Snowmelt and Lake Recharge Monitoring for Selected North Slope, Alaska, Lakes: May/June 2007



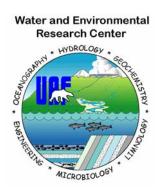
Alpine Facility from L9312 during flood event, Photo by C. Cormack

by

Kristie Holland, Dan Reichardt, Chad Cormack, Jeff Derry, Greta Myerchin, Horacio Toniolo, and Michael Lilly

August 2008

North Slope Lakes Hydrologic Modeling Project Report No. INE/WERC 07.21











Snowmelt and Lake Recharge Monitoring For Selected North Slope, Alaska, Lakes: May/June 2007

By:

Kristie Holland¹, Dan Reichardt¹, Chad Cormack², Jeff Derry¹, Greta Myerchin², Horacio Toniolo², Michael Lilly¹

A report on research sponsored by:

- U.S. Department of Energy
- National Energy Technology Laboratory
- BP Exploration (Alaska), Inc.
- ConocoPhillips Alaska, Inc.
- Bureau of Land Management
- Geo-Watersheds Scientific

August 2008 North Slope Lakes Hydrologic Project Report Number INE/WERC 07.21

¹Geo-Watersheds Scientific

²University of Alaska Fairbanks, Water and Environmental Research Center

Recommended Citation:

Holland, K., Reichardt, D., Cormack, C., Derry, J., Myerchin, G., Toniolo, H., and Lilly, M.R. 2008. Snowmelt and lake recharge monitoring for selected North Slope, Alaska, lakes: May/June 2007. University of Alaska Fairbanks, Water and Environmental Research Center, Report INE/WERC 07.21, Fairbanks, Alaska, 11 p.

Fairbanks, Alaska August 2008

For additional information write to:

Publications,
Water and Environmental Research Center
University of Alaska Fairbanks
Fairbanks, Alaska 99775
www.uaf.edu/water/

For Project Information write to:

Daniel White – Project Manager Box 5860, WERC. UAF Fairbanks, AK 99775-5860 907-474-6222 ffdmw@uaf.edu

TABLE OF CONTENTS

TABLE OF CONTENTS	i
LIST OF FIGURES	i
DISCLAIMER	ii
CONVERSION FACTORS, UNITS, WATER QUALITY UNITS, VERTICAL AND	
HORIZONTAL DATUM, ABBREVIATIONS AND SYMBOLS	iii
PROJECT COOPERATORS	. vii
ACKNOWLEDGEMENTS	. vii
INTRODUCTION	1
TRIP OBJECTIVES	2
PROCEDURES	4
SELECTED SNOWMELT AND RECHARGE MONITORING OBSERVATIONS	6
SUMMARY	. 10
REFERENCES	. 11
LIST OF FIGURES	
Figure 1. Location of study lakes in the NPR-A, Alpine, Kuparuk, and Prudhoe Bay field	
operating areas, North Slope, Alaska	2
Figure 2. Chad Cormack conducting an elevation survey, photo by D. Reichardt	6
Figure 3. Kuparuk Deadarm Reservoirs, cells 1-3, water levels. First figure shows changes	
throughout snowmelt period, second figure shows cumulative change throughout entire	
winter	7
Figure 4. Mine Site B water levels. First figure shows changes throughout snowmelt period,	
second figure shows cumulative change throughout entire winter	8
Figure 5. Snow water equivalence changes at L9312 during snowmelt 2007	9
Figure 6. L9312 water levels. First figure shows changes throughout snowmelt period, secon	d
figure shows cumulative change throughout entire winter	. 10

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 or policies of the DOE, NETL, BLM, BPX, CPA, GWS, or any local sponsor. This work does not constitute a standard, specification, or regulation.

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

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

Conversion Factors

Multiply	Ву	To obtain
	,	
	<u>Length</u>	
inch (in)	25.4	millimeter (mm)
inch (in)	2.54	centimeter (cm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
	<u>Area</u>	0
Acre	43560.0	square feet (ft²)
Acre	0.405	hectare (ha)
square foot (ft ²)	3.587e-8	square mile (mi ²)
square mile (mi ²)	2.590	square kilometer (km²)
	<u>Volume</u>	
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 (m³)
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 (m²/d)
cubic foot per second (ft ³ /s)	0.02832	cubic meter per second (m³/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)
	<u>Pressure</u>	
pound per square inch (lb/in²)	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 (m³/s) in parentheses.

Physical and Chemical Water-Quality Units:

Temperature:

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

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

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

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:

 $SC25 = Specific Conductance at 25°C, in \mu S/cm$

 $AC = Actual Conductivity, in \mu S/cm$

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

T = temperature of the sample, in °C

iv

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 (°F).

ft feet

GWS Geo-Watersheds Scientific

GWSI USGS Ground-Water Site Inventory

km² square kilometers

kPa kilopascal

lb/in² pounds per square inch

m meters

mg/L milligrams per liter, equivalent to ppm

μg/L micrograms per liter

mi² square miles mm millimeters

uS/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°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

ACKNOWLEDGEMENTS

This project was funded by cooperative agreement number DE-FC26_01NT41248, from the U.S. Department of Energy's (DOE) Arctic Energy Office to the University of Alaska Fairbanks Arctic Energy Technology Development Laboratory (AETDL). Field coordination and logistics support were provided by BP Exploration (Alaska) Inc. and ConocoPhillips Alaska. Additional support was provided by other project cooperators, North Slope Borough, Bureau of Land Management (BLM), National Weather Service, and Geo-Watersheds Scientific (GWS), in the form of financial and in-kind match.

Lake Chemistry and Physical Data For Selected North Slope,

Alaska, Lakes: May-June 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 Nuigsut. 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 purposes of this publication are to 1) report data collected during the snowmelt period of 2007 (end of May through beginning of June), 2) summarize accomplished field trip objectives.

1

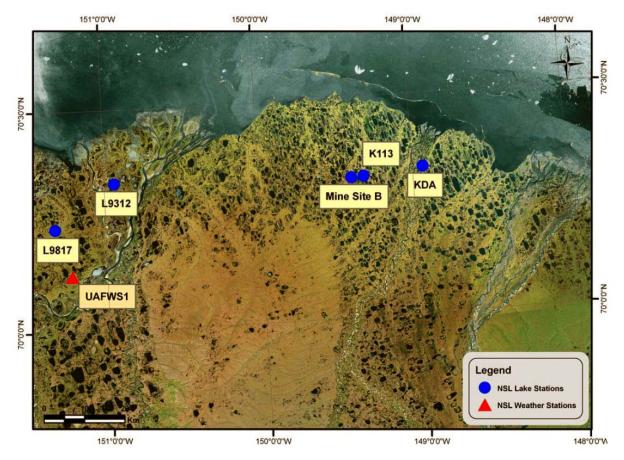


Figure 1. Location of study lakes in the NPR-A, Alpine, Kuparuk, and Prudhoe Bay field operating areas, North Slope, Alaska.

TRIP OBJECTIVES

The goal of each regular sampling trip is to collect physical and chemical data from each study lake, however, the purpose of the May/June trip is primarily for observation of snowmelt and lake recharge processes. For each lake, a series of water level elevation and snow distribution surveys were conducted. Logistical, personnel, and weather constraints, can limit the amount of time available in the field for sampling which may result in deviation from the project work plan which was distributed before the trip outlining the sampling schedule (Lilly and others, 2007). The spring snowmelt trip duration was from 17 May, 2007 to 15 June, 2007. During the trip we focused on the following locations/tasks:

- 1. Lake L9312: Alpine operating area.
 - Survey water level to local elevation control.

- Conduct snow-course measurements and document snow ablation processes.
- Conduct snow depth transects across selected sections of lake to help identify available recharge volumes.
- Document observations of lake recharge processes, including photographs, field measurements of snowmelt, inflow and lake outflows.
- Document timing of initial melt water on lake/reservoir ice, initial stream flow and lake outflow.
- 2. Mine Site B: Kuparuk operating area.
 - Survey water level to local elevation control.
 - Conduct snow-course measurements and document snow ablation processes.
 - Conduct snow depth transects across selected sections of lake to help identify available recharge volumes.
 - Document observations of lake recharge processes, including photographs, field measurements of snowmelt, inflow and lake outflows.
 - Document timing of initial melt water on lake/reservoir ice, initial stream flow and lake outflow.
- 3. Kuparuk Dead Arm (KDA) Reservoirs: Prudhoe Bay operating area.
 - Survey water level to local elevation controls.
 - Conduct snow-course measurements and document snow ablation processes.
 - Conduct snow depth transects across selected sections of lake to help identify available recharge volumes.
 - Document observations of lake recharge processes, including photographs, field measurements of snowmelt, inflow and lake outflows.
 - Document timing of initial melt water on lake/reservoir ice, initial stream flow and lake outflow.
- 4. West Dock, Prudhoe Bay operating area.
 - Daily snow surveys document show ablation processes at L9312, Kuparuk Deadarm Reservoirs and Mine Site B.
 - Snow depth transects across selected sections of each lake/reservoir watershed to help identify available recharge volumes.

- 5. Betty Pingo, Prudhoe Bay operating area.
 - Daily snow surveys document show ablation processes at L9312, Kuparuk Deadarm Reservoirs and Mine Site B.
 - Snow depth transects across selected sections of each lake/reservoir watershed to help identify available recharge volumes.

PROCEDURES

All field work follows the specified health, safety, and environmental guidelines outlined by BPX and CPA (White and Lilly, 2007a,b,c).

Snowmelt Monitoring

Snowmelt surveying took place at L9312, Mine Site B, Kuparuk Deadarm Reservoir, West Dock, and Betty Pingo. Standard snow course measurements were made throughout the snowmelt period. Standard field methods and forms were used for snow water equivalent (SWE) data. Some of the key snowmelt dates of interest recorded for each site include:

- Maximum SWE date
- Beginning of snowmelt
- End of snowmelt date for snow courses
- End of visible snow distribution in local watershed area

Lake and Reservoir Recharge Monitoring

Lake and reservoir recharge monitoring included a combination of water level surveying, staff gage readings, potential flow observations in channels, and general field observations of runoff and recharge conditions to lake and reservoirs. Elevation surveys used standard project methods and field forms. Permanent or temporary staff gages were used for water surface elevation surveys, such as at L9312. Temporary staff gages may have been used at Mine Site B and Kuparuk Deadarm Lakes to make daily water elevation measurements more efficient. Some of the specific recharge observations made at these sites may include the following;

First melt-water date observed on lake ice (with photographs)

- ➤ Date of first ponding and moating around lake and reservoir shorelines (with photographs)
- ➤ Date inflow was first observed at lake/reservoir inlets or overland drainages
- ➤ Date outflow was first observed at lake/reservoir outlets or overland drainages
- ➤ Date of any recharge by surface water flooding, such as L9312
- > Timing of flood recession
- ➤ Daily photographs taken of the primary snow survey area at each location, or another representative area, to document the snow melt.

Field water-quality meters were used to help characterize the changes in water quality in inflowing channels, lake/reservoir perimeters, outlets and other points of interest. Field water quality meters were checked against water quality standards weekly, or as required.

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).

L9312/L9817 Snow Grids:

Snow depth measurements were conduced across a grid that overlaid the watershed areas at L9312 and L9817. The grid was spaced approximately 500 ft. by 500 ft. and contained snow depths on both the lake and tundra. At each location along the grid, 5 snow depths were taken spaced 1 ft. apart. The L9312 grid contained 34 nodes (170 depth measurements), and the L9817 grid contained 42 nodes (210 depth measurements). These grids were performed to gain a better estimate of the spatial distribution of snow within the watershed areas of L9312 and L9817.



Figure 2. Chad Cormack conducting an elevation survey, photo by D. Reichardt.

SELECTED SNOWMELT AND RECHARGE MONITORING OBSERVATIONS

Sampling occurred at Kuparuk Deadarm Lakes, Mine Site B, L9312, Betty Pingo, and West Dock during the Snowmelt trip field activities.

Kuparuk Deadarm Reservoirs:

On 5/23/07 the Kuparuk Deadarm Reservoirs were observed to have minimal snowmelt and/or standing water in the parking lots around KDA 1-3. On 5/25/07, a pool of water approximately 500 square feet was noticed in the southern end of the parking lot, south of the water filling area. Additional pools and wet spots had begun forming in all 3 cells and the snow began to disappear around the edges and top of berms. On 5/27/07, little change had been observed due to cold weather. Water rested on top of approximately 5 feet of ice with a layer of ice above it on all 3 cells. There was no evidence of water entering the system at this point, however the tundra became exposed around cells 1-3. On 5/28/07, open water was detected on

cell 3, but was re-frozen by 5/29/07. On 6/5/07, consistent flow into KDA3, and subsequently KDA2, was observed going through culverts from KDA4. At this time, two of the larger culverts and two of the smaller culverts were flowing at near full for several hours. These culverts appeared to manage the flow so that the road was not overtopped. There was still no evidence of water flow from the Kuparuk river to KDA1 through the culverts. On 6/6/07, water began flowing freely between KDA3 and KDA4 over the road. KDA1, KDA2, and KDA3 had also become hydraulically connected. At this point the primary source of water into the cells was the culverts from the Kuparuk river. By 6/8/07, the water levels had decreased by several feet in all 3 cells. Water was still flooding from the Kuparuk river. On 6/9/07, it was recognized that KDA 1-3 were near maximum capacity and all excess flood water had runoff through the culverts to cell 4. The culvert which connects cell 1 with the Kuparuk river had dried up, as the Kuparuk river elevation had dropped below the culver inflow elevation. KDA1 and KDA2 were barely connected through a small shallow channel. This connection ended by 6/10/07, however cells 1 and 2 remained connected through a culvert at the northern end of the berm. At this point the water levels had also dropped slightly in all 3 cells (KDA 1-3).

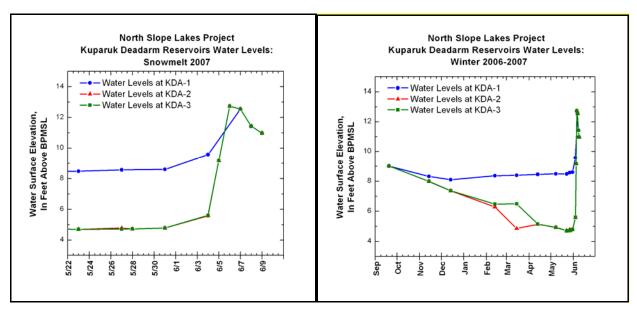


Figure 3. Kuparuk Deadarm Reservoirs, cells 1-3, water levels. First figure shows changes throughout snowmelt period, second figure shows cumulative change throughout entire winter.

Mine Site B:

On 5/22/07, it was observed that the western and lowest portion of the road was melting, this was the first snowmelt into the Mine Site B cells. On 5/23/07, 2 runoff areas were identified on the roadway to the north of the northern cell, one at a low spot east of the waterfill spigot, and the other up hill of the western waterfill spigot. On 5/25/07, there was little to no snow on the roadway north of the northern cell. A pool was forming in the turnaround area east of the weather station which was running off into the eastern side of the north cell. By 5/28/07, liquid water was seen on the North Cell. Cracks had begun to form along the boundaries and vertical displacement of ice ranged from 10 to 15 cm. A channel, approximately 30 inches wide and 1.25 inches deep, was detected on the South Cell. There was still no obvious main surface water input/output in the system, however, the main stream was well defined upstream of the south cell. In addition, near-channel areas were recharging the south cell. On 5/29/07 water began flowing from Milne Creek to the South Cell in two locations. By 6/5/07, flow from the west into the south cell had increased. Flow was added through the main channel and from another side stream to the east of the South Cell. This stream had increased the flow significantly which contributed to the increase in water levels of both the North and South Cells from the previous day. Unfortunately, due to the Kuparuk river bridge closing, Mine Site B was not visited again on this trip.

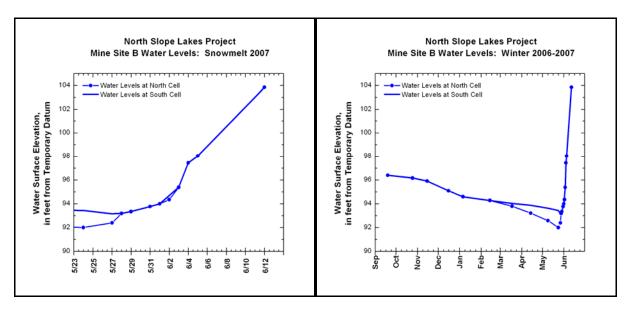


Figure 4. Mine Site B water levels. First figure shows changes throughout snowmelt period, second figure shows cumulative change throughout entire winter.

L9312:

Four locations on the tundra around L9312 were chosen to be snow course sites. Snow courses were conducted every 1 to 2 days to calculate SWE. As seen in Figure 5, snowmelt began around 5/25/07 and continued until early June.

As seen in the L9312 water level graphs (Figure 6), recharge of the lake began on 6/1/2007. Over the next four days, the snowmelt from the watershed raised the water level by 0.16 ft. The lake was very close to recharging on its own before the entire area was flooded on 6/6/2007. On this day, the entire north end of the watershed was 3-4 ft high with water. By 5/7/2007 the floodwaters had receded considerably, however inflow was observed from the southeast end of the lake until 6/9/2007 when the flow stopped. The northwest outlet was flowing at a high rate until 6/10/2007. Flow was slowed after this date, but was still observed until 6/14/2007 when field work ended.

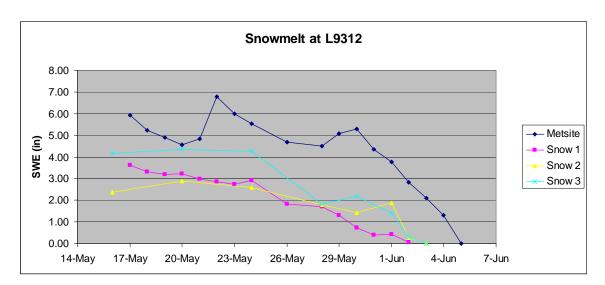


Figure 5. Snow water equivalence changes at L9312 during snowmelt 2007.

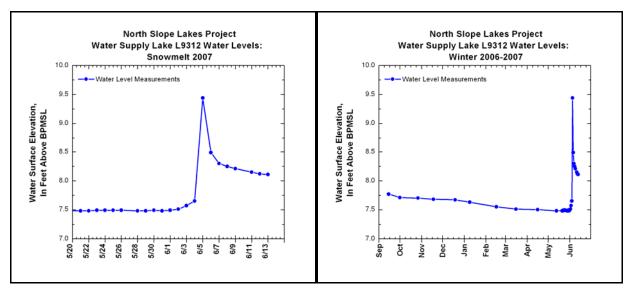


Figure 6. L9312 water levels. First figure shows changes throughout snowmelt period, second figure shows cumulative change throughout entire winter.

SUMMARY

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.

REFERENCES

- Lilly, M.R., Reichardt, D., and Derry, J. 2007. A Workplan for Lake Chemistry Sampling and Surveying, Snowmelt, and Lake Recharge Monitoring at Study Lakes in NPRA, Alpine, Kuparuk River, and Prudhoe Bay Areas: May 2007. Water and Environmental Research Center, University of Alaska Fairbanks. 21 p.
- White, D.M., and Lilly, M.R. 2007a. BPX: Health, Safety, and Environmental Interface

 Document. Water and Environmental Research Center, University of Alaska Fairbanks. 4
 p.
- White, D.M., and Lilly, M.R. 2007b. BPX: Health, Safety, and Environmental Plan. Water and Environmental Research Center, University of Alaska Fairbanks. 6 p.
- White, D.M., and Lilly, M.R. 2007c. ConocoPhillips Alaska, Inc.: Health, Safety, and Environmental Plan. Water and Environmental Research Center, University of Alaska Fairbanks. 5 p.

APPENDIX A. WATER QUALITY FIELD SAMPLING FORMS

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

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

Project ID: North Slope Lakes Site Location/Lake ID: Sample Purpose: **Lake Water Quality** Date: 5/16/07 Time: 16:01

FIELD MEASUREMENTS

GPS Coord. Northing: N70°20.438' Easting: W148°50.071' Datum: NAD27 Measurements By:

DAR/GMM Time: 16:01

Water Depth (ft): Ice Thickness (ft): 5.45 47.3 Freeboard (ft): 0.5

Snow Depth (ft): 0.20
Survey By: JED/HT
Sample Depths BWS (ft): 1 Elev. (BPMSL +/- .02): Date: 6/2/07 Date: 5/16/07 15:30 18.82 Time: Water Sampling By: GMM 16:01 Time:

25 3 37.5

WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Mete	er Make/N	lodel	Seria	Serial No.		ampling Check	Post-Sampling QAQC Check		
Multi	GWS	S IN-SITU TROLL 9000 33033					PA	SS		Pass	
Parameters		Field Measurements									
Time:	16:14	16:23	16:26	16:30	16:33	16:36	16:40	16:43	16:48	16:52	
Depth BWS (ft):	6	7	9	12	15	18	21	24	27	30	
Temp (°C):	0.08	0.16	0.81	1.09	1.09	1.10	1.08	1.09	1.09	1.10	
pH:	7.97	7.92	7.74	7.64	7.63	7.58	7.49	7.47	7.39	7.27	
Barometeric (mmHg):	765.8	765.7	765.7	765.8	765.9	766.0	766.0	766.1	766.2	766.3	
Pressure (kPa):	16.570	19.136	25.145	34.237	43.253	52.163	61.009	70.198	78.987	87.92	
Conductivity (ųS/cm):	0.0	133.0	132.9	132.2	132.1	131.8	131.6	131.4	131.2	131.1	
RDO (ppm): (mg/L)	14.24	14.62	14.44	13.75	13.60	13.57	13.60	13.57	13.55	13.63	
Turbidity (NTU):	0.3	0.2	0.3	0.1	0.2	0.2	0.1	0.1	0.1	0.2	
ORP											

FIELD TES Probe:	TING OF WATER S	AMPLES	(if small pr	obe is use	ed)
Depth (ft)					
Depth (ft) Temp (°C)					
pН					
Eh					

NORTH SLOPE LAB CHEMISTRY ANALYSIS

Parameter	Depth E	3WS (ft):_	6	Depth B	WS (ft):_	_25	Depth BV	NS (ft):	_37.5	Method
Oxygen (mg/L)										Hach spec 0.3-15 mg/L
Alkalinity (mg/L as CaCO ₃)	115	105	105	103	105	107	100	100	97	10-4000 mg/L as CaCO3
Total ironUF (mg/L)	0.01	0	0	0.03	0.01	0.01	0.01	0	0	Hach spec 0.02-3.00 mg/L
Filtered IronF tot Fe (mg/L)	0.03	0.01	0.01	0	0	0.01	0.00	0.01	0.01	Hach spec 0.02-3.00 mg/L
Ammonia (mg/L NH ₃ -N)****										0.01-0.50 mg/L NH3-
Ammonia/ Iron dilution										

Remarks: Log 2007-05-16 16:28

Field-Form Filled Out By: 8/15/08 A. Blackburn Date: QAQC Check By: K. Holland Date: 8/18/08

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

Project ID:	North Slope Lakes	;		Site Location	n/Lake ID:		KDA4	
Sample Purpose:	Lake Water Quality	у	-	Date:	5/16/07	Time:	16:01	
FIELD MEASUREMENTS								
GPS Coord. Northing:	N70°20.438'	Easting:	W148°50.071'	Datum:	NAD27			
Measurements By:	DAR/GMM		16:01					
Water Depth (ft):	47.3	Ice Thickness (ft):	5.45					

Snow Depth (ft): 0.20
Survey By: JED/HT
Sample Depths BWS (ft): 1 Freeboard (ft): 0.5 Elev. (BPMSL +/- .02): Date: 6/2/07 Date: 5/16/07 18.82 Time: 15:30 GMM Water Sampling By: 16:01 Time:

25 WATER QUALITY METER INFORMATION 3 37.5

Calibration Information

Parameter (s)	Owner	Mete	er Make/N	lodel	Seria	al No.		ampling Check		Post-Sampling QAQC Check	
Multi	GWS	IN-SI	U TROLL 9000		330	033 PASS		PASS		Pass	
Parameters		Field Measurements									
Time:	16:57	17:01	17:11	17:16	17:22	17:24	17:29				
Depth BWS (ft):	33	36	39	42	45	46	вот				
Temp (°C):	1.11	1.10	1.07	1.01	0.97	0.94	0.89				
pH:	7.19	7.13	6.77	6.59	6.96	7.05	7.13				
Barometeric (mmHg):	766.4	766.4	766.5	766.5	766.6	766.6	766.6				
Pressure (kPa):	96.937	105.863	115.014	124.399	128.817	128.832	128.822				
Conductivity (ųS/cm):	131.2	131.2	136.1	150.8	220.0	239.8	279.3				
RDO (ppm): (mg/L)	13.63	13.63	9.37	2.79	0.43	0.24	0.27				
Turbidity (NTU):	0.2	0.1	0.3	1.1	0.5	0.8	48.8				
ORP											

FIELD TES Probe:	TING OF WATER S	AMPLES	(if small pr	obe is use	ed)
Depth (ft)					
Depth (ft) Temp (°C)					
pH Eh					
Eh					

NORTH SLOPE LAB CHEMISTRY ANALYSIS

Parameter	Depth E	BWS (ft):_	6	Depth B	WS (ft):_	25	Depth BV	NS (ft):	_37.5	Method
Oxygen (mg/L)										Hach spec 0.3-15 mg/L
Alkalinity (mg/L as CaCO ₃)	115	105	105	103	105	107	100	100	97	Digital titrator 10-4000 mg/L as CaCO3
Total ironUF (mg/L)	0.01	0	0	0.03	0.01	0.01	0.01	0	0	Hach spec 0.02-3.00 mg/L
Filtered IronF tot Fe (mg/L)	0.03	0.01	0.01	0	0	0.01	0.00	0.01	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: Log 2007-05-16 16:28

Field-Form Filled Out By: A. Blackburn 8/15/08 Date: QAQC Check By: K. Holland Date: 8/18/08

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

Project ID: North Slope Lakes Site Location/Lake ID: KDA5 Sample Purpose: **Lake Water Quality** Date: 5/17/07 Time: 14:06

FIELD MEASUREMENTS

GPS Coord. Northing: N70°20.642' Datum: NAD83

Easting: W148°56.135'
Time: 14:06
Ice Thickness (ft): 5.85 Measurements By: DAR/GMM 54.0

Water Depth (ft): Freeboard (ft): Snow Depth (ft): 0.20 0.40

Date: 6/6/07 Date: 5/17/07 Elev. (BPMSL +/- .02): 12.63 Survey By: JED/GMM Time: 11:35 Water Sampling By: Sample Depths BWS (ft): 1 DAR 6 Time: 14:06

26 37.5

WATER QUALITY METER INFORMATION

Parameter (s)	Owner	Mot	er Make/M	lodol	Sorie	al No.		ampling Check	Post-Sampling QAQC Check		
()											~N
Multi	GWS	IN-SI	ΓU TROLL	_ 9000	330	033	PA	ASS		Pass	
Parameters		Field Measurements									
Time:	14:36	14:40	14:42	14:49	14:54	14:58	15:03	15:11	15:17	15:21	15:24
Depth BWS (ft):	6	7	9	12	15	18	21	24	27	30	33
Temp (°C):	0.06	0.24	0.95	1.19	1.20	1.19	1.21	1.20	1.21	1.2	1.20
pH:	7.76	7.66	7.59	7.53	7.52	7.53	7.54	7.53	7.51	7.49	7.46
Barometeric (mmHg):	762.2	762.2	762.3	762.5	762.5	762.6	762.8	762.9	762.9	763.0	763.1
Pressure (kPa):	16.274	19.307	25.276	34.403	43.210	52.252	61.480	70.276	76.092	88.172	97.091
Conductivity (ųS/cm):	102.2	102.5	101.8	102.1	102.0	101.9	101.8	101.6	101.6	101.4	101.4
RDO (ppm): (mg/L)	14.58	14.50	14.03	13.54	13.24	13.28	13.38	13.55	13.49	13.45	13.41
Turbidity (NTU):	0.0	0.2	0.1	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.2
ORP											

FIELD TES	TING OF WATER S	AMPLES	(if small pr	obe is use	ed)						
Probe:											
Depth (ft) Temp (°C) pH Eh											
Temp (°C)											
рН											
Eh											

NORTH SLOPE LAB CHEMISTRY ANALYSIS

Parameter	Depth B	Depth BWS (ft):6		Depth BWS (ft):26			Depth B\	NS (ft):	_37.5	Method
Oxygen (mg/L)										Hach spec 0.3-15 mg/L
Alkalinity (mg/L as CaCO ₃)	80	80	80	67	72	73	75	75		titrator 10-4000
Total ironUF (mg/L)	0.05	0.03	0.02	0	0	0.01	0.04	0.05		0.02-3.00 mg/L
Filtered IronF tot Fe (mg/L)	0	0.01	0	0.01	0.01	0.01	0.00	0		0.02-3.00 mg/L
Ammonia (mg/L NH ₃ -N)****										0.01-0.50
Ammonia/ Iron dilution										

Remarks: No log recorded on In-Situ.

Field-Form Filled Out By: A. Blackburn Date: 8/15/08 QAQC Check By: 8/18/08 K. Holland Date:

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

Project ID:	North Slope Lakes	.		Site Location	/Lake ID: _	KD	A5
Sample Purpose:	Lake Water Qualit	у		Date: _	5/17/07	Time:	14:06
FIELD MEASUREMENTS							
GPS Coord. Northing:	N70°20.642'	Easting: W148°56.13	35'	Datum:	NAD83		
Measurements By:	DAR/GMM	Time: 14:06					
Water Depth (ft):	54.0	Ice Thickness (ft): 5.85					
Freeboard (ft):	0.40	Snow Depth (ft): 0.20		<u></u>			

 Elev. (BPMSL +/- .02):
 12.63
 Survey By: JED/GMM
 Date: 6/6/07

 Water Sampling By:
 DAR
 Sample Depths BWS (ft): 1 6 2 26
 Date: 5/17/07

2 <u>26</u> 3 37.5 Time:

11:35

Time: 14:06

WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Mete	er Make/N	lodel	Seria	ıl No.		mpling Check		Post-Sampli QAQC Che	•
Multi	GWS	IN-SITU TROLL 9000		9000	33033		PASS		Pass		
Parameters		Field Measurements									
Time:	15:26	15:28	15:30	15:32	15:34	15:37	15:40	15:43			
Depth BWS (ft):	36	39	42	45	48	51	53	вот			
Temp (°C):	1.20	1.19	1.19	1.19	1.18	1.09	1.00	0.95			
pH:	7.44	7.42	7.40	7.21	7.14	6.83	6.70	6.67			
Barometeric (mmHg):	763.2	763.2	763.3	763.4	763.5	763.5	763.6	763.6			
Pressure (kPa):	106.006	111.998	124.099	128.801	128.815	128.814	128.813	128.817			
Conductivity (ųS/cm):	101.4	101.4	101.4	101.7	103.4	112.3	125.7	137.1			
RDO (ppm): (mg/L)	13.39	13.37	13.31	13.21	12.65	9.14	3.61	1.79			
Turbidity (NTU):	0.3	0.3	0.3	0.3	0.4	8.0	2.7	101.4			
ORP							, and the second				
•								·			

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

NORTH SLOPE LAB CHEMISTRY ANALYSIS

Parameter	Depth E	3WS (ft):_	6	Depth B	WS (ft):_	_26	Depth B\	NS (ft):	_37.5	Method
Oxygen (mg/L)										Hach spec 0.3-15 mg/L
Alkalinity (mg/L as CaCO ₃)	80	80	80	67	72	73	75	75		titrator 10-4000
Total ironUF (mg/L)	0.05	0.03	0.02	0	0	0.01	0.04	0.05		0.02-3.00 mg/L
Filtered IronF tot Fe (mg/L)	0	0.01	0	0.01	0.01	0.01	0.00	0		0.02-3.00 mg/L
Ammonia (mg/L NH ₃ -N)****										0.01-0.50
Ammonia/ Iron dilution										

Remarks:	No log recorded on In-Situ.

 Field-Form Filled Out By:
 A. Blackburn
 Date:
 8/15/08

 QAQC Check By:
 K. Holland
 Date:
 8/18/08

Form F-004a: Water Qu	ality Field-Sam	oling General				
Project ID:	North Slope Lak	es	5	Site Location/Lake ID:	KD	A9
Sample Purpose:	Lake Water Qua	lity		Date: 5/18/07	Time:	16:05
FIELD MEASUREMENTS						
GPS Coord. Northing:	N70°20.526'	Easting: W148°	56.854'	Datum: NAD83		
Measurements By:	DAR/GMM	Time: 16:05				
Water Depth (ft):	13.5	Ice Thickness (ft): 5.80	 ;			
Freeboard (ft):	0.45	Snow Depth (ft): 0.30		_		
Elev. (BPMSL +/02):	n/a	Survey By: n/a		Date: n/a	Time:	n/a
Water Sampling By:	DAR /GMM	Sample Depths BWS (ft):	1 6	Date: 5/18/07	Time:	16:05
		_	2 9		_	
WATER QUALITY METER IN Calibration Information	IFORMATION		3 12	_		

Parameter (s)	Owner				Serial No. 33033		Pre-Sampling QAQC Check PASS		Post-Sampling QAQC Check			
Multi	GWS	IN-SI	IU IROLL	9000	331	J33	PASS			Pass		
Parameters					Field Me	asureme	nts					
Time:	16:27	16:31	16:33	16:35	16:37	16:39	16:43	16:46	16:51			
Depth BWS (ft):	6	7	8	9	10	11	12	13	вот			
Temp (°C):	0.14	0.47	0.79	1.12	1.23	1.37	1.44	1.50	1.55			
pH:	7.24	7.21	7.20	7.18	7.16	7.13	7.10	7.08	7.06			
Barometeric (mmHg):	764.4	764.5	764.5	764.6	764.6	764.7	764.8	764.8	764.9			
Pressure (kPa):	16.457	19.230	22.407	25.269	28.203	31.374	34.310	37.219	39.596			
Conductivity (ųS/cm):	245.8	250.3	255.0	258.1	259.0	259.9	260.3	260.8	261.1			
RDO (ppm): (mg/L)	10.29	10.49	10.55	10.56	10.43	10.20	9.78	9.61	9.57			
Turbidity (NTU):	0.2	0.3	0.4	0.5	0.5	1.0	1.0	1.1	4.6			
ORP		•										

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

NORTH SLOPE LAB CHEMISTRY ANALYSIS

Parameter	Depth B	Depth BWS (ft):6		_6 Depth BWS (ft):9			Depth B	WS (ft):	_12	Method
Oxygen (mg/L)										Hach spec 0.3-15 mg/L
Alkalinity (mg/L as CaCO ₃)	162	160	164	160	166	164	160	164		titrator 10-4000
Total ironUF (mg/L)	0.03	0.02	0.03	0.03	0.06	0.04	0.11	0.11		0.02-3.00 mg/L
Filtered IronF tot Fe (mg/L)	0.03	0.01	0.07	0.03	0.01	0.02	0.01	0.01		0.02-3.00 mg/L
Ammonia (mg/L NH ₃ -N)****										0.01-0.50
Ammonia/ Iron dilution										

Remarks:					
Field-Form Filled Out By:	A. Blackburn	Date:	8/15/08		
QAQC Check By:	K. Holland	Date:	8/18/08	- -	

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.

Form F-004e: Water Quality Meter Calibration Form

Project ID:	North Slope Lakes	Site Location/Lake ID: L9817
Sample Purpose:	Lake Water Quality	

WATER QUALITY METER INFORMATION

Make: Troll 9000 S/N: 33033 Meter Make: Insitu Owner: GWS

CALIBRATION AND QUALITY ASSURANCE INFORMATION Pre-Sampling QA

Fie-Sampling WA							
Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
pH 4.01	5/12/07	1631	Oakton	2610411	Oct-08	4.04 @ 9.32	Pass
pH 7.00	5/12/07	1634	Oakton	2612531	Dec-08	7.03 @ 9.81	Pass
pH 10.00	5/12/07	1638	Oakton	2612532	Jun-08	10.15 @ 10.78	Pass
Conductivity	5/12/07	1640	Oakton 447us/cm	2701471	Apr-08	447 @ 17.08	Pass
DO 100	5/12/07	1625	Bubbled Nanopure			92.1 @ 7.38	Pass
DO 0	5/10/07	1934	Hanna H17040	G1012	Feb-11	0.01 @17.45	Pass

Post-Sampling QA

r ost oumpling &A							
Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
pH 4.01	5/16/07	2124	Oakton	2612530	Dec-08	4.09 @ 19.75	Pass
pH 7.00	5/16/07	2127	Oakton	2612531	Dec-08	7.07 @ 19.25	Pass
pH 10.00	5/16/07	2130	Oakton	2612532	Jun-08	10.20 @ 19.21	Pass
Conductivity	5/16/07	2133	Oakton 447us/cm	260977	Sep-07	404.3 @ 19.45	Pass
DO 100	5/16/07	2158	Bubbled Nanopure			93.2 @ 15.73	Pass
DO 0	5/16/07	2204	Hanna H17040	G1012	Feb-11	0.01 @15.23	Pass

Remarks: Insitu leaked into device and removed from service on 5/14/07. Fixed and placed in service 5/16/07.

Field-Form Filled Out By:	Greta Myerchin	Date:	6/12/2007
QAQC Check By:	A. Blackburn	Date:	7/21/2007

University of Alaska Fairbanks, Water and Environmental Research Center Form F-004e: Water Quality Meter Calibration Form North Slope Lakes Site Location/Lake ID: L9817 Project ID: Sample Purpose: **Lake Water Quality** WATER QUALITY METER INFORMATION Make: Troll 9000 Meter Make: Insitu UAF S/N: 33205 Owner: CALIBRATION AND QUALITY ASSURANCE INFORMATION **Pre-Sampling QA** Parameter Date Time Standard Meter Reading Pass/Fail Lot No. Ехр. pH 4.01 5/15/07 1829 Oakton 2610411 Oct-08 4.10 @ 18.68 Pass pH 7.00 5/15/07 1836 Oakton 2612531 Dec-08 7.05 @ 18.20 Pass pH 10.00 5/15/07 1844 Oakton 2612532 Jun-08 10.04 @ 18.61 Pass Conductivity 5/15/07 1825 Oakton 447us/cm 260977 Sep-07 350.1 @ 18.03 Pass Pass DO 100 5/15/07 1701 Bubbled Nanopure 109 @ 18.0 ---Post-Sampling QA Parameter Date Standard Lot No. Ехр. Meter Reading Pass/Fail No Post QAQC performed on UAF Insitu Remarks:

Date:

6/12/2007

Date: 7/21/2007

Field-Form Filled Out By:

QAQC Check By:

Greta Myerchin

A. Blackburn

Form F-004e: Water Quality Meter Calibration Form Project ID: North Slope Lakes Sample Purpose: Lake Water Quality					n Site Location/Lake ID: <u>L9817</u>					
WATER QUALITY I	METER INFO	RMATION	I							
Meter Make:	Insitu		Make:	Troll 9000						
Owner:	GWS		S/N:	33033		•				
CALIBRATION ANI Pre-Sampling QA	QUALITY A	ASSURAN	CE INFORMATION							
Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fa			
pH 4.01	5/16/07	2124	Oakton	2610411	Oct-08	4.09 @ 19.75	Pass			
pH 7.00	5/16/07	2127	Oakton	2612531	Dec-08	7.07 @ 19.25	Pass			
pH 10.00	5/16/07	2130	Oakton	2612532	Jun-08	10.20 @ 19.21	Pass			
Conductivity	5/16/07	2133	Oakton 447us/cm	260977	Sep-07	404.3 @ 19.45	Pass			
DO 100	5/16/07	2158	Bubbled Nanopure			93.2 @ 15.73	Pass			
DO 0	5/16/07	2204	Hanna H17040	G1012	Feb-11	0.01 @15.23	Pass			
Post-Sampling QA										
Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fa			
pH 4.01	5/18/07	1008	Oakton	2612530	Dec-08	4.01 @ 16.36	Pass			
pH 7.00	5/18/07	1010	Oakton	2612531	Dec-08	6.96 @ 15.97	Pass			
pH 10.00	5/18/07	1014	Oakton	2612532	Jun-08	9.99 @ 16.12	Pass			
Conductivity	5/18/07	1106	Oakton 1413 us/cm	2501347	Jan-06	1128 @ 14.92	Pass			

Remarks:				

Date:

Date:

G1012

6/12/2007

7/21/2007

95.7 @ 16.12

0.01 @14.12

Feb-11

Pass

Pass

1139 Bubbled Nanopure

1144 Hanna H17040

Greta Myerchin

A. Blackburn

DO 100

Field-Form Filled Out By:

QAQC Check By:

DO 0

5/18/07

5/18/07

Form F-004e: Water Quality Meter Calibration Form

Project ID:	North Slope Lakes	Site Location/Lake ID: L9817
Sample Purpose:	Lake Water Quality	

WATER QUALITY METER INFORMATION

Make: Troll 9000 S/N: 33033 Meter Make: Insitu Owner: GWS

CALIBRATION AND QUALITY ASSURANCE INFORMATION Pre-Sampling QA

Fie-Sampling WA							
Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
pH 4.01	5/18/07	1008	Oakton	2612530	Dec-08	4.01 @ 16.36	Pass
pH 7.00	5/18/07	1010	Oakton	2612531	Dec-08	6.96 @ 15.97	Pass
pH 10.00	5/18/07	1014	Oakton	2612532	Jun-08	9.99 @ 16.12	Pass
Conductivity	5/18/07	1106	Oakton 1413 us/cm	2501347	Jan-06	1128 @ 14.92	Pass
DO 100	5/18/07	1139	Bubbled Nanopure			93.2 @ 15.73	Pass
DO 0	5/18/07	1144	Hanna H17040	G1012	Feb-11	0.01 @15.23	Pass

Post-Sampling QA

1 OSt Gampling &A							
Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
pH 4.01	5/19/07	1131	Oakton	2612530	Dec-08	4.17 @ 16.58	Pass
pH 7.00	5/19/07	1132	Oakton	2612531	Dec-08	7.15 @ 15.12	Pass
pH 10.00	5/19/07	1135	Oakton	2612532	Jun-08	10.13 @ 15.04	Pass
Conductivity	5/19/07	1105	Oakton 146 us/cm	Mix	Nov-07	1164 @ 16.43	Pass
Conductivity	5/19/07	1105	Oakton 1413 us/cm	2501347	Jan-06	150.5 @ 25.14	Pass
DO 100	5/19/07	1145	Bubbled Nanopure			91.8 @ 15.26	Pass
DO 0	5/19/07	1151	Hanna H17040	G1012	Feb-11	0.01 @13.91	Pass

Remarks: Conductivity 146 us/cm solution = 0.74 g KCL to 1 L of DO. Solution from Arctic Fox Environmental, Deadho

Field-Form Filled Out By: Greta Myerchin Date: 6/12/2007 QAQC Check By: A. Blackburn Date: 7/21/2007

Form F-004e: W	Vater Quali		r Calibration For		ion/Lake ID:	Ca/Mg Samplin	g and
Sample Purpose:	Lake Wate			- -		Chemistry - pos	
WATER QUALITY I	METER INFO	DMATION	•				
WATER QUALITY I Meter Make:	Insitu	RIVIATION		Troll 9000			
Owner:	GWS			33033			
o union	0110			00000			
CALIBRATION ANI Pre-Sampling QA	D QUALITY A	SSURAN	CE INFORMATION				
Parameter	Date	Time	Standard	Lot No.	Ехр.	Meter Reading	Pass/Fai
oH 4.01	5/19/07	1131	Oakton	2612530	Dec-08	4.17 @ 16.58	Pass
H 7.00	5/19/07	1132	Oakton	2612531	Dec-08	7.15 @ 15.12	Pass
H 10.00	5/19/07	1135	Oakton	2612532	Jun-08	10.13 @ 15.04	Pass
Conductivity	6/8/07	1002	Oakton 447 us/cm	2701471	Jan-08	364.7 @ 14.58	Pass
				1			
				1			
				1			
Post-Sampling QA	l l			l l			I
Parameter	Date	Time	Standard	Lot No.	Ехр.	Meter Reading	Pass/Fai
oH 4.01	6/8/07	1606	Oakton	2612530	Dec-08	4.20 @ 16.88	Pass
H 7.00	6/8/07	1613	Oakton	2612531	Dec-08	6.95 @ 16.63	Pass
H 10.00	6/8/07	1616	Oakton	2612532	Jun-08	10.09 @ 16.70	Pass
Conductivity	6/8/07	1618	Oakton 447 us/cm	2701471	Jan-08	393.1 @ 17.60	Pass
·				1			
				1			
				1			
				† †			
Remarks: Conducti	ivity 146 us/cn	n solution	= 0.74 g KCL to 1 L of	f DO.			l.
Solution from Arctic							
20.2.011 110111 / 110110	. CA LITTIONIC	ai, Doa					

Date: 6/12/2007 Date: 7/21/2007

Field-Form Filled Out By: QAQC Check By:

Greta Myerchin A. Blackburn

		•	r Calibration Fori		tion / Labor ID.	O = /NA = O = === !!=	
Project ID: Sample Purpose:	North Slop			Site Location/Lake ID			
Sample Fulpose.	Lake Wate	i Quality		-		Chemistry - pos	гыеакир
WATER QUALITY I	METER INFO	RMATION	I				
Meter Make:	Insitu		Make:	Troll 9000			
Owner:	GWS		S/N:	33033			
CALIBRATION ANI Pre-Sampling QA	D QUALITY A	SSURAN	CE INFORMATION				
Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
pH 4.01	6/8/07	1606	Oakton	2612530	Dec-08	4.20 @ 16.88	Pass
pH 7.00	6/8/07	1613	Oakton	2612531	Dec-08	6.95 @ 16.63	Pass
pH 10.00	6/8/07	1616	Oakton	2612532	Jun-08	10.09 @ 16.70	Pass
Conductivity	6/8/07	1618	Oakton 447 us/cm	2701471	Jan-08	393.1 @ 17.60	Pass
Post-Sampling QA							
Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
pH 4.01	6/10/07	1731	Oakton	2612530	Dec-08	4.20 @ 17.04	Pass
pH 7.00	6/10/07	1733	Oakton	2612531	Dec-08	7.18 @ 16.73	Pass
pH 10.00	6/10/07	1735	Oakton	2612532	Jun-08	10.15 @ 16.62	Pass
Conductivity	6/10/07	1727	Oakton 447 us/cm	2701471	Jan-08	373.0 @ 16.49	Pass
Remarks: Conducti	ivity 146 us/cr	n solution	= 0.74 g KCL to 1 L o	f DO. Solution	from Arctic	Fox Environmen	tal, Deadho
Field-Form Filled Ou QAQC Check By:	ut By:	Greta Mye A. Bla	erchin Date				

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:
 KDA

 Survey Purpose:
 Water-Level Elevations
 Date: 5/23/2007
 Time: 11:00am

Location:			Kupar	uk Deadarm	Reservoirs (Cells 4, 5, 9		
Survey objective:		Lake water	elevation survey		Weat Observa	thin overcast		
Instrument Type:	Leica N	A720	Instrument ID:	5482367 (G	WS owned)	~10F.	. overcast.	visibility 0.5 miles
Rod Type:	Craine fibe	rglass 20'	Rod ID:	GWS (owned		,	, , , , , , , , , , , , , , , , , , , ,
		Bench Mar	k Information:	l.		Survey Tea	m Names	
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Long (ddd-mn	n.mmm)		DAR	, GMM
BM#1	BP	19.32'	N70 20.048	W148 !				
WO040768 Station	BS	Н	NAD83 FS	NAI Elevation	Distance	Horizontal	Vertical	Remarks
Station	(ft)	(ft)	(ft)	(fasl)	(ft)	Angle	Angle	Remarks
BM3	0.72	19.62	, ,	18.90		3		Shooting from cell 1
SH4		19.62	14.63	4.99				
TOI 4		19.62	13.22	6.40				WL 4= 6.40'
TOI 5		19.62	13.86	5.76				WL 5 =5.76'
SH 5		19.62	14.69	4.93				
TP1		19.62	13.21	6.41				
			l	Move instrun	nent			
TP1	4.91	11.32		6.41				
TP2		11.32	5.85	5.47				
			N	Move instrum	ent to			
TP2	8.43	13.90		5.47				
TOC 9		13.90	6.34	7.56				
KDA9		13.90	8.65	5.25				
			I	Move instrun	nent			
KDA9	8.80	14.05		5.25				
TOI 9		14.05	6.51	7.54				Close survey

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

 Project ID:
 North Slope Lakes
 Site Location/Lake ID:
 KDA

 Survey Purpose:
 Water-Level Elevations
 Date: 5/23/2007
 Time: 11:00am

Location:			Kupar	uk Deadarm	Reservoirs (Cells 1, 2, 3		
Survey objective:		Lake water	elevation survey					thin overcast
Instrument Type:	Leica N	A720	Instrument ID:	5482367 (G	WS owned)			wind, bright sunshine
Rod Type:	Craine fibe	rglass 20'	Rod ID:	GWS	owned	o Degree	OST OWN TT	wina, bright sansmin
		Bench Mar	k Information:			Survey Tea	m Names	
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Long (ddd-mn	itude n.mmm)		GM,J	IED
BM#1 NO040768	BP	19.32'	N70 20.048 NAD83	W148 ! NAI				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
TBM_1	1.32	20.64		19.32				
KDA3-SH		20.64	15.95	4.69				KDA3-WL
KDA2-SH		20.64	15.95	4.69				KDA2-WL
			Turn on KDA	.2-SH1, move	e instrument	to ^2	I.	
KDA2-SH	16.11	20.80		4.69				
KDA3-SH		20.80	16.11	4.69				
TBM_1		20.80	1.47	19.33				
		Move instru	ment to Island, to	ırn on KDA2	Water Surfa	ce. Shooting	from ^3	
KDA2-SH	11.35	16.04		4.69				
KDA1-SH		16.04	7.56	8.48				KDA1 WL
			Move instru	ment to ^4, to	urn on KDA1	-SH		
KDA1-SH	7.14	15.62		8.48				
KDA2-SH		15.62	10.92	4.70				

Project ID:	North Slope Lakes	Site Locat	Site Location/Lake ID: _		KDA	
Survey Purpose:	Water-Level Elevations	Date:	5/24/2007	Time:	2:00pm	

	_							
Location:			Kupa	aruk Deadarn	n Reservoirs	Cells 4, 5		
Survey objective:		Lake water	elevation survey			Weat Observa		OVC
Instrument	Leica N	A720	Instrument ID:	5482367 (G	WS owned)			
Type:						~5 Degree	es F 5MPH	I wind, bright sunshine
Rod Type:	Craine fibe	rglass 20'	Rod ID:	GWS	owned			
	•	Bench Mar	k Information:			Survey Team Names GM,JED, Horachio		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Long (ddd-mn	itude n.mmm)			, Horachio
BM#1 WO040766	BP	18.90'	70 20 22.0 WGS 84	148 56 WGS				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
WO040766 B	1.88	20.78		18.90				
KDA_4		20.78	15.78	5.00				KDA4-WL
KDA_5		20.78	15.82	4.96				KDA5-WL
			Turn on KDA	.5-SH1, move	e instrument	to ^2		
KDA_5	15.54	20.50		4.96				
KDA_4		20.50	15.49	5.01				
WO040766 B		20.50	1.60	18.90				
								_

Project ID:	North Slope Lakes	Site Location/Lake ID:	KDA	
Survey Purnose:	Water-Level Elevations	Date: 5/27/2007	Time: 12:30nm	

Location:			Kupar	uk Deadarm	Reservoirs (Cells 1, 2, 3			
Survey objective:		Lake water	elevation survey			Weather Observations:		thin overcast, windy	
Instrument Type:	Leica N	A720	Instrument ID:	5482367 (G	WS owned)				
Rod Type:	Craine fiber	rglass 20'	Rod ID:	GWS o	owned				
		Bench Mar	k Information:			Survey Tea	m Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Long (ddd-mm			GM	,JED	
BM#1 NO040768	BP	19.32'	N70 20.048 NAD83	W148 5 NAI					
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks	
TBM_1	1.60	20.92		19.32				Shot to flagged benchmark	
KDA3-SH		20.92	16.22	4.70				KDA3-WL	
KDA2-SH		20.92	16.15	4.77				KDA2-WL	
			Turn on KDA	2-SH1, move	instrument	to ^2	l		
KDA2-SH	16.39	21.16		4.77					
KDA3-SH		21.16	16.46	4.70					
TBM_1		21.16	1.84	19.32				Close survey to 0.00	
		Move instru	ment to Island, tu	urn on KDA2	Water Surfa	ce. Shooting	from ^3		
KDA2-SH	11.23	16.00		4.77					
KDA1-SH		16.00	7.43	8.57				KDA1 WL	
			Move instru	ment to ^4, tu	ırn on KDA1	-SH			
KDA1-SH	7.31	15.88		8.57					
KDA2-SH		15.88	11.12	4.76				Close survey to 0.01	

Project ID:	North Slope Lakes	Site Location/Lake ID	KDA	
Survey Purpose:	Water-Level Flevations	Date: 5/27/2007	Time: 3:0	0nm

Location:			Kupa	n Reservoirs	Cells 4, 5				
Survey objective:		Lake water	elevation survey			Weat Observa		thin overcast, breezy	
Instrument Type:	Leica N	A720	Instrument ID:	5482367 (G	WS owned)			_	
Rod Type:	Craine fibe	rglass 20'	Rod ID:	GWS (owned				
<u> </u>		Bench Mar	k Information:	Į.		Survey Tea	m Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Long (ddd-mn	n.mmm)		GM	,JED	
BM#1 WO040766	BP	18.90'	70 20 22.0 WGS 84	148 56 WGS					
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks	
WO040766 B	1.09	19.99		18.90				Shot to flagged benchmark	
KDA_4		19.99	15.01	4.98				KDA4-WL	
KDA_5		19.99	14.96	5.03				KDA5-WL	
			Turn on KDA	.5-SH1, move	instrument	to ^2			
KDA_5	14.87	19.90		5.03					
KDA_4		19.90	14.93	4.97					
WO040766 B		19.90	1.00	18.90				Close survey to 0.00	

Project ID:	North Slope Lakes	Site Location/Lake ID:	KDA	
Survey Purpose:	Water-Level Elevations	Date: 5/28/2007	Time: 12:30pm	Ī

			παραί	uk Deadarm	i vesei voiis v	JOHO 1, 2, 0			
Survey objective:		Lake water	elevation survey			Weat Observa		thin overcast, windy	
Instrument Type:	Leica N	A720	Instrument ID:	5482367 (G	WS owned)				
Rod Type:	Craine fibe	rglass 20'	Rod ID:	GWS (owned				
		Bench Mar	k Information:			Survey Tea	m Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Long (ddd-mn	n.mmm)		GMN	И,JED	
BM#1 WO040768	BP	19.32'	N70 20.048 NAD83	W148 ! NAI					
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks	
TBM_1	1.90	21.22	,	19.32	, ,			Shot to flagged benchmark	
KDA3-SH		21.22	16.50	4.72				KDA3-WL	
KDA2-SH		21.22	16.51	4.71				KDA2-WL	
			Turn on KDA	2-SH1, move	instrument	to ^2			
KDA2-SH	16.30	21.01		4.71					
KDA3-SH		21.01	16.28	4.73				Close survey to 0.01	
TBM_1		21.01	1.69	19.32				Close survey to 0.00	

Project ID:	North Slope Lakes	Site Location/Lake ID:	KDA	
Survey Purpose:	Water-Level Elevations	Date: 5/29/2007	Time: nr	

Location:		Kupar	uk Deadarm Res	ervoirs Cells	5, and re-ba	r that serve a	as stage m	narkers
Survey objective:		Lake water	elevation survey			Weather Observations:		overcast, snow
Instrument Type:	Leica N	A720	Instrument ID:	5482367 (G	WS owned)			ı
Rod Type:	Craine fibe	rglass 20'	Rod ID:	GWS o	owned			
		Bench Mar	k Information:			Survey Tea	m Names	
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Long (ddd-mm		GMM?JED		M?JED
BM#1 WO040766	BP	100	70 20 22.0 WGS 84	148 56 WGS				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
TBM_1	1.12	101.12		100.00				
KDA_5		101.12	15.06	86.06				KDA5-WL
RB1		101.12	11.09	90.03				
KDA4		101.12	14.98	86.14				
			mo	ove instrumer	nt to ^2			1
KDA4	15.20	101.34		86.14				Re-bar: RB3 elevation
KDA5		101.34	15.27	86.07				Re-bar: RB2 elevation
RB1		101.34	11.32	90.02				
TBM_1		101.34	1.34	100.00				Close survey to 0.00

Project ID:	North Slope Lakes	Site Location/Lake ID:	KDA	
Survey Purpose:	Water-Level Elevations	Date: 5/30/2007	Time: 11:00	

Location:		Kupar	uk Deadarm Res	ervoirs Cells	5, and re-ba	r that serve a	as stage m	arkers
Survey objective:		Lake water	elevation survey			Weatl Observa		overcast, snow
Instrument Type:	Leica N	A720	Instrument ID:	5482367 (G	WS owned)			'
Rod Type:	Craine fibe	rglass 20'	Rod ID:	GWS	owned	1		
		Bench Mar	k Information:			Survey Team Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Long (ddd-mn	itude n.mmm)		HT	,JED
BM#1 WO040766	BP	18.90'	70 20 22.0 WGS 84	148 56 WGS				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
WO040766 B	1.27	20.17		18.90			-	Shot to flagged benchmark
KDA_5		20.17	15.20	4.97				KDA5-WL
RB2		20.17	10.94	9.23				
RB3		20.17	8.75	11.42				
			Turn on KDA	5-SH1, move	e instrument	to ^2		
RB3	8.96	20.38		11.42				Re-bar: RB3 elevation
RB2		20.38	11.15	9.23				Re-bar: RB2 elevation
KDA_5		20.38	15.41	4.97				
WO040766 B		20.38	1.48	18.91				Close survey to 0.005

Project ID:	North Slope Lakes	Site Location/Lake ID:	KDA		
Survey Purpose:	Water-Level Elevations	Date: 5/30/2007	Time: 1:00pm	Ī	

Location:			Kuparı	ık Deadarm F	Reservoirs C	Cells 5 and 9		
Survey objective:		Lake water	elevation survey			Weat Observa		overcast, snow
Instrument Type:	Leica N	A720	Instrument ID:	5482367 (G	WS owned)			l
Rod Type:	Craine fibe	rglass 20'	Rod ID:	GWS (owned			
Ų		Bench Mar	k Information:			Survey Tea	m Names	
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Long (ddd-mm	n.mmm)		НТ	JED
BM#1 WO040766	BP	18.90'	70 20 22.0 WGS 84	148 56 WGS				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
KDA_5	6.36	11.33		4.97				KDA5-WL
KDA_9		11.33	6.01	5.32				
			Turn on KDA	5-SH1, move	instrument	to ^2		
KDA_9	6.19	11.50		5.32				KDA9-WL
KDA_5		11.50	6.51	4.99				Close survey to +0.0

Project ID:	North Slope Lakes	Site Location/	Lake ID:	KDA		
Survey Purpose:	Water-Level Elevations	Date: 5/	30/2007	Time:	2:00pm	

			i Lievations		Date.	3/30/2007	· IIIIG.	2.00pm	
Location:			Kuparı	uk Deadarm I	Reservoirs C	Cells 5 and 6			
Survey objective:		Lake water	elevation survey			Weat Observa		overcast, snow	
Instrument Type:	Leica N	A720	Instrument ID:	5482367 (G	WS owned)			l	
Rod Type:	Craine fibe	rglass 20'	Rod ID:	GWS (owned				
		Bench Mar	k Information:	•		Survey Team Names			
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Long (ddd-mn	n.mmm)		HT	,JED	
BM#1 WO040766	BP	18.90'	70 20 22.0 WGS 84	148 56 WGS					
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks	
KDA_5	11.83	16.80	(1-)	4.97	(,			KDA5-WL	
KDA_6		16.80	11.22	5.58				KDA6-WL	
			Turn on KDA	.5-SH1, move	instrument	to ^2			
KDA_6	11.31	16.89		5.58					
KDA_5		16.89	11.94	4.95				Close survey to +0.02	
_									

Project ID:	North Slope Lakes	Site Location/Lake ID:	KDA		
Survey Purpose:	Water-Level Elevations	Date: 5/31/2007	Time: 12:25pm		

Location:	KDA 4 and	5, and re-ba	ar RB1 that serve	e as stage ma	arkers. Seco	ond time RB1	is survey	ed for QA/QC reasons.	
Survey objective:		Lake water e	elevation survey			Weat Observa		Partly cloudy	
Instrument Type:	Leica N	A720	Instrument ID:	5482367 (G	WS owned)			I	
Rod Type:	Craine fibe	rglass 20'	Rod ID:	GWS (owned				
		Bench Mar	k Information:			Survey Team Names			
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Long (ddd-mn	n.mmm)		НТ	,JED	
BM#3 WO040766	BP	18.90'	70 20 22.0 WGS 84	148 56 WGS					
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks	
WO040766 B	1.37	20.27		18.90				Shot to flagged benchmark	
KDA_4 - culvert		20.27	14.43	5.84				KDA_4-culvert elevation	
RB1		20.27	11.36	8.91					
			Turn on F	RB1, move in	strument to	^2			
RB1	11.50	20.41		8.91				Re-bar: RB1 elevation	
KDA_4- culvert		20.41	14.57	5.84					
WO040766 B		20.41	1.51	18.90				Close survey to 0.00	
	, measured do urface from RB		2.80	6.11				KDA 5 WL	
•	measured dov urface from RB		2.40	6.51				KDA 5 WL	
	measured dov urface from RB		1.50	7.41				KDA 5 WL	

Project ID:	North Slope Lakes	Site Location/	Lake ID:	KDA		
Survey Purpose:	Water-Level Elevations	Date: 5/	31/2007	Time:	1:30pm	

Location:			Kupar	uk Deadarm	Reservoirs (Cells 1, 2, 3		
Survey objective:		Lake water	elevation survey			Weat Observa	-	partly cloudy
Instrument Type:	Leica N	A720	Instrument ID:	5482367 (G	WS owned)			
Rod Type:	Craine fibe	rglass 20'	Rod ID:	GWS o	owned			
		Bench Mar	k Information:			Survey Tea	m Names	
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Long (ddd-mm			HT	JED
BM#1 NO040768	BP	19.32'	N70 20.048 NAD83	W148 5 NAI				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
TBM_1	2.27	21.59		19.32				
KDA3-SH		21.59	16.82	4.77				KDA3-WL
KDA2-SH		21.59	16.81	4.78				KDA2-WL
			Turn on KDA	2-SH1, move	instrument	to ^2		
KDA2-SH	16.95	21.73		4.78				
KDA3-SH		21.73	16.97	4.76				Close survey to 0.0
TBM_1		21.73	2.41	19.32				Close survey to 0.00
		Move instru	ment to Island, tu	ırn on KDA2	Water Surfa	ce. Shooting	from ^3	
KDA2-SH	11.21	15.99		4.78				
KDA1-SH		15.99	7.39	8.60				KDA1 WL
			Move instru	ment to ^4, to	ırn on KDA1	-SH		
KDA1-SH	7.53	16.13		8.60				
KDA2-SH		16.13	11.35	4.78				Close survey to 0.00

Project ID:	North Slope Lakes	Site Location/Lake ID:	KDA		
Survey Purpose:	Water-Level Elevations	Date: 5/31/2007	Time: 3:30pm	1	

Location:		Kuparuk D	eadarm Reservo	irs Cell 1 and	I base of cul	vert pipe on s	south shor	e of KDA1
Survey			elevation survey			Weat	her	partly cloudy
objective:						Observa	ations:	
Instrument Type:	Leica N	A720	Instrument ID:	5482367 (G	WS owned)			
Rod Type:	Craine fibe	rglass 20'	Rod ID:	GWS (owned			
		Bench Mar	k Information:			Survey Tea	m Names	
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Long (ddd-mn	itude n.mmm)	HT,JED		,JED
BM#1 WO040768	BP	19.32'	N70 20.048 NAD83	W148 : NAI				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
KDA1-SH	5.54	14.15	(11)	8.61	(11)	7 tilglo	7 tiligio	
South pipe corner		14.15	1.68	12.47				South pipe elevation
555.			Move instrumer	nt to ^2, turn o	on South pip	e corner		
South pipe corner	1.82	14.29		12.47				
KDA1-SH		14.29	5.66	8.63				Close survey to +0.0

Project ID:	North Slope Lakes	Site Location/Lake ID:	KDA		
Survey Purpose:	Water-Level Elevations	Date: 5/31/2007	Time: 4:00pm		

Location:	K	iparuk Deac	larm Reservoirs	Surveyed in t	emporary be	enchmark on	East side	OI KDA 1, 2, 3	
Survey objective:		Lake water	elevation survey			Weat Observa		partly cloudy	
Instrument Type:	Leica N	A720	Instrument ID:	5482367 (G	WS owned)				
Rod Type:	Craine fibe	rglass 20'	Rod ID:	GWS (owned				
		Bench Mar	k Information:			Survey Tea			
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	(ddd-mn			НТ	,JED	
BM#1 WO040768	BP	19.32'	N70 20.048 NAD83	W148 ! NAI					
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks	
KDA2-SH	14.51	19.29		4.78					
TBM_23		19.29	0.24	19.05				TBM_23 elevation	
			Move instru	ument to ^2, t	urn on TBM	_23			
TBM_23	0.44	19.49		19.05					
KDA2-SH		19.49	14.71	4.78				Close survey to +0.0	
	_							_	

Project ID:	North Slope Lakes	Site Location/Lake ID:	KDA		
Survey Purpose:	Water-Level Elevations	Date: 5/31/2007	Time: 5:00pm		

Ourvey runp	,000.	Water Leve	Lievations		Date.	3/31/2007	· · · · · · · · · · · · · · · · · · ·	3.00pm	
Location:		Kuparuk	Deadarm Reserv	voirs Cells 6 a	and 7. Used	TBM_RD to	survey wa	iter level.	
Survey objective:		Lake water	elevation survey			Weat Observa		overcast	
Instrument Type:	Leica N	IA720	Instrument ID:	5482367 (G	WS owned)			l	
Rod Type:	Craine fibe	rglass 20'	Rod ID:	GWS	owned				
		Bench Mar	k Information:	•		Survey Tea	m Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	(ddd-mn			HT	,JED	
BM#1 WO040766	BP	18.90'	70 20 22.0 WGS 84	148 50 WGS					
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks	
TBM_RD	2.64	17.38		14.74				Shot to KDA_6 and 7 - WL	
KDA_6		17.38	8.87	8.51				KDA_6_7-WL	

Project ID:	North Slope Lakes	Site Locati	on/Lake ID:		KDA	
Survey Purpose:	Water-Level Elevations	Date:	6/1/2007	Time:	10:50am	

Location:		Kuparuk l	Deadarm Reserve	oirs Cells 6 a	nd 7. Used	TBM_RD to s	urvey wate	er level.
Survey objective:		Lake water e	elevation survey			Weat Observa		overcast and windy
Instrument Type:	Leica N	A720	Instrument ID:	5482367 (G	WS owned)			•
Rod Type:	Craine fiber	glass 20'	Rod ID:	GWS	owned			
		Bench Mar	k Information:			Survey Tea	m Names	
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Long (ddd-mn			НТ	,JED
BM#1 WO040766	BP	18.90'	70 20 22.0 WGS 84	148 56 WGS				
Station	BS	HI	FS	Elevation	Distance	Horizontal	Vertical	Remarks
	(ft)	(ft)	(ft)	(fasl)	(ft)	Angle	Angle	
TBM_RD	3.13	17.87		14.74				Shot to TBM_RD between KDA 6 and 7
KDA_6_7		17.87	8.80	9.07				KDA_6_7-WL
			Turn on KD	A_6_7, move	instrument to	0 ^2		
KDA_6_7	8.90	17.97		9.07				Shot to KDA_6 and 7 - WL
TBM_RD		17.97	3.23	14.74				Close survey to 0.00'

Project ID:	North Slope Lakes	Site Locati	ion/Lake ID:		KDA	
Survey Purpose:	Water-Level Elevations	Date:	6/1/2007	Time:	5.00pm	

Location:		Kuparuk	Deadarm Reserve	oirs Cells 6 a	nd 7. Used	TBM_RD to s	urvey wate	er level.
Survey objective:		Lake water e	elevation survey			Weat Observa		overcast
Instrument Type:	Leica N	A720	Instrument ID:	5482367 (G	WS owned)			•
Rod Type:	Craine fiber	rglass 20'	Rod ID:	GWS (owned			
		Bench Mar	k Information:			Survey Tea	m Names	
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longi (ddd-mn			НТ	,JED
BM#1 WO040766	BP	18.90'	70 20 22.0 WGS 84	148 56 18.3 WGS 84		1		
Station	BS	HI	FS	Elevation	Distance	Horizontal	Vertical	Remarks
	(ft)	(ft)	(ft)	(fasl)	(ft)	Angle	Angle	
TBM_RD	2.98	17.72		14.74				Shot to TBM_RD between KDA 6 and 7
TBM_HT		17.72	6.91	10.81				TBM_HT elevation
			Turn on TBI	M_HT, move	nstrument to	0 ^2		
TBM_HT	7.05	17.86		10.81				
TBM_RD		17.86	3.12	14.74				Close survey to 0.00'

Project ID:	North Slope Lakes	Site Locat	tion/Lake ID:	KDA		
Survey Purpose:	Water-Level Elevations	Date:	6/2/2007	Time:	3:30pm	

				<u>-</u> '			3.30pm
	Use	d TBM_RD to rur	n re-bar TBM'	s down to th	e river and ko	da 7 junctio	on
	Lake water e	elevation survey					Scattered clouds and windy
Leica N	A720	Instrument ID:	5482367 (G	WS owned)			
Craine fiber	rglass 20'	Rod ID:	GWS	owned			
	Bench Mar	k Information:	I.		Survey Tear	m Names	
Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	_		Je	eff Derry, H	loracio Toniolo
BP	18.90'	70 20 22.0 WGS 84					
BS	HI	FS	Elevation	Distance	Horizontal	Vertical	Remarks
(ft)	(ft)	(ft)	(fasl)	(ft)	Angle	Angle	
4.50	19.24		14.74				Shot to TBM_RD
							between KDA 6 and 7
	19.24	1.48	17.76				West of TBM_RD
		Turn on TBM	I_RD2, move	instrument t	to ^2		
1.36	19.12		17.76				Elevation of TBM_RD2
	19.12	4.38	14.74				Close survey to 0.00'
		Surve	ı ey in re-bar T	BM_RD3			
2.10	19.86		17.76				Shot to TBM_RD2
	19.86	1.69	18.17				West of TBM_RD2
		Turn on TBM	I_RD3, move	instrument t	to ^2		
1.78	19.95		18.17				Elevation of TBM_RD3
	19.95	2.19	17.76				Close survey to 0.00'
		Surve	ey in re-bar T	BM_RD4	<u>I</u>		
3.22	21.39		18.17				Shot to TBM_RD3
	21.39	2.57	18.82				West of TBM_RD3
		Turn on TBM	I_RD4, move	instrument t	to ^2		
2.68	21.50		18.82				Elevation of TBM_RD4
	21.50	3.33	18.17				Close survey to 0.00'
	Leica N Craine fiber Agency Responsible BP BS (ft) 4.50 1.36 1.78	Lake water of Leica NA720 Craine fiberglass 20' Bench Mari Agency Responsible (ft) BP 18.90' BS HI (ft) 4.50 19.24 1.36 19.12 2.10 19.86 1.78 19.95 1.78 19.95 3.22 21.39 2.68 21.50	Lake water elevation survey	Leica NA720			

 Project ID:
 North Slope Lakes
 Site Location/Lake ID:
 KDA

 Survey Purpose:
 Water-Level Elevations
 Date: 6/3/2007
 Time: 2:30pm

Location:			Kupar	uk Deadarm	Reservoirs (Cells 1, 2, 3		
Survey objective:		Lake water	elevation survey			Weat Observa		
Instrument Type:	Leica N	A720	Instrument ID:	5482372 (G	WS owned)			I wind, bright sunshine
Rod Type:	Craine fibe	rglass 20'	Rod ID:	GWS (owned	0 2 0g. 0.		a, eg eaee
	•	Bench Mar	k Information:			Survey Tea	m Names	
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	(ddd-mn	•		DAF	R,JED
TBM	nr	100' Temp.	na	n	a			
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
		Survey	in re-bar TBM_R	D6 (Survey o	continued fro	m previous p	age)	
TBM_RD5	3.27	20.41		17.14				Shot to TBM_RD5
TBM_RD6		20.41	3.34	17.07				North of TBM_RD5
			Turn on TBM	/_RD6, move	instrument	to ^2		
TBM_RD6	3.47	20.54		17.07				Elevation of TBM_RD
TBM_RD5		20.54	3.40	17.14				Close survey to 0.00
		Sur	vey Kuparuk Riv	er and KDA 7	at approxim	ately 3:30pm	1	
TBM_RD6	0.09	17.16		17.07				Shot to TBM_RD6
KDA_7		17.16	8.03	9.14				Water surface of KDA_7
K_River		17.16	7.91	9.25				Water surface of K_River
			Turn on K_	River, move	instrument to	o ^2		
K_River	8.09	17.34		9.25				K_River - WL
KDA_7		17.34	8.20	9.14				KDA_7 - WL
TBM_RD6		17.34	0.27	17.07				Close survey to 0.00

Project ID:	North Slope Lakes	Site Location/Lake ID:	KDA		
Survey Purpose:	Water-Level Elevations	Date: 6/4/2007	Time: 2:30pm		

Location:		Kup	oaruk Deadarm F	Reservoirs Ce	lls 1, 2, 3 us	sing TBM_23	east of lal	ces
Survey objective:		Lake water	elevation survey			Weat Observa		Sunny, calm
Instrument Type:	Leica N	A720	Instrument ID:	5482367 (G	WS owned)			'
Rod Type:	Craine fibe	rglass 20'	Rod ID:	GWS o	owned			
		Bench Mar	k Information:			Survey Tea	m Names	
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Long (ddd-mm			Jeff Derry	, Rob Geick
BM#1 NO040768	BP	19.32'	N70 20.048 NAD83	W148 5 NAI				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
TBM_23	0.03	19.08		19.05				Shot to re-bar TBM_2
KDA2-SH		19.08	13.51	5.57				KDA2-WL
KDA3-SH		19.08	13.48	5.60				KDA3-WL
			Turn on KDA	A3-SH, move	instrument t	to ^2		
KDA3-SH	13.74	19.34		5.60				
KDA2-SH		19.34	13.78	5.56				
TBM_23		19.34	0.30	19.05				Close survey to 0.00
		Move instru	ment to Island, tu	ırn on KDA2	Water Surfa	ce. Shooting	from ^3	
KDA2-SH	10.35	15.92		5.57				
KDA1-SH		15.92	6.35	9.57				KDA1 WL
	l		Move instru	ment to ^4, to	ırn on KDA1	-SH		
KDA1-SH	6.56	16.13		9.57				
KDA2-SH		16.13	10.55	5.58				Close survey to 0.01

Project ID:	North Slope Lakes	Site Location/Lake ID:	KDA		
Survey Purpose:	Water-Level Elevations	Date: 6/5/2007	Time: 14:30		

Location:		Kupa	ruk Deadarm Re	servoirs Cell	s 2, 3 using	TBM_23 to ir	nstall TBM	_RG	
Survey objective:		Lake water	elevation survey			Weat Observa		Sunny, windy	
Instrument Type:	Leica N	A720	Instrument ID:	5482367 (G	WS owned)	1)		-	
Rod Type:	Craine fibe	rglass 20'	Rod ID:	GWS (owned				
		Bench Mar	k Information:	Į.		Survey Tea	m Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Long (ddd-mn	itude n.mmm)	Je	eff Derry, C	Greta Myerchin	
BM#1 WO040768	BP	19.32'	N70 20.048 NAD83	W148 ! NAI					
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks	
TBM_23	1.31	20.36		19.05				Shot to re-bar TBM_2	
TBM_RG		20.36	8.42	11.94				Re-bar labeled TBM_RG	
			Turn on TBI	M_RG, move	instrument t	to ^2			
TBM_RG	8.25	20.19		11.94				TBM_RG - Elevation	
TBM_23		20.19	1.14	19.05				Close survey to 0.00	
		Mea	asured down to v	vater surface	from TBM_F	RG on KDA 3	3		
TBM_RG				11.94					
At 19:20, m	neasured down TBM_RG	from top of	2.77	9.17				KDA 2 and 3 - WL	
		No	otes: KDA cells:	2 and 3 are h	ydrologically	connected			

Project ID:	North Slope Lakes	Site Location/Lake ID:			KDA	
Survey Purpose:	Water-Level Elevations	Date:	6/5/2007	Time:	1:20	

Ourvey i dip	,000.	Trator Love	Lievations		Date.	0/3/2007	· · · · · · · · · · · · · · · · · · ·	1.20	
Location:		Installed ne	ew TBM water el	evation mark	er labeled Ti	BM_JED. Be	etween KD	A 4 and 5.	
Survey objective:		Lake water	elevation survey			Weat Observa		Sunny and windy	
Instrument Type:	Leica N	A720	Instrument ID:	5482367 (G	WS owned)			I	
Rod Type:	Craine fibe	rglass 20'	Rod ID:	GWS	owned				
		Bench Mar	k Information:	<u>I</u>		Survey Tea			
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Long (ddd-mn	n.mmm)	Je	eff Derry, C	Greta Myerchin	
BM#3 WO040766	BP	18.90'	70 20 22.0 WGS 84	148 50 WGS					
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks	
TBM_3	1.96	20.86	(-2/	18.90	(/	- mg-c		Elevation of Re-bar # 3 between KDA 4 and 5	
TBM_JED		20.86	6.84	14.02				Elevation of re-bar TBM_JED	
			Turn on TBN	/_JED, move	instrument	to ^2			
TBM_JED	6.53	20.55		14.02					
TBM_3		20.55	1.65	18.90				Close survey to 0.00'	
			Į	!	ļ	L		ļ	

Project ID:	North Slope Lakes	Site Location/Lake ID:	: KDA	
Survey Purpose:	Water-Level Flevations	Date: 6/5/2007	Time: 12:45	

Location:	Installed n	new TBM wa	ter elevation mai	rker labeled T	BM_GM at	KDA cell 6 ar	nd 7. Use	d TBM_RD as control.	
Survey objective:		Lake water	elevation survey			Weat Observa		Sunny and calm	
Instrument Type:	Leica N	A720	Instrument ID:	5482367 (G	WS owned)	(1)		-	
Rod Type:	Craine fibe	rglass 20'	Rod ID:	GWS o	owned				
		Bench Mar	k Information:			Survey Tea	m Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Long (ddd-mm		Je	eff Derry, C	Greta Myerchin	
BM#3 WO040766	BP	18.90'	70 20 22.0 WGS 84	148 56 WGS					
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks	
TBM_RD	3.84	18.58		14.74				Elevation of Re-bar TBM_RD between KD	
TBM_GM		18.58	2.71	15.87				Elevation of re-bar TBM_GM	
TBM_GM	2.49	18.36		15.87					
TBM_RD		18.36	3.62	14.74				Close survey to 0.00'	

Project ID:	oject ID: North Slope Lakes		KDA		
Survey Purpose:	Water-Level Flevations	Date: 6/5/2007	Time: 12:45	Ξ	

Location:			KDA 7. Mea	sured from to	p of TBM_R	D to water su	ırface.		
Survey objective:		Lake water	elevation survey			Weat Observa	-	Sunny and windy	
Instrument Type:	Leica N	A720	Instrument ID:	5482367 (G	WS owned)	0)		-	
Rod Type:	Craine fibe	rglass 20'	Rod ID:	GWS	owned				
		Bench Mar	k Information:	l		Survey Tea	m Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Long (ddd-mn		Je	eff Derry, G	Greta Myerchin	
BM#3 WO040766	BP	100	70 20 22.0 WGS 84	148 56 WGS					
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks	
TBM_RD58	3.05	103.05		100.00				Measured down from TBM_RD to water	
KRIVER		103.05	7.05	96.00					
KDA7		103.05	7.50	95.55				KDA7 WL	
			•	move inst	r.				
KDA7	7.38	102.93		95.55					
KRIVER		102.93	6.91	96.02					
TBM_RD5		102.93	2.92	100.01				close survey to 0.01	

roject ID: North Slope Lakes		Site Location/Lake ID:	KDA		
Survey Purpose:	Water-Level Elevations	Date: 6/6/2007	Time: 13:30		

Location:		Kupa	aruk Deadarm Re	eservoirs Cell	s 2, 3 using	TBM_23 to ir	nstall TBM	_ML	
Survey objective:		Lake water	elevation survey			Weat Observa		Sunny, warm,calm	
Instrument Type:	Leica N	A720	Instrument ID:	5482367 (G	WS owned)	(1)			
Rod Type:	Craine fibe	rglass 20'	Rod ID:	GWS	owned				
	•	Bench Mar	k Information:	•		Survey Tea	m Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	(ddd-mn		J€	eff Derry, C	Greta Myerchin	
BM#1 WO040768	BP	19.32'	N70 20.048 NAD83	W148 : NAI					
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks	
TBM_23	1.70	20.75		19.05				Shot to re-bar TBM_2	
TBM_ML		20.75	4.94	15.81				Re-bar labeled TBM_ML	
			Turn on TBI	M_ML, move	instrument t	o ^2			
TBM_ML	5.18	20.99		15.81				TBM_ML - Elevation	
TBM_23		20.99	1.94	19.05				Close survey to 0.00	
		Me	asured down to v	vater surface	from TBM_I	ML on KDA 3	}		
TBM_ML				15.81					
KDA 3	At 13:10 KD tape down m	easurment	3.08	12.73				KDA 2 and 3 - WL	
	1	N	otes: KDA cells:	2 and 3 are h	ydrologically	/ connected			
]					

roject ID: North Slope Lakes		Site Location/Lake ID:	KDA		
Survey Purpose:	Water-Level Elevations	Date: 6/6/2007	Time: 12:30		

Location:		Installe	d two re-bar on I	Kuparuk Rive	r and KDA 9	to compare	water elev	vations	
Survey objective:		Lake water e	elevation survey			Weat Observa		Sunny and calm	
Instrument Type:	Leica N	A720	Instrument ID:	5482367 (G	WS owned))		•	
Rod Type:	Craine fibe	rglass 20'	Rod ID:	GWS (owned				
		Bench Mar	k Information:			Survey Tea	m Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)		Je	eff Derry, C	Greta Myerchin	
BM#3 WO040766	BP	18.90'	70 20 22.0 WGS 84	148 56 WGS					
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks	
TBM_toni_ 5	14.77	29.16		14.39				Re-bar, elevation of re	
TBM_tonirv		29.16	9.55	19.61				Re-bar in Kuparuk riv	
			Turn on TBM ₋	_toniRV, mov	e instrumen	t to ^2			
TBM_tonirv	9.33	28.94		19.61				Elevation of top of re	
TBM_toni5		28.94	14.55	14.39				Close survey to 0.00	
From top TI	BM_tonirv to w	ater surface	2.31	17.30				K_river water elevation	
From top TE	BM_toni_5 to w	ater surface	1.75	12.64				KDA9 water elevation	

Project ID:	North Slope Lakes	Site Location/Lake ID:	KDA	
Survey Purpose:	Water-Level Flevations	Date: 6/6/2007	Time: 11:00	

Location:			Compared k	Kuparuk Rive	r and KDA 7	water elevat	ions.		
Survey objective:		Lake water	elevation survey			Weat Observa		Sunny and warm	
Instrument Type:	Leica N	A720	Instrument ID:	5482367 (G	WS owned)			•	
Rod Type:	Craine fibe	rglass 20'	Rod ID:	GWS (owned				
		Bench Mar	k Information:	•		Survey Tea	m Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Long (ddd-mn	n.mmm)	Je	eff Derry, G	Greta Myerchin	
BM#3 WO040766	BP	18.90'	70 20 22.0 WGS 84	148 56 WGS					
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks	
TBM_RD6	3.05	20.12		17.07				Elevation of Re-bar TBM_RD6	
K_River		20.12	7.05	13.07				Elevation of K_Rive	
KDA_7		20.12	7.49	12.63				Elevation of KDA 7	
			Turn on KE	DA_7, move i	nstrument to	^2			
KDA_7	7.37	20.00		12.63					
K_River		20.00	6.91	13.09				Close survey to 0.02	
TBM_RD6		20.00	2.92	17.08				Close survey to 0.01	

Project ID:	North Slope Lakes	Site Location/Lake ID:	KDA	
Survey Purpose:	Water-Level Elevations	Date: 6/6/2007	Time: 3:30pm	

Survey									
objective:		River water	elevation survey			Weat Observa		Sunny, warm,calm	
Instrument Type:	Leica N	A720	Instrument ID:	5482367 (G	WS owned)			•	
Rod Type:	Craine fibe	rglass 20'	Rod ID:	GWS (owned	1			
		Bench Mar	k Information:			Survey Tea	m Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Long (ddd-mn	itude n.mmm)	Jeff Derry, Greta Myerchir		Greta Myerchin	
USGS_M3	USGS	25.34'							
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks	
USGS_M3	7.62	32.96		25.34				Shot to USGS_M3	
TP1		32.96	5.56	27.40				Temporary turning poir	
	•		Turn on T	P1, move ins	strument to /	^2		I	
TP1	5.19	32.59		27.40				TP1 elevation	
USGS_M3		32.59	7.24	25.35				Close survey to 0.01'	
				Moved stat	ion			1	
TP1	5.93	33.33		27.40				Shot to TP1	
TP2		33.33	6.62	26.71				Temporary turning poir	
			Turn on T	P2, move ins	strument to /	\3			
TP2	6.36	33.07		26.71				TP2 elevation	
TP1		33.07	5.67	27.40				Close survey to 0.00	
			Moved station (S	urvey continu	ued on follov	ving page)			

Project ID:	North Slope Lakes	Site Location/Lake ID:			KDA	
Survey Purpose:	Water-Level Flevations	Date:	6/6/2007	Time:	3:30nm	

Location:	Survey	ed elevatior	ns from USGS M	_3 on M-pad	to a gravel s	spite in order	to asserta	in bridge elevation.	
Survey objective:		River water	elevation survey			Weat Observa		Sunny, warm,calm	
Instrument Type:	Leica N	A720	Instrument ID:	5482367 (G	WS owned)			•	
Rod Type:	Craine fibe	rglass 20'	Rod ID:	GWS	owned				
	L	Bench Mar	k Information:	l.		Survey Team Names			
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Long (ddd-mn	itude n.mmm)	Je	eff Derry, C	Greta Myerchin	
USGS_M3	USGS	25.34'							
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks	
		N	Noved station (Su	urvey continu	ed from prev	vious page)			
TP2	5.11	31.82		26.71				Shot to TP2	
TP3		31.82	3.52	28.30				Temporary turning poin	
			Turn on 1	P3, move ins	strument to /	4			
TP3	3.39	31.69		28.30				TP3 elevation	
TP2		31.69	4.98	26.71				Close survey to 0.00	
				Moved stat	ion				
TP3	4.05	32.35		28.30				Shot to TP3	
TP4		32.35	5.63	26.72				Temporary turning poin	
			Turn on T	P4, move ins	strument to /	\ 5			
TP4	5.47	32.19		26.72				TP4 elevation	
TP3		32.19	3.89	28.30				Close survey to 0.00	
			Moved station (S	urvey continu	ued on follow	ving page)			

Project ID:	North Slope Lakes	Site Location/Lake ID:	KDA	
Survey Purpose:	Water-Level Elevations	Date: 6/6/2007	Time: 3:30pm	

Location:	Survey	ed elevation	ns from USGS M	_3 on M-pad	to a gravel s	spite in order	to asserta	in bridge elevation.	
Survey objective:		River water	elevation survey			Weat Observa		Sunny, warm,calm	
Instrument Type:	Leica N	A720	Instrument ID:	5482367 (G	WS owned)				
Rod Type:	Craine fibe	rglass 20'	Rod ID:	GWS	owned				
		Bench Mar	k Information:			Survey Tea			
Name	Agency Responsible USGS	Elevation (ft)	Latitude (dd-mm.mmm)	Long (ddd-mn	itude n.mmm)	Je	eff Derry, C	Greta Myerchin	
USGS_M3 Station	BS (ft)	25.34' HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks	
	(11)		Noved station (Su				Angle		
TP4	4.53	31.25	1	26.72	ı	 		Shot to TP4	
174	4.55	31.25		20.72				51101 10 174	
TP5		31.25	3.11	28.14				Temporary turning poir	
			Turn on T	P5, move in	strument to /	\ 6			
TP5	3.01	31.15		28.14				TP5 elevation	
TP4		31.15	4.44	26.71				Close survey to 0.01'	
			•	Moved stat	ion				
TP5	4.24	32.38		28.14				Shot to TP5	
TP6		32.38	6.50	25.88				Temporary turning poir	
			Turn on T	P6, move in	strument to /	7			
TP6	6.68	32.56		25.88				TP6; aka TBM_rlx elevation	
TP5		32.56	4.42	28.14				Close survey to 0.00	

Project ID:	North Slope Lakes	Site Location/Lake ID:			KDA	
Survey Purpose:	Water-Level Flevations	Date:	6/7/2007	Time:	13:00	

ourvey ruip	,030.	Water Leve	i Lievations		Date.	0/1/2001	· · · · · · · · · · · · · · · · · · ·	15.00
Location:			Compared h	Kuparuk Rive	r and KDA 7	water elevat	tions.	
Survey objective:		Lake water	elevation survey			Weat Observa		Sunny and very windy
Instrument Type:	Leica N	A720	Instrument ID:	5482367 (G	WS owned)			I
Rod Type:	Craine fibe	rglass 20'	Rod ID:	GWS	owned			
		Bench Mar	k Information:			Survey Tea	m Names	
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Long (ddd-mn	n.mmm)	Je	eff Derry, C	Greta Myerchin
BM#3 WO040766	BP	18.90'	70 20 22.0 WGS 84	148 50 WGS				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
TBM_RD6	2.88	19.95		17.07	•		<u> </u>	Elevation of Re-bar TBM_RD6
K_River		19.95	6.92	13.03				Elevation of K_River
KDA_7		19.95	7.56	12.39				Elevation of KDA 7
			Turn on KI	DA_7, move i	nstrument to	^2		
KDA_7	7.33	19.72		12.39				
K_River		19.72	6.71	13.01				Close survey to 0.02'
TBM_RD6		19.72	2.67	17.05				Close survey to 0.02
				<u> </u>				

Project ID:	North Slope Lakes	Site Location/Lake ID:	KDA		
Survey Purpose:	Water-Level Elevations	Date: 6/9/2007	Time: 14:00:00 F	M	

Ourvey r urp			i Lievations		Date.	0/3/2001	Tillie.	1 1.00.00 1 101	
Location:	(Compare TB	M #1, #2, #3 at h	KDA to make	sure they di	d not move o	ver the wi	nter months.	
Survey objective:		Lake water	elevation survey			Weat Observa		Sunny and very windy	
Instrument Type:	Leica N	A720	Instrument ID:	5482367 (G	WS owned)			1	
Rod Type:	Craine fibe	rglass 20'	Rod ID:	GWS	owned				
		Bench Mar	k Information:			Survey Tea	m Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	(ddd-mn	,	Je	eff Derry, (Greta Myerchin	
BM#3 WO040766	BP	18.90'	70 20 22.0 WGS 84	148 50 WGS					
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks	
TBM_3	3.33	22.23	(11)	18.90	(11)	7	7 g. .e	Elevation of Re-bar TBM_# 3	
TP1		22.23	2.47	19.76					
			Turn on T	ΓP1, move ins	strument to /	^2			
TP1	2.74	22.50		19.76					
TBM_3		22.50	3.60	18.90				Close survey to 0.00	
				Survey to T	P2				
TP1	4.91	24.67		19.76				Elevation of Re-bar TI	
TP2		24.67	3.98	20.69					
			Turn on T	ΓP2, move ins	strument to /	^2			
TP2	4.16	24.85		20.69					
TP1		24.85	5.10	19.75				Close survey to +0.0	
		;	Survey to TP3 (S	Survey continu	ued on follov	ving page)			
			I	L					

 Project ID:
 North Slope Lakes
 Site Location/Lake ID:
 KDA

 Survey Purpose:
 Water-Level Elevations
 Date: 6/9/2007
 Time: 14:00:00 PM

Location:	,	Joinpale 1D	M #1, #2, #3 at k	NDA to make	sure triey did	u not move o	ver the wil	nter months.
Survey objective:		Lake water	elevation survey			Weat Observa		Sunny and very windy
Instrument Type:	Leica N	A720	Instrument ID:	5482367 (G	WS owned)			_
Rod Type:	Craine fiber	rglass 20'	Rod ID:	GWS	owned			
Ų		Bench Mar	k Information:	ı		Survey Tea	m Names	
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Long (ddd-mn	n.mmm)	J€	eff Derry, (Greta Myerchin
BM#3 WO040766	BP	18.90'	70 20 22.0 WGS 84	148 56 WGS				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
		S	urvey to TP3 (Su	urvey continu	ed from prev	vious page)		
TP2	3.19	23.88		20.69				Elevation of Re-bar TF
TBM2		23.88	4.77	19.11				
TP3		23.88	3.18	20.70				
			Turn on T	TP2, move ins	strument to ^	2		
TP3	3.44	24.14		20.70				Elevation of Re-bar TF
TBM2		24.14	5.04	19.10				
TP2		24.14	3.44	20.70				Close survey to +0.01
				Survey to T	P4			
TP3	4.62	25.32		20.70				Elevation of Re-bar TF
TP4		25.32	4.15	21.17				
			Turn on T	ΓP4, move ins	strument to ^	2		
TP4	4.29	25.46		21.17				Elevation of Re-bar TF
TP3		25.46	4.75	20.71				Close survey to +0.01
		Sı	urvey to TBM_1 ((Survey conti	nued on follo	owing page)		

Project ID:	North Slope Lakes	Site Location/Lake ID:	KDA	
Survey Purpose:	Water-Level Elevations	Date: 6/9/2007	Time: 14:00:00 F	M

Location:	(Compare 1B	M #1, #2, #3 at k	CDA to make	sure they di	d not move o	ver the wil	nter months.	
Survey objective:		Lake water	elevation survey			Weat Observa		Sunny and very windy	
Instrument Type:	Leica N	A720	Instrument ID:	5482367 (G	WS owned)			•	
Rod Type:	Craine fibe	rglass 20'	Rod ID:	GWS (owned				
		Bench Mar	k Information:			Survey Tea		1	
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	(ddd-mn		Je	eff Derry, (Greta Myerchin	
BM#3 WO040766	BP	18.90'	70 20 22.0 WGS 84	148 56 WGS					
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks	
		Su	rvey to TBM_1 (S	Survey contin	ued from pro	evious page)			
TP4	4.25	25.42		21.17				Elevation of Re-bar TP	
TBM_1		25.42	6.08	19.34					
			Turn on T	P2, move ins	strument to /	^2			
TBM_1	6.29	25.63		19.34				Elevation of TBM_1	
TP4		25.63	4.45	21.18				Close survey to +0.01	
Notes: TBM	1_1 = 19.34'. T	BM_2 = 19.	10'/19.11'. TBM	_3 = 18.90		1		T	

Project ID:	North Slope Lakes	Site Location/Lake ID:	Min	e Site B	
Survey Purpose:	Water-Level Elevations	Date: 5/24/2007	Time:	12:30	

Survey Purp	oose.	water-Leve	el Elevations		Date.	5/24/2007	I ime:	12:30
Location:	Mine Site B, N	IE corner of	North Cell, tempo	rary datum				
Survey objective:	Lake water ele	evation surve	ЭУ			Weather Observation	ns:	
Instrument Type:	Leica N	IA720	Instrument ID:	Leica Ru Serial # 5		23F, 5 mph wind, ove		rcast
Rod Type:	Craine Fibe	erglass 20'	Rod ID:	GW	/S			
			Information:			Survey Tea		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Long (ddd-mm	ı.mmm)	Daniel Reic Michael Lilly		
"Post"	WERC	100 Temp.	na	n	a			
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
Post TBM1	5.45	105.45		100.00	(11)	Arrigio	raigic	Top of nail in post,
NC-WL		105.45	13.45	92.00				temp elevation North Cell, closest to
ТВМЗ		105.45	1.99	103.46				north bank VSM 387A on Pipeline, north side
TBM2		105.45	1.61	103.84				VSM 387B on Pipeline, south side
			Move instrun	nent to ^2, t	urn on TB	M2		<u> </u>
TBM2	1.72	105.56		103.84				VSM 387B on Pipeline
ТВМ3		105.56	2.09	103.47				VSM 387A on Pipeline, +0.01
NC-WL		105.56	13.56	92.00				North Cell, closest to north bank, +0.00
TBM1		105.56		100.00				close survey to +0.00
		Mov	e instrument to is	sland, turn o	n MSBN V	Vater Level.		
NC-WL	11.19	103.19		92.00				Frozen water level
SC-WL		103.19	9.76	93.43				TBM, tripod
			Move to	\4, use MSI	BS as TP.			
SC-WL	9.57	103.00		93.43				South Cell, unfrozen, water level
NC-WL		103.00	10.99	92.01				close survey to +0.01
								to measured depth from

Note: Unfrozen water levels measured by following method. Rod placed on wood lathe and added to measured depth from 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 Survey Purpose: Water-Level Elevations Date: 5/27/2007 Time

Mine Site B

Location:	Mine Site B, N	E corner of I	North Cell, tempo	orary datum				
Survey objective:	Lake water ele	ey	Weather Observation	ıs:				
Instrument Type:	Leica N	A720	Instrument ID:	Leica Ru Serial # 5		Overcast, windy		•
Rod Type:	Craine Fibe	rglass 20'	Rod ID:	GW	VS	- Overeast, willay		
		Bench Mark	Information:			Survey Tea	m Names	
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longi (ddd-mm		Jeff Derry,	Greta Mye	erchin
"Post"	WERC	100 Temp.	na	na	a			
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
Post TBM1	5.36	105.36		100.00				Top of nail in post, temp elevation
NC-WL		105.36	12.97	92.39				North Cell, closest to north bank
			Move instrur	nent to ^2, t	urn on TBI	M2		
NC-WL	13.13	105.52		92.39				North Cell, closest to north bank, +0.00
TBM1		105.52	5.53	99.99				close survey to 0.01
		Mov	e instrument to is	sland, turn o	n MSBN V	Vater Level.		
NC-WL	10.49	102.88		92.39				
SC-WL		102.88	9.72	93.16				TBM, tripod
			Move to	^4, use MSI	BS as TP.			
SC-WL	9.49	102.65		93.16				South Cell
NC-WL		102.65	10.24	92.41				close survey to 0.02
Note:	<u> </u>							l

 Project ID:
 North Slope Lakes
 Site Location/Lake ID:
 Mine Site B

 Survey Purpose:
 Water-Level Elevations
 Date: 5/28/2007
 Time: 12:00

Location:	Mine Site B, N	E corner of	North Cell, tempo	orary datum				
Survey objective:	Lake water ele			Weather Observation	ıs:			
Instrument Type:	Leica NA720		Instrument ID: Leica Runn Serial # 548			Overcast, windy		•
Rod Type:	Craine Fibe	rglass 20'	Rod ID:	GW	/S		,	
	•	Bench Mark	Information:			Survey Tear	m Names	
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Long (ddd-mm		Jeff Derry,	erchin	
"Post"	WERC	100 Temp.	na	na	a			
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
Post TBM1	5.16	105.16		100.00				Top of nail in post, temp elevation
NC-WL		105.16	11.98	93.18				North Cell, closest to north bank
SC-WL		105.16	11.97	93.19				South Cell
			Move instru	ment to ^2, t	urn on TB	M2		
SC-WL	11.74	104.93		93.19				
NC-WL		104.93	11.75	93.18				close survey to 0.00
TBM1		104.93	4.92	100.01				close survey to 0.01
Note:	1					<u>I</u>		<u>I</u>

 Project ID:
 North Slope Lakes
 Site Location/Lake ID:
 Mine Site B

 Survey Purpose:
 Water-Level Elevations
 Date: 5/29/2007
 Time: 10:30

Location:	Mine Site R N	E corner of N	North Cell, tempo	rary datum				
				-				1
Survey objective:	Lake water ele elevations for s		y and determining	g rebar		Weather Observation	ie.	
Instrument	Leica N		Instrument ID:	Leica Ru	inner 24	Observation	13.	1
Type:				Serial # 5	5482367	Overcast, Breezy		
Rod Type:	Craine Fiber	rglass 20'	Rod ID:	GV	VS .			
		Bench Mark	Information:			Survey Tear		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longi (ddd-mn		Jeff Derry,	Greta Mye	erchin
"Post"	WERC	100 Temp.	na	n	a			
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
Post TBM1	1.50	101.50		100.00	-		_	Top of nail in post, temp elevation
NC-WL		101.50	8.16	93.34				North Cell Water
RB4		101.50	2.67	98.83				Elevation
ND4		101.50	2.67	98.83				Re-bar 4, most NW
RB3		101.50	2.05	99.45				Re-bar 3, most NE
RB2		101.50	2.86	98.64				
			-	Turn on RB2	2.			L
RB2	2.70	101.34		98.64				
RB3		101.34	1.88	99.46				RB3 closes to 0.01'
RB4		101.34	2.51	98.83				RB4 closes to 0.00
NC-WL		101.34	8.00	93.34				North Cell, closest to north bank, +0.00
TBM1		101.34	1.33	100.01				Close survey to 0.01'
	l l		M	ove instrume	ent			
RB2	2.67	101.31		98.64				
SC-WL		101.31	7.96	93.35				South Cell Water Elevation
RB1		101.31	2.30	99.02				Re-bar #1
	<u> </u>		<u>.</u>	Turn on RB	1			I
RB1	2.50	101.51		99.02				
SC-WL		101.51	8.16	93.35				SC-WL closes to 0.00'
RB2		101.51	2.87	98.64				Survey closes to 0.00'
Note:	1					<u> </u>		<u> </u>

Note:

Project ID:	North Slope Lakes	Site Location/Lake ID:	Min	ne Site B	
Survey Purpose:	Water-Level Flevations	Date: 5/31/2007	Time:	10:30	

r elevation surve for spring melt ca NA720 Fiberglass 20'	North Cell, temporey and determining Instrument ID: Rod ID: Information: Latitude (dd-mm.mmm) na FS (ft)		itude n.mmm)	Weather Observation Survey Tear Jeff Derry, I	m Names	partly cloudy
for spring melt ca NA720 Fiberglass 20' Bench Mark (Elevation ble (ft) 100 Temp. HI (ft)	Instrument ID: Rod ID: Information: Latitude (dd-mm.mmm) na FS	Leica Ru Serial # 5 GW Longi (ddd-mn	itude n.mmm)	Observation Survey Tear	m Names	parity cloudy
Fiberglass 20' Bench Mark Elevation ble (ft) 100 Temp. HI (ft)	Rod ID: Information: Latitude (dd-mm.mmm) na FS	Serial # 5 GV Longi (ddd-mm	itude n.mmm)			
Bench Mark / Elevation ble (ft) - 100 - Temp HI - (ft)	Latitude (dd-mm.mmm) na	Longi (ddd-mm	itude n.mmm)			
Bench Mark / Elevation ble (ft) - 100 - Temp HI - (ft)	Latitude (dd-mm.mmm) na	Longi (ddd-mn	itude n.mmm) a			
Elevation (ft) 100 Temp. HI (ft)	Latitude (dd-mm.mmm) na	(ddd-mn	n.mmm) a			
ble (ft) 100 Temp. HI (ft)	(dd-mm.mmm) na FS	(ddd-mn	n.mmm) a	Jeff Derry, I	HT	•
100 Temp. HI (ft)	na FS	n:	a	-		
Temp. HI (ft)	FS					
HI (ft)		Elevation				
	(ft)		Distance	Horizontal	Vertical	Remarks
0.89 100.89	()	(fasl)	(ft)	Angle	Angle	
	9	100.00				Top of nail in post, temp elevation
100.89	7.13	93.76				North Cell, closest to north bank
100.89	7.13	93.76				South Cell
	Move instr	ument, turn	on SC-WL			
7.25 101.0		93.76				
101.01	7.24	93.77				
101.0	1.00	100.01				Close survey to 0.01'
Sur	vey of water level	of pooled wa	ater at edge	e of NC-WL		
1.17 104.17	7	100.00				Top of nail in post, temp elevation
104.17	7 10.40	93.77				
I	Move instru	ument, turn	on NC-WL			<u>I</u>
0.60 104.37	7	93.77				NC-WL
104.37	7 4.36	100.01				Close survey to 0.01'
	7.25 101.01 101.01 101.01 Sun 4.17 104.17 104.17	100.89 7.13 Move instr 7.25 101.01 101.01 7.24 101.01 1.00 Survey of water level 4.17 104.17 104.17 10.40 Move instri 0.60 104.37	100.89 7.13 93.76	100.89 7.13 93.76	100.89 7.13 93.76	100.89 7.13 93.76

Note:

Project ID:	North Slope Lakes	Site Location/Lake ID:	Min	e Site B	
Survey Purpose:	Water-Level Elevations	Date: 6/1/2007	Time:	12:10	

Location:	Mine Site B, w	ater levels of	open water pool	s at edge of	both cells	and levels fro	om drilled	holes.
Survey objective:	Lake water ele		y and determining	g rebar		Weather Observation	s:	partly cloudy
Instrument Type:	Leica N		Instrument ID:	Leica Ru Serial # 5				1
Rod Type:	Craine Fibe	rglass 20'	Rod ID:	GV	/S	1		
		Bench Mark	Information:	L		Survey Tear		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longi (ddd-mn		Jeff Derry, I	HT	
"Post"	WERC	100 Temp.	na	n	а			
Station	BS	HI	FS	Elevation	Distance	Horizontal	Vertical	Remarks
Post TBM1	(ft) 3.66	(ft) 103.66	(ft)	(fasl) 100.00	(ft)	Angle	Angle	Top of nail in post,
	0.00			.00.00				temp elevation
NC_Pool		103.66	9.68	93.98				North Cell, pooled water near south end
NC		103.66	9.68					North Cell, level from drilled holes in ice
		Move instrun	nent, turn on Nort	th Cell water	level from	drilled ice lo	cation.	
NC	9.57	103.55		93.98				NC - WL
NC_Pool		103.55	9.57	93.98				NC_Pool - WL
Post TBM1		103.55	3.55	100.00				Close survey to 0.00'
	Below: Surve	ey of water le	evel of South Cell	. Both pool	ed surface	water and tw	o from dri	lled holes
NC_Pool	5.25	99.23		93.98				Top of nail in post, temp elevation
SC_SW		99.23	5.26	93.97				SC_SW - WL
SC		99.23	5.24	93.99				
			Move ins	strument, tur	n on SC.			
SC	5.38	99.37		93.99				SC_S - WL
SC_SW		99.37	5.38	93.99				
NC_Pool		99.37	5.37	94.00				Close survey to 0.02'
	Bel	ow: Survey	of water level of p	pooled water	r in the Sou	uth Cell of Mi	ne Site B.	1
SC_SW	5.63	99.60		93.97				SC_SW - WL
SC_Pool		99.60	5.61	93.99				
			Move instru	iment, turn o	on SC_Poo	l.		
SC_Pool	5.74	99.73		93.99				SC_Pool - WL
SC_SW		99.73	5.75	93.98				Survey closes to 0.01

Note: See Jeff Derry logbook. SC = South cell, SC_SW = South cell southwest location, SC_Pool = South cell pooled surface water. NC = North cell, NC_Pool = North cell pooled surface water.

Project ID:	North Slope Lakes	Site Location/Lake ID:	Mine Site B		
Survey Purpose:	Water-Level Elevations	Date: 6/2/2007	Time:	13:15	

Location:	Mine Site B wa	ater level of r	orth and south ce	ells. Also w	ater elevat	ion of stream	just west	of
Survey objective:	Lake water ele		y and determining	g rebar		Weather Observation	ıs:	Broken cloud cover. Windy.
Instrument Type:	Leica N	A720	Instrument ID:	Leica Ru Serial # \$				
Rod Type:	Craine Fibe	rglass 20'	Rod ID:	GWS				
		Bench Mark	Information:			Survey Tear	m Names	
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Long (ddd-mn		Jeff Derry, Horacio Toniolo		
"Post"	WERC	100 Temp.	na	n	а			
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
Post TBM1	1.14	101.14		100.00				Top of nail in post, temp elevation
ST_WS		101.14	4.94	96.20				ST_WS - WL
MSB_WS		101.14	6.795	94.35				
		Move instrun	nent, turn on Nort	h Cell water	r level from	drilled ice lo	cation.	
MSB_WS	6.905	101.26		94.35				NC - WL
ST_WS		101.26	5.05	96.21				Water surface at stream
Post TBM1		101.26	1.25	100.01				Close survey to 0.01'

Note: ST_WS = Stream water surface.

 Project ID:
 North Slope Lakes
 Site Location/Lake ID:
 Mine Site B

 Survey Purpose:
 Water-Level Elevations
 Date: 6/3/2007
 Time: 12:50

Location:	Mine Site B wa	iter level of r	orth and south ce	ells. Also, h	ammered l	RB4 further in	n ground a	nd re-surveyed
Survey objective:	Lake water ele	vation surve	у			Weather Observation	ıs:	Scattered clouds, calm winds, warm.
Instrument Type:	Leica N	A720	Instrument ID:	Leica Ru Serial # 5				-
Rod Type:	Craine Fibe	rglass 20'	Rod ID:	GWS		1		
	•	Bench Mark	Information:			Survey Tea	m Names	
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longi (ddd-mn		Jeff Derry, Horacio Toniolo		
"Post"	WERC	100 Temp.	na	n	a			
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
Post TBM1	3.89	103.89		100.00				Top of nail in post, temp elevation
MSB_WS		103.89	8.51	95.38				MSB_WS - WL
RB4		103.89	5.20	98.69				Re-bar number 4
			Move ins	trument, turi	n on RB4.	1		
RB4	5.33	104.02		98.69				Elevation of RB4
MSB_WS		104.02	8.65	95.38				Water surface of north and south cells
Post TBM1		104.02	4.02	100.00				Close survey to 0.00'

Note: MSB_WS is the hydrologically connected water surface of the north and south cells.

 Project ID:
 North Slope Lakes
 Site Location/Lake ID:
 Mine Site B

 Survey Purpose:
 Water-Level Elevations
 Date: 6/12/2007
 Time: 16:00

Location:	Mine Site B, N	E corner of N	North Cell, tempor	rary datum				
Survey objective:	Lake water ele		y and determining	g rebar		Weather Observation	s:	
Instrument Type:	Leica NA720 Instrument		Instrument ID:	Leica Runner 24 Serial # 5482367		Overcast, B	reezv	-
Rod Type:	Craine Fibe	rglass 20'	Rod ID:	GW	VS .	210029		
	•	Bench Mark	Information:			Survey Tear	m Names	
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longi (ddd-mm		Greta Myerchin, Michael Lilly		
"Post"	WERC	100 Temp.	na	na	а			
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
TBM1	5.26	105.26		100.00				Top of nail in post, temp elevation
TBM2		105.26	7.81	97.45				TMB2
MSB-WL		105.26	1.42	103.84				North Cell WL
			Move insti	rument, turn	on TBM1.			l
MSB-WL	1.60	105.44		103.84				
TBM2		105.44	8.00	97.44				closes to 0.01'
TBM1		105.44	5.44	100.00				closes to 0.01'
Rob Picture WL Elev.		105.44	3.73	101.71				estimated WL - not need to close

Note:

APPENDIX D. SNOW SURVEY FORMS

The following forms report the snow survey information obtained during field sampling.

 Project ID:
 Tundra Lakes
 Site Location/Lake ID:
 KDA_2 CT

 Survey Purpose:
 Snow Water Equivalent
 Date: 5/23/2007
 Time: 15:00

Location Description:	KDA - Cell 2						
Survey objective:	Estimate SWE				Weather cloudy Observations:		
Latitude:	N70°1	9.9776'	Longitude:	W148°56.4462'	Datum:	WGS84	
Elevation:			Elevation Datum:		Reference Markers:	Site staked with lathe	
Drainage Basin:	Kuparuk		Slope Direction:	flat	Vegetation Type:	Snow Survey located on ice	
Slope Angle:	Flat		Access Notes:	none	Other:	1 meter increments	
Snow Depth Probe Type:					Snow-Survey Team Names		
Snow Tube Type: Adirondak, 6.			.74 cm diamete	er cutter, area = 35.7cm^2	Horacio Toni	iolo	

Snow Course Depths (cm)

	1	2	3	4	5
1	15.0	11.0	10.0	7.0	11.0
2	13.0	8.0	9.0	10.0	9.0
3	12.0	8.0	10.0	9.0	15.0
4	11.0	8.0	10.0	12.0	17.0
5	14.0	9.0	11.0	12.0	14.0
6	9.0	7.0	9.0	11.0	11.0
7	11.0	9.0	8.0	11.0	9.0
8	13.0	9.0	9.0	10.0	14.0
9	12.0	8.0	7.0	9.0	12.0
10	11.0	8.0	8.0	9.0	12.0

	(cm)
Average snow depth =	10.4
Maximum snow depth =	17.0
Minimum snow depth =	7.0
Standard variation =	2.3

Snow Sample Depths and Weights

Bag #	Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)
FE1	13	128.2	464.1	0.28
FE3	8	85.2	285.6	0.30
FE4	8	83.0	285.6	0.29
FB2	9	69.3	321.3	0.22
FB3	10	92.1	357.0	0.26

Average Density = 0.27

Average Snow Water Equivalent (SWE) = 2.8 cm H2O

Average Snow Water Equivalent = 1.10 inches H2O

Average Snow Water Equivalent = 0.09 feet H2O

 Project ID:
 Tundra Lakes
 Site Location/Lake ID:
 MSB_N

 Survey Purpose:
 Snow Water Equivalent
 Date: 5/24/2007
 Time: 11:15

Location Description:	Mine Site B - Center North Cell						
Survey objective:	Snow depths	and snow-wate	r content for l	ake recharge estimates	Weather Observations	cloudy s:	
Latitude:	N70 31. 134	31. 134 Longitude: W149 40.015		Datum:	NAD27		
Elevation:			Elevation Datum:		Reference Markers:	representative area	
Drainage Basin:	Mine Site B		Slope Direction:	Flat	Vegetation Type:	Ice Surface	
Slope Angle:	Flat		Access Notes:	none	Other:	1 meter increments	
Snow Depth F	Probe Type:				Snow-Survey	/ Team Names	
Snow Tube T	now Tube Type: Adirondak, 6.7		74 cm diamete	er cutter, area = 35.7cm^2	Horacio Toni	olo	

Snow Course Depths (cm)

	1	2	3	4	5
1	20.0	10.0	15.0	14.0	11.0
2	22.0	9.0	14.0	11.0	10.0
3	27.0	9.0	17.0	10.0	8.0
4	19.0	10.0	15.0	10.0	7.0
5	17.0	9.0	13.0	8.0	8.0
6	15.0	11.0	12.0	5.0	6.0
7	14.0	13.0	11.0	6.0	9.0
8	13.0	13.0	15.0	9.0	8.0
9	9.0	12.0	16.0	9.0	10.0
10	10.0	15.0	15.0	9.0	12.0

	(cm)
Average snow depth =	12.0
Maximum snow depth =	27.0
Minimum snow depth =	5.0
Standard variation =	4.3

Snow Sample Depths and Weights

Bag #	Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)
AB1	21	290.5	749.7	0.39
AB2	10	135.9	357.0	0.38
AB3	14	201.8	499.8	0.40
AB4	8	107.8	285.6	0.38
AB5	7	85.2	249.9	0.34

Average Density = 0.38

Average Snow Water Equivalent (SWE) = 4.5 cm H2O

Average Snow Water Equivalent = 1.79 inches H2O

Average Snow Water Equivalent = 0.15 feet H2O

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: 5/19/2007	Time: 13:00

Location Description:	Snow course located directly north of the Met Site next to the pumphouse.						
Survey objective:	Snow depths	and snow-wat	er content for I	ake recharge estimates	Weather Obs	servations:	
Latitude:	N 70º19.9444	!	Longitude:	W 150° 57.047'	Datum:	NAD27 Alaska	
Elevation:			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. area = 35.7 c		.74 cm diamete :m^2	er cutter,	Horacio Roni	Horacio Roniolo		

Snow Course Depths, in cm.

	1	2	3	4	5
1	47	54	40	60	51
2	52	46	49	44	77
3	49	49	44	41	80
4	57	57	30	45	66
5	56	55	24	36	56
6	50	50	20	40	46
7	57	35	30	34	51
8	68	29	29	23	57
9	64	22	33	35	65
10	59	25	41	47	58

	(cm)
Average snow depth =	46.7
Maximum snow depth =	80.0
Minimum snow depth =	20.0
Standard variation =	14.1

Snow Sample Depths and Weights

Bag #	Depth (cm)	Weight (gr)	Volume (cm^3)	Density (gr/cm^3)
SWE1	35.56	352.7	1269.5	0.28
SWE2	36.83	231.3	1314.8	0.18
SWE3	38.1	335	1360.2	0.25
SWE4	35.56	398.5	1269.5	0.31
SWE5	58.42	663.8	2085.6	0.32

 Average Density =
 0.27
 gr/cm^3

 Average Snow Water Equivalent (SWE) =
 12.4
 cm H2O

 Average Snow Water Equivalent =
 4.89
 inches H2O

 Average Snow Water Equivalent =
 0.41
 feet H2O

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: 5/19/2007	Time: 14:00

Location Description:	Located on South end of lake. Marked with three orange poles							
Survey objective:	Snow depths	and snow-wat	er content for I	ake recharge estimates	Weather Obs	servations:		
Latitude:	N 70º19.944	4'	Longitude:	W 150° 57.047'	Datum:	NAD27 Alaska		
Elevation:			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, 6.7 area = 35.7 cr		.74 cm diamete cm^2	er cutter,	Horacio Toni	iolo			

Snow Course Depths, in cm.

	1	2	3	4	5
1	42	27	24	43	
2	47	24	41	33	
3	22	29	44	24	
4	31	28	38	30	
5	35	25	20	23	
6	36	26	42	24	
7	30	20	44	30	
8	33	44	29	47	
9	26	48	30	36	
10	31	35	45	26	

	(cm)
Average snow depth =	32.8
Maximum snow depth =	48.0
Minimum snow depth =	20.0
Standard variation =	8.4

Snow Sample Depths and Weights

Bag #	Depth (cm)	Weight (gr)	Volume (cm^3)	Density (gr/cm^3)
SWE1	30.48	229.5	1088.1	0.21
SWE2	20.32	236.1	725.4	0.33
SWE3	40.64	390.4	1450.8	0.27
SWE4	45.72	435	1632.2	0.27
SWE5	22.86	130.1	816.1	0.16

 Average Density =
 0.25
 gr/cm^3

 Average Snow Water Equivalent (SWE) =
 8.1
 cm H2O

 Average Snow Water Equivalent =
 3.18
 inches H2O

 Average Snow Water Equivalent =
 0.27
 feet H2O

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: 5/25/2007	Time: 13:30	

ourroy raipo		Onon Bopin	una mator o	<u> </u>			
Location Description:	Did "L" shap Went East, t		ake between b	elford gauge and snow sen	sor. 25 x 25 met	ers at 1 meter i	ncrements.
Survey objective:	Snow depths	Snow depths and snow-water content for lake recharge estimates Weather Observations: Foggy, 30					
Latitude:	N 70° 16.832	2	Longitude:	W 148° 53.856	Datum:	NAD83 Alask	ка
Elevation:	100' approxi	mately	Elevation Datum:	BPMSL	Reference Markers:	Site marked	with GPS
Drainage Basin:	L9817		Slope Direction:	flat	Vegetation Type:	snow depth o	on tundra
Slope Angle:	Flat		Access Notes:		Other:	1 meter incre	ments
Snow Depth I	Probe Type:		T-handle sno	ow depth probe,	Snow-Surve	y Team Names	
Snow Tube Type: Adirondal area = 35			5.74 cm diameter cutter, cm^2		Chad Corma	ıck, Dan Reicha	ardt

Snow Course Depths, in cm.

	1	2	3	4	5
1	21	23	31	36	35
2	17	23	26	25	35
3	5	23	35	29	36
4	11	17	34	38	30.0
5	25	9	34	42	33
6	33	2.0	26	37	33
7	9	0	29	44.0	34
8	28	8	30.0	37	34
9	26	14	34	40	29
10	22	9.0	18	16	23

	(cm)
Average snow depth =	25.8
Maximum snow depth =	44.0
Minimum snow depth =	0.0
Standard variation =	10.9

Snow Sample Depths and Weights

		3 1		
Bag #	Depth (cm)	Weight (gr)	Volume (cm^3)	Density (gr/cm^3)
0)4/54	, ,			,
SWE1	15.24	224.9	544.1	0.41
SWE2		404.4		
SVVEZ	21.59	161.1	770.8	0.21
SWE3	31.75	285.1	1133.5	0.25
OVVEO	31.75	200.1	1133.3	0.25
SWE4	40.64	402.9	1450.8	0.28
	40.04	702.3	1430.0	0.20
SWE5	30.48	284.2	1088.1	0.26
	00.10		1000.1	0.20

Average Density = 0.28 gr/cm^3

Average Snow Water Equivalent (SWE) = 7.3 cm H2O

Average Snow Water Equivalent = 2.87 inches H2O

Average Snow Water Equivalent = 0.24 feet H2O

 Project ID:
 Tundra Lakes
 Site Location/Lake ID:
 Betty Pingo

 Survey Purpose:
 Snow Water Equivalent
 Date: 5/24/2007
 Time: 16:02

Location Description:	Betty Pingo r	near Wyoming gauge.				
Survey objective:	Snow depths	now depths and snow-water content for lake recharge estimates Weather clou				cloudy
Latitude:	N 70.28085	Longitu	ide: W 148.89	304	Datum:	NAD27 Alaska
Elevation:		Elevati Datum:	-	-	Reference Markers:	Near weather station
Drainage Basin:		Slope Direction	on:		/egetation Гуре:	Tussock
Slope Angle:	Flat	Access Notes:	Truck	(Other:	1 meter increments
Snow Depth I	Probe Type:	T-hand	le	S	Snow-Survey	Team Names
Snow Tube T	ype:	Adirondak, 6.74 cm di	ameter cutter, are		Jed, Horachio	

Snow Course Depths (cm)

	1	2	3	4	5
1	27.0	33.0	26.0	31.0	49.0
2	31.0	32.0	0.0	12.0	41.0
3	25.0	34.0	8.0	14.0	41.0
4	26.0	32.0	9.0	54.0	36.0
5	24.0	34.0	12.0	36.0	23.0
6	23.0	32.0	15.0	42.0	23.0
7	30.0	36.0	18.0	46.0	37.0
8	32.0	33.0	28.0	50.0	21.0
9	35.0	36.0	28.0	44.0	35.0
10	31.0	28.0	33.0	50.0	55.0

	(cm)
Average snow depth =	30.6
Maximum snow depth =	55.0
Minimum snow depth =	0.0
Standard variation =	11.9

Snow Sample Depths and Weights

Bag #	Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)
AB6	31	352.0	1106.7	0.32
AB7	27	263.7	963.9	0.27
AB8	31	285.0	1106.7	0.26
AB9	24	188.5	856.8	0.22
AB10	27	258.6	963.9	0.27

Average Density = 0.27

Average Snow Water Equivalent (SWE) = 8.2 cm H2O

Average Snow Water Equivalent = 3.22 inches H2O

Average Snow Water Equivalent = 0.27 feet H2O

Project ID:	Tundra Lakes	Site Location/Lake ID:	Betty Pingo	
Survey Purpose:	Snow Water Equivalent	Date: 5/26/2007	Time: 2:00pm	

Location Description:	Betty Pingo near Wyoming gauge.							
Survey objective:	Snow depths	and snow-water content fo	or lake recharge estimates	Weather Observations	Breezy, cold, overcast			
Latitude:	N 70.28085	Longitude	: W 148.89304	Datum:	NAD27 Alaska			
Elevation:		Elevation Datum:	BPMSL	Reference Markers:	Near weather station			
Drainage Basin:		Slope Direction:		Vegetation Type:	Tussock			
Slope Angle:	Flat	Access Notes:	Truck	Other:	1 meter increments			
Snow Depth Probe Type: T-h		T-handle	T-handle		y Team Names			
Snow Tube Type: Adirondak, 6.74 cm diameter cutter, area = 35.7cm^2			Jed, Horachi	0				

Snow Course Depths (cm)

	1	2	3	4	5
1	22.0	25.0	19.0	21.0	19.0
2	25.0	22.0	12.0	33.0	41.0
3	27.0	23.0	10.0	40.0	50.0
4	17.0	31.0	4.0	44.0	41.0
5	28.0	29.0	11.0	52.0	47.0
6	25.0	31.0	16.0	53.0	44.0
7	32.0	28.0	24.0	52.0	39.0
8	35.0	35.0	29.0	49.0	22.0
9	29.0	30.0	34.0	55.0	40.0
10	25.0	31.0	29.0	40.0	33.0

	(cm)
Average snow depth =	31.1
Maximum snow depth =	55.0
Minimum snow depth =	4.0
Standard variation =	12.0

Snow Sample Depths and Weights

Bag #	Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)
1	24	219.2	856.8	0.26
2	28	279.4	999.6	0.28
3	26	281.8	928.2	0.30
4	50	541.6	1785.0	0.30
5	22	211.8	785.4	0.27

Average Density = 0.28

Average Snow Water Equivalent (SWE) = 8.8 cm H2O

Average Snow Water Equivalent = 3.45 inches H2O

Average Snow Water Equivalent = 0.29 feet H2O

 Project ID:
 Tundra Lakes
 Site Location/Lake ID:
 Betty Pingo

 Survey Purpose:
 Snow Water Equivalent
 Date: 5/28/2007
 Time: 11:07am

Location Description:	Near Wyoming gauge							
Survey objective:	Snow depths	and snow-water	overcast, light breeze					
Latitude:	N 70.28085		Longitude:	W 148.89304	Datum:	NAD27 Alaska		
Elevation:			Elevation Datum:	BPMSL	Reference Markers:	wyoming gauge		
Drainage Basin:			Slope Direction:		Vegetation Type:	Tussock tundra		
Slope Angle:	flat		Access Notes:	truck	Other:	1 meter increments		
Snow Depth Probe Type: T-handle			Snow-Survey	/ Team Names				
Snow Tube T	Snow Tube Type: Adirondak, 6.74 cm diameter cutter, area = 35.7cm^2			JED, GM				

Snow Course Depths (cm)

	1	2	3	4	5
1	11.0	22.0	25.0	28.0	34.0
2	20.0	26.0	26.0	27.0	37.0
3	21.0	25.0	25.0	37.0	41.0
4	14.0	17.0	22.0	41.0	39.0
5	22.0	23.0	27.0	38.0	41.0
6	29.0	25.0	10.0	44.0	36.0
7	27.0	25.0	0.0	43.0	38.0
8	25.0	27.0	7.0	63.0	40.0
9	23.0	21.0	20.0	44.0	30.0
10	19.0	34.0	25.0	16.0	33.0

	(cm)
Average snow depth =	27.9
Maximum snow depth =	63.0
Minimum snow depth =	0.0
Standard variation =	11.2

Snow Sample Depths and Weights

Show Sample Depths and Weights						
Bag #	Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)		
1	18	148.1	642.6	0.23		
2	28	366.8	999.6	0.37		
3	25	307.7	892.5	0.34		
4	19	240.4	678.3	0.35		
5	18	226.2	642.6	0.35		

Average Density = 0.33

Average Snow Water Equivalent (SWE) = 9.2 cm H2O

Average Snow Water Equivalent = 3.62 inches H2O

Average Snow Water Equivalent = 0.30 feet H2O

 Project ID:
 Tundra Lakes
 Site Location/Lake ID:
 West Dock

 Survey Purpose:
 Snow Water Equivalent
 Date: 5/24/2007
 Time: 5:07pm

Location Description:	lathes mark V	Vest Dock snov	v course locati	ion.				
Survey objective:	Snow depths	and snow-wate	er content for I	ake recharge estimates	Weather Obs	Weather Observations: Overcast winds		
Latitude:	N 70°21.553'		Longitude:	W 148º 34.116'	Datum:	NAD27 Alask	a	
Elevation:	Elevation BPMSL Reference Site statement Markers:			Site staked w	ith lathe			
Drainage Basin:	L9312		Slope Direction:	Flat	Vegetation Type:	Tussock		
Slope Angle:	e: Flat Access Hagglund Other: 1 meter in Notes:		1 meter incre	ments				
Snow Depth F	Probe Type:		T-handle		Snow-Survey	/ Team Names		
Snow Tube T	ow Tube Type: Adirondak, 6.74 cm diameter cutter, area = 35.7cm^2			JED, GM, Ho	orachio			

Snow Course Depths (cm)

	1	2	3	4	5
1	16.0	24.0	31.0	22.0	36.0
2	13.0	25.0	29.0	22.0	35.0
3	15.0	31.0	24.0	26.0	35.0
4	13.0	33.0	18.0	29.0	36.0
5	15.0	32.0	14.0	31.0	33.0
6	21.0	37.0	23.0	28.0	34.0
7	23.0	40.0	22.0	32.0	35.0
8	22.0	41.0	22.0	34.0	37.0
9	28.0	43.0	22.0	36.0	36.0
10	23.0	42.0	24.0	37.0	39.0

	(cm)
Average snow depth =	28.4
Maximum snow depth =	43.0
Minimum snow depth =	13.0
Standard variation =	8.2

Snow Sample Depths and Weights

Bag #	Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)
1	17	187.5	606.9	0.31
2	14	112.9	499.8	0.23
3	24	267.5	856.8	0.31
4	18	207.6	642.6	0.32
5	19	242.1	678.3	0.36

Average Density = 0.31

Average Snow Water Equivalent (SWE) = 8.7 cm H2O

Average Snow Water Equivalent = 3.41 inches H2O

Average Snow Water Equivalent = 0.28 feet H2O

 Project ID:
 Tundra Lakes
 Site Location/Lake ID:
 West Dock

 Survey Purpose:
 Snow Water Equivalent
 Date: 5/26/2007
 Time: 0:00

Location Description:	West dock located at the coordinates given by Rob Geick					
Survey objective:	Snow depths	and snow-wate	er content for I	ake recharge estimates	Weather overcast, brezzy, cold, Observations: snow,	
Latitude:	70 21.553		Longitude:	148 34.116	Datum:	NAD 83
Elevation:			Elevation Datum:		Reference Markers:	lathe
Drainage Basin:			Slope Direction:		Vegetation Type:	tussock tundra
Slope Angle:	flat		Access Notes:	truck	Other:	
Snow Depth I	Probe Type:		T-handle		Snow-Survey	y Team Names
Snow Tube T	ype:	Adirondak, 6.	74 cm diamet	er cutter, area = 35.7cm^2	G. Myerchin,	J. Derry

Snow Course Depths (cm)

	1	2	3	4	5
1	12.0	30.0	19.0	32.0	10.0
2	24.0	30.0	13.0	34.0	18.0
3	29.0	29.0	12.0	49.0	12.0
4	33.0	27.0	10.0	24.0	25.0
5	32.0	29.0	10.0	22.0	0.0
6	32.0	30.0	15.0	25.0	0.0
7	26.0	29.0	22.0	28.0	7.0
8	34.0	26.0	34.0	21.0	12.0
9	31.0	21.0	42.0	31.0	17.0
10	32.0	26.0	39.0	0.0	14.0

	(cm)
Average snow depth =	23.2
Maximum snow depth =	49.0
Minimum snow depth =	0.0
Standard variation =	10.8

Snow Sample Depths and Weights

Bag #	Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)
1	22	173.0	785.4	0.22
2	27	252.9	963.9	0.26
3	20	157.3	714.0	0.22
4	26	267.7	928.2	0.29
5	26	315.0	928.2	0.34

Average Density = 0.27

Average Snow Water Equivalent (SWE) = 6.2 cm H2O

Average Snow Water Equivalent = 2.43 inches H2O

Average Snow Water Equivalent = 0.20 feet H2O

 Project ID:
 Tundra Lakes
 Site Location/Lake ID:
 West Dock

 Survey Purpose:
 Snow Water Equivalent
 Date: 5/28/2007
 Time: 10:07am

Location Description:	West dock located at the coordinates given by Rob Geick						
Survey objective:	Estimate SW	Έ			Weather overcast slight breeze Observations:		
Latitude:	70 21.553		Longitude:	148 34.116	Datum:	NAD 83	
Elevation:			Elevation Datum:		Reference Markers:		
Drainage Basin:			Slope Direction:		Vegetation Type:	tussock tundra	
Slope Angle:	flat		Access Notes:	truck	Other:		
Snow Depth I	Probe Type:		T-handle		Snow-Surve	y Team Names	
Snow Tube T	ype:	Adirondak, 6.	74 cm diamet	er cutter, area = 35.7cm^2	JED, GM		

Snow Course Depths (cm)

	1	2	3	4	5
1	24.0	35.0	19.0	25.0	19.0
2	14.0	30.0	6.0	33.0	16.0
3	10.0	24.0	0.0	19.0	15.0
4	10.0	25.0	17.0	25.0	13.0
5	0.0	27.0	16.0	23.0	9.0
6	11.0	29.0	0.0	24.0	16.0
7	25.0	35.0	15.0	26.0	16.0
8	33.0	37.0	15.0	18.0	14.0
9	34.0	36.0	0.0	20.0	10.0
10	33.0	37.0	18.0	15.0	15.0

	(cm)
Average snow depth =	19.7
Maximum snow depth =	37.0
Minimum snow depth =	0.0
Standard variation =	10.1

Snow Sample Depths and Weights

Bag #	Depth (cm)	Weight (g)	Volume (cm^3)	Density (g/cm^3)
1	25	269.0	892.5	0.30
2	36	390.7	1285.2	0.30
3	37	460.0	1320.9	0.35
4	38	467.3	1356.6	0.34
5	15	120.8	535.5	0.23

Average Density = 0.30

Average Snow Water Equivalent (SWE) = 6.0 cm H2O

Average Snow Water Equivalent = 2.37 inches H2O

Average Snow Water Equivalent = 0.20 feet H2O