Lake Chemistry and Physical Data For Selected North Slope, Alaska, Lakes: March 2007

Lake-ice fractures at Kuparuk Dead Arm Reservoirs, by D. Reichardt

by

Chad Cormack, Dan Reichardt, Hannah Clilverd, Michael Lilly, and Matt Whitman

April 2007

North Slope Lakes Hydrologic Modeling Project

Report No. INE/WERC 07.08

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By:

Chad Cormack[1], Dan Reichardt[2], Hannah Cliverd[1], Michael Lilly[2], Matthew Whitman[3]

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[1]University of Alaska Fairbanks, Water and Environmental Research Center
[2]Geo-Watersheds Scientific
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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) and the 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 of policies of the DOE, NETL, BLM, BPX, CPA, GWS, or any local sponsor. This work does not constitute a standard, specification, or regulation.

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

Conversion Factors

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

$$°F = 1.8(°C) + 32$$

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:

In this report, "sea level" 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 (^{o}F).
ft	feet
GWS	Geo-Watersheds Scientific
GWSI	USGS Ground-Water Site Inventory
km^2	square kilometers
kPa	kilopascal
lb/in^2	pounds per square inch
m	meters
mg/L	milligrams per liter, equivalent to ppm
µg/L	micrograms per liter
mi^2	square miles
mm	millimeters
µS/cm	microsiemens per centimeter
mV	Millivolt
NGVD	National Geodetic Vertical Datum
NPR-A	National Petroleum Reserve - Alaska
NTU	Nephelometric Turbidity Units
NWIS	National Water Information System
ORP	oxygen-reduction potential
ppm	parts per million, equivalent to mg/L
SC25	specific conductance at 25^{o}C
SWE	Snow Water Equivalent
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

Lake Nomenclature

KDA	Kuparuk Dead Arm (Prudhoe Bay field, serves Prudhoe Bay field operations)
MSB	Mine Site B (Prudhoe Bay field, serves Milne Point and Kuparuk field operations)
L9312	Lake L9312 (Alpine field, serves Alpine field operations)
L9817	Lake L9817 (Alpine field, serves Alpine field operations)
K113	Lake K113 (Prudhoe Bay field, not currently used for field operations)

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.

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

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Lake Chemistry and Physical Data For Selected North Slope, Alaska, Lakes: March 2007

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 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 (Figure 1). 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. This lake has been used in previous years for ice-road construction, but was not used during winter 2005-06, nor will it 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 Road and has two cells connected to East Milne Creek. The Kuparuk Reservoir System (Kuparuk Deadarm Lakes) has 9 reservoirs. The three southernmost reservoir cells (1-3) are included in the study to observe ground-water and surface-water interactions between each cell 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 purpose of this publication is to 1) report data collected for the month of March 2007, 2) summarize accomplished field trip objectives.

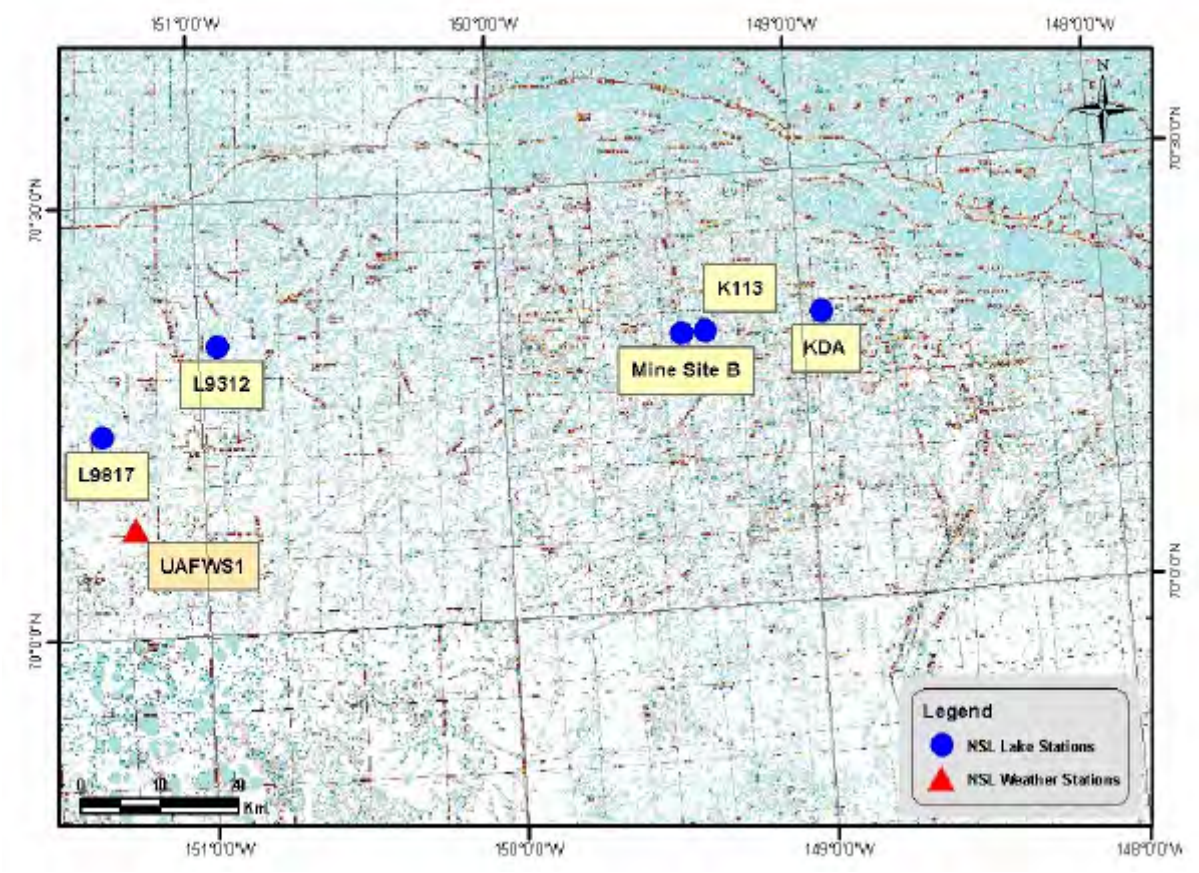

Figure 1. Location of study lakes in the NPR-A, Alpine, Kuparuk, and Prudhoe Bay field operating areas, North Slope, Alaska.

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, 2007). In March 2007, we focused on the following locations/tasks:

1. Kuparuk Dead Arm (KDA) Reservoirs: Prudhoe Bay operating area.
    - Survey water levels to local elevation control on cells 1, 2, and 3.
    - Measure water-quality profile parameters in cells 1, 2, and 3.
    - Conduct snow-course measurements.

- Collect water-column samples from cells 1 and 2.
- Observe the channel excavation between cells 1 and 2.

2. Mine Site B: Kuparuk operating area.
    - Survey water levels to local elevation control on North and South cells
    - Measure water-quality profile parameters on North and South cells and adjacent stream as practical.
    - Conduct snow-course measurements.
    - Collect water-column samples from North Cell and South Cell sampling locations.
3. Lake L9312: Alpine operating area.
    - Survey water level to local elevation control.
    - Collect water-quality profile data.
    - Collect water-column samples from sampling locations.
    - Automated data collection station maintenance
    - Conduct snow-course measurements, along with additional transitional and lake area transects.
    - Record with underwater camera to observe water pipe screens.
4. Lake L9817: NPR-A.
    - Survey water level to local BLM elevation control.
    - Collect water-quality profile data.
    - Collect water-column samples from sampling locations
    - Automated data collection station maintenance
    - Conduct snow course measurements.

PROCEDURES

Water Chemistry Sampling

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-surface elevation surveys were conducted using closed level loops and optical levels (Figure 2). Water quality parameters such as temperature, pH, turbidity, oxygen reduction potential (ORP), conductivity, and dissolved oxygen (DO) were obtained by using an In-Situ Troll 9000 (submersible meter), at multiple depths throughout the water column. The precision with which physical measurements were reported takes into account field conditions. 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.

Parameter	Standards used	Acceptable deviation from calibration standard value
Turbidity	Factory calibrated	± 2 (NTU)
pH	4.01, 7.0, 10.0	± 0.2
Conductivity	447 (µs/cm)	within 10%
100% DO	100 % saturated	within 10%
0% DO	0 % saturated solution	within 0.3 mg/L
ORP	InSitu QuickCal 224 mV	within 10%

Figure 2. Sunset at Kuparuk Dead Arm, photo by Chad Cormack.

Water samples were also collected at 3 depths (1 ft. (0.3 m) below bottom of ice, within the central part of the water column, 1 ft. (0.3 m) above lake bottom). Some of these samples were preserved for further analysis at UAF, while other samples were analyzed with a Hach spectrophotometer at Prudhoe Bay and Alpine facilities. UAF laboratory chemistry analysis will be reported separately.

Snow Surveys

Small-scale snow depth measurements were conducted in "L" shaped patterns on the lake surface and/or tundra surface at predetermined snow-course locations. Snow depth measurements were taken every 3.3 ft (1 m) for 82 ft (25 m), then turning 90 degrees, and continuing for another 82 ft (25 m). Snow-density samples were also collected at even intervals along transects with an Adirondack snow sampler. Five samples were collected from points along the snow courses and averaged to establish a representative density. Larger-scale snow-depth measurements were conducted at L9312 along general east/west and north/south transects. Depth measurements were typically recorded every 10 ft (3 m, 2 paces). Measurements at transition zones from tundra to lake were recorded 5 ft (1.5 m, 1 pace), and on homogeneous lake surfaces depths were recorded every 20 ft (6.1 m, 4 paces).

SELECTED RESULTS

Mine Site B is a gravel mine site that consists of two cells (North and South), with overburden placed on the eastern side of the cells, uphill of the adjacent East Milne Creek to the west of the mine site. The two cells are connected to each other by two channels. Each channel has a fairly flat bottom and allows a connection during both summer and most winter conditions. February 2007 results showed that the two cells were still connected to each other, while the difference in water levels in the north and south cells in March 2007 demonstrate that the two cells are now disconnected. (Figure 3.)

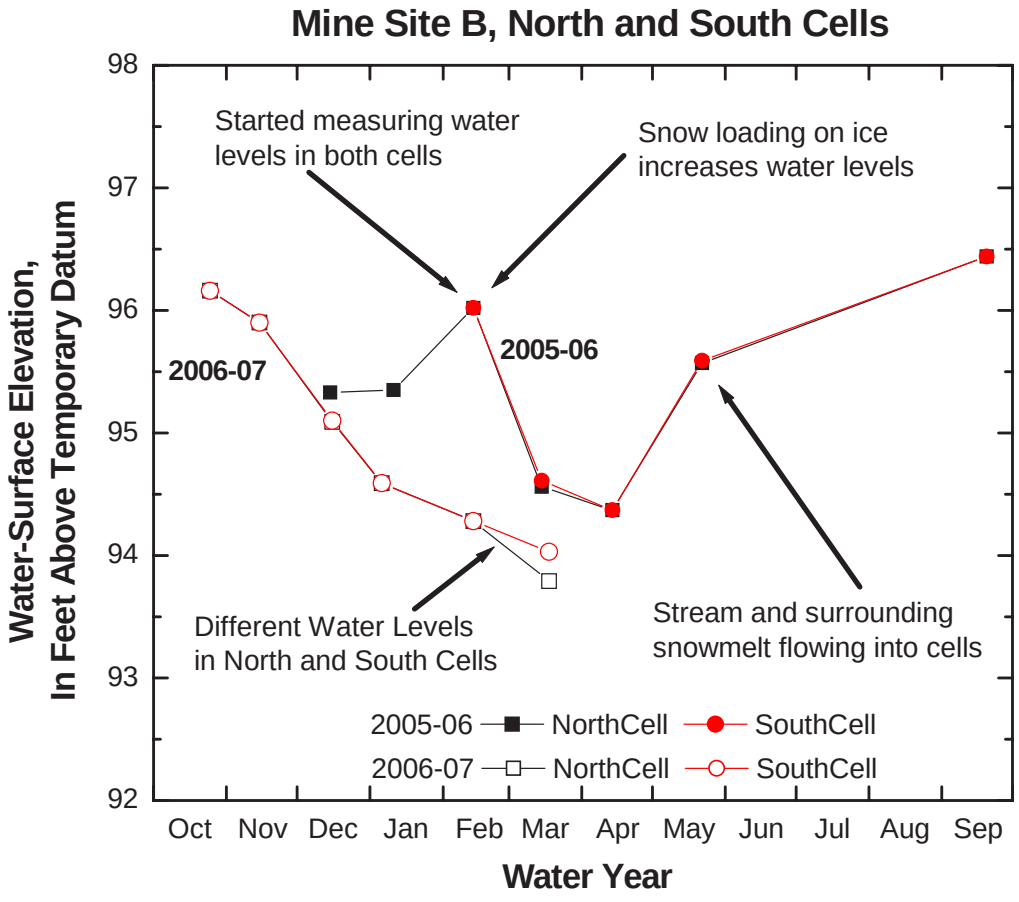

Figure 3. Mine Site B (Six Mile Lake) water levels for 2005-07 water years.

The water surface levels in both cells remain over 4.5 ft (1.4 m) higher than the recorded bottom of the West Channel (Table 2.) This suggests the hydraulic connectivity at Mine Site B is currently limited by ice growth blocking flow through each channel. Free water is recorded between the bottom of ice and bottom of channel in both the East Channel (0.57 ft, .2 m) and the West Channel (1.57 ft, 0.5 m). This is evidence that the center channel locations that we observe ice and water physical parameters have a slightly deeper channel bottom, or thinner ice cover than the true outlet control for each channel.

Table 2. Mine Site B, Channel Elevations April 18, 2007

North Cell, Water Surface	South Cell, Water Surface	Bottom of East Channel	Bottom of West Channel	Bottom of Ice, East Channel	Bottom of Ice, West Channel
93.79	94.03	90.55	88.96	91.12	90.53

Ice thickness, freeboard, and the open water below ice are also measured in both of the access channels between the North and South cells. This data is shown in Appendix E.

SUMMARY

Sampling occurred at Kuparuk Deadarm Lakes, Mine Site B, L9312, and L9817 during March field activities. Due to weather constraints, the work plan was not followed exactly as planned. However, with some rescheduling, all trip objectives were completed. Table 3 summarizes these conditions at “priority sampling sites”. Median results represent all values measured from the listed sampling site. Each lake we visit has one or more locations where we draw water samples from multiple depths for laboratory analysis. These locations have more historical data than other locations on the lakes, and have been chosen as representative of the deeper portion of the respective lakes.

As Table 3 demonstrates, the water level in KDA Reservoir 2 is dropping at a rapid rate. Construction activities occurred at Reservoir 2 during March in order to re-establish hydraulic connectivity with Reservoir 3. If successful, this should reduce the rate of water level drop in Reservoir 2, or even recharge the reservoir. Mine Site B continues to have a water level drop

between 0.25 ft (0.1m) and 0.5 ft (0.2 m) per month, however we are beginning to see the water drop faster in the north cell, as the south cell is no longer contributing water to the north cell when water is withdrawn. L9312 continues to show a very minor drop in water level, while L9817 shows no drop in water level, as is expected for an un-pumped lake.

Table 3. Ice thickness, Median DO Concentration, Median Actual Conductance and Monthly Water Drop for North Slope lakes in mid-March.

Sampling Site	Ice Thickness [ft; (m)]	Median DO Concentration [mg/L]	Median Actual Conductivity [μS/cm]	Water level drop since mid February [ft; (m)]
KDA2-CT	4.84; (1.48)	15.72	157.3	3.52; (1.073)
MSBS-CT	4.80; (1.46)	7.77	276.9	0.25; (0.076)
MSBN-CT	4.70; (1.43)	8.93	261.9	0.49; (0.149)
L9312 Raft B	4.85; (1.48)	9.88	87.38	0.04; (0.012)
L9817-1	4.30; (1.31)	0.88	552.6	-.01; (0.003) (Since January)

Monthly monitoring of water-quality parameters and spatial distribution of snow cover at North Slope lakes throughout the winter will help in the understanding and development of simulation tools necessary for water-resources management. As lake 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-snowmelt recharge. This information is important for permitting agencies as well as industry professionals who depend on water assets for facility use and ice road/pad construction. Through monthly hydrologic assessments, water-chemistry testing, and water-sample analysis, we will continue to answer some of the questions on the hydrology of North Slope lakes and adaptive management strategies.

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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: KDA2 - RES2

Sample Purpose: **Lake Water Quality** Date: 3/15/07 Time: 11:38

FIELD MEASUREMENTS

GPS Coord. Northing: N70°19.966' Easting: W148°56.429' Datum: NAD83

Measurements By: HMC Time:

Water Depth (ft): 16.7 Ice Thickness (ft): 4.35

Freeboard (ft): 0.55 Snow Depth (ft): 0.20

Elev. (BPMSL +/- .02): 4.84 Survey By: CMC, MRL Date: 3/15/07 Time: 13:00

Water Sampling By: HMC Sample Depths BWS (ft): 1 5 Date: Time:

2 11

WATER QUALITY METER INFORMATION 3 16

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
In-Situ	GWS	IN-SITU TROLL 9000	33033	PASS	PASS

Parameters	**Field Measurements**									
Time:	11:40	11:42	11:45	11:49	11:53	12:00	12:08	12:13	12:21	12:29
Depth BWS (ft):	5	6	7	9	11	13	14	15	16	BOT
Temp (°C):	-0.09	-0.19	0.07	0.21	0.24	0.48	0.68	0.78	1.06	1.16
pH:	7.69	7.72	7.77	7.76	7.76	7.79	7.63	7.60	7.30	7.29
Barometeric (mmHg):	779.5	779.5	779.5	779.6	779.7	779.8	779.9	779.9	779.9	779.9
Pressure (kPa):	13.322	16.162	19.269	25.138	31.147	37.150	40.120	42.941	46.236	49.284
Conductivity (µS/cm):	159.0	158.3	157.8	157.6	157.3	156.7	155.9	156.1	154.5	164.9
RDO (ppm): (mg/L)	14.99	15.42	15.77	16.25	16.59	16.86	15.68	15.72	7.07	5.44
Turbidity (NTU):	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.2	1.2	3.2
ORP	152	154	155	158	161	165	170	169	176	172

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):___5____**			**Depth BWS (ft):__11____**			**Depth BWS (ft):___16___**			**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 $CaCO_3$)	121			127			131			Digital titrator 10-4000 mg/L as CaCO3
Total iron--UF (mg/L)	0.02	0.02	0.03	0.03	0.01	0	0.04	0.02	0.03	Hach spec 0.02-3.00 mg/L
Filtered Iron--F tot Fe (mg/L)	0.03	0.01	0.01	0.04	0.02	0.01	0.01	0.02	0.01	Hach spec 0.02-3.00 mg/L
Ammonia (mg/L NH_3-N)****										0.01-0.50 mg/L NH3-N
Ammonia/ Iron dilution										

Remarks: 70 ft East of KDA2

Field-Form Filled Out By: HMC Date: 3/15/07

QAQC Check By: JED Date: 4/11/07

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: KDA3-CT

Sample Purpose: **Lake Water Quality** Date: 3/15/07 Time: 13:25

FIELD MEASUREMENTS

GPS Coord. Northing: N70°20.025 Easting: W148°56.2044 Datum: NAD83

Measurements By: Time:

Water Depth (ft): 22.1 Ice Thickness (ft): 4.50

Freeboard (ft): 0.4 Snow Depth (ft): 0.25

Elev. (BPMSL +/- .02): 6.48 Survey By: CMC, MRL Date: 3/15/07 Time: 13:00

Water Sampling By: HMC Sample Depths BWS (ft): 1 Date: Time:

2

3

WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
In-Situ	GWS	IN-SITU TROLL 9000	33033	Pass	PASS

Parameters	**Field Measurements**									
Time:	13:36	13:38	13:41	13:44	13:46	13:48	13:51	13:53	13:56	14:00
Depth BWS (ft):	5	6	7	9	11	13	15	17	19	20
Temp (°C):	0.00	-0.05	0.28	0.37	0.44	0.43	0.47	0.58	0.73	0.84
pH:	7.70	7.66	7.77	7.76	7.75	7.71	7.69	7.75	7.68	7.67
Barometeric (mmHg):	779.4	779.4	779.4	779.5	779.5	779.6	779.6	779.7	779.7	779.7
Pressure (kPa):	13.295	16.495	19.164	25.204	31.228	37.274	43.116	49.029	55.038	57.896
Conductivity (µS/cm):	136.2	135.4	134.2	133.8	133.6	133.2	133.0	132.70	132.60	132.4
RDO (ppm): (mg/L)	15.24	15.44	15.22	15.22	15.21	15.20	15.12	14.95	14.52	14.01
Turbidity (NTU):	0.2	0.2	0.2	0.3	0.2	0.3	0.2	0.1	0.2	0.3
ORP	185	186	183	184	184	185	186	185	187	187

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 $CaCO_3$)										Digital titrator 10-4000 mg/L as CaCO3
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_3-N)****										0.01-0.50 mg/L NH3-N
Ammonia/ Iron dilution										

Remarks:

Field-Form Filled Out By: HMC Date: 3/15/07

QAQC Check By: JED Date: 4/11/07

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: KDA3-CT

Sample Purpose: **Lake Water Quality** Date: 3/15/07 Time: 13:25

FIELD MEASUREMENTS

GPS Coord. Northing: N70°20.025 Easting: W148°56.2044 Datum: NAD83

Measurements By: Time:

Water Depth (ft): 22.1 Ice Thickness (ft): 4.50

Freeboard (ft): 0.4 Snow Depth (ft): 0.25

Elev. (BPMSL +/- .02): Survey By: CC Date: Time:

Water Sampling By: HMC Sample Depths BWS (ft): 1 Date: Time:

2

3

WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
In-Situ	GWS	IN-SITU TROLL 9000	33033	Pass	PASS

Parameters	**Field Measurements**									
Time:	14:03	14:10								
Depth BWS (ft):	21	BOT								
Temp (°C):	0.98	1.08								
pH:	7.56	7.37								
Barometeric (mmHg):	779.8	779.8								
Pressure (kPa):	60.906	65.244								
Conductivity (µS/cm):	132.4	135.3								
RDO (ppm): (mg/L)	12.97	10.82								
Turbidity (NTU):	0.5	519.8								
ORP	190	678								

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 $CaCO_3$)										Digital titrator 10-4000 mg/L as CaCO3
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_3-N)****										0.01-0.50 mg/L NH3-N
Ammonia/ Iron dilution										

Remarks:

Field-Form Filled Out By: HMC Date: 3/15/07

QAQC Check By: JED Date: 4/11/07

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: 3/18/07 Time: 14:16

FIELD MEASUREMENTS

GPS Coord. Northing: N70°19.280' Easting: W149°24.009' Datum: NAD83

Measurements By: HMC Time: 14:16

Water Depth (ft): 33.20 Ice Thickness (ft): 4.70

Freeboard (ft): 0.50 Snow Depth (ft): 0.45

Elev. (BPMSL +/- .02): 93.79 Survey By: DAR, CMC Date: 3/18/07 Time: 19:00

Water Sampling By: HMC Sample Depths BWS (ft): 1 5 Date: 3/18/07 Time: 15:30

2 18

3 32

WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
MULTI	UAF	IN-SITU TROLL 9000	33205	PASS	Pass, pH Fail, ORP fail

Parameters	**Field Measurements**									
Time:	14:35	14:37	14:39	14:42	14:45	14:50	1:53	14:55	14:58	
Depth BWS (ft):	5	6	7	9	11	13	15	17	19	
Temp (°C):	0.11	0.07	0.08	0.07	0.07	0.07	0.07	0.08	0.09	
pH:										
Barometeric (mmHg):	767.7	0.0	767.8	761.8	767.8	0.0	0.0	767.9	0.0	
Pressure (kPa):	14.068	16.811	19.547	25.726	31.602	37.405	43.256	49.600	55.359	
Conductivity (µS/cm):	259.8	258.5	258.5	258.3	258.2	258.1	258.1	258.0	257.4	
RDO (ppm): (mg/L)	8.89	8.89	8.91	8.96	8.98	8.97	8.96	8.96	8.93	
Turbidity (NTU):	0.4	0.4	0.5	0.5	0.4	0.4	0.4	0.4	0.4	
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): 5**			**Depth BWS (ft): 18**			**Depth BWS (ft): 32**			**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 $CaCO_3$)	165	190	185	193	193	194	187	189	188	Digital titrator 10-4000 mg/L as CaCO3
Total iron--UF (mg/L)	0.09	0.06	0.05	0.05	0.03	0.05	2.5*	2.6*	2.6*	Hach spec 0.02-3.00 mg/L
Filtered Iron--F tot Fe (mg/L)	0.05	0.1	0.09	0.03	0.02	0.03	1.34	1.34	1.33	Hach spec 0.02-3.00 mg/L
Ammonia (mg/L NH_3-N)****										0.01-0.50 mg/L NH3-N
Ammonia/ Iron dilution										

Remarks: Log 2007-03-18 141811 Note: pH and ORP not working properly. *Concentration determined by running 1:10 dilution.

Field-Form Filled Out By: DAR Date: 3/20/07

QAQC Check By: JED Date: 4/11/07

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: 3/18/07 Time: 14:16

FIELD MEASUREMENTS

GPS Coord. Northing: N70°19.280' Easting: W149°24.009' Datum: NAD83

Measurements By: HMC Time: 14:16

Water Depth (ft): 33.20 Ice Thickness (ft): 4.70

Freeboard (ft): 0.50 Snow Depth (ft): 0.45

Elev. (BPMSL +/- .02): 93.79 Survey By: DAR, CMC Date: 3/18/07 Time: 19:00

Water Sampling By: HMC Sample Depths BWS (ft): 1 5 Date: 3/18/07 Time: 15:30

2 18

3 32

WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
MULTI	UAF	IN-SITU TROLL 9000	33205	PASS	Pass, pH Fail, ORP fail

Parameters	**Field Measurements**									
Time:	15:00	15:09	15:13	15:20	15:25	15:32	15:40			
Depth BWS (ft):	21	23	25	27	29	30	31			
Temp (°C):	0.18	0.35	0.45	0.54	0.64	0.76	0.82			
pH:										
Barometeric (mmHg):	0.0	0.0	0.0	767.8	0.0	0.0	0.0			
Pressure (kPa):	61.569	67.564	73.340	79.054	84.789	88.208	91.429			
Conductivity (µS/cm):	256.5	255.7	255.6	255.4	255.6	255.8	261.9			
RDO (ppm): (mg/L)	8.73	8.28	8.08	7.86	7.48	5.66	3.35			
Turbidity (NTU):	0.5	0.9	0.8	1.1	1.6	2.9	4.1			
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 $CaCO_3$)										Digital titrator 10-4000 mg/L as CaCO3
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_3-N)****										0.01-0.50 mg/L NH3-N
Ammonia/ Iron dilution										

Remarks:

Field-Form Filled Out By: DAR Date: 3/20/07

QAQC Check By: Jed Date: 4/11/07

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: MSBS-CT

Sample Purpose: **Lake Water Quality** Date: 3/18/07 Time: 16:46

FIELD MEASUREMENTS

GPS Coord. Northing: N70°19.214' Easting: W149°24.020' Datum: NAD83

Measurements By: HMC Time: 15:15

Water Depth (ft): 26.90 Ice Thickness (ft): 4.80

Freeboard (ft): 0.40 Snow Depth (ft): 0.40

Elev. (BPMSL +/- .02): 94.03 Survey By: DAR, CMC Date: 3/18/07 Time: 19:00

Water Sampling By: DAR Sample Depths BWS (ft): 1 5 Date: 3/18/07 Time: 17:45

2 16

3 26

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

Parameters	**Field Measurements**									
Time:	16:46	16:49	16:51	16:55	16:59	17:02	17:04	17:06	17:10	
Depth BWS (ft):	5	6	7	9	11	13	15	17	19	
Temp (°C):	-0.30	-0.28	-0.28	-0.20	-0.19	-0.20	-0.20	-0.18	-0.11	
pH:	7.26	7.27	7.25	7.28	7.26	7.26	7.28	7.28	7.27	
Barometeric (mmHg):	765.5	765.4	765.4	765.5	765.5	765.6	765.6	765.6	765.7	
Pressure (kPa):	13.704	16.410	19.384	25.694	31.311	37.749	43.582	49.159	55.366	
Conductivity (µS/cm):	281.6	279.8	279.4	277.4	277.4	276.9	276.8	275.9	275.2	
RDO (ppm): (mg/L)	7.98	7.98	7.98	7.79	7.77	7.78	7.81	7.77	7.60	
Turbidity (NTU):	1.0	0.9	1.3	0.7	0.7	0.7	0.8	0.6	0.9	
ORP	193	193	192	192	193	193	192	192	193	

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): 5**			**Depth BWS (ft): 16**			**Depth BWS (ft): 26**			**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 $CaCO_3$)	209	207	208	206	208	208	203	202	200	Digital titrator 10-4000 mg/L as CaCO3
Total iron--UF (mg/L)	0.06	0.07	0.08	0.08	0.08	0.09	0.38	0.37	0.37	Hach spec 0.02-3.00 mg/L
Filtered Iron--F tot Fe (mg/L)	0.03	0.04	0.05	0.07	0.05	0.04	0.08	0.09	0.1	Hach spec 0.02-3.00 mg/L
Ammonia (mg/L NH_3-N)****										0.01-0.50 mg/L NH3-N
Ammonia/ Iron dilution										

Remarks: log 2007-03-18 164136

Field-Form Filled Out By: DAR Date: 3/20/07

QAQC Check By: Jed Date: 4/11/07

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: MSBS-CT

Sample Purpose: **Lake Water Quality** Date: 3/18/07 Time: 16:46

FIELD MEASUREMENTS

GPS Coord. Northing: N70°19.214' Easting: W149°24.020' Datum: NAD83

Measurements By: HMC Time: 15:15

Water Depth (ft): 27.23 Ice Thickness (ft): 3.80

Freeboard (ft): 0.25 Snow Depth (ft): 0.30

Elev. (BPMSL +/- .02): 94.03 Survey By: DAR, CMC Date: 3/18/07 Time: 19:00

Water Sampling By: DAR Sample Depths BWS (ft): 1 5 Date: 3/18/07 Time: 17:45

2 16

WATER QUALITY METER INFORMATION 3 26

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

Parameters	**Field Measurements**									
Time:	17:14	17:18	17:25	17:32	nr					
Depth BWS (ft):	21	23	25	26	Bot					
Temp (°C):	0.04	0.24	0.42	0.52	0.63					
pH:	7.27	7.28	7.28	7.25	7.29					
Barometeric (mmHg):	765.7	765.7	765.7	765.8	765.8					
Pressure (kPa):	61.511	67.457	73.276	76.439	79.808					
Conductivity (µS/cm):	274.7	274.6	274.9	279.0	356.5					
RDO (ppm): (mg/L)	7.48	7.27	7.10	5.21	2.96					
Turbidity (NTU):	1.3	1.3	1.7	3.2	30.4					
ORP	193	192	192	83	-38					

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 $CaCO_3$)										Digital titrator 10-4000 mg/L as CaCO3
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_3-N)****										0.01-0.50 mg/L NH3-N
Ammonia/ Iron dilution										

Remarks:

Field-Form Filled Out By: DAR Date: 3/20/07

QAQC Check By: JED Date: 4/11/07

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: MSBS-SW

Sample Purpose: **Lake Water Quality** Date: 3/18/07 Time: 18:20

FIELD MEASUREMENTS

GPS Coord. Northing: N70°19.186' Easting: W149°24.234' Datum: NAD83

Measurements By: HMC Time: 18:20

Water Depth (ft): 18.80 Ice Thickness (ft): 5.50

Freeboard (ft): 0.55 Snow Depth (ft): 0.40

Elev. (BPMSL +/- .02): 94.03 Survey By: DAR, CMC Date: 3/18/07 Time: 19:00

Water Sampling By: HMC Sample Depths BWS (ft): 1 Date: Time:

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

Parameters	**Field Measurements**									
Time:	18:30	18:32	18:34	18:36	18:39	18:43	18:45	18:49	18:51	18:54
Depth BWS (ft):	6	7	8	9	11	13	15	17	18	Bot
Temp (°C):	-0.26	-0.21	-0.18	-0.17	-0.17	-0.17	-0.17	-0.17	-0.17	-0.17
pH:	7.45	7.40	7.38	7.40	7.39	7.40	7.37	7.39	7.36	7.37
Barometeric (mmHg):	764.7	764.7	764.6	764.6	764.7	764.7	764.7	764.8	764.8	764.7
Pressure (kPa):	16.444	19.602	22.633	25.583	31.439	37.613	43.369	49.268	52.121	55.411
Conductivity (µS/cm):	286.1	284.6	283.7	283.3	283.1	282.8	282.7	282.50	282.60	282.6
RDO (ppm): (mg/L)	8.28	8.02	7.97	7.93	7.92	7.96	7.85	7.86	7.82	7.84
Turbidity (NTU):	1.1	1.3	0.8	0.7	0.8	0.7	0.7	0.8	0.8	19.8
ORP	143	147	149	150	152	154	156	158	160	154

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 $CaCO_3$)										Digital titrator 10-4000 mg/L as CaCO3
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_3-N)****										0.01-0.50 mg/L NH3-N
Ammonia/ Iron dilution										

Remarks: Log 2007-03-18 182254

Field-Form Filled Out By: DAR Date: 3/20/07

QAQC Check By: JED Date: 4/11/07

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: L9312 Raft B

Sample Purpose: **Lake Water Quality** Date: 3/16/07 Time 11:01

FIELD MEASUREMENTS

GPS Coord. Northing: N70°19.995' Easting: W150°56.918' Datum: NAD83

Measurements By: HCM Time: 11:05

Water Depth (ft): 11.1 Ice Thickness (ft): 4.85

Freeboard (ft): 0.35 Snow Depth (ft): 0.65

Elev. (BPMSL): 7.51 Survey By: MRL, MSW Date: 3/16/07 Time: 15:32

Water Sampling By: HMC Sample Depths BWS (ft): 1 5 Date: Time:

2 7

WATER QUALITY METER INFORMATION 3 11 Additional Samples at 9ft, 10 ft.

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
In-Situ	GWS	InSitu Troll 9000	33033	PASS	PASS

Parameters	**Field Measurements**									
Time:	11:13	11:17	11:27	11:34	11:38	11:41	11:58			
Depth BWS (ft):	5	6	7	8	9	10	BOT			
Temp (°C):	-0.21	0.2	0.66	0.92	1.22	1.52	1.68			
pH:	6.77	6.74	6.72	6.71	6.73	6.70	6.77			
Barometeric (mmHg):	778.8	777.8	777.9	777.9	778.0	778.0	778.0			
Pressure (kPa):	13.571	16.148	19.332	22.325	25.060	28.371	31.260			
Conductivity (µS/cm):	87.50	87.62	87.38	87.04	86.68	85.37	90.26			
RDO (ppm): (mg/L)	10.86	10.97	10.10	9.88	9.86	9.77	5.60			
Turbidity (NTU):	1.1	1.4	6.6	2.8	2.2	2.6	7.6			
ORP	173	175	180	183	163	179	75			

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):____5 ft___**			**Depth BWS (ft):__7ft__**			**Depth BWS (ft):___11___**			**Method**
	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	
Alkalinity (mg/L as $CaCO_3$)	38	-	-	50	-	-	69	-	-	
Total iron--UF (mg/L)	0.27	0.26	0.28	0.29	0.27	0.28	2.06	2.05	2.09	
Filtered Iron--F tot Fe (mg/L)	0.14	0.12	0.15	0.31	0.31	0.32	1.03	1.02	1.02	

Remarks:

Field-Form Filled Out By: CMC Date: 3/18/07

QAQC Check By: DAR Date: 4/11/07

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: L9312 Raft A

Sample Purpose: **Lake Water Quality** Date: 3/16/07 Time: 12:55

FIELD MEASUREMENTS

GPS Coord. Northing: N70°20.053' Easting: W150°56.600' Datum: NAD83

Measurements By: HMC Time:

Water Depth (ft): 10.2 Ice Thickness (ft): 4.10

Freeboard (ft): 0.3 Snow Depth (ft): 0.5

Elev. (BPMSL): 7.51 Survey By: MRL, MSW Date: 3/16/07 Time: 15:32

Water Sampling By: HMC Sample Depths BWS (ft): 1 Date: Time:

2

WATER QUALITY METER INFORMATION 3

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
In-Situ	GWS	InSitu Troll 9000	33033	PASS	PASS

Parameters										
Time:	13:01	13:08	13:15	13:23	13:39	13:50				
Depth BWS (ft):	5	6	7	8	9	BOT				
Temp (°C):	-0.21	0.29	0.61	0.90	1.22	1.28				
pH:	6.70	6.71	6.71	6.69	6.61	6.63				
Barometeric (mmHg):	777.9	778.0	778.0	778.1	778.0	778.1				
Pressure (kPa):	13.226	16.598	19.304	22.415	25.381	29.766				
Conductivity (µS/cm):	88.61	88.96	89.29	89.78	89.16	92.77				
RDO (ppm):	10.88	10.62	10.45	10.32	7.98	6.92				
Turbidity (NTU):	1.5	1.7	1.9	8.6	6.6	72.9				
ORP	173	177	179	180	187	46				

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	
Alkalinity (mg/L as $CaCO_3$)										
Total iron--UF (mg/L)										
Filtered Iron--F tot Fe (mg/L)										

Remarks: LOG 2007-03-16 125254

Field-Form Filled Out By: HMC Date: 3/16/07

QAQC Check By: DAR Date: 4/11/07

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: L9312 AB Midpoint

Sample Purpose: **Lake Water Quality** Date: 3/16/07 Time: 14:12

FIELD MEASUREMENTS

GPS Coord. Northing: N70°20.024' Easting: W150°56.753' Datum: NAD83

Measurements By: HMC Time:

Water Depth (ft): 11 Ice Thickness (ft): 4.75

Freeboard (ft): 0.35 Snow Depth (ft): 0.35

Elev. (BPMSL): 7.51 Survey By: MRL, MSW Date: 3/16/07 Time: 15:32

Water Sampling By: HMC Sample Depths BWS (ft): 1 Date: Time:

2

WATER QUALITY METER INFORMATION 3

Calibration Information

Parameter (s)	Owner	Meter Make/Model			Serial No.		Pre-Sampling QAQC Check		Post-Sampling QAQC Check	
In-Situ	GWS	InSitu Troll 9000			33033		PASS		Pass	
Parameters										
Time:	14:15	14:21	14:26	14:30	14:34	14:48	15:04			
Depth BWS (ft):	5	6	7	8	9	10	BOT			
Temp (°C):	-0.19	0.18	0.55	0.85	1.09	1.38	1.54			
pH:	6.70	6.67	6.67	6.68	6.66	6.68	6.80			
Barometeric (mmHg):	777.8	777.8	777.9	777.9	777.8	777.9	777.9			
Pressure (kPa):	13.708	16.259	19.320	22.297	24.965	28.603	32.420			
Conductivity (µS/cm):	91.23	90.18	90.62	90.59	90.64	91.98	116.00			
RDO (ppm):	8.95	9.09	9.13	9.13	9.08	8.58	7.06			
Turbidity (NTU):	3.4	3.8	5.0	5.7	6.0	6.7	22.4			
ORP	153	162	167	171	175	179	21			

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	
Alkalinity (mg/L as $CaCO_3$)										
Total iron--UF (mg/L)										
Filtered Iron--F tot Fe (mg/L)										

Remarks: LOG 2007-03-16 141049

Field-Form Filled Out By: HMC Date: 3/16/07

QAQC Check By: DAR Date: 4/11/07

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: L9312 Screen

Sample Purpose: **Lake Water Quality** Date: 3/16/07 Time: 15:30

FIELD MEASUREMENTS

GPS Coord. Northing: N70°20.003' Easting: W150°57.005' Datum: NAD83

Measurements By: Time: 15:30

Water Depth (ft): 11.1 Ice Thickness (ft): 4.47

Freeboard (ft): 0.55 Snow Depth (ft): 0.5

Elev. (BPMSL): 7.51 Survey By: MRL, MSW Date: 3/16/07 Time: 15:32

Water Sampling By: DAR Sample Depths BWS (ft): 1 Date: Time:

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	UAF	InSitu Troll 9000	33205	PASS	PASS

Parameters										
Time:	15:30	15:33	15:35	15:39	15:42	15:50	15:55			
Depth BWS (ft):	5	6	7	9	10	11	BOT			
Temp (°C):	0.14	0.68	0.92	1.54	1.70	1.83	1.89			
pH:	6.68	6.68	6.67	6.54	6.57	6.65	6.83			
Barometeric (mmHg):	778.9	778.9	778.9	778.9	778.8	778.9	778.9			
Pressure (kPa):	13.442	16.444	19.464	25.255	28.378	31.263	32.902			
Conductivity (µS/cm):	87.29	85.77	85.58	86.42	88.86	101.40	131.00			
RDO (ppm):	10.92	11.13	11.31	9.23	7.56	7.18	5.88			
Turbidity (NTU):	0.9	1.0	1.2	6.9	6.0	7.3	41.2			
ORP	101	102	102	100	94	72	19			

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	
Alkalinity (mg/L as $CaCO_3$)										
Total iron--UF (mg/L)										
Filtered Iron--F tot Fe (mg/L)										

Remarks: LOG 2007-03-16 142751

Field-Form Filled Out By: HMC Date: 3/16/07

QAQC Check By: DAR Date: 4/11/07

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: L9312 SH

Sample Purpose: **Lake Water Quality** Date: 3/16/07 Time: 15:45

FIELD MEASUREMENTS

GPS Coord. Northing: N70°20.017' Easting: W150°57.076' Datum: NAD83

Measurements By: MSW Time:

Water Depth (ft): 9.85 Ice Thickness (ft): 4.75

Freeboard (ft): 0.33 Snow Depth (ft): 0.3

Elev. (BPMSL): 7.51 Survey By: MRL, MSW Date: 3/16/07 Time: 15:32

Water Sampling By: MSW Sample Depths BWS (ft): 1 Date: Time:

2

WATER QUALITY METER INFORMATION 3

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
In-Situ	GWS	InSitu Troll 9000	33033	PASS	Pass

Parameters										
Time:	15:51	16:15	16:27	16:38	16:54	17:09				
Depth BWS (ft):	5	6	7	8	9	BOT				
Temp (°C):	-0.30	0.23	0.50	0.81	0.91	1.02				
pH:	6.68	6.74	6.71	6.67	6.61	6.62				
Barometeric (mmHg):	777.6	777.4	777.5	777.4	777.2	777.1				
Pressure (kPa):	13.118	16.225	19.378	22.236	25.222	29.304				
Conductivity (µS/cm):	93.36	94.07	93.63	86.89	94.01	96.60				
RDO (ppm):	10.60	10.62	10.12	8.05	7.48	7.06				
Turbidity (NTU):	1.3	2.0	2.7	4.1	5.9	58.3				
ORP	170	186	189	191	198	96				

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	
Alkalinity (mg/L as $CaCO_3$)										
Total iron--UF (mg/L)										
Filtered Iron--F tot Fe (mg/L)										

Remarks:

Field-Form Filled Out By: HMC Date: 3/16/07

QAQC Check By: DAR Date: 4/11/07

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: L9817-1

Sample Purpose: **Lake Water Quality** Date: 3/17/07 Time 13:00

FIELD MEASUREMENTS

GPS Coord. Northing: N70°14.070' Easting: W151°20.121' Datum: NAD83

Measurements By: HMC Time: 13:00

Water Depth (ft): 8.64 Ice Thickness (ft): 4.30

Freeboard (ft): 0.35 Snow Depth (ft): 0.40

Elev. (BPMSL): 53.06 Survey By: MRL,CMC Date: 3/17/07 14:00

Water Sampling By: HCM/DAR Sample Depths BWS (ft): 1 5 Date: Time:

2 7

WATER QUALITY METER INFORMATION 3 8

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
MULTI	GWS	InSitu Troll 9000	33035	PASS	Pass

Parameters	**Field Measurements**									
Time:	13:22	13:24	13:25	13:27	13:31					
Depth BWS (ft):	5	6	7	8	BOT					
Temp (°C):	0.13	0.26	0.50	0.78	1.09					
pH:	6.86	6.84	6.85	6.87	8.15					
Barometeric (mmHg):	774.3	774.3	774.3	774.3	774.4					
Pressure (kPa):	13.540	16.553	19.402	22.533	24.634					
Conductivity (µS/cm):	552.6	551.9	552.4	554.2	559.0					
RDO (ppm): (mg/L)	1.08	0.96	0.88	0.78	0.65					
Turbidity (NTU):	11.5	11.1	11.7	15.1	44.2					
ORP	73	73	72	55	-249					

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):____5 ft__**			**Depth BWS (ft):__7ft__**			**Depth BWS (ft):___8___**			**Method**
	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	
Alkalinity (mg/L as $CaCO_3$)	171			167			170			
Total iron--UF (mg/L)	0.99	0.98	0.93	1.08	1.04	1.14	7.4*	7.8*	7.5*	
Filtered Iron--F tot Fe (mg/L)	0.06	0.05	0.06	0.36	0.33	0.34	6.7*	6.7*	6.9*	

Remarks: LOG 2007-03-17 131557 * 1:10 dilution corrected

Field-Form Filled Out By: CMC Date: 3/17/07

QAQC Check By: DAR Date: 4/11/07

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: L9817 - 20

Sample Purpose: **Lake Water Quality** Date: 3/17/07 Time 12:05

FIELD MEASUREMENTS

GPS Coord. Northing: N70°14.079' Easting: W151°19.969' Datum: NAD83

Measurements By: DAR Time:

Water Depth (ft): 8.92 Ice Thickness (ft): 4.76

Freeboard (ft): 0.15 Snow Depth (ft): 0.90

Elev. (BPMSL): 53.06 Survey By: MRL,CMC Date: 3/17/07 14:00

Water Sampling By: DAR Sample Depths BWS (ft): 1 5 Date: Time:

2 7

3 8

WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
MULTI	GWS	InSitu Troll 9000	33035	PASS	Pass

Parameters	**Field Measurements**									
Time:	12:33	12:37	12:39	12:40	12:42	nr				
Depth BWS (ft):	5	6	7	8	8.5	BOT				
Temp (°C):	0.13	0.22	0.39	0.61	0.75	0.83				
pH:	6.82	6.83	8.82	8.84	7.05	7.83				
Barometeric (mmHg):	774.1	774.1	774.2	774.2	774.2	774.3				
Pressure (kPa):	13.484	16.473	19.450	22.441	23.690	26.166				
Conductivity (µS/cm):	545.9	552.6	555.2	555.6	549.6	554.9				
RDO (ppm): (mg/L)	0.76	0.76	0.74	0.66	0.50	0.52				
Turbidity (NTU):	13.4	11.0	12.3	15.3	20.2	948.8				
ORP	79	80	80	50	1	-244				

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):____5 ft__**			**Depth BWS (ft):__7ft__**			**Depth BWS (ft):___8___**			**Method**
	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	rep 1	rep 2	rep 3	
Alkalinity (mg/L as $CaCO_3$)	170			166				194		
Total iron--UF (mg/L)	1.20	1.24	1.22	1.79	1.79	1.89	25.4*	25.3*	25.5*	
Filtered Iron--F tot Fe (mg/L)	0.20	0.18	0.22	1.41	1.45	1.44	16.8*	16.9*	16.6*	

Remarks: LOG 2007-03-17 12428 *1:10 Dilution Corrected

Field-Form Filled Out By: CMC Date: 3/17/07

QAQC Check By: DAR Date: 4/11/07

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: L9817 - 2

Sample Purpose: **Lake Water Quality** Date: 3/17/07 Time

FIELD MEASUREMENTS

GPS Coord. Northing: N70°14.046' Easting: W151°20.079' Datum: NAD83

Measurements By: DAR Time:

Water Depth (ft): 6.91 Ice Thickness (ft): 4.40

Freeboard (ft): 0.28 Snow Depth (ft): 0.35

Elev. (BPMSL): 53.06 Survey By: MRL,CMC Date: 3/17/07 14:00

Water Sampling By: CMC Sample Depths BWS (ft): 1 Date: Time:

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	InSitu Troll 9000	33035	PASS	PASS

Parameters	**Field Measurements**									
Time:	15:10	15:13	15:16	15:18						
Depth BWS (ft):	5	6	6.5	BOT						
Temp (°C):	0.06	0.06	0.11	0.22						
pH:	6.88	6.88	6.87	6.87						
Barometeric (mmHg):	774.1	774.2	774.2	774.2						
Pressure (kPa):	13.492	16.513	18.093	19.901						
Conductivity (µS/cm):	569.3	569.9	572.2	572.5						
RDO (ppm): (mg/L)	1.40	1.24	1.16	1.14						
Turbidity (NTU):	7.7	7.5	7.4	11.4						
ORP	49	48	49	48						

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	
Alkalinity (mg/L as $CaCO_3$)										
Total iron--UF (mg/L)										
Filtered Iron--F tot Fe (mg/L)										

Remarks: LOG 2007-03-17 150944

Field-Form Filled Out By: CMC Date: 3/17/07

QAQC Check By: DAR Date: 4/11/07

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: L9817 - 3

Sample Purpose: **Lake Water Quality** Date: 3/17/07 Time 14:30

FIELD MEASUREMENTS

GPS Coord. Northing: N70°14.022' Easting: W151°20.037' Datum: NAD83

Measurements By: DAR Time: 14:30

Water Depth (ft): 7.88 Ice Thickness (ft):

Freeboard (ft): 0.42 Snow Depth (ft): 0.20

Elev. (BPMSL): 53.06 Survey By: MRL,CMC Date: 3/17/07 14:00

Water Sampling By: DAR Sample Depths BWS (ft): 1 Date: Time:

2

WATER QUALITY METER INFORMATION 3

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
MULTI	GWS	InSitu Troll 9000	33035	PASS	PASS

Parameters	**Field Measurements**									
Time:	14:39	14:45	14:48	14:50						
Depth BWS (ft):	5	6	7	BOT						
Temp (°C):	0.11	0.17	0.21	0.46						
pH:	6.88	6.88	6.88	7.83						
Barometeric (mmHg):	774.3	774.3	774.3	774.3						
Pressure (kPa):	13.566	16.310	19.539	22.115						
Conductivity (µS/cm):	564.0	565.2	572.4	576.3						
RDO (ppm): (mg/L)	1.07	0.93	0.92	0.85						
Turbidity (NTU):	8.4	7.6	7.7	90.4						
ORP	54	53	52	-221						

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	
Alkalinity (mg/L as $CaCO_3$)										
Total iron--UF (mg/L)										
Filtered Iron--F tot Fe (mg/L)										

Remarks: LOG 2007-03-17 142950

Field-Form Filled Out By: DAR Date: 3/17/07

QAQC Check By: DAR Date: 4/11/07

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: L9817 - 4

Sample Purpose: **Lake Water Quality** Date: 3/17/07 Time 13:55

FIELD MEASUREMENTS

GPS Coord. Northing: N70°13.998' Easting: W151°19.997' Datum: NAD83

Measurements By: DAR Time: 13:55

Water Depth (ft): 5.80 Ice Thickness (ft): 3.70

Freeboard (ft): 0.10 Snow Depth (ft): 1.75

Elev. (BPMSL): 53.06 Survey By: MRL,CMC Date: 3/17/07 14:00

Water Sampling By: DAR Sample Depths BWS (ft): 1 Date: Time:

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	InSitu Troll 9000	33035	PASS	PASS

Parameters	**Field Measurements**									
Time:	14:02	14:11	14:17	14:19						
Depth BWS (ft):	4	5	5.5	BOT						
Temp (°C):	0.04	0.15	0.22	0.26						
pH:	6.88	6.87	6.87	7.13						
Barometeric (mmHg):	774.2	774.3	774.3	774.3						
Pressure (kPa):	10.219	13.004	14.927	16.445						
Conductivity (µS/cm):	557.5	557.7	558.2	559.4						
RDO (ppm): (mg/L)	0.42	0.25	0.24	0.24						
Turbidity (NTU):	11.6	11.4	12.0	43.2						
ORP	57	52	46	-29						

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	
Alkalinity (mg/L as $CaCO_3$)										
Total iron--UF (mg/L)										
Filtered Iron--F tot Fe (mg/L)										

Remarks: Next to Survey Hole

LOG 2007-03-17 135408

Field-Form Filled Out By: CMC Date: 3/17/07

QAQC Check By: DAR Date: 4/11/07

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: L9817 - 22

Sample Purpose: **Lake Water Quality** Date: 3/17/07 Time 15:30

FIELD MEASUREMENTS

GPS Coord. Northing: N70°14.074' Easting: W151°20.017 Datum: NAD83

Measurements By: DAR Time: 15:30

Water Depth (ft): 9.20 Ice Thickness (ft): 4.65

Freeboard (ft): 0.25 Snow Depth (ft): 0.25

Elev. (BPMSL): 53.06 Survey By: MRL,CMC Date: 3/17/07 14:00

Water Sampling By: DAR Sample Depths BWS (ft): 1 Date: Time:

2

WATER QUALITY METER INFORMATION 3

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
MULTI	GWS	InSitu Troll 9000	33033	Pass	Pass

Parameters	**Field Measurements**									
Time:	15:39	15:41	15:43	15:45	15:48	15:53				
Depth BWS (ft):	5	6	7	8	9	BOT				
Temp (°C):	0.12	0.09	0.17	0.34	0.80	1.06				
pH:	6.88	6.87	6.86	6.86	7.36	7.59				
Barometeric (mmHg):	774.2	774.2	774.2	774.3	774.3	774.3				
Pressure (kPa):	13.344	16.380	19.382	22.409	25.563	26.766				
Conductivity (µS/cm):	556.6	561.2	573.0	579.1	595.1	621.4				
RDO (ppm): (mg/L)	1.36	1.11	1.13	1.06	0.58	0.41				
Turbidity (NTU):	8.1	7.6	5.7	6.7	19.1	22.8				
ORP	48	48	48	46	-86	-203				

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	
Alkalinity (mg/L as $CaCO_3$)										
Total iron--UF (mg/L)										
Filtered Iron--F tot Fe (mg/L)										

Remarks: L9817-22 is located 1/3 of the straight line distance from L9817-20 to L9817-1.

March 2007 is the first time that we have sampled at this location.

Field-Form Filled Out By: DAR Date: 3/17/07

QAQC Check By: DAR Date: 4/11/07

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: L9817 - 23

Sample Purpose: **Lake Water Quality** Date: 3/17/07 Time 16:00

FIELD MEASUREMENTS

GPS Coord. Northing: N70°14.071' Easting: W151°20.067 Datum: NAD83

Measurements By: DAR Time: 16:00

Water Depth (ft): 8.60 Ice Thickness (ft): 4.75

Freeboard (ft): 0.33 Snow Depth (ft): 0.20

Elev. (BPMSL): 53.06 Survey By: MRL,CMC Date: 3/17/07 14:00

Water Sampling By: DAR Sample Depths BWS (ft): 1 Date: Time:

2

WATER QUALITY METER INFORMATION 3

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
MULTI	GWS	InSitu Troll 9000	33033	Pass	Pass

Parameters	**Field Measurements**									
Time:	16:05	16:13	16:15	16:18	16:20					
Depth BWS (ft):	5	6	7	8	Bot					
Temp (°C):	0.14	0.06	0.22	0.65	0.95					
pH:	6.90	6.87	6.87	6.87	6.97					
Barometeric (mmHg):	774.2	774.1	774.2	774.2	774.2					
Pressure (kPa):	13.640	16.390	19.263	22.367	25.048					
Conductivity (µS/cm):	567.1	565.7	567.7	568.5	568.3					
RDO (ppm): (mg/L)	1.04	0.95	0.97	0.96	0.67					
Turbidity (NTU):	9.1	9.4	10.0	12.9	50.8					
ORP	36	36	34	26	-18					

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	
Alkalinity (mg/L as $CaCO_3$)										
Total iron--UF (mg/L)										
Filtered Iron--F tot Fe (mg/L)										

Remarks: L9817-23 is located 2/3 of the straight line distance from L9817-20 to L9817-1. Log 2007-03-17 160306

March 2007 is the first time that we have sampled at this location.

Field-Form Filled Out By: DAR Date: 3/17/07

QAQC Check By: DAR Date: 4/11/07

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 I Prudhoe SRT Lab

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/Post-Sampling QA

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Temp (°C)	Pass/Fail
pH	3/12/07	18:00	Oakton 4.01	2512012	10/1/08	4.04	14..38	Pass
pH	3/12/07	18:00	Oakton 7.00	2612531	10/1/08	7.04	14.07	Pass
pH	3/12/07	18:00	Oakton 10.00	2612532	10/1/08	10.01	13.20	Pass
ORP	3/12/07	18:00	InSitu QuickCal	2207B	5/1/07	240	12.93	Pass
RDO - 100% DO	3/12/07	18:00	Bubbled Nanopure	n/a	n/a	10.48	11.67	Pass
RDO - Zero DO	3/12/07	18:00	HANNA HI7040	W012	2/1/11	0.00	13.40	Pass
Conductivity	3/12/07	18:00	Oakton 447uS	2701471	1/1/08	334.8	12.31	Pass

ORP read in mV, RDO read in mg/L, Conductivity read in uS/cm AC. Pre sample cal check KDA.

Field-Form Filled Out By:	HMC	Date:	3/19/2007			
QAQC Check By:	DAR	Date:	4/11/07			

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 I Alpine WTP

Sample Purpose: **Lake Water Quality**

WATER QUALITY METER INFORMATION

Meter Make: In-Situ Model: Troll 9000

Owner: UAF S/N: 33205

CALIBRATION AND QUALITY ASSURANCE INFORMATION

Pre/Post-Sampling QA

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Temp (°C)	Pass/Fail
pH	3/12/07	18:00	Oakton 4.01	2512012	10/1/08	4.07	15.94	Pass
pH	3/12/07	18:00	Oakton 7.00	2612531	10/1/08	7.04	15.84	Pass
pH	3/12/07	18:00	Oakton 10.00	2612532	10/1/08	10.03	15.76	Pass
ORP	3/12/07	18:00	InSitu QuickCal	2207B	5/1/07	238	14.60	Pass
RDO - 100% DO	3/12/07	18:00	Bubbled Nanopure	n/a	n/a	9.18	14.70	Pass
RDO - Zero DO	3/12/07	18:00	HANNA HI7040	W012	2/1/11	0.00	13.99	Pass
Conductivity	3/12/07	18:00	Oakton 447uS	2701471	1/1/08	392.0	15.60	Pass

ORP read in mV, RDO read in mg/L, Conductivity read in uS/cm AC. Pre sample cal check KDA.

Field-Form Filled Out By:	HMC	Date:	3/19/2007			
QAQC Check By:	DAR	Date:	4/11/2007			

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 I Alpine WTP

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/Post-Sampling QA

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Temp (°C)	Pass/Fail
pH	3/16/07	7:40	Oakton 4.01	2512012	10/1/08	4.03	15.76	Pass
pH	3/16/07	7:40	Oakton 7.00	2612531	4/1/08	6.98	15.53	Pass
pH	3/16/07	7:40	Oakton 10.00	2612532	10/1/08	10.02	15.51	Pass
ORP	3/16/07	7:40	InSitu QuickCal	2207B	5/1/07	230	16.31	Pass
RDO - 100% DO	3/16/07	7:40	Bubbled Nanopure	n/a	n/a	11.46	14.95	Pass
RDO - Zero DO	3/16/07	7:40	HANNA HI7040	91012	2/1/11	0.02	11.54	Pass
Conductivity	3/16/07	7:40	Oakton 447uS	2701471	1/1/08	361	15.95	Pass

ORP read in mV, RDO read in mg/L, Conductivity read in uS/cm AC. Post sample cal check KDA. Pre sample cal check L9312.

Field-Form Filled Out By:	HMC	Date:	3/19/2007			
QAQC Check By:	DAR	Date:	4/11/2007			

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 I Alpine WTP

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/Post-Sampling QA

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Temp (°C)	Pass/Fail
pH	3/16/07	20:45	Oakton 4.01	2612530	10/1/08	4.08	14.54	Pass
pH	3/16/07	20:45	Oakton 7.00	2612531	4/1/08	7.07	14.36	Pass
pH	3/16/07	20:45	Oakton 10.00	2612532	10/1/08	10.12	14.38	Pass
ORP	3/16/07	20:45	InSitu QuickCal	2207B	5/1/07	368	14.16	Pass
RDO - 100% DO	3/16/07	20:45	Bubbled Nanopure	n/a	n/a	11.56	12.26	Pass
RDO - Zero DO	3/16/07	20:45	HANNA HI7040	G1012	2/1/11	0.02	7.52	Pass
Conductivity	3/16/07	20:45	Oakton 447uS	2701471	1/1/08	367.8	14.16	Pass

ORP read in mV, RDO read in mg/L, Conductivity read in uS/cm AC. Post sample cal check for L9312. Pre sample cal check L9817.

Field-Form Filled Out By:	HMC	Date:	3/19/2007			
QAQC Check By:	DAR	Date:	4/11/2007			

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 I Alpine WTP

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/Post-Sampling QA

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Temp (°C)	Pass/Fail
pH	3/16/07	19:51	Oakton 4.01	2612530	10/1/08	4.02	14.41	Pass
pH	3/16/07	19:51	Oakton 7.00	2612531	4/1/08	7.03	14.18	Pass
pH	3/16/07	19:51	Oakton 10.00	2612532	10/1/08	10.04	14.03	Pass
ORP	3/16/07	19:51	InSitu QuickCal	2207B	5/1/07	234	14.27	Pass
RDO - 100% DO	3/16/07	19:51	Bubbled Nanopure	n/a	n/a	10.79	12.60	Pass
RDO - Zero DO	3/16/07	19:51	HANNA HI7040	G1012	2/1/11	0.00	10.00	Pass
Conductivity	3/16/07	19:51	Oakton 447uS	2701471	1/1/08	375.5	13.97	Pass

ORP read in mV, RDO read in mg/L, Conductivity read in uS/cm AC. Post sample cal check for L9312. Pre sample cal check L9817.

Field-Form Filled Out By:	HMC	Date:	3/19/2007			
QAQC Check By:	DAR	Date:	4/11/2007			

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 I Alpine WTP

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/Post-Sampling QA

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Temp (°C)	Pass/Fail
pH	3/17/07	2:38	Oakton 4.01	2612530	10/1/08	4.05	17.16	Pass
pH	3/17/07	2:38	Oakton 7.00	2612531	4/1/08	7.03	17.31	Pass
pH	3/17/07	2:38	Oakton 10.00	2612532	10/1/08	10.17	17.10	Pass
ORP	3/17/07	2:38	InSitu QuickCal	2207B	5/1/07	218	17.53	Pass
RDO - 100% DO	3/17/07	2:38	Bubbled Nanopure	n/a	n/a	10.38	15.74	Pass
RDO - Zero DO	3/17/07	2:38	HANNA HI7040	G1012	2/1/11	0.01	15.67	Pass
Conductivity	3/17/07	2:38	Oakton 447uS	2701471	1/1/08	385.0	17.00	Pass

Conductivity read in uS/cm AC. Post Sample Check for L9817. Pre Sample Check for MSB

Field-Form Filled Out By:	HMC	Date:	3/19/2007			
QAQC Check By:	DAR	Date:	4/11/2007			

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 I Prudhoe SRT Lab

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/Post-Sampling QA

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Temp (°C)	Pass/Fail
pH	3/18/07	23:30	Oakton 4.01	2612530	10/1/08			Fail
pH	3/18/07	23:30	Oakton 7.00	2610412	4/1/08			Fail
pH	3/18/07	23:30	Oakton 10.00	2612532	10/1/08			Fail
ORP	3/18/07	23:30	InSitu QuickCal	2207B	5/1/07			Fail
RDO - 100% DO	3/18/07	23:30	Bubbled Nanopure	n/a	n/a	10.09	19.26	Pass
RDO - Zero DO	3/18/07	23:30	HANNA HI7040	HI7040	2/1/11	0.03	17.08	Pass
Conductivity	3/18/07	23:30	Oakton 447uS	2701471	1/1/08	417.8	19.13	Pass

Conductivity read in uS/cm AC. Post Sample Check for MSB. Pre Sample Check for KDA1

Field-Form Filled Out By:	HMC	Date:	3/19/2007			
QAQC Check By:	DAR	Date:	4/11/2007			

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 I Prudhoe SRT Lab

Sample Purpose: **Lake Water Quality**

WATER QUALITY METER INFORMATION

Meter Make: In-Situ Model: Troll 9000

Owner: UAF S/N: 33205

CALIBRATION AND QUALITY ASSURANCE INFORMATION

Pre/Post-Sampling QA

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Temp (°C)	Pass/Fail
pH	3/18/07	23:30	Oakton 4.01	2612530	10/1/08	3.99	18.17	Pass
pH	3/18/07	23:30	Oakton 7.00	2610412	4/1/08	7	19.11	Pass
pH	3/18/07	23:30	Oakton 10.00	2612532	10/1/08	9.97	18.26	Pass
ORP	3/18/07	23:30	InSitu QuickCal	2207B	5/1/07	227	17.70	Pass
RDO - 100% DO	3/18/07	23:30	Bubbled Nanopure	n/a	n/a	10.14	19.12	Pass
RDO - Zero DO	3/18/07	23:30	HANNA HI7040	HI7040	2/1/11	0.00	17.92	Pass
Conductivity	3/18/07	23:30	Oakton 447uS	2701471	1/1/08	389.6	17.94	Pass

Conductivity read in uS/cm AC. Post Sample Check for MSB. Pre Sample Check for KDA1

Field-Form Filled Out By:	HMC	Date:	3/19/2007			
QAQC Check By:	DAR	Date:	4/11/2007			

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 Reservoirs

Survey Purpose: **Water-Level Elevations** Date: 3/15/2007 Time: 13:00

Location:	Kuparuk Deadarm Reservoirs Cells 1, 2, 3							
Survey objective:	Determine FWS Elevation of KDA 1,2,3					Weather Observations:		
Instrument Type:	Leica NA720		Instrument ID:	5482372 (GWS owned)		30 F Below, Clear Sunny, 5-10 mph Wind		
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)		Chad Cormack, Michael Lilly		
BM #1 WO040768	BP	19.32	N70 20.048 NAD83	W148 56.367 NAD83				
Station	**BS (ft)**	**HI (ft)**	**FS (ft)**	**Elevation (fasl)**	**Distance (ft)**	**Horizontal Angle**	**Vertical Angle**	**Remarks**
BM#1	0.17	19.49		19.32				Shot to flagged benchmark
KDA3-SH		19.49	13.01	**6.48**				**WS Elevation for Reservoir #3**
KDA2-SH1		19.49	14.65	**4.84**				**WS Elevation for Reservoir #2**
Turn point, Moved instrument.								
KDA2-SH1	14.99	19.83		4.84				
KDA3-SH		19.83	13.33	6.50				
BM#1		19.83	0.49	19.34				Close survey to 0.02
Move instrument to island between KDA2 and KDA1. Use KDA2 FWS as turn point.								
KDA2-SH2	10.76	15.60		4.84				
KDA1-SH		15.60	7.21	**8.39**				**WS Elevation for Reservoir #1**
Turn point, Moved instrument.								
KDA1-SH	6.99	15.38		8.39				
KDA2-SH2		15.38	10.54	4.84				Close survey to 0.00

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: 3/18/2007 Time: 19:00

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)		-25F, clear, no wind		
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)		Daniel Reichardt Chad Cormack		
"Post"	WERC	100 Temp.	na	na				
Station	**BS (ft)**	**HI (ft)**	**FS (ft)**	**Elevation (fasl)**	**Distance (ft)**	**Horizontal Angle**	**Vertical Angle**	**Remarks**
Post TBM1	4.90	104.90		100.00				Top of nail in post, temp elevation
TBM2		104.90	1.06	103.84				VSM 387B on Pipeline, south side
TBM3		104.90	1.44	103.46				VSM 387A on Pipeline, north side
NC-WL		104.90	11.11	93.79				North Cell, closest to north bank
TBM4		104.90	3.52	101.38				Top of old cutoff VSM
								moved Instr., used TBM4 as turn point
TBM4	4.05	105.43		101.38				Top of old cutoff VSM
NC-WL		105.43	11.64	**93.79**				North Cell, closest to north bank, 0.00
TBM3								
TBM2		105.43	1.59	103.84				VSM on Pipeline, south side, 0.00
TBM1		105.43	5.43	100.00				close survey to -0.00
NC-WL	9.09	102.88		93.79				Frozen water level
NSC-East Channel		102.88	8.83	**94.05**				North Cell, closest to island
SC-WL		102.88	8.85	**94.03**				TBM, tripod
								moved Instr., used SC-WL as turn point
SC-WL	8.62	102.65		94.03				South Cell, frozen water level
NSC-West Channel		102.65	8.59	**94.06**				South Cell, closest to island
NC-WL		102.65	8.86	93.79				close survey to +0.00

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: L9312

Survey Purpose: **Water-Level Elevations** Date: 3/16/2007 Time: 15:32

Location:	Lake L9312, located southeast of Alpine pad, survey by pump house benchmarks							
Survey objective:	Determine FWS Elevation of KDA 1,2,3					Weather Observations:		
Instrument Type:	Leica NA720		Instrument ID:	5482372 (GWS owned)		Cold, clear, no wind, sunny		
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)		Michael Lilly Matthew Whitman (BLM)		
L9312 "P"	CP	11.72 BPMSL	na	na				

Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
P	1.57	13.29		11.72				Top of inlet pipe support
O		13.29	1.84	11.45				Top of inlet pipe support
PH-VSM		13.29	-1.26	14.55				Top of VSM plate, SE corner of pump house
WL		13.29	5.78	**7.51**				**Top of ice in refrozen hole**
								moved Instr., used WL ice as turn point
WL	5.91	13.42		7.51				
PH-VSM		13.42	-1.12	14.54				+0.01
O		13.42	1.97	11.45				+0.00
P		13.42	1.71	11.71				close survey to +0.01

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: L9817

Survey Purpose: **Water-Level Elevations** Date: 3/17/2007 Time: 14:00

Location:	Lake L9817, located west of Nuiqsut, survey control at southeast corner of lake							
Survey objective:	Determine FWS Elevation of KDA 1,2,3					Weather Observations:		
Instrument Type:	Leica NA720		Instrument ID:	5482372 (GWS owned)		Mild, overcast, no wind		
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)		Chad Cormack, Michael Lilly		
L9817 "B"	BLM	54.98 BPMSL	na	na				
Station	**BS (ft)**	**HI (ft)**	**FS (ft)**	**Elevation (fasl)**	**Distance (ft)**	**Horizontal Angle**	**Vertical Angle**	**Remarks**
B	6.57	61.55		54.98				SE TBM, rebar stake
A		61.55	6.43	55.12				NE TBM, rebar stake
D		61.55	6.87	54.68				NW TBM, rebar stake
C		61.55	5.62	55.93				south-central TBM, rebar stake
E		61.55	5.08	56.47				SW TBM, rebar stake
F		61.55	8.07	53.48				WL TBM, rebar stake
F-hub		61.55	8.18	53.37				WL TBM, 2"x2" hub, shoreline
WL		61.55	8.49	53.06				Top of ice in refrozen hole
moved Instr., used WL ice as turn point								
WL	8.32	61.38		**53.06**				**L9817 WL**
F-hub		61.38	8.02	53.36				-0.01
F		61.38	7.90	53.48				+0.00
E		61.38	4.92	56.46				-0.01
C		61.38	5.45	55.93				-0.00
D		61.38	6.70	54.68				+0.00
A		61.38	6.26	55.12				+0.00
B		61.38	6.41	54.97				close survey to +0.01

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

APPENDIX D. SNOW DEPTH AND WATER CONTENT SURVEY FORMS

The following forms report 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:	**North Slope Lakes Project**	Site Location/Lake ID:	**KDA2-CT**
Survey Purpose:	**Snow Depth and Water Content**	Date: 3/15/2007	Time: 13:30

Location Description:	Located at center of Lake 2 near KDA2-CT. "L" shaped pattern, first going south, then going east in 1 meter in crements for 25 meters each direction. Snow is very hard pack, consolidated by drifting. Lake visually appears 75% covered by snow.				
Survey objective:	Snow depths and snow-water content for lake recharge estimates			Weather Observations	30 F Below, Clear, Sunny, 5 10 mph Wind
Latitude: N70°19.9776'	Longitude: W148°56.4462'			Datum:	NAD83
Elevation:	5'	Elevation Datum:	BPMSL	Reference Markers:	KDA2-CT 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^2			Matthew Whitman, Dan Reichardt	

Snow Course Depths, in cm.

	1	2	3	4	5
1	4.5	0.5	1.0	12.0	5.0
2	4.0	0.5	2.5	10.0	0.5
3	2.0	0.0	4.0	7.0	2.0
4	0.0	2.5	3.0	6.0	3.0
5	0.0	0.0	3.0	2.0	3.0
6	1.0	0.0	1.0	0.0	6.0
7	0.0	0.0	0.0	0.0	2.5
8	0.5	2.0	0.0	0.0	0.0
9	0.5	0.5	0.0	2.0	0.0
10	0.0	1.0	1.0	3.0	0.0

	(cm)
Average snow depth =	**2.0**
Maximum snow depth =	12.0
Minimum snow depth =	0.0
Standard variation =	2.6

Snow Sample Depths and Weights

Bag #	Depth (cm)	Weight (gr)	Volume (cm^3)	Density (gr/cm^3)
A-A	5.08	56.0	181.4	0.31
A-B	3.048	30.0	108.8	0.28
A-C	7.62	63.0	272.0	0.23
A-D	9.906	134.0	353.6	0.38
A-E	8.89	97.0	317.4	0.31

Average Density =	**0.30**	
Average Snow Water Equivalent (SWE) =	**0.6**	cm H2O
Average Snow Water Equivalent =	**0.23**	inches H2O
Average Snow Water Equivalent =	**0.02**	feet H2O

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: **Mine Site B**
Survey Purpose: **Snow Depth and Water Content** Date: 3/19/2006 Time: 18:30

Location Description:	Center of MSB North Cell, near MSBN-CT. From MSBN-CT take depths 25 meters west x 25 meters south, in 1 meter increments.				
Survey objective:	Snow depths and snow-water content for lake recharge estimates			Weather Observations:	Low visibility 15 F below
Latitude:	N70°19.280'	Longitude:	W149°24.009'	Datum:	NAD83
Elevation:	near sea level	Elevation Datum:	nr	Reference Markers:	MSBN-CT staked with lathe
Drainage Basin:	Milne Creek	Slope Direction:	Flat	Vegetation Type:	Ice
Slope Angle:	Flat	Access Notes:	Highway Vehicle to MSB	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^2			Chad Cormack, Dan Reichardt	

Snow Course Depths, in cm.

	1	2	3	4	5
1	10	7	12.5	19	24
2	12.5	9	12.5	21	23.5
3	14.5	11.5	14	23	22
4	13.5	4	14	23.5	18
5	11	6	14	25	13
6	10	7	13	24	10
7	9	8	12	24	7
8	8.5	10	13	23	7
9	8	10.5	16.5	22	7
10	7	12	19	21.5	4.5

	(cm)
Average snow depth =	**13.9**
Maximum snow depth =	25.0
Minimum snow depth =	4.0
Standard variation =	6.3

Snow Sample Depths and Weights

Bag #	Depth (cm)	Weight (gr)	Volume (cm^3)	Density (gr/cm^3)
SWE1	10.2	92	362.7	0.25
SWE2	11.9	106	426.2	0.25
SWE3	14.2	147	507.8	0.29
SWE4	22.4	229	798.0	0.29
SWE5	7.4	65	263.0	0.25

Average Density =	**0.27**	gr/cm^3
Average Snow Water Equivalent (SWE) =	**3.7**	cm H2O
Average Snow Water Equivalent =	**1.45**	inches H2O
Average Snow Water Equivalent =	**0.12**	feet H2O

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:	**Betty Pingo**
Survey Purpose:	**Snow Depth and Water Content**	Date: 3/19/2007	Time: 17:30

Location Description:	App. 50 yards north of Wyoming gauge. L-shaped, 25 m east by 25 m north. Measurments taken every 1 meter. Snow Course by Reichardt, Lilly.				
Survey objective:	Snow depths and snow-water content for comparison with lake snow survey				
Latitude:	N 70° 16.831	Longitude:	W 148° 53.8833	Datum:	NAD83
Elevation:	nr	Elevation Datum:	nr	Reference Markers:	Wyoming precipitation gauge
Drainage Basin:	Kuparuk River	Slope Direction:	Flat	Vegetation Type:	Tussock
Slope Angle:	Flat	Access Notes:	truck	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^2			Jeff Derry	

Snow Course Depths, in cm.

	1	2	3	4	5
1	15.5	21.5	20	27	28
2	21.5	13	19	27	46
3	14.5	16	13	29	46.5
4	20	13	11	28.5	43
5	16	6.5	15	25.5	44
6	15	7	13.5	21	40.5
7	19	6	16	20	40
8	18.5	6	15	37	45
9	23	8	20.5	30.5	48.5
10	23	15	24.5	13	49

	(cm)
Average snow depth =	**23.1**
Maximum snow depth =	49.0
Minimum snow depth =	6.0
Standard variation =	12.2

Snow Sample Depths and Weights

Bag #	Depth (cm)	Weight (gr)	Volume (cm^3)	Density (gr/cm^3)
DW3-1	22.9	149.0	816.1	0.18
DW3-2	22.9	208.0	816.1	0.25
DW3-3	16.0	163.0	571.2	0.29
DW3-4	26.7	200.0	952.1	0.21
DW3-5	39.4	364.0	1405.5	0.26

Average Density =	**0.24**	
Average Snow Water Equivalent (SWE) =	**5.5**	cm H2O
Average Snow Water Equivalent =	**2.17**	inches H2O
Average Snow Water Equivalent =	**0.18**	feet H2O

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: 3/16/2007	Time: 18:30

Location Description:	Did "L" shape, started at stake between belford gauge and snow sensor. 25 x 25 meters at 1 meter increments. Went North, then West.				
Survey objective:	Snow depths and snow-water content for lake recharge estimates			Weather Observations:	Sunny, 15 F below
Latitude:	N 70º19.9444'	Longitude:	W 150º 57.047'	Datum:	NAD27 Alaska
Elevation:	100' approximately	Elevation Datum:	BPMSL	Reference Markers:	Site marked with GPS
Drainage Basin:	L9312	Slope Direction:	flat	Vegetation Type:	snow depth on tundra 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^2			Chad Cormack, Field notes on audio file	

Snow Course Depths, in cm.

	1	2	3	4	5
1	15	36	9	12	15
2	19	31	15	19	23
3	22	29	20	38	33
4	23	28	22	40	33.0
5	31	35	30	29	55
6	30	34.0	15	10	33
7	30	32	10	12.0	25
8	19	22	15.0	13	14
9	40	28	17	15	16
10	36	12.0	15	30	24

	(cm)
Average snow depth =	**24.2**
Maximum snow depth =	55.0
Minimum snow depth =	9.0
Standard variation =	10.0

Snow Sample Depths and Weights

Bag #	Depth (cm)	Weight (gr)	Volume (cm^3)	Density (gr/cm^3)
SWE1	20.32	183	725.4	0.25
SWE2	23.622	180	843.3	0.21
SWE3	20.32	252	725.4	0.35
SWE4	10.16	91	362.7	0.25
SWE5	33.274	241	1187.9	0.20

Average Density =	**0.25**	gr/cm^3
Average Snow Water Equivalent (SWE) =	**6.1**	cm H2O
Average Snow Water Equivalent =	**2.41**	inches H2O
Average Snow Water Equivalent =	**0.20**	feet H2O

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: 3/16/2006 Time: 18:30

Location Description:	On lake surface, towards south end. Did "L" shape, started at North and went West 25 x 25m for 1m increments				
Survey objective:	Snow depths and snow-water content for lake recharge estimates			Weather Observations:	Clear, sunny, 15 F below
Latitude:	N70°19.995'	Longitude:	W150°56.918'	Datum:	WGS84
Elevation:	8' aproximately	Elevation Datum:	BPMSL	Reference Markers:	Site staked with lathe
Drainage Basin:	L9312	Slope Direction:	Flat	Vegetation Type:	Tussock
Slope Angle:	Flat	Access Notes:	Hagglund	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^2			Chad Cormack, Dan Reichardt	

Snow Course Depths, in cm.

	1	2	3	4	5
1	13	7	11	14	5
2	8	6	4	4	1
3	10	10	14	1	2
4	6	11	11	0	8
5	6	14	9	0	9
6	5	15	16	3	11
7	7	15	25	6	11
8	13	14	33	4	12
9	12	11	44	6	12
10	11	7	31	6	11

	(cm)
Average snow depth =	**10.5**
Maximum snow depth =	44.0
Minimum snow depth =	0.0
Standard variation =	8.2

Snow Sample Depths and Weights

Bag #	Depth (cm)	Weight (gr)	Volume (cm^3)	Density (gr/cm^3)
SWE1	3.675	43	131.2	0.33
SWE2	7.62	95	272.0	0.35
SWE3	21.59	296	770.8	0.38
SWE4	11.43	103	408.1	0.25
SWE5	17.018	186	607.5	0.31

Average Density =	**0.32**	gr/cm^3
Average Snow Water Equivalent (SWE) =	**3.4**	cm H2O
Average Snow Water Equivalent =	**1.34**	inches H2O
Average Snow Water Equivalent =	**0.11**	feet H2O

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: 3/16/2007 Time: 4:00:00 PM

Location Description:	Did "L" shape, started at orange pole at southerly end of lake on tundra, went 25 m to orange pole, turned, and 25m to other pole.				
Survey objective:	Snow depths and snow-water content for lake recharge estimates			Weather Observations:	Clear, 15 F below
Latitude:	N 70º19.9444'	Longitude:	W 150º 57.047'	Datum:	NAD27 Alaska
Elevation:	100' approximately	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^2			Chad Cormack, Field notes on audio file	

Snow Course Depths, in cm.

	1	2	3	4	5
1	21	21	21	32	40
2	38	22	18	30	32
3	31	31	19	21	12
4	20.0	19	17	19	20
5	23.0	21	19	18	24
6	26	18	17	18	33
7	33	37	45	21	35
8	33	46	42	19	32
9	25	19	21	19	21
10	24	27	26	16	27

	(cm)
Average snow depth =	**25.4**
Maximum snow depth =	46.0
Minimum snow depth =	12.0
Standard variation =	8.1

Snow Sample Depths and Weights

Bag #	Depth (cm)	Weight (gr)	Volume (cm^3)	Density (gr/cm^3)
SWE1				
SWE2				
SWE3				
SWE4				
SWE5				

Average Density = _____ gr/cm^3
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)

L9312: Snow depth transects:

Project ID:	**North Slope Lakes Project**		Site Location/Lake ID:	**L9312**	
Survey Purpose	**Snow Depth and Water Content**	Date:	3/16/2007	Time: 1:00:00 PM	
Location Description:	Transects conducted in north/southerly and east/westerly direction. East/west starts at lathe on easterly side of lake and heads north of the pumphouse to where the pipes intersect. North/south begins at closest orange pole marking snow course at southerly end of lake and heading towards Alpine.				
Survey objective:	Snow depths and snow-water content for lake recharge estimates		Weather Observations:	Clear, Sunny, 15 F below, 5 mph Wind	
Elevation:	8' approximately BPMSL	Conducted by: Chad Cormack Field notes and numbers available from audio files	Reference Markers:	Lathe and Pumphouse, Westmost Stake GPS#43, Eastmost Transect GPS#44	
Drainage Basin:	L9312	Slope Direction: Flat	Vegetation Type:	snow depth on ice surface and tundra	

EAST/WEST TRANSECT

Position (ft)	depth (cm)		Position (ft)	depth (cm)		Position (ft)	depth (cm)	
0	25	Begin on Tundra	910	5		2070	10	Start Tundra
10	27	taken every 10'	930	2		2080	39	taken every 10'
20	20		950	0		2090	29	
30	22		970	3		2100	22	
40	25		990	14		2110	29	
50	13		1010	10		2120	33	
60	26		1030	4		2130	29	
70	31		1050	10		2140	34	
80	20		1070	7		2150	33	
90	30		1090	16		2160	26	
100	33		1110	8		2170	34	
110	16		1130	10		2180	32	
120	20		1150	6		2190	21	
130	26		1170	8		2200	4	
140	20		1190	3		2210	35	
150	29		1210	5		2220	35	
160	157		1230	3		2230	15	
170	215		1250	3		2240	11	
180	225		1270	2		2250	15	
190	195		1290	4		2260	13	
200	157		1310	5		2270	33	
210	133		1330	10		2280	15	
220	105		1350	8		2290	34	
230	70	Begin Transition z	1370	3		2300	43	
240	69	taken every 10'	1390	4		2310	28	
250	65		1410	3		2320	28	
260	65		1430	4		2330	24	
270	34		1450	2		2340	15	
280	25		1470	3		2350	16	
290	20	Begin Lake	1490	8		2360	38	
310	14	Taken every 20'	1510	6		2370	41	
330	11		1530	3		2380	39	
350	6		1550	25		2390	15	
370	5		1570	11		2400	12	
390	5		1590	4		2410	34	
410	2		1610	5		2420	39	
430	3		1630	3		2430	33	
450	3		1650	1		2440	14	
470	6		1670	3		2450	7	
490	1		1690	23		2460	30	
510	1		1710	6		2470	50	
530	9		1730	3		2480	46	
550	15		1750	1		2490	25	
570	12		1770	4		2500	13	
590	12		1790	8		2510	20	
610	9		1810	19		2520	24	
630	3		1830	6		2530	38	
650	1		1850	10		2540	36	
670	4		1870	36		2550	45	
690	0		1890	57		2560	26	
710	4		1910	8		2570	26	
730	4		1930	4		2580	15	
750	4		1950	6		2590	20	
770	5		1970	6		2600	20	
790	10		1990	7		2610	20	
810	3		2010	18		2620	40	
830	2		2030	41	Begin Transition z	2630	25	Pipes Intersect
850	5		2040	43	taken every 10'			
870	17		2050	37				
890	8		2060	19				

L9312: Snow depth transects:

Project ID:	**North Slope Lakes Project**		Site Location/Lake ID:	**L9312**	
Survey Purpose	**Snow Depth and Water Content**	Date:	3/16/2007	Time: 1:00:00 PM	
Location Description:	Transects conducted in north/southerly and east/westerly direction. East/west starts at lathe on easterly side of lake and heads north of the pumphouse to where the pipes intersect. North/south begins at closest orange pole marking snow course at southerly end of lake and heading towards Alpine.				
Survey objective:	Snow depths and snow-water content for lake recharge estimates		Weather Observations:	Clear, Sunny, 15 F below, 5 mph Wind	
Elevation:	8' approximately BPMSL	Conducted by: Chad Cormack Field notes and numbers available from audio files	Reference Markers:	Southmost Transect Snow 1 GPS#41	
Drainage Basin:	L9312	Slope Direction: Flat	Vegetation Type:	snow depth on ice surface and tundra	

NORTH/SOUTH TRANSECT

Position (ft)	depth (cm)		Position (ft)	depth (cm)	Position (ft)	depth (cm)
0	20	Begin on Tundra	940	8	2140	4
10	46	taken every 10'	960	11	2160	14
20	32		980	5	2180	43
30	29		1000	3	2200	24
40	38		1020	9	2220	21
50	27		1040	4	2240	13
60	21		1060	9	2260	10
70	16		1080	15	2280	12
80	34		1100	9	2300	8
90	22		1120	5	2320	32
100	38		1140	5	2340	31
110	36		1160	7	2360	20
120	32		1180	9	2380	18
130	28		1200	12	2400	18
140	12		1220	8	2420	11
150	14		1240	2	2440	11
160	16	Begin Transition z	1260	11	2460	8
170	23	taken every 10'	1280	12	2480	12
180	20		1300	6	2500	19
190	20		1320	2	2520	13
200	14		1340	4	2540	5
210	17		1360	4	2560	9
220	19		1380	0	2580	4
230	15		1400	12	2600	16
240	28		1420	12	2620	3
250	22		1440	7	2640	0
260	16	Begin Lake	1460	10	2660	4
280	8	Taken every 20'	1480	8	2680	7
300	3		1500	2	2700	8
320	1		1520	9	2720	14
340	2		1540	16	2740	4
360	2		1560	5	2760	2
380	14		1580	8	2780	8
400	9		1600	13	2800	2
420	18		1620	5	2820	3
440	6		1640	3	2840	8
460	1		1660	0	2860	12
480	1		1680	0	2880	9
500	2		1700	2	2900	11
520	3		1720	4	2920	8
540	0		1740	16	2940	10
560	2		1760	11	2960	4
580	4		1780	15	2980	19
600	12		1800	8	3000	22
620	16		1820	6	3020	3
640	12		1840	1	3040	8
660	6		1860	3	3060	14
680	4		1880	2	3080	5
700	6		1900	1	3100	1
720	3		1920	12	3120	4
740	4		1940	5	3140	10
760	0		1960	6	3160	12
780	1		1980	19	3180	17
800	1		2000	9	3200	16
820	1		2020	8	3220	14
840	3		2040	8	3240	12
860	2		2060	7	3260	7
880	7		2080	3	3280	6
900	4		2100	3	3300	3
920	1		2120	14	3320	0

L9312: Snow depth transects:

Project ID:	**North Slope Lakes Project**		Site Location/Lake ID:	**L9312**	
Survey Purpose	**Snow Depth and Water Content**	Date:	3/16/2007	Time: 1:00:00 PM	
Location Description:	Transects conducted in north/southerly and east/westerly direction. East/west starts at lathe on easterly side of lake and heads north of the pumphouse to where the pipes intersect. North/south begins at closest orange pole marking snow course at southe				
Survey objective:	Snow depths and snow-water content for lake recharge estimates		Weather Observations:	Clear, Sunny, 15 F below, 5 mph Wind	
Elevation:	8' approximately BPMSL	Conducted by: Chad Cormack Field notes and numbers available from audio files	Reference Markers:	Southmost Transect Snow 1 GPS#41	
Drainage Basin:	L9312	Slope Direction: Flat	Vegetation Type:	snow depth on ice surface and tundra	

NORTH/SOUTH TRANSECT

Position (ft)	depth (cm)		Position (ft)	depth (cm)		Position (ft)	depth (cm)
3340	4		4310	20			
3360	2		4320	30			
3380	2		4330	19			
3400	8		4340	16			
3420	17		4350	28			
3440	9		4360	26			
3460	6		4370	57			
3480	8		4380	45			
3500	6		4390	24			
3520	9		4400	19			
3540	10		4410	19			
3560	12		4420	20	even with marker		
3580	12		4430	31			
3600	3		4440	36			
3620	9		4450	24			
3640	11		4460	42			
3660	10		4470	48			
3680	8		4480	45			
3700	9		4490	58			
3720	7						
3740	3						
3760	8						
3780	16						
3800	10						
3820	8						
3840	6						
3860	16						
3880	14						
3900	12						
3920	13						
3940	12						
3960	18						
3980	10						
4000	10						
4020	8						
4040	3						
4060	10						
4080	2						
4090	7	Begin Transition zone					
4100	16	taken every 10'					
4110	16						
4120	16						
4130	23						
4140	20						
4150	22						
4160	25						
4170	17						
4180	21	Begin Tundra					
4190	22	taken every 10'					
4200	31						
4210	26						
4220	28						
4230	38						
4240	55						
4250	47						
4260	37						
4270	24						
4280	23						
4290	20						
4300	18						

L9312: Snow depth transects:

Project ID:	**North Slope Lakes Project**	Site Location/Lake ID:	**L9312**
Survey Purpose	**Snow Depth and Water Content**	Date: 3/16/2006	Time: 1:30:00 PM

Location Description:	Northwest part of lake. Transition zone from lake to tundra. Flat surface. See map in Chad Cormack, 001, Fieldbook for better visualization.			
Survey objective:	Snow depths and snow-water content for lake recharge estimates		Weather Observations:	Clear, Sunny, 15 F below, 5 mph Wind
Elevation:	8' approximately BPMSL	Conducted by: Chad Cormack Field notes and numbers available from audio	Reference Markers:	6A - GPS #14, 6B - GPS # 13
Drainage Basin:	L9312	Slope Direction: Flat	Vegetation Type:	snow depth on ice surface and tundra

increment (ft)	depth (cm)	
0	9	Begin on Tundra
10	9	
20	10	
30	13	
40	9	
50	12	
60	3	
70	3	
80	2	
90	0.5	
100	2	
110	1	
120	1	
130	3	

L9312: Snow depth transects:

Project ID: **North Slope Lakes Project** Site Location/Lake ID: **L9312**
Survey Purpose **Snow Depth and Water Content** Date: 3/16/2006 Time: 1:30:00 PM

Location Description:	Northeastern most transect. Transition zone from lake to tundra. Flat surface. See map in Chad Cormack, 001, Fieldbook for better visualization. Snow on lake is very dense from this transect			
Survey objective:	Snow depths and snow-water content for lake recharge estimates		Weather Observations:	Clear, Sunny, 15 F below, 5 mph Wind
Elevation:	8' approximately BPMSL	Conducted by: Chad Cormack Field notes and numbers available from audio	Reference Markers:	5A - GPS #16, 5B - GPS # 15
Drainage Basin:	L9312	Slope Direction: Flat	Vegetation Type:	snow depth on ice surface and tundra

increment (ft)	depth (cm)	
0	25	Begin on Lake
10	17	
20	4	
30	5	
40	10	
50	6	
60	3	
70	5	
80	14	
90	10	
100	24	
110	23	
120	14	
130	16	

L9312: Snow depth transects:

Project ID:	**North Slope Lakes Project**	Site Location/Lake ID:	**L9312**
Survey Purpose	**Snow Depth and Water Content**	Date: 3/16/2006	Time: 1:30:00 PM

Location Description:	First part of cliff area from north. This is the hill which is between the overflow area for 9312. Transition zone from lake to tundra. Steady incline. See map in Chad Cormack, 001, Fieldbook for better visualization. 4B1 is located at the top of the cliff.			
Survey objective:	Snow depths and snow-water content for lake recharge estimates		Weather Observations:	Clear, Sunny, 15 F below, 5 mph Wind
Elevation:	8' approximately BPMSL	Conducted by: Chad Cormack Field notes and numbers available from audio	Reference Markers:	4A1 - GPS #19, 4B1 - GPS # 17
Drainage Basin:	L9312	Slope Direction: Sloped	Vegetation Type:	snow depth on ice surface and tundra

increment (ft)	depth (cm)	
0	20	Begin on Lake
10	14	
20	11	
30	19	
40	33	
50	34	
60	56	
70	60	
80	65	
90	79	
100	102	
110	119	
120	126	
130	137	Much Less Dense then snow on lake from here on
140	163	
150	187	
160	165	
170	75	Top of Cliff

L9312: Snow depth transects:

Project ID: **North Slope Lakes Project** Site Location/Lake ID: **L9312**
Survey Purpose **Snow Depth and Water Content** Date: 3/16/2006 Time: 1:30:00 PM

Location Description:	Second part of cliff area from north. Transition zone from lake to tundra. Steady incline. See map in Chad Cormack, 001, Fieldbook for better visualization.			
Survey objective:	Snow depths and snow-water content for lake recharge estimates		Weather Observations:	Clear, Sunny, 15 F below, 5 mph Wind
Elevation:	8' approximately BPMSL	Conducted by: Chad Cormack Field notes and numbers available from audio	Reference Markers:	4A - GPS #21, 4B - GPS # 20
Drainage Basin:	L9312	Slope Direction: Sloped	Vegetation Type:	snow depth on ice surface and tundra

increment (ft)	depth (cm)	
0	29	Begin on Lake
10	27	
20	51	
30	54	
40	75	Interesting Looking Drifts with very high snow density
50	75	
60	109	
70	107	
80	124	
90	132	
100	157	
110	174	
120	187	
130	210	
140	39	Top of cliff

L9312: Snow depth transects:

Project ID:	**North Slope Lakes Project**	Site Location/Lake ID:	**L9312**
Survey Purpose	**Snow Depth and Water Content**	Date: 3/16/2006	Time: 1:30:00 PM

Location Description:	Third part of cliff area from north. Transition zone from lake to tundra. Steady incline. See map in Chad Cormack, 001, Fieldbook for better visualization.			
Survey objective:	Snow depths and snow-water content for lake recharge estimates		Weather Observations:	Clear, Sunny, 15 F below, 5 mph Wind
Elevation:	8' approximately BPMSL	Conducted by: Chad Cormack Field notes and numbers available from audio	Reference Markers:	4C - GPS #22, 4D - GPS # 23
Drainage Basin:	L9312	Slope Direction: Sloped	Vegetation Type:	snow depth on ice surface and tundra

increment (ft)	depth (cm)	
0	8	Begin on Lake
10	2	Not Dense Snow
20	8	
30	19	
40	20	
50	12	
60	19	
70	34	Incline Begins
80	68	
90	90	
100	126	
110	135	
120	148	
130	185	
140	200	
150	230	*Recording says 130, but 230 is the correct reading
160	26	
170	29	Very top of cliff

L9312: Snow depth transects:

Project ID:	**North Slope Lakes Project**	Site Location/Lake ID:	**L9312**
Survey Purpose	**Snow Depth and Water Content**	Date: 3/16/2006	Time: 1:30:00 PM

Location Description:	First tansect south of East/West transect marker. Transition zone from lake to tundra. Steepest incline yet. See map in Chad Cormack, 001, Fieldbook for better visualization.			
Survey objective:	Snow depths and snow-water content for lake recharge estimates		Weather Observations:	Clear, Sunny, 15 F below, 5 mph Wind
Elevation:	8' approximately BPMSL	Conducted by: Chad Cormack Field notes and numbers available from audio	Reference Markers:	3A - GPS #25 *No Stake here, 3B - GPS # 24
Drainage Basin:	L9312	Slope Direction: Steep Incline	Vegetation Type:	snow depth on ice surface and tundra

increment (ft)	depth (cm)	
0	3	Begin on Lake
10	10	
20	21	
30	19	
40	21	
50	29	
60	23	
70	38	Start incline
80	53	
90	79	Very Steep
100	94	
110	139	
120	179	
130	210	
140	240	
150	305	
160	23	Very top of cliff

L9312: Snow depth transects:

Project ID:	**North Slope Lakes Project**	Site Location/Lake ID:	**L9312**
Survey Purpose	**Snow Depth and Water Content**	Date: 3/16/2006	Time: 1:30:00 PM

Location Description:	Last Transect for the cliff area. Transition zone from lake to tundra. Very Steep Incline. See map in Chad Cormack, 001, Fieldbook for better visualization. Very ineresting snow cliffs directly north of this area. I can't measure this area, nor climb up there, so I avoided it on purpose. It is the highest elevation of the cliffs area. I am about 50 feet south of the snow cliffs.			
Survey objective:	Snow depths and snow-water content for lake recharge estimates		Weather Observations:	Clear, Sunny, 15 F below, 5 mph Wind
Elevation:	8' approximately BPMSL	Conducted by: Chad Cormack Field notes and numbers available from audio	Reference Markers:	3C - GPS #26, 3D - GPS # 42
Drainage Basin:	L9312	Slope Direction: Steep Incline	Vegetation Type:	snow depth on ice surface and tundra

increment (ft)	depth (cm)	
0	12	Begin on Lake
10	8	
20	10	
30	11	
40	25	
50	21	
60	36	
70	48	
80	96	Steep Drift
90	115	
100	178	Very Steep Drift
110	260	Rod gets stuck in snow for about 2 hours
120	275	
130	265	
140	50	Top of Cliff

L9312: Snow depth transects:

Project ID: **North Slope Lakes Project** Site Location/Lake ID: **L9312**
Survey Purpose **Snow Depth and Water Content** Date: 3/16/2006 Time: 1:30:00 PM

Location Description:	First Transect south of cliff area. Very flat, quick transition zone. See map in Chad Cormack, 001, Fieldbook for better visualization.			
Survey objective:	Snow depths and snow-water content for lake recharge estimates		Weather Observations:	Clear, Sunny, 15 F below, 5 mph Wind
Elevation:	8' approximately BPMSL	Conducted by: Chad Cormack Field notes and numbers available from audio	Reference Markers:	1A - GPS # 35, 1B - GPS # 34
Drainage Basin:	L9312	Slope Direction: Flat	Vegetation Type:	snow depth on ice surface and tundra

increment (ft)	depth (cm)	
0	1	Begin on Lake
10	2	
20	2	
30	4	
40	8	
50	27	
60	33	
70	21	
80	43	
90	36	
100	34	

L9312: Snow depth transects:

Project ID: **North Slope Lakes Project** Site Location/Lake ID: **L9312**
Survey Purpose **Snow Depth and Water Content** Date: 3/16/2006 Time: 1:30:00 PM

Location Description:	Southern most Transect. Very flat, quick transition zone. See map in Chad Cormack, 001, Fieldbook for better visualization.			
Survey objective:	Snow depths and snow-water content for lake recharge estimates		Weather Observations:	Clear, Sunny, 15 F below, 5 mph Wind
Elevation:	8' approximately BPMSL	Conducted by: Chad Cormack Field notes and numbers available from audio	Reference Markers:	10A - GPS # 37, 10B - GPS #36
Drainage Basin:	L9312	Slope Direction: Flat	Vegetation Type:	snow depth on ice surface and tundra

increment (ft)	depth (cm)	
0	10	Begin on Lake
10	19	
20	34	
30	41	
40	25	
50	41	
60	34	
70	16	
80	20	

L9312: Snow depth transects:

Project ID: **North Slope Lakes Project** Site Location/Lake ID: **L9312**
Survey Purpose **Snow Depth and Water Content** Date: 3/16/2006 Time: 1:30:00 PM

Location Description:	South of pumphouse. Southeast area of lake. Very flat, quick transition zone. See map in Chad Cormack, 001, Fieldbook for better visualization.			
Survey objective:	Snow depths and snow-water content for lake recharge estimates		Weather Observations:	Clear, Sunny, 15 F below, 5 mph Wind
Elevation:	8' approximately BPMSL	Conducted by: Chad Cormack Field notes and numbers available from audio	Reference Markers:	9A - GPS # 39, 9B - GPS #38
Drainage Basin:	L9312	Slope Direction: Flat	Vegetation Type:	snow depth on ice surface and tundra

increment (ft)	depth (cm)	
0	25	Begin on Lake
10	9	
20	18	
30	19	
40	27	
50	40	
60	41	
70	53	
80	21	
90	34	
100	40	
110	50	
120	70	

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: **Ublutuoch Gage**
Survey Purpose: **Snow Depth and Water Content** Date: 3/17/2006 Time: 23:00

Location Description:	Ublutuoch River BLM stream gage/weather station. Start snow course 30 ft. east of fence around tower. Course is 25 m East x 25 m North, 1 meter increments. See photograph. Course stays above low spots.				
Survey objective:	Snow depths and snow-water content			Weather Observations:	15 F below, 10 mph wind, medium visibility
Latitude:	nr	Longitude:	nr	Datum:	
Elevation:	nr	Elevation Datum:		Reference Markers:	BLM station tower
Drainage Basin:	Ublitiwok	Slope Direction:	East	Vegetation Type:	Tussock
Slope Angle:	0% to 4%	Access Notes:	Hagglund	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^2			Reichardt, Cormack	

Snow Course Depths, in cm.

	1	2	3	4	5
1	27	20	20	20	41
2	30	23	12	19	42
3	26	17	13	21	45
4	25	26	12	21	32
5	28	31	15	18	44
6	17	28	16	19	43
7	33	25	16	14	44
8	10	25	30	18	35
9	13	23	44	29	54
10	18	16	21	44	43

	(cm)
Average snow depth =	**26.1**
Maximum snow depth =	54.0
Minimum snow depth =	10.0
Standard variation =	11.0

Snow Sample Depths and Weights

Bag #	Depth (cm)	Weight (gr)	Volume (cm^3)	Density (gr/cm^3)
SWE1	13.2	126	471.5	0.27
SWE2	25.4	148	906.8	0.16
SWE3	24.1	94	861.4	0.11
SWE4	13.7	91	489.7	0.19
SWE5	39.4	279	1405.5	0.20

Average Density =	**0.18**	gr/cm^3
Average Snow Water Equivalent (SWE) =	**4.8**	cm H2O
Average Snow Water Equivalent =	**1.90**	inches H2O
Average Snow Water Equivalent =	**0.16**	feet H2O

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: **Ublutuoch Gage**
Survey Purpose: **Snow Depth and Water Content** Date: 3/17/2006 Time: 23:00

Location Description:	Ublitiwok stream gage/weather station. One snow density measurement in Ublutuoch River. Channel has up to 12 feet of snow drifted. Sample from channel directly north of tower. Sample not taken for entire depth.				
Survey objective:	Snow density			Weather Observations:	15 F below, 10 mph wind, medium visibility
Latitude:	nr	Longitude:	nr	Datum:	
Elevation:	nr	Elevation Datum:		Reference Markers:	BLM station tower
Drainage Basin:	Ublitiwok	Slope Direction:	East	Vegetation Type:	Ice, river channel
Slope Angle:	0% to 4%	Access Notes:	Hagglund	Other:	1 meter increments
Snow Depth Probe Type:		Adirondak snow tube		Snow-Survey Team Names	
Snow Tube Type:	Adirondak, 6.74 cm diameter cutter, area = 35.7 cm^2			Reichardt, Lilly	

Snow Course Depths, in cm.

	1	2	3	4	5
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

(cm)
Average snow depth =
Maximum snow depth =
Minimum snow depth =
Standard variation =

Snow Sample Depths and Weights

Bag #	Depth (cm)	Weight (gr)	Volume (cm^3)	Density (gr/cm^3)
SWE1	25.4	357	906.8	0.39

Average Density = **0.39** gr/cm^3
Average Snow Water Equivalent (SWE) = **0.0** cm H2O
Average Snow Water Equivalent = **0.00** inches H2O
Average Snow Water Equivalent = **0.00** feet H2O

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: **L9817**
Survey Purpose: **Snow Depth and Water Content** Date: 3/17/2006 Time: 12:00

Location Description:	On lake surface. Did "L" shape, started at South then towards shore 25 x 25m for 1m increments				
Survey objective:	Snow depths and snow-water content for lake recharge estimates			Weather Observations:	Low visibility 15 F below
Latitude:	N70°14.070'	Longitude:	W151°20.121'	Datum:	NAD83
Elevation:	8' aproximately	Elevation Datum:	BPMSL	Reference Markers:	Site staked with lathe
Drainage Basin:	L9817	Slope Direction:	Flat	Vegetation Type:	Tussock
Slope Angle:	Flat	Access Notes:	Hagglund	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^2			Chad Cormack	

Snow Course Depths, in cm.

	1	2	3	4	5
1	23.0	5.0	7.0	7.0	7.0
2	20.0	4.0	7.0	5.0	13.0
3	17.0	6.0	5.0	4.0	16.0
4	12.0	7.0	4.0	5.0	26.0
5	11.0	9.0	4.0	9.0	39.0
6	5.0	13.0	3.0	11.0	43.0
7	6.0	9.0	4.0	6.0	30.0
8	6.0	9.0	8.0	6.0	20.0
9	9.0	7.0	2.0	6.0	17.0
10	11.0	11.0	5.0	6.0	12.0

	(cm)
Average snow depth =	**10.7**
Maximum snow depth =	43.0
Minimum snow depth =	2.0
Standard variation =	8.7

Snow Sample Depths and Weights

Bag #	Depth (cm)	Weight (gr)	Volume (cm^3)	Density (gr/cm^3)
SWE1	16	223	571.2	0.39
SWE2	8	89	285.6	0.31
SWE3	8	71	285.6	0.25
SWE4	10	77	357.0	0.22
SWE5	22	346	785.4	0.44

Average Density =	**0.32**	gr/cm^3
Average Snow Water Equivalent (SWE) =	**3.5**	cm H2O
Average Snow Water Equivalent =	**1.36**	inches H2O
Average Snow Water Equivalent =	**0.11**	feet H2O

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:	**L9817**
Survey Purpose:	**Snow Depth and Water Content**	Date: 3/17/2007	Time: 18:30

Location Description:	Did "L" shape, started at stake between belford gauge and snow sensor. 25 x 25 meters at 1 meter increments. Went East, then North.				
Survey objective:	Snow depths and snow-water content for lake recharge estimates			Weather Observations:	Low visibility 15 F below
Latitude:	nr	Longitude:	nr	Datum:	nr
Elevation:	100' approximately	Elevation Datum:	BPMSL	Reference Markers:	Site marked with GPS
Drainage Basin:	L9817	Slope Direction:	flat	Vegetation Type:	snow depth on tundra 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^2			Chad Cormack, Field notes on audio file	

Snow Course Depths, in cm.

	1	2	3	4	5
1	31.0	20.0	24.0	45.0	37.0
2	25.0	21.0	32.0	48.0	40.0
3	22.0	22.0	22.0	46.0	38.0
4	21.0	24.0	24.0	49.0	38.0
5	24.0	27.0	22.0	52.0	34.0
6	22.0	24.0	24.0	52.0	34.0
7	25.0	36.0	24.0	48.0	36.0
8	21.0	35.0	28.0	41.0	40.0
9	21.0	35.0	40.0	43.0	42.0
10	27.0	30.0	46.0	36.0	41.0

	(cm)
Average snow depth =	**32.8**
Maximum snow depth =	52.0
Minimum snow depth =	20.0
Standard variation =	9.7

Snow Sample Depths and Weights

Bag #	Depth (cm)	Weight (gr)	Volume (cm^3)	Density (gr/cm^3)
SWE1	28	179	999.6	0.18
SWE2	21	116	749.7	0.15
SWE3	24	211	856.8	0.25
SWE4	44	431	1570.8	0.27
SWE5	29	243	1035.3	0.23

Average Density =	**0.22**	gr/cm^3
Average Snow Water Equivalent (SWE) =	**7.1**	cm H2O
Average Snow Water Equivalent =	**2.81**	inches H2O
Average Snow Water Equivalent =	**0.23**	feet H2O

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

APPENDIX E. WATER-LEVEL MEASUREMENT FORMS

The following forms report the water levels, ice thickness, freeboard and other physical information obtained during field sampling.

North Slope Lakes Project
University of Alaska Fairbanks, Water and Environmental Research Center
FORM F-005: WATER-LEVEL MEASUREMENT FORM

Lake or Site ID: **Mine Site B**
Local Number: East Channel

All measurements in feet, unless noted	Elevation	Latitude (degrees)	Longitude (degrees)
Lake-Bottom Datum at Station:	n/a		

Vertical-Datum Corrections, reference survey notes in site folders

Date	MP ID	MP Elevation (feet above BP Sea Level)
TBM1	100.00	Arbitrary Datum

ABBREVIATIONS
BOI, bottom of ice

Calib, used to calibrate PT
IS, ice surface
LB, lake bottom
LS, land surface
MM, mass measurement
MP, measuring point
N/A, not available
PM, partial measurement
WS, water surface

Date	Time	Method	Snow Depth	Total Depth WS to LB	Estimated Error	Ice Thickness (IS to BOI)	Freeboard (IS to WS)	WS Elevation	IS Elevation	BOI to LB	REMARKS
10/25/06	17:55	Tape	- -	5.39	0.02	0.60	0.02			**4.81**	
11/15/06	16:46	Tape	0.15	5.22	0.02	1.25	0.05	95.90	95.95	**4.02**	
12/16/06	16:16	Tape	- -	4.50	0.02	2.15	0.50	95.10	95.60	**2.85**	
01/06/07	14:05	Tape	- -	3.95	0.02	2.70	0.50	94.59	95.09	**1.75**	
2/14/07	10:30	Tape	0.85	3.65	0.02	3.55	0.95	94.28	95.23	**1.05**	
3/18/07	15:30	Tape	1.10	3.50	0.02	4.08	1.15	94.05	95.20	**0.57**	

Collected Data Values
Lake-Full Elevation = measured at staff gage or near vertical benchmark after lake outflow ceased following spring snowmelt
Freeboard (FB) = Height of ice level over water level in open hole
Ice Thickness (IT) = Measured distance between top and bottom of ice
Total Depth (TD) = Measured distance from water surface to lake bottom
Estimated Error = Field estimate of water level measurement error
Calculated Values
Ice Surface (IS) Elevation = Water Elevation + Freeboard
Ice Bottom (IB) Elevation = Ice Surface Elevation - Ice Thickness
Open Water Depth = (Total Depth + Freeboard) - Ice Thickness = BOI to LB

North Slope Lakes Project
University of Alaska Fairbanks, Water and Environmental Research Center
FORM F-005: WATER-LEVEL MEASUREMENT FORM

Lake or Site ID: **Mine Site B**
Local Number: West Channel

All measurements in feet, unless noted	Elevation	Latitude (degrees)	Longitude (degrees)
Lake-Bottom Datum at Station:	n/a		

Vertical-Datum Corrections, reference survey notes in site folders

Date	MP ID	MP Elevation (feet above BP Sea Level)
TBM1	100.00	Arbitrary Datum

ABBREVIATIONS
BOI, bottom of ice

Calib, used to calibrate PT
IS, ice surface
LB, lake bottom
LS, land surface
MM, mass measurement
MP, measuring point
N/A, not available
PM, partial measurement
WS, water surface

Date	Time	Method	Snow Depth	Total Depth WS to LB	Estimated Error	Ice Thickness (IS to BOI)	Freeboard (IS to WS)	WS Elevation	IS Elevation	BOI to LB	REMARKS
10/25/06	17:45	Tape	- -	6.90	0.02	0.59	0.03			**6.34**	
11/15/06	17:10	Tape	0.15	6.75	0.02	1.28	0.03	95.90	95.93	**5.50**	
12/16/06	16:18	Tape	- -	6.05	0.02	2.20	0.50	95.10	95.60	**4.35**	
01/06/07	14:00	Tape	- -	5.35	0.02	2.80	0.70	94.59	95.29	**3.25**	
2/14/07	10:58	Tape	0.30	4.80	0.02	3.87	1.10	94.28	95.38	**2.03**	
3/18/07	16:00	Tape	1.40	5.10	0.02	4.72	1.19	94.06	95.25	**1.57**	

Collected Data Values
Lake-Full Elevation = measured at staff gage or near vertical benchmark after lake outflow ceased following spring snowmelt
Freeboard (FB) = Height of ice level over water level in open hole
Ice Thickness (IT) = Measured distance between top and bottom of ice
Total Depth (TD) = Measured distance from water surface to lake bottom
Estimated Error = Field estimate of water level measurement error
Calculated Values
Ice Surface (IS) Elevation = Water Elevation + Freeboard
Ice Bottom (IB) Elevation = Ice Surface Elevation - Ice Thickness
Open Water Depth = (Total Depth + Freeboard) - Ice Thickness = BOI to LB