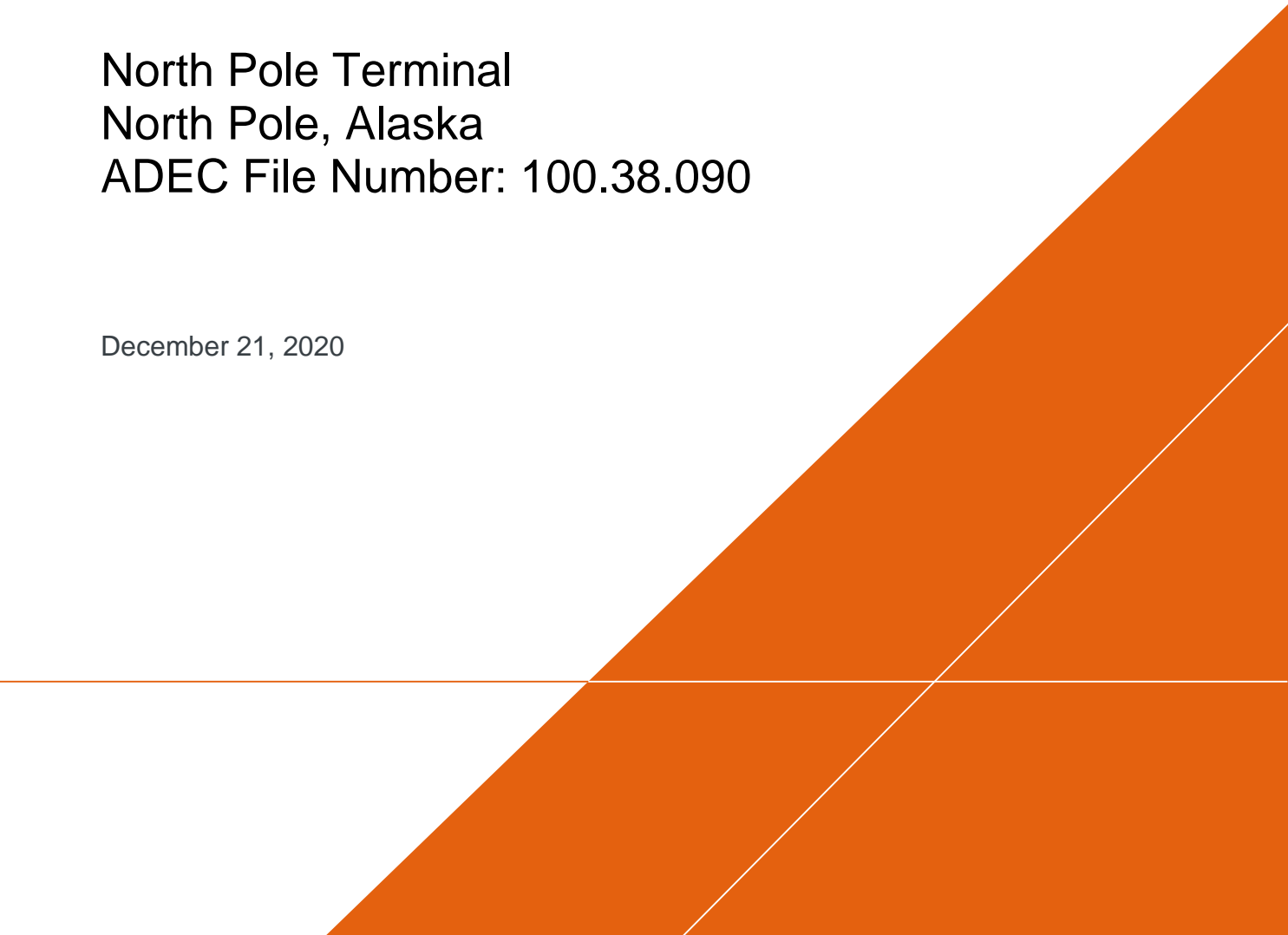


# ANNUAL 2020 ONSITE GROUNDWATER MONITORING REPORT

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

December 21, 2020



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## ACRONYMS AND ABBREVIATIONS

2017 LTM Plan	Long-Term Monitoring Plan – 2017 Update
2020 LTM Plan	Long-Term Monitoring Plan – 2020 Update
AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
Arcadis	Arcadis U.S., Inc.
BTEX	benzene, toluene, ethylbenzene, and xylenes
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 2020 Onsite Groundwater Monitoring Report
reporting period	first and third quarters of 2020
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 2020 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 2020 (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 by 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 also 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 in Appendix A to the ROCP [Arcadis 2017b]).
- Revised Onsite Sampling and Analysis Plan (Onsite RSAP; provided in Appendix A to the Second Semiannual 2016 Onsite Groundwater Monitoring Report [Arcadis 2017a]).
- Long-Term Monitoring Plan – 2020 Update (2020 LTM Plan; provided as emails dated March 2 and July 9, 2020 [Arcadis 2020a, 2020b]).

The site, offsite area, and the site's physical setting are described in the conceptual site model, which was provided in Appendix A of the Onsite Site Characterization Report – 2013 Addendum (Onsite SCR – 2013; Arcadis 2013). The site location, current site features, and an onsite site plan are shown on Figures 1-1, 1-2, and 1-3, respectively. The former treatment systems, GAC West and GAC East, are shown on Figure 1-2. The GAC West system was shut down in third quarter 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 and 2020 LTM Plan (Arcadis 2017b, 2020a, 2020b):

- Groundwater elevation
- Light nonaqueous phase liquid (LNAPL) migration monitoring

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- 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)
- Groundwater sampling and analysis of natural attenuation parameters (iron, manganese, sulfate, methane, and dissolved oxygen).

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 and 2020 LTM Plan (Arcadis 2017b, 2020a, 2020b) were noted during the reporting period:

- The comprehensive gauging event was conducted in April 2020.
- Monitoring wells MW-198-150 and MW-366-15 were frozen during the planned groundwater elevation monitoring event; therefore, a depth to water measurement was not collected from these wells during the first semiannual monitoring event.

### 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 provided in Appendix A. Analytical laboratory reports are provided in Appendix B. A data quality evaluation, including ADEC quality assurance/quality control checklists, is provided in Appendix C. Field data sheets are provided in Appendix D.

#### 3.1 Groundwater Elevation

Depth to water measurements were collected from monitoring wells during the reporting period on April 20 and September 11, 2020. Measurements were also recorded from gauging points located at the North Gravel Pit on April 20 and September 11, 2020. 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 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 presented in Table 3-1. Groundwater elevations for the reporting period, as well as surface water elevations and depth to LNAPL, are presented in Tables 3-2a and 3-2b. Historical gauging data are provided 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 and 2020 LTM Plan (Arcadis 2017b, 2020a, 2020b). Additionally, LNAPL was gauged throughout the reporting period during monitoring events at wells outside of the LNAPL migration networks. Comprehensive LNAPL gauging data are provided 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 presented 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 in 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. Gauging data from each monitoring event conducted at the site during the reporting period are provided in Appendix E.

LNAPL thickness measurements were similar to historical results. 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

Thirteen 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, except MW-116-15 where a sheen was observed prior to sampling. Field parameters, including dissolved oxygen, from the 13 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 shown 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, within, and immediately downgradient of 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 decreased from upgradient monitoring locations to the source zone and downgradient monitoring locations, indicating sulfate reduction from anaerobic degradation.

- Dissolved iron concentrations generally increased from upgradient monitoring locations to the source zone monitoring and downgradient locations, indicating iron production as a product of anaerobic degradation.
- Dissolved manganese concentrations generally increased from upgradient monitoring locations to the source zone and downgradient monitoring locations, indicating manganese production as a product of anaerobic degradation.
- Methane concentrations generally increased from upgradient locations to the source zone monitoring locations, indicating carbon dioxide reduction or organic acid fermentation from anaerobic degradation.
- There was no significant change in dissolved oxygen concentrations across the LNAPL source zone. This observation is a result of the fact that the aquifer is naturally anoxic; therefore, oxygen is not a readily available electron acceptor at the site.

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.

### 3.3 Monitoring Well Sampling

Monitoring wells included in the monitoring network for other COCs in the 2017 LTM Plan and 2020 LTM Plan (Arcadis 2017b, 2020a, 2020b) 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 presented in Tables 3-5a and 3-5b. Figures 3-11 and 3-12 show analytical results for benzene.

Analyses for sulfolane were completed on groundwater samples collected from the wells identified in the 2017 LTM Plan and 2020 LTM Plan (Arcadis 2017b, 2020a, 2020b). Sulfolane analytical results are summarized in Tables 3-6a and 3-6b, and on Figures 3-13 through 3-19.

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 presented 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 3-20 and 3-21. 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 evaluation of benzene and sulfolane concentration trends using a Mann-Kendall trend analysis is conducted annually using analytical data for samples collected through the third quarter to evaluate plume migration, stability, and remedial action effectiveness. A graphical analysis of analytical and gauging data is also completed 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 provided in Appendix F, Tables F-1 and F-2, and Figures F-1A, F-1B, and F-2C; and in the table below.

Parameter Trend	Third Quarter	
	Benzene	Sulfolane
Number of wells	27	61
All results nondetect <sup>1</sup>	6	1
Insufficient data points <sup>1</sup>	5	0
Probably decreasing	1	2
Decreasing	3	23
Probably increasing	2	0
Increasing	2	10
Stable	1	7
No trend	7	18

**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, O-4, and O-24 during the reporting period, as seen on the benzene time series plots provided in Appendix F, Attachment F-1.

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 and 2020, and current concentrations are less than historical levels observed in this well. MW-321-15 is located 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, the concentration measured in 2020 is within the fluctuation range observed from 2016 through 2018. Wells O-4 and O-24 are within the detectable benzene plume at the site, near the downgradient extent. The results at O-4 decreased in 2019 and 2020. The results at O-24 have indicated seasonal variation and are less than historical maximums.

### 3.4.2 Sulfolane Statistical Evaluation

As noted in Section 3.3, the cleanup objective for sulfolane in groundwater is 400 µg/L 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. Current trends support the cleanup objective and 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 provided in Appendix F, Attachment F-1. These time series plots are presented with both linear and logarithmic concentration scales to facilitate the evaluation of concentration trends since 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 well S-51, located along the main plume axis upgradient of the former recovery wells, has dropped to less than 400 µg/L, supporting the goal of meeting the cleanup objective for sulfolane. The source area wells with current concentrations exceeding 400 µg/L closest to the POC are wells MW-354-35 and O-34, which are more than 2,000 feet from the POC and approximately 800 feet upgradient of the former treatment system recovery wells (Figure 1-3). These wells have an overall decreasing concentration trend.

The onsite wells with current sulfolane concentrations exceeding 400 µg/L (MW-336-20, MW-354-35, MW-372-15, O-1, and O-34) exhibit either no trend or a decreasing trend. The onsite wells exhibiting an increasing sulfolane concentration trend during the reporting period are located adjacent to or downgradient from the recovery wells associated with the former treatment systems (MW-304-80, MW-304-96, MW-345-15, MW-345-55, MW-345-75, MW-359-80, O-2, O-26-65, 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 in 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 sampled during the reporting period in areas where 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 377 µg/L (MW-186A-15; Table 3-6a). Six of these wells exhibit stabilized or stabilizing concentrations since GRTS shutdown (MW-186A-15, MW-186B-60, MW-334-15, MW-344-15, MW-345-15, and O-2); three wells exhibit steadily or sporadically increasing trends (MW-309-15, MW-345-55, and MW-345-75).<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 310 µg/L (O-27; Table 3-6b) Eight of the nine wells in this area sampled multiple times since GRTS shutdown exhibit stabilized or stabilizing concentrations following the shutdown (MW-127-25, MW-139-25, MW-142-20, MW-154B-95, MW-371-15, O-26, O-26-65, and O-27-65). Sulfolane concentrations had stabilized in O-27 as of 2018 but have since increased. In well MW-371-55, which was sampled for the first time since GRTS shutdown, a sulfolane concentration of 30 µg/L was detected, compared with a maximum in the well nest of 188 µg/L in MW-371-15.
- *Wells in the VPT.* The highest sulfolane concentration in any well in this area during the reporting period was 255 µg/L (MW-303-CMT-19; Table 3-6b). The 11 wells in this group that have been sampled multiple times since GRTS shutdown exhibit stabilized or stabilizing concentrations since GRTS shutdown (MW-302-CMT-20, MW-303-CMT-19, MW-303-CMT-39, MW-303-CMT-59, MW-303-80, MW-304-CMT-20, MW-304-CMT-40, MW-304-CMT-60, MW-304-80, MW-305-CMT-28, and MW-305-

<sup>1</sup> For the purposes of this evaluation, “stabilized” means that the concentration reached a maximum value then remained at similar values or declined. “Stabilizing” means that the rate of increase appears to be slowing and a corresponding chart of data with a logarithmic concentration scale is flattening out but still increasing with time based on the most current data.

CMT-48). Wells MW-303-95 and MW-304-96 had non-detectable sulfolane concentrations for multiple sampling events prior to 2020 and results of 8.66J µg/L and 13.8 µg/L, respectively during the reporting period. Wells MW-303-CMT-29, MW-303-CMT-49, MW-303-130, and MW-304-125 were sampled for the first time since GRTS shutdown. The sulfolane concentrations at these four wells were 241 µg/L, 135 µg/L, and 7.86J µg/L, and non-detectable, respectively, compared with a maximum in the well nest of 255 µg/L in MW-309-CMT-19.

- *Wells in and downgradient of the POC.* The highest sulfolane concentration in any well in this area during the reporting period was 238 µg/L (MW-359-35; Table 3-6b). Thirteen of the 16 wells in this group sampled during the reporting period exhibit stabilized or stabilizing concentrations since GRTS shutdown (MW-148A-15, MW-148B-30, MW-148C-55, MW-148-80, MW-358-20, MW-358-40, MW-359-15, MW-359-60, MW-360-15, MW-360-35, MW-360-50, MW-360-80, and MW-364-65). One of these wells exhibits an increasing trend with possible signs of stabilization (MW-359-35). Wells MW-359-80 and MW-364-90 show increasing trends with sulfolane concentrations of 43.2 and 45.7 µg/L, respectively.

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).

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 concentrations 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 Onsite RSAP, 2017 LTM Plan, and 2020 LTM Plan (Arcadis 2017a, 2017b, 2020).

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).

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- The statistical analyses included in Appendix F show that sulfolane concentrations in 25 wells and benzene concentrations in four wells across the plume are decreasing or probably decreasing, while sulfolane concentrations in 10 wells and benzene concentrations in four 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.
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- Arcadis. 2020b. Email from David A. Smith (Global Remediation & Environmental Services, LLC) to James T. Fish (Alaska Department of Environmental Conservation) re: Onsite well updates. July 9.

# TABLES





**Table 1-1  
Field Activities**

**Annual 2020 Onsite Groundwater Monitoring Report  
North Pole Terminal, North Pole, Alaska**

<b>Activity</b>	<b>Frequency during 2020</b>
Groundwater Elevation Monitoring	Semiannual (March and September)
LNAPL Migration Monitoring	Annual (October)
Sulfolane Network Sampling	Throughout Q1 and Q3
Constituents of Concern (BTEX, GRO, and DRO) Monitoring Network Sampling	Throughout Q1 and Q3
Natural Source Zone Depletion Monitoring Network Sampling	Throughout Q3
Monitoring Well Repair and Maintenance	No major well repairs in Q1-Q3. Potential repairs coming in Q4.

**General Notes:**

Q1 represents field activities associated with the sample results received January 1, 2020 through March 31, 2020.  
Q3 represents field activities associated with the sample results received July 1, 2020 through September 30, 2020.

**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**

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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	7/15/2020	COC, NSZD	9.63	--	3.9	0.11	230.6	7.11	168.2	Clear	SP	
MW-116-15	MW-116-15	8/6/2020	NSZD	8.19	8.19	7.4	0.18	553	6.79	-112.9	Clear	3WV	Sheen noticed following purge and YSI use.
MW-125-25	MW-125-25	8/7/2020	NSZD	9.75	--	3.5	0.23	318.3	6.81	-92.3	Clear	3WV	
MW-127-25	MW-127-25	7/22/2020	S	10.83	--	3.8	0.09	248.1	7.19	-75.8	Clear	3WV	
MW-130-25	MW-130-25	8/7/2020	NSZD	10.34	--	3.8	0.05	292.1	6.77	-105.0	Clear	3WV	
MW-131-25	MW-131-25	7/13/2020	COC	10.35	--	3.6	0.24	271.0	6.82	129.6	Clear	SP	
MW-135-20	MW-135-20	8/6/2020	NSZD	10.37	--	8.1	0.14	246.2	6.09	-33.4	Clear	SP	
MW-137-20	MW-137-20	7/22/2020	COC, ‡	10.88	--	3.3	0.12	294.6	7.02	-87.6	Clear	3WV	
MW-139-25	MW-139-25	3/17/2020	COC	12.65	--	3.4	0.16	292.6	7.00	-87.9	Clear	SP	
MW-154B-95	MW-154B-95	3/17/2020	S, COC	13.36	--	4.0	0.18	234.9	7.33	-105.7	Clear	SP	
MW-186A-15	MW-186A-15	3/17/2020	S	11.04	11.04	—	—	—	—	—	Clear	1WV	No parameters collected due to the presence of product.
MW-139-25	MW-139-25	7/13/2020	S, COC	11.45	--	2.8	0.14	261.1	6.72	50.0	Clear	SP	
MW-142-20	MW-142-20	7/10/2020	S, NSZD, ‡	10.22	--	3.2	0.05	291.9	7.13	-91.0	Clear	3WV	
MW-143-20	MW-143-20	7/17/2020	COC	9.58	--	4.4	0.62	278.5	7.22	23.7	Clear	3WV	
MW-145-20	MW-145-20	7/23/2020	NSZD, ‡	9.21	--	4.4	0.31	385.4	6.92	78.1	Clear	3WV	
MW-148A-15	MW-148A-15	7/8/2020	S	8.67	--	5.7	0.62	175.5	6.48	137.8	Clear	3WV	0.26 feet of casing removed. Well ran dry eight times during purge and was turbid.
MW-148B-30	MW-148B-30	7/8/2020	S	8.71	--	3.2	0.15	256.0	7.04	85.3	Clear	SP	0.12 feet of casing removed.
MW-148C-55	MW-148C-55	7/8/2020	S	8.85	--	3.9	0.42	223.4	7.13	-34.9	Clear	SP	0.32 feet of casing removed.
MW-148-80	MW-148-80	7/8/2020	S	8.96	--	4.5	0.15	208.3	6.97	112.6	Clear	SP	
MW-154B-95	MW-154B-95	7/13/2020	S, COC	12.18	--	4.6	0.08	233.6	7.28	-50.2	Clear	SP	Tilted casing, but still functional.
MW-176A-15	MW-176A-15	8/7/2020	S	10.04	9.61	—	—	—	—	—	Clear	1WV	No parameters collected due to the presence of product.
MW-180A-15	MW-180A-15	8/6/2020	NSZD+	9.35	--	9.0	0.16	245.4	6.60	67.2	Clear	3WV	
MW-186A-15	MW-186A-15	7/15/2020	S	9.76	18.31	—	—	—	—	—	Clear	1WV	No parameters collected due to the presence of product.
MW-186B-60	MW-186B-60	7/15/2020	S	9.71	--	4.8	0.12	206.7	7.46	122.4	Clear	3WV	
MW-192A-15	MW-192A-15	8/6/2020	NSZD	7.73	--	6.6	1.60	246.7	6.85	131.0	Clear	3WV	
MW-302-CMT-20	MW-302-CMT-20	7/15/2020	S	8.80	--	6.0	0.08	243.5	7.48	-29.2	Clear	SP	
MW-303-CMT-19	MW-303-CMT-19	3/17/2020	S, COC	11.89	--	3.4	0.76	271.2	7.00	-126.6	Clear	3WV	Frost-jacking or settling of CMT riser.
MW-303-CMT-19	MW-303-CMT-19	7/10/2020	S, COC	10.26	--	4.50	0.69	277	7.26	-78.1	Clear	SP	Frost-jacking or settling of CMT riser.
MW-303-CMT-29	MW-303-CMT-29	7/10/2020	S	10.26	--	4.99	0.68	263	7.32	-99.9	Clear	3WV	Frost-jacking or settling of CMT riser.
MW-303-CMT-39	MW-303-CMT-39	3/17/2020	S, COC	11.85	--	4.0	0.82	238.7	7.14	-76.6	Clear	3WV	Frost-jacking or settling of CMT riser.
MW-303-CMT-39	MW-303-CMT-39	7/10/2020	S, COC	10.22	--	5.33	0.72	242	7.30	-63.9	Clear	3WV	Frost-jacking or settling of CMT riser.
MW-303-CMT-49	MW-303-CMT-49	7/10/2020	S	10.26	--	5.56	0.87	236	7.29	-83.9	Clear	3WV	Frost-jacking or settling of CMT riser.
MW-303-CMT-59	MW-303-CMT-59	7/10/2020	S	10.29	--	5.49	1.22	225	7.24	-82.2	Clear	3WV	Frost-jacking or settling of CMT riser.
MW-303-80	MW-303-80	7/17/2020	S	6.20	--	4.6	0.07	201.5	7.54	63.2	Clear	SP	
MW-303-95	MW-303-95	7/17/2020	S	9.66	--	4.9	0.08	199.9	7.45	181.1	Clear	SP	
MW-303-130	MW-303-130	7/19/2020	S	9.82	--	5.0	0.11	195.8	7.48	178.6	Clear	SP	
MW-304-CMT-20	MW-304-CMT-20	7/9/2020	S	12.10	--	4.8	0.13	281.5	6.91	54.5	Clear	SP	
MW-304-CMT-40	MW-304-CMT-40	7/9/2020	S	12.10	--	5.2	0.13	246.8	7.24	70.7	Clear	SP	
MW-304-CMT-60	MW-304-CMT-60	7/9/2020	S	12.10	--	5.5	0.15	215.0	7.33	102.1	Clear	SP	
MW-304-80	MW-304-80	7/9/2020	S	11.21	--	4.6	0.10	205.0	7.38	207.2	Clear	SP	
MW-304-96	MW-304-96	7/9/2020	S	11.42	--	4.5	0.08	201.1	7.41	207.7	Clear	SP	Monument was labeled MW-304-95. Corrected the label.
MW-304-125	MW-304-125	7/9/2020	S	11.50	--	4.7	0.08	193.2	7.45	195.1	Clear	SP	
MW-305-CMT-28	MW-305-CMT-28	7/10/2020	S	10.85	--	5.8	0.10	258.0	7.27	49.3	Clear	SP	
MW-305-CMT-48	MW-305-CMT-48	7/10/2020	S	10.85	--	5.7	0.17	228.2	7.24	48.9	Clear	SP	
MW-309-15	MW-309-15	8/10/2020	S	8.64	--	3.8	0.53	231.8	6.66	45.7	Clear	3WV	
MW-321-15	MW-321-15	8/6/2020	NSZD	8.53	--	5.3	0.12	298.9	6.76	-88.2	Clear	3WV	
MW-330-20	MW-330-20	8/7/2020	S	13.14	--	6.2	0.37	288.7	6.51	100.4	Clear	3WV	
MW-334-15	MW-334-15	8/6/2020	S	11.16	10.60	—	—	—	—	—	Clear	1WV	No parameters collected due to the presence of product.

**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-336-20	MW-336-20	8/6/2020	S, NSZD+		--	9.1	0.22	375.9	6.46	-86.9	Clear	SP	
MW-344-15	MW-344-15	7/10/2020	S	7.24	--	5.8	0.22	297.4	6.81	21.1	Clear	3WV	
MW-345-15	MW-345-15	7/10/2020	S	9.43	--	3.2	0.48	325.0	7.11	-105.7	Clear	3WV	Slight fuel odor in purge water.
MW-345-55	MW-345-55	7/10/2020	S	10.27	--	4.9	0.06	218.5	7.27	-0.9	Clear	SP	
MW-345-75	MW-345-75	7/13/2020	S	9.44	--	5.1	0.06	218.2	7.35	73.6	Clear	SP	
MW-354-35	MW-354-35	8/6/2020	S	9.79	--	4.6	0.05	227.2	7.24	-98.5	Clear	SP	
MW-358-20	MW-358-20	7/15/2020	S	10.58	--	4.1	0.12	264.7	7.05	56.0	Clear	3WV	
MW-358-40	MW-358-40	7/15/2020	S	10.21	--	4.1	0.48	250.3	7.17	218.2	Clear	SP	
MW-359-15	MW-359-15	7/17/2020	S, COC	9.90	--	6.3	0.30	329.2	6.57	192.7	Clear	3WV	
MW-359-35	MW-359-35	3/17/2020	S	11.28	--	3.1	0.12	254.0	7.32	-22.3	Clear	SP	
MW-359-35	MW-359-35	7/17/2020	S, COC	9.86	--	3.7	0.50	268.4	7.04	189.6	Clear	3WV	
MW-359-60	MW-359-60	7/17/2020	S	10.92	--	4.3	0.10	219.1	7.39	7.3	Clear	SP	
MW-359-80	MW-359-80	7/17/2020	S	10.96	--	4.5	0.08	204.9	7.53	96.6	Clear	SP	
MW-360-15	MW-360-15	7/17/2020	S	10.02	--	4.6	0.13	387.9	6.78	-50.6	Clear	SP	
MW-360-35	MW-360-35	7/17/2020	S	10.14	--	3.3	0.07	266.7	7.21	-66.1	Clear	SP	
MW-360-50	MW-360-50	7/17/2020	S	10.04	--	4.1	0.09	272.9	6.76	141.8	Clear	SP	
MW-360-80	MW-360-80	7/17/2020	S	10.58	--	4.5	0.11	202.3	7.29	197.0	Clear	SP	
MW-364-65	MW-364-65	7/9/2020	S	9.45	--	4.1	0.12	207.5	7.29	189.7	Clear	SP	
MW-364-90	MW-364-90	7/9/2020	S	9.71	--	4.3	0.15	207.2	7.32	185.4	Clear	SP	
MW-369-16	MW-369-16	7/13/2020	NSZD	11.91	--	5.4	0.04	278.8	6.93	109.6	Clear	3WV	
MW-371-15	MW-371-15	7/15/2020	S, COC	10.43	--	5.8	0.27	299.8	6.93	147.4	Clear	SP	
MW-371-55	MW-371-55	7/15/2020	S	9.71	--	5.1	0.07	215.0	7.45	9.8	Clear	SP	
MW-372-15	MW-372-15	7/13/2020	S	13.59	--	3.1	0.04	407.4	6.91	148.6	Clear	3WV	
O-1	O-1	8/6/2020	S	9.36	--	11.7	0.09	309.1	6.98	-93.5	Clear	SP	
O-2	O-2	7/10/2020	S	11.04	11.04	—	—	—	—	—	Clear	1WV	No parameters collected due to the presence of product.
O-2	O-2	3/17/2020	S	12.42	12.42	—	—	—	—	—	Clear	1WV	No parameters collected due to the presence of product.
O-3	O-3	7/23/2020	COC	11.58	--	5.5	0.38	559	6.90	39.2	Clear	3WV	
O-4	O-4	7/13/2020	COC	10.44	--	5.0	0.10	321.4	6.80	132.0	Clear	3WV	
O-15	O-15	7/24/2020	NSZD	10.36	--	4.4	0.20	254.8	6.31	266.7	Clear	SP	
O-24	O-24	7/23/2020	S, COC	10.99	--	5.2	0.06	584	6.85	-50.7	Clear	3WV	
O-25	O-25	7/23/2020	COC	11.78	--	6.5	0.79	245.3	6.86	44.6	Clear	3WV	Bottom of well soft. Water was turbid when purge started.
O-26	O-26	3/17/2020	S	12.40	--	2.8	0.17	377.7	7.3	-126.1	Clear	SP	
O-26	O-26	7/22/2020	S	10.98	--	2.9	0.35	399.0	7.03	-27.0	Clear	3WV	
O-26-65	O-26-65	7/22/2020	S	10.58	--	4.7	0.14	217.9	6.96	168.8	Clear	SP	
O-27	O-27	3/17/2020	S	12.25	12.24	—	—	—	—	—	Clear	1WV	No parameters collected due to the presence of product.
O-27	O-27	8/10/2020	S	10.94	10.94	—	—	—	—	—	Clear	1WV	
O-27-65	O-27-65	7/13/2020	S	11.42	--	5.2	0.03	220.3	7.34	94.4	Clear	SP	
O-34	O-34	8/7/2020	S	9.11	--	—	—	—	—	—	Clear	1WV	No parameters collected due to the presence of product.
S-51	S-51	7/10/2020	S	9.38	9.38	—	—	—	—	—	Turbid	1WV	No parameters collected due to the presence of product.

**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

‡ = 1,2,4-Trimethylbenzene and 1,3,5-Trimethylbenzene added to the 8260 analysis and 1-Methylnaphthalene added to the 8270 analysis

1WV = One well volume

3WV = Three well volumes

CMT = Continuous multichannel tubing

COC = Contaminants of concern (benzene, toluene, ethylbenzene, xylenes [BTEX], gasoline range organics [GRO], and diesel range organics [DRO])

DRO = Diesel range organics

GRO = Gasoline range organics

LNAPL = Light-nonaqueous-phase liquid

mg/L = Milligrams per liter

mV = Millivolt

MW = Monitoring well

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 2020 Groundwater Elevation, Surface Water Elevations and Depth to LNAPL Monitoring Results**

**Annual 2020 Onsite Groundwater Monitoring Report**  
**North Pole Terminal, North Pole, Alaska**

Well ID	Zone	Date	Riser Elevation (feet MSL)	Depth to LNAPL (feet)	Depth to Water (feet)	LNAPL Thickness (feet)	Corrected Water Table Elevation (feet MSL)	Notes
MW-104-65	10-55	4/20/2020	496.03	--	11.26	--	484.77	
MW-142-20	Water Table	4/20/2020	495.83	--	10.98	--	484.85	
MW-144BR-90	55-90	4/20/2020	495.03	--	9.70	--	485.33	
MW-145-20	Water Table	4/20/2020	495.63	--	10.04	--	485.59	
MW-149A-15	Water Table	4/20/2020	493.20	--	9.43	--	483.77	
MW-173B-150	90-150	4/20/2020	496.33	--	11.05	--	485.28	
MW-174-15	Water Table	4/20/2020	494.43	--	8.60	--	485.83	
MW-174A-50	10-55	4/20/2020	493.59	--	7.69	--	485.90	
MW-174B-90	55-90	4/20/2020	493.49	--	7.59	--	485.90	
MW-176A-15	Water Table	4/20/2020	497.11	Sheen	10.41	Sheen	486.70	
MW-176B-50	10-55	4/20/2020	496.93	--	10.20	--	486.73	
MW-186A-15	Water Table	4/20/2020	495.98	Sheen	10.48	Sheen	485.50	
MW-186B-60	10-55	4/20/2020	495.97	--	10.47	--	485.50	
MW-192A-15	Water Table	4/20/2020	496.28	--	8.42	--	487.86	
MW-192B-55	10-55	4/20/2020	495.59	--	7.69	--	487.90	
MW-198-150	90-150	4/20/2020	493.16	--	Frozen	--	--	Frozen at 5.85 feet btoc.
MW-300-150	90-150	4/20/2020	495.94	--	9.01	--	486.93	
MW-301-60	10-55	4/20/2020	492.70	--	8.08	--	484.62	
MW-302-CMT-50	10-55	4/20/2020	494.21	--	9.55	--	484.66	
MW-302-80	55-90	4/20/2020	493.41	--	8.74	--	484.67	
MW-303-CMT-59	10-55	4/20/2020	495.73	--	11.32	--	484.41	
MW-303-80	55-90	4/20/2020	491.56	--	6.92	--	484.64	
MW-306-80	55-90	4/20/2020	496.47	--	11.97	--	484.50	
MW-309-15	Water Table	4/20/2020	494.77	--	9.33	--	485.44	
MW-310-15	Water Table	4/20/2020	494.26	--	9.29	--	484.97	
MW-310-110	90-150	4/20/2020	493.85	--	8.43	--	485.42	
MW-321-15	Water Table	4/20/2020	495.59	--	9.36	--	486.23	
MW-334-15	Water Table	4/20/2020	497.06	Sheen	11.59	Sheen	485.47	
MW-336-20	Water Table	4/20/2020	493.26	--	5.87	--	487.39	
MW-358-20	Water Table	4/20/2020	495.53	--	11.31	--	484.22	
MW-358-40	10-55	4/20/2020	495.19	--	10.92	--	484.27	
MW-358-60	10-55	4/20/2020	495.46	--	10.99	--	484.47	
MW-359-15	Water Table	4/20/2020	495.16	--	10.86	--	484.30	
MW-359-60	10-55	4/20/2020	495.02	--	10.65	--	484.37	
MW-359-80	55-90	4/20/2020	495.02	--	10.68	--	484.34	
MW-360-15	Water Table	4/20/2020	494.96	--	10.70	--	484.26	
MW-360-50	10-55	4/20/2020	494.86	--	10.74	--	484.12	
MW-360-80	55-90	4/20/2020	494.46	--	10.28	--	484.18	
MW-360-150	90-150	4/20/2020	494.57	--	10.37	--	484.20	

**Table 3-2a  
First Semiannual 2020 Groundwater Elevation, Surface Water Elevations and Depth to LNAPL Monitoring Results**

**Annual 2020 Onsite Groundwater Monitoring Report  
North Pole Terminal, North Pole, Alaska**

Well ID	Zone	Date	Riser Elevation (feet MSL)	Depth to LNAPL (feet)	Depth to Water (feet)	LNAPL Thickness (feet)	Corrected Water Table Elevation (feet MSL)	Notes
MW-362-15	Water Table	4/20/2020	495.09	--	10.71	--	484.38	
MW-362-50	10-55	4/20/2020	494.99	--	10.48	--	484.51	
MW-362-150	90-150	4/20/2020	495.27	--	10.85	--	484.42	
MW-364-15	Water Table	4/20/2020	494.23	--	10.36	--	483.87	
MW-364-65	10-55	4/20/2020	494.09	--	10.05	--	484.04	
MW-364-90	55-90	4/20/2020	494.28	--	10.32	--	483.96	
MW-366-15	Water Table	4/20/2020	493.51	Sheen	Frozen	Sheen	---	Frozen at 6.48 feet btoc.
North Gravel Pit	Surface Water	4/20/2020	492.78	--	7.74	--	485.04	
O-34	Water Table	4/20/2020	496.56	Sheen	9.90	Sheen	486.66	

**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.

btoc = Below top of casing

CMT = Continuous Multichannel Tubing

LNAPL = Light Non-Aqueous Phase Liquid

MSL = Mean sea level

No LNAPL = An air-oil-water interface probe was used. LNAPL was not detected.

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

**Table 3-2b  
Second Semiannual 2020 Groundwater Elevation, Surface Water Elevations and Depth to LNAPL Monitoring Results**

**Annual 2020 Onsite Groundwater Monitoring Report  
North Pole Terminal, North Pole, Alaska**

Well ID	Zone	Date	Riser Elevation (feet MSL)	Depth to LNAPL (feet)	Depth to Water (feet)	LNAPL Thickness (feet)	Corrected Water Table Elevation (feet MSL)	Notes
MW-104-65	10-55	9/11/2020	496.03	--	10.89	--	485.14	
MW-142-20	Water Table	9/11/2020	495.83	--	10.69	--	485.14	
MW-144BR-90	55-90	9/11/2020	495.03	--	9.42	--	485.61	
MW-145-20	Water Table	9/11/2020	495.63	--	9.74	--	485.89	
MW-149A-15	Water Table	9/11/2020	493.20	--	9.07	--	484.13	
MW-173B-150	90-150	9/11/2020	496.33	--	10.65	--	485.68	
MW-174-15	Water Table	9/11/2020	494.43	--	8.50	--	485.93	
MW-174A-50	10-55	9/11/2020	493.59	--	7.57	--	486.02	
MW-174B-90	55-90	9/11/2020	493.49	--	7.44	--	486.05	
MW-176A-15	Water Table	9/11/2020	497.11	10.24	10.96	0.72	486.74	
MW-176B-50	10-55	9/11/2020	496.93	--	10.12	--	486.81	
MW-186A-15	Water Table	9/11/2020	495.98	No LNAPL	10.25	0.00	485.73	
MW-186B-60	10-55	9/11/2020	495.97	--	10.19	--	485.78	
MW-192A-15	Water Table	9/11/2020	496.28	--	8.53	--	487.75	
MW-192B-55	10-55	9/11/2020	495.59	--	7.80	--	487.79	
MW-198-150	90-150	9/11/2020	493.16	--	6.16	--	487.00	
MW-300-150	90-150	9/11/2020	495.94	--	8.93	--	487.01	
MW-301-60	10-55	9/11/2020	492.70	--	7.84	--	484.86	
MW-302-CMT-50	10-55	9/11/2020	494.21	--	9.29	--	484.92	
MW-302-80	55-90	9/11/2020	493.41	--	8.49	--	484.92	
MW-303-CMT-59	10-55	9/11/2020	495.73	--	10.80	--	484.93	
MW-303-80	55-90	9/11/2020	491.56	--	6.64	--	484.92	
MW-306-80	55-90	9/11/2020	496.47	--	11.86	--	484.61	
MW-309-15	Water Table	9/11/2020	494.77	--	9.14	--	485.63	
MW-310-15	Water Table	9/11/2020	494.26	--	9.05	--	485.21	
MW-310-110	90-150	9/11/2020	493.85	--	8.25	--	485.60	
MW-321-15	Water Table	9/11/2020	495.59	--	9.24	--	486.35	
MW-334-15	Water Table	9/11/2020	497.06	11.32	11.51	0.19	485.70	
MW-336-20	Water Table	9/11/2020	493.26	--	5.97	--	487.29	
MW-358-20	Water Table	9/11/2020	495.53	--	11.03	--	484.50	
MW-358-40	10-55	9/11/2020	495.19	--	10.67	--	484.52	
MW-358-60	10-55	9/11/2020	495.46	--	10.72	--	484.74	
MW-359-15	Water Table	9/11/2020	495.16	--	10.31	--	484.85	
MW-359-60	10-55	9/11/2020	495.02	--	10.35	--	484.67	
MW-359-80	55-90	9/11/2020	495.02	--	10.42	--	484.60	
MW-360-15	Water Table	9/11/2020	494.96	--	10.41	--	484.55	
MW-360-50	10-55	9/11/2020	494.86	--	10.46	--	484.40	
MW-360-80	55-90	9/11/2020	494.46	--	10.00	--	484.46	
MW-360-150	90-150	9/11/2020	494.57	--	10.10	--	484.47	

**Table 3-2b  
Second Semiannual 2020 Groundwater Elevation, Surface Water Elevations and Depth to LNAPL Monitoring Results**

**Annual 2020 Onsite Groundwater Monitoring Report  
North Pole Terminal, North Pole, Alaska**

Well ID	Zone	Date	Riser Elevation (feet MSL)	Depth to LNAPL (feet)	Depth to Water (feet)	LNAPL Thickness (feet)	Corrected Water Table Elevation (feet MSL)	Notes
MW-362-15	Water Table	9/11/2020	495.09	--	10.46	--	484.63	
MW-362-50	10-55	9/11/2020	494.99	--	10.26	--	484.73	
MW-362-150	90-150	9/11/2020	495.27	--	10.61	--	484.66	
MW-364-15	Water Table	9/11/2020	494.23	--	10.06	--	484.17	
MW-364-65	10-55	9/11/2020	494.09	--	9.77	--	484.32	
MW-364-90	55-90	9/11/2020	494.28	--	10.04	--	484.24	
MW-366-15	Water Table	9/11/2020	493.51	6.19	6.25	0.06	487.31	
North Gravel Pit	Surface Water	9/11/2020	492.78	--	6.91	--	485.87	
O-34	Water Table	9/11/2020	496.56	No LNAPL	9.77	--	486.79	

**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.

btoc = Below top of casing

CMT = Continuous Multichannel Tubing

LNAPL = Light Non-Aqueous Phase Liquid

MSL = Mean sea level

No LNAPL = An air-oil-water interface probe was used. LNAPL was not detected.

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 2020 Onsite Groundwater Monitoring Report  
North Pole Terminal, North Pole, Alaska**

Well ID	Date	Event	Top of Riser Elevation (feet MSL)	Depth to LNAPL (feet)	Depth to Water (feet)	LNAPL Thickness (feet)	Water Table Elevation (feet MSL)
MW-139-25	10/26/2020	Annual	497.24	No LNAPL	13.56	0.00	483.68
MW-142-20	10/26/2020	Annual	495.83	No LNAPL	12.39	0.00	483.44
MW-145-20	10/26/2020	Annual	495.63	No LNAPL	11.47	0.00	484.16
O-4	10/26/2020	Annual	496.58	No LNAPL	12.76	0.00	483.82
O-5	10/26/2020	Annual	495.83	No LNAPL	11.92	0.00	483.91
O-7	10/26/2020	Annual	496.47	No LNAPL	12.01	0.00	484.46
O-11	10/26/2020	Annual	497.91	14.03	14.10	0.07	483.87
O-12	10/26/2020	Annual	496.44	No LNAPL	12.63	0.00	483.81
O-24	10/26/2020	Annual	497.15	No LNAPL	13.29	0.00	483.86
O-25	10/26/2020	Annual	497.86	No LNAPL	14.07	0.00	483.79
O-26	10/26/2020	Annual	497.00	No LNAPL	13.29	0.00	483.71
O-27	10/26/2020	Annual	496.91	13.05	13.54	0.49	483.78

**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 2020 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	--	7/15/2020	<0.200	<0.500	<0.500	<1.00	<0.500	<1.50	<0.0500	0.418J	0.647	1.99	31.9	0.0233
MW-101A-25	10-55	MW-201A-25	DUP	7/15/2020	<0.200	<0.500	<0.500	<1.00	<0.500	<1.50	<0.0500	0.418J	0.695	2.11	32.5	0.0266
MW-116-15	Water Table	MW-116-15	--	8/6/2020	11500	<5.00	710	3670	17.3	3690	37.1	14.0	63.7	3.65	0.168J	15.5
MW-125-25	10-55	MW-125-25	--	8/7/2020	366	<5.00	182	2070	<5.00	2070	13.1JH*	2.61JH*	22.4	14.7	<0.100	2.48
MW-130-25	10-55	MW-130-25	--	8/7/2020	254	45.2	108	536	201	737	3.44JH*	5.52	29.5	7.96	6.84	3.55
MW-135-20	Water Table	MW-135-20	--	8/6/2020	43.4	1250	185	8290	3980	12300	34.2JH*	6.42	64.4	6.31	<0.492B*	0.00780
MW-142-20	Water Table	MW-142-20	--	7/10/2020	2.49J*	<0.500	<0.500	<1.00	<0.500	<1.50	0.0533J	<0.863B*	14.6	8.56	7.82	1.36
MW-142-20	Water Table	MW-242-20	DUP	7/10/2020	3.45J*	<0.500	<0.500	<1.00	<0.500	<1.50	0.0472J	<0.988B*	14.1	8.40	7.76	1.35
MW-145-20	Water Table	MW-145-20	--	7/23/2020	<0.200	<0.500	<0.500	<1.00	<0.500	<1.50	<0.100B*	<0.577B*	0.834	2.17	18.5	0.0541
MW-180A-15	Water Table	MW-180A-15	--	8/6/2020	0.504	<0.500	0.352J	0.828J	<0.500	<1.50	0.0320J	0.300J	1.67	1.55	26.9	0.0178
MW-192A-15	Water Table	MW-192A-15	--	8/6/2020	<0.200	<0.500	<0.500	<1.00	<0.500	<1.50	<0.0500	<0.300	<0.125	0.0442	37.4	0.0148
MW-321-15	Water Table	MW-321-15	--	8/6/2020	153	3.16	2.32	2.32	1.58	3.90	0.487	1.16	21.2	7.47	1.90JH*	0.584
MW-336-20	Water Table	MW-336-20	--	8/6/2020	17100	<100	638	8670	753	9420	56.9	14.6	28.3	4.02	<0.100	11.0
MW-369-16	Water Table	MW-369-16	--	7/13/2020	<0.200	<0.500	<0.500	<1.00	<0.500	<1.50	<0.0500	<0.577B*	3.93	2.96	33.2	0.0482
O-15	Water Table	O-15	--	7/24/2020	<0.200	<0.500	<0.500	<1.00	<0.500	<1.50	<0.100B*	<0.577B*	<0.125	0.387	42.8	0.0234

**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.

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.

mg/L = Milligrams per liter

**Table 3-5a  
First Semiannual 2020 Constituents of Concern Analytical Results**

**Annual 2020 Onsite Groundwater Monitoring Report  
North Pole Terminal, North Pole, Alaska**

Well ID	Zone	Sample Name	DUP	Date	Benzene	Toluene	Ethylbenzene	P & M -Xylenes	O-Xylene	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	--	3/17/2020	25.9	<0.500	31.0	354	0.366J	355	1.46JH*	1.54JH*
MW-139-25	10-55	MW-239-25	DUP	3/17/2020	22.1	<0.500	26.1	304	<0.500	304	1.45JH*	1.50JH*
MW-154B-95	55-90	MW-154B-95	--	3/17/2020	<0.200	<0.500	<0.500	<1.00	<0.500	<1.50	<0.0500	<0.294B*
MW-303-CMT-19	Water Table	MW-303-CMT-19	--	3/17/2020	<0.200	<0.500	<0.500	<1.00	<0.500	<1.50	<0.0500	<0.294B*
MW-303-CMT-39	10-55	MW-303-CMT-39	--	3/17/2020	<0.200	<0.500	<0.500	<1.00	<0.500	<1.50	<0.0500	<0.294B*

**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 - 2020 Update are shown here. 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 due to quality control failures.

µg/L = Micrograms per liter

B\* = Result is considered estimated (no direction of bias), due to method blank detection. 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\* = Result is considered estimated, biased high, due to QC failures. Flag applied by Shannon & Wilson, Inc.

mg/L = Milligrams per liter

**Table 3-5b  
Second Semiannual 2020 Constituents of Concern Analytical Results**

**Annual 2020 Onsite Groundwater Monitoring Report  
North Pole Terminal, North Pole, Alaska**

Well ID	Zone	Sample Name	DUP	Date	Benzene	Toluene	Ethylbenzene	P & M - Xylenes	O-Xylene	Total Xylenes	Gasoline Range Organics	Diesel Range Organics	1-Methyl-naphthalene	1,3,5-Trimethylbenzene	1,2,4-Trimethylbenzene
					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	--	7/15/2020	<0.200	<0.500	<0.500	<1.00	<0.500	<1.50	<0.0500	0.418J	--	--	--
MW-101A-25	10-55	MW-201A-25	DUP	7/15/2020	<0.200	<0.500	<0.500	<1.00	<0.500	<1.50	<0.0500	0.418J	--	--	--
MW-130-25	10-55	MW-130-25	--	8/7/2020	254	45.2	108	536	201	737	3.44JH*	5.52	--	--	--
MW-131-25	10-55	MW-131-25	--	7/13/2020	<0.200	<0.500	<0.500	<1.00	<0.500	<1.50	<0.0500	<0.556B*	--	--	--
MW-137-20	Water Table	MW-137-20	--	7/23/2020	876	3870	1490	7170	3570	10700	45.7	4.92	7.88JL*	258	710
MW-139-25	10-55	MW-139-25	--	7/13/2020	23.3	<2.50	30.2	319	<2.50	319	1.33JH*	2.44	39.7	43.7	127
MW-139-25	10-55	MW-239-25	DUP	7/13/2020	23.1	<2.50	30.4	324	<2.50	324	1.75JH*	2.65	41.5	44.2	131
MW-143-20	Water Table	MW-143-20	--	7/17/2020	<0.200	<0.500	<0.500	<1.00	<0.500	<1.50	<0.0500	<0.810B*	--	--	--
MW-145-20	Water Table	MW-145-20	--	7/23/2020	<0.200	<0.500	<0.500	<1.00	<0.500	<1.50	<0.100B*	<0.577B*	<0.0243J*	<0.500	<0.500
MW-154B-95	55-90	MW-154B-95	--	7/13/2020	1.13	<0.500	<0.500	1.20J	<0.500	1.20J	0.0369J	<0.660B*	--	--	--
MW-303-CMT-19	Water Table	MW-303-CMT-19	--	7/10/2020	<0.200	<0.500	<0.500	<1.00	<0.500	<1.50	<0.0500	<0.775B*	--	--	--
MW-303-CMT-39	10-55	MW-303-CMT-39	--	7/10/2020	<0.200	<0.500	<0.500	<1.00	<0.500	<1.50	<0.0500	<0.577B*	--	--	--
MW-359-15	Water Table	MW-359-15	--	7/17/2020	<0.200	<0.500	<0.500	<1.00	<0.500	<1.50	<0.0500	<0.577B*	--	--	--
MW-359-35	10-55	MW-359-35	--	7/17/2020	<0.200	<0.500	<0.500	<1.00	<0.500	<1.50	<0.0500	<0.801B*	--	--	--
MW-371-15	Water Table	MW-371-15	--	7/15/2020	<0.200	<0.500	<0.500	<1.00	<0.500	<1.50	<0.0500	0.838	--	--	--
O-3	Water Table	O-3	--	7/23/2020	0.267J	<0.500	<0.500	<1.00	<0.500	<1.50	<0.100B*	<0.556B*	--	--	--
O-4	Water Table	O-4	--	7/13/2020	4.63	<0.500	<0.500	0.762J	2.88	3.64	0.0756J	1.83JH*	--	--	--
O-24	Water Table	O-24	--	7/23/2020	48.6	<0.500	<0.500	<1.00	<0.500	<1.50	<0.146B*	<1.08B*	--	--	--
O-25	Water Table	O-25	--	7/23/2020	1.40	<0.500	<0.500	<1.00	<0.500	<1.50	<0.100B*	<0.556B*	--	--	--

**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 - 2020 Update are shown here. 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

B\* = Result is considered not detected, due to QC failures. 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.

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 2020 Onsite Sulfolane Analytical Results**

**Annual 2020 Onsite Groundwater Monitoring Report  
North Pole Terminal, North Pole, Alaska**

Well ID	Zone	Sample Name	DUP	Date	Sulfolane
					µg/L
MW-154B-95	55-90	MW-154B-95	--	3/17/2020	221
MW-186A-15	Water Table	MW-186A-15	--	3/17/2020	377
MW-303-CMT-19	Water Table	MW-303-CMT-19	--	3/17/2020	243
MW-303-CMT-39	10-55	MW-303-CMT-39	--	3/17/2020	188
MW-359-35	10-55	MW-359-35	--	3/17/2020	180
MW-359-35	10-55	MW-459-35	DUP	3/17/2020	178
O-2	Water Table	O-2	--	3/17/2020	227
O-26	Water Table	O-26	--	3/17/2020	102
O-27	Water Table	O-27	--	3/17/2020	280

**General Notes:**

Only monitoring wells scheduled for sampling per Table 3-3 of the Long-Term Monitoring Plan - 2020 Update are shown here.

**Acronyms and Abbreviations:**

-- = Not applicable

µg/L = micrograms per liter

DUP = Field-duplicate sample

**Table 3-6b  
Second Semiannual 2020 Onsite Sulfolane Analytical Results**

**Annual 2020 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	--	7/23/2020	46.6
MW-139-25	10-55	MW-139-25	--	7/13/2020	208
MW-142-20	Water Table	MW-142-20	--	7/10/2020	152
MW-142-20	Water Table	MW-242-20	DUP	7/10/2020	144
MW-148A-15	Water Table	MW-148A-15	--	7/8/2020	<5.15
MW-148-80	55-90	MW-148-80	--	7/8/2020	43.2
MW-148B-30	10-55	MW-148B-30	--	7/8/2020	40.6
MW-148C-55	10-55	MW-148C-55	--	7/8/2020	71.2
MW-154B-95	55-90	MW-154B-95	--	7/13/2020	191
MW-176A-15	Water Table	MW-176A-15	--	8/7/2020	123
MW-176A-15	Water Table	MW-276A-15	DUP	8/7/2020	101
MW-186A-15	Water Table	MW-186A-15	--	7/15/2020	355
MW-186B-60	10-55	MW-186B-60	--	7/15/2020	35.6
MW-302-CMT-20	Water Table	MW-302-CMT-20	--	7/15/2020	25.1
MW-303-CMT-19	Water Table	MW-303-CMT-19	--	7/10/2020	255
MW-303-CMT-29	10-55	MW-303-CMT-29	--	7/10/2020	241
MW-303-CMT-39	10-55	MW-303-CMT-39	--	7/10/2020	184
MW-303-CMT-49	10-55	MW-303-CMT-49	--	7/10/2020	135
MW-303-CMT-59	10-55	MW-303-CMT-59	--	7/10/2020	96.8
MW-303-80	55-90	MW-303-80	--	7/17/2020	7.53J
MW-303-95	55-90	MW-303-95	--	7/17/2020	8.66J
MW-303-130	90-150	MW-303-130	--	7/17/2020	7.86J
MW-304-CMT-20	Water Table	MW-304-CMT-20	--	7/9/2020	20.4
MW-304-CMT-20	Water Table	MW-404-CMT-20	DUP	7/9/2020	22.3
MW-304-CMT-40	10-55	MW-304-CMT-40	--	7/9/2020	57.3
MW-304-CMT-60	10-55	MW-304-CMT-60	--	7/9/2020	8.67J
MW-304-80	55-90	MW-304-80	--	7/9/2020	8.56J
MW-304-96	55-90	MW-304-96	--	7/9/2020	13.8
MW-304-125	90-150	MW-304-125	--	7/9/2020	<5.15
MW-305-CMT-28	10-55	MW-305-CMT-28	--	7/10/2020	14.6
MW-305-CMT-48	10-55	MW-305-CMT-48	--	7/10/2020	3.26J
MW-309-15	Water Table	MW-309-15	--	8/10/2020	159
MW-330-20	Water Table	MW-330-20	--	8/7/2020	178
MW-330-20	Water Table	MW-430-20	DUP	8/7/2020	201
MW-334-15	Water Table	MW-334-15	--	8/6/2020	56.3
MW-336-20	Water Table	MW-336-20	--	8/6/2020	5740JL*
MW-344-15	Water Table	MW-344-15	--	7/10/2020	72.5
MW-345-15	Water Table	MW-345-15	--	7/10/2020	279
MW-345-15	Water Table	MW-445-15	DUP	7/10/2020	252
MW-345-55	10-55	MW-345-55	--	7/10/2020	134
MW-345-75	55-90	MW-345-75	--	7/13/2020	117
MW-354-35	10-55	MW-354-35	--	8/6/2020	495
MW-358-20	Water Table	MW-358-20	--	7/15/2020	71.9
MW-358-40	10-55	MW-358-40	--	7/15/2020	90.4
MW-359-15	Water Table	MW-359-15	--	7/17/2020	50.8
MW-359-35	10-55	MW-359-35	--	7/17/2020	238
MW-359-60	10-55	MW-359-60	--	7/17/2020	108
MW-359-80	55-90	MW-359-80	--	7/17/2020	43.2
MW-360-15	Water Table	MW-360-15	--	7/17/2020	5.63J
MW-360-35	10-55	MW-360-35	--	7/17/2020	49.0
MW-360-50	10-55	MW-360-50	--	7/17/2020	62.5

**Table 3-6b  
Second Semiannual 2020 Onsite Sulfolane Analytical Results**

**Annual 2020 Onsite Groundwater Monitoring Report  
North Pole Terminal, North Pole, Alaska**

Well ID	Zone	Sample Name	DUP	Date	Sulfolane
					µg/L
MW-360-80	55-90	MW-360-80	--	7/17/2020	27.7
MW-364-65	10-55	MW-364-65	--	7/9/2020	40.0
MW-364-90	55-90	MW-364-90	--	7/9/2020	45.7
MW-371-15	Water Table	MW-371-15	--	7/15/2020	188
MW-371-55	90-150	MW-371-55	--	7/15/2020	30.0
MW-372-15	Water Table	MW-372-15	--	7/13/2020	888
O-1	Water Table	O-1	--	8/6/2020	1960JL*
O-2	Water Table	O-2	--	7/10/2020	116
O-24	Water Table	O-124	DUP	7/23/2020	<5.10
O-24	Water Table	O-24	--	7/23/2020	<5.20
O-26	Water Table	O-26	--	7/23/2020	78.5
O-26-65	10-55	O-26-65	--	7/23/2020	24.1
O-27	Water Table	O-27	--	8/10/2020	310
O-27-65	10-55	O-27-65	--	7/13/2020	121
O-34	Water Table	O-34	--	8/7/2020	464
S-51	Water Table	S-51	--	7/10/2020	171

**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 - 2020 Update are shown here.

**Acronyms and Abbreviations:**

-- = Not applicable

µg/L = micrograms per liter

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.

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

**Table 3-7  
Sulfolane Analytical Results - Point of Compliance**

**Annual 2020 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	--	7/15/2020	71.9
MW-358-40	10-55	MW-358-40	--	7/15/2020	90.4
MW-359-15	Water Table	MW-359-15	--	7/17/2020	50.8
MW-359-35	10-55	MW-359-35	--	3/17/2020	180
MW-359-35	10-55	MW-459-35	DUP	3/17/2020	178
MW-359-35	10-55	MW-359-35	--	7/17/2020	238
MW-359-60	10-55	MW-359-60	--	7/17/2020	108
MW-359-80	55-90	MW-359-80	--	7/17/2020	43.2
MW-360-15	Water Table	MW-360-15	--	7/17/2020	5.63J
MW-360-35	10-55	MW-360-35	--	7/17/2020	49.0
MW-360-50	10-55	MW-360-50	--	7/17/2020	62.5
MW-360-80	55-90	MW-360-80	--	7/17/2020	27.7
MW-364-65	10-55	MW-364-65	--	7/9/2020	40.0
MW-364-90	55-90	MW-364-90	--	7/9/2020	45.7

**General Notes:**

Only monitoring wells scheduled for sampling per Table 3-3 of the Long-Term Monitoring Plan - 2020 Update are shown here.

**Acronyms and Abbreviations:**

-- = Not applicable

µg/L = micrograms per liter

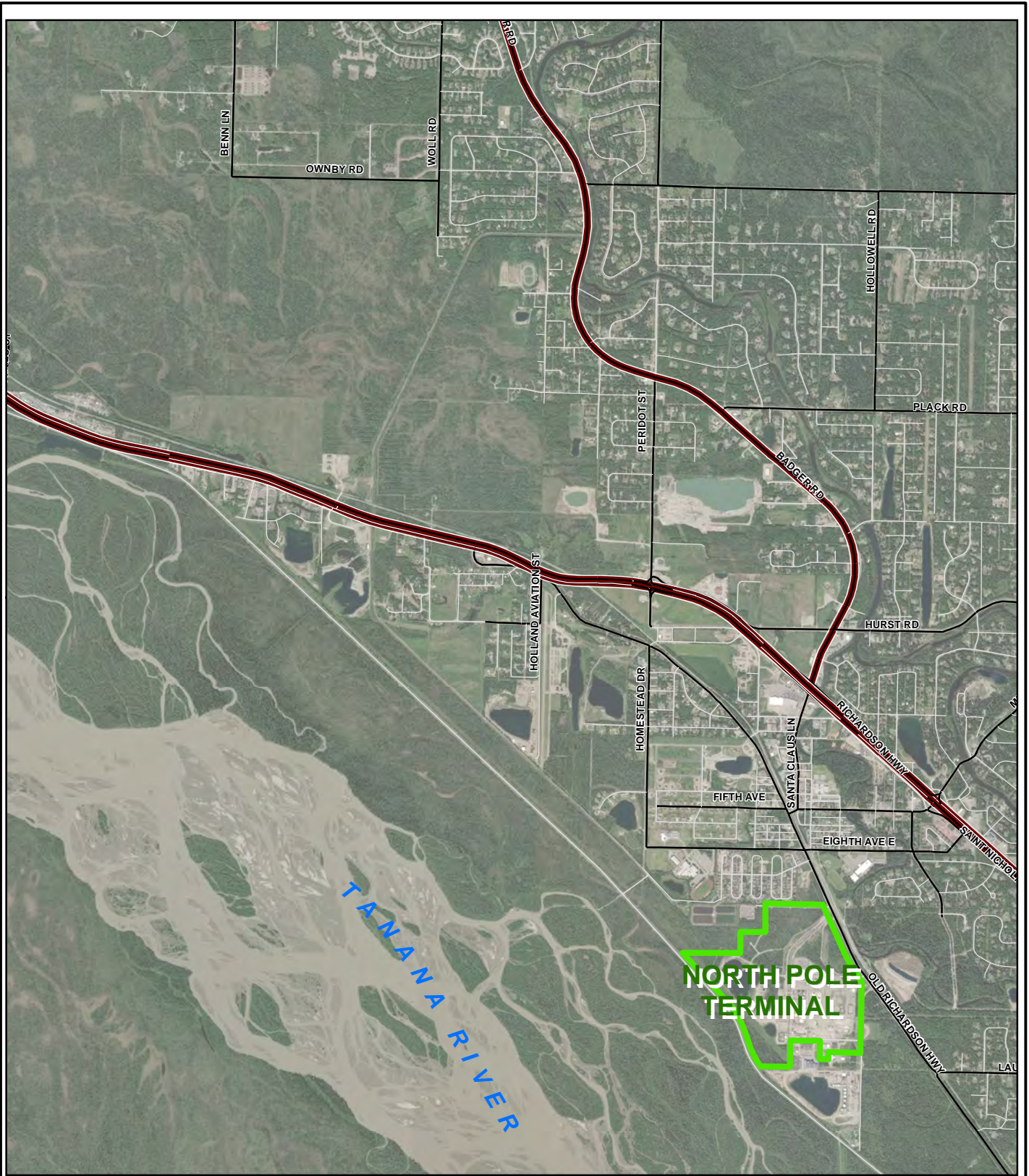
DUP = Field-duplicate sample

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

# FIGURES

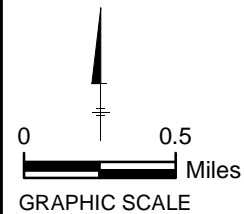






LEGEND:

 PROPERTY BOUNDARY



Note:  
May 2015 ESRI Cloud Imagery

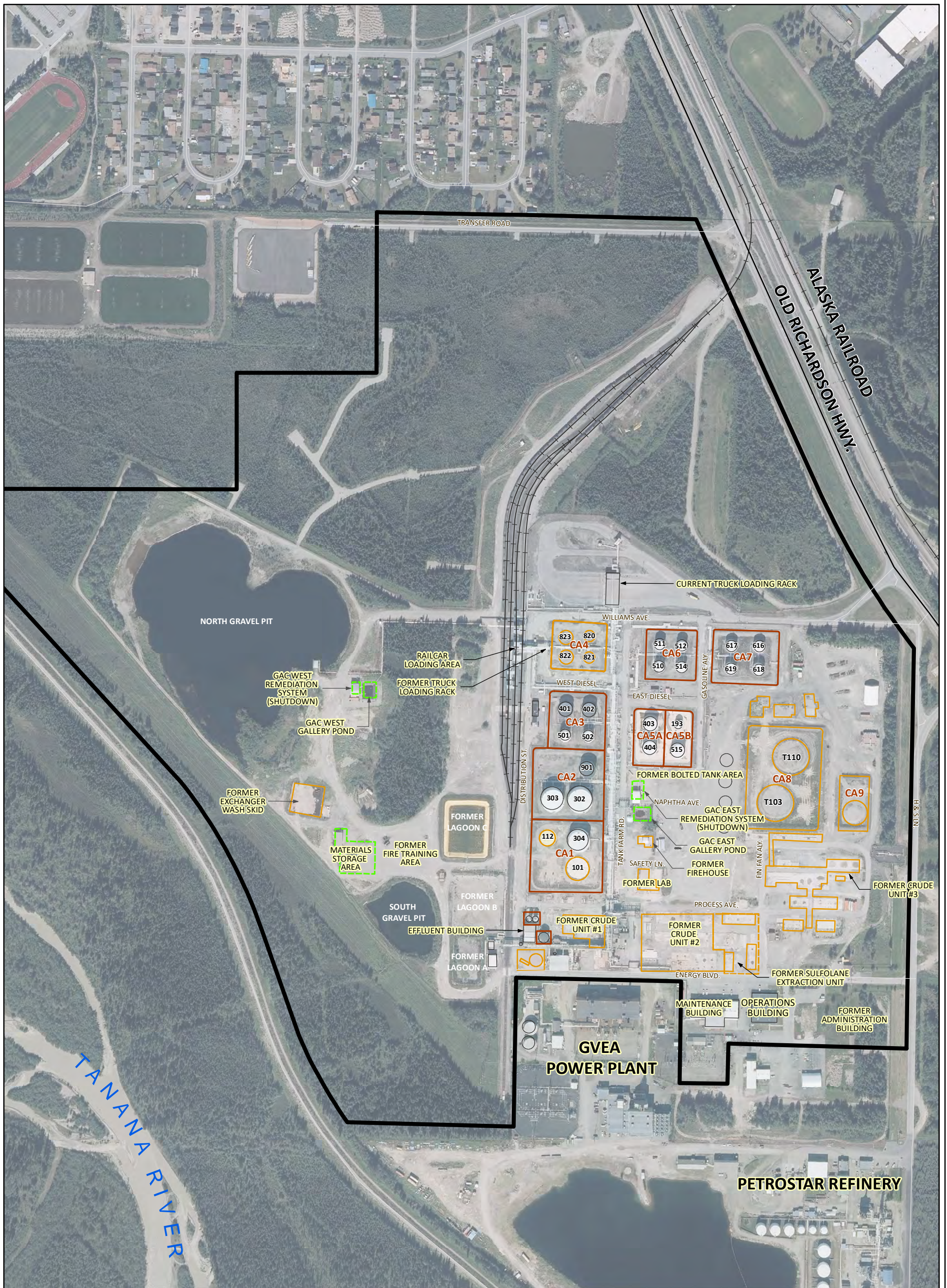


NORTH POLE TERMINAL, NORTH POLE, ALASKA  
ANNUAL 2020 ONSITE GROUNDWATER  
MONITORING REPORT

SITE LOCATION

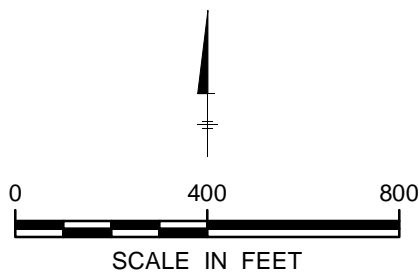


FIGURE  
1-1



- 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



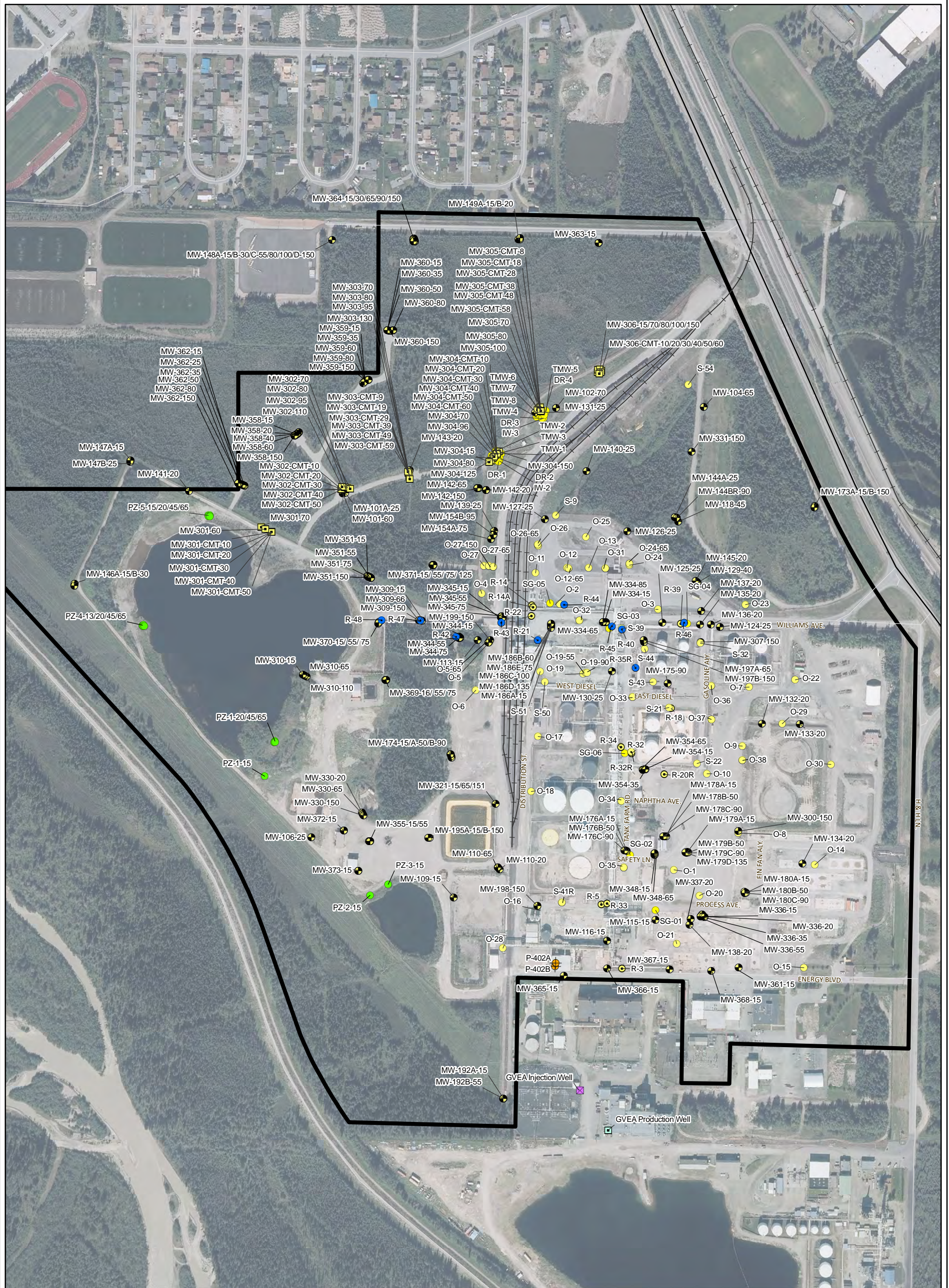
NORTH POLE TERMINAL, NORTH POLE, ALASKA  
 ANNUAL 2020 ONSITE GROUNDWATER  
 MONITORING REPORT

**SITE FEATURES**



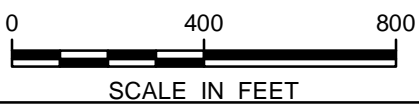
FIGURE

**1-2**



**Legend**

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



**Notes:**  
 GVEA = Golden Valley Electrical Authority  
 - July 21, 2018 Imagery provided by Quantum Spatial

NORTH POLE TERMINAL, NORTH POLE, ALASKA  
**ANNUAL 2020 ONSITE GROUNDWATER MONITORING REPORT**

**SITE PLAN - ONSITE**



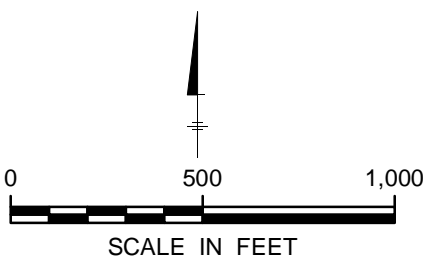
FIGURE

**1-3**



**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 April 2020  
 - 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

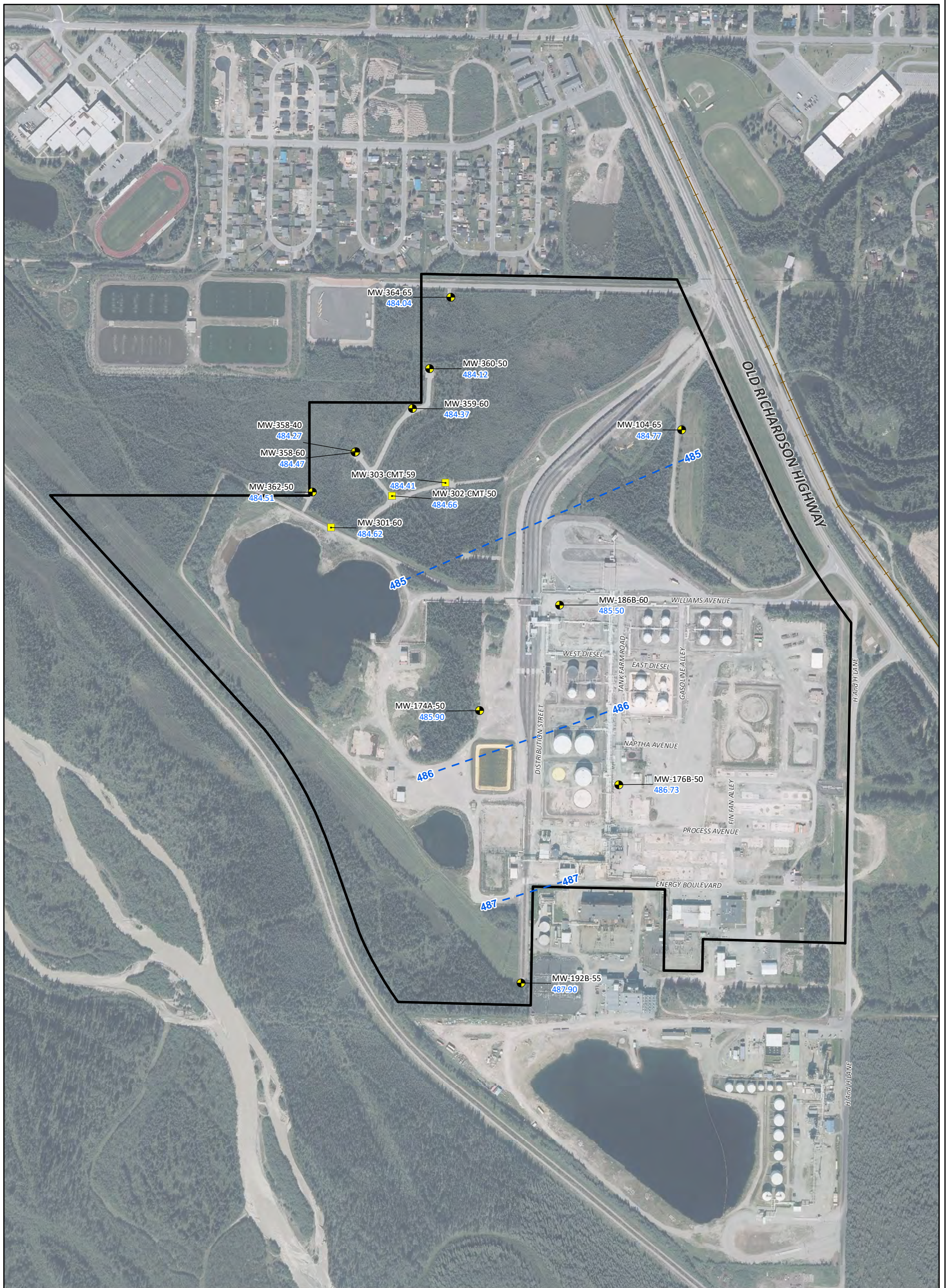
**NORTH POLE TERMINAL, NORTH POLE, ALASKA  
 ANNUAL 2020 ONSITE GROUNDWATER  
 MONITORING REPORT**

**FIRST SEMIANNUAL 2020 GROUNDWATER  
 CONTOUR MAP - ONSITE WELLS  
 AT WATER TABLE**



FIGURE

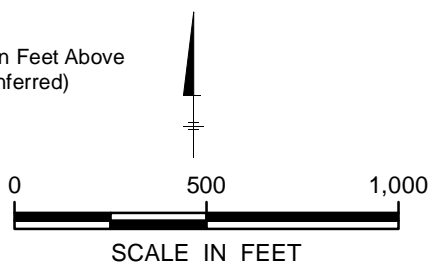
**3-1**



**Legend**

- Vertical Profile Transect Well
- Monitoring Well
- Property Boundary

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



Notes:  
 - Wells were gauged in April 2020  
 - 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

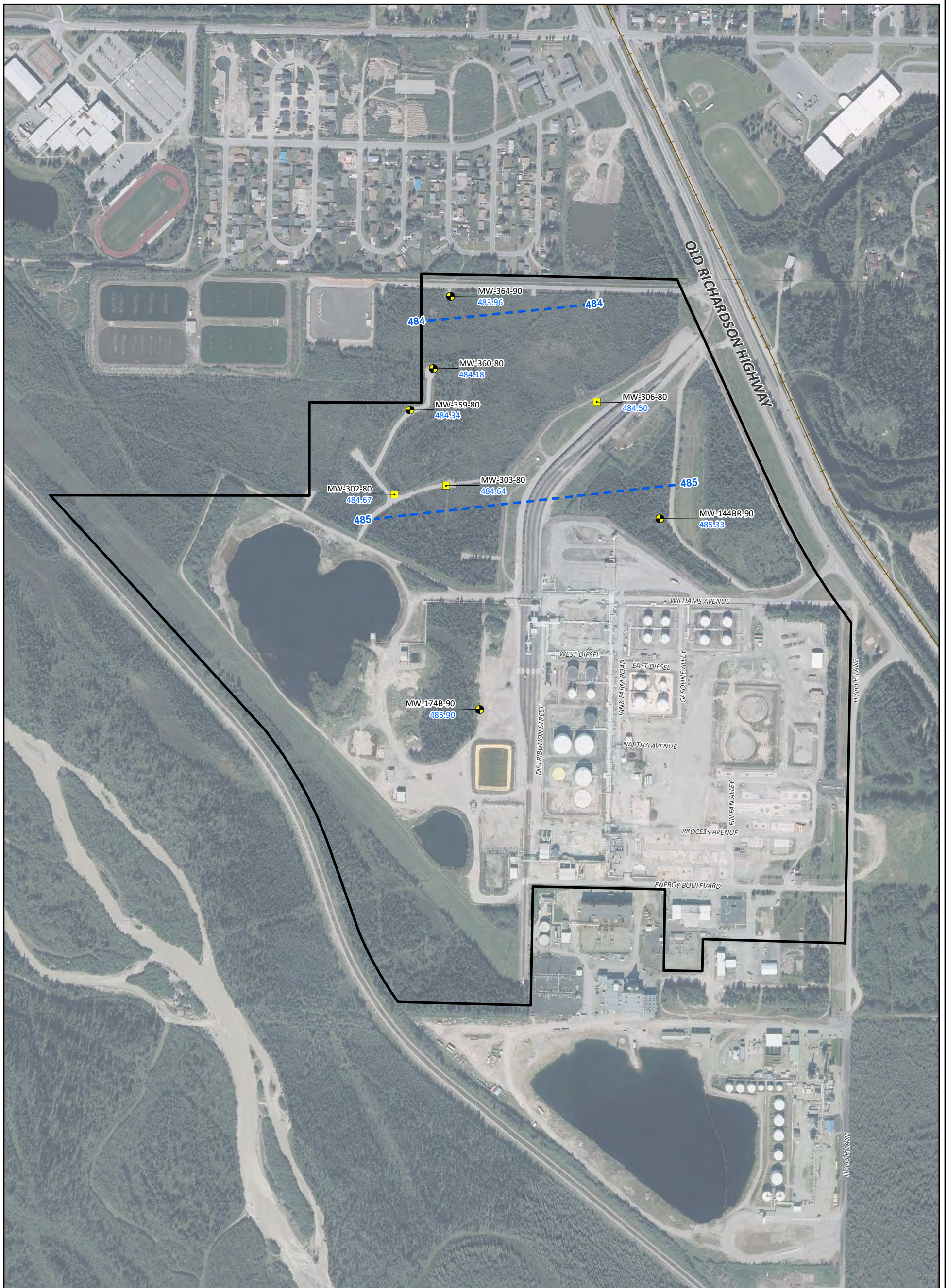
**ANNUAL 2020 ONSITE GROUNDWATER MONITORING REPORT**

**FIRST SEMI ANNUAL 2020 GROUNDWATER CONTOUR MAP - ONSITE WELLS 10 TO 55 FEET BELOW WATER TABLE**



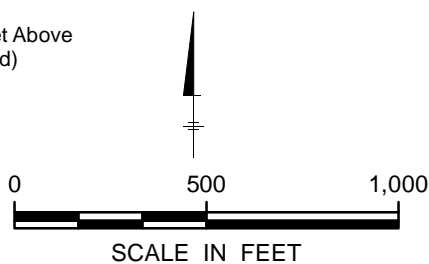
FIGURE

**3-2**



**Legend**

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



Notes:  
 - Wells were gauged in April 2020  
 - 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 2020 ONSITE GROUNDWATER MONITORING REPORT**

**FIRST SEMI-ANNUAL 2020 GROUNDWATER CONTOUR MAP - ONSITE WELLS 55 TO 90 FEET BELOW WATER TABLE**

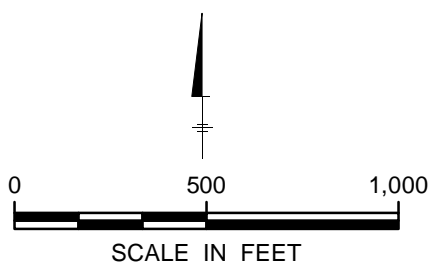


FIGURE  
**3-3**



**Legend**

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



Notes:  
 - Wells were gauged in April 2020  
 - 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

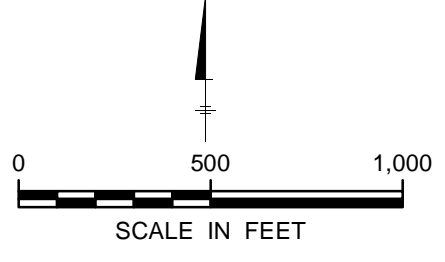
NORTH POLE TERMINAL, NORTH POLE, ALASKA  
**ANNUAL 2020 ONSITE GROUNDWATER MONITORING REPORT**  
**FIRST SEMI ANNUAL 2020 GROUNDWATER CONTOUR MAP - ONSITE WELLS 90 TO 160 FEET BELOW WATER TABLE**

FIGURE  
**3-4**



**Legend**

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



Notes:  
 -Wells were gauged in September 2020  
 -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 2020 ONSITE GROUNDWATER MONITORING REPORT**

**SECOND SEMIANNUAL 2020 GROUNDWATER CONTOUR MAP - ONSITE WELLS AT WATER TABLE**


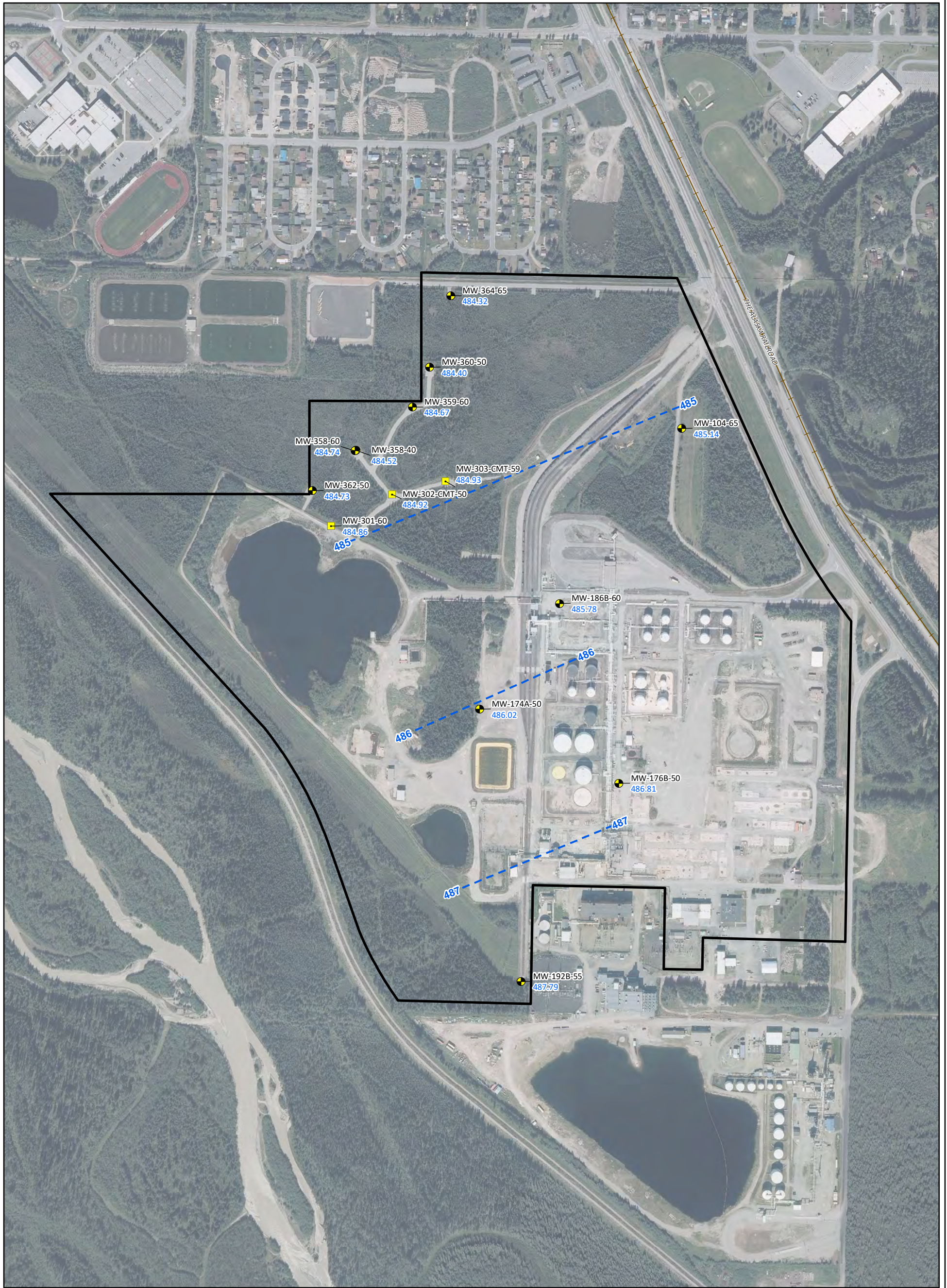


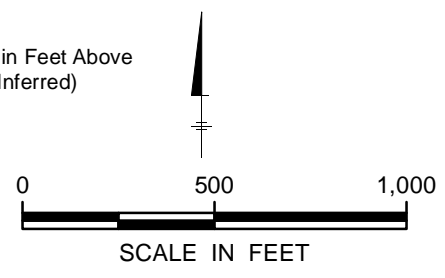
FIGURE  
**3-5**





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

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

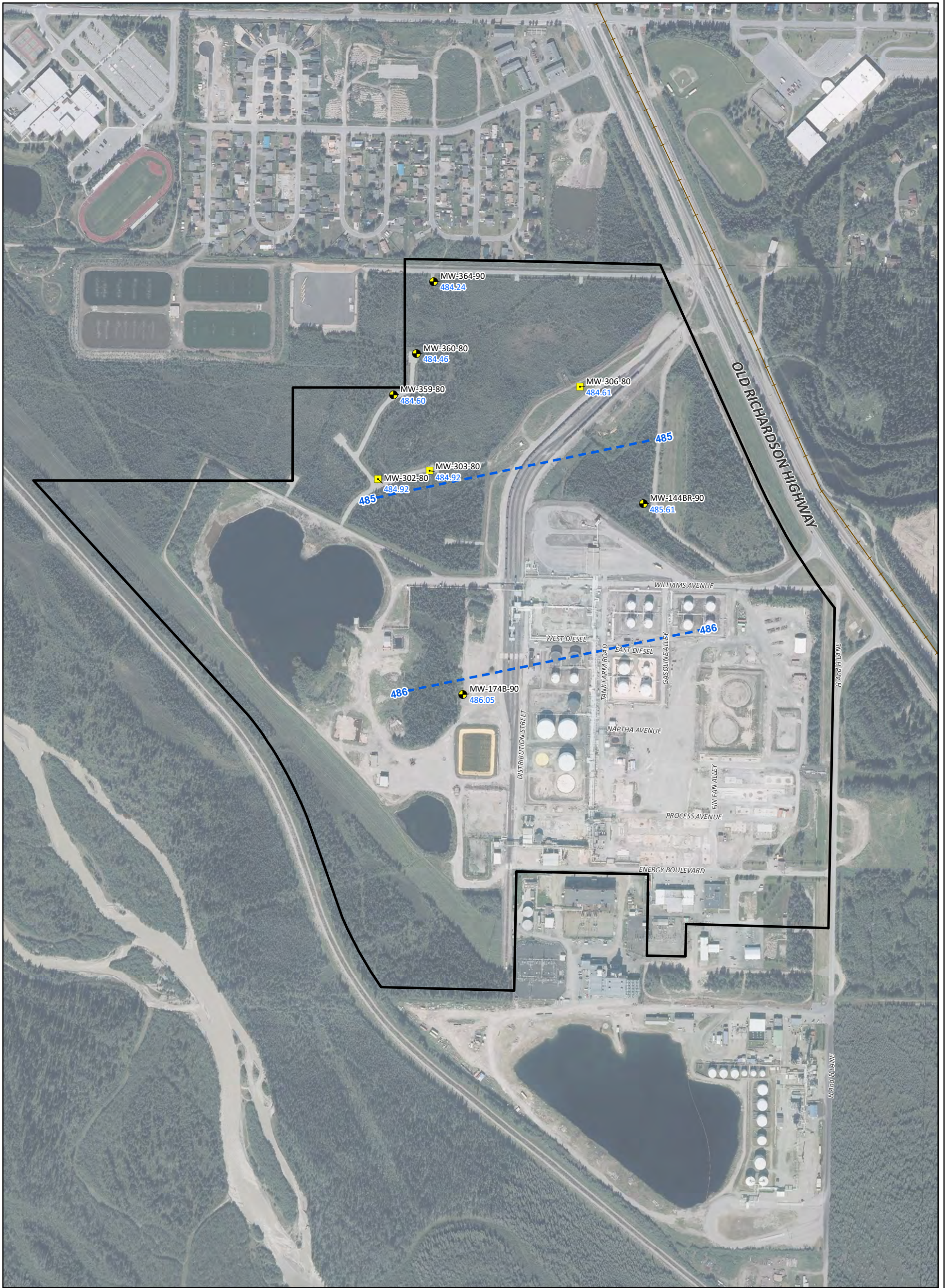


NORTH POLE TERMINAL, NORTH POLE, ALASKA  
**ANNUAL 2020 ONSITE GROUNDWATER MONITORING REPORT**  
**SECOND SEMI ANNUAL 2020 GROUNDWATER CONTOUR MAP - ONSITE WELLS 10 TO 55 FEET BELOW WATER TABLE**

Notes:  
 -Wells were gauged in September 2020  
 -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

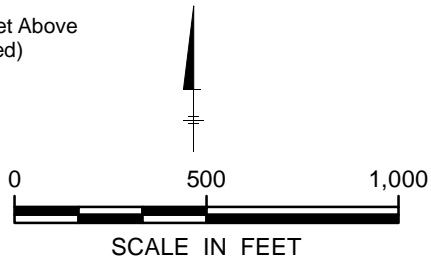


FIGURE  
**3-6**



**Legend**

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

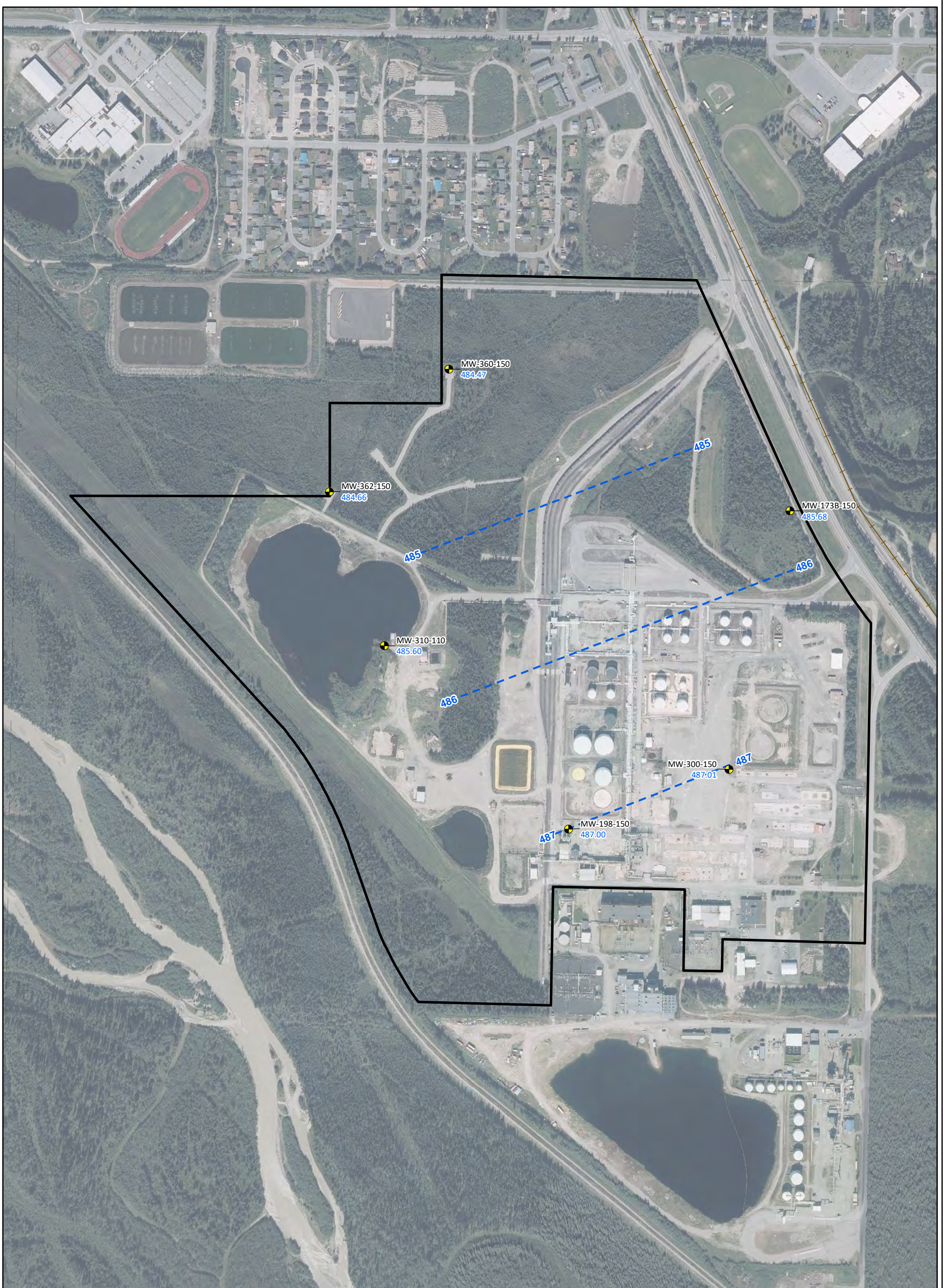


Notes:  
 -Wells were gauged in September 2020  
 -Only monitoring wells scheduled for gauging per Table 3-1 of the Long Term Monitoring Plan - 2017 Update are shown on the figure.  
 - July 21, 2018 Imagery provided by Quantum Spatial

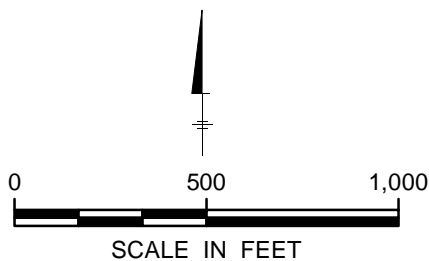
**NORTH POLE TERMINAL, NORTH POLE, ALASKA  
 ANNUAL 2020 ONSITE GROUNDWATER  
 MONITORING REPORT**

**SECOND SEMI-ANNUAL 2020 GROUNDWATER  
 CONTOUR MAP - ONSITE WELLS 55 TO 90  
 FEET BELOW WATER TABLE**





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



NORTH POLE TERMINAL, NORTH POLE, ALASKA  
**ANNUAL 2020 ONSITE GROUNDWATER  
 MONITORING REPORT**

**SECOND SEMI-ANNUAL 2020 GROUNDWATER  
 CONTOUR MAP - ONSITE WELLS 90 TO 160  
 FEET BELOW WATER TABLE**



FIGURE

**3-8**

Notes:  
 -Wells were gauged in September 2020  
 -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**

<b>No LNAPL or Sheen Observed</b>	<b>LNAPL or Sheen Observed</b>	Property Boundary
Monitoring Well	Monitoring Well	<b>0.72</b> LNAPL Thickness (feet)
Observation Well	Observation Well	<b>Sheen</b> An interface probe was used. No measurable LNAPL was present, but LNAPL sheen was observed visually.
Recovery Well (Inactive)	Recovery Well (Inactive)	<b>--</b> No LNAPL measured or sheen observed

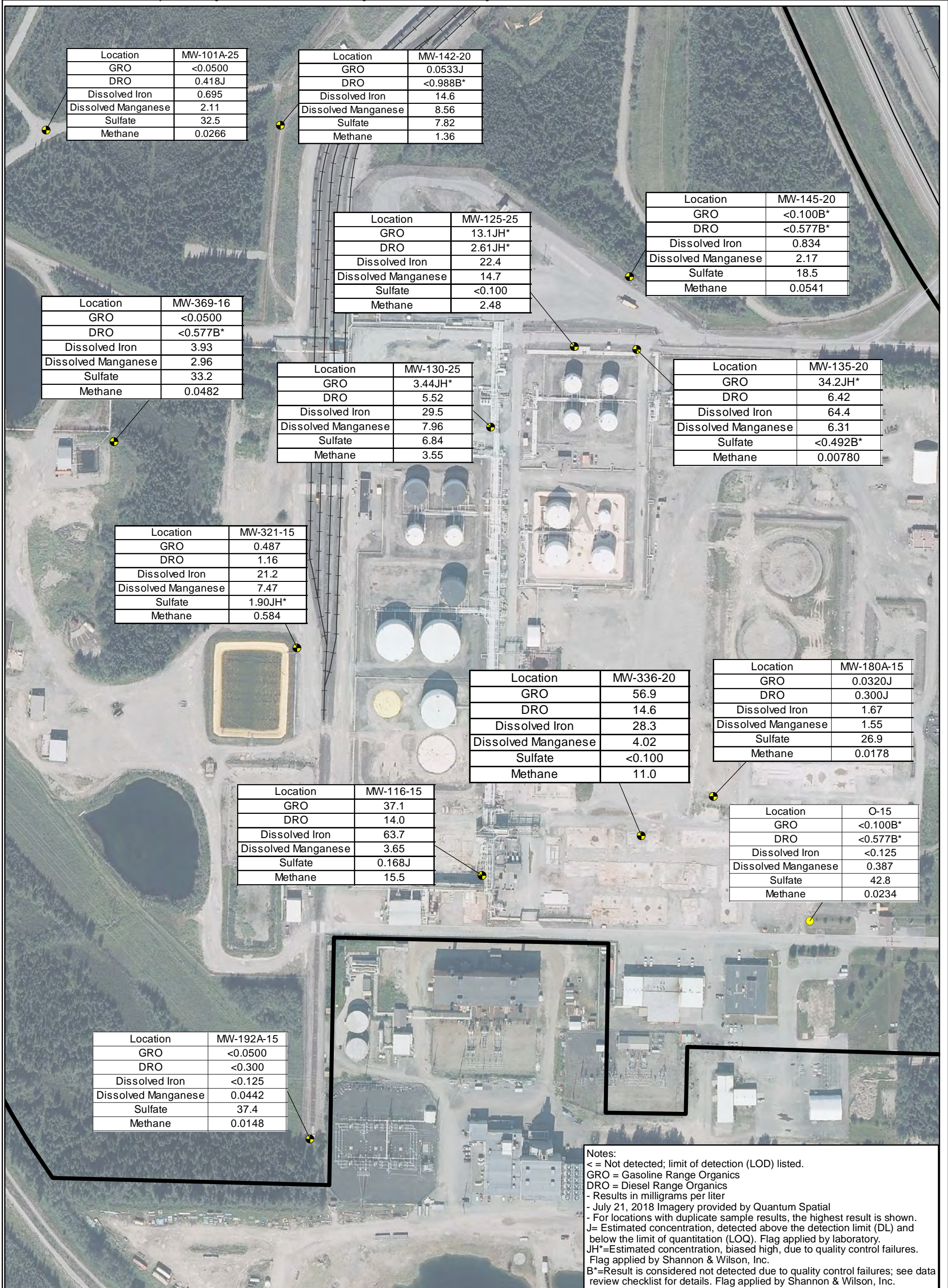
Notes:  
 LNAPL = Light Nonaqueous Phase Liquid  
 LNAPL results posted on figure are in feet.  
 - The maximum LNAPL thickness for wells gauged as part of the Long Term Monitoring Plan - 2017 Update are shown on the figure.  
 - Wells with LNAPL or sheen observed during the reporting period are also shown on this figure.  
 - July 21, 2018 Imagery provided by Quantum Spatial  
 - Annual gauging was conducted in September and October 2020.

0 200 400  
 SCALE IN FEET

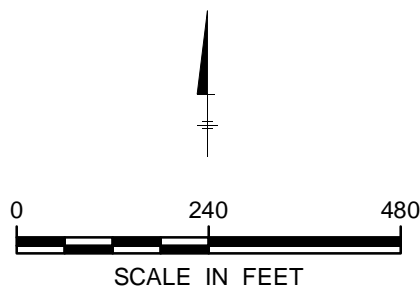
NORTH POLE TERMINAL, NORTH POLE, ALASKA  
**ANNUAL 2020 ONSITE GROUNDWATER MONITORING REPORT**

**ANNUAL 2020 LNAPL MONITORING DATA**

FIGURE  
**3-9**



**Legend**  
 Monitoring Well  
 Observation Well  
 Property Boundary

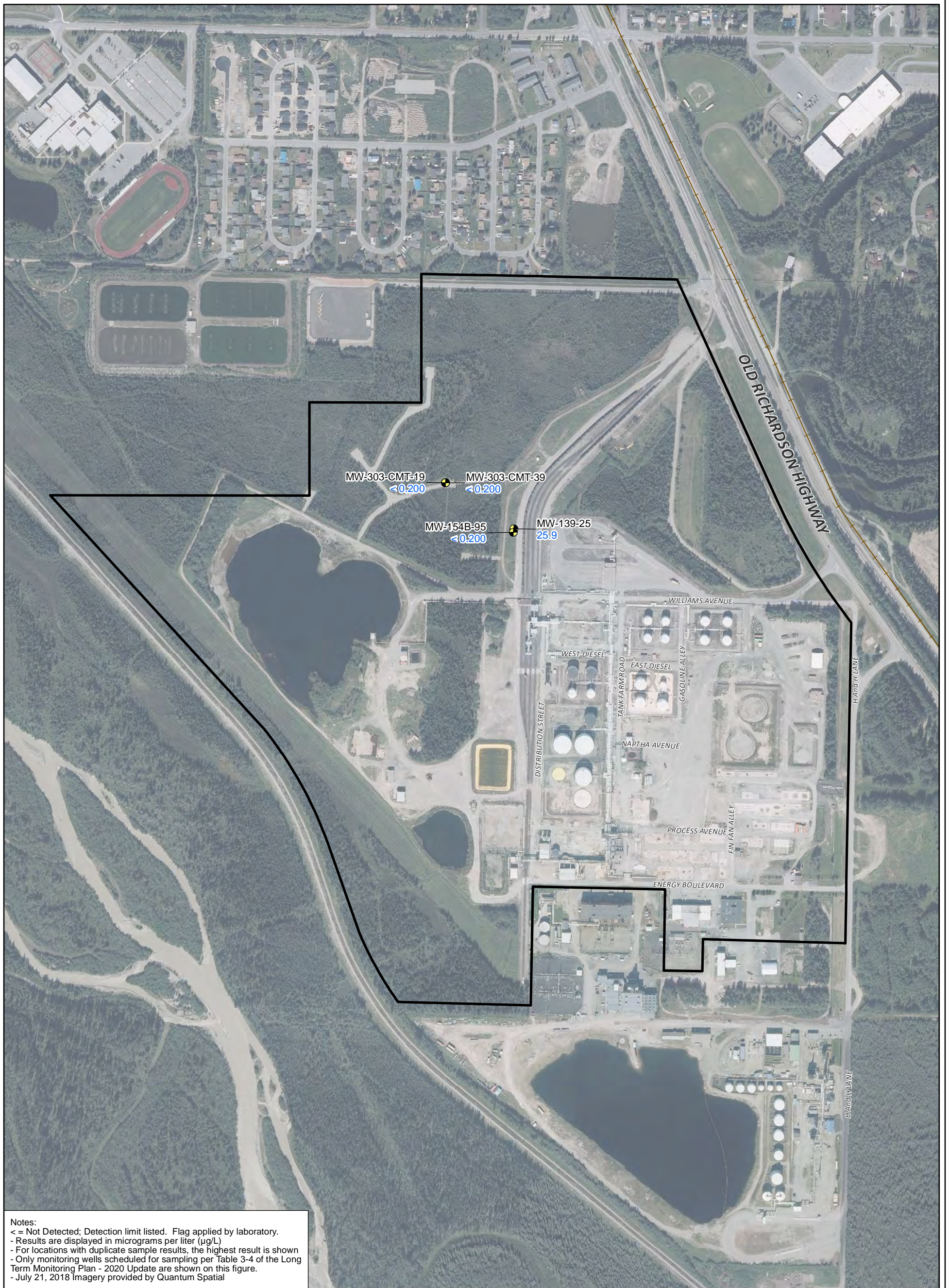


NORTH POLE TERMINAL, NORTH POLE, ALASKA  
**ANNUAL 2020 ONSITE GROUNDWATER MONITORING REPORT**



**ANNUAL 2020 NATURAL SOURCE ZONE DEPLETION MONITORING RESULTS**

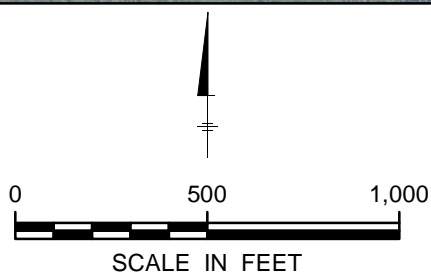


FIGURE  
**3-10**



Notes:  
 <math>\le</math> = Not Detected; Detection limit listed. Flag applied by laboratory.  
 - Results are displayed in micrograms per liter ( $\mu\text{g/L}$ )  
 - For locations with duplicate sample results, the highest result is shown  
 - Only monitoring wells scheduled for sampling per Table 3-4 of the Long Term Monitoring Plan - 2020 Update are shown on this figure.  
 - July 21, 2018 Imagery provided by Quantum Spatial

**Legend:**  
 Monitoring Well  
 Property Boundary

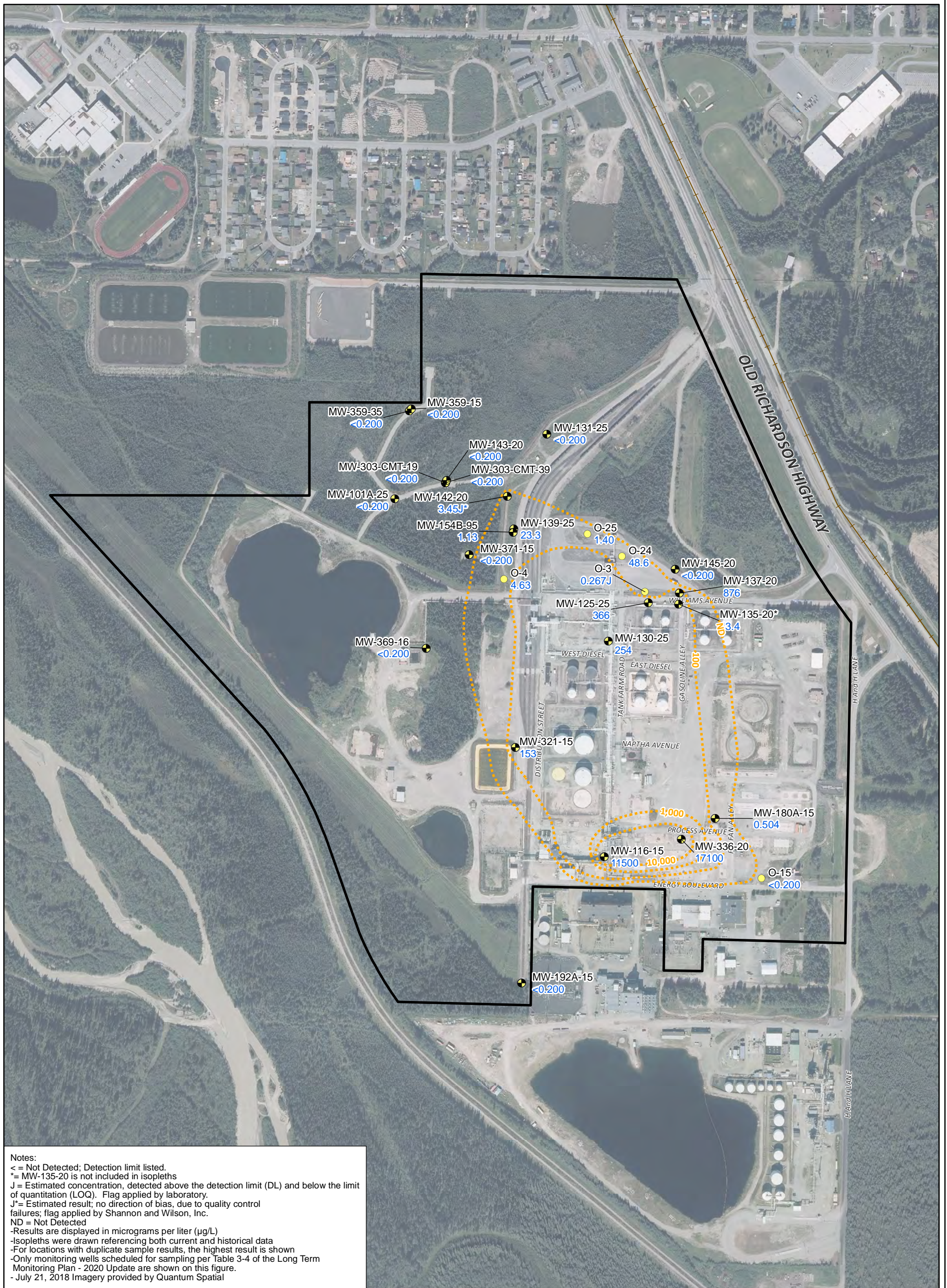


NORTH POLE TERMINAL, NORTH POLE, ALASKA  
 ANNUAL 2020 ONSITE GROUNDWATER  
 MONITORING REPORT  
 FIRST SEMIANNUAL 2020  
 ONSITE BENZENE GROUNDWATER  
 ANALYTICAL RESULTS



FIGURE

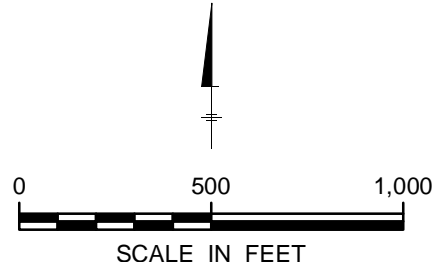
3-11



Notes:  
 < = Not Detected; Detection limit listed.  
 \* = MW-135-20 is not included in isopleths  
 J = Estimated concentration, detected above the detection limit (DL) and below the limit of quantitation (LOQ). Flag applied by laboratory.  
 J\* = Estimated result; no direction of bias, due to quality control failures; flag applied by Shannon and Wilson, Inc.  
 ND = Not Detected  
 -Results are displayed in micrograms per liter ( $\mu\text{g/L}$ )  
 -Isopleths were drawn referencing both current and historical data  
 -For locations with duplicate sample results, the highest result is shown  
 -Only monitoring wells scheduled for sampling per Table 3-4 of the Long Term Monitoring Plan - 2020 Update are shown on this figure.  
 - July 21, 2018 Imagery provided by Quantum Spatial

**Legend:**

- Monitoring Well
- Observation Well
- ⋯ Benzene Isopleth in  $\mu\text{g/L}$
- Property Boundary



NORTH POLE TERMINAL, NORTH POLE, ALASKA  
**ANNUAL 2020 ONSITE GROUNDWATER MONITORING REPORT**  
**SECOND SEMI ANNUAL 2020 ONSITE BENZENE GROUNDWATER ANALYTICAL RESULTS**



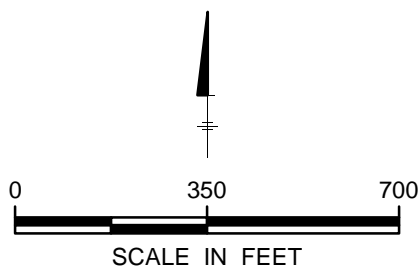
FIGURE  
**3-12**



Notes:  
 ND = Not Detected  
 µg/L = micrograms per liter  
 - Refer to Figure 3-16 for estimated contours  
 - Only monitoring wells scheduled for sampling per the Long Term Monitoring Plan - 2020 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.

**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  
 ● > 400 µg/L



NORTH POLE TERMINAL, NORTH POLE, ALASKA  
**ANNUAL 2020 ONSITE GROUNDWATER MONITORING REPORT**  
**FIRST SEMIANNUAL 2020 ONSITE SULFOLANE GROUNDWATER ANALYTICAL RESULTS - WATER TABLE**  
 FIGURE  
**ARCADIS** | **3-13**

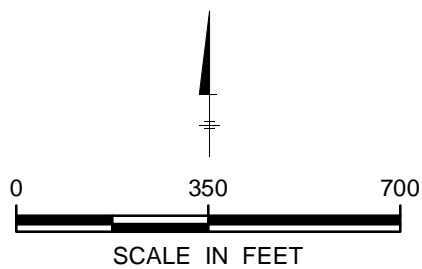




Notes:  
 µg/L = micrograms per liter  
 - Only monitoring wells scheduled for sampling per the Long Term Monitoring Plan - 2020 Update are shown on this figure.  
 - July 21, 2018 Imagery provided by Quantum Spatial  
 - For locations with duplicate sample results, the highest result is shown.

**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 µg/L



NORTH POLE TERMINAL, NORTH POLE, ALASKA  
**ANNUAL 2020 ONSITE GROUNDWATER MONITORING REPORT**  
**FIRST SEMIANNUAL 2020 ONSITE SULFOLANE GROUNDWATER ANALYTICAL RESULTS - 10 TO 55 FEET BELOW WATER TABLE**



FIGURE

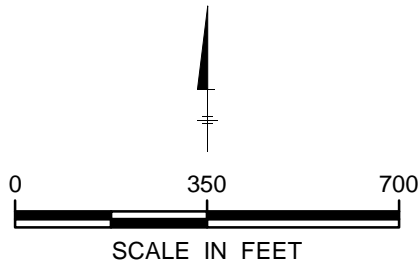
**3-14**



Notes:  
 µg/L = micrograms per liter  
 - Only monitoring wells scheduled for sampling per the Long Term Monitoring Plan - 2020 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.

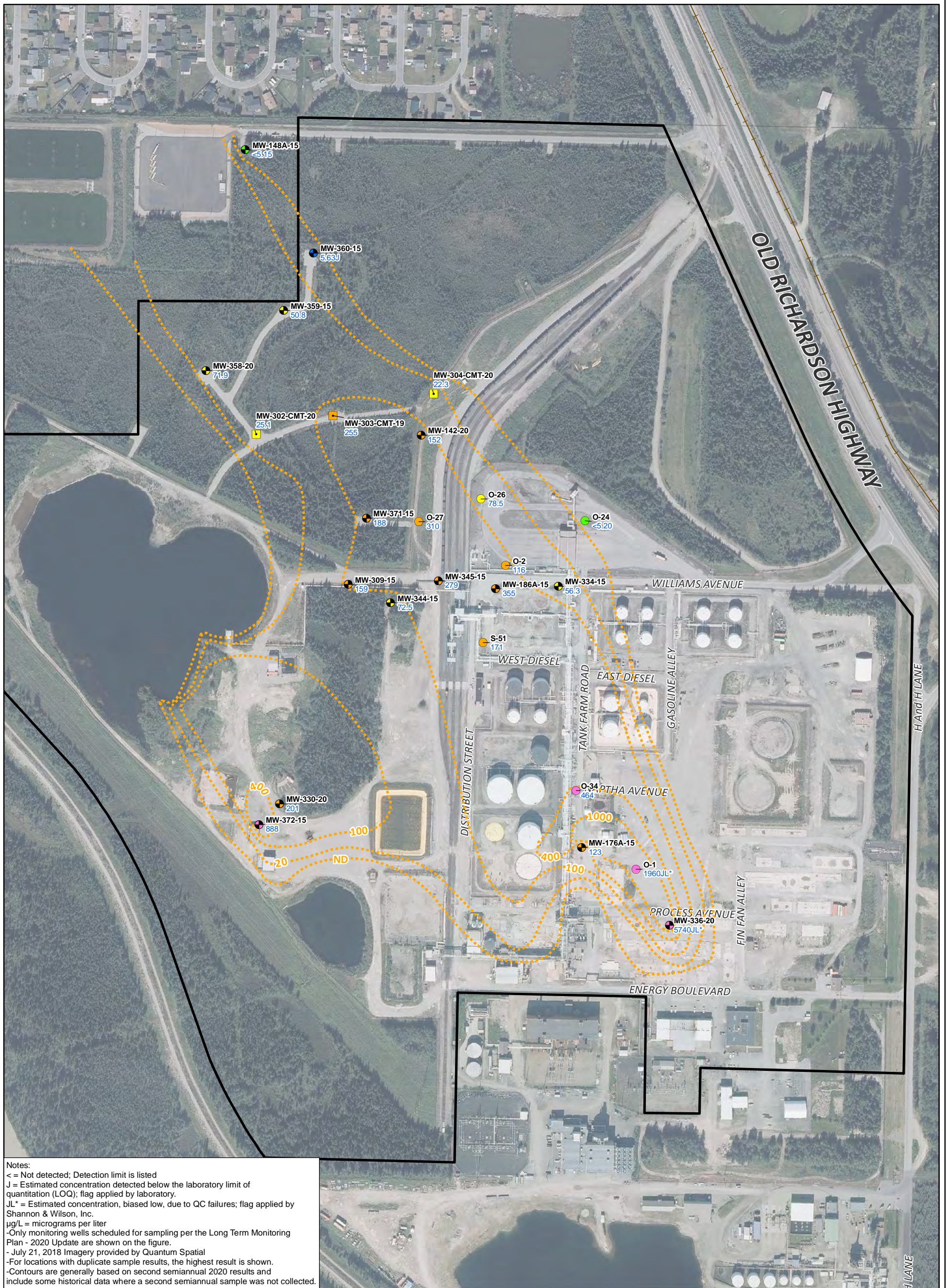
**Legend**  
 Monitoring Well  
 Property Boundary

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



NORTH POLE TERMINAL, NORTH POLE, ALASKA  
**ANNUAL 2020 ONSITE GROUNDWATER MONITORING REPORT**  
**FIRST SEMIANNUAL 2020 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.  
 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 - 2020 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 2020 results and include some historical data where a second semiannual sample was not collected.

<b>Legend</b>	
● Monitoring Well	<b>Sulfolane Results</b>
○ Observation Well	● Not Detected
▣ Vertical Profile Transect	● 3.14 - Less Than 20 µg/L
▭ Property Boundary	● 20 - 100 µg/L
⋯ Approximate Sulfolane Isopleth in µg/L	● 100 - 400 µg/L
	● > 400 µg/L

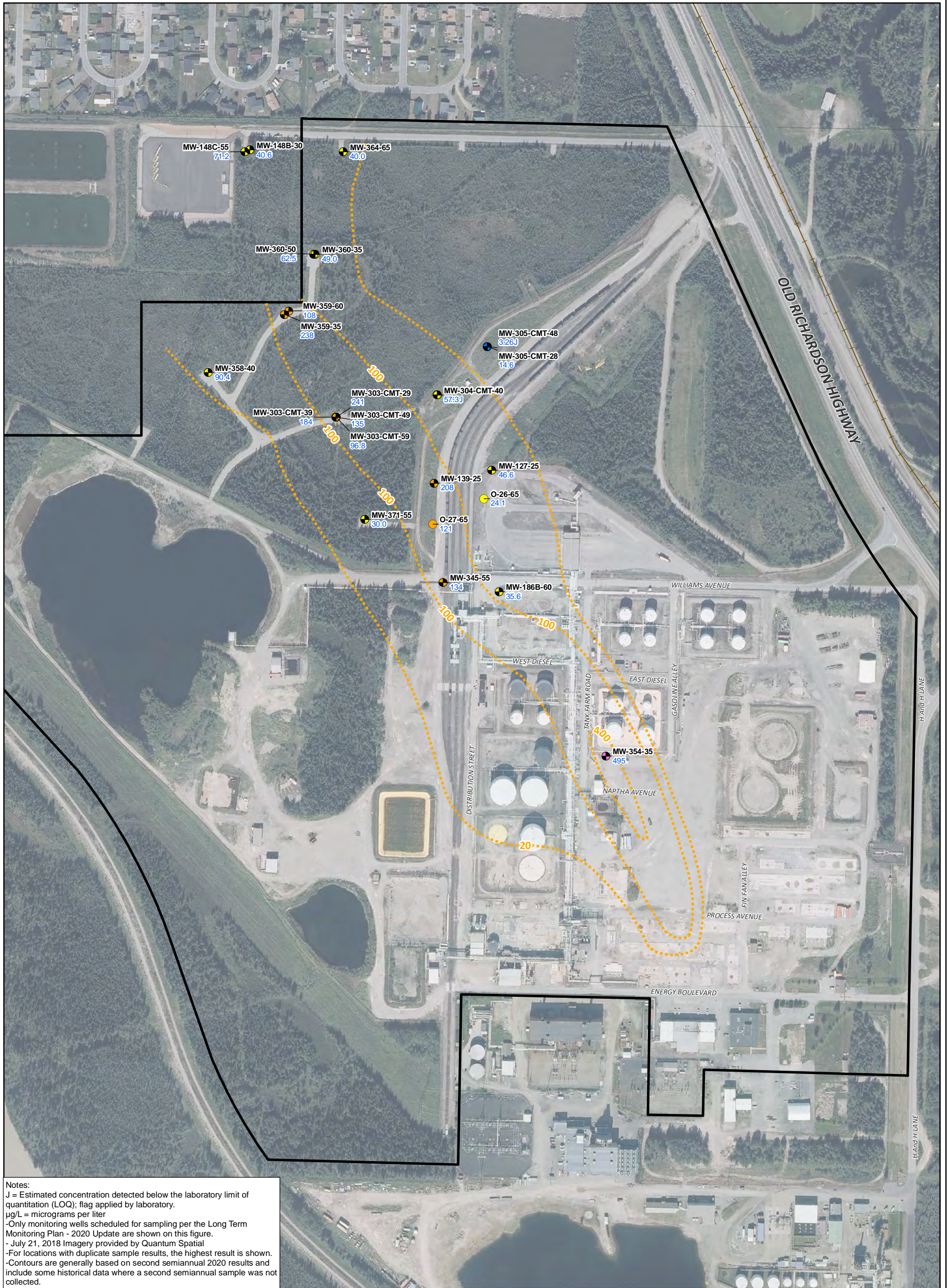
SCALE IN FEET

NORTH POLE TERMINAL, NORTH POLE, ALASKA

**ANNUAL 2020 ONSITE GROUNDWATER MONITORING REPORT**

**SECOND SEMIANNUAL 2020 ONSITE SULFOLANE GROUNDWATER ANALYTICAL RESULTS WATER TABLE**

FIGURE  
**3-16**



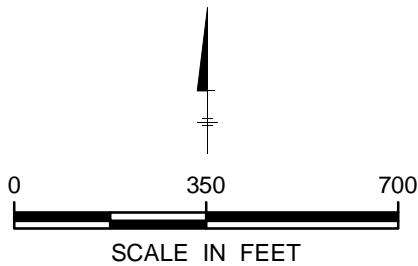
Notes:  
 J = Estimated concentration detected below the laboratory limit of quantitation (LOQ); flag applied by laboratory.  
 µg/L = micrograms per liter  
 -Only monitoring wells scheduled for sampling per the Long Term Monitoring Plan - 2020 Update are shown on this figure.  
 - July 21, 2018 Imagery provided by Quantum Spatial  
 -For locations with duplicate sample results, the highest result is shown.  
 -Contours are generally based on second semiannual 2020 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



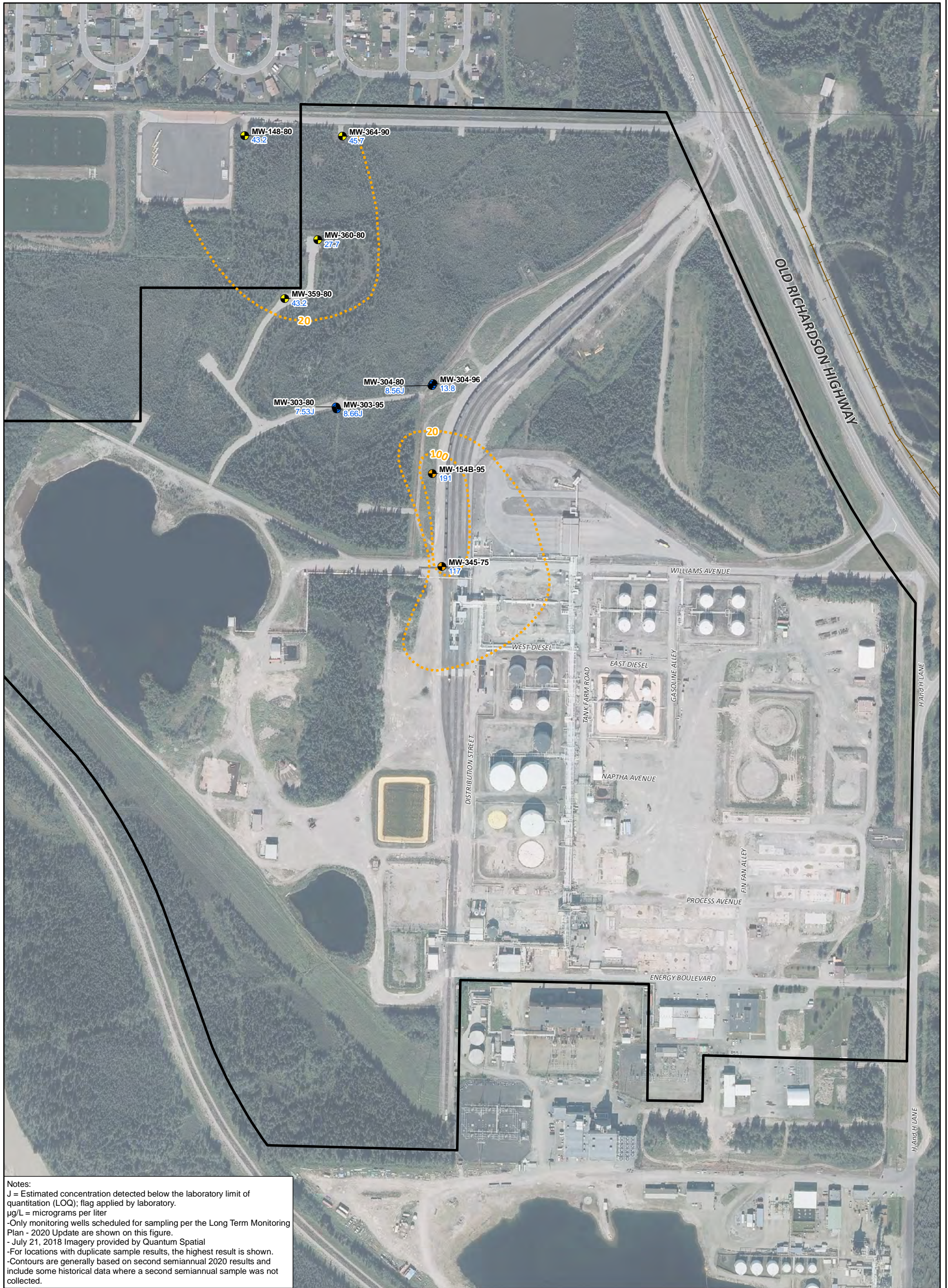
NORTH POLE TERMINAL, NORTH POLE, ALASKA  
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**SECOND SEMIANNUAL 2020 ONSITE SULFOLANE GROUNDWATER ANALYTICAL RESULTS - 10 TO 55 FEET BELOW WATER TABLE**



FIGURE

**3-17**



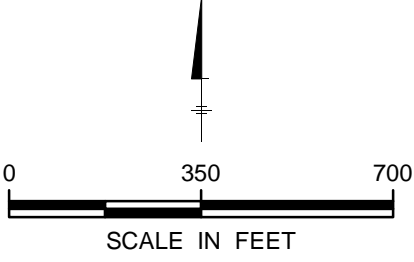
Notes:  
 J = Estimated concentration detected below the laboratory limit of quantitation (LOQ); flag applied by laboratory.  
 µg/L = micrograms per liter  
 -Only monitoring wells scheduled for sampling per the Long Term Monitoring Plan - 2020 Update are shown on this figure.  
 - July 21, 2018 Imagery provided by Quantum Spatial  
 -For locations with duplicate sample results, the highest result is shown.  
 -Contours are generally based on second semiannual 2020 results and include some historical data where a second semiannual sample was not collected.

**Legend**

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

**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 2020 ONSITE SULFOLANE GROUNDWATER ANALYTICAL RESULTS - 55 TO 90 FEET BELOW WATER TABLE**

FIGURE  
**3-18**








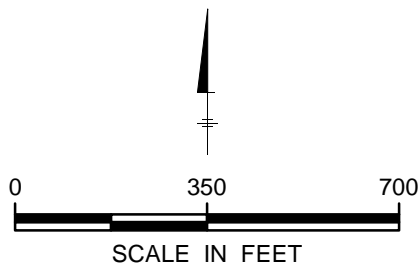
Notes:  
 J = Estimated concentration detected below the laboratory limit of quantitation (LOQ); flag applied by laboratory.  
 µg/L = micrograms per liter  
 -Only monitoring wells scheduled for sampling per the Long Term Monitoring Plan - 2020 Update are shown on this figure.  
 - July 21, 2018 Imagery 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 µg/L



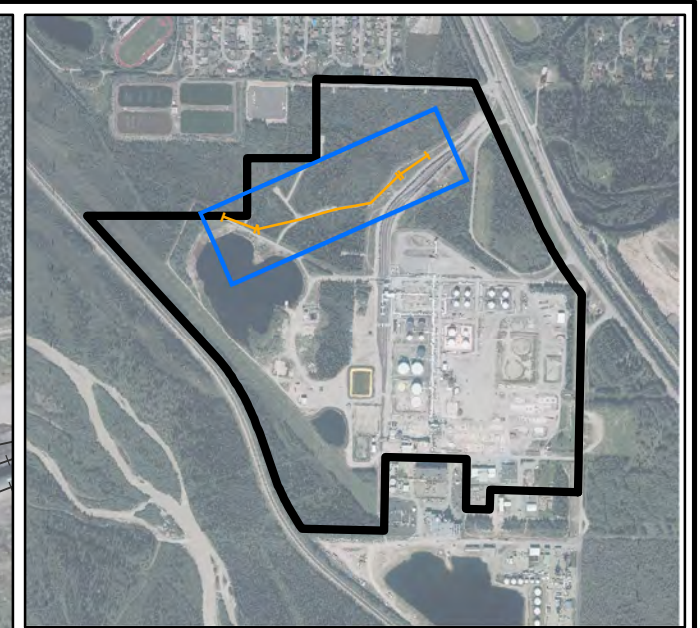
NORTH POLE TERMINAL, NORTH POLE, ALASKA  
**ANNUAL 2020 ONSITE GROUNDWATER MONITORING REPORT**

**SECOND SEMIANNUAL 2020 ONSITE SULFOLANE GROUNDWATER ANALYTICAL RESULTS - 90 TO 160 FEET BELOW WATER TABLE**

FIGURE



**3-19**

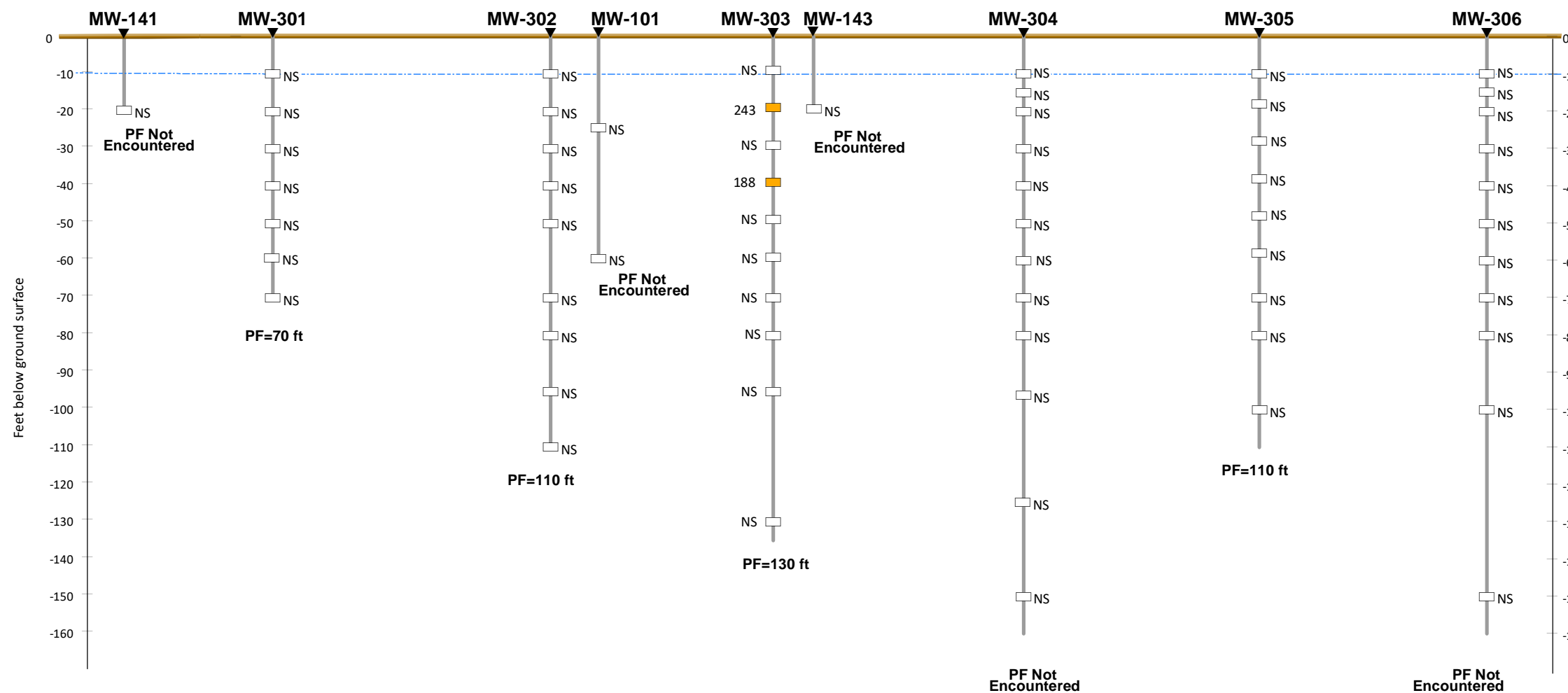


### Legend:

#### 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

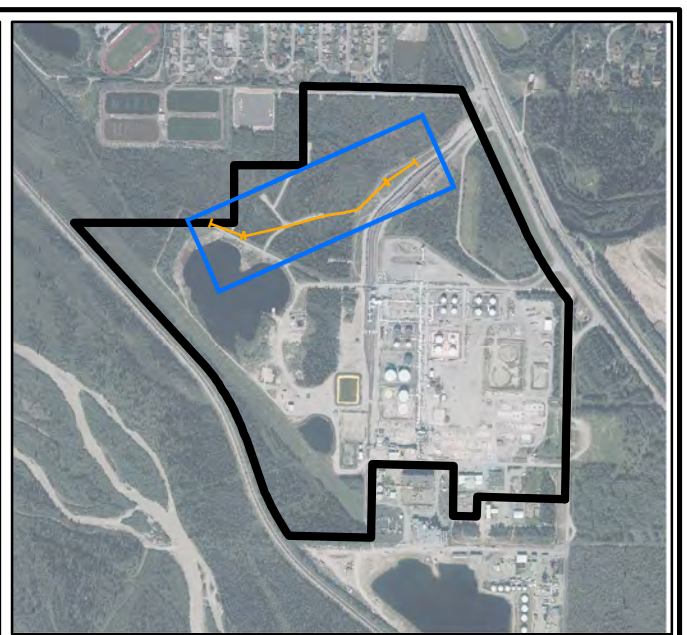
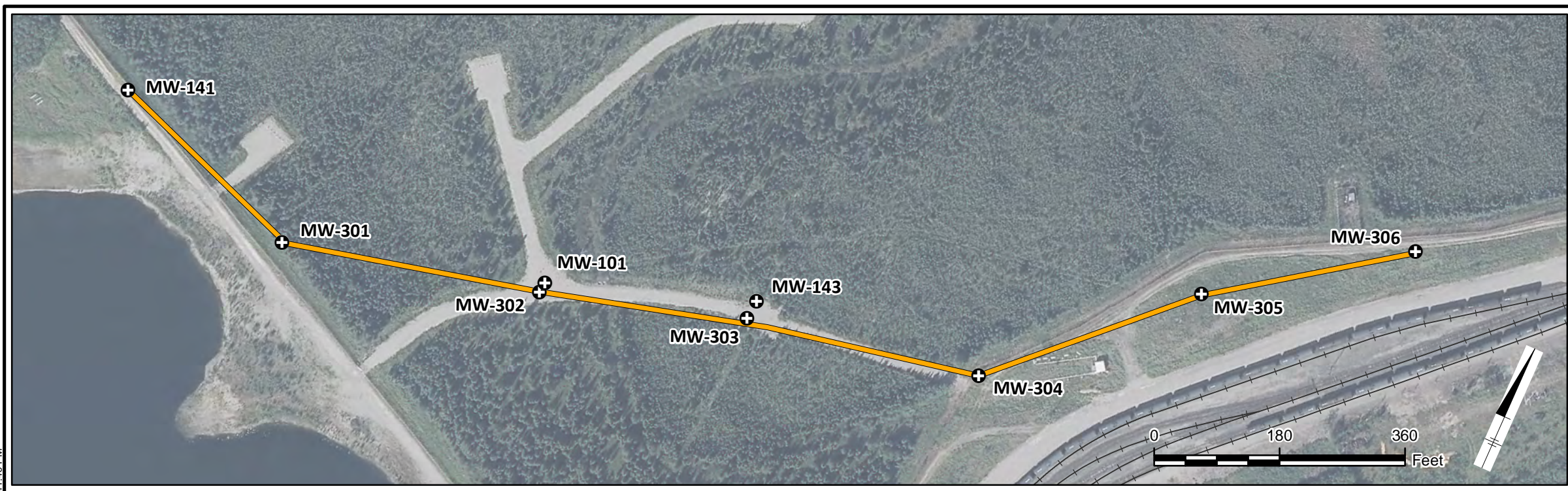


NOTES:  
 NS = Not sampled per Long-Term Monitoring Plan (LTM)  
 PF= Permafrost encountered at bottom of boring.  
 ft = feet  
 µg/L = micrograms per liter  
 - For locations with duplicate sample results, the highest value is shown  
 - Profile has a vertical exaggeration of 5x  
 - July 21, 2018 Imagery provided by Quantum Spatial

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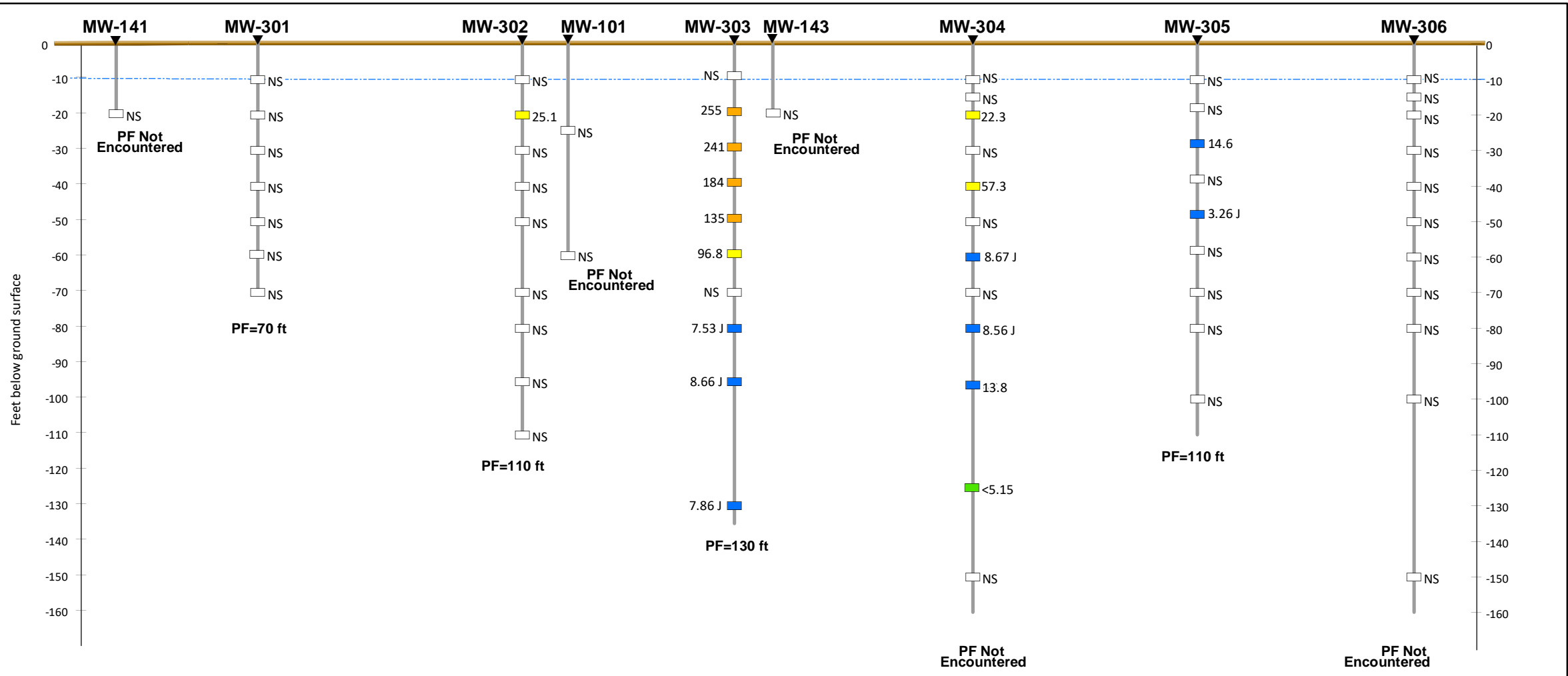
FIRST SEMIANNUAL 2020 SULFOLANE  
 AT THE VERTICAL PROFILING TRANSECT

CITY: Citrix DIV/GROUP: IM/DV DB: K Sinsabaugh LD: G FRANCE Path: T:\ENV\FHR\FHR\_AK\NorthPoleRefinery\GW\_Monitoring\2020\_Q3\Second\_Semiannual\_Onsite\Fig 3-20 3Q20 Sulfolane\_VPT\_Profile.mxd Date: 11/6/2020 Time: 4:41:40 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  
 <= Not detected; limit of detection (LOD) listed.  
 - 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 2020 SULFOLANE AT THE VERTICAL PROFILING TRANSECT**

FIGURE  
**3-21**