | 20.3 | |
| R-40 | Water Table | R-40 | | 6/6/2017 | 17.6JL* | |
| R-42 | Water Table | R-42 | | 1/5/2017 | 14.6J* | |
| R-42 | Water Table | R-42 | | 2/1/2017 | 16.9 | |
| R-42 | Water Table | R-42 | | 3/1/2017 | 16.0 | |
| R-42 | Water Table | R-42 | | 4/5/2017 | 16.5 | |
| R-42 | Water Table | R-42 | | 5/3/2017 | 16.1 | |
| R-42 | Water Table | R-42 | | 6/6/2017 | 15.4 | |
| R-43 | Water Table | R-43 | | 1/5/2017 | 87.6J* | |
| R-43 | Water Table | R-43 | | 2/1/2017 | 86.1 | |
| R-43 | Water Table | R-43 | | 3/1/2017 | 77.9 | |
| R-43 | Water Table | R-43 | | 4/5/2017 | 85.4 | |
| R-43 | Water Table | R-43 | | 5/3/2017 | 79.2 | |
| R-43 | Water Table | R-43 | | 6/6/2017 | 76.1 | |
| R-44 | Water Table | R-44 | | 1/5/2017 | 39.3 | |
| R-44 | Water Table | R-44 | | 2/1/2017 | 38.9 | |
| R-44 | Water Table | R-44 | | 3/1/2017 | 34.4 | |
| R-44 | Water Table | R-44 | | 4/5/2017 | 33.7 | |
| R-44 | Water Table | R-44 | | 5/3/2017 | 32.0J* | |
| R-44 | Water Table | R-44 | | 6/6/2017 | 29.2JL* | |
| R-45 | Water Table | R-45 | | 1/5/2017 | 37.4 | |
| R-45 | Water Table | R-45 | | 2/1/2017 | 36.7 | |
| R-45 | Water Table | R-45 | | 3/1/2017 | 30.7JL* | |
| R-45 | Water Table | R-45 | | 4/5/2017 | 34.2 | |
| R-45 | Water Table | R-45 | | 5/3/2017 | 32.1 | |
| R-45 | Water Table | R-45 | | 6/6/2017 | 26.7J* | |
| R-46 | Water Table | R-46 | | 1/5/2017 | <5.05 | |
| R-46 | Water Table | R-46 | | 2/1/2017 | <5.05 | |
| R-46 | Water Table | R-46 | | 3/1/2017 | <5.20 | |
| R-46 | Water Table | R-46 | | 4/5/2017 | <5.00 | |
| R-46 | Water Table | R-46 | | 5/3/2017 | <5.20 | |
| R-46 | Water Table | R-46 | | 6/6/2017 | <5.25 | |
| S-21 | Water Table | S-21 | | 2/28/2017 | 5.42JL* | |
| S-39 | Water Table | -- | | -- | -- | Well purged dry, no sample collected |
| S-39 | Water Table | S-39 | | 4/13/2017 | 5.23J | |
| S-41R | Water Table | S-41R | | 2/23/2017 | 64.6 | |
| S-43 | Water Table | S-43 | | 2/27/2017 | 5.26J | |
| S-43 | Water Table | S-43 | | 4/12/2017 | 5.11J | |
| S-50 | Water Table | S-50 | | 2/27/2017 | 309 | |
| S-51 | Water Table | S-51 | | 2/27/2017 | 333 | |
| S-51 | Water Table | S-51 | | 4/12/2017 | 482 | |

**General Notes:**
First Quarter 2017 represents January 5, 2017 through March 10, 2017.
Second Quarter 2017 represents April 5, 2017 through June 6, 2017.
Frozen or dry wells were checked and remained frozen or dry during both quarters unless analytical results are listed.
MW-148 nest is located offsite near the property boundary, but is being monitored and reported as part of the onsite groundwater monitoring program.
Samples were analyzed by EPA1625B with isotope dilution.

**Acronyms and Abbreviations:**
--- = information not provided, a sample was not collected; refer to the comments for details
< = not detected; limit of detection (LOD) listed
DUP = field duplicate sample
EPA = Environmental Protection Agency
J - estimated concentration detected below the laboratory limit of quantitation (LOQ), flag applied by laboratory
J* = estimated concentration due to quality control (QC) failures or lack of field QC samples, flag applied by Shannon & Wilson, Inc.
JL* = estimated concentration, biased low due to quality control failures; flag applied by Shannon & Wilson, Inc.
µg/L = micrograms per liter

**Table 3-8**
**Sulfolane Analytical Results - Alternative Point of Compliance**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Well ID | Zone | Sample Name | Dup | Date | Sulfolane (µg/L) | Comments |
|---|---|---|---|---|---|---|
| MW-101A-25 | 10-55 | MW-101A-25 | | 2/14/2017 | 10.3 | |
| MW-101A-25 | 10-55 | MW-201A-25 | DUP | 2/14/2017 | 9.67J | |
| MW-143-20 | Water Table | MW-143-20 | | 2/14/2017 | 8.88J | |
| MW-301-60 | 10-55 | MW-301-60 | | 2/14/2017 | <5.95 | |
| MW-302-CMT-10 | Water Table | MW-302-CMT-10 | | 2/17/2017 | 5.82J | |
| MW-302-CMT-20 | Water Table | MW-302-CMT-20 | | 2/17/2017 | 9.99J | |
| MW-302-CMT-20 | Water Table | MW-302-CMT-20 | | 4/10/2017 | 10.7J | |
| MW-302-CMT-30 | 10-55 | MW-302-CMT-30 | | 2/17/2017 | 6.97J | |
| MW-302-70 | 55-90 | MW-302-70 | | 2/14/2017 | 4.50J | |
| MW-303-CMT-19 | Water Table | MW-303-CMT-19 | | 2/17/2017 | 8.40J | |
| MW-303-CMT-29 | 10-55 | MW-303-CMT-29 | | 2/17/2017 | 5.68J | |
| MW-303-CMT-39 | 10-55 | MW-303-CMT-39 | | 2/17/2017 | 5.14J* | |
| MW-304-CMT-10 | Water Table | -- | | -- | -- | Well was dry, no sample collected |
| MW-304-CMT-10 | Water Table | -- | | -- | -- | Well was dry, no sample collected; scheduled for Q1, revisited in Q2 due to dry status. |
| MW-304-15 | Water Table | MW-304-15 | | 2/13/2017 | 12.0 | |
| MW-304-15 | Water Table | MW-404-15 | DUP | 2/13/2017 | 12.8 | |
| MW-304-15 | Water Table | MW-304-15 | | 4/10/2017 | 8.09J | |
| MW-304-15 | Water Table | MW-404-15 | DUP | 4/10/2017 | 7.65J | |
| MW-304-CMT-20 | Water Table | MW-304-CMT-20 | | 2/16/2017 | 22.0 | |
| MW-304-CMT-20 | Water Table | MW-304-CMT-20 | | 4/11/2017 | 12.5 | |
| MW-304-CMT-30 | 10-55 | MW-304-CMT-30 | | 2/16/2017 | <6.00 | |

**General Notes:**
First Quarter 2017 represents January 5, 2017 through March 10, 2017.
Second Quarter 2017 represents April 5, 2017 through June 6, 2017.
Alternative Point of Compliance locations MW-141-20 and well nests MW-305 and MW-306 were not sampled during First and Second Quarter 2017 in accordance with Table 3-4 of the Long Term Monitoring Plan - 2016 Update (Arcadis 2016)
Frozen or dry wells were checked and remained frozen or dry during both quarters unless analytical results are listed.
Samples were analyzed by EPA1625B with isotope dilution.

**Acronyms and Abbreviations:**
--- = information not provided, a sample was not collected; refer to the comments for details
< = not detected; limit of detection (LOD) listed
DUP = field duplicate sample
J - estimated concentration detected below the laboratory limit of quantitation (LOQ), flag applied by laboratory
J* = estimated concentration due to quality control (QC) failures or lack of field QC samples, flag applied by Shannon & Wilson, Inc.
µg/L = micrograms per liter

**Table 4-1**
**Remediation System Operation - Groundwater Recovery**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Date | Monthly Total (gallons) | Monthly Average (gallons/day) | Monthly Average (gallons/minute) |
|---|---|---|---|
| January 2009 | 5,637,292 | 181,848 | 126 |
| February 2009 | 4,965,414 | 177,336 | 123 |
| March 2009 | 5,673,504 | 183,016 | 127 |
| April 2009 | 5,845,823 | 194,861 | 135 |
| May 2009 | 6,430,915 | 207,449 | 144 |
| June 2009 | 6,229,883 | 207,663 | 144 |
| July 2009 | 6,316,965 | 203,773 | 142 |
| August 2009 | 6,243,319 | 201,397 | 140 |
| September 2009 | 10,634,423 | 354,481 | 246 |
| October 2009 | 5,114,811 | 164,994 | 115 |
| November 2009 | 0 | 0 | 0 |
| December 2009 | 6,153,173 | 198,489 | 138 |
| January 2010 | 8,676,601 | 279,890 | 194 |
| February 2010 | 9,185,582 | 328,057 | 228 |
| March 2010 | 9,424,363 | 304,012 | 211 |
| April 2010 | 9,914,262 | 330,475 | 229 |
| May 2010 | 9,812,735 | 316,540 | 220 |
| June 2010 | 9,282,464 | 309,415 | 215 |
| July 2010 | 9,325,475 | 300,822 | 209 |
| August 2010 | 9,872,250 | 318,460 | 221 |
| September 2010 | 9,122,386 | 304,080 | 211 |
| October 2010 | 7,700,526 | 248,404 | 173 |
| November 2010 | 7,489,601 | 249,653 | 173 |
| December 2010 | 7,279,463 | 234,821 | 163 |
| January 2011 | 8,605,402 | 277,594 | 193 |
| February 2011 | 7,409,928 | 264,640 | 184 |
| March 2011 | 7,144,062 | 230,454 | 160 |
| April 2011 | 8,034,008 | 267,800 | 186 |
| May 2011 | 8,076,367 | 260,528 | 181 |
| June 2011 | 9,735,245 | 324,508 | 225 |
| July 2011 | 11,838,286 | 381,880 | 265 |
| August 2011 | 12,119,042 | 390,937 | 271 |
| September 2011 | 15,458,620 | 515,287 | 358 |
| October 2011 | 15,492,362 | 499,754 | 347 |
| November 2011 | 16,279,722 | 542,657 | 377 |
| December 2011 | 16,711,381 | 539,077 | 374 |
| January 2012 | 15,645,486 | 504,381 | 350 |
| February 2012 | 15,936,577 | 515,987 | 358 |
| March 2012 | 16,390,112 | 530,180 | 368 |
| April 2012 | 16,010,934 | 514,711 | 357 |
| May 2012 | 14,639,653 | 472,247 | 328 |
| June 2012 | 14,109,044 | 451,769 | 314 |
| July 2012 | 16,721,808 | 540,994 | 376 |
| August 2012 | 16,256,379 | 523,831 | 364 |
| September 2012 | 15,402,121 | 515,527 | 358 |
| October 2012 | 16,377,507 | 527,101 | 366 |
| November 2012 | 15,069,768 | 503,018 | 349 |
| December 2012 | 15,740,566 | 507,135 | 352 |
| January 2013 | 15,663,097 | 505,261 | 357 |
| February 2013 | 14,380,130 | 513,576 | 323 |

**Table 4-1**
**Remediation System Operation - Groundwater Recovery**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Date | Monthly Total (gallons) | Monthly Average (gallons/day) | Monthly Average (gallons/minute) |
|---|---|---|---|
| March 2013 | 14,398,601 | 464,471 | 352 |
| April 2013 | 15,168,307 | 505,610 | 351 |
| May 2013 | 15,887,224 | 512,491 | 356 |
| June 2013 | 18,656,997 | 621,900 | 432 |
| July 2013 | 20,702,663 | 667,828 | 464 |
| August 2013 | 20,456,333 | 659,882 | 458 |
| September 2013 | 19,538,981 | 651,299 | 452 |
| October 2013 | 19,438,949 | 627,063 | 435 |
| November 2013 | 13,057,783 | 435,259 | 302 |
| December 2013 | 13,466,226 | 434,394 | 302 |
| January 2014 | 17,443,790 | 562,703 | 391 |
| February 2014 | 15,155,194 | 541,257 | 376 |
| March 2014 | 14,278,904 | 460,610 | 320 |
| April 2014 | 11,616,666 | 387,222 | 269 |
| May 2014 | 18,097,092 | 583,777 | 405 |
| June 2014 | 14,544,845 | 469,189 | 326 |
| July 2014 | 24,418,890 | 787,706 | 547 |
| August 2014 | 22,678,723 | 731,572 | 508 |
| September 2014 | 24,862,849 | 802,027 | 557 |
| October 2014 | 25,828,347 | 833,172 | 579 |
| November 2014 | 23,907,788 | 771,219 | 536 |
| December 2014 | 24,515,399 | 790,819 | 549 |
| January 2015 | 25,569,160 | 824,812 | 573 |
| February 2015 | 22,691,540 | 810,412 | 563 |
| March 2015 | 25,079,442 | 809,014 | 562 |
| April 2015 | 23,835,264 | 794,509 | 552 |
| May 2015 | 25,560,499 | 824,532 | 573 |
| June 2015 | 24,365,449 | 812,182 | 564 |
| July 2015 | 26,243,058 | 846,550 | 588 |
| August 2015 | 25,518,123 | 823,165 | 572 |
| September 2015 | 22,357,602 | 745,253 | 518 |
| October 2015 | 23,877,038 | 770,227 | 535 |
| November 2015 | 21,849,568 | 728,319 | 506 |
| December 2015 | 24,476,154 | 789,553 | 548 |
| January 2016 | 24,175,565 | 779,857 | 542 |
| February 2016 | 21,802,867 | 751,823 | 522 |
| March 2016 | 25,079,442 | 809,014 | 562 |
| April 2016 | 19,986,668 | 666,222 | 463 |
| May 2016 | 23,805,158 | 767,908 | 533 |
| June 2016 | 23,167,211 | 772,240 | 536 |
| July 2016 | 22,832,725 | 736,540 | 511 |
| August 2016 | 22,618,085 | 729,616 | 507 |
| September 2016 | 11,023,282 | 367,443 | 255 |
| October 2016 | 15,512,443 | 500,401 | 348 |
| November 2016 | 14,948,767 | 498,292 | 346 |
| December 2016 | 15,312,324 | 493,946 | 343 |
| January 2017 | 15,429,387 | 497,722 | 346 |
| February 2017 | 14,030,617 | 501,093 | 348 |
| March 2017 | 15,312,801 | 493,961 | 343 |
| April 2017 | 14,993,931 | 499,798 | 347 |
| May 2017 | 15,324,688 | 494,345 | 343 |
| June 2017 | 14,731,108 | 491,037 | 341 |

**Table 4-2a**
**Remediation System Operation - GAC East Treatment System Performance - Sulfolane**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Location | Date | Dup | Sulfolane (µg/L) |
|---|---|---|---|
| COMBINED INFLUENT | 1/05/2017 | | 58.1 |
| COMBINED INFLUENT | 2/01/2017 | | 58.0 |
| COMBINED INFLUENT | 3/01/2017 | | 51.9 |
| COMBINED INFLUENT | 3/29/2017 | | 55.1 |
| COMBINED INFLUENT | 4/05/2017 | | 54.5 |
| COMBINED INFLUENT | 5/03/2017 | | 52.0 |
| COMBINED INFLUENT | 6/06/2017 | | 46.0 |
| GAC VESSEL A-OUTLET | 1/05/2017 | | <5.00 J* |
| GAC VESSEL A-OUTLET | 2/01/2017 | | <5.15 |
| GAC VESSEL A-OUTLET | 3/01/2017 | | <5.05 |
| GAC VESSEL A-OUTLET | 4/05/2017 | | <5.05 |
| GAC VESSEL A-OUTLET | 5/03/2017 | | <5.30 |
| GAC VESSEL A-OUTLET | 6/06/2017 | | <5.45 |
| GAC VESSEL B-OUTLET | 1/05/2017 | | <5.15 |
| GAC VESSEL B-OUTLET | 2/01/2017 | | <5.05 |
| GAC VESSEL B-OUTLET | 3/01/2017 | | <5.20 |
| GAC VESSEL B-OUTLET | 4/05/2017 | | <5.10 |
| GAC VESSEL B-OUTLET | 5/03/2017 | | <5.10 |
| GAC VESSEL B-OUTLET | 6/06/2017 | | <5.25 |
| LEAD VESSEL INLET | 1/05/2017 | | 6.37 J |
| LEAD VESSEL INLET | 1/05/2017 | DUP | 6.36 J |
| LEAD VESSEL INLET | 2/01/2017 | | 7.68 J |
| LEAD VESSEL INLET | 2/01/2017 | DUP | 8.43 J |
| LEAD VESSEL INLET | 3/01/2017 | | 23.8 |
| LEAD VESSEL INLET | 3/01/2017 | DUP | 23.2 |
| LEAD VESSEL INLET | 4/05/2017 | | 19.3 |
| LEAD VESSEL INLET | 4/05/2017 | DUP | 22.9 |
| LEAD VESSEL INLET | 5/03/2017 | | 11.1 J* |
| LEAD VESSEL INLET | 5/03/2017 | DUP | 9.74 J* |
| LEAD VESSEL INLET | 6/06/2017 | | 17.3 |
| LEAD VESSEL INLET | 6/06/2017 | DUP | 16.8 |
| R-21 | 1/05/2017 | | 235 J* |
| R-21 | 1/05/2017 | DUP | 227 J* |
| R-21 | 2/01/2017 | | 223 |
| R-21 | 2/01/2017 | DUP | 216 |
| R-21 | 3/01/2017 | | 211 JL* |
| R-21 | 3/01/2017 | DUP | 207 JL* |
| R-21 | 4/05/2017 | | 204 |
| R-21 | 4/05/2017 | DUP | 211 |
| R-21 | 5/03/2017 | | 193 |
| R-21 | 5/03/2017 | DUP | 194 |
| R-21 | 6/06/2017 | | 184 J* |
| R-21 | 6/06/2017 | DUP | 173 |
| R-35R | 1/05/2017 | | 36.1 |
| R-35R | 2/01/2017 | | 35.0 |
| R-35R | 3/01/2017 | | 33.7 |
| R-35R | 4/05/2017 | | 32.0 |
| R-35R | 5/03/2017 | | 30.2 |
| R-35R | 6/06/2017 | | 23.1 |
| R-40 | 1/05/2017 | | 23.0 |
| R-40 | 2/01/2017 | | 20.2 |
| R-40 | 3/01/2017 | | 22.6 |

**Table 4-2a**
**Remediation System Operation - GAC East Treatment System Performance - Sulfolane**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Location | Date | Dup | Sulfolane (µg/L) |
|---|---|---|---|
| R-40 | 4/05/2017 | | 21.0 |
| R-40 | 5/03/2017 | | 20.3 |
| R-40 | 6/06/2017 | | 17.6 JL* |
| R-42 | 1/05/2017 | | 14.6 J* |
| R-42 | 2/01/2017 | | 16.9 |
| R-42 | 3/01/2017 | | 16.0 |
| R-42 | 4/05/2017 | | 16.5 |
| R-42 | 5/03/2017 | | 16.1 |
| R-42 | 6/06/2017 | | 15.4 |
| R-43 | 1/05/2017 | | 87.6 J* |
| R-43 | 2/01/2017 | | 86.1 |
| R-43 | 3/01/2017 | | 77.9 |
| R-43 | 4/05/2017 | | 85.4 |
| R-43 | 5/03/2017 | | 79.2 |
| R-43 | 6/06/2017 | | 76.1 |
| R-44 | 1/05/2017 | | 39.3 |
| R-44 | 2/01/2017 | | 38.9 |
| R-44 | 3/01/2017 | | 34.4 |
| R-44 | 4/05/2017 | | 33.7 |
| R-44 | 5/03/2017 | | 32.0 J* |
| R-44 | 6/06/2017 | | 29.2 JL* |
| R-45 | 1/05/2017 | | 37.4 |
| R-45 | 2/01/2017 | | 36.7 |
| R-45 | 3/01/2017 | | 30.7 JL* |
| R-45 | 4/05/2017 | | 34.2 |
| R-45 | 5/03/2017 | | 32.1 |
| R-45 | 6/06/2017 | | 26.7 J* |
| R-46 | 1/05/2017 | | <5.05 |
| R-46 | 2/01/2017 | | <5.05 |
| R-46 | 3/01/2017 | | <5.20 |
| R-46 | 4/05/2017 | | <5.00 |
| R-46 | 5/03/2017 | | <5.20 |
| R-46 | 6/06/2017 | | <5.25 |
| TRMT SYS EFFLUENT | 1/05/2017 | | <5.10 |
| TRMT SYS EFFLUENT | 2/01/2017 | | <5.10 |
| TRMT SYS EFFLUENT | 3/01/2017 | | R* |
| TRMT SYS EFFLUENT | 3/29/2017 | | <5.15 |
| TRMT SYS EFFLUENT | 4/05/2017 | | <5.00 |
| TRMT SYS EFFLUENT | 5/03/2017 | | <5.30 |
| TRMT SYS EFFLUENT | 6/06/2017 | | <5.20 |

**Acronyms and Abbreviations:**
< = not detected; limit of detection (LOD) listed, flag applied by laboratory
DUP = field duplicate sample
GAC = granular activated carbon
J = estimated concentration detected below the laboratory limit of quantitation (LOQ), flag applied by laboratory
J*= estimated concentration due to quality control (QC) failures or lack of field QC samples, flag applied by Shannon & Wilson, Inc.
JL*= estimated concentration, biased low due to quality control failures; flag applied by Shannon & Wilson, Inc.
R*= result rejected due to QC failures. Flag applied by Shannon & Wilson, Inc.
µg/L = micrograms per liter

**Table 4-2b**
**Remediation System Operation - GAC East Treatment System Performance - BTEX**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Location | Date | Dup | Benzene (µg/L) | Toluene (µg/L) | Ethylbenzene (µg/L) | Xylene, m & p (µg/L) | Xylene, o (µg/L) | Xylene, total (µg/L) |
|---|---|---|---|---|---|---|---|---|
| AIR STRIPPER EFFLUENT A | 3/01/2017 | | 0.170 J | <0.500 | <0.500 | <1.00 | <0.500 | <1.50 |
| AIR STRIPPER EFFLUENT A | 3/15/2017 | | 0.120 J | <0.500 | <0.500 | <1.00 | <0.500 | <1.50 |
| AIR STRIPPER EFFLUENT A | 4/05/2017 | | 0.150 J | <0.500 | <0.500 | <1.00 | <0.500 | <1.50 |
| AIR STRIPPER EFFLUENT A | 4/18/2017 | | 0.270 J | <0.500 | <0.500 | 0.820 J | 0.410 J | 1.23 J |
| AIR STRIPPER EFFLUENT A | 5/03/2017 | | 0.330 J | <0.500 | <0.500 | 1.01 J | 0.510 J | 1.52 J |
| AIR STRIPPER EFFLUENT A | 5/15/2017 | | 0.570 | 0.650 J | <0.500 | 1.64 J | 0.850 J | 2.49 J |
| AIR STRIPPER EFFLUENT A | 6/06/2017 | | 0.710 | 0.480 J | 0.330 J | 1.67 J | 0.910 J | 2.58 J |
| AIR STRIPPER EFFLUENT A | 6/13/2017 | | <0.200 | <0.500 | <0.500 | <1.00 | <0.500 | <1.50 |
| AIR STRIPPER EFFLUENT B | 3/01/2017 | | 0.220 J | <0.500 | <0.500 | <1.00 | <0.500 | <1.50 |
| AIR STRIPPER EFFLUENT B | 3/15/2017 | | 0.190 J | <0.500 | <0.500 | <1.00 | <0.500 | <1.50 |
| AIR STRIPPER EFFLUENT B | 4/05/2017 | | 0.190 J | <0.500 | <0.500 | <1.00 | <0.500 | <1.50 |
| AIR STRIPPER EFFLUENT B | 4/18/2017 | | 0.280 J | <0.500 | <0.500 | 0.770 J | 0.410 J | 1.18 J |
| AIR STRIPPER EFFLUENT B | 5/03/2017 | | 0.480 | 0.360 J | <0.500 | 1.56 J | 0.780 J | 2.34 J |
| AIR STRIPPER EFFLUENT B | 5/15/2017 | | 0.770 | 0.760 J | 0.380 J | 2.06 | 1.06 | 3.12 |
| AIR STRIPPER EFFLUENT B | 6/06/2017 | | 1.93 | 1.09 | 0.730 J | 3.97 | 1.82 | 5.79 |
| AIR STRIPPER EFFLUENT B | 6/13/2017 | | <0.200 | <0.500 | <0.500 | <1.00 | <0.500 | <1.50 |
| AIR STRIPPER EFFLUENT C | 1/05/2017 | | 0.270 J | <0.500 | <0.500 | 0.700 J | 0.320 J | 1.02 J |
| AIR STRIPPER EFFLUENT C | 1/16/2017 | | 0.510 | <0.500 | <0.500 | 1.25 J | 0.570 J | 1.82 J |
| AIR STRIPPER EFFLUENT C | 2/01/2017 | | 2.02 | 1.43 | 0.740 J | 4.15 | 1.72 | 5.87 |
| AIR STRIPPER EFFLUENT C | 2/15/2017 | | 5.06 | 2.23 | 1.68 | 10.3 | 3.58 | 13.9 |
| AIR STRIPPER EFFLUENT D | 1/05/2017 | | 0.660 | 0.360 J | <0.500 | 1.42 J | 0.680 J | 2.10 J |
| AIR STRIPPER EFFLUENT D | 1/16/2017 | | 1.16 | 0.600 J | 0.470 J | 2.74 | 1.28 | 4.02 |
| AIR STRIPPER EFFLUENT D | 2/01/2017 | | 1.77 | 1.17 | 0.600 J | 3.24 | 1.31 | 4.55 |
| AIR STRIPPER EFFLUENT D | 2/15/2017 | | 4.34 | 2.15 | 1.45 | 8.95 | 3.33 | 12.3 |
| COMBINED INFLUENT | 1/05/2017 | | 37.8 | 15.9 | 12.9 | 62.2 | 14.4 | 76.6 |
| COMBINED INFLUENT | 1/16/2017 | | 32.0 | 13.1 | 11.7 | 55.7 | 13.1 | 68.8 |
| COMBINED INFLUENT | 2/01/2017 | | 32.3 | 12.3 | 10.2 | 51.9 | 11.8 | 63.7 |
| COMBINED INFLUENT | 2/15/2017 | | 29.4 | 13.2 | 10.4 | 55.7 | 13.4 | 69.1 |
| COMBINED INFLUENT | 3/01/2017 | | 26.1 | 9.78 | 9.55 | 49.4 | 11.3 | 60.7 |
| COMBINED INFLUENT | 3/15/2017 | | 23.4 | 9.62 | 9.12 | 45.9 | 10.4 | 56.3 |
| COMBINED INFLUENT | 4/05/2017 | | 22.6 | 9.43 | 8.68 | 47.3 | 10.6 | 57.9 |
| COMBINED INFLUENT | 4/18/2017 | | 27.6 | 16.1 | 11.4 | 61.0 | 15.3 | 76.3 |
| COMBINED INFLUENT | 5/03/2017 | | 22.5 | 11.6 | 9.97 | 51.9 | 12.8 | 64.8 |
| COMBINED INFLUENT | 5/15/2017 | | 29.2 | 15.4 | 12.0 | 58.3 | 15.2 | 73.5 |
| COMBINED INFLUENT | 6/06/2017 | | 24.8 | 12.0 | 9.31 | 42.4 | 11.8 | 54.3 |

**Table 4-2b**
**Remediation System Operation - GAC East Treatment System Performance - BTEX**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Location | Date | Dup | Benzene (µg/L) | Toluene (µg/L) | Ethylbenzene (µg/L) | Xylene, m & p (µg/L) | Xylene, o (µg/L) | Xylene, total (µg/L) |
|---|---|---|---|---|---|---|---|---|
| COMBINED INFLUENT | 6/13/2017 | | 37.4 | 22.4 | 14.8 | 71.5 | 19.4 | 90.9 |
| LEAD VESSEL INLET | 1/05/2017 | | 0.120 J | <0.500 | <0.500 | <1.00 | <0.500 | <1.50 |
| LEAD VESSEL INLET | 1/05/2017 | DUP | 0.120 J | <0.500 | <0.500 | <1.00 | <0.500 | <1.50 |
| LEAD VESSEL INLET | 1/16/2017 | | 0.290 J | <0.500 | <0.500 | <1.00 | <0.500 | <1.50 |
| LEAD VESSEL INLET | 2/01/2017 | | 0.740 | 0.350 J | <0.500 | 0.980 J | 0.440 J | 1.42 J |
| LEAD VESSEL INLET | 2/01/2017 | DUP | 0.750 | 0.350 J | <0.500 | 0.920 J | 0.430 J | 1.35 J |
| LEAD VESSEL INLET | 2/15/2017 | | 2.20 | 0.920 J | 0.580 J | 3.56 | 1.64 | 5.20 |
| LEAD VESSEL INLET | 3/01/2017 | | 0.120 J | <0.500 | <0.500 | <1.00 | <0.500 | <1.50 |
| LEAD VESSEL INLET | 3/01/2017 | DUP | 0.120 J | <0.500 | <0.500 | <1.00 | <0.500 | <1.50 |
| LEAD VESSEL INLET | 3/15/2017 | | <0.200 | <0.500 | <0.500 | <1.00 | <0.500 | <1.50 |
| LEAD VESSEL INLET | 4/05/2017 | | <0.200 | <0.500 | <0.500 | <1.00 | <0.500 | <1.50 |
| LEAD VESSEL INLET | 4/05/2017 | DUP | <0.200 | <0.500 | <0.500 | <1.00 | <0.500 | <1.50 |
| LEAD VESSEL INLET | 4/18/2017 | | 0.140 J | <0.500 | <0.500 | 0.620 J | 0.430 J | 1.05 J |
| LEAD VESSEL INLET | 5/03/2017 | | 0.210 J | <0.500 | <0.500 | <1.00 | <0.500 | <1.50 |
| LEAD VESSEL INLET | 5/03/2017 | DUP | 0.210 J | <0.500 | <0.500 | <1.00 | <0.500 | <1.50 |
| LEAD VESSEL INLET | 5/15/2017 | | 0.380 J | 0.460 J | <0.500 | 0.780 J | 0.440 J | 1.22 J |
| LEAD VESSEL INLET | 6/06/2017 | | 0.820 | 0.440 J | <0.500 | 1.14 J | 0.650 J | 1.79 J |
| LEAD VESSEL INLET | 6/06/2017 | DUP | 0.820 | 0.460 J | <0.500 | 1.12 J | 0.640 J | 1.76 J |
| LEAD VESSEL INLET | 6/13/2017 | | 0.393 J | <0.500 | <0.500 | 0.660 J | 0.379 J | 1.04 J |
| MW-106-25 | 3/01/2017 | | <0.200 | <0.500 | <0.500 | <1.00 | <0.500 | <1.50 |
| MW-141-20 | 3/01/2017 | | <0.200 | <0.500 | <0.500 | <1.00 | <0.500 | <1.50 |
| R-21 | 1/05/2017 | | 55.8 | 6.50 J | 15.6 | 135 | 23.6 | 159 |
| R-21 | 1/05/2017 | DUP | 61.4 | 9.00 J | 17.5 | 152 | 26.7 | 179 |
| R-21 | 2/01/2017 | | 53.3 | 9.00 J | 19.4 | 146 | 26.1 | 172 |
| R-21 | 2/01/2017 | DUP | 48.6 | 9.00 J | 18.8 | 145 | 26.8 | 172 |
| R-21 | 3/01/2017 | | 46.6 | 44.8 | 72.2 | 468 | 121 | 589 |
| R-21 | 3/01/2017 | DUP | 49.1 | 46.0 | 74.2 | 479 | 125 | 604 |
| R-21 | 4/05/2017 | | 35.3 | 12.8 | 19.7 | 169 | 40.7 | 210 |
| R-21 | 4/05/2017 | DUP | 36.0 | 12.9 | 19.6 | 172 | 41.9 | 214 |
| R-21 | 5/03/2017 | | 40.6 | 21.9 | 20.0 | 143 | 30.2 | 173 |
| R-21 | 5/03/2017 | DUP | 39.9 | 22.6 | 20.5 | 144 | 30.7 | 175 |
| R-21 | 6/06/2017 | | 42.0 | 15.5 J* | 20.1 | 136 J* | 31.8 J* | 167 J* |
| R-21 | 6/06/2017 | DUP | 36.8 | 11.4 J* | 15.0 | 99.3 J* | 19.8 J* | 119 J* |
| R-35R | 1/05/2017 | | 29.2 | 2.64 | 16.8 | 59.9 | 5.24 | 65.1 |
| R-35R | 2/01/2017 | | 22.3 | 1.86 | 12.4 | 45.3 | 3.75 | 49.0 |

**Table 4-2b**
**Remediation System Operation - GAC East Treatment System Performance - BTEX**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Location | Date | Dup | Benzene (µg/L) | Toluene (µg/L) | Ethylbenzene (µg/L) | Xylene, m & p (µg/L) | Xylene, o (µg/L) | Xylene, total (µg/L) |
|---|---|---|---|---|---|---|---|---|
| R-35R | 3/01/2017 | | 19.5 | 1.38 | 11.4 | 41.7 | 3.39 | 45.1 |
| R-35R | 4/05/2017 | | 14.8 | 1.37 | 9.07 | 34.2 | 2.17 | 36.4 |
| R-35R | 5/03/2017 | | 16.1 | 1.93 | 12.4 | 40.5 | 2.83 | 43.3 |
| R-35R | 6/06/2017 | | 17.0 | 4.44 | 10.3 | 34.9 | 2.83 | 37.7 |
| R-40 | 1/05/2017 | | 98.1 | 81.0 | 65.2 | 214 | 54.8 | 269 |
| R-40 | 2/01/2017 | | 93.6 | 80.7 | 58.6 | 188 | 49.6 | 238 |
| R-40 | 3/01/2017 | | 69.8 | 61.6 | 45.7 | 152 | 41.9 | 194 |
| R-40 | 4/05/2017 | | 65.6 | 61.2 | 46.9 | 160 | 43.8 | 204 |
| R-40 | 5/03/2017 | | 70.4 | 97.7 | 51.1 | 212 | 71.5 | 283 |
| R-40 | 6/06/2017 | | 82.3 | 102 | 56.0 | 195 | 77.6 | 273 |
| R-42 | 1/05/2017 | | <0.200 | <0.500 | <0.500 | <1.00 | <0.500 | <1.50 |
| R-42 | 2/01/2017 | | <0.200 | <0.500 | <0.500 | <1.00 | <0.500 | <1.50 |
| R-42 | 3/01/2017 | | <0.200 | <0.500 | <0.500 | <1.00 | <0.500 | <1.50 |
| R-42 | 4/05/2017 | | <0.200 | <0.500 | <0.500 | <1.00 | <0.500 | <1.50 |
| R-42 | 5/03/2017 | | <0.200 | <0.500 | <0.500 | <1.00 | <0.500 | <1.50 |
| R-42 | 6/06/2017 | | <0.200 | 0.400 J | <0.500 | <1.00 | <0.500 | <1.50 |
| R-43 | 1/05/2017 | | 43.7 | 7.99 | 5.27 | 22.8 | 8.07 | 30.9 |
| R-43 | 2/01/2017 | | 33.2 | 5.28 | 3.65 | 15.2 | 5.54 | 20.8 |
| R-43 | 3/01/2017 | | 37.0 | 7.58 | 4.65 | 21.1 | 7.78 | 28.9 |
| R-43 | 4/05/2017 | | 29.2 | 6.69 | 3.45 | 16.6 | 6.31 | 22.9 |
| R-43 | 5/03/2017 | | 28.5 | 8.11 | 3.78 | 17.8 | 6.96 | 24.8 |
| R-43 | 6/06/2017 | | 32.8 | 9.04 | 5.18 | 21.1 | 9.02 | 30.1 |
| R-44 | 1/05/2017 | | 1.85 | <0.500 | <0.500 | 1.20 J | <0.500 | 1.20 J |
| R-44 | 2/01/2017 | | 1.54 | <0.500 | <0.500 | 0.790 J | <0.500 | <1.50 |
| R-44 | 3/01/2017 | | 1.26 | <0.500 | <0.500 | 1.17 J | <0.500 | 1.17 J |
| R-44 | 4/05/2017 | | 1.54 | <0.500 | <0.500 | 0.820 J | <0.500 | <1.50 |
| R-44 | 5/03/2017 | | 1.26 | <0.500 | 0.420 J | 2.07 | <0.500 | 2.07 J |
| R-44 | 6/06/2017 | | 1.78 | <0.500 | 1.46 | 4.70 | 0.670 J | 5.37 |
| R-45 | 1/05/2017 | | 110 | 91.9 | 52.9 | 232 | 98.1 | 330 |
| R-45 | 2/01/2017 | | 87.6 | 58.5 | 34.4 | 146 | 58.4 | 205 |
| R-45 | 3/01/2017 | | 73.8 | 51.1 | 34.0 | 149 | 61.6 | 211 |
| R-45 | 4/05/2017 | | 60.6 | 39.6 | 27.5 | 130 | 51.7 | 182 |
| R-45 | 5/03/2017 | | 50.0 | 35.3 | 23.3 | 90.3 | 34.9 | 125 |
| R-45 | 6/06/2017 | | 94.4 | 47.3 | 24.2 | 96.3 | 45.3 | 142 |
| R-46 | 1/05/2017 | | 49.8 | 61.0 | 21.6 | 152 | 40.2 | 192 |

**Table 4-2b**
**Remediation System Operation - GAC East Treatment System Performance - BTEX**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Location | Date | Dup | Benzene (µg/L) | Toluene (µg/L) | Ethylbenzene (µg/L) | Xylene, m & p (µg/L) | Xylene, o (µg/L) | Xylene, total (µg/L) |
|---|---|---|---|---|---|---|---|---|
| R-46 | 2/01/2017 | | 37.8 | 46.2 | 14.8 | 116 | 30.2 | 146 |
| R-46 | 3/01/2017 | | 39.8 | 48.8 | 20.3 | 158 | 41.4 | 200 |
| R-46 | 4/05/2017 | | 27.6 | 30.0 | 13.4 | 110 | 28.0 | 138 |
| R-46 | 5/03/2017 | | 27.7 | 29.8 | 15.1 | 113 | 29.9 | 143 |
| R-46 | 6/06/2017 | | 27.4 | 39.6 | 18.1 | 106 | 30.7 | 137 |
| TRMT SYS EFFLUENT | 1/05/2017 | | <0.200 | <0.500 | <0.500 | <1.00 | <0.500 | <1.50 |
| TRMT SYS EFFLUENT | 1/16/2017 | | <0.200 | <0.500 | <0.500 | <1.00 | <0.500 | <1.50 |
| TRMT SYS EFFLUENT | 2/01/2017 | | <0.200 | <0.500 | <0.500 | <1.00 | <0.500 | <1.50 |
| TRMT SYS EFFLUENT | 2/15/2017 | | <0.200 | <0.500 | <0.500 | <1.00 | <0.500 | <1.50 |
| TRMT SYS EFFLUENT | 3/01/2017 | | <0.200 | <0.500 | <0.500 | <1.00 | <0.500 | <1.50 |
| TRMT SYS EFFLUENT | 3/15/2017 | | <0.200 | <0.500 | <0.500 | <1.00 | <0.500 | <1.50 |
| TRMT SYS EFFLUENT | 4/05/2017 | | <0.200 | <0.500 | <0.500 | <1.00 | <0.500 | <1.50 |
| TRMT SYS EFFLUENT | 4/18/2017 | | <0.200 | <0.500 | <0.500 | <1.00 | <0.500 | <1.50 |
| TRMT SYS EFFLUENT | 5/03/2017 | | <0.200 | <0.500 | <0.500 | <1.00 | <0.500 | <1.50 |
| TRMT SYS EFFLUENT | 5/15/2017 | | <0.200 | <0.500 | <0.500 | <1.00 | <0.500 | <1.50 |
| TRMT SYS EFFLUENT | 6/06/2017 | | <0.200 | <0.500 | <0.500 | <1.00 | <0.500 | <1.50 |
| TRMT SYS EFFLUENT | 6/13/2017 | | <0.200 | <0.500 | <0.500 | <1.00 | <0.500 | <1.50 |

**Acronyms and Abbreviations:**
< = not detected; limit of detection (LOD) listed, flag applied by laboratory
BTEX = benzene, toluene, ethylbenzene, xylenes
DUP = field duplicate sample
J = estimated concentration detected above the detection limit (DL) and below the limit of quantitation (LOQ); flag applied by laboratory.
J*= estimated concentration due to quality control (QC) failures or lack of field QC samples, flag applied by Shannon & Wilson, Inc.
µg/L = micrograms per liter

**Table 4-2c**
**Remediation System Operation - GAC East Treatment System Performance - SVOCs**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Location | Date | Dup | Acenaphthene (µg/L) | Acenaphthylene (µg/L) | Anthracene (µg/L) | Benz(a) anthracene (µg/L) | Benzo(a) pyrene (µg/L) | Benzo(b) fluoranthene (µg/L) | Benzo(g,h,i) perylene (µg/L) | Benzo(k) fluoranthene (µg/L) | Chrysene (µg/L) | Dibenz(a,h) anthracene (µg/L) | Fluoranthene (µg/L) | Fluorene (µg/L) | Indeno(1,2,3-cd) pyrene (µg/L) | Naphthalene (µg/L) | Phenanthrene (µg/L) | Pyrene (µg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MW-106-25 | 3/01/2017 | | <0.0245 | <0.0245 | <0.0245 | <0.0245 | <0.00980 | <0.0245 | <0.0245 | <0.0245 | <0.0245 | <0.00980 | <0.0245 | <0.0245 | <0.0245 | <0.0490 | <0.0245 | <0.0245 |
| MW-141-20 | 3/01/2017 | | <0.0251 | <0.0251 | <0.0251 | <0.0251 | <0.0101 | <0.0251 | <0.0251 | <0.0251 | <0.0251 | <0.0101 | <0.0251 | <0.0251 | <0.0251 | <0.0500 | <0.0251 | <0.0251 |
| TRMT SYS EFFLUENT | 1/05/2017 | | <0.0236 J* | <0.0236 J* | <0.0236 J* | <0.0236 J* | <0.00945 J* | <0.0236 J* | <0.0236 J* | <0.0236 J* | <0.0236 J* | <0.00945 J* | <0.0236 J* | <0.0236 J* | <0.0236 J* | 0.0382 J* | 0.0190 J* | <0.0236 J* |
| TRMT SYS EFFLUENT | 2/01/2017 | | <0.0240 | <0.0240 | <0.0240 | <0.0240 | <0.00960 | <0.0240 | <0.0240 | <0.0240 | <0.0240 | <0.00960 | <0.0240 | <0.0240 | <0.0240 | <0.0481 | <0.0240 | <0.0240 |
| TRMT SYS EFFLUENT | 2/16/2017 | | <0.0236 | <0.0236 | <0.0236 | <0.0236 | <0.00945 | <0.0236 | <0.0236 | <0.0236 | <0.0236 | <0.00945 | <0.0236 | <0.0236 | <0.0236 | <0.0471 | <0.0236 | <0.0236 |
| TRMT SYS EFFLUENT | 3/01/2017 | | <0.0125 | <0.0125 | <0.0125 | <0.0125 | <0.00500 | <0.0125 | <0.0125 | <0.0125 | <0.0125 | <0.00500 J* | <0.0125 | <0.0125 | <0.0125 | <0.0250 | <0.0125 | <0.0125 |
| TRMT SYS EFFLUENT | 4/05/2017 | | <0.0245 | <0.0245 | <0.0245 | <0.0245 | <0.00980 | <0.0245 | <0.0245 | <0.0245 | <0.0245 | <0.00980 | <0.0245 | <0.0245 | <0.0245 | <0.0490 | 0.0176 J | 0.0548 |
| TRMT SYS EFFLUENT | 5/03/2017 | | <0.0240 | <0.0240 | <0.0240 | <0.0240 | <0.00960 | <0.0240 | <0.0240 | <0.0240 | <0.0240 | <0.00960 | <0.0240 | <0.0240 | <0.0240 | <0.0481 | <0.0240 | <0.0240 |
| TRMT SYS EFFLUENT | 6/06/2017 | | <0.0236 | <0.0236 | <0.0236 | <0.0236 | <0.00945 | <0.0236 | <0.0236 | <0.0236 | <0.0236 | <0.00945 | <0.0236 | <0.0236 | <0.0236 | <0.0471 | <0.0236 | <0.0236 |

**Acronyms and Abbreviations:**
< = not detected; limit of detection (LOD) listed, flag applied by laboratory
DUP = field duplicate sample
J = estimated concentration detected above the detection limit (DL) and below the limit of quantitation (LOQ), flag applied by laboratory.
J*= estimated concentration due to quality control (QC) failures or lack of field QC samples, flag applied by Shannon & Wilson, Inc.
SVOCs = semi volatile organic compounds
µg/L = micrograms per liter

**Table 4-2d**
**Remediation System Operation - GAC East Treatment System Performance - TOC**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Location | Date | Dup | Carbon, total organic (mg/L) |
|---|---|---|---|
| COMBINED INFLUENT | 1/05/2017 | | 2.27 |
| LEAD VESSEL INLET | 1/05/2017 | | 1.99 |
| LEAD VESSEL INLET | 1/05/2017 | DUP | 1.95 |
| TRMT SYS EFFLUENT | 1/05/2017 | | 1.72 |

**Acronyms and Abbreviations:**
DUP = field duplicate sample
mg/L = milligrams per liter
TOC = Total Organic Carbon

**Table 4-3**
**2017 LNAPL Recovery**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| 2017 | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MW-115-15 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | 0.0 |
| MW-138-20 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | 0.0 |
| MW-176A-15 | 0.7 | 3.7 | 0.8 | 0.7 | 1.2 | 0.9 | | | | | | | 7.8 |
| MW-186A-15 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | 0.0 |
| MW-334-15 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | 0.0 |
| MW-366-15 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | 0.0 |
| O-2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | 0.0 |
| O-10 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | 0.0 |
| O-11 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | 0.0 |
| O-13 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | 0.0 |
| O-19 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | 0.0 |
| O-21 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | | | | | | | 0.3 |
| O-27 | 0.0 | 0.0 | 0.2 | 0.1 | 0.0 | 0.0 | | | | | | | 0.3 |
| O-31 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | 0.0 |
| O-33 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | 0.0 |
| O-34 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | 0.0 |
| O-37 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | 0.0 |
| O-38 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | 0.0 |
| S-21 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | 0.0 |
| S-22 | 0.0 | 0.0 | 0.4 | 0.5 | 0.0 | 0.0 | | | | | | | 0.9 |
| S-39 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | | | | | | | 0.3 |
| S-44 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | 0.0 |
| S-50 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | 0.0 |
| S-51 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | 0.0 |
| R-14A | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | 0.0 |
| R-18 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | 0.0 |
| R-20R | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | 0.0 |
| R-21 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 18.5 | | | | | | | 18.5 |
| R-32 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | | | | | | | 0.3 |
| R-32R | 0.0 | 0.0 | 5.0 | 4.5 | 0.0 | 0.0 | | | | | | | 9.5 |
| R-34 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | 0.0 |
| R-35R | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | 0.0 |
| R-40 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5.2 | | | | | | | 5.2 |
| R-44 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | 0.0 |
| R-45 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | | | | | | 0.0 |

**Table 4-3**
**2017 LNAPL Recovery**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| 2017 | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Coalescer | NA | NA | NA | NA | NA | NA | | | | | | | NA |
| TOTAL | 0.7 | 3.7 | 7.4 | 5.7 | 1.2 | 24.6 | | | | | | | 43.2 |

**General Notes:**

All unit in gallons.

This summary includes only product that has been recovered for recycling. Product that has been recovered but has not yet been removed from the storage tank for recycling is not included in the table.

NA = not applicable, coalescer is not currently online.

**Table 4-4**
**Annual LNAPL Recovery**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Well ID | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | Well Total (gallons) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R-1 | 3,243 | 1,165 | 340 | 218 | 60 | 35 | 25 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Removed July 2008 | | | | | | | | | | 5,086 |
| R-2 | 1,538 | 1,546 | 175 | 40 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Destroyed prior to 2008 | | | | | | | | | | 3,299 |
| R-3 | 39 | 313 | 0 | 42 | 25 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 419 |
| R-4 | 412 | 430 | 110 | 148 | 20 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,140 |
| R-5&5A | 4,170 | 3,606 | 978 | 1,464 | 1,115 | 447 | 316 | 209 | 141 | 321 | 175 | 236 | 222 | 25 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13,425 |
| R-6 | 25 | 55 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Removed October 2009 | | | | | | | | | 80 |
| R-7 & 8 | 14,216 | 17,108 | 67 | 809 | 1,438 | 575 | 1,793 | 1,693 | 385 | 250 | 0 | Removed | | | | | | | | | | | | | | | | | | | | | 38,334 |
| R-9 | 11,011 | 22,378 | 744 | 479 | 385 | 510 | 1,036 | 565 | 106 | 71 | 23 | 25 | 29 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 2 | 0 | Removed October 2011 | | | | | | 37,381 |
| R-10&10A | 2,558 | 5,271 | 200 | 352 | 280 | 127 | 0 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Removed May 2005 | | | | | | | | | | | | | 8,808 |
| R-11 | 15,796 | 14,920 | 724 | 241 | 190 | 5 | 0 | 317 | 444 | 117 | 0 | 0 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | Removed May 2005 | | | | | | | | | | | | | 32,765 |
| R-12 | 4,099 | 0 | 80 | 51 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Removed September 2012 | | | | | | 4,230 |
| R-13 | 1,044 | 3,563 | 79 | 177 | 55 | 0 | 27 | 15 | 62 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Removed October 2011 | | | | | | 5,022 |
| R-14&14A | 4,664 | 773 | 125 | 341 | 344 | 48 | 116 | 182 | 96 | 123 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 6,813 |
| R-18 | 0 | 1,955 | 5,128 | 13 | 0 | 10 | 17 | 0 | 151 | 30 | 0 | 25 | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 29 | 5 | 101 | 9 | 8 | 0 | 8 | 0 | 7,498 |
| R-19 | 0 | 6,106 | 1,623 | 106 | 90 | 30 | 138 | 496 | 205 | 9 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 14 | Removed August 2010 | | | | | | | 8,831 |
| R-20 & 20R | 0 | 5,165 | 28,603 | 46 | 281 | 2,443 | 2,193 | 1,131 | 296 | 69 | 123 | 112 | 88 | 115 | 33 | 56 | 16 | 0 | 94 | 46 | 100 | 87 | 49 | 50 | 48 | 34 | 144 | 87 | 0.1 | 19 | 59 | 0 | 41,587 |
| R-21 | 0 | 4,859 | 46,028 | 767 | 422 | 175 | 370 | 5,993 | 6,621 | 1,441 | 2,154 | 1,118 | 3,364 | 737 | 314 | 207 | 112 | 303 | 786 | 1,225 | 157 | 6,489 | 2,799 | 92 | 2,403 | 2,254 | 629 | 225 | 216 | 57 | 386 | 19 | 92,720 |
| R-22 | 0 | 0 | 411 | 136 | 45 | 101 | 775 | 34 | 0 | 64 | 26 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 1,598 |
| R-23 | 0 | 210 | 147 | 0 | 0 | 15 | 7 | 183 | 71 | 33 | 12 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Removed May 2005 | | | | | | | | | | | | | 683 |
| R-24 | 0 | 1,070 | 109 | 30 | 0 | 30 | 18 | 254 | 156 | 5 | 40 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Removed May 2005 | | | | | | | | | | | | | 1,712 |
| R-25 | 0 | 435 | 44 | 20 | 30 | 70 | 91 | 227 | 177 | 62 | 40 | 62 | 5 | 0 | 21 | 0 | 0 | 0 | 0 | Removed May 2005 | | | | | | | | | | | | | 1,284 |
| R-26 | 0 | 0 | 26 | 73 | 157 | 149 | 79 | 57 | 47 | 13 | 12 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Removed May 2005 | | | | | | | | | | | | | 615 |
| R-27 | 0 | 460 | 477 | 120 | 305 | 124 | 68 | 25 | 55 | 26 | 0 | 9 | 54 | 11 | 3 | 0 | 0 | 0 | 0 | Removed May 2005 | | | | | | | | | | | | | 1,737 |
| R-28 | 0 | 35 | 14 | 10 | 78 | 0 | 48 | 40 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Removed May 2005 | | | | | | | | | | | | | 232 |
| R-29 | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 40 | 21 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | Removed October 2011 | | | | | | 75 |
| R-30 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 26 | 21 | 0 | 14 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 0 | Removed October 2011 | | | | | | 82 |
| R-31 | 0 | 2,255 | 3,452 | 269 | 110 | 350 | 316 | 340 | 343 | 20 | 52 | 85 | 110 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Destroyed-approximately 2012 | | | | | 7,708 |
| R-32 | 0 | 7,360 | 5,498 | 394 | 543 | 1,089 | 1,242 | 1,074 | 1,642 | 555 | 118 | 315 | 602 | 141 | 18 | 56 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 55 | 318 | 25 | 453 | 198 | 159 | 31 | 196 | 0.3 | 22,081 |
| R-32R | Installed September 2013 | | | | | | | | | | | | | | | | | | | | | | | | | | | 0 | 2 | 11 | 30 | 9.5 | 52 |
| R-33 | 0 | 0 | 162 | 47 | 290 | 685 | 19 | 112 | 50 | 0 | 25 | 22 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 1,434 |
| R-34 | 0 | 0 | 201 | 1,216 | 4,922 | 2,734 | 4,208 | 3,177 | 5,923 | 3,077 | 508 | 193 | 200 | 407 | 190 | 5 | 155 | 110 | 502 | 327 | 913 | 201 | 0 | 11 | 43 | 4 | 46 | 17 | 13 | 0 | 9 | 0 | 29,310 |
| R-35 & 35R | 0 | 0 | 22 | 37 | 1,042 | 2,659 | 740 | 468 | 26 | 0 | 0 | 0 | 0 | 0 | 4 | 5 | 0 | 0 | 13 | 0 | 0 | 0 | 0 | 18 | 234 | 201 | 358 | 0 | 0 | 1 | 0 | 0 | 5,828 |
| R-36 | 0 | 0 | 20 | 23 | 0 | 0 | 191 | 261 | 491 | 0 | 26 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Removed-approximately 2010 | | | | | | | | 1,016 |
| R-37 | 0 | 0 | 8 | 15 | 65 | 1,147 | 297 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Destroyed- approximately 2010 | | | | | | | | 1,532 |
| R-39 | 0 | 0 | 0 | 0 | 50 | 336 | 40 | 68 | 27 | 0 | 0 | 1,261 | 1,090 | 6 | 61 | 7 | 4 | 9 | 1 | 4 | 21 | 0 | 58 | 2 | 33 | 46 | 17 | 0 | 0 | 0 | 0 | 0 | 3,141 |
| R-40 | 0 | 0 | 0 | 0 | 0 | 141 | 128 | 27 | 0 | 0 | 0 | 0 | 0 | 0 | 28 | 173 | 85 | 85 | 106 | 27 | 211 | 58 | 253 | 46 | 19 | 350 | 512 | 37 | 5 | 122 | 1 | 5.2 | 2,419 |
| R-44 | Installed April 2013 | | | | | | | | | | | | | | | | | | | | | | | | | | | 4 | 0.1 | 0 | 2 | 0 | 5 |
| R-45 | Installed April 2013 | | | | | | | | | | | | | | | | | | | | | | | | | | | 95 | 0 | 0 | 0 | 0 | 95 |
| MW-115-15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.01 | 0 | 0.01 |
| MW-138-20 | Installed April 2001 | | | | | | | | | | | | | | | 0 | 0 | 76 | 352 | 469 | 365 | 367 | 187 | 321 | 216 | 144 | 286 | 10 | 2.0 | 9.4 | 0 | 0 | 2,804 |
| MW-176A-15 | Installed October 2010 | | | | | | | | | | | | | | | | | | | | | | | | 0 | 0 | 4 | 6 | 7.1 | 19 | 20 | 7.8 | 63 |
| MW-186A-15 | Installed October 2010 | | | | | | | | | | | | | | | | | | | | | | | | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| MW-334-15 | Installed August 2012 | | | | | | | | | | | | | | | | | | | | | | | | | | 11 | 66 | 1141 | 336 | 440 | 0 | 1,994 |
| MW-366-15 | Installed December 2013 | | | | | | | | | | | | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0.7 | 0 | 0.7 |
| S-21 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.3 | 0.3 | 0.2 | 0 | 0.1 | 0 | 0.8 |
| S-22 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.7 | 7 | 7 | 0.9 | 18 |
| S-27 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 340 | 0 | 0 | 2 | 1 | 0 | 4 | 0 | 0 | Removed May 2005 | | | | | | | | | | | | | 347 |
| S-28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 44 | 0 | 0 | 0 | 1 | 3 | 1 | 0 | 0 | Removed May 2005 | | | | | | | | | | | | | 49 |
| S-33 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 28 | 0 | 0 | 0 | 0 | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Destroyed-Approximately 2011 | | | | | | 37 |
| S-34 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 38 | 4 | 0 | 0 | 0 | 1 | Removed after 2001 | | | | | | | | | | | | | | | | 43 |
| S-39 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.5 | 0.6 | 0.7 | 2 | 0.3 | 4 |
| S-40 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 53 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Removed September 2012 | | | | | 53 |
| S-42 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 |
| S-44 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 2 | 5 | 0 | 13 |
| S-46 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 50 | 21 | 0 | Removed May 1999 | | | | | | | | | | | | | | | | | | | 71 |
| S-47 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 92 | 9 | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 104 |
| S-48 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 225 | 44 | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 272 |
| S-49 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 450 | 401 | 181 | 38 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,071 |

**Table 4-4**
**Annual LNAPL Recovery**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Well ID | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | Well Total (gallons) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S-50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 0 | 0 | 3 | 4 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 4 | 0 | 3 | 12 | 5 | 8 | 10 | 0 | 63 |
| S-51 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 65 | 0 | 0 | 0 | 1 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0.8 | 7 | 10 | 0 | 89 |
| S-52 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 70 | 22 | 0 | 3 | 6 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | Removed September 2012 | | | | | 108 |
| O-2 | Installed September 2010 | | | | | | | | | | | | | | | | | | | | | | | | 0 | 176 | 0.1 | 0 | 0 | 0 | 0.2 | 0 | 176 |
| O-9 | Installed September 2011 | | | | | | | | | | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0.4 | 0 | 0 | 0 | 0 |
| O-10 | Installed September 2011 | | | | | | | | | | | | | | | | | | | | | | | | | 0 | 12 | 10 | 2.5 | 0 | 8 | 0 | 32 |
| O-11 | Installed September 2011 | | | | | | | | | | | | | | | | | | | | | | | | | 0 | 0.6 | 0.1 | 0.1 | 3 | 0.2 | 0 | 4 |
| O-13 | Installed September 2011 | | | | | | | | | | | | | | | | | | | | | | | | | 0 | 2 | 0 | 0.8 | 0 | 3 | 0 | 7 |
| O-19 | Installed October 2011 | | | | | | | | | | | | | | | | | | | | | | | | | 0 | 0.3 | 0 | 0.4 | 2 | 2.1 | 0 | 4 |
| O-21 | Installed October 2011 | | | | | | | | | | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 | 1 | 0.8 | 0.3 | 2 |
| O-27 | Installed November 2011 | | | | | | | | | | | | | | | | | | | | | | | | | 0 | 0.2 | 0.3 | 0 | 0 | 0.3 | 0.3 | 1 |
| O-31 | Installed September 2013 | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | 2.5 | 23 | 29 | 0 | 55 |
| O-33 | Installed September 2013 | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | 1.7 | 2 | 6 | 0 | 11 |
| O-34 | Installed September 2013 | | | | | | | | | | | | | | | | | | | | | | | | | | | 6 | 5.8 | 3 | 17 | 0 | 32 |
| O-37 | Installed November 2011 | | | | | | | | | | | | | | | | | | | | | | | | | 0 | 0 | 0 | 0 | 0 | 0.01 | 0 | 0.01 |
| O-38 | Installed September 2013 | | | | | | | | | | | | | | | | | | | | | | | | | | | 0 | 0.5 | 4 | 7 | 0 | 12 |
| Coalescer | Installed December 2009 | | | | | | | | | | | | | | | | | | | | | | | 0 | 264 | 355 | 38 | 18 | 19 | 0 | 0 | 0 | 694 |
| Annual Total | 62,815 | 101,038 | 95,611 | 7,684 | 12,342 | 14,059 | 14,298 | 17,008 | 17,562 | 6,342 | 4,573 | 4,111 | 5,972 | 1,505 | 703 | 537 | 393 | 583 | 1,854 | 2,150 | 1,767 | 7,201 | 3,345 | 635 | 3,634 | 3,603 | 2,625 | 804 | 1,595 | 669 | 1,257 | 43 | 398,318 |

**General Notes:**
All unit in gallons

**Table 4-5**
**Groundwater Recovery System - BTEX Mass Recovery**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Date | GAC East Groundwater Recovery (gpm) | Recovered Benzene Concentration (µg/L) | Benzene Mass Recovery (lb/day) | Recovered Toluene Concentration (µg/L) | Toluene Mass Recovery (lb/day) | Recovered Ethylbenzene Concentration (µg/L) | Ethylbenzene Mass Recovery (lb/day) | Recovered Total Xylene Concentration (µg/L) | Total Xylene Mass Recovery (lb/day) | Total BTEX Mass Recovered Per Month (lbs)[1] |
|---|---|---|---|---|---|---|---|---|---|---|
| 1/5/2017[2] | 344.2 | 37.8 | 0.16 | 15.9 | 0.07 | 12.9 | 0.05 | 76.6 | 0.32 | 17.2 |
| 1/16/2017[2] | 347.2 | 32.0 | 0.13 | 13.1 | 0.05 | 11.7 | 0.05 | 68.8 | 0.29 | |
| 2/1/2017[2] | 351.4 | 32.3 | 0.14 | 12.3 | 0.05 | 10.2 | 0.04 | 63.7 | 0.27 | 14.0 |
| 2/15/2017[2] | 343.5 | 29.4 | 0.12 | 13.2 | 0.05 | 10.4 | 0.04 | 69.1 | 0.29 | |
| 3/1/2017[2] | 353.1 | 26.1 | 0.11 | 9.78 | 0.04 | 9.55 | 0.04 | 60.7 | 0.26 | 13.3 |
| 3/15/2017[2] | 348.1 | 23.4 | 0.10 | 9.62 | 0.04 | 9.12 | 0.04 | 56.3 | 0.24 | |
| 4/5/2017[2] | 349.4 | 22.6 | 0.09 | 9.43 | 0.04 | 8.68 | 0.04 | 57.9 | 0.24 | 14.7 |
| 4/18/2017[2] | 358.2 | 27.6 | 0.12 | 16.1 | 0.07 | 11.4 | 0.05 | 76.3 | 0.33 | |
| 5/3/2017[2] | 345.2 | 22.5 | 0.09 | 11.6 | 0.05 | 9.97 | 0.04 | 64.8 | 0.27 | 15.4 |
| 5/15/2017[2] | 347.0 | 29.2 | 0.12 | 15.4 | 0.06 | 12.0 | 0.05 | 73.5 | 0.31 | |
| 6/6/2017[2] | 337.3 | 24.8 | 0.10 | 12.0 | 0.05 | 9.31 | 0.04 | 54.3 | 0.22 | 16.4 |
| 6/13/2017[2] | 343.8 | 37.4 | 0.15 | 22.4 | 0.09 | 14.8 | 0.06 | 90.9 | 0.38 | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| First Quarter 2017 Average | 0.13 | First Quarter 2017 Average | 0.05 | First Quarter 2017 Average | 0.05 | First Quarter 2017 Average | 0.28 |
| Second Quarter 2017 Average | 0.11 | Second Quarter 2017 Average | 0.06 | Second Quarter 2017 Average | 0.06 | Second Quarter 2017 Average | 0.29 |

| | |
|---|---|
| Total BTEX First Quarter 2017 Average (lb/day) | 0.50 |
| Total BTEX Second Quarter 2017 Average (lb/day) | 0.52 |
| Total BTEX Removal First Quarter 2017 (lbs) | 44.4 |
| Total BTEX Removal Second Quarter 2017 (lbs) | 46.4 |
| Total BTEX Removal First and Second Quarter (lbs) | 90.8 |

**Footnotes:**
1. Total mass recovered based on measured recovery rate at time of sampling and average runtime for each quarter.
2. BTEX concentrations reported and mass removed calculations based on sampling at Combined Influent.

**Acronyms and Abbreviations:**
BTEX = benzene, toluene, ethylbenzene, xylenes
gpm = gallons per minute
lbs = pounds
lb/day = pounds per day
µg/L = micrograms per liter

**Table 4-6**
**Groundwater Recovery System - Sulfolane Mass Recovery GAC East Recovery Wells**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Date | R-21 | | | R-35R | | | R-40 | | | R-42 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Groundwater Recovery (gpm) | Recovered Sulfolane Concentration (µg/L) | Sulfolane Mass Recovery (lb/day) | Groundwater Recovery (gpm) | Recovered Sulfolane Concentration (µg/L) | Sulfolane Mass Recovery (lb/day) | Groundwater Recovery (gpm) | Recovered Sulfolane Concentration (µg/L) | Sulfolane Mass Recovery (lb/day) | Groundwater Recovery (gpm) | Recovered Sulfolane Concentration (µg/L) | Sulfolane Mass Recovery (lb/day) |
| 1/05/2017 | 41 | 235 | 0.11 | 50 | 36.1 | 0.02 | 18 | 23.0 | 0.005 | 60 | 14.6 | 0.01 |
| 2/01/2017 | 41 | 223 | 0.11 | 51 | 35.0 | 0.02 | 17 | 20.2 | 0.004 | 60 | 16.9 | 0.01 |
| 3/01/2017 | 41 | 211 | 0.10 | 50 | 33.7 | 0.02 | 18 | 22.6 | 0.005 | 60 | 16.0 | 0.01 |
| 4/05/2017 | 41 | 204 | 0.10 | 51 | 32.0 | 0.02 | 17 | 21.0 | 0.004 | 60 | 16.5 | 0.01 |
| 5/03/2017 | 41 | 193 | 0.09 | 51 | 30.2 | 0.02 | 17 | 20.3 | 0.004 | 60 | 16.1 | 0.01 |
| 6/06/2017 | 40 | 184 | 0.09 | 50 | 23.1 | 0.01 | 16 | 17.6 | 0.003 | 60 | 15.4 | 0.01 |
| First Quarter 2017 Average | | | 0.11 | First Quarter 2017 Average | | 0.02 | First Quarter 2017 Average | | 0.005 | First Quarter 2017 Average | | 0.01 |
| Second Quarter 2017 Average | | | 0.09 | Second Quarter 2017 Average | | 0.02 | Second Quarter 2017 Average | | 0.004 | Second Quarter 2017 Average | | 0.01 |

| Date | R-43 | | | R-44 | | | R-45 | | | R-46 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Groundwater Recovery (gpm) | Recovered Sulfolane Concentration (µg/L) | Sulfolane Mass Recovery (lb/day) | Groundwater Recovery (gpm) | Recovered Sulfolane Concentration (µg/L) | Sulfolane Mass Recovery (lb/day) | Groundwater Recovery (gpm) | Recovered Sulfolane Concentration (µg/L) | Sulfolane Mass Recovery (lb/day) | Groundwater Recovery (gpm) | Recovered Sulfolane Concentration (µg/L) | Sulfolane Mass Recovery (lb/day) |
| 1/05/2017 | 60 | 87.6 | 0.06 | 61 | 39.3 | 0.03 | 33 | 37.4 | 0.01 | 28 | < 5.05 | 0.00 |
| 2/01/2017 | 62 | 86.1 | 0.06 | 61 | 38.9 | 0.03 | 36 | 36.7 | 0.02 | 32 | < 5.05 | 0.00 |
| 3/01/2017 | 62 | 77.9 | 0.06 | 61 | 34.4 | 0.03 | 36 | 30.7 | 0.01 | 30 | < 5.20 | 0.00 |
| 4/05/2017 | 60 | 85.4 | 0.06 | 61 | 33.7 | 0.02 | 32 | 34.2 | 0.01 | 31 | < 5.00 | 0.00 |
| 5/03/2017 | 60 | 79.2 | 0.06 | 60 | 32.0 | 0.02 | 32 | 32.1 | 0.01 | 31 | < 5.20 | 0.00 |
| 6/06/2017 | 59 | 76.1 | 0.05 | 60 | 29.2 | 0.02 | 34 | 26.7 | 0.01 | 30 | < 5.25 | 0.00 |
| First Quarter 2017 Average | | | 0.06 | First Quarter 2017 Average | | 0.03 | First Quarter 2017 Average | | 0.01 | First Quarter 2017 Average | | 0.00 |
| Second Quarter 2017 Average | | | 0.06 | Second Quarter 2017 Average | | 0.02 | Second Quarter 2017 Average | | 0.01 | Second Quarter 2017 Average | | 0.00 |

**Acronyms and Abbreviations:**
gpm = gallons per minute
lb/day = pounds per day
µg/L = micrograms per liter

**Table 4-7**
**Overall Groundwater Recovery System - Sulfolane Mass Recovery**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Date | GAC East Groundwater Recovery (gpm) | GAC East Recovered Sulfolane Concentration (µg/L)* | Sulfolane Mass Recovery Rate (lb/day) | Sulfolane Mass Recovery (lbs)[1] |
|---|---|---|---|---|
| 1/05/2017 | 344.2 | 58.1 | 0.24 | 7.4 |
| 2/01/2017 | 351.4 | 58.0 | 0.24 | 6.8 |
| 3/01/2017 | 353.1 | 51.9 | 0.22 | 6.8 |
| 4/05/2017 | 346.6 | 54.5 | 0.23 | 6.8 |
| 5/03/2017 | 345.2 | 52.0 | 0.22 | 6.7 |
| 6/06/2017 | 337.3 | 46.0 | 0.19 | 5.6 |

| | |
|---|---|
| Total Sulfolane First Quarter 2017 Average (lb/day) | 0.24 |
| Total Sulfolane Second Quarter 2017 Average (lb/day) | 0.21 |
| Total Sulfolane Removal First Quarter 2017[1] (lbs) | 21.0 |
| Total Sulfolane Removal Second Quarter 2017[1] (lbs) | 19.1 |
| Total Sulfolane Removal First and Second Quarter (lbs) | 40.1 |

**General Notes:**
* = as measured at the combined air stripper influent
**Footnote:**
1. Mass recovered based on measured recovery rate and runtime for each month.
**Acronyms and Abbreviations:**
gpm = gallons per minute
lbs = pounds
lb/day = pounds per day
µg/L = micrograms per liter

**Table 4-8**
**Summary of Routine and Non-Routine Repairs, Changes, and Maintenance**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Event Date | Location(s) | Downtime-When applicable (hours) | Description |
|---|---|---|---|
| 1/24/2017 | R-35R, R-43, R-44, R-45, R-46 | 0.3 to 0.6 | Interim well rehabilitation including brushing, and hydropuls |
| 1/28/2017 | R-21, R-35R ,R-40, R-42, R-43, R-44, R-45, R-46 | 3.5 | All wells off for sand filter inspection and maintenance |
| 2/2/2017 | R-21, R-35R ,R-40, R-42, R-43, R-44, R-45, R-46 | 4.0 | All wells off for sand filter inspection, and collection of samples from the sand filters and gallery pond. |
| 2/15/2017 | R-35R, R-43, R-44, R-45, R-46 | 0.2 to 0.5 | Interim well rehabilitation including brushing, and hydropuls |
| 2/17/2017 | R-21, R-35R ,R-40, R-42, R-43, R-44, R-45, R-46 | 1.2 | All wells off to add media to sand filter vessels |
| 3/10/2017 | R-45, R-46 | 0.2 to 0.6 | Interim well rehabilitation including brushing, and hydropuls |
| 3/29/2017 | R-45, R-46 | 0.3 to 1.0 | Interim well rehabilitation including brushing, and hydropuls |
| 3/30/2017 | R-21, R-35R ,R-40, R-42, R-43, R-44, R-45, R-46 | 5.5 to 6.0 | All wells off for extended backwashing of sand filters |
| 4/15/2017 | R-21, R-35R ,R-40, R-43, R-44, R-45, R-46 | 0.2 | All wells except R-42 off due to high-level in gallery pond during backwashing of GAC vessels |
| 4/18/2017 | R-45, R-46 | 0.3 to 0.4 | Interim well rehabilitation including brushing, and hydropuls |
| 5/9/2017 | R-45, R-46 | 0.4 | Interim well rehabilitation including brushing, and hydropuls |
| 5/31/2017 | R-45, R-46 | 0.3 to 0.4 | Interim well rehabilitation including brushing, and hydropuls |
| 6/20/2017 | R-45, R-46 | 0.2 to 0.3 | Interim well rehabilitation including brushing, and hydropuls |

**Table 5-1**
**Concentration Trends in the Remediation System Performance Monitoring Network - Sulfolane**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Location | | Screen Interval | Mann-Kendall Trend [a] | Qualitative Evaluation [b] |
|---|---|---|---|---|
| Upgradient Wells | MW-130-25 | 19 to 23 ft bgs | Decreasing | Decreasing with potential seasonal variation |
| | MW-175-90 | 85.8 - 90.3 ft bgs | All results ND | Stable, all results ND |
| | MW-369-16 | Water Table | Stable | Stable, potential increase in 2017 |
| | MW-369-55 | 50.9 - 55.4 ft bgs | Decreasing | Decreasing with potential seasonal variation |
| | MW-369-75 | 70.1 - 74.6 ft bgs | Stable | Decreasing with potential seasonal variation |
| | O-6 | Water Table | No trend | Fluctuating, decreasing past 5 events |
| | O-19 | Water Table | Decreasing | Decreasing with potential seasonal variation |
| | O-19-55 | 49.5 - 53.9 ft bgs | Stable | Decreasing with potential seasonal variation |
| | O-19-90 | 85.7 - 90.2 ft bgs | Probably Decreasing | Stable, all results ND or <LOQ |
| | S-43 | Water Table | No Trend | Stable, all results <15 µg/L except for 4Q 2014 |
| | S-51 | Water Table | Decreasing | Decreasing with potential seasonal variation |
| Treatment Zone Wells | MW-113-15 | 11.5 - 15 ft bgs | Decreasing | Decreasing, with fluctuations likely due to recovery well pumping |
| | MW-125-25 | 19.5 - 24.0 ft bgs | No trend | Stable, all results ND or <LOQ since 2011 |
| | MW-186A-15 | Water Table | Decreasing | Decreasing overall, stable since 2Q 2013 |
| | MW-186B-60 | 50-60 ft bgs | Stable | Stable with potential seasonal variation |
| | MW-186E-75 | 70-75 ft bgs | Stable | Stable with potential seasonal variation |
| | MW-199-150 | 144.7 - 149.4 ft bgs | All results ND | Stable, all results ND |
| | MW-309-15 | Water Table | Decreasing | Decreasing with potential seasonal variation or increase due to R-47 shutdown |
| | MW-309-66 | 59-64 ft bgs | Decreasing | Decreasing, last 8 results ND or <LOQ |
| | MW-334-15 | Water Table | Decreasing | Decreasing overall, stable since 2Q 2013 |
| | MW-334-65 | 60-65 ft bgs | No trend | Stable, all results ND or <LOQ |
| | MW-344-15 | Water Table | Probably Decreasing | Decreasing with potential seasonal variation |
| | MW-344-55 | 51.6 - 56.2 ft bgs | Decreasing | Decreasing, all results ND or <LOQ |
| | MW-344-75 | 70.8 - 75.3 ft bgs | All results ND | Stable, all results ND |
| | MW-345-15 | Water Table | Decreasing | Decreasing |
| | MW-345-55 | 50.3 - 54.9 ft bgs | Increasing | Increasing with potential seasonal variation |
| | MW-345-75 | 71.0 - 75.0 ft bgs | Increasing | Increasing with potential seasonal variation |
| | MW-370-15 | Water Table | Stable | Stable until increase in 4Q 2016 likely related to R-48 shutdown, decreasing past 2 events. |
| | MW-370-55 | 50.5 - 55.1 ft bgs | Probably Decreasing | Stable until increase in 4Q 2016 likely related to R-48 shutdown, decreasing past 2 events. |
| | MW-370-75 | 70.6 - 75.1 ft bgs | All results ND | Stable, all results ND |
| | O-2 | Water Table | No Trend | Stable since 2014 |
| | O-3 | Water Table | Decreasing | Decreasing, last 9 results ND |
| | O-5 | Water Table | Stable | Decreasing with fluctuations likely due to recovery well pumping |
| | O-5-65 | 59.6 - 64.2 ft bgs | Stable | Decreasing with potential seasonal variation |

**Table 5-1**
**Concentration Trends in the Remediation System Performance Monitoring Network - Sulfolane**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Location | | Screen Interval | Mann-Kendall Trend [a] | Qualitative Evaluation [b] |
|---|---|---|---|---|
| Downgradient Wells | MW-127-25 | 20 - 25 ft bgs | Decreasing | Decreasing, last 14 results ND or <LOQ |
| | MW-129-40 | 37 - 41.5 ft bgs | All results ND | Stable, all results ND |
| | MW-139-25 | Water Table | Decreasing | Decreasing and Stable since 2015 |
| | MW-142-20 | Water Table | Decreasing | Decreasing |
| | MW-145-20 | Water Table | All results ND | Stable, all results ND |
| | MW-154A-75 | 71 -75 ft bgs | Decreasing | Decreasing overall, stable since 1Q 2014 |
| | MW-154B-95 | 90 - 95 ft bgs | Decreasing | Decreasing overall, stable since 2Q 2014 |
| | MW-351-15 | Water Table | Decreasing | Decreasing with potential seasonal variation, last 8 results ND or <LOQ |
| | MW-351-55 | 50.6 - 55.1 ft bgs | No trend | Stable, last 11 results ND or <LOQ |
| | MW-351-75 | 71.4 - 75.9 ft bgs | Stable | Stable, last 11 results ND |
| | MW-351-150 | 145.7 - 150.3 ft bgs | All results ND | Stable, all results ND |
| | MW-371-15 | Water Table | Decreasing | Decreasing until increase in 2017 likely related to GAC West shutdown. |
| | MW-371-55 | 50.6 - 55.1 ft bgs | Stable | Stable, all results ND or <LOQ |
| | MW-371-75 | 71.0 - 75.5 ft bgs | Probably Decreasing | Stable, all results ND or <LOQ |
| | MW-371-125 | 123.0 - 127.5 bgs | All results ND | Stable, all results ND |
| | O-4 | Water Table | Decreasing | Decreasing, last 9 results ND or <LOQ |
| | O-12 | Water Table | Decreasing | Decreasing, last 12 results ND or <LOQ |
| | O-12-65 | 60 - 65 ft bgs | All results ND | Stable, all results ND |
| | O-24 | Water Table | Stable | Stable, all results ND or <LOQ |
| | O-24-65 | 60.3 - 64.9 ft bgs | All results ND | Stable, all results ND |
| | O-26 | Water Table | Decreasing | Decreasing |
| | O-26-65 | 60.9 - 65.4 ft bgs | All results ND | Stable, all results ND |

**Footnotes:**

[a] Mann-Kendall Trend is through First Quarter 2017

[b] Qualitative Evaluation is through Second Quarter 2017

**Acronyms and Abbreviations:**

ft bgs = feet below ground surface
<LOQ = less than the limit of quantitation
ND = nondetect concentration
µg/L = micrograms per liter

**Table 5-2**
**Concentration Trends in the Remediation System Performance Monitoring Network - Benzene**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Location | | Screen Interval | Mann-Kendall Trend [a] | Qualitative Evaluation [b] |
|---|---|---|---|---|
| Upgradient Wells | MW-130-25 | 19 to 23 ft bgs | Probably Increasing | Increasing 2010- 2015, then decreasing 2016 - 2017 |
| | MW-369-16 | Water Table | All results ND | Stable, all results ND |
| | O-6 | Water Table | All results ND | Stable, all results ND |
| | O-19 | Water Table | Not completed | Not sampled due to LNAPL presence |
| | O-19-55 | 49.5 - 53.9 ft bgs | Stable | Stable, all results ND or <LOQ |
| | S-43 | Water Table | Not completed | Decreasing |
| | S-51 | Water Table | Not completed | Not sampled due to LNAPL presence |
| Treatment Zone Wells | MW-113-15 | 11.5 - 15 ft bgs | No trend | Stable, ND or <LOQ since 2012 |
| | MW-125-25 | 19.5 - 24.0 ft bgs | Decreasing | Decreasing, last 4 results ND |
| | MW-186A-15 | Water Table | Not completed | Not sampled in 2017 due to LNAPL presence |
| | MW-309-15 | Water Table | All results ND | Stable, all results ND |
| | MW-334-15 | Water Table | Not completed | Not sampled due to LNAPL presence |
| | MW-344-15 | Water Table | No trend | Decreasing, last 3 results ND |
| | MW-344-55 | 51.6 - 56.2 ft bgs | No trend | Stable |
| | MW-345-15 | Water Table | No trend | Decreasing, last 3 results ND |
| | MW-345-55 | 50.3 - 54.9 ft bgs | All results ND | Stable, all results ND |
| | MW-370-15 | Water Table | All results ND | Stable, all results ND |
| | O-2 | Water Table | Not evaluated per RSAP | Not sampled due to LNAPL presence |
| | O-3 | Water Table | Decreasing | Decreasing, last 2 results ND |
| | O-5 | Water Table | No trend | Decreasing since 3Q 2014 |
| Downgradient Wells | MW-127-25 | 20 - 25 ft bgs | No trend | Stable, last 3 results ND |
| | MW-129-40 | 37 - 41.5 ft bgs | All results ND | Stable, all results ND since 2002 |
| | MW-139-25 | Water Table | Decreasing | Decreasing |
| | MW-142-20 | Water Table | No trend | Stable, ND since 2011 |
| | MW-145-20 | Water Table | No trend | Stable, all results ND since 2011 |
| | MW-351-15 | Water Table | All results ND | Stable, all results ND |
| | MW-351-55 | 50.6 - 55.1 ft bgs | All results ND | Stable, all results ND |
| | MW-371-15 | Water Table | All results ND | Stable, all results ND |
| | O-4 | Water Table | All results ND | Stable, all results ND |
| | O-26 | Water Table | Decreasing | Decreasing, last 4 results ND |
| | O-12 | Water Table | No trend | Decreasing since 3Q 2013 with potential seasonal variation |
| | O-24 | Water Table | Probably Increasing | Increasing 2013-2015, then decreasing 2016-2017, with potential seasonal variation |

**Footnotes:**

[a] Mann-Kendall Trend is through First Quarter 2017

[b] Qualitative Evaluation is through Second Quarter 2017

**Acronyms and Abbreviations:**

ft bgs = feet below ground surface
LNAPL = Light Non-Aqueous Phase Liquid
<LOQ = less than the limit of quantitation
ND = nondetect concentration
RSAP = Revised Onsite Sampling and Analysis Plan

**Table 5-3**
**GAC West Shutdown Well Monitoring**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Well ID | Zone | Sample Date | Sulfolane (µg/L) | Comment |
|---|---|---|---|---|
| MW-101A-25 | 10-55 | 04/19/2006 | 360 | |
| MW-101A-25 | 10-55 | 05/16/2006 | 410 | |
| MW-101A-25 | 10-55 | 06/21/2006 | 390 | |
| MW-101A-25 | 10-55 | 07/19/2006 | 320 | |
| MW-101A-25 | 10-55 | 11/16/2006 | 260 | |
| MW-101A-25 | 10-55 | 12/08/2006 | 380 | |
| MW-101A-25 | 10-55 | 01/15/2007 | 250 | |
| MW-101A-25 | 10-55 | 02/13/2007 | 270 | |
| MW-101A-25 | 10-55 | 03/19/2007 | 360 | |
| MW-101A-25 | 10-55 | 04/17/2007 | 251 | |
| MW-101A-25 | 10-55 | 05/22/2007 | 204 | |
| MW-101A-25 | 10-55 | 06/20/2007 | 316 | |
| MW-101A-25 | 10-55 | 07/18/2007 | 231 | |
| MW-101A-25 | 10-55 | 08/21/2007 | 214 | |
| MW-101A-25 | 10-55 | 09/20/2007 | 266 | |
| MW-101A-25 | 10-55 | 10/17/2007 | 251 | |
| MW-101A-25 | 10-55 | 11/15/2007 | 313 | |
| MW-101A-25 | 10-55 | 01/03/2008 | 127 | |
| MW-101A-25 | 10-55 | 02/13/2008 | 185 | |
| MW-101A-25 | 10-55 | 03/05/2008 | 156 | |
| MW-101A-25 | 10-55 | 04/03/2008 | 149 | |
| MW-101A-25 | 10-55 | 05/08/2008 | 153 | |
| MW-101A-25 | 10-55 | 06/10/2008 | 156 | |
| MW-101A-25 | 10-55 | 07/01/2008 | 129 | |
| MW-101A-25 | 10-55 | 08/07/2008 | 150 | |
| MW-101A-25 | 10-55 | 09/04/2008 | 193 | |
| MW-101A-25 | 10-55 | 10/02/2008 | 140 | |
| MW-101A-25 | 10-55 | 11/06/2008 | 129 | |
| MW-101A-25 | 10-55 | 12/04/2008 | 131 | |
| MW-101A-25 | 10-55 | 01/13/2009 | 110 | |
| MW-101A-25 | 10-55 | 02/09/2009 | 101 | |
| MW-101A-25 | 10-55 | 03/03/2009 | 121 | |
| MW-101A-25 | 10-55 | 04/09/2009 | 87.9 | |
| MW-101A-25 | 10-55 | 05/06/2009 | 77.8 | |
| MW-101A-25 | 10-55 | 06/05/2009 | 96.8 | |
| MW-101A-25 | 10-55 | 07/06/2009 | 110 | |
| MW-101A-25 | 10-55 | 08/03/2009 | 72.0 | |
| MW-101A-25 | 10-55 | 09/02/2009 | 78.1 | |
| MW-101A-25 | 10-55 | 10/01/2009 | 72.5 | |
| MW-101A-25 | 10-55 | 11/03/2009 | 86.4 | |
| MW-101A-25 | 10-55 | 12/01/2009 | 80.8 | |
| MW-101A-25 | 10-55 | 01/21/2010 | 90.6 | |
| MW-101A-25 | 10-55 | 02/12/2010 | 55.5 | |
| MW-101A-25 | 10-55 | 03/04/2010 | 63.8 | |
| MW-101A-25 | 10-55 | 04/05/2010 | 54.4 | |
| MW-101A-25 | 10-55 | 05/03/2010 | 60.5 | |
| MW-101A-25 | 10-55 | 07/19/2010 | 53.1 | |
| MW-101A-25 | 10-55 | 07/16/2010 | 66.7 | |
| MW-101A-25 | 10-55 | 08/10/2010 | 67.1 | |
| MW-101A-25 | 10-55 | 09/02/2010 | 54.0 | |

**Table 5-3**
**GAC West Shutdown Well Monitoring**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Well ID | Zone | Sample Date | Sulfolane (µg/L) | Comment |
|---|---|---|---|---|
| MW-101A-25 | 10-55 | 10/05/2010 | 67.6 | |
| MW-101A-25 | 10-55 | 11/04/2010 | 67.6 | |
| MW-101A-25 | 10-55 | 02/25/2011 | 55.7 | |
| MW-101A-25 | 10-55 | 04/12/2011 | 37.0 | |
| MW-101A-25 | 10-55 | 08/15/2011 | 70.7 | |
| MW-101A-25 | 10-55 | 02/21/2012 | 73.3 | |
| MW-101A-25 | 10-55 | 05/03/2012 | 48.6JL* | |
| MW-101A-25 | 10-55 | 07/24/2012 | 63.5 | |
| MW-101A-25 | 10-55 | 01/21/2013 | 52.3 | |
| MW-101A-25 | 10-55 | 04/17/2013 | 44.0 | |
| MW-101A-25 | 10-55 | 07/25/2013 | 52.6 | |
| MW-101A-25 | 10-55 | 10/14/2013 | 49.2 | |
| MW-101A-25 | 10-55 | 07/22/2014 | 39.3 | |
| MW-101A-25 | 10-55 | 02/18/2015 | 6.96J | |
| MW-101A-25 | 10-55 | 04/15/2015 | 5.06J | |
| MW-101A-25 | 10-55 | 07/31/2015 | 4.08J | |
| MW-101A-25 | 10-55 | 02/12/2016 | 3.67J | |
| MW-101A-25 | 10-55 | 07/19/2016 | <5.10 | |
| MW-101A-25 | 10-55 | 02/14/2017 | 10.3 | sampled post-GAC West shutdown |
| MW-101-60 | 10-55 | 04/19/2006 | 100 | |
| MW-101-60 | 10-55 | 05/16/2006 | 160 | |
| MW-101-60 | 10-55 | 06/21/2006 | 160 | |
| MW-101-60 | 10-55 | 07/19/2006 | 96.0 | |
| MW-101-60 | 10-55 | 01/15/2007 | 120 | |
| MW-101-60 | 10-55 | 04/17/2007 | 123 | |
| MW-101-60 | 10-55 | 07/18/2007 | 109 | |
| MW-101-60 | 10-55 | 10/17/2007 | 80.9 | |
| MW-101-60 | 10-55 | 01/03/2008 | 65.6 | |
| MW-101-60 | 10-55 | 04/03/2008 | 70.6 | |
| MW-101-60 | 10-55 | 07/01/2008 | 53.8 | |
| MW-101-60 | 10-55 | 10/02/2008 | 44.0 | |
| MW-101-60 | 10-55 | 04/09/2009 | 32.1 | |
| MW-101-60 | 10-55 | 07/06/2009 | 46.3 | |
| MW-101-60 | 10-55 | 08/03/2009 | 34.9 | |
| MW-101-60 | 10-55 | 10/01/2009 | 20.8 | |
| MW-101-60 | 10-55 | 01/21/2010 | 38.8 | |
| MW-101-60 | 10-55 | 04/05/2010 | 14.7 | |
| MW-101-60 | 10-55 | 07/16/2010 | 29.4 | |
| MW-101-60 | 10-55 | 10/05/2010 | 23.8 | |
| MW-101-60 | 10-55 | 02/09/2011 | 18.6 | |
| MW-101-60 | 10-55 | 04/12/2011 | 21.1 | |
| MW-101-60 | 10-55 | 08/15/2011 | 40.7 | |
| MW-101-60 | 10-55 | 10/11/2011 | 35.6 | |
| MW-101-60 | 10-55 | 02/21/2012 | 37.0 | |
| MW-101-60 | 10-55 | 05/03/2012 | 32.9JL* | |
| MW-101-60 | 10-55 | 07/24/2012 | 33.7 | |
| MW-101-60 | 10-55 | 04/17/2013 | 18.5 | |
| MW-101-60 | 10-55 | 07/25/2013 | 20.0 | |
| MW-101-60 | 10-55 | 10/14/2013 | 19.4 | |
| MW-101-60 | 10-55 | 07/23/2014 | 18.2 | |

**Table 5-3**
**GAC West Shutdown Well Monitoring**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Well ID | Zone | Sample Date | Sulfolane (µg/L) | Comment |
|---|---|---|---|---|
| MW-101-60 | 10-55 | 02/18/2015 | 3.50J | |
| MW-101-60 | 10-55 | 04/15/2015 | <5.40 | |
| MW-101-60 | 10-55 | 07/21/2015 | <5.00 | |
| MW-101-60 | 10-55 | 07/14/2016 | <5.10 | |
| MW-143-20 | Water Table | 04/19/2006 | 290 | |
| MW-143-20 | Water Table | 05/16/2006 | 360 | |
| MW-143-20 | Water Table | 06/21/2006 | 380 | |
| MW-143-20 | Water Table | 07/19/2006 | <120 | |
| MW-143-20 | Water Table | 11/16/2006 | 150 | |
| MW-143-20 | Water Table | 12/08/2006 | 290 | |
| MW-143-20 | Water Table | 01/17/2007 | 350 | |
| MW-143-20 | Water Table | 02/13/2007 | 400 | |
| MW-143-20 | Water Table | 03/19/2007 | 360 | |
| MW-143-20 | Water Table | 04/17/2007 | 297 | |
| MW-143-20 | Water Table | 05/22/2007 | 522 | |
| MW-143-20 | Water Table | 06/20/2007 | 88.5 | |
| MW-143-20 | Water Table | 07/18/2007 | 51.0 | |
| MW-143-20 | Water Table | 08/21/2007 | 142 | |
| MW-143-20 | Water Table | 09/20/2007 | 94.1 | |
| MW-143-20 | Water Table | 10/17/2007 | 42.5 | |
| MW-143-20 | Water Table | 11/12/2007 | 228 | |
| MW-143-20 | Water Table | 01/04/2008 | 192 | |
| MW-143-20 | Water Table | 02/13/2008 | 249 | |
| MW-143-20 | Water Table | 03/05/2008 | 355 | |
| MW-143-20 | Water Table | 04/03/2008 | 246 | |
| MW-143-20 | Water Table | 05/07/2008 | 200 | |
| MW-143-20 | Water Table | 06/10/2008 | 149 | |
| MW-143-20 | Water Table | 07/01/2008 | 136 | |
| MW-143-20 | Water Table | 08/07/2008 | 12.9 | |
| MW-143-20 | Water Table | 09/04/2008 | 33.3 | |
| MW-143-20 | Water Table | 10/02/2008 | 52.0 | |
| MW-143-20 | Water Table | 11/06/2008 | 189 | |
| MW-143-20 | Water Table | 12/04/2008 | 215 | |
| MW-143-20 | Water Table | 01/13/2009 | 171 | |
| MW-143-20 | Water Table | 02/09/2009 | 132 | |
| MW-143-20 | Water Table | 03/03/2009 | 280 | |
| MW-143-20 | Water Table | 04/09/2009 | 111 | |
| MW-143-20 | Water Table | 05/06/2009 | 111 | |
| MW-143-20 | Water Table | 06/08/2009 | 102 | |
| MW-143-20 | Water Table | 07/06/2009 | 98.2 | |
| MW-143-20 | Water Table | 08/03/2009 | 105 | |
| MW-143-20 | Water Table | 09/02/2009 | 44.8 | |
| MW-143-20 | Water Table | 10/01/2009 | 59.1 | |
| MW-143-20 | Water Table | 11/03/2009 | 172 | |
| MW-143-20 | Water Table | 12/01/2009 | 155 | |
| MW-143-20 | Water Table | 01/21/2010 | 145 | |
| MW-143-20 | Water Table | 02/12/2010 | 163 | |
| MW-143-20 | Water Table | 03/04/2010 | 179 | |
| MW-143-20 | Water Table | 04/05/2010 | 137 | |
| MW-143-20 | Water Table | 05/03/2010 | 107 | |

**Table 5-3**
**GAC West Shutdown Well Monitoring**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Well ID | Zone | Sample Date | Sulfolane (µg/L) | Comment |
|---|---|---|---|---|
| MW-143-20 | Water Table | 06/14/2010 | 89.8 | |
| MW-143-20 | Water Table | 07/23/2010 | 79.4 | |
| MW-143-20 | Water Table | 08/10/2010 | 37.8 | |
| MW-143-20 | Water Table | 09/03/2010 | 32.2 | |
| MW-143-20 | Water Table | 10/05/2010 | 56.4 | |
| MW-143-20 | Water Table | 11/04/2010 | 68.7 | |
| MW-143-20 | Water Table | 03/09/2011 | 134 | |
| MW-143-20 | Water Table | 04/08/2011 | 76.1 | |
| MW-143-20 | Water Table | 08/12/2011 | 58.0 | |
| MW-143-20 | Water Table | 10/20/2011 | 56.4 | |
| MW-143-20 | Water Table | 02/08/2012 | 117 | |
| MW-143-20 | Water Table | 05/03/2012 | 35.8JL* | |
| MW-143-20 | Water Table | 08/15/2012 | 36.8 | |
| MW-143-20 | Water Table | 11/15/2012 | 70.1 | |
| MW-143-20 | Water Table | 01/21/2013 | 66.6 | |
| MW-143-20 | Water Table | 04/18/2013 | 64.7 | |
| MW-143-20 | Water Table | 07/25/2013 | 26.1 | |
| MW-143-20 | Water Table | 10/15/2013 | 15.7 | |
| MW-143-20 | Water Table | 02/27/2014 | 21.9 | |
| MW-143-20 | Water Table | 04/15/2014 | 17.5 | |
| MW-143-20 | Water Table | 07/22/2014 | 5.25J | |
| MW-143-20 | Water Table | 10/15/2014 | 5.56J | |
| MW-143-20 | Water Table | 02/18/2015 | 16.4 | |
| MW-143-20 | Water Table | 04/16/2015 | 14.3 | |
| MW-143-20 | Water Table | 07/24/2015 | 7.61J | |
| MW-143-20 | Water Table | 02/09/2016 | 12.3 | |
| MW-143-20 | Water Table | 07/18/2016 | 7.33J | |
| MW-143-20 | Water Table | 02/14/2017 | 8.88J | sampled post-GAC West shutdown |
| MW-302-CMT-10 | Water Table | 11/10/2011 | 55.5 | |
| MW-302-CMT-10 | Water Table | 03/26/2012 | 66.1 | |
| MW-302-CMT-10 | Water Table | 06/06/2012 | 32.7 | |
| MW-302-CMT-10 | Water Table | 08/15/2012 | 62.2 | |
| MW-302-CMT-10 | Water Table | 01/22/2013 | 56.6 | |
| MW-302-CMT-10 | Water Table | 04/17/2013 | 50.1 | |
| MW-302-CMT-10 | Water Table | 08/28/2013 | 43.3 | |
| MW-302-CMT-10 | Water Table | 10/14/2013 | 37.2 | |
| MW-302-CMT-10 | Water Table | 03/12/2014 | 46.6 | |
| MW-302-CMT-10 | Water Table | 04/15/2014 | 41.7 | |
| MW-302-CMT-10 | Water Table | 07/16/2014 | 14.4 | |
| MW-302-CMT-10 | Water Table | 10/20/2014 | 19.9 | |
| MW-302-CMT-10 | Water Table | 02/19/2015 | 17.3 | |
| MW-302-CMT-10 | Water Table | 04/16/2015 | 11.4 | |
| MW-302-CMT-10 | Water Table | 07/21/2015 | 6.04J | |
| MW-302-CMT-10 | Water Table | 02/08/2016 | 3.64J | |
| MW-302-CMT-10 | Water Table | 07/14/2016 | 3.25J | |
| MW-302-CMT-10 | Water Table | 02/17/2017 | 5.82J | sampled post-GAC West shutdown |
| MW-302-CMT-20 | Water Table | 11/10/2011 | 76.2 | |
| MW-302-CMT-20 | Water Table | 03/26/2012 | 66.1 | |
| MW-302-CMT-20 | Water Table | 06/06/2012 | 70.3 | |
| MW-302-CMT-20 | Water Table | 08/15/2012 | 68.5 | |

**Table 5-3**
**GAC West Shutdown Well Monitoring**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Well ID | Zone | Sample Date | Sulfolane (µg/L) | Comment |
|---|---|---|---|---|
| MW-302-CMT-20 | Water Table | 12/09/2012 | 59.4 | |
| MW-302-CMT-20 | Water Table | 01/22/2013 | 61.0 | |
| MW-302-CMT-20 | Water Table | 04/17/2013 | 46.4 | |
| MW-302-CMT-20 | Water Table | 08/28/2013 | 47.4 | |
| MW-302-CMT-20 | Water Table | 10/14/2013 | 52.7 | |
| MW-302-CMT-20 | Water Table | 03/12/2014 | 45.2 | |
| MW-302-CMT-20 | Water Table | 04/15/2014 | 42.9 | |
| MW-302-CMT-20 | Water Table | 07/16/2014 | 36.2 | |
| MW-302-CMT-20 | Water Table | 10/20/2014 | 19.4 | |
| MW-302-CMT-20 | Water Table | 02/19/2015 | 8.48J | |
| MW-302-CMT-20 | Water Table | 04/16/2015 | 5.03J | |
| MW-302-CMT-20 | Water Table | 07/21/2015 | 3.98J | |
| MW-302-CMT-20 | Water Table | 02/08/2016 | <5.20 | |
| MW-302-CMT-20 | Water Table | 07/14/2016 | <5.05 | |
| MW-302-CMT-20 | Water Table | 10/19/2016 | 3.38J | sampled post-GAC West shutdown |
| MW-302-CMT-20 | Water Table | 02/17/2017 | 9.99J | |
| MW-302-CMT-20 | Water Table | 04/10/2017 | 10.7J | |
| MW-302-CMT-30 | 10-55 | 11/10/2011 | 63.0 | |
| MW-302-CMT-30 | 10-55 | 03/26/2012 | 59.0 | |
| MW-302-CMT-30 | 10-55 | 06/06/2012 | 50.3 | |
| MW-302-CMT-30 | 10-55 | 01/22/2013 | 52.3 | |
| MW-302-CMT-30 | 10-55 | 04/17/2013 | 37.8 | |
| MW-302-CMT-30 | 10-55 | 08/28/2013 | 43.9 | |
| MW-302-CMT-30 | 10-55 | 10/14/2013 | 43.4 | |
| MW-302-CMT-30 | 10-55 | 03/12/2014 | 42.8 | |
| MW-302-CMT-30 | 10-55 | 04/15/2014 | 40.0 | |
| MW-302-CMT-30 | 10-55 | 07/16/2014 | 38.6 | |
| MW-302-CMT-30 | 10-55 | 10/20/2014 | 24.2 | |
| MW-302-CMT-30 | 10-55 | 02/19/2015 | 7.94J | |
| MW-302-CMT-30 | 10-55 | 04/16/2015 | 5.01J | |
| MW-302-CMT-30 | 10-55 | 07/21/2015 | 5.14J | |
| MW-302-CMT-30 | 10-55 | 02/08/2016 | 3.54J | |
| MW-302-CMT-30 | 10-55 | 07/14/2016 | 3.50J | |
| MW-302-CMT-30 | 10-55 | 02/17/2017 | 6.97J | sampled post-GAC West shutdown |
| MW-302-70 | 55-90 | 11/10/2011 | 28.7 | |
| MW-302-70 | 55-90 | 03/26/2012 | 32.7 | |
| MW-302-70 | 55-90 | 06/06/2012 | 31.0 | |
| MW-302-70 | 55-90 | 08/15/2012 | 27.4 | |
| MW-302-70 | 55-90 | 01/22/2013 | 21.6 | |
| MW-302-70 | 55-90 | 04/17/2013 | 17.1 | |
| MW-302-70 | 55-90 | 08/28/2013 | 17.2 | |
| MW-302-70 | 55-90 | 10/14/2013 | 16.4 | |
| MW-302-70 | 55-90 | 03/13/2014 | 16.9 | |
| MW-302-70 | 55-90 | 04/16/2014 | 16.1 | |
| MW-302-70 | 55-90 | 07/22/2014 | 15.7 | |
| MW-302-70 | 55-90 | 10/16/2014 | 7.15J | |
| MW-302-70 | 55-90 | 02/18/2015 | 4.15J | |
| MW-302-70 | 55-90 | 04/16/2015 | <5.00 | |
| MW-302-70 | 55-90 | 07/21/2015 | <5.10 | |
| MW-302-70 | 55-90 | 07/14/2016 | <5.05 | |

**Table 5-3**
**GAC West Shutdown Well Monitoring**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Well ID | Zone | Sample Date | Sulfolane (µg/L) | Comment |
|---|---|---|---|---|
| MW-302-70 | 55-90 | 02/14/2017 | 4.50J | sampled post-GAC West shutdown |
| MW-302-80 | 55-90 | 11/10/2011 | 3.39J | |
| MW-302-80 | 55-90 | 03/26/2012 | 27.6 | |
| MW-302-80 | 55-90 | 06/06/2012 | 26.1 | |
| MW-302-80 | 55-90 | 08/15/2012 | 23.8 | |
| MW-302-80 | 55-90 | 01/21/2013 | 18.0 | |
| MW-302-80 | 55-90 | 04/17/2013 | 14.9 | |
| MW-302-80 | 55-90 | 08/28/2013 | 16.6 | |
| MW-302-80 | 55-90 | 10/14/2013 | 14.7 | |
| MW-302-80 | 55-90 | 03/13/2014 | 14.3 | |
| MW-302-80 | 55-90 | 04/16/2014 | 12.3 | |
| MW-302-80 | 55-90 | 07/21/2014 | 18.4 | |
| MW-302-80 | 55-90 | 10/16/2014 | 7.23J | |
| MW-302-80 | 55-90 | 02/18/2015 | 3.94J | |
| MW-302-80 | 55-90 | 04/16/2015 | <5.15 | |
| MW-302-80 | 55-90 | 07/21/2015 | <5.15 | |
| MW-302-80 | 55-90 | 07/14/2016 | <5.15 | |
| MW-303-CMT-9 | Water Table | 11/11/2011 | 4.22J | |
| MW-303-CMT-9 | Water Table | 03/27/2012 | 5.25J | |
| MW-303-CMT-9 | Water Table | 06/07/2012 | <6.32 | |
| MW-303-CMT-9 | Water Table | 08/15/2012 | <6.20 | |
| MW-303-CMT-9 | Water Table | 12/09/2012 | 6.07J | |
| MW-303-CMT-9 | Water Table | 01/21/2013 | 9.56J | |
| MW-303-CMT-9 | Water Table | 04/18/2013 | 6.77J | |
| MW-303-CMT-9 | Water Table | 08/08/2013 | 6.87J | |
| MW-303-CMT-9 | Water Table | 10/15/2013 | <6.32 | |
| MW-303-CMT-9 | Water Table | 03/13/2014 | <5.00 | |
| MW-303-CMT-9 | Water Table | 04/15/2014 | <5.15 | |
| MW-303-CMT-9 | Water Table | 07/16/2014 | <5.20 | |
| MW-303-CMT-9 | Water Table | 10/18/2014 | <5.40 | |
| MW-303-CMT-9 | Water Table | 02/19/2015 | <5.00 | |
| MW-303-CMT-9 | Water Table | 04/16/2015 | <5.10 | |
| MW-303-CMT-9 | Water Table | 07/29/2015 | <5.10 | |
| MW-303-CMT-9 | Water Table | 07/14/2016 | <5.00 | |
| MW-303-CMT-19 | Water Table | 11/11/2011 | 123 | |
| MW-303-CMT-19 | Water Table | 03/27/2012 | 94.6 | |
| MW-303-CMT-19 | Water Table | 06/07/2012 | 97.8 | |
| MW-303-CMT-19 | Water Table | 08/15/2012 | 56.7 | |
| MW-303-CMT-19 | Water Table | 12/09/2012 | 61.2 | |
| MW-303-CMT-19 | Water Table | 01/21/2013 | 69.9 | |
| MW-303-CMT-19 | Water Table | 04/18/2013 | 61.6 | |
| MW-303-CMT-19 | Water Table | 08/08/2013 | 59.2 | |
| MW-303-CMT-19 | Water Table | 10/15/2013 | 44.4 | |
| MW-303-CMT-19 | Water Table | 03/13/2014 | 54.2 | |
| MW-303-CMT-19 | Water Table | 04/15/2014 | 48.9 | |
| MW-303-CMT-19 | Water Table | 07/16/2014 | 32.0 | |
| MW-303-CMT-19 | Water Table | 10/18/2014 | 25.1 | |
| MW-303-CMT-19 | Water Table | 02/19/2015 | 19.7 | |
| MW-303-CMT-19 | Water Table | 04/16/2015 | 18.8 | |
| MW-303-CMT-19 | Water Table | 07/29/2015 | 12.8 | |

**Table 5-3**
**GAC West Shutdown Well Monitoring**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Well ID | Zone | Sample Date | Sulfolane (µg/L) | Comment |
|---|---|---|---|---|
| MW-303-CMT-19 | Water Table | 10/20/2015 | 10.4 | |
| MW-303-CMT-19 | Water Table | 02/16/2016 | 11.1J | |
| MW-303-CMT-19 | Water Table | 07/14/2016 | 9.40J | |
| MW-303-CMT-19 | Water Table | 02/17/2017 | 8.40J | sampled post-GAC West shutdown |
| MW-303-CMT-29 | 10-55 | 11/11/2011 | 88.5 | |
| MW-303-CMT-29 | 10-55 | 03/27/2012 | 57.9 | |
| MW-303-CMT-29 | 10-55 | 06/07/2012 | 54.3 | |
| MW-303-CMT-29 | 10-55 | 08/15/2012 | 61.5 | |
| MW-303-CMT-29 | 10-55 | 01/21/2013 | 37.6 | |
| MW-303-CMT-29 | 10-55 | 04/18/2013 | 33.6 | |
| MW-303-CMT-29 | 10-55 | 08/08/2013 | 29.3 | |
| MW-303-CMT-29 | 10-55 | 10/15/2013 | 51.2 | |
| MW-303-CMT-29 | 10-55 | 03/13/2014 | 20.2 | |
| MW-303-CMT-29 | 10-55 | 04/15/2014 | 18.6 | |
| MW-303-CMT-29 | 10-55 | 07/16/2014 | 31.7J* | |
| MW-303-CMT-29 | 10-55 | 10/18/2014 | 24.7 | |
| MW-303-CMT-29 | 10-55 | 02/19/2015 | 9.56J | |
| MW-303-CMT-29 | 10-55 | 04/16/2015 | 8.96J | |
| MW-303-CMT-29 | 10-55 | 07/29/2015 | 8.46J* | |
| MW-303-CMT-29 | 10-55 | 02/16/2016 | 9.42J | |
| MW-303-CMT-29 | 10-55 | 07/14/2016 | 6.11J | |
| MW-303-CMT-29 | 10-55 | 02/17/2017 | 5.68J | sampled post-GAC West shutdown |
| MW-303-CMT-39 | 10-55 | 11/11/2011 | 47.5 | |
| MW-303-CMT-39 | 10-55 | 03/27/2012 | 28.6 | |
| MW-303-CMT-39 | 10-55 | 06/07/2012 | 27.8 | |
| MW-303-CMT-39 | 10-55 | 08/15/2012 | 22.1 | |
| MW-303-CMT-39 | 10-55 | 12/09/2012 | 35.2 | |
| MW-303-CMT-39 | 10-55 | 01/21/2013 | 21.9 | |
| MW-303-CMT-39 | 10-55 | 04/18/2013 | 19.0 | |
| MW-303-CMT-39 | 10-55 | 08/08/2013 | 14.8 | |
| MW-303-CMT-39 | 10-55 | 10/15/2013 | 13.4 | |
| MW-303-CMT-39 | 10-55 | 03/13/2014 | 9.42J | |
| MW-303-CMT-39 | 10-55 | 04/15/2014 | 8.74J | |
| MW-303-CMT-39 | 10-55 | 07/16/2014 | 7.89J | |
| MW-303-CMT-39 | 10-55 | 10/18/2014 | 6.16J | |
| MW-303-CMT-39 | 10-55 | 02/19/2015 | 5.67J | |
| MW-303-CMT-39 | 10-55 | 04/16/2015 | 4.76J | |
| MW-303-CMT-39 | 10-55 | 07/29/2015 | 3.85J | |
| MW-303-CMT-39 | 10-55 | 02/12/2016 | 5.32J | |
| MW-303-CMT-39 | 10-55 | 07/14/2016 | 3.49J | |
| MW-303-CMT-39 | 10-55 | 02/17/2017 | 5.14J* | sampled post-GAC West shutdown |
| MW-303-CMT-49 | 10-55 | 11/11/2011 | 29.3 | |
| MW-303-CMT-49 | 10-55 | 03/27/2012 | 20.8 | |
| MW-303-CMT-49 | 10-55 | 06/07/2012 | 18.7 | |
| MW-303-CMT-49 | 10-55 | 08/15/2012 | 20.9 | |
| MW-303-CMT-49 | 10-55 | 01/21/2013 | 17.1 | |
| MW-303-CMT-49 | 10-55 | 04/18/2013 | 12.4 | |
| MW-303-CMT-49 | 10-55 | 08/08/2013 | 13.3 | |
| MW-303-CMT-49 | 10-55 | 10/15/2013 | 11.8 | |
| MW-303-CMT-49 | 10-55 | 03/13/2014 | 7.97J | |

**Table 5-3**
**GAC West Shutdown Well Monitoring**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Well ID | Zone | Sample Date | Sulfolane (µg/L) | Comment |
|---|---|---|---|---|
| MW-303-CMT-49 | 10-55 | 04/15/2014 | 7.98J | |
| MW-303-CMT-49 | 10-55 | 07/16/2014 | 8.25J | |
| MW-303-CMT-49 | 10-55 | 10/18/2014 | 4.49J | |
| MW-303-CMT-49 | 10-55 | 02/19/2015 | 3.36J | |
| MW-303-CMT-49 | 10-55 | 04/16/2015 | <5.00 | |
| MW-303-CMT-49 | 10-55 | 07/29/2015 | 3.34J | |
| MW-303-CMT-49 | 10-55 | 02/16/2016 | <6.30 | |
| MW-303-CMT-49 | 10-55 | 07/14/2016 | <5.05 | |
| MW-309-15 | Water Table | 04/27/2012 | 88.5 | |
| MW-309-15 | Water Table | 07/25/2012 | 66.6 | |
| MW-309-15 | Water Table | 11/11/2012 | 77.2 | |
| MW-309-15 | Water Table | 01/31/2013 | 74.3 | |
| MW-309-15 | Water Table | 05/16/2013 | 68.0 | |
| MW-309-15 | Water Table | 07/17/2013 | 65.9 | |
| MW-309-15 | Water Table | 10/22/2013 | 21.6 | |
| MW-309-15 | Water Table | 03/03/2014 | 51.9 | |
| MW-309-15 | Water Table | 04/22/2014 | 45.1 | |
| MW-309-15 | Water Table | 08/02/2014 | 15.7 | |
| MW-309-15 | Water Table | 10/27/2014 | 34.1 | |
| MW-309-15 | Water Table | 02/26/2015 | 41.1 | |
| MW-309-15 | Water Table | 04/22/2015 | 44.5 | |
| MW-309-15 | Water Table | 07/29/2015 | 33.7 | |
| MW-309-15 | Water Table | 10/16/2015 | 20.4 | |
| MW-309-15 | Water Table | 02/11/2016 | 34.2 | |
| MW-309-15 | Water Table | 04/06/2016 | 32.2 | |
| MW-309-15 | Water Table | 07/19/2016 | 26.5 | |
| MW-309-15 | Water Table | 10/14/2016 | 25.0 | sampled post-GAC West shutdown |
| MW-309-15 | Water Table | 02/17/2017 | 31.0 | |
| MW-309-15 | Water Table | 04/10/2017 | 32.2 | |
| MW-351-15 | Water Table | 02/26/2014 | 40.0 | |
| MW-351-15 | Water Table | 04/16/2014 | 47.8 | |
| MW-351-15 | Water Table | 07/23/2014 | 11.4 | |
| MW-351-15 | Water Table | 10/16/2014 | <5.00 | |
| MW-351-15 | Water Table | 02/20/2015 | 38.1 | |
| MW-351-15 | Water Table | 04/22/2015 | 34.6 | |
| MW-351-15 | Water Table | 08/03/2015 | 7.94J | |
| MW-351-15 | Water Table | 10/16/2015 | <5.05 | |
| MW-351-15 | Water Table | 02/11/2016 | <5.30 | |
| MW-351-15 | Water Table | 04/07/2016 | <5.05 | |
| MW-351-15 | Water Table | 07/19/2016 | <5.00 | |
| MW-351-15 | Water Table | 10/19/2016 | <5.05 | sampled post-GAC West shutdown |
| MW-351-15 | Water Table | 01/25/2017 | 4.32J | |
| MW-351-15 | Water Table | 04/10/2017 | 8.41J | |
| MW-351-55 | 10-55 | 01/02/2014 | 15.5 | |
| MW-351-55 | 10-55 | 04/16/2014 | 18.4 | |
| MW-351-55 | 10-55 | 07/23/2014 | 4.07J | |
| MW-351-55 | 10-55 | 10/16/2014 | 4.53J | |
| MW-351-55 | 10-55 | 02/20/2015 | <5.15J* | |
| MW-351-55 | 10-55 | 04/22/2015 | <5.10 | |
| MW-351-55 | 10-55 | 08/03/2015 | <5.15 | |

**Table 5-3**
**GAC West Shutdown Well Monitoring**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Well ID | Zone | Sample Date | Sulfolane (µg/L) | Comment |
|---|---|---|---|---|
| MW-351-55 | 10-55 | 10/16/2015 | 3.47J | |
| MW-351-55 | 10-55 | 02/11/2016 | <5.10 | |
| MW-351-55 | 10-55 | 07/19/2016 | <5.10 | |
| MW-351-55 | 10-55 | 10/19/2016 | 5.57J | sampled post-GAC West shutdown |
| MW-351-55 | 10-55 | 01/25/2017 | 6.06J | |
| MW-351-55 | 10-55 | 04/10/2017 | 5.01J | |
| MW-351-75 | 55-90 | 02/26/2014 | 9.07J | |
| MW-351-75 | 55-90 | 04/17/2014 | 9.71J | |
| MW-351-75 | 55-90 | 07/23/2014 | <5.00 | |
| MW-351-75 | 55-90 | 10/16/2014 | <5.00 | |
| MW-351-75 | 55-90 | 02/19/2015 | <5.00 | |
| MW-351-75 | 55-90 | 04/22/2015 | <5.00 | |
| MW-351-75 | 55-90 | 07/29/2015 | <5.00 | |
| MW-351-75 | 55-90 | 10/16/2015 | <5.10 | |
| MW-351-75 | 55-90 | 02/11/2016 | <5.10 | |
| MW-351-75 | 55-90 | 07/19/2016 | <5.05 | |
| MW-351-75 | 55-90 | 10/19/2016 | <5.10 | sampled post-GAC West shutdown |
| MW-351-75 | 55-90 | 01/25/2017 | <5.10 | |
| MW-351-75 | 55-90 | 04/11/2017 | <5.15 | |
| MW-358-20 | Water Table | 11/05/2013 | 24.7 | |
| MW-358-20 | Water Table | 03/11/2014 | 29.5 | |
| MW-358-20 | Water Table | 04/15/2014 | 28.8 | |
| MW-358-20 | Water Table | 07/21/2014 | 18.8 | |
| MW-358-20 | Water Table | 10/15/2014 | 12.0 | |
| MW-358-20 | Water Table | 02/16/2015 | 17.9 | |
| MW-358-20 | Water Table | 04/15/2015 | 15.8 | |
| MW-358-20 | Water Table | 07/23/2015 | 8.81J | |
| MW-358-20 | Water Table | 10/19/2015 | 3.47J | |
| MW-358-20 | Water Table | 02/09/2016 | 5.68J | |
| MW-358-20 | Water Table | 07/18/2016 | 4.04J | |
| MW-358-20 | Water Table | 01/26/2017 | 4.68J | sampled post-GAC West shutdown |
| MW-358-40 | 10-55 | 11/05/2013 | 39.0 | |
| MW-358-40 | 10-55 | 03/11/2014 | 34.8 | |
| MW-358-40 | 10-55 | 04/15/2014 | 33.2 | |
| MW-358-40 | 10-55 | 07/21/2014 | 26.5 | |
| MW-358-40 | 10-55 | 10/15/2014 | 23.6 | |
| MW-358-40 | 10-55 | 02/16/2015 | 19.9 | |
| MW-358-40 | 10-55 | 04/15/2015 | 18.7 | |
| MW-358-40 | 10-55 | 07/22/2015 | 14.1 | |
| MW-358-40 | 10-55 | 10/19/2015 | 8.02J | |
| MW-358-40 | 10-55 | 02/09/2016 | 5.60J | |
| MW-358-40 | 10-55 | 07/18/2016 | 4.98J | |
| MW-358-40 | 10-55 | 01/26/2017 | 3.86J | sampled post-GAC West shutdown |
| MW-358-60 | 10-55 | 11/04/2013 | 25.2 | |
| MW-358-60 | 10-55 | 03/11/2014 | 23.6 | |
| MW-358-60 | 10-55 | 04/15/2014 | 22.4 | |
| MW-358-60 | 10-55 | 07/21/2014 | 25.0 | |
| MW-358-60 | 10-55 | 10/15/2014 | 20.4 | |
| MW-358-60 | 10-55 | 02/16/2015 | 10.6 | |
| MW-358-60 | 10-55 | 04/15/2015 | 8.15J | |

**Table 5-3**
**GAC West Shutdown Well Monitoring**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Well ID | Zone | Sample Date | Sulfolane (µg/L) | Comment |
|---|---|---|---|---|
| MW-358-60 | 10-55 | 07/22/2015 | 5.55J | |
| MW-358-60 | 10-55 | 02/09/2016 | <5.15 | |
| MW-358-60 | 10-55 | 07/19/2016 | 3.62J | |
| MW-358-60 | 10-55 | 01/26/2017 | 3.85J | sampled post-GAC West shutdown |
| MW-370-15 | Water Table | 01/22/2014 | 40.4 | |
| MW-370-15 | Water Table | 04/18/2014 | 45.7 | |
| MW-370-15 | Water Table | 08/02/2014 | 19.4 | |
| MW-370-15 | Water Table | 10/21/2014 | <5.00 | |
| MW-370-15 | Water Table | 02/25/2015 | 3.79J | |
| MW-370-15 | Water Table | 04/17/2015 | <5.10 | |
| MW-370-15 | Water Table | 07/29/2015 | <5.00 | |
| MW-370-15 | Water Table | 10/17/2015 | <5.20 | |
| MW-370-15 | Water Table | 02/11/2016 | 5.65J | |
| MW-370-15 | Water Table | 07/19/2016 | <5.00 | |
| MW-370-15 | Water Table | 10/18/2016 | 34.8 | sampled post-GAC West shutdown |
| MW-370-15 | Water Table | 02/17/2017 | 29.4 | |
| MW-370-15 | Water Table | 04/10/2017 | 27.4 | |
| MW-370-55 | 10-55 | 01/22/2014 | 19.4 | |
| MW-370-55 | 10-55 | 04/25/2014 | 22.8 | |
| MW-370-55 | 10-55 | 08/02/2014 | 9.59J | |
| MW-370-55 | 10-55 | 10/21/2014 | 9.78J | |
| MW-370-55 | 10-55 | 02/25/2015 | 8.35J | |
| MW-370-55 | 10-55 | 04/17/2015 | 7.05J | |
| MW-370-55 | 10-55 | 07/29/2015 | 6.74J* | |
| MW-370-55 | 10-55 | 10/17/2015 | 6.37J | |
| MW-370-55 | 10-55 | 02/11/2016 | 6.89J | |
| MW-370-55 | 10-55 | 04/06/2016 | 7.68J | |
| MW-370-55 | 10-55 | 07/19/2016 | 6.42J | |
| MW-370-55 | 10-55 | 10/18/2016 | 11.4 | sampled post-GAC West shutdown |
| MW-370-55 | 10-55 | 02/17/2017 | 9.36J | |
| MW-370-55 | 10-55 | 04/10/2017 | 8.69J | |
| MW-371-15 | Water Table | 06/05/2014 | 32.0 | |
| MW-371-15 | Water Table | 07/25/2014 | 71.0 | |
| MW-371-15 | Water Table | 10/17/2014 | 15.1 | |
| MW-371-15 | Water Table | 02/20/2015 | 5.99JL* | |
| MW-371-15 | Water Table | 04/17/2015 | 7.73J | |
| MW-371-15 | Water Table | 07/24/2015 | 7.04J | |
| MW-371-15 | Water Table | 10/19/2015 | 5.27J | |
| MW-371-15 | Water Table | 02/11/2016 | 6.14J | |
| MW-371-15 | Water Table | 04/07/2016 | 4.78J | |
| MW-371-15 | Water Table | 07/15/2016 | 3.52J | |
| MW-371-15 | Water Table | 10/19/2016 | 6.38J | sampled post-GAC West shutdown |
| MW-371-15 | Water Table | 02/14/2017 | 24.8 | |
| MW-371-15 | Water Table | 04/10/2017 | 19.4 | |
| MW-371-55 | 10-55 | 06/06/2014 | 5.50JL* | |
| MW-371-55 | 10-55 | 07/25/2014 | 7.18J | |
| MW-371-55 | 10-55 | 10/17/2014 | 4.83J | |
| MW-371-55 | 10-55 | 02/19/2015 | 4.75J | |
| MW-371-55 | 10-55 | 04/17/2015 | 4.15J | |
| MW-371-55 | 10-55 | 07/24/2015 | 3.40J | |

**Table 5-3**
**GAC West Shutdown Well Monitoring**

**First Semiannual 2017 Onsite Groundwater Monitoring Report**
**Flint Hills Resources Alaska, LLC**
**North Pole Terminal, North Pole, Alaska**

| Well ID | Zone | Sample Date | Sulfolane (µg/L) | Comment |
|---|---|---|---|---|
| MW-371-55 | 10-55 | 10/19/2015 | <5.15 | |
| MW-371-55 | 10-55 | 02/11/2016 | <5.30 | |
| MW-371-55 | 10-55 | 04/07/2016 | <5.10 | |
| MW-371-55 | 10-55 | 07/15/2016 | <5.05 | |
| MW-371-55 | 10-55 | 10/19/2016 | <5.10 | sampled post-GAC West shutdown |
| MW-371-55 | 10-55 | 02/14/2017 | 3.21J | |
| MW-371-75 | 55-90 | 06/06/2014 | 5.41JL* | |
| MW-371-75 | 55-90 | 07/25/2014 | 4.86J | |
| MW-371-75 | 55-90 | 10/17/2014 | 5.29J | |
| MW-371-75 | 55-90 | 02/19/2015 | 4.47J | |
| MW-371-75 | 55-90 | 04/17/2015 | 3.80J | |
| MW-371-75 | 55-90 | 07/24/2015 | <5.00 | |
| MW-371-75 | 55-90 | 10/19/2015 | <5.00 | |
| MW-371-75 | 55-90 | 02/11/2016 | 3.36J | |
| MW-371-75 | 55-90 | 04/07/2016 | 3.32J | |
| MW-371-75 | 55-90 | 07/15/2016 | <5.10 | |
| MW-371-75 | 55-90 | 10/19/2016 | 3.48J | sampled post-GAC West shutdown |
| MW-371-75 | 55-90 | 02/14/2017 | <5.10 | |
| MW-371-75 | 55-90 | 04/11/2017 | <5.10 | |
| MW-371-125 | 90-160 | 06/06/2014 | <5.45J* | |
| MW-371-125 | 90-160 | 07/25/2014 | <5.00 | |
| MW-371-125 | 90-160 | 10/17/2014 | <5.00 | |
| MW-371-125 | 90-160 | 02/19/2015 | <5.00 | |
| MW-371-125 | 90-160 | 04/17/2015 | <5.10 | |
| MW-371-125 | 90-160 | 07/24/2015 | <5.00 | |
| MW-371-125 | 90-160 | 10/19/2015 | <5.10 | |
| MW-371-125 | 90-160 | 02/11/2016 | <5.15 | |
| MW-371-125 | 90-160 | 07/15/2016 | <5.00 | |
| MW-371-125 | 90-160 | 02/14/2017 | <5.15 | sampled post-GAC West shutdown |

**General Notes:**
GAC West shut down on August 31, 2016.
Higher result of a field-duplicate pair is reported.
**Acronyms and Abbreviations:**
< = not detected; limit of detection (LOD) listed.
GAC = granular activated carbon
J = estimated concentration detected above the detection limit (DL) and below the limit of quantitation (LOQ), flag applied by laboratory.
J* = result is considered estimated (no direction of bias), due to QC failures or sample-handling anomalies, flag applied by Shannon & Wilson, Inc.
JL* = estimated concentration, biased low due to quality control failures, flag applied by Shannon & Wilson, Inc.
µg/L = micrograms per liter

# FIGURES


LEGEND:

FHRA PROPERTY BOUNDARY

0 0.5 Miles

GRAPHIC SCALE

Note:
Image provided courtesy of Pictometry International 2012

FLINT HILLS RESOURCES ALASKA, LLC
NORTH POLE TERMINAL, NORTH POLE, ALASKA

**FIRST SEMIANNUAL 2017 ONSITE GROUNDWATER MONITORING REPORT**

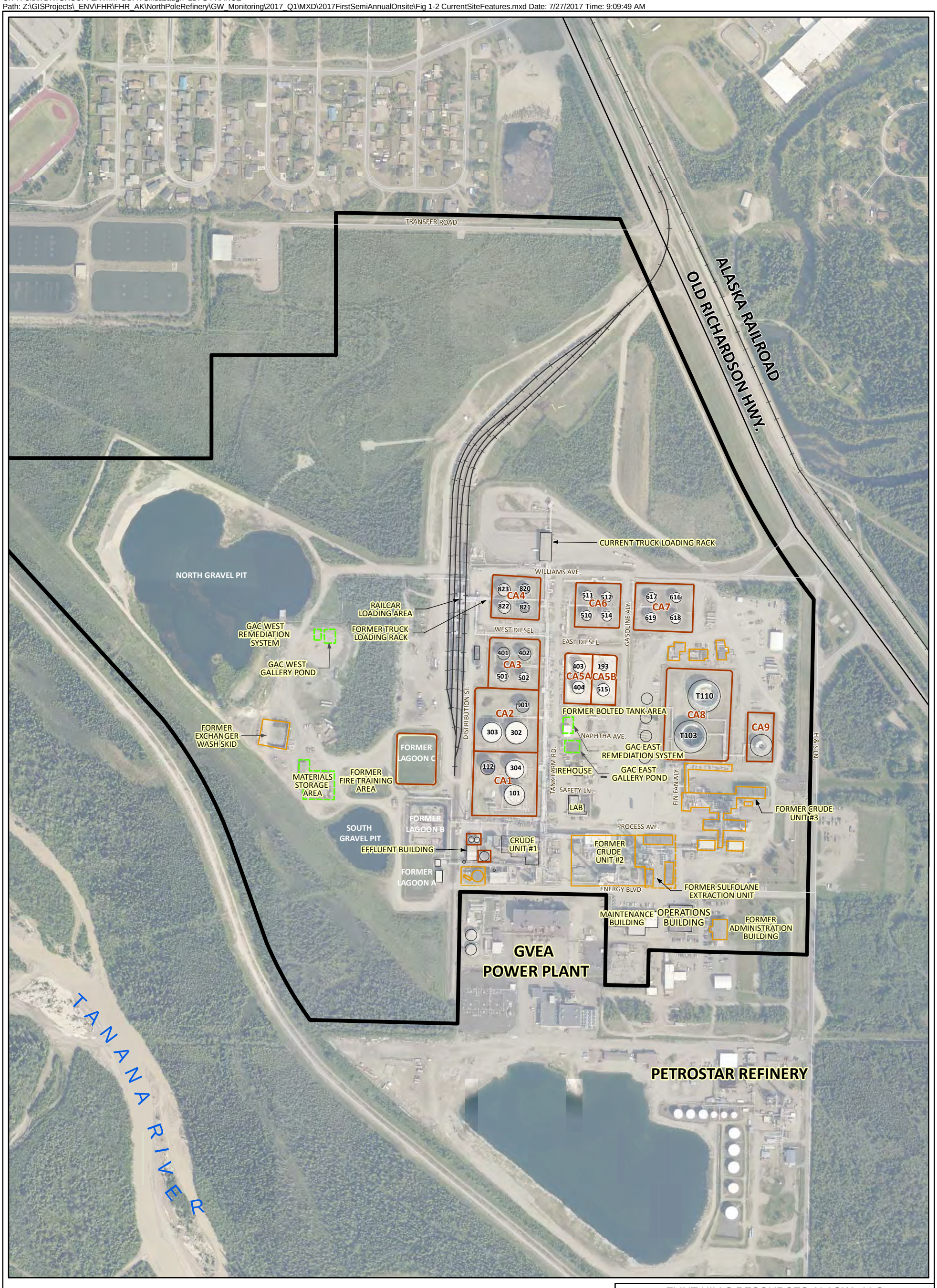
# SITE LOCATION

ARCADIS

**FIGURE 1-1**

CITY: Citrix DIV/GROUP: ENV/IM DB: K Sinsabaugh LD: G FRANCE
Path: Z:\GISProjects_ENV\FHR_AK\NorthPoleRefinery\GW_Monitoring\2017_Q1MXD\2017FirstSemiAnnualOnsite\Fig 1-1 SiteLocation.mxd Date: 4/13/2017 Time: 2:08:45 PM

CITY: Citrix DIV/GROUP: ENV/IM DB: K Sinsabaugh LD: G FRANCE
Path: Z:\GISProjects_ENV\FHR\FHR_AK\NorthPoleRefinery\GW_Monitoring\2017_Q1\MXD\2017FirstSemiAnnualOnsite\Fig 1-2 CurrentSiteFeatures.mxd Date: 7/27/2017 Time: 9:09:49 AM




**Legend**

- Bermed Containment Areas (CA)
- Approximate Area
- FHRA Property Boundary
- Structure Demolished

**Notes:**

GAC: Granular Activated Carbon
GVEA: Golden Valley Electrical Authority
-Image provided courtesy of Pictometry International 2012

0 400 800
SCALE IN FEET

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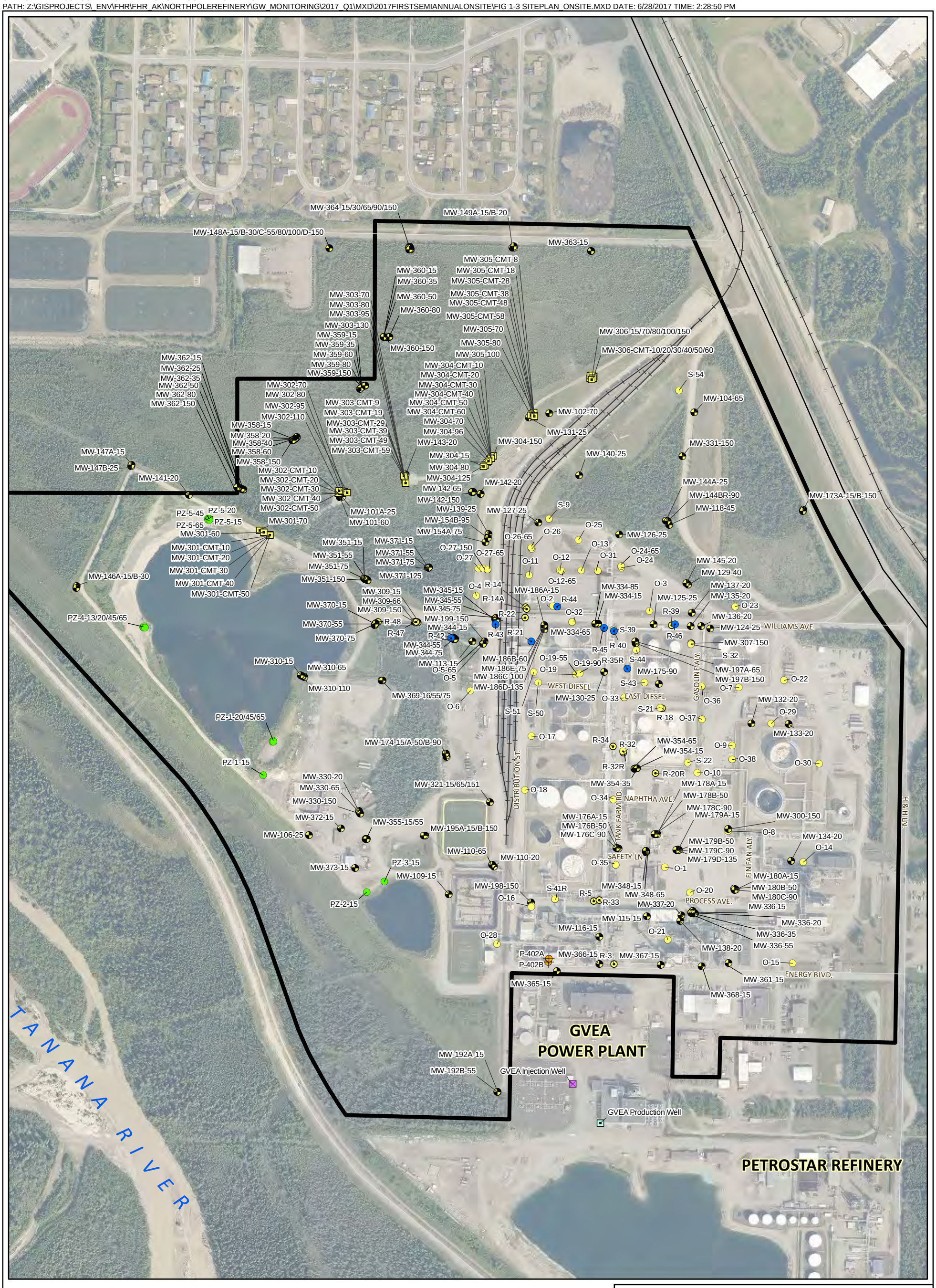
**FIRST SEMIANNUAL 2017 ONSITE GROUNDWATER MONITORING REPORT**

## SITE FEATURES

ARCADIS

FIGURE
**1-2**

CITY: CITRIX DIV/GROUP: ENV/IM DB: K SINSABAUGH LD: G FRANCE
PATH: Z:\GISPROJECTS_ENV\FHR\FHR_AK\NORTHPOLEREFINERY\GW_MONITORING\2017_Q1\MXD\2017FIRSTSEMIANNUALONSITE\FIG 1-3 SITEPLAN_ONSITE.MXD DATE: 6/28/2017 TIME: 2:28:50 PM




**Legend**

- Monitoring Well
- Observation Well
- Vertical Profile Transect Well
- Recovery Well
- Active Recovery Wells
- GVEA Injection Well (Approximate)
- GVEA Production Well (Approximate)
- Production Wells (Approximate)
- Piezometer
- FHRA Property Boundary
- Major Road
- Local Road
- Rail Line

0 400 800
SCALE IN FEET

**Notes:**
GVEA = Golden Valley Electrical Authority
-Image provided courtesy of Pictometry International 2012

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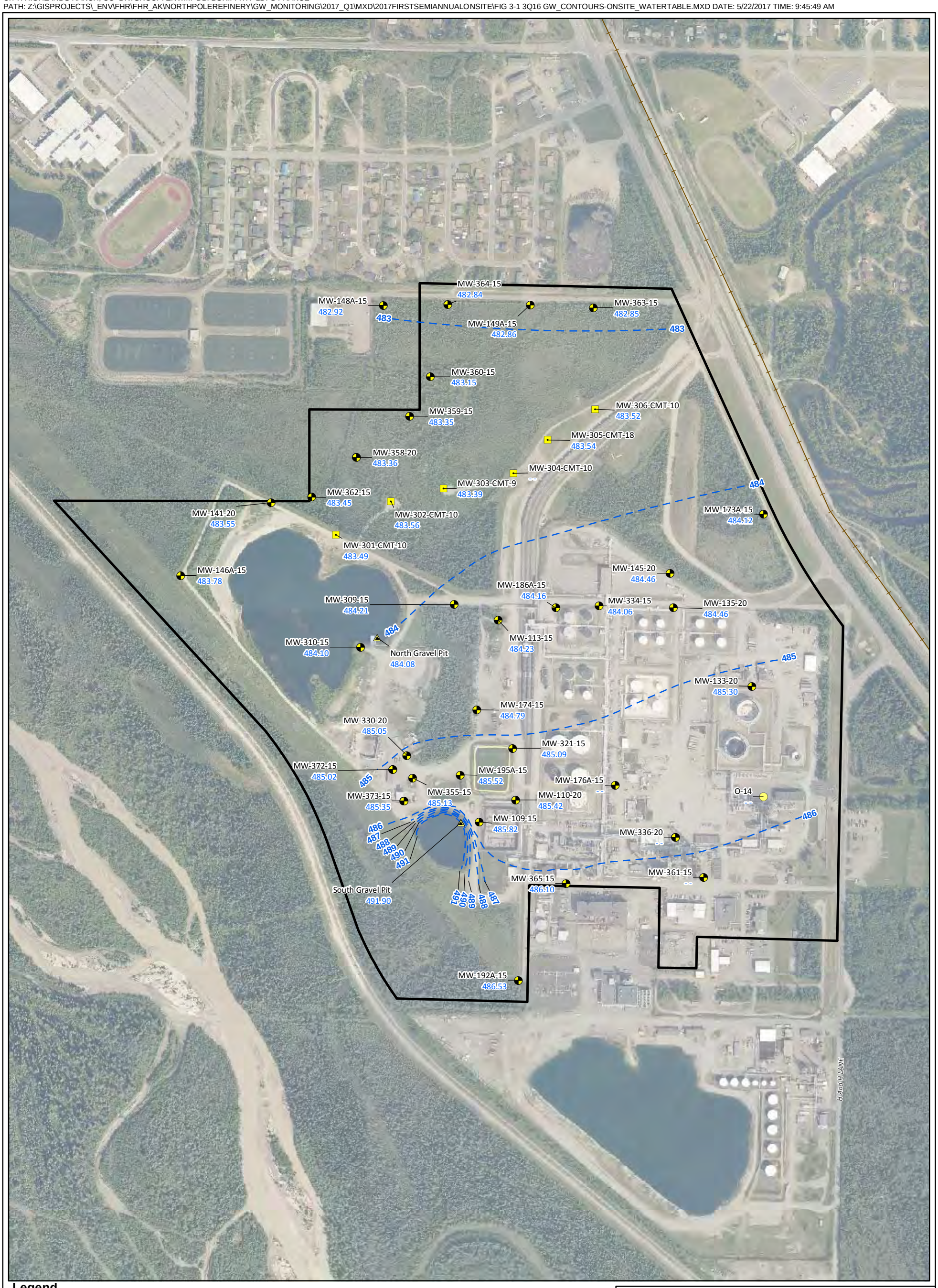
NORTH POLE TERMINAL, NORTH POLE, ALASKA
**FIRST SEMIANNUAL 2017 ONSITE GROUNDWATER MONITORING REPORT**

## SITE PLAN - ONSITE

ARCADIS

FIGURE
**1-3**

CITY: HIGHLANDS RANCH, CO DIV/GROUP: ENV/IM DB: BGRIFFITH LD: G FRANCE
PATH: Z:\GISPROJECTS_ENV\FHR\FHR_AK\NORTHPOLEREFINERY\GW_MONITORING\2017_Q1\MXD\2017FIRSTSEMIANNUALONSITE\FIG 3-1 3Q16 GW_CONTOURS-ONSITE_WATERTABLE.MXD DATE: 5/22/2017 TIME: 9:45:49 AM




**Legend**

- Vertical Profile Transect Well
- Monitoring Well
- Observation Well
- Surface Water
- FHRA Property Boundary
- 486 — Groundwater Elevation Contours in Feet Above Mean Sea Level (Dashed where Inferred)
- - - Not gauged due to well being dry, frozen, or obstructed

0 500 1,000
SCALE IN FEET

Notes:
-Wells were gauged in March 2017
-Refer to Capture Zone Monitoring Appendix for water elevation detail in the area of the recovery well system
-Only monitoring wells scheduled for gauging per Table 3-1 of the Long Term Monitoring Plan - 2016 Update are shown on the figure.
-Vertical gradient data are evaluated in more detail in Appendix J of the First Semiannual 2017 Onsite Groundwater Monitoring Report
-Image provided courtesy of Pictometry International 2012

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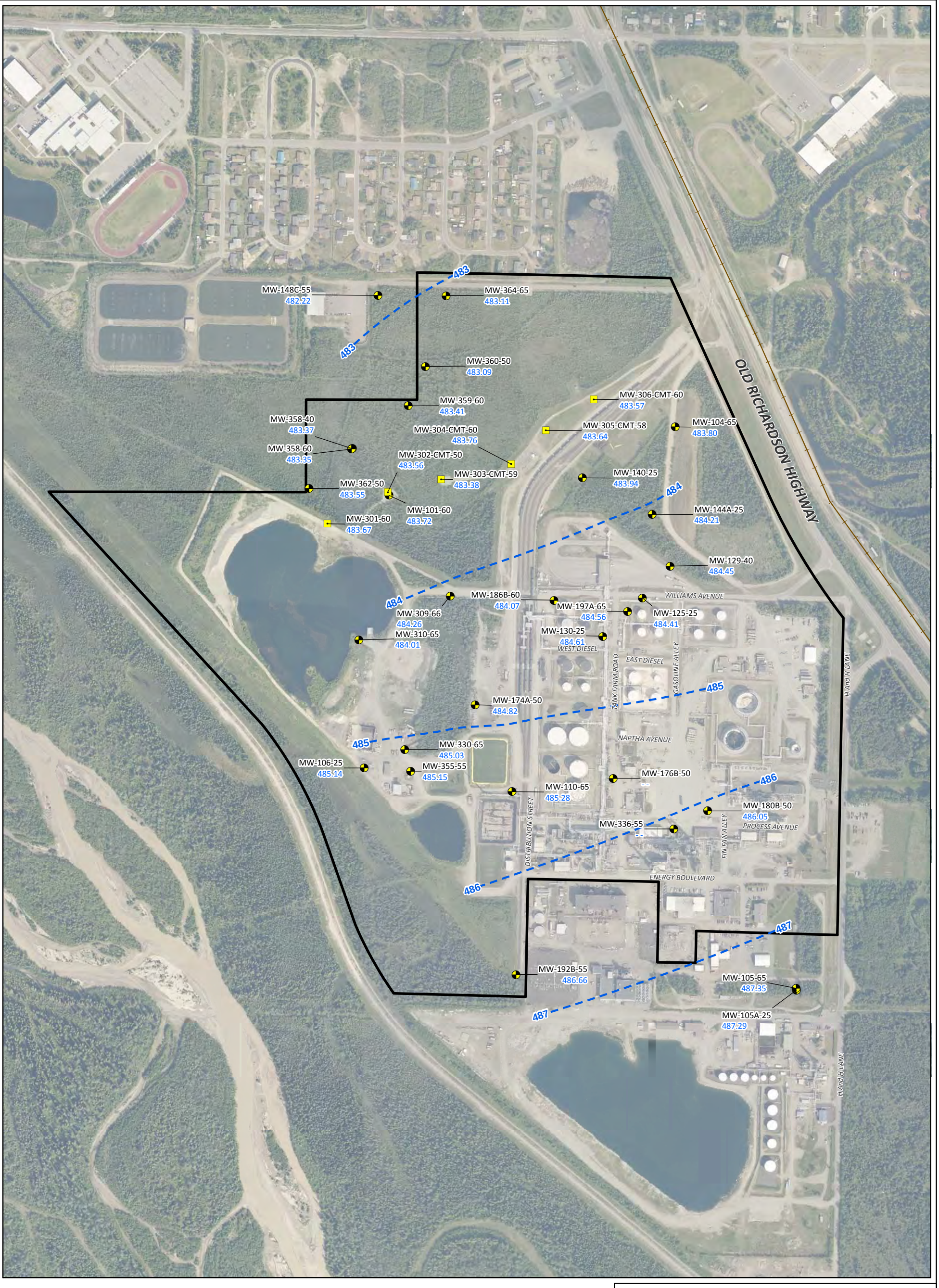
**FIRST SEMIANNUAL 2017 ONSITE GROUNDWATER MONITORING REPORT**

**FIRST QUARTER 2017 GROUNDWATER CONTOUR MAP- ONSITE WELLS AT WATER TABLE**

ARCADIS

FIGURE
**3-1**

CITY: HIGHLANDS RANCH, CO DIV/GROUP: ENV/IM DB: BGRIFFITH LD: G FRANCE
PATH: Z:\GISPROJECTS_ENV\FHR\FHR_AK\NORTHPOLEREFINERY\GW_MONITORING\2017_Q1\MXD\2017FIRSTSEMIANNUALONSITE\FIG 3-2 3Q16 GW_CONTOURS-ONSITE_10-55FT.MXD DATE: 5/16/2017 TIME: 3:58:04 PM




**Legend**

- Vertical Profile Transect Well
- Monitoring Well
- FHRA Property Boundary
- 485 — Groundwater Elevation Contours in Feet Above Mean Sea Level (Dashed where Inferred)
- - - Not gauged due to well being dry, frozen, or obstructed

0 500 1,000
SCALE IN FEET

Notes:
-Wells were gauged in March 2017
-Only monitoring wells scheduled for gauging per Table 3-1 of the Long Term Monitoring Plan - 2016 Update are shown on the figure.
-Vertical gradient data are evaluated in more detail in Appendix J of the First Semiannual 2017 Onsite Groundwater Monitoring Report
-Image provided courtesy of Pictometry International 2012

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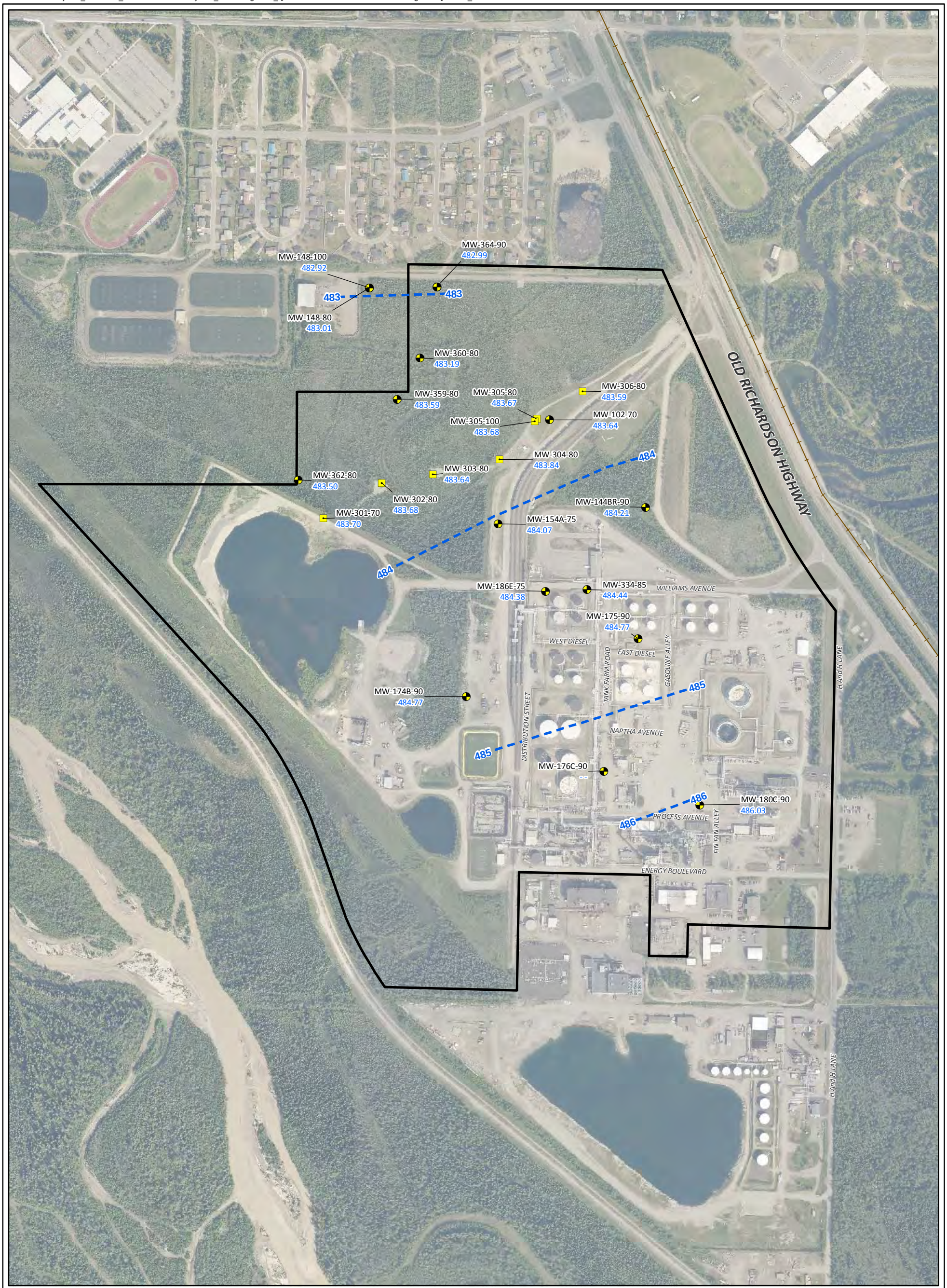
**FIRST SEMIANNUAL 2017 ONSITE GROUNDWATER MONITORING REPORT**

**FIRST QUARTER 2017 GROUNDWATER CONTOUR MAP - ONSITE WELLS 10 TO 55 FEET BELOW WATER TABLE**

ARCADIS

FIGURE
**3-2**

CITY: SF DIV/GROUP: ENV/IM DB: KSINSABAUGH LD: PIC: PM: TM: TR:
PROJECT: (PROJECT #)
PATH: Z:\GISProjects_ENV\FHR_AK\NorthPoleRefinery\GW_Monitoring\2017_Q1\MXD\2017FirstSemiAnnualOnsite\Fig 3-3 3Q16 GW_Contours-55-90ft.mxd 4/13/2017 2:03:38 PM




**Legend**

- Vertical Profile Transect Well
- Monitoring Well
- FHRA Property Boundary
- 485 — Groundwater Elevation Contours in Feet Above Mean Sea Level (Dashed where Inferred)
- - - Not gauged due to well being dry, frozen, or obstructed

0 500 1,000

SCALE IN FEET

Notes:
-Wells were gauged in March 2017
-Only monitoring wells scheduled for gauging per Table 3-1 of the Long Term Monitoring Plan - 2016 Update are shown on the figure.
-Vertical gradient data are evaluated in more detail in Appendix J of the First Semiannual 2017 Onsite Groundwater Monitoring Report
-Image provided courtesy of Pictometry International 2012

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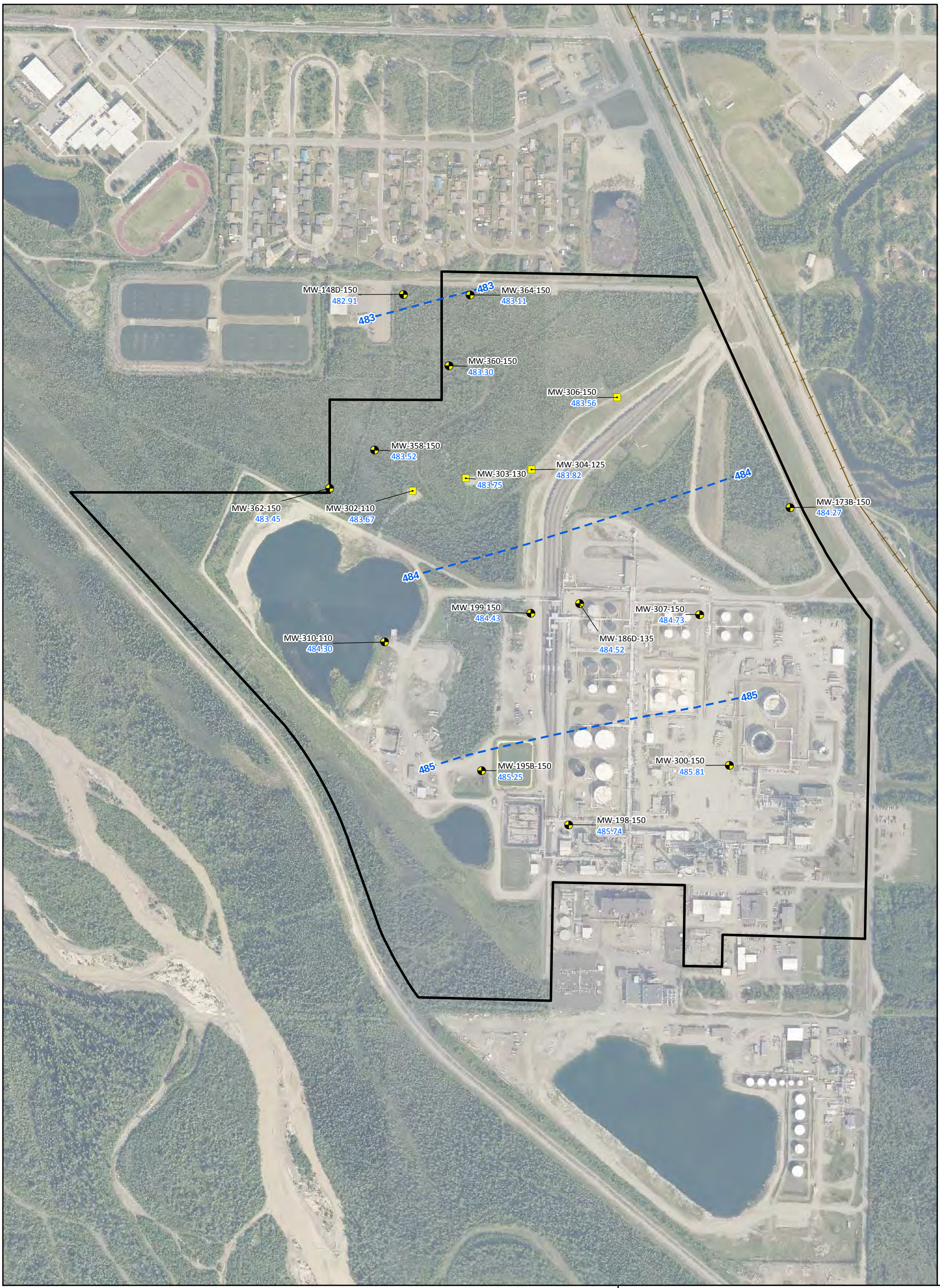
**FIRST SEMIANNUAL 2017 ONSITE GROUNDWATER MONITORING REPORT**

**FIRST QUARTER 2017 GROUNDWATER CONTOUR MAP - ONSITE WELLS 55 TO 90 FEET BELOW WATER TABLE**

ARCADIS

FIGURE
**3-3**

CITY: SF DIV/GROUP: ENV/IM DB: KSINSABAUGH LD: PIC: PM: TM: TR:
PROJECT: (PROJECT #)
PATH: Z:\GISProjects_ENV\FHR_AK\NorthPoleRefinery\GW_Monitoring\2017_Q1\MXD\2017FirstSemiAnnualOnsite\Fig 3-4 3Q16 GW_Contours-90-160ft.mxd 4/13/2017 2:06:10 PM




**Legend**

- Vertical Profile Transect Well
- Monitoring Well
- FHRA Property Boundary
- 480 — Groundwater Elevation Contours in Feet Above Mean Sea Level (Dashed where Inferred)

Notes:
-Wells were gauged in March 2017
-Only monitoring wells scheduled for gauging per Table 3-1 of the Long Term Monitoring Plan - 2016 Update are shown on the figure.
-Vertical gradient data are evaluated in more detail in Appendix J of the First Semiannual 2017 Onsite Groundwater Monitoring Report.
-Image provided courtesy of Pictometry International 2012

0 500 1,000
SCALE IN FEET

FLINT HILLS RESOURCES ALASKA, LLC
NORTH POLE TERMINAL, NORTH POLE, ALASKA

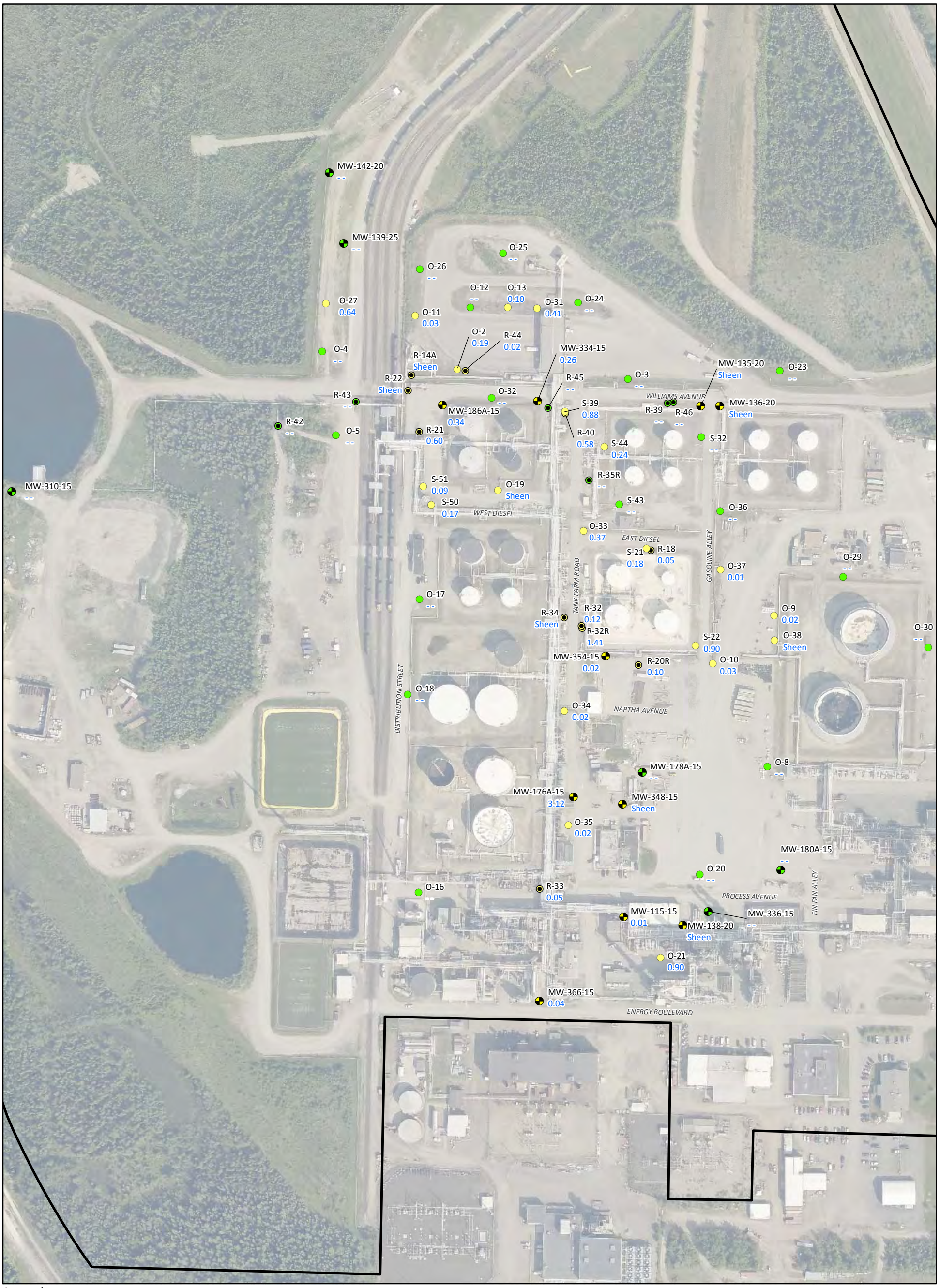
**FIRST SEMIANNUAL 2017 ONSITE GROUNDWATER MONITORING REPORT**

**FIRST QUARTER 2017 GROUNDWATER CONTOUR MAP - ONSITE WELLS 90 TO 160 FEET BELOW WATER TABLE**

ARCADIS

FIGURE
**3-4**

CITY: HIGHLANDS RANCH, CO DIV/GROUP: ENV/IM DB: BGRIFFITH LD: G FRANCE
PATH: Z:\GISPROJECTS\ ENV\FHR\FHR_AK\NORTHPOLEREFINERY\GW_MONITORING\2017_Q1\MXD\2017FIRSTSEMIANNUALONSITE\FIG 3-5 1Q17 LNAPL_MONITORINGDATA.MXD DATE: 5/22/2017 TIME: 9:43:07 AM




Legend

**No LNAPL or Sheen Observed**
- Monitoring Well
- Observation Well
- Recovery Well

**LNAPL or Sheen Observed**
- Monitoring Well
- Observation Well
- Recovery Well

FHRA Property Boundary

3.12 LNAPL Thickness (feet)

Sheen An interface probe was used. No measurable LNAPL was present, but LNAPL sheen was observed visually.

-- No LNAPL measured or sheen observed

0 230 460

SCALE IN FEET

Notes:
LNAPL = Light Nonaqueous Phase Liquid
LNAPL results posted on figure are in feet.
-The maximum LNAPL thickness for wells gauged as part of the Long Term Monitoring Plan (Arcadis 2016), the Operations, Maintenance, and Monitoring Plan (Barr 2016), and the Final Onsite Cleanup Plan (Arcadis 2016) are shown on the figure. A comprehensive gauging table is included in Appendix F.
-Image provided courtesy of Pictometry International 2012

FLINT HILLS RESOURCES ALASKA, LLC
NORTH POLE TERMINAL, NORTH POLE, ALASKA

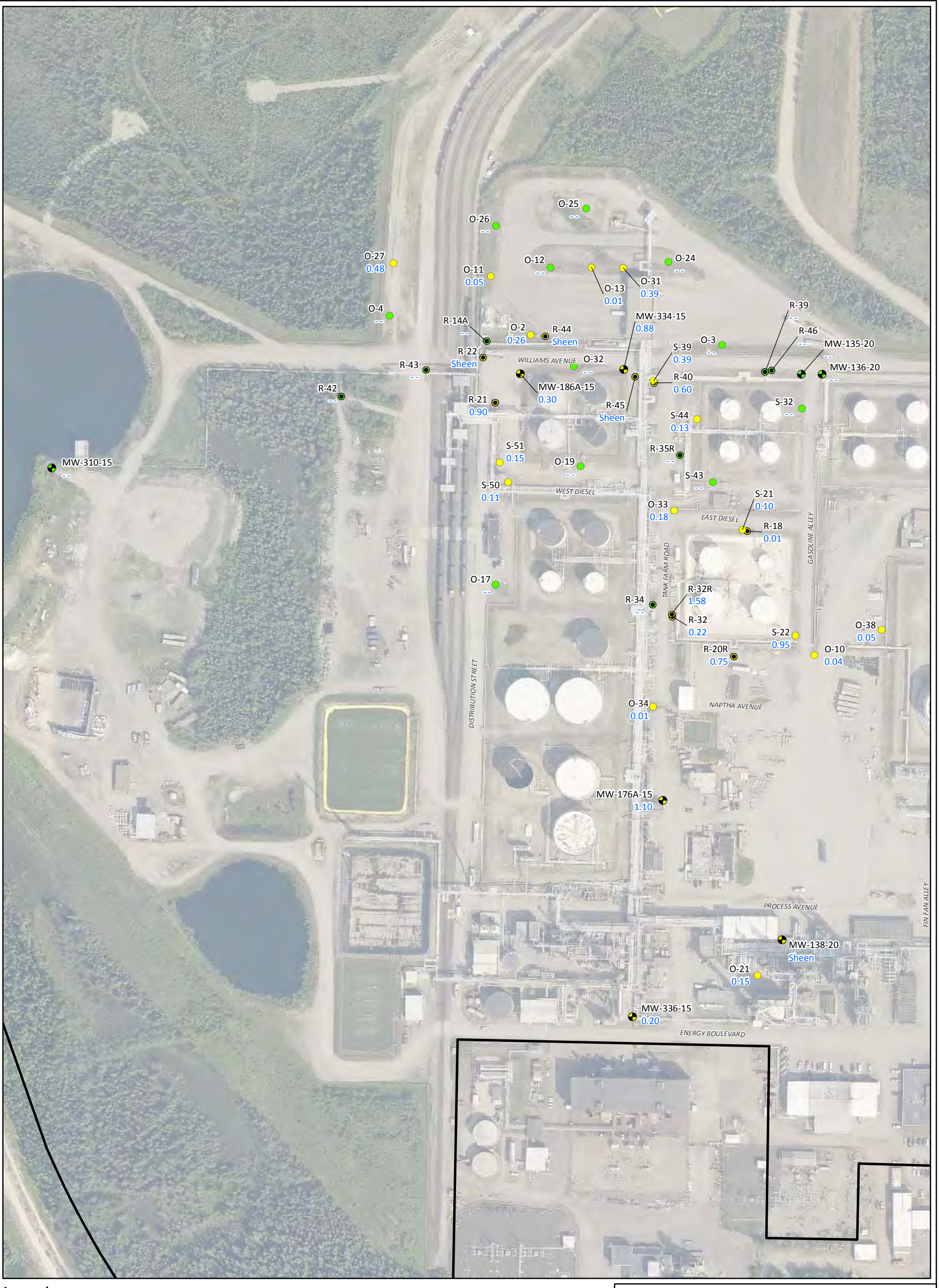
**FIRST SEMIANNUAL 2017 ONSITE GROUNDWATER MONITORING REPORT**

# FIRST QUARTER 2017 LNAPL MONITORING DATA

ARCADIS

FIGURE
**3-5**

CITY: Citrix DIV/GROUP: IM/DV DB: K Sinsabaugh LD: G FRANCE
Path: Z:\GISProjects_ENV\FHR\FHR_AK\NorthPoleRefinery\GW_Monitoring\2017_Q2\MXD\2017FirstSemiAnnualOnsite\Fig 3-6 2Q17 LNAPL_MonitoringData.mxd Date: 7/21/2017 Time: 8:39:22 AM




**Legend**

**No LNAPL or Sheen Observed**
- Monitoring Well
- Observation Well
- Recovery Well

**LNAPL or Sheen Observed**
- Monitoring Well
- Observation Well
- Recovery Well

FHRA Property Boundary

1.10 LNAPL Thickness (feet)

Sheen An interface probe was used. No measurable LNAPL was present, but LNAPL sheen was observed visually.

-- No LNAPL measured or sheen observed

0 210 420
SCALE IN FEET

Notes:
LNAPL = Light Nonaqueous Phase Liquid
LNAPL results posted on figure are in feet.
-The maximum LNAPL thickness for wells gauged as part of the the Long Term Monitoring Plan (Arcadis 2016), the Operations, Maintenance, and Monitoring Plan (Barr 2016), and the Final Onsite Cleanup Plan (Arcadis 2016) are shown on the figure. A comprehensive gauging table is included in Appendix F.
-Image provided courtesy of Pictometry International 2012

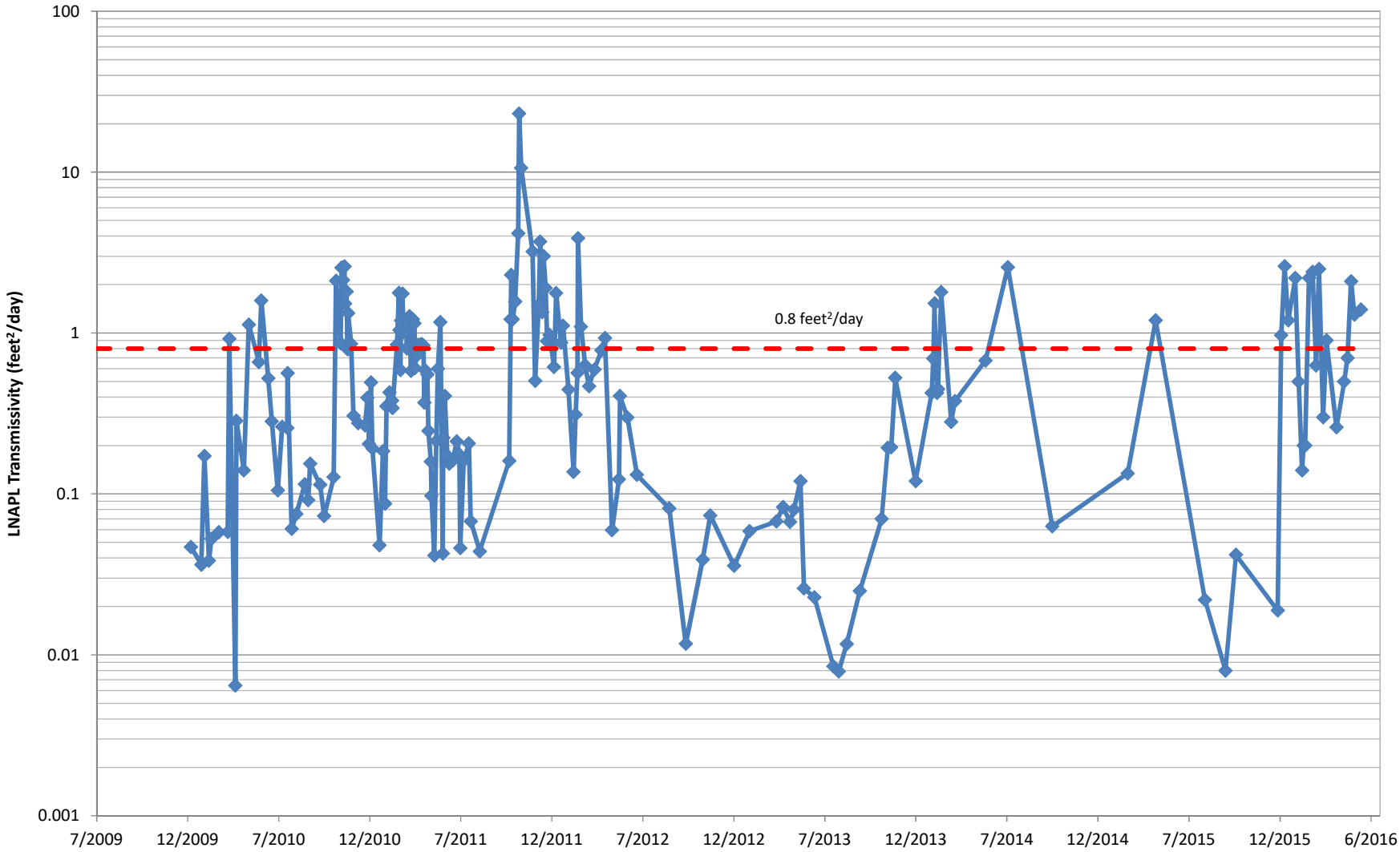
FLINT HILLS RESOURCES ALASKA, LLC
NORTH POLE TERMINAL, NORTH POLE, ALASKA

**FIRST SEMIANNUAL 2017 ONSITE GROUNDWATER MONITORING REPORT**

# SECOND QUARTER 2017 LNAPL MONITORING DATA

ARCADIS

FIGURE
**3-6**




NOTES:
LNAPL = light nonaqueous phase liquid

Data includes LNAPL transmissivity estimates using separate equations for small relative LNAPL drawdown and large relative LNAPL drawdown. Methodology is available in Appendix 7-D of the Onsite Site Characterization Report – 2013 Addendum (ARCADIS 2013a).

Data collected on October 27, 2011 resulted in a high Tn value of 23.13 feet²/day due to a high in-well LNAPL thickness and low water table elevation at the time of the test. This resulted in higher LNAPL from the pore space and subsequent recovery.

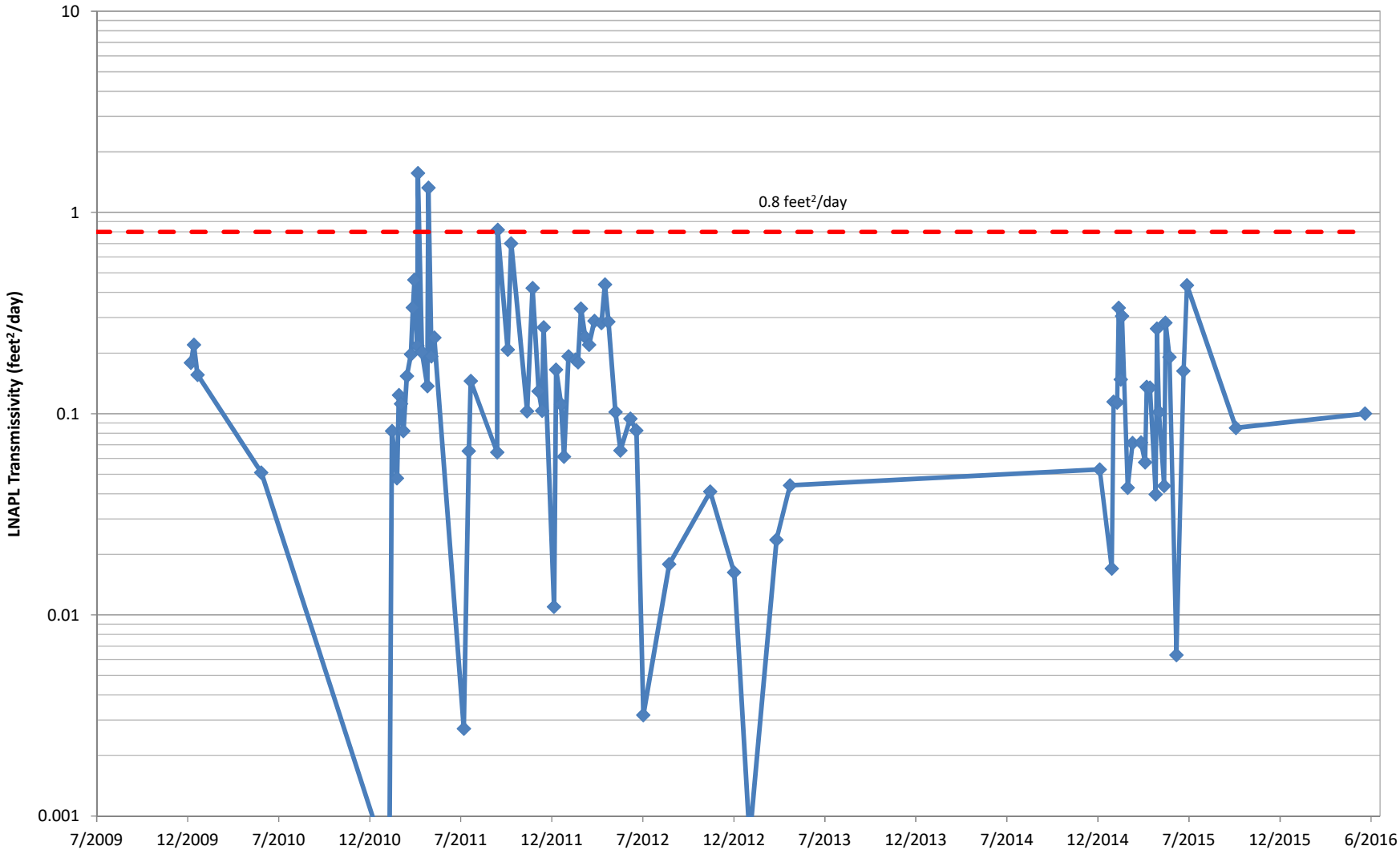
Upper Interstate Technology & Regulatory Council criterion of LNAPL Tn for beneficial LNAPL mass recovery (ITRC 2009)

FLINT HILLS RESOURCES ALASKA, LLC
NORTH POLE TERMINAL, NORTH POLE, ALASKA
**FIRST SEMIANNUAL 2017 ONSITE GROUNDWATER MONITORING REPORT**

## WELL R-21 GROUNDWATER EXTRACTION - ENHANCED LNAPL RECOVERY

ARCADIS Design & Consultancy for natural and built assets

**FIGURE 3-7a**




NOTES:
LNAPL = light nonaqueous phase liquid

Data includes LNAPL transmissivity estimates using separate equations for small relative LNAPL drawdown and large relative LNAPL drawdown. Methodology is available in Appendix 7-D of the Onsite Site Characterization Report – 2013 Addendum (ARCADIS 2013a).

Upper Interstate Technology & Regulatory Council criterion of LNAPL Tn for beneficial LNAPL mass recovery (ITRC 2009)

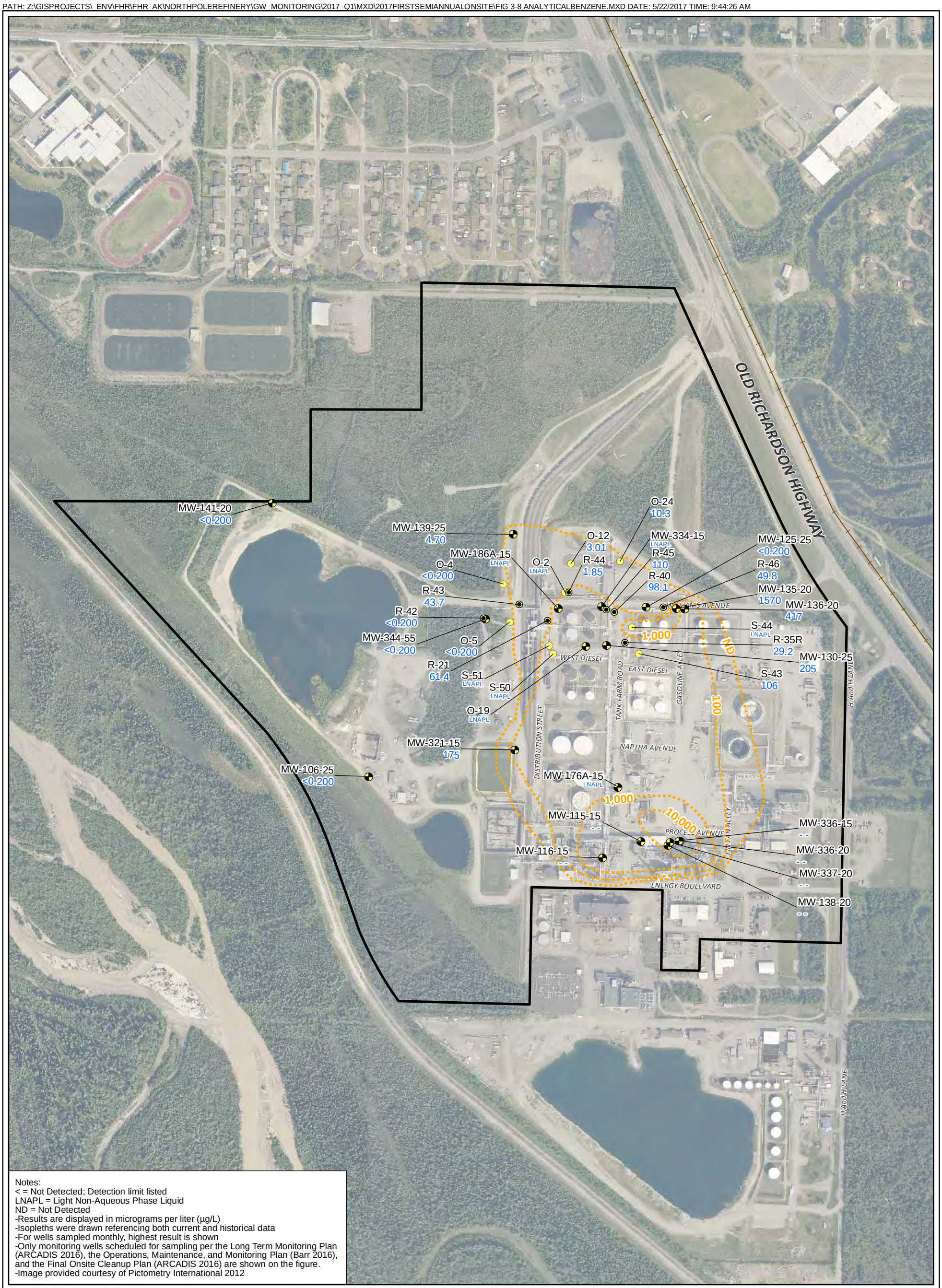
FLINT HILLS RESOURCES ALASKA, LLC
NORTH POLE TERMIANL, NORTH POLE, ALASKA
**FIRST SEMIANNUAL 2017 ONSITE GROUNDWATER MONITORING REPORT**

# WELL R-40 GROUNDWATER EXTRACTION - ENHANCED LNAPL RECOVERY

ARCADIS Design & Consultancy for natural and built assets

**FIGURE**
**3-7b**

CITY: CITRIX DIV/GROUP: ENV/IM DB: K SINSABAUGH LD: G FRANCE
PATH: Z:\GISPROJECTS_ENV\FHR\FHR_AK\NORTHPOLEREFINERY\GW_MONITORING\2017_Q1\MXD\2017FIRSTSEMIANNUALONSITE\FIG 3-8 ANALYTICALBENZENE.MXD DATE: 5/22/2017 TIME: 9:44:26 AM




Notes:
< = Not Detected; Detection limit listed
LNAPL = Light Non-Aqueous Phase Liquid
ND = Not Detected
-Results are displayed in micrograms per liter (µg/L)
-Isopleths were drawn referencing both current and historical data
-For wells sampled monthly, highest result is shown
-Only monitoring wells scheduled for sampling per the Long Term Monitoring Plan (ARCADIS 2016), the Operations, Maintenance, and Monitoring Plan (Barr 2016), and the Final Onsite Cleanup Plan (ARCADIS 2016) are shown on the figure.
-Image provided courtesy of Pictometry International 2012

**Legend:**

- Monitoring Well
- Observation Well
- Recovery Well
- Inferred benzene isopleth in µg/L
- FHRA Property Boundary
- LNAPL Well not sampled due to LNAPL presence
- - - Well frozen or dry

0 500 1,000
SCALE IN FEET

FLINT HILLS RESOURCES ALASKA, LLC
NORTH POLE TERMINAL, NORTH POLE, ALASKA

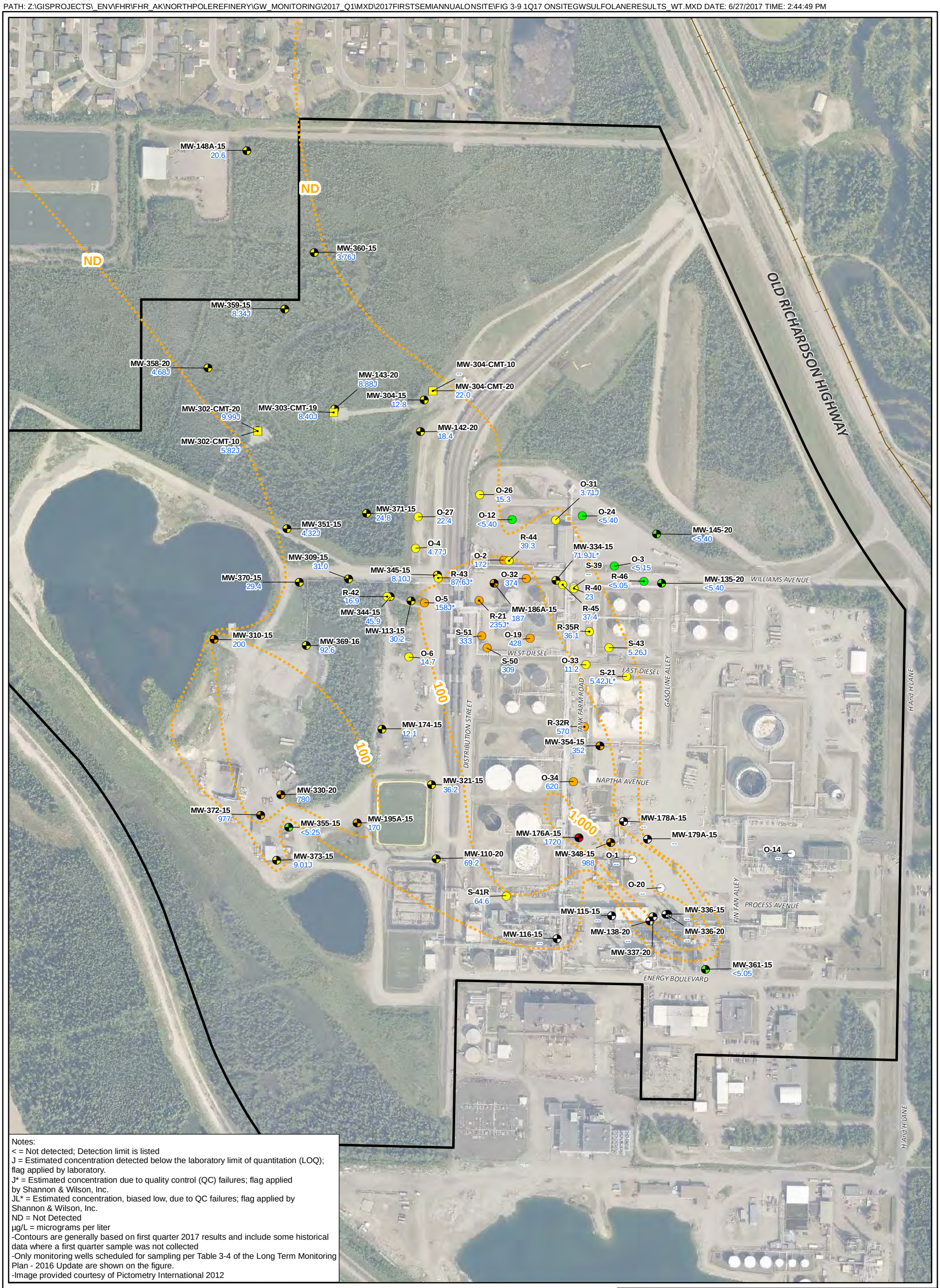
**FIRST SEMIANNUAL 2017 ONSITE GROUNDWATER MONITORING REPORT**

**FIRST SEMIANNUAL 2017 ONSITE BENZENE GROUNDWATER ANALYTICAL RESULTS**

ARCADIS

FIGURE
**3-8**

CITY: CITRIX DIV/GROUP: ENV/IM DB: K SINSABAUGH LD: G FRANCE
PATH: Z:\GISPROJECTS_ENV\FHR\FHR_AK\NORTHPOLEREFINERY\GW_MONITORING\2017_Q1\MXD\2017FIRSTSEMIANNUALONSITE\FIG 3-9 1Q17 ONSITEGWSULFOLANERESULTS_WT.MXD DATE: 6/27/2017 TIME: 2:44:49 PM




Notes:
< = Not detected; Detection limit is listed
J = Estimated concentration detected below the laboratory limit of quantitation (LOQ); flag applied by laboratory.
J* = Estimated concentration due to quality control (QC) failures; flag applied by Shannon & Wilson, Inc.
JL* = Estimated concentration, biased low, due to QC failures; flag applied by Shannon & Wilson, Inc.
ND = Not Detected
µg/L = micrograms per liter
-Contours are generally based on first quarter 2017 results and include some historical data where a first quarter sample was not collected
-Only monitoring wells scheduled for sampling per Table 3-4 of the Long Term Monitoring Plan - 2016 Update are shown on the figure.
-Image provided courtesy of Pictometry International 2012

**Legend**

- Monitoring Well
- Observation Well
- Recovery Well
- Vertical Profile Transect Well
- Approximate Sulfolane Isopleth in µg/L at Water Table
- FHRA Property Boundary

**Sulfolane Results**

- Not Detected
- 3.14 - 100 µg/L
- 100 - 1,000 µg/L
- >1,000 µg/L
- Well Dry/Frozen

0 350 700
SCALE IN FEET

FLINT HILLS RESOURCES ALASKA, LLC
NORTH POLE TERMINAL, NORTH POLE, ALASKA

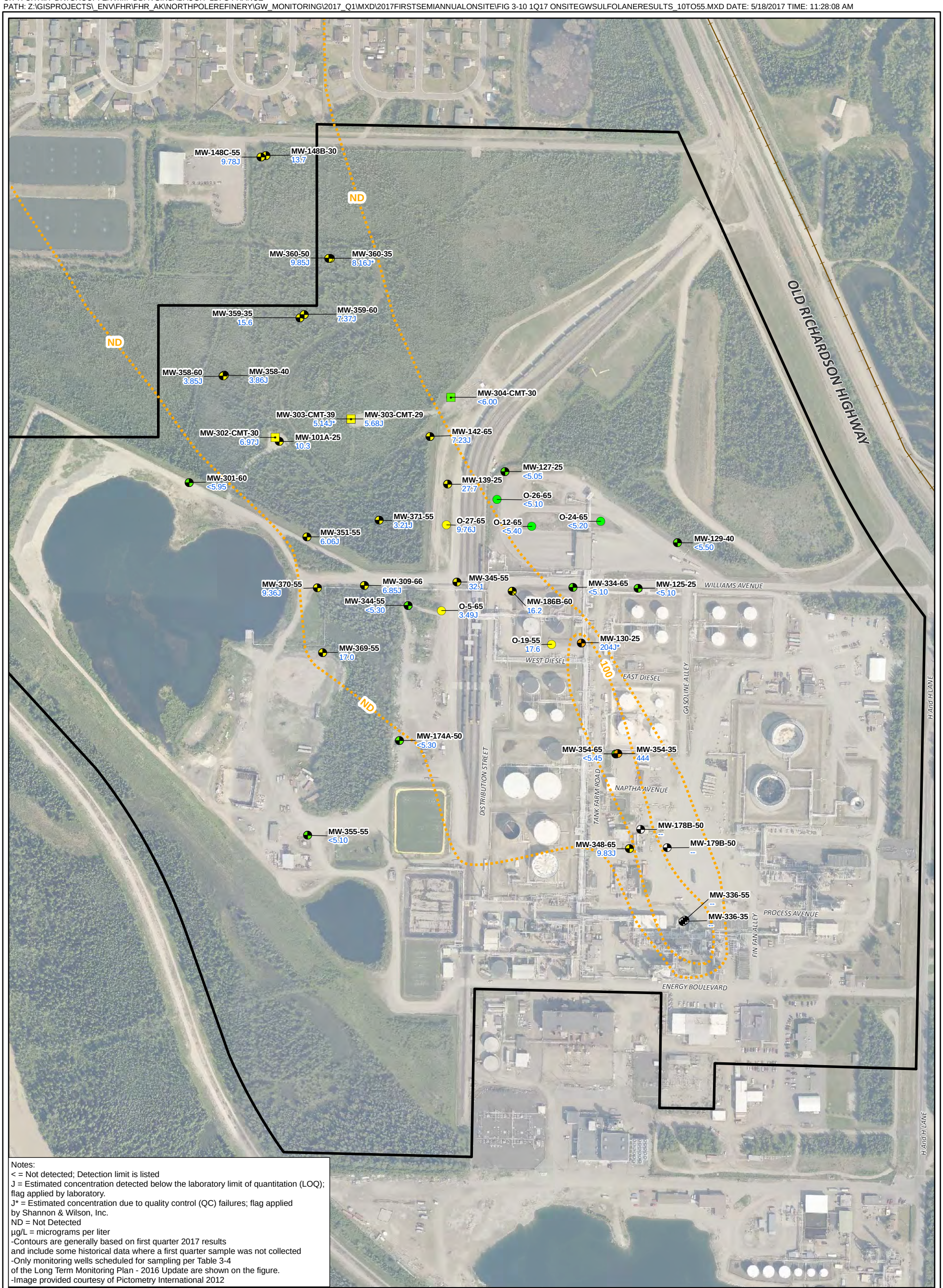
**FIRST SEMIANNUAL 2017 ONSITE GROUNDWATER MONITORING REPORT**

**FIRST QUARTER 2017 ONSITE SULFOLANE GROUNDWATER ANALYTICAL RESULTS - WATER TABLE**

ARCADIS

FIGURE
**3-9**

CITY: CITRIX DIV/GROUP: ENV/IM DB: K SINSABAUGH LD: G FRANCE
PATH: Z:\GISPROJECTS_ENV\FHR\FHR_AK\NORTHPOLEREFINERY\GW_MONITORING\2017_Q1\MXD\2017FIRSTSEMIANNUALONSITE\FIG 3-10 1Q17 ONSITEGWSULFOLANERESULTS_10TO55.MXD DATE: 5/18/2017 TIME: 11:28:08 AM




Notes:
< = Not detected; Detection limit is listed
J = Estimated concentration detected below the laboratory limit of quantitation (LOQ); flag applied by laboratory.
J* = Estimated concentration due to quality control (QC) failures; flag applied by Shannon & Wilson, Inc.
ND = Not Detected
µg/L = micrograms per liter
-Contours are generally based on first quarter 2017 results and include some historical data where a first quarter sample was not collected
-Only monitoring wells scheduled for sampling per Table 3-4 of the Long Term Monitoring Plan - 2016 Update are shown on the figure.
-Image provided courtesy of Pictometry International 2012

**Legend**

- Monitoring Well
- Observation Well
- Vertical Profile Transect Well
- Approximate Sulfolane Isopleth in µg/L
- FHRA Property Boundary

**Sulfolane Results**

- Not Detected
- 3.14 - 100 µg/L
- 100 - 1,000 µg/L
- -- Well Dry/Frozen

0 350 700
SCALE IN FEET

FLINT HILLS RESOURCES ALASKA, LLC
NORTH POLE TERMINAL, NORTH POLE, ALASKA

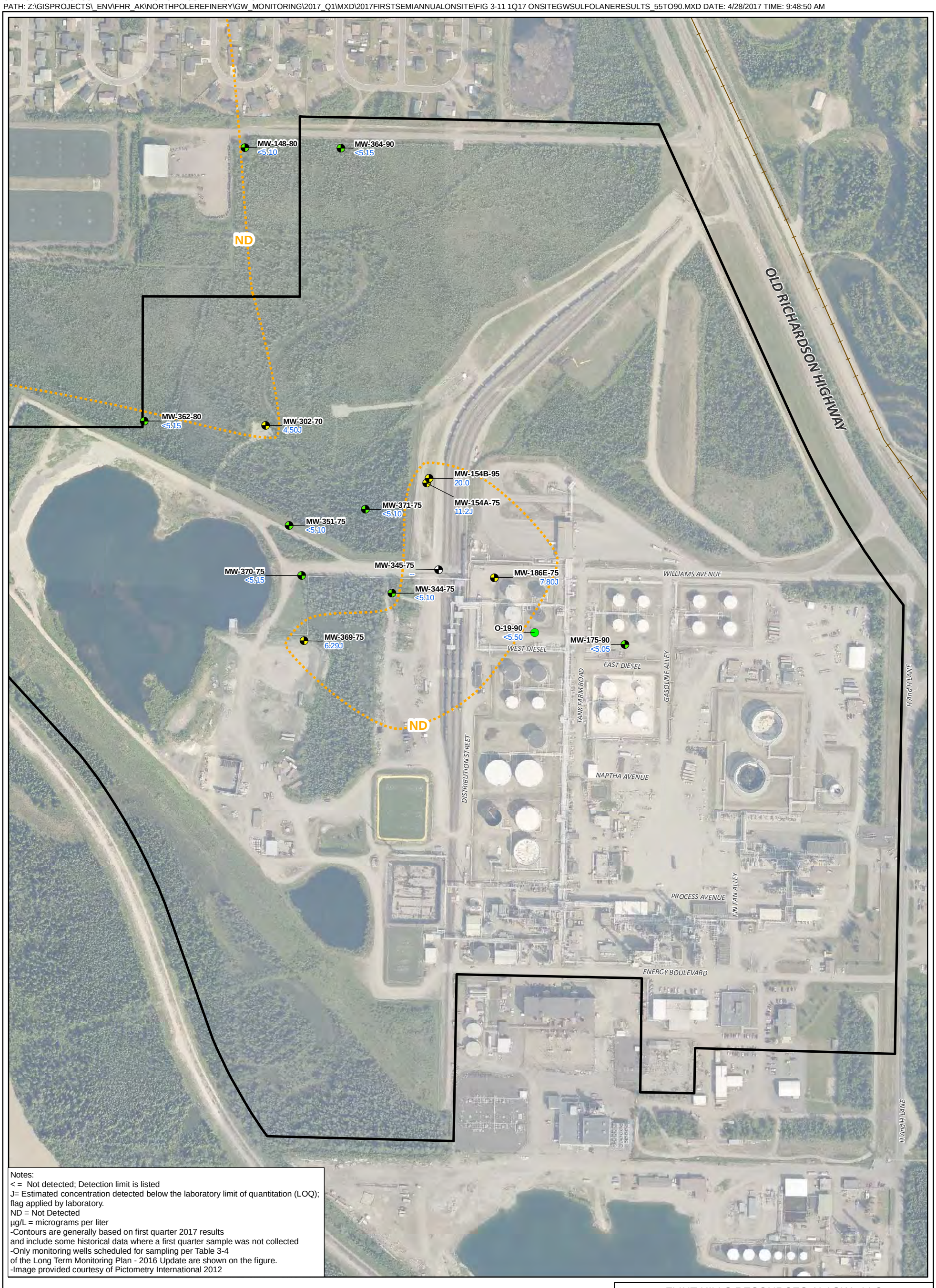
**FIRST SEMIANNUAL 2017 ONSITE GROUNDWATER MONITORING REPORT**

**FIRST QUARTER 2017 ONSITE SULFOLANE GROUNDWATER ANALYTICAL RESULTS - 10 TO 55 FEET BELOW WATER TABLE**

ARCADIS

FIGURE
**3-10**

CITY: CITRIX DIV/GROUP: ENV/IM DB: K SINSABAUGH LD: G FRANCE
PATH: Z:\GISPROJECTS_ENV\FHR_AK\NORTHPOLEREFINERY\GW_MONITORING\2017_Q1\MXD\2017FIRSTSEMIANNUALONSITE\FIG 3-11 1Q17 ONSITEGWSULFOLANERESULTS_55TO90.MXD DATE: 4/28/2017 TIME: 9:48:50 AM




Notes:
< = Not detected; Detection limit is listed
J= Estimated concentration detected below the laboratory limit of quantitation (LOQ); flag applied by laboratory.
ND = Not Detected
µg/L = micrograms per liter
-Contours are generally based on first quarter 2017 results and include some historical data where a first quarter sample was not collected
-Only monitoring wells scheduled for sampling per Table 3-4 of the Long Term Monitoring Plan - 2016 Update are shown on the figure.
-Image provided courtesy of Pictometry International 2012

**Legend**

- Monitoring Well
- Observation Well
- Approximate Sulfolane Isopleth in µg/L
- FHRA Property Boundary

**Sulfolane Results**

- Not Detected
- 3.14 - 100 µg/L
- -- Well Dry/Frozen

0 350 700
SCALE IN FEET

FLINT HILLS RESOURCES ALASKA, LLC
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**FIRST SEMIANNUAL 2017 ONSITE GROUNDWATER MONITORING REPORT**

**FIRST QUARTER 2017 ONSITE SULFOLANE GROUNDWATER ANALYTICAL RESULTS - 55 TO 90 FEET BELOW WATER TABLE**

ARCADIS

FIGURE
**3-11**

CITY: CITRIX DIV/GROUP: ENV/IM DB: K SINSABAUGH LD: G FRANCE
PATH: Z:\GISPROJECTS_ENV\FHR_AK\NORTHPOLEREFINERY\GW_MONITORING\2017_Q1\MXD\2017FIRSTSEMIANNUALONSITE\FIG 3-12 1Q17 ONSITEGWSULFOLANERESULTS_90TO160.MXD DATE: 4/24/2017 TIME: 2:47:38 PM


Notes:
< = Not detected; Detection limit is listed
µg/L = micrograms per liter
-Only monitoring wells scheduled for sampling per Table 3-4 of the Long Term Monitoring Plan - 2016 Update are shown on the figure.
-Image provided courtesy of Pictometry International 2012

**Legend**

- Monitoring Well
- FHRA Property Boundary

**Sulfolane Results**

- Not Detected

Depth to Top of Permafrost in feet

- < 10
- 10 - 30
- 30 - 60
- 60 - 90
- 90 - 120
- 120 - 150

0 350 700

SCALE IN FEET

FLINT HILLS RESOURCES ALASKA, LLC
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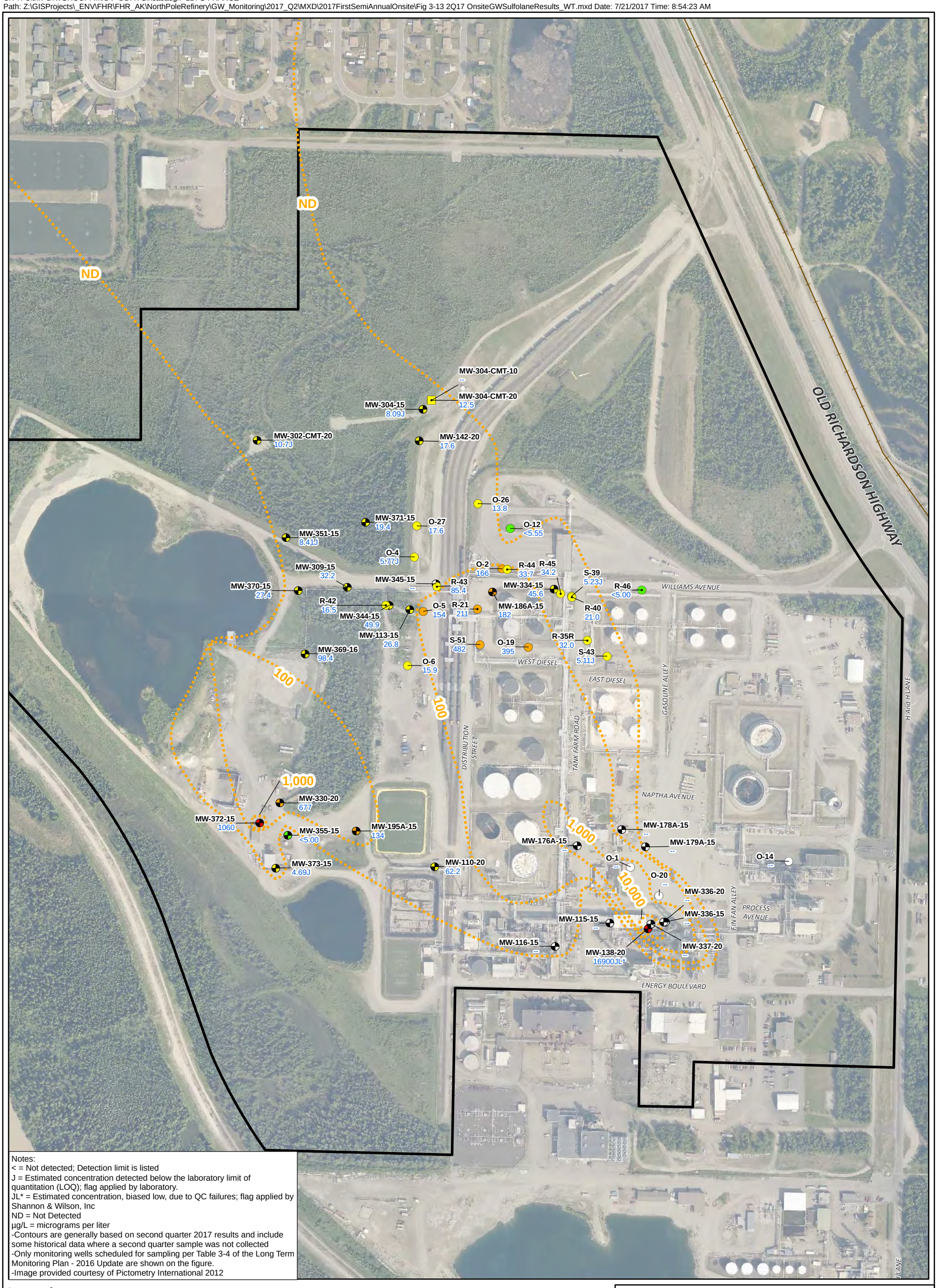
**FIRST SEMIANNUAL 2017 ONSITE GROUNDWATER MONITORING REPORT**

**FIRST QUARTER 2017 ONSITE SULFOLANE GROUNDWATER ANALYTICAL RESULTS - 90 TO 160 FEET BELOW WATER TABLE**

ARCADIS

FIGURE
**3-12**

CITY: Citrix DIV/GROUP: IM/DV DB: K Sinsabaugh LD: G FRANCE
Path: Z:\GISProjects_ENV\FHR\FHR_AK\NorthPoleRefinery\GW_Monitoring\2017_Q2\MXD\2017FirstSemiAnnualOnsite\Fig 3-13 2Q17 OnsiteGWSulfolaneResults_WT.mxd Date: 7/21/2017 Time: 8:54:23 AM




Notes:
< = Not detected; Detection limit is listed
J = Estimated concentration detected below the laboratory limit of quantitation (LOQ); flag applied by laboratory.
JL* = Estimated concentration, biased low, due to QC failures; flag applied by Shannon & Wilson, Inc
ND = Not Detected
µg/L = micrograms per liter
-Contours are generally based on second quarter 2017 results and include some historical data where a second quarter sample was not collected
-Only monitoring wells scheduled for sampling per Table 3-4 of the Long Term Monitoring Plan - 2016 Update are shown on the figure.
-Image provided courtesy of Pictometry International 2012

**Legend**

- Monitoring Well
- Observation Well
- Recovery Well
- Vertical Profile Transect Well
- Approximate Sulfolane Isopleth in µg/L at Water Table
- FHRA Property Boundary

**Sulfolane Results**

- Not Detected
- 3.14 - 100 µg/L
- 100 - 1,000 µg/L
- >1,000 µg/L
- Well Dry/Frozen

0 350 700
SCALE IN FEET

FLINT HILLS RESOURCES ALASKA, LLC
NORTH POLE TERMINAL, NORTH POLE, ALASKA

**FIRST SEMIANNUAL 2017 ONSITE GROUNDWATER MONITORING REPORT**

**SECOND QUARTER 2017 ONSITE SULFOLANE GROUNDWATER ANALYTICAL RESULTS - WATER TABLE**

ARCADIS

FIGURE
**3-13**

CITY: Citrix DIV/GROUP: IM/DV DB: K Sinsabaugh LD: G FRANCE
Path: Z:\GISProjects_ENV\FHR\FHR_AK\NorthPoleRefinery\GW_Monitoring\2017_Q2\MXD\2017FirstSemiAnnualOnsite\Fig 3-14 2Q17 OnsiteGWSulfolaneResults_10to55.mxd Date: 6/28/2017 Time: 2:24:41 PM


Notes:
< = Not detected; Detection limit is listed
J = Estimated concentration detected below the laboratory limit of quantitation (LOQ); flag applied by laboratory.
J* = Estimated concentration due to quality control (QC) failures; flag applied by Shannon & Wilson, Inc.
ND = Not Detected
µg/L = micrograms per liter
-Contours are generally based on second quarter 2017 results and include some historical data where a second quarter sample was not collected
-Only monitoring wells scheduled for sampling per Table 3-4 of the Long Term Monitoring Plan - 2016 Update are shown on the figure.
-Image provided courtesy of Pictometry International 2012

**Legend**

- Monitoring Well
- Observation Well
- Approximate Sulfolane Isopleth in µg/L
- FHRA Property Boundary

**Sulfolane Results**

- Not Detected
- 3.14 - 100 µg/L
- 100 - 1,000 µg/L
- -- Well Dry/Frozen

0 350 700
SCALE IN FEET

FLINT HILLS RESOURCES ALASKA, LLC
NORTH POLE TERMINAL, NORTH POLE, ALASKA

**FIRST SEMIANNUAL 2017 ONSITE GROUNDWATER MONITORING REPORT**

**SECOND QUARTER 2017 ONSITE SULFOLANE GROUNDWATER ANALYTICAL RESULTS - 10 TO 55 FEET BELOW WATER TABLE**

ARCADIS

FIGURE
**3-14**

CITY: Citrix DIV/GROUP: IM/DV DB: K Sinsabaugh LD: G FRANCE
Path: Z:\GISProjects_ENV\FHR\FHR_AK\NorthPoleRefinery\GW_Monitoring\2017_Q2\MXD\2017FirstSemiAnnualOnsite\Fig 3-15 2Q17 OnsiteGWSulfolaneResults_55to90.mxd Date: 6/27/2017 Time: 3:07:12 PM


Notes:
< = Not detected; Detection limit is listed
J= Estimated concentration detected below the laboratory limit of quantitation (LOQ); flag applied by laboratory.
ND = Not Detected
µg/L = micrograms per liter
-Contours are generally based on second quarter 2017 results and include some historical data where a second quarter sample was not collected
-Only monitoring wells scheduled for sampling per Table 3-4 of the Long Term Monitoring Plan - 2016 Update are shown on the figure.
-Image provided courtesy of Pictometry International 2012

**Legend**

- Monitoring Well
- Observation Well
- Approximate Sulfolane Isopleth in µg/L
- FHRA Property Boundary

**Sulfolane Results**

- Not Detected
- 3.14 - 100 µg/L
- Well Dry/Frozen

0 350 700
SCALE IN FEET

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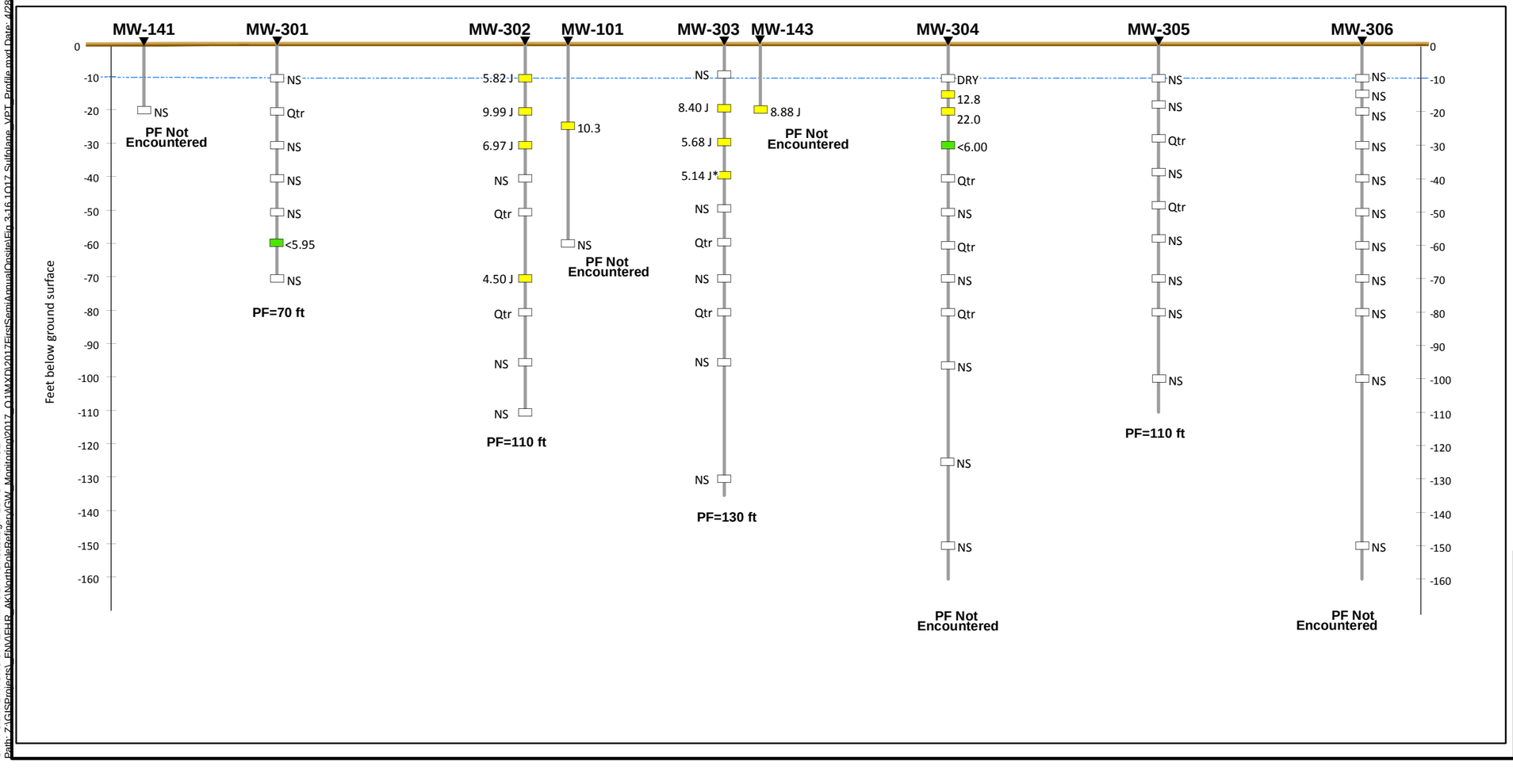
**FIRST SEMIANNUAL 2017 ONSITE GROUNDWATER MONITORING REPORT**

**SECOND QUARTER 2017 ONSITE SULFOLANE GROUNDWATER ANALYTICAL RESULTS - 55 TO 90 FEET BELOW WATER TABLE**

ARCADIS

FIGURE
**3-15**


# Legend:

**Sulfolane Results**

- Not Detected
- 3.17 - 100 µg/L
- 100 - 1,000 µg/L
- Ground Surface
- Approximate Groundwater Surface
- Well Profile

NOTES:
< = Not detected. Detection limit is listed.
J = Estimated concentration detected below the laboratory limit of quantitation (LOQ). Flag applied by laboratory.
J* = Estimated concentration due to quality control (QC) failures. Flag applied by Shannon & Wilson, Inc.
NS = Not sampled per Long-Term Monitoring Plan (LTM)
PF= Permafrost encountered at bottom of boring.
Qtr = Sampled quarterly starting third quarter 2017 as part of one year sampling program to be initiated following GRTS shutdown per 2017 LTM, in accordance with the approved 2017 Revised Onsite Cleanup Plan.
ft = feet
µg/L = micrograms per liter
- For locations with duplicate sample results, the highest value is shown
- Profile has a vertical exaggeration of 5x

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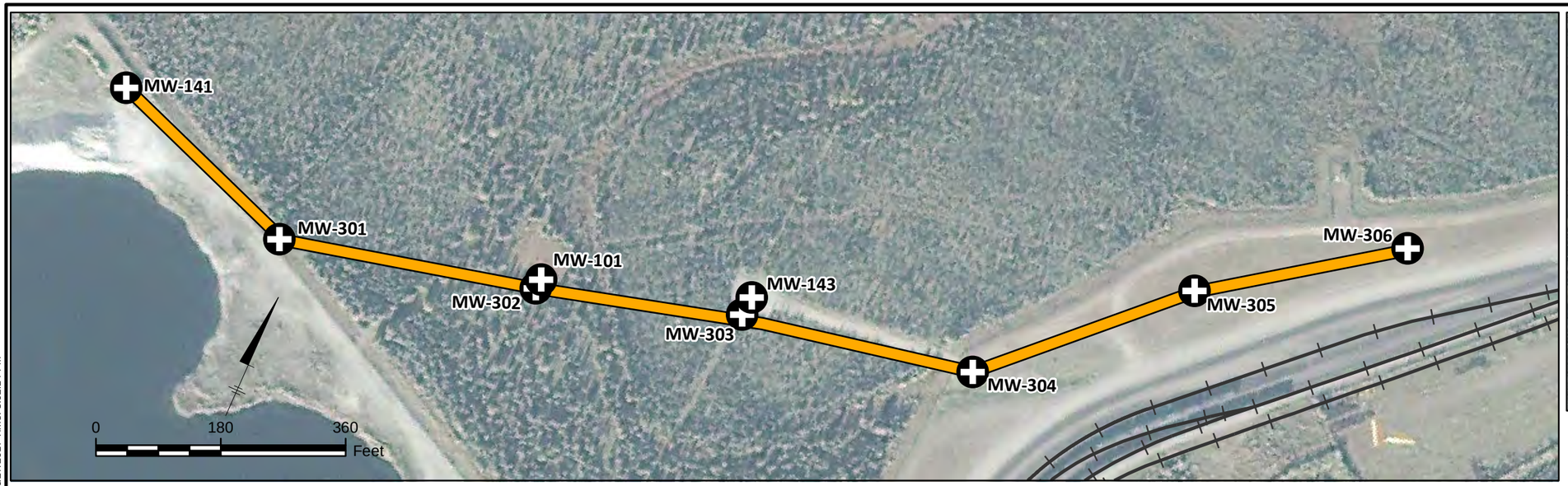
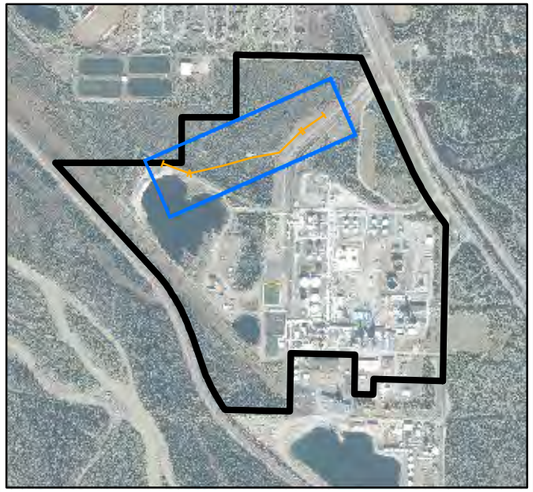
**FIRST SEMIANNUAL 2017 ONSITE GROUNDWATER MONITORING REPORT**

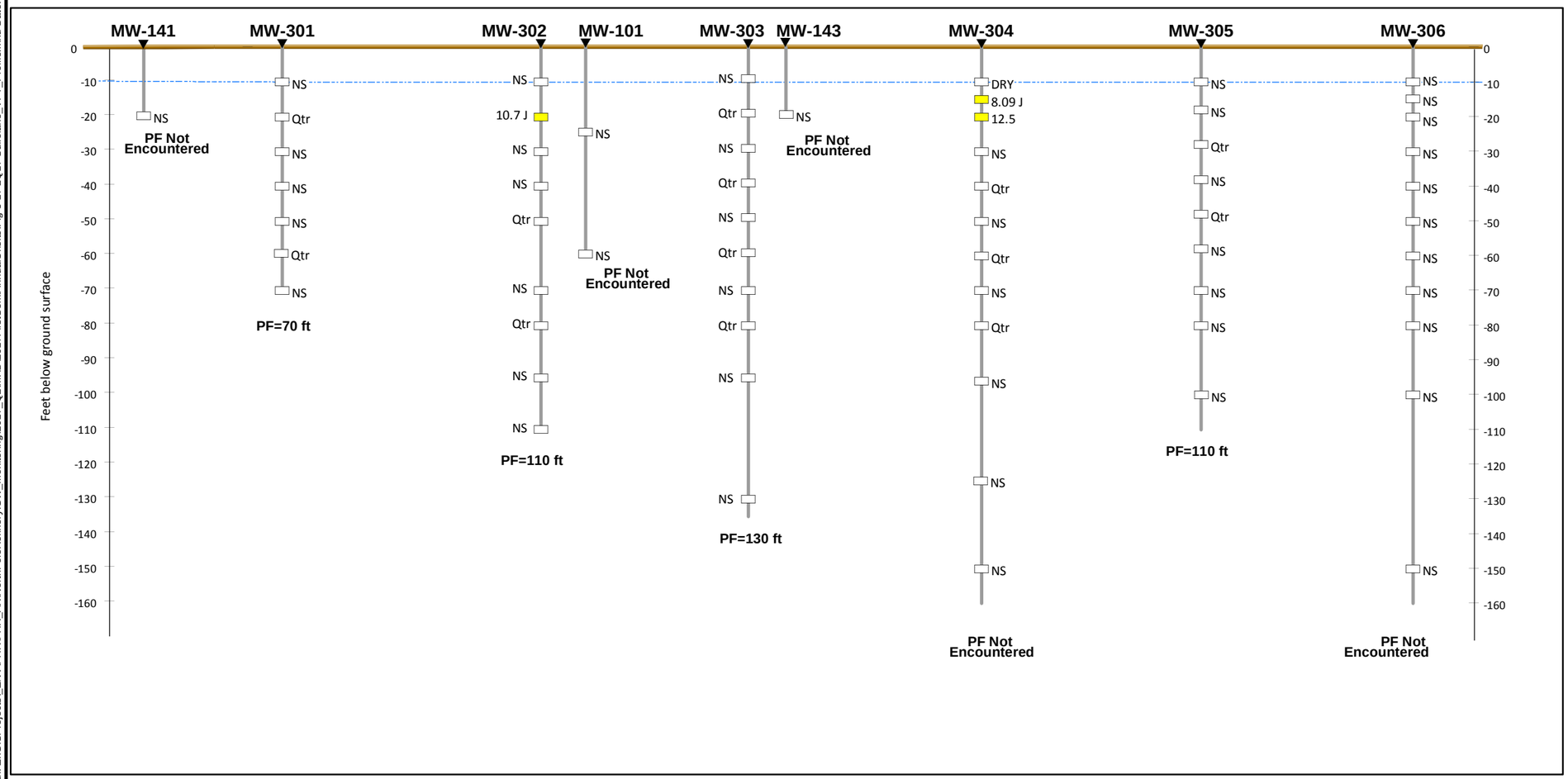
**FIRST QUARTER 2017 SULFOLANE AT THE ALTERNATIVE POINT OF COMPLIANCE**

ARCADIS

**FIGURE 3-16**






## Legend:

**Sulfolane Results**

- Not Detected
- 3.17 - 100 µg/L
- 100 - 1,000 µg/L
- Ground Surface
- Approximate Groundwater Surface
- Well Profile

NOTES:
J = Estimated concentration detected below the laboratory limit of quantitation (LOQ). Flag applied by laboratory.
NS = Not sampled per Long-Term Monitoring Plan (LTM)
PF= Permafrost encountered at bottom of boring.
Qtr = Sampled quarterly starting third quarter 2017 as part of one year sampling program to be initiated following GRTS shutdown per 2017 LTM, in accordance with the approved 2017 Revised Onsite Cleanup Plan.
ft = feet
µg/L = micrograms per liter
- For locations with duplicate sample results, the highest value is shown
- Profile has a vertical exaggeration of 5x

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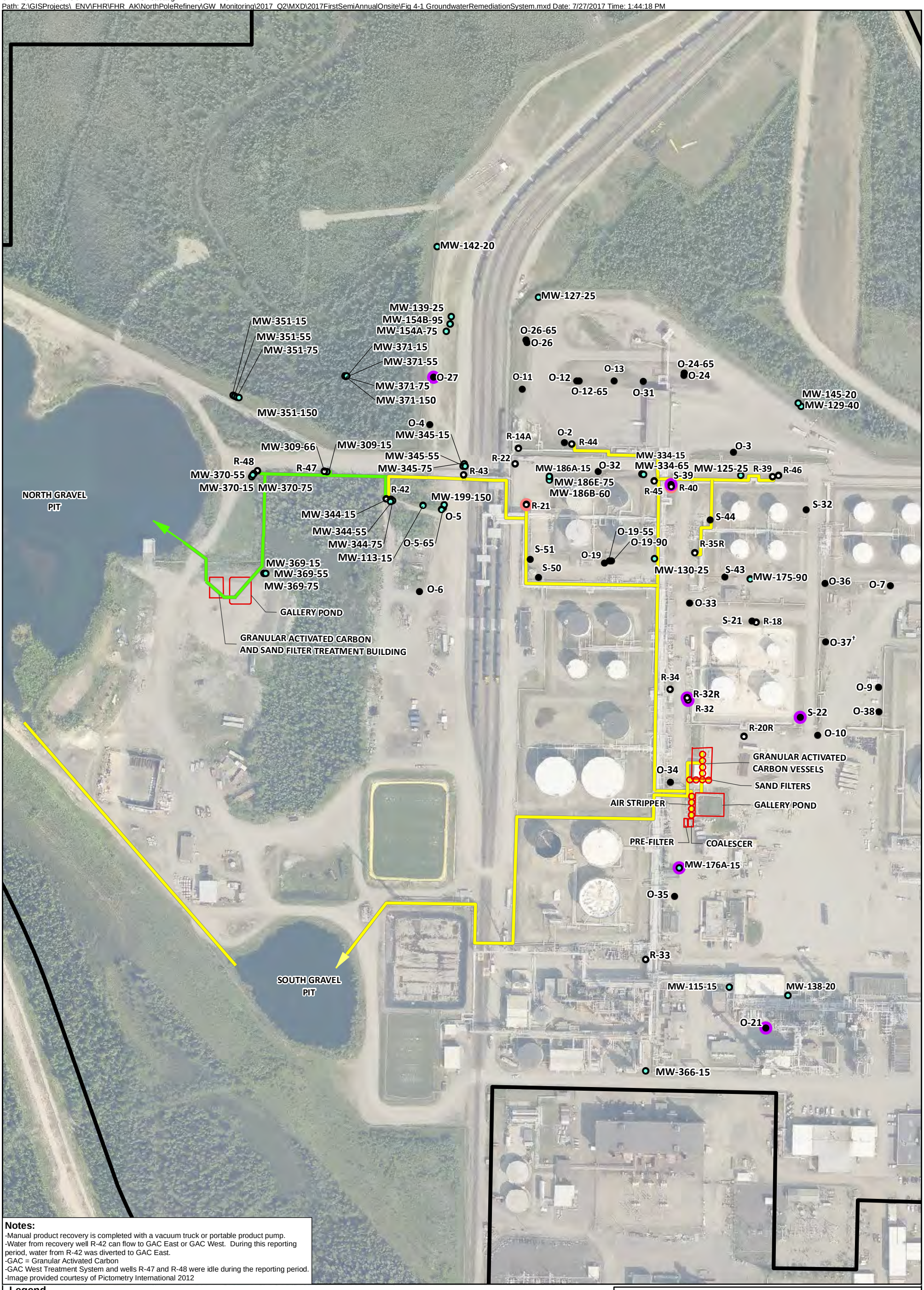
**FIRST SEMIANNUAL 2017 ONSITE GROUNDWATER MONITORING REPORT**

**SECOND QUARTER 2017 SULFOLANE AT THE ALTERNATIVE POINT OF COMPLIANCE**

ARCADIS

**FIGURE 3-17**

CITY: Citrix DIV/GROUP: ENV/IM DB: K Sinsabaugh LD: G FRANCE
Path: Z:\GISProjects_ENV\FHR\FHR_AK\NorthPoleRefinery\GW_Monitoring\2017_Q2\MXD\2017FirstSemiAnnualOnsite\Fig 4-1 GroundwaterRemediationSystem.mxd Date: 7/27/2017 Time: 1:44:18 PM




**Notes:**
-Manual product recovery is completed with a vacuum truck or portable product pump.
-Water from recovery well R-42 can flow to GAC East or GAC West. During this reporting period, water from R-42 was diverted to GAC East.
-GAC = Granular Activated Carbon
-GAC West Treatment System and wells R-47 and R-48 were idle during the reporting period.
-Image provided courtesy of Pictometry International 2012

**Legend**

- Monitoring Well
- Observation Well
- Recovery Well
- Installed Product Recovery System
- Manual Product Recovery
- FHRA Property Boundary
- GAC West Groundwater Remediation and Treatment System Piping
- GAC East Groundwater Remediation and Treatment System Piping

0 220 440
SCALE IN FEET

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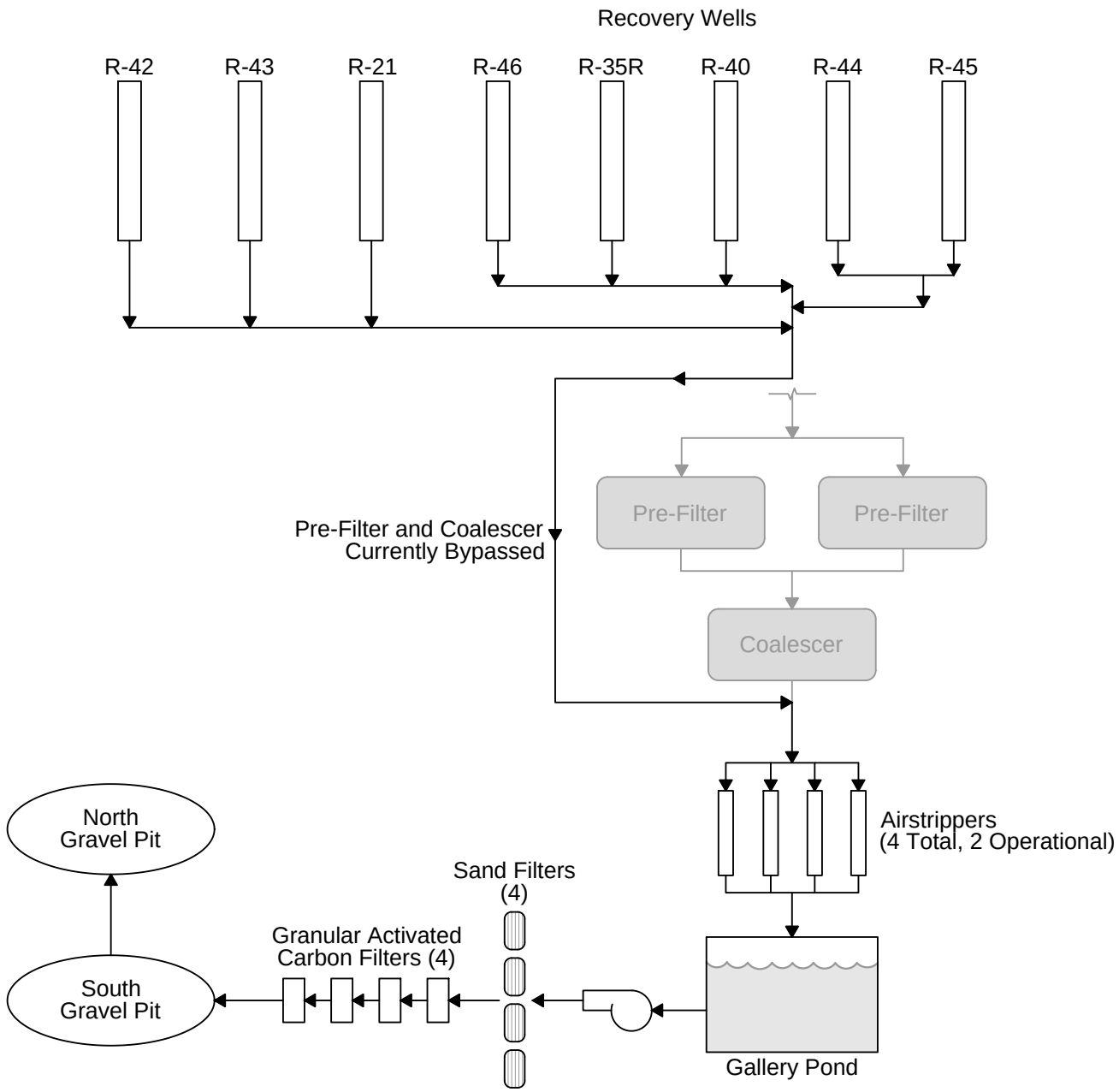
**FIRST SEMIANNUAL 2017 ONSITE GROUNDWATER MONITORING REPORT**

**GROUNDWATER REMEDIATION AND TREATMENT SYSTEM**

ARCADIS

FIGURE
**4-1**




NOTES:

1. WATER FROM RECOVERY WELL R-42 CAN FLOW TO EITHER THE GAC EAST OR GAC WEST GROUNDWATER REMEDIATION AND TREATMENT SYSTEMS.
2. GAC = GRANULAR ACTIVATED CARBON
3. DUE TO FOULING ISSUES WITHIN THE WELL CASING OF RECOVERY WELL R-45, R-40 WAS RETURNED TO SERVICE ON DECEMBER 23, 2014.
4. THE PRE-FILTERS AND COALESCER REMAIN IN PLACE, BUT ARE NO LONGER IN SERVICE AND ARE CURRENTLY BYPASSED AS SHOWN.

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## CURRENT PROCESS FLOW DIAGRAM- GAC EAST

ARCADIS Design & Consultancy for natural and built assets

FIGURE
**4-2**

CITY: Citrix DIV/GROUP: ENV/IM DB: K Sinsabaugh LD: G FRANCE
Path: Z:\GISProjects_ENV\FHR\FHR_AK\NorthPoleRefinery\GW_Monitoring\2017_Q2\MXD\2017FirstSemiAnnualOnsite\Fig 5-1 GroundwaterRecoverySystemPerfMon_Transects.mxd Date: 7/27/2017 Time: 1:45:49 PM

MW-142-20
MW-139-25
MW-154B-95
A'
C'
B'
MW-127-25
MW-351-15
MW-351-55
MW-351-75
MW-154A-75
O-26-65
O-26
MW-371-15
MW-371-55
MW-371-75
O-27
MW-371-150
O-11
O-12
O-12-65
O-13
O-31
O-24-65
O-24
MW-145-20
MW-129-40
MW-351-150
O-4
MW-345-15
MW-309-66
MW-309-15
R-14A
O-2
R-44
MW-334-15
O-3
MW-345-55
R-22
O-32
MW-334-65
MW-125-25
R-39
R-46
MW-370-15
R-48
R-47
MW-345-75
R-43
MW-186A-15
MW-186B-60
MW-186E-75
R-45
S-39
R-40
MW-370-75
MW-370-55
R-42
MW-199-150
R-21
S-32
MW-344-15
MW-344-55
MW-344-75
O-5
O-5-65
O-19-90
O-19-55
S-44
R-35R
MW-113-15
S-51
S-50
O-19
C
A
B
MW-130-25
S-43
MW-175-90
O-36
O-7
MW-369-15
MW-369-55
MW-369-75
O-6
O-33
R-18
S-21
O-37
GALLERY POND
GRANULAR ACTIVATED CARBON
AND SAND FILTER TREATMENT BUILDING
R-34
R-32R
O-9
R-32
S-22
O-38
R-20R
O-10
GRANULAR ACTIVATED
CARBON VESSELS
O-34
SAND FILTERS
AIR STRIPPER
GALLERY POND
PRE-FILTER
COALESCER
MW-176A-15
O-35
R-33
MW-115-15
MW-138-20
SOUTH GRAVEL
PIT
O-21
MW-366-15

**Notes:**
-Manual product recovery is completed with a vacuum truck or portable product pump.
-Water from recovery well R-42 can flow to GAC East or GAC West. During this reporting period, water from R-42 was diverted to GAC East.
-GAC = Granular Activated Carbon
-GAC West Treatment System and wells R-47 and R-48 were idle during the reporting period.
-Image provided courtesy of Pictometry International 2012

**Legend**
- Monitoring Well
- Observation Well
- Recovery Well
- Active Recovery Wells
- Installed Product Recovery System
- Manual Product Recovery
- FHRA Property Boundary
- GAC West Groundwater Remediation and Treatment System Piping
- GAC East Groundwater Remediation and Treatment System Piping

0 200 400
SCALE IN FEET

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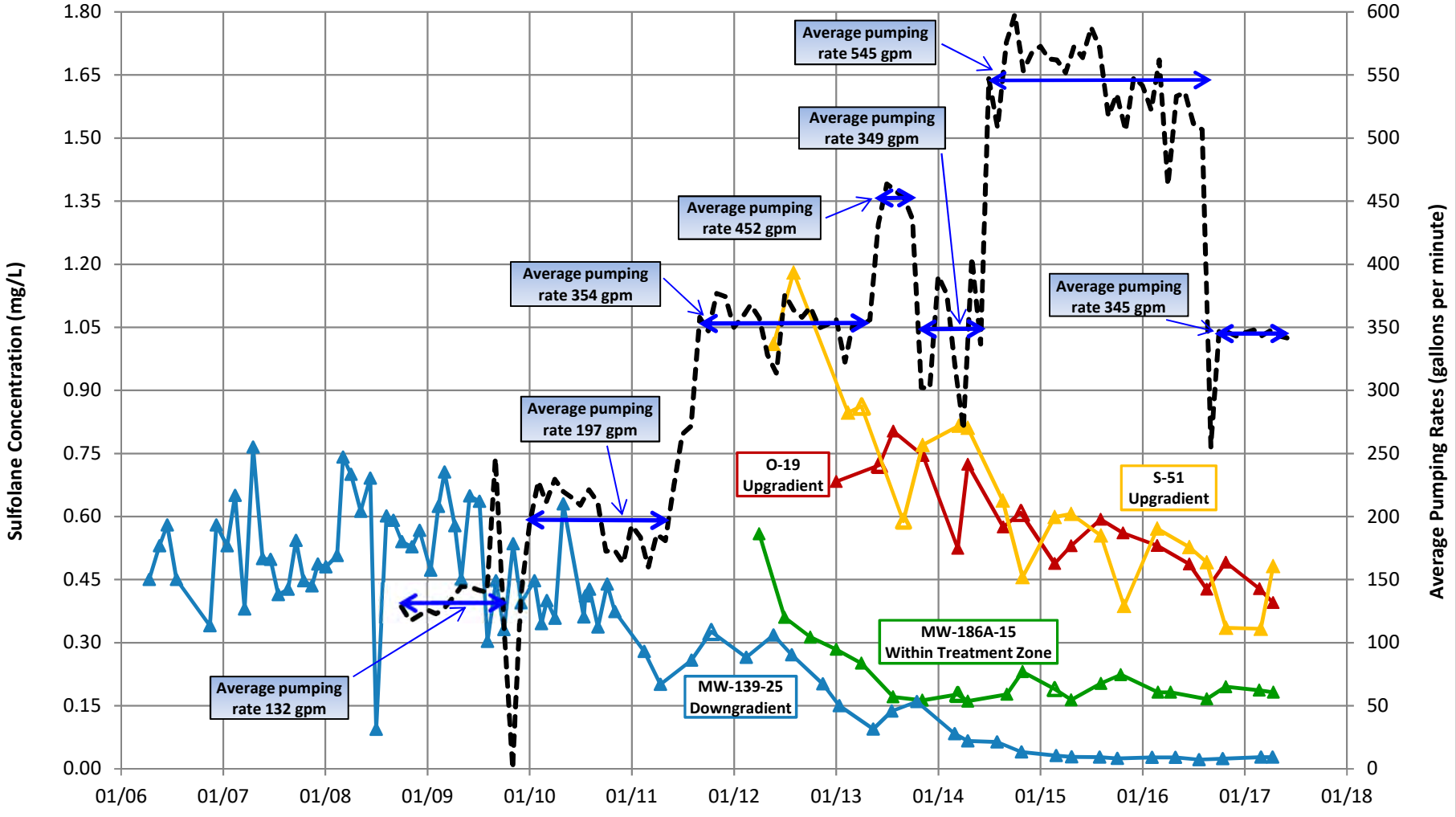
# FIRST SEMIANNUAL 2017 ONSITE GROUNDWATER MONITORING REPORT

## GROUNDWATER REMEDIATION AND TREATMENT SYSTEM PERFORMANCE MONITORING LONGITUDINAL TRANSECTS

ARCADIS

FIGURE
5-1

**Figure 5-2**
**MONITORING WELL ANALYTICAL DATA - Transect A (shallow)**
**North Pole Terminal**
**Flint Hills Resources Alaska, LLC**




Non-Detect values are plotted at the reporting limit and are represented by a circular marker. Estimated (J) values are represented by an open triangle, and detections by a closed triangle.

S-51 and O-19 are both located upgradient of the recovery wells. S-51 is approximately 185' west of O-19.

**Figure 5-3**
**MONITORING WELL ANALYTICAL DATA - Transect B (shallow)**
**North Pole Terminal**
**Flint Hills Resources Alaska, LLC**

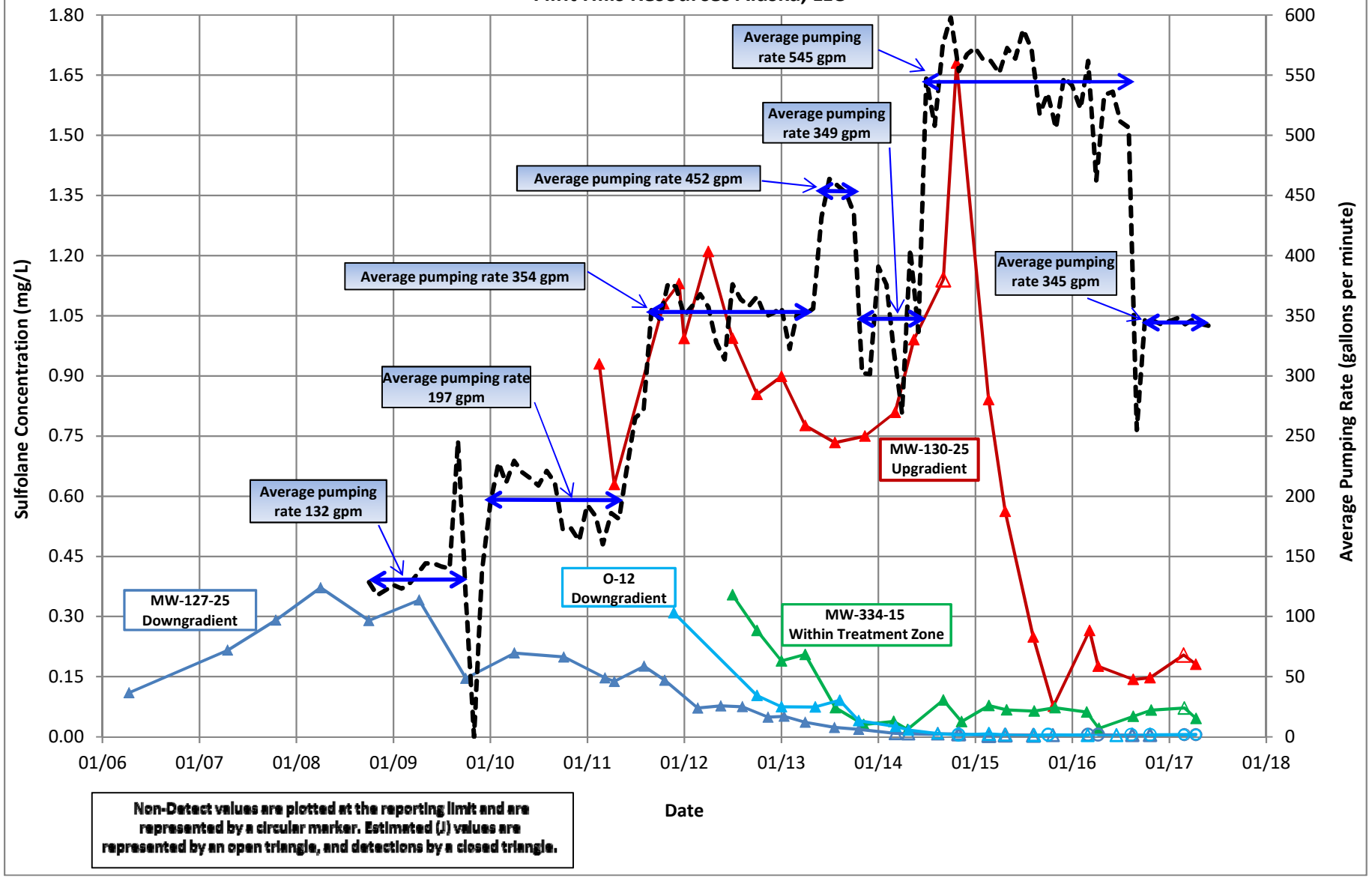
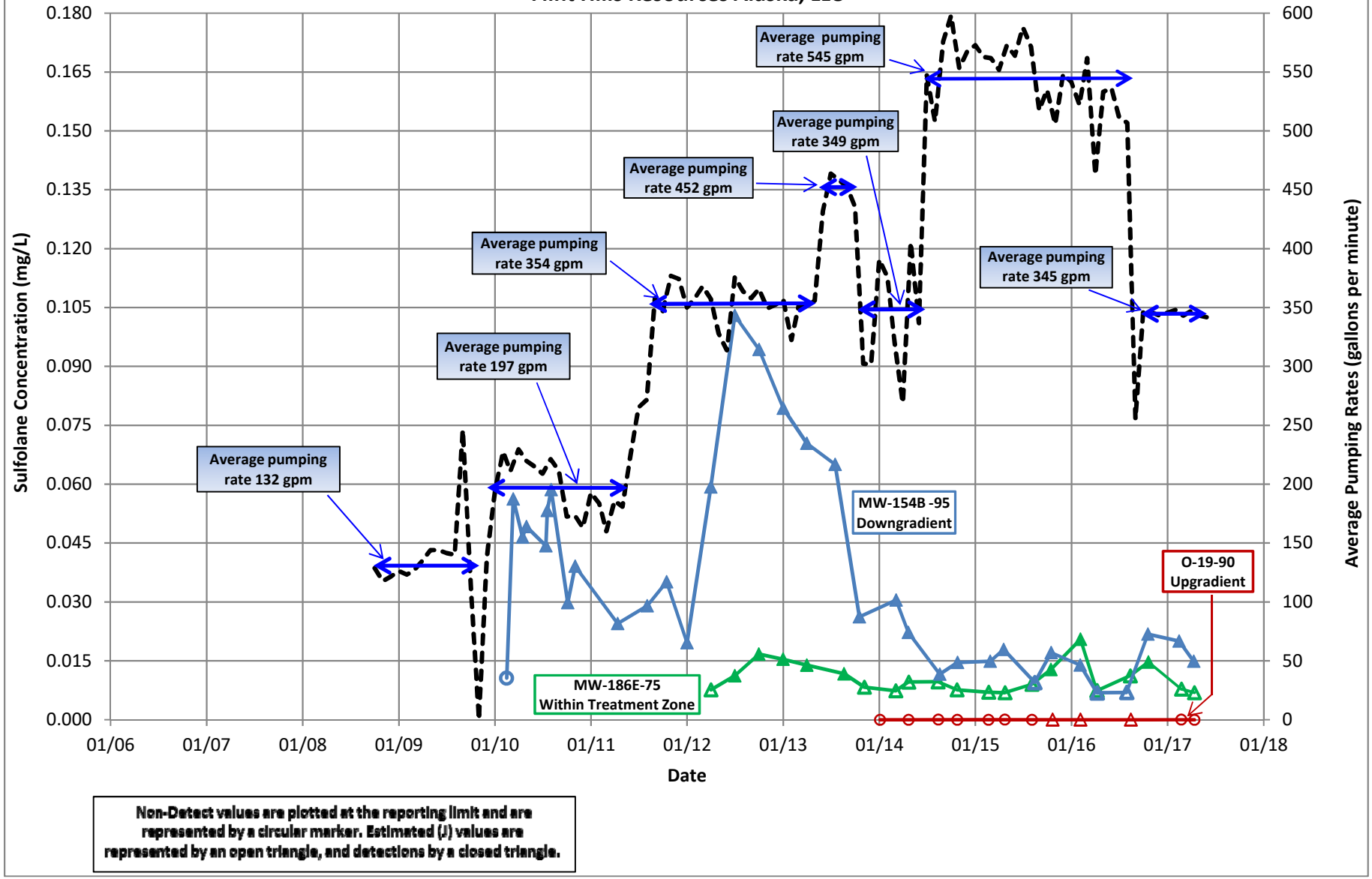


**Figure 5-4**
**MONITORING WELL ANALYTICAL DATA - Transect C (Deep)**
**North Pole Terminal**
**Flint Hills Resources Alaska, LLC**




Non-Detect values are plotted at the reporting limit and are represented by a circular marker. Estimated (J) values are represented by an open triangle, and detections by a closed triangle.