

# Lake Chemistry and Physical Data For Selected North Slope, Alaska, Lakes: October 2006



*Photo of October conditions in the Brooks Range, by J. Derry.*

by

Kristie Holland, Michael Lilly, Jeff Derry, and Daniel Reichardt

September 2007

North Slope Lakes Hydrologic Modeling Project

Report No. INE/WERC 07.02

Water and Environmental  
Research Center



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Kristie Holland<sup>1</sup>, Michael Lilly<sup>1</sup>, Jeff Derry<sup>1</sup>, Dan Reichardt<sup>1</sup>

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**Alaska Department of Energy, National Energy Technology Laboratory, BP  
Exploration (Alaska) Inc., ConocoPhillips Alaska, Inc., and the Bureau of  
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<sup>1</sup>Geo-Watersheds Scientific, Fairbanks, Alaska

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## **DISCLAIMER**

The contents of this report reflect the views of the authors, who are responsible for the accuracy of the data presented herein. This research was funded by the U.S. Department of Energy (DOE), National Energy Technology Laboratory (NETL). Funding and support was also provided by the Bureau of Land Management (BLM), BP Exploration (Alaska) Inc. (BPX), ConocoPhillips Alaska, Inc. (CPA), and Geo-Watersheds Scientific (GWS). The contents of the report do not necessarily reflect the views or policies of the DOE, NETL, BLM, BPX, CPA, GWS, or any local sponsor. This work does not constitute a standard, specification, or regulation.

The use of trade and firm names in this document is for the purpose of identification only and does not imply endorsement by the University of Alaska Fairbanks, DOE, NETL, BLM, BPX, CPA, GWS, or other project sponsors.

# CONVERSION FACTORS, UNITS, WATER QUALITY UNITS, VERTICAL AND HORIZONTAL DATUM, ABBREVIATIONS AND SYMBOLS

## Conversion Factors

Multiply	By	To obtain
<u>Length</u>		
Inch (in)	25.4	millimeter (mm)
Inch (in)	2.54	centimeter (cm)
Foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
<u>Area</u>		
Acre	43560.0	square feet (ft <sup>2</sup> )
Acre	0.405	hectare (ha)
square foot (ft <sup>2</sup> )	3.587e-8	square mile (mi <sup>2</sup> )
square mile (mi <sup>2</sup> )	2.590	square kilometer (km <sup>2</sup> )
<u>Volume</u>		
gallon (gal)	3.785	liter (L)
gallon (gal)	3785.412	milliliter (mL)
cubic foot (ft <sup>3</sup> )	28.317	liter (L)
Acre-ft	1233.482	cubic meter (m <sup>3</sup> )
Acre-ft	325851.43	gallon(gal)
gallon(gal)	0.1337	cubic feet (ft <sup>3</sup> )
<u>Velocity and Discharge</u>		
foot per day (ft/d)	0.3048	meter per day (m/d)
Square foot per day (ft <sup>2</sup> /d)	0.0929	square meter per day (m <sup>2</sup> /d)
cubic foot per second (ft <sup>3</sup> /s)	0.02832	cubic meter per second (m <sup>3</sup> /sec)
<u>Hydraulic Conductivity</u>		
foot per day (ft/d)	0.3048	meter per day (m/d)
foot per day (ft/d)	0.00035	centimeter per second (cm/sec)
meter per day (m/d)	0.00116	centimeter per second (cm/sec)
<u>Hydraulic Gradient</u>		
foot per foot (ft/ft)	5280	foot per mile (ft/mi)
foot per mile (ft/mi)	0.1894	meter per kilometer (m/km)
<u>Pressure</u>		
pound per square inch (lb/in <sup>2</sup> )	6.895	kilopascal (kPa)

## Units

For the purposes of this report, both English and Metric (SI) units were employed. The choice of “primary” units employed depended on common reporting standards for a particular property or parameter measured. Whenever possible, the approximate value in the “secondary” units was also provided in parentheses. Thus, for instance, stream flow was reported in cubic feet per second (cfs) followed by the value in cubic meters per second (m<sup>3</sup>/s) in parentheses.

### Physical and Chemical Water-Quality Units:

#### Temperature:

Water and air temperature is given in degrees Celsius (°C) and in degrees Fahrenheit (°F).

Degrees Celsius can be converted to degrees Fahrenheit by use of the following equation:

$$^{\circ}\text{F} = 1.8(^{\circ}\text{C}) + 32$$

#### Electrical Conductance (Actual Conductivity and Specific Conductance):

In this report conductivity of water is expressed as Actual Conductivity [AC] in microSiemens per centimeter (μS/cm). This unit is equivalent to micromhos per centimeter. Elsewhere, conductivity is commonly expressed as Specific Conductance at 25°C [SC25] in μS/cm which is temperature corrected. To convert AC to SC25 the following equation can be used:

$$SC25 = \frac{AC}{1 + r(T - 25)}$$

where:

SC25 = Specific Conductance at 25°C, in μS/cm

AC = Actual Conductivity, in μS/cm

R = temperature correction coefficient for the sample, in °C

T = temperature of the sample, in °C



Milligrams per liter (mg/L) or micrograms per liter (µg/L):

Milligrams per liter is a unit of measurement indicating the concentration of chemical constituents in solution as weight (milligrams) of solute per unit volume (liter) of water. One thousand micrograms per liter is equivalent to one milligram per liter. For concentrations less than 7,000 mg/L, the numerical value is the same as for concentrations in parts per million (ppm).

Millivolt (mV):

A unit of electromotive force equal to one thousandth of a volt.

Vertical Datum:

“Sea level” in the following report refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929), a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called *Sea Level Datum of 1929*.

Horizontal Datum:

The horizontal datum for all locations in this report is the North American Datum of 1983 or North American Datum of 1927.

## Abbreviations, Acronyms, and Symbols

AC	Actual conductivity
ADOT&PF	Alaska Department of Transportation and Public Facilities
ASTM	American Society for Testing and Materials
atm	atmospheres
C	Celsius
DO	Dissolved oxygen
DVM	digital voltage multi-meter
e-tape	electric tape
F	Fahrenheit (°F).
ft	feet
GWS	Geo-Watersheds Scientific
GWSI	USGS Ground-Water Site Inventory
km <sup>2</sup>	square kilometers
kPa	kilopascal
lb/in <sup>2</sup>	pounds per square inch
m	meters
mg/L	milligrams per liter, equivalent to ppm
µg/L	micrograms per liter
mi <sup>2</sup>	square miles
mm	millimeters
µS/cm	microsiemens per centimeter
mV	Millivolt
NGVD	National Geodetic Vertical Datum
NWIS	National Water Information System
ORP	oxygen-reduction potential
ppm	parts per million, equivalent to mg/L
SC25	specific conductance at 25°C
QA	quality assurance
QC	quality control
UAF	University of Alaska Fairbanks
USACE	U.S. Army Corps of Engineers, Alaska District
USGS	U.S. Geological Survey
WERC	Water and Environmental Research Center
WWW	World Wide Web
YSI	Yellow Springs Instruments

## **PROJECT COOPERATORS**

The North Slope Lakes project covers a large area of the North Slope and benefits from a number of positive partnerships, all contributing to the overall project objectives.

- Bureau of Land Management
- BP Exploration (Alaska) Inc.
- ConocoPhillips Alaska (CPA)
- Alaska Department of Natural Resources
- The Nature Conservancy
- Northern Alaska Environmental Center

## **ACKNOWLEDGEMENTS**

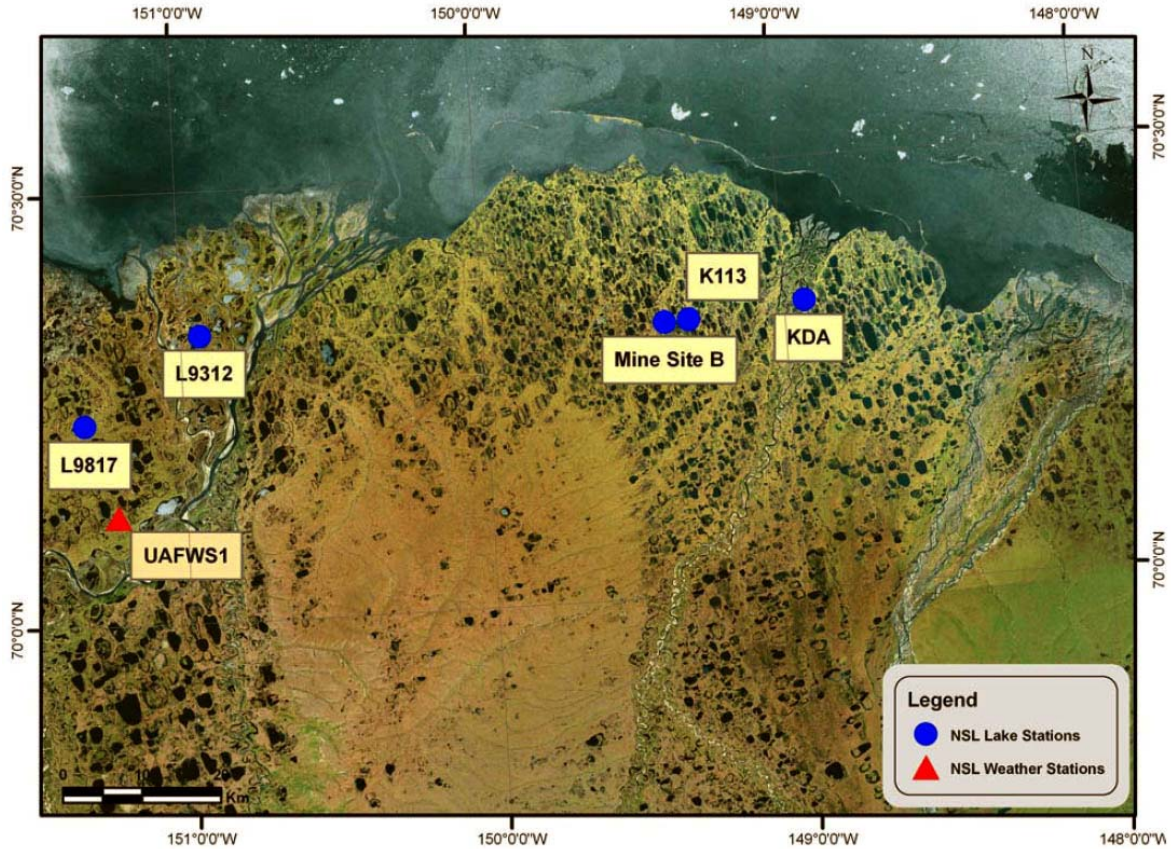
This project was funded by cooperative agreement number DE-FC26\_01NT41248, from the U.S. Department of Energy's (DOE) Arctic Energy Office to the University of Alaska- Fairbanks Arctic Energy Technology Development Laboratory (AETDL). Field coordination and logistics support were provided by BP Exploration (Alaska) Inc. and ConocoPhillips Alaska. Additional support was provided by other project cooperators, Geo-Watersheds Scientific (GWS), North Slope Borough, Bureau of Land Management (BLM), and National Weather Service in the form of financial and in-kind match

# **Lake Chemistry and Physical Data For Selected North Slope, Alaska, Lakes: October 2006**

## **INTRODUCTION**

The University of Alaska Fairbanks (UAF) Water and Environmental Research Center (WERC) and Geo-Watersheds Scientific (GWS), together with project cooperators, initiated a study in the Fall of 2002 (Phase One) to obtain baseline information about the physical and chemical characteristics of North Slope tundra lakes. The project was extended in 2005 (Phase Two). The location of the study lakes changed and was expanded to include other reservoirs so as to further develop the understanding and simulation tools necessary for water-source management. K113 is an un-pumped lake in the Kuparuk oilfield and is sampled on selected field trips during the year. L9312 is a natural lake studied in the Alpine operations area. L9817 is a natural lake in eastern NPRA, west of Nuiqsut. L9817 has been used in previous years for ice-road construction, but was not used during winter 2005-06, nor will be used during the winter of 2006-07. Two reservoir systems (mine sites) were added to the study in 2005. Mine Site B, also known as Six-mile Lake, is located near the Milne Point facility at the intersection of the Spine Road with the Milne Point access road and has two cells connected to Milne Creek. The Kuparuk Reservoir System (Kuparuk Deadarm Lakes) has nine reservoirs. The three southernmost reservoir cells (1-3) are included in the study to observe ground-water and surface-water interactions between each cells and the adjacent Kuparuk River.

Water-quality and hydrologic data is collected in the field during monthly visits to the lakes and water samples are collected from priority locations for further analysis at the UAF-WERC chemistry laboratories. The purposes of this publication are to 1) report data collected for the month of October 2006, 2) summarize accomplished field trip objectives.



**Figure 1. Location of study lakes in NPR-A, Alpine, Kuparuk, and Prudhoe Bay field operating areas, North Slope, Alaska.**

## **TRIP OBJECTIVES**

The goal of each sampling trip is to collect physical and chemical data from each study lake. For each lake, a series of holes are drilled at designated sampling locations. Logistical, personnel, and weather constraints, can limit the amount of time available in the field for sampling. A project workplan was distributed before the trip outlining the sampling schedule (Lilly and others, 2006). In October, we focused on the following locations/tasks:

1. Kuparuk Dead Arm Reservoirs (1-5): Prudhoe Bay operating area.
  - Survey water levels to local elevation control on cells 1, 2, 3, and 4.
  - Install automated data collection stations at cell 2 for water temperature monitoring.
  - Measure snow depth, ice thickness, and field water quality parameters for cell 2.
  - Conduct snow survey.

2. Mine Site B: Prudhoe Bay operating area.
  - Survey water levels to North and South Cells.
  - Install automated data collection stations at North cell for water temperature monitoring.
  - Measure water quality parameters at North Cell and stream.
  - Establish snow survey location for the winter of 2006.
3. L9312: Alpine Facility.
  - Survey water surface elevation of lake and surface gradient transect.
  - Survey lake outlet control elevation system and inspect for problems.
  - Inspect automated data-collection system and service Belfort snow gage.
  - Conduct snow survey.

## **PROCEDURES**

All field work follows the specified health, safety, and environmental guidelines outlined by BPX and CPA (White and Lilly, 2006 *a,b,c*). Using a gas powered auger, holes were drilled through the ice at specified locations at each study lake. Physical measurements of water depth (top of water to bottom of lake), ice thickness (top of ice to bottom of ice), freeboard (top of water to top of ice), and snow depth (top of ice to top of snow), were taken at each sampling location. Water quality parameters such as temperature, pH, conductivity, and dissolved oxygen (DO) were obtained in-situ by using an In-Situ Troll 9000 (submersible meter), at several depths throughout the water column. The precision with which physical measurements were reported takes into account field conditions, and the calibration of each parameter was checked before and after each day of sampling using the criteria in Table 1.

**Table 1. In-Situ Troll 9000 calibration quality control criteria.**

<b>Parameter</b>	<b>Standards used</b>	<b>Acceptable deviation from calibration standard value</b>
Turbidity	Factory calibrated	$\pm 2$ (NTU)
pH	4.01, 7.0, 10.0	$\pm 0.2$
Conductivity	447 ( $\mu\text{s}/\text{cm}$ )	within 10%
100% DO	100 % saturated	within 10%
0% DO	0 % saturated solution	within 0.3 mg/L
ORP	In-Situ Quick Cal 224 mV	within 10%



**Figure 2. . Precipitation gauge at the L9312 weather station, photo by J. Derry.**

## SELECTED RESULTS

Water quality sampling was limited due to time restrictions and prior obligations to installation of weather stations and winter sampling preparation. A few locations were chosen for baseline measurements which could be used for comparative purposes throughout the year. Table 2 summarizes conditions at the priority sampling sites. These locations have more historical data and have been chosen to represent other water bodies in the area.

**Table 2. Ice thickness, Median DO Concentration, Median Actual Conductance, Median Temperature, and Median Depth of selected locations in mid-October.**

Sampling Site	Median DO Concentration[mg/L]	Median Actual Conductivity[ $\mu$ S/cm]	Median Temperature [C]	Median Depth [ft]
<b>KDA-2</b>	-	93.35	0.18	12
<b>MSB-NC</b>	12.67	-	0.155	19
<b>MSB-Stream</b>	8.18	207.7	-0.25	2.5

The October sampling trip was unique in that the primary objective was not to collect data, but to solidify winter sampling procedures and to install new data stations at the Kugaruk Deadarm Reservoirs (KDA-2) and at Mine Site B (North Cell). Snow surveys were conducted at L9312 and KDA, but were not possible at Mine Site B due to a lack of snow. Table 3 summarizes the results. In addition to the installation/maintenance of data stations and identifying winter snow survey locations, thorough elevation surveys were conducted at each lake while weather conditions were optimal. Once winter is in full force, these tasks may be hindered by snow, wind, and/or temperature.

**Table 3. Average and maximum snow depths for L9312 and KDA-2 [cm].**

	Average Depth (cm)	Maximum Depth (cm)
<b>L9312</b>	<b>7.4</b>	<b>18.0</b>
<b>KDA-2</b>	<b>5.2</b>	<b>8.0</b>



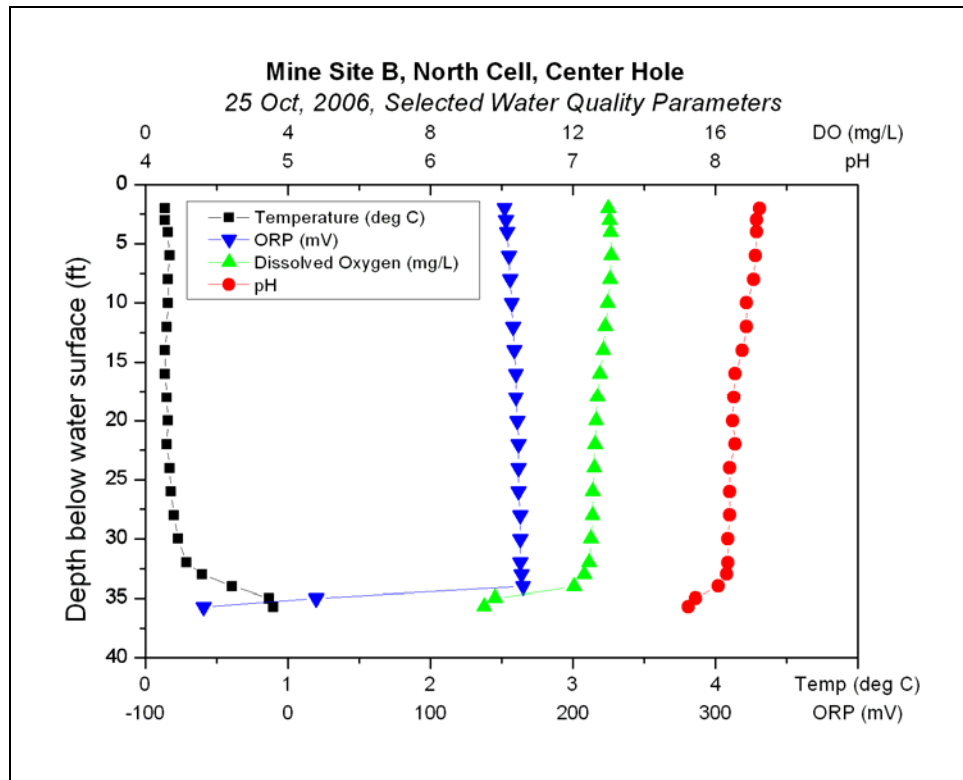


Figure 3. Water quality profile of Mine Site B- North Cell, including temperature DO, ORP and pH.

## SUMMARY

Continuous monitoring of the water-quality parameters seen in North Slope lakes throughout the winter will help in the understanding and development of simulation tools necessary for water resource management. As water levels change due to freezing and pumping activities in the winter, it is important to identify the changing water chemistry as well as the potential spring recharge. This information is important for permitting agencies as well as the industry professionals who depend on this resource for facility use and ice road/pad construction.

Through monthly hydrologic assessments, water-chemistry testing, and water-sample analysis, we hope to answer some of the questions brought forth on the effects of mid-winter pumping of North Slope lakes.

## REFERENCES

- Rust, C., Holland, K., Reichardt, D., and Lilly, M.R. 2006. Lake Chemistry and Physical Data For Selected North Slope, Alaska, Lakes: September 2006. Water and Environmental Research Center, University of Alaska Fairbanks. 19 p.
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## **APPENDIX A. WATER QUALITY FIELD SAMPLING FORMS**

The following forms report the data collected with the water quality meters during field sampling.

**University of Alaska Fairbanks, Water and Environmental Research Center**

**Form F-004a: Water Quality Field-Sampling General**

Project ID: North Slope Lakes Site Location/Lake ID: MSBN-CT  
 Sample Purpose: Lake Water Quality Date: 10/25/06 Time: nr

**FIELD MEASUREMENTS**

GPS Coord. Northing: N70°19.280' Easting: W149°24.009' Datum: NAD83  
 Measurements By: DAR Time: nr  
 Water Depth (ft): n/a Ice Thickness (ft): n/a  
 Freeboard (ft): n/a Snow Depth (ft): n/a  
 Elev. (BPMSL +/- .02): 96.16 Survey By: MRL Date: 10/25/07 Time: nr  
 Water Sampling By: DAR Sample Depths BWS (ft): 1 na Date: na Time: na  
 2 \_\_\_\_\_  
 3 \_\_\_\_\_

**WATER QUALITY METER INFORMATION**

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
Multi	GWS	In-Situ Troll 9000	33033	PASS	PASS
<b>Parameters</b>					
<b>Field Measurements</b>					
Time:	nr	nr	nr	nr	nr
Depth BWS (ft):	2	3	4	6	8
Temp (°C):	0.14	0.14	0.16	0.17	0.16
pH:	8.31	8.29	8.29	8.28	8.27
Barometric (mmHg):					
Pressure (kPa):					
Conductivity (µS/cm):					
RDO (ppm): (mg/L)	13.00	13.03	13.06	13.08	13.05
Turbidity (NTU):					
ORP	152	153	154	155	156

**FIELD TESTING OF WATER SAMPLES (if small probe is used)**

Probe:					
Depth (ft)					
Temp (°C)					
pH					
Eh					

**NORTH SLOPE LAB CHEMISTRY ANALYSIS**

Parameter	Depth BWS (ft): _____			Depth BWS (ft): _____			Depth BWS (ft): _____			Method
	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	
Oxygen (mg/L)										Hach spec 0.3-15 mg/L
Alkalinity (mg/L as CaCO <sub>3</sub> )										10-4000 mg/L as CaCO <sub>3</sub>
Total iron--UF (mg/L)										Hach spec 0.02-3.00 mg/L
Filtered Iron--F tot Fe (mg/L)										Hach spec 0.02-3.00 mg/L
Ammonia (mg/L NH <sub>3</sub> -N)****										0.01-0.50 mg/L NH <sub>3</sub> -
Ammonia/ Iron dilution										

Remarks: Sample taken from Raw Water tap. Supply is from L9312.

Field-Form Filled Out By: K. Holland Date: 9/9/07  
 QAQC Check By: A. Blackburn Date: 9/12/07

**University of Alaska Fairbanks, Water and Environmental Research Center**

**Form F-004a: Water Quality Field-Sampling General**

Project ID: North Slope Lakes Site Location/Lake ID: MSBN-CT  
 Sample Purpose: Lake Water Quality Date: 10/25/06 Time: nr

**FIELD MEASUREMENTS**

GPS Coord. Northing: N70°19.280' Easting: W149°24.009' Datum: NAD83  
 Measurements By: DAR Time: nr  
 Water Depth (ft): n/a Ice Thickness (ft): n/a  
 Freeboard (ft): n/a Snow Depth (ft): n/a  
 Elev. (BPMSL +/- .02): 96.16 Survey By: MRL Date: 10/25/07 Time: nr  
 Water Sampling By: DAR Sample Depths BWS (ft): 1 na Date: na Time: na  
 2 \_\_\_\_\_  
 3 \_\_\_\_\_

**WATER QUALITY METER INFORMATION**

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
Multi	GWS	In-Situ Troll 9000	33033	PASS	PASS
<b>Parameters</b>					
<b>Field Measurements</b>					
Time:	nr	nr	nr	nr	nr
Depth BWS (ft):	20	22	24	26	28
Temp (°C):	0.16	0.15	0.17	0.18	0.20
pH:	8.12	8.14	8.10	8.10	8.10
Barometric (mmHg):					
Pressure (kPa):					
Conductivity (µS/cm):					
RDO (ppm): (mg/L)	12.65	12.62	12.60	12.56	12.55
Turbidity (NTU):					
ORP	161	162	162	162	163

**FIELD TESTING OF WATER SAMPLES (if small probe is used)**

Probe:					
Depth (ft)					
Temp (°C)					
pH					
Eh					

**NORTH SLOPE LAB CHEMISTRY ANALYSIS**

Parameter	Depth BWS (ft): _____			Depth BWS (ft): _____			Depth BWS (ft): _____			Method
	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	
Oxygen (mg/L)										Hach spec 0.3-15 mg/L
Alkalinity (mg/L as CaCO <sub>3</sub> )										10-4000 mg/L as CaCO <sub>3</sub>
Total iron--UF (mg/L)										Hach spec 0.02-3.00 mg/L
Filtered Iron--F tot Fe (mg/L)										Hach spec 0.02-3.00 mg/L
Ammonia (mg/L NH <sub>3</sub> -N)****										0.01-0.50 mg/L NH <sub>3</sub> -
Ammonia/ Iron dilution										

Remarks: Sample taken from Raw Water tap. Supply is from L9312.

Field-Form Filled Out By: K. Holland Date: 9/9/07  
 QAQC Check By: A. Blakcburn Date: 9/12/07

**University of Alaska Fairbanks, Water and Environmental Research Center**

**Form F-004a: Water Quality Field-Sampling General**

Project ID: North Slope Lakes  
 Sample Purpose: Lake Water Quality

Site Location/Lake ID: MSB-MC1  
 Date: 10/25/07 Time: 19:32

**FIELD MEASUREMENTS**

GPS Coord. Northing: nr Easting: nr Datum: na  
 Measurements By: DAR Time: 19:32  
 Water Depth (ft): nr Ice Thickness (ft): nr  
 Freeboard (ft): nr Snow Depth (ft): nr  
 Elev. (BPMSL +/- .02): 96.15 Survey By: DAR/JED Date: 6/25/06 Time: nr  
 Water Sampling By: DAR Sample Depths BWS (ft): 1 na Date: na Time: na  
 2 \_\_\_\_\_  
 3 \_\_\_\_\_

**WATER QUALITY METER INFORMATION**

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
Multi	GWS	In-Situ Troll 9000	33033	PASS	PASS
<b>Parameters</b>					
<b>Field Measurements</b>					
Time:	19:32				
Depth BWS (ft):	2.5				
Temp (°C):	-0.25				
pH:	7.36				
Barometric (mmHg):	752.0				
Pressure (kPa):	6.760				
Conductivity (µS/cm):	207.7				
RDO (ppm): (mg/L)	8.18				
Turbidity (NTU):	1.1				
ORP	74				

FIELD TESTING OF WATER SAMPLES (if small probe is used)					
Probe:					
Depth (ft)					
Temp (°C)					
pH					
Eh					

**NORTH SLOPE LAB CHEMISTRY ANALYSIS**

Parameter	Depth BWS (ft): _____			Depth BWS (ft): _____			Depth BWS (ft): _____			Method
	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	
Oxygen (mg/L)										Hach spec 0.3-15 mg/L
Alkalinity (mg/L as CaCO <sub>3</sub> )										Digital titrator 10-4000 mg/L as CaCO <sub>3</sub>
Total iron--UF (mg/L)										Hach spec 0.02-3.00 mg/L
Filtered Iron--F tot Fe (mg/L)										Hach spec 0.02-3.00 mg/L
Ammonia (mg/L NH <sub>3</sub> -N)****										0.01-0.50 mg/L NH <sub>3</sub> -N
Ammonia/ Iron dilution										

Remarks: MC1 is Milne Creek above junction with MSB.

Field-Form Filled Out By: A. Blackburn Date: 7/10/07  
 QAQC Check By: K. Holland Date: 9/6/07

**University of Alaska Fairbanks, Water and Environmental Research Center**

**Form F-004a: Water Quality Field-Sampling General**

Project ID: North Slope Lakes Site Location/Lake ID: KDA2-T1 (1 of 2)  
 Sample Purpose: Lake Water Quality Date: 10/29/06 Time: 16:37

**FIELD MEASUREMENTS**

GPS Coord. Northing: N70° 20.011' Easting: W148° 56.365' Datum: NAD 83  
 Measurements By: DAR/JD Time: 16:37  
 Water Depth (ft): 18.9 Ice Thickness (ft): 0.8  
 Freeboard (ft): 0.1 Snow Depth (ft): no snow  
 Elev. (BPMSL): 97.32 Survey By: DAR/JED Date: 10/24/06 Time: 14:16  
 Water Sampling By: DAR/JD Sample Depths BWS (ft): 1 na Date: na Time: na  
 2 \_\_\_\_\_  
 3 \_\_\_\_\_

**WATER QUALITY METER INFORMATION**

Calibration Information

Parameter (s)	Owner	Meter Make/Model		Serial No.		Pre-Sampling QAQC Check		Post-Sampling QAQC Check		
Multi	GWS	In-Situ Troll 9000		33033		PASS		PASS		
<b>Parameters</b>										
<b>Field Measurements</b>										
Time:	16:39	16:40	16:40	16:41	16:41	16:42	16:43	16:44	16:45	16:46
Depth BWS (ft):	2.0	3.0	4.0	5.0	7.0	9.0	11.0	13.0	15.0	16.0
Temp (°C):	0.12	0.12	0.14	0.14	0.16	0.16	0.17	0.19	0.24	0.28
pH:										
Barometric (mmHg):										
Pressure (kPa):										
Conductivity (µS/cm):	98.1	94.5	94.2	94.0	93.6	93.4	93.3	93.4	93.6	93.72
RDO (ppm): (mg/L)										
Turbidity (NTU):	-0.1	-0.2	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	0.0	0.00
ORP										

FIELD TESTING OF WATER SAMPLES (if small probe is used)					
Probe:					
Depth (ft)					
Temp (°C)					
pH					
Eh					

**NORTH SLOPE LAB CHEMISTRY ANALYSIS**

Parameter	Depth BWS (ft):			Depth BWS (ft):			Depth BWS (ft):			Method
	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	
Oxygen (mg/L)										Hach spec 0.3-15 mg/L
Alkalinity (mg/L as CaCO <sub>3</sub> )										Digital titrator 10-4000 mg/L as CaCO <sub>3</sub>
Total iron--UF (mg/L)										Hach spec 0.02-3.00 mg/L
Filtered Iron--F tot Fe (mg/L)										Hach spec 0.02-3.00 mg/L
Ammonia (mg/L NH <sub>3</sub> -N)****										Hach spec 0.01-0.50 mg/L NH <sub>3</sub> -N
Ammonia/ Iron dilution										

Remarks: GWS In-Situ does not have pH and RDO probe

Field-Form Filled Out By: A. Blackburn Date: 7/11/07  
 QAQC Check By: A. Brown Date: 7/14/07

**University of Alaska Fairbanks, Water and Environmental Research Center**

**Form F-004a: Water Quality Field-Sampling General**

Project ID: North Slope Lakes  
 Sample Purpose: Lake Water Quality

Site Location/Lake ID: KDA2-T1 (2 of 2)  
 Date: 10/29/06 Time: 16:37

**FIELD MEASUREMENTS**

GPS Coord. Northing: N70° 20.011' Easting: W148° 56.365' Datum: NAD 83  
 Measurements By: DAR/JD Time: 16:37  
 Water Depth (ft): 18.9 Ice Thickness (ft): 0.8  
 Freeboard (ft): 0.1 Snow Depth (ft): no snow  
 Elev. (BPMSL): 97.32 Survey By: DAR/JED Date: 10/24/06 Time: 14:16  
 Water Sampling By: DAR/JD Sample Depths BWS (ft): 1 na Date: na Time: na  
 2 \_\_\_\_\_  
 3 \_\_\_\_\_

**WATER QUALITY METER INFORMATION**

Calibration Information

Parameter (s)	Owner	Meter Make/Model				Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check		
Multi	GWS	In-Situ Trolle 9000				33033	PASS	PASS		
<b>Parameters</b>		<b>Field Measurements</b>								
Time:	16:46	16:46	16:47	16:48						
Depth BWS (ft):	17.0	18.0	19.0	Bot						
Temp (°C):	0.36	0.49	0.98	1.01						
pH:										
Barometric (mmHg):										
Pressure (kPa):										
Conductivity (µS/cm):	94.3	95.7	107.5	115.0						
RDO (ppm): (mg/L)										
Turbidity (NTU):	-0.1	0.3	26.0	-0.6						
ORP										

**FIELD TESTING OF WATER SAMPLES** (if small probe is used)

Probe:

Depth (ft)				
Temp (°C)				
pH				
Eh				

**NORTH SLOPE LAB CHEMISTRY ANALYSIS**

Parameter	Depth BWS (ft): _____			Depth BWS (ft): _____			Depth BWS (ft): _____			Method
	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	
Oxygen (mg/L)										Hach spec 0.3-15 mg/L
Alkalinity (mg/L as CaCO <sub>3</sub> )										Digital titrator 10-4000 mg/L as CaCO <sub>3</sub>
Total iron--UF (mg/L)										Hach spec 0.02-3.00 mg/L
Filtered Iron--F tot Fe (mg/L)										Hach spec 0.02-3.00 mg/L
Ammonia (mg/L NH <sub>3</sub> -N)****										Hach spec 0.01-0.50 mg/L NH <sub>3</sub> -N
Ammonia/ Iron dilution										

Remarks: GWS In-Situ does not have pH and RDO probe

Field-Form Filled Out By: A. Blackburn Date: 7/11/07  
 QAQC Check By: A. Brown Date: 7/14/07



## **APPENDIX B. WATER QUALITY METER CALIBRATION FORMS**

The following forms report the pre- and post-calibration checks for the water quality meters used during field sampling.

**University of Alaska Fairbanks, Water and Environmental Research Center**

**Form F-004e: Water Quality Meter Calibration Form**

Project ID: North Slope Lakes Site Location/Lake ID: SRT  
 Sample Purpose: Lake Water Quality

**WATER QUALITY METER INFORMATION**

Meter Make: In-Situ Model: Troll 9000  
 Owner: GWS S/N: 33033

**CALIBRATION AND QUALITY ASSURANCE INFORMATION**

**Pre-Sampling QA**

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
pH 4.01	10/19/06	0:05	Oakton pH 4.01	240479	Mar-06	4.04 @ 21.00	Pass
pH 7.00	10/19/06	0:10	In-Situ pH 7.00	531034-3	Sep-06	7.02 @ 22.07	Pass
pH 10.01	10/19/06	0:14	In-Situ pH 10.01	531001-1	Sep-06	9.91 @ 21.86	Pass
ORP	10/19/06	22:57	In-Situ Quick-Cal	9406B	Nov-06	244 @ 21.95	Pass
100% DO	10/19/06	23:35	Nanopure	---	---	8.74 @ 21.30	Pass
Zero DO	10/19/06	23:47	Hanna HI 7040	690	Dec-06	0.0 @ 19.48	Pass
Conductivity	10/19/06	23:50	Oakton 447uS	2603492	Mar-07	412.1 @ 21.07	Pass

**Post-Sampling QA**

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
pH 4.01	10/23/06	19:19	Oakton	521202	Nov-07	4.10 @ 15.62	Pass
pH 7.00	10/23/06	19:19	Oakton	2512282	Dec-07	7.22 @ 15.62	Fail
ORP	10/23/06	19:27	In-Situ QuickCal	9406B	Nov-06	240 @ 17.0	Pass
100% DO	10/23/06	19:33	Nanopure	---	---	9.77 @ 16.4	Pass
Zero DO	10/23/06	19:42	Hanna HI 746	690	Dec-06	0.10	Pass
Conductivity	10/23/06	19:24	Oakton 447uS	2603492	Mar-07	342.3 @ 16.4	Pass

Remarks: pH was recalibrated on Post cal check

Field-Form Filled Out By: A. Blackburn Date: 8/28/2007  
 QAQC Check By: K. Holland Date: 9/5/2007

**University of Alaska Fairbanks, Water and Environmental Research Center**

**Form F-004e: Water Quality Meter Calibration Form**

Project ID: North Slope Lakes  
 Sample Purpose: Lake Water Quality

Site Location/Lake ID: SRT

**WATER QUALITY METER INFORMATION**

Meter Make: In-Situ  
 Owner: GWS

Model: Troll 9000  
 S/N: 33033

**CALIBRATION AND QUALITY ASSURANCE INFORMATION**

**Pre-Sampling QA**

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
pH 4.01	10/23/06	19:19	Oakton	2512012	Nov-07	4.04 @ 16.8	Pass
pH 7.00	10/23/06	19:19	Oakton	2512282	Dec-07	7.04 @ 16.5	Pass
pH 10.01	10/23/06	19:21	Oakton	2512278	Jun-07	10.01 @ 16.12	Pass
ORP	10/23/06	19:27	In-Situ QuickCal	9406B	Nov-06	240 @ 17.0	Pass
100% DO	10/23/06	19:33	Nanopure	---	---	9.77 @ 16.4	Pass
Zero DO	10/23/06	19:42	Hanna HI 746	690	Dec-06	0.10	Pass
Conductivity	10/23/06	19:24	Oakton 447uS	2603492	Mar-07	342.3 @ 16.4	Pass

**Post-Sampling QA**

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
pH 4.01	10/26/06	9:44	Oakton	2512012	Nov-07	4.09 @ 14.41	Pass
pH 7.00	10/26/06	9:45	Oakton	2512282	Dec-07	7.12 @ 14.50	Pass
pH 10.01	10/26/06	9:47	Oakton	2512278	Jun-07	10.12 @ 14.49	Pass
ORP	10/26/06	9:56	In-Situ QuickCal	9406B	Nov-06	249 @ 14.50	Pass
100% DO	10/26/06	9:25	Nanopure	---	---	10.52 @ 14.07	Pass
Zero DO	10/26/06	9:34	Hanna HI 746	690	Dec-06	0.00 @ 13.35	Pass
Conductivity	10/26/06	9:48	Oakton 447uS	531284-15	Apr-05	119.5 @ 14.69	Pass

Remarks: \_\_\_\_\_

Field-Form Filled Out By: A. Blackburn

Date: 8/28/2007

QAQC Check By: A. Brown

Date: 8/31/2007

## **APPENDIX C. ELEVATION SURVEY FORMS**

The following form reports the elevation survey information obtained during field sampling.

**University of Alaska Fairbanks, Water and Environmental Research Center**

**Form F-011: Elevation Survey Form**

Project ID: North Slope Lakes Site Location/Lake ID: Kuparuk Dead Arm  
 Survey Purpose: Water-Level Elevations Date: 10/24/2006 Time: 14:45

Location:		Kuparuk Deadarm Reservoirs Cells 1, 2, 3, 4, 5						
Survey objective:		Lake water elevation survey				Weather Observations:		
Instrument Type:		Leica NA720	Instrument ID:		5482372 (GWS owned)			19 Degrees F, calm, overcast, flat light 1.5" of snow accumulation in last 24 hrs
Rod Type:		Craine fiberglass 20'	Rod ID:		GWS owned			
Bench Mark Information:						Survey Team Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)		Dan Reichardt Jeff Derry		
TBM__	nr	100 Temp.	N70 20.045 NAD27	W148 56.375 NAD27				
<b>Station</b>	<b>BS (ft)</b>	<b>HI (ft)</b>	<b>FS (ft)</b>	<b>Elevation (fasl)</b>	<b>Distance (ft)</b>	<b>Horizontal Angle</b>	<b>Vertical Angle</b>	<b>Remarks</b>
KDA2-SHB	7.80	96.88		89.08				Close within .00
Shooting from ^5, KDA3 FWS=89.08								
KDA3-SH>		89.21	0.13	89.08				FWS
KDA3-SHC		95.99	6.78	89.21				TOI
KDA4-SHA		95.99		85.83				TOI FB=0.00
Use KDA4-SHA as TP, move to ^6								
KDA4-SHA	9.35	95.18		85.83				
TP1		95.18	4.06	91.12				Close within 0.02
Use TP1 as TP, move to ^7								
TP1	6.84	97.96		91.12				
KDA3-SHC		97.96	8.73	89.23				Close to within 0.02
Shooting from ^8, KDA4 FWS=85.83								
KDA5-SHA>	6.68	92.51		<b>85.83</b>				<b>KDA 5 Water Level</b>
KDA4-SHB>		92.51	6.68	85.83				
Use KDA4-SHB> as TP, move to ^9								
KDA4-SHB>	7.14	92.97		<b>85.83</b>				<b>KDA 4 Water Level</b>
KDA5-SHA>		92.97	7.15	85.82				Close to within 0.01

Abbreviations: backsight, BS; degrees, dd; feet, ft; feet above mean sea level, fasm!; foresight, FS; height of instrument, HI; minutes, mm; seconds, ss; BP Mean Sea Level, BPMSL

**University of Alaska Fairbanks, Water and Environmental Research Center**

**Form F-011: Elevation Survey Form**

Project ID: North Slope Lakes Site Location/Lake ID: Kuparuk Dead Arm  
 Survey Purpose: Water-Level Elevations Date: 10/24/2006 Time: 14:45

Location:		Kuparuk Deadarm Reservoirs Cells 1, 2, 3, 4, 5						
Survey objective:		Lake water elevation survey				Weather Observations:		
Instrument Type:	Leica NA720	Instrument ID:	5482372 (GWS owned)					
Rod Type:	Craine fiberglass 20'	Rod ID:	GWS owned					
Bench Mark Information:							Survey Team Names	
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)		Dan Reichardt Jeff Derry		
TBM__	nr	100 Temp.	N70 20.045 NAD27	W148 56.375 NAD27				
<b>Station</b>	<b>BS (ft)</b>	<b>HI (ft)</b>	<b>FS (ft)</b>	<b>Elevation (fasl)</b>	<b>Distance (ft)</b>	<b>Horizontal Angle</b>	<b>Vertical Angle</b>	<b>Remarks</b>
TBM__	0.00	100.00		100.00				Survey begins at TBM ^1
KDA3-SHA		100.00	10.72	89.29				TOI
KDA3-SHA>		89.29	0.21	89.08				FWS
KDA3-SHB		100.00	10.90	89.10				TOI
KDA3-SHB>		89.10	0.02	<b>89.08</b>				FWS <b>KDA 3 Water</b>
KDA2-SHA		100.00	10.90	89.11				TOI
KDA2-SHA>		89.11	0.03	<b>89.08</b>				FWS <b>KDA 2 Water</b>
Use KDA2-SHA as TP, move to ^2.								
KDA2-SHA	11.60	100.71		89.11				
KDA3-SHB		100.71	11.62	89.09				Close within .01
TBM__		100.71	0.71	100.00				Close within .01
Shooting from ^3, KDA2 FWS=89.08'								
KDA2-SHB>	0.00	89.08		89.08				FWS
KDA2-SHB		97.32	8.24	89.08				TOI
KDA1-SHA		97.32	7.96	89.36				TOI
KDA1-SHA>		89.36	0.03	89.33				FWS
Use KDA1-SHA as TP, move to ^4								
KDA1-SHA		96.88	7.52	<b>89.36</b>				<b>KDA 1 Water Level</b>

Abbreviations: backsight, BS; degrees, dd; feet, ft; feet above mean sea level, fasml; foresight, FS; height of instrument, HI; minutes, mm; seconds, ss; BP Mean Sea Level, BPMSL

**University of Alaska Fairbanks, Water and Environmental Research Center**  
**Form F-011: Elevation Survey Form**

Project ID: North Slope Lakes Site Location/Lake ID: Mine Site B  
 Survey Purpose: Water-Level Elevations Date: 10/25/2006 Time: nr

Location:	Mine Site B, NE corner of North Cell, temporary datum								
Survey objective:	Lake water elevation survey					Weather Observations:			
Instrument Type:	Leica NA720		Instrument ID:	5482372 (GWS owned)				nr	
Rod Type:	Craine fiberglass 20'		Rod ID:	GWS owned					
Bench Mark Information:						Survey Team Names			
Name	Agency Responsible	Elevation (ft)	Latitude (dd-	Longitude (ddd-mm.mmm)		D. Reichardt, J. Derry			
TBM__	nr	100 Temp.	na	na					
<b>Station</b>	<b>BS (ft)</b>	<b>HI (ft)</b>	<b>FS (ft)</b>	<b>Elevation (fasl)</b>	<b>Distance (ft)</b>	<b>Horizontal Angle</b>	<b>Vertical Angle</b>	<b>Remarks</b>	
TBM__	1.80	101.80		100.00				Shooting from ^1	
MSBN-A>		101.80	5.64	96.16					
MSBS-A>		101.80	5.64	96.16					
Turn to MSBS-A>, shooting from ^2.									
MSBS-A>	5.67	101.83		96.16					
MC1>		101.83	5.68	96.15					
MC2>		101.83	5.67	96.16					
MC3>		101.83	5.68	96.15					
MC40>		101.83	5.69	96.14					
Turn to MC40, shooting from ^3									
MC40>	5.46	101.60		96.14				TOI	
WC1		101.60	4.96	96.64				TOI	
WC2		101.60	5.22	96.38				TOI	

Abbreviations: backsight, BS; degrees, dd; feet, ft; feet above mean sea level, fasl; foresight, FS; height of instrument, HI; minutes, mm; seconds, ss; BP Mean Sea Level, BPMSL

**University of Alaska Fairbanks, Water and Environmental Research Center**  
**Form F-011: Elevation Survey Form**

Project ID: North Slope Lakes Site Location/Lake ID: Mine Site B  
 Survey Purpose: Water-Level Elevations Date: 10/25/2006 Time: nr

Location:		Mine Site B, NE corner of North Cell, temporary datum						
Survey objective:		Lake water elevation survey				Weather Observations:		
Instrument Type:		Leica NA720	Instrument ID:		5482372 (GWS owned)			nr
Rod Type:		Craine fiberglass 20'	Rod ID:		GWS owned			
Bench Mark Information:						Survey Team Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)		D. Reichardt, J. Derry		
TBM__	nr	100 Temp.	na	na				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
WC3		101.60	5.34	96.26				TOI
WC4		101.60	5.43	96.17				TOI
WC5		101.60	5.42	96.18				TOI
WC6		101.60	5.41	96.19				TOI
WC7		101.60	5.41	96.19				TOI
WC8		101.60	5.41	96.19				TOI
WC9		101.60	5.41	96.19				TOI
WC10		101.60	5.42	96.18				TOI
WC11		101.60	5.43	96.17				TOI
WC12		101.60	5.4	96.20				TOI
WC13		101.60	5.28	96.32				TOI
WC14		101.60	4.90	96.70				TOI
MSBS-A>		101.60	5.44	96.16				TOI

Abbreviations: backsight, BS; degrees, dd; feet, ft; feet above mean sea level, fasl; foresight, FS; height of instrument, HI; minutes, mm; seconds, ss; BP Mean Sea Level, BPMSL



**University of Alaska Fairbanks, Water and Environmental Research Center**  
**Form F-011: Elevation Survey Form**

Project ID: North Slope Lakes Site Location/Lake ID: Mine Site B  
 Survey Purpose: Water-Level Elevations Date: 10/25/2006 Time: nr

Location:		Mine Site B, NE corner of North Cell, temporary datum						
Survey objective:		Lake water elevation survey				Weather Observations:		
Instrument Type:		Leica NA720	Instrument ID:		5482372 (GWS owned)			nr
Rod Type:		Craine fiberglass 20'	Rod ID:		GWS owned			
Bench Mark Information:						Survey Team Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)		D. Reichardt, J. Derry		
TBM__	nr	100 Temp.	na	na				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
WC-MD	5.41	101.60		96.19				
MSBN-A>		101.60	5.44	96.16				
TBM__		101.60	1.61	99.99				
Move instrumnt to ^3, use TBM__ ASTP								
TBM__		103.09		99.99				
MC50>	6.95	103.09		96.14				

Abbreviations: backsight, BS; degrees, dd; feet, ft; feet above mean sea level, fasm; foresight, FS; height of instrument, HI; minutes, mm; seconds, ss; BP Mean Sea Level, BPMSL

**University of Alaska Fairbanks, Water and Environmental Research Center**

**Form F-011: Elevation Survey Form**

Project ID: North Slope Lakes Site Location/Lake ID: L9312\_PHT (pg 1 of 2)  
 Survey Purpose: Water-Level Elevations Date: 10/27/07 Time: 14:30

Location:	L9312							
Survey objective:	Lake water elevation survey					Weather Observations:		
Instrument Type:	Leica NA720	Instrument ID:	5482372 (GWS owned)			15F 8mph North wind 20% cloud cover		
Rod Type:	Craine fiberglass 20'	Rod ID:	GWS owned					
Bench Mark Information:						Survey Team Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)		D. Reichardt, J. Derry		
L9312 "P"	CP	11.72 BPMSL	70-20.032 NAD83	150-57.138 NAD83				
<b>Station</b>	<b>BS (ft)</b>	<b>HI (ft)</b>	<b>FS (ft)</b>	<b>Elevation (fasm)</b>	<b>Distance (ft)</b>	<b>Horizontal Angle</b>	<b>Vertical Angle</b>	<b>Remarks</b>

shooting from inst. 1

TBM 39 "P"	2.80	14.52		11.72				SW corner of HSM in lake near pumphouse
TBM 39 "O"		14.52	3.13	11.39				Reads 0.07' low
PHT 2		14.52	6.63	7.89				TOI
PHT 3		14.52	6.35	8.17				puddle has dirt botom (frozen)
PHT 4		14.52	6.60	7.92				TOI
PHT 5		14.52	6.51	8.01				TOI
PHT 6		14.52	6.21	8.31				puddle has dirt botom (frozen)
PHT 7		14.52	6.28	8.24				TOI
PHT 8		14.52	5.69	8.83				TOI
PHT 9		14.52	5.75	8.77				TOI
PHT 10		14.52	5.74	8.78				TOI
PHT 11		14.52	5.64	8.87				TOI
PHT 12		14.52	6.46	8.06				TOI
TP1		14.52	5.94	8.58				
move instrument to inst. 2 TP1 as TP								
TP1	4.54	13.12		8.58				
L9312 OC		13.12	5.39	7.73				outlet control on North Shore. TOI

Abbreviations: backsight, BS; degrees, dd; feet, ft; feet above mean sea level, fasm; foresight, FS; height of instrument, HI; minutes, mm; seconds, ss; BP Mean Sea Level, BPMSL

**University of Alaska Fairbanks, Water and Environmental Research Center**

**Form F-011: Elevation Survey Form**

Project ID: North Slope Lakes Site Location/Lake ID: L9312\_PHT (pg 2 of 2)  
 Survey Purpose: Water-Level Elevations Date: 10/27/07 Time: 14:30

Location:		L9312						
Survey objective:		Lake water elevation survey				Weather Observations:		
Instrument Type:		Leica NA720	Instrument ID:	5482372 (GWS owned)			15F 8mph North wind 20% cloud cover	
Rod Type:		Craine fiberglass 20'	Rod ID:	GWS owned				
Bench Mark Information:						Survey Team Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)		D. Reichardt, J. Derry		
L9312 "P"	CP	11.72 BPMSL	70-20.032 NAD83	150-57.138 NAD83				
<b>Station</b>	<b>BS (ft)</b>	<b>HI (ft)</b>	<b>FS (ft)</b>	<b>Elevation (fasl)</b>	<b>Distance (ft)</b>	<b>Horizontal Angle</b>	<b>Vertical Angle</b>	<b>Remarks</b>
DSC 1		13.12	5.49	7.63				
DSC 2		13.12	5.65	7.47				
L9312SH_v		13.12	5.42	<b>7.70</b>				<b>L9312 Water Level</b>
SH-PH-mid_ice		13.12	5.38	7.74				
SH-PH-mid_v		13.12	5.42	7.70				
TBM "O"		13.12	1.65	11.47				
TBM"P"		13.12	1.40	11.72				

Abbreviations: backsight, BS; degrees, dd; feet, ft; feet above mean sea level, fasm; foresight, FS; height of instrument, HI; minutes, mm; seconds, ss; BP Mean Sea Level, BPMSL

## **APPENDIX D. SNOW SURVEY FORMS**

The following form reports the snow survey information obtained during field sampling.

**University of Alaska Fairbanks, Water and Environmental Research Center**  
**Form F-012: Snow Depth and Water Content Survey Form**

Project ID: \_\_\_\_\_  
 Survey Purpose: North Slope Lakes Project  
Snow Depth and Water Content

Site Location/Lake ID: Kuparuk Dead Arm  
 Date: 10/26/2006 Time: 11:30

Location Description:	From KDA2-CT, snow course goes North 25m, west 25m. Depth in cm. North.				
Survey objective:	Snow depths and snow-water content for lake recharge estimates			Weather Observations:	15F, 7mph N. wind
Latitude:	nr	Longitude:	nr	Datum:	na
Elevation:		Elevation Datum:	nr	Reference Markers:	Site staked with lathe
Drainage Basin:	Kuparuk	Slope Direction:	flat	Vegetation Type:	Snow Survey located on ice
Slope Angle:	Flat	Access Notes:	none	Other:	1 meter increments
Snow Depth Probe Type:	T-handle snow depth probe,			Snow-Survey Team Names	
Snow Tube Type:	Adirondak, 6.74 cm diameter cutter, area = 35.7 cm <sup>2</sup>			D. Reichardt, J. Dery	

Snow Course Depths, in cm.

	1	2	3	4	5
1	5.0	3.5	5.0	6.0	4.5
2	5.5	6.5	5.0	5.0	5.0
3	4.5	6.0	4.5	4.5	4.5
4	4.5	5.5	5.0	4.5	4.5
5	5.0	5.5	4.5	5.0	5.0
6	4.5	4.0	5.0	4.5	5.0
7	5.0	5.0	5.0	4.5	6.0
8	5.0	7.5	5.0	4.5	8.0
9	4.0	6.0	5.5	5.0	8.0
10	4.0	6.0	6.0	5.0	8.0

(cm)  
 Average snow depth = 5.2  
 Maximum snow depth = 8.0  
 Minimum snow depth = 3.5  
 Standard variation = 1.0

Snow Sample Depths and Weights

Bag #	Depth (cm)	Weight (gr)	Volume (cm <sup>3</sup> )	Density (gr/cm <sup>3</sup> )

Average Density = \_\_\_\_\_  
 Average Snow Water Equivalent (SWE) = \_\_\_\_\_ cm H<sub>2</sub>O  
 Average Snow Water Equivalent = \_\_\_\_\_ inches H<sub>2</sub>O  
 Average Snow Water Equivalent = \_\_\_\_\_ feet H<sub>2</sub>O

SWE = avg. snow depth\*(density snow/density water)

**University of Alaska Fairbanks, Water and Environmental Research Center**  
**Form F-012: Snow Depth and Water Content Survey Form**

Project ID: North Slope Lakes Project Site Location/Lake ID: L9312  
 Survey Purpose: Snow Depth and Water Content Date: 10/27/2007 Time: 15:00

Location Description:	Point 1 to 25 Proceeds North Point 25 to 50 Proceeds West 1 Meter Increments				
Survey objective:	Snow depths and snow-water content for lake recharge estimates			Weather Observations:	nr
Latitude:	N 70°19.9444'	Longitude:	W 150° 57.047'	Datum:	NAD27 Alaska
Elevation:		Elevation Datum:	BPMSL	Reference Markers:	Site marked with GPS
Drainage Basin:	L9312	Slope Direction:	flat	Vegetation Type:	snow depth on ice surface
Slope Angle:	Flat	Access Notes:		Other:	1 meter increments
Snow Depth Probe Type:	T-handle snow depth probe,			Snow-Survey Team Names	
Snow Tube Type:	Adirondak, 6.74 cm diameter cutter, area = 35.7 cm <sup>2</sup>			D. Reichardt, J. Derry	

Snow Course Depths, in cm.

	1	2	3	4	5
1	5.0	13.5	1.0	7.0	
2	4.5	7.0	8.5	5.0	
3	4.0	5.0	9.0	4.0	
4	6.0	5.5	7.0	10.0	
5	5.0	6.0	8.5	11.0	
6	3.0	5.5	10.0	11.5	
7	5.0	6.0	13.0	12.5	
8	9.0	8.0	18.0	15.0	
9	3.0	0.0	8.0	13.0	
10	1.0	3.0	8.0	11.0	

(cm)  
 Average snow depth = 7.4  
 Maximum snow depth = 18.0  
 Minimum snow depth = 0.0  
 Standard variation = 4.0

Snow Sample Depths and Weights

Bag #	Depth (cm)	Weight (gr)	Volume (cm <sup>3</sup> )	Density (gr/cm <sup>3</sup> )

Average Density = \_\_\_\_\_  
 Average Snow Water Equivalent (SWE) = \_\_\_\_\_ cm H2O  
 Average Snow Water Equivalent = \_\_\_\_\_ inches H2O  
 Average Snow Water Equivalent = \_\_\_\_\_ feet H2O

SWE = avg. snow depth\*(density snow/density water)