Environmental
Resources
Management

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13 November 2013

Dennis Harwood / David Allen
Alaska Department of Environmental Conservation
555 Cordova Street
Anchorage, Alaska 99501

Subject: North Pole Gravel Pond and Slough Sampling (NTP 18400211038)

Dear Mr. Harwood and Mr. Allen:

The purpose of this report is to document the results of sulfolane surface water, groundwater and sediment sampling performed in June 2013 at several water bodies located within or near the sulfolane-affected area in North Pole, Alaska. All of the sample locations are within the Fairbanks North Star Borough (FNSB).

The Alaska Department of Environmental Conservation (ADEC) retained ERM Alaska, Inc. (ERM) to collect samples needed to assess sulfolane concentrations in different media to support gravel mining operations in the area; to evaluate potential ecological risk in surface water; and to investigate groundwater-surface water interactions to assist with interpreting previous surface water and piezometer samples collected by Flint Hills Resources (FHR), as well as provide further information on the fate and dissolved sulfolane in the transition between groundwater and surface water.

BACKGROUND

The North Pole Refinery (NPR) is an active petroleum refinery that receives crude oil feedstock from the Trans-Alaska Pipeline. The site was developed in the mid-1970s, and operations began in 1977. The NPR contains crude oil processing units, tank farms, truck-loading racks, wastewater treatment lagoons, storage areas and two flooded gravel pits. Since 1985, the NPR has used a proprietary chemical, sulfolane, in the refining process to extract aromatics from the feedstock. Throughout the years, there were documented releases of sulfolane at the NPR, and high concentrations of sulfolane were historically detected in the wastewater lagoons. In 2009, sulfolane was first detected in groundwater samples from offsite monitoring wells.

In 2012, the state of Alaska established an alternative cleanup level (ACL) of 14 micrograms per liter (μg/L) for sulfolane in water at the site (ADEC 2012b). Extensive characterization work has shown the sulfolane groundwater plume above the ACL to extend approximately 3.5 miles downgradient (north) of the NPR. Sulfolane has been detected in shallow monitoring wells screened across the water table, deeper monitoring wells, and also in private wells completed below the permafrost at depths up to approximately 300 feet below ground surface (bgs). The extent of sulfolane in groundwater exceeding the 14 µg/L ACL at the water table, as of the 4th quarter of 2012 (Arcadis 2013), is shown in Figure 1.

SAMPLE LOCATIONS

Ten gravel ponds and other small surface water bodies located within and near the sulfolane groundwater plume to the north, northeast and northwest of the NPR were identified for sampling in the Gravel Pits, Ponds, Badger Slough Surface Water, Groundwater and Sediment Sampling Work Plan (ERM 2013). Before the current effort, a very limited number of samples had been collected from surface water or shallow groundwater adjacent to surface water north of the refinery. The historical sample results are presented in the Revised Site Characterization Report Through 2011 (Arcadis 2013) and summarized in Table 1.

ERM worked with the ADEC to identify and contact the owners of the ten ponds proposed for sampling. Not all property owners were successfully reached, and some did not grant access, resulting in the sampling of a total of six pond locations. Contact information is summarized in the work plan (ERM 2013). Sample locations are shown in Figure 1.

At each pond, surface water and sediment samples were collected from three locations (typically east, middle and west) along the shoreline closest to the refinery. However, at Pond #10, only one surface water and sediment sample were collected, because this pond is located outside of the mapped sulfolane plume (Figure 1). One groundwater sample was collected at the middle location of each pond. Individual pond sampling locations are shown in Figures 2 through 6.

Three locations along the Badger Slough were sampled: a north, middle and south location. One surface water, sediment and groundwater sample was collected at each slough location. An additional surface water sample was collected from each location for stable isotope analysis to support ongoing work by the University of Alaska, Fairbanks (UAF). This work is not discussed in this report.

FIELD WORK AND SAMPLING PROCEDURES

Samples were collected between 18 and 26 June 2013 by ERM staff. Field notes are provided in Attachment A. Weather at the time of sampling was mostly sunny with air temperatures ranging from 65 to 80 degrees Fahrenheit. Samples were collected at nine separate locations as shown in Figure 1. Figures 2 through 6 depict the individual sampling locations of each pond or slough. A photograph log of the sampling events is presented in Attachment B.

The field team coordinated with analytical laboratory SGS North America, Inc. (SGS) in Fairbanks and the UAF to pick up sample containers. UAF provided six vials for collecting surface water and groundwater samples from each of the slough locations for stable isotope analysis.

Subsurface clearance (SSC) was conducted at each groundwater sample location by ERM personnel before sampling activities. Sample locations were selected to be approximately 4 feet from the edge of each pond. Ground disturbance activities were conducted by physically clearing each location with a shovel to a depth of at least 1 foot bgs, or until groundwater or frozen ground were encountered. Each of the ground disturbance locations were outside of known or suspected critical zones (as defined for subsurface clearance risk). Frozen ground was encountered at approximately 1 foot bgs at the first SSC location (Pond #4). The SSC personnel attempted, but were unsuccessful to find an alternative location with unfrozen gravelly soils along Pond #4. Gravelly areas were preferentially selected, where present, at the remaining ponds to avoid frozen ground.

The procedures for surface water, groundwater and sediment sample collection are described in the following sections.

Surface Water

From the pond bank, clean polyethylene tubing was run through a 6-foot long, ¾-inch diameter polyvinyl chloride (PVC) pipe and extended into the lake to a depth of 4 to 8 inches to collect the surface water sample. A floating boom system was constructed by attaching two disposable pieces of Styrofoam to the PVC pipe, which prevented the PVC pipe from coming into contact with the surface water. New Styrofoam was attached to the PVC pipe at each water body location.

The samples were collected using a peristaltic pump attached to a ¼-inch polyethylene tube, extended into the lake through the PVC pipe. The tube typically extended 4 to 6 inches below the surface of the water. Water quality parameters were measured using an YSI® 556 Multi Parameter Water Quality Meter and flow-through cell and were allowed to stabilize before sample collection. A new section of tubing was used at each sample location. Surface water quality parameters are presented in Table 2 and sample data sheets are provided in Attachment A.

Water exiting the flow-through cell and excess sample water were collected in a 5-gallon bucket and then discharged on the ground surface after sampling was completed.

Groundwater Samples

Groundwater samples were collected from the previously dug SSC holes, which were located at approximately the linear mid-point of each of the pond shorelines. A ¼-inch polyethylene tube was extended below the water surface for sample collection. Water quality parameters were taken every 3 to 5 minutes until stabilization was reached.

Water quality parameters are presented in Table 3, and sample data sheets are included in Attachment A.

Sediment Samples

Sediment samples were collected from a location just above the water line along a straight line from the surface water sample to the shore. A decontaminated shovel was used to dig a hole approximately 6 inches deep. The sample was collected using a disposable sample spoon to remove the upper half inch of material from the sample site, and then collecting the sample material below the water level. Sediment sample information is summarized in Table 4.

Finer-grained material was selected for the sample by using a gloved hand to remove larger debris and to squeeze out as much of the water from the sediment as possible before placing the sample into the container. The container was filled completely, and any material adhering to the lip or threaded section of the container was wiped off.

Work Plan Deviations

Groundwater samples were collected by purging water from the previously cleared SSC locations, as opposed to using the temporary well points described in the work plan. Frozen ground encountered during the SSC process at the first pond cleared (Pond #4), prevented the use of the temporary well point equipment. Due to the non-volatile characteristic of sulfolane and field observations indicating connectivity between the groundwater encountered in the SSC hole and the pond, it was determined that the SSC hole was a sufficient groundwater sampling location. After successfully sampling Pond #4, field personnel recommended collecting all groundwater samples from SSC pits, instead of introducing another variable by using two different groundwater sample methods (i.e., collection from SSC holes at ponds with frozen soil and temporary well points at the other ponds). Concurrence for this deviation was obtained from the ADEC by email. Thereafter, the groundwater samples were collected by purging accumulated groundwater through a flow-through cell at low-flow rates from one SSC location at each pond.

Another work plan deviation involved a change in decontamination method. Due to extreme fire danger at the time the sampling efforts took place, a propane torch was not used to decontaminate non-disposable sampling tools. The decision to not use temporary well points significantly decreased the amount of non-disposable tools requiring decontamination. Non-disposable tools were brushed free of debris and rinsed thoroughly with de-ionized water. An equipment blank was collected and did not result in any detection of sulfolane.

QUALITY ASSURANCE AND QUALITY CONTROL

The laboratory analysis was performed by SGS using analytical methods consistent with the ADEC’s Key Elements Document for sulfolane analysis in water and soil. Tabulated results are presented in Table 5. The data were reviewed and verified to conform to the ADEC Environmental Laboratory Data and Quality Assurance Requirements, Technical Memo-06-2002, dated March 2009. The ADEC Laboratory Data Review Checklists were completed for each laboratory work order and are provided as Attachment C. A quality assurance review (QAR) was prepared and is provided in Attachment C and contains more details regarding data quality. Laboratory analytical reports are provided as Attachment D. In summary, all data was found to be of appropriate quality and usability.

The samples were received at the laboratory in good condition and within holding times and acceptable temperature ranges. There were no issues with the chain of custody documentation. The sensitivity of the methods and analysis were found to be acceptable. The limit of detection for all samples was below the ADEC's groundwater ACL of 14 μg/L and soil screening level of 38 μg/kg. No target levels have been set for surface water or sediment at the site. There were no detections of sulfolane in the method blanks.

One groundwater, two sediment and three surface water sample duplicates were collected to evaluate the precision of analytical measurements. Sulfolane was not detected in any of the primary-duplicate pairs above the limit of quantitation (LOQ) so the relative percent difference (RPD) could not be calculated. Laboratory analytical precision was evaluated by the RPD calculations using the laboratory control sample (LCS)/laboratory control sample duplicate (LCSD) and matrix spike (MS)/matrix spike duplicate (MSD).

Laboratory analytical accuracy was assessed by evaluating the analyte recoveries from LCS/LCSD and MS/MSD analyses. Accuracy was also assessed by evaluating the recovery of the internal standard, sulfolane-d8. Recovery of sulfolane-d8, LCS/LCSD and MS/MSD recoveries were within acceptable limits with the exception of the sediment MS/MSD in sample delivery group 1137945, which had percent recovery and RPD values above acceptable limits. Associated sample NPR-13-SO-8W was flagged estimated J-M due to MS/MSD failure. Sample NPR-13-SO-8W was also estimated (J) because the result was between the method detection limit (DL) and LOQ.

Based on the quality assurance (QA) review, all samples were determined to be usable with appropriate flags.

RESULTS

Analytical sample results are presented in Table 5 and are summarized below.

- Sulfolane was not detected above the analytical reporting limit (also known as LOQ) in any of the sediment samples. Sulfolane was detected in sample NPR-13-SO-8W (Pond #8) at 10.9 μg/kg, which is below the laboratory LOQ, but above the laboratory method DL, and is therefore an estimated value.

- Sulfolane was not detected above the laboratory DL in any of the surface water samples.
- Sulfolane was detected above the laboratory reporting limit and above the ADEC ACL of 14 µg/L in one groundwater sample, 13-NPR-GW-4M (Pond #4) at a concentration of 20.6 µg/L. Sulfolane was not detected above the laboratory DL in any other groundwater sample.
- Data were considered useable to assess sulfolane concentrations at the time and locations of the sampling event.
- DLs were below risk screening values appropriate for the site (ADEC 2012b).
- Sediments were generally silty sand or sandy silt with gravel (Table 4).

EVALUATION

Sulfolane was not detected in any surface water sample. This result supports the conceptual site model assumption that ecological receptors are not exposed to sulfolane in surface water.

The connectivity between surface water and groundwater was not thoroughly investigated, but as discussed on page 4, field observations indicate a connection between the groundwater and adjacent ponds. However, the connection likely varies locally and temporally due to seasonal frost and pond freezing. The ponds were thawed at the time of the current sampling, and two of the SSC holes encountered seasonal frost (Locations #4M and #8M), suggesting that the groundwater samples may have better connection to adjacent surface water than deeper groundwater. The other SSC holes did not encounter frost, at least to the maximum depth of the hole. Conditions at the time of FHR's previous piezometer sampling were different. The ponds were frozen, and piezometer samples were collected approximately 3 to 4 feet below the water table; therefore, FHR concluded that the samples may be more representative of groundwater than of conditions at the interface between surface water and groundwater. As a result of the different site conditions, the current groundwater results are not directly comparable to FHR's piezometer results.

The 2013 data suggest that high groundwater sulfolane concentrations are not indicative of high sulfolane concentrations in nearby surface water bodies. Ponds #4, #5 and #8 are located in an area of known suprapermafrost sulfolane groundwater concentrations between 200 µg/L and 300 µg/L (based on MW-161A/B), as well as elevated sulfolane concentrations in FHR's previous piezometer sampling (Table 1). However, the June 2013 samples showed only a single groundwater detection of 20.6 µg/L from a shallow pit adjacent to Pond #4 and no surface water detections in these ponds. In comparison, July 2013 sulfolane concentrations in groundwater from MW-161A and B were 226 µg/L and 263 µg/L, respectively. The reason that the June 2013 sulfolane concentrations in surface water and adjacent shallow groundwater samples are significantly lower than sulfolane concentrations in nearby monitoring wells, such as MW-161, is not known and has not been investigated; dilution and possibly degradation in the presence of oxygen may play a role.

The surface water, groundwater and sediment results do not indicate that active gravel mining operations are impacted by sulfolane. The only pond sampled that is in active use as a gravel pit is Pond #6, and there were no sulfolane detections in any samples from Pond #6. In addition, sulfolane was not detected in previous piezometer and soil sampling performed by FHR at this location (Table 1). The single sulfolane detection in sediment was from Pond #8; which, along with Ponds #4 and #5, has not been used for gravel mining in many years, and there is no intent to resume gravel mining operations in these areas (verbal communication with the property owner).

The samples from Badger Slough show no indication of sulfolane impact to the slough surface water or sediment, nor to shallow groundwater adjacent to the slough.

Please contact us if you have any questions or require additional information.

Sincerely,

Jane H Paris

Digitally signed by Jane Paris
DN: cn=Jane Paris, o=ERM, ou, email=jane.paris@erm.com, c=US
Date: 2013.11.13 13:17:37 -07'00'

Jane Paris
Project Manager

Max W Schwenne

Max Schwenne
2013.11.13
10:58:03 -10'00'

Max Schwenne
Managing Partner

cc:

Tamara Cardona, ADEC (via e-mail)

Attachments:

A. Field Notes
B. Photograph Log
C. QAR and ADEC Checklist
D. Laboratory Data

REFERENCES

ADEC 2009. Environmental Laboratory Data and Quality Assurance Requirements. March 2009.

ADEC 2012a. Oil and Hazardous Substances Pollution Control. Alaska Department of Environmental Conservation. 8 April 2012.

ADEC 2012b. Letter from Steve Bainbridge to Loren Garner, Alaska Department of Environmental Conservation. 19 July 2012

Arcadis 2013. Fourth Quarter 2012 Groundwater Monitoring Report. North Pole Refinery, North Pole, Alaska. 1 March 2013.

ERM 2013. Gravel Pits, Ponds and Badger Slough Groundwater, Surface water and Sediment Sampling Work Plan, North Pole, Alaska. June 2013.

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FIGURES

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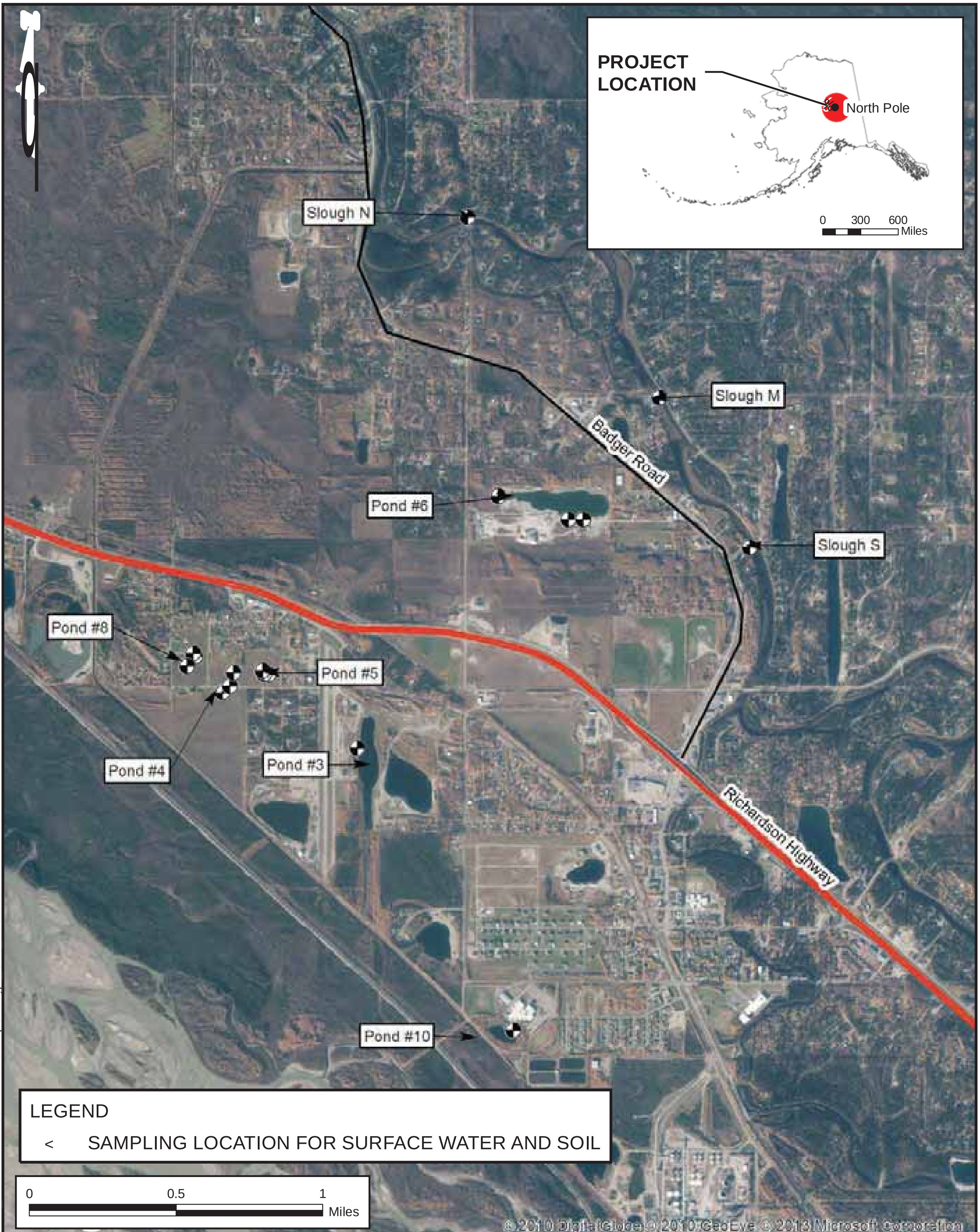

F:\GIS\Projects\0149896 Flint Hills\Flint Hills\mxd\2013 Report\Fig1 Site Location.mxd

ERM	DATE: JUNE 2013 CHKD: J.P. DRWN: S.M.C. PROJ. No.: 0149896 825 W. 8th Ave., Anchorage, AK 99501, (907) 258-4880	**SITE LOCATION** GRAVEL PITS & BADGER SLOUGH GRAVEL PITS SURFACE WATER AND GRAVEL SAMPLING REPORT North Pole, Alaska	FIGURE 1

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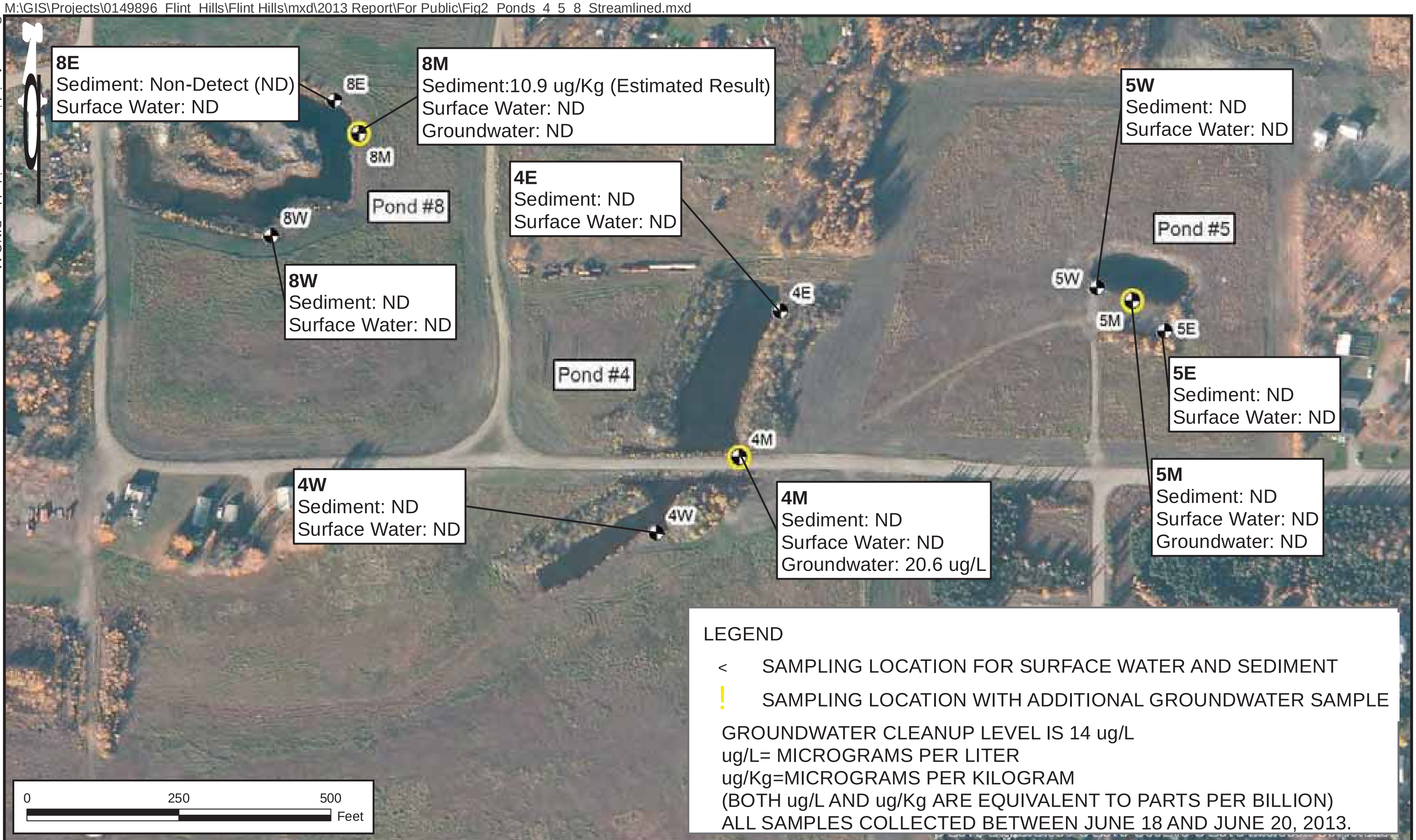

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PROJ. No.: 0149896

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PONDS #4, #5, AND #8

GRAVEL PITS & BADGER SLOUGH
REPORT FOR THE ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION
North Pole, Alaska

FIGURE 2

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DRWN: W.C.K.
PROJ. No.: 0149896

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POND #6

GRAVEL PITS
REPORT FOR THE ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION
North Pole, Alaska

FIGURE 3

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JUNE 2013 SULFOLANE SAMPLE RESULTS

GRAVEL PITS
REPORT FOR THE ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION
North Pole, Alaska

FIGURE 4

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ERM	DATE: SEP. 2013 CHKD: J.P. DRWN: W.C.K. PROJ. No.: 0149896 825 W. 8th Ave., Anchorage, AK 99501, (907) 258-4880	**POND #3** GRAVEL PITS REPORT FOR THE ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION North Pole, Alaska	FIGURE **5**

Source: Aerial image provided by BING Maps

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SLOUGHS N, M, AND S

GRAVEL PITS
REPORT FOR THE ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION
North Pole, Alaska

FIGURE
6

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TABLES

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Table 1: Historical Surface Water and Piezometer Sample Summary North Pole, Alaska

FHR Sample #	Pond ID*	Date	On/Off Site	Location	Sample Type	Result	Units
North Gravel Pit	n/a	August 2010	On-site	North Gravel Pit	Surface Water	<10	ug/L
South Gravel Pit	n/a	August 2010	On-site	South Gravel Pit	Surface Water	<10	ug/L
Surface-001	Slough-N	October 2010	Off-site	Badger Slough	Surface Water	<10.2	ug/L
Pore-1	n/a	December 2011	On-site	North Gravel Pit	Piezometer	407	ug/L
Pore-2	Pond #1	March 2012	Off-site	Rosson's Gravel Pit	Access Denied		
Pore-3	Pond #4	March 2012	Off-site	Gravel Pit NW of MW-161	Piezometer	156	ug/L
Pore-4	Pond #5	March 2012	Off-site	Gravel Pit NW of MW-161	Piezometer	29	ug/L
Pore-5	Pond #6	December 2011	Off-site	HC Construction Pit (Intersection near Badger Road and Peridot Road	Pore-water	<6.2	ug/L
Pore-6	Pond #6	March 2012	Off-site	HC Construction Pit	Not collected due to field miscommunication issue		

*Pond ID as identified in this report and shown on Figures 1-5.
Piezometer samples collected from piezometers screened 3-4 feet below water table. Adjacent ponds were frozen at the time of sampling.

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Table 2: Surface Water Water Quality Parameters
Gravel Pits, Ponds, and Badger Slough Sampling
North Pole, Alaska

Location	Sample Date	Sample Time	Temp. (°C)	pH	Specific Conductivity $mS/cm^{c°}$)	Conductivity (μS/cm)	Dissolved Oxygen (mg/L)	ORP (mV)	Color/ Turbidity	Odor	Sample Depth (feet)	Total Depth (feet)
SW-3M	6/26/2013	1:10 PM	25.3	8.3	0.300	302	7.4	-230	clear/none	none	0.4	1.2
SW-3N	6/26/2013	12:09 PM	24.4	8.2	0.305	301	7.2	-196	clear/none	none	0.6	1.5
SW-3S	6/26/2013	3:10 PM	25.5	8.3	0.301	304	7.5	-190	clear/none	none	0.7	3.0
SW-4M	6/19/2013	3:40 PM	24.2	7.5	0.182	179	7.3	-153	clear/none	none	0.3	1.5
SW-4W	6/19/2013	4:20 PM	25.2	7.6	0.229	230	7.5	-81	clear/none	none	0.5	3.0
SW-4E	6/19/2013	5:00 PM	25.5	7.6	0.181	182	7.8	-90	clear/none	none	0.2	2.0
SW-5M	6/18/2013	12:45 AM	27.0	7.2	0.184	191	7.2	-211	amber/none	none	3.0	6.0
SW-5W	6/18/2013	3:25 PM	24.4	8.1	0.184	182	8.2	-236	clear/none	none	0.4	1.8
SW-5E	6/18/2013	4:15 PM	27.6	8.3	0.184	193	7.9	-201	clear/none	none	0.2	0.4
SW-6M	6/20/2013	10:20 AM	17.9	7.0	0.378	326	8.6	-180	clear/none	none	0.4	1.5
SW-6W	6/20/2013	11:50 AM	21.9	8.2	0.368	346	9.9	-205	clear/none	none	0.3	0.7
SW-6E	6/20/2013	11:15 AM	18.8	7.5	0.366	322	8.9	-232	clear/none	none	0.3	0.8
SW-8M	6/19/2013	10:30 AM	21.9	7.8	0.297	280	7.1	-157	clear/none	none	0.6	2.0
SW-8W	6/19/2013	12:00 PM	23.8	8.1	0.298	291	8.6	-190	clear/none	none	0.2	1.0
SW-8E	6/19/2013	11:10 AM	22.2	7.8	0.297	281	8.2	-161	clear/none	none	0.7	2.5
SW-10M	6/20/2013	2:20 PM	25.8	9.5	0.221	225	13.9	-230	clear/none	none	0.2	2.0
SW-S-S	6/20/2013	4:00 PM	16.7	7.6	0.347	292	9.5	-115	clear/none	none	0.6	1.0
SW-S-M	6/21/2013	10:10 AM	14.0	6.5	0.358	282	9.6	-115	clear/none	none	0.4	0.6
SW-S-N	6/21/2013	11:15 AM	12.6	8.0	0.341	260	10.2	-194	clear/none	none	0.4	1.0

Notes:

mg/L = milligram per liter

mV =millivolt

$mS/cm^{c°}$= milliSiemens per centimeter (corrected for temperature)

μS/cm = microSiemens per centimeter

ORP = oxygen reduction potential

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Table 3: Groundwater Water Quality Parameters
Gravel Pits, Ponds, and Badger Slough Sampling
North Pole, Alaska

Location	Sample Date	Sample Time	Temp. (°C)	pH	Specific Conductivity $mS/cm^{c°}$	Conductivity (µS/cm)	Dissolved Oxygen (mg/L)	ORP (mV)	Color/ Turbidity	Odor	Sample Depth (feet)	Total Depth (feet)	Frozen Ground (ft. bgs)
GW-3M	6/26/2013	2:16 PM	23.7	7.0	0.341	333	0.9	-221	clear/none	none	0.5	1.3	none
GW-4M	6/19/2013	3:15 PM	12.9	6.5	0.670	515	3.0	-258	clear/none	none	0.5	1.0	2.0
GW-5M	6/18/2013	2:40 PM	22.3	6.1	0.320	351	2.0	-305	clear/none	none	0.7	1.4	none
GW-6W	6/20/2013	12:30 PM	20.3	7.0	0.427	388	2.1	-187	clear/none	none	0.1	0.6	none
GW-8M	6/19/2013	10:00 AM	12.2	6.9	0.545	412	4.4	-228	clear/none	none	0.5	1.3	1.0
GW-10M	6/21/2013	1:45 PM	10.0	6.9	0.740	530	1.9	-256	brown/low	none	0.6	1.0	none
GW-S-S	6/21/2013	1:00 PM	11.4	7.1	0.324	240	0.7	-308	amber/high	none	0.2	1.5	none
GW-S-M	6/21/2013	10:40 AM	6.3	5.3	0.425	273	1.8	-249	grey/low	none	0.1	0.6	1.25
GW-S-N	6/21/2013	12:00 PM	9.1	6.4	0.264	184	1.2	-259	clear/none	none	0.2	0.8	none

Notes:
mg/L = milligram per liter
mV =millivolt
$mS/cm^{c°}$= milliSiemens per centimeter (corrected for temperature)
µS/cm = microSiemens per centimeter
ORP = oxygen reduction potential

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Table 4: Sediment Types
Gravel Pits, Ponds, and Badger Slough Sampling
North Pole, Alaska

Location	Sample Date	Time	Sample Depth (inches)	Soil Type	Total Solids (%)
SO-3M	6/26/2013	1:20 PM	NA	sandy gravel	79.7
SO-3N	6/26/2013	12:20 PM	NA	silty sand	79.9
SO-3S	6/26/2013	3:20 PM	NA	silty sand	77.2
SO-4M	6/19/2013	3:50 PM	5-6	sandy gravel	51.2
SO-4W	6/19/2013	4:30 PM	4-5	silty sand with gravel	79.2
SO-4E	6/19/2013	5:10 PM	4-5	silty sand	57.7
SO-5M	6/18/2013	2:55 PM	3-4	sandy gravel	83
SO-5W	6/18/2013	3:45 PM	3-4	sandy gravel	82.9
SO-5E	6/18/2013	4:45 PM	2-3	silty sand	86.7
SO-6M	6/20/2013	10:30 AM	NA	gravel	88.7
SO-6W	6/20/2013	11:55 AM	1-6	sandy gravel	88.7
SO-6E	6/20/2013	11:25 AM	NA	sandy gravel	88.3
SO-8M	6/19/2013	12:10 PM	2-3	sandy gravel	77.7
SO-8W	6/19/2013	10:20 AM	5-6	silty sand	72.7
SO-8E	6/19/2013	11:20 AM	3-4	gravelly sand	72.3
SO-10M	6/20/2013	2:30 PM	NA	sandy gravel with organics	76.6
SO-S-S	6/20/2013	4:10 PM	NA	sandy gravel	64.7
SO-S-M	6/21/2013	10:20 AM	NA	silty sand with gravel	76.2
SO-S-N	6/21/2013	11:25 AM	NA	sandy gravel	77.6

Notes:
NA - not available, not recorded. Sample depths were generally less than 6 inches.

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Table 5: Analytical Results
Gravel Pits, Ponds, and Badger Slough Sampling
North Pole, Alaska

Sample ID	Location	Date Sampled	Sulfolane-SW8270D M with Isotope Dilution	Sulfolane-EPA1625B
			Sulfolane (mg/Kg)	Sulfolane (mg/L)
Sediment Samples: No ADEC target level set				
NPR-13-SO-3M	Pond #3	6/26/2013	ND (0.00770)	--
NPR-13-SO-3N	Pond #3	6/26/2013	ND (0.00768)	--
NPR-13-SO-3S	Pond #3	6/26/2013	ND (0.00794)	--
NPR-13-SO-4E	Pond #4	6/19/2013	ND (0.01204)	--
NPR-13-SO-4M	Pond #4	6/19/2013	ND (0.00772)	--
NPR-13-SO-4W	Pond #4	6/19/2013	ND (0.0107)	--
NPR-13-SO-5E	Pond #5	6/18/2013	ND (0.00734)	--
NPR-13-SO-5M	Pond #5	6/18/2013	ND (0.00746)	--
NPR-13-SO-5W	Pond #5	6/18/2013	ND (0.00706)	--
NPR-13-SO-6E	Pond #6	6/20/2013	ND (0.00698)	--
NPR-13-SO-6M	Pond #6	6/20/2013	ND (0.00694)	--
NPR-13-SO-6W	Pond #6	6/20/2013	ND (0.00696)	--
NPR-13-SO-8M	Pond #8	6/19/2013	ND (0.00786)	--
NPR-13-SO-8W	Pond #8	6/19/2013	0.0109 J-M	--
NPR-13-SO-8E	Pond #8	6/19/2013	ND (0.00852)	--
NPR-13-FD-2 (dup of SO-8E)	Pond #8	6/19/2013	ND (0.00842)	--
NPR-13-SO-10M	Pond #10	6/20/2013	ND (0.00804)	--
NPR-13-FD-4 (dup of SO-10M)	Pond #10	6/20/2013	ND (0.00842)	--
NPR-13-SO-S-S	Slough S	6/20/2013	ND (0.00956)	--
NPR-13-SO-S-N	Slough N	6/21/2013	ND (0.00806)	--
NPR-13-SO-S-M	Slough M	6/21/2013	ND (0.00796)	--
Groundwater Samples: ADEC ACL 0.014 mg/L				
NPR-13-GW-3M	Pond #3	6/26/2013	--	ND (0.00678)
NPR-13-GW-4M	Pond #4	6/19/2013	--	**0.0206**
NPR-13-GW-5M	Pond #5	6/18/2013	--	ND (0.00646)
NPR-13-GW-6W	Pond #6	6/20/2013	--	ND (0.00682)
NPR-13-GW-8M	Pond #8	6/19/2013	--	ND (0.00646)
NPR-13-GW-10M	Pond #10	6/21/2013	--	ND (0.00660)
NPR-13-GW-S-M	Slough S	6/21/2013	--	ND (0.00652)
NPR-13-FD-S (dup of GW-S-M)	Slough S	6/21/2013	--	ND (0.00652)
NPR-13-GW-S-N	Slough S	6/21/2013	--	ND (0.00640)
NPR-13-GW-S-S	Slough S	6/21/2013	--	ND (0.00660)
Surface Water Samples: No ADEC target level set				
NPR-13-FD-6 (dup of SW-3M)	Pond #3	6/26/2013	--	ND (0.00688)
NPR-13-SW-3M	Pond #3	6/26/2013	--	ND (0.00674)

Table 5: Analytical Results
Gravel Pits, Ponds, and Badger Slough Sampling
North Pole, Alaska

Sample ID	Location	Date Sampled	Sulfolane-SW8270D M with Isotope Dilution	Sulfolane-EPA1625B
			Sulfolane (mg/Kg)	Sulfolane (mg/L)
NPR-13-SW-3N	Pond #3	6/26/2013	--	ND (0.00688)
NPR-13-SW-3S	Pond #3	6/26/2013	--	ND (0.00666)
NPR-13-SW-4E	Pond #4	6/19/2013	--	ND (0.00652)
NPR-13-SW-4M	Pond #4	6/19/2013	--	ND (0.00630)
NPR-13-SW-4W	Pond #4	6/19/2013	--	ND (0.00652)
NPR-13-SW-5E	Pond #5	6/18/2013	--	ND (0.00652)
NPR-13-SW-5M	Pond #5	6/18/2013	--	ND (0.00620)
NPR-13-SW-5W	Pond #5	6/18/2013	--	ND (0.00652)
NPR-13-SW-6E	Pond #6	6/20/2013	--	ND (0.0062)
NPR-13-FD-3 (dup of SW-6E)	Pond #6	6/20/2013	--	ND (0.00646)
NPR-13-SW-6M	Pond #6	6/20/2013	--	ND (0.00652)
NPR-13-SW-6W	Pond #6	6/20/2013	--	ND (0.00620)
NPR-13-SW-8E	Pond #8	6/19/2013	--	ND (0.00660)
NPR-13-SW-8M	Pond #8	6/19/2013	--	ND (0.00640)
NPR-13-FD-1 (dup of SW-8M)	Pond #8	6/19/2013	--	ND (0.00682)
NPR-13-SW-8W	Pond #8	6/19/2013	--	ND (0.00646)
NPR-13-SW-10M	Pond #10	6/20/2013	--	ND (0.00642)
NPR-13-SW-S-S	Slough S	6/20/2013	--	ND (0.00640)
NPR-13-SW-S-M	Slough M	6/21/2013	--	ND (0.00640)
NPR-13-SW-S-N	Slough N	6/21/2013	--	ND (0.00660)
Equipment Blank Sample				
NPR-13-EB-1	EB	6/26/2013	--	ND (0.00670)

Notes:

GW = groundwater SW = surface water EB=equipment blank

J-M = result is estimated due to Matrix Spike (MS)/MS duplicate failure

mg/Kg = milligram per kilogram

mg/L = milligram per liter

-- not applicable

ND (###) = not detected above the laboratory limit of detection, where "###" is the limit of detection (LOD

LOD = 2 x detection limit

Results above ADEC cleanup levels are bolded and underlined

ADEC = Alaska Department of Environmental Conservation