Lake Chemistry and Physical Data For Selected North Slope, Alaska, Lakes: August 2005



Mine Site B (Connection between South Cell and North Cell), Photo by K. Hilton.

by

Kristie Hilton, Dan Reichardt, Michael Lilly, and Daniel White.

March 2007

North Slope Lakes Hydrologic Modeling Project Report No. INE/WERC 06.01











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March 2007 North Slope Lakes Hydrologic Modeling Project Report Number INE/WERC 06.01

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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	Ву	To obtain
inch (in.) inch (in.) foot (ft) mile (mi)	<u>Length</u> 25.4 2.54 0.3048 1.609	millimeter (mm) centimeter (cm) meter (m) kilometer (km)
Acre Acre square foot (ft <sup>2</sup> ) square mile (mi <sup>2</sup> )	<u>Area</u> 43559.999 0.405 3.587e-8 2.590	square feet (ft <sup>2</sup> ) hectare (ha) square mile (mi <sup>2</sup> ) square kilometer (km <sup>2</sup> )
gallon (gal) gallon (gal) cubic foot (ft <sup>3</sup> ) Acre-ft	<u>Volume</u> 3.785 3785.412 28.317 1233	liter (L) milliliter (mL) liter (L) cubic meter (m <sup>3</sup> )
foot per day (ft/d) Square foot per day (ft²/d ) cubic foot per second (ft³/s)	Velocity and Discharge 0.3048 .0929 0.02832	meter per day (m/d) square meter per day (m <sup>2</sup> /d) cubic meter per second (m <sup>3</sup> /sec)
foot per day (ft/d) foot per day (ft/d) meter per day (m/d)	Hydraulic Conductivity 0.3048 0.00035 0.00115	meter per day (m/d) centimeter per second (cm/sec) centimeter per second (cm/sec)
foot per foot (ft/ft) foot per mile (ft/mi)	<u>Hydraulic Gradient</u> 5280 0.1894	foot per mile (ft/mi) meter per kilometer (m/km)
pound per square inch (lb/in <sup>2</sup> )	Pressure 6.895	kilopascal (kPa)

#### Units

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

#### **Physical and Chemical Water-Quality Units:**

#### Temperature:

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

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

Specific electrical conductance (conductivity):

Conductivity of water is expressed in microsiemens per centimeter at 25°C ( $\mu$ S/cm). This unit is equivalent to microhms per centimeter at 25°C.

Milligrams per liter (mg/L) or micrograms per liter ( $\mu$ g/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.

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

## **PROJECT COOPERATORS**

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

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

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# Lake Chemistry and Physical Data For Selected North Slope, Alaska, Lakes: August 2005

### INTRODUCTION

The University of Alaska Fairbanks (UAF) Water and Environmental Research Center (WERC) and Geo-Watersheds Scientific (GWS), together with project cooperators, initiated a study in the Fall of 2002 (Phase One) to obtain baseline information about the physical and chemical characteristics of North Slope tundra lakes. The project was extended in 2005 (Phase Two). The location of study lakes changed and was expanded to include other reservoirs so as to further develop the understanding and simulation tools necessary for water source management. K113 is an unpumped lake in the Kuparuk oilfield and is sampled on selected field trips during the year. L9312 is a natural lake used for facility water in the Alpine operations area. L9817 is a natural lake in eastern NPRA, west of Nuigsut. This lake has been used in previous years for ice-road construction, but was not used during winter 2005-06. Two new reservoir systems (mine sites) were included in the study in 2005. Mine Site B is located near the Milne Point facility at the intersection of the Spine Road with the Milne Point access road and has two cells connected to Milne Creek. The Kuparuk Reservoir System (Kuparuk Deadarm Lakes) has 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. The new locations are also utilized as various water resources.

Water-quality data is collected during monthly visits to the lakes and samples are collected for further analysis in UAF-WERC chemistry laboratories. This information will be reported in separate data reports.



Figure 1. Location of study lakes in the NPRA, Alpine, Kuparuk, and Prudhoe Bay field operating area, North Slope, Alaska.

## **TRIP OBJECTIVES**

The goal of each sampling trip is to collect physical and chemical data from each study lake. For each lake, a series of holes are drilled at designated sampling locations. Logistical, personnel, and weather constraints can limit the amount of time available in the field for sampling. A project workplan was distributed before the trip outlining the sampling schedule (Galloway and others, 2005). In August, we focused on the following locations/tasks:

- 1. Kuparuk Dead Arm Reservoirs: Prudhoe Bay operating area.
  - Reservoirs 1-5.
  - Survey water levels to local elevation control.
  - Measure field water quality parameters.

- Collect water samples for analysis.
- Hydrologic assessment of watershed area.
- 2. Mine Site B: Prudhoe Bay operating area.
  - North Cell, South Cell, and stream junction.
  - Survey water levels to local elevation control.
  - Measure field water quality parameters.
  - Collect water samples for analysis.
  - Hydrologic assessment of watershed area.
- 3. Big Lake: Prudhoe Bay operating area
  - Measure field water quality parameters.
  - Survey water levels to local elevation control.
  - Collect water samples for analysis.
  - Hydrologic assessment of watershed area.

### PROCEDURES

All field work follows the specified health, safety, and environmental guidelines outlined by BPX and CPA (White and Lilly, 2005). Pictures, initial observations, and survey information were taken at each location. Water quality parameters such as temperature, pH, conductivity, and dissolved oxygen (DO) were obtained by using an In-Situ Troll 9000 (submersible meter), at several depths throughout the water column. The precision with which physical measurements were reported takes into account field conditions, and the calibration of each parameter was checked before and after each day of sampling. To pass the calibration check, pH had to be within 0.2 pH units, turbidity had to be within 2 NTU, and ORP, DO, and conductivity had to be within 10% of the calibration standard value. Water samples were also taken at 1 ft depths at each location. Some of these samples were preserved for further analysis at UAF, while other samples were analyzed for alkalinity while still at the facility. Chemistry analysis will be addressed in a separate report.



Figure 2. Kuparuk Deadarm Reservoirs 2 and 3, Photo by K. Hilton.

### SELECTED RESULTS

The first visit to Mine Site B, Kuparuk Deadarm Reservoirs, and Big Lake, occurred on the August sampling trip. Initial surveys, pictures, and observations were taken to determine the best sampling locations for inclusion in our research. This trip led us to select the Kuparuk Deadarm Reservoirs 1-3 (Figure 2) and Mine Site B as our newest sampling sites. Both sites are used as water supplies for various purposes, and both locations are influenced by a flowing rivers and streams such as the Kuparuk River and Milne Creek. The water-quality parameters taken at each site will be used for comparison throughout the season, and between years. The data retrieved from Big Lake has been included in the appendices.

### SUMMARY

Continuous monitoring of the water-quality parameters seen in North Slope lakes throughout the winter will help in the understanding and development of simulation tools necessary for water resource management. As available unfrozen water decreases due to freezing and pumping activities in the winter, it is important to identify the changing water chemistry as well as the potential spring recharge. This information is important for permitting agencies as well as the industry professionals who depend on this resource for facility use and ice road/pad construction. Through monthly hydrologic assessments, water chemistry testing, and water sample analysis, we hope to answer some of the questions brought forth on the effects of mid-winter pumping of North Slope tundra lakes.

### REFERENCES

- Galloway, B., Hinzman, L., Hilton, K., and Lilly, M. 2005. A Workplan for Sampling at Lakes L9312 and K113, 3 BP lakes and Shoring of Hydrologic Data Collection Stations at Lakes L9312, K113, K214 and K209: August, Water and Environmental Research Center, University of Alaska Fairbanks. 11 p.
- Hinzman, L., White, D.M., and Lilly, M.R. 2005a. BPX: Health, Safety, and Environmental Interface Document. Water and Environmental Research Center, University of Alaska Fairbanks. 4 p.
- Hinzman, L., White, D.M., and Lilly, M.R. 2005b. BPX: Health, Safety, and Environmental Plan. Water and Environmental Research Center, University of Alaska Fairbanks. 6 p.

# APPENDIX A. WATER QUALITY FIELD SAMPLING FORMS

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

Project ID:	North Slope Lakes	Site Location/Lake ID:	Mine Site B- NC
Sample Purpose:	Lake Water Quality	Date: 8/8/2005	Time: 3:00

#### FIELD MEASUREMENTS

GPS Coord. Northing:	N70 19.309	Easting: W149 19.376	Datum: NAD 27
Measurements By:	Hilton/Galloway	Time: 3:15	
Water Depth (ft):	na	Ice Thickness (ft): na	
Freeboard (ft):	na	Snow Depth (ft): na	
Elev. (BPMSL):	3.82 +/02	Survey By: Galloway	Time: nr
Sampled By:	Hilton	Sample Depth BWS (ft): 1	Time: 3:20

#### WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Meter Make/Model			Serial No.	Pre-Samp	Pos QA(	st-Samp QC Chk
pH, conductivity, DO, Turbidity	GWS	In-S	Situ Troll	9000	33033	yes		yes
Parameters				Field Mea	asurements	6		
Time:	3:20	3:24	3:26					
Depth BWS (ft):	1	1	1					
Temp (°C):	11.84	11.87	11.87					
pH:	7.80	7.83	7.85					
Barometeric (mmHg):	761.40	761.30	761.3					
Pressure (kPa):	4.73	4.73	4.742					
Conductivity (ųS/cm):	204.50	204.20	204.3					
RDO (ppm):	11.14	11.18	11.22					
Turbidity (NTU):								

#### IN-FIELD CHEMISTRY ANALYSIS

Parameter	Result (s	5)	Method
Remarks:			

Remarks:

Field-Form Filled Out By: QAQC Check By:

Hilton Lawson

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

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

Project ID:	North Slope Lakes	Site Location/Lake ID: Mine Site B				
Sample Purpose:	<b>Comparative Analysis</b>	of Equipment	Date: 8/8/2005	Tim	e: 3:00	
FIELD MEASUREMENT	S					
GPS Coord. Northing:	N70 19.324	Easting:	W149 23.768	Datum:	NAD 27	
Sampled By:	Hilton	Sample Dep	oth BWS (ft): 1	Tim	e: <u>3:15</u>	

#### WATER QUALITY METER INFORMATION

Calibration Information

				Pre-Samp	Post-Samp
Parameter (s)	Owner	Meter Make/Model	Serial No.	QAQC Chk	QAQC Chk
pH, conductivity, DO, Turbidity	GWS	In-Situ Troll 9000	33033	yes	yes
				Pre-Samp	Post-Samp
Parameter (s)	Owner	Meter Make/Model	Serial No.	QAQC Chk	QAQC Chk
			00005		
pH, conductivity, DO, Turbidity	UAF	In-Situ I roll 9000	33025	yes	yes
				Pre-Samp	Post-Samp
Parameter (s)	Owner	Meter Make/Model	Serial No.	QAQC Chk	QAQC Chk
Conductivity, Temperature	GWS	YSI Meter	00B0064	yes	yes

	Type/ Owner of Equipment & Field Measurements								
	GWS In-	UAF In-		GWS In-			GWS In-		
Parameters	Situ	Situ	YSI/pH	Situ	<b>UAF In-Situ</b>	YSI	Situ	<b>UAF In-Situ</b>	YSI
Time:	3:30	3:20	3:19	3:24	3:22	3:22	3:26	3:26	3:24
Temperature:	11.84	11.92	12.1/12.7	11.87	11.94	12.1	11.87	11.93	12.1
pH:	7.80	7.88	9.13	7.83	7.88		7.85	7.89	
Barometeric (mmHg):	761.40	760.30		761.3	760.2		761.3	760.1	
Pressure (kPa):	4.729	4.942		4.734	4.958		4.742	4.96	
Conductivity (ųS/cm):	204.50	185.00	169.2	204.2	185.1	169.2	204.3	185	169.1
RDO (ppm):	11.14	10.97		11.18	11.02		11.22	11.05	
Turbidity (NTU):									

#### **YSI Calibration Information**

Date:	8/5/2005		
Conductivity (ųS/cm):	1253		
Temperature:	21 C		
Calibration Solution:	2406082		
Expiration Date:	Jun-05		
Pass/Fail:	Pass		

Remarks: UAF & GWS In-Situ Calibration information will be the same as Mine Site B, Kuparuk Reservoir, and Big Lake.

Field-Form Filled Out By:	Hilton	Date:	8/8/2005
QAQC Check By:	Lawson	Date:	2/6/2005

Draia at ID:	North Clane Lakes	Cite Leasting /Leks ID:	Kupowsk Dee #1	
Project ID:	North Slope Lakes	Site Location/Lake ID:	Kuparuk Res #1	
Sample Purpose:	Lake Water Quality	Date: 8/9/2005	Time: 1:15	

#### FIELD MEASUREMENTS

GPS Coord. Northing:	N70 19.908	Easting: W148 56.480	Datum: NAD 27
Measurements By:	Hilton/Galloway	Time: 1:20	
Water Depth (ft):	na	Ice Thickness (ft): na	_
Freeboard (ft):	na	Snow Depth (ft): na	
Elev. (BPMSL):	2.04 +/- 0.02	Survey By Galloway	Time: nr
Sampled By:	Hilton	Sample Depth BWS (ft): 1	Time: 1:15

# WATER QUALITY METER INFORMATION Calibration Information

Parameter (s)	Owner	Mete	er Make/	Model	Serial No.	Pre-Samp QAQC	Pos C	st-Samp AQC
pH, conductivity, DO, Turbidity	GWS	In-S	Situ I roll	9000	33033	yes		yes
Parameters				Field Me	asurements	5		
Time	1:29	1:30						
Depth BWS (ft):	1	1						
Temp (°C):	11.53	11.48						
pH:	7.82	7.83						
Barometeric (mmHg):	763.00	763.00						
Pressure (kPa):	2.67	1.95						
Conductivity (ųS/cm):	156.70	156.80						
RDO (ppm):	11.26	11.27						
Turbidity (NTU):	1.40	1.70						

#### IN-FIELD CHEMISTRY ANALYSIS

Result (s)	Method
	Result (s)

Remarks:

Field-Form Filled Out By: QAQC Check By:

Hilton Lawson

Project ID:	North Slope Lakes		Site Location/Lake ID:	Kuparuk Res #2
Sample Purpose:	Lake Water Quality	1	Date: 8/9/2005	Time: 11:30

#### FIELD MEASUREMENTS

GPS Coord. Northing:	N70 19.947	Easting: W148 56.212	Datum: NAD 27
Measurements By:	Hilton/Galloway	Time: 11:30	
Water Depth (ft):	na	Ice Thickness (ft): na	
Freeboard (ft):	na	Snow Depth (ft): na	
Elev. (BPMSL):	2.04 +/- 0.02	Survey By: Galloway	Time: nr
Sampled By:	Hilton	Sample Depth BWS (ft): 1	Time: 11:50

#### WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Mete	er Make/	Model	Serial No.	Pre-Samp QAQC	Post-Samp QAQC
pH, conductivity, DO, Turbidity	GWS	In-Situ Troll 9000			33033	yes	yes
Parameters				Field Mea	surements		
Time:	11:58	12:00	12:01				
Depth BWS (ft):	1	1	1				
Temp (°C):	10.83	10.84	10.85				
pH:	7.59	7.61	7.62				
Barometeric (mmHg):	762.60	762.60	762.6				
Pressure (kPa):	2.32	2.29	2.451				
Conductivity (ųS/cm):	139.50	139.70	139.6				
RDO (ppm):	11.19	11.25	11.29				
Turbidity (NTU):	0.70	0.50	0.5				

#### IN-FIELD CHEMISTRY ANALYSIS

Parameter	Result (s)		Method		
YSI:	12:03				
Conductivity (ųS/cm):	153				
Temp (°C):	11.1				
Pomarks:					

Remarks:

Field-Form Filled Out By:
QAQC Check By:

Hilton Lawson

Project ID:	North Slope Lakes	Site Location/Lake ID:	Kuparuk Res #3
Sample Purpose:	Lake Water Quality	Date: 8/9/2005	Time: 1:30

#### FIELD MEASUREMENTS

GPS Coord. Northing:	N70 19.977	Easting: W148 56.007	Datum: NAD 27
Measurements By:	Hilton/Galloway	Time: 1:30	
Water Depth (ft):	na	Ice Thickness (ft): na	
Freeboard (ft):	na	Snow Depth (ft): na	
Elev. (BPMSL):	2.04 +/- 0.02	Survey E Galloway	Time: nr
Sampled By:	Hilton	Sample Depth BWS (ft): 1	Time: 1:30

#### WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Mete	er Make/Model	Serial No.	Pre-Samp QAQC	Post-Samp QAQC	
pH, conductivity, DO, Turbidity	GWS	In-S	itu Troll 9000	33033	yes	yes	
Parameters			Field Measurements				
Time	1:40	1:41					
Depth BWS (ft):	1	1					
Temp (°C):	10.81	10.82					
pH:	7.72	7.72					
Barometeric (mmHg):	763.00	763.00					
Pressure (kPa):	2.56	2.59					
Conductivity (ųS/cm):	139.00	138.90					
RDO (ppm):	11.37	11.39					
Turbidity (NTU):	2.60	2.80					

#### **IN-FIELD CHEMISTRY ANALYSIS**

Parameter	Result (s)	Method
YSI:		
Conductivity (ųS/cm):		
Temp (°C):		
Remarks:		

Field-Form Filled Out By: QAQC Check By:

Hilton	
Lawson	

Project ID:	North Slope Lakes	i	Site Location/Lake ID:	Kuparuk F	Res #4
Sample Purpose:	Lake Water Quality	/	Date: 8/9/2005	Time: 12	2:30

#### FIELD MEASUREMENTS

GPS Coord. Northing:	N70 20.438	Easting:	W148 56.071	Datum: NAD 27
Measurements By:	Hilton/Galloway	Time:	12:50	
Water Depth (ft):	na	Ice Thickness (ft):	na	
Freeboard (ft):	na	Snow Depth (ft):	na	
Elev. (BPMSL):	4.55 +/- 0.02	Survey By:	Galloway	Time: nr
Sampled By:	Hilton	Sample Dep	th BWS (ft): <u>1.5</u>	Time: 12:30

#### WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Meter Make/Model			Serial No.	Pre-Samp QAQC Chk	Pos QA(	st-Samp QC Chk
pH, conductivity, DO, Turbidity	GWS	In-Situ Troll 9000			33033	yes		yes
Parameters				Field Me	easurement	S		
Time:	12:50	12:51	12:52					
Depth BWS (ft):	1.5	1.5	1.5					
Temp (°C):	10.33	10.33	10.32					
pH:	7.77	7.78	7.79					
Barometeric (mmHg):	763.00	763.00	763.0					
Pressure (kPa):	5.55	5.62	5.651					
Conductivity (ųS/cm):	144.30	144.20	144.3					
RDO (ppm):	11.72	11.72	11.72					
Turbidity (NTU):	0.80	0.90	0.6					

#### **IN-FIELD CHEMISTRY ANALYSIS**

Parameter	Res	sult (s)	Method
YSI:	12:54		
Conductivity (ųS/cm):	159.5		
Temp (°C):	10.7		
Remarks:		_	

Field-Form Filled Out By: QAQC Check By:

Hilton Lawson

Project ID:	North Slope Lakes	Site Location/Lake ID:	Kuparuk Res #5
Sample Purpose:	Lake Water Quality	Date: 8/9/2005	Time: 12:30

#### FIELD MEASUREMENTS

GPS Coord. Northing:	N70 20.436	Easting: W148 56.083	Datum:	NAD 27
Measurements By:	Hilton/Galloway	Time: 12:50		
Water Depth (ft):	na	Ice Thickness (ft): na	_	
Freeboard (ft):	na	Snow Depth (ft): na	_	
Elev. (BPMSL):	4.55 +/- 0.02	Survey B Galloway	Time:	nr
Sampled By:	Hilton	Sample Depth BWS (ft): 1.5	Time:	12:30

#### WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Meter Make/Model			Serial No.	Pre-Samp QAQC	Post- QA	Samp \QC
pH, conductivity, DO, Turbidity	GWS	In-Si	tu Troll 90	000	33033	yes	у	es
Parameters				Field Mea	surements			
Time	12:59	1:00	1:01					
Depth BWS (ft):	1.5	1.5	1.5					
Temp (°C):	9.73	9.63	9.70					
pH:	7.68	7.68	7.68					
Barometeric (mmHg):	763.00	763.00	763.0					
Pressure (kPa):	5.78	6.01	6.066					
Conductivity (ųS/cm):	127.70	127.90	127.2					
RDO (ppm):	11.86	11.86	11.87					
Turbidity (NTU):	0.60	1.20	1.0					

#### **IN-FIELD CHEMISTRY ANALYSIS**

Parameter		Result (s)	Method
YSI:	12:58	1:01	
Conductivity (ųS/cm):	100.2	101.2	
Temp (°C):	9.9	9.9	
Remarks:			

Field-Form Filled Out By: QAQC Check By:

Hilton
Lawson

Project ID:	North Slope Lakes	Site Location/Lake ID: Big Lake	
Sample Purpose:	Lake Water Quality	Date: 8/10/2005 Time: 3:00	
			_

#### FIELD MEASUREMENTS

GPS Coord. Northing:	N70 17.682	Easting: W148 44.864	Datum: NAD 27
Measurements By:	Hilton/Galloway	Time: 3:20	
Water Depth (ft):	na	Ice Thickness (ft): na	
Freeboard (ft):	na	Snow Depth (ft): na	
Elev. (BPMSL):	9.76 +/- 0.02	Survey By: Galloway	Time: 14:00
Sampled By:	Hilton	Sample Depth BWS (ft): 1	Time: 3:30

#### WATER QUALITY METER INFORMATION

Calibration Information

Parameter (s)	Owner	Meter Make/Model		Serial No.	Pre-Samp QAQC	Pos C	t-Samp AQC	
pH, conductivity, DO, Turbidity	UAF	In-S	Situ Troll	9000	33025	yes		yes
Parameters		Field Measurements						
Time	3:34	3:36	3:37					
Depth BWS (ft):	1	1	1					
Temp (°C):	15.95	16.02	15.90					
pH:	7.94	7.90	7.89					
Barometeric (mmHg):	761.99	761.75	761.75					
Pressure (kPa):	2.59	2.54	1.914					
Conductivity (ųS/cm):	254.00	253.60	254.1					
RDO (ppm):	10.54	10.52	10.55					
Turbidity (NTU):	3.10	2.50	2.6					

#### **IN-FIELD CHEMISTRY ANALYSIS**

Parameter	Result (s)	Method
YSI:		
Conductivity (ųS/cm):		
Temp (°C):		

Remarks:

Field-Form Filled Out By: QAQC Check By: Hilton Lawson

# APPENDIX B. WATER QUALITY METER CALIBRATION FORMS

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

#### University of Alaska Fairbanks, Water and Environmental Research Center Form F-004e: Water Quality Meter Calibration Form

Project ID:	North Slope Lakes	Site Location/Lake ID: Mine Site B,
Sample Purpose:	Lake Water Quality	Kuparuk Reser

Kuparuk Reservoir, Big Lake

#### WATER QUALITY METER INFORMATION

Meter Make:	In-Situ	
Owner:	UAF	•

Model:	Troll 9000
S/N:	33025

#### CALIBRATION AND QUALITY ASSURANCE INFORMATION Pre-Sampling QA

Fie-Sampling QA							
Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
pH 7.00	8/5/05	16:10	Oakton	2405162	May-06	7.02	Pass
Conductivity	8/5/05	16:30	Oakton 447	2412150	Dec-05	407 @ 21C	Pass
0% RDO	8/5/05	16:40	Hanna Zero Oxygen	690	Dec-06	0.00 mg/L	Pass
100% RDO	8/5/05	16:50	Tetra Bubbler	na	na	9.05 mg/L @18C	Pass
Post-Sampling QA							

#### Pass/Fail Parameter Standard Meter Reading Date Time Lot No. Exp. pH 7.00 8/10/06 21:40 Oakton 2405162 May-06 6.92 Pass 8/10/06 21:40 Oakton 447 2412150 Dec-05 434.6 @23.96C Conductivity Pass 21:40 Hanna Zero Oxygen 0% RDO 8/10/06 690 Dec-06 0.01 Pass 100% RDO 8/10/06 21:40 Tetra Bubbler 8.2 @25.61 C na na Pass Remarks:

Field-Form Filled Out I	Зу:	Hilton	Date:	8/9/2005
QAQC Check By:	Lawson		Date:	9/1/2005

#### University of Alaska Fairbanks, Water and Environmental Research Center Form F-004e: Water Quality Meter Calibration Form

Project ID:	North Slope Lakes	Site Location/Lake ID: Mine Site B,
Sample Purpose:	Lake Water Quality	Kuparuk Reservoir,
		 Big Lake

WATER QUALITY METER INFORMATION

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

# CALIBRATION AND QUALITY ASSURANCE INFORMATION

Fre-Sampling QA							
Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
pH 4.01	8/5/05	18:10	Oakton	2404386	Apr-06	4.00	Pass
pH 7.00	8/5/05	18:20	Oakton	2405162	May-06	7.00	Pass
pH 10.00	8/5/05	18:30	Oakton	2404386	Apr-06	10.02	Pass
Conductivity	8/5/05	18:40	Oakton 447	2412150	Dec-05	421.7 @ 20.82C	Pass
0% RDO	8/5/05	18:50	Hanna Zero Oxygen	690	Dec-06	0.00 mg/L	Pass
100% RDO	8/5/05	19:00	Tetra Bubbler	na	na	9.84 @ 18.14	Pass
				<u> </u>			
Post-Sampling QA							
Parameter	Date	Time	Standard	Lot No.	Exp.	Meter Reading	Pass/Fail
pH 7.00	8/10/06	22:00	Oakton	2405162	May-06	6.97	Pass
Conductivity	8/10/06	22:00	Oakton 447	2412150	Dec-05	442.0 @23.53C	Pass
0% RDO	8/10/06	22:00	Hanna Zero Oxygen	690	Dec-06	0.00	Pass
100% RDO	8/10/06	22:00	Tetra Bubbler	na	na	8.75 @25.49C	Pass

Remarks:

Field-Form Filled Out	By:	Hilton	Date:	8/9/2005
QAQC Check By:	Lawson		Date:	9/1/2005

# APPENDIX C. ELEVATION SURVEY FORMS

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

# **Project Survey Form**

Project:	North Slope Tundra Lakes Project Date:					8/9/2005
Location:	Reservoir Lakes #1, #2 and #3 Time:					11:00 AKST
Survey objective:	Water Surface	(WS) Elev	Weather Observations:			
Instrument Type:	Optical Level Leica NA720		Instrument ID:	SN 5242555		Overcast, slight drizzle and
Rod Type:	Stadia Rod		Rod ID:	Sokkia <sup>-</sup>	FSE 1171	breeze (<5mpn), cool (50F)
Bench Mark Ir	nformation:	-	-	-		Survey Team Names:
Name	Agency Responsible	Elev (ft)	Latitude (dd-mm-ss)	Longitua (ddd-mr	de n-ss)	Braden Galloway
NA	NA	NA	NA	NA		Samir Patil
Station	BS (ft)	HI (ft)	FS (ft)	Elevatio (ft)	n	Remarks
ТВМ А	6.20	106.20		100.00		arbitrary elevation used for calcuations. 2.8' dia culvert.
В			8.05	9	98.15	0.8' dia culvert
ws			8.24	9	97.96	
TP C			5.38	1	00.82	2.8' dia culvert
ТР С	5.21	106.03				
ws			8.08	9	97.95	
В			7.87	9	98.16	
A			6.03	100.00		

Notes: Water surface elevation 2.04 <u>+</u> 0.02ft below TBM A. Reservoir Lakes 1, 2 and 3 and hydrologically connected yielding the same water surface elevations. Culvert diameters given in remarks column to help identify TBM's in future.

Abbreviations: backsight, BS; height of instrument, HI; foresight, FS; British Petroleum Mean Sea Level, BPMSL; Temporary Bench Mark, TBM



Rservoir Lakes 1, 2, and 3 survey. Lake 3 shown in photograph taken 8/9/05 taken 10:36 AM AKST.

# **Project Survey Form**

Project:	North Slope Tundra Lakes Project Date:					8/9/2005
Location:	Reservoir Lakes #4 and #5 Time:					12:00 AKST
Survey objective:	Water Surface (WS) Elevation					Weather Observations:
Instrument Type:	Optical Level Leica NA720		Instrument ID:	SN 5242555		Overcast, slight drizzle and
Rod Type:	Stadia Rod		Rod ID:	Sokkia <sup>-</sup>	FSE 1171	breeze (<5mpn), cool (50F)
Bench Mark II	nformation:			-		Survey Team Names:
Name	Agency Responsible	Elev (ft)	Latitude (dd-mm-ss)	Longitua (ddd-mr	de n-ss)	Braden Galloway
NA	NA	NA	NA	NA		Samir Patil
Station	BS (ft)	HI (ft)	FS (ft)	Elevatio (ft)	n	Remarks
ТВМ А	6.07	11.84			5.77	marked TBM 22-91-43 Elev 5.77ft
ws			7.28		4.56	
ТР В			5.56		6.28	1.8' dia culvert
ТР В	5.33	11.61				
WS			7.07		4.54	
A			5.84		5.77	

Notes: Water surface elevation 4.55 <u>+</u> 0.02ft. Need to verify TBM 22-91-43 Elevation 5.77ft with Lounsbury?

Abbreviations: backsight, BS; height of instrument, HI; foresight, FS; British Petroleum Mean Sea Level, BPMSL; Temporary Bench Mark, TBM



Reservoir Lake 4 (on right) and Lake 5 (on left) with survey TBM's identified. Picture taken 8/9/05 11:46 AM AKST.

# **Project Survey Form**

Project:	North Slope Tundra Lakes Project Date: 2					8/10/2005
Location:	Big Lake BOC Drinking Water Lake Time:					14:00 AKST
Survey objective:	Water Surface	(WS) Ele	vation	Weather Observations:		
Instrument Type:	Optical Level L NA720	eica	Instrument ID:	SN 524	2555	Clear and sunny, slight breeze
Rod Type:	Stadia Rod		Rod ID:	Sokkia	TSE 1171	( <ompn), (our)<="" td="" warm=""></ompn),>
Bench Mark II	nformation:					Survey Team Names:
Name	Agency Responsible	Elev (ft)	Latitude (dd-mm-ss)	Longitua (ddd-mr	de n-ss)	Braden Galloway
NA	NA	NA	NA	NA		Samir Patil
Station	BS (ft)	HI (ft)	FS (ft)	Elevatio (ft)	'n	Remarks
1310	1.54	101.54		1	100.00	
1311			1.52	1	100.02	
WS			11.30	,	90.24	WS is 9.76 +/- 0.02ft below TBM 1310
1311.5 TP	T		0.90	1	00.64	
1311.5 TP	0.78	101.42				
WS			11.17		90.25	WS is 9.75 +/- 0.02ft below TBM 1310
1311	T		1.40	T		
1310			1.42	1	100.00	

Notes: Water surface elevation 9.74  $\pm$  0.02ft below TBM 1310.

Abbreviations: backsight, BS; height of instrument, HI; foresight, FS; British Petroleum Mean Sea Level, BPMSL; Temporary Bench Mark, TBM



Big Lake survey TBM's identified. Picture taken 8/10/05 at 14:48 AKST.

### 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: 8/8/2005	Time: 14:00		

Location:	Mine Site B, NE corner of North Cell, temporary datum									
Survey objective:	Lake water ele	vation surve	у			Weather Observation	IS:			
Instrument Type:	Optical Sur	n	а			1				
Rod Type:	na	l	Rod ID:	n	а					
	•	Bench Mark	Information:			Survey Tear	m Names			
Name	Agency Elevation Responsible (ft)		Latitude Long (dd-mm.mmm) (ddd-mr		itude 1.mmm)	de Braden Galloway, nmm) Samir Patil				
TBM"A"	WERC	100 Temp.	na	na	а					
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks		
TBM"A"	4.69	104.69		100.00			0	Top of Post embedded in gravel		
WL		104.69	8.51	96.18				Water Level next to shore		
TP1		104.69	5.18	99.51				moved Instr., used arbitrary point east of TBM"A" as turning point		
TP1	4.86	104.37		99.51						
WL		104.37	8.18	96.19				Water Level next to shore		
TBM"A"		104.37	4.36	100.01				close survey to +0.01		

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

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

Project ID:	North Slope Lakes	Site Location/Lake ID:	Mine Site B		
Survey Purpose:	TBM"A" elevation	Date: 8/10/2005	Time:	na	

Location:	Mine Site B, NE corner of North Cell, temporary datum									
Survey objective:	Lake water ele	evation surve	У			Weather Observation	IS:			
Instrument Type:	Optical Survey Level Instrument ID:			n	а			-		
Rod Type:	na Rod ID:			n	а					
	Bench Mark Information:					Survey Tea	m Names			
Name	Agency Elevation Responsible (ft)		Latitude (dd-mm.mmm)	Long (ddd-mm	Longitude (ddd-mm.mmm)		oway,	-		
VSM376A	BPX	10.00 Temp	na	n	а					
Station	BS (ft)	HI (ft)	FS (ft)	Elevation (fasl)	Distance (ft)	Horizontal Angle	Vertical Angle	Remarks		
VSM376A	0.40	10.40		10.00				Mark on Pipeline Support		
VSM377		10.40	-0.88	11.28				Mark on Pipeline Support		
WS		10.40	5.85	4.55				Water Level next to shore		
VSM375		10.40	-0.43	10.83				Mark on Pipeline Support		
								moved Instr., used VSM375 as TP		
VSM375	-0.61	10.22		10.83						
TBM"A"		10.22	1.87	8.35				Temp BM used in 8/8/05 Survey		
WS		10.22	5.70	4.52						
VSM377		10.22	-1.04	11.26						
VSM376A		10.22	0.21	10.01				close survey to +0.01		

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