

# Snowmelt and Lake Recharge Monitoring for Selected North Slope, Alaska, Lakes: May/June 2008



*Kuparuk River Breakup at Kuparuk Dead Arm Reservoirs, Photo by C. Cormack*

by

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

October 2008

North Slope Lakes Hydrologic Modeling Project  
Report No. INE/WERC 08.13

Water and Environmental  
Research Center



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Kristie Holland<sup>1</sup>, Dan Reichardt<sup>1</sup>, Chad Cormack<sup>2</sup>, Jeff Derry<sup>1</sup>, Greta Myerchin<sup>2</sup>,  
Horacio Toniolo<sup>2</sup>, Michael Lilly<sup>1</sup>

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

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North Slope Lakes Hydrologic Project

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## **DISCLAIMER**

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

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

## Conversion Factors

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

## Units

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

### Physical and Chemical Water-Quality Units:

#### Temperature:

Water and air temperature is given in degrees Celsius (°C) and in degrees Fahrenheit (°F). Degrees Celsius can be converted to degrees Fahrenheit by use of the following equation:

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

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

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

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

where:

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

AC = Actual Conductivity, in μS/cm

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

T = temperature of the sample, in °C

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

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

Millivolt (mV):

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

Vertical Datum:

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
km <sup>2</sup>	square kilometers
kPa	kilopascal
lb/in <sup>2</sup>	pounds per square inch
m	meters
mg/L	milligrams per liter, equivalent to ppm
µg/L	micrograms per liter
mi <sup>2</sup>	square miles
mm	millimeters
µS/cm	microsiemens per centimeter
mV	Millivolt
NGVD	National Geodetic Vertical Datum
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.

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

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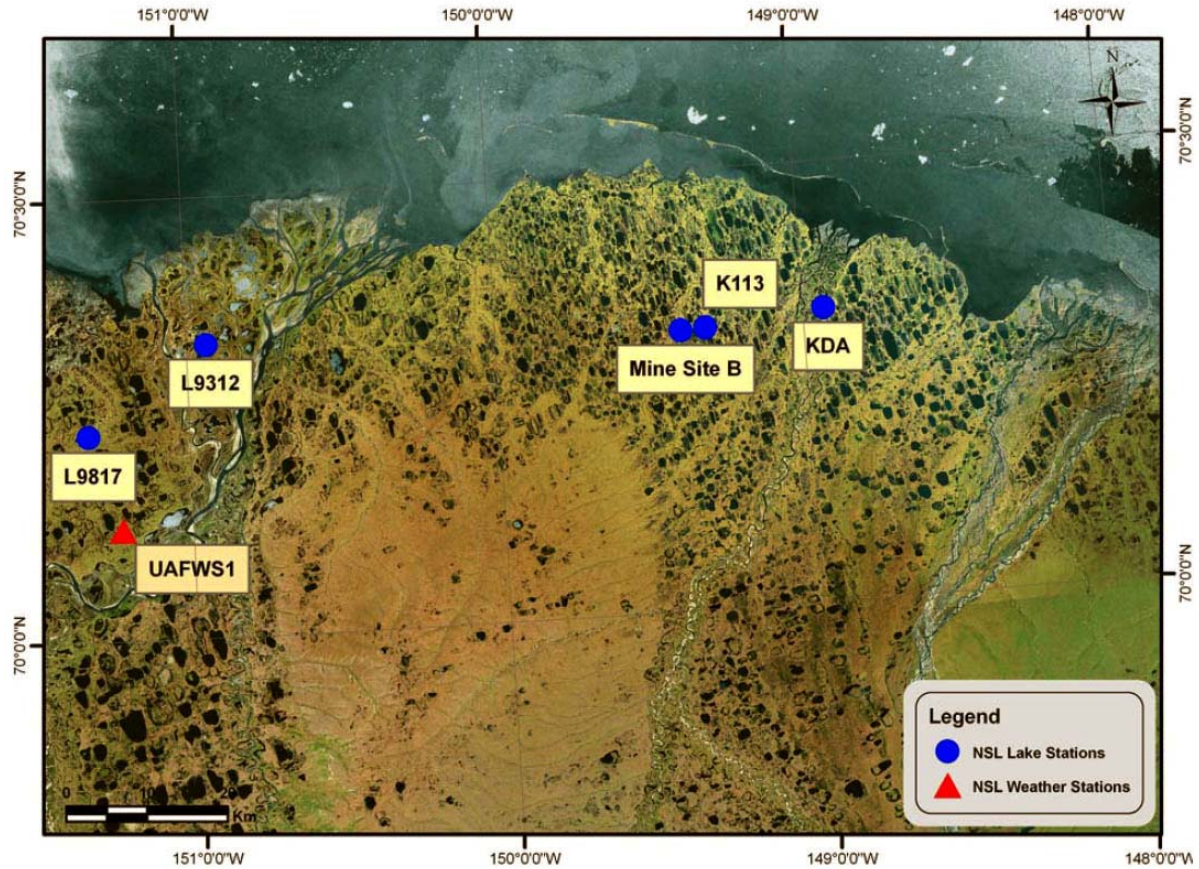
This project was funded by cooperative agreement number DE-FC26\_01NT41248, from the U.S. Department of Energy's (DOE) Arctic Energy Office to the University of Alaska Fairbanks Arctic Energy Technology Development Laboratory (AETDL). Field coordination and logistics support were provided by BP Exploration (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 2008**

## **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). Some of the study lakes were discontinued and gravel mine-site reservoirs were added to the remaining study lakes to further develop the understanding and simulation tools necessary for water-source management (Figure 1). K113 is an un-pumped lake in the Kuparuk oilfield and is sampled on selected field trips during the year. L9312 is a natural lake studied in the Alpine operations area. L9817 is a natural lake in eastern NPRA, west of Nuiqsut. . L9817 had been used in past years for ice-road construction, but was not pumped during the 2005-06 or 2006-07 winters, however, it was heavily pumped throughout the 2007-08 winter 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 2008 (middle of May through beginning of June), 2) summarize accomplished field trip objectives.



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

## **TRIP OBJECTIVES**

The goal of each 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, 2008). The spring snowmelt trip duration was from 19 May, 2008 to 3 June, 2008. During the trip we focused on the following locations/tasks:

1. Lake L9312: Alpine operating area.
  - Survey water levels 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. Lake L9817, NPRA
- Survey water levels to local BLM elevation control.
  - Adjust remote camera station and install markers to aid in water level observations.
  - Conduct snow course measurements.
  - Conduct snow depth transects across selected sections of lake to help identify available recharge volumes.
  - Remotely monitor snowmelt and lake recharge conditions
3. Mine Site B: Kuparuk operating area.
- Survey water levels to local elevation control.
  - Conduct snow-course measurements and document snow ablation processes.
  - Document observations of reservoir recharge processes, including photographs, field measurements of snowmelt, inflow and lake outflows.
  - Document timing of initial melt water on reservoir ice, initial stream flow and reservoir outflow.
4. Kuparuk Dead Arm (KDA) Reservoirs: Prudhoe Bay operating area.
- Survey water levels to local elevation controls.
  - Conduct snow-course measurements and document snow ablation processes.
  - Document observations of lake recharge processes, including photographs, field measurements of snowmelt, inflow and lake outflows.
  - Document timing of initial melt water on reservoir ice, initial stream flow and reservoir outflow.
5. West Dock, Prudhoe Bay operating area.
- Daily snow surveys as needed to document snow ablation processes.

6. Betty Pingo, Prudhoe Bay operating area.
  - Daily snow surveys as needed to document snow ablation processes.

## **PROCEDURES**

All field work follows the specified health, safety, and environmental guidelines outlined by BPX and CPA (White and Lilly, 2008*a,b,c*).

### Snowmelt Monitoring

Snowmelt surveying took place at L9312, L9817, 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;

- Ø First melt-water date observed on lake ice (with photographs)
- Ø Date of first ponding and moating around lake and reservoir shorelines (with photographs)
- Ø Date inflow was first observed at lake/reservoir inlets or overland drainages
- Ø Date outflow was first observed at lake/reservoir outlets or overland drainages
- Ø Date of any recharge by surface water flooding, such as L9312

- Ø Timing of flood recession
- Ø 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).



Figure 2. Culvert leading from Kuparuk Deadarm cell 1 into cell 2, photo by C. Cormack.

## **SELECTED SNOWMELT AND RECHARGE MONITORING OBSERVATIONS**

Field observations occurred at Kuparuk Deadarm Lakes, Mine Site B, L9312, L9817, Betty Pingo, and West Dock during the Snowmelt trip field activities. To show stages of snowmelt, a series of photos for some of the sites have been included in this report.

### **Kuparuk Deadarm Reservoirs 1-3:**

On 5/26/08 it was observed that ponds had formed near KDA2 and water was running through the culvert from KDA1 to KDA2. About 50% of the snow pack was still present. On 5/27/08, a slight increase in water level was detected at KDA2. On 5/28/08, with about 20% of the snowpack remained, KDA2 and KDA3 were connected and the culvert between KDA1 and KDA2 was full and flow was not visible. There was also low flow from runoff on the south side

of KDA4 with the majority of flow directed into the culvert which led to KDA3. By 5/30/08 most of the snow pack had melted. By 5/31/08 water levels had reached their maximum with connections between KDA1, KDA2, and KDA3. On 6/2/08, the connection between KDA1 and KDA2 was underwater, and there was continued flow from KDA3 to KDA4.



**Figure 3. View of KDA 3 from road on 5/25/08, 5/27/08, 5/29/08, 5/31/08, 6/2/08 and 6/3/08.**

#### Kuparuk Deadarm Reservoirs 4-5:

Water levels were observed rising in KDA 4 and 5 from snowmelt on 5/24/08. The water levels between KDA 4 and 5 are shown in Figure 4. By 5/31/08 water levels had reached their maximum and started to decline with the following stage of the Kuparuk River (Figure 5). On 6/2/08, it was noted that there was continued flow from KDA3 to KDA4.



**Figure 4. Road between KDA 4 and KDA 5 on 5/28/08, 5/29/08, 5/31/08, and 6/2/08.**

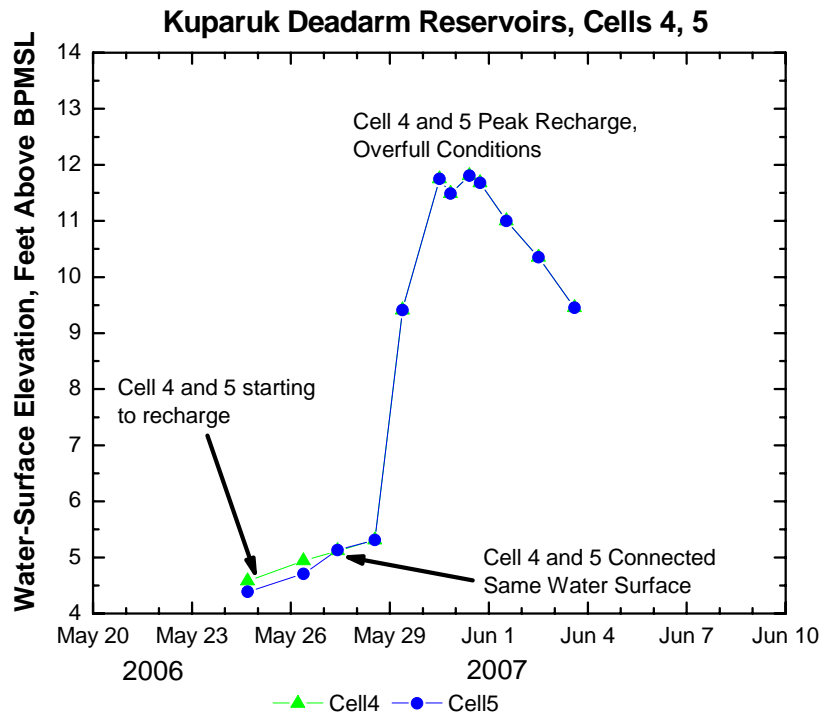
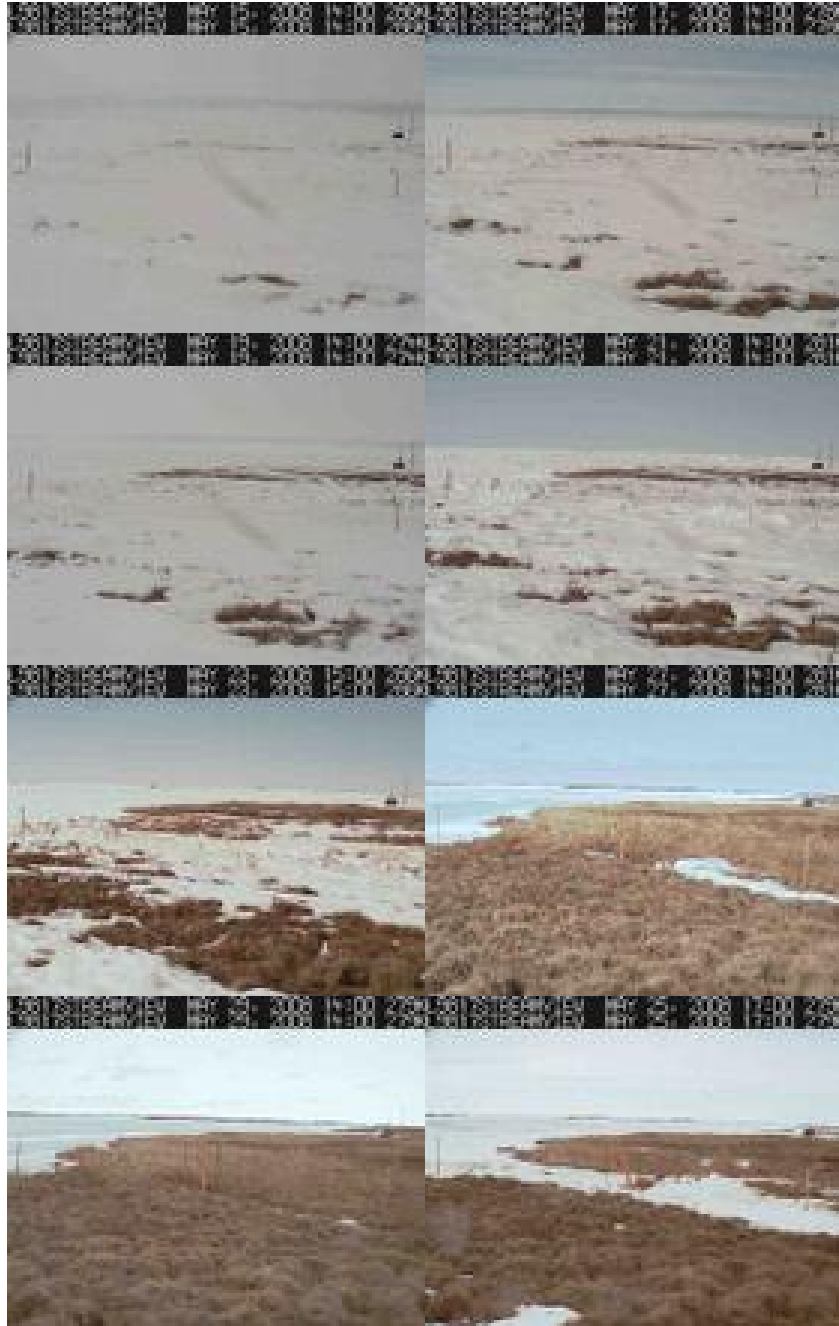


Figure 5. Water level elevations for KDA 4, 5 during snowmelt and Kuparuk River backwater flooding.

L9817:

On 5/17/08 L9817 was visited and it was observed that there was hard packed snow covering about 95% of the site, more than what was seen at L9312, and it appeared as if there was more snow accumulated to the west. By 5/23/08 there had been significant snow melt at the weather station sites (UAFWS1, UAFWS3, UAFWS4), with the greatest amount of snow at UAFWS3. By 5/22/08 a large portion of the snow on the tundra had melted, as noted in the following met station camera photos in figure 5.



**Figure 6. L9817 snowmelt as seen from the met station camera, photos are from every other day between 5/15/08 and 5/29/08.**

**Mine Site B:**

On 5/26/08, Milne Creek was flowing, which is the outlet for Mine Site B, and the water levels were up. By the next day the water levels had begun to go down, but snowmelt continued past 6/3/08. On 5/30/08, Mine Site B had reached its highest water mark of 100.45 ft. By 6/1/08, the water mark had dropped a foot to 99.1 ft.



**Figure 7. Snowmelt at Mine Site B from weather station on 5/25/08, 5/27/08, 5/29/08, 5/31/08, 6/2/08, and 6/3/08.**

L9312:

Snowmelt was first observed between 5/15/08 and 5/17/08. By 5/25/08 there was not a lot of snow left at L9312 anywhere and it rained for several hours. The tundra was very wet, the outlet was saturated, and there was water flowing into the lake from several points on the tundra. By 5/29/08 almost all of the snow was melted and snowmelt for this site was nearly complete. Water levels continued to rise into the first week in June (Figure 8).

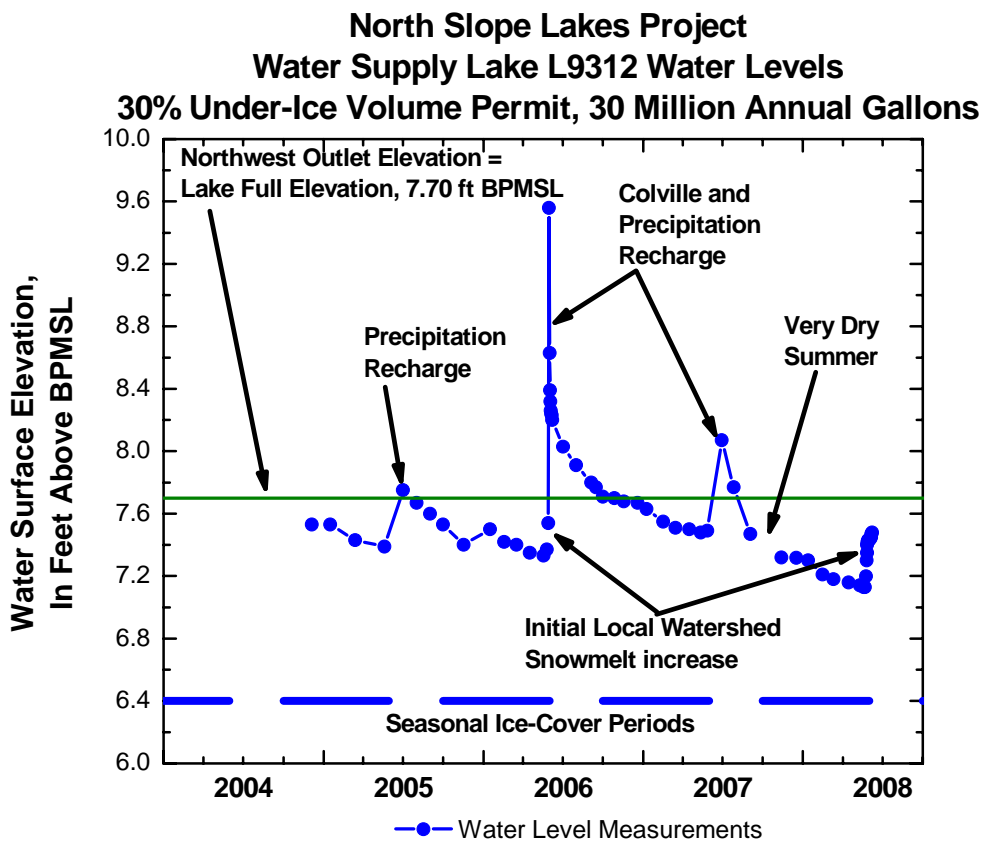


Figure 8. Water levels at L9312. Snowmelt recharge is seen at the end of May 2008



**Figure 9. L9312 snowmelt as seen from the met station camera, photos are from every other day between 5/15/08 and 5/29/08.**

## **SUMMARY**

Snowmelt recharge was observed at L9817 and L9312. L9817 completely filled up to its outlet elevation. L9312 did not fully recharge but came close to its outlet elevation of 7.70 ft above BPMLS on June 7 when it reached an elevation of 7.48 ft. Kuparuk Deadarm Reservoirs were overfilled by both snowmelt and backwater flooding from the Kuparuk River. Mine Site B was also overfilled from snowmelt runoff from East Milne Creek. Lakes and reservoirs that did receive overbank or backwater flooding from streams and rivers were also observed to recharge during early snowmelt. 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.

## REFERENCES

- Reichardt, D., and Lilly, M.R., 2008. A Workplan for Meteorological Station Maintenance, Lake Chemistry Sampling, and Spring Snowmelt Recharge Monitoring in NPRA, Alpine, Kuparuk River, and Prudhoe Bay Areas: May/June 2008. Water and Environmental Research Center, University of Alaska Fairbanks. 18 p.
- White, D.M., and Lilly, M.R. 2008*a*. 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. 2008*b*. BPX: Health, Safety, and Environmental Plan. Water and Environmental Research Center, University of Alaska Fairbanks. 6 p.
- White, D.M., and Lilly, M.R. 2008*c*. 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.

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

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

Project ID: North Slope Foothills Site Location/Lake ID: Lake 27.7  
 Sample Purpose: Lake Water Quality - Field Form Date: 5/23/08 Time: 18:00

**FIELD MEASUREMENTS**

GPS Coord. Northing: 69° 53.374 Easting: 148° 46.943 Datum: NAD83  
 Measurements By: GMM/JED Time: NA  
 Water Depth (ft): 7.92 Ice Thickness (ft): 6.42  
 Freeboard (ft): 0 Snow Depth (ft): 1.08  
 Water Sampling By: n/a Sample Depths BWS (ft): 1 n/a Date: n/a Time: n/a  
 2 \_\_\_\_\_  
 3 \_\_\_\_\_

**WATER QUALITY METER INFORMATION**

Calibration Information

Parameter (s)	Owner	Meter Make/Model	Serial No.	Pre-Sampling QAQC Check	Post-Sampling QAQC Check
Dissolved Oxygen	GWS	Hach LDO HQ10	50200003625	PASS	PASS
Conductivity	GWS	YSI30	07L100864	PASS	PASS
<b>Parameters</b>	<b>Field Measurements</b>				
Time:	18:28	nr	nr		
Depth BWS (ft):	6	7	7.90		
Temp (°C):	0.3	0.3	0.3		
Conductivity (µS/cm):	92	869	949		
DO (mg/L)	12.6	0.9	0.4		
Pressure (mm-HG)	755	755	755		

Remarks: water from snowmelt was heard running down the hole during the drilling process. Sunny and 50F

Field-Form Filled Out By: GMM Date: 5/31/08  
 QAQC Check By: AJB Date: 8/25/08

## **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.

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

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

Project ID: North Slope Lakes - Snowmelt Site Location/Lake ID: Lake 27.2  
 Sample Purpose: Lake Water Quality

**WATER QUALITY METER INFORMATION**

Meter Make: HACH LDO HQ10  
 Owner: GWS S/N: 50200003625

**CALIBRATION AND QUALITY ASSURANCE INFORMATION**

**Pre-Sampling QA**

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
DO 100%	5/8/08	8:40	nanopure	n/a	n/a	105.6% @ 9.91	Pass
Zero DO	5/8/08	8:40	nr	n/a	n/a	0.34 @ 9.90	Pass

**Post-Sampling QA**

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
Dissolved Oxygen	5/31/08	1230	Well shaken Nanopure	n/a		9.6mg/L @ 760mmHg	Pass

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

Field-Form Filled Out By: Greta Myerchin Date: 5/31/2008  
 QAQC Check By: AJB Date: 8/25/2008

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

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

Project ID: North Slope Lakes - Snowmelt Site Location/Lake ID: Lake 27.2  
 Sample Purpose: Lake Water Quality

**WATER QUALITY METER INFORMATION**

Meter Make: YSI30  
 Owner: GWS S/N: 07L100864

**CALIBRATION AND QUALITY ASSURANCE INFORMATION**

**Pre-Sampling QA**

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
Conductivity	5/8/08	8:40	Oakton 447 us/cm	nr	nr	149 @ 9.72	**Failed and

**Post-Sampling QA**

Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
Conductivity	5/31/08	1230	Oakton 84 us/cm	2711331	Nov-08	79.1	Pass
Conductivity	5/31/08	1230	Oakton 447 us/cm	2709363	Sep-08	395.9	Pass

Remarks: \*\*Recalibrated conductivity value was not recorded.

Field-Form Filled Out By: Greta Myerchin Date: 5/31/2008  
 QAQC Check By: AJB Date: 8/25/2008

## **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: L9310  
 Survey Purpose: Water-Level Elevations Date: 6/2/2008 Time: 10:00

Location:	SE Outlet Elevation							
Survey objective:	Find Channel Elevation				Weather Observations:		35 F, Cloudy, 30 mph	
Instrument Type:	Leica NA720		Instrument ID: 5482372 (GWS owned)					
Rod Type:	Craine fiberglass 20'		Rod ID: GWS owned					
Bench Mark Information:					Survey Team Names			
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)		Chad Cormack, Toniolo		
L9312 Water Surf.		8.15	na	na				
<b>Station</b>	<b>BS (ft)</b>	<b>HI (ft)</b>	<b>FS (ft)</b>	<b>Elevation (fasl)</b>	<b>GPS</b>			<b>Remarks</b>
Baker Gage	2.68	14.22		11.54				
Puddle1		14.22	4.57	9.65				
TP1		14.22	4.43	9.79				
TP1	4.68	14.47		9.79				
Puddle1		14.47	4.82	9.65				
Baker Gage		14.47	2.93	11.54				Survey Closes to 0.00'
Closed Survey 1, go to Survey 2								
Puddle1	4.78	14.43		9.65				
L9311 WL		14.43	4.91	9.52				
TP2		14.43	4.47	9.96				
move instrument								
TP2	4.55	14.51		9.96				
L9311 WL		14.51	4.98	9.53				
Puddle1		14.51	4.85	9.66				Closes to 0.01'

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

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

Project ID: North Slope Lakes Site Location/Lake ID: L9310  
 Survey Purpose: Water-Level Elevations Date: 5/30/2008 Time: 10:00

Location:		SE Outlet Elevation						
Survey objective:		Find Channel Elevation				Weather Observations:		35 F, Cloudy, 30 mph
Instrument Type:		Leica NA720	Instrument ID:		5482372 (GWS owned)			
Rod Type:		Craine fiberglass 20'	Rod ID:		GWS owned			
Bench Mark Information:					Survey Team Names			
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)		Chad Cormack, Toniolo		
L9312		8.15	na	na				
Water Surf.								
<b>Station</b>	<b>BS (ft)</b>	<b>HI (ft)</b>	<b>FS (ft)</b>	<b>Elevation (fasl)</b>	<b>GPS</b>	<b>Vertical Angle</b>	<b>Remarks</b>	
Close Survey 2, Move to Survey 3								
L9311 WL	5.91	15.43		9.52				
L9310 WL		15.43	6.72	8.71			L9310 WL = 8.71'	
TP3		15.43	6.31	9.12				
TP3	6.39	15.51		9.12				
L9310 WL		15.51	6.80	8.71				
L9311 WL		15.51	5.98	9.53			Survey closes to 0.01'	

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

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

Project ID: North Slope Lakes Site Location/Lake ID: L9311  
 Survey Purpose: Water-Level Elevations Date: 5/30/2008 Time: 10:00

Location:	SE Outlet Elevation								
Survey objective:	Find Channel Elevation					Weather Observations:	35 F, Cloudy, 30 mph		
Instrument Type:	Leica NA720		Instrument ID:	5482372 (GWS owned)					
Rod Type:	Craine fiberglass 20'		Rod ID:	GWS owned					
Bench Mark Information:						Survey Team Names			
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)		Chad Cormack, Toniolo			
L9312 Water Surf.		8.15	na	na					
<b>Station</b>	<b>BS (ft)</b>	<b>HI (ft)</b>	<b>FS (ft)</b>	<b>Elevation (fasl)</b>	<b>GPS</b>			<b>Remarks</b>	
L9312 Water Surf.	6.86	14.29		7.43	41				
P0		14.29	5.68	<b>8.61</b>	42			See Fieldbook for Pond Identification	
P0.5		14.29	5.15	<b>9.14</b>	43				
P0.75		14.29	4.37	<b>9.92</b>	44				
P1		14.29	4.67	<b>9.62</b>	45				
P2		14.29	4.46	<b>9.83</b>	46				
TP1		14.29	3.95	10.34					
TP1	3.65	13.99		10.34					
P2		13.99	4.16	9.83					
P1		13.99	4.37	9.62					
P0.75		13.99	4.07	9.92					
P0.5		13.99	4.85	9.14					
P0		13.99	5.37	8.62					

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

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

Project ID: North Slope Lakes Site Location/Lake ID: L9311  
 Survey Purpose: Water-Level Elevations Date: 5/30/2008 Time: 10:00

Location:		SE Outlet Elevation						
Survey objective:		Find Channel Elevation				Weather Observations:		35 F, Cloudy, 30 mph
Instrument Type:		Leica NA720		Instrument ID:		5482372 (GWS owned)		
Rod Type:		Craine fiberglass 20'		Rod ID:		GWS owned		
Bench Mark Information:						Survey Team Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)		Chad Cormack, Toniolo		
L9312 Water Surf.		8.15	na	na				
<b>Station</b>	<b>BS (ft)</b>	<b>HI (ft)</b>	<b>FS (ft)</b>	<b>Elevation (fasl)</b>	<b>GPS</b>		<b>Vertical Angle</b>	<b>Remarks</b>
L9312 Water Surf.		13.99	6.55	7.44				Survey Closes to 0.01'
Close Survey 1, Move on to Survey 2								
P2	5.00	14.83		<b>9.83</b>				
P3		14.83	5.24	<b>9.59</b>	47			
P4		14.83	5.16	<b>9.67</b>	48			
P6		14.83	5.19	<b>9.64</b>	49			
P5		14.83	4.67	<b>10.16</b>	50			
P8		14.83	5.22	<b>9.61</b>	51			
P7		14.83	5.18	<b>9.65</b>	52			
P9		14.83	5.26	<b>9.57</b>	53			
P10		14.83	4.92	<b>9.91</b>	54			
L9311 Water Surf.		14.83	5.33	<b>9.50</b>	55			
TP2		14.83	4.77	10.06				

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

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

Project ID: North Slope Lakes Site Location/Lake ID: L9311  
 Survey Purpose: Water-Level Elevations Date: 5/30/2008 Time: 10:00

Location:		SE Outlet Elevation						
Survey objective:		Find Channel Elevation				Weather Observations:		35 F, Cloudy, 30 mph
Instrument Type:		Leica NA720		Instrument ID:		5482372 (GWS owned)		
Rod Type:		Craine fiberglass 20'		Rod ID:		GWS owned		
Bench Mark Information:						Survey Team Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)		Chad Cormack, Toniolo		
L9312 Water Surf.		8.15	na	na				
<b>Station</b>	<b>BS (ft)</b>	<b>HI (ft)</b>	<b>FS (ft)</b>	<b>Elevation (fasl)</b>	<b>GPS</b>			<b>Remarks</b>
TP2	4.57	14.63		10.06				
L9311 Water Surf.		14.63	5.13	9.50				
P10		14.63	4.71	9.92				
P9		14.63	5.06	10.31				
P7		14.63	4.99	9.64				
P8		14.63	5.01	9.62				
P5		14.63	4.47	10.16				
P6		14.63	5.00	9.63				
P4		14.63	4.96	9.67				
P3		14.63	5.04	9.59				
P2		14.63	4.80	9.83				Survey Closes to 0.00'

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

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

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

Project ID: North Slope Lakes Site Location/Lake ID: L9312  
 Survey Purpose: Water-Level Elevations Date: 5/19/2008 Time: 10:00

Location:		L9312, Survey to LCMF BM elevations. Point "P" is 11.72'						
Survey objective:		Lake water elevation survey				Weather Observations:		
Instrument Type:	Leica NA720	Instrument ID:	5482372 (GWS owned)					
Rod Type:	Craine fiberglass 20'	Rod ID:	GWS owned					
Bench Mark Information:					Survey Team Names			
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)	Cormack, Reichardt			
P	LCMF	11.72	na	na				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
P	1.08	12.80		11.72				
O		12.80	1.34	11.46				
PH-VSM		12.80	1.75	14.55				
WL		12.80	5.67	7.13				<b>WL = 7.13 ft.</b>
TOI		12.80	5.44	7.36				
TOI	5.06	12.42		7.36				
WL		12.42	5.30	7.12				
PH-VSM		12.42	2.13	14.55				
O		12.42	0.96	11.46				
P		12.42	0.70	11.72				

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

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

Project ID: North Slope Lakes Site Location/Lake ID: L9312  
 Survey Purpose: Water-Level Elevations Date: 5/21/2008 Time: 15:00

Location:		L9312, Survey to LCMF BM elevations. Point "P" is 11.72'						
Survey objective:		Lake water elevation survey				Weather Observations:		
Instrument Type:		Leica NA720		Instrument ID: 5482372 (GWS owned)				
Rod Type:		Craine fiberglass 20'		Rod ID: GWS owned				
Bench Mark Information:					Survey Team Names			
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)		Cormack, Reichardt		
P	LCMF	11.72	na	na				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
P	0.40	12.12		11.72				
O		12.12	0.66	11.46				
PH-VSM		12.12	2.44	14.56				
WL		12.12	5.00	7.12				<b>WL = 7.13 ft.</b>
TOI		12.12	4.90	7.22				
TOI	5.12	12.34		7.22				
WL		12.34	5.20	7.14				
PH-VSM		12.34	2.22	14.56				close point to 0.00
O		12.34	0.88	11.46				close point to 0.01
P		12.34	0.62	11.72				close survey 0.00'

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

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

Project ID: North Slope Lakes Site Location/Lake ID: L9312  
 Survey Purpose: Water-Level Elevations Date: 5/24/2008 Time: 14:30

Location:		L9312, Survey to LCMF BM elevations. Point "P" is 11.72'						
Survey objective:		Lake water elevation survey				Weather Observations:		
Instrument Type:		Leica NA720		Instrument ID:		5482372 (GWS owned)		
Rod Type:		Craine fiberglass 20'		Rod ID:		GWS owned		
Bench Mark Information:						Survey Team Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)		Cormack, Reichardt		
P	LCMF	11.72	na	na				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
P	1.35	13.07		11.72				
O		13.07	1.62	11.45				
PH-VSM		13.07	-	-				
WL		13.07	5.87	7.20				<b>WL = 7.20 ft.</b>
TOI		13.07	5.63	7.44				
TOI	5.39	12.83		7.44				
WL		12.83	5.62	7.21				
PH-VSM		12.83	-	-				
O		12.83	1.37	11.46				
P		12.83	1.11	11.72				

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

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

Project ID: North Slope Lakes Site Location/Lake ID: L9312  
 Survey Purpose: Water-Level Elevations Date: 5/25/2008 Time: 14:30

Location:	L9312, Survey to LCMF BM elevations. Point "P" is 11.72'							
Survey objective:	Lake water elevation survey					Weather Observations:		
Instrument Type:	Leica NA720	Instrument ID:		5482372 (GWS owned)				
Rod Type:	Craine fiberglass 20'	Rod ID:		GWS owned				
Bench Mark Information:						Survey Team Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)		Chad Cormack, AJ (LCMF)		
P	LCMF	11.72	na	na				
<b>Station</b>	<b>BS (ft)</b>	<b>HI (ft)</b>	<b>FS (ft)</b>	<b>Elevation (fasl)</b>	<b>Distance (ft)</b>	<b>Horizontal Angle</b>	<b>Vertical Angle</b>	<b>Remarks</b>
P	1.42	13.14		11.72				
O		13.14	1.69	11.45				
WL		13.14	5.84	7.30				
PH-VSM		13.14	1.40	14.54				<b>WL = 7.30 ft.</b>
								<b>Gage WL = 7.40</b>
PH-VSM	-1.52	13.02		14.54				
WL		13.02	5.73	7.29				
O		13.02	1.58	11.44				
P		13.02	1.31	11.71				

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

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

Project ID: North Slope Lakes Site Location/Lake ID: L9312  
 Survey Purpose: Water-Level Elevations Date: 5/26/2008 Time: 13:30

Location:	L9312, Survey to LCMF BM elevations. Point "P" is 11.72'							
Survey objective:	Lake water elevation survey					Weather Observations:		
Instrument Type:	Leica NA720	Instrument ID:		5482372 (GWS owned)				
Rod Type:	Craine fiberglass 20'	Rod ID:		GWS owned				
Bench Mark Information:						Survey Team Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)		Cormack, Toniolo		
P	LCMF	11.72	na	na				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
P	1.15	12.87		11.72				
O		12.87	1.42	11.45				
PH-VSM		12.87	1.68	14.55				
WL		12.87	5.52	7.35				<b>WL = 7.35 ft.</b>
TOI		12.87	5.12	7.75				<b>Gage WL = 7.42</b>
TOI	5.39	13.14		7.75				
WL		13.14	5.79	7.35				
PH-VSM		13.14	1.41	14.55				
O		13.14	1.69	11.45				
P		13.14	1.42	11.72				

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

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

Project ID: North Slope Lakes Site Location/Lake ID: L9312  
 Survey Purpose: Water-Level Elevations Date: 5/27/2008 Time: 10:30

Location:	L9312, Survey to LCMF BM elevations. Point "P" is 11.72'							
Survey objective:	Lake water elevation survey					Weather Observations:		
Instrument Type:	Leica NA720	Instrument ID:	5482372 (GWS owned)					
Rod Type:	Craine fiberglass 20'	Rod ID:	GWS owned					
Bench Mark Information:					Survey Team Names			
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)	Cormack, Toniolo			
P	LCMF	11.72	na	na				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
P	1.15	12.87		11.72				
O		12.87	1.41	11.46				
PH-VSM		12.87	1.68	14.55				
WL		12.87	5.46	7.41				<b>WL = 7.40 ft.</b>
TOI		12.87	5.00	7.87				<b>Gage WL = 7.40</b>
TOI	5.26	13.13		7.87				<b>Gage Reads 7.42</b>
WL		13.13	5.74	7.39				
PH-VSM		13.13	1.42	14.55				
O		13.13	1.68	11.45				
P		13.13	1.42	11.71				

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

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

Project ID: North Slope Lakes Site Location/Lake ID: L9312  
 Survey Purpose: Water-Level Elevations Date: 5/28/2008 Time: 15:00

Location:		L9312, Survey to LCMF BM elevations. Point "P" is 11.72'						
Survey objective:		Lake water elevation survey				Weather Observations:		
Instrument Type:	Leica NA720	Instrument ID:	5482372 (GWS owned)					
Rod Type:	Craine fiberglass 20'	Rod ID:	GWS owned					
Bench Mark Information:					Survey Team Names			
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)	Cormack, Toniolo			
P	LCMF	11.72	na	na				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
P	0.98	12.70		11.72				
O		12.70	1.25	11.45				
PH-VSM		12.70	1.85	14.55				
WL		12.70	5.28	7.42				<b>WL = 7.42 ft.</b>
TOI		12.70	4.77	7.93				<b>Gage WL = 7.42</b>
TOI	4.92	12.85		7.93				<b>Gage Reads 7.46</b>
WL		12.85	5.43	7.42				
PH-VSM		12.85	1.70	14.55				
O		12.85	1.40	11.45				
P		12.85	1.13	11.72				

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

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

Project ID: North Slope Lakes Site Location/Lake ID: L9312  
 Survey Purpose: Water-Level Elevations Date: 5/29/2008 Time: 15:00

Location:	L9312, Survey to LCMF BM elevations. Point "P" is 11.72'							
Survey objective:	Lake water elevation survey					Weather Observations:		
Instrument Type:	Leica NA720	Instrument ID:		5482372 (GWS owned)				
Rod Type:	Craine fiberglass 20'	Rod ID:		GWS owned				
Bench Mark Information:						Survey Team Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)		Cormack, Toniolo		
P	LCMF	11.72	na	na				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
P	1.48	13.20		11.72				
O		13.20	1.75	11.45				
PH-VSM		13.20	1.35	14.55				
WL		13.20	5.77	7.43				<b>WL = 7.43 ft.</b>
TOI		13.20	5.22	7.98				<b>Gage WL = 7.43</b>
TOI	5.05	13.03		7.98				<b>Gage Reads 7.47</b>
WL		13.03	5.60	7.43				
PH-VSM		13.03	1.53	14.56				
O		13.03	1.57	11.46				
P		13.03	1.30	11.73				

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

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

Project ID: North Slope Lakes Site Location/Lake ID: L9312  
 Survey Purpose: Water-Level Elevations Date: 6/1/2008 Time: 15:00

Location:		L9312, Survey to LCMF BM elevations. Point "P" is 11.72'						
Survey objective:		Lake water elevation survey				Weather Observations:		
Instrument Type:		Leica NA720		Instrument ID: 5482372 (GWS owned)		Very Windy		
Rod Type:		Craine fiberglass 20'		Rod ID: GWS owned				
Bench Mark Information:						Survey Team Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)		Cormack, Toniolo		
P	LCMF	11.72	na	na				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
P	1.01	12.73		11.72				
O		12.73	1.28	11.45				
PH-VSM		12.73	-	-				
WL		12.73	5.30	7.43				<b>WL = 7.43 ft.</b>
TOI		12.73	4.01	8.72				<b>Gage WL = 7.43</b>
TOI	4.09	12.81		8.72				<b>Gage Reads 7.45</b>
WL		12.81	5.37	7.44				
PH-VSM		12.81	-	-				
O		12.81	1.36	11.45				
P		12.81	1.09	11.72				

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

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

Project ID: North Slope Lakes Site Location/Lake ID: L9817  
 Survey Purpose: Water-Level Elevations Date: 5/11/2008 Time: 12:30

Location: Lake L9817 in NPRA, adjacent to Rondy Ice Road								
Survey objective: Determine FWS Elevation.					Weather Observations:			
Instrument Type: Leica NA720		Instrument ID: SN:5482372		10°F, 18 mph winds, overcast				
Rod Type: Fiberglass		Rod ID: Crane 20' Fiberglass						
Bench Mark Information:					Survey Team Names			
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)	Michael Lilly, Roy Baldwin (LCMF)			
B	nr	54.98	na	na				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
B	4.190	59.17		54.98				rebar survey control
C		59.17	3.24	55.93				rebar survey control
E		59.17	2.83	56.34				rebar survey control
L9817_WL		59.17	7.34	<b>51.83</b>				<b>WL=51.83</b>
L9817_TOI		59.17	6.62	52.55				Top of lake ice near L9817_WL hole (#3)
Turn on L9817_TOI, Move to Inst.2								
L9817_TOI	6.72	59.27		52.55				
L9817_WL		59.27	7.44	51.83				closes to 0.01
E		59.27	2.92	56.35				closes to 0.01
C		59.27	3.33	55.94				closes to 0.01
B		59.27	4.28	54.99				Survey closes within 0.01'

Note: L9817\_WL did not freeze over. Held survey rod base at water surface.

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

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

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

Project ID: North Slope Lakes Site Location/Lake ID: L9817  
 Survey Purpose: Water-Level Elevations Date: 5/24/2008 Time: 12:30

Location: Lake L9817 in NPRA, adjacent to Rondy Ice Road								
Survey objective: Determine FWS Elevation.					Weather Observations:			
Instrument Type: Leica NA720		Instrument ID: SN:5482372		50 F, Clear, Light Wind				
Rod Type: Fiberglass		Rod ID: Crane 20' Fiberglass						
Bench Mark Information:					Survey Team Names			
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)	Reichardt, Cormack			
B	nr	54.98	na	na				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
B	3.810	58.79		54.98				rebar survey control
C		58.79	2.87	55.92				rebar survey control
E		58.79	2.46	56.33				rebar survey control
L9817_WL		58.79	6.77	<b>52.02</b>				<b>WL=52.03</b>
L9817_TOI		58.79	6.65	52.14				Top of lake ice near L9817_WL hole (#3)
Turn on L9817_TOI, Move to Inst.2								
L9817_TOI	6.74	58.88		52.14				
L9817_WL		58.88	6.84	52.04				closes to 0.01
E		58.88	2.54	56.34				closes to 0.01
C		58.88	2.95	55.93				closes to 0.01
B		58.88	2.89	55.99				Survey closes within 0.01'

Note: L9817\_WL did not freeze over. Held survey rod base at water surface.

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

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

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

Project ID: North Slope Lakes Site Location/Lake ID: L9817  
 Survey Purpose: Water-Level Elevations Date: 5/28/2008 Time: 14:30

Location: Lake L9817 in NPRA, adjacent to Rondy Ice Road								
Survey objective: Determine FWS Elevation.					Weather Observations:			
Instrument Type: Leica NA720		Instrument ID: SN:5482372		30 F, Cloudy, Light Wind				
Rod Type: Fiberglass		Rod ID: Crane 20' Fiberglass						
Bench Mark Information:					Survey Team Names			
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)	Cormack, Toniolo			
B	nr	54.98	na	na				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
B	3.70	58.68		54.98				rebar survey control
C		58.68	2.76	55.92				rebar survey control
E		58.68	2.34	56.34				rebar survey control
SH-WL		58.68	5.85	52.83				Shored Water
L9817 WL		58.68	<b>5.86</b>	52.82				<b>WL = 52.82</b>
L9817_TOI		58.68	5.27	53.41				Top of lake ice near L9817_WL hole (#3)
L9817_TOI	5.00	58.41		53.41				Top of lake ice near L9817_WL hole (#3)
L9817 WL		58.41	5.58	52.83				closes to 0.01
SH-WL		58.41	5.59	52.82				closes to 0.01
E		58.41	2.08	56.33				closes to 0.01
C		58.41	2.49	55.92				closes to 0.00
B		58.41	3.43	54.98				Survey closes within 0.00'

Note: L9817\_WL did not freeze over. Held survey rod base at water surface.

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

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

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

Project ID: North Slope Lakes Site Location/Lake ID: L9817  
 Survey Purpose: Water-Level Elevations Date: 6/1/2008 Time: 12:00

Location: Lake L9817 in NPRA, adjacent to Rondy Ice Road								
Survey objective: Determine FWS Elevation.					Weather Observations:			
Instrument Type: Leica NA720		Instrument ID: SN:5482372		30 F, Overcast, Light Wind				
Rod Type: Fiberglass		Rod ID: Crane 20' Fiberglass						
Bench Mark Information:					Survey Team Names			
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)	Cormack, Toniolo			
B	nr	54.98	na	na				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
B	4.330	59.31		54.98				rebar survey control
C		59.31	3.38	55.93				rebar survey control
E		59.31	2.97	56.34				rebar survey control
L9817_WL		59.31	6.41	<b>52.90</b>				<b>WL=52.90</b>
TP		59.31	5.26	54.05				Top of lake ice near L9817_WL hole (#3)
Turn on TP, Move to Inst.2								
TP	5.06	59.11		54.05				
L9817_WL		59.11	6.21	52.90				closes to 0.00
E		59.11	2.77	56.34				closes to 0.00
C		59.11	3.18	55.93				closes to 0.00
B		59.11	4.13	54.98				Survey closes within 0.00

Note: L9817\_WL did not freeze over. Held survey rod base at water surface.

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

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

Project ID: North Slope Lakes Site Location/Lake ID: L9817  
 Survey Purpose: Water-Level Elevations Date: 6/3/2008 Time: 12:00

Location: Lake L9817 in NPRA, adjacent to Rondy Ice Road								
Survey objective: Determine FWS Elevation.					Weather Observations:			
Instrument Type: Leica NA720		Instrument ID: SN:5482372		Very Windy				
Rod Type: Fiberglass		Rod ID: Crane 20' Fiberglass						
Bench Mark Information:					Survey Team Names			
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)	Cormack, Toniolo			
B	nr	54.98	na	na				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasi)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
B	3.920	58.90		54.98				rebar survey control
C		58.90	2.98	55.92				rebar survey control
E		58.90	2.57	56.33				rebar survey control
RP1		58.90	5.50	53.40				<b>RP 1 = 53.40</b>
RP2		58.90	5.35	53.55				<b>RP 2 = 53.55</b>
WL		58.90	6.01	52.89				<b>WL = 52.88</b>
TP		58.90	3.65	55.25				
Move Instrument and Turn on TP								
TP	4.01	59.26		55.25				
WL		59.26	6.39	52.87				Closes to 0.02'
RP2		59.26	5.71	53.55				Closes to 0.00'
RP1		59.26	5.86	53.40				Closes to 0.00'

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

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

Project ID: North Slope Lakes Site Location/Lake ID: L9817 Page 2  
 Survey Purpose: Water-Level Elevations Date: 6/3/2008 Time: 12:00

Location: Lake L9817 in NPRA, adjacent to Rondy Ice Road								
Survey objective: Determine FWS Elevation.				Weather Observations:				
Instrument Type: Leica NA720		Instrument ID: SN:5482372		Very Windy				
Rod Type: Fiberglass		Rod ID: Crane 20' Fiberglass						
Bench Mark Information:				Survey Team Names				
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)		Cormack, Toniolo		
B	nr	54.98	na	na				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
E		59.26	2.93	56.33				
C		59.26	3.34	55.92				
B		59.26	4.28	54.98				Survey Closes to 0.00'

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

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

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

Project ID: North Slope Lakes Site Location/Lake ID: L9817  
 Survey Purpose: Water-Level Elevations Date: 6/7/2008 Time: 12:00

Location: Lake L9817 in NPRA, adjacent to Rondy Ice Road								
Survey objective: Determine FWS Elevation.					Weather Observations:			
Instrument Type: Leica NA720		Instrument ID: SN:5482372		Very Windy				
Rod Type: Fiberglass		Rod ID: Crane 20' Fiberglass						
Bench Mark Information:					Survey Team Names			
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)	Cormack, Reichardt			
B	nr	54.98	na	na				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
B	4.260	59.24		54.98				rebar survey control
C		59.24	3.32	55.92				rebar survey control
E		59.24	2.90	56.34				rebar survey control
RP1		59.24	5.83	53.41				<b>RP 1 = 53.41</b>
RP2		59.24	5.69	53.55				<b>RP 2 = 53.55</b>
		59.24						<b>WL = 52.93</b>
D		59.24	4.82	54.42				
Move Instrument and Turn on TP								
D	4.69	59.11		54.42				
WL		59.11	6.18	<b>52.93</b>				Closes to 0.02'
RP2		59.11	5.70	53.41				Closes to 0.00'
RP1		59.11	2.77	56.34				Closes to 0.00'

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

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

Project ID: North Slope Lakes Site Location/Lake ID: L9817 Page 2  
 Survey Purpose: Water-Level Elevations Date: 6/7/2008 Time: 12:00

Location: Lake L9817 in NPRA, adjacent to Rondy Ice Road								
Survey objective: Determine FWS Elevation.					Weather Observations:			
Instrument Type: Leica NA720		Instrument ID: SN:5482372		Very Windy				
Rod Type: Fiberglass		Rod ID: Crane 20' Fiberglass						
Bench Mark Information:					Survey Team Names			
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)	Cormack, Reichardt			
B	nr	54.98	na	na				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
E		59.11	2.77	56.34				
C		59.11	3.18	55.93				
B		59.11	4.13	54.98				Survey Closes to 0.00'

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

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

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

Project ID: North Slope Lakes Site Location/Lake ID: Mine Site B  
 Survey Purpose: Water-Level Elevations Date: 5/24/2008 Time: 12:00

Location:	Mine Site B aka 6 mile Lake							
Survey objective:	Determine lake water elevation in North and South Cells				Weather Observations:		40°F, sunny, no wind	
Instrument Type:	Leica NA720	Instrument ID: 5482372 (GWS owned)						
Rod Type:	Craine fiberglass 20'	Rod ID: GWS owned						
Bench Mark Information:				Survey Team Names				
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)	Greta Myerchin, Jeff Derry			
TBM_1A	nr	100.23	N70°19.308'	W149°23.882'				
<b>Station</b>	<b>BS (ft)</b>	<b>HI (ft)</b>	<b>FS (ft)</b>	<b>Elevation (fasl)</b>	<b>Distance (ft)</b>	<b>Horizontal Angle</b>	<b>Vertical Angle</b>	<b>Remarks</b>
TBM_1A	1.585	101.815		100.23				Surveyed in 5/22/08
Mine-3		101.815	1.755	<b>100.06</b>				<b>Mine-3 = 100.06</b>
Mine-2		101.815	3.235	<b>98.58</b>				<b>Mine-2 =98.58</b>
Mine-4		101.815	3.285	<b>98.53</b>				<b>Mine-4 = 98.53</b>
Move instrument to 2, turn on TBM 4								
Mine-4	3.640	102.170		98.53				
Mine-2		102.170	3.580	98.59				
Mine-3		102.170	2.110	100.06				
TBM_1A		102.170	1.940	100.23				Survey closes to 0.00
Move instrument to 3								
TBM_1A	1.940	101.940		100.00				
MSBN-SH		102.170	7.960	<b>94.21</b>				<b>WL MSBN=94.21'</b>
MSBS-SH		102.170	8.010	<b>94.16</b>				<b>WL MSBS=94.16'</b>
MSBS-ICE		102.170	7.330	94.84				
Move instrument to 4								
MSBS-ICE	7.070	101.910		94.84				
MSBS-SH		101.910	7.750	94.16				
MSBN-SH		101.910	7.700	94.21				
TBM_1A		101.910	1.680	100.23				Survey closes to 0.00
Notes:								

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

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

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

Project ID: North Slope Lakes Site Location/Lake ID: Mine Site B  
 Survey Purpose: Water-Level Elevations Date: 5/25/2008 Time: 16:00

Location:		Mine Site B aka 6 mile Lake						
Survey objective:		Determine lake water elevation in North and South Cells			Weather Observations:		45°F, cloudy, 5mph wind, light rain	
Instrument Type:		Leica NA720	Instrument ID:	5482372 (GWS owned)				
Rod Type:		Craine fiberglass 20'	Rod ID:	GWS owned				
Bench Mark Information:					Survey Team Names			
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)		Greta Myerchin, Jeff Derry		
TBM_1	GWS	100.00	N70°19.308'	W149°23.882'				
<b>Station</b>	<b>BS (ft)</b>	<b>HI (ft)</b>	<b>FS (ft)</b>	<b>Elevation (fasl)</b>	<b>Distance (ft)</b>	<b>Horizontal Angle</b>	<b>Vertical Angle</b>	<b>Remarks</b>
TBM_1	6.290	106.290		100.00				
Yo		106.290	2.320	<b>103.97</b>				<b>TBM Yo = 103.97'</b>
Move instrument to 2, turn on TBM 4								
Yo	1.900	105.870		103.97				
TBM_1		105.870	5.870	100.00				Survey closes to 0.00
MSB WL: measured down from Mine-3 at 100.06'				<b>1.70</b>				<b>MSB N&amp;S WL= 98.36'</b>
Notes:								

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

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

Project ID: North Slope Lakes Site Location/Lake ID: Mine Site B  
 Survey Purpose: Water-Level Elevations Date: 5/26/2008 Time: 10:00

Location:		Mine Site B aka 6 mile Lake						
Survey objective:		Determine lake water elevation in North and South Cells			Weather Observations:		45°F, partly cloudy, wind	
Instrument Type:		Leica NA720	Instrument ID:	5482372 (GWS owned)				
Rod Type:		Craine fiberglass 20'	Rod ID:	GWS owned				
Bench Mark Information:					Survey Team Names			
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)		Greta Myerchin, Jeff Derry		
TBM_1	GWS	100.00	N70°19.308'	W149°23.882'				
<b>Station</b>	<b>BS (ft)</b>	<b>HI (ft)</b>	<b>FS (ft)</b>	<b>Elevation (fasl)</b>	<b>Distance (ft)</b>	<b>Horizontal Angle</b>	<b>Vertical Angle</b>	<b>Remarks</b>
TBM_1				100.00				
At 10:00am, measured down to water surface from TBM1			1.70	<b>98.30</b>				<b>MSB N&amp;S WL= 98.3'</b>
Notes:								

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

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

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

Project ID: North Slope Lakes Site Location/Lake ID: Mine Site B  
 Survey Purpose: Water-Level Elevations Date: 5/27/2008 Time: 10:30

Location:		Mine Site B aka 6 mile Lake						
Survey objective:		Determine lake water elevation in North and South Cells			Weather Observations:		40°F, cloudy, 5 mph wind	
Instrument Type:		Leica NA720	Instrument ID:	5482372 (GWS owned)				
Rod Type:		Craine fiberglass 20'	Rod ID:	GWS owned				
Bench Mark Information:					Survey Team Names			
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)		Greta Myerchin		
TBM_1	GWS	100.00	N70°19.308'	W149°23.882'				
<b>Station</b>	<b>BS (ft)</b>	<b>HI (ft)</b>	<b>FS (ft)</b>	<b>Elevation (fasl)</b>	<b>Distance (ft)</b>	<b>Horizontal Angle</b>	<b>Vertical Angle</b>	<b>Remarks</b>
TBM_OYE				97.45				See notes
At 10:30am, measured down to water surface from TBM1			0.49	<b>96.96</b>				<b>MSB N&amp;S WL= 97.0'</b>
Notes: TBM_OYE not surveyed on this date. TBM elevation determined on 05/28/08.								

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

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

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

Project ID: North Slope Lakes Site Location/Lake ID: Mine Site B  
 Survey Purpose: Water-Level Elevations Date: 5/28/2008 Time: 16:00

Location:	Mine Site B aka 6 mile Lake							
Survey objective:	Determine lake water elevation in North and South Cells				Weather Observations:		32°F, cloudy, light wind and snow	
Instrument Type:	Leica NA720	Instrument ID:		5482372 (GWS owned)				
Rod Type:	Craine fiberglass 20'	Rod ID:		GWS owned				
Bench Mark Information:						Survey Team Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)		Greta Myerchin, Amy Tidwell		
TBM_1	GWS	100.00	N70°19.308'	W149°23.882'				
<b>Station</b>	<b>BS (ft)</b>	<b>HI (ft)</b>	<b>FS (ft)</b>	<b>Elevation (fasl)</b>	<b>Distance (ft)</b>	<b>Horizontal Angle</b>	<b>Vertical Angle</b>	<b>Remarks</b>
TBM_1	4.95	104.95		100.00				
OYE		104.95	7.500	<b>97.45</b>				<b>TBM OYE = 97.45'</b>
Move instrument to 2, turn on TBM OYE								
OYE	7.22	104.67		97.45				
TBM_1		104.67	4.670	100.00				Survey closes to 0.00
TBM OYE				97.45				
At 10:00am, measured down to water surface from TBM1			0.07	<b>97.38</b>				<b>MSB N&amp;S WL= 97.4'</b>
Notes:								

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

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

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

Project ID: North Slope Lakes Site Location/Lake ID: Mine Site B  
 Survey Purpose: Water-Level Elevations Date: 5/29/2008 Time: 10:00

Location:		Mine Site B aka 6 mile Lake						
Survey objective:		Determine lake water elevation in North and South Cells			Weather Observations:		40°F, cloudy, light wind	
Instrument Type:		Leica NA720	Instrument ID:	5482372 (GWS owned)				
Rod Type:		Craine fiberglass 20'	Rod ID:	GWS owned				
Bench Mark Information:					Survey Team Names			
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)		Greta Myerchin		
TBM_1	GWS	100.00	N70°19.308'	W149°23.882'				
<b>Station</b>	<b>BS (ft)</b>	<b>HI (ft)</b>	<b>FS (ft)</b>	<b>Elevation (fasl)</b>	<b>Distance (ft)</b>	<b>Horizontal Angle</b>	<b>Vertical Angle</b>	<b>Remarks</b>
TBM_1				100.00				
At 10:00am, measured down to water surface from TBM1			1.17	<b>98.83</b>				<b>MSB N&amp;S WL= 98.8'</b>
Notes:								

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

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

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

Project ID: North Slope Lakes Site Location/Lake ID: Mine Site B  
 Survey Purpose: Water-Level Elevations Date: 5/30/2008 Time: 11:31

Location:		Mine Site B aka 6 mile Lake						
Survey objective:		Determine lake water elevation in North and South Cells			Weather Observations:		34°F, cloudy, 5 mph wind	
Instrument Type:		Leica NA720	Instrument ID:	5482372 (GWS owned)				
Rod Type:		Craine fiberglass 20'	Rod ID:	GWS owned				
Bench Mark Information:					Survey Team Names			
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)	Greta Myerchin, Amy Tidwell			
TBM_1	GWS	100.00	N70°19.308'	W149°23.882'				
<b>Station</b>	<b>BS (ft)</b>	<b>HI (ft)</b>	<b>FS (ft)</b>	<b>Elevation (fasl)</b>	<b>Distance (ft)</b>	<b>Horizontal Angle</b>	<b>Vertical Angle</b>	<b>Remarks</b>
TBM_1				100.00				
At 11:31am, measured down to water surface from TBM1			0.08	<b>99.92</b>				<b>MSB N&amp;S WL= 99.9'</b>
MSB WL				99.92				Measured up from MSB WL
At 10:00am, measured down to water surface from TBM1			0.53	<b>100.45</b>				<b>High Water Mark= 100.5'</b>
Notes: High Water Mark observed on adjacent unsurveyed stick. Elevation calculated from MSB WL. Time of peak unknown.								

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

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

Project ID: North Slope Lakes Site Location/Lake ID: Mine Site B  
 Survey Purpose: Water-Level Elevations Date: 5/31/2008 Time: 9:05

Location:		Mine Site B aka 6 mile Lake						
Survey objective:		Determine lake water elevation in North and South Cells			Weather Observations:		32°F, cloudy, light wind	
Instrument Type:		Leica NA720	Instrument ID:	5482372 (GWS owned)				
Rod Type:		Craine fiberglass 20'	Rod ID:	GWS owned				
Bench Mark Information:					Survey Team Names			
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)	Greta Myerchin			
TBM_1	GWS	100.00	N70°19.308'	W149°23.882'				
<b>Station</b>	<b>BS (ft)</b>	<b>HI (ft)</b>	<b>FS (ft)</b>	<b>Elevation (fasl)</b>	<b>Distance (ft)</b>	<b>Horizontal Angle</b>	<b>Vertical Angle</b>	<b>Remarks</b>
TBM_1				100.00				
At 9:05am, measured down to water surface from TBM1			0.95	<b>99.05</b>				<b>MSB N&amp;S WL= 99.9'</b>
Notes:								

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

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

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

Project ID: North Slope Lakes Site Location/Lake ID: Mine Site B  
 Survey Purpose: Water-Level Elevations Date: 6/1/2008 Time: 13:28

Location:		Mine Site B aka 6 mile Lake						
Survey objective:		Determine lake water elevation in North and South Cells			Weather Observations:		32°F, cloudy, light wind	
Instrument Type:		Leica NA720	Instrument ID:	5482372 (GWS owned)				
Rod Type:		Craine fiberglass 20'	Rod ID:	GWS owned				
Bench Mark Information:					Survey Team Names			
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)		Greta Myerchin, Amy Tidwell		
TBM_1	GWS	100.00	N70°19.308'	W149°23.882'				
<b>Station</b>	<b>BS (ft)</b>	<b>HI (ft)</b>	<b>FS (ft)</b>	<b>Elevation (fasl)</b>	<b>Distance (ft)</b>	<b>Horizontal Angle</b>	<b>Vertical Angle</b>	<b>Remarks</b>
TBM_1				100.00				
At 1:28pm, measured down to water surface from TBM1			1.45	<b>98.55</b>				<b>MSB N&amp;S WL= 98.6'</b>
Notes:								

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

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

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

Project ID: North Slope Lakes Site Location/Lake ID: Mine Site B  
 Survey Purpose: Water-Level Elevations Date: 6/2/2008 Time: 11:07

Location:		Mine Site B aka 6 mile Lake						
Survey objective:		Determine lake water elevation in North and South Cells			Weather Observations:		30°F, clear, 15 mph wind	
Instrument Type:		Leica NA720	Instrument ID:	5482372 (GWS owned)				
Rod Type:		Craine fiberglass 20'	Rod ID:	GWS owned				
Bench Mark Information:					Survey Team Names			
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)		Greta Myerchin		
TBM_1	GWS	100.00	N70°19.308'	W149°23.882'				
<b>Station</b>	<b>BS (ft)</b>	<b>HI (ft)</b>	<b>FS (ft)</b>	<b>Elevation (fasl)</b>	<b>Distance (ft)</b>	<b>Horizontal Angle</b>	<b>Vertical Angle</b>	<b>Remarks</b>
TBM_1				100.00				
At 11:07am, measured down to water surface from TBM1			2.02	<b>97.98</b>				<b>MSB N&amp;S WL= 98.0'</b>
Notes:								

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

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

Project ID: North Slope Lakes Site Location/Lake ID: Mine Site B  
 Survey Purpose: Water-Level Elevations Date: 6/3/2008 Time: 13:35

Location:		Mine Site B aka 6 mile Lake						
Survey objective:		Determine lake water elevation in North and South Cells			Weather Observations:		35°F, clear, 10 mph wind	
Instrument Type:		Leica NA720	Instrument ID:	5482372 (GWS owned)				
Rod Type:		Craine fiberglass 20'	Rod ID:	GWS owned				
Bench Mark Information:					Survey Team Names			
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)	Greta Myerchin, Amy Tidwell			
TBM_1	GWS	100.00	N70°19.308'	W149°23.882'				
<b>Station</b>	<b>BS (ft)</b>	<b>HI (ft)</b>	<b>FS (ft)</b>	<b>Elevation (fasl)</b>	<b>Distance (ft)</b>	<b>Horizontal Angle</b>	<b>Vertical Angle</b>	<b>Remarks</b>
TBM_1				100.00				
At 1:35pm, measured down to water surface from TBM1			1.65	<b>98.35</b>				<b>MSB N&amp;S WL= 98.0'</b>
Notes:								

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

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

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

Project ID: North Slope Lakes Site Location/Lake ID: KDA 1,2,3  
 Survey Purpose: Water-Level Elevations Date: 5/24/2008 Time: 14:00

Location: Kuparuk Deadarm Lakes, east of the Spine Road Kuparuk bridge.								
Survey objective: Determine FWS Elevation of cell 1, cell 2 and cell 3 and establish TBM for measuring FWS during snowmelt				Weather Observations: 40°F, sunny, no wind				
Instrument Type: Leica NA 720		Instrument ID: 5482332 (GWS owned)						
Rod Type: Craine fiberglass 25'		Rod ID:						
Bench Mark Information:						Survey Team Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)	Greta Myerchin, Jeff Derry			
BM1	BP	19.32	na	na				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fas)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
BM1	0.60	19.92		19.32				
KDA3-SH		19.92	13.85	6.07				
KDA3-ICE		19.92	13.50	6.42				
TBM - 2/3		19.92	7.73	12.19				
KDA2-SH		19.92	16.76	3.16				
KDA2-ICE		19.92	17.91	2.01				
Turn on KDA2-Ice. Move to Inst.2								
KDA2-ICE	18.01	20.02		2.01				
KDA2-SH		20.02	16.87	<b>3.15</b>				<b>KDA2 WL=3.15'</b>
TBM - 2/3		20.02	7.84	<b>12.18</b>				<b>TBM 2/3 =12.18'</b>
KDA3-ICE		20.02	13.60	<b>6.42</b>				
KDA3-SH		20.02	13.95	<b>6.07</b>				<b>KDA3 WL=6.07'</b>
BM1		20.02	0.71	19.31				close survey to 0.01
Move to Inst.3								
KDA2-SH	12.41	15.56		3.15				
KDA2-ICE		15.56	12.17	<b>3.39</b>				<b>KDA1 WL=8.10</b>
KDA1-SH		15.56	7.06	<b>8.50</b>				<b>KDA1 WL=8.10</b>
KDA1-1		15.56	4.21	11.35				
Turn on TBM KDA1-1. Move to Inst.4								
KDA1-1	4.49	15.84		<b>11.35</b>				<b>TBM KDA1-1=11.35'</b>
KDA1-SH		15.84	7.34	8.50				Note: WL taken near shore, gradient may exist with inflowing melt water
KDA2-ICE		15.84	12.44	3.40				
KDA2-SH		15.84	12.70	3.14				close survey to 0.01

Move to Inst.5								
TBM 2/3	8.30	20.48		12.18				
KDA3-1		20.48	11.71	8.77				
KDA3-2		20.48	10.23	10.25				
KDA3-3		20.48	7.28	13.20				
KDA3-4		20.48	4.71	15.77				
KDA3-5		20.48	1.47	19.01				
Turn on KDA3-5. Move to Inst.6								
KDA3-5	1.64	20.65		<b>19.01</b>				<b>TBM KDA3-5=19.01'</b>
KDA3-4		20.65	4.88	<b>15.77</b>				<b>TBM KDA3-4=15.77'</b>
KDA3-3		20.65	7.46	<b>13.19</b>				<b>TBM KDA3-3=13.19'</b>
KDA3-2		20.65	10.39	<b>10.26</b>				<b>TBM KDA3-2=10.26'</b>
KDA3-1		20.65	11.88	<b>8.77</b>				<b>TBM KDA3-1=8.77'</b>
TBM 2/3		20.65	8.47	12.18				close survey to 0.00

Note: TBM KDA3-3 is anchored in ice and shallow ground. If ice is absent when TBM is needed for determining FWL, omit point and resurvey TBM.

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

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

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

Project ID: North Slope Lakes Site Location/Lake ID: KDA 1,2,3  
 Survey Purpose: Water-Level Elevations Date: 5/26/2008 Time: 8:30

Location: Kuparuk Deadarm Lakes, east of the Spine Road Kuparuk bridge.								
Survey objective: Determine FWS Elevation of cell 1, cell 2 and cell 3				Weather Observations: 45°F, partly cloudy, wind				
Instrument Type: Leica NA 720		Instrument ID: 5482332 (GWS owned)						
Rod Type: Craine fiberglass 25'		Rod ID:						
Bench Mark Information:						Survey Team Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)	Greta Myerchin, Jeff Derry			
TBM 2/3	GWS	12.18	na	na				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
TBM 2/3	3.19	15.37		12.18				
KDA2-WL		15.37	11.74	3.63				
KDA3-WL		15.37	8.92	6.45				
KDA3-ICE		15.37	8.35	7.02				
Turn on KDA2-Ice. Move to Inst.2								
KDA3-ICE	8.55	15.57		7.02				
KDA3-WL		15.57	9.12	<b>6.45</b>				<b>KDA3 WL=6.45'</b>
KDA2-WL		15.57	11.93	<b>3.64</b>				<b>KDA2 WL=3.64'</b>
TBM 2/3		15.57	3.39	<b>12.18</b>				close survey to 0.00
KDA1-1				11.35				Measured down to water surface
At 8:30am, measured down to water surface from TBM KDA1-1			2.16	<b>9.19</b>				<b>KDA1 WL= 9.19'</b>

Note: TBM KDA3-3 is anchored in ice and shallow ground. If ice is absent when TBM is needed for determining FWL, omit point and resurvey TBM.

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

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

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

Project ID: North Slope Lakes Site Location/Lake ID: KDA 1,2,3  
 Survey Purpose: Water-Level Elevations Date: 5/27/2008 Time: 9:30

Location: Kuparuk Deadarm Lakes, east of the Spine Road Kuparuk bridge.								
Survey objective: Determine FWS Elevation of cell 1, cell 2 and cell 3				Weather Observations: 40°F, cloudy, 5 mph wind				
Instrument Type: Leica NA 720		Instrument ID: 5482332 (GWS owned)						
Rod Type: Craine fiberglass 25'		Rod ID:						
Bench Mark Information:						Survey Team Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)		Greta Myerchin		
TBM 2/3	GWS	12.18	na	na				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
KDA1-1				11.35				Measured down to water surface
At 9:30am, measured down to water surface from TBM KDA1-1			2.16	<b>9.19</b>				<b>KDA1 WL= 9.19'</b>

Note: TBM KDA3-3 is anchored in ice and shallow ground. If ice is absent when TBM is needed for determining FWL, omit point and resurvey TBM.

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

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

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

Project ID: North Slope Lakes Site Location/Lake ID: KDA 1,2,3  
 Survey Purpose: Water-Level Elevations Date: 5/28/2008 Time: 13:20

Location: Kuparuk Deadarm Lakes, east of the Spine Road Kuparuk bridge.								
Survey objective: Determine FWS Elevation of cell 1, cell 2 and cell 3				Weather Observations: 32°F, cloudy, light wind and snow				
Instrument Type: Leica NA 720		Instrument ID: 5482332 (GWS owned)						
Rod Type: Craine fiberglass 25'		Rod ID:						
Bench Mark Information:						Survey Team Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)	Greta Myerchin, Amy Tidwell			
TBM 2/3	na	12.18	na	na				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
TBM 2/3	3.41	15.59		12.18				
KDA2-1		15.59	3.89	11.70				
KDA2-WL		15.59	9.29	6.30				
KDA3-WL		15.59	9.31	6.28				
KDA3-1		15.59	5.82	9.77				
KDA3-3		15.59	3.23	12.36				
Turn on KDA2-Ice. Move to Inst.2								
KDA3-3	3.06	15.42		12.36				KDA3-3=12.36'
KDA3-1		15.42	5.66	9.76				KDA3-1=9.76'
KDA3-WL		15.42	9.14	<b>6.28</b>				<b>KDA3 WL=6.28'</b>
KDA2-WL		15.42	9.14	<b>6.28</b>				<b>KDA2 WL=6.28'</b>
KDA2-1		15.42	3.71	11.71				KDA2 WL=11.71'
TBM 2/3		15.42	3.24	<b>12.18</b>				close survey to 0.00
TBM KDA1-1				11.35				Measured down from TBM_RD to water
At 1:20pm, measured down to water surface from TBM KDA1-1			2.13	<b>9.22</b>				<b>KDA1 WL= 9.22'</b>

Note: TBM KDA3-3 is anchored in ice and shallow ground. If ice is absent when TBM is needed for determining FWL, omit point and resurvey TBM.

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

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

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

Project ID: North Slope Lakes Site Location/Lake ID: KDA 1,2,3  
 Survey Purpose: Water-Level Elevations Date: 5/29/2008 Time: 9:27

Location: Kuparuk Deadarm Lakes, east of the Spine Road Kuparuk bridge.								
Survey objective: Determine FWS Elevation of cell 1, cell 2 and cell 3				Weather Observations: 40°F, cloudy, light wind				
Instrument Type: Leica NA 720		Instrument ID: 5482332 (GWS owned)						
Rod Type: Craine fiberglass 25'		Rod ID:						
Bench Mark Information:						Survey Team Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)		Greta Myerchin		
TBM 2/3	GWS	12.18	na	na				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
KDA1-1				11.35				Measured down to water surface
At 9:27am, measured down to water surface from TBM KDA1-1			2.18	<b>9.17</b>				<b>KDA1 WL= 9.17'</b>
Note: TBM KDA3-3 is anchored in ice and shallow ground. If ice is absent when TBM is needed for determining FWL, omit point and resurvey TBM.								

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

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

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

Project ID: North Slope Lakes Site Location/Lake ID: KDA 1,2,3  
 Survey Purpose: Water-Level Elevations Date: 5/30/2008 Time: 11:58

Location: Kuparuk Deadarm Lakes, east of the Spine Road Kuparuk bridge.								
Survey objective: Determine FWS Elevation of cell 1, cell 2 and cell 3				Weather Observations: 34°F, cloudy, 5 mph wind				
Instrument Type: Leica NA 720		Instrument ID: 5482332 (GWS owned)						
Rod Type: Craine fiberglass 25'		Rod ID:						
Bench Mark Information:						Survey Team Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)	Greta Myerchin, Amy Tidwell			
TBM 2/3	GWS	12.18	na	na				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
KDA1-1				11.35				Measured down to water surface
At 12:02am, measured down to water surface from TBM KDA1-1			0.89	<b>10.46</b>				<b>KDA1 WL= 10.46'</b>
KDA3-3				12.36				Measured down to water surface
At 11:58am, measured down to water surface from TBM KDA3-3			1.87	<b>10.49</b>				<b>KDA2 and 3 WL= 10.49'</b>
Note: KDA2 and 3 are combined; the banks have been overtopped. KDA2 is flowing into 1 through the culvert. They have not equilibrated yet, as the water can be seen flowing. The culverts from the Kuparuk to KDA1 is flowing lightly and the main culvert from KDA4 to 3 heavily, and secondary culvert is flowing less heavily.								

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

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

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

Project ID: North Slope Lakes Site Location/Lake ID: KDA 1,2,3  
 Survey Purpose: Water-Level Elevations Date: 5/31/2008 Time: 9:42

Location: Kuparuk Deadarm Lakes, east of the Spine Road Kuparuk bridge.								
Survey objective: Determine FWS Elevation of cell 1, cell 2 and cell 3				Weather Observations: 32°F, cloudy, light wind				
Instrument Type: Leica NA 720		Instrument ID: 5482332 (GWS owned)						
Rod Type: Craine fiberglass 25'		Rod ID:						
Bench Mark Information:						Survey Team Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)	Greta Myerchin			
TBM 2/3	GWS	12.18	na	na				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
KDA3-3				12.36				Measured down to water surface
At 11:58am, measured down to water surface from TBM KDA3-3			0.69	<b>11.67</b>				<b>KDA1, 2 and 3 WL= 11.67'</b>
KDA3-3				12.36				Measured down to water surface
At 5:30pm, measured down to water surface from TBM KDA3-3			0.74	<b>11.62</b>				<b>KDA1, 2 and 3 WL= 11.62'</b>
Note:								

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

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

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

Project ID: North Slope Lakes Site Location/Lake ID: KDA 1,2,3  
 Survey Purpose: Water-Level Elevations Date: 6/1/2008 Time: 12:46

Location: Kuparuk Deadarm Lakes, east of the Spine Road Kuparuk bridge.								
Survey objective: Determine FWS Elevation of cell 1, cell 2 and cell 3				Weather Observations:		32°F, cloudy, light wind		
Instrument Type: Leica NA 720		Instrument ID: 5482332 (GWS owned)						
Rod Type: Craine fiberglass 25'		Rod ID:						
Bench Mark Information:						Survey Team Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)		Greta Myerchin. Amy Tidwell		
TBM 2/3	GWS	12.18	na	na				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
KDA3-3				12.36				Measured down to water surface
At 12:46pm, measured down to water surface from TBM KDA3-3			1.23	<b>11.13</b>				<b>KDA1, 2 and 3 WL= 11.13'</b>
Note: Main culvert between KDA3 to 4 flowing from 3 to 4.								

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

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

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

Project ID: North Slope Lakes Site Location/Lake ID: KDA 1,2,3  
 Survey Purpose: Water-Level Elevations Date: 6/2/2008 Time: 11:53

Location: Kuparuk Deadarm Lakes, east of the Spine Road Kuparuk bridge.								
Survey objective: Determine FWS Elevation of cell 1, cell 2 and cell 3				Weather Observations: 32°F, cloudy, light wind				
Instrument Type: Leica NA 720		Instrument ID: 5482332 (GWS owned)						
Rod Type: Craine fiberglass 25'		Rod ID:						
Bench Mark Information:						Survey Team Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)	Greta Myerchin			
TBM 2/3	GWS	12.18	na	na				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
KDA3-3				12.36				Measured down to water surface
At 11:56am, measured down to water surface from TBM KDA3-3			1.58	<b>10.78</b>				<b>KDA1, 2 and 3 WL= 10.78'</b>
Note: Main culvert between KDA 3 and 4 still draining from 3 to 4. Elevation of KDA 4 significantly lower than KDA 3.								

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

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

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

Project ID: North Slope Lakes Site Location/Lake ID: KDA 1,2,3  
 Survey Purpose: Water-Level Elevations Date: 6/3/2008 Time: 14:07

Location: Kuparuk Deadarm Lakes, east of the Spine Road Kuparuk bridge.								
Survey objective: Determine FWS Elevation of cell 1, cell 2 and cell 3				Weather Observations:		35°F, clear, 10 mph wind		
Instrument Type: Leica NA 720		Instrument ID: 5482332 (GWS owned)						
Rod Type: Craine fiberglass 25'		Rod ID:						
Bench Mark Information:						Survey Team Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)	Greta Myerchin. Amy Tidwell			
TBM 2/3	GWS	12.18	na	na				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
KDA3-3				12.36				Measured down to water surface
At 2:07pm, measured down to water surface from TBM KDA3-3			1.72	<b>10.64</b>				<b>KDA2 and 3 WL= 10.64'</b>
KDA1-1				11.35				Measured down to water surface
At 2:14pm, measured down to water surface from TBM KDA1-1			0.69	<b>10.66</b>				<b>KDA1 WL= 10.66'</b>
Note: KDA2 and KDA3 water surface no longer connected. Still connected by the culvert.								

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

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

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

Project ID: North Slope Lakes Site Location/Lake ID: KDA 4,5  
 Survey Purpose: Water-Level Elevations Date: 5/24/2008 Time: 16:30

Location: Kuparuk Deadarm Lakes, east of the Spine Road Kuparuk bridge.								
Survey objective: Determine FWS Elevation of cell 4 and 5 and establish TBM for measuring FWS during snowmelt				Weather Observations: 40°F, sunny, no wind				
Instrument Type: Leica NA 720		Instrument ID: 5482332 (GWS owned)						
Rod Type: Craine fiberglass 25'		Rod ID:						
Bench Mark Information:						Survey Team Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)	Greta Myerchin, Jeff Derry			
BM3	BP	18.9	na	na				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
BM3	0.43	19.33		18.90				
JD-1		19.33	5.33	14.00				
JD-2		19.33	9.06	10.27				
Culvert-4		19.33	13.48	5.85				
Culvert-5		19.33	13.56	5.77				
Turn on Culvert-5. Move to Inst.2								
Culvert-5	13.63	19.40		<b>5.77</b>				<b>Top of Culvert for KDA5 = 5.77'</b>
Culvert-4		19.40	13.56	<b>5.84</b>				<b>Top of Culvert for KDA4 = 5.84'</b>
JD-2		19.40	9.14	<b>10.26</b>				<b>TBM JD2=10.26'</b>
JD-1		19.40	5.40	<b>14.00</b>				<b>TBM JD1=14.00'</b>
BM3		19.40	0.50	18.90				close survey to 0.00
TBM Culvert-5				5.77				Measured down from Culvert-5 to water
At 4:30pm, measured down to water surface from Top of Culvert-5			1.38	<b>4.39</b>				<b>KDA5 WL= 4.39'</b>
TBM Culvert-4				5.84				Measured down from Culvert-4 to water
At 4:32pm, measured down to water surface from Top of Culvert-4			1.26	<b>4.58</b>				<b>KDA4 WL= 4.58'</b>

Note:

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

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

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

Project ID: North Slope Lakes Site Location/Lake ID: KDA 4,5  
 Survey Purpose: Water-Level Elevations Date: 5/26/2008 Time: 9:00

Location: Kuparuk Deadarm Lakes, east of the Spine Road Kuparuk bridge.								
Survey objective: Determine FWS Elevation of cell 4 and 5 and establish TBM for measuring FWS during snowmelt				Weather Observations: 40°F, sunny, no wind				
Instrument Type: Leica NA 720		Instrument ID: 5482332 (GWS owned)						
Rod Type: Craine fiberglass 25'		Rod ID:						
Bench Mark Information:						Survey Team Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)		Greta Myerchin, Jeff Derry		
BM3	BP	18.9	na	na				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
TBM Culvert-5				5.77				Measured down from Culvert-5 to water
At 9:00am, measured down to water surface from Top of Culvert-5			1.06	<b>4.71</b>				<b>KDA5 WL= 4.71'</b>
TBM Culvert-4				5.84				Measured down from Culvert-4 to water
At 9:00am, measured down to water surface from Top of Culvert-4			0.90	<b>4.94</b>				<b>KDA4 WL= 4.94'</b>

Note:

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

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

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

Project ID: North Slope Lakes Site Location/Lake ID: KDA 4,5  
 Survey Purpose: Water-Level Elevations Date: 5/27/2008 Time: 10:00

Location: Kuparuk Deadarm Lakes, east of the Spine Road Kuparuk bridge.								
Survey objective: Determine FWS Elevation of cell 4 and 5 and establish TBM for measuring FWS during snowmelt				Weather Observations: 40°F, cloudy, 5 mph wind				
Instrument Type: Leica NA 720		Instrument ID: 5482332 (GWS owned)						
Rod Type: Craine fiberglass 25'		Rod ID:						
Bench Mark Information:						Survey Team Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)	Greta Myerchin			
BM3	BP	18.9	na	na				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
TBM Culvert-5				5.77				Measured down from Culvert-5 to water
At 10:00am, measured down to water surface from Top of Culvert-5			0.64	<b>5.13</b>				<b>KDA5 WL= 5.13'</b>
TBM Culvert-4				5.84				Measured down from Culvert-4 to water
At 10:00am, measured down to water surface from Top of Culvert-4			0.72	<b>5.12</b>				<b>KDA4 WL= 5.12'</b>

Note:

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

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

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

Project ID: North Slope Lakes Site Location/Lake ID: KDA 4,5  
 Survey Purpose: Water-Level Elevations Date: 5/28/2008 Time: 13:10

Location: Kuparuk Deadarm Lakes, east of the Spine Road Kuparuk bridge.								
Survey objective: Determine FWS Elevation of cell 4 and 5 and establish TBM for measuring FWS during snowmelt				Weather Observations:		32°F, cloudy, light wind and snow		
Instrument Type: Leica NA 720		Instrument ID: 5482332 (GWS owned)						
Rod Type: Craine fiberglass 25'		Rod ID:						
Bench Mark Information:						Survey Team Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)		Greta Myerchin, Amy Tidwell		
BM3	BP	18.9	na	na				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
TBM Culvert-5				5.77				Measured down from Culvert-5 to water
At 1:10pm, measured down to water surface from Top of Culvert-5			0.46	<b>5.31</b>				<b>KDA5 WL= 5.31'</b>
TBM Culvert-4				5.84				Measured down from Culvert-4 to water
At 1:10pm, measured down to water surface from Top of Culvert-4			0.53	<b>5.31</b>				<b>KDA4 WL= 5.31'</b>

Note:

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

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

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

Project ID: North Slope Lakes Site Location/Lake ID: KDA 4,5  
 Survey Purpose: Water-Level Elevations Date: 5/29/2008 Time: 9:15

Location: Kuparuk Deadarm Lakes, east of the Spine Road Kuparuk bridge.								
Survey objective: Determine FWS Elevation of cell 4 and 5 and establish TBM for measuring FWS during snowmelt				Weather Observations:		40°F, cloudy, light wind		
Instrument Type: Leica NA 720		Instrument ID: 5482332 (GWS owned)						
Rod Type: Craine fiberglass 25'		Rod ID:						
Bench Mark Information:						Survey Team Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)		Greta Myerchin		
BM3	BP	18.9	na	na				
<b>Station</b>	<b>BS (ft)</b>	<b>HI (ft)</b>	<b>FS (ft)</b>	<b>Elevation (fasl)</b>	<b>Distance (ft)</b>	<b>Horizontal Angle</b>	<b>Vertical Angle</b>	<b>Remarks</b>
JD-2				10.26				Measured down from JD-2 to water surface
At 9:15am, measured down to water surface from JD-2			0.85	<b>9.41</b>				<b>KDA4 and 5 WL= 9.41'</b>

Note: Water has overtopped the road and KDA4 and 5 are the same water surface.

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

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

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

Project ID: North Slope Lakes Site Location/Lake ID: KDA 4,5  
 Survey Purpose: Water-Level Elevations Date: 5/30/2008 Time: 12:12

Location: Kuparuk Deadarm Lakes, east of the Spine Road Kuparuk bridge.								
Survey objective: Determine FWS Elevation of cell 4 and 5 and establish TBM for measuring FWS during snowmelt				Weather Observations:		34°F, cloudy, 5mph wind		
Instrument Type: Leica NA 720		Instrument ID: 5482332 (GWS owned)						
Rod Type: Craine fiberglass 25'		Rod ID:						
Bench Mark Information:						Survey Team Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)		Greta Myerchin, Amy Tidwell		
BM3	BP	18.9	na	na				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
JD-1				14.00				Measured down from JD-1 to water surface
At 12:12pm, measured down to water surface from JD-1			2.25	<b>11.75</b>				<b>KDA4 and 5 WL= 11.75'</b>
JD-1				14.00				Measured down from JD-1 to water surface
At 8:15pm, measured down to water surface from JD-1			2.51	<b>11.49</b>				<b>KDA4 and 5 WL= 11.49'</b>

Note:

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

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

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

Project ID: North Slope Lakes Site Location/Lake ID: KDA 4,5  
 Survey Purpose: Water-Level Elevations Date: 5/31/2008 Time: 9:50

Location: Kuparuk Deadarm Lakes, east of the Spine Road Kuparuk bridge.								
Survey objective: Determine FWS Elevation of cell 4 and 5 and establish TBM for measuring FWS during snowmelt				Weather Observations: 32°F, cloudy, light wind				
Instrument Type: Leica NA 720		Instrument ID: 5482332 (GWS owned)						
Rod Type: Craine fiberglass 25'		Rod ID:						
Bench Mark Information:						Survey Team Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)	Greta Myerchin			
BM3	BP	18.9	na	na				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
JD-1				14.00				Measured down from JD-1 to water surface
At 9:50am, measured down to water surface from JD-1			2.19	<b>11.81</b>				<b>KDA4 and 5 WL= 11.81'</b>
JD-1				14.00				Measured down from JD-1 to water surface
At 5:35pm, measured down to water surface from JD-1			2.32	<b>11.68</b>				<b>KDA4 and 5 WL= 11.68'</b>

Note:

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

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

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

Project ID: North Slope Lakes Site Location/Lake ID: KDA 4,5  
 Survey Purpose: Water-Level Elevations Date: 6/1/2008 Time: 12:53

Location: Kuparuk Deadarm Lakes, east of the Spine Road Kuparuk bridge.								
Survey objective: Determine FWS Elevation of cell 4 and 5 and establish TBM for measuring FWS during snowmelt				Weather Observations:		32°F, cloudy, light wind		
Instrument Type: Leica NA 720		Instrument ID: 5482332 (GWS owned)						
Rod Type: Craine fiberglass 25'		Rod ID:						
Bench Mark Information:						Survey Team Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)		Greta Myerchin, Amy Tidwell		
BM3	BP	18.9	na	na				
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks
JD-1				14.00				Measured down from JD-1 to water surface
At 12:53am, measured down to water surface from JD-1			3.00	<b>11.00</b>				<b>KDA4 and 5 WL= 11.00'</b>

Note:

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

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

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

Project ID: North Slope Lakes Site Location/Lake ID: KDA 4,5  
 Survey Purpose: Water-Level Elevations Date: 6/2/2008 Time: 12:06

Location: Kuparuk Deadarm Lakes, east of the Spine Road Kuparuk bridge.								
Survey objective: Determine FWS Elevation of cell 4 and 5 and establish TBM for measuring FWS during snowmelt				Weather Observations:		30°F, clear, 15 mph wind		
Instrument Type: Leica NA 720		Instrument ID: 5482332 (GWS owned)						
Rod Type: Craine fiberglass 25'		Rod ID:						
Bench Mark Information:					Survey Team Names			
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)	Greta Myerchin			
BM3	BP	18.9	na	na				
<b>Station</b>	<b>BS (ft)</b>	<b>HI (ft)</b>	<b>FS (ft)</b>	<b>Elevation (fasl)</b>	<b>Distance (ft)</b>	<b>Horizontal Angle</b>	<b>Vertical Angle</b>	<b>Remarks</b>
JD-1				14.00				Measured down from JD-1 to water surface
At 12:06pm, measured down to water surface from JD-1			3.65	<b>10.35</b>				<b>KDA4 and 5 WL= 10.35'</b>

Note:

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

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

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

Project ID: North Slope Lakes Site Location/Lake ID: KDA 4,5  
 Survey Purpose: Water-Level Elevations Date: 6/3/2008 Time: 14:25

Location: Kuparuk Deadarm Lakes, east of the Spine Road Kuparuk bridge.								
Survey objective: Determine FWS Elevation of cell 4 and 5 and establish TBM for measuring FWS during snowmelt				Weather Observations:		35°F, clear, 10 mph wind		
Instrument Type: Leica NA 720		Instrument ID: 5482332 (GWS owned)						
Rod Type: Craine fiberglass 25'		Rod ID:						
Bench Mark Information:						Survey Team Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)		Greta Myerchin, Amy Tidwell		
BM3	BP	18.9	na	na				
<b>Station</b>	<b>BS (ft)</b>	<b>HI (ft)</b>	<b>FS (ft)</b>	<b>Elevation (fasl)</b>	<b>Distance (ft)</b>	<b>Horizontal Angle</b>	<b>Vertical Angle</b>	<b>Remarks</b>
JD-1				14.00				Measured down from JD-1 to water surface
At 2:25pm, measured down to water surface from JD-1			4.55	<b>9.45</b>				<b>KDA4 and 5 WL= 9.45'</b>

Note:

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

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

Project ID: North Slope Lakes Site Location/Lake ID: KDA - Kuparuk River  
 Survey Purpose: Water-Level Elevations Date: 2008 Time: \_\_\_\_\_

Location: Kuparuk Bridge, water levels. Measurement taken from point labeled UAF 6/1/07 prior year.						
Survey objective: Lake water elevation survey				Weather Observations:		
Instrument Type: Leica NA720		Instrument ID: 5482367 (GWS owned)				
Rod Type: Craine fiberglass 20'		Rod ID: GWS owned				
Bench Mark Information:				Survey Team Names		
Name	Agency Responsible	Elevation (ft)	Latitude (dd-mm.mmm)	Longitude (ddd-mm.mmm)	Greta Myerchin	
<b>Date</b>	<b>Distance from Bridge to water surface</b>					<b>Remarks</b>
May 28 at 1:00pm	10.83					First day with flow
May 29 at 9:00 am	Jammed with ice					Backhoe working on bridge to open flow
May 30 at 11:01am	6.85					
May 30 at 8:02pm	6.90					
May 31 at 8:40am	6.66					
May 31 at 5:23pm	6.96					
June 1 at 1:03pm	7.55					
June 2 at 10:45am	8.35					
June 3 at 1:15pm	8.95					
Notes:						
Abbreviations: backsight, BS; degrees, dd; feet, ft; feet above mean sea level, fasm; foresight, FS; height of instrument, HI; minutes, mm; seconds, ss; BP Mean Sea Level, BPMSL						

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

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

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

Project ID: North Slope Lakes Project Site Location/Lake ID: L9312  
 Survey Purpose: Snow Depth and Water Content Date: 5/16/2008 Time: 14:00

Location Description:	Snow course located directly north of the Met Site next to the pumphouse.				
Survey objective:	Snow depths and snow-water content for lake recharge estimates			Weather Observations:	nr
Latitude:	N 70°19.9444'	Longitude:	W 150° 57.047'	Datum:	NAD27 Alaska
Elevation:		Elevation Datum:	BPMSL	Reference Markers:	Site staked with lathe
Drainage Basin:	L9312	Slope Direction:	Flat	Vegetation Type:	Tussock
Slope Angle:	Flat	Access Notes:	Hagglund	Other:	1 meter increments
Snow Depth Probe Type:	T-handle snow depth probe,			Snow-Survey Team Names	
Snow Tube Type:	Adirondak, 6.74 cm diameter cutter, area = 35.7 cm <sup>2</sup>			Chad Cormack	

Snow Course Depths, in cm.

	1	2	3	4	5
1	72	40	39	34	38
2	67	38	43	46	26
3	53	25	3	38	28
4	52	20	19	25	16
5	44	20	17	18	36
6	20	33	18	0	58
7	34	48	18	11	27
8	35	52	11	6	24
9	45	61	20	23	27
10	44	52	34	35	29

(cm)  
 Average snow depth = 32.4  
 Maximum snow depth = 72.0  
 Minimum snow depth = 0.0  
 Standard variation = 16.2

Snow Sample Depths and Weights

Bag #	Depth (cm)	Weight (gr)	Volume (cm <sup>3</sup> )	Density (gr/cm <sup>3</sup> )
SWE1	75	1004.5	2677.5	0.38
SWE2	20	278	714.0	0.39
SWE3	31	370.6	1106.7	0.33
SWE4	22	222.6	785.4	0.28
SWE5	16	181.6	571.2	0.32

Average Density = 0.34 gr/cm<sup>3</sup>  
 Average Snow Water Equivalent (SWE) = 11.0 cm H<sub>2</sub>O  
 Average Snow Water Equivalent = 4.34 inches H<sub>2</sub>O  
 Average Snow Water Equivalent = 0.36 feet H<sub>2</sub>O

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

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

Project ID: North Slope Lakes Project Site Location/Lake ID: L9312  
 Survey Purpose: Snow Depth and Water Content Date: 5/18/2008 Time: 15:00

Location Description:	Snow course located directly north of the Met Site next to the pumphouse.				
Survey objective:	Snow depths and snow-water content for lake recharge estimates			Weather Observations:	nr
Latitude:	N 70°19.9444'	Longitude:	W 150° 57.047'	Datum:	NAD27 Alaska
Elevation:		Elevation Datum:	BPMSL	Reference Markers:	Site staked with lathe
Drainage Basin:	L9312	Slope Direction:	Flat	Vegetation Type:	Tussock
Slope Angle:	Flat	Access Notes:	Hagglund	Other:	1 meter increments
Snow Depth Probe Type:	T-handle snow depth probe,			Snow-Survey Team Names	
Snow Tube Type:	Adirondak, 6.74 cm diameter cutter, area = 35.7 cm <sup>2</sup>			Chad Cormack	

Snow Course Depths, in cm.

	1	2	3	4	5
1	60	35	38	39	28
2	63	34	41	42	24
3	51	12	0	21	17
4	49	0	10	16	19
5	39	15	0	0	19
6	15	30	13	0	45
7	24	42	0	0	28
8	31	43	0	15	18
9	37	57	14	24	22
10	42	44	32	27	25

(cm)  
 Average snow depth = 26.0  
 Maximum snow depth = 63.0  
 Minimum snow depth = 0.0  
 Standard variation = 17.1

Snow Sample Depths and Weights

Bag #	Depth (cm)	Weight (gr)	Volume (cm <sup>3</sup> )	Density (gr/cm <sup>3</sup> )
SWE1	76	1152.9	2713.2	0.42
SWE2	13	244.7	464.1	0.53
SWE3	20	212.1	714.0	0.30
SWE4	32	260.7	1142.4	0.23
SWE5	7	232.6	249.9	0.93

Average Density = 0.48 gr/cm<sup>3</sup>  
 Average Snow Water Equivalent (SWE) = 12.5 cm H<sub>2</sub>O  
 Average Snow Water Equivalent = 4.93 inches H<sub>2</sub>O  
 Average Snow Water Equivalent = 0.41 feet H<sub>2</sub>O

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

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

Project ID: North Slope Lakes Project Site Location/Lake ID: L9312  
 Survey Purpose: Snow Depth and Water Content Date: 5/19/2008 Time: 10:00

Location Description:	Snow course located directly north of the Met Site next to the pumphouse.				
Survey objective:	Snow depths and snow-water content for lake recharge estimates			Weather Observations:	nr
Latitude:	N 70°19.9444'	Longitude:	W 150° 57.047'	Datum:	NAD27 Alaska
Elevation:		Elevation Datum:	BPMSL	Reference Markers:	Site staked with lathe
Drainage Basin:	L9312	Slope Direction:	Flat	Vegetation Type:	Tussock
Slope Angle:	Flat	Access Notes:	Hagglund	Other:	1 meter increments
Snow Depth Probe Type:	T-handle snow depth probe,			Snow-Survey Team Names	
Snow Tube Type:	Adirondak, 6.74 cm diameter cutter, area = 35.7 cm <sup>2</sup>			Chad Cormack, Dan Reichardt	

Snow Course Depths, in cm.

	1	2	3	4	5
1	74	35	14	46	23
2	58	26	0	30	17
3	51	17	0	24	20
4	47	30	7	0	11
5	37	43	0	0	15
6	11	43	0	0	61
7	22	57	10	4	13
8	29	46	0	21	18
9	35	39	15	20	20
10	37	37	33	29	19

(cm)  
 Average snow depth = 24.9  
 Maximum snow depth = 74.0  
 Minimum snow depth = 0.0  
 Standard variation = 18.4

Snow Sample Depths and Weights

Bag #	Depth (cm)	Weight (gr)	Volume (cm <sup>3</sup> )	Density (gr/cm <sup>3</sup> )
SWE1	51	622	1820.7	0.34
SWE2	22	364.7	785.4	0.46
SWE3	27	321.5	963.9	0.33
SWE4	36	460.5	1285.2	0.36
SWE5	31	379.8	1106.7	0.34

Average Density = 0.37 gr/cm<sup>3</sup>  
 Average Snow Water Equivalent (SWE) = 9.2 cm H<sub>2</sub>O  
 Average Snow Water Equivalent = 3.61 inches H<sub>2</sub>O  
 Average Snow Water Equivalent = 0.30 feet H<sub>2</sub>O

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

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

Project ID: North Slope Lakes Project Site Location/Lake ID: L9312  
 Survey Purpose: Snow Depth and Water Content Date: 5/21/2008 Time: 11:00

Location Description:	Snow course located directly north of the Met Site next to the pumphouse.				
Survey objective:	Snow depths and snow-water content for lake recharge estimates		Weather Observations:	17 F, Foggy, Light Wind	
Latitude:	N 70°19.9444'	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, 6.74 cm diameter cutter, area = 35.7 cm <sup>2</sup>			Chad Cormack	

Snow Course Depths, in cm.

	1	2	3	4	5
1	66	35	22	32	20
2	60	25	26	40	19
3	48	10	0	29	12
4	46	0	0	15	0
5	34	35	0	0	0
6	0	43	0	0	0
7	8	32	0	0	35
8	27	52	0	0	58
9	31	37	2	2	7
10	37	25	33	2	9

(cm)  
 Average snow depth = 20.3  
 Maximum snow depth = 66.0  
 Minimum snow depth = 0.0  
 Standard variation = 19.4

Snow Sample Depths and Weights

Bag #	Depth (cm)	Weight (gr)	Volume (cm <sup>3</sup> )	Density (gr/cm <sup>3</sup> )
SWE1	65	930	2320.5	0.40
SWE2	23	238.7	821.1	0.29
SWE3	28	328.3	999.6	0.33
SWE4	22	177.2	785.4	0.23
SWE5	10	77.1	357.0	0.22

Average Density = 0.29 gr/cm<sup>3</sup>  
 Average Snow Water Equivalent (SWE) = 5.9 cm H<sub>2</sub>O  
 Average Snow Water Equivalent = 2.33 inches H<sub>2</sub>O  
 Average Snow Water Equivalent = 0.19 feet H<sub>2</sub>O

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

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

Project ID: North Slope Lakes Project Site Location/Lake ID: L9312  
 Survey Purpose: Snow Depth and Water Content Date: 5/16/2007 Time: 14:00

Location Description:	Located on South end of lake. Marked with three orange poles				
Survey objective:	Snow depths and snow-water content for lake recharge estimates			Weather Observations:	nr
Latitude:	N 70°19.9444'	Longitude:	W 150° 57.047'	Datum:	NAD27 Alaska
Elevation:		Elevation Datum:	BPMSL	Reference Markers:	Site staked with lathe
Drainage Basin:	L9312	Slope Direction:	Flat	Vegetation Type:	Tussock
Slope Angle:	Flat	Access Notes:	Hagglund	Other:	1 meter increments
Snow Depth Probe Type:	T-handle snow depth probe,			Snow-Survey Team Names	
Snow Tube Type:	Adirondak, 6.74 cm diameter cutter, area = 35.7 cm <sup>2</sup>			Chad Cormack	

Snow Course Depths, in cm.

	1	2	3	4	5
1	30	16	50	44	47
2	45	32	42	51	49
3	43	17	22	58	37
4	35	30	0	60	24
5	34	30	20	59	30
6	34	37	30	54	30
7	33	24	29	31	31
8	35	15	85	24	25
9	32	13	63	22	38
10	34	36	44	26	50

(cm)  
 Average snow depth = 35.6  
 Maximum snow depth = 85.0  
 Minimum snow depth = 0.0  
 Standard variation = 14.9

Snow Sample Depths and Weights

Bag #	Depth (cm)	Weight (gr)	Volume (cm <sup>3</sup> )	Density (gr/cm <sup>3</sup> )
SWE1	47	559.9	1677.9	0.33
SWE2	24	233.7	856.8	0.27
SWE3	43	504.2	1535.1	0.33
SWE4	35	569.6	1249.5	0.46
SWE5	21	138.5	749.7	0.18

Average Density = 0.32 gr/cm<sup>3</sup>  
 Average Snow Water Equivalent (SWE) = 11.2 cm H<sub>2</sub>O  
 Average Snow Water Equivalent = 4.42 inches H<sub>2</sub>O  
 Average Snow Water Equivalent = 0.37 feet H<sub>2</sub>O

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

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

Project ID: North Slope Lakes Project Site Location/Lake ID: L9312  
 Survey Purpose: Snow Depth and Water Content Date: 5/18/2008 Time: 14:00

Location Description:	Located on South end of lake. Marked with three orange poles				
Survey objective:	Snow depths and snow-water content for lake recharge estimates			Weather Observations:	nr
Latitude:	N 70°19.9444'	Longitude:	W 150° 57.047'	Datum:	NAD27 Alaska
Elevation:		Elevation Datum:	BPMSL	Reference Markers:	Site staked with lathe
Drainage Basin:	L9312	Slope Direction:	Flat	Vegetation Type:	Tussock
Slope Angle:	Flat	Access Notes:	Hagglund	Other:	1 meter increments
Snow Depth Probe Type:	T-handle snow depth probe,			Snow-Survey Team Names	
Snow Tube Type:	Adirondak, 6.74 cm diameter cutter, area = 35.7 cm <sup>2</sup>			Chad Cormack	

Snow Course Depths, in cm.

	1	2	3	4	5
1	28	33	39	44	43
2	42	19	16	49	43
3	31	28	20	53	29
4	30	27	28	52	22
5	32	35	34	48	29
6	28	22	24	40	17
7	29	0	22	27	17
8	24	9	64	14	15
9	35	38	62	12	29
10	27	50	38	21	39

(cm)  
 Average snow depth = 31.1  
 Maximum snow depth = 64.0  
 Minimum snow depth = 0.0  
 Standard variation = 13.3

Snow Sample Depths and Weights

Bag #	Depth (cm)	Weight (gr)	Volume (cm <sup>3</sup> )	Density (gr/cm <sup>3</sup> )
SWE1	56	643.9	1999.2	0.32
SWE2	24	281.6	856.8	0.33
SWE3	28	308.3	999.6	0.31
SWE4	50	530.5	1785.0	0.30
SWE5	30	406.9	1071.0	0.38

Average Density = 0.33 gr/cm<sup>3</sup>  
 Average Snow Water Equivalent (SWE) = 10.2 cm H<sub>2</sub>O  
 Average Snow Water Equivalent = 4.01 inches H<sub>2</sub>O  
 Average Snow Water Equivalent = 0.33 feet H<sub>2</sub>O

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

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

Project ID: North Slope Lakes Project Site Location/Lake ID: L9312  
 Survey Purpose: Snow Depth and Water Content Date: 5/19/2008 Time: 10:00

Location Description:	Located on South end of lake. Marked with three orange poles				
Survey objective:	Snow depths and snow-water content for lake recharge estimates			Weather Observations:	nr
Latitude:	N 70°19.9444'	Longitude:	W 150° 57.047'	Datum:	NAD27 Alaska
Elevation:		Elevation Datum:	BPMSL	Reference Markers:	Site staked with lathe
Drainage Basin:	L9312	Slope Direction:	Flat	Vegetation Type:	Tussock
Slope Angle:	Flat	Access Notes:	Hagglund	Other:	1 meter increments
Snow Depth Probe Type:	T-handle snow depth probe,			Snow-Survey Team Names	
Snow Tube Type:	Adirondak, 6.74 cm diameter cutter, area = 35.7 cm <sup>2</sup>			Chad Cormack, Dan Reichardt	

Snow Course Depths, in cm.

	1	2	3	4	5
1	26	32	5	45	26
2	44	28	38	49	39
3	30	31	37	52	43
4	29	32	34	49	20
5	32	31	39	48	30
6	26	16	26	41	25
7	27	9	21	25	27
8	24	21	79	16	18
9	31	46	50	22	30
10	17	34	37	24	29

(cm)  
 Average snow depth = 31.8  
 Maximum snow depth = 79.0  
 Minimum snow depth = 5.0  
 Standard variation = 12.6

Snow Sample Depths and Weights

Bag #	Depth (cm)	Weight (gr)	Volume (cm <sup>3</sup> )	Density (gr/cm <sup>3</sup> )
SWE1	22	238	785.4	0.30
SWE2	28	242.2	999.6	0.24
SWE3	34	297.7	1213.8	0.25
SWE4	42	446.6	1499.4	0.30
SWE5	26	247	928.2	0.27

Average Density = 0.27 gr/cm<sup>3</sup>  
 Average Snow Water Equivalent (SWE) = 8.6 cm H<sub>2</sub>O  
 Average Snow Water Equivalent = 3.39 inches H<sub>2</sub>O  
 Average Snow Water Equivalent = 0.28 feet H<sub>2</sub>O

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

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

Project ID: North Slope Lakes Project Site Location/Lake ID: L9312  
 Survey Purpose: Snow Depth and Water Content Date: 5/21/2008 Time: 11:30

Location Description:	Located on South end of lake. Marked with three orange poles				
Survey objective:	Snow depths and snow-water content for lake recharge estimates		Weather Observations:	17 F, Foggy, Light Wind	
Latitude:	N 70°19.9444'	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, 6.74 cm diameter cutter, area = 35.7 cm <sup>2</sup>			Chad Cormack	

Snow Course Depths, in cm.

	1	2	3	4	5
1	29	30	49	48	24
2	49	21	19	50	32
3	18	31	10	50	24
4	21	29	39	46	14
5	33	43	38	41	23
6	24	22	23	37	15
7	25	0	15	14	4
8	17	0	75	0	25
9	30	15	55	8	15
10	18	46	34	12	36

(cm)  
 Average snow depth = 27.5  
 Maximum snow depth = 75.0  
 Minimum snow depth = 0.0  
 Standard variation = 15.8

Snow Sample Depths and Weights

Bag #	Depth (cm)	Weight (gr)	Volume (cm <sup>3</sup> )	Density (gr/cm <sup>3</sup> )
SWE1	16	227.2	571.2	0.40
SWE2	26.5	400.5	946.1	0.42
SWE3	32	305.1	1142.4	0.27
SWE4	28	332.3	999.6	0.33
SWE5	18	132.6	642.6	0.21

Average Density = 0.33 gr/cm<sup>3</sup>  
 Average Snow Water Equivalent (SWE) = 9.0 cm H<sub>2</sub>O  
 Average Snow Water Equivalent = 3.53 inches H<sub>2</sub>O  
 Average Snow Water Equivalent = 0.29 feet H<sub>2</sub>O

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

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

Project ID: North Slope Lakes Site Location/Lake ID: L9817  
 Survey Purpose: Determine snow water equivalent Date: 5/17/2008 Time: 16:00

Location Description:	Upwind side of Ice Road				
Survey objective:	Determine Snow Water Equivalent			Weather Observations:	nr
Latitude:	nr	Longitude:	nr	Datum:	nr
Elevation:	Approximately 10 ft	Elevation Datum:	BPMSL	Reference Markers:	Mile 5
Drainage Basin:	Kuparuk River	Slope Direction:	flat	Vegetation Type:	Tundra
Slope Angle:	flat	Access Notes:	Highway vehicle	Other:	
Snow Depth Probe Type:	T-handle probe			Snow-Survey Team Names	
Snow Tube Type:	n/a			Chad Cormack	

Snow Course Depths, in cm.

	1	2	3	4	5
1	12.0	25.0	0.0	13.0	13.0
2	0.0	20.0	0.0	10.0	12.0
3	14.0	24.0	24.0	0.0	13.0
4	15.0	24.0	14.0	11.0	15.0
5	15.0	0.0	18.0	25.0	16.0
6	0.0	18.0	16.0	29.0	20.0
7	0.0	12.0	13.0	26.0	18.0
8	15.0	14.0	20.0	17.0	18.0
9	9.0	12.0	14.0	14.0	26.0
10	0.0	15.0	0.0	0.0	27.0

(cm)  
 Average snow depth = 13.7  
 Maximum snow depth = 29.0  
 Minimum snow depth = 0.0  
 Standard variation = 8.4

Snow Sample Depths and Weights

Bag #	Depth (cm)	Weight (gr)	Volume (cm <sup>3</sup> )	Density (gr/cm <sup>3</sup> )
5A	6	139.1	214.2	0.65
5B	21	206.0	749.7	0.27
5C	18	182.1	642.6	0.28
5D	33	382.2	1178.1	0.32
5E	31	340.2	1106.7	0.31

Average Density = 0.37  
 Average Snow Water Equivalent (SWE) = 5.0 cm H<sub>2</sub>O  
 Average Snow Water Equivalent = 1.99 inches H<sub>2</sub>O  
 Average Snow Water Equivalent = 0.17 feet H<sub>2</sub>O

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

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

Project ID: North Slope Lakes Site Location/Lake ID: L9817-WxStation, Tundra  
 Survey Purpose: Determine snow water equivalent Date: 5/21/2008 Time: 13:30

Location Description:	East side of lake, on tundra. Did "L" shape, started at ~30 south of Met Pole, went do south, then west, 25 x 25m for 1m increments				
Survey objective:	Determine Snow Water Equivalent			Weather Observations:	Clear, Sunny
Latitude:	N 70° 16.832	Longitude:	W 148° 53.856	Datum:	NAD83
Elevation:	Approximately 55 ft	Elevation Datum:	BPMSL	Reference Markers:	Lathe
Drainage Basin:	Lake L9817	Slope Direction:	Flat	Vegetation Type:	Tussuck tundra
Slope Angle:	Flat	Access Notes:	Haggland	Other:	
Snow Depth Probe Type:	T-handle probe			Snow-Survey Team Names	
Snow Tube Type:	Adirondak, 6.74 cm diameter cutter, area = 35.7 cm <sup>2</sup>			Reichardt, Cormack	

Snow Course Depths, in cm.

	1	2	3	4	5
1	28.0	0.0	19.0	16.0	26.0
2	12.0	0.0	0.0	22.0	29.0
3	0.0	0.0	5.0	0.0	21.0
4	0.0	0.0	0.0	28.0	28.0
5	0.0	0.0	21.0	16.0	24.0
6	0.0	18.0	10.0	0.0	29.0
7	0.0	17.0	8.0	17.0	23.0
8	0.0	13.0	0.0	22.0	31.0
9	12.0	0.0	0.0	30.0	24.0
10	0.0	0.0	0.0	24.0	28.0

(cm)  
 Average snow depth = 12.0  
 Maximum snow depth = 31.0  
 Minimum snow depth = 0.0  
 Standard variation = 11.7

Snow Sample Depths and Weights

Bag #	Depth (cm)	Weight (gr)	Volume (cm <sup>3</sup> )	Density (gr/cm <sup>3</sup> )
1	21	306.8	749.7	0.41
2	25	249.8	892.5	0.28
3	22.5	153.9	803.3	0.19
4	26	245.9	928.2	0.26
5	27	255.4	963.9	0.26

Average Density = 0.28  
 Average Snow Water Equivalent (SWE) = 3.4 cm H2O  
 Average Snow Water Equivalent = 1.34 inches H2O  
 Average Snow Water Equivalent = 0.11 feet H2O

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

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

Project ID: North Slope Lakes Site Location/Lake ID: Mile 1  
 Survey Purpose: Determine snow water equivalent Date: 5/17/2008 Time: 16:00

Location Description:	Upwind side of Ice Road				
Survey objective:	Determine Snow Water Equivalent			Weather Observations:	nr
Latitude:	nr	Longitude:	nr	Datum:	nr
Elevation:	Approximately 10 ft	Elevation Datum:	BPMSL	Reference Markers:	Mile 1
Drainage Basin:	Kuparuk River	Slope Direction:	flat	Vegetation Type:	Tundra
Slope Angle:	flat	Access Notes:	Highway vehicle	Other:	
Snow Depth Probe Type:	T-handle probe			Snow-Survey Team Names	
Snow Tube Type:	n/a			Chad Cormack	

Snow Course Depths, in cm.

	1	2	3	4	5
1	27.0	28.0	0.0	3.0	7.0
2	3.0	22.0	25.0	0.0	30.0
3	10.0	10.0	0.0	14.0	36.0
4	0.0	0.0	0.0	23.0	30.0
5	15.0	22.0	0.0	24.0	35.0
6	32.0	25.0	0.0	30.0	19.0
7	34.0	20.0	0.0	20.0	30.0
8	34.0	30.0	0.0	28.0	46.0
9	20.0	31.0	0.0	5.0	30.0
10	29.0	29.0	9.0	0.0	28.0

(cm)  
 Average snow depth = 17.9  
 Maximum snow depth = 46.0  
 Minimum snow depth = 0.0  
 Standard variation = 13.4

Snow Sample Depths and Weights

Bag #	Depth (cm)	Weight (gr)	Volume (cm <sup>3</sup> )	Density (gr/cm <sup>3</sup> )
1A	29	383.2	1035.3	0.37
1B	16	118.2	571.2	0.21
1C	18	145.1	642.6	0.23
1D	18	196.5	642.6	0.31
1E	22	168.1	785.4	0.21

Average Density = 0.26  
 Average Snow Water Equivalent (SWE) = 4.7 cm H<sub>2</sub>O  
 Average Snow Water Equivalent = 1.86 inches H<sub>2</sub>O  
 Average Snow Water Equivalent = 0.16 feet H<sub>2</sub>O

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

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

Project ID: North Slope Lakes Site Location/Lake ID: Mile 5  
 Survey Purpose: Determine snow water equivalent Date: 5/17/2008 Time: 16:00

Location Description:	Upwind side of Ice Road				
Survey objective:	Determine Snow Water Equivalent			Weather Observations:	nr
Latitude:	nr	Longitude:	nr	Datum:	nr
Elevation:	Approximately 10 ft	Elevation Datum:	BPMSL	Reference Markers:	Mile 5
Drainage Basin:	Kuparuk River	Slope Direction:	flat	Vegetation Type:	Tundra
Slope Angle:	flat	Access Notes:	Highway vehicle	Other:	
Snow Depth Probe Type:	T-handle probe			Snow-Survey Team Names	
Snow Tube Type:	n/a			Chad Cormack	

Snow Course Depths, in cm.

	1	2	3	4	5
1	36.0	36.0	38.0	32.0	36.0
2	35.0	36.0	34.0	36.0	38.0
3	36.0	35.0	33.0	35.0	28.0
4	35.0	36.0	35.0	6.0	27.0
5	30.0	36.0	32.0	9.0	29.0
6	32.0	39.0	32.0	12.0	24.0
7	36.0	35.0	30.0	15.0	23.0
8	38.0	29.0	37.0	25.0	27.0
9	44.0	33.0	34.0	35.0	36.0
10	37.0	37.0	29.0	32.0	29.0

(cm)  
 Average snow depth = 31.6  
 Maximum snow depth = 44.0  
 Minimum snow depth = 6.0  
 Standard variation = 7.6

Snow Sample Depths and Weights

Bag #	Depth (cm)	Weight (gr)	Volume (cm <sup>3</sup> )	Density (gr/cm <sup>3</sup> )
5A	32	409.9	1142.4	0.36
5B	34	386.9	1213.8	0.32
5C	31	364.6	1106.7	0.33
5D	27	333.1	963.9	0.35
5E	36	453.1	1285.2	0.35

Average Density = 0.34  
 Average Snow Water Equivalent (SWE) = 10.8 cm H2O  
 Average Snow Water Equivalent = 4.24 inches H2O  
 Average Snow Water Equivalent = 0.35 feet H2O

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

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

Project ID: North Slope Lakes Site Location/Lake ID: Mile 5  
 Survey Purpose: Determine snow water equivalent Date: 5/17/2008 Time: 16:00

Location Description:	Upwind side of Ice Road				
Survey objective:	Determine Snow Water Equivalent			Weather Observations:	nr
Latitude:	nr	Longitude:	nr	Datum:	nr
Elevation:	Approximately 10 ft	Elevation Datum:	BPMSL	Reference Markers:	Mile 5
Drainage Basin:	Kuparuk River	Slope Direction:	flat	Vegetation Type:	Tundra
Slope Angle:	flat	Access Notes:	Highway vehicle	Other:	
Snow Depth Probe Type:	T-handle probe			Snow-Survey Team Names	
Snow Tube Type:	n/a			Chad Cormack	

Snow Course Depths, in cm.

	1	2	3	4	5
1	12.0	25.0	0.0	13.0	13.0
2	0.0	20.0	0.0	10.0	12.0
3	14.0	24.0	24.0	0.0	13.0
4	15.0	24.0	14.0	11.0	15.0
5	15.0	0.0	18.0	25.0	16.0
6	0.0	18.0	16.0	29.0	20.0
7	0.0	12.0	13.0	26.0	18.0
8	15.0	14.0	20.0	17.0	18.0
9	9.0	12.0	14.0	14.0	26.0
10	0.0	15.0	0.0	0.0	27.0

(cm)  
 Average snow depth = 13.7  
 Maximum snow depth = 29.0  
 Minimum snow depth = 0.0  
 Standard variation = 8.4

Snow Sample Depths and Weights

Bag #	Depth (cm)	Weight (gr)	Volume (cm <sup>3</sup> )	Density (gr/cm <sup>3</sup> )
5A	6	139.1	214.2	0.65
5B	21	206.0	749.7	0.27
5C	18	182.1	642.6	0.28
5D	33	382.2	1178.1	0.32
5E	31	340.2	1106.7	0.31

Average Density = 0.37  
 Average Snow Water Equivalent (SWE) = 5.0 cm H<sub>2</sub>O  
 Average Snow Water Equivalent = 1.99 inches H<sub>2</sub>O  
 Average Snow Water Equivalent = 0.17 feet H<sub>2</sub>O

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

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

Project ID: North Slope Lakes Site Location/Lake ID: Mile 13  
 Survey Purpose: Determine snow water equivalent Date: 5/17/2008 Time: 16:00

Location Description:	Upwind side of Ice Road				
Survey objective:	Determine Snow Water Equivalent			Weather Observations:	nr
Latitude:	nr	Longitude:	nr	Datum:	nr
Elevation:	Approximately 10 ft	Elevation Datum:	BPMSL	Reference Markers:	Mile 13
Drainage Basin:	Kuparuk River	Slope Direction:	flat	Vegetation Type:	Tundra
Slope Angle:	flat	Access Notes:	Highway vehicle	Other:	
Snow Depth Probe Type:	T-handle probe			Snow-Survey Team Names	
Snow Tube Type:	n/a			Chad Cormack, Horacio Toniolo	

Snow Course Depths, in cm.

	1	2	3	4	5
1	51.0	54.0	18.0	71.0	76.0
2	48.0	47.0	36.0	71.0	77.0
3	47.0	47.0	46.0	73.0	80.0
4	53.0	40.0	56.0	81.0	83.0
5	51.0	41.0	64.0	68.0	76.0
6	58.0	42.0	67.0	76.0	79.0
7	68.0	40.0	67.0	75.0	77.0
8	64.0	29.0	66.0	73.0	80.0
9	64.0	20.0	69.0	73.0	83.0
10	60.0	42.0	71.0	78.0	83.0

(cm)  
 Average snow depth = 61.2  
 Maximum snow depth = 83.0  
 Minimum snow depth = 18.0  
 Standard variation = 17.0

Snow Sample Depths and Weights

Bag #	Depth (cm)	Weight (gr)	Volume (cm <sup>3</sup> )	Density (gr/cm <sup>3</sup> )
13A	49	643.3	1749.3	0.37
13B	24	372.0	856.8	0.43
13C	60	711.2	2142.0	0.33
13D	38	547.0	1356.6	0.40
13E	78	953.5	2784.6	0.34

Average Density = 0.38  
 Average Snow Water Equivalent (SWE) = 23.0 cm H2O  
 Average Snow Water Equivalent = 9.05 inches H2O  
 Average Snow Water Equivalent = 0.75 feet H2O

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

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

Project ID: North Slope Lakes Site Location/Lake ID: Mile 17  
 Survey Purpose: Determine snow water equivalent Date: 5/17/2008 Time: 16:00

Location Description:	Upwind side of Ice Road				
Survey objective:	Determine Snow Water Equivalent			Weather Observations:	nr
Latitude:	nr	Longitude:	nr	Datum:	nr
Elevation:	Approximately 10 ft	Elevation Datum:	BPMSL	Reference Markers:	Mile 17
Drainage Basin:	Kuparuk River	Slope Direction:	flat	Vegetation Type:	Tundra
Slope Angle:	flat	Access Notes:	Highway vehicle	Other:	
Snow Depth Probe Type:	T-handle probe			Snow-Survey Team Names	
Snow Tube Type:	n/a			Chad Cormack	

Snow Course Depths, in cm.

	1	2	3	4	5
1	36.0	30.0	28.0	33.0	28.0
2	32.0	21.0	36.0	23.0	16.0
3	45.0	10.0	43.0	37.0	20.0
4	38.0	28.0	43.0	26.0	29.0
5	30.0	30.0	47.0	21.0	29.0
6	40.0	29.0	43.0	32.0	27.0
7	30.0	35.0	42.0	28.0	14.0
8	32.0	33.0	30.0	18.0	0.0
9	28.0	33.0	28.0	12.0	3.0
10	27.0	29.0	29.0	29.0	17.0

(cm)  
 Average snow depth = 28.5  
 Maximum snow depth = 47.0  
 Minimum snow depth = 0.0  
 Standard variation = 10.0

Snow Sample Depths and Weights

Bag #	Depth (cm)	Weight (gr)	Volume (cm <sup>3</sup> )	Density (gr/cm <sup>3</sup> )
17A	23	240.0	821.1	0.29
17B	23	285.0	821.1	0.35
17C	40	441.2	1428.0	0.31
17D	19	204.8	678.3	0.30
17E	26	288.4	928.2	0.31

Average Density = 0.31  
 Average Snow Water Equivalent (SWE) = 8.9 cm H<sub>2</sub>O  
 Average Snow Water Equivalent = 3.51 inches H<sub>2</sub>O  
 Average Snow Water Equivalent = 0.29 feet H<sub>2</sub>O

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

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

Project ID: North Slope Lakes Site Location/Lake ID: Mile 19  
 Survey Purpose: Determine snow water equivalent Date: 5/17/2008 Time: 16:00

Location Description:	Upwind side of Ice Road				
Survey objective:	Determine Snow Water Equivalent			Weather Observations:	nr
Latitude:	nr	Longitude:	nr	Datum:	nr
Elevation:	Approximately 10 ft	Elevation Datum:	BPMSL	Reference Markers:	Mile 19
Drainage Basin:	Kuparuk River	Slope Direction:	flat	Vegetation Type:	Tundra
Slope Angle:	flat	Access Notes:	Highway vehicle	Other:	
Snow Depth Probe Type:	T-handle probe			Snow-Survey Team Names	
Snow Tube Type:	n/a			Chad Cormack	

Snow Course Depths, in cm.

	1	2	3	4	5
1	38.0	45.0	57.0	80.0	78.0
2	36.0	37.0	62.0	76.0	78.0
3	40.0	52.0	65.0	85.0	76.0
4	44.0	56.0	82.0	89.0	75.0
5	49.0	44.0	68.0	86.0	73.0
6	51.0	52.0	76.0	86.0	68.0
7	51.0	72.0	80.0	87.0	62.0
8	48.0	74.0	79.0	82.0	69.0
9	43.0	59.0	83.0	85.0	57.0
10	45.0	57.0	82.0	82.0	50.0

(cm)  
 Average snow depth = 65.0  
 Maximum snow depth = 89.0  
 Minimum snow depth = 36.0  
 Standard variation = 16.2

Snow Sample Depths and Weights

Bag #	Depth (cm)	Weight (gr)	Volume (cm <sup>3</sup> )	Density (gr/cm <sup>3</sup> )
19A	20	252.0	714.0	0.35
19B	45	528.7	1606.5	0.33
19C	80	848.2	2856.0	0.30
19D	73	728.6	2606.1	0.28
19E	35	451.9	1249.5	0.36

Average Density = 0.32  
 Average Snow Water Equivalent (SWE) = 21.1 cm H2O  
 Average Snow Water Equivalent = 8.30 inches H2O  
 Average Snow Water Equivalent = 0.69 feet H2O

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