

# ANNUAL 2019 ONSITE GROUNDWATER MONITORING REPORT

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

December 2, 2019



**ANNUAL 2019 ONSITE  
GROUNDWATER  
MONITORING REPORT**

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## ACRONYMS AND ABBREVIATIONS

2017 LTM Plan	Long-Term Monitoring Plan – 2017 Update
AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
Arcadis	Arcadis U.S., Inc.
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
GRO	gasoline-range organics
GRTS	groundwater remediation and treatment system
LNAPL	light nonaqueous phase liquid
NSZD	natural source zone depletion
Onsite RSAP	Revised Onsite Sampling and Analysis Plan
Onsite SCR – 2013	Onsite Site Characterization Report – 2013 Addendum
POC	point of compliance
report	Annual 2019 Onsite Groundwater Monitoring Report
reporting period	first and third quarters of 2019
ROCP	Revised Onsite Cleanup Plan
site	North Pole Terminal, located on H and H Lane in North Pole, Alaska
VPT	vertical profile transect
µg/L	micrograms per liter

## 1 INTRODUCTION

Arcadis U.S., Inc. (Arcadis) prepared this Annual 2019 Onsite Groundwater Monitoring Report (report) for the 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 third quarters of 2019 (reporting period) as described in Section 3 and Table 1-1.

The data, analyses, and conclusions presented in this report are the product of a collaborative effort among a consulting team engaged by Flint Hills Resources Alaska, LLC (FHRA) to undertake the work discussed in this report. The team includes qualified professionals in a variety of technical disciplines from three environmental consulting firms: Arcadis, Shannon & Wilson, Inc., and Barr Engineering Co. 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):

- Revised Onsite Cleanup Plan (ROCP; Arcadis 2017b).
- Long-Term Monitoring Plan – 2017 Update (2017 LTM Plan; provided as Appendix A to the ROCP [Arcadis 2017b]).
- Revised Onsite Sampling and Analysis Plan (Onsite RSAP; provided as Appendix A to the Second Semiannual 2016 Onsite Groundwater Monitoring Report [Arcadis 2017a]).

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 location 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. The former treatment systems, GAC West and GAC East, are shown on Figure 1-2. The GAC West system was shut down in the third quarter of 2016. The GAC East system is also referred to in this report as the groundwater remediation and treatment system (GRTS). Shutdown of the GRTS occurred in third quarter 2017 (see Section 2). Responses to shutdown of the treatment system are discussed in Section 3. The former recovery well locations are shown 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 2017 LTM Plan (Arcadis 2017b):

- Groundwater elevation
- Light nonaqueous phase liquid (LNAPL) migration monitoring
- Groundwater sampling and analysis of sulfolane

- Groundwater sampling and analysis of other constituents of concern (COCs), including benzene, toluene, ethylbenzene, and xylenes (BTEX); gasoline-range organics (GRO); and diesel-range organics (DRO).

The ROCP (Arcadis 2017b) was submitted to and approved by ADEC in February 2017. In accordance with the ROCP, in third quarter 2017 the GRTS was shut down and the updated sampling program defined under the ROCP was implemented.

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

- Monitoring well MW-144BR-90 was inaccessible under a snow berm during a planned groundwater elevation monitoring event; therefore, a depth to water measurement was not collected from this well during the first semiannual monitoring event.
- LNAPL was encountered in wells MW-176A-15 and O-2 during planned monitoring events in 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 3-7.

Historical groundwater elevation and LNAPL thickness measurements, and BTEX, GRO, DRO, and sulfolane analytical results are included as Appendix A. Analytical laboratory reports are included as Appendix B. A data quality evaluation, including ADEC quality assurance/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 during the first and third quarters of 2019 on March 1 and September 9 and 10, 2019. Measurements were also recorded from gauging points located at the North Gravel Pit on March 1 and September 9, 2019. Potentiometric maps are included for each monitoring zone: water table, 10 to 55, 55 to 90, and 90 to 160 feet below the water table (bwt) for each monitoring event (Figures 3-1 through 3-8). 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 for the reporting period are summarized in Table 3-1. Groundwater elevations for the reporting period are summarized in Tables 3-2a and 3-2b. Surface water elevations and depth to LNAPL are also summarized in Tables 3-2a and 3-2b. Historical gauging data are summarized in Appendix A.



## 3.2 Light Nonaqueous Phase Liquid Monitoring Results

LNAPL migration observations were collected from a network of monitoring, observation, and recovery wells screened across the water table according to the 2017 LTM Plan (Arcadis 2017b). Additionally, LNAPL was gauged throughout the reporting period during monitoring events at wells outside of the LNAPL migration networks. A comprehensive LNAPL gauging table is presented in Appendix E.

### 3.2.1 Light Nonaqueous Phase Liquid Extent

Per the 2017 LTM Plan (Arcadis 2017b), LNAPL migration observations were made from wells along the perimeter of the LNAPL plume. During the annual LNAPL migration monitoring event, LNAPL was observed in LNAPL migration wells O-11 and O-27. Results are summarized in Table 3-3. Figure 3-9 shows thickness data from the LNAPL migration monitoring event, as well as maximum thickness data measured during the reporting period during other gauging events. LNAPL was gauged during the following monitoring events throughout the reporting period: groundwater elevation monitoring, and groundwater sampling and field parameter collection. A comprehensive table including gauging data from each monitoring event conducted at the site during the reporting period is included in Appendix E.

LNAPL thickness measurements were similar to historical results; significant changes in LNAPL thicknesses resulting from shutdown of the GRTS were not observed during the reporting period. Some LNAPL thickness increases were noted during the reporting period, although LNAPL thicknesses are still within the range of historical measurements at the site. LNAPL was not detected in any new wells during the reporting period (that is, in wells that have not previously had a detection).

### 3.2.2 Natural Source Zone Depletion Assessment Results

A total of 15 monitoring wells were sampled for natural source zone depletion (NSZD) parameters in groundwater to evaluate the potential for ongoing NSZD to be occurring at the site. Sample locations are defined in the 2017 LTM Plan (Arcadis 2017b). LNAPL was not present in any of the NSZD monitoring wells at the time of sampling. Field parameters, including dissolved oxygen, from the 15 monitoring wells where samples were collected are presented in Table 3-1. Natural attenuation parameters (including iron, manganese, sulfate, and methane), GRO, and DRO are presented in Table 3-4 and on Figure 3-10.

The occurrence of ongoing biodegradation and dissolution of the submerged portion of the LNAPL can be assessed by comparing the chemical composition of groundwater upgradient from, within, and immediately downgradient from the source zone. Biodegradation of petroleum hydrocarbons results in a decrease in electron acceptor concentrations and a corresponding increase in biodegradation transformation products, observable in groundwater samples from upgradient wells to wells within and/or downgradient from the LNAPL plume. The NSZD process is further discussed in the Onsite SCR – 2013 (Arcadis 2013).

A comparison of the upgradient and source zone/downgradient data indicates the following:

- Sulfate concentrations generally decrease from upgradient monitoring locations to the source zone and downgradient monitoring locations, indicating sulfate reduction from anaerobic degradation.

- Dissolved iron concentrations generally increase from upgradient monitoring locations to the source zone monitoring and downgradient locations, indicating iron production as product of anaerobic degradation.
- Dissolved manganese concentrations generally increase from upgradient monitoring locations to the source zone and downgradient monitoring locations, indicating manganese production as a product of anaerobic degradation.
- The methane concentrations generally increased from upgradient locations to the source zone monitoring locations, indicating carbon dioxide reduction or organic acid fermentation from anaerobic degradation.

This spatial comparison of upgradient, source zone, and downgradient natural attenuation parameters shows a clear decreasing trend in electron acceptor concentrations and an increasing trend in biodegradation transformation products, which indicates that biodegradation of LNAPL is occurring in the submerged portion of the LNAPL body. Downgradient parameters do not continue to exhibit the influence of ongoing NSZD, because concentrations appear to have reached background conditions in the most downgradient wells due to distance from the source zone. Dissolved oxygen was measured at nominal levels in the NSZD network monitoring wells, indicating that oxygen was not readily available as an electron acceptor and the aquifer in the area is generally anoxic.

### 3.3 Monitoring Well Sampling

Monitoring wells included in the monitoring network for other COCs in the 2017 LTM Plan (Arcadis 2017b) were sampled for BTEX. Additionally, select monitoring wells were sampled for 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, and 1-methylnaphthalene during the reporting period. Results are summarized in Tables 3-5a and 3-5b. Figures 3-11 and 3-12 present analytical results for benzene.

Analyses for sulfolane were completed on groundwater samples collected from the wells identified in the 2017 LTM Plan (Arcadis 2017b). Sulfolane analytical results are summarized in Tables 3-6a and 3-6b, and on Figures 3-13 through 3-18. In accordance with the updated sampling schedule (Arcadis 2017b), no data were collected at the interval from 90 to 160 feet bwt.

Groundwater samples were collected from the point of compliance (POC) wells to evaluate the vertical distribution of sulfolane concentrations. Sulfolane concentrations for the POC, which includes well nests MW-358, MW-359, MW-360, MW-362, MW-364, and well MW-149A-15, are summarized in Table 3-7. Groundwater samples were also collected from wells along the vertical profile transect (VPT), which is located between 250 and 950 feet upgradient of the POC wells. Sulfolane concentrations across the VPT are shown on Figures 3-19 and 3-20. Sulfolane concentrations along the VPT are generally less than historical maximums and do not exceed the cleanup objective for groundwater of 400 micrograms per liter ( $\mu\text{g/L}$ ) sulfolane at the POC.

### 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 annually during the third quarter at monitoring and observation wells to evaluate plume migration and stability, and 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. Only wells that were sampled during the monitoring period were included in this analysis. Wells with LNAPL were excluded from evaluation of the benzene statistical trend.

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, 1B, and 2C in Appendix F; and in the table below.

Parameter Trend	Third Quarter	
	Benzene	Sulfolane
Number of wells	27	59
All results nondetect <sup>1</sup>	7	1
Insufficient data points <sup>1</sup>	3	0
Probably decreasing	0	2
Decreasing	3	30
Probably increasing	2	1
Increasing	1	6
Stable	2	11
No trend	9	8

**Note:**

<sup>1</sup>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 Mann-Kendall trend analyses were evaluated and compared to visual evaluation of the trend charts; this evaluation is discussed below. The observations from the reporting period were as expected based on the conceptual site model. Increases were noted in areas where increases were expected, such as downgradient of the former GRTS treatment wells. Sulfolane concentrations exceeding 400 µg/L are limited to wells within the source zone. Sulfolane concentrations at the VPT and at the POC wells are less than 400 µg/L, and current trends do not suggest a future exceedance of 400 µg/L.

### 3.4.1 Benzene Statistical Evaluation

The Mann-Kendall trend analysis indicated an increasing or probably increasing benzene concentration trend in wells MW-130-25, MW-321-15, and O-24 during the reporting period, as seen on the benzene time series plots included as Attachment 1 in Appendix F.

Monitoring well MW-130-25 is within the detectable benzene plume at the site, near the downgradient extent. Although the Mann-Kendall analysis indicates a trend that is probably increasing in this well,

concentrations consistently decreased from 2015 to 2018, with a partial rebound in 2019, although current concentrations are less than historical levels observed in this well. MW-321-15 is within the detectable benzene plume at the site at the western extent and has exhibited seasonal variation since 2016. The analysis indicates a trend that is probably increasing in this well; however, concentrations have decreased since sampling in 2017. Well O-24 is within the detectable benzene plume at the site, near the downgradient extent. Some seasonal variation is evident in this well.

### 3.4.2 Sulfolane Statistical Evaluation

As noted in Section 3.3, the cleanup objective for sulfolane in groundwater is 400 µg/L sulfolane at the POC. As discussed below, none of the POC wells or wells along the VPT had sulfolane concentrations exceeding 400 µg/L during the reporting period and current trends support the cleanup objective in that these trends do not suggest that sulfolane will exceed 400 µg/L at the POC.

Sulfolane time series plots for all wells sampled during the reporting period are included as Attachment 1 in Appendix F. These time series plots are presented with both linear and logarithmic concentration scales to facilitate the evaluation of concentration trends since the shutdown of the GRTS. The time since GRTS shutdown is relatively short compared to the periods of record for most of the monitoring wells; therefore, stabilization of sulfolane concentrations in many wells is apparent in charts with the logarithmic concentration scale, whereas stabilization may not be as apparent in the charts with linear concentration scales.

The Mann-Kendall trend analysis was used during development of the conceptual site model and to document site groundwater conditions in the groundwater monitoring reports. This analysis indicates that the majority of onsite wells exhibit decreasing or probably decreasing trends. In particular, concentrations in wells S-51 and O-34, located along the main plume axis upgradient of the former recovery wells, have dropped to less than 400 µg/L, supporting the goal of meeting the cleanup objective for sulfolane. The source area well with a current concentration exceeding 400 µg/L closest to the POC is MW-354-35, which is more than 2,000 feet from the POC and approximately 800 feet upgradient of the former treatment system recovery wells (Figure 3-17). This well has a decreasing concentration trend.

The onsite wells exhibiting an increasing or probably increasing sulfolane concentration trend during the reporting period are all located adjacent to or downgradient from the recovery wells associated with the former treatment systems (MW-304-80, MW-345-15, MW-345-55, MW-359-80, O-2, O-27, and O-27-65). These results are as expected, as discussed below, and do not suggest that sulfolane will exceed 400 µg/L at the POC.

In addition to these Mann-Kendall trend analysis results, other wells located within and downgradient from the former recovery wells exhibit increases in concentration following GRTS shutdown, but not an overall increasing or probably increasing trend based on all data from a given well. As with the Mann-Kendall results described above, these are expected outcomes that do not suggest that sulfolane will exceed 400 µg/L at the POC. The observed sulfolane trends that have developed in response to the GRTS shutdown are discussed in Section 3.4.3.

### 3.4.3 Sulfolane Trend Summary in Response to Groundwater Remediation and Treatment System Shutdown

As shown on Figures 3-16, 3-17, and 3-18, the plume axis is well-defined and the plume orientation downgradient of the former treatment systems is consistent with the north-northwest groundwater flow directions presented in Section 3.1. Maximum concentrations in the plume in this area decrease in the downgradient direction and do not exceed 400 µg/L at POC wells or at the VPT. Sulfolane concentrations and trends within the plume in the area influenced by the GRTS shutdown do not suggest that sulfolane will exceed 400 µg/L at the POC.

Sulfolane concentrations during the reporting period and concentration trends since GRTS shutdown for all wells in areas in which increases were observed following GRTS shutdown are summarized below:

- *Wells adjacent to the former recovery wells.* The highest sulfolane concentration in any well in this area during the reporting period was 353 µg/L (MW-186A-15, Table 3-6b). Five of these wells exhibit stabilized or stabilizing concentrations since GRTS shutdown; two exhibit steadily or sporadically increasing trends (MW-186A-15 and MW-345-55).<sup>1</sup>
- *Wells between the former recovery wells and the VPT.* The highest sulfolane concentration in any well in this area during the reporting period was 264 µg/L (O-27, Table 3-6a), followed by an estimated 257 µg/L (MW-154B-95, Table 3-6b). Sulfolane was noted to increase in MW-154B-95 in 2012 to nearly 100 µg/L, then decrease in 2013. In subsequent monitoring events at the VPT (downgradient from MW-154B-95), the higher sulfolane concentrations previously noted in MW-154B-95 apparently intersected the VPT at shallower depths, indicating that the current monitoring network is appropriate for ongoing evaluation of the trends downgradient of MW-154B-95. All nine of the wells in this area exhibit stabilized or stabilizing concentrations since GRTS shutdown and, as noted above, all wells adjacent to the former recovery wells have concentrations less than 400 µg/L.
- *Wells in the VPT.* The highest sulfolane concentration in any well in this area during the reporting period was 173 µg/L (MW-303-CMT-19, Table 3-6b). Six of these wells exhibit stabilized or stabilizing concentrations since GRTS shutdown. Seven of these wells exhibit steadily increasing trends; however, the highest concentration in any of these seven wells was 17.8 µg/L (in MW-302-CMT-50).
- *Wells in and downgradient of the POC.* The highest sulfolane concentration in any well in this area during the reporting period was 127 µg/L (MW-359-35, Table 3-6b). Seven of these wells exhibit stabilized or stabilizing concentrations since GRTS shutdown. Four of these wells exhibit steadily increasing trends (MW-148C-55, MW-359-35, MW-360-35, and MW-360-50).

In each of the wells listed above, the increases were expected. In many locations, initial increases following GRTS shutdown were followed by stabilization and, in some cases, decreases in concentration (as noted in MW-334-15 and O-2).

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<sup>1</sup> "Stabilized" means that the concentration reached a maximum value then remained at similar values or declined. "Stabilizing" means that the chart of data with a logarithmic concentration scale is flattening out but still increasing with time based on the most current data.

As noted in Section 3.3, the cleanup objective for sulfolane is 400 µg/L sulfolane at the POC. None of the wells in any of the areas influenced by the GRTS shutdown had sulfolane concentrations exceeding 400 µg/L during the reporting period or since GRTS shutdown. In addition, the concentration trends do not suggest that sulfolane will exceed 400 µg/L at the POC.

### 3.5 Nonroutine Activities

No nonroutine activities were conducted during the reporting period.

## 4 CONCLUSIONS

Groundwater monitoring and sampling events were conducted during the reporting period in accordance with the 2017 LTM Plan (Arcadis 2017b) and Onsite RSAP (Arcadis 2017a).

The cleanup objectives for groundwater established in the ROCP (Arcadis 2017b) are that sulfolane will not exceed 400 µg/L at the POC and that cleanup objectives for other COCs listed in 18 AAC 75.345 Table C will be met at the POC.

Conclusions based on results of the onsite field activities conducted during the reporting period are summarized below:

- Groundwater monitoring data collected during the reporting period are within expected ranges and support the cleanup objective presented in the ROCP (Arcadis 2017b).
- Sulfolane concentrations in the source areas are decreasing in most cases. Increases in sulfolane and benzene concentrations were noted in wells downgradient of the former treatment systems. These concentration increases were expected and support the cleanup objectives presented in the ROCP (Arcadis 2017b).
- The statistical analyses included in Appendix F show that sulfolane concentrations in 32 wells and benzene concentrations in three wells across the plume are decreasing or probably decreasing, while sulfolane concentrations in seven wells and benzene concentrations in three wells across the plume are increasing or probably increasing.
- As expected, sulfolane concentration rebound has occurred in many wells near and downgradient from the former treatment systems. In most cases, concentrations have stabilized or the rate of increase in concentration with time is decreasing.

The current nature and extent of the COCs is supportive of the cleanup objectives, and the current monitoring network is appropriate for ongoing evaluation of the LNAPL and dissolved-phase plumes.

## 5 REFERENCES

Arcadis. 2013. Onsite Site Characterization Report – 2013 Addendum. North Pole Terminal, North Pole, Alaska. DEC File No. 100.38.090. December 20.

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

Arcadis. 2017b. Revised Onsite Cleanup Plan. North Pole Terminal, North Pole, Alaska. DEC File No. 100.38.090. February.

# TABLES





**Table 1-1  
Field Activities**

**Annual 2019 Onsite Groundwater Monitoring Report  
North Pole Terminal, North Pole, Alaska**

<b>Activity</b>	<b>Frequency during 2019</b>
Groundwater Elevation Monitoring	Semiannual (March and September)
Data Loggers	Removed in July 2018
LNAPL Migration Monitoring	Conducted in October 2019
LNAPL Transmissivity Testing	Not conducted
Sulfolane Network Sampling	Throughout Q1 and Q3
Constituents of Concern (BTEX, GRO, and DRO) Monitoring Network Sampling	Throughout Q1 and Q3
Perfluorinated Compound Monitoring Network Sampling	Not conducted
Natural Source Zone Depletion Monitoring Network Sampling	Throughout Q3
Hydraulic Capture Performance Monitoring Network GWEs	Not conducted; recovery wells no longer active.
Interim Recovery Well Rehabilitation Services	Not conducted; recovery wells no longer active.
Monitoring Well Repair and Maintenance	No major well repairs in Q1-Q3
Wells Installed	0 monitoring or observation wells installed
Wells Developed	No wells were developed in Q1-Q3

**General Notes:**

Q1 represents field activities associated with the sample results received January 1, 2019 through March 31, 2019.

Q3 represents field activities associated with the sample results received July 1, 2019 through September 30, 2019.

**Acronyms and Abbreviations:**

BTEX = Benzene, Toluene, Ethylbenzene, and Xylenes

DRO = Diesel Range Organics

GWE = Groundwater Elevation

GRO = Gasoline Range Organics

LNAPL = Light Non-Aqueous Phase Liquid

Table 3-1  
Groundwater Well Field Parameters  
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North Pole Terminal, North Pole, Alaska

Well ID	Sample Name	Date	Analysis	Depth to Water (feet)	Depth to LNAPL (feet)	Temperature (°C)	Dissolved Oxygen (mg/L)	Conductivity (µS/cm)	pH	ORP (mV)	Water Clarity	Purge Criteria	Sample Collection Notes
MW-101A-25	MW-101A-25	8/5/2019	COC, NSZD	9.46	--	4.5	0.25	239.0	7.36	43.0	Clear	3WV	
MW-116-15	MW-116-15	8/12/2019	NSZD	7.96	Sheen	8.3	0.08	579	6.71	-87.4	Clear	SP	Product present. Parameters collected inadvertently.
MW-125-25	MW-125-25	7/23/2019	NSZD	10.41	--	4.0	1.04	340.9	7.17	-97.9	Clear	3WV	
MW-127-25	MW-127-25	7/22/2019	S	11.50	--	4.1	0.11	274.7	6.78	112.7	Clear	3WV	
MW-130-25	MW-130-25	7/23/2019	COC, NSZD	10.94	--	4.5	1.13	313.4	6.74	-83.7	Clear	3WV	Petroleum odor.
MW-131-25	MW-131-25	8/5/2019	COC	10.23	--	3.7	0.42	271.3	6.93	87.8	Clear	3WV	
MW-135-20	MW-135-20	8/6/2019	COC, NSZD	10.37	Sheen	8.1	0.32	366.5	6.75	-54.2	Clear	3WV	Product present. Parameters collected inadvertently.
MW-137-20	MW-137-20	7/24/2019	COC	11.35	--	4.5	0.84	438.1	6.95	-96.3	Clear	3WV	
MW-139-25	MW-139-25	2/25/2019	COC	13.23	--	4.0	2.02	288.6	7.00	-103.8	Clear	3WV	
MW-139-25	MW-139-25	8/12/2019	S, COC	10.98	--	3.9	0.07	290.9	6.94	-72.3	Clear	3WV	
MW-140-25	MW-140-25	2/20/2019	COC	10.95	--	3.1	0.93	267.6	7.01	18.9	Clear	SP	
MW-140-25	MW-140-25	8/5/2019	COC	9.04	--	6.3	0.60	338.6	7.03	179.1	Clear	3WV	
MW-142-20	MW-142-20	2/20/2019	COC	12.01	--	3.8	0.68	285.5	7.24	-80.0	Clear	3WV	
MW-142-20	MW-142-20	8/12/2019	S, COC, NSZD	9.82	--	4.6	0.05	289.0	7.18	-79.8	Clear	3WV	
MW-143-20	MW-143-20	8/12/2019	COC	9.09	--	6.0	0.80	293.8	6.98	-8.5	Clear	SP	
MW-144A-25	MW-144A-25	8/7/2019	COC	8.86	--	3.9	1.71	255.3	6.60	201.4	Low to very low tan color	3WV	
MW-145-20	MW-145-20	7/24/2019	S, COC, NSZD	9.87	--	4.7	6.69	429.4	6.69	137.0	Clear	3WV	
MW-148A-15	MW-148A-15	2/19/2019	S	10.90	--	0.6	2.99	171.8	6.12	82.9	Brown, turbid	3WV	
MW-148A-15	MW-148A-15	8/3/2019	S	8.49	--	6.9	3.94	222.2	6.21	247.5	Slightly turbid; tan color	3WV	
MW-148B-30	MW-148B-30	2/19/2019	S	10.34	--	3.0	0.97	239.1	7.10	-26.8	Clear	SP	
MW-148B-30	MW-148B-30	8/3/2019	S	8.55	--	3.1	0.18	258.4	5.23	152.9	Clear	3WV	
MW-148C-55	MW-148C-55	2/19/2019	S	10.58	--	3.6	0.40	219.3	6.58	74.9	Clear	3WV	
MW-148C-55	MW-148C-55	8/3/2019	S	8.72	--	4.0	0.13	236.8	7.96	130.0	Clear	3WV	
MW-148-80	MW-148-80	2/19/2019	S	10.62	--	4.3	1.34	202.9	6.98	6.97	Clear	SP	
MW-148-80	MW-148-80	7/30/2019	S	9.05	--	5.1	0.34	136.8	7.40	39.1	Clear	SP	
MW-149A-15	MW-149A-15	8/4/2019	COC	8.67	--	3.1	3.37	181.4	6.59	239.0	Clear	3WV	
MW-154B-95	MW-154B-95	7/29/2019	S	12.34	--	4.8	0.38	239.6	7.09	31.3	Clear	--	Sample collected before stable parameters or three well volumes purged.
MW-176A-15	MW-176A-15	2/13/2019	S	12.96	11.46	1.6	0.56	367.5	6.88	89.3	Clear	3WV	Product present. Parameters collected inadvertently.
MW-176A-15	MW-176A-15	8/8/2019	S	8.99	Sheen	--	--	--	--	--	Clear	1WV	No parameters collected due to presence of product in well.
MW-180A-15	MW-180A-15	7/23/2019	NSZD	8.58	--	9.9	1.35	268.0	6.64	93.1	Clear	3WV	
MW-186A-15	MW-186A-15	2/13/2019	S	11.77	11.58	2.8	0.47	315.2	7.08	60.3	Clear	SP	Product present. Parameters collected inadvertently.
MW-186A-15	MW-186A-15	7/24/2019	S	10.24	Sheen	--	--	--	--	--	--	1WV	No parameters collected due to presence of product in well.
MW-186B-60	MW-186B-60	7/24/2019	S	10.20	--	4.8	0.76	207.2	7.33	11.2	Clear	3WV	
MW-192A-15	MW-192A-15	8/6/2019	NSZD	7.60	--	7.9	0.79	252.1	6.82	184.9	Clear	3WV	
MW-302-CMT-20	MW-302-CMT-20	8/2/2019	S	8.93	--	6.7	0.30	256.9	6.85	32.5	Clear	3WV	
MW-302-CMT-50	MW-302-CMT-50	8/2/2019	S	8.96	--	6.3	0.26	228.6	7.44	-12.1	Clear	SP	
MW-302-80	MW-302-80	7/29/2019	S	8.24	--	5.6	0.32	211.1	7.01	89.6	Clear	SP	
MW-303-CMT-19	MW-303-CMT-19	2/25/2019	S	12.37	--	3.1	0.33	271.4	7.30	-71.5	Clear	SP	
MW-303-CMT-19	MW-303-CMT-19	8/2/2019	S	10.52	--	5.3	0.23	292.1	6.85	127.7	Clear	3WV	
MW-303-CMT-39	MW-303-CMT-39	8/2/2019	S	10.31	--	6.4	0.18	261	7.15	93.5	Clear	SP	
MW-303-CMT-59	MW-303-CMT-59	8/2/2019	S	10.58	--	5.9	0.17	237.5	7.24	69.9	Clear	SP	
MW-303-80	MW-303-80	7/29/2019	S	6.36	--	5.0	0.40	204.7	6063	113.1	Clear	--	Sample collected before stable parameters or three well volumes purged.
MW-304-CMT-20	MW-304-CMT-20	2/25/2019	S	13.86	--	3.8	0.68	368.7	6.84	-43.1	Clear	3WV	
MW-304-CMT-20	MW-304-CMT-20	7/30/2019	S	12.22	--	4.9	0.66	291.3	6.66	61.0	Clear	3WV	
MW-304-CMT-40	MW-304-CMT-40	7/30/2019	S	12.19	--	5.1	0.58	243.3	7.11	22.5	Clear	SP	
MW-304-CMT-60	MW-304-CMT-60	7/30/2019	S	12.25	--	5.3	0.36	214.1	7.20	14.9	Clear	SP	
MW-304-80	MW-304-80	7/29/2019	S	11.19	--	4.8	0.62	205.7	7.22	83.9	Clear	--	Sample collected before stable parameters or three well volumes purged.
MW-305-CMT-28	MW-305-CMT-28	7/30/2019	S	12.15	--	7.2	0.26	260.9	7.24	13.3	Clear	SP	
MW-305-CMT-48	MW-305-CMT-48	7/30/2019	S	12.17	--	7.2	0.28	235.8	7.29	24.8	Clear	SP	
MW-309-15	MW-309-15	8/5/2019	S	8.46	--	5.3	2.22	298.7	6.78	57.4	Clear/light tan	3WV	
MW-310-15	MW-310-15	8/5/2019	S	8.31	--	8.0	1.17	312.1	6.55	50.7	Clear/light tan color	3WV	
MW-321-15	MW-321-15	8/12/2019	COC, NSZD	8.21	--	6.9	0.09	282.7	6.61	41.4	Clear	3WV	
MW-330-20	MW-330-20	2/12/2019	S	15.09	--	6.3	0.6	313.4	6.61	103.1	Clear	3WV	
MW-330-20	MW-330-20	8/5/2019	S	13.05	--	6.2	0.31	268.8	6.83	49.1	Clear	3WV	
MW-334-15	MW-334-15	2/19/2019	S	12.91	12.67	--	--	--	--	--	--	1WV	No parameters collected due to presence of product in well.
MW-334-15	MW-334-15	8/8/2019	S	10.83	9.99	--	--	--	--	--	Clear	1WV	No parameters collected due to presence of product in well.
MW-336-20	MW-336-20	2/25/2019	S	7.25	--	2.9	2.02	352.1	6.55	-44.6	Clear	3WV	
MW-336-20	MW-336-20	8/12/2019	S, NSZD	5.02	Sheen	10.5	0.15	519	6.51	-25.8	Clear	--	Sample collected before stable parameters or three well volumes purged.
MW-345-15	MW-345-15	2/12/2019	S	11.31	--	2.5	0.69	334.2	7.10	69.6	Clear	3WV	
MW-345-15	MW-345-15	8/6/2019	S	9.19	--	7.7	1.25	352.8	7.01	-65.6	Clear	3WV	
MW-345-55	MW-345-55	7/22/2019	S	10.22	--	4.9	0.21	224.1	6.25	207.2	Clear	SP	
MW-351-15	MW-351-15	8/5/2019	COC	7.42	--	7.4	5.76	267.6	6.69	56.6	Clear	3WV	
MW-354-35	MW-354-35	2/13/2019	S	11.63	--	4.7	0.23	240.5	6.97	87.5	Clear	SP	
MW-354-35	MW-354-35	7/22/2019	S	10.22	--	4.4	0.17	234.8	6.94	131.1	Clear	3WV	
MW-358-15	MW-358-15	8/1/2019	COC	10.52	--	8.0	0.92	348.3	6.61	105.2	Clear	SP	
MW-358-20	MW-358-20	8/1/2019	S	10.70	--	5.4	0.32	271.1	6.84	116.5	Clear	3WV	
MW-358-40	MW-358-40	8/1/2019	S	10.33	--	4.2	0.35	398.6	6.97	101.5	Clear	SP	
MW-358-60	MW-358-60	8/1/2019	S	10.35	--	5.5	0.31	329.9	7.22	106.1	Clear	SP	
MW-359-15	MW-359-15	8/1/2019	S	10.32	--	7.5	2.66	305.5	6.28	145.7	Clear	3WV	
MW-359-35	MW-359-35	7/25/2019	S	10.39	--	3.8	0.41	260.4	7.10	68.6	Clear	3WV	

**Table 3-1  
Groundwater Well Field Parameters  
Annual 2019 Onsite Groundwater Monitoring Report  
North Pole Terminal, North Pole, Alaska**

Well ID	Sample Name	Date	Analysis	Depth to Water (feet)	Depth to LNAPL (feet)	Temperature (°C)	Dissolved Oxygen (mg/L)	Conductivity (µS/cm)	pH	ORP (mV)	Water Clarity	Purge Criteria	Sample Collection Notes
MW-359-60	MW-359-60	7/25/2019	S	10.32	--	4.6	0.47	219.7	7.23	46.6	Clear	SP	
MW-359-80	MW-359-80	7/25/2019	S	10.34	--	6.2	0.30	208.2	7.26	55.9	Clear	SP	
MW-360-15	MW-360-15	8/5/2019	S, COC	9.79	--	6.4	0.16	377.2	6.65	15.3	Light tan/light brown	3WV	
MW-360-35	MW-360-35	7/25/2019	S	10.51	--	4.1	0.22	264.4	6.69	79.2	Clear	3WV	
MW-360-50	MW-360-50	7/25/2019	S	10.43	--	4.1	0.18	264.2	6.84	68.4	Clear	--	Sample collected before stable parameters or three well volumes purged.
MW-360-80	MW-360-80	7/25/2019	S	9.96	--	5.6	0.20	207.8	7.2	53.5	Clear	SP	
MW-364-15	MW-364-15	8/4/2019	S	9.50	--	5.3	0.18	197.1	6.92	193.1	Clear	3WV	
MW-364-30	MW-364-30	8/4/2019	S	9.54	--	3.0	0.17	213.8	7.43	214.8	Clear	3WV	
MW-364-65	MW-364-65	8/4/2019	S	9.25	--	4.3	0.36	214.8	1.81	219.4	Clear	3WV	pH dropped at end of purge, <3.0 for last 4 readings.
MW-364-90	MW-364-90	7/30/2019	S	9.83	--	4.7	0.28	209.4	7.28	72.5	Clear	SP	
MW-369-16	MW-369-16	8/6/2019	NSZD	11.64	--	11.5	0.55	318.0	6.96	0.2	Slight brown	3WV	
MW-371-15	MW-371-15	8/2/2019	S	10.53	--	8.8	0.34	323.5	6.91	37.2	Light brown/tan color	3WV	
MW-372-15	MW-372-15	2/13/2019	S	15.49	--	4.2	0.56	483.3	6.64	91.2	Clear	3WV	
MW-372-15	MW-372-15	8/6/2019	S	13.22	--	5.9	0.23	349.7	6.72	150.8	Clear	3WV	
O-1	O-1	2/12/2019	S	11.36	--	1.9	0.59	299.4	7.25	-13.6	Clear	3WV	
O-1	O-1	7/23/2019	S	10.06	--	11.4	0.88	358.0	7.13	-89.3	Clear	SP	
O-2	O-2	2/19/2019	S	13.50	12.93	--	--	--	--	--	--	1WV	No parameters collected due to presence of product in well.
O-2	O-2	8/8/2019	S	10.35	Sheen	--	--	--	--	--	Clear	1WV	No parameters collected due to presence of product in well.
O-3	O-3	7/24/2019	COC	12.17	--	6.1	1.69	561	6.89	-30.0	Clear	3WV	
O-4	O-4	8/5/2019	COC	10.41	--	5.3	0.26	317.1	6.88	56.1	Clear	3WV	
O-15	O-15	8/12/2019	NSZD	9.98	--	7.2	0.15	280.9	6.51	71.9	Clear	SP	
O-24	O-24	2/12/2019	S	12.98	--	3.8	0.46	288.4	6.80	23.6	Clear	3WV	
O-24	O-24	7/24/2019	S, COC	6.20	--	5.9	0.84	414.1	6.68	-43.2	Clear	3WV	
O-26	O-26	2/12/2019	S	12.94	--	3.8	0.54	368.4	7.19	-5.4	Clear	3WV	
O-26	O-26	7/24/2019	S	11.62	--	4.5	1.02	386.5	7.19	-111.1	Clear	SP	
O-26-65	O-26-65	7/24/2019	S	10.21	--	4.6	0.91	213.4	7.31	-22.1	Clear	SP	
O-27	O-27	2/19/2019	S	13.32	12.68	--	--	--	--	--	--	1WV	No parameters collected due to presence of product in well.
O-27	O-27	8/8/2019	S	10.19	Sheen	--	--	--	--	--	Clear	1WV	No parameters collected due to presence of product in well.
O-27-65	O-27-65	8/6/2019	S	11.14	--	4.7	0.15	203.1	7.32	59.1	Clear	SP	
O-34	O-34	2/19/2019	S	11.40	11.39	--	--	--	--	--	--	1WV	No parameters collected due to presence of product in well.
O-34	O-34	8/8/2019	S	8.37	Sheen	--	--	--	--	--	Clear	1WV	No parameters collected due to presence of product in well.
S-9	S-9	2/20/2019	COC	11.07	--	4.4	1.48	260.1	6.43	28.4	Clear	3WV	
S-9	S-9	7/24/2019	COC	9.81	--	4.5	1.10	286.5	7.17	-74.8	Clear	3WV	
S-51	S-51	8/8/2019	S	8.71	Sheen	--	--	--	--	--	Clear	1WV	No parameters collected due to presence of product in well.

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

**Acronyms and Abbreviations:**

- = not applicable
- °C = degrees Celsius
- µS/cm = microsiemens per centimeter
- 1WV = one well volume
- 3WV = three well volumes
- CMT = continuous multichannel tubing
- COC = contaminants of concern (BTEX, GRO, DRO)
- DRO = diesel range organics
- GRO = gasoline range organics
- LNAPL = Light-Nonaqueous Phase Liquid
- mg/L = milligrams per liter
- mV = millivolts
- NSZD = natural source zone depletion (BTEX, GRO, DRO, oxygen, sulfate, dissolved iron, dissolved manganese, and methane)
- ORP = oxidation-reduction potential
- S = sulfolane
- SP = stable parameters

**Table 3-2a**  
**First Semiannual 2019 Groundwater Elevation, Surface Water Elevation, and Depth to LNAPL Monitoring Results**

**Annual 2019 Onsite Groundwater Monitoring Report**  
**North Pole Terminal, North Pole, Alaska**

Well ID	Zone	Date	Riser Elevation (MSL feet)	Depth to LNAPL (feet)	Depth to Water (feet)	LNAPL Thickness (feet)	Corrected Water Table Elevation (MSL feet)	Notes
MW-104-65	10-55	3/1/2019	496.03	--	12.30	--	483.73	
MW-142-20	Water Table	3/1/2019	495.83	--	12.06	--	483.77	
MW-144BR-90	55-90	3/1/2019	495.03	--	10.81	--	484.22	
MW-145-20	Water Table	—	495.63	—	—	—	—	Inaccessible under snow berm.
MW-149A-15	Water Table	3/1/2019	493.20	--	10.44	--	482.76	
MW-173B-150	90-160	3/1/2019	496.33	--	12.14	--	484.19	
MW-174-15	Water Table	3/1/2019	494.43	--	9.82	--	484.61	
MW-174A-50	10-55	3/1/2019	493.59	--	8.88	--	484.71	
MW-174B-90	55-90	3/1/2019	493.49	--	8.77	--	484.72	
MW-176A-15	Water Table	3/1/2019	497.11	11.44	13.04	1.60	485.37	
MW-176B-50	10-55	3/1/2019	496.93	--	11.45	--	485.48	
MW-186A-15	Water Table	3/1/2019	495.98	11.59	11.83	0.24	484.35	
MW-186B-60	10-55	3/1/2019	495.97	--	11.55	--	484.42	
MW-192A-15	Water Table	3/1/2019	496.28	--	9.78	--	486.50	
MW-192B-55	10-55	3/1/2019	495.59	--	9.05	--	486.54	
MW-198-150	90-160	3/1/2019	493.16	--	7.42	--	485.74	
MW-300-150	90-160	3/1/2019	495.94	--	10.26	--	485.68	
MW-301-60	10-55	3/1/2019	492.70	--	9.18	--	483.52	
MW-302-80	55-90	3/1/2019	493.41	--	9.85	--	483.56	
MW-302-CMT-50	10-55	3/1/2019	494.21	--	10.62	--	483.59	
MW-303-80	55-90	3/1/2019	491.56	--	8.23	--	483.33	
MW-303-CMT-59	10-55	3/1/2019	495.73	--	12.37	--	483.36	
MW-306-80	55-90	3/1/2019	496.47	--	13.02	--	483.45	
MW-309-15	Water Table	3/1/2019	494.77	--	10.51	--	484.26	
MW-310-110	90-160	3/1/2019	493.85	--	9.59	--	484.26	
MW-310-15	Water Table	3/1/2019	494.26	--	10.26	--	484.00	
MW-321-15	Water Table	3/1/2019	495.59	--	10.51	--	485.08	
MW-334-15	Water Table	3/1/2019	497.06	12.61	12.95	0.34	484.38	
MW-336-20	Water Table	3/1/2019	493.26	--	7.30	--	485.96	
MW-358-20	Water Table	3/1/2019	495.53	--	12.33	--	483.20	
MW-358-40	10-55	3/1/2019	495.19	--	11.98	--	483.21	
MW-358-60	10-55	3/1/2019	495.46	--	12.28	--	483.18	
MW-359-15	Water Table	3/1/2019	495.16	--	11.92	--	483.24	
MW-359-60	10-55	3/1/2019	495.02	--	11.71	--	483.31	
MW-359-80	55-90	3/1/2019	495.02	--	11.77	--	483.25	
MW-360-15	Water Table	3/1/2019	494.96	--	11.89	--	483.07	
MW-360-50	10-55	3/1/2019	494.86	--	11.78	--	483.08	
MW-360-80	55-90	3/1/2019	494.46	--	11.36	--	483.10	
MW-360-150	90-160	3/1/2019	494.57	--	11.44	--	483.13	
MW-362-15	Water Table	3/1/2019	495.09	--	11.78	--	483.31	
MW-362-50	10-55	3/1/2019	494.99	--	11.62	--	483.37	
MW-362-150	90-160	3/1/2019	495.27	--	11.98	--	483.29	
MW-364-15	Water Table	3/1/2019	494.23	--	11.35	--	482.88	
MW-364-65	10-55	3/1/2019	494.09	--	11.10	--	482.99	
MW-364-90	55-160	3/1/2019	494.28	--	11.36	--	482.92	
MW-366-15	Water Table	3/1/2019	493.51	7.46	7.77	0.31	485.99	
North Gravel Pit	Surface Water	3/1/2019	492.78	--	8.75	--	484.03	
O-34	Water Table	3/1/2019	496.56	No LNAPL	11.38	0.00	485.18	

**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  
 CMT = Continuous Multichannel Tubing  
 LNAPL = Light Non-Aqueous Phase Liquid  
 MSL = mean sea level

**Table 3-2b**  
**Second Semiannual 2019 Groundwater Elevation, Surface Water Elevations, and Depth to LNAPL Monitoring Results**  
**Annual 2019 Onsite Groundwater Monitoring Report**  
**North Pole Terminal, North Pole, Alaska**

Well ID	Zone	Date	Riser Elevation (MSL feet)	Depth to LNAPL (feet)	Depth to Water (feet)	LNAPL Thickness (feet)	Corrected Water Table Elevation (MSL feet)
MW-104-65	10-55	9/9/2019	496.03	--	10.94	--	485.09
MW-142-20	Water Table	9/9/2019	495.83	--	10.79	--	485.04
MW-144BR-90	55-90	9/9/2019	495.03	--	9.49	--	485.54
MW-145-20	Water Table	9/9/2019	495.63	--	9.87	--	485.76
MW-149A-15	Water Table	9/9/2019	493.20	--	9.17	--	484.03
MW-173B-150	90-160	9/9/2019	496.33	--	10.63	--	485.70
MW-174-15	Water Table	9/9/2019	494.43	--	8.53	--	485.90
MW-174A-50	10-55	9/9/2019	493.59	--	7.72	--	485.87
MW-174B-90	55-90	9/9/2019	493.49	--	7.61	--	485.88
MW-176A-15	Water Table	9/9/2019	497.11	10.39	11.19	0.80	486.57
MW-176B-50	10-55	9/9/2019	496.93	--	10.24	--	486.69
MW-186A-15	Water Table	9/10/2019	495.98	10.36	10.65	0.29	485.57
MW-186B-60	10-55	9/10/2019	495.97	--	10.35	--	485.62
MW-192A-15	Water Table	9/10/2019	496.28	--	8.70	--	487.58
MW-192B-55	10-55	9/10/2019	495.59	--	8.03	--	487.56
MW-198-150	90-160	9/10/2019	493.16	--	6.28	--	486.88
MW-300-150	90-160	9/9/2019	495.94	--	9.01	--	486.93
MW-301-60	10-55	9/9/2019	492.70	--	8.02	--	484.68
MW-302-CMT-50	10-55	9/10/2019	494.21	--	9.50	--	484.71
MW-302-80	55-90	9/10/2019	493.41	--	8.66	--	484.75
MW-303-80	55-90	9/10/2019	491.56	--	6.78	--	484.78
MW-303-CMT-59	10-55	9/10/2019	495.73	--	11.03	--	484.70
MW-306-80	55-90	9/9/2019	496.47	--	11.78	--	484.69
MW-309-15	Water Table	9/9/2019	494.77	--	9.38	--	485.39
MW-310-15	Water Table	9/9/2019	494.26	--	9.12	--	485.14
MW-310-110	90-160	9/9/2019	493.85	--	8.43	--	485.42
MW-321-15	Water Table	9/9/2019	495.59	--	9.35	--	486.24
MW-334-15	Water Table	9/10/2019	497.06	Sheen	11.40	Sheen	485.66
MW-336-20	Water Table	9/9/2019	493.26	--	6.07	--	487.19
MW-358-20	Water Table	9/9/2019	495.53	--	11.17	--	484.36
MW-358-40	10-55	9/9/2019	495.19	--	10.81	--	484.38
MW-358-60	10-55	9/9/2019	495.46	--	10.84	--	484.62
MW-359-15	Water Table	9/9/2019	495.16	--	10.78	--	484.38
MW-359-60	10-55	9/9/2019	495.02	--	10.54	--	484.48
MW-359-80	55-90	9/9/2019	495.02	--	10.56	--	484.46
MW-360-15	Water Table	9/9/2019	494.96	--	10.55	--	484.41
MW-360-50	10-55	9/9/2019	494.86	--	10.59	--	484.27
MW-360-80	55-90	9/9/2019	494.46	--	10.21	--	484.25
MW-360-150	90-160	9/9/2019	494.57	--	10.25	--	484.32
MW-362-15	Water Table	9/10/2019	495.09	--	10.65	--	484.44
MW-362-50	10-55	9/10/2019	494.99	--	10.48	--	484.51
MW-362-150	90-160	9/10/2019	495.27	--	10.81	--	484.46
MW-364-15	Water Table	9/9/2019	494.23	--	10.15	--	484.08
MW-364-65	10-55	9/9/2019	494.09	--	9.92	--	484.17

**Table 3-2b**  
**Second Semiannual 2019 Groundwater Elevation, Surface Water Elevations, and Depth to LNAPL Monitoring Results**

**Annual 2019 Onsite Groundwater Monitoring Report**  
**North Pole Terminal, North Pole, Alaska**

Well ID	Zone	Date	Riser Elevation (MSL feet)	Depth to LNAPL (feet)	Depth to Water (feet)	LNAPL Thickness (feet)	Corrected Water Table Elevation (MSL feet)
MW-364-90	90-160	9/9/2019	494.28	--	10.17	--	484.11
MW-366-15	Water Table	9/10/2019	493.51	--	6.41	--	487.10
North Gravel Pit	Surface Water	9/9/2019	492.78	--	7.63	--	485.15
O-34	Water Table	9/10/2019	496.56	Sheen	9.85	Sheen	486.71

**General Notes:**

If LNAPL is present, the water table elevation is corrected according to the following formula (riser elevation - depth to water) + (0.8 x LNAPL thickness)

Only monitoring wells scheduled for gauging per Table 3-1 of the Long-Term Monitoring Plan - 2017 Update are shown here (Arcadis. 2017. Long-Term Monitoring Plan – 2017 Update. February).

**Acronyms and Abbreviations:**

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

CMT = Continuous Multichannel Tubing

LNAPL = Light Non-Aqueous Phase Liquid

MSL = mean sea level

Sheen = LNAPL thickness was less than 0.01 feet and not detected with an interface probe; product was detected visually.

**Table 3-3  
LNAPL Migration Monitoring**

**Annual 2019 Onsite Groundwater Monitoring Report  
North Pole Terminal, North Pole, Alaska**

Well ID	Date	Event	Top of Riser Elevation (MSL feet)	Depth to LNAPL (feet)	Depth to Water (feet)	LNAPL Thickness (feet)	Corrected Water Table Elevation (feet MSL)
MW-139-25	10/29/2019	Annual	497.24	No LNAPL	13.06	0.00	484.18
MW-142-20	10/29/2019	Annual	495.83	No LNAPL	11.86	0.00	483.97
MW-145-20	10/29/2019	Annual	495.63	No LNAPL	10.93	0.00	484.70
O-4	10/29/2019	Annual	496.58	No LNAPL	12.21	0.00	484.37
O-5	10/29/2019	Annual	495.83	No LNAPL	11.31	0.00	484.52
O-7	10/29/2019	Annual	496.47	No LNAPL	11.35	0.00	485.12
O-11	10/29/2019	Annual	497.91	13.51	13.53	0.02	484.40
O-12	10/29/2019	Annual	496.44	No LNAPL	12.07	0.00	484.37
O-24	10/29/2019	Annual	497.15	No LNAPL	12.69	0.00	484.46
O-25	10/29/2019	Annual	497.86	No LNAPL	13.50	0.00	484.36
O-26	10/29/2019	Annual	497.00	No LNAPL	12.74	0.00	484.26
O-27	10/29/2019	Annual	496.91	12.46	13.33	0.87	484.30

**General Notes:**

If LNAPL is present, the water table elevation is corrected according to the following formula (riser elevation - depth to water) + (0.8 x LNAPL thickness).

Only monitoring wells scheduled for gauging per Table 3-2 of the Long-Term Monitoring Plan - 2017 Updates are shown here (Arcadis. 2017. Long-Term Monitoring Plan – 2017 Update. February). A comprehensive LNAPL gauging table is included in Appendix E.

**Acronyms and Abbreviations:**

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  
Natural Source Zone Depletion Monitoring Results**

**Annual 2019 Onsite Groundwater Monitoring Report  
North Pole Terminal, North Pole, Alaska**

Well ID	Zone	Sample Name	DUP	Date	Benzene	Toluene	Ethylbenzene	P & M - Xylene	o-Xylene	Total Xylenes	Gasoline Range Organics	Diesel Range Organics	Dissolved Iron	Dissolved Manganese	Sulfate	Methane
					µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
MW-101A-25	10-55	MW-101A-25	--	8/5/2019	<0.200	<0.500	<0.500	<1.00	<0.500	<1.50	<0.0500	<0.283	0.168J	2.02	25.0	0.0348JL*
MW-116-15	Water Table	MW-116-15	--	8/12/2019	14500	<50.0	798	4430	<50.0	4430	37.1	8.88	60.7	4.46	0.110J	13.3
MW-116-15	Water Table	MW-216-15	DUP	8/12/2019	13500	<50.0	716	4210	<50.0	4210	36.4	11.1	61.7	4.30	0.113J	17.6
MW-125-25	10-55	MW-125-25	--	7/23/2019	377	<5.00	176	1780	3.72J	1790	10.9	1.38	17.0	13.0	<0.100	1.69
MW-130-25	10-55	MW-130-25	--	7/23/2019	201	79.6	115	581	221	802	3.90	2.02	31.4	8.76	6.18	1.98
MW-135-20	Water Table	MW-135-20	--	8/5/2019	1060	7620	1740	7590	3400	11000	55.5	3.46	2.79	16.0	0.536	0.381
MW-142-20	Water Table	MW-142-20	--	8/12/2019	0.220J	<0.500	<0.500	<1.00	<0.500	<1.50	<0.100B*	0.725	12.9	8.60	9.68	1.33
MW-145-20	Water Table	MW-145-20	--	7/24/2019	<0.200	<0.500	<0.500	<1.00	<0.500	<1.50	<0.0500	<0.294	1.36	2.33	21.0	0.0625
MW-180A-15	Water Table	MW-180A-15	--	7/23/2019	0.371J	<0.500	0.684J	1.36J	<0.500	1.36J	0.0433J	<0.273	2.05	1.78	30.2	0.00850
MW-192A-15	Water Table	MW-192A-15	--	8/5/2019	<0.200	<0.500	<0.500	<1.00	<0.500	<1.50	0.0391J	<0.294	<0.125	0.0690	34.8	0.0124
MW-321-15	Water Table	MW-321-15	--	8/12/2019	81.3	0.340J	<0.500	<1.00	<0.500	<1.50	0.184JH*	0.446J	13.4	5.54	6.00	0.328
MW-321-15	Water Table	MW-421-15	DUP	8/12/2019	84.0	0.350J	<0.500	<1.00	<0.500	<1.50	0.181JH*	0.419J	13.8	5.87	4.58	0.245
MW-336-20	Water Table	MW-336-20	--	8/12/2019	19900	614	838	8550	2920	11500	70.9	13.8	30.1	4.94	3.52	10.7J*
MW-369-16	Water Table	MW-369-16	--	8/5/2019	<0.200	<0.500	<0.500	<1.00	<0.500	<1.50	<0.0500	<0.300	0.672	2.56	30.7	0.0738
O-15	Water Table	O-15	--	8/12/2019	<0.200	<0.500	<0.500	<1.00	<0.500	<1.50	<0.0500	<0.288	<0.125	0.276	44.3	0.0101

**General Notes:**

Total xylenes are calculated by Shannon & Wilson, Inc. as the sum of o-, p- and m-xylenes

Only monitoring wells scheduled for sampling per Table 3-6 of the Long-Term Monitoring Plan - 2017 Update are shown here (Arcadis. 2017. Long-Term Monitoring Plan – 2017 Update. February). Additional constituents of concern (COC) sampling data are included on Tables 3-5a and 3-5b.

**Acronyms and Abbreviations:**

-- = not applicable

< = not detected; limit of detection (LOD) listed; unless otherwise noted due to quality control failures.

µg/L = micrograms per liter

B\* = Result is considered not detected due to quality control failures; see data review checklist for details. Flag applied by Shannon & Wilson, Inc.

DUP = field-duplicate sample

J = Estimated concentration, detected above the detection limit (DL) and below the limit of quantitation (LOQ). Flag applied by laboratory.

JH\* = Estimated concentration, biased high, due to quality control failures. Flag applied by Shannon & Wilson, Inc.

JL\* = Estimated concentration, biased low, due to quality control failures. Flag applied by Shannon & Wilson, Inc.

mg/L - milligrams per liter



**Table 3-5a  
First Semiannual 2019 Constituents of Concern Analytical Results**

**Annual 2019 Onsite Groundwater Monitoring Report  
North Pole Terminal, North Pole, Alaska**

Well ID	Zone	Sample Name	DUP	Date	Benzene	Ethylbenzene	o-Xylene	P & M -Xylene	Toluene	Total Xylenes	Gasoline Range Organics	Diesel Range Organics
					µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L
MW-139-25	10-55	MW-139-25	--	02/25/19	49.9	34.6	3.71	357	0.490J	361	1.69	1.29
MW-140-25	10-55	MW-140-25	--	02/20/19	<0.200	<0.500	<0.500	<1.00	<0.500	<1.50	<0.0500	<0.294
MW-140-25	10-55	MW-240-25	DUP	02/20/19	<0.200	<0.500	<0.500	<1.00	<0.500	<1.50	<0.0500	<0.566B*
MW-142-20	Water Table	MW-142-20	--	02/20/19	<0.200	<0.500	<0.500	<1.00	<0.500	<1.50	0.0311J	<0.771B*
S-9	Water Table	S-9	--	02/20/19	<0.200	<0.500	<0.500	<1.00	<0.500	<1.50	<0.0500	<0.588B*

**General Notes:**

Total xylenes are calculated by Shannon & Wilson, Inc. as the sum of o-, p- and m-xylenes

Only monitoring wells scheduled for sampling per Table 3-4 of the Long-Term Monitoring Plan - 2017 Update are shown here (Arcadis. 2017. Long-Term Monitoring Plan – 2017 Update. February). Additional constituents of concern (COC) data collected as part of the natural source zone depletion (NSZD) sampling are included on Table 3-4.

**Acronyms and Abbreviations:**

-- = not applicable

< = Analyte not detected; listed as less than the limit of detection (LOD) unless otherwise flagged due to quality-control failures.

µg/L = micrograms per liter

B\* = Result is considered not detected due to quality control failures; see checklist for details. Flag applied by Shannon & Wilson, Inc.

DUP = field-duplicate sample

J = Estimated concentration, detected greater than the detection limit (DL) and less than the limit of quantitation (LOQ). Flag applied by the laboratory.

mg/L = milligrams per liter

**Table 3-5b  
Second Semiannual 2019 Constituents of Concern Analytical Results**

**Annual 2019 Onsite Groundwater Monitoring Report  
North Pole Terminal, North Pole, Alaska**

Well ID	Zone	Sample Name	DUP	Date	Benzene	Toluene	Ethyl- benzene	P & M - Xylenes	O-Xylene	Total Xylenes	Gasoline Range Organics	Diesel Range Organics	1-Methyl- naphthalene	1,3,5- Trimethyl- benzene	1,2,4- Trimethyl- benzene
					µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L	µg/L	µg/L	µg/L
MW-101A-25	10-55	MW-101A-25	--	8/5/2019	<0.200	<0.500	<0.500	<1.00	<0.500	<1.50	<0.0500	<0.283	--	--	--
MW-130-25	10-55	MW-130-25	--	7/23/2019	201	79.6	115	581	221	802	3.90	2.02	--	--	--
MW-131-25	10-55	MW-131-25	--	8/5/2019	<0.200	<0.500	<0.500	<1.00	<0.500	<1.50	<0.0500	<0.300	--	--	--
MW-135-20	Water Table	MW-135-20	--	8/5/2019	1060	7620	1740	7590	3400	11000	55.5	3.46	--	--	--
MW-137-20	Water Table	MW-137-20	--	7/24/2019	1010	2310	1270	5060	2190	7250	25.8JH*	1.93	8.80	195	608
MW-139-25	10-55	MW-139-25	--	8/12/2019	34.0	1.10J*	35.4	359	0.580J	360	2.05JH*	1.75	51.2	55.2	162
MW-139-25	10-55	MW-239-25	DUP	8/12/2019	36.9	0.440J*	40.7	384	0.600J	384	2.00JH*	2.13	--	--	--
MW-140-25	10-55	MW-140-25	--	8/5/2019	<0.200	<0.500	<0.500	<1.00	<0.500	<1.50	0.0333J	<0.294	--	--	--
MW-142-20	Water Table	MW-142-20	--	8/12/2019	0.220J	<0.500	<0.500	<1.00	<0.500	<1.50	<0.100B*	0.725	<0.0232	<0.500	<0.500
MW-143-20	Water Table	MW-143-20	--	8/12/2019	0.220J	0.870J	<0.500	<1.00	<0.500	<1.50	<0.0500	0.337J	--	--	--
MW-144A-25	10-55	MW-144A-25	--	8/7/2019	<0.200	<0.500	<0.500	<1.00	<0.500	<1.50	0.0415J	<0.283	--	--	--
MW-145-20	Water Table	MW-145-20	--	7/24/2019	<0.200	<0.500	<0.500	<1.00	<0.500	<1.50	<0.0500	<0.294	<0.00650	<0.500	<0.500
MW-149A-15	Water Table	MW-149A-15	--	8/4/2019	<0.200	<0.500	<0.500	<1.00	<0.500	<1.50	<0.0500	<0.273	--	--	--
MW-176A-15	Water Table	MW-176A-15	--	8/8/2019	Product Present - COC Analytes Not Collected										
MW-321-15	Water Table	MW-321-15	--	8/12/2019	81.3	0.340J	<0.500	<1.00	<0.500	<1.50	0.184JH*	0.446J	--	--	--
MW-321-15	Water Table	MW-421-15	DUP	8/12/2019	84.0	0.350J	<0.500	<1.00	<0.500	<1.50	0.181JH*	0.419J	--	--	--
MW-351-15	Water Table	MW-351-15	--	8/5/2019	<0.200	<0.500	<0.500	<1.00	<0.500	<1.50	<0.0500	<0.283	--	--	--
MW-358-15	Water Table	MW-358-15	--	8/1/2019	<0.200	<0.500	<0.500	<1.00	<0.500	<1.50	<0.0500	<0.283	--	--	--
MW-360-15	Water Table	MW-360-15	--	8/5/2019	<0.200	<0.500	<0.500	<1.00	<0.500	<1.50	<0.0500	<0.283	--	--	--
O-2	Water Table	O-2	--	8/8/2019	Product Present - COC Analytes Not Collected										
O-3	Water Table	O-3	--	7/24/2019	2.17	<0.500	<0.500	4.10	<0.500	4.10	0.0322J	<0.294	--	--	--
O-3	Water Table	O-103	DUP	7/24/2019	1.72	<0.500	<0.500	3.44	<0.500	3.44	0.0383J	<0.294	--	--	--
O-4	Water Table	O-4	--	8/5/2019	4.85	0.320J	<0.500	<1.00	<0.500	<1.50	0.0446J	0.504J	--	--	--
O-24	Water Table	O-24	--	7/24/2019	44.7	<0.500	<0.500	<1.00	<0.500	<1.50	0.126	0.374J	--	--	--
S-9	Water Table	S-9	--	7/24/2019	0.410	<0.500	<0.500	<1.00	<0.500	<1.50	<0.0500	<0.283	--	--	--

**General Notes:**

Total xylenes are calculated by Shannon & Wilson, Inc. as the sum of o-, p- and m-xylenes

Only monitoring wells scheduled for sampling per Table 3-4 of the Long-Term Monitoring Plan - 2017 Update are shown here (Arcadis. 2017. Long-Term Monitoring Plan – 2017 Update. February). Additional constituents of concern (COC) data collected as part of the natural source zone depletion (NSZD) sampling are included on Table 3-4.

**Acronyms and Abbreviations:**

-- = not applicable

< = Not detected; limit of detection (LOD) listed. Unless otherwise noted by quality control failures.

µg/L = micrograms per liter

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\* = Result is considered estimated (no direction of bias), due to QC failures or sample-handling anomalies. Flag applied by Shannon & Wilson, Inc.

JH\* = Result is considered estimated, biased high, due to QC failures. Flag applied by Shannon & Wilson, Inc.

mg/L = milligrams per liter

**Table 3-6a  
First Semiannual 2019 Onsite Sulfolane Analytical Results**

**Annual 2019 Onsite Groundwater Monitoring Report  
North Pole Terminal, North Pole, Alaska**

Well ID	Zone	Sample Name	DUP	Date	Sulfolane
					µg/L
MW-148A-15	Water Table	MW-148A-15	--	02/19/19	5.83J
MW-148B-30	10-55	MW-148B-30	--	02/19/19	17.5
MW-148C-55	10-55	MW-148C-55	--	02/19/19	29.4
MW-148-80	55-90	MW-148-80	--	02/19/19	18.3
MW-176A-15	Water Table	MW-176A-15	--	02/13/19	2,570JL*
MW-186A-15	Water Table	MW-186A-15	--	02/13/19	261J*
MW-303-CMT-19	Water Table	MW-303-CMT-19	--	02/25/19	147JL*
MW-304-CMT-20	Water Table	MW-304-CMT-20	--	02/25/19	3.96JL*
MW-330-20	Water Table	MW-330-20	--	02/12/19	294J*
MW-330-20	Water Table	MW-430-20	DUP	02/12/19	274J*
MW-334-15	Water Table	MW-334-15	--	02/19/19	86.3
MW-336-20	Water Table	MW-336-20	--	02/25/19	19,600JL*
MW-345-15	Water Table	MW-345-15	--	02/12/19	240J*
MW-354-35	10-55	MW-354-35	--	02/13/19	870J*
MW-372-15	Water Table	MW-372-15	--	02/13/19	575J*
O-1	Water Table	O-1	--	02/12/19	3,920JL*
O-2	Water Table	O-2	--	02/19/19	185
O-24	Water Table	O-24	--	02/12/19	4.71J*
O-26	Water Table	O-26	--	02/12/19	116J*
O-27	Water Table	O-27	--	02/19/19	257
O-27	Water Table	O-127	DUP	02/19/19	264
O-34	Water Table	O-34	--	02/19/19	647

**General Notes:**

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

Only monitoring wells scheduled for sampling per Table 3-3 of the Long-Term Monitoring Plan - 2017 Update are shown here (Arcadis. 2017. Long-Term Monitoring Plan – 2017 Update. February).

**Acronyms and Abbreviations:**

-- = not applicable

DUP = field-duplicate sample

J = Estimated concentration, detected greater than the detection limit (DL) and less than the limit of quantitation (LOQ). Flag applied by the laboratory.

J\* = Estimated concentration due to quality control failures. 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 3-6b  
Second Semiannual 2019 Onsite Sulfolane Analytical Results**

**Annual 2019 Onsite Groundwater Monitoring Report  
North Pole Terminal, North Pole, Alaska**

Well ID	Zone	Sample Name	DUP	Date	Sulfolane
					µg/L
MW-127-25	10-55	MW-127-25	--	7/22/2019	61.6
MW-139-25	10-55	MW-139-25	--	8/12/2019	172
MW-139-25	10-55	MW-239-25	DUP	8/12/2019	176
MW-142-20	Water Table	MW-142-20	--	8/12/2019	133
MW-145-20	Water Table	MW-145-20	--	7/24/2019	<5.15
MW-148A-15	Water Table	MW-148A-15	--	8/3/2019	5.97J
MW-148B-30	10-55	MW-148B-30	--	8/3/2019	24.4
MW-148C-55	10-55	MW-148C-55	--	8/3/2019	47.9
MW-148-80	55-90	MW-148-80	--	7/30/2019	28.7
MW-154B-95	55-90	MW-154B-95	--	7/29/2019	257J*
MW-176A-15	Water Table	MW-176A-15	--	8/8/2019	2,070JL*
MW-186A-15	Water Table	MW-186A-15	--	7/24/2019	353
MW-186B-60	10-55	MW-186B-60	--	7/24/2019	39.8
MW-302-CMT-20	Water Table	MW-302-CMT-20	--	8/2/2019	22.4
MW-302-CMT-50	10-55	MW-302-CMT-50	--	8/2/2019	12.0
MW-302-80	55-90	MW-302-80	--	7/29/2019	4.52J
MW-302-80	55-90	MW-302-180	DUP	7/29/2019	4.31J
MW-303-CMT-19	Water Table	MW-303-CMT-19	--	8/2/2019	173
MW-303-CMT-39	10-55	MW-303-CMT-39	--	8/2/2019	150
MW-303-CMT-59	10-55	MW-303-CMT-59	--	8/2/2019	76.2
MW-303-80	55-90	MW-303-80	--	7/29/2019	7.94J*
MW-304-CMT-20	Water Table	MW-304-CMT-20	--	7/30/2019	11.5
MW-304-CMT-40	10-55	MW-304-CMT-40	--	7/30/2019	69.1
MW-304-CMT-60	10-55	MW-304-CMT-60	--	7/30/2019	11.9
MW-304-80	55-90	MW-304-80	--	7/29/2019	15.9J*
MW-305-CMT-28	10-55	MW-305-CMT-28	--	7/30/2019	17.8
MW-305-CMT-48	10-55	MW-305-CMT-48	--	7/30/2019	3.55J
MW-309-15	Water Table	MW-309-15	--	8/5/2019	88.9
MW-310-15	Water Table	MW-310-15	--	8/5/2019	42.1J*
MW-310-15	Water Table	MW-310-115	DUP	8/5/2019	25.6J*
MW-330-20	Water Table	MW-330-20	--	8/5/2019	148
MW-334-15	Water Table	MW-334-15	--	8/8/2019	62.8JL*
MW-336-20	Water Table	MW-336-20	--	8/12/2019	17,200JL*
MW-345-15	Water Table	MW-345-15	--	8/6/2019	160
MW-345-15	Water Table	MW-345-115	DUP	8/6/2019	137
MW-345-55	10-55	MW-345-55	--	7/22/2019	148
MW-354-35	10-55	MW-354-35	--	7/22/2019	564
MW-358-20	Water Table	MW-358-20	--	8/1/2019	69.9
MW-358-40	10-55	MW-358-40	--	8/1/2019	60.7
MW-358-60	10-55	MW-358-60	--	8/1/2019	8.36J
MW-359-15	Water Table	MW-359-15	--	8/1/2019	40.3

**Table 3-6b  
Second Semiannual 2019 Onsite Sulfolane Analytical Results**

**Annual 2019 Onsite Groundwater Monitoring Report  
North Pole Terminal, North Pole, Alaska**

Well ID	Zone	Sample Name	DUP	Date	Sulfolane
					µg/L
MW-359-15	Water Table	MW-359-115	DUP	8/1/2019	41.2
MW-359-35	10-55	MW-359-35	--	7/25/2019	127
MW-359-60	10-55	MW-359-60	--	7/25/2019	79.1
MW-359-80	55-90	MW-359-80	--	7/25/2019	28.7
MW-360-15	Water Table	MW-360-15	--	8/5/2019	5.94J
MW-360-35	10-55	MW-360-35	--	7/25/2019	31.6
MW-360-50	10-55	MW-360-50	--	7/25/2019	39.2J*
MW-360-80	55-90	MW-360-80	--	7/25/2019	21.5
MW-364-15	Water Table	MW-364-15	--	8/4/2019	<5.05
MW-364-30	10-55	MW-364-30	--	8/4/2019	16.1
MW-364-65	10-55	MW-364-65	--	8/4/2019	44.1J*
MW-364-90	55-90	MW-364-90	--	7/30/2019	28.9
MW-371-15	Water Table	MW-371-15	--	8/2/2019	198
MW-372-15	Water Table	MW-372-15	--	8/6/2019	522
O-1	Water Table	O-1	--	7/23/2019	2,940JL*
O-2	Water Table	O-2	--	8/8/2019	97.0
O-24	Water Table	O-24	--	7/24/2019	3.55J
O-26	Water Table	O-26	--	7/24/2019	99.9
O-26-65	10-55	O-26-65	--	7/24/2019	32.8
O-27	Water Table	O-27	--	8/8/2019	257
O-27	Water Table	O-127	DUP	8/8/2019	230
O-27-65	10-55	O-27-65	--	8/6/2019	99.0
O-34	Water Table	O-34	--	8/8/2019	373
S-51	Water Table	S-51	--	8/8/2019	167

**General Notes:**

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

Only monitoring wells scheduled for sampling per Table 3-3 of the Long-Term Monitoring Plan - 2017 Update are shown here (Arcadis. 2017. Long-Term Monitoring Plan – 2017 Update. February).

**Acronyms and Abbreviations:**

< = not detected; limit of detection (LOD) listed

-- = not applicable

DUP = field-duplicate sample

J = Estimated concentration, detected greater than the detection limit (DL) and less than the limit of quantitation (LOQ). Flag applied by the laboratory.

J\* = Estimated concentration due to quality control failures. 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 3-7  
Sulfolane Analytical Results - Point of Compliance**

**Annual 2019 Onsite Groundwater Monitoring Report  
North Pole Terminal, North Pole, Alaska**

Well ID	Zone	Sample Name	DUP	Date	Sulfolane
					µg/L
MW-358-20	Water Table	MW-358-20	--	8/1/2019	69.9
MW-358-40	10-55	MW-358-40	--	8/1/2019	60.7
MW-358-60	10-55	MW-358-60	--	8/1/2019	8.36J
MW-359-15	Water Table	MW-359-15	--	8/1/2019	40.3
MW-359-15	Water Table	MW-359-115	DUP	8/1/2019	41.2
MW-359-35	10-55	MW-359-35	--	7/25/2019	127
MW-359-60	10-55	MW-359-60	--	7/25/2019	79.1
MW-359-80	55-90	MW-359-80	--	7/25/2019	28.7
MW-360-15	Water Table	MW-360-15	--	8/5/2019	5.94J
MW-360-35	10-55	MW-360-35	--	7/25/2019	31.6
MW-360-50	10-55	MW-360-50	--	7/25/2019	39.2J*
MW-360-80	55-90	MW-360-80	--	7/25/2019	21.5
MW-364-15	Water Table	MW-364-15	--	8/4/2019	<5.05
MW-364-30	10-55	MW-364-30	--	8/4/2019	16.1
MW-364-65	10-55	MW-364-65	--	8/4/2019	44.1J*
MW-364-90	55-90	MW-364-90	--	7/30/2019	28.9

**General Notes:**

Only monitoring wells identified as Point of Compliance Wells per Section 4 of the Long-Term Monitoring Plan - 2017 Update are shown here (Arcadis. 2017. Long-Term Monitoring Plan – 2017 Update. February).

**Acronyms and Abbreviations:**

< = not detected; limit of detection (LOD) listed

-- = not applicable

DUP = field-duplicate sample

J = Estimated concentration, detected greater than the detection limit (DL) and less than the limit of quantitation (LOQ). Flag applied by the laboratory.

J\* = Estimated concentration due to quality control failures. Flag applied by Shannon & Wilson, Inc.

JL\* = Estimated concentration, biased low, due to quality control failures. Flag applied by Shannon & Wilson, Inc.

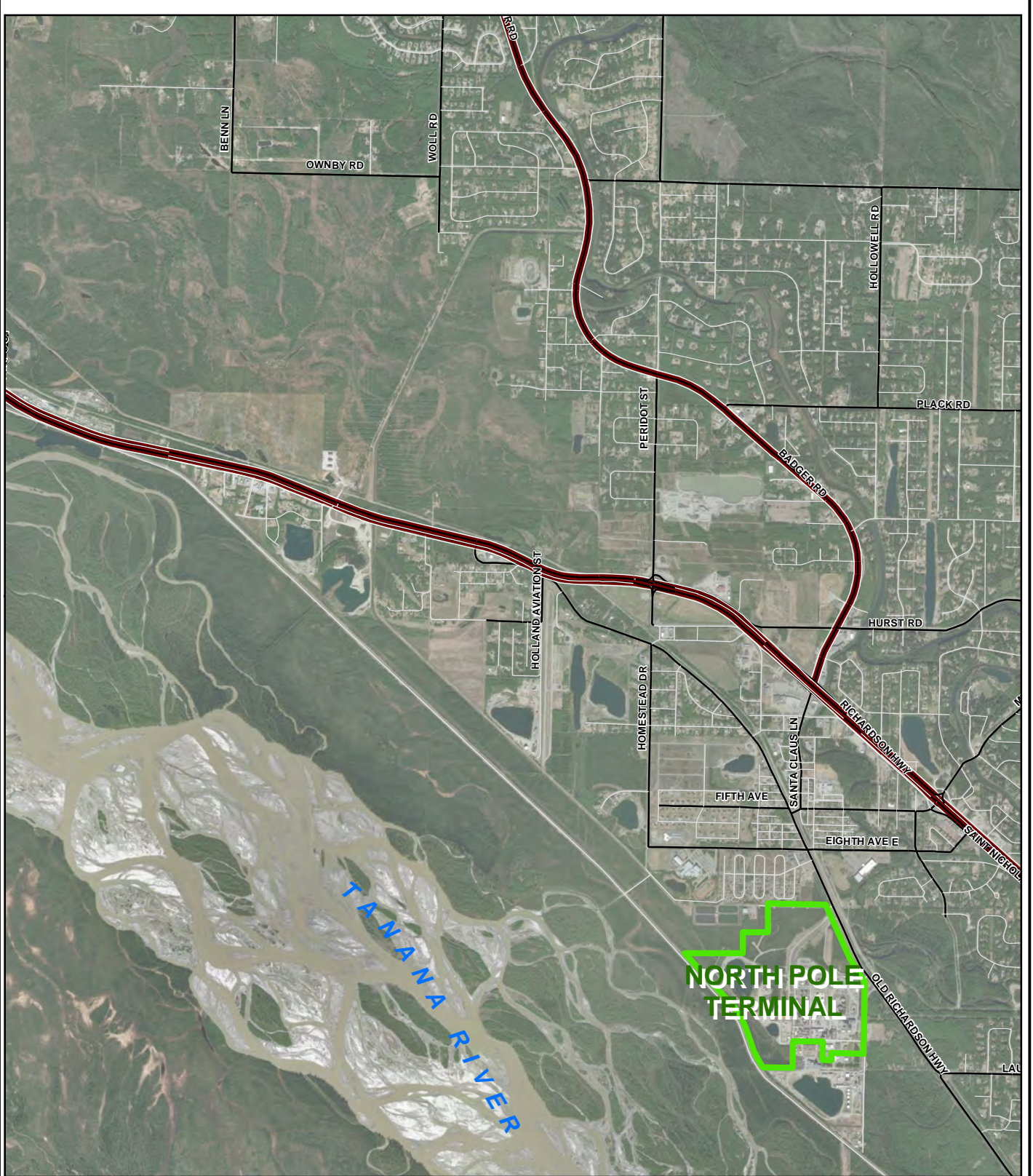
µg/L = micrograms per liter

# FIGURES

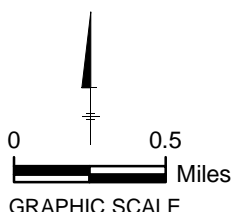




CITY: Citrix DIV/GROUP: ENV/IM DB: K Sinsabaugh LD: G FRANCE  
 Path: Z:\GIS\Projects\ENV\FHR\FHR\_AK\NorthPoleRefinery\GW\_Monitoring\2019\_03\mxd\2019SecondSemiAnnualOnSite\Fig 1-1 SiteLocation.mxd Date: 11/18/2019 Time: 2:32:17 PM



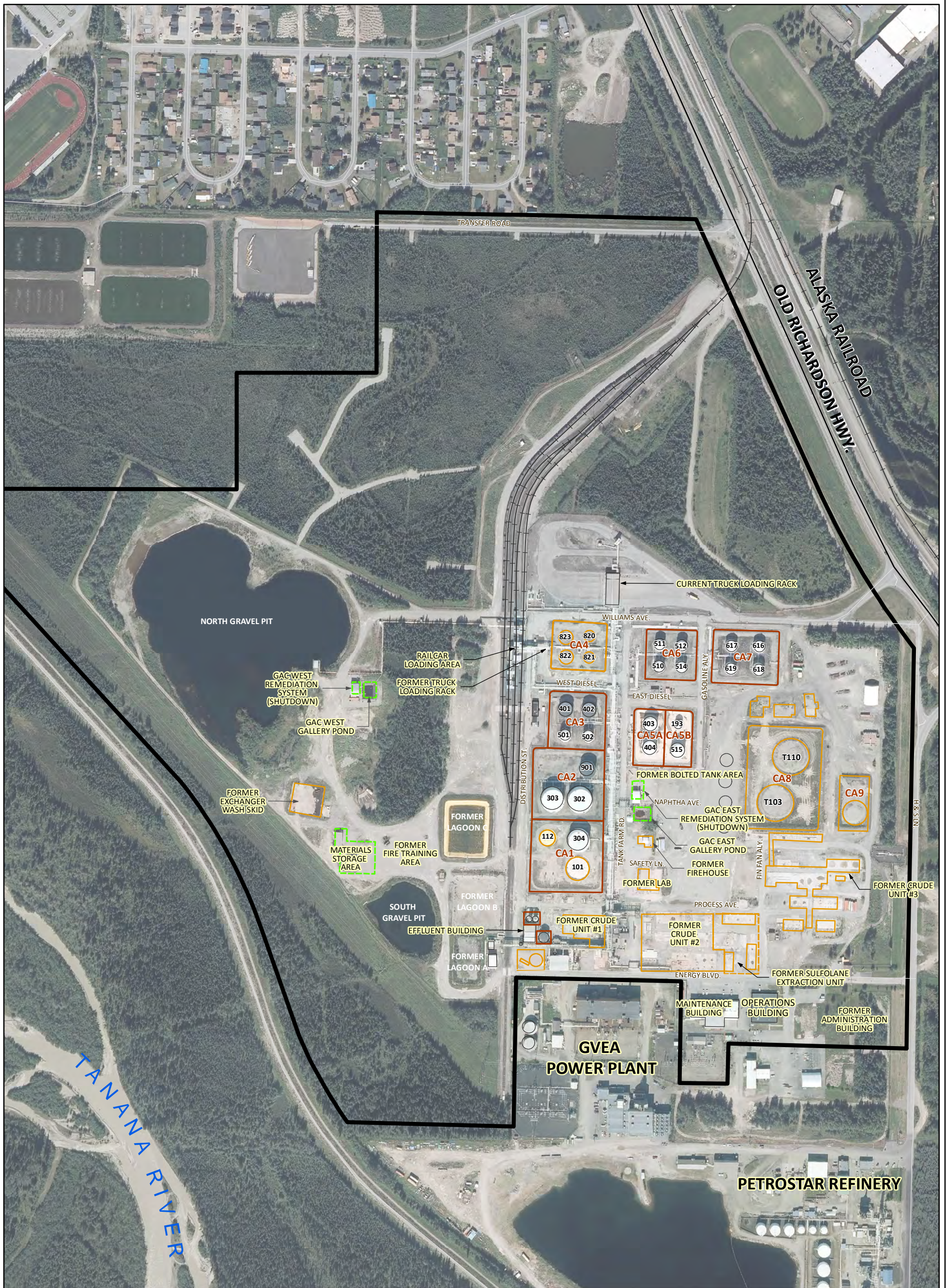
**LEGEND:**  
 PROPERTY BOUNDARY



Note:  
 May 2015 ESRI Cloud Imagery

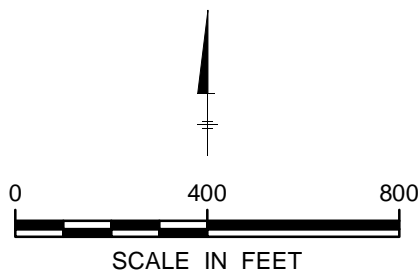
NORTH POLE TERMINAL, NORTH POLE, ALASKA	
ANNUAL 2019 ONSITE GROUNDWATER MONITORING REPORT	
<b>SITE LOCATION</b>	
	<b>FIGURE 1-1</b>





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

**Notes:**  
 GAC: Granular Activated Carbon  
 GVEA: Golden Valley Electrical Authority  
 - July 21, 2018 Imagery provided by Quantum Spatial



NORTH POLE TERMINAL, NORTH POLE, ALASKA  
 ANNUAL 2019 ONSITE GROUNDWATER  
 MONITORING REPORT

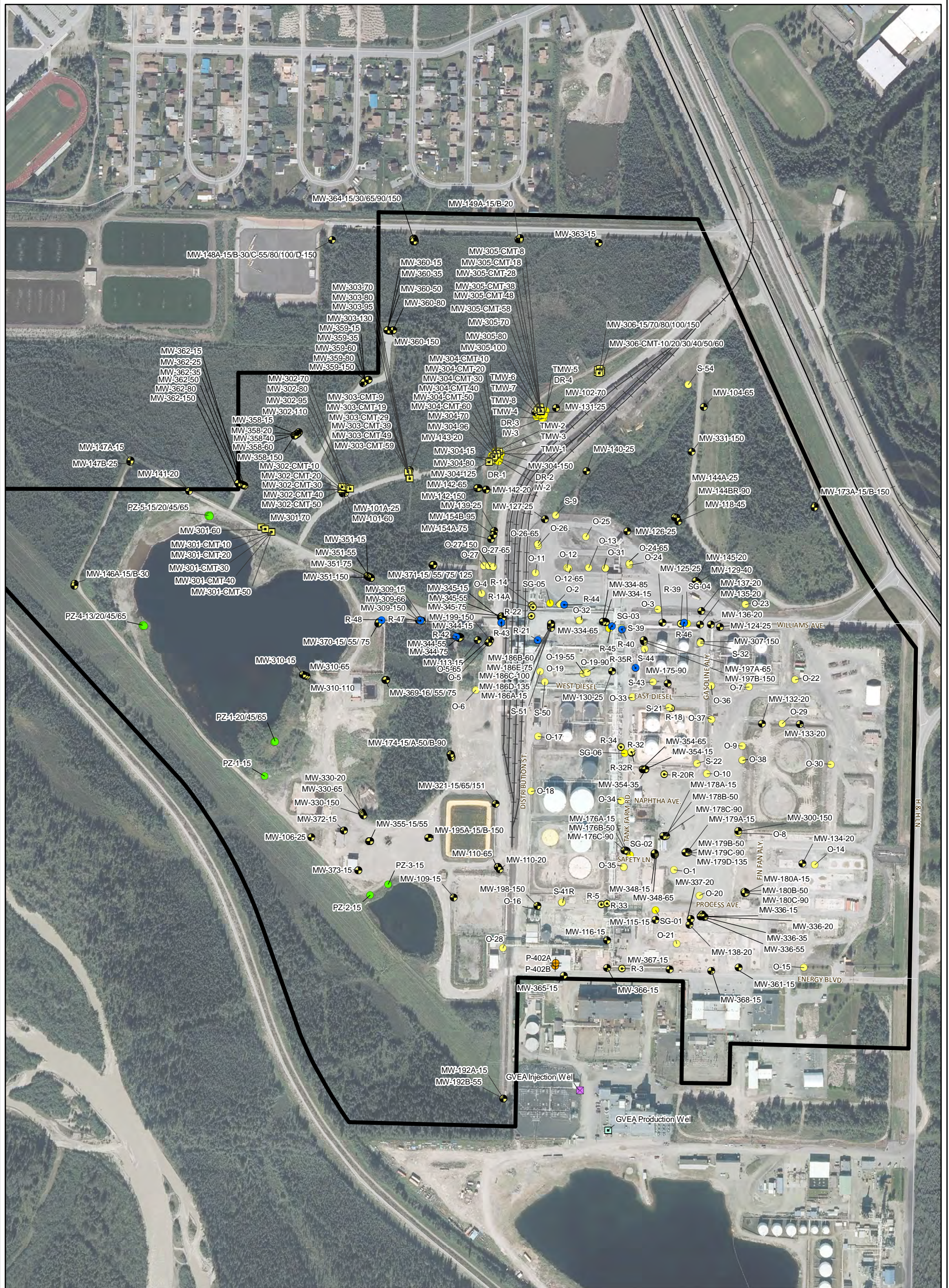
**SITE FEATURES**



FIGURE

**1-2**





<b>Legend</b> <ul style="list-style-type: none"> <li><span style="color: yellow;">●</span> Monitoring Well</li> <li><span style="color: yellow;">○</span> Observation Well</li> <li><span style="border: 1px solid black; padding: 2px;">□</span> Vertical Profile Transect Well</li> <li><span style="color: yellow;">○</span> Recovery Well (Former)</li> <li><span style="color: blue;">○</span> Recovery Wells (Inactive)</li> <li><span style="color: green;">●</span> Piezometer</li> <li><span style="border: 1px dashed purple; padding: 2px;">□</span> GVEA Injection Well (Approximate)</li> <li><span style="border: 1px dashed green; padding: 2px;">□</span> GVEA Production Well (Approximate)</li> <li><span style="color: orange;">●</span> Production Wells (Approximate)</li> <li><span style="border-bottom: 2px solid black; width: 20px; display: inline-block;"></span> Major Road</li> <li><span style="border-bottom: 1px solid black; width: 20px; display: inline-block;"></span> Local Road</li> <li><span style="border-bottom: 1px dashed black; width: 20px; display: inline-block;"></span> Rail Line</li> <li><span style="border: 2px solid black; width: 20px; height: 10px; display: inline-block;"></span> Property Boundary</li> </ul>		 NORTH POLE TERMINAL, NORTH POLE, ALASKA <b>ANNUAL 2019 ONSITE GROUNDWATER MONITORING REPORT</b> <b>SITE PLAN - ONSITE</b>
0      400      800  SCALE IN FEET	<b>Notes:</b> GVEA = Golden Valley Electrical Authority - July 21, 2018 Imagery provided by Quantum Spatial	
FIGURE <span style="font-size: 24pt; font-weight: bold;">1-3</span>		

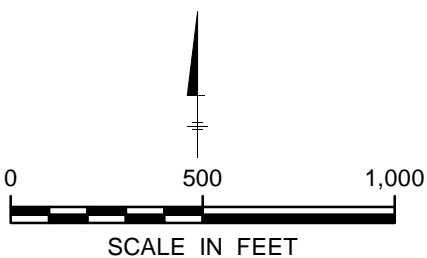






**Legend**

- Monitoring Well
- Observation Well
- ▲ Surface Water
- ▭ Property Boundary
- 486 Groundwater Elevation Contours in Feet Above Mean Sea Level (Dashed where Inferred)
- - - Not gauged due to well obstruction



Notes:  
 - Wells were gauged in March 2019  
 - Only monitoring wells scheduled for gauging per Table 3-1 of the Long Term Monitoring Plan - 2017 Update are shown on the figure.  
 - July 21, 2018 Imagery provided by Quantum Spatial

NORTH POLE TERMINAL, NORTH POLE, ALASKA  
**ANNUAL 2019 ONSITE GROUNDWATER MONITORING REPORT**  
**FIRST SEMIANNUAL 2019 GROUNDWATER CONTOUR MAP - ONSITE WELLS AT WATER TABLE**



FIGURE

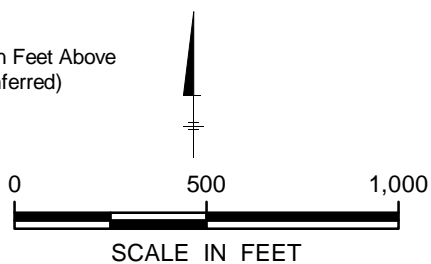
**3-1**





**Legend**

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



NORTH POLE TERMINAL, NORTH POLE, ALASKA

**ANNUAL 2019 ONSITE GROUNDWATER MONITORING REPORT**

**FIRST SEMI ANNUAL 2019 GROUNDWATER CONTOUR MAP - ONSITE WELLS 10 TO 55 FEET BELOW WATER TABLE**

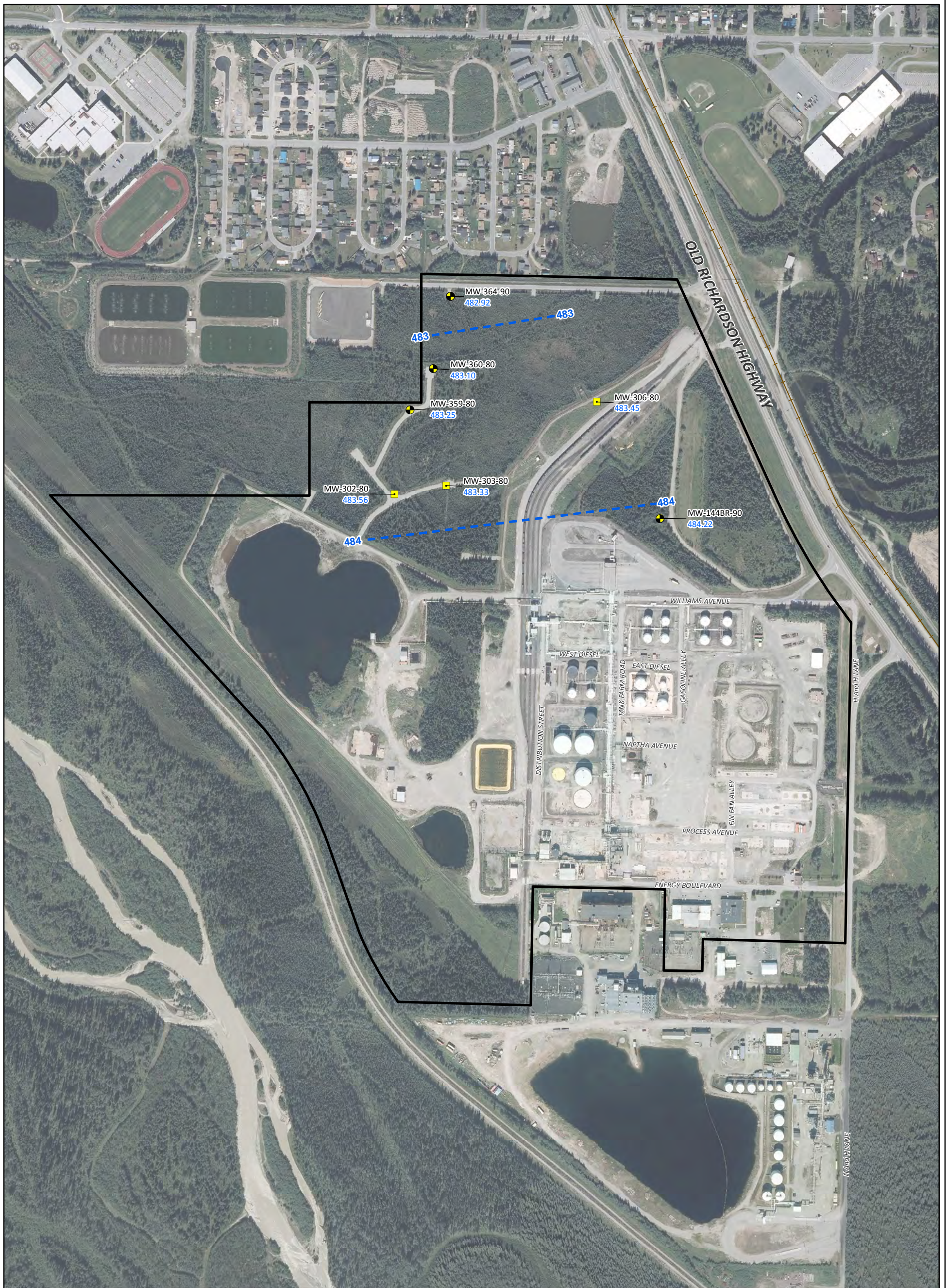
FIGURE



**3-2**

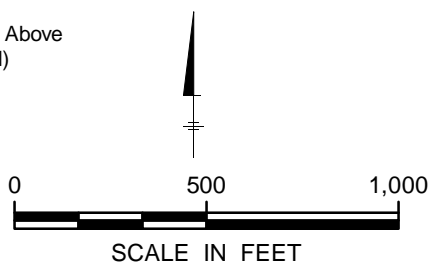
Notes:  
 - Wells were gauged in March 2019  
 - Only monitoring wells scheduled for gauging per Table 3-1 of the Long Term Monitoring Plan - 2017 Update are shown on the figure.  
 - July 21, 2018 Imagery provided by Quantum Spatial





**Legend**

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



Notes:  
 - Wells were gauged in March 2019  
 - Only monitoring wells scheduled for gauging per Table 3-1 of the Long Term Monitoring Plan - 2017 Update are shown on the figure.  
 - July 21, 2018 Imagery provided by Quantum Spatial

NORTH POLE TERMINAL, NORTH POLE, ALASKA

**ANNUAL 2019 ONSITE GROUNDWATER MONITORING REPORT**

**FIRST SEMIANNUAL 2019 GROUNDWATER CONTOUR MAP - ONSITE WELLS 55 TO 90 FEET BELOW WATER TABLE**

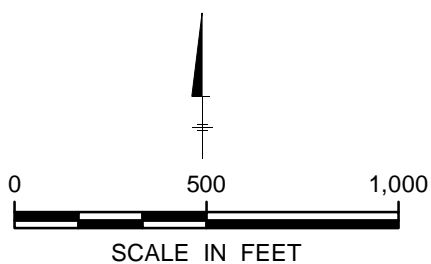


FIGURE  
**3-3**





**Legend**  
 ● Monitoring Well  
 □ Property Boundary  
 — Groundwater Elevation Contours in Feet Above Mean Sea Level (Dashed where Inferred)



Notes:  
 - Wells were gauged in March 2019  
 - Only monitoring wells scheduled for gauging per Table 3-1 of the Long Term Monitoring Plan - 2017 Update are shown on the figure.  
 - July 21, 2018 Imagery provided by Quantum Spatial

NORTH POLE TERMINAL, NORTH POLE, ALASKA  
**ANNUAL 2019 ONSITE GROUNDWATER MONITORING REPORT**  
**FIRST SEMI ANNUAL 2019 GROUNDWATER CONTOUR MAP - ONSITE WELLS 90 TO 160 FEET BELOW WATER TABLE**



FIGURE

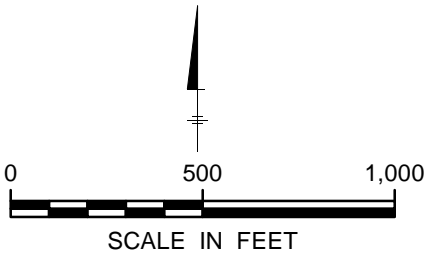
**3-4**





**Legend**

- Monitoring Well
- Observation Well
- ▲ Surface Water
- ▭ Property Boundary
- 486 — Groundwater Elevation Contours in Feet Above Mean Sea Level (Dashed where Inferred)



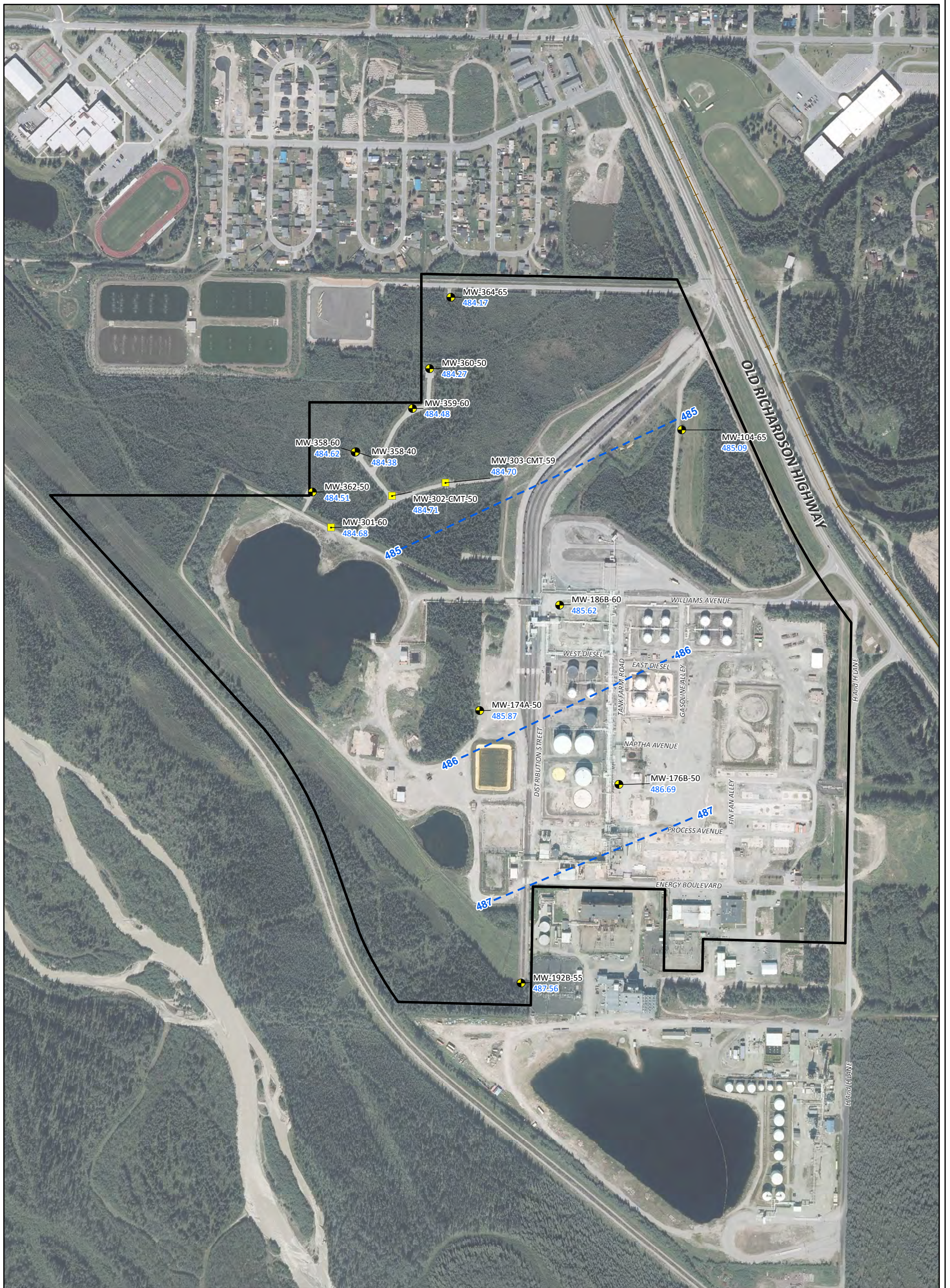
Notes:  
 -Wells were gauged in September 2019  
 -Only monitoring wells scheduled for gauging per Table 3-1 of the Long Term Monitoring Plan - 2017 Update are shown on the figure.  
 - July 21, 2018 Imagery provided by Quantum Spatial

NORTH POLE TERMINAL, NORTH POLE, ALASKA  
**ANNUAL 2019 ONSITE GROUNDWATER MONITORING REPORT**  
**SECOND SEMIANNUAL 2019 GROUNDWATER CONTOUR MAP - ONSITE WELLS AT WATER TABLE**



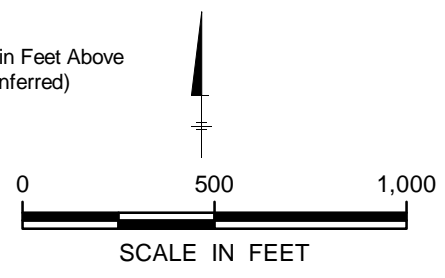
FIGURE  
**3-5**





- Legend**
- Vertical Profile Transect Well
  - Monitoring Well
  - Property Boundary

485 — Groundwater Elevation Contours in Feet Above Mean Sea Level (Dashed where Inferred)



NORTH POLE TERMINAL, NORTH POLE, ALASKA  
**ANNUAL 2019 ONSITE GROUNDWATER MONITORING REPORT**

**SECOND SEMI-ANNUAL 2019 GROUNDWATER CONTOUR MAP - ONSITE WELLS 10 TO 55 FEET BELOW WATER TABLE**

Notes:  
 -Wells were gauged in September 2019  
 -Only monitoring wells scheduled for gauging per Table 3-1 of the Long Term Monitoring Plan - 2017 Update are shown on the figure.  
 - July 21, 2018 Imagery provided by Quantum Spatial

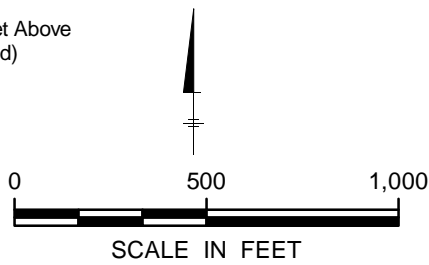






**Legend**

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



Notes:  
 -Wells were gauged in September 2019  
 -Only monitoring wells scheduled for gauging per Table 3-1 of the Long Term Monitoring Plan - 2017 Update are shown on the figure.  
 - July 21, 2018 Imagery provided by Quantum Spatial

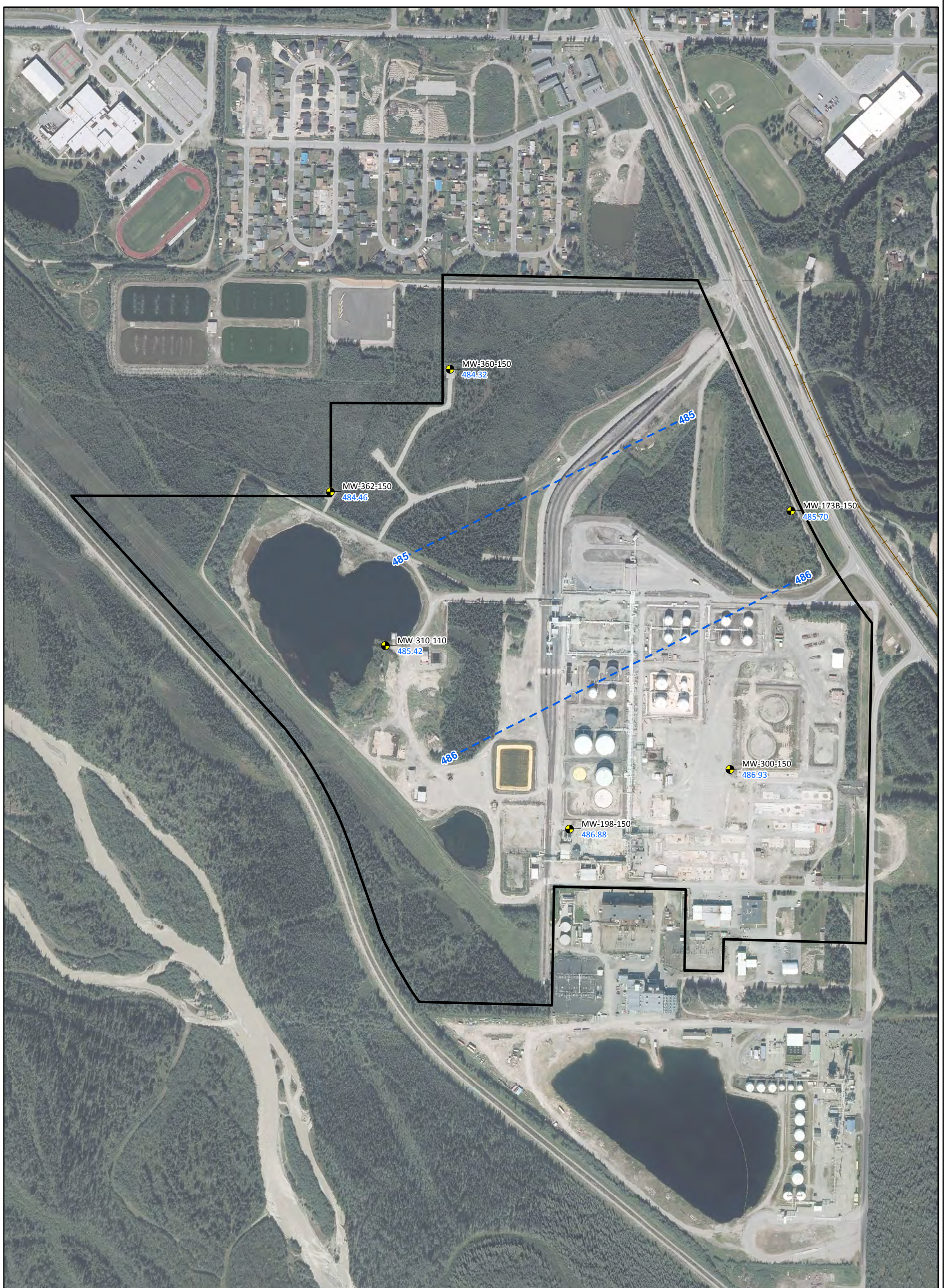
NORTH POLE TERMINAL, NORTH POLE, ALASKA  
**ANNUAL 2019 ONSITE GROUNDWATER MONITORING REPORT**

**SECOND SEMI ANNUAL 2019 GROUNDWATER CONTOUR MAP - ONSITE WELLS 55 TO 90 FEET BELOW WATER TABLE**

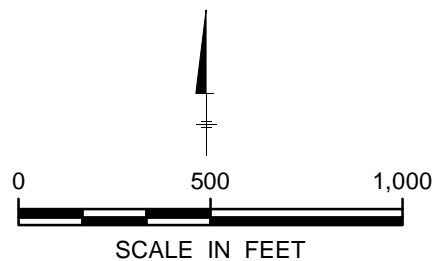


FIGURE  
**3-7**





**Legend**  
 Monitoring Well  
 Property Boundary  
 Groundwater Elevation Contours in Feet Above Mean Sea Level (Dashed where Inferred)



**Notes:**  
 -Wells were gauged in September 2019  
 -Only monitoring wells scheduled for gauging per Table 3-1 of the Long Term Monitoring Plan - 2017 Update are shown on the figure.  
 - July 21, 2018 Imagery provided by Quantum Spatial

NORTH POLE TERMINAL, NORTH POLE, ALASKA  
**ANNUAL 2019 ONSITE GROUNDWATER MONITORING REPORT**

**SECOND SEMIANNUAL 2019 GROUNDWATER CONTOUR MAP - ONSITE WELLS 90 TO 160 FEET BELOW WATER TABLE**



FIGURE

**3-8**





**Legend**

<b>No LNAPL or Sheen Observed</b>	<b>LNAPL or Sheen Observed</b>	<b>Property Boundary</b>
● Monitoring Well	● Monitoring Well	1.60 LNAPL Thickness (feet)
● Observation Well	● Observation Well	Sheen An interface probe was used. No measurable LNAPL was present, but LNAPL sheen was observed visually.
● Recovery Well (Inactive)	● Recovery Well (Inactive)	-- No LNAPL measured or sheen observed

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 - 2017 Update are shown on the figure.  
 - Wells with LNAPL or sheen observed during the reporting period are also shown on this figure.  
 - July 21, 2018 Imagery provided by Quantum Spatial  
 - Annual gauging was conducted in October 2019.

0 200 400  
 SCALE IN FEET

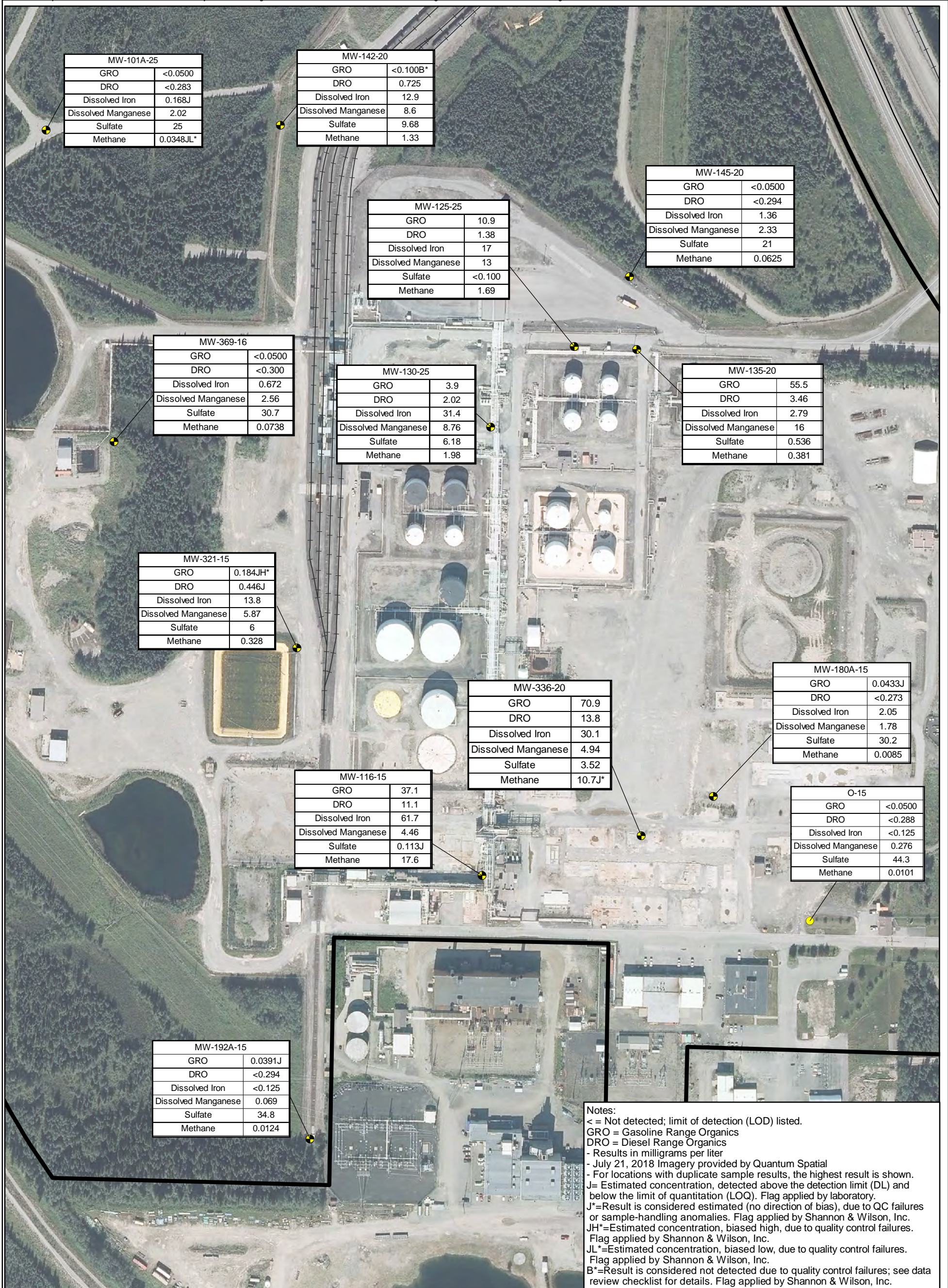
NORTH POLE TERMINAL, NORTH POLE, ALASKA  
**ANNUAL 2019 ONSITE GROUNDWATER MONITORING REPORT**

**ANNUAL 2019 LNAPL MONITORING DATA**

FIGURE 3-9

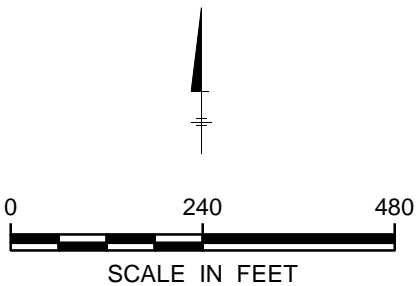
**ARCADIS**





Notes:  
 < = Not detected; limit of detection (LOD) listed.  
 GRO = Gasoline Range Organics  
 DRO = Diesel Range Organics  
 - Results in milligrams per liter  
 - July 21, 2018 Imagery provided by Quantum Spatial  
 - For locations with duplicate sample results, the highest result is shown.  
 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.  
 JH\*=Estimated concentration, biased high, due to quality control failures. Flag applied by Shannon & Wilson, Inc.  
 JL\*=Estimated concentration, biased low, due to quality control failures. Flag applied by Shannon & Wilson, Inc.  
 B\*=Result is considered not detected due to quality control failures; see data review checklist for details. Flag applied by Shannon & Wilson, Inc.

**Legend**  
 Monitoring Well  
 Observation Well  
 Property Boundary



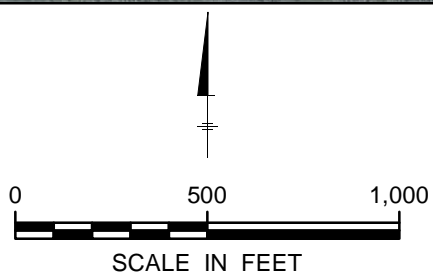
NORTH POLE TERMINAL, NORTH POLE, ALASKA  
**ANNUAL 2019 ONSITE GROUNDWATER MONITORING REPORT**  
**SECOND SEMIANNUAL 2019 NATURAL SOURCE ZONE DEPLETION MONITORING RESULTS**







- Legend:**
- Monitoring Well
  - Observation Well
  - Property Boundary



NORTH POLE TERMINAL, NORTH POLE, ALASKA  
**ANNUAL 2019 ONSITE GROUNDWATER  
 MONITORING REPORT**  
**FIRST SEMIANNUAL 2019  
 ONSITE BENZENE GROUNDWATER  
 ANALYTICAL RESULTS**



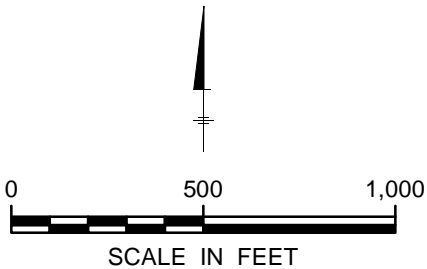
FIGURE

**3-11**





- Legend:**
- Monitoring Well
  - Observation Well
  - Inferred benzene isopleth in µg/L
  - ▭ Property Boundary



NORTH POLE TERMINAL, NORTH POLE, ALASKA  
 ANNUAL 2019 ONSITE GROUNDWATER MONITORING REPORT  
 SECOND SEMI-ANNUAL 2019 ONSITE BENZENE GROUNDWATER ANALYTICAL RESULTS



FIGURE

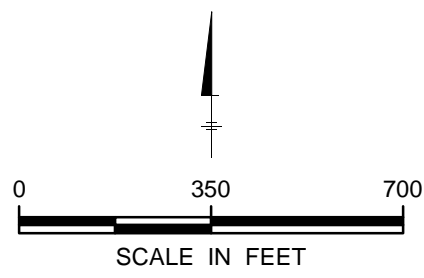
3-12





- Legend**
- Monitoring Well
  - Observation Well
  - Recovery Well (Inactive)
  - Vertical Profile Transect Well
  - Approximate Sulfolane Isopleth in µg/L at Water Table
  - ▭ Property Boundary

- Sulfolane Results**
- Not Detected
  - 3.14 - Less Than 20 µg/L
  - 20 - 100 µg/L
  - 100 - 400 µg/L
  - 400 - 1,000 µg/L
  - Greater Than 1,000 µg/L



NORTH POLE TERMINAL, NORTH POLE, ALASKA  
**ANNUAL 2019 ONSITE GROUNDWATER MONITORING REPORT**  
**FIRST SEMIANNUAL 2019 ONSITE SULFOLANE GROUNDWATER ANALYTICAL RESULTS - WATER TABLE**  
 FIGURE  
**ARCADIS** | **3-13**

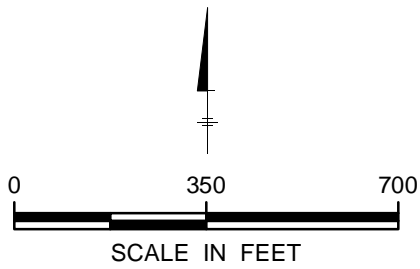




Notes:  
 J\* = Estimated concentration due to quality control failures. Flag applied by Shannon & Wilson, Inc.  
 µg/L = micrograms per liter  
 - Only monitoring wells scheduled for sampling per the Long Term Monitoring Plan - 2017 Update are shown on this figure.  
 - July 21, 2018 Imagery provided by Quantum Spatial  
 - For locations with duplicate sample results, the highest result is shown.

**Legend**  
 Monitoring Well  
 Property Boundary

**Sulfolane Results**  
 Not Detected  
 3.14 - Less Than 20 µg/L  
 20 - 100 µg/L  
 100 - 400 µg/L  
 400 - 1,000 µg/L



NORTH POLE TERMINAL, NORTH POLE, ALASKA  
**ANNUAL 2019 ONSITE GROUNDWATER MONITORING REPORT**  
**FIRST SEMIANNUAL 2019 ONSITE SULFOLANE GROUNDWATER ANALYTICAL RESULTS - 10 TO 55 FEET BELOW WATER TABLE**  
 FIGURE  
**ARCADIS** **3-14**

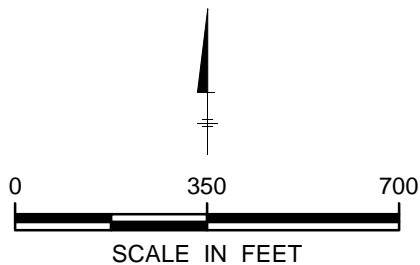




Notes:  
 µg/L = micrograms per liter  
 - Only monitoring wells scheduled for sampling per the Long Term Monitoring Plan - 2017 Update are shown on this figure.  
 - July 21, 2018 Imagery provided by Quantum Spatial  
 - For locations with duplicate sample results, the highest result is shown.

- Legend**
- Monitoring Well
  - Observation Well
  - ▭ Property Boundary

- Sulfolane Results**
- Not Detected
  - 3.14 - Less Than 20 µg/L
  - 20 - 100 µg/L
  - 100 - 400 µg/L



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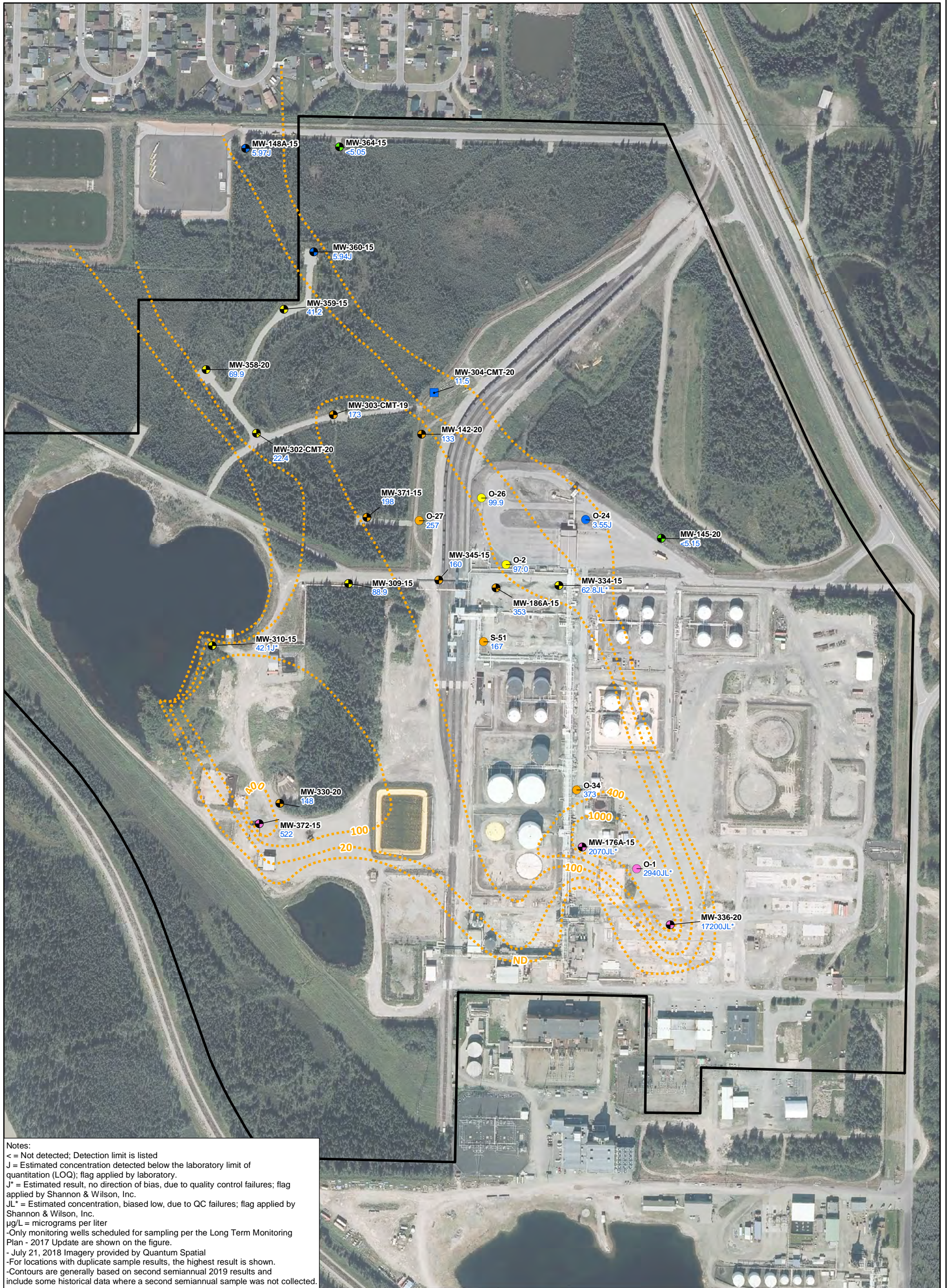
**FIRST SEMIANNUAL 2019 ONSITE SULFOLANE GROUNDWATER ANALYTICAL RESULTS - 55 TO 90 FEET BELOW WATER TABLE**



FIGURE

**3-15**



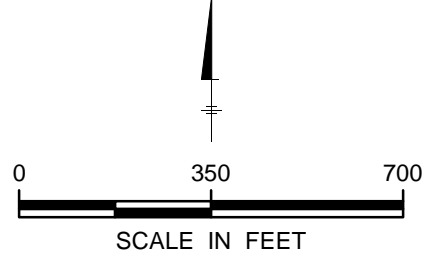


Notes:  
 < = Not detected; Detection limit is listed  
 J = Estimated concentration detected below the laboratory limit of quantitation (LOQ); flag applied by laboratory.  
 J\* = Estimated result, no direction of bias, due to quality control failures; flag applied by Shannon & Wilson, Inc.  
 JL\* = Estimated concentration, biased low, due to QC failures; flag applied by Shannon & Wilson, Inc.  
 µg/L = micrograms per liter  
 -Only monitoring wells scheduled for sampling per the Long Term Monitoring Plan - 2017 Update are shown on the figure.  
 - July 21, 2018 Imagery provided by Quantum Spatial  
 -For locations with duplicate sample results, the highest result is shown.  
 -Contours are generally based on second semiannual 2019 results and include some historical data where a second semiannual sample was not collected.

**Legend**

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

- Sulfolane Results**
- Not Detected
  - 3.14 - Less Than 20 µg/L
  - 20 - 100 µg/L
  - 100 - 400 µg/L
  - > 400 µg/L



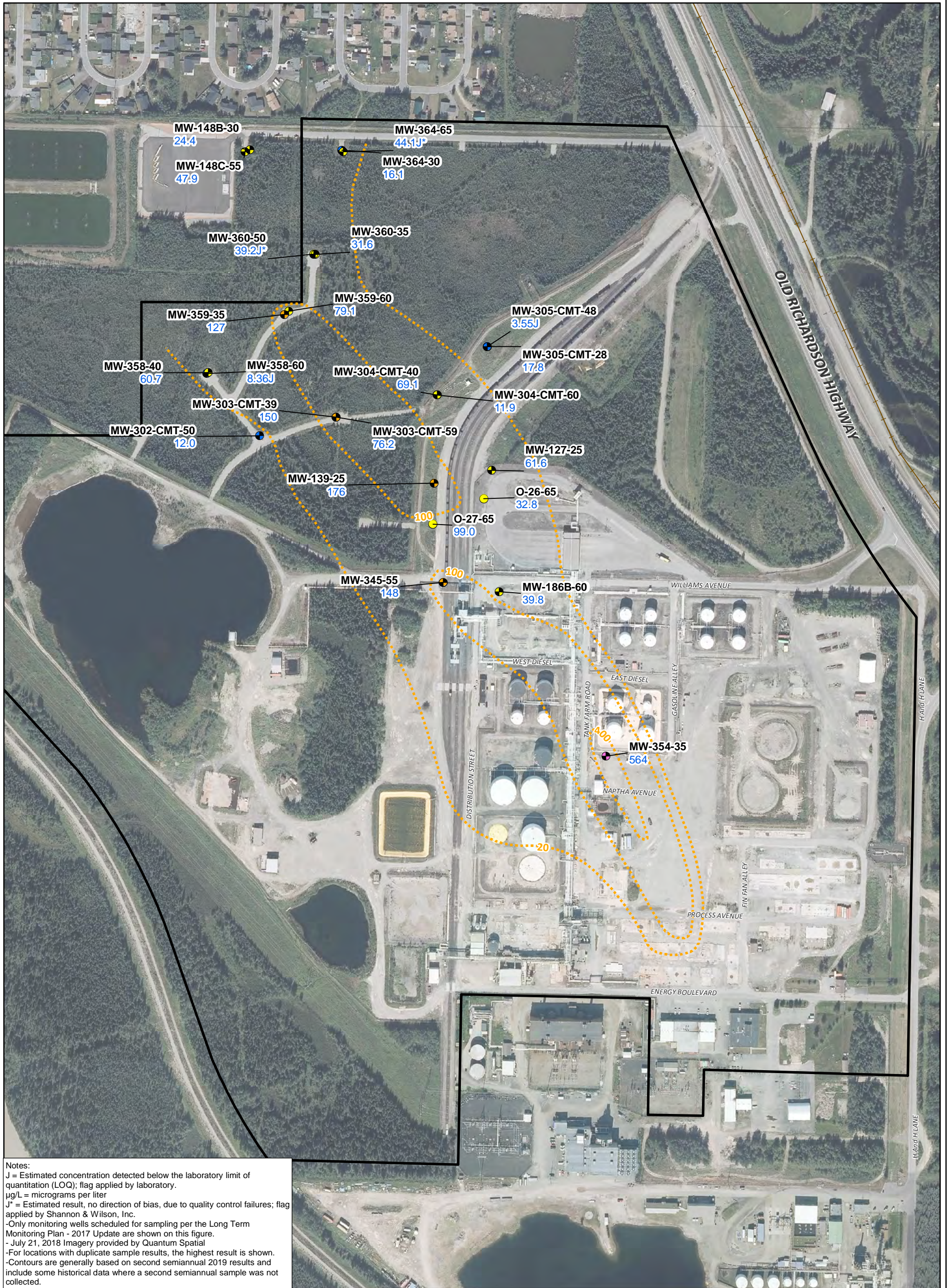
NORTH POLE TERMINAL, NORTH POLE, ALASKA

**ANNUAL 2019 ONSITE GROUNDWATER MONITORING REPORT**

**SECOND SEMIANNUAL 2019 ONSITE SULFOLANE GROUNDWATER ANALYTICAL RESULTS WATER TABLE**

FIGURE  
**3-16**

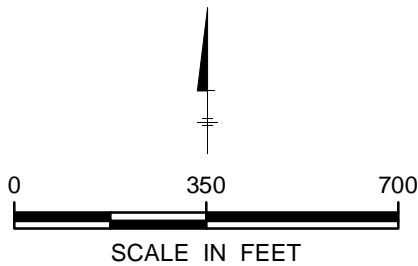




Notes:  
 J = Estimated concentration detected below the laboratory limit of quantitation (LOQ); flag applied by laboratory.  
 µg/L = micrograms per liter  
 J\* = Estimated result, no direction of bias, due to quality control failures; flag applied by Shannon & Wilson, Inc.  
 -Only monitoring wells scheduled for sampling per the Long Term Monitoring Plan - 2017 Update are shown on this figure.  
 - July 21, 2018 Imagery provided by Quantum Spatial  
 -For locations with duplicate sample results, the highest result is shown.  
 -Contours are generally based on second semiannual 2019 results and include some historical data where a second semiannual sample was not collected.

- Legend**
- Monitoring Well
  - Observation Well
  - ▭ Property Boundary
  - ⋯ Approximate Sulfolane Isopleth in µg/L

- Sulfolane Results**
- Not Detected
  - 3.14 - Less Than 20 µg/L
  - 20 - 100 µg/L
  - 100 - 400 µg/L
  - > 400 µg/L



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FIGURE  
**3-17**



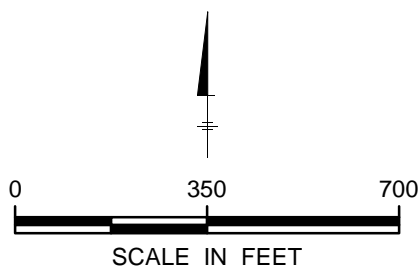


**Legend**

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

**Sulfolane Results**

- Not Detected
- 3.14 - Less Than 20 µg/L
- 20 - 100 µg/L
- 100 - 400 µg/L
- > 400 µg/L



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**SECOND SEMIANNUAL 2019 ONSITE SULFOLANE GROUNDWATER ANALYTICAL RESULTS - 55 TO 90 FEET BELOW WATER TABLE**

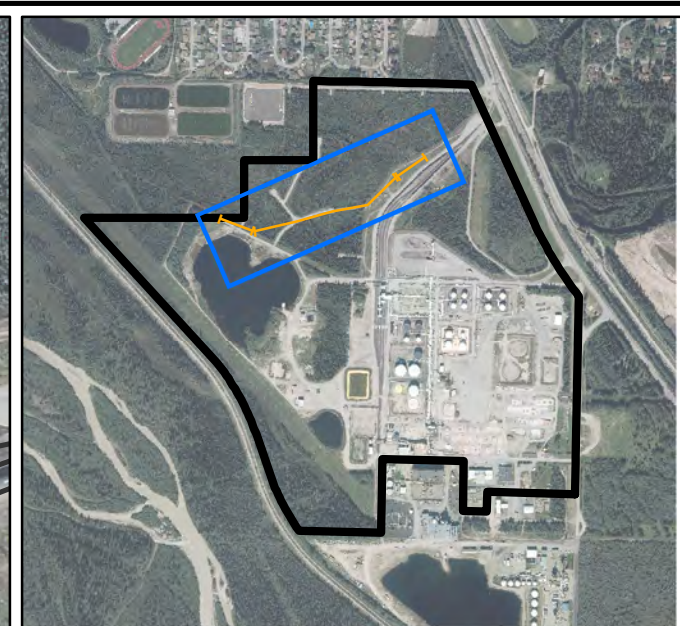
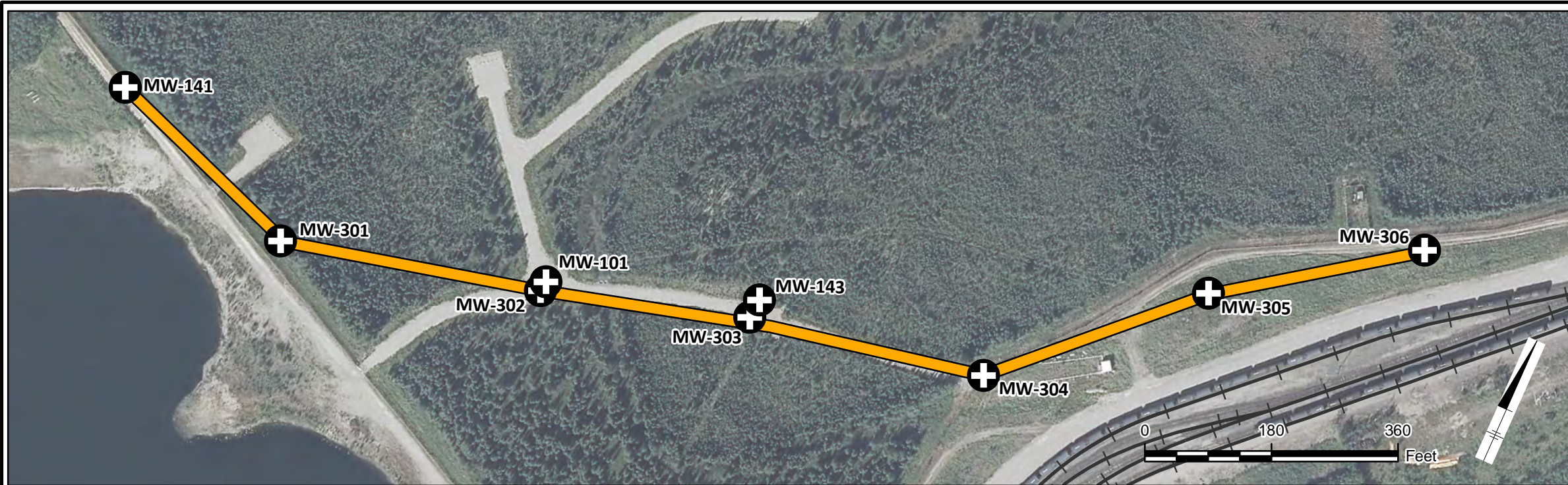


FIGURE

**3-18**

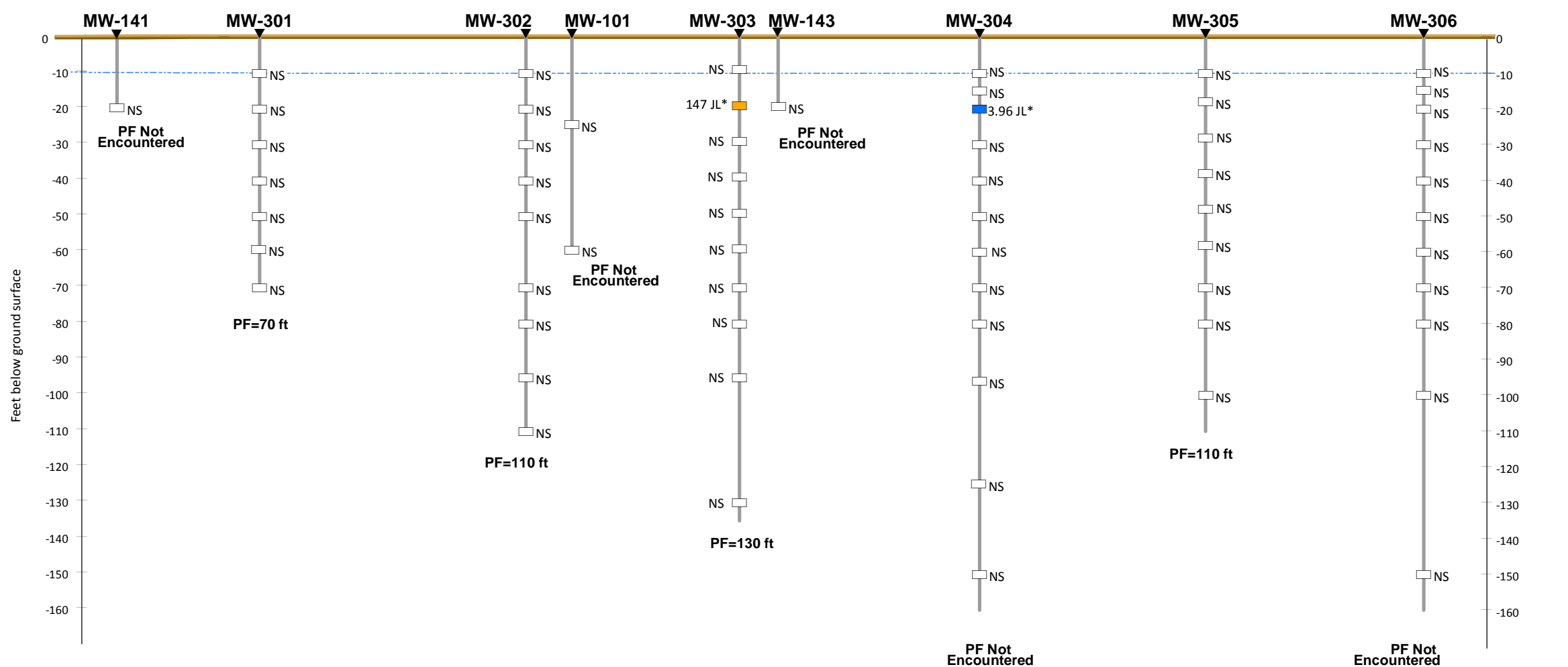


CITY: Citrix DIV/GROUP: IM/DV DB: K Sinsabaugh LD: G FRANCE Path: Z:\GIS\Projects\ENW\FHR\FHR\_AK\NorthPoleRefinery\GW\_Monitoring\2019\_Q3\mxd\2019SemiAnnual\Onsite\Fig 3-19 3Q18 Sulfolane\_VPT\_Profile.mxd Date: 11/18/2019 Time: 4:28:41 PM



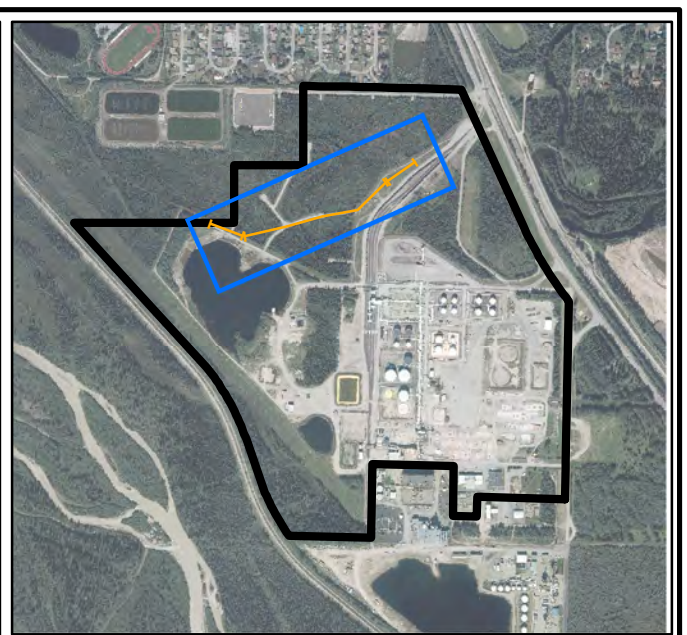
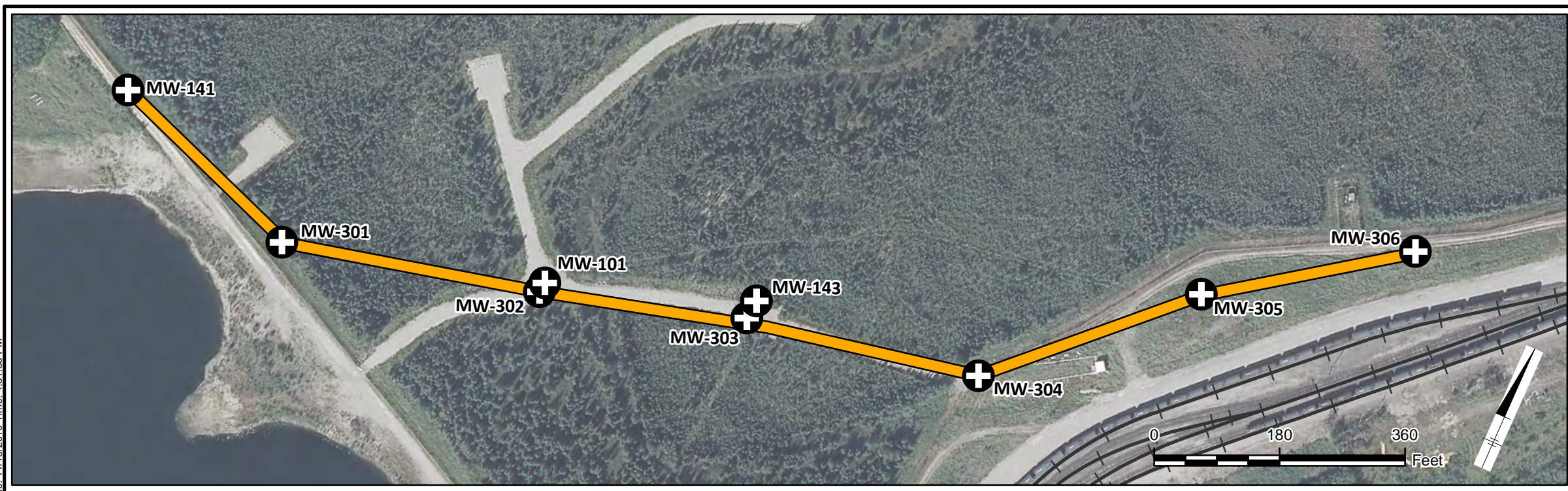
### Legend:

- Sulfolane Results**
- Not Detected
  - 3.14 - Less Than 20 µg/L
  - 20 - 100 µg/L
  - 100 - 400 µg/L
  - Ground Surface
  - Approximate Groundwater Surface
  - Well Profile



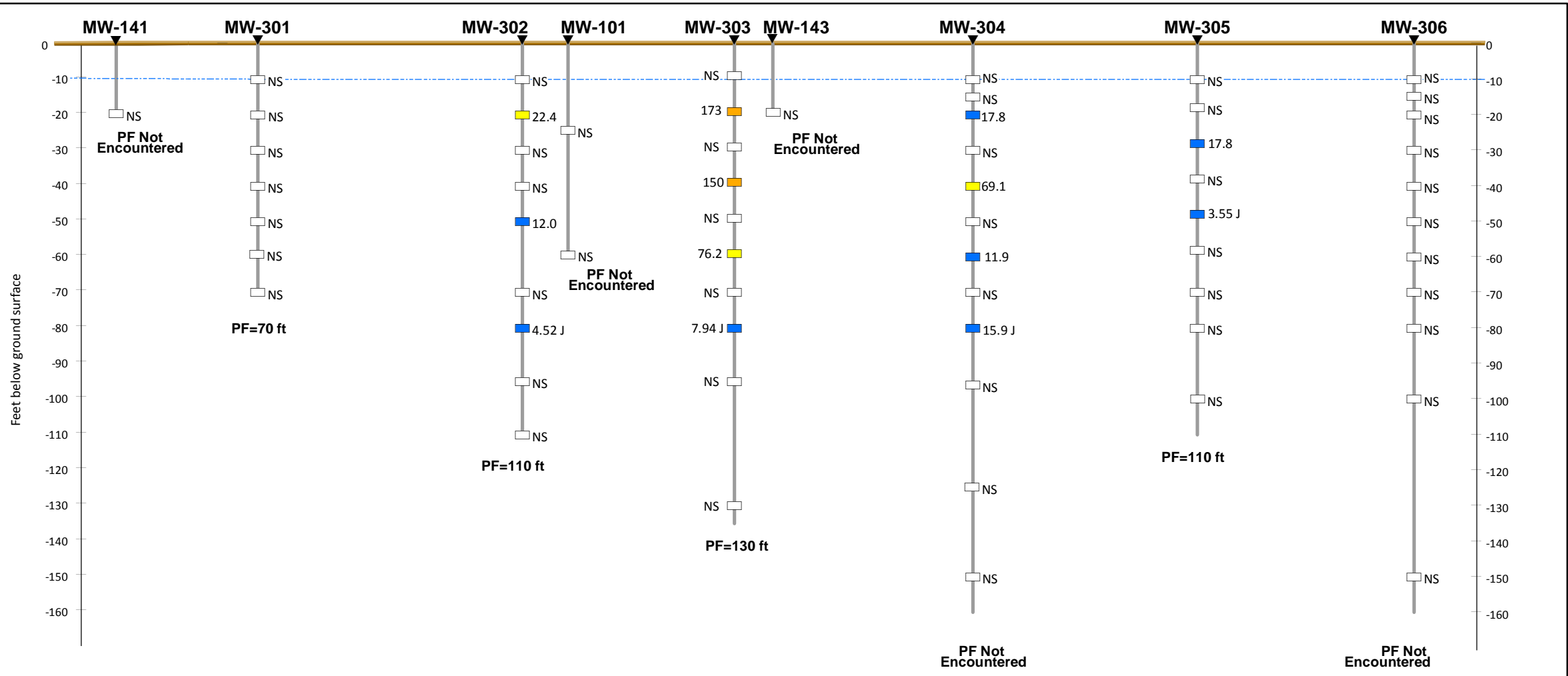


CITY: Citrix DIV/GROUP: IM/DV DB: K Sinsabaugh LD: G FRANCE Path: Z:\GIS\Projects\ENW\FHR\AK\NorthPoleRefinery\GW\_Monitoring\2019\_Q3\mxd\2019SecondSemiAnnual\Onsite\Fig 3-20 3Q19 Sulfolane\_VPT\_Profile.mxd Date: 11/18/2019 Time: 4:31:33 PM



**Legend:**

- Sulfolane Results**
- Not Detected
  - 3.14 - Less Than 20 µg/L
  - 20 - 100 µg/L
  - 100 - 400 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.  
 ft = feet  
 µg/L = micrograms per liter  
 - For locations with duplicate sample results, the highest value is shown  
 - July 21, 2018 Imagery provided by Quantum Spatial  
 - Profile has a vertical exaggeration of 5x

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**SECOND SEMIANNUAL 2019 SULFOLANE AT THE VERTICAL PROFILING TRANSECT**




FIGURE  
**3-20**