2020 Pogo Plan of Operations Supporting Safe Work Plan (SWP) Documents

1. PURPOSE

The purpose of this SWP is to assure that when Pogo personnel are downloading piezometer data at the Dry Stack Tails Facility (DSTF) they are doing so safely and correctly.

2. SCOPE

This instruction summarizes the procedures for data downloading from DSTF vibrating wire piezometers and compilation of the collected data.

3. REFERENCE DOCUMENTS

Document Name	Document Number
ADEC Waste Management Permit 2011DB0012	
Pogo Mine Monitoring Plan	
QAP - Quality Assurance Project Plan	
RST Wireless Datalogger and Vibrating Wire Piezometer SWP	

4. DEFINITIONS

ADEC	Alaska Department of Environmental Conservation
COC	Chain of Custody
SWP	Safe Work Procedure
QAP	Quality Assurance Plan

5. RESPONSIBILITY

Environmental Manager	Environmental Manager is responsible for permit provisions and requirements, as well as any updates or renewals associated with the permit and any required notifications to the state or federal agencies
Environmental Engineer	To perform downloading and data management of piezometers and to assure other department personnel can perform tasks when needed
Environmental Coordinator / Specialist	Perform DSTF downloading as required when Environmental Engineer is not available

6. DSTF PIEZOMETERS

There three holes installed: SB1, GP1, and RR1. **Figure 1** shows the location of DSTF Piezometer drill holes and **Figure 2** shows the location of dataloggers. **Table 1** shows the information of these holes.

Table 1: DSTF Piezometer Drill Holes Details

Drill Hole	Description	Easting	Northing	Collar Elevation (ft)	Depth (ft)
SB1	Starter berm	1817073	3819217	2,408	106.5
GP1	General placement	1817382	3819010	2,486	147
RR1	'Red Rock' area	1817696	3818669	2,509	97

Figure 1 – Location Map of DSTF Piezometer Drill Holes

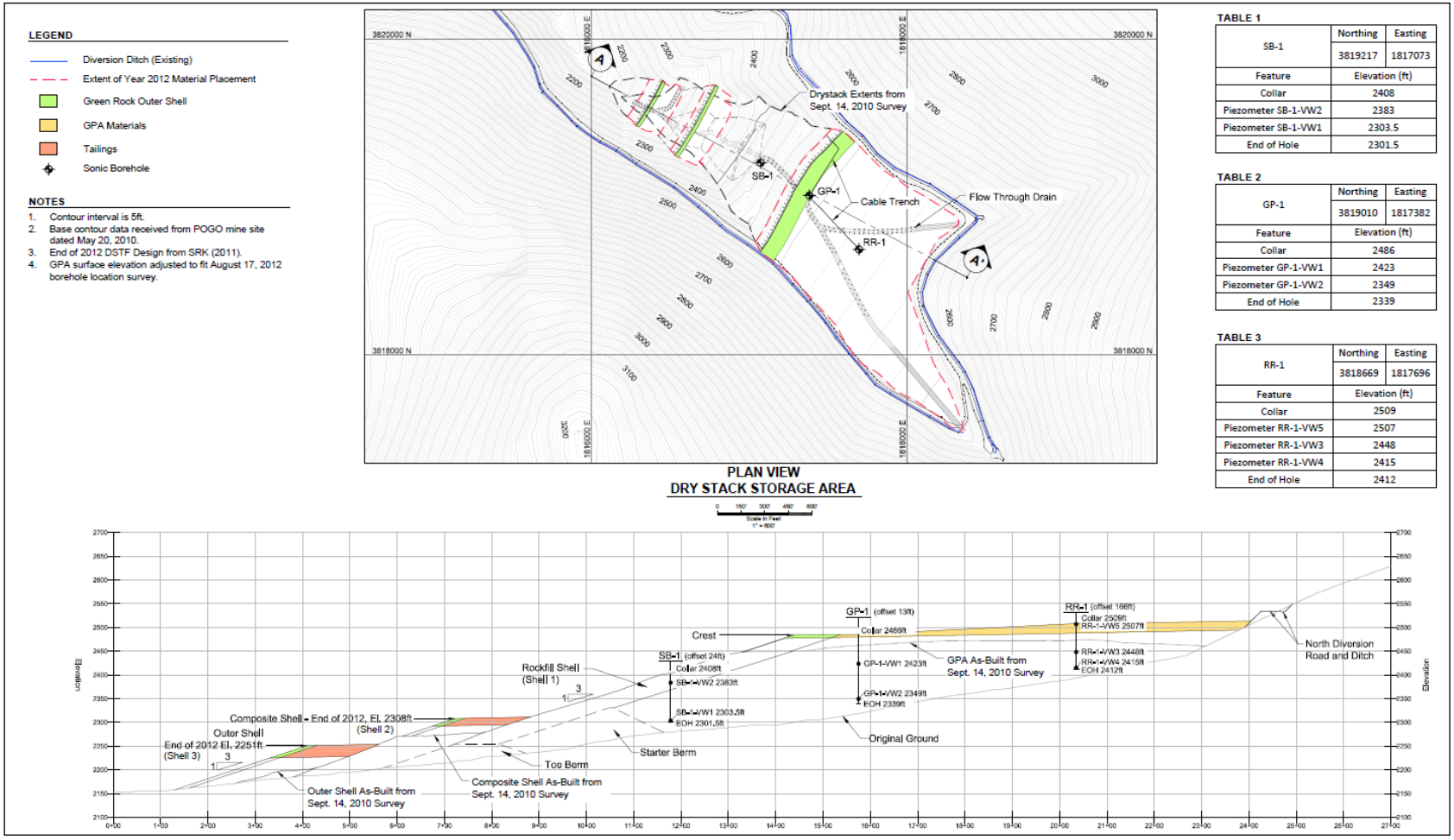


TABLE 1

SB-1	Northing	Easting
	3819217	1817073
Feature	Elevation (ft)	
Collar	2408	
Piezometer SB-1-VW2	2383	
Piezometer SB-1-VW1	2303.5	
End of Hole	2301.5	

TABLE 2

GP-1	Northing	Easting
	3819010	1817382
Feature	Elevation (ft)	
Collar	2486	
Piezometer GP-1-VW1	2423	
Piezometer GP-1-VW2	2349	
End of Hole	2339	

TABLE 3

RR-1	Northing	Easting
	3818669	1817696
Feature	Elevation (ft)	
Collar	2509	
Piezometer RR-1-VW5	2507	
Piezometer RR-1-VW3	2448	
Piezometer RR-1-VW4	2415	
End of Hole	2412	

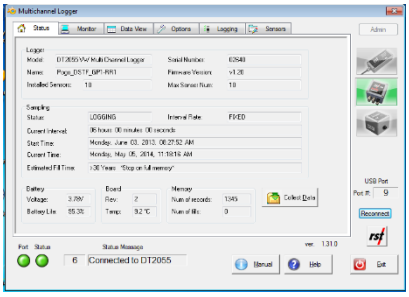
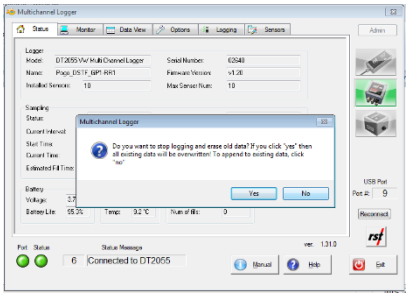
Figure 2 – Datalogger Locations

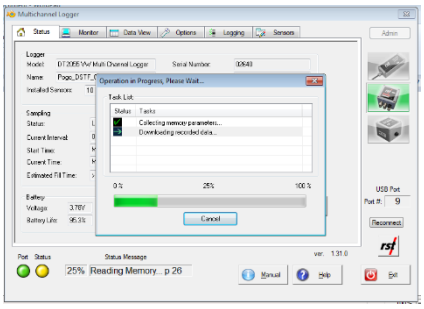
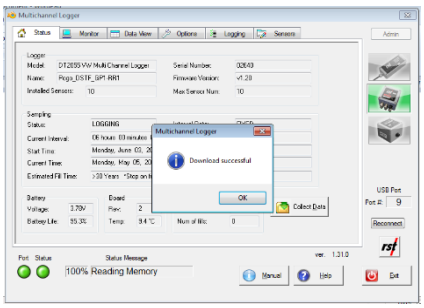
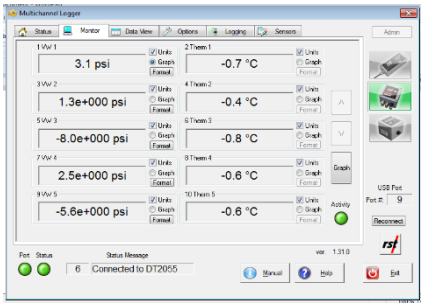
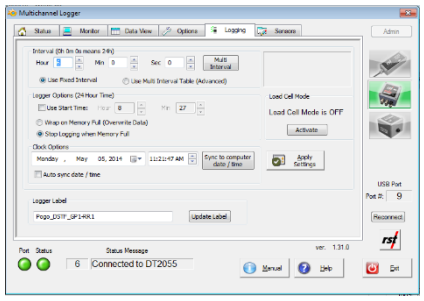
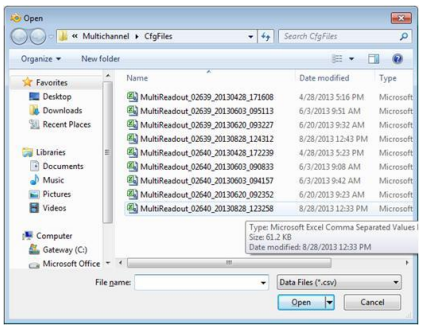
Table 2 summarizes the location of vibrating wire sensors in the drill holes.

Table 2: Vibrating Wire Piezometer Location

Drill Hole	Piezometer ID	Description	Depth from Collar (ft)	Elevation (ft)
SB1	SB1-VW2	Shallow	25	2383
	SB1-VW1	Deep	104.5	2303.5
GP1	GP1-VW1	Shallow	63	2423
	GP2-VW2	Deep	137	2349
RR1	RR1-VW5	Shallow	2	2507
	RR1-VW3	Mid	61	2448
	RR1-VW4	Deep	94	2415

6.1 Data Download Procedure

Connect computer with Datalogger via USB cable.	
Turn on computer. Activate "Multichannel Logger".	
Once the software is running, click the Status tab, and then click "Collect Data" in the lower right of that tab.	
Click "No".	

Download progress chart appears on the screen.	
When data download completes, click "ok". Then "Exit". If for some reason the download completed with errors, try re-downloading the data. Ensure the USB cable and laptop are stationary during the download process.	
Display of Monitor tab.	
Display of Logging tab. Check if the clock is correct.	
Data is downloaded in the folder: "C:\Users\FieldData\Documents\Multichannel\CfgFiles"	

6.2 Data Compilation Procedure

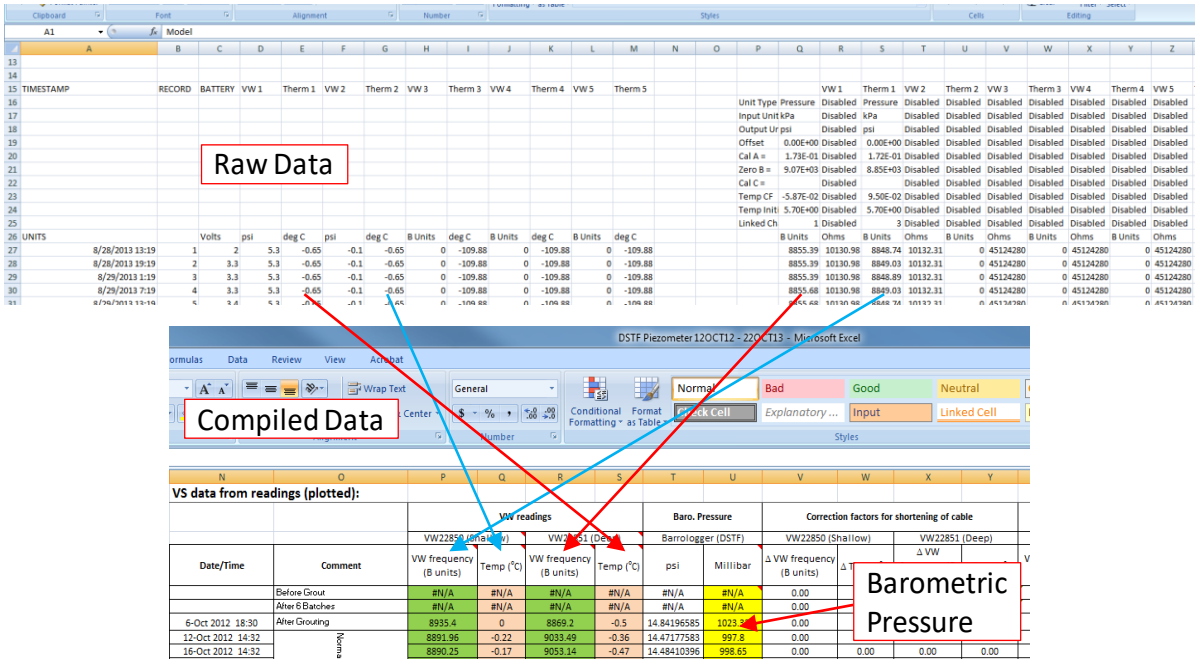
Excel file for data compilation can be found at the following folder:

G:\Enviro\Private\DSTF\DSTF Vibrating Wire Piezometers\DSTF Piezometer Compiled Data
There are three worksheets for SB1, GP1, and RR1.

6.2.1 SBI Data Compilation

1. Open SB1 downloaded file.
2. Copy downloaded raw data (VW frequency (B unit) and temperature) to SB1 worksheet of data compilation file shown as below.
3. Input barometric pressure (marked with yellow) from PRG MET Station data.
   See section 6.2.4 for details.

Hole ID	Sensor	Data	Raw Data
SB1	VW22850 (Shallow)	VW Frequency (Bunit)	Column S VW2 - B Units
		Temp (Degree C)	Column G Therm 2
	VW22851 (Deep)	VW frequency (Bunit)	Column Q VW1 - B Units
		Temp (Degree C)	Column E Therm 1



6.2.2 GP1 Data Compilation

1. Open GP1-RR1 downloaded file.
2. Copy downloaded raw data (VW frequency (B unit) and temperature) to GP1 worksheet of data compilation file shown as below:

Hole ID	Sensor	Data	Raw Data
GP1	VW22852 (shallow)	VW frequency (B unit)	Column Q VW 1 - B units
		Temp (degree C)	Column E Therm 1
	VW22853 (deep)	VW frequency (B unit)	Column S VW 2 - B units
		Temp (degree C)	Column E Therm 2

3. Input barometric pressure (marked with yellow) from PRG MET Station data.
   See section 6.2.4 for details.

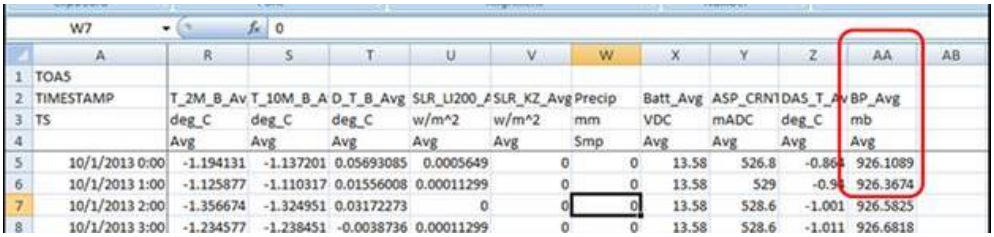
6.2.3 RR1 Data Compilation

1. Open GP1-RR1 downloaded file.
2. Copy downloaded raw data (VW frequency (B unit) and temperature) to RR1 worksheet of data compilation file shown as below:

Hole ID	Sensor	Data	Raw Data
RR1	VW23152 (shallow)	VW frequency (B unit)	Column U VW 3 - B units
		Temp (degree C)	Column I Therm 3
	VW22854 (mid)	VW frequency (B unit)	Column W VW 4 - B units
		Temp (degree C)	Column K Therm 4
	VW22855 (deep)	VW frequency (B unit)	Column Y VW 5 - B units
		Temp (degree C)	Column M Therm 5

6.2.4 Barometric Pressure

1. The data of barometric pressure (Column E of data compilation file) should be copied from the Pogo Ridge (PRG) MET Station data.
2. The barometric pressure (millibar) is shown in the Column "BP_Ave" of MET Station data. Pick up the data at 1:00, 7:00, 13:00, and 19:00 for SB1, and 2:00, 8:00, 14:00, and 20:00 for GP1 and RR1, in order to match the time with piezometers.



	A	R	S	T	U	V	W	X	Y	Z	AA	AB
1	TOA5											
2	TIMESTAMP	T_2M_B_Av	T_10M_B_A	D_T_B_Avg	SLR_LI200_A	SLR_KZ_Avg	Precip	Batt_Avg	ASP_CRN1	DAS_T_Av	BP_Avg	
3	TS	deg_C	deg_C	deg_C	w/m^2	w/m^2	mm	VDC	mADC	deg_C	mb	
4		Avg	Avg	Avg	Avg	Avg	Smp	Avg	Avg	Avg	Avg	
5	10/1/2013 0:00	-1.194131	-1.137201	0.05693085	0.0005649	0	0	13.58	526.8	-0.864	926.1089	
6	10/1/2013 1:00	-1.125877	-1.110317	0.01556008	0.00011299	0	0	13.58	529	-0.9	926.3674	
7	10/1/2013 2:00	-1.356674	-1.324951	0.03172273	0	0	0	13.58	528.6	-1.001	926.5825	
8	10/1/2013 3:00	-1.234577	-1.238451	-0.0038736	0.00011299	0	0	13.58	528.6	-1.011	926.6818	

7. MONITORING AND INSPECTION

DSTF piezometer data is to be downloaded as per the schedule noted in the Pogo DSTF Construction and Maintenance Plan. The data should be downloaded quarterly at a minimum. The second downloading event is also an opportunity to check the condition of the datalogger and battery. Additional downloads are done upon request or are project dependent.

8. MAINTENANCE AND CALIBRATION

DSTF Piezometers are calibrated prior to installation. Maintenance includes routine observation of the condition of the datalogger and battery during downloading events. Instructions on how to connect, setup, and program the RST wireless dataloggers (DTLink) with vibrating wire piezometer sensors are found in the RST Wireless Datalogger and Vibrating Wire Piezometer SWP.

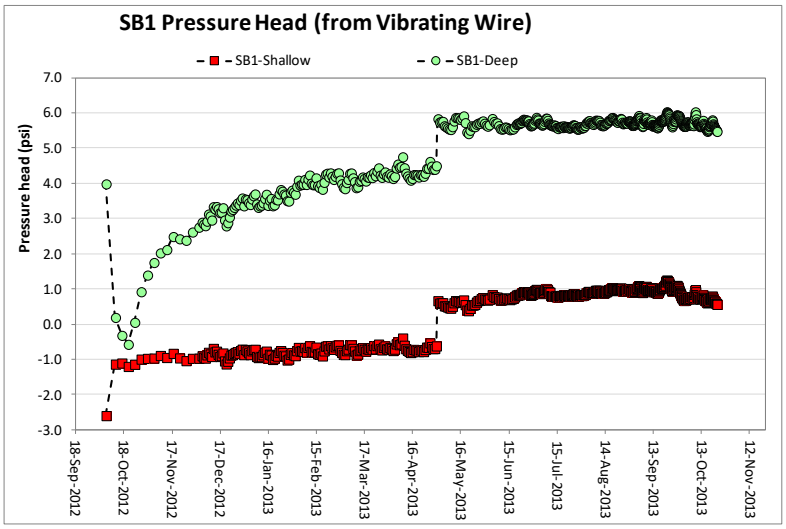
9. RECORDS

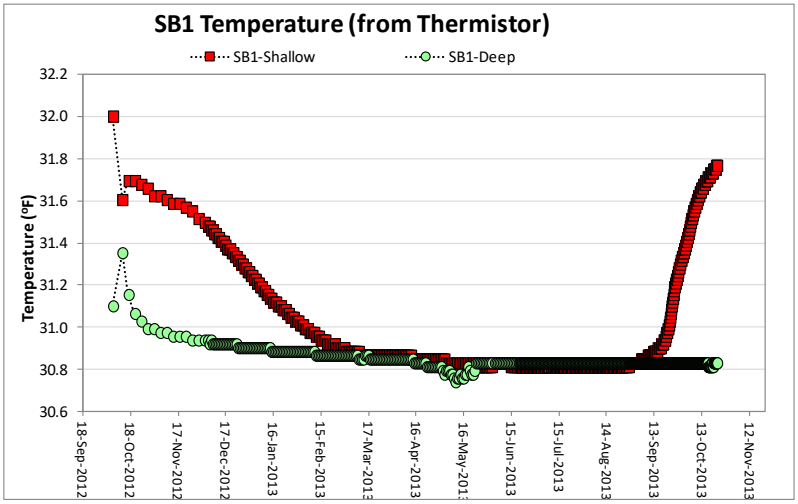
Record Description	Record Location/ Retention Responsibility	Minimum Retention Time
Data Compilation Spreadsheets	Environmental Archives / Environmental Manager	2 years

10. APPENDIX

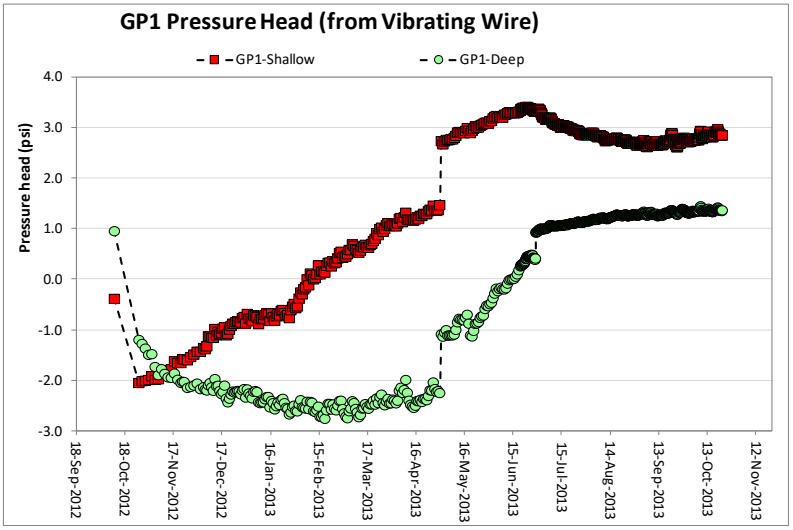
10.1 APPENDIX I - Historical Data

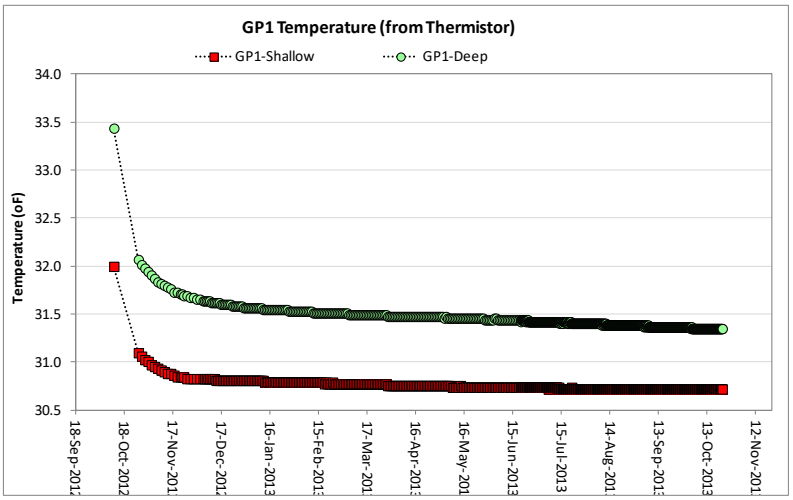
Historical Data – SB1 (October 2012 – October 2013)



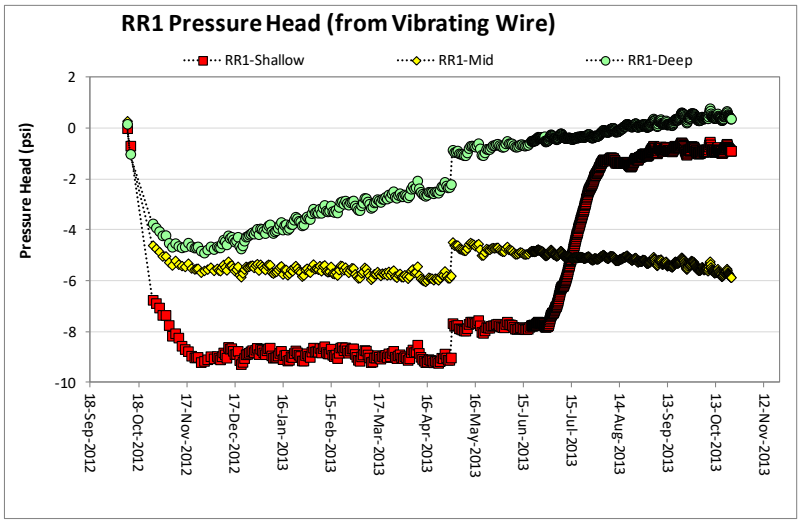


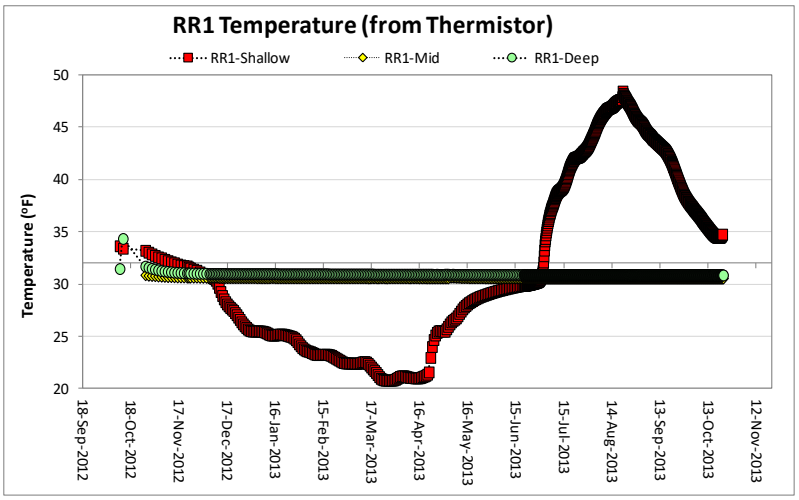
Historical Data – GP1 (October 2012 – October 2013)





Historical Data – RR1 (October 2012 – October 2013)





1. PURPOSE

The objective of this procedure is to make sure the Dry Stack Tailings Facility (DSTF) is compacted in accordance with the *Pogo DSTF Construction and Maintenance Plan*. DSTF density testing will need to occur as specified in the Testing Regime section of this SWP (Section 7.1) to reduce the DSTF's erosion potential. This Safe Work Procedure (SWP) will clarify DSTF density tests, equipment, procedure, and responsible personnel.

2. SCOPE

The procedure describes the DSTF density testing procedure, record keeping, and outlines the procedures for contour plowing.

3. REFERENCE DOCUMENTS

Humboldt Product Manual H-4114SD.3F (2017)

Technical Specifications for Pogo Dry Stack Tailings Facility Expansion – Revision 2 (2011, SRK Consulting)

Pogo DSTF Construction and Maintenance Plan (2011, Pogo)

ASTM Standard D1556/D1556M-15e1, "Standard Test method for Density and unit Weight of Soil in Place by Sand-Cone Method" ASTM International, West Conshohocken, PA, www.astm.org.

ASTM Standard D3080/D3080M-11, "Standard Test method for Direct Shear Test of Soil Under Consolidated Drained Conditions" ASTM International, West Conshohocken, PA, www.astm.org.

ASTM Standard D2216-10, "Standard Test method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass" ASTM International, West Conshohocken, PA, www.astm.org.

ASTM Standard D698-12e2, "Standard Test method for Laboratory Compaction Characteristics of Soil using Standard Effort" ASTM International, West Conshohocken, PA, www.astm.org.

ASTM Standard D6938-17a, "Standard Test method for In-Place Density and Water Content of Soil and Soil-Aggregate by Electrical Methods (Shallow Depth)" ASTM International, West Conshohocken, PA, www.astm.org.

4. DEFINITIONS

ADNR	Alaska Department of Natural Resources
ASTM	American Society for Testing Materials
Contour Plowing	A method of preventing erosion by plowing or driving parallel to the DSTF elevation contour lines
DI	Distilled Water
DSTF	Dry Stack Tailings Facility
SWP	Safe Work Procedure
QA	Quality Assurance
QC	Quality Control

5. RESPONSIBILITY

Surface Operators	To understand this SOP and DSTF density testing procedure and conduct contour plowing and visual inspections. All questions should be directed to his or her supervisor or to the Environmental Department. Notify the Environmental Department if erosion or noncompliance is observed.
Surface Supervisor	Ensure compliance with this procedure, oversee density testing, and ensure proper disposal and compaction techniques are used. The Surface Supervisor should be able to answer all questions brought to his or her attention by the surface operators. Notify the Environmental Department if erosion or noncompliance is observed.

Environmental Department	Ensure the DSTF is compacted to the requirements in the Pogo Mine DSTF Construction and Operation Plan and to distribute this SWP and train necessary personnel on density testing techniques. Conduct Density Tests in accordance with the Testing Regime section of this SWP (Section 7.1)
Health and Safety, and Environmental Manager	Are responsible for the implementation of the *Pogo DSTF Construction and Maintenance Plan*, and for reports to the relevant agencies. All revisions to the *Pogo DSTF Construction and Maintenance Plan* will be submitted to ADNR.
Maintenance Manager	Responsible for the construction of the DSTF.

6. PROCEDURE

The DSTF must be kept at a minimum dry density of 95% to remain within regulatory standards. The maximum lift before compaction is one (1) foot. Density requirements cannot be met if lifts are larger than one foot. The minimum passes for each lift is 5 of a 15t vibratory compactor or equivalent, or until the density meets specifications.

DSTF material moisture needs to remain below 15% to obtain optimum compaction and above 10% to reduce erosion due to wind. If moisture remains below 10% silt fences will need to be installed along the perimeter of the DSTF. Moisture content of the tailings is evaluated by the mill and reported to the Environmental Department.

6.1 Electrical Densitometer Test

Only personnel trained to use the Humboldt H-4114SD.3F can conduct a Electrical density test. The individuals authorized to conduct this test must follow all procedures and protocol within the manual provided by the manufacturer. This test must be conducted in accordance with the Testing Regime section of this SWP (Section 7.1). The density should be tested at least 24 inches away from any object or soil unconformity when using the Backscatter or Backscatter/Air-Gap Ratio methods. The density should be tested at least 6 inches away from any object or soil unconformity when using the Direct Transmission method.

Required Materials (ASTM D6938-17a, 3):

1. Electrical Density / Moisture Gauge
2. Reference Standard
3. Site Preparation Device
4. Drive Pin
   a) Drive Pin-Guide
5. Hammer
6. Drive Pin Extractor
7. Slide Hammer
8. Probe

Read and understand the ASTM International Manual Designated D6938-17a and the Humboldt manual H-4114SD.3F before attempting the Electrical Densitometer Test. It is the operator's responsibility to keep up to date on new ASTM and Humboldt procedures and policies regarding the Electrical Densitometer Test. The field record sheet used for the Electrical Densitometer Test is found Appendix I.

6.2 Sand Cone Test

This test method should only be used in soils "without appreciable amounts of rock or coarse materials in excess of 1½ in [38 mm] in diameter" (ASTM D1556/D1556M – 15e1, 1). This test method should not be used when the sand used can infiltrate the voids of the soil.

Required Materials (ASTM D1556/D1556M-15e1, 7):

1. Sand Cone Apparatus
2. Scale
3. Proctor Mold – Container of known volume
4. Base Plate
5. Trowel

6. Drying Dish
7. Dry Sand
8. Drying Oven
9. Straightedge

Read and understand the ASTM International Manual Designation D1556 / D1556M-15e1 before attempting the Sand Cone Test. It is the operator's responsibility to keep up to date on new ASTM procedures and policies regarding the Sand Cone Test. The field record sheet used for the Sand Cone Test is found in Appendix II.

6.3 Standard Proctor Test

The Standard Proctor Test is a laboratory compaction test. The soil must have 30% or less mass retained on the $^3/_4$ in sieve.

Required Materials (ASTM D698-12e2)

1. Mold Assembly
   a) 4in or
   b) 6in
2. Rammer
   a) Manual or
   b) Mechanical
3. Sample Extruder
4. Scale
5. Drying Oven
6. Straightedge
7. Sieves
   a) $^3/_4$ in
   b) $^3/_8$ in
   c) No. 4
8. Mixing Tools
   a) Pan
   b) Spoon
   c) Trowel
   d) Spatula
   e) Spray Bottle
   f) Etc.

Read and understand the ASTM International Manual Designation D698-12e2 before attempting the Standard Proctor Test. It is the operator's responsibility to keep up to date on new ASTM procedures and policies regarding the Standard Proctor Test.

6.4 Moisture Content Test

This Test finds water content based on weight not volume. It is assumed that the soil is not easily soluble in water. Materials that contain hydrated water such as gypsum should be dried under different conditions than the standard drying temperature.

Required Materials (ASTM D2216-10, 3):

1. Drying Oven
2. Scale
3. Specimen Containers
4. Desiccator (optional)
5. Heat Resistant Gloves - for handling specimen containers after drying
6. Miscellaneous
   a) Knives
   b) Spatulas

c) Scoops
d) Quartering Cloth
e) Wire Saws
f) Etc. as required

Read and understand the ASTM International Manual Designation D2216-10 before attempting the Moisture Content Test. It is the operator's responsibility to keep up to date on new ASTM procedures and policies regarding the Moisture Content Test.

6.5 Direct Shear Test

The Direct Shear Test is a laboratory shear strength test. Test results may be inaccurate if course soil or rock is present in the sample.

Required Materials (ASTM D3080/D3080M-11)

1. Shear Device
2. Shear Box
3. Porous Inserts
4. Loading Devices
   a) Device for applying the Normal Force
   b) Device for Shearing the Specimen
   c) Top Half of Shear Box
5. Normal Force Measurement Device
6. Shear Force Measuring Device
7. Deformation Indicators
8. Shear Box Bowl
9. Controlled High Humidity Environment
10. Test Water
11. Trimmer or Cutting Ring
12. Scale
13. Apparatus for Determining Water Content
14. Equipment for Compacting Specimen
15. Miscellaneous Equipment
    a) Timer with second hand
    b) DI water
    c) Spatula
    d) Knife
    e) Straightedge
    f) Wire Saw
    g) Etc.

Read and understand the ASTM International Manual Designation D3080 / D3080M-11 before attempting the Direct Shear Test. It is the operator's responsibility to keep up to date on new ASTM procedures and policies regarding the Direct Shear Test.

6.6 Erosion Control

Contour plowing is the cheapest and most effective method to prevent soil erosion when vegetation is not present. To achieve this run a plow, tractor or truck parallel to the elevation contour lines. This will create rows that trap the precipitation and prevent it from running off the DSTF and forming ruts or gullies.

Contour plowing should be performed after every new layer of rock or tailings is added to the DSTF, after it shows sign of wear, and after every rain event exceeding 2 in 24 hours.

7. MONITORING AND CHECKING

The DSTF needs to be checked to determine if it is meeting compaction requirements. The DSTF needs to be inspected visually on a daily basis by the surface operators and surface supervisor. The

observations will be recorded in a fashion similar to what is shown in the records section (Section 8). The DSTF's density needs to be checked by mechanical methods (Section 6.0) in accordance with the Testing Regime (section 7.1).

7.1 Testing Regime

The following table is copied from and can be found in the *Pogo DSTF Construction and Maintenance Plan*:

QA / QC	Test Description	ASTM Method*	Test Frequency	Test Procedures	Target
Quality Control Program	In-Situ Nuclear Densitometer	D6938-10	Quarterly when the dry stack is not frozen (usually May – October)	Performed on material placed and compacted in all areas within 24 hours prior to test day. Maximum testing spacing of 30 ft to a target depth of 12 inches. Test density results should be reported in pcf and moisture content in %. Compare results to laboratory Standard Proctor test results.	Avg. Density of 98.1 pcf or 90% Standard Proctor
	Standard Proctor	D698-07		Completed for three equally spaced grab samples from each test area.	N/A
	Moisture Content	D2216		Completed for three equally spaced grab samples from each test area.	N/A
	Grain Size Distribution	D422		Completed for three equally spaced grab samples from each test area.	Verify Tailings Consistency
Quality Assurance Program**	In-Situ Nuclear Densitometer	D6938-10	Annually (performed during summer months)	Performed on material placed and compacted in all areas within 24 hours prior to test day. Maximum testing spacing of 30 ft to a target depth of 12 inches. Test density results should be reported in pcf and moisture content in %. Compare results to laboratory Standard Proctor test results.	As above
	Sand Cone Test	D1556-07		One test for every ten densometer tests completed.	Consistency with ASTM D6938-10 results
	Standard Proctor	D698-07		Completed for three equally spaced grab samples from each test area.	As above
	Moisture Content	D2216		Completed for the three samples collected for the Proctor test.	As above
	Grain Size Distribution	D422		Completed for the three samples collected for the Proctor test.	As above

*ASTM Methods have been updated to reflect current documents
**QA tests, apart from the Sand Cone test, are not required if the QC program is conducted by a certified, independent lab.

8. RECORDS

Mechanical density tests are recorded in the DSTF GPA Density Testing Log, found in the Environmental Folder on Pogo's G Drive. The log includes the information found below, which is entered into the INX InControl system.

Date	Density Test Method	Density Found	Within Specifications	Cause of Test (Testing Regime, Rain, Requested, etc.)

The daily visual inspections by the surface group follow the format given in the Pogo DSTF Construction and *Maintenance* Plan in Appendix *II*. An example of this spreadsheet can be found below.

Dry Stack Weekly Inspection Log							
Date	Name of Inspector	Observations (Y = Observed, N = Not Observed)					Description of Observations
		Unusual Cracking	Bulging	Signs of Settlement	Seepage	Erosion	

8.1 Internal Notifications

If a surface operator believes the DSTF is not meeting compaction specification, he or she will notify their supervisor and the Environmental Department immediately.

All unusual or unsafe situations must be reported immediately to the Maintenance, Health and Safety, and Environmental Managers.

Following all QA/QC of the DSTF, results from the data will be shared with the surface crew and site management.

9. DATA DOWNLOAD

9.1 Data Access

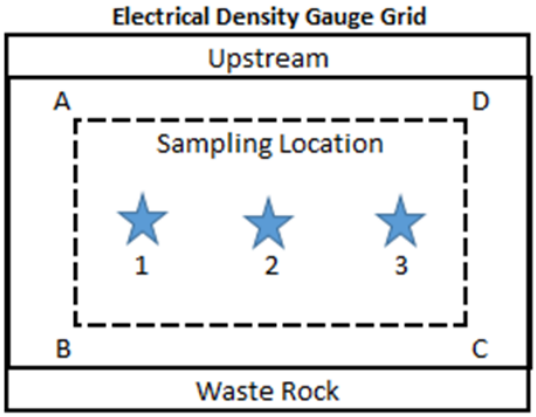
Data can be downloaded to the Dell laptop computer interface through the Bluetooth connection with the EDG. Software can be downloaded by visiting the Humboldt Manufacturing website at: https://www.humboldtmfg.com/support/. Contact Pogo's IT department for assistance in downloading software as it requires Administrative privileges.

Data can also be directly downloaded to a USB drive and transferred to: G:\Enviro\Private\6. Monitoring\DSTF\EDG.

9.2 Data Management

Data will be reported to the Environmental Manager. If discrepancies are found regarding compliance with requirements set forth in the DSTF Maintenance and Operations Manual, formal notification will be reported to the Environmental Manager.

10. APPENDIX I – ELECTRICAL DENSITY GAGE GRID

Date Tested			Reported by	
Date Compacted			Elevation (ft)	
GPS Coordinates (degree) Electrical Density Gauge Grid			Map	
A	N:	W:		
B	N:	W:		
C	N:	W:		
D	N:	W:		
Sampling Location				
1	N:	W:		
2	N:	W:		
3	N:	W:		
Calibration Time:				

Moisture Content / Standard Proctor Test (Three Samples per Monitoring)				
Sample No.	**1**	**2**	**3**	**Average**
Moisture Content (%)				
Maximum Dry Density (pcf)				
Optimum Moisture Content (%)				

11. APPENDIX II – ELECTRONIC GAUGE AND SAND CONE TEST RESULTS SPREADSHEET

Date tested:		Number of Measurements:	
Electrical Density Gauge (30 ft grid, Target Depth is 12 inch)			
Items	Minimum	Maximum	Average
Moisture Content (%)			
Dry Density (pcf)			
% of Standard Proctor			

Sand Cone Test (One test for every ten EDG measurements) (QA Program)							
Test Hole No.	1	2	3	4	5	6	Average
Moisture Content (%)							
Dry Density (pcf)							
Comments:							

Table of Contents

1. PURPOSE AND SCOPE

The purpose of this document is to define standard procedures for collection of hydrologic field data and maintenance of instrumentation from In-Situ pressure transducers/dataloggers (PTs) located in underground wells, surface wells and surface stream flumes. This Safe Work Procedure (SWP) gives descriptions of equipment, site locations, field procedures, and QA/QC procedures necessary to collect useable data for interpretation of water sources and mechanisms of inflow to the mine workings, as well as for future updates to Pogo's numerical groundwater model. The key requirement for the instrumentation is to accurately measure:

- Pressures underground from exploration coreholes;
- Depth to water in surface wells for a regional piezometric surface; and
- Storm events and potential stream loss/gain down Liese Creek.

Please refer to Appendix A for the In-Situ Pressure Transducer Specification Sheets, Appendix B for Data Download Procedures, and Appendix C for the Programming PT's Procedures.

Please refer to http://www.in-situ.com/ for the In-Situ Pressure Transducer Operation Manuals.

2. GENERAL DATA COLLECTION PROCEDURES

Monitoring activities include recording observations, taking manual measurements to corroborate digital data (where appropriate), and downloading and managing the data.

2.1 Schedule for Data Collection

Visit each site once every two months except as follows:

- Surface piezometers: Winter conditions will preclude access during winter months. At a minimum, the piezometers should be visited as early as possible in the spring, mid-summer, and as late as possible in the fall;
- Underground drill holes: In addition to routine visits, data from all sites should be promptly downloaded after uncommonly large inflow events. Data from large inflows can shed light on the response of the larger-scale groundwater flow system, and potentially assist in the interpretation of the interconnectedness of geologic structures; and
- Flumes: Should be visited after periods of high surface flows; either from snow melt or rainfall events. The flumes will also require inspection for damage, removal of sediment deposited in the flume by high flows, and a download of the dataloggers.

2.2 Field Forms

Field forms will be completed during each scheduled visit. The field forms are shown in Appendix D and include, the surface piezometers, the underground drillholes, and a form for the flumes. The forms provide are an important aspect of monitoring as they serve to provide:

1. Written documentation of the monitoring visit;
2. Confirmation that the station is providing data as intended;
3. A basis for remembering the activities to complete the visit;
4. A record of conditions encountered that can affect the quality of the monitoring data and provide insight into interpretation and use of those data; and
5. Provide a quantitative check of the digital data by manually measuring depth to water in the piezometers and noting the depth of flow on the staff gages (or measured with a tape measure) in the flumes.

3. RECORD AND DATA MANAGEMENT

- Field Data Sheets are to be filed in the Environmental office immediately after a site visit;
- Digital data files from the downloaded PTs are to be placed in an appropriate file directory within the Environmental directory on the Pogo computer network. The files can also remain on the field computer for inspection of past behavior of the data during subsequent site visits. The files should be transferred to the network as soon as practical after downloaded in the field; and

- The original downloaded files should remain as downloaded, with no additions for modifications such as calculations, plots or compilations with other data sets. Any such modifications are to be done in a copy of the data file and renamed, or in a new file created for analysis or calculations.

4. EQUIPMENT AND LOCATION DESCRIPTIONS

4.1 Equipment

4.1.1 PRESSURE TRANSDUCERS (PTS)

All PT's are from In-Situ, work with Win-Situ Software, and consist of the following (**Photo 1**):

- Nonvented RuggedTroll 100 & 200 (RT-100 & RT-200) hung on wire cable;
- Nonvented LevelTroll 300 (LT-300) hung on wire cable; and
- Vented LevelTroll 500 & 700 (LT-500 & LT-700) with desiccant and 10ft vented cable.

Specifications Sheets for all PT's are attached in Appendix **A** or can be found online at http://www.in-situ.com/spec_sheets.

Photo 1: The LT-500 & 700 look the same and the RT-100 & 200 also look the same

The communication cables for each are noted below (**Photos 2-4**):

Docking Station

Photo 2: RT-100 & 200:

Photo 3: LT-300 (LT-500 & 700):

Photo 4: LT-500 & 700 (LT-300)

The direct-connect communication cable has a female plastic end that connects directly to the PT. The cable-connect communication cable has a male titanium end with a quick connect that connects to the female titanium quick connect on the vented cables (**Photo 5**).

Photo 5: LT-300, 500 & 700 Communication Cables

Note: The one on the left (male) is much easier to connect. Take this one underground.

The software, Win-Situ, works with Windows 7 & 8 and is installed on the Pogo Environmental Gateway Field Laptop. Win-Situ on CD's were also provided by SRK for easy installation onto other field equipment (tablets/laptops) or desktop computers as needed.

The vented PT's require desiccant plugs when attached to cables should be encased with red rubber caps when not attached to cables (**Photos 6, 7 & 8**). Extra blue desiccant and the red rubber caps were provided by SRK. The small storage desiccant plugs can also be used temporarily while changing out the desiccant in the larger plugs.

Photo 6: XL Desiccant Plug Plug for Storage

Photo 7: L Desiccant Plug

Photo 8: S Desiccant

4.1.2 UNDERGROUND SHUT-IN ASSEMBLIES

Underground coreholes used for monitoring hydrostatic pressures are fitted with a shut-in assembly attached to the Margo grout plugs. The shut-in assembly is a devise with valves to control flow from the hole, accommodate a PT to monitor hydrostatic pressure in the rock, and accommodate a hose to convey discharge for flow measurement or to convey it away from the location. **Photo 9** shows the assembly.

Photo 9: Shut-in Assembly

The assembly is fabricated from supplies purchase at a local hardware or home supply store. The pieces of the assembly consist of brass-cased steel ball valves and carbon steel pipe fittings with NPT threads. All fittings and valves are of one-inch (1") diameter, except for the 1" x ¼" reducer bushing that threads the PT to the assembly. Adjustments can be made to the length of nipples or types and number of elbows to accommodate physical constraints at a given location.

4.2 Underground Coreholes

The underground locations consist of 2012 and in 2013 core holes located in 1300 East Deep (1300Exp), 1170 (1170Exp), L3 (L3Exp) and 1260 North Zone Vent Raise (1260ExpNZVR) exploration drifts.

All locations are instrumented with LT-500 PT, 10ft of cable encased in hose, XL & L desiccant, a discharge head with hose for sampling and are well marked/fenced (**Photos 10, 11 & 12**).

Photo 10: Discharge Head & Instrumentation

Photo 11: Hose for Sampling

Photo 12: Markings

1300Exp Locations:

12U201 and 12U209 were drilled in 2012. 13Hydro-01, 13Hydro-04 and 13Hydro-05 were drilled in 2013. A picture of each site and a red-line map from the 1875 Portal to these locations are as follows (**Photos 13 & 14, Map 1**):

Photo 13: Bay with 12U201 and 12U209

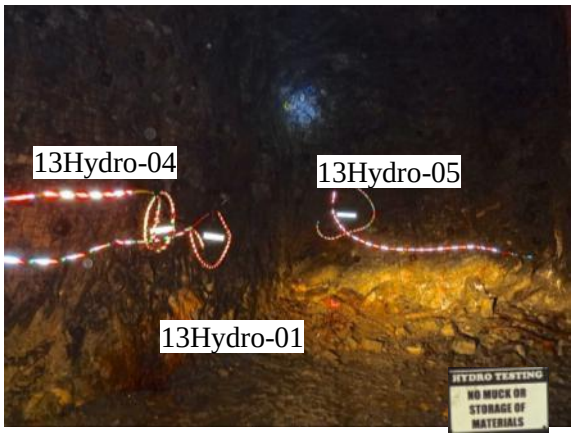
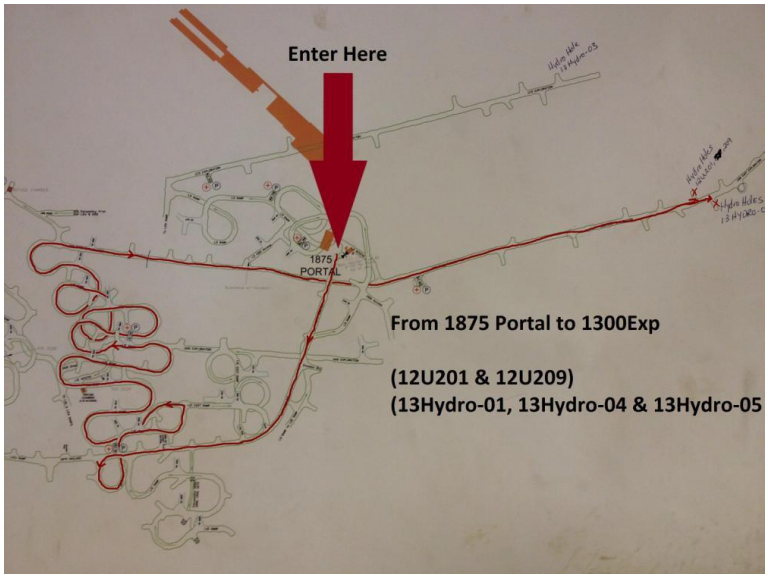


Photo 14: Bay with 13Hydro-01, 04 & 05

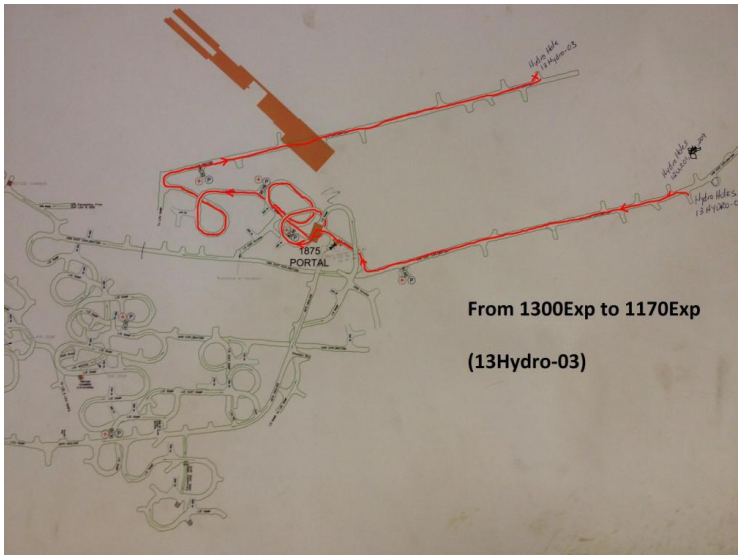


Map 1: Travel from the 1875Portal to the 1300Exp Hydro-Testing Locations

1170Exp Location:

13Hydro-03 was drilled in 2013. A picture of this site and a red-line map from the 1300Exp locations to this location are as follows (**Photo 15**, **Map 2**):

Photo 15: 13Hydro-03

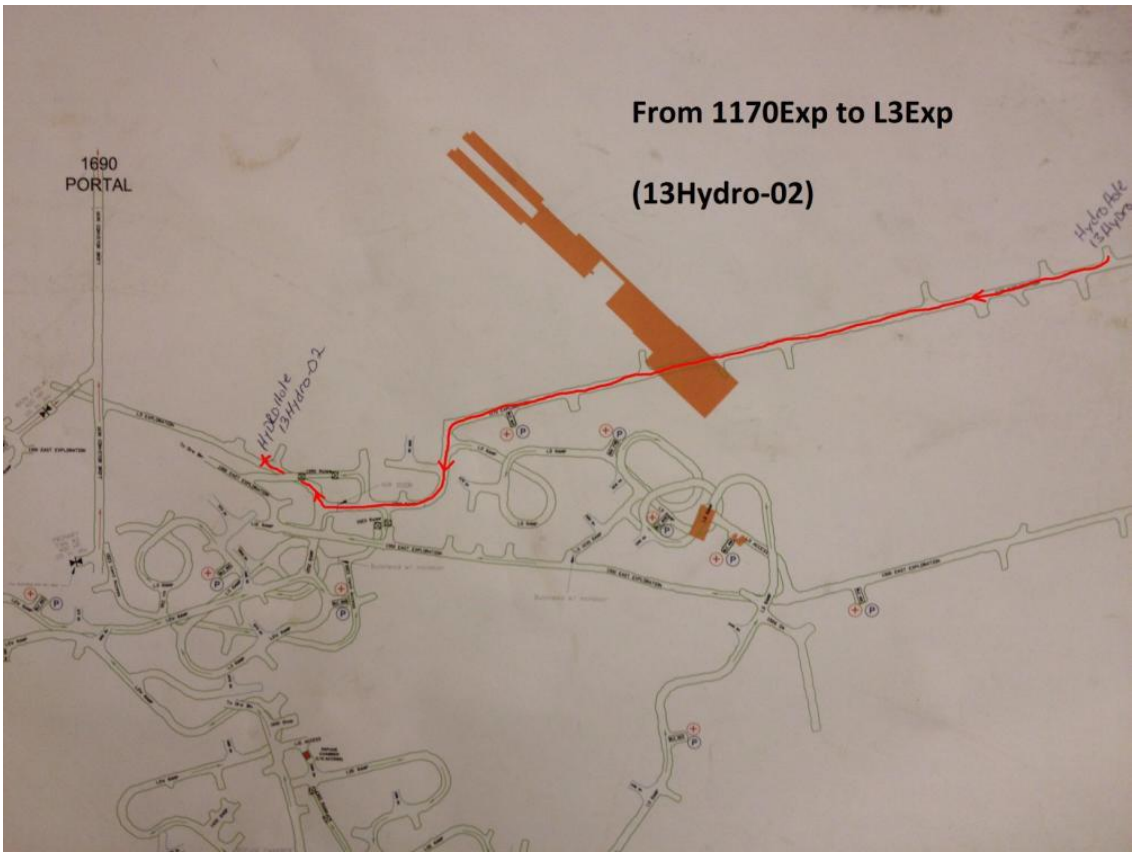


Map 2: Travel from the 1300Exp Locations to the 1170Exp Location

L3Exp Location:

13Hydro-02 was drilled in 2013. A picture of this site and a red-line map from the 1170Exp location to this location are as follows (**Photo 16**, **Map 3**):

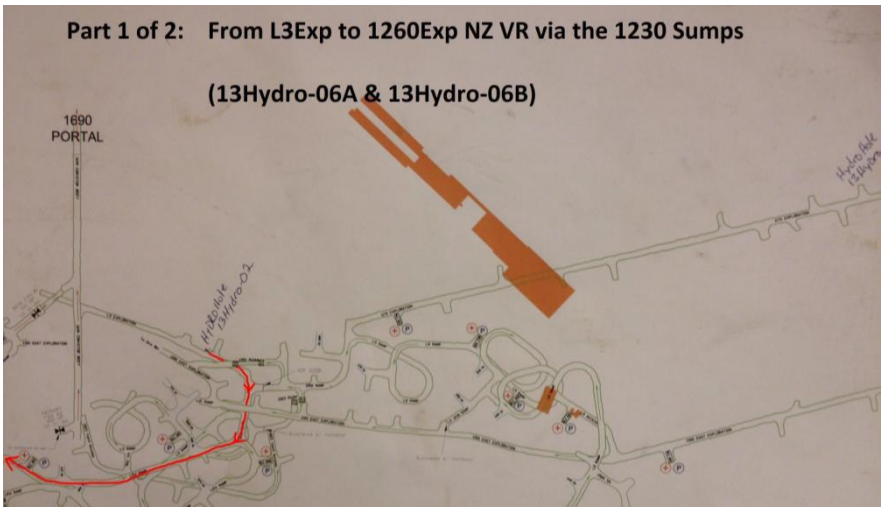
Photo 16: 13Hydro-02



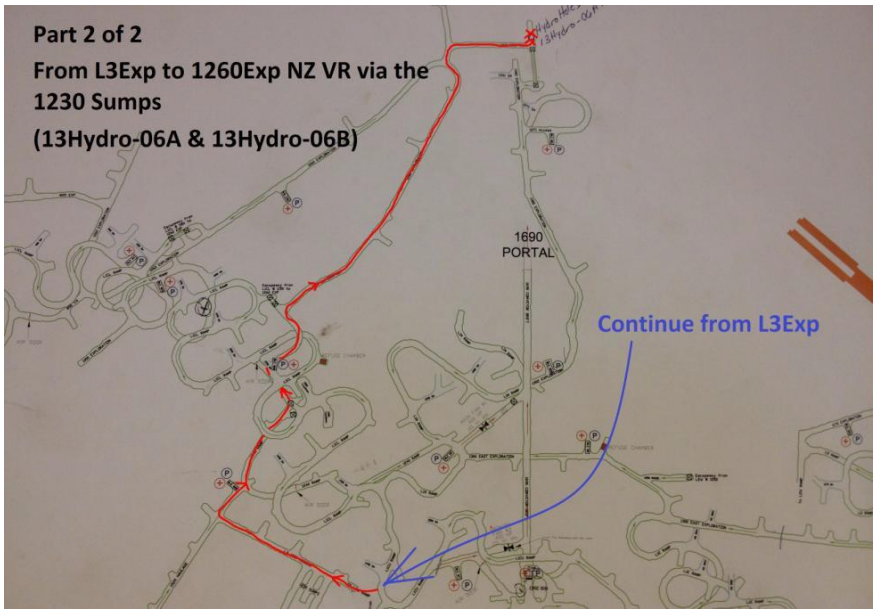
Map 3: Travel from 1170Exp Location to the L3Exp Location

1260ExpNZVR Locations: 13Hydro-06A and 13Hydro-06B were drilled in 2013. A picture of these sites and a red-line map from the L3Exp location to this location are as follows (Photo 17, Maps 4 & 5):

Photo 17: 13Hydro-06A and 06B



Map 4: Travel from L3Exp Location to the 1260ExpNZVR Locations (Part 1)



Map 5: Travel from L3Exp Location to the 1260ExpNZVR Locations (Part 2)

Larger copies of the maps along with all data, pics, etc. are available on the G drive at the following base folder: **G:\Environmental\AHS Pogo\AHS Pogo Stuff 2013\SRK-AHS Pogo Files 8-28-13/.**

4.3 Surface Wells

The surface locations consist of 1999, 2012 and 2013 piezometers located on Pogo Ridge, Liese Ridge and the Airstrip Core yard.

All of the 2012/2013 locations are instrumented (except the Airstrip Core Yard) with either a RT-100 or 200 PT. The MW99-216 is instrumented with a LT-300 PT. All instruments are hung on steel cable. The piezometers are flagged and labeled (**Photos 18 and 19**).

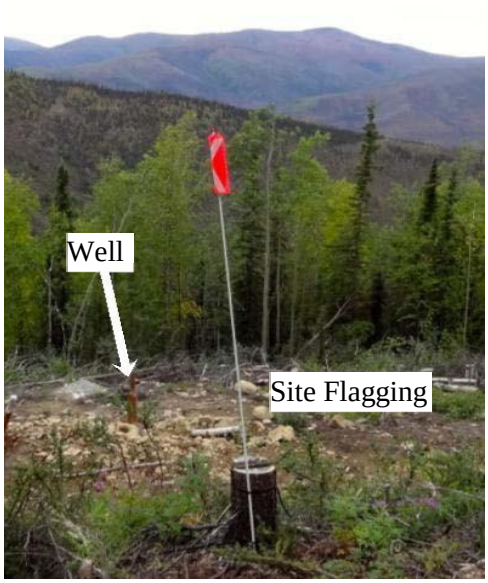


Photo 18: Liese Ridge piezometer

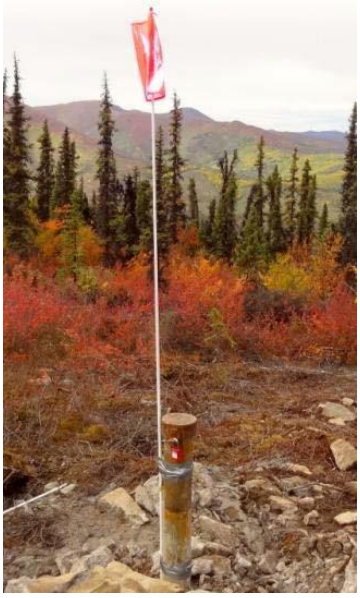


Photo 19: Pogo Ridge Piezometer

All of the 2012 Liese Ridge piezometers are accessible by strenuous uphill hiking from the new exploration road by the 2150 Portal up to the site located at the old geology camp (**Figure 1 with inset photos of each site**).

All of the 2013 Liese Ridge piezometers are accessible by the new exploration road by the 2150 Portal (**Figure 2 with inset Photos of one site**). The 1999/2013 Pogo Ridge piezometers can also be hiked to (**Figure 3 with inset Photos of all sites but one**).

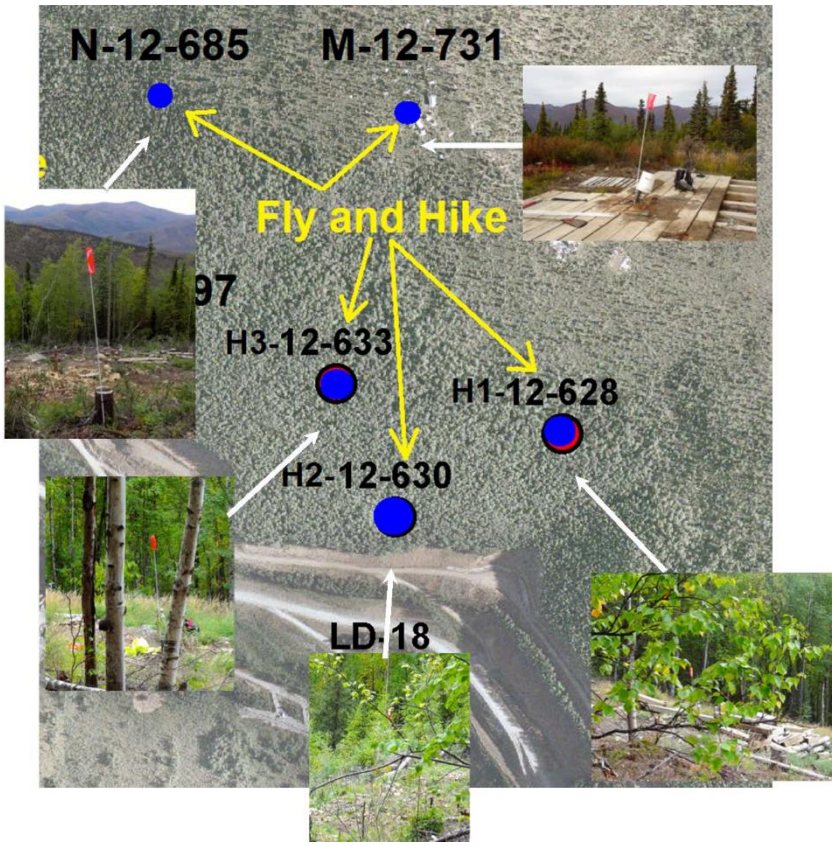


Figure 1: 2012 Liese Ridge Well Locations

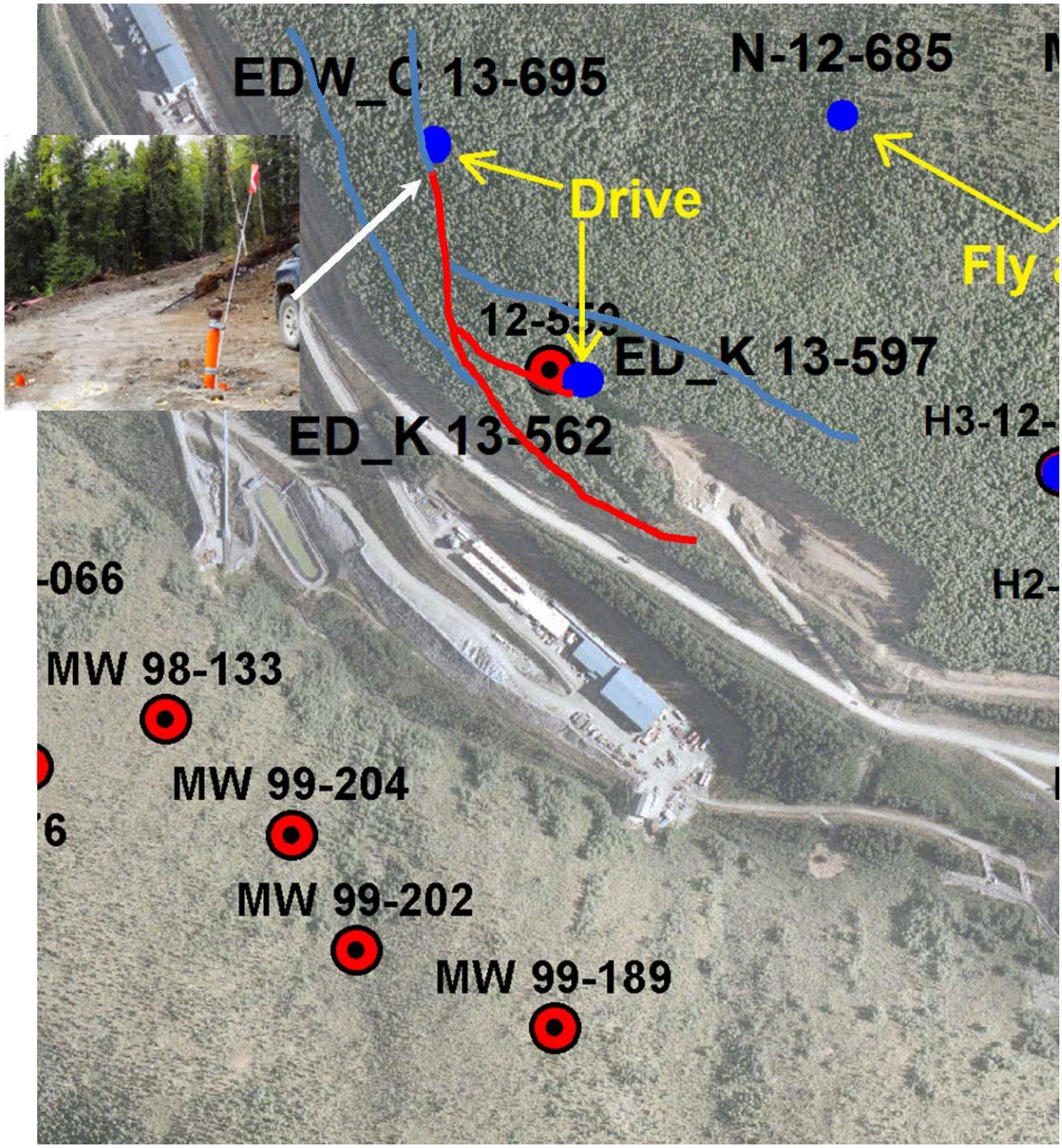


Figure 2: 2013 Liese Ridge Well Locations (No Site Pictures for ED_K 13-597 or ED_K 13-562) (No Site Pictures for ED_K 13-597 or ED_K 13-562 as the drill rig covered that pad)

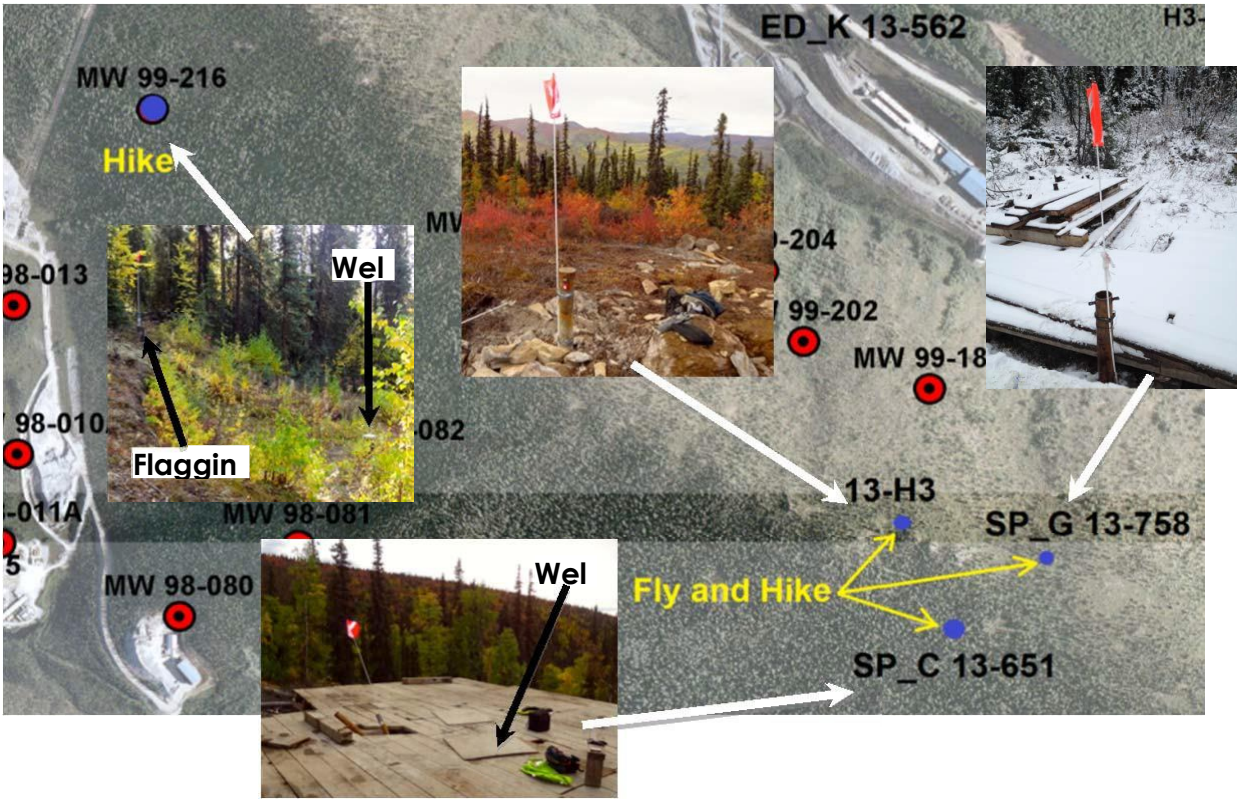


Figure 3: 1999/2013 Pogo Ridge Well Locations

The wells located in the Airstrip Core Yard have dedicated sample pumps. They are currently being sampled for Pogo Profile 13g in order to establish baseline water quality (**Figure 4**).

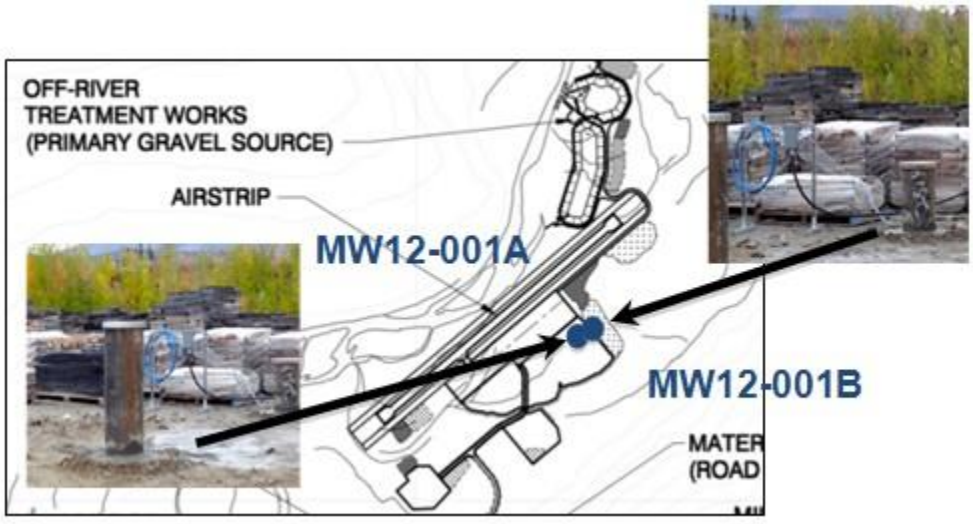


Figure 4: MW12-001A and MW12-001B

4.4 Flumes

Flumes 1 through 4 are located along Liese Creek from below the Drystack Tailings Facility (DSTF) down to Liese Creek Bridge on Road 7.

All the flume locations have a vented LT-700 PT, 10ft cable and desiccant in stilling wells on the H Flumes (installed in summer season only). Their locations and site pictures are noted in **Figure 5**.

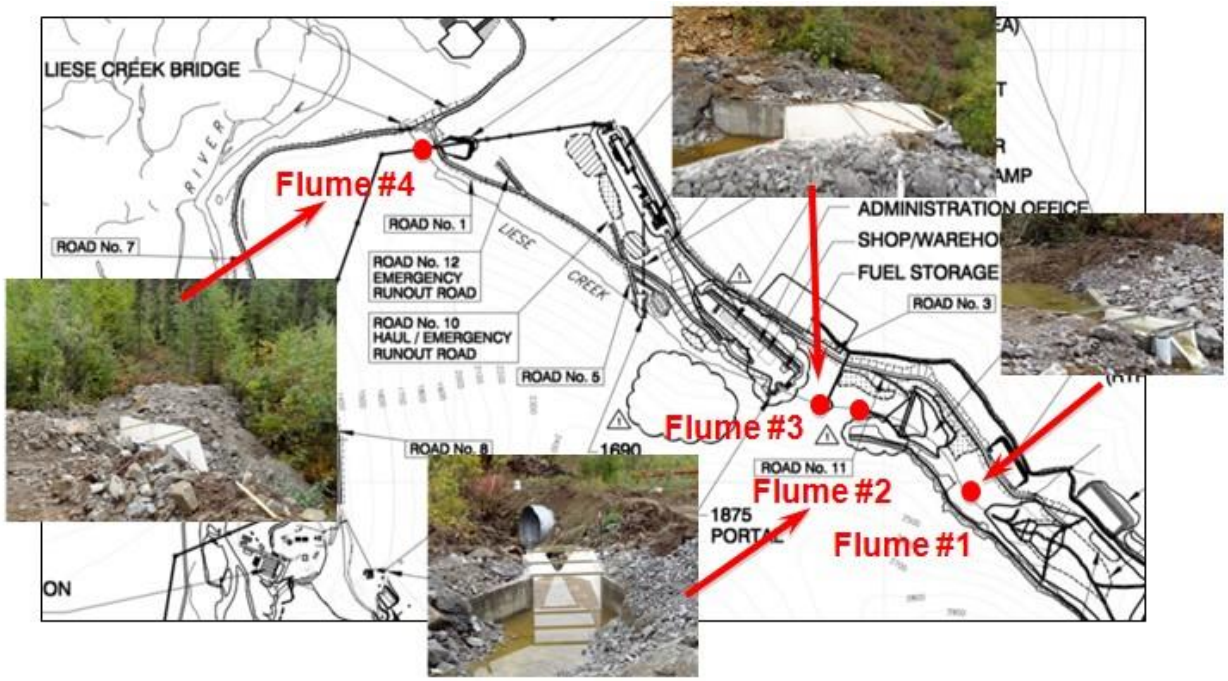


Figure 5: Flume Locations along Liese Creek with Site Photos

5. APPENDICIES

Appendix A – In-Situ Pressure Transducer Specification Sheets

Appendix B – Procedure for Data Download

Appendix C – Procedure for Programming PT's

Appendix D – Field Forms

5.1 Appendix A – In-Situ Pressure Transducer Specification Sheets

ugged TROLL® 100 and 200 Instruments

ed TROLL 100 and 200 instruments are designed for long-
hort-term groundwater and surface-water monitoring. The
ute (non-vented) instruments monitor and record changes
ter level, pressure, and temperature. Use with a Rugged
'ROLL® Instrument for optimum accuracy. All instruments are
atible with the user-friendly Win-Situ® 5 or Win-Situ® Mobile
are for programming and data retrieval.

ordable Titanium Data Loggers

Jse in harsh environments. Titanium construction offers
hemical- and corrosion-resistance.

Simplified Setup and Data Retrieval

- Use a Rugged TROLL® Docking Station for programming downloading data (all instruments).
- Use a Rugged TROLL® Com Device as the communicatio between a Rugged TROLL 200 or a Rugged BaroTROLL a RuggedReader® Handheld PC or a PC.

Flexible Deployment Options

- Use suspension wire and hanger for applications requiring minimal instrument access.
- Deploy with direct-read cable for real-time data access (o Rugged TROLL 200 and Rugged BaroTROLL).
- Connect to a TROLL® Link Telemetry System or a SCADA system via Modbus/RS485 or SDI-12 (only Rugged TROL 200 and Rugged BaroTROLL).

Applications

- Coastal wetland and estuary research
- Crest stage gaging
- Drilling and well development
- Flood and storm surge monitoring

Rugged TROLL® 100 and 200 Instruments

General	Rugged TROLL 100 & 200	Rugged BaroTROLL
Temperature ranges[1]	Operational: 0-50° C (32-122° F) Storage: -40-80° C (-40-176° F) Calibrated: 0-50° C (32-122° F)	Operational: 0-50° C (32-122° F) Storage: -40-80° C (-40-176° F) Calibrated: 0-50° C (32-122° F)
Diameter	2.62 cm (1.03 in)	2.62 cm (1.03 in)
Length	14.43 cm (5.68 in)	14.43 cm (5.68 in)
Weight	170 g (0.37 lb)	170 g (0.37 lb)
Materials	Titanium body; Delrin® nose cone, hanger, backend	Titanium body; Delrin nose cone, hanger, backend
Output options	Rugged TROLL 100: USB or RS232 via docking station Rugged TROLL 200: USB or RS232 via docking station; Modbus/RS485 or SDI-12 via Rugged TROLL 200 Cable	USB or RS232 via docking station; Modbus/RS485 or SDI-12 via Rugged TROLL 200 Cable
Battery type & life[2]	3.6V lithium; 10 years or 2M readings	3.6V lithium; 10 years or 2M readings
External power	Rugged TROLL 100: NA Rugged TROLL 200: 8-36 VDC	8-36 VDC
Memory Data records[3] Data logs	1.0 MB 65,000 Rugged TROLL 100: 1 log Rugged TROLL 200: 2 logs	1.0 MB 65,000 2 logs
Fastest logging rate	1 per second	1 per minute
Fastest output rate	Rugged TROLL 200 only Modbus & SDI-12: 1 per second	Modbus & SDI-12: 1 per second
Log types	Linear, Fast Linear, and Event	Linear
Sensor Type/Material	Piezoresistive; Ceramic	Piezoresistive; Ceramic
Range	9.0 m (30 ft) (Burst: 18 m; 60 ft) 30 m (100 ft) (Burst: 40 m; 134 ft) 76 m (250 ft) (Burst: 112 m; 368 ft)	7.0 to 30.0 psi; 0.5 to 2 bar
Accuracy @ 15° C[4]	Typical ±0.1% full scale (FS)	Typical ±0.1% FS
Accuracy (FS)[5]	±0.3% FS max.	±0.3% FS max.
Resolution	±0.01% FS or better	±0.01% FS or better
Units of measure	Pressure: psi, kPa, bar, mbar, mmHg Level: in, ft, mm, cm, m	Pressure: psi, kPa, bar, mbar, mmHg, inHg
Temperature Sensor		
Accuracy	±0.3° C	±0.3° C
Resolution	0.01° C or better	0.01° C or better
Units of measure	Celsius or Fahrenheit	Celsius or Fahrenheit
Warranty	1 year	1 year

CE FC

[1] Temperature range for non-freezing liquids
[2] Typical battery life when used within the factory-calibrated temperature range
[3] 1 data record = date/time plus 2 parameters logged (no wrapping) from device within the factory-calibrated temperature range
[4] Across factory-calibrated pressure range
[5] Across factory-calibrated pressure and temperature ranges
Specifications are subject to change without notice. Delrin is a registered trademark of E. I. du Pont de Nemours & Co.

Rugged BaroTROLL® Instrument

Use the titanium Rugged BaroTROLL Instrument with either a Rugged TROLL 100 or 200 instrument. Win-Situ® Baro Merge™ Software simplifies post-correction of water level data.

Rugged TROLL® 200 Cable

Use Rugged TROLL 200 Cable with a Rugged TROLL 200 or a Rugged BaroTROLL. Use the Rugged TROLL 200 Cable Suspension Kit to anchor the cable in place. Available configurations:

- Modbus/RS485 stripped-and-tinned cable or SDI-12 stripped and tinned cable—Use with PLC, telemetry system, or logger
- Modbus/RS485 top-of-well cable—Use with Rugged TROLL Com Device and a RuggedReader® Handheld PC or a PC (desktop or laptop computer)

Jacket options	TPU (thermoplastic polyurethane)
Conductors	4 conductors, 24 AWG, polypropylene insulation
Diameter	Cable: 5.1 mm (0.200 in) Connector: 26.1 mm (1.03 in)
Cable lengths	Modbus/RS485: Customizable up to 300 m (1,000 ft) SDI-12: Standard lengths up to 60 m (200 ft)
Minimum bend radius	5X cable diameter
Break strength	68 kg (150 lbs)

Rugged TROLL® Com Communication Device

Use the Rugged TROLL Com Device for communication between a cabled Rugged TROLL 200 or a cabled Rugged BaroTROLL and a RuggedReader Handheld PC or a PC. The Rugged TROLL Com Device communicates via Modbus/RS485.

Operating temp. range	0-50° C (32-122° F)
Storage temp. range	-40-80° C (-40-176° F)
Materials	Delrin, rubber, copper pins
Environmental rating	IP67 with battery cover closed
Dimensions (LxWxH)	8.9 x 2.9 x 4.8 cm (3.5 x 1.14 x 1.88 in)
Input connection	Modbus/RS485
Output connection	Available with either USB or RS232
Power source	9V alkaline battery, user-replaceable
Cable	Black polyurethane, 91 cm (3 ft) long

Rugged TROLL® Docking Station

Use the docking station to program and download data from a Rugged TROLL 100 or 200 or from a Rugged BaroTROLL. The docking station is available with either a USB or RS232 communication interface. USB allows fast data transfer to a PC. The RS232 version is used with a PC or a RuggedReader Handheld PC.

In-Situ Inc.

Call to purchase—www.in-situ.com
221 East Lincoln Avenue, Fort Collins, Colorado, U.S.A. 80524
1-800-446-7488 (toll-free in U.S.A. and Canada)
1-970-498-1500 (U.S.A. and international)

Level TROLL® 700 Instrument

Optimized for aquifer characterization
Gauged (vented) and absolute (non-vented) instruments
Linear, fast linear, linear average, event, step linear, and true logarithmic logging modes
Rugged titanium probe and sensor (OD: 1.83 cm; 0.72 in)

Level TROLL® 500 Instrument

Ideal for groundwater and surface-water monitoring
Gauged and absolute instruments
Linear, fast linear, and event logging modes
Durable titanium probe and sensor (OD: 1.83 cm; 0.72 in)

Level TROLL® 300 Instrument

Suitable for fresh water and industrial monitoring
Absolute instrument
Linear, fast linear, and event logging modes

Powerful, Accurate, Reliable Performance

- **Superior accuracy**—For guaranteed accuracy under all operating conditions, instruments undergo extensive calibration procedures for pressure and temperature. Each instrument includes a serialized calibration report.
- **Telemetry and SCADA integration**—Access data when you need it. No adapters or confusing proprietary protocols are required. Outputs include standard Modbus/RS485, SDI-12, and 4-20 mA.
- **Low power consumption**—Batteries have a typical life of 10 years or 2 million readings. 8-36 VDC input is compatible with external batteries and solar power.
- **Intuitive interface**—Win-Situ® 5 and Win-Situ® Mobile Software simplify data collection and management. Software features setup wizards, fast data download rates, multiple water level reference options, and more.

Applications

- Aquifer characterization
- Coastal deployments—tide/harbor levels, storm surge systems, and wetlands research
- Construction and mine dewatering
- River, lake, and reservoir monitoring

Level TROLL® 300, 500 & 700 Instruments

General	Level TROLL 300	Level TROLL 500	Level TROLL 700	BaroTROLL
Temperature ranges[1]	Operational: -20-80° C (-4-176° F) Storage: -40-80° C (-40-176° F) Calibrated: -5-50° C (23-122° F)	Operational: -20-80° C (-4-176° F) Storage: -40-80° C (-40-176° F) Calibrated: -5-50° C (23-122° F)	Operational: -20-80° C (-4-176° F) Storage: -40-80° C (-40-176° F) Calibrated: -5-50° C (23-122° F)	Operational: -20-80° C (-4-176° F) Storage: -40-80° C (-40-176° F) Calibrated: -5-50° C (23-122° F)
Diameter	2.08 cm (0.82 in)	1.83 cm (0.72 in)	1.83 cm (0.72 in)	1.83 cm (0.72 in)
Length	22.9 cm (9.0 in)	21.6 cm (8.5 in)	21.6 cm (8.5 in)	21.6 cm (8.5 in)
Weight	245 g (0.54 lb)	197 g (0.43 lb)	197 g (0.43 lb)	197 g (0.43 lb)
Materials	Stainless steel body; Delrin® nose cone	Titanium body; Delrin nose cone	Titanium body; Delrin nose cone	Titanium body; Delrin nose cone
Output options	Modbus/RS485, SDI-12, 4-20 mA	Modbus/RS485, SDI-12, 4-20 mA	Modbus/RS485, SDI-12, 4-20 mA	Modbus/RS485, SDI-12, 4-20 mA
Battery type & life[2]	3.6V lithium; 10 years or 2M readings	3.6V lithium; 10 years or 2M readings	3.6V lithium; 10 years or 2M readings	3.6V lithium; 10 years or 2M readings
External power	8-36 VDC	8-36 VDC	8-36 VDC	8-36 VDC
Memory Data records[3] Data logs	1.0 MB 65,000 2	2.0 MB 130,000 50	4.0 MB 260,000 50	1.0 MB 65,000 2
Log types	Linear, Fast Linear, and Event	Linear, Fast Linear, and Event	Linear, Fast Linear, Linear Average, Event, Step Linear, True Logarithmic	Linear
Fastest logging rate & Modbus rate	2 per second	2 per second	4 per second	1 per minute
Fastest SDI-12 & 4-20 mA output rate	1 per second	1 per second	1 per second	1 per second
Real-time clock	Accurate to 1 second/24-hr period	Accurate to 1 second/24-hr period	Accurate to 1 second/24-hr period	Accurate to 1 second/24-hr period
Sensor Type/Material	Piezoresistive; stainless steel	Piezoresistive; titanium	Piezoresistive; titanium	Piezoresistive; titanium
Range	*Absolute (non-vented)* 30 psia: 10.9 m (35.8 ft) 100 psia: 60.1 m (197.3 ft) 300 psia: 200.7 m (658.7 ft)	*Absolute (non-vented)* 30 psia: 10.9 m (35.8 ft) 100 psia: 60.1 m (197.3 ft) 300 psia: 200.7 m (658.7 ft) 500 psia: 341.3 m (1120 ft) *Gauged (vented)* 5 psig: 3.5 m (11.5 ft) 15 psig: 11 m (35 ft) 30 psig: 21 m (69 ft) 100 psig: 70 m (231 ft) 300 psig: 210 m (692 ft) 500 psig: 351 m (1153 ft)	*Absolute (non-vented)* 30 psia: 10.9 m (35.8 ft) 100 psia: 60.1 m (197.3 ft) 300 psia: 200.7 m (658.7 ft) 500 psia: 341.3 m (1120 ft) 1000 psia: 703 m (2306.4 ft) *Gauged (vented)* 5 psig: 3.5 m (11.5 ft) 15 psig: 11 m (35 ft) 30 psig: 21 m (69 ft) 100 psig: 70 m (231 ft) 300 psig: 210 m (692 ft) 500 psig: 351 m (1153 ft)	0 to 16.5 psi; 0 to 1.14 bar
Burst pressure	Max. 2x range; burst > 3x range	Max. 2x range; burst > 3x range	Max. 2x range; burst > 3x range	Vacuum over-pressure above 16.5 psi damages sensor
Accuracy @ 15° C[4]	±0.1% full scale (FS)	±0.05% FS	±0.05% FS	±0.1% FS
Accuracy (FS)[5]	±0.2% FS	±0.1% FS	±0.1% FS	±0.2% FS
Resolution	±0.01% FS or better	±0.005% FS or better	±0.005% FS or better	±0.005% FS or better
Units of measure	Pressure: psi, kPa, bar, mbar, mmHg, inHg, cmH$_2$O, inH$_2$O Level: in, ft, mm, cm, m	Pressure: psi, kPa, bar, mbar, mmHg, inHg, cmH$_2$O, inH$_2$O Level: in, ft, mm, cm, m	Pressure: psi, kPa, bar, mbar, mmHg, inHg, cmH$_2$O, inH$_2$O Level: in, ft, mm, cm, m	Pressure: psi, kPa, bar, mbar, mmHg, inHg, cmH$_2$O, inH$_2$O
Temperature Sensor				
Accuracy & resolution	±0.1° C; 0.01° C or better	±0.1° C; 0.01° C or better	±0.1° C; 0.01° C or better	±0.1° C; 0.01° C or better
Units of measure	Celsius or Fahrenheit	Celsius or Fahrenheit	Celsius or Fahrenheit	Celsius or Fahrenheit
Warranty	1 year	2 years	2 years	2 years
	Up to 5-year extended warranties are available for all instruments—call for details			

BaroTROLL® Instrument

The titanium BaroTROLL measures and logs barometric pressure and temperature. Use the BaroTROLL in conjunction with Level TROLL instruments.

Win-Situ® Baro Merge™ Software simplifies post-correction of water level data. Barometric readings are automatically subtracted from data collected by an absolute Level TROLL to compensate for changes in pressure due to barometric fluctuations.

24/7 Support

In-Situ technical support specialists assist with instrument setup, application support, and troubleshooting. Call for free technical support.

[1] Temperature range for non-freezing liquids
[2] Typical battery life when used within the factory-calibrated temperature range
[3] 1 data record = date/time plus 2 parameters logged (no wrapping) from device within the factory-calibrated temperature range
[4] Across factory-calibrated pressure range
[5] Across factory-calibrated pressure and temperature ranges
Specifications are subject to change without notice.
Delrin is a registered trademark of E.I. du Pont de Nemours and Company.

CE FC

Call to purchase or rent—www.in-situ.com
221 East Lincoln Avenue, Fort Collins, Colorado, U.S.A. 80524
1-800-446-7488 (toll-free in U.S.A. and Canada)
1-970-498-1500 (U.S.A. and international)

5.2 Appendix B – Procedure for Data Download

5.2.1 EQUIPMENT LIST FOR ALL PT DATA MANIPULATION

Equipment used for downloading data from the instruments is as follows:

5.2.2 UNDERGROUND COREHOLES

1. Field Laptop/Tablet with or without Field Notebook
2. Cable-Connect Communication Cable for the LT-500
3. New Desiccant Plugs or storage plugs (to replace used desiccant plugs as needed)
4. Underground (UG) PPE
5. Underground Maps 1-5
6. Underground Drive Training or an appointed Guide from the UG Shifter/Foreman/Trainer

5.2.3 SURFACE RIDGE WELLS

1. Field Laptop/Tablet with or without Field Notebook
2. Docking Station Communication Cable for the RT-100/200
3. Direct-Connect Communication Cable for the LT-300 (MW99-216)
4. Water Level Meter (Sounder) 300ft Length
5. Surface PPE including Bear Spray and Bug Spray/Nets
6. Keys to Locks (keys to individual locks currently located in Lucas Walker's office on a map on the wall behind his desk – change these out to the general environmental lock (single key) once new locks arrive)
7. Figures 1-3
8. Schedule Chopper time as needed
9. Second person required as bear guard/pack mule
10. Second pick up as needed

5.2.4 FLUMES

1. Field Laptop/Tablet with or without Field Notebook
2. Cable-Connect Communication Cable for the LT-700
3. Surface PPE
4. Shovel/Broom (to clean out flumes as needed)

5.2.5 DOWNLOAD PROCEDURES

This section gives the step-by-step procedures for downloading PT data in the field. Observations made during data collection should be recorded in the field notebook or in Word/Wordpad on the field laptop/tablet. The observations can then be entered into EDMS.

In-Situ operation manuals for all instruments are located in **Appendix A** or can be found online at http://www.in-situ.com/manuals.

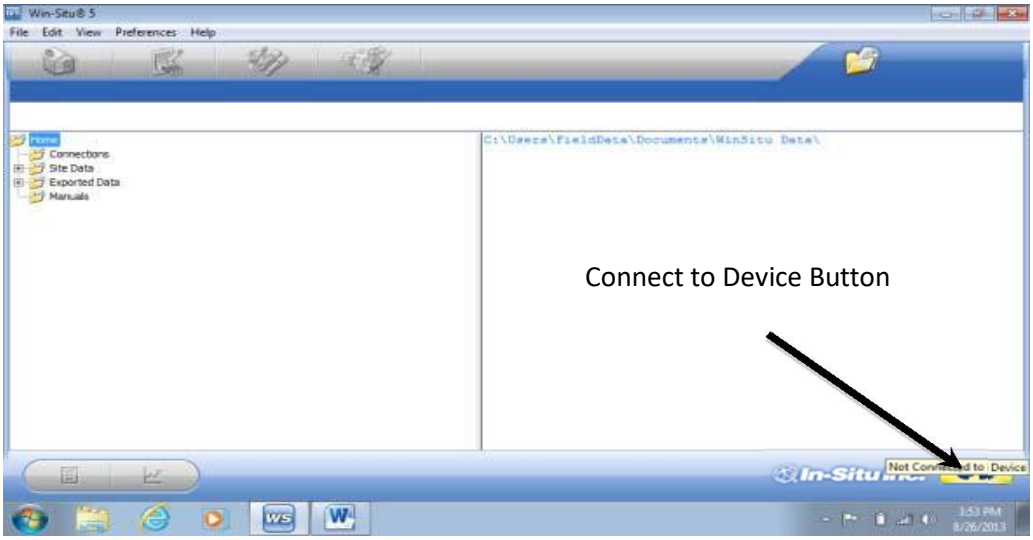
5.2.6 UNDERGROUND COREHOLES

1. Discuss locations and routes to sites with the UG guide using Maps 1-5 (as needed – and keep in mind the ever changing UG environment – your guide may have a better route and will not be familiar with the test locations).
2. Disconnect the desiccant plug taking care to **not** unscrew the male end from the plug. This is done by pushing down and turning the quick connect, then pulling it up off the plug. Temporarily store in a dry place.
3. Connect the cable-connect communication cable using the quick connect plug. Do **not** force this connection. One side of the male/female plug is flat. Insert and slowly turn the plug until the flat

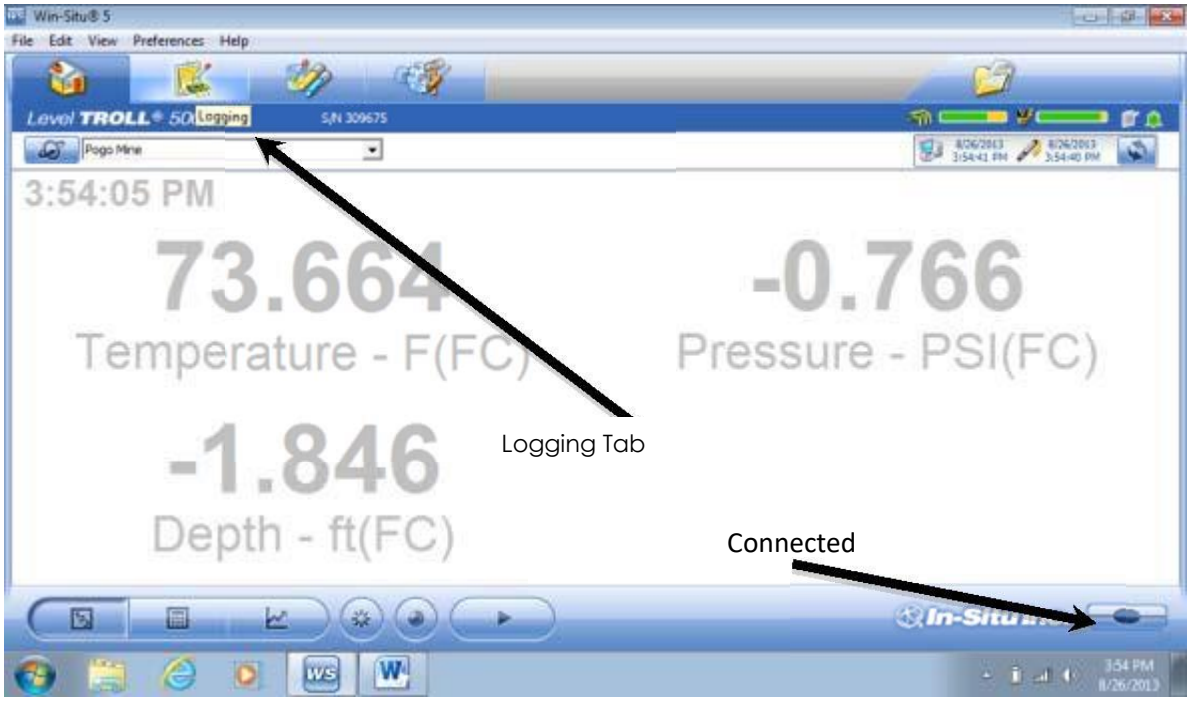
sides match up, then push the plug into place. Push the quick connect over the prongs on the plug to secure.

4. Turn on the Field Laptop/Tablet and connect the cable-connect communication cable via USB port.
5. From this point on, the download process with Win-Situ is the same for all the PT's.
6. Click or Double Click on the Win-Situ Icon to open the software (**ScreenGrab 1**):

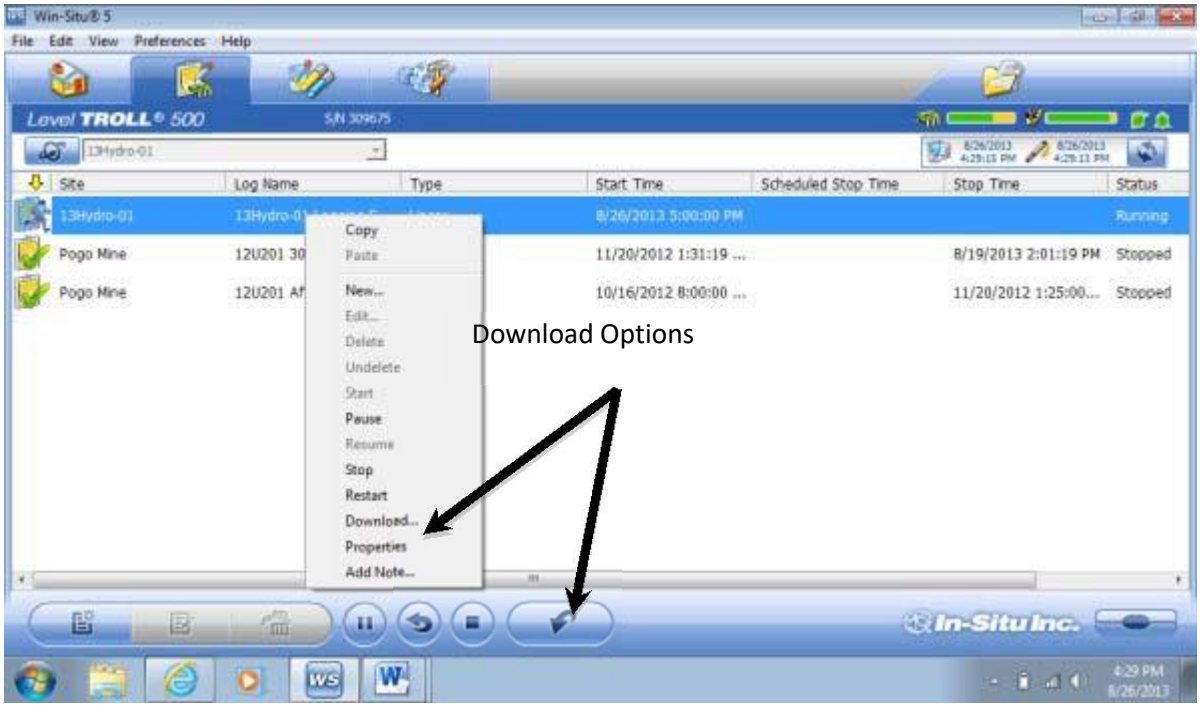
7. Click the connect to device button in the lower right hand corner (**ScreenGrab 2**):



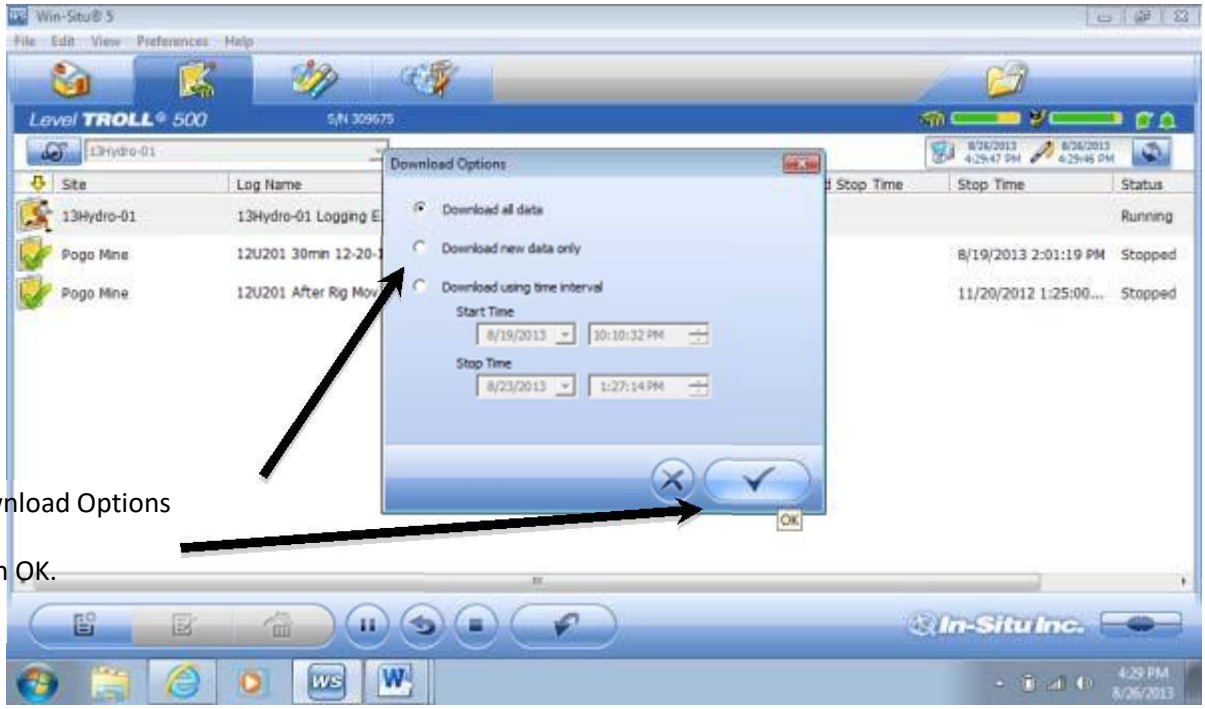
8. Once connected, click on the Logging Tab (**ScreenGrab 3**):



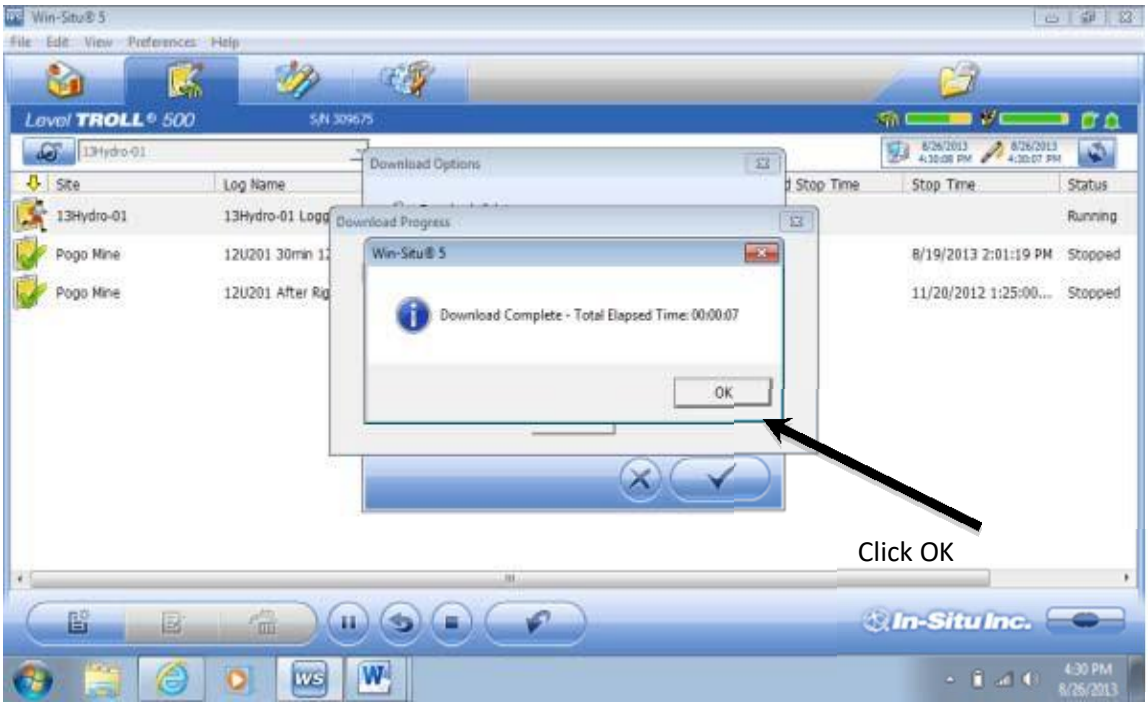
9. On the Logging Screen, highlight the log with the running man. You can either click the Download Button or right click while the arrow is on the running program to bring up the menu and click on download (**ScreenGrab 4**):



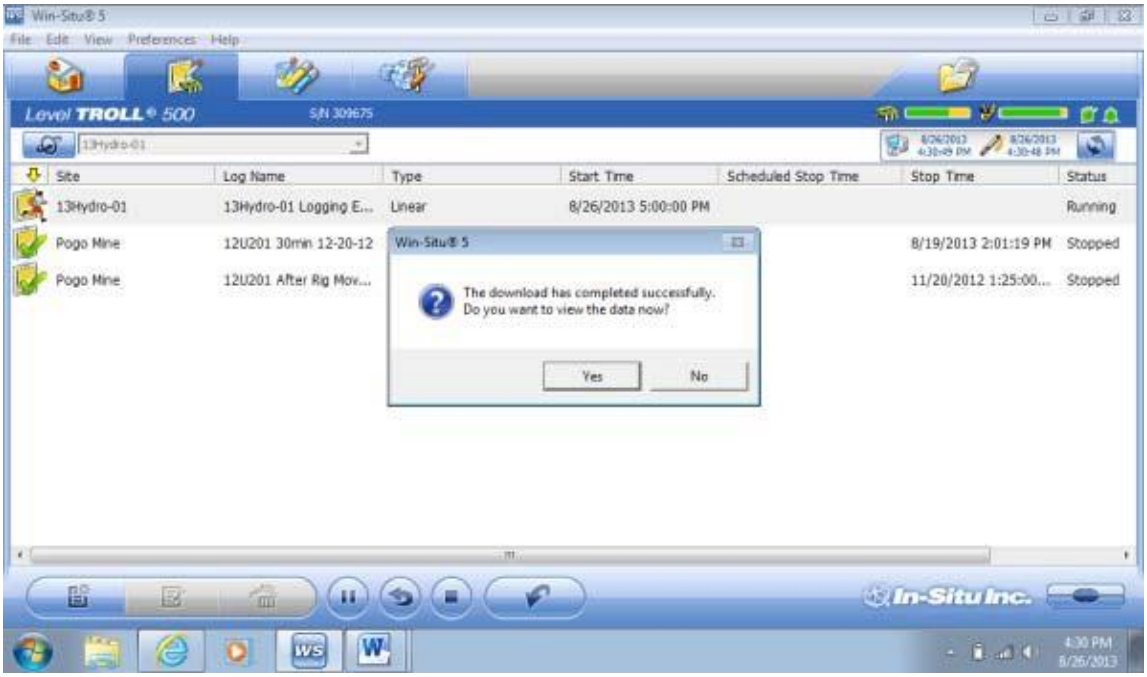
10. On the Download Options Menu, you can choose between several different options. Download all data will do just that and can take some time. After the first download, choose the Download new data only option to save download/upload time and then the checkmark (**ScreenGrab 5**):



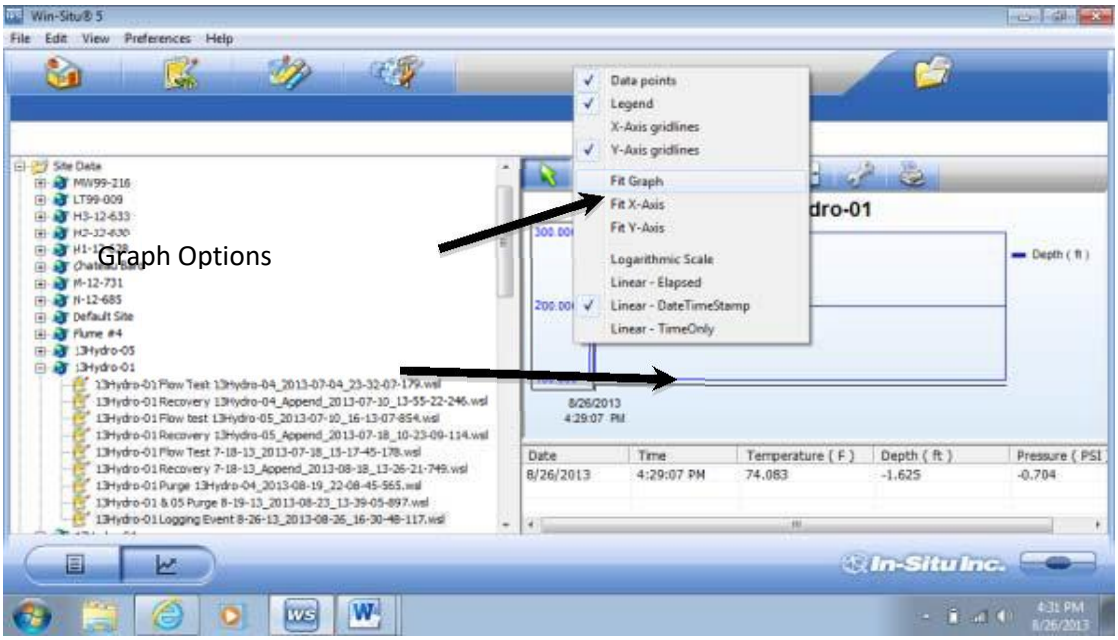
11. Once the download is complete, click OK (**ScreenGrab 6**):



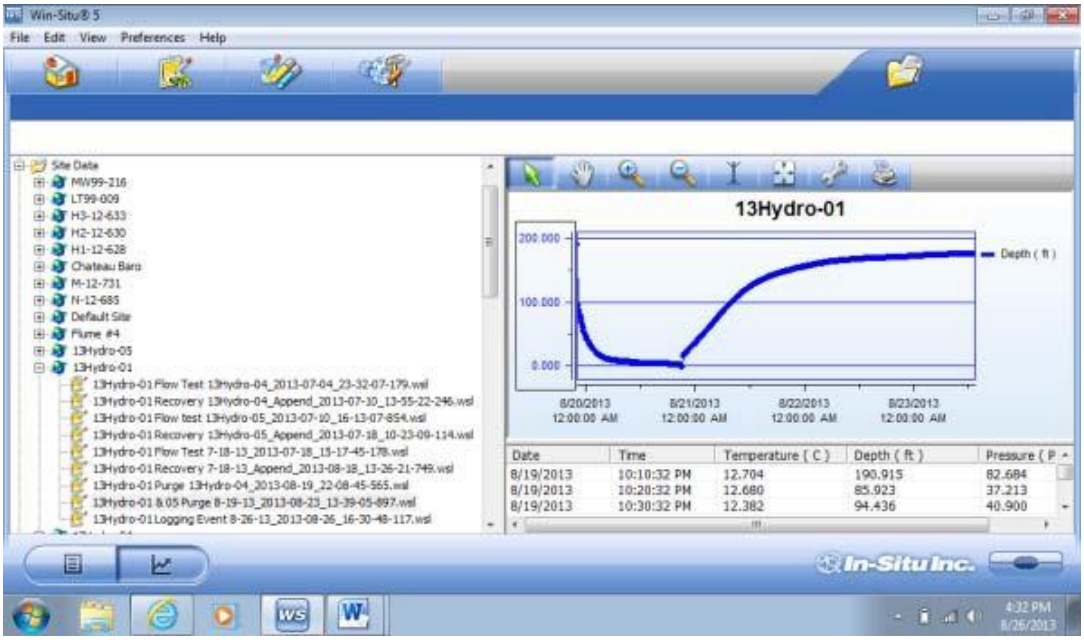
12. View the data following download (as needed) (**ScreenGrab 7**):



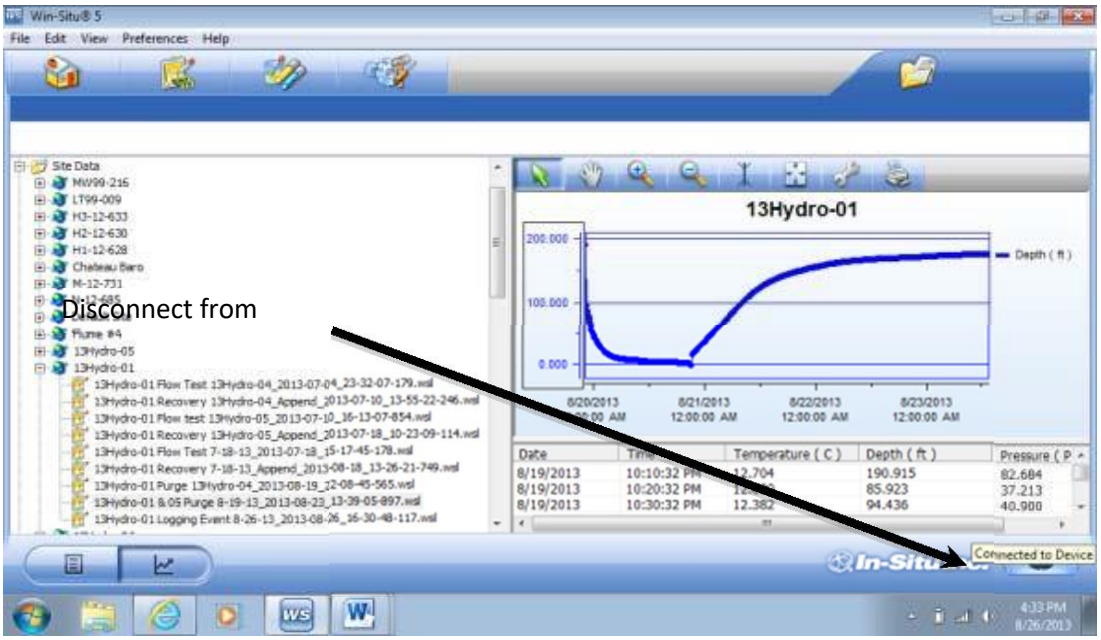
13. When viewing the data, in order to ensure that you are seeing all the data, right click on the graph and click on Fit Graph (**ScreenGrab 8**):



14. The following is an example of data fit to the graph (**ScreenGrab 9**):



15. If this is a regular download with no need to setup a new log, then simply click on the Connected to Device Button in order to disconnect from the PT. This must be done prior to physically disconnecting the communication cable (**ScreenGrab 10**):



16. Once disconnected from the device, the laptop/tablet can be put to sleep or shut down. Remove the communication from the USB Port and store in the field laptop/tablet bag along with the laptop/tablet.

17. Remove the cable-connect communication cable in the same way that the desiccant plug was removed. Re-install the desiccant plug gently taking care to keep it dry.

18. If the desiccant has turned from dark blue to light pink, it is time to replace the desiccant in the plug. If the desiccant has turned white (**Photo 1**), it is past time to replace the desiccant in the plug, and water may enter the cable then the PT. Water in the PT will ruin it (no warranty) and potentially cause a loss of data.

Photo B-1: Desiccant Color Stages

5.2.7 SURFACE RIDGE WELLS

1. Discuss locations and route to sites with the chopper pilot using Figures 1 through 3 (as needed).
2. Once at the site, unlock and remove the cap (as needed), then pull the PT out of the well laying out the cable carefully so as not to create tangles or kink it unnecessarily. Cable lengths will vary and can be several hundred feet long (**Photo 2**).

Photo B-2: Pulling an RT-200 Hung on Wire Cable

3. Using the 300ft sounder, take a static water level noting it along with date and time for reference.
4. Turn on the Field Laptop/Tablet and connect the docking station communication cable via USB port for all RT-100/200's or the direct-connect communication cable via USB for the LT- 300 (**Photo 3**):

Photo B-3: Laptop Setup at MW99-216 with Direct-Connect Communication Cable and LT- 300

5. For the direct-connect communication cable with LT-300, remove the quick connect female cap (attached to the wire cable) from the PT (Similar method as removing the desiccant plug in **UG Corehole step 2**) and connect the cable to the PT by sliding it over the female PT end.

6. For the docking station communication cable with the RT-100/200's, unscrew the cap (attached to the wire cable) from the PT, then set the PT in the docking station. Ensure that the station is dry and level for adequate connection (**Photo 4**).

Photo B-4: Docking Station Communication Cable with RT-100/200

7. From this point on, the download process with Win-Situ is the same for all the PT's (**Follow steps 6 through 16 in the UG Corehole section above**).
8. Remove PT's from the communication cable and re-attach the caps with the wire cable.
9. Re-install the PT into the well on the wire cable. Ensure that weight is maintained on the cable throughout reset. If the wire cable suddenly feels very light or loose, slow install until weight is felt again or pull the PT out and try again.
10. Recap and relock well.

5.2.8 FLUMES

1. Using Figure 5, note the locations of the four flumes along Liese Creek. Flume #1 located below the DSTF is accessible from Road 3. Flume #2 and #3 are located below the Recycle Tailings Pond (RTP) accessible from Road 2 past the truck shop and the 1875Portal. Flume
2. #4 is located immediately above the Liese Creek Bridge accessible from Road 7.
3. At each site, disconnect the desiccant plug taking care to **not** unscrew the male end from the plug. This is done by pushing down and turning the quick connect, then pulling it up off the plug. Temporarily store in a dry place.
4. Connect the cable-connect communication cable using the quick connect plug. Do **not** force this connection. One side of the male/female plug is flat. Insert and slowly turn the plug until the flat sides match up, then push the plug into place. Push the quick connect over the prongs on the plug to secure.
5. Turn on the Field Laptop/Tablet and connect the cable-connect communication cable via USB port.
6. From this point on, the download process with Win-Situ is the same for all the PT's. (**Follow steps 6 through 16 in the UG Corehole section above**).
7. Remove the cable-connect communication cable in the same way that the desiccant plug was removed. Re-install the desiccant plug gently taking care to keep it dry.
8. If the desiccant has turned from dark blue to light pink, it is time to replace the desiccant in the plug. If the desiccant has turned white, it is past time to replace the desiccant in the plug, and water may enter the cable then the PT. Water in the PT will ruin it (no warranty) and potentially cause a loss of data.

5.3 Appendix C – Procedure for Programming PT's

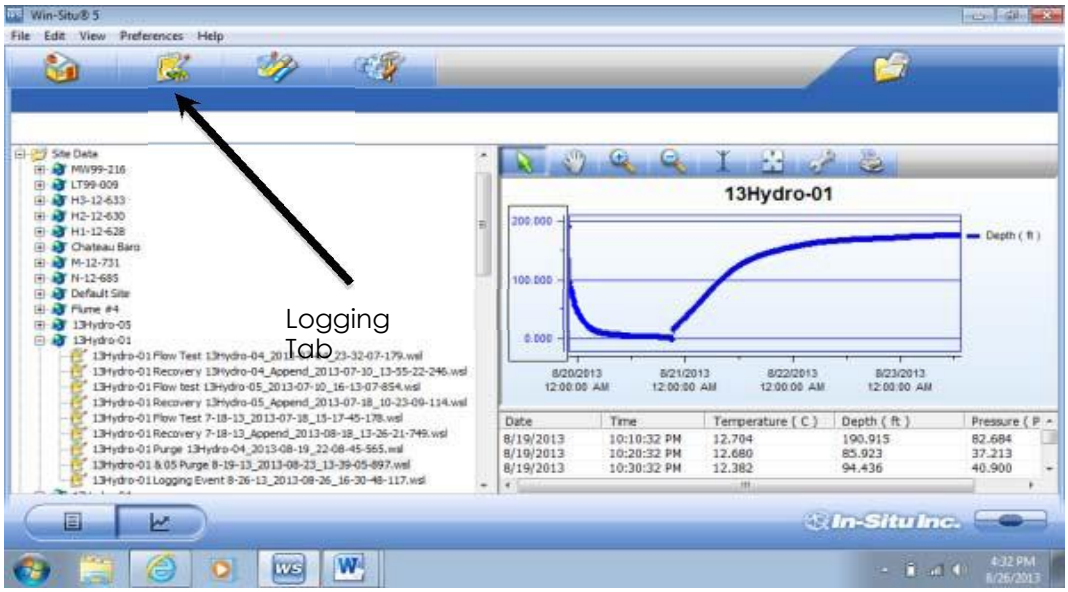
5.3.1 EQUIPMENT LIST FOR ALL PT DATA MANIPULATION

Equipment list is the same as in Section 3.1 for all locations.

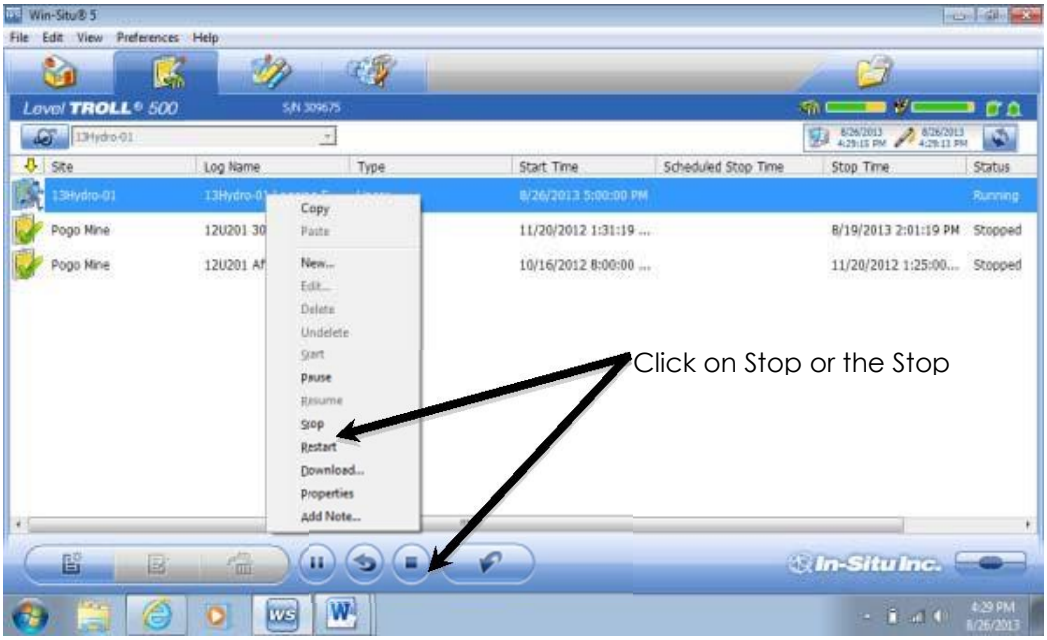
5.3.2 UG COREHOLE PROGRAMMING PROCEDURE

This section gives the step-by-step procedures for stopping running logs and programming new logs in the field for UG coreholes. Observations made during the procedures should be recorded on the appropriate field form (Appendix D). The observations can then be entered into EDMS.

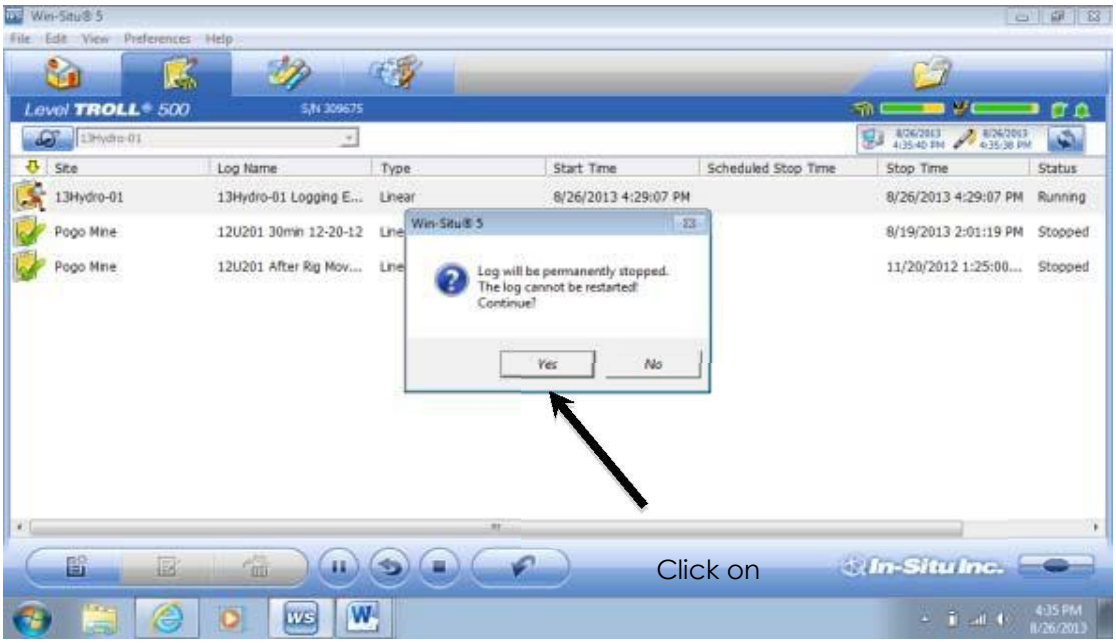
1. Follow **steps 1 through 14** in **Section B.2.1 Download Procedures – Underground Coreholes**, for PT's that are installed and logging data. Programing a newly installed PT is detailed in this appendix in **Section C.4.2**.
2. After viewing the data, click the Logging Tab again to take you back to the running log and a list of saved logs (**ScreenGrab**



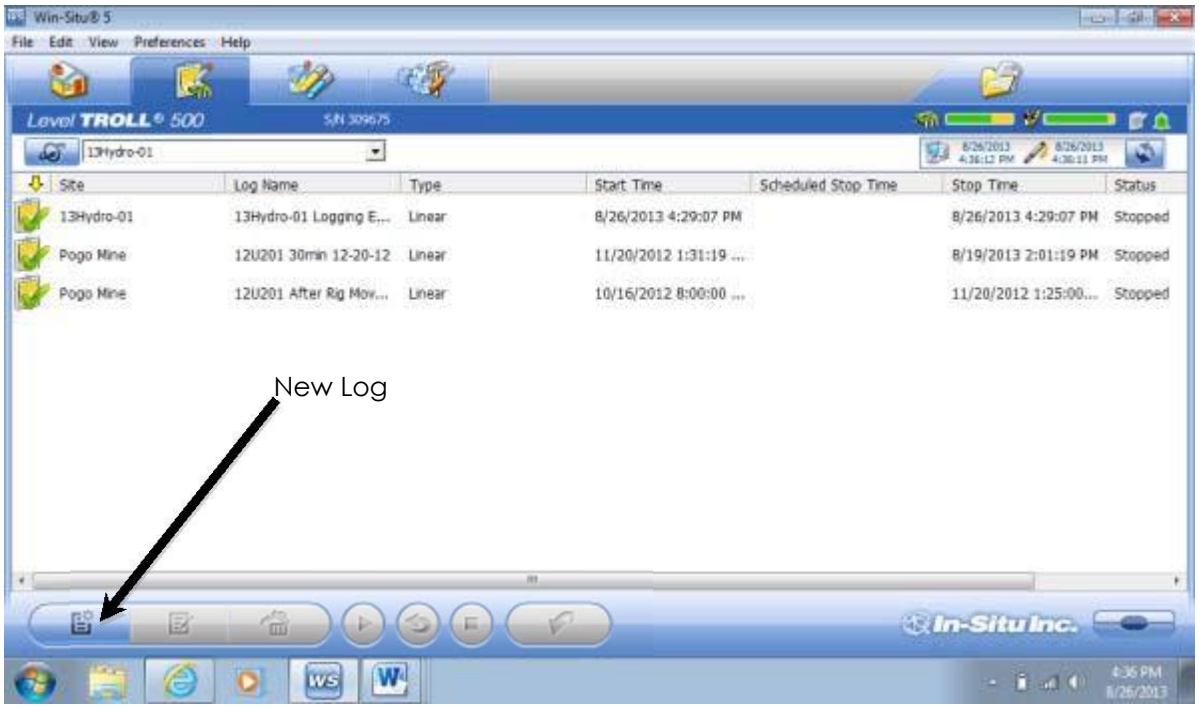
3. Right click on the running log to bring up the menu and click on stop (**ScreenGrab 12**):



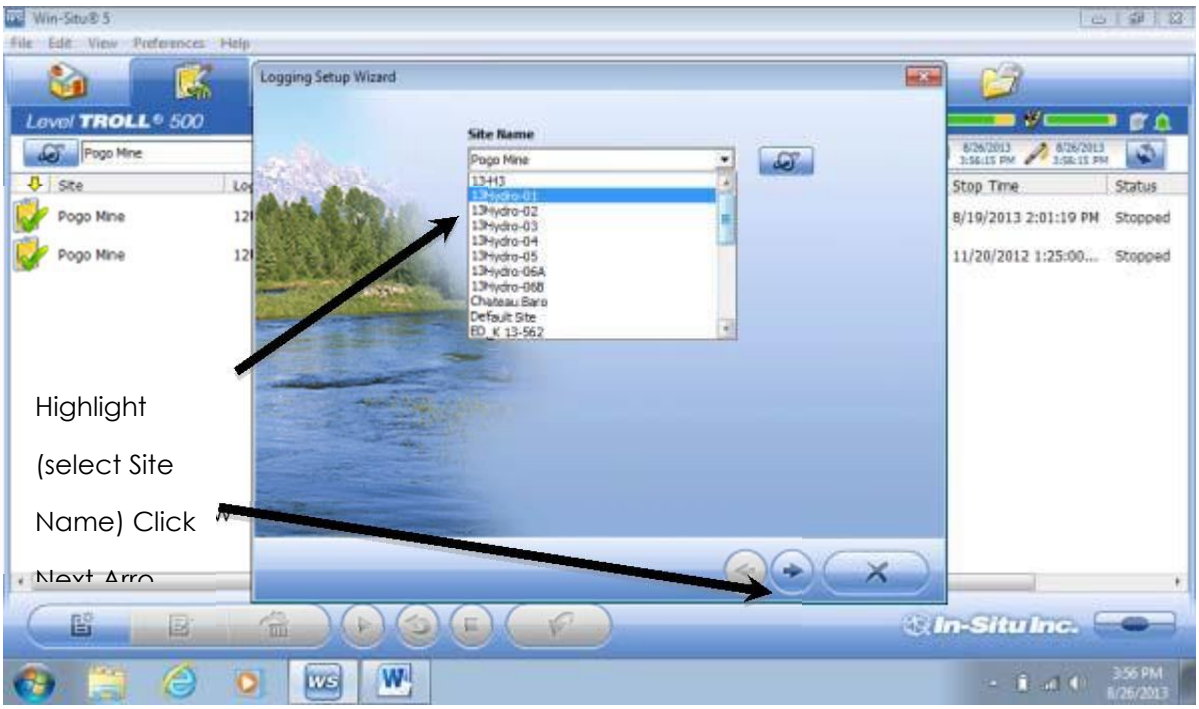
4. A quick menu asking you if you want to stop the log will pop up – click Yes (**ScreenGrab 13**):



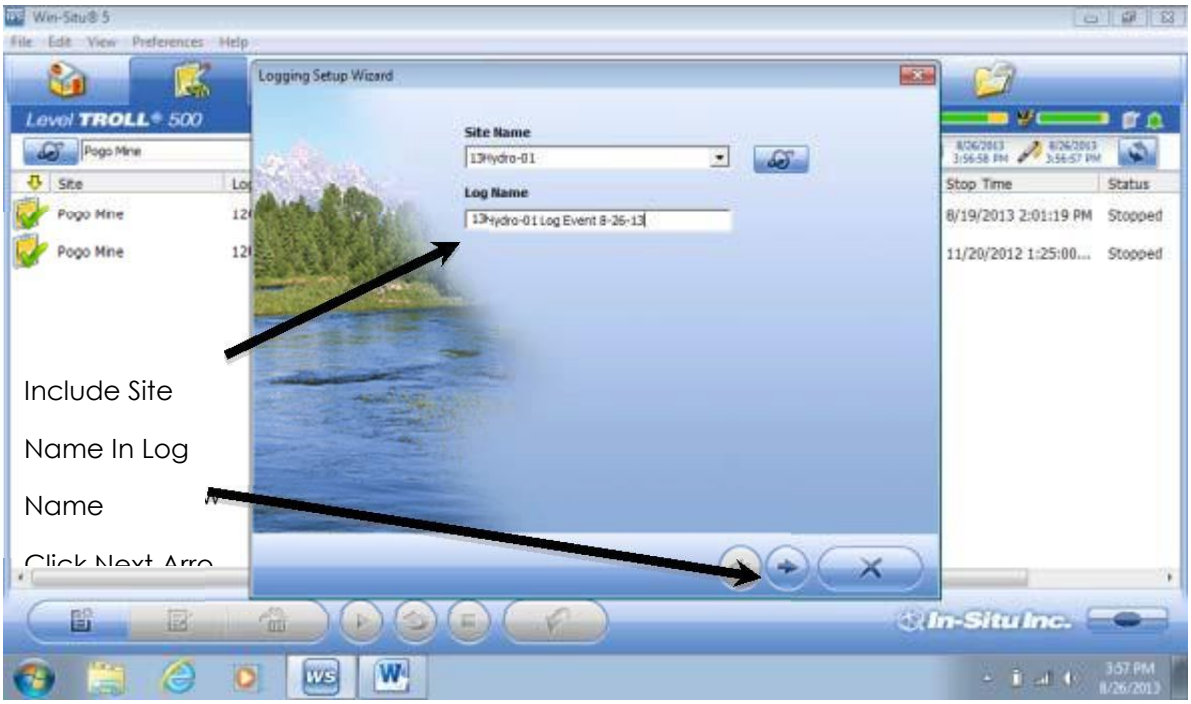
5. The stopped log will now have a green checkmark instead of a running man. Now you are ready to program a new log by clicking on the New Log button at the bottom left corner (**ScreenGrab 14**):



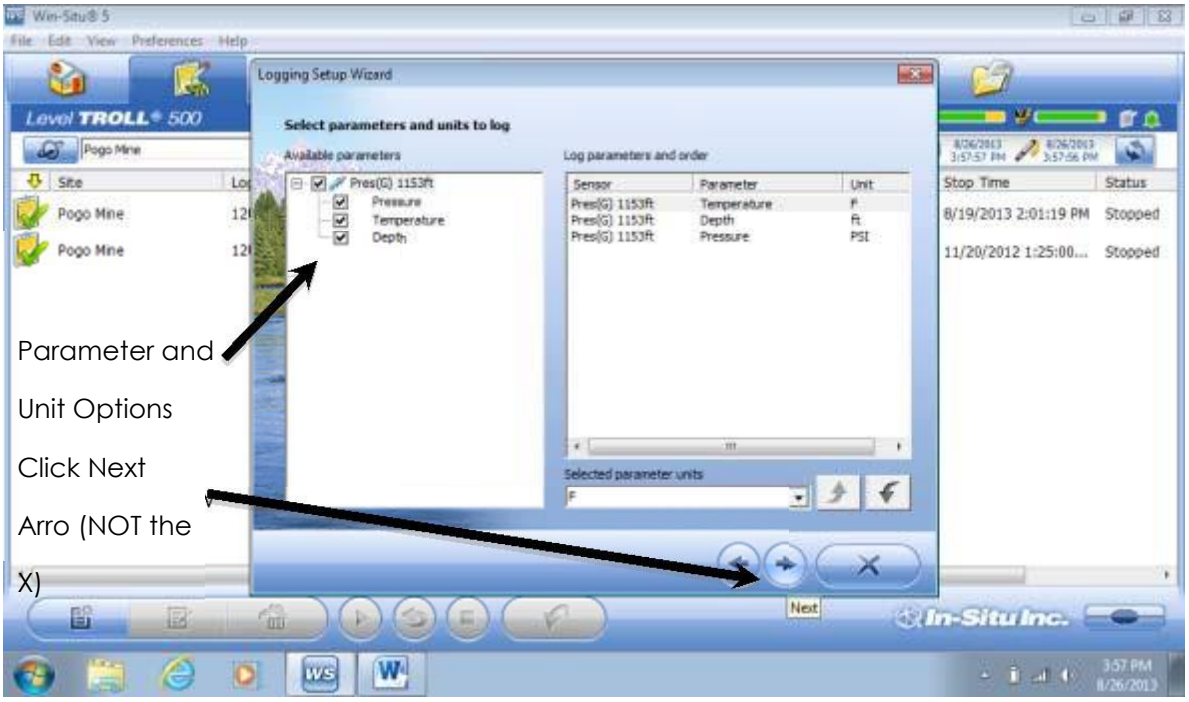
6. The Logging Setup Wizard menu will pop up. The first step is to pick your site name from a drop down list (**ScreenGrab 15**). If you have moved the PT to a new site that is not setup in Win-Situ, you will need to setup a new site. New site setup is detailed in **Section C.4.3.**:



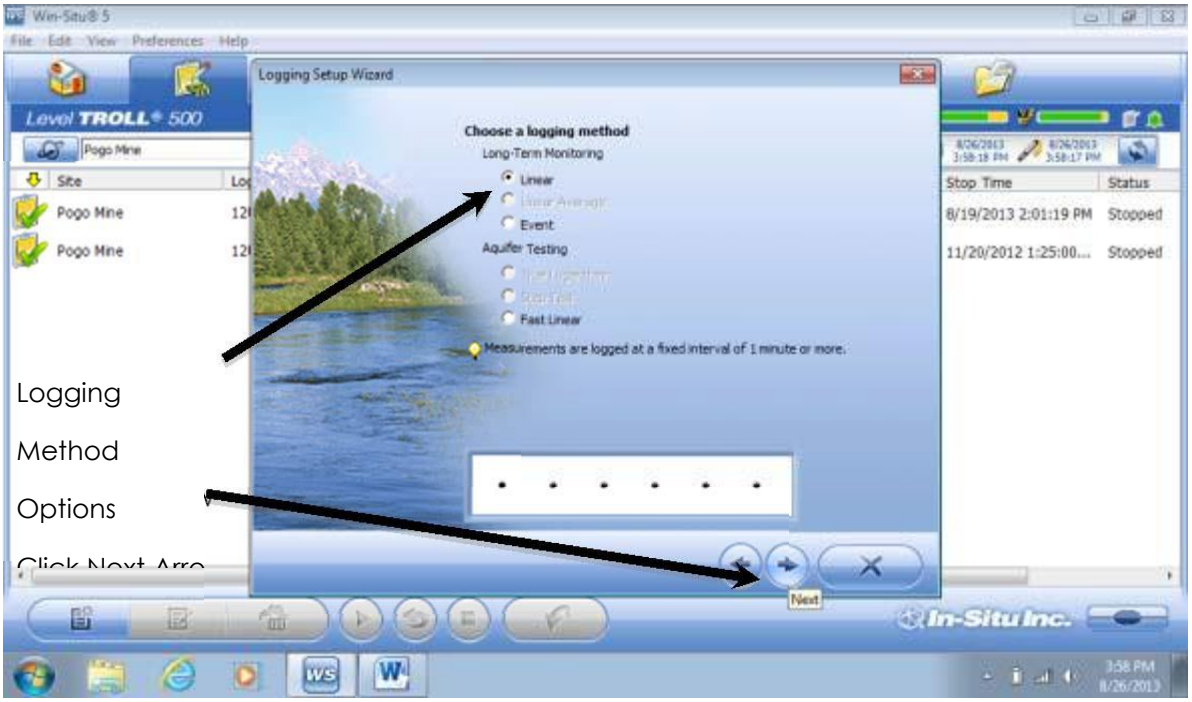
7. The Logging Setup Wizard will then need a log name. Always include the site name in the log title (**ScreenGrab 16**):



8. The Logging Setup Wizard then asks which parameters and their units that you want measured and logged (**ScreenGrab 17**):

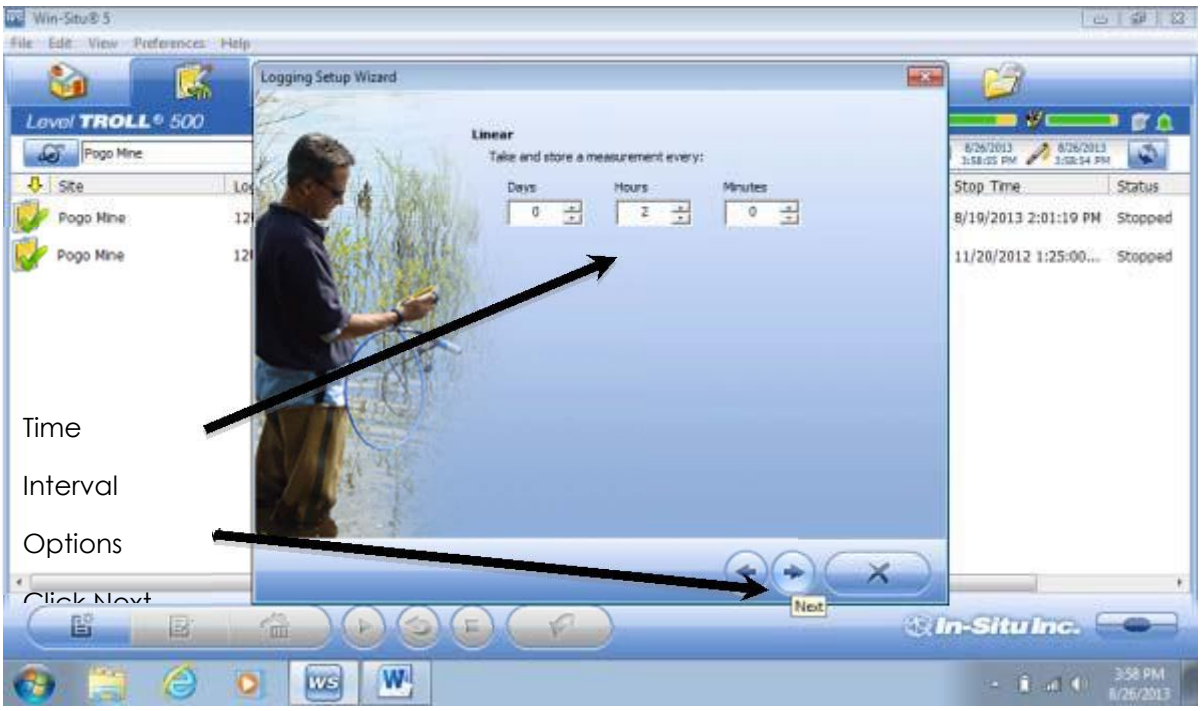


9. The Logging Setup Wizard will provide several different logging methods to choose from on the next screen. For the UG coreholes long-term monitoring or short tests (during sampling, etc.), choose

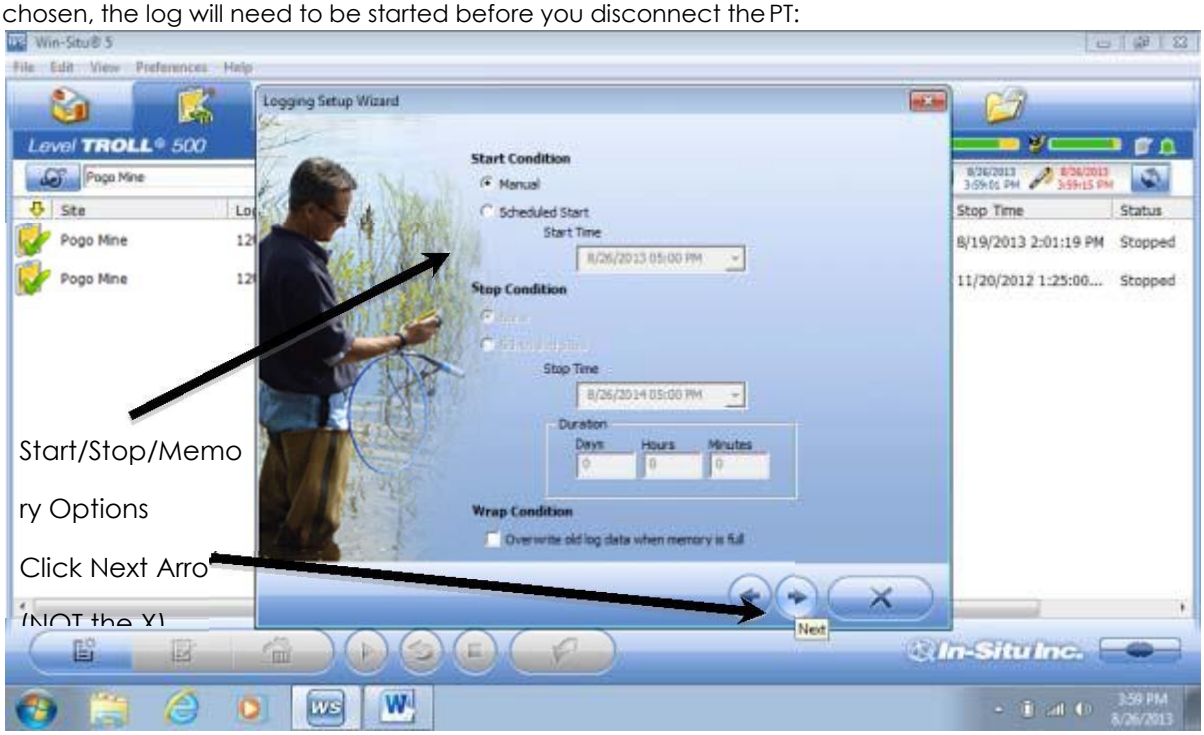


Linear under Long-Term Monitoring (**ScreenGrab 18**):

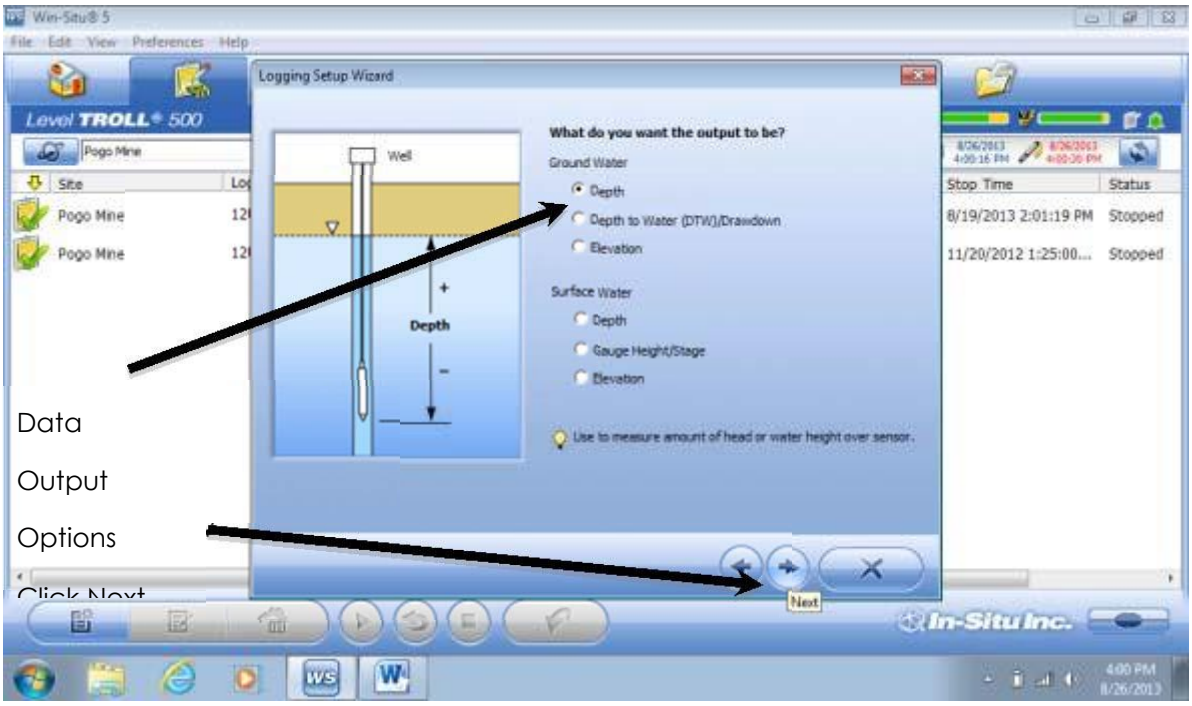
10. The next screen in the Logging Setup Wizard gives you time interval options for taking measurements. For UG corehole long-term monitoring, a two hour interval is used. For purging during sampling and recovery after shut-in, a 10 minute interval is used (**ScreenGrab 19**):



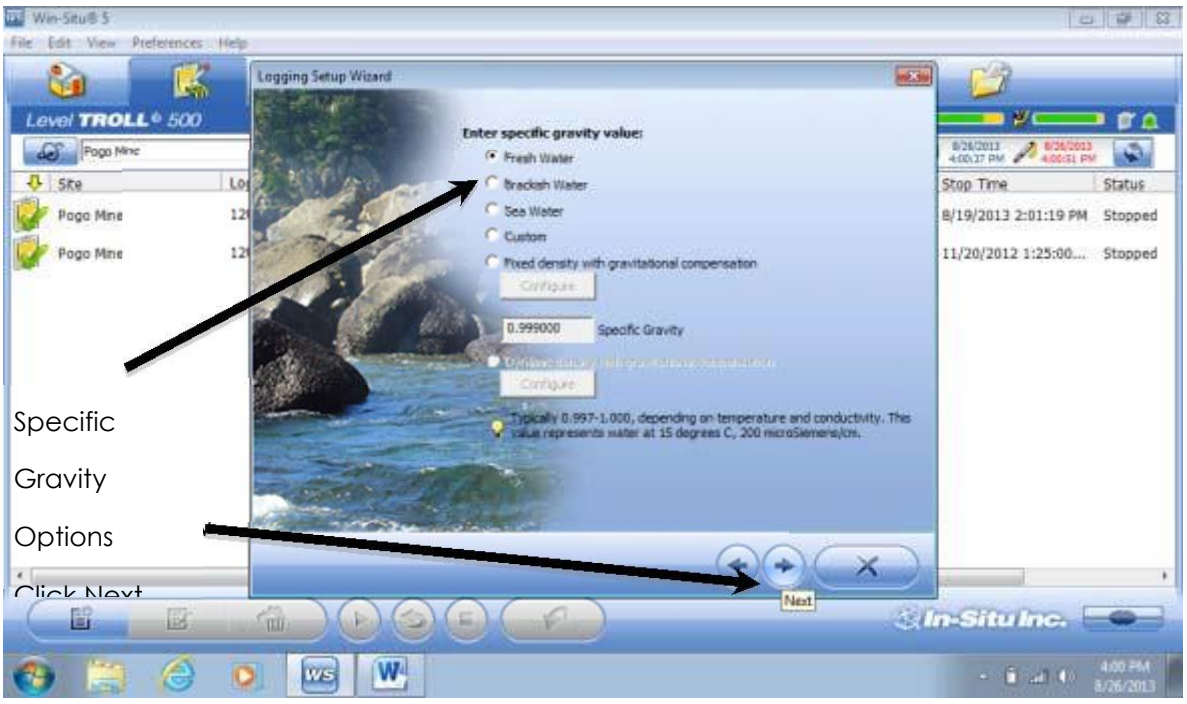
11. The next screen offers different start/stop options for the log (**ScreenGrab 20**). A scheduled start works well if you want all the readings to be consistent at different locations. If a manual start is chosen, the log will need to be started before you disconnect the PT:



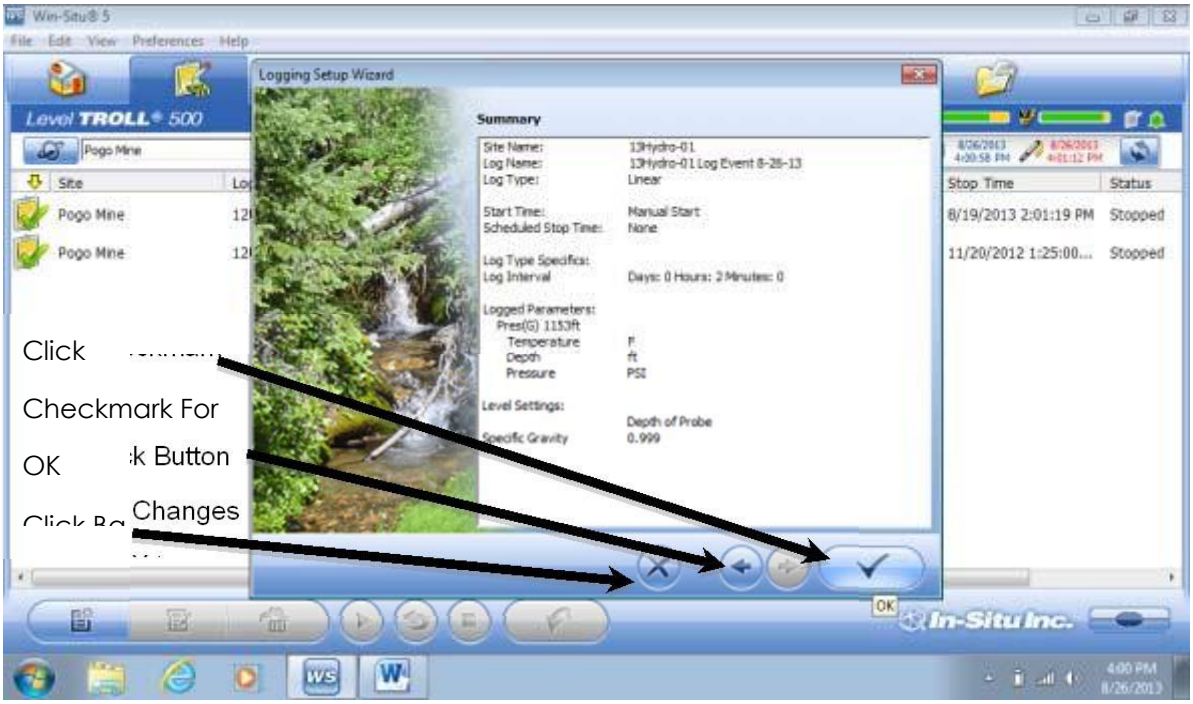
12. Data output options are available on the next screen (**ScreenGrab 21**). As this is a groundwater measurement from underground, use the option under Ground Water for Depth (above the PT). Regardless of which option you choose, the PT will always measure pressure at the nose of the PT. For each option (other than Depth), the datalogger will mathematically convert the pressure to your output of choice.



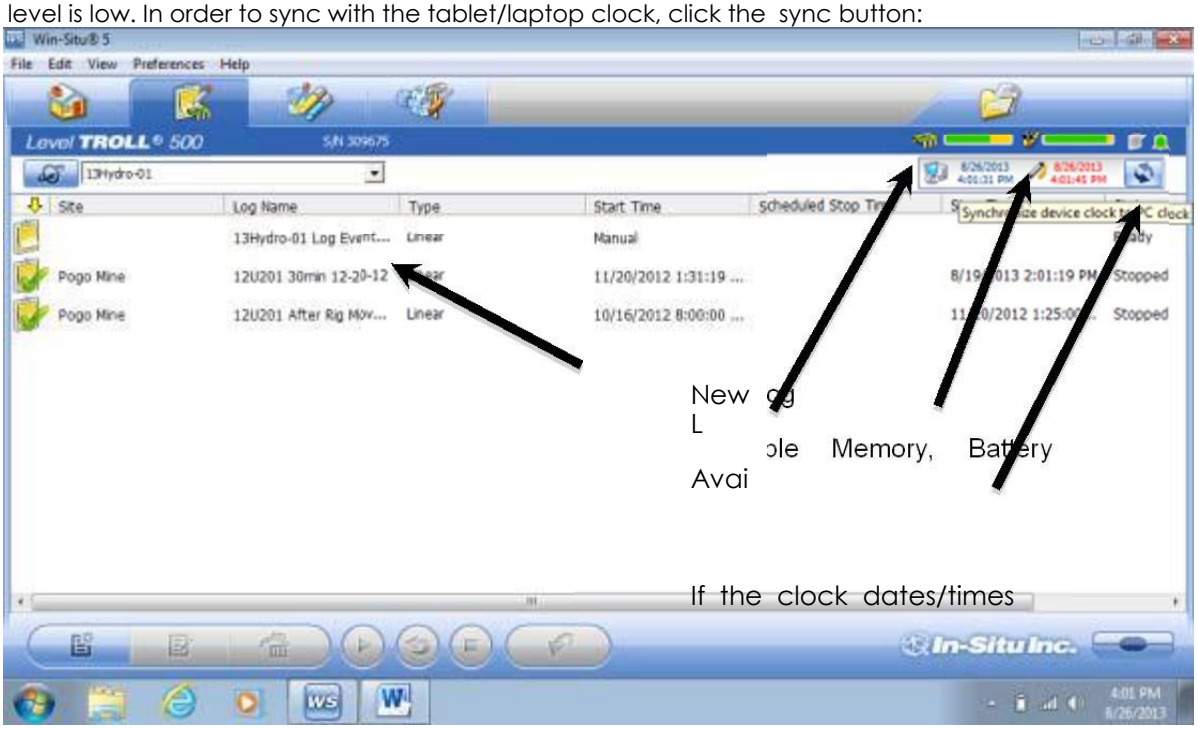
13. The next screen gives specific gravity option for various types of water that is being monitored (**ScreenGrab 22**):



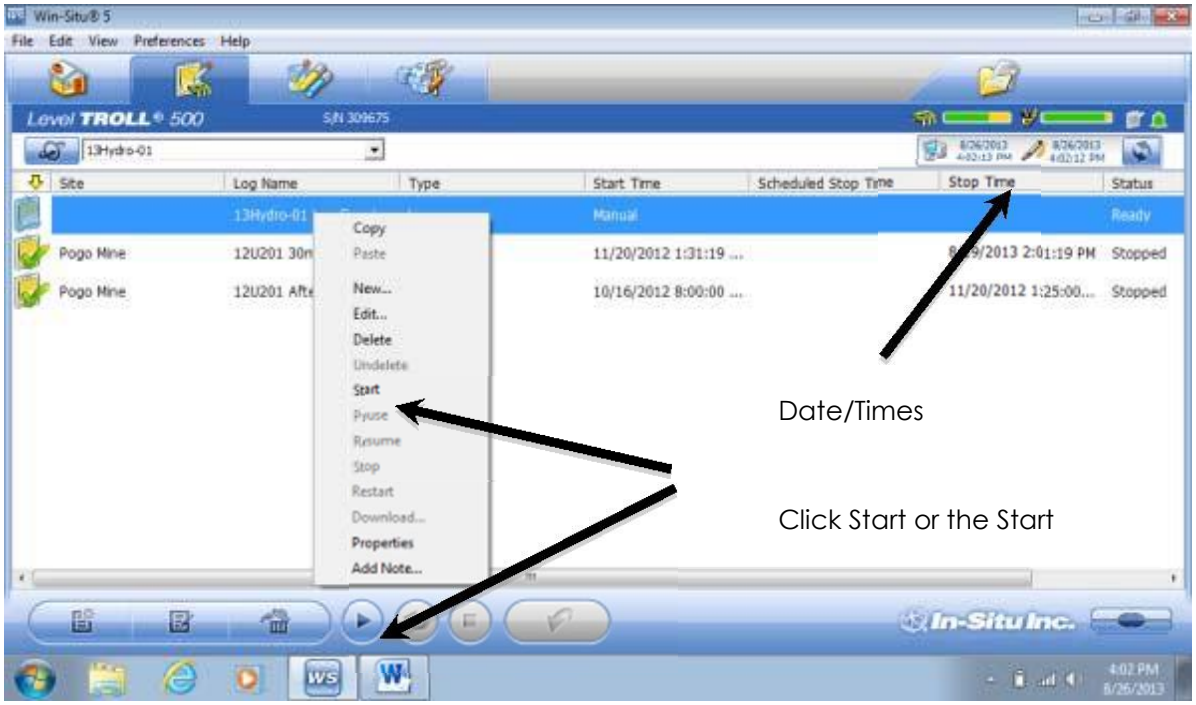
14. The last screen in the Logging Setup Wizard shows a summary of the programming and gives you the opportunity to verify the settings and use the back button to make changes to the log (**ScreenGrab 23**):



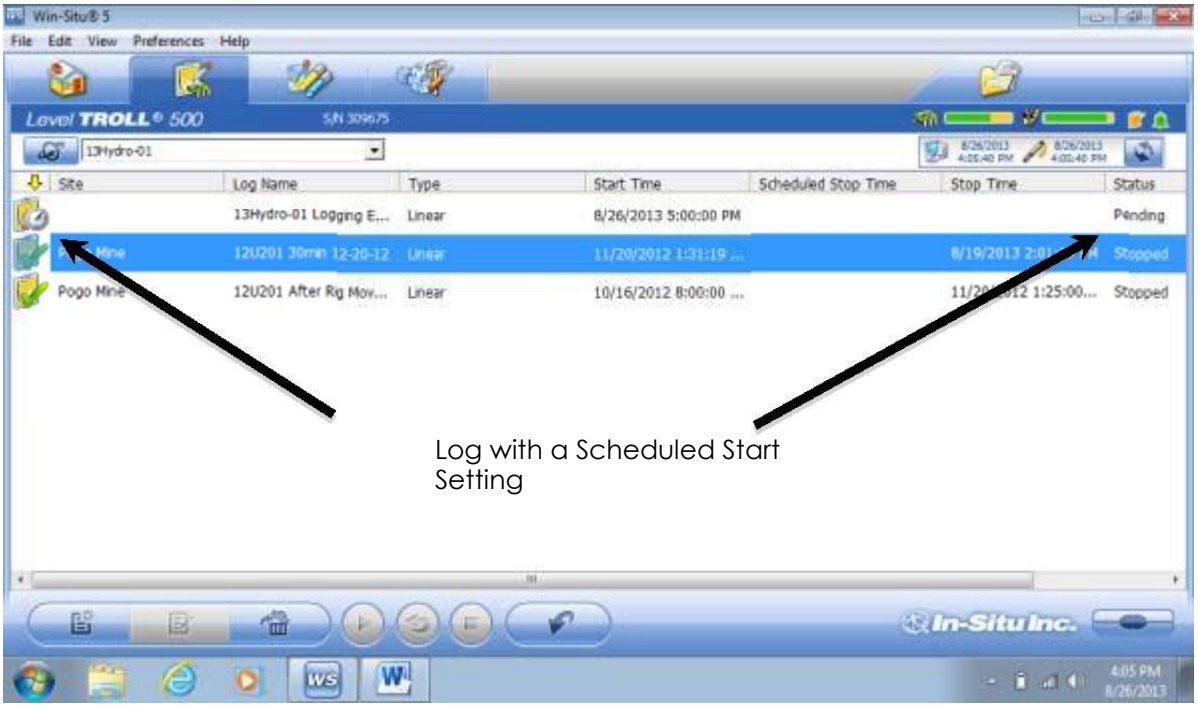
15. With a manual start setting, the log will appear as follows (**ScreenGrab 24**). Prior to starting the log, review the datalogger memory space, battery life and clock synchronization with the laptop/tablet. If memory space is low, stored logs can be deleted (**Section C.4.3**). Replace the 3.6v Li battery if the level is low. In order to sync with the tablet/laptop clock, click the sync button:



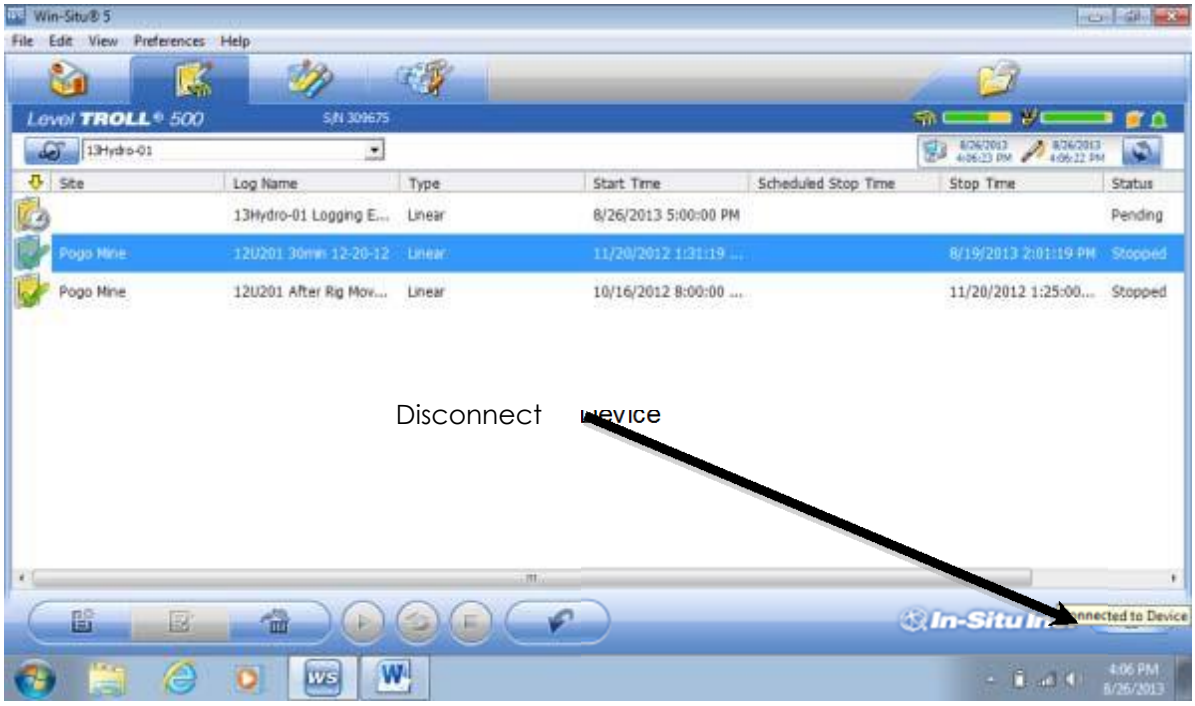
16. Once the time is synced (this cannot be done if a log is running), it is time to start the log manually (**ScreenGrab 25**). Right click on the new log to bring up a menu with log options and click on Start or click the Start Button:



17. With the scheduled start setting, the log will appear as follows (**ScreenGrab 26**). As with the manual start setting (**Step 15**), review PT characteristics and remedy as needed



18. With the scheduled start, once you verify that it is pending, you can disconnect the device. With the manual start, once you start it manually and see the running man, you can disconnect the device (**ScreenGrab 27**):

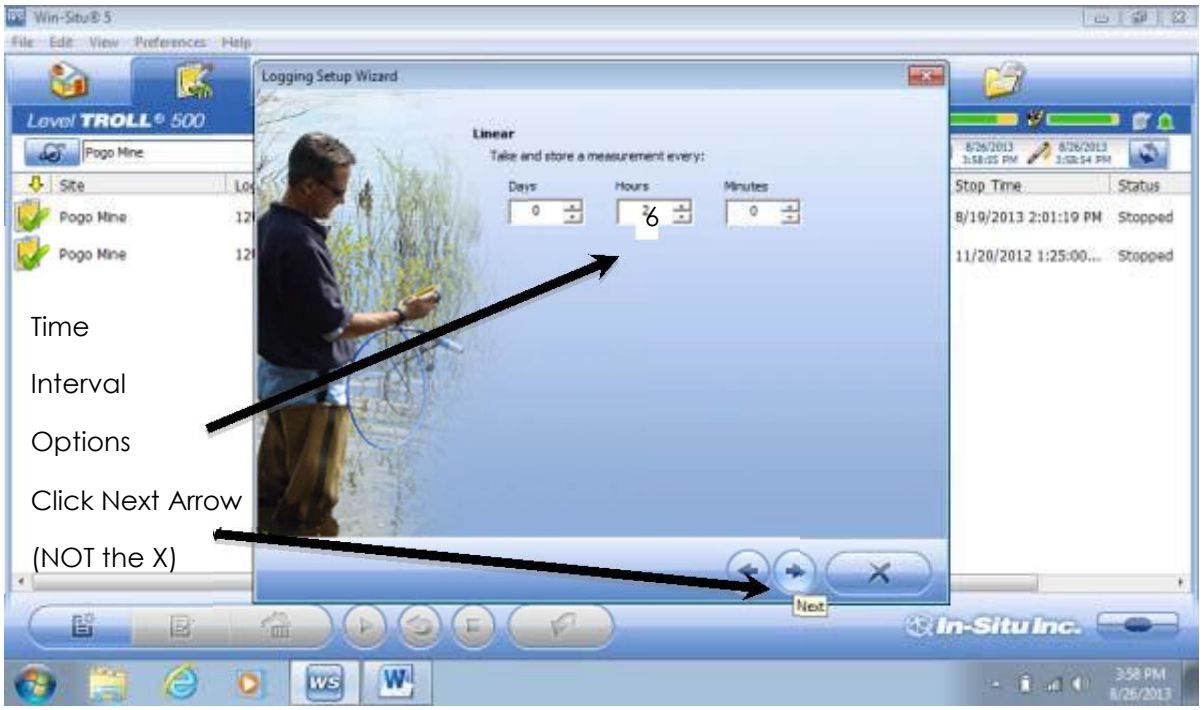


19. Follow steps 16 through 18 from Section B.2.1 Download Procedures – UG Coreholes to finish.

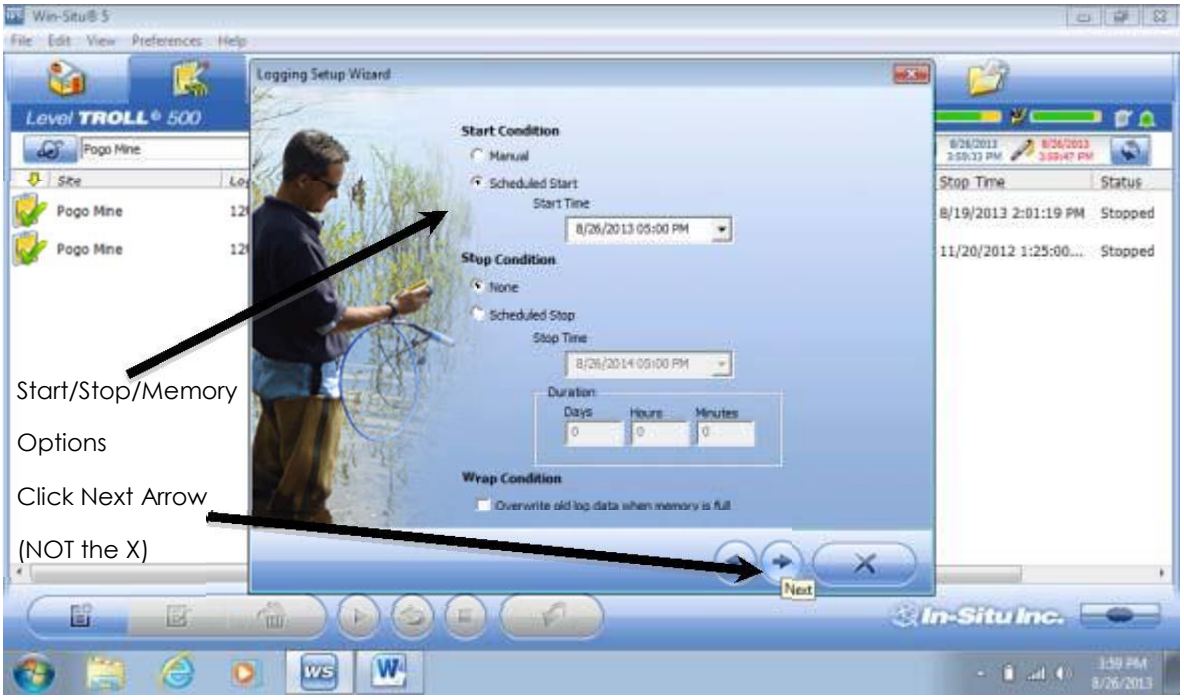
5.3.3 SURFACE WELL PROGRAMMING PROCEDURE

This section gives the step-by-step procedures for stopping running logs and programming new logs in the field for surface wells. Observations made during the procedures should be recorded on the appropriate field form (Appendix D). The observations can then be entered into EDMS.

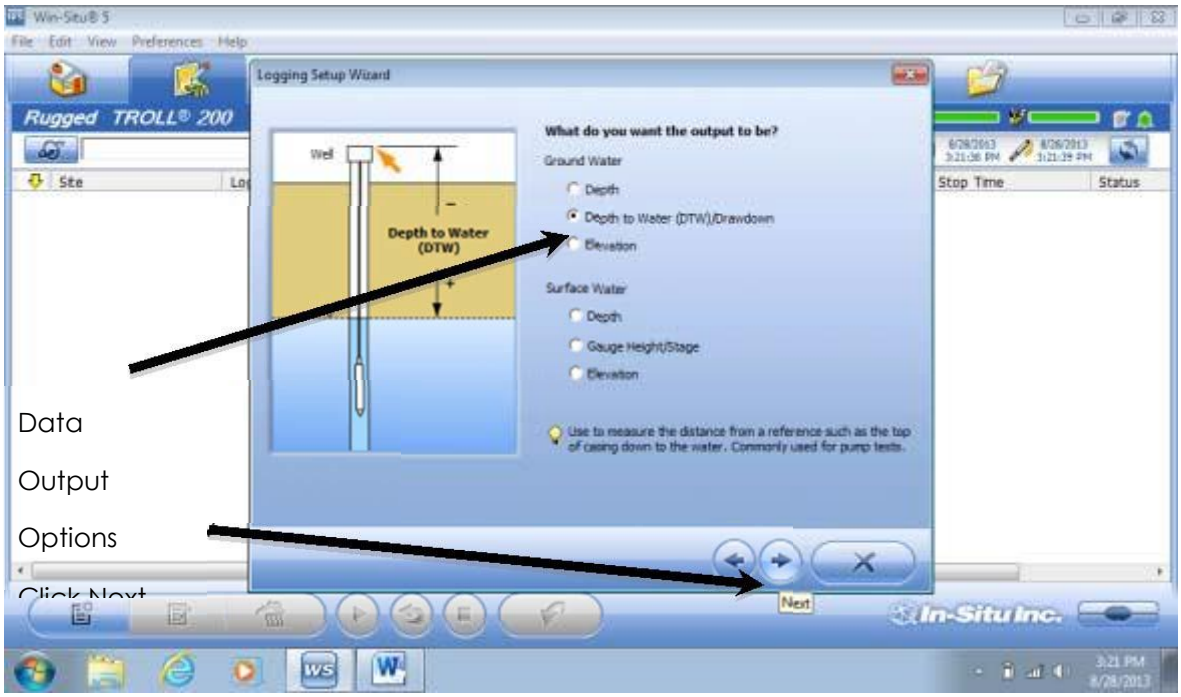
1. Follow steps 1 through 6 in **Section B.2.2** Download Procedures – Surface Ridge Wells and steps 6 through 14 in **Section B.2.1** Download Procedures - Underground Coreholes, for PT's that are installed and logging data. New PT installation is in section C.4.
2. Follow steps 2 through 5 in **Section C.1.1** UG Corehole Programming Procedure.
3. The RT-100 can only have one log programmed on it at any time. The RT-200 and the LT- 300 can hold two logs. Once the data is downloaded to the field laptop/Tablet, the logs can be deleted. Log deletion is described in **Section C.4.3**. Prior to deleting the log off the PT, you will need to export the log as a csv file and then copy the logs from the laptop/tablet to a flash drive so that you have a backup copy of the log should something happen to the laptop/tablet.
4. Follow steps 5 through 9 in **Section C.1.1** UG Corehole Programming Procedure.
5. The next screen in the Logging Setup Wizard gives you time interval options for taking measurements. For surface well long-term monitoring, a six hour interval is used (**ScreenGrab 28**):



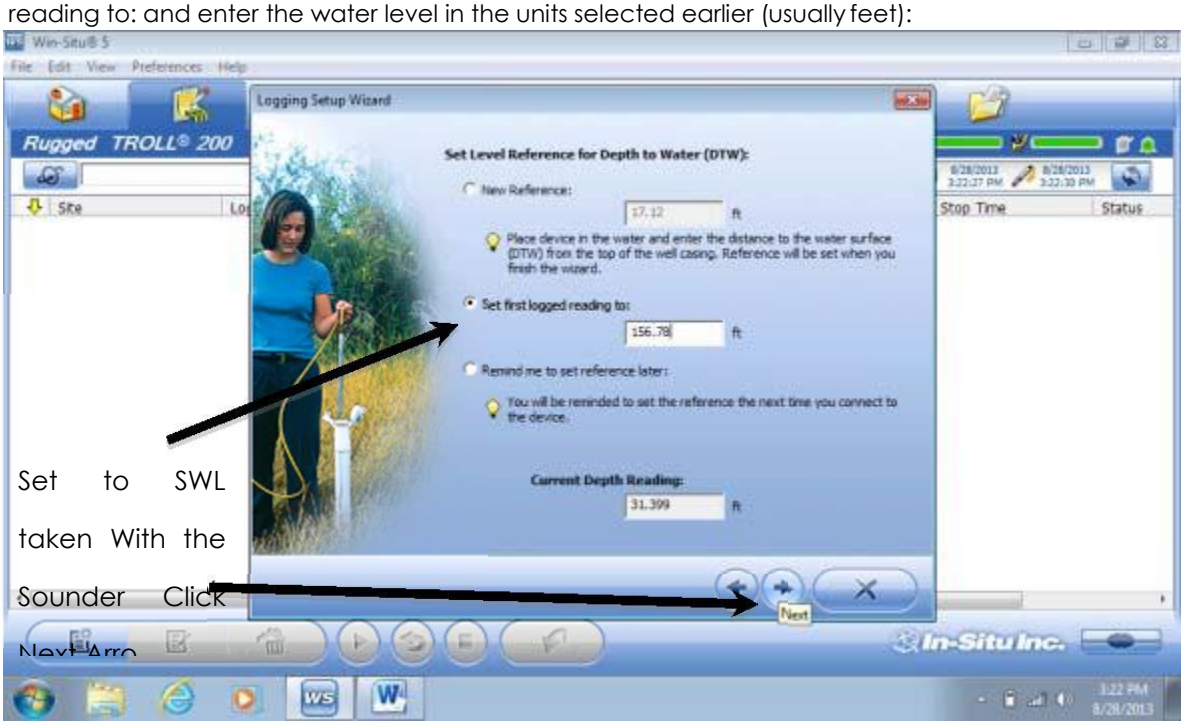
6. The next screen offers different start/stop options for the log (**ScreenGrab 29**). Select scheduled start and ensure that the time selected will not start taking data until the PT is set in the well at depth:



7. Data output options are available on the next screen (**ScreenGrab 30**). As this is a groundwater measurement from the surface, use the option under Ground Water for Depth to Water (DTW) drawdown. Regardless of which option you choose, the PT will always measure pressure at the nose of the PT. For each option (other than Depth), the datalogger will mathematically convert the pressure to your output of choice.



8. The next screen in the Logging Setup Wizard gives options for setting a reference point for the output calculations (**ScreenGrab 31**). Using the SWL just taken with the sounder, select Set first logged reading to: and enter the water level in the units selected earlier (usually feet):

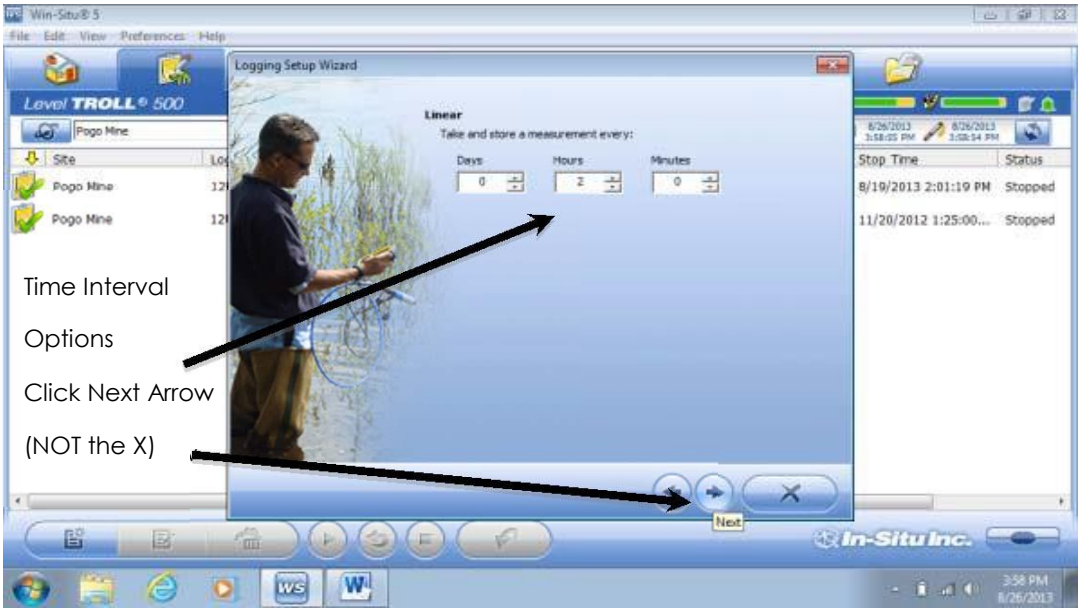


9. Follow steps 13 & 14 then 17 & 18 in **Section C.1.1** UG Corehole Programming Procedure.
10. Follow steps 8 through 10 in **Section B.2.2** Download Procedures – Surface Ridge Wells to finish.

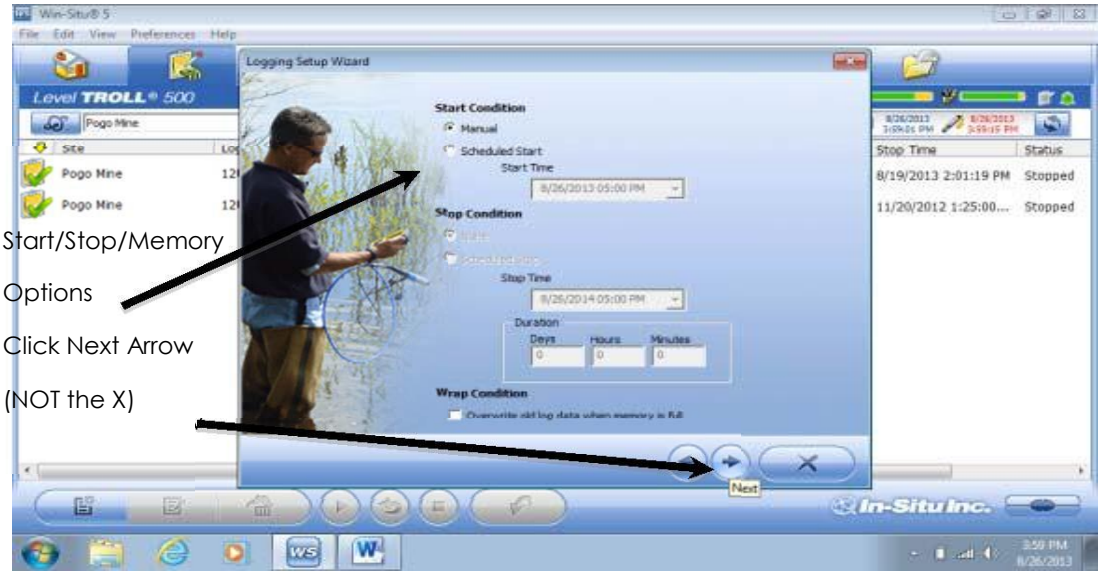
5.3.4 FLUME PROGRAMMING PROCEDURE

This section gives the step-by-step procedures for stopping running logs and programming new logs in the field for the H Flumes on Liese Creek. Observations made during the procedures should be recorded in the field notebook or in Word/Wordpad on the field laptop/tablet. The observations can then be entered into EDMS.

1. Follow steps 1 through 4 in **Section B.2.3** Download Procedures – Flumes and steps 6 through 14 in **Section B.2.1** Download Procedures - Underground Coreholes, for PT's that are installed and logging data. Programming a new PT installation is in **Section 4.1.**
2. Follow steps 2 through 9 in **Section C.1.1** UG Corehole Programming Procedure.
3. The next screen in the Logging Setup Wizard gives you time interval options for taking measurements. For flume long-term monitoring, a two hour interval is used (**ScreenGrab 32**), and for short-term monitoring (spring thaw, precipitation events, etc.), use a 10 minute interval:

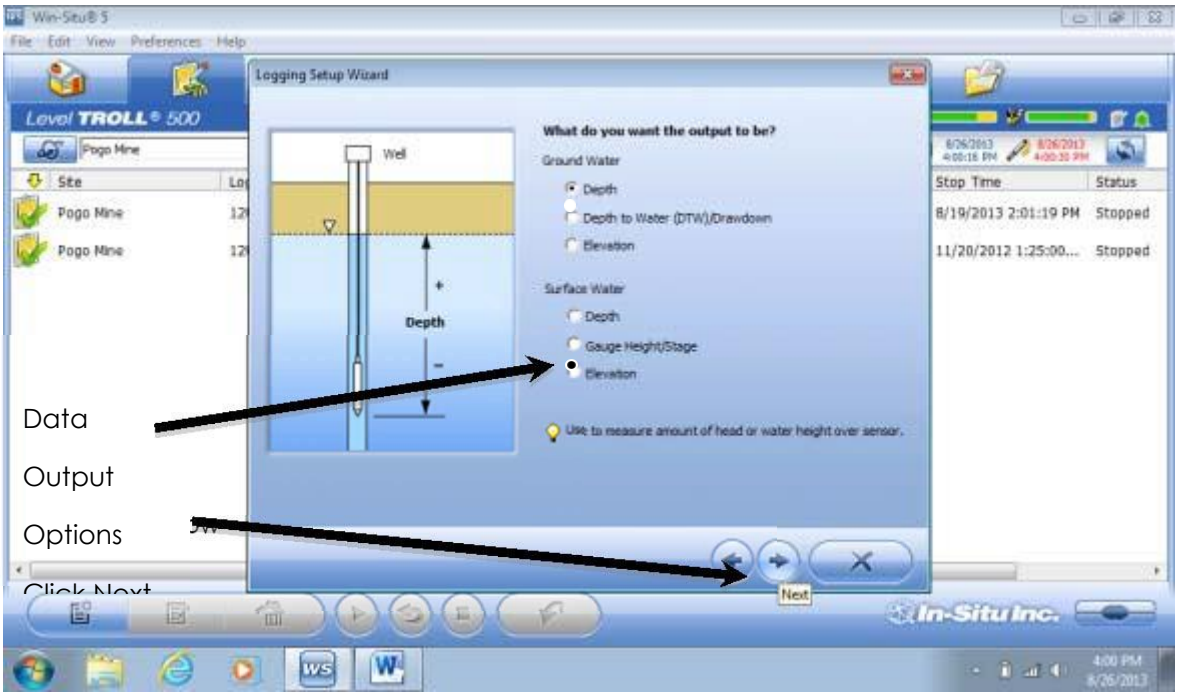


4. The next screen offers different start/stop options for the log (**ScreenGrab 33**). A scheduled start works well if you want all the readings to be consistent at different locations. If a manual start is



chosen, the log will need to be started before you disconnect the PT:

5. Data output options are available on the next screen (**ScreenGrab 34**). As this is a surface water measurement, use the option under Surface Water for Gauge Height/Stage. Regardless of which option you choose, the PT will always measure pressure at the nose of the PT. For each option (other than Depth), the datalogger will mathematically convert the pressure to your output of choice.



6. The next screen in the Logging Setup Wizard gives options for setting a reference point for the output calculations (**ScreenGrab 35**). Set the reference point to zero and ensure water is in the stilling well level to the bottom of the flume (fill with water from a bottle or bucket). Reference will be logged with first reading (works best if there is no water running through the flume).
7. Follow steps 15 through 18 in **Section C.1.1** UG Corehole Programming Procedure.
8. Follow steps 6 and 7 in **Section B.2.3** Download Procedures – Flumes to finish.

5.3.5 MISCELLANEOUS PT INFO, PROGRAMMING PROCEDURES AND ERRORS

5.3.5.1 PT Installation

The following **Photos C-1 & C-2** show the discharge head for the LT-500 for an UG corehole:

Photo C-1: Discharge Head with Instrumentation

Photo C-2: Discharge Head Sampling Hose

The following **Photo C-3** shows the top support for the cable connected to an RT-200 for a surface well. The cable is connected to the RT in the same manner:

Photo C-3: Top of Cable to RT-100/200

The following **Photo C-4** shows the installation of an LT-700 in a flume stilling well. For consistency over the years and to protect the instrumentation and cable, the PT should hang vertically and the cable should be secured above the flume to keep the desiccant/cable out of water in high precipitation events and spring thaw:

Photo C-4: PT Installed in Flume Stilling Well

Additional Installation Guidelines:

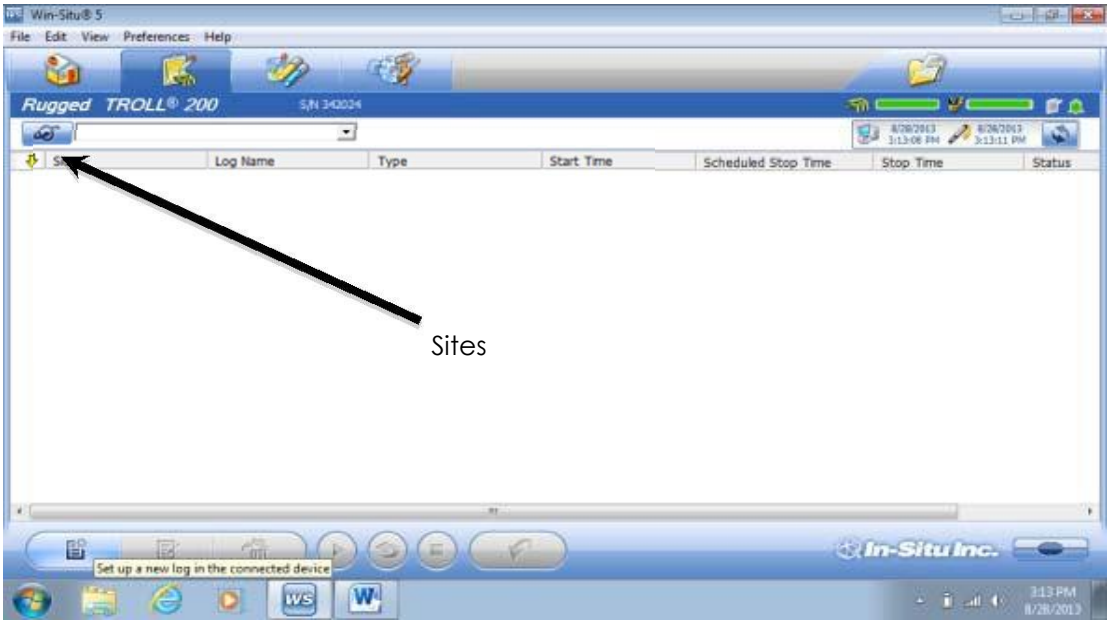
- Never let the instrument fall freely down a well. Doing so will damage the sensor.
- After you have installed the instrument, verify the water level reading (LT-500/700 only). Move the instrument and take another reading to ensure that the instrument shows reasonable change. The instrument could be wedged against the well casing with a loop of cable hanging below. An instrument in such a position could become dislodged and move while it is logging data, which would record a false change in the water level.
- For accurate measurements, the instrument should remain immobile while it is logging data.

- Make sure that the uphole cable end is protected. The vented cable must be protected with a desiccant, and the non-vented cable must be protected with a dust cap. The uphole cable end must be positioned above the highest anticipated water level. Avoid placing this end in a location that might flood.
- Do not deploy instruments in such a way that ice may form on or near the sensor or cable connections. Ice formation is a powerful expansive force that can over- pressurize the sensor or otherwise cause damage. Damage associated with ice formation is not covered by the instrument warranty.
- Do not allow vented cable to bend enough to obstruct the internal vent tube. The recommended bend radius is 13.5 mm (0.54 in), which is twice the cable diameter.

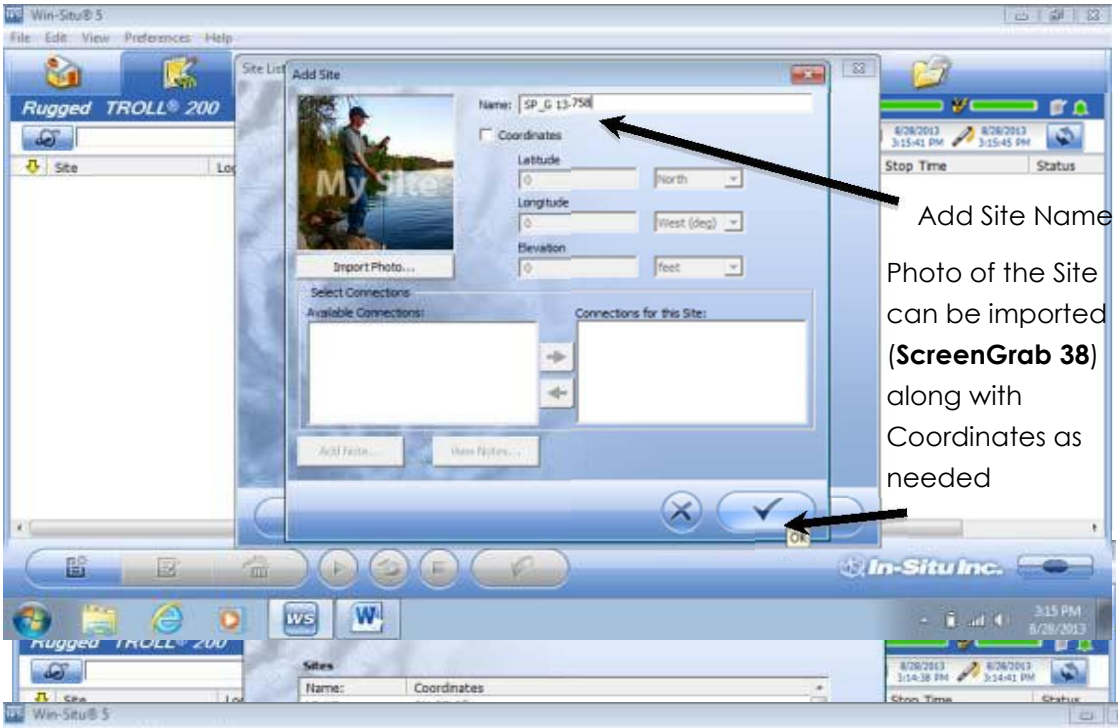
5.3.6 SITE SETUP FOR ALL PT'S

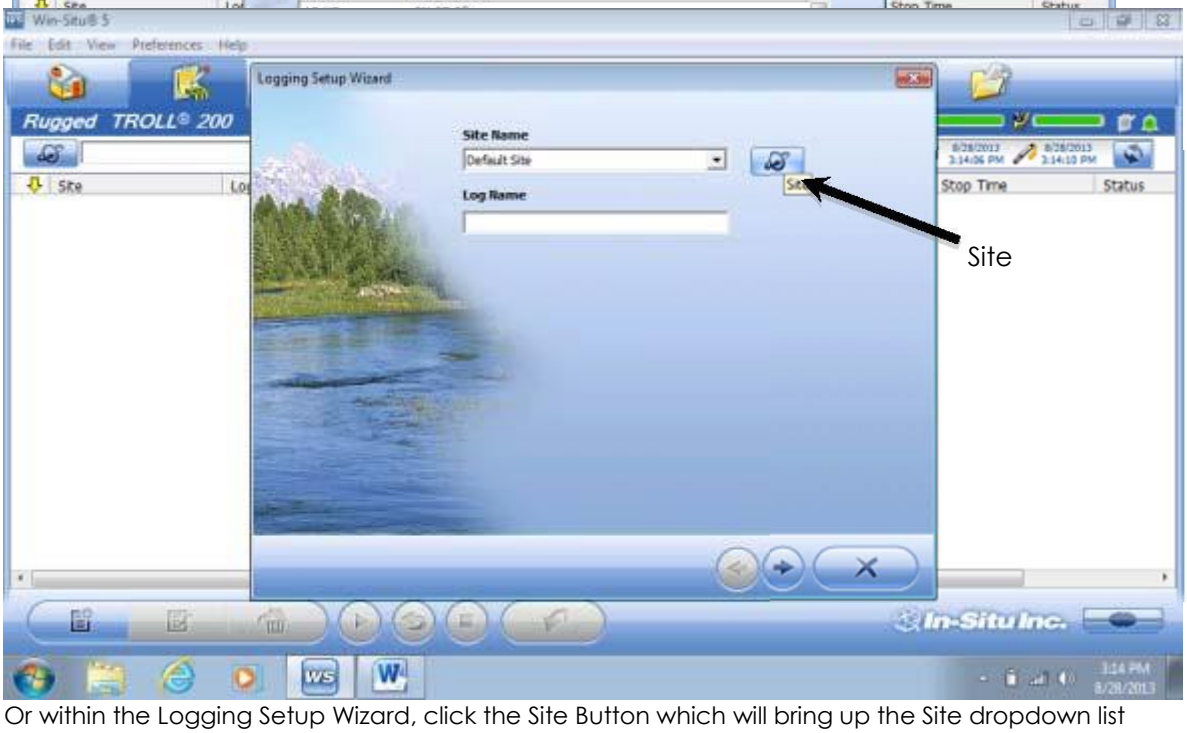
The site setup procedure is the same for all sites and PT's in Win-Situ.

1. To add a new site to the site database in your working directory do one of the following:
2. On the Data tab, click the Site Data folder, select File> New > Site. (No ScreenGrab for this)
3. Or on any of the tabs, click the Site button to display the site list (**ScreenGrab 36**):



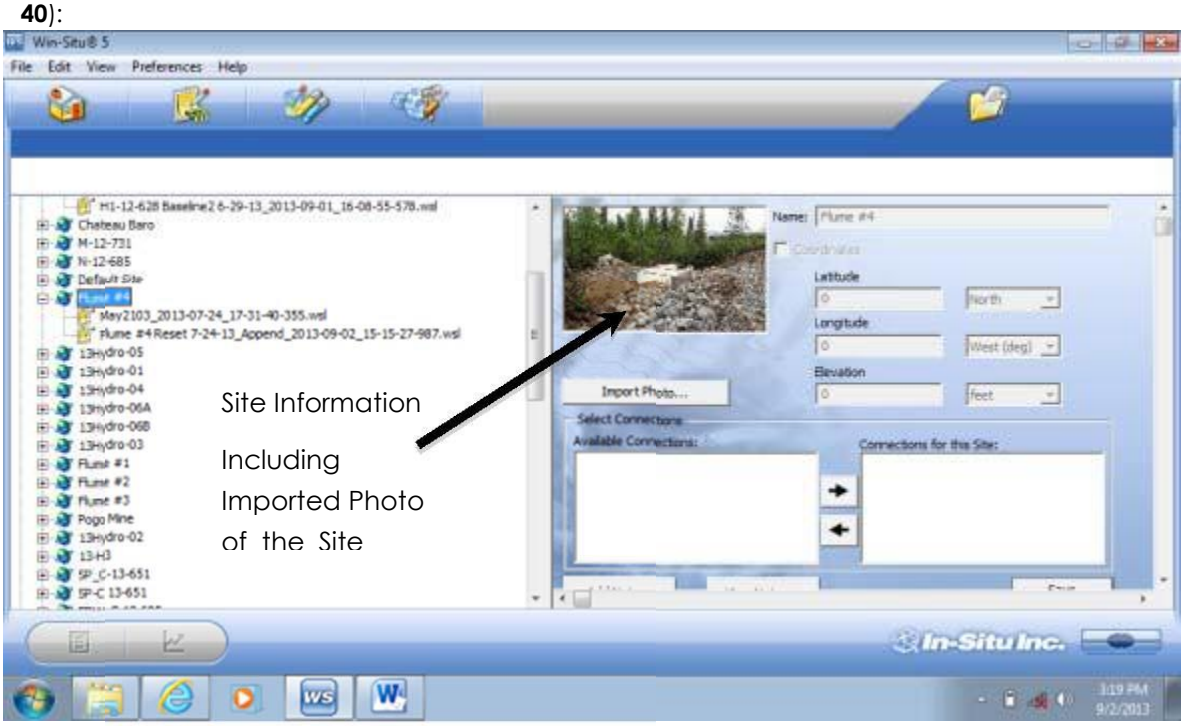
4. The sites drop down list will appear. Click on the New button (**ScreenGrab 37**):
5. Enter a name for the site. This is the only required field. Additional information can be added at a later date as needed through the Edit Site Button. Click Save (**ScreenGrab 38**):





6. Or within the Logging Setup Wizard, click the Site Button which will bring up the Site dropdown list and follow above steps 4 & 5 (ScreenGrab 39):
7. The new site will appear in the Site Data folder, and Win-Situ will add it to the site database in the working directory on your computer. It is now available to select for any instrument log.

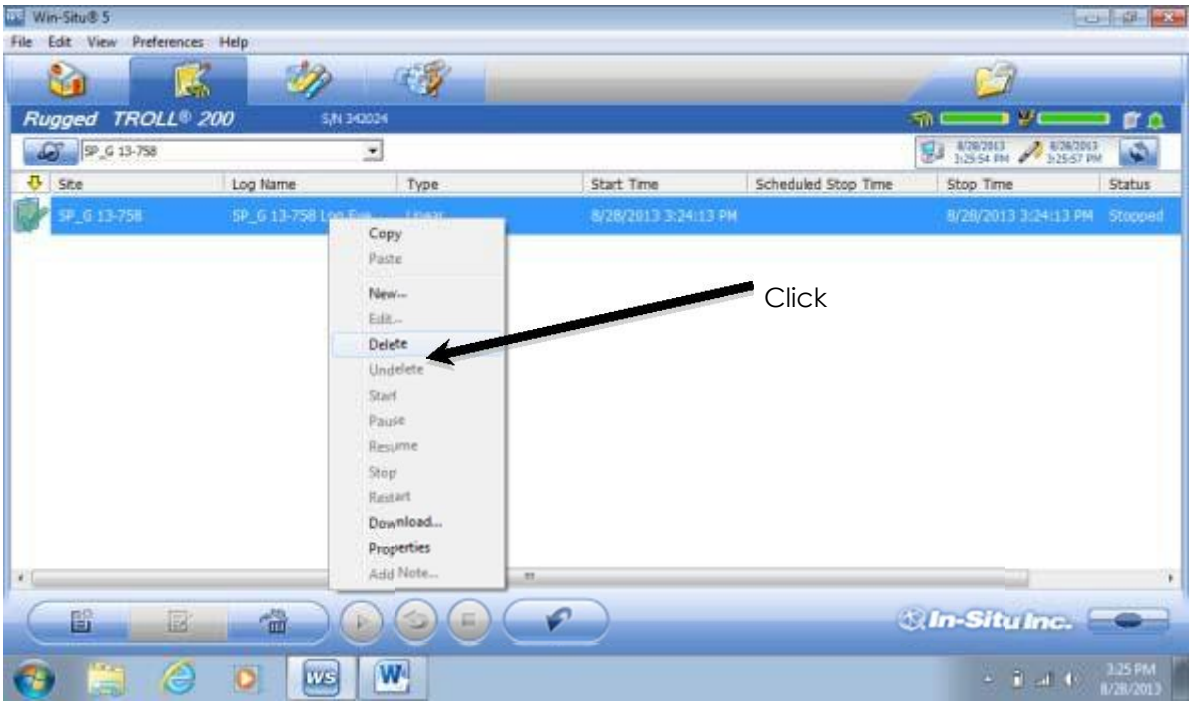
8. When in the Data Tab, click on any listed site and site information will be displayed (**ScreenGrab 40**):



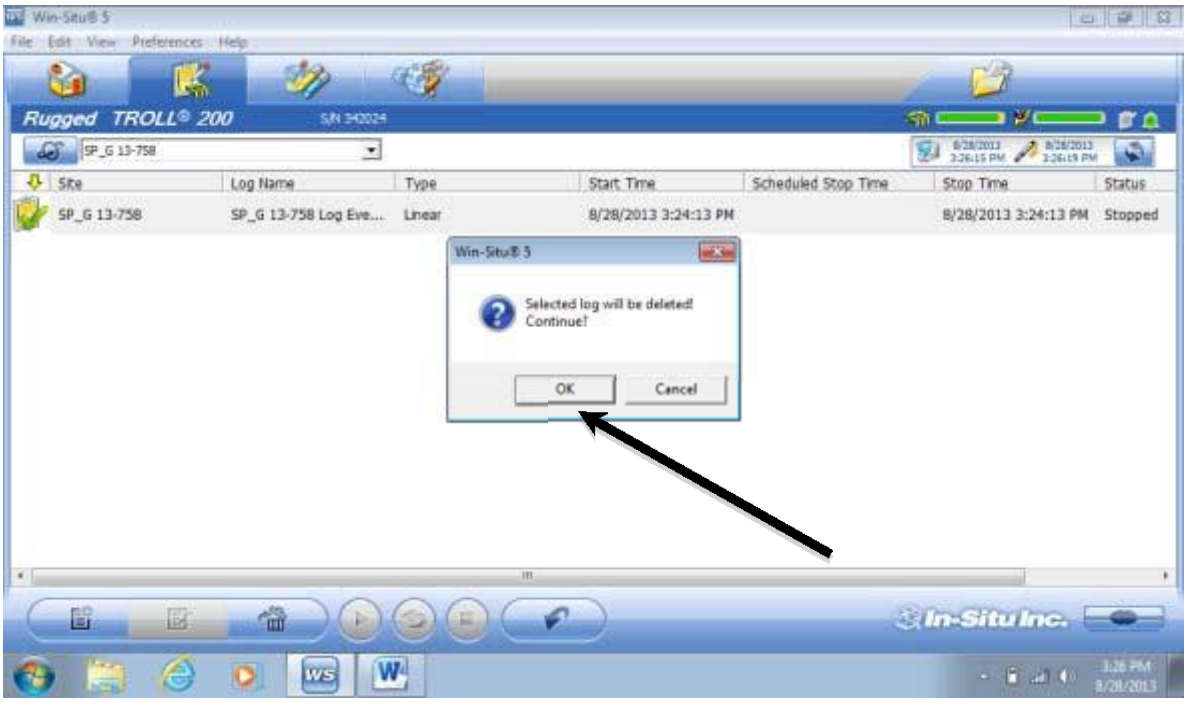
5.3.7 DELETING LOGS OFF THE PT'S

The procedure to permanently delete logs is the same for all PT's.

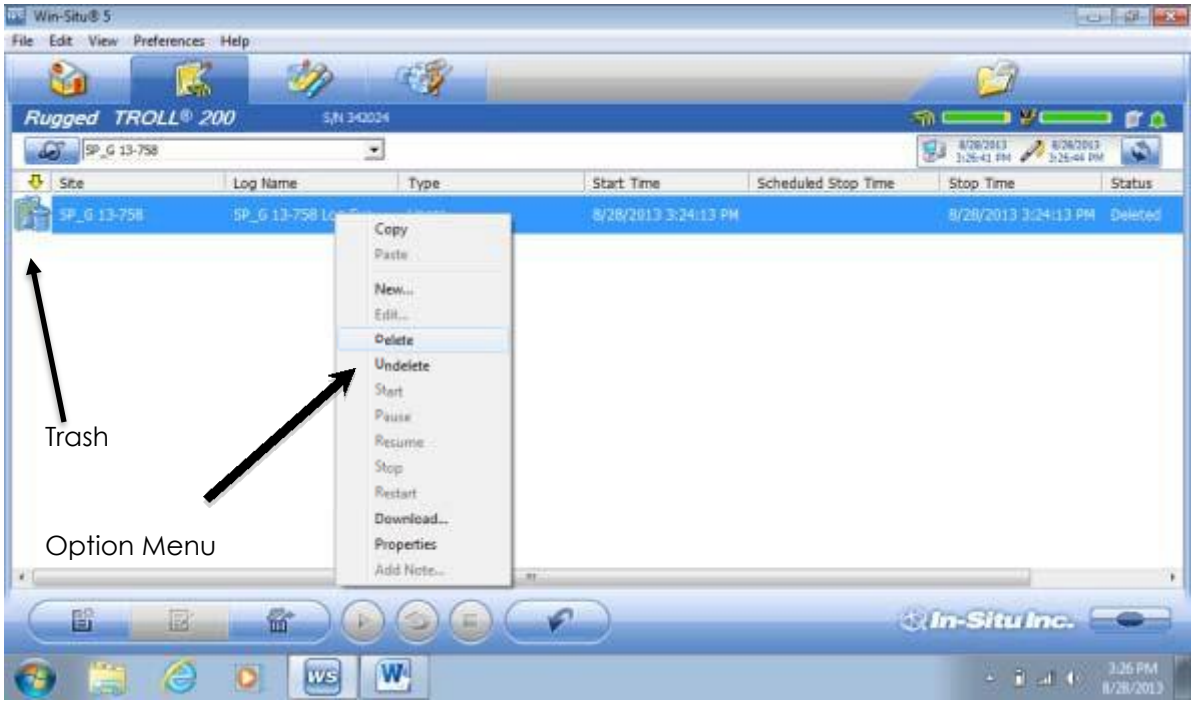
1. While in the Log Tab, highlight and then right click on the log to bring up the options menu and click on Delete (**ScreenGrab 41**):



2. The verification question will come up next. Click on OK (**ScreenGrab 42**):

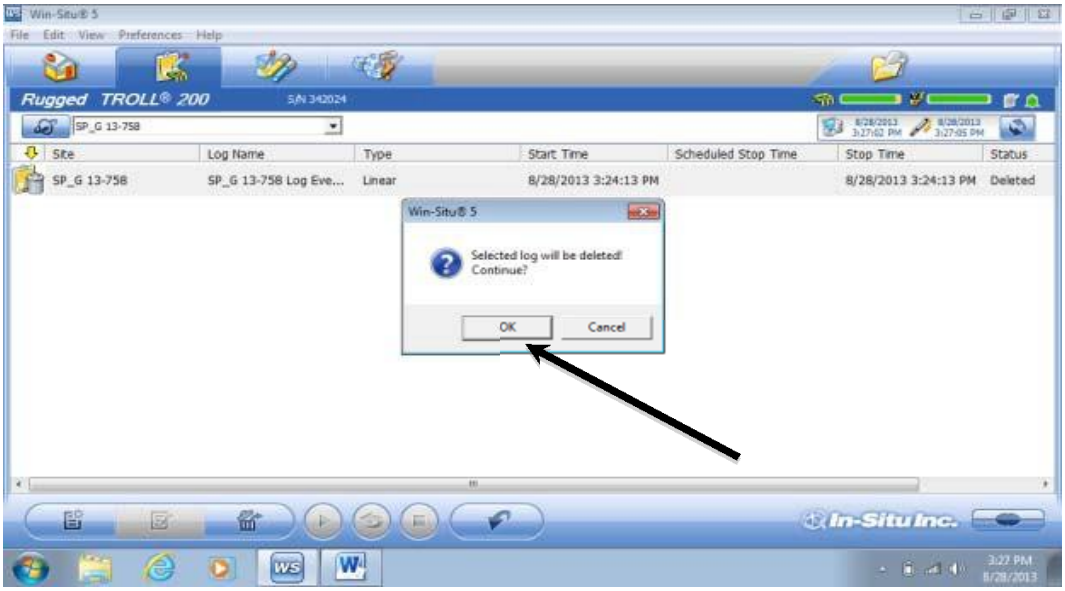


3. The Log screen will show the log with a trash can instead of a checkmark. At this point it can still be undeleted. In order to permanently delete it from the PT, right click on the log again and select the



Delete option again (**ScreenGrab 43**):

4. This will bring up the verification question again. Click on OK to permanently delete the log from the PT (**ScreenGrab44**).

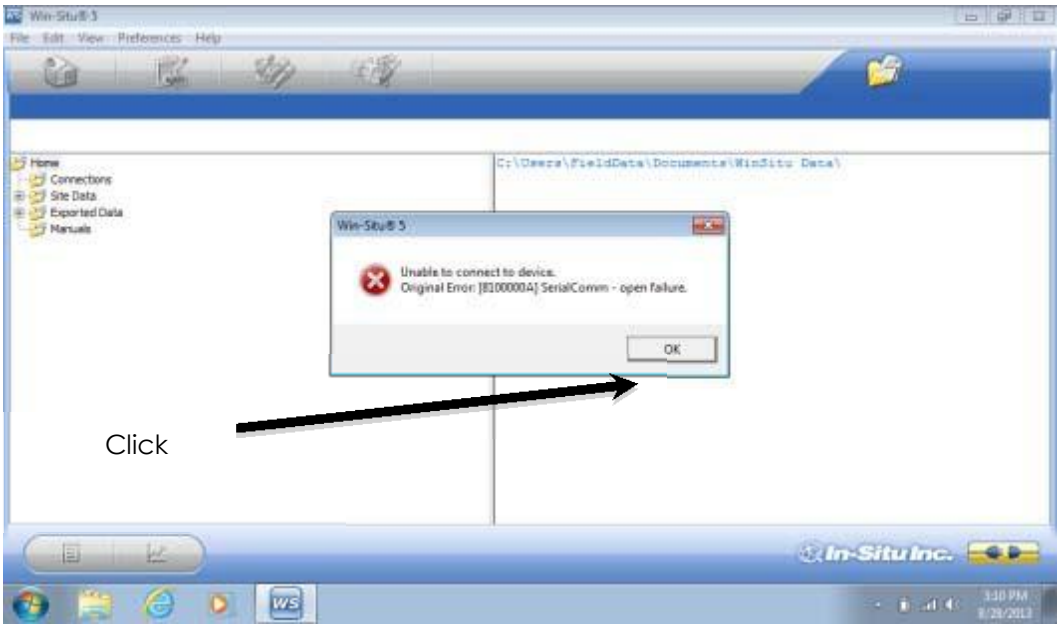


5.3.8 EXPORTING DATA FILES FROM WIN-SITU TO CSV FILES FOR EDMS UPLOAD

Select export from the File menu, then select Export csv.

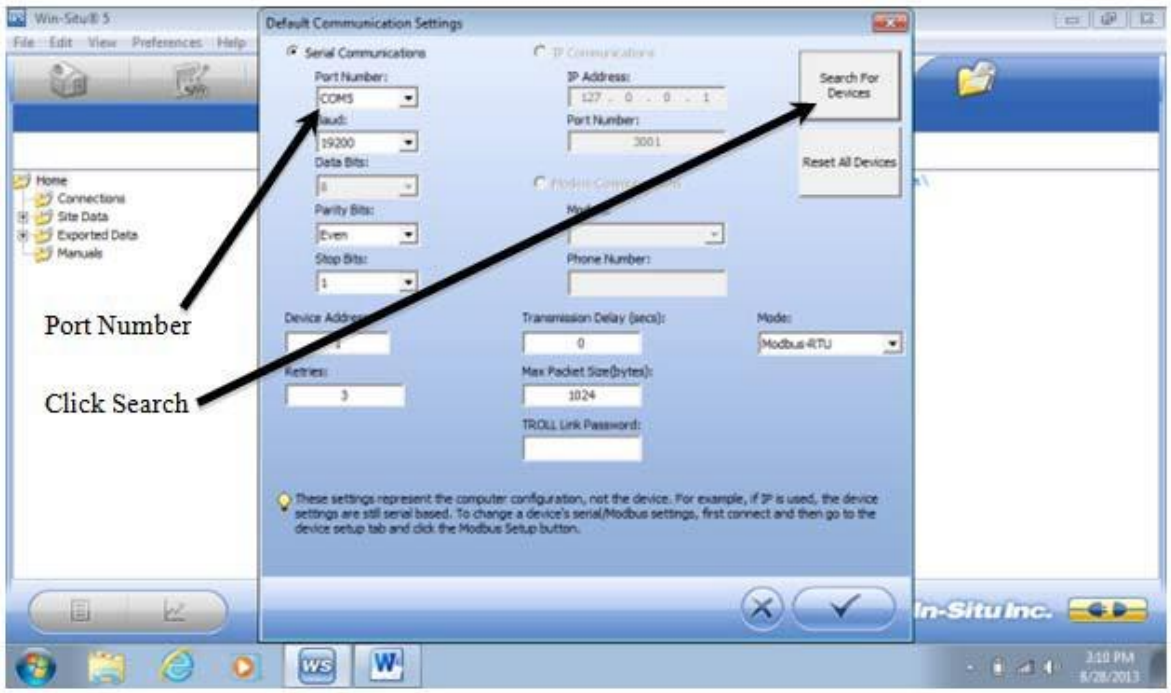
5.3.9 CONNECTION ERRORS WITH THE FIELD LAPTOP

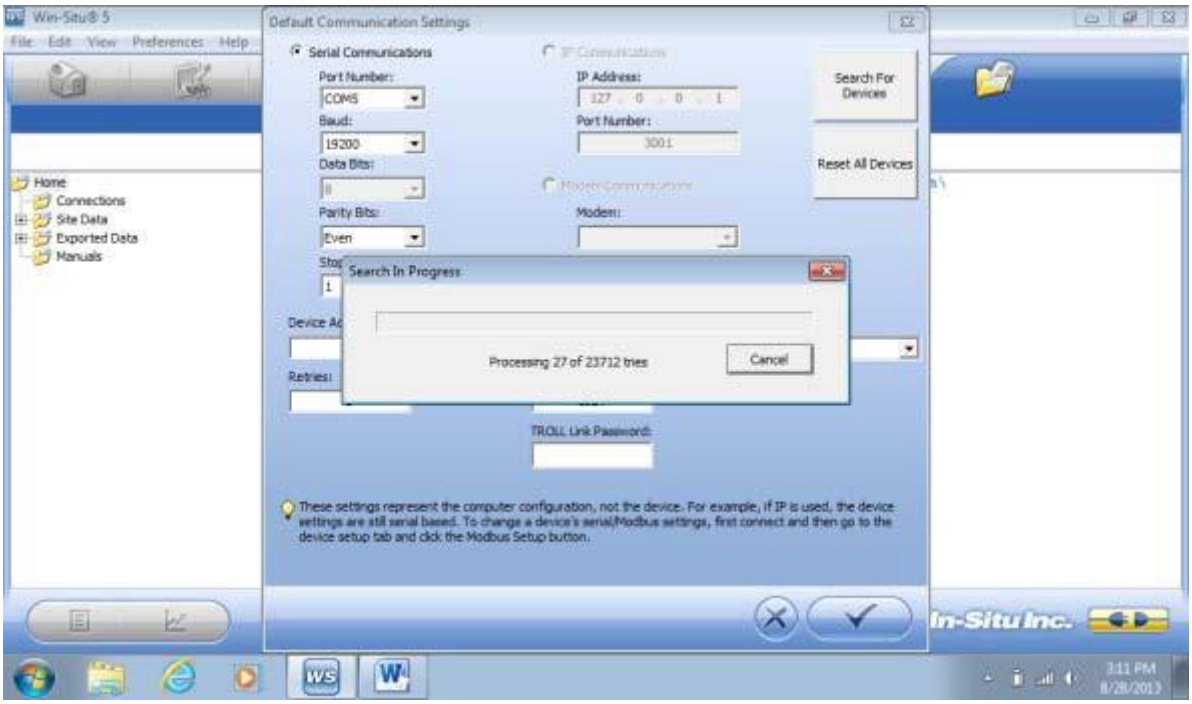
1. At times when connecting to the PT's, a connection error will come up (**ScreenGrab 45**):



2. The Default Communication Settings menu will come up. If the Port Number is not blank, then click on the Search for Devices button. If the Port Number is blank, close Win-Situ and then re-open it and attempt to connect to the PT again. If the error comes up again and the Port Number is still blank, close Win-Situ and shut down the computer and restart (**ScreenGrab 46**):

3. Win-Situ will search for connection and will connect on the 37th try. If it doesn't, then it won't (**ScreenGrab 47**). Go back to **step 2** until it connects.





4. Click OK after it connects to the device (PT).

5.4 Appendix D – Field Forms

Piezometer Field Data Sheet – Pogo Mine

Piezo Num. _____ **Date:** _____

Measured Depth of Water _____ feet below top of steel casing

Condition of Piezo at Surface (capped, iced, flagged, etc.) _____

Condition Downhole (clear, blockage) _____

Time Datalogger Pulled _____ Time Datalogger Back in Position _____

Datalogging Interval _____ sec min hr day

Datalogger Storage Remaining _____ Level Measurement Mode _____

Datalogger Battery Remaining _____ Level Reference Offset _____

Extracted Filename _____ Time _____

Improvements/Maintenance

Item Action

_____

_____

_____

_____

_____

Observations/Comments

Personnel _____

Underground Drillhole Shut-in Field Data Sheet – Pogo Mine

Hole Num. _____ **Date:** _____

Datalogger Pressure Reading _____ feet Time _____

Condition of Collar Assembly _____

_____

Visual Estimate of Leakage (drips/sec, gpm) _____

Condition of Flagging and Signing _____

Datalogging Interval _____ sec min hr day

Datalogger Storage Remaining _____ Level Measurement Mode _____

Datalogger Battery Remaining _____ Level Reference Offset _____

Extracted Filename _____ Time _____

Name of Datalogger Run Program _____

Improvements/Maintenance

Item Action

_____

_____

_____

_____

_____

Observations/Comments

Personnel _____

Flume Field Data Sheet – Pogo Mine

Flume. _____ **Date:** _____

Head at Measurement Point _____ feet Time _____ Meas. Pt. _____

Datalogger Head Reading _____ feet Time _____

Visual Estimate of Leakage as a Percentage of Flow Through Flume _____ %

Condition of Flume _____

_____

Transverse Level Checked _____ Result (ft/ft) _____

Longitudinal Level Checked _____ Result (ft/ft) _____

Datalogging Interval _____ sec min hr day

Datalogger Storage Remaining _____ Level Measurement Mode _____

Datalogger Battery Remaining _____ Level Reference Offset _____

Extracted Filename _____ Time _____

Improvements/Maintenance

Item Action

_____

_____

_____

_____

_____

Observations/Comments

Personnel _____

1. PURPOSE

This instruction provides guidelines for proper operation and handling of fluid transfer equipment on mine site.

2. SCOPE

This instruction is applicable to fuel transfer at fuel islands, fuel trucks, fuel tanks, drums, and any other similar fluid transfer situations on the mine site or on the pogo access road.

3. ROLES AND RESPONSIBILITIES

Role	Key Responsibilities
Pogo Employees, Contractors, & Sub-Contractors	are responsible for following this SWP while handling fuel (or other fluids) onsite or on the access road.
Environmental Manager	Environmental Manager is responsible for overseeing spill reporting and spill management as needed.
Environmental Engineer, Coordinator, Specialist or Technician	are responsible for assisting in any spill clean-up and performing secondary containment inspections as per the SPCC.
Maintenance Manager & Surface Supervisor	are responsible for the inspection repair and maintenance of the fuel islands, and designated fuel storage areas.
Mine Manager	is responsible for the inspection of designated fuel islands.
Warehouse Supervisor	is responsible for inspections of designated fuel storage areas.

4. DEFINITIONS AND ACRONYMS

SPCC	Spill Prevention, Control and Countermeasures Plan

5. FLUID TRANSFER PROCEDURE

1. Prior to filling and departure, your vehicle and/or equipment should be inspected for leaks or spillage. Ensure that it is has been properly maintained and that there are no leaking parts. **If your vehicle or equipment does not appear to be in proper order and leaks are apparent, stop the job and have adequate repairs done.**
2. Wheel chocks shall be used to prevent vehicle departure before disconnecting from a completed fluid transfer.
3. Position equipment so that valves, piping, tanks, etc., are protected from damage by other vehicles or heavy equipment.
4. Verify that you have adequate secondary containment and absorbent pads on hand to catch drips / small spills.
5. Before starting any fluid transfer operation, inspect all hoses, connections, valves, etc. Ensure that these items have been properly maintained; gaskets are present and in good shape; all valves are checked to verify they're in the proper on/off position, and that each connection is tightened properly.
6. Prior to the actual fluid transfer, check all tank and container levels, valves, and vents to prevent overfilling or accidental releases.
7. Use secondary containment (i.e. a duck pond, etc.) under all appropriate connections, vents or any other likely source of spillage. Use as many secondary containers as are practical.
8. Upon starting the transfer of liquids, remain within arm's reach and constantly observe the transfer operation. Be prepared to stop proceedings if any leak is noticed. **Do not attempt to repair a leaking situation while fluid is being transferred. Stop operations to fix leaks!**
9. **Transfer operations must not be left unattended.**
10. After transfer is complete, take every precaution while breaking connections. Secondary containment and absorbent pads must continue to be used until the rigging down process is complete. Clean out spillage into secondary containment once transfer is complete.
11. Check all tank and container levels after each transfer for signs of spills. Immediately report **all** spills to your Supervisor, or if unavailable, call Environmental on the Surface channel.

6. MONITORING AND CHECKING

Environmental Department inspects and manages secondary containment as required by the Pogo Mine Spill Prevention, Control and Countermeasures Plan (SPCC).

Equipment inspections on the 1875 area fuel station will be performed by Maintenance and Mine Departments.

The Lower Camp fuel island equipment will be inspected and maintained by the Maintenance Department.

The Mill Department will inspect equipment associated with the heating oil fuel storage areas near the Mill and the Sewage Treatment Plant.

The Warehouse monitors fuel use and coordinates fuel delivery from vendors. Warehouse personnel will inspect and maintain the heating fuel areas near the administration building.

7. MAINTENANCE AND CALIBRATION

The Maintenance Department is responsible for any repairs to fuel islands and fuel storage areas, as required, as well as the regularly scheduled preventative maintenance (PMs).

8. RECORDS

Record Description	Record Location/ Retention Responsibility	Minimum Retention Time
SPCC monthly inspections	INX / Environmental Manager	2 years
Spill Reporting	INX / Environmental Manager	2 years
Fuel supply and delivery	Pronto Data Management System/ Warehouse Supervisor	2 years
Maintenance and repairs to fuel islands and fuel storage areas.	Pronto Data Management System/ Maintenance Supervisor	2 years

9. DEPARTURES FROM PROCEDURES

9.1 Notifications

Pogo employees are responsible for informing his/her supervisor of any spills or any equipment malfunctions or maintenance issues that occur during a fuelling procedure. If supervisor is unavailable contact Environmental Department immediately.

9.2 Environmental and Legal Consequences

Failure to follow this procedure could lead to an increased number of reportable spills and negatively impact the Pogo Mine operations.

9.3 Consequences to Employees

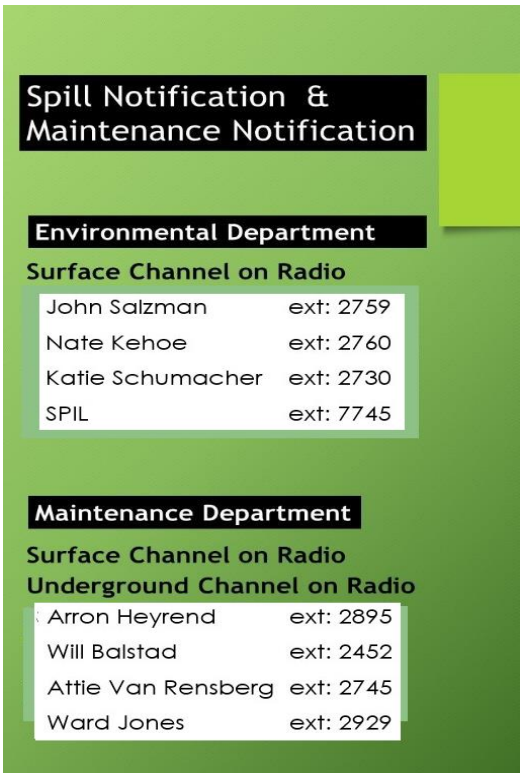
Failure to follow this procedure could result in unsafe practices or conditions contributing to an incident possibly resulting in injury or harm to the environment. In some instances, particular requirements will dictate variances from this procedure. However, any variance must be viewed with caution and possible contingencies accounted for at all times. A variance shall only be given through management only.

10. RELATED DOCUMENTS

Document Name	Document Number
Spill Prevention, Control and Countermeasures Plan	PGO-ENV-006-PLA

11. APPENDIX

Fuel Transfer Procedure Sign



Spill Notification, & Maintenance Notification Sign

1. PURPOSE AND SCOPE

This SWP provides best practices guidance for the placement and management of tailings (i.e., dry stack) and rock in the Dry stack Tailings Facility (DSTF) General Placement Area (GPA). This is a significant aspect of the Pogo operations.

This SWP applies to the construction and maintenance of the DSTF General Placement Area. The issues covered in this SWP are:

- Placement procedures and requirements;
- Placement guidelines for summer, wet weather and winter conditions;
- Requirements for the placement of mineralized and non-mineralized rock;
- Grubbing and erosion control during construction;
- Construction sequencing;
- Prohibited items for disposal in DSTF;
- Monitoring and checking; and
- Departures from procedures.

2. KEY RESPONSIBILITIES

Maintenance Manager	Is responsible for the construction of the DSTF and for ensuring that all relevant personnel are informed of the standard practices described in this SWP and adhere to the guidelines provided.
Site Services Supervisor	Is directly responsible for ensuring that all the procedures and guidelines in this SWP are followed by employees during the construction of the DSTF.
Site Services Operators	Are responsible for understanding and adhering to the procedures described in this SWP.
Environmental Manager	Is responsible for permit renewals associated with the DSTF, ensuring that the required monitoring and inspections are conducted by the Environmental staff, and for any permit required notifications.
Environmental Engineer	Is responsible for quality control during the construction of the DSTF by Site Services Operators and for overseeing geotechnical testing. The Environmental Engineer also develops the DSTF annual construction plan and updates the material balance.

3. DEFINITIONS

ADEC	Alaska Department of Environmental Conservation
DSFT	Dry stack Tailing Facility
GPA	General Placement Area
Green Rock	Non-mineralized waste rock that is below the thresholds for red rock.
Red Rock	Mineralized waste rock that contains: ▪ more than 0.5% sulphur or ▪ more than 600 mg/kg arsenic
Tailings	Sand/silt like material that is left after the flotation process where gold is removed from ore (not subjected to cyanide leaching) otherwise known as dry stack.

4. PROCEDURE

As the DSTF evolves and equipment changes occur, the Site Services Supervisor shall direct all construction activities to meet the following requirements under any conditions.

- Trucks shall only dump on even stable surfaces away from edges or banks.
- Trucks should not leave ruts, so recommend not traveling in the tracks of the truck before them.
- Truck routes must be maintained smooth at all times.
- All material is to be compacted as follows: 4 passes from the compactor or 3 passes with the D7 dozer.
- Tailings are to be dumped in rows that are 12-feet apart.
- Tailings shall not be placed over one foot thick before compaction.

- Red rock shall be placed 50 feet away from any outside limit of the DSTF.
- Red Rock shall be placed 100 feet away from shell one at the front of the GPA.
- Red rock placement shall be in 3-foot lifts and compacted.
- Green rock placement shall be in 3-foot lifts and compacted.
- After grubbing, green rock will be placed on the outside limits.
- Install of water bars and erosion controls where needed.
- Dust control: if unable to water – then slow down.
- All the truck loads must be logged.
- Annual surveys are required.

Seasonal weather conditions require adjustment to operations as described in the following sections.

4.1 Summer Placement

Summer provides the best operating conditions and allows operators to prepare for wet and winter conditions. Erosion controls are most critical on the front or the west end of the DSTF. If additional erosion controls are required by the Environmental Department, schedule and implement as soon as possible.

The following additional requirements apply:

- Dust control
- Grubbing and green rock placement
- Erosion control maintenance and installation of sediment traps
- Evaluation of compaction procedures

4.2 Wet Weather Placement

This is the most problematic time for placement of materials at the DSTF. Tailings are silt in size and become slippery when wet. During rainy periods, tailings shall be placed in the back or east end of the dry stack. If ponding occurs, the dozer operator should cut a shallow drainage ditch to the edge of the dry stack to prevent water from standing. As soon as the pond is drained, the wet material on the top shall be scraped off and fresh tailings placed and compacted to fill in the pond. If material gets soft to the edge of the DSTF, then replace the tailings and compact with fresh tailings on 1-foot layers. Erosion controls shall be monitored more closely during the wet season by the lead operator and continuously maintained.

During extended periods of rain, red rock may be placed in 1-foot lifts across the tailings up to 50 feet from the edges. If this does not stabilize the surface, continue placing and compacting one-foot layers until the truck traffic is able to travel the area.

- Keep tailings placement area as small as possible.
- Prior to placement of tailings in this small area, the saturated and softened surface will be scraped off.
- If the tailings cannot be compacted immediately, then do not spread at all, but leave in a pile. If the tailings remain in a pile, the rain will generally only penetrate the outer surface of the pile.
- Once tailings placement in the area is complete, the tailings surface shall be smooth, free of water traps, and graded to allow water to run off the surface.

4.3 Winter Placement

Winter placement is the period where equipment and situational awareness is most critical due to limited daylight hours. The following winter requirements apply.

- Haul roads need to be cleared and well sanded. If not, stop haulage until safe conditions are restored.
- Inspect truck boxes after every dump to ensure material is not building up. Even the heated boxes may have frozen material in them.
- If the compactor is unable to operate, use the dozer (D7) with 3 passes at a minimum.
- Placement area needs to be regularly cleared of snow and ice.
- Windrows of dry stack tailings have to be dozed down and spread within three days.

4.4 Tailings Placement

Tailings produced from the mill have a very small particle size similar to silt, because of this the thickness of each lift can only be one-foot to meet compaction requirements. The dozer operator will spread tailings piles to one-foot maximum lifts with the roller compactor making four passes for each lift. Tailings shall be placed over red rock placement areas following procedures outlined in Section 6.5.

4.5 Mineralized Waste Rock (Red Rock)

Red rock must be encapsulated in the tailings to prevent contact with air and water.

- Red rock shall be placed at least 100 feet away from shell one.
- Red rock shall be placed at least 50 feet away from perimeter of DSTF.
- All red rock shall be placed in maximum 3-foot lifts, for three lifts to total no more than nine feet thick per area.
- When a red rock area is completed, two 1-foot layers of tailings must be placed to separate it from the next placement of red rock on top.

4.6 Non-Mineralized Barrier Waste Rock (Green Rock)

Green rock is placed in the GPA and is used for building shell one at the front of the GPA.

- Shell 1 face shall be constructed at a 3 to 1 slope.
- Shell 1 shall be constructed 100 feet wide and sloped at 2% northwest.
- 3 to 1 slope shall be maintained or re-established after every 2 lifts.
- Loads of green rock 3 feet away from berm on Shell 1 to help minimize the effort needed to maintain the 3 to 1 slope.
- Maintain 100 feet on the top of Shell 1 by the addition of an extra row every 2 lifts.

Green rock can be used for berms, erosion control, and construction of temporary roads.

4.7 Grubbing

Grubbing is the procedure of removing trees, shrubs and the topsoil before green rock is placed against native ground to provide a barrier for the tailings. This allows for water drainage, and binding of the facility to the native ground. The grubbed material is to be transported to a growth media storage location.

4.8 Erosion Control

The main purpose of erosion control is to prevent the tailings from eroding into the Recycled Tailings Pond (RTP). Erosion controls include water bars, sediment ponds, culverts, and drainage ditches that maintain the integrity of the facility. No cross drainage should be greater than 2% slope. When drainages are greater than 2%, green rock should be used to prevent rutting and erosion of tailings. Erosion controls will be changed and moved as the facility grows.

4.9 Construction Sequencing

Construction is done in a manner that promotes positive drainage, minimizes erosion and maximizes the equipment use. The DSTF Year by Year Plan (drawing of current and planned construction) and the DSTF Material Balance are developed and updated annually by the Environmental Engineer. The documents are given annually to the Sites Services Supervisor. They include the placement sequencing and erosion control requirements for the DSTF.

4.10 Shell 2 & 3 Construction

Refer to the Pogo DSTF Construction and Maintenance Plan, May 2014 for proper procedures for Shell construction.

4.11 Prohibited Materials

The following materials may not be disposed into the DSTF, underground or any ADEC approved inert solid waste landfill, unless specifically approved by ADEC in writing (Waste Management Permit No. 2011DB0012, Section 1.2.2).

- Other than interstitial waters entrained in the dry stack or paste backfill, treated or untreated process water with constituent concentrations exceeding Water Quality Standards in 18AAC70;
- Chemical containers with fewer than three rinses, and discarded, unused chemicals;
- Un-combusted household waste;
- Laboratory wastes;
- Sewage solids that are untreated or have less than 10% solids by weight;
- Asbestos waste;
- Hazardous wastes as defined by 40CFR Part 261, and radioactive material, explosives, strong acids, untreated pathogenic waste, glycol, solvents, oily wastes, waste oil, greases, paints, chemical wastes, transformers, and packing material or associated equipment;
- Fuels, oil, transformers, paint, equipment and packing material;
- Glycol and solvents;
- Batteries; or

- CIP tailings, which have not been subjected to cyanide detoxification as required by Pogo's permit.

Any other materials that are to be disposed require prior written approval from the Alaska Department of Conservation (ACEC).

4.12 Monitoring and Checking

The Pogo DSTF Construction and Maintenance Plan, May 2014 outlines visual and geotechnical monitoring, as well as survey requirements for the DSTF to be performed by the Environmental Department. Surface Operators document amount of materials placed in DSTF and perform daily visual inspections that are documented in Dry stack Daily Inspection Log by the Site Services Supervisor. They also log any wildlife interactions as they occur and inform the Environmental Department.

4.13 Maintenance and Calibration

Monitoring of DSTF tailings and rock placed by Site Services Operations does not require the use of any instruments that require maintenance or calibration. Refer to the Pogo DSTF Construction and Maintenance Plan, May 2014 for the geotechnical monitoring requirements performed by the Environmental Department and/or consultants.

5. RELATED DOCUMENTS

Document Name	Document Number
DSTF Material Balance Update	
DSTF Year by Year 2014-2019	
Load Counts	
Dry stack Daily Inspection Log	

6. DEPARTURE FROM PROCEDURE

6.1 Notifications

Activities at Pogo which cause a greater amount of waste material to be treated and disposed of than contemplated in Section 1 of Pogo's Waste Management Permit No. 2011DB0012, are prohibited without prior written approval by ADEC.

The DSTF is limited to a maximum of 20 million tons of inert solid waste, consisting of approximately 12,500 tons per week of flotation tailings and approximately 10,000 tons per week of waste rock meeting the conditions in Pogo's Waste Management Permit No. 2011DB0012. Waste rock with a content greater than 0.5% sulfur or exceeding 600 mg/kg arsenic shall be classified as mineralized; whereas, waste rock below both of those criteria shall be classified as non-mineralized.

The Environmental Department must have prior written approval from ADEC before any planned activity causes a greater amount of waste material to be disposed of than is approved under Pogo's Waste Management Permit 2011DB0012, Section 1.5.7.

Pogo's Change Management Program will be utilized to assess (and approve) any change prior to seeking approval from ADEC.

The Environmental Department must notify ADEC:

- At least 60 days in advance if any planned modifications at Pogo significantly modify the DSTF (Waste Management Permit 2011DB0012 Section 1.5.7);
- If damage, or potential damage from settlement, ponding, leakage, or erosion could lead to an exceedance of Water Quality Standards or harm wildlife at the DSTF.
- Corrective actions may be initiated in accordance with Section 1.8 of the Pogo Waste Management Permit 2011DB0012.

6.2 Environmental and Legal Consequences

Failure to follow this SWP could lead to DSTF instability and possible slope that would negatively impact Pogo operations.

6.3 Consequnces to Employees

Failure to follow this SWP could result in unsafe work practices or conditions contributing to an incident possibly resulting in injury or death. Failure to follow this SWP could result in disciplinary action up to termination of employment.

1. PURPOSE

The purpose of this Safe Work Practice (SWP) is to provide technical requirements and operational guidelines for the Northern Star (Pogo) LLC Alaska Pollutant Discharge Elimination System (APDES) Permit, and the Waste Management permit requirements.

2. SCOPE

The Environmental Department is responsible for collecting the samples in accordance with the schedule provided in the APDES Permit AK0053341, the Pogo Mine Quality Assurance Plan (QAP), and the Pogo Mine Monitoring Plan. The SWP is applicable for sampling rivers and streams, wastewater conveyances, lakes, ponds, and shallow areas, such as wetlands or drainage ditches. This SWP should be used in conjunction with other Pogo project record documents as necessary.

3. DEFINITIONS

ADEC	Alaska Department of Environmental Conservation
APDES	Alaska Pollution Discharge Elimination System
COC	Chain of Custody
EDMS	Environmental Data Management System
GPS	Global Positioning System
IDW	Investigation-Derived Waste
EPA	Environmental Protection Agency
PPE	Personal Protective Equipment
SWP	Safe Work Procedure
QAP	Quality Assurance Plan
QC	Quality Control
USGS	United States Geological Survey

4. ROLES AND RESPONSIBILITIES

Role	Key Responsibilities
Environmental Manager	The Environmental Manager is responsible for APDES Permit provisions and requirements, as well as any updates or renewals associated with the permit and any required notifications to the state or federal agencies.
Environmental Personnel	Environmental personnel are responsible for following this SWP while collecting all APDES Outfall samples.
Pogo Expeditor	The Pogo expeditor is responsible for delivering the APDES surface water samples to the laboratory designated by the Environmental Department in a timely manner.

5. PROCEDURE

5.1 General Considerations

Potential hazards associated with the planned tasks should be thoroughly evaluated prior to conducting field activities.

It is preferred that personnel do not enter waterways to collect samples. However, if conditions require entering a waterway, personnel should use the United States Geological Survey (USGS) rule of thumb - do not wade into flowing water when the product of depth (in feet) and velocity (in feet per second) equals 10 or greater (USGS, variously dated). If flow data are unavailable, personnel should not exceed a water depth of knee height. Every attempt should be made to utilize a sampling device, such that personnel entry into the waterbody is avoided. A dock or bridge may be employed for sample locations a considerable distance from the shoreline. Water safety hazards and associated precautions should be thoroughly considered and understood prior to conducting sampling activities in the vicinity of surface water of any type (moving, still, or frozen).

Personnel will wear powder-free nitrile gloves while performing the procedures described in this SWP. Specifically, powder-free nitrile gloves will be worn while preparing and handling sample bottle-ware and during sample collection and packing.

Reusable field sampling equipment should be decontaminated in accordance with procedures described in this SWP prior to use.

Sampling activities are to be documented on Field Data Forms. Example Field Data Forms used during surface water sampling are provided as attachments to this SWP.

5.2 Sampling Procedure

This section describes approved operating procedures and methods associated with field documentation activities. If these procedures cannot be performed as written in this SWP, field personnel must contact the Pogo Environmental Manager to obtain approval for the deviation to the procedure prior to conducting sampling activities to the extent practicable. The Pogo Environmental Manager is responsible for determining whether the deviation has the potential to affect data reliability. Documentation of approved deviations will be recorded on the field data sheet.

Surface water samples will be collected at locations that are specified in APDES or Waste Management permits. Surface water samples will be collected prior to the collection of any sediment, benthic, or fish samples to avoid contamination of the sample by agitation of the bottom sediments. If possible, use a container large enough to collect samples for both field and laboratory analysis. Do not pre-rinse laboratory-provided, certified-clean, sample containers. The following devices are generally used during surface water sampling and monitoring:

- Laboratory-supplied sample bottle
- Dip sampler
- Water bottle sampler
- Water quality parameter measurement instrumentation
- Handheld or portable Global Positioning System (GPS), to identify sample location

In addition, the following equipment may be needed for surface water sampling:

- Peristaltic pump and associated tubing
- Ice/snow breaking and clearing equipment

5.2.1 Pre-Job Preparation

The sample collection personnel will verify that the following activities have been completed prior to mobilizing to the site:

a) Evaluate weather conditions and adjust equipment and plans accordingly.

b) Coordinate transportation to sample locations as necessary.

c) Obtain equipment necessary for completing the sampling activities (see Attachment Table 1 for an example checklist of equipment and materials needed for sampling).

d) Ensure appropriate laboratory-provided bottle-ware is available for both the required analyses and for quality control (QC) samples and that there has been appropriate coordination with the analytical laboratory.

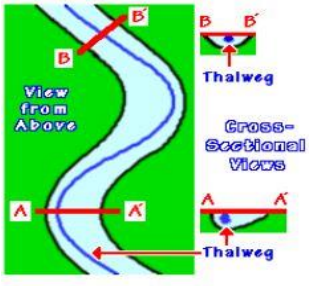
e) Obtain location and coordinates of the permit specified sampling location.

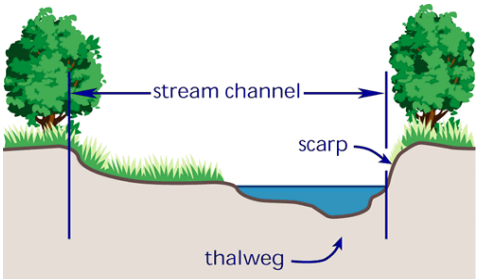
f) Conduct a site reconnaissance to identify points of entry/access limitations, health and safety concerns, and sample locations.

g) Review the *Pogo Water Meter Calibration SWP* if field parameters need to be collected as part of the surface water sampling.

5.2.2 Sampling Flowing Surface Waters (Rivers, streams, or drainage ditches)

Consult the applicable permit to determine sample collection location. If project-specific requirements do not specify a sampling location, the preferable sampling location of flowing water bodies is where the water is well mixed laterally and vertically. These locations are characterized by fast moving or turbulent waters. Sites immediately below riffle areas are generally representative of the entire flow. In the case of calmer waters, the preferred sampling location is the thalweg (area of highest flow rate).





a) Begin by selecting the farthest downstream sampling location. If possible, downstream samples are to be collected first, followed by upstream samples. This order minimizes the disturbance of bottom sediments impacting subsequent sample locations.

b) A single sample at mid-depth and the mid-point of the main current, conditions permitting, is adequate for most streams where there is good lateral and vertical mixing.

c) Prior to sample collection, measure the required field parameters at each sample location with water quality meters calibrated in accordance with the Pogo Water Meter Calibration SWP. Typically, the following water quality parameters are collected at each location. Consult the specific permit and/or special work instructions to identify required parameters.
   - Temperature
   - pH
   - Specific Conductivity
   - Turbidity

Measured field parameters will be recorded on the field data sheet.

5.2.3 Water Bottle Sampler or Dip Sampler

Whenever practicable, grab samples should be collected directly into a laboratory-supplied sample bottle which is referred to as a water bottle sampler. It may be necessary at times to utilize either water bottle sampler or a dip sampler during sample collection. A water bottle sampler is a certified clean or properly decontaminated collection vessel which is used to collect aliquots of sample water to transfer to laboratory supplied sample containers. A water bottle sampler may be preferred to collect surface water samples at a limited depth, in times or locations of low flow or at the surface. A dip sampler is a fixed length or extendable pole which can secure the laboratory-supplied sample bottle or intermediate collection vessel and allows the sampler to safely collect the sample without entering the body of water. When water bottle sampler is a laboratory-supplied sample bottle is unpreserved, proceed as follows.

a) Prior to sample collection inspect the sampling point for evidence of visible debris or material that may inadvertently impact the sample. Remove if present and document on the field data sheet. Samples should be collected as close to the same location as possible from one sampling event to the next.

b) Lower unpreserved sample container to the desired depth. Point mouth of sample container upstream/against the flow. Use caution not to disturb sediment during sample collection.

c) Allow the sample container to fill completely.

d) Remove the container from the water and secure the lid.

   Note: When using sample bottles containing preservatives, using a water bottle sampler, or using a dip sampler with an intermediate collection vessel, fill the clean unpreserved bottle as defined in steps a through c above, then follow the step below.

e) Immediately decant from the clean, unpreserved bottle or dip sampler into the sample bottle.

f) Add preservative if necessary.

g) Secure the lid.

h) Immediately place the sample in the sample cooler.

In the winter months, it may be necessary to remove ice prior to sample collection as described below:

i) Clear snow from an area of the ice large enough for the sampling equipment.

j) Drill or chisel a hole in the ice, periodically cleaning ice chips from the hole.

k) After breaking through the ice, cut an area large enough for proper sample collection.

l) If it is not possible to lower the dip sampler below the bottom of the ice to collect flowing water, remove three hole-volumes of water with a properly decontaminated container or laboratory-supplied sample bottle. Approximate this volume based on the dimensions of the hole cut through the ice and the ice thickness.

m) Follow steps a-g above for sampled collection.

Note: If a surface film or sheen is suspected (or visible), the surface of the water will be sampled by gently lowering the sample bottle horizontally into the water with the mouth of the bottle directed upstream, taking reasonable measures to avoid suspended/floating debris.

Non-certified clean containers used to retrieve water from the designated sampling location require proper decontamination as described below and in the *Pogo Quality Assurance Plan (Pogo QAP)* Section 4.7.3. These containers will also be used in the collection of field quality control samples as described below and in the *Pogo QAP* 5.1.3.

5.3 Discrete Samples at a Specified Depth

In the event the collection of a discrete sample at a certain depth is required (such as beneath formed ice or an epibenthic sample), a peristaltic pump and associated tubing should be used.

a) Use new, certified-clean, disposable Silastic®, Teflon®, Tygon®, or equivalent tubing.

b) Use dedicated tubing and inert weights at each sampling location. Inert weights must be constructed of solid PVC so there is no potential to cross-contaminate the sample.

c) Lower the weighted peristaltic pump tubing to the appropriate depth.

d) Once at the desired depth, turn on the pump and begin purging for approximately 1 to 2 minutes before sampling to allow three times the tubing capacity volume to be purged through the tubing.

e) Fill the appropriate certified-clean bottle-ware.

f) Secure the lid and complete the sample label.

g) Immediately place the sample in the sample cooler.

5.4 Sample Documentation

Field data forms to record daily activities, including sample collection and tracking information, will be maintained by the sampling team. Information will be entered onto the field data form by the appropriate field team member. Entries will be made in indelible ink.

In addition to the minimum requirements discussed in the *Pogo QAP* Section 6.6, the field data forms will contain the following:

a) Sample identification code and/or number.

b) Water depth and location of sample (e.g., surface, mid-depth).

c) Water characteristics (e.g., color, visible suspended solids, flow rate, ice).

d) Any change in sampling location from previous sampling events and reasons.

e) Description of any photographs should they be taken.

In addition to field data sheets, a paginated sampling field notebook is required for sampling. Record date, location, arrival time, weather conditions, and sample profile. Field parameters should be identical between the field notebook and field data sheets.

5.5 Investigation-Derived Waste

Investigation-Derived Waste (IDW) associated with sampling activities includes decontamination fluids, disposable sampling equipment, and disposable Personal Protective Equipment (PPE). Dispose of IDW in accordance with Pogo waste handling and disposal procedures.

5.6 Sample Handling, Packing, and Shipping

Samples will be marked, labelled, packaged, and shipped in accordance with the *Pogo QAP*. Sample labels will contain, at a minimum, the sample ID, sample collection date and sample collection time. Samples will be packed and shipped in order to meet the required hold times for analysis. Samples will be managed under the chain-of-custody (COC) procedures described in the *Pogo QAP* Section 4.6.1.

When packing samples for Energy Labs, line cooler with plastic bag (drum liner) and place all samples, ice, and gel ice in the bag. Make sure an address label is on each cooler. After the Expeditor signs COCs, they should be placed inside the cooler. Coolers should be taped closed in the Environmental field lab with custody seals attached (The air cargo handlers do not sign COCs). The Expeditor should have all other account info for shipping samples via GoldStreak, but the information is on a printed form and copies are kept in the field lab if needed.

5.7 Decontamination and Cleanup

Decontamination of sampling equipment will be performed in a manner consistent with the *Pogo QAP* Section 4.7.3.

6. MONITORING AND CHECKING

Field quality control (QC) samples include field blanks, equipment rinsate blanks, and field duplicate samples. Refer to the *Pogo QAP*, Section 5.1.3, for a description of common field QC samples, the associated collection method, and the applicable QC sample frequency.

7. MAINTENANCE AND CALIBRATION

Calibration of instruments used in collecting field parameters (i.e. YSI Meter) are performed before every sampling event (refer to *Water Meter Calibration SWP*). Maintenance is performed at regular intervals recommended by the manufacturer. This includes maintenance done by Environmental personnel on a monthly basis and an annual maintenance/calibration by manufactures' representative. Refer to the *Water Meter Calibration SWP* for calibration and maintenance forms.

8. RECORDS

Record Description	Record Location / Retention Responsibility	Minimum Retention Time
Chain of Custody and Analytical Results	Environmental Archives / Environmental Manager	5 years
Sampling Field Data Sheets	Environmental Archives / Environmental Manager	5 years
Pogo Mine Hach Turbidimeter Calibration Form	Environmental Archives / Environmental Manager	5 years
Pogo Mine YSI Meter Calibration Form	Environmental Archives / Environmental Manager	5 years
Instrument Maintenance Form	Environmental Archives / Environmental Manager	5 years

9. DEPARTURES FROM PROCEDURES

9.1 Notifications

9.1.1 Internal Notifications

During sample collection, if field parameters or sample collection issues are deemed unusual (i.e. the pH at Outfall 001) notification of supervisor is required immediately.

9.1.2 External Notifications

Exceedances of the effluent limitations of the APDES permit may require immediate reporting to ADEC, other exceedance require monthly reporting on the DMR.

9.2 Environmental and Legal Consequences

Non-compliance with Pogo's environmental permits such as APDES Permit No. AK0053341 could have a potentially adverse effect to the environment. Non-compliance with the Pogo QAP, or this SWP could result in loss of data integrity.

9.3 Consequences to Employees

Failure to follow this procedure could result in unsafe practices or conditions contributing to an incident possibly resulting in injury. In some instances, situations will dictate variances from this procedure. A variance shall only be given with approval from the Environmental Manager.

Failure to follow this procedure may result in an adverse effect to the environment which could lead to civil and/or criminal penalties for the company and those involved. Procedural failures may also adversely affect company performance records and NSR's public image.

10. RELATED DOCUMENTS

Document Name	Document Number
ADEC Waste Management Permit 2018DB0001	
ADEC APDES Permit AK0053341	
Pogo Mine Monitoring Plan	PGO-ENV-011-PLA
QAP – Quality Assurance Project Plan	PGO-ENV-039-PLA
Water Meter Calibration SWP	PGO-ENV-037-SWP
US Geological Survey, variously dated*, National Field Manual for the Collection of Water-Quality Data: US Geological Survey Techniques of Water-Resources Investigations, Book 9, Chaps. A1-A9.	
US EPA. Region 4, Surface Water Sampling. Document Number SESDPROC-201-R3, February 2013.	
US EPA Region 4, Wastewater Sampling. Document # SESDPRCO-306-R3. February 2013.	

11. APPENDICES

Appendix I - Table 1: Surface Water Sampling Equipment & Material Checklist

Appendix II - Surface Water Field Data Sheets

11.1 Appendix I - Table 1: Surface Water Sampling Equipment & Material Checklist

1.0 Table 1: Surface Water Sampling Equipment & Materials Checklist	
Item Description	**CHECK☐**
Health & Safety	
Nitrile gloves	
Hard hat	
Steel-toed boots	
Hearing protection	
Field first-aid kit	
Safety glasses	
US Coast Guard-approved flotation device	
Paperwork	
Sampling plan/Scope-of-Work/project guidance documents	
Location map, field data from previous sampling events	
Field data forms	
Chain-of-Custody forms and custody seals	
Equipment	
Laboratory-Supplied Sample Bottles	
Dip Sampler	
Ice Chisel or Ice Auger	
Peristaltic Pump	
Calibrated Water Quality Meters	
Sample Coolers	

11.2 Appendix II - Surface Water Field Data Sheets

Pogo Mine Surface Water Sampling Field Data Sheet

Arrival Time:		Channel Depth	inches
EDMS Site Number		Ice Depth	inches
EDMS Sample Identifier		Flow Conditions	
Date			
Time			
Profile			
Duplicate Sample Indentifier		Time	
Blank Sample Identifier		Time	

Field Preserved			
Field Filtered			
Field Parameters			
Lab- Preserved		Time	
Lab-Filtered		Time	
Lab-Parameters		Time	

Temperature		°C
DO-Dissolved Oxygen		mg/L
pH		s.u. (two readings ±0.1)
Specific Conductance		µS
Turbidity		NTU
Appearance		

Field Conditions	Indoors	Temperature	Skies	Wind

Field Equipment	YSI #	Turbidimeter #	Gloves	Bottles	Coolers	Dip Stick	DI Water

Lifejacket	PPE

Notes/Comments	
If Sample Not Collected Give Reason	
Field Team Members Signatures	

Profile 13s SurfaceWater — Energy Lab

Sample Bottle	Preservative	Bottles	Analytes	Bottles Check
1	NaOh >12 (green)	500 ml, dark poly	WAD Cn	
2	HNO3, pH <2 (red)	250 ml, red lid	Sb, As, Cd, Cu, Fe, Pb, Mn, Ni, Se, Ag, Zn (dissolved metals)	
3	HNO3, pH <2 (red)	250 ml, red lid	Sb, Ca, Cr, Mg (total metals,) Hardness	
4	None	1 liter, white poly	Conductivity Solids, Total Dissolved Alkalinity, Chloride, Fluoride, Sulfate Turbidity, Total Dissolved Solids	
5	H2SO4, pH <2 (yellow)	250 ml, white poly yellow lid	Nitrogen as Nitrate + Nitrite	

Profile 10a Outfall001 & NPDES001B - weekly — Energy Lab

Sample Bottle	Preservative	Bottles	Analytes	Bottles Check
1	NaOh >12	500 ml, dark poly	WAD Cn	
2	HNO3, pH <3	250 ml, white poly red lid	Cu,Pb, Mn (total metals)	

Profile 10b Outfall001 & NPDES001B - monthly — Energy Lab

Sample Bottle	Preservative	Bottles	Analytes	Bottles Check
1	None	1 liter, white poly	Turbidity,	
2	HNO3, pH <2	250 ml,white poly red lid	Cd, Hg, Zn (total metals), Hardness	

Profile 11a Outfall011 & WTP-FEED2 - weekly — Energy Lab

Sample Bottle	Preservative	Bottles	Analytes	Bottles Check
1	NaOh >12	500 ml, dark poly	WAD Cn	

Profile 11b Outfall011 & WTP-FEED2 - quarterly — Energy Lab

Sample Bottle	Preservative	Bottles	Analytes	Bottles Check
1	None	1 liter, white poly	TDS, Sulfate,	
2	HNO3, pH <2	250 ml, white poly red lid	As,Cd, Cu, Fe, Pb, Mn, Hg, Se, Zn (total metals), Hardness	

Profile 12a Outfall002 - Monthly — Pollen

Sample Bottle	Pre-Preserved	Bottles	Analytes	Bottles Check
1	Na2S2O3	125 ml, clear poly	Fecal Coliform	
2	HNO3, pH <2	250 ml, white poly red lid	As,Cd, Cu, Pb, Mn, Hg, Zn (total metals), Hardness	
3	None	1 liter, white poly	BOD 5-day, TSS,	
4	H2SO4, pH <2	250 ml, white poly	Nitrate+Nitirate as N	

Profile 12b STP002 - Quarterly — Pollen

Sample Bottle	Pre-Preserved	Bottles	Analytes	Bottles Check
1	None	1 liter, white poly	BOD 5-day, TSS	

SW01	LC North Fork	RTP	Flume #1
SW12	LC South Fork	RTP-SCW 5	Flume #2
SW15	LCD	RTP-SCW 6	Flume #3
SW41	DRYTOE	RTP-SCW 7	Flume #4
SW45		RTP-SCW 8	
		RTP-SCW 9	

WHOLE EFFLUENT TOXICITY (WET) TEST SAMPLE COLLECTION SAFE WORK PROCEDURE

1. PURPOSE

The purpose of this procedure is to establish a standard method for conducting annual Whole Effluent Toxicity sampling at Pogo Mine in accordance with AS 46.03 and to meet requirements set forth by the ADEC in Pogo Mine's APDES Permit No. AK0053341, section 1.7.

2. SCOPE

- The permittee must conduct chronic toxicity test on effluent samples from Outfall 001 annually prior to August 1.
- The permittee must conduct short-term tests with the water flea, Ceriodaphnia dubia (survival and reproduction test), and the fathead minnow, Pimephales promelas (larval survival and growth test).
- In addition, a split of each sample collected must be analyzed for the chemical and physical parameters required in Permit Part 1.7.2.
- The effluent collected for toxicity testing must be collected at the same time as the receiving water surface water monitoring (see Permit Part 1.7.3.1.).
- The permittee must confirm on the DMR for the month following receipt of the results that the toxicity test was conducted and whether any toxicity was found. The full toxicity test results will be included in the annual report due March 1 of the following year, as required in Permit Part 1.7.8.1 and 1.7.8.2.

3. ROLES AND RESPONSIBILITIES

Role	Key Responsibilities
Environmental Manager	Environmental Manager is responsible for APDES Permit provisions and requirements, as well as any updates or renewals associated with the permit and any required notifications to the state or federal agencies.
Environmental Coordinator / Specialist	The Environmental Coordinator/Specialist is responsible for contacting labs and expeditors, obtaining quotes and acquiring a PO for analytical work and transportation.
Environmental Technician	The Environmental Technician is responsible for preparing COCs, collecting and shipping samples, preparing and taking care of sampling equipment.
Pogo Expeditor	Pogo's Expeditor is responsible for delivering the WET Test water samples to the GoldStreak along with the appropriate COC and custody seal and for sending copies of Air Waybills to the Environmental Department in a timely manner.

4. DEFINITIONS AND ACRONYMS

ADEC	Alaska Department of Environmental Conservation
APDES	Alaska Pollutant Discharge Elimination System
COC	Chain of Custody
SWP	Safe Work Procedure
QAP	Quality Assurance Plan
CFS	Cubic Feet per Second
WET	Whole Effluent Toxicity

5. PROCEDURE

5.1 Transportation Logistics

- The WET Test sampling does not occur until mid-June; however, preparations need to begin in April. Testing must be conducted prior to August 1st so allow time for a second sample event if needed.
- Request a quote from Denver Boulder Couriers for forwarding WET Test coolers from Denver International Airport (DIA) to TRE Environmental Strategies. Contact City Delivery to deliver samples from Portland to TestAmerica Bioassay Laboratories

  Denver Boulder Couriers
  3229 Walnut St
  Boulder, CO 80301
  Ph: 303-571-5719
  info@dbcouriers.com

Melinda Martin
City Delivery Service
Ph: 541-926-7300
delivery@peak.org

- Request a quote for analytical work to be done through TRE Environment and TestAmerica Bioassay Laboratories. Rami Naddy is our project manager at TRE and Brett Muckey is our project manager at TestAmerica Bioassay Laboratories. The labs will send us coolers and sample containers for each sample, arrange for delivery of the coolers at least two weeks prior to the scheduled sampling.

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  1100 NE Circle Blvd
  Suite 310
  Corvallis, OR 97330
  Ph: 541.207.0995
  Brett.Muckey@TestAmericainc.com
- Send the laboratories a copy of APDES Permit No. AK0053341 Section 1.7 pages 8-10 for quote preparation. Prepare purchase order requests based on the quotes from TRE, TestAmerica, City Delivery Services and Denver Boulder Couriers.
- Notify Pogo Purchasing Manager and Expeditor of the scheduled sampling dates at least three weeks prior to the sampling event. The expeditor must take samples to the airport on Monday, Wednesday and Friday. Book GoldStreak airway bills at least one week in advance for sample shipments on the Tuesday, Thursday and Friday of the same week as sampling is scheduled to occur.
- Surface water sampling must be conducted in conjunction with the WET Testing. Plan to use the boat for the surface water sampling if the river flow is greater than 800 cfs. Prepare a helicopter request form through exploration or Aurora Aviation for the days of the testing in case of low river flow.
- At least one week in advance of WET Test make sure there is plenty of ice bottles to ship with the samples, 60 bottles of ice are recommended.

5.2 Sampling

- Prepare field data sheets, COC's, and container labels prior to the sampling event. Prepare 10a and 10b profiles for the split samples at Outfall 001. Prepare 13s profiles for the surface water sampling.
- WET samples must be collected Monday, Wednesday, and Friday mornings along with the split samples (profiles 10a and 10b) on Wednesday morning. Have all samples collected and packaged for the expediter by 11am. Surface water sampling usually takes place on Tuesday or Thursday.
- When collecting the cubitainers of effluent for the WET test be sure to rinse each cubitainer thoroughly at least three times. When filling, lift neck of cubitainer up make sure all the headspace is filled in each cubitainer. TestAmerica sends a 5-gallon cubitainer and TRE sends two smaller cubitainers for each day of sampling. Follow sampling plans and procedures outlined in the Pogo Mine QAP and the Pogo Mine Monitoring Plan.

5.3 Shipping Samples

- After the cubitainers have been filled, place them inside a drum liner in the center of the cooler and put 8-10 liters of ice, as evenly distributed as possible, on each side of the cubitainer. Cover the top of the cubitainer and ice with bubble wrap. DO NOT put bubble wrap between the ice and the cubitainer, water will not get cold enough.
- An address label goes on top of each cooler, a GoldStreak form as well as the custody seal (provided by each lab). After the expeditor signs COCs, the COCs are put into the coolers. The coolers are then taped shut and sealed with Custody Seals (the air cargo handlers do not sign COCs). The expeditor delivers the coolers to GoldStreak in Fairbanks.
- The Expeditor will, as soon as possible, scan and email copies of the Air Waybills to the Environmental Department. These will immediately be forwarded to the laboratories and their respective delivery services. The labs will notify Pogo Environmental when the samples are received.

6. MONITIORING AND CHECKING

Field quality control (QC) samples include field blanks, equipment rinsate blanks, and field duplicate samples. Refer to the Pogo QAP, Section 5.1.3, for a description of common field QC samples, the associated collection method, and the applicable QC sample frequency.

7. MAINTENANCE AND CALIBRATION

Calibration of instruments used in collecting field parameters (i.e. YSI Meter) is performed before every sampling event. Maintenance is performed at regular intervals recommended by the manufacturer. Calibration and maintenance are documented in the *Water Meter Calibration SWP*.

8. RECORDS

Record Description	Record Location / Retention Responsibility	Minimum Retention Time
Chain of Custody and Analytical Results	Environmental Archives / Environmental Manager	5 years
WET Field Data Sheet	Environmental Archives / Environmental Manager	5 years
Pogo Mine YSI Meter Calibration Form	Environmental Archives / Environmental Manager	5 years
Pogo Mine Turbidimeter Calibration Form	Environmental Archives / Environmental Manager	5 years
Instrument Maintenance Form	Environmental Archives / Environmental Manager	5 years

9. DEPARTURES FROM PROCEDURE

This SWP was written to comply with applicable laws and regulations pertaining to the collection of APDES Outfall Samples at Pogo Mine.

9.1 Notifications

During sample collection, if any unusual circumstances occur notification of supervisor is required immediately.

9.2 Environmental and Legal Consequences

Non-compliance with Pogo's environmental permits such as APDES Permit No. AK0053341 could have a potentially adverse effect to the environment. A permit exceedance may lead to Notice of Violation, or a Compliance Order by Consent.

9.3 Consequences to Employees

Failure to follow this procedure could result in unsafe practices or conditions contributing to an incident possibly resulting in injury. In some instances, situations will dictate variances from this procedure. A variance shall only be given with approval from the Environmental Manager.

Failure to follow this procedure may result in an adverse effect to the environment which could lead to civil and/or criminal penalties for the company and those involved. Procedural failures may also adversely affect company performance records and NSR's public image.

10. RELATED DOCUMENTS

Document Name	Document Number
ADEC Waste Management Permit 2018DB0001	
Pogo Mine Monitoring Plan	PGO-ENV-011-PLA
Pogo QAP - Quality Assurance Plan	PGO-ENV-039-PLA
YSI Professional Plus User Manual	
YSI Professional Plus Quick-Start Guide	

11. APPENDICES

Appendix I - WET Test Filed Data Sheet

Appendix II - Chain of Custody Templates (Eurofins TestAmerica, Seattle)

Appendix III - Chain of Custody Templates (Eurofins TestAmerica, ASL (Corvallis)

11.1 Appendix I - WET Test Filed Data Sheet

Pogo Mine Effluent Sampling Field Data Sheet

Arrival Time:			
EDMS Site Number		Discharge in progress?	
EDMS Sample Identifier			
Date			
Time			
Profile			
Duplicate Sample Indentifier		Time	
Blank Sample Identifier		Time	

Field Preserved			
Field Filtered			
Field Parameters			
Lab- Preserved		Time	
Lab-Filtered		Time	
Lab-Parameters		Time	

References:

Outfall Sample Collection SOP
QualTrax # XXXX

Water Meter Calibration SOP
Qualtrax XXXX

Temperature				°C
DO-Dissolved Oxygen				mg/L
N03-Nitrates				mg/L
pH				s.u. (two readings ±0.1)
Specific Conductance				µS
Turbidity				NTU
Appearance				

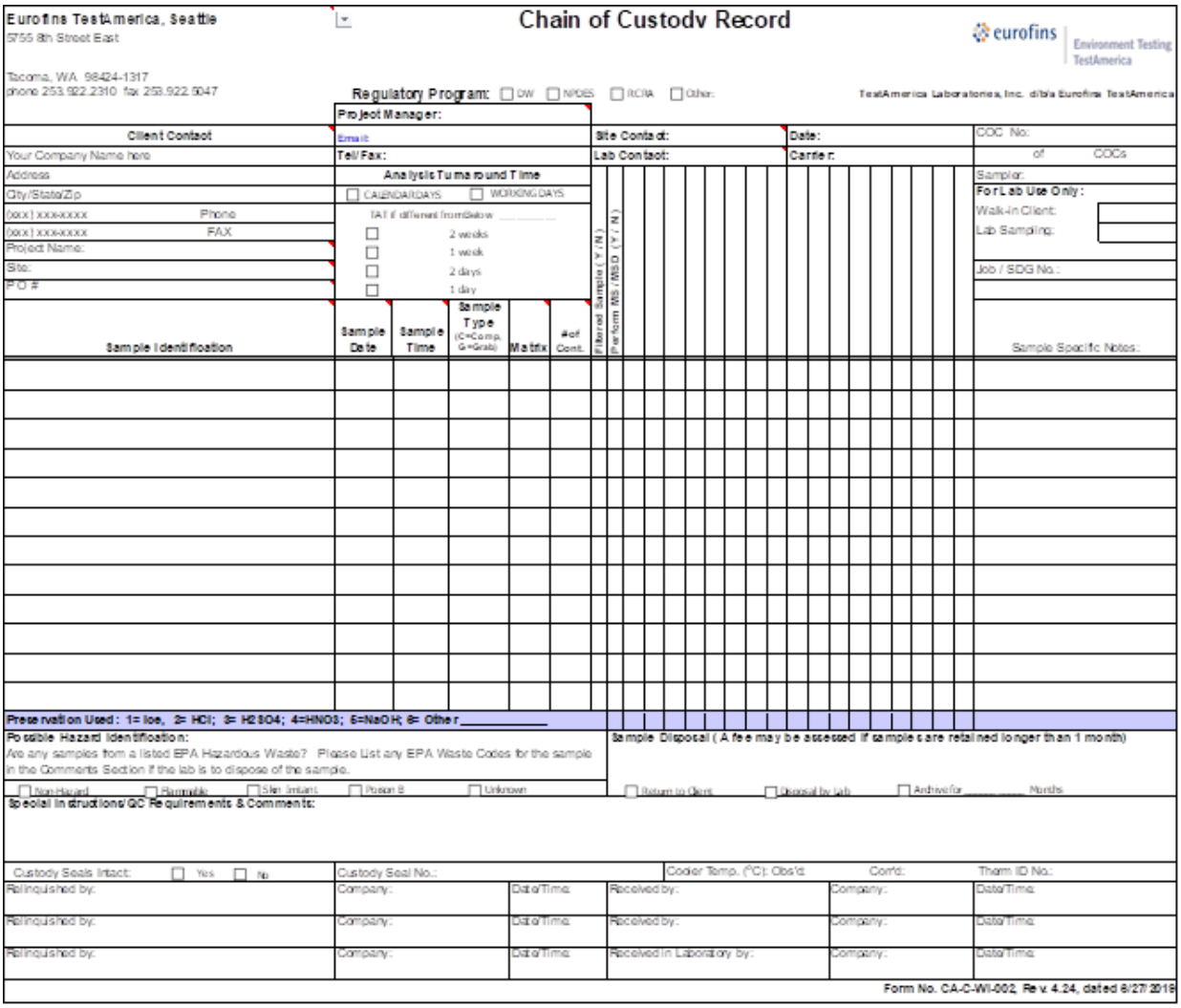
Field Conditions	Indoors	Temperature	Skies	Wind

Field Equipment	YSI #	Turbidimeter #	Gloves	Bottles	Coolers	Dip Stick	DI Water

Lifejacket	PPE

Notes/Comments	
If Sample Not Collected Give Reason	
Field Team Members Signatures	

11.2 Appendix II - Chain of Custody Templates (Eurofins TestAmerica, Seattle)



Eurofins TestAmerica, Seattle
5755 8th Street East
Tacoma, WA 98424-1317
phone 253.922.2310 fax 253.922.5047

Chain of Custody Record

eurofins | Environment Testing TestAmerica

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc. d/b/a Eurofins TestAmerica

Client Contact	Project Manager:	Site Contact:	Date:	COC No:
Your Company Name here	Email:	Lab Contact:	Carrier:	of COCs
Address	Tel/Fax:	Analysis Turnaround Time		Sampler:
City/State/Zip		☐ CALENDAR DAYS ☐ WORKING DAYS		For Lab Use Only:
(xxx) xxx-xxxx Phone		TAT if different from Below		Walk-in Client:
(xxx) xxx-xxxx FAX		☐ 2 weeks		Lab Sampling:
Project Name:		☐ 1 week		
Site:		☐ 2 days		Job / SDG No.:
PO #		☐ 1 day		

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Sample Specific Notes:

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other _____

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

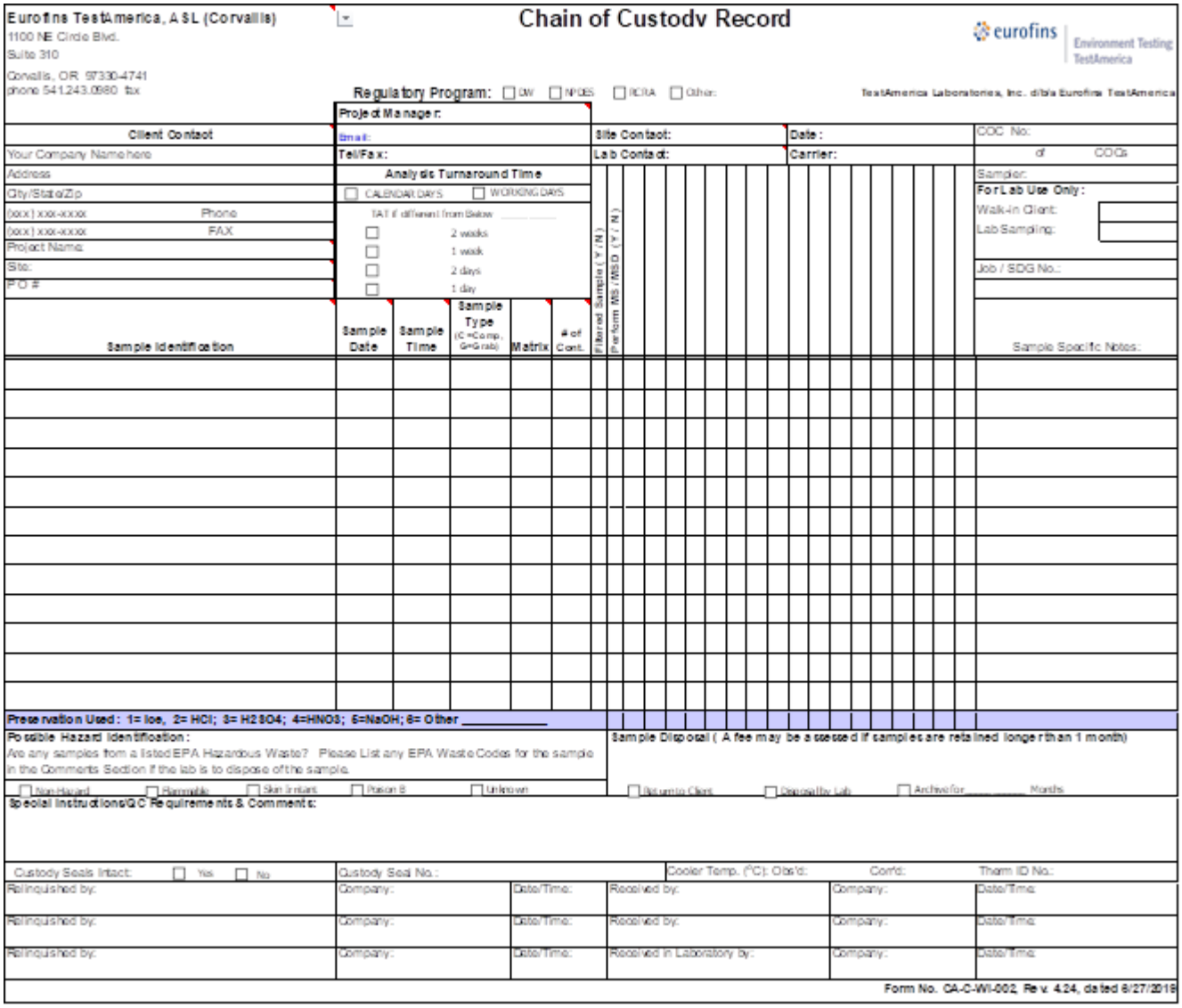
Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return to Client ☐ Disposal by Lab ☐ Archive for _____ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No	Custody Seal No.:		Cooler Temp. (°C): Obs'd:	Corr'd:	Therm ID No.:
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Form No. CA-C-WI-002, Rev. 4.24, dated 8/27/2018

11.3 Appendix III - Chain of Custody Templates (Eurofins TestAmerica, ASL (Corvallis)



Eurofins TestAmerica, ASL (Corvallis)
1100 NE Circle Blvd.
Suite 310
Corvallis, OR 97330-4741
phone 541.243.0980 fax

Chain of Custody Record

eurofins | Environment Testing TestAmerica

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc. d/b/a Eurofins TestAmerica

Client Contact	Project Manager:	Site Contact:	Date:	COC No:
Your Company Name here	Email: / Tel/Fax:	Lab Contact:	Carrier:	of COCs
Address	Analysis Turnaround Time			Sampler:
City/State/Zip	☐ CALENDAR DAYS ☐ WORKING DAYS			For Lab Use Only:
(xxx) xxx-xxxx Phone	TAT if different from Below			Walk-in Client:
(xxx) xxx-xxxx FAX	☐ 2 weeks			Lab Sampling:
Project Name:	☐ 1 week			
Site:	☐ 2 days			Job / SDG No.:
PO #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)																Sample Specific Notes:

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other _____

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for _____ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No	Custody Seal No.:		Cooler Temp. (°C): Obs'd:	Corr'd:	Therm ID No.:
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Form No. CA-C-WI-002, Rev. 4.24, dated 6/27/2018

1. PURPOSE

The purpose of this Safe Work Procedure (SWP) is to assure that Pogo personnel conducting annual snow surveys at Pogo Mine in accordance with standard methods outlined in the *United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Snow Survey Sampling Guide* (see attachment) and are prepared and working in a safe manner.

2. SCOPE

As part of the Alaska Department of Environmental Conservation (ADEC) Waste Disposal Permit, Pogo is required to "monitor process water management by accounting for water discharged into or withdrawn from the RTP (Recycle Tailings Pond), RTP water recycled to the mill, and water treated and discharged." As part of that requirement, the Pogo Fluid Management Program, Section 10.1.1 of the Pogo Quality Assurance Plan (QAP) and section mandate annual collection of snow cover measurements in the RTP watershed for depth and density information. For data consistency, this monitoring event occurs in late March.

3. ROLES AND RESPONSIBILITIES

Role	Key Responsibilities
Environmental Manager	The Environmental Manager is responsible for APDES Permit provisions and requirements, as well as any updates or renewals associated with the permit and any required notifications to the state or federal agencies.
Environmental Personnel	Environmental personnel are responsible for following this SWP while collecting all APDES Outfall samples.
Pogo Expeditor	The Pogo expeditor is responsible for delivering the APDES surface water samples to the laboratory designated by the Environmental Department in a timely manner.

4. DEFINITIONS AND ACRONYMS

ADEC	Alaska Department of Environmental Conservation
APDES	Alaska Pollution Discharge Elimination System
COC	Chain of Custody
EDMS	Environmental Data Management System
GPS	Global Positioning System
IDW	Investigation-Derived Waste
EPA	Environmental Protection Agency
PPE	Personal Protective Equipment
SWP	Safe Work Procedure
QAP	Quality Assurance Plan
QC	Quality Control
USGS	United States Geological Survey

5. PROCEDURE

Accuracy is essential during the snow survey. Small errors in snow sampling over an entire watershed can cause large errors in the snowmelt and water forecast. Errors not only affect current survey reports but also analyses of archival data in future years. Special care must be taken in reading measurements to the nearest half inch.

5.1 Preparation

a) Check all equipment before leaving the field office.
b) See that all tubes are properly silicone or waxed.
c) Check coupling threads to make sure they are clean, and screw together without binding. If the threads are dry, get some anti-seize lubricant from the maintenance shop and put on threads.

d) Check sampling kit for the following:
- Matching sampling tube sections
- Spanner wrenches
- Thread protector
- Driving wrench
- Screwdriver
- Field data notebook or sheets (printed on waterproof paper)
- Pencil
- Weighing scale and cradle
- Snow course map
- GPS unit
- First aid kit
- Snow survey sampling guide (for reference, troubleshooting, etc.)
- Extra batteries
- Camera
- Radio

e) Check over snow traveling equipment, i.e.: snowshoes, skis, etc.

f) Check clothing and make sure it is adequate for weather conditions.

5.2 Snow Sampling Procedures

5.2.1 Step 1

Check the location of the first snow sampling point on the map. There are three permanent snow courses in the Liese Creek watershed: L1 (south aspect), L2 (north aspect), and L3 (west aspect). Proceed to the first sampling location using the pre-programmed GPS unit as a guide as listed in Table 1. While approaching the sampling location do not walk in the sampling location and disturb the snowpack as little as possible. When snow conditions indicate, use snowshoes to keep snowpack compaction to a minimum.

Table 1: Snow Course Coordinates

Snow Station	Latitude	Longitude	Elevation
L1-2800	N64.45637	W144.88580	2800
L1-2600	N64.45477	W144.88880	2593
L1-2500	N64.45445	W144.89032	2504
L1-2350	N64.45380	W144.89120	2350
L2-2800	N64.44687	W144.89610	2796
L2-2700	N64.44733	W144.89750	2760
L2-2600	N64.44833	W144.89777	2675
L2-2400	N64.44908	W144.89692	2575
L2-2200	N64.45005	W144..89793	2286
L2-2000	N64.45125	W144.89868	2070
L2-1900	N64.45180	W144.89845	1954
L3-3600	N64.44328	W144.85150	3585
L3-3500	N64.44348	W144.85513	3512
L3-3400	N64.44335	W144.85785	3368
L3-3200	N64.44330	W144.86087	3189
L3-3000	N64.44353	W144.86538	2980
L3-2800	N64.43938	W144.86858	2800
L3-2600	N64.44502	W144.87223	2610

5.2.2 Step 2

Assemble sampling tubes by screwing them together hand tight (do not use wrenches). Line up the depth numbers on the sides of the snow tube sections for more accurate readings. Also, be careful not to cross-thread sections. Use both sections of tubing and leave accessory weights on the cradle in order to read the weight on the scale. Use the thread protector on top section of tubing.

5.2.3 Step 3

Fill in heading portion of the Field Data Sheet. This includes sample station, GPS coordinates, altitude, sampler(s), and date/time. Use 24-hour time formats.

5.2.4 Step 4

Before taking a sample, look through the tube to make sure it is clean and free of dirt, vegetation, and snow. Always look through the end with the tread protector, keeping the cutting edge away from you. Place the sampling tube on the weighing cradle and measure the weight of the empty clean sampling tube. Record the weight of empty tube on field data sheet.

5.2.5 Step 5

Hold the sampling tube vertical and push it down through the snow to ground level. If there is no snow at the sampling point, record a zero in the snow depth column. Do not move to an alternate location. If snow depth varies at the sampling point, try to take a collective sample of varying depths.

5.2.6 Step 6

Read the depth of snow on the tube to the nearest half inch. Record the reading on the field data sheet.

5.2.7 Step 7

Push the tube down into the moss or dirt an extra inch, to ensure collection of the entire snow column. Turn the tube at least one turn to the right to cut the core loose from the earth. Slowly and carefully pull the tube up, look through the slots in the tube, and measure the length of the snow core to the nearest half inch minus debris. Record the reading on the field data sheet. If there is just snow in the bottom of the tube, reinsert the tube at an undisturbed, nearby location and try again. If there is no vegetative debris or soil at the bottom of the tube, it probably means that you do not have a full snow column in your tube.

5.2.8 Step 8

Inspect the cutter end of sampling tube for dirt, moss, or litter. With gloves on, use a screwdriver to carefully remove all litter from the end of the tube and cutter. Throw dirt far enough from the sampling point to prevent creating melt holes at the sample location. Correct the reading for snow depth and core length by subtracting the distance driven into the soil or vegetation. Record the snow core length to the nearest half-inch.

5.2.9 Step 9

Carefully balance the sampling tube containing the snow core on the weighing cradle. Suspend the sampling tube in the air making sure it is not swinging or touching anything. If conditions are windy, be sure to point the tube into the wind. Take weight reading from scale and record it on the field data sheet. The scale's units are inches of water.

5.2.10 Step 10

Lift the tube from the cradle and turn the cutter end up. Tap the tube against a soft surface such as plastic on a snowshoe, your hand, or leg to remove the snow core. Do not tap on side of tube with hard objects as this can damage the tube. Sweep the tube with brush if snow does not come out. Inspect the inside of the tube to make sure all snow has been removed. In order to get a good average, obtain ten measurements at each sampling point.

5.2.11 Step 11

All readings at a single sample point should be similar to each other and not vary more than five percent. If the difference is more than five percent, take another sample. If readings vary due to ponded water, differential snowmelt, brush, drifting, etc., note the cause under the "remarks" section and continue.

5.2.12 Step 12

Measure and sample the stations along the snow course using the same methods to ensure an accurate survey.

5.2.13 Step 13

Before leaving each sample point and finally before leaving the snow course inspect all field data sheets. Make sure all sampling points were sampled and check all equipment to make sure nothing was lost or dropped.

5.3 Troubleshooting

See pages 26 through 32 of the USDA Snow Survey Sampling Guide for techniques to use under special conditions such as snow freezing in tubes, very shallow snow, very deep snow, etc.

5.4 Calculations

All measurements must be taken in the field. Calculations can be conducted in the field during nice weather or they can be done after returning to headquarters in inclement weather. Field calculations need to be thorough enough, however, to determine the uniformity of the data (Step 11).

5.4.1 Step 1

Subtract weight of empty tube from weight of tube and core to get water content. Record this number on the field data sheet.

Example:

Weight of Tube and Core (Inches)	Weight of Empty Tube (Inches)	Water Content (Inches)
9.5	3.5	6.0

5.4.2 Step 2

Divide the water content in inches by the depth of the snow to get density.

Example: 6.0in/25.0in = 24%

Depth of Snow (Inches)	Length of Core (Inches)	Weight of Tube and Core (Inches)	Weight of Empty Tube (Inches)	Water Content (Inches)	Density (Percent)
25	17	9.5	3.5	6.0	24

5.4.3 Step 3

Create a row in the field data sheet table for a total and average in each column. Add all figures in each column to get the total. Divide the total by the number of samples to get an average.

Example:

#	Depth of Snow (Inches)	Length of Core (Inches)	Weight of Tube and Core (Inches)	Weight of Empty Tube (Inches)	Water Content (Inches)	Density (Percent)
1	25.0	17.0	9.5	3.5	6.0	24.0
2	21.5	16.0	7.5	3.5	4.0	18.6
3	20.0	13.5	8.0	3.5	4.5	22.5
Total	**66.5**	**46.5**			**14.5**	**65.1**
Avg.	**22.17**	**15.5**			**4.83**	**21.7**

5.4.4 Step 4

Enter all data into Snow Survey Data spreadsheet attached to this SWP. It can also be found at G:\Private\6. Monitoring\Snow Survey.

6. MONITORING AND CHECKING

As per the QAP, internal auditing of sample collection takes place at regular intervals. Collection of field parameters is performed during sample collection, and any unusual circumstances noted on the sample Field Data Sheets.

7. MAINTENANCE AND CALIBRATION

Proper care of sampling equipment can make the difference between a good data and poor data. It will also make it easier and more efficient for the sampler to conduct the survey. Following are a few points to consider:

1. Handle equipment carefully. A full set of snow survey tubes and equipment is very expensive and rather delicate.
2. Do not cling to sampling tubes while working on steep slopes. A bend in the tubing can create sampling issues in the future.
3. Keep the sampling tubes clean and covered with silicone or wax. This keeps snow from adhering to the tubes and prevents corrosion. Keep a small amount of anti-seize lubricant on the tube threads to allow easy coupling.
4. Ice and rock have similar properties. Make sure you are driving the tube through ice and not rock before exerting downward pressure.
5. Keep the cutter sharp, true to diameter, and the tube straight. If something is broken or bent, make sure to obtain a replacement for the following survey.
6. Before storing the sampling equipment, make sure all parts are dry and free of water. Cover all parts with a fine layer of silicone or wax to prevent rusting, corrosion, etc. Cover tube threads with anti-seize lubricant. Prior to storage, remove the batteries from the scale.

8. RECORDS

Record Description	Record Location / Retention Responsibility	Minimum Retention Time
Pogo Mine Snow Survey and Field Data Sheet	Environmental Archives / Environmental Manager	5 years

9. DEPARTURES FROM PROCEDURES

9.1 Notifications

During sample collection, if any unusual circumstances occur, notification of supervisor is required immediately.

9.2 Environmental and Legal Consequences

Non-compliance with Pogo's environmental permits such as the ADEC Waste Management Permit 2011DB0012, could have a potentially adverse effect to the environment. A permit exceedance may lead to Notice of Violation, or a Compliance Order by Consent.

9.3 Consequences to Employees

Failure to follow this procedure could result in unsafe practices or conditions contributing to an incident possibly resulting in injury. In some instances, situations will dictate variances from this procedure. A variance shall only be given with approval from the Environmental Manager.

Failure to follow this procedure may result in an adverse effect to the environment which could lead to civil and/or criminal penalties for the company and those involved. Procedural failures may also adversely affect company performance records and NSR's public image.

10. RELATED DOCUMENTS

Document Name	Document Number
ADEC Waste Management Permit 2018DB0001	
Pogo Mine Monitoring Plan	PGO-ENV-011-PLA
NRCS Snow Survey Sampling Guide: http://www.wcc.nrcs.usda.gov/factpub/ah169/ah169.htm	

11. APPENDICES

Appendix I - Pogo Mine Snow Survey Field Data Sheet

Appendix II - USDA Natural Resources Conservation Service Snow Survey Sampling Guide

11.1 Appendix I - Pogo Mine Snow Survey Field Data Sheet

POGO MINE SNOW SURVEY

FIELD DATA SHEET

(after SCS-EN-708 12-79)

Snow Course __**Liese Creek**_____

Drainage Basin __**Goodpaster**_____ State **Alaska**

Sample Station _____Coordinates_____ Altitude (ft.) _____

Sampler _____ Note Taker _____

Date _____Began _____Ended _____ (use 24-hour time)

Sample Number	Depth of Snow Inches	Length of Core Inches	Weight of Tube and Core	Weight of Empty Tube	Water Content (Ounces)	Water Content (Inches)	Density Percent	Remarks (see reverse)

No. of tube sections used _____ Was a driving wrench used? _____

No. _____of _____ sheets.

Comp. by _____

Checked by_____

Field conditions and other notes: _____

_____

_____

11.2 Appendix II - USDA Natural Resources Conservation Service Snow Survey Sampling Guide

United States Department of Agriculture

Soil Conservation Service

Agriculture Handbook Number 169

Snow Survey Sampling Guide

Ready Reference

1

Snow Survey Sampling Guide

The purpose of this guide is to promote efficient and accurate snow surveying and to establish uniform sampling procedures.

It is a training and reference guide designed for snow surveyors who use sampling equipment to measure snow accumulation. It explains sampling and recording procedures essential for accurate forecasts of the Nation's water supplies.

Importance of accuracy

Accuracy is essential. A small error in snow sampling can produce a large error in the water supply forecast. An error in measurement affects not only current reports but also analyses of archival data in future years.

Take special care to avoid error while reading snow depth and tube weight. Be sure the core sample represents the full depth of the snow.

Care of sampling equipment

Taking good care of your sampling equipment can make the difference between a good survey and a poor one.

1. Handle the equipment carefully to prevent damage. A four-section sampling set costs more than $500.

2

2. Do not cling to the sampling tubes while sampling on steep slopes.

3. Keep the sampling tubes clean and covered inside and out with a thin coating of spray silicone or wax. A coating keeps the snow from adhering to the tube and prevents corrosion.

4. Ice and rock feel and sound similar when struck by the sampling tube. Before you exert pressure, be sure you are striking ice.

5. Keep the cutter sharp and the orifice true to its original diameter. If the cutter is broken or badly worn, ask for a replacement.

Checking equipment

Before leaving headquarters—

1. See that tubes are properly siliconed or waxed.

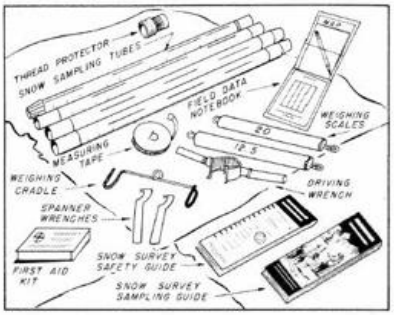
2. Make sure the coupling threads are clean and that all the tube sections screw together without binding.

3. Check the sampling kit for the following items:
   - Sampling tube sections that match
   - Spanner wrenches
   - Thread protector
   - Driving wrench (optional)
   - Field data notebook (SCS-EN-708)
   - Pencil
   - Weighing scale and cradle
   - Snow course map

3

- Measuring tape
- Snow Survey Safety Guide
- First aid kit
- Snow Survey Sampling Guide

Snow Sampling Kit



4. Check your oversnow traveling equipment for:
   - Goggles
   - Skis—running surface, binding, poles, climbers
   - Snowshoes—varnish coating, webbing, bindings
   - Oversnow vehicle—fuel and oil (see operating manual)
5. Check your clothing and that of your companions. See Snow Survey Safety Guide.

It is much easier to check these items at headquarters, where replacements are available, than at the snow course.

4

Snow sampling procedures

Step 1
Check the location sketch map of the snow course for sampling point No. 1. Do not drive the snow machine on the snow course. Do not walk on the snow course without snowshoes or skis. Keep walking to a minimum.

5

Step 2
Assemble sampling tube, screwing sections together handtight (no wrenches). Make sure the numbers run consecutively throughout the length. Use three or more sections of tubing unless the scale has been adjusted for light weights or accessory weights are added. Add thread protector to top section of tubing.

6

Step 3
Fill in heading on field note.

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
SCS-EN-708
12-79

FEDERAL-STATE-PRIVATE
COOPERATIVE SNOW SURVEYS

Snow Course Blizzard Ridge
Drainage Basin Missouri-Gallatin State Montana
Sampler G. Clagett Note Taker P.E. Farnes
Date Feb. 28, 1984 Began 1:00 p.m. Ended ____ p.m.

Sample Number	Depth of Snow Inches	Length of Core Inches	Weight of Tube and Core	Weight of Empty Tube	Water Content Inches	Density Percent	Remarks (See reverse)
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
(10)							Total
(10)							Average

No. of tube sections used. _____
Was driving wrench used? _____
No. 1 of ___ sheets. Comp. by _____ Checked by _____

7

Step 4
If there is no marker at sampling point No. 1, find the point by measuring the correct distance from the snow course end marker, following directions shown on the snow course map.

One surveyor should carry the sampling tube and headend of tape. The second surveyor should carry the scale and notebook and hold the rear end of the tape. The second surveyor sights the first surveyor on line of the course with the next marker.

8

Step 5
Before taking a sample, look through the tube to check for cleanliness. Hold the sampling tube away from your eye, cutter end up.

9

Step 6
Hold the sampling tube vertically (cutter end down) and drive it to the ground surface. Wear gloves to keep the tube cool and to make sampling easier. Be sure the cutter penetrates to the ground surface.

10

Step 7
Before raising the tube, read the depth of snow to the nearest one-half inch. Record the reading.

11

Step 8
Turn tube at least one turn to right to cut core loose from earth. Carefully raise tube, look through slots, and read core length to the nearest one-half inch.

Call reading to the recorder.

Raise tube carefully out of snow.

Note: Core length should be at least 90 percent of the snow depth except in snow of very low density or mushy snow. If it isn't, retake the sample or explain any deviation under "Remarks."

Step 9
Inspect cutter end of tube for dirt or litter.

12

Step 10
With gloves on, use a knife, can opener, or other tool to carefully remove soil and litter from the cutter and tube. Throw the debris or litter several feet (15 feet or more) away from sampling point. This prevents the formation of melt holes at the sampling point.

Correct the reading for snow depth and core length by subtracting the distance driven into soil or litter.

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FEDERAL-STATE-PRIVATE
COOPERATIVE SNOW SURVEYS

Snow Course Blizzard Ridge
Drainage Basin Missouri-Gallatin State Montana
Sampler G. Clagett Note Taker P.E. Farnes
Date Feb. 28, 1984 Began 1:00 p.m. Ended ____ a.m. p.m.

Sample Number	Depth of Snow Inches	Length of Core Inches	Weight of Tube and Core	Weight of Empty Tube	Water Content Inches	Density Percent	Remarks (Use reverse)
1	(94)	(92)					GNF Damp

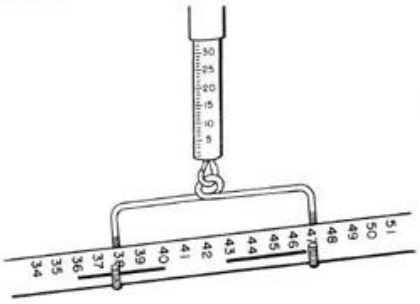
13

Record data as follows:

Record depth of snow to nearest one-half inch (94 inches, circled above).

If sampling point is bare, record a zero in snow-depth column. Do not move away from sampling point to find a spot with snow.

Record length of core to nearest one-half inch (92 inches).



Step 11
Carefully balance the sampling tube containing the core on the weighing cradle.

Never hold the weighing scale with hand around barrel. Suspend it like a pendulum from a ski pole.

If windy, point the tube into the wind.

To ensure an accurate reading, gently tap the scale to be sure it is not sticking or binding.

14

Step 12
Read the weight of tube and core from the graduations on the scale. The scale is marked in inches of water.

Caution: Scales of 12-½-foot-tube capacity have graduations equal to 1 inch. Scales of 20-foot-tube capacity have graduations equal to 2 inches.

15

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FEDERAL-STATE-PRIVATE
COOPERATIVE SNOW SURVEYS

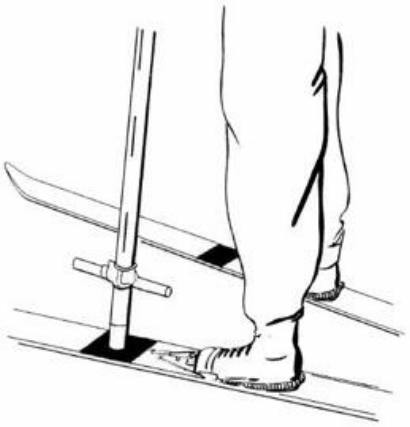
Snow Course Blizzard Ridge
Drainage Basin Missouri-Gallatin State Montana
Sampler G. Clagett Note Taker P.E. Farnes
Date Feb. 28, 1984 Began 1:00 p.m. Ended a.m. p.m.

Sample Number	Depth of Snow Inches	Length of Core Inches	Weight of Tube and Core	Weight of Empty Tube	Water Content Inches	Density Percent	Remarks (See reverse)
1	94	92	62½				GNF Damp

Step 13
Record the weight of the tube and core to the nearest one-half inch (62-½ inches) when using scales for 12-½-foot tubes and to the nearest inch when using scales for 20-foot tubes.

When the primary snowpack area of a watershed normally contains snow of low water content or very low density, or both, it is desirable to read the 12-½-foot scale to the nearest one-tenth inch.

16



Step 14
Lift the tube from the cradle and turn cutter end up. Tap the tube against a rubber pad on the ski or snowshoe to remove the snow core. Inspect the inside to see that all snow has been removed.

Note: A well-siliconed or waxed tube helps in removing the core.

17

Step 15
Weigh the empty sampling tube. The weight of the empty tube must read greater than zero on the scale. If using a driving wrench, be sure to leave it attached when weighing the empty tube and when weighing the tube and core of snow.

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FEDERAL-STATE-PRIVATE
COOPERATIVE SNOW SURVEYS

Snow Course Blizzard Ridge
Drainage Basin Missouri-Gallatin State Montana
Sampler G. Clagett Note Taker P.E. Farnes
Date Feb. 28, 1984 Began 1:00 p.m. Ended a.m. p.m.

Sample Number	Depth of Snow Inches	Length of Core Inches	Weight of Tube and Core	Weight of Empty Tube	Water Content Inches	Density Percent	Remarks (See reverse)
1	94	92	62½	35	27⅞		GNF Damp

Step 16
Record the weight of the empty tube to the nearest one-half inch or one-tenth inch for 12-½-foot tubes and to the nearest 1 inch for 20-foot tubes.

Check weight of the empty tube at least every fifth sample because small particles of water or snow often cling to the inside and outside of the tube. Checking helps make the sampling more accurate.

Whenever sections of tube are put on or taken off during the sampling, obtain a new empty weight.

Step 17
Subtract the weight of the empty tube from the weight of the tube and core to obtain the water content.

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FEDERAL-STATE-PRIVATE
COOPERATIVE SNOW SURVEYS

Snow Course Blizzard Ridge
Drainage Basin Missouri-Gallatin State Montana
Sampler G. Clagett Note Taker P.E. Farnes
Date Feb. 28, 1984 Began 1:00 p.m. Ended ____ p.m.

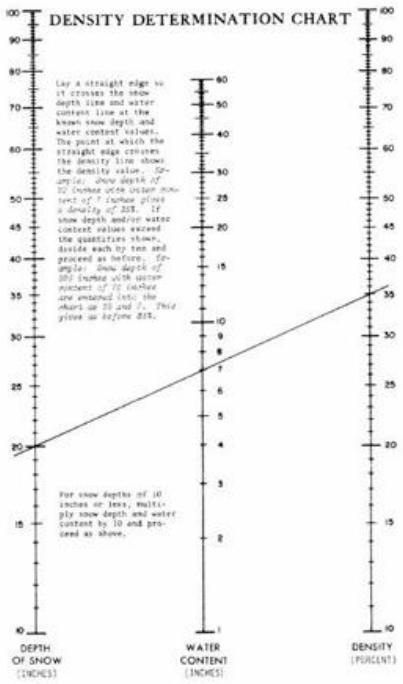
Sample number	Depth of Snow Inches	Length of Core Inches	Weight of Tube and Core	Weight of Empty Tube	Water Content Inches	Density Percent	Remarks (See reverse)
1	94	92	625	35	27½	(29)	GNF Dump

Step 18
To obtain the density, divide the water content by the depth of snow or use the density determination chart on page 21. Record density to nearest whole percent.

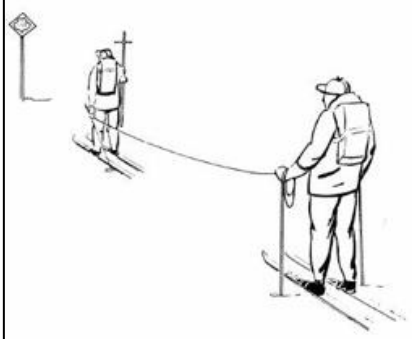
Ordinarily, density of individual samples should not vary more than 3 percent unless site conditions are not uniform. If the difference is more than 5 percent, take another sample.

If density varies because of ponded water, differential snowmelt, brush, and the like, note cause under "Remarks."

20



21



Step 19
Measure and sample the remaining points shown on the snow course map.

22

Step 20
Before leaving the snow course, both surveyors must inspect the notes. Add the figures in the depth-of-snow column and divide the total by the number of sampling points to get the average depth. Add the figures in the water-content column and divide the total by the number of sampling points to obtain the average water content to the nearest tenth of an inch.

Note: The number of sampling points includes those with zero depth. See completed set of notes on pages 24 and 25. Fill in checklist on back of field notes, adding comments about other conditions.

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FEDERAL-STATE-PRIVATE
COOPERATIVE SNOW SURVEYS

Snow Course Blizzard Ridge
Drainage Basin Missouri-Gallatin State Montana
Sampler G. Clagett Note Taker P.E. Farnes
Date Feb. 28, 1984 Began 1:00 p.m. Ended 2:35 p.m.

Sample Number	Depth of Snow Inches	Length of Core Inches	Weight of Tube and Core	Weight of Empty Tube	Water Content Inches	Density Percent	Remarks (See reverse)
1	94	92	62½	35	27½	29	GNF Damp
2	91	89	62		27	30	
3	92	86	62		27	29	
4	85½	79	60½		25½	30	
5	87	82½	60½	35	25½	29	Dry Soil
6	87	82	61½		26½	30	
7	83½	79	59		24	29	
8	84½	81½	60		25	30	Needles
9	85	76	80½	56	24½	29	
10	79½	71½	78½	56	22½	28	2 samples
(10)	869				255	29	Total
(10)	86.9				25.5		Average

No. of tube sections used 4
Was driving wrench used? Yes, on samples 9 and 10.
No. 1 of 1 sheets. Comp. by P.E.F. Checked by G.C.

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NOTE. - Please fill in while in the field.

SAMPLING CONDITIONS
(Please check items descriptive of present conditions)

Weather at Time of Sampling

___ Clear, ✓ Partly cloudy, ___ Overcast, ___ Rain
✓ Snowing, ___ Blowing, ✓ Freezing, ___ Thaw

Snow Conditions at Snow Course

Snow samples obtained with ✓ ease, ___ moderate difficul
Snow samples obtained with ___ extreme difficulty.*
Ground under snow: ___ frozen, ✓ not fro
___ dry, ✓ damp, ___ wet (saturat
Ice layer on ground None How thick? ___ inches.
How many inches of new snow at snow course? 19 inc
Depth to first snow crust 17 inches.
Are there ice layers in snow pack? Yes ___ No ✓
If yes, show depth from surface ___ in

General Conditions

Snow on ground at Hdqtrs. office 4 inches.
Name and location of Hdqtrs. office State Office, Bozeman, MT
Air temperature (°f known) ___
If at aerial marker, record snow depth ___ in
*Explain fully under remarks

PRECIPITATION DATA

Month	Day	Year	Precipitation	Readings	Reading Made by (check)	Dipstick	Wei
			Current				
			Previous				
Station name			Catch, inches		Scale adjusted to ze		
			After recharge		___Yes ___No		

Remarks: Heavy crust down 45-50 inc
Snowshoed last half mile to Course.

25

For special conditions

Snow freezing in tube
If snow melts and freezes in the point of the sampler and the entire core does not enter the tube, it is probably because the tube is above freezing temperature and the snow below freezing. The following steps can help you meet this difficulty:

1. Cool the tube by setting it in the shade or burying it in the snow.
2. Clean the tube thoroughly, then push it rapidly through the snow without stopping until you reach ground surface.
3. Take samples in the early morning or evening when it is cool.

If these precautions do not help, follow these steps:

1. Thrust the tube as deeply as possible without stopping.
2. Remove the tube carefully so as not to disturb the hole.
3. Record the core length and weight.
4. Empty the tube and return it carefully to the bottom of the hole.
5. Again thrust the tube deeper into the snow until it stops or reaches the ground.

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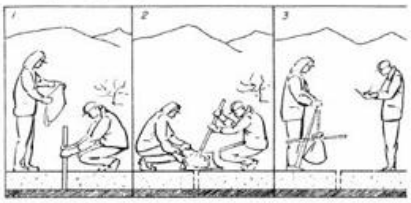
6. Repeat as many times as necessary to reach the ground.

Record data as shown on sample note, page 31.

Sampling very shallow snow



If water content of the snow is less than 2 inches, it is difficult to read the weighing scale accurately for single sampling points. Do as follows:

1. Take a sample at the sampling point.
2. Empty the core into a bucket or any container that can be tied to the weight scale. (If the empty container is not heavy enough to record an empty weight on the scale, add more weight. Use sections of sampling tubes, driving wrenches, or anything handy.)
3. Record the depth of snow and length of core as shown on sample note on the next page.
4. Weigh container and any added weights when all the sample cores have been accumulated.

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5. Record this weight in the bottom of the column "Weight of Tube and Core."

6. Empty snow from container. Weigh container and weights and record this figure at the bottom of the column "Weight of Empty Tube."

7. Subtract weight of empty container from weight of container and core. Record the difference at the bottom of the column "Water Content Inches." To obtain average water content on the snow course, divide total water content by total number of sampling points.

8. Total the snow depths and divide by number of sampling points to get average snow depth.

FEDERAL-STATE-PRIVATE
COOPERATIVE SNOW SURVEYS

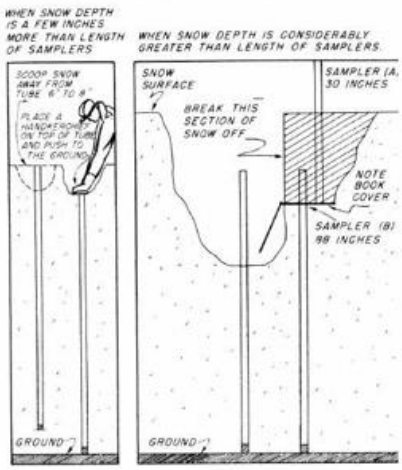
Snow Course Suicide Park
Drainage Basin Gila State Arizona
Sampler G. Watt Note Taker D. Enz
Date Feb. 15, 1984 Began 11:00 a.m. Ended 11:30 p.m.

Sample Number	Depth of Snow Inches	Length of Core Inches	Weight of Tube and Core	Weight of Empty Tube	Water Content Inches	Density Percent	Remarks (See reverse)
1	2	2					Dry
2	2½	2					
3	6	5					
4	3½	3					G D F
5	2	2					
6	6	5½					
7	8½	7					G D F
8	2	2					
9	3½	2½					
10	5	4½					
	11						
(10)	41		30.5	18	12.5	30	Total
10	4.1				1.3		Average

Bulk Sampled

28

Tubes too short for depth of snow



If the depth of snow is greater than the length of tubing at hand, do the following:

1. Drive the tube its full length into the snow.

2. Place a handkerchief or similar object over the top of the tube.

3. Dig down around the tube to a depth of about 1 foot.

4. Stand on tube and force it down farther.

29

5. Remove the wadding and observe the depth of the core. When the core reaches the top of the tube, you have reached the limit for this method of measurement.

The depth of the snow is the distance from the snow surface to the top of the tube added to the length of the tube.

If the snow is too deep to get a whole sample by this method, then do the following:

1. Dig a hole in the snow at the sampling point to a depth of 2 to 3 feet. Try sampler in bottom of hole. If you have not reached the ground surface, dig deeper. Use ski heel or tip of snow-shoe for a shovel if nothing else is available.

2. Slide a metal plate or firm, flat object (aluminum notebook cover) into side of pit at a depth below the top of the grounded sampler.

3. Drive sampler down to metal plate.

4. Measure snow depth and core length of the first section of snowpack.

5. Break off snow into pit down to metal plate.

6. Weigh and record weight of tube and core and weight of empty tube. (See p. 31.)

7. Sample from metal plate down to the ground surface. Weigh and add depths and water contents for that sampling point. (See p. 31.)

8. Be sure to fill the hole if the course is to be sampled at a later date. Make a note to bring additional sections of sampler tubing for future surveys.

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FEDERAL-STATE-PRIVATE
COOPERATIVE SNOW SURVEYS

Snow Course Dead Man Creek
Drainage Basin Columbia-Willamette State Oregon
Sampler T. George Note Taker M. Vance
Date Apr. 1, 1984 Began 11:00 a.m. Ended p.m.

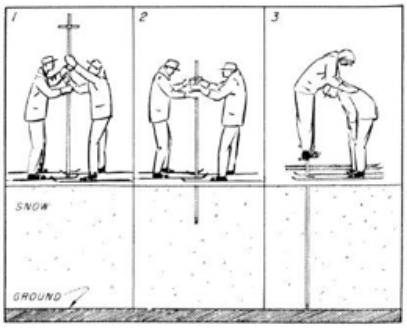
Sample Number	Depth of Snow Inches	Length of Core Inches	Weight of Tube and Core	Weight of Empty Tube	Water Content Inches	Density Percent	Remarks (See reverse)
1a	30	29	31½	19	10½	42	Tube too short GNF
1b	88	88	58	19	39½	45	Damp
1	118	117			52	44	←
2a	38	36	34	19	15	39	GNF
2b	86	85	55	19	36	42	Wet
2	124	121			51	41	←
3a	22	20	28	19	9	41	GNF
3b	89	88	57	19	38	43	Grass Damp
3	111	108			47	42	

Example of note keeping for samples taken in sections.

Totals are found by adding figures in rows 1, 2, 3, etc.

No. of tube sections used 3.
Was driving wrench used? Yes
No. 1 of 3 sheets. Comp. by M.V. Checked by T.G.

31



Driving sampler through layers of deep snow

When sampling deep snow, drive the sampler rapidly. Keep it moving continuously until the ground surface is reached.

The following procedure is suggested:

1. Both surveyors drive the sampler with a hand-over-hand motion, keeping the sampler in motion.
2. Grab the driving wrench handle and push down.
3. If the tube stops, one surveyor steps on the handles and drives the tube down to the ground surface with a pumping action of the knees while balancing against his partner's shoulders.

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Notes

This Guide was written by the Water Supply Forecasting Unit, West National Technical Center, and state snow survey supervisors of the Soil Conservation Service in the West, in consultation with other snow surveyors and equipment manufacturers.

Slightly Revised December 1984
Washington D.C.

☆ GPO 594-305

1. PURPOSE

The purpose of this Safe Work Procedure (SWP) is to ensure that ground water monitoring required by the Waste Management Permit 2018DB0001, are collected safely and that they are representational and uncontaminated.

2. SCOPE

The Environmental Department is responsible for collecting the samples in accordance with the schedule provided in the ADEC Waste Management Permit 2018DB0001 for Northern Star (Pogo) LLC and the Pogo Mine Monitoring Plan. Monitoring Well samples must be collected according to US Environmental Protection Agency (EPA) and the Alaska Department of Environmental Conservations (ADEC) requirements in order to maintain compliance with Pogo's permits.

3. ROLES AND RESPONSIBILITIES

Role	Key Responsibilities
Environmental Manager	Environmental Manager is responsible for permit provisions and requirements, as well as any updates or renewals associated with the permit and any required notifications to the state or federal agencies.
Environmental Personnel	Environmental personnel are responsible for following this SWP while collecting all monitoring well samples.
Pogo Expeditor	Pogo Expeditor is responsible for delivering the samples to the correct laboratory in a timely manner.

4. DEFINITIONS AND ACRONYMS

ADEC	Alaska Department of Environmental Conservation
COC	Chain of Custody
EPA	Environmental Protection Agency
QAP	Quality Assurance Plan
SWP	Safe Work Procedure

5. PROCEDURE

Review all sampling procedures as outlined in the *Pogo Quality Assurance Plan (QAP*), Sections 3 and 4, before the sampling event, if unfamiliar with them. The QAP also lists sample bottle type, preservative requirements, and hold times (Section 17 of the QAP). Section 17.0 of the QAP also gives an overview the sampling procedures for groundwater including how to calculate well volumes, well purging, and filtering water samples.

5.1 Preparations for Sampling

5.1.1 Field Data Sheets and COCs

Field Data Sheets are designed for general categories of sites. They are kept in the Field Lab file cabinet or on the Pogo Environmental G: drive (G:\Enviro\Private\5. Sampling\Field Data Sheets) and can be partially filled out before going into the field. A clipboard and pen are also recommended. If errors are made in the field, a single line though the error and the sampler's initials next to it are required by law. The correction can be written next to the lined-out item.

In addition to field data sheets, a paginated sampling field notebook is required for sampling. Record date, location, arrival time, weather conditions (if applicable), and sample profile. Field parameters should be identical between the field notebook and field data sheets.

COCs can be prepared on the computer ahead of time and printed out, leaving only the sampling time to be filled in after the sampling events. Alternately, if time allows, COC's can be filled out on Field Lab computer and printed out ready to sign. Be sure to sign, date, and time of relinquishment to the Expeditor. After the Expeditor signs and notes relinquishment date time on the COC, copy all the COC's before giving the Expeditor the originals.

5.1.2 Sample Bottle Sets and Profiles

Sample bottle labels can be prepared before the sampling event, but the date and time must remain blank until the sample is collected. Sample bottle sets are organized differently according to which laboratory will receive the samples.

Groundwater samples go to Energy Labs; Profile 13g comes assembled in Ziploc bag with preservatives included in separate vials with color-coded caps.

Place sampling gloves into a large Ziploc bag for each cooler used for the days sampling. Gloves are necessary to prevent contamination whenever handling sample bottles, including labelling, collecting samples, and when adding preservatives. Gloves and safety glasses are required when handling preservatives as per Pogo policy; they provide eye and skin protection while handling preservatives. Make sure to switch gloves in between sample locations to prevent cross-contamination.

5.1.3 Instrument Calibration

Calibrate the YSI meter and turbidimeter immediately prior to sample collection (as described in the *Water Meter Calibration SWP)*.

5.1.4 Frozen Wells

Check the day before sampling to determine if the wells are frozen and need to be thawed. If the well(s) are frozen, locate a generator at the well(s) the night sampling and connect heat trace in order to thaw the well overnight.

5.2 Purge Calculations

Use a depth to water probe to determine the depth to water in a monitoring well. The depth to water probe should be decontaminated after each use.

A minimum of three well volumes must be purged before sampling. Total purge is calculated by multiplying the water column height (the difference between total well depth and depth to water) by a volume/foot constant, then multiplying this result by three.

5.3 Hand Purging

Wear neoprene gloves to prevent your hands from contaminating the well tubing. Monitoring wells with Waterra foot valve pumps use dedicated systems and should only be used in the well they were placed in, to prevent cross contamination.

The tubing works via a Waterra foot valve which is secured onto the bottom of the tubing. Pull the tubing out of the well approximately 4-6' and, while holding the end over a collection bucket, begin moving the tubing up and down to actuate the foot valve moving water up and out of the tubing. See following figure. Use a 5-gallon bucket to track the volume of water that has been purged.

When finished sampling the wells pull the tubing out as much as 10' if possible and face the end of the tubing toward the ground with the bend up in the air to drain as much excess water from the tubing as possible. Slowly lower the tubing back into the well and push it to the bottom if possible, to try and open the foot valve for the tubing to drain down. This prevents the tubing from freezing solid in cold weather.

5.4 Dedicated Grundfos Pumps

Most monitoring wells at Pogo have dedicated Grundfos Redi-Flo2 2" submersible environmental sampling pumps installed. These pumps are operated with a Grundfos Variable Frequency Drive (VFD), which allows users to slow down or speed up the pump flow rate.

Warning: Grundfos pumps and VFDs can be damaged by inappropriate start up or shut down. Follow start up and shut down instructions carefully.

To operate Grundfos pumps, begin by connecting the VFD electrical supply plug to the wellhead receiver. Start a generator and allow it several minutes to warm up. Plug the VFD electrical input plug into the generator. An introductory display will show for several seconds, followed by the main display. The VFD should be in **Stop** mode (indicated by an LED in the corner of the stop button) with voltage and hertz readings of 0. Select **Forward** once – this will set the voltage and hertz readings to 1.5 and 15 respectively. Use the up and down arrows to adjust power supply until the desired flow rate is reached. After sampling is complete, use the down arrow to bring power supply back to minimum readings, then select **Stop**. Voltage and hertz readings will return to 0. Unplug the power supply from the generator and wait one minute before disconnecting the VFD electrical supply plug from the wellhead receiver. Protect the VFD from moisture and dry it if needed prior to storage.

Note: The suggested voltage/hertz readings written on the VFD produce a sustained flow of 2.5 gallons/minute. If water elevations low, a flow rate of 2 gallons/minute might be more appropriate.

5.5 Generators

To start the Honda EU2000i Generator, start by inspecting oil, hosing, and gasoline. Once pre-op check is complete, turn the switch to "On". Use the choke so the generator will have an easier time starting, especially during winter months. Pull on the cord until the generator has started. Slowly turn the choke off. Allow sufficient time for generator motor to warm up before plugging anything into the AC circuit (1-3 minutes). Once the motor is warm, plug in either heat trace or pump controller. The generator has a run time of 4 hours before the engine will run out of fuel. Turn the switch to "Off" to shut off generator.

5.6 Well Purge and Field Parameter Collection

Monitoring well samples can only be collected when field parameters stabilize. Field parameters should be collected several times during the purge. One set of parameters should be taken very early in the purge, after enough water has passed through the lines to clear the pump and hose (usually 5 gallons is sufficient). Parameters should be collected again at relatively even intervals during the purge. The final two parameters must meet the following conditions:

- pH +/- 0.1 SU
- Specific Conductance +/- 5%
- Dissolved Oxygen +/- 0.2 mg/L

A flow-thru cell will yield much more accurate results than individual aliquots and is highly recommended. If wells are not fitted for the YSI flow-thru cell, a gallon water container can easily be modified into a flow-thru cell.

5.7 Cleanup

Make sure to take all trash, any cut tubing, and equipment back the Environmental Field Lab. Make sure the VFD is dry and in good condition prior to storage. Refill the generator gas tank so it is ready to go the next time it is needed. If any tubing or foot valves need to be replaced make the necessary arrangements.

5.8 Sample Custody and Shipping

After samples are collected, the bottles are kept cold in refrigerator until they are shipped, following standard transportation procedures (see Section 4, Pogo QAP procedures). A laboratory specific Chain of Custody Form (COC) and custody seals are included in every shipment of samples to all laboratories.

When packing samples for Energy Labs, line cooler with plastic bag (drum liner) and place all samples, ice, and gel ice in the bag. Make sure an address label is on each cooler. After the Expeditor signs COCs, they should be placed inside the cooler. Coolers should be taped closed in the Environmental field lab with custody seals attached (The air cargo handlers do not sign COCs). Prior to shipment, create an airway bill with Alaska Air Cargo Goldstreak and provide to the Expeditor with the PO# written on top if the PO is available. The Expeditor should have all other account information for shipping samples via Goldstreak.

6. MONITORING AND CHECKING

Field quality control (QC) samples include field blanks, equipment rinsate blanks, and field duplicate samples. Refer to the *Pogo QAP*, Section 5.1.3, for a description of common field QC samples, the associated collection method, and the applicable QC sample frequency.

7. MAINTENANCE AND CALIBRATION

Calibration of instruments used in collecting field parameters (i.e. YSI Meter) is performed before every sampling event (refer to Water Meter Calibration SWP). Maintenance is performed at regular intervals recommended by the manufacturer. Calibration and maintenance are documented on the Pogo Mine YSI Meter Calibration Form, the Pogo Mine Hach Turbidimeter Calibration Form, and the Instrument Maintenance Log.

8. EQUIPMENT DECONTAMINATION

Decontaminate sample equipment by cleaning thoroughly with DI water.

9. RECORDS

Record Description	Record Location / Retention Responsibility	Minimum Retention Time
Chain of Custody and Analytical Results	Environmental Archives / Environmental Manager	5 years
Sampling Field Data Sheets	Environmental Archives / Environmental Manager	5 years
Pogo Mine YSI Meter Calibration Form	Environmental Archives / Environmental Manager	5 years
Pogo Mine Hach Turbidimeter Calibration Form	Environmental Archives / Environmental Manager	5 years
Instrument Maintenance Log	Environmental Archives / Environmental Manager	5 years

10. DEPARTURES FROM PROCEDURES

10.1 Notifications

10.1.1 Internal notifications

During sample collection, if field parameters are outside APDES trigger limitations, notification of supervisor is required immediately.

10.1.2 External Notifications

Exceedances of the effluent limitations of the APDES permit may require immediate reporting to ADEC, other exceedance require monthly reporting on the DMR.

10.2 Environmental and Legal Consequences

Non-compliance with Pogo's environmental permits such as APDES Permit Number AK0053341 and ADEC Waste Management Permit 018DB0001 could have a potentially adverse effect to the environment. Non-compliance with the Pogo QAP, or this SOP could result in loss of data integrity.

10.3 Consequences to Employees

Failure to follow this procedure could result in unsafe practices or conditions contributing to an incident possibly resulting in injury. In some instances, situations will dictate variances from this procedure. A variance shall only be given with approval from the Environmental Manager.

Failure to follow this procedure may result in an adverse effect to the environment which could lead to civil and/or criminal penalties for the company and those involved. Procedural failures may also adversely affect company performance records and NSR's public image.

11. RELATED DOCUMENTS

Document Name	Document Number
ADEC Waste Management Permit 2018DB0001	
Pogo Mine Monitoring Plan	PGO-ENV-011-PLA
QAP – Quality Assurance Project Plan	PGO-ENV-039-PLA
Water Meter Calibration SWP	PGO-ENV-037-SWP

12. APPENDICES

Appendix I - Groundwater Field Data Sheet

Appendix II - Chain of Custody Template

12.1 Appendix I - Groundwater Field Data Sheet

Pogo Mine Groundwater Sampling Field Data Sheet

Arrival Time			
EDMS Site Number		Temperature	
Date		Skies	
Sample Time		Wind	
Profile	13g (Groundwater)		
Duplicate sample Indentifier		Time:	YSI #
Blank Sample Identifier		Time:	Turbidimeter #
			D-to-W Meter
		Dedicated Pump	Bottles
Field Preserved		Portable Pump	Cooler
Field Filtered		Hand Bailer	Gloves
Field Parameters Measured			DI Water
Lab-Preserved	Time:		PPE
Lab-Filtered	Time:		Calculator
Lab-Parameters Measured	Time:		Pump/Filters/Tubing

Time (Hours)	Volume Purged (gals)	Temperature (°C)	Turbidity (NTU)	Appearance	pH	Specific Conductance	D.O. (mg/L)	
Before sampling-check for stablization of parameters					**Difference +/- 0.1 SU**	**Difference +/- 5%**	**Difference +/- 0.2 mg/l**	

Well	*example*	
Depth to Bottom	*50*	
Depth to Water	- *25*	-
Water Height	= *25*	=
Volume Constant	x *0.653*	x
One Well Volume	= *16.325*	=
	x *3*	x 3
Total Purge	*48.975*	

If applicable, reason for sample collection failure:

Notes:

References: Monitoring Well Sample Collection SWP

Water Meter Calibration SWP

Field Team Members Signatures

Profile 13g	Groundwater			
Sample Bottle	**Preservative**	**Bottles**	**Analytes**	**Bottles Check**
1	NaOh >12		WAD Cn	
2	HNO3, pH <2		Sb, As, Cd, Cu, Fe, Pb, Mn, Ni, Se, Ag, Zn (dissolved metals) bulk bottle/filter	
3	HNO3, pH <3		Sb, Ca, Cr, Mg (total metals), Hardness	
4	None		Conductivity Solids, Total Dissolved Chloride, Flouride, Sulfate Alkalinity, as CaCO3 Turbidity Total Dissolved Solids	
5	H2SO4, pH <2		Nitrogen as Nitrate + Nitrite	

	MW12-500	MW12-501	MW12-502	MW12-001A	MW12-001B	MW99-216
Depth to Bottom	36.45'	27.5'	17.8'	67.0'	160.0'	500.0'
Volume Constant	1.47	1.47	1.47	1.47	1.47	0.041
	LL04-031	**LL04-032**	**MW04-213**	**MW11-216**	**MW11-001A**	**MW11-001B**
Depth to Bottom	63.0'	58.9'	152.6'	234.0'	38.85'	74.9'
Volume Constant	0.163	0.163	0.163	0.653	0.653	0.653
	LT99-009	**MW18-FL4**	**MW18-FL4 Deep**	**MW18-FL3**	**MW18-SCW**	
Depth to Bottom		73.5'	242'	40.25'	43.8'	
Volume Constant	0.163	0.163	0.163	0.163	0.163	

12.2 Appendix II - Chain of Custody Template

Northern Star (Pogo) LLC Chain of Custody	Page of
	# of Coolers:

Company Name: Northern Star (Pogo) LLC	Contact Name: Phone:	Laboratory Name:
Report Mail Address: *3205 International Street* *Fairbanks, Alaska 99701*	Invoice to: pogo.ap@nsrltd.com P.O. #:	Mail Adddress:
Email: pogoenvironment@nsrltd.com	Turnaround Time for Results (TAT) X Standard ____ Expedited	Lab Phone:
Special Instructions/Comments:	Requested Analysis/Method:	Work Order #:

APDES Permit #: AK0053341
Public Water System (PWS) ID#:

Lab ID#

Client Sample Identification / Location	Date Sampled	Time Sampled	Matrix (S-DW-WW-Other)	No. of Containers								Field Preserved

Relinquished by:	Date	Time	Received by:	Date	Time
Relinquished by:	Date	Time	Received by:	Date	Time
Relinquished by:	Date	Time	Received by:	Date	Time

Section To Be Completed by Laboratory
Custody Seal Intact? Y / N _____
Samples On Ice? Y / N _____
Receipt Temperature: _____°C
Signatures Complete? Y / N _____
Signatures Match? Y / N _____
Add'l Notes: _____

Name of Sampler: (printed)

Version 1.0 G:\Enviro\Private\Sampling\COC Forms_Profiles

MINERALIZED WASTE ROCK (RED ROCK) PC002 GEOCHEMISTRY SAMPLE COLLECTION SAFE WORK PROCEDURE

1. PURPOSE

The purpose of this SWP is to assure that Pogo personnel collecting compliance mineralized waste rock (PC002) samples are doing so safely and correctly.

2. SCOPE

This instruction includes the required quarterly sampling and analysis as required by the State of Alaska Waste Management Permit 2018DB0001.

3. ROLES AND RESPONSIBILITIES

Role	Key Responsibilities
Environmental Manager	The Environmental Manager is responsible for permit provisions and requirements, as well as any updates or renewals associated with the permit and any required notifications to the state or federal agencies.
Environmental Coordinator / Specialist	The Environmental Coordinator / Specialist are responsible for contacting labs and expediters, obtaining quotes and acquiring purchase orders for analytical work and transportation.
Environmental Technician / Intern	The Environmental Technician / Intern is responsible for preparing COCs, collecting and shipping samples, preparing and taking care of sampling equipment.
Pogo Expeditor	The expeditor is responsible for delivering the samples to the correct laboratory in a timely manner along processing the COCs appropriately.

4. DEFINITIONS AND ACRONYMS

ADEC	Alaska Department of Environmental Conservation
COC	Chain of Custody
SWP	Safe Work Procedure
QAP	Quality Assurance Plan

5. PROCEDURE

The Environmental Department is responsible for collecting the PC002, the mineralized waste rock sample on a monthly basis for a sample that is submitted to the lab on a quarterly basis. The laboratory composites the three-monthly rock samples for the quarterly analysis. Once a year, a duplicate sample is collected, during this quarter two sample bags are filled each month. Supplies needed to collect the PC002 sample include:

- A cloth rock bag with a label
- A permanent marker
- A small shovel
- Sampling gloves
- Field data sheet and pen

The mineralized waste rock is generally located in an active section at the center of the Drystack (mineralize waste rock must be placed at least 50 feet from the edges of the Drystack). When collecting sample:

1. Announce your presence on the radio as you drive up Road #3 and Road #4 to the dry stack to alert surface equipment/truck operators.
2. Ask Surface Operator for the location of mineralized (red) rock and let them know you will be collecting a sample.
3. Collect several handfuls of loose rock along the edges of mineralized rock piles until the sample bag is full, while wearing sampling gloves.
   a. Collected sand to gravel sized pieces. Large pieces of rock can be difficult for the labs to process.
4. Label the sample bag with sample name, date, and time of collection.

5. Fill out field data sheet Pogo Mine Sampling Field Data Sheet (PC002). One data sheet is used for all three samples collected during the quarter.
6. Announce your departure from the dry stack on the radio to Surface Operators.

After the third monthly sample is collected for each quarter, the three bags of rock samples are composited together in a new canvas bag by scooping roughly 1/3rd of the mixed material from each month's sample bag into the new bag. Make sure the bag is labelled as the PC002 Quarterly Composite Sample. The sample is transported by the Pogo Expeditor, to ALS Chemex in Fairbanks. When filling out the ALS Chemex Chain of Custody (COC), request "Template PC002" as the analysis requested. Template PC002 includes: Acid Base Accounting, 48 metals-ICP, and total mercury. An annual mineralized rock sample is also collected for TRI reporting, this uses the "Template TRI" analysis request on the COC.

6. MONITORING AND CHECKING

Field quality control (QC) samples include field blanks, equipment rinsate blanks, and field duplicate samples. Refer to the Pogo QAP, Section 5.1.3, for a description of common field QC samples, the associated collection method, and the applicable QC sample frequency.

7. MAINTENANCE AND CALIBRATION

No maintenance or calibration is required for this activity.

8. RECORDS

Record Description	Record Location/ Retention Responsibility	Minimum Retention Time
Chain of Custody and Analytical Results	Environmental Archives / Environmental Manager	5 years
Pogo Mine Sampling Field Data Sheet (PC002)	Environmental Archives / Environmental Manager	5 years

9. DEPARTURES FROM PROCEDURES

9.1 Notifications

During sample collection, if any unusual circumstances occur, notification of supervisor is required immediately.

9.2 Environmental and Legal Consequences

Non-compliance with Pogo's environmental permits such as the ADEC Waste Management Permit 2018DB0001, could have a potentially adverse effect to the environment. A permit exceedance may lead to Notice of Violation, or a Compliance Order by Consent.

9.3 Consequences to Employees

Failure to follow this procedure could result in unsafe practices or conditions contributing to an incident possibly resulting in injury. In some instances, situations will dictate variances from this procedure. A variance shall only be given with approval from the Environmental Manager.

Failure to follow this procedure may result in an adverse effect to the environment which could lead to civil and/or criminal penalties for the company and those involved. Procedural failures may also adversely affect company performance records and NSR's public image.

10. REFERENCE DOCUMENTS

Document Name	Document Number
ADEC Waste Management Permit 2018DB0001	
Pogo Mine Monitoring Plan	PGO-ENV-011-PLA
QAP – Quality Assurance Plan	PGO-ENV-039-PLA

11. APPENDICES

Appendix I - Pogo Mine Sampling Field Data Sheet (PC002)

11.1 Appendix I - Pogo Mine Sampling Field Data Sheet (PC002)

Pogo Mine Sampling Field Data Sheet

Arrival Time:			
EDMS Site Number	**PC002 (Red Rock)**		
EDMS Sample Identifier	PC002	Month 2	Month 1
Date			
Time			
Profile	**PC002 Template (ALS CHEMEX Lab)**		
Duplicate Sample Indentifier		Time	
Blank Sample Identifier		Time	

Field Conditions	Indoors	Temperature	Skies	Wind
	N/A			

Field Equipment	YSI Meter	Gloves	Bottles	Coolers	Dip Stick	DI Water	PPE

Notes/Comments	
Field Team Members Signatures	

1. PURPOSE

The purpose of this SWP is to assure that Pogo personnel collecting compliance lead and copper samples (from the two public drinking water systems maintained by Pogo) are doing so safely and correctly.

2. SCOPE

The Environmental Department is responsible for collecting the samples in accordance with the schedule provided in the Annual Monitoring Summary from the Alaska Department of Conservation (ADEC) for Public Water Systems (PWS) ID# 372643 (Pogo Lower Camp) and PWS ID# 372685 (Pogo Permanent Camp). Lead and copper samples must be collected according to US Environmental Protection Agency (EPA) and ADEC requirements in order to maintain compliance with Pogo's permits.

3. DEFINITIONS AND ACRONYMS

ADEC	Alaska Department of Environmental Conservation
CFR	Code of Federal Regulation
COC	Chain of Custody
Cu	Copper
EPA	Environmental Collection Agency
Pb	Lead
PWS	Public Water System
QAP	Quality Assurance Plan
SWP	Safe Work Procedure
WTP	Water Treatment Plant

4. ROLES AND RESPONSIBILITIES

Role	Key Responsibilities
Environmental Manager	Environmental Manager is responsible for permit provisions and requirements, as well as any updates or renewals associated with the permit and any required notifications to state or federal agencies.
Environmental Personnel	Environmental personnel are responsible for preparing COCs, collecting and shipping samples, preparing and taking care of sampling equipment, and following this SWP while collecting samples.
Mill Water Operators	Mill Water Operators are responsible for operating and maintaining the drinking water systems.
Pogo Expeditor	Pogo Expeditor is responsible for delivering the samples to the correct laboratory in a timely manner along processing the COCs appropriately.

5. PROCEDURE

Sample sites at Pogo are selected according to 40 CFR 141.86, for non-transient, non-community water systems. These sites are required to be representative sites throughout the distribution system, in which the plumbing material used at these sites, would be commonly found at other sites in the system. The Lead and Copper Rule also prioritizes drinking water and food preparation areas for sampling.

5.1 Action Levels and Monitoring Program

The number of sampling sites is described in the ADEC monitoring plan and is based on the size of system (how many people it serves) and prior sample results. Standard monitoring (10 sample sites) is required every six months (one sampling event between January and June, and one sampling event between July and December of any given year) for the first year a drinking water system is in service, or after an exceedance of the 90th percentile. If no further exceedances occur, and 90% of each sampling event remains under the action limits, the public water system will qualify for reduced sampling (5 sample sites) status on an annual basis for two more years. At this point, if no other exceedances occur, reduced monitoring will only be required once every three years.

Table 1: Action levels and monitoring programs for Lead and Copper.

	Action Level (State of Alaska)	System Size (number of people served)	Number of Sites (standard monitoring)	Number of Sites (reduced monitoring)
Lead	15 ug/L (ppb)	101 to 500	10	5
Copper	1300 ug/L (ppb)	101 to 500	10	5

The Pogo Permanent Camp water system is currently on the reduced monitoring schedule, sampling 5 sites once every three years. The Pogo Lower Camp is currently monitored annually.

Calculating the 90th percentile when collecting 10 samples means that the 9th highest sample result is the 90th percentile, and if this is higher than the ADEC Action Limit (See Table 1) then the action level has been exceeded. Calculating the 90th percentile when collecting 5 samples means that the average of the 4th and 5th highest sample result is the 90th percentile, and if this is higher than the ADEC Action Limit (See Table 1) then the action level has been exceeded. More than 10 samples may be collected to test for Pb and Cu during a sampling event, however, all the data will be included in determining whether the 90th percentile exceeded the action limits. Example of 90th percentile calculation attached.

If sampling events show Pb and Cu above the 90th percentile, consider the following:

- The corrosion control system may need adjustment.
- Copper pipes with lead solder may need to be replaced.
- Faucets that do not meet the 2014 low level (California Standard) Pb and Cu content may need to be replaced.
- Faucets that do not have separate handles for hot and cold water may need to be replaced, as hot water can mobilize metals and contaminate sample.
- Replace any metal aerator screens with nylon aerator screen in faucets.
- Faucets with aerator screens need to be cleaned regularly and at least one month prior to sampling event (do not clean just prior to event or take out screens).
- Check for any grounding wires that may be attached to copper pipes, this increases electrolysis and dissolves metals into the water.
- Review sampling procedures for any introduced contaminants.

Table 2, below, shows the current sampling schedule (2019) for Pb and Cu for both drinking water systems. The schedule may change, depending on Pogo's compliance status with action limits for Pb and Cu.

Table 2: 2019 Lead and Copper Sampling Location and Schedules.

Site ID	Location	Lead & Copper Sampling	Site ID	Location	Lead & Copper Sampling
Pogo Lower Camp PWS ID# 372643			**Pogo Permanent Camp PWS ID# 372685**		
DS029	Potable Water Treatment Plant #3, Entry Point into system		DS050	Potable Water Treatment Plant #2, Entry Point into system	Every 3 years (due 2019)
DS031	Contractor Camp E -wing (room # E22)	Annually	DS052	Dorm A 1st Floor Sink (room # A134)	
DS043	Contractor Camp Office (Old Redpath)		DS054	Dorm B 3rd Floor sink (room # B 324)	
DS080	Kitchen Prep Area Sink	Annually	DS056	Admin Building Lunchroom sink	Every 3 years (due 2019)
DS081	Women's Restroom Sink (Left)		DS057	Mobile Maintenance Lunchroom	Every 3 years (due 2019)
DS082	Men's Dry, (back middle sink)	Annually	DS058	Filter Building Restroom Sink	
DS083	Women's Dry (middle Sink)	Annually	DS059	Mill Building Lunchroom	Every 3 years (due 2019)
DS084	Men's Shower	Annually	DS060	Rear Kitchen Sink, Prep area	Every 3 years (due 2019)
DS085	Women's Shower		DS061	Dorm C 2nd Floor sink (room # C 226)	
DS086	Laundry Room Sink		DS062	Mill Bench Offices (AMEC Chateau) Lunchroom sink	

5.2 Reporting Requirements

The State of Alaska requires that laboratories performing water analysis for public water systems enter results directly into an online database system maintained by the State. ADEC reviews the data and determines whether the public water system has exceeded the action limits. ADEC then notifies the public water system of any exceedances. If a water system is above the 90th percentile after a Pb and Cu Rule sampling event, corrective action will be required by ADEC. ADEC will specify the terms of a Corrective Action Plan, which will likely include:

- A "Notice to the Public" must be posted on prominent bulletin boards around site providing information on the effects of potential lead contamination. The language of the "Notice to the Public" is dictated by ADEC, only the corrective action section can be modified by Pogo. These documents need to be posted within 90 days of discovering that the 90th percentile was exceeded. It must remain posted for at least 30 days. Once this notice is posted, copies must be emailed to ADEC.
- An informational sheet titled: "Important Information About Your Drinking Water" must also be posted at every sampling site. This notice includes the sample date, analytical results, and any corrective actions planned by Pogo. The remaining language in this notice is also dictated by ADEC. This document needs to be posted within 90 days of discovering that the 90th percentile was exceeded. This notice must remain posted at each sampling site for 30 days, even if the site did not exceed the action limits. (This document needs to be posted after every sampling event, regardless of whether the 90th percentile was exceeded.) Once this notice is posted, copies must be emailed to ADEC.
- Other Corrective actions, such as adjustment to the corrosion control system or faucet replacements etc., must also be included, as well as approximate dates of completion.
- The Corrective Action Plan must be emailed to ADEC before the next Pb and Cu sampling event. The due date for the Corrective Action Plan is set by ADEC.

5.3 Preparations for Sampling

To prepare for the Pb and Cu Rule sampling event, request one-liter sampling bottles from the analytical laboratory, several weeks in advance of the sampling event.

If samples are being collected from dormitory room(s), the Camp Contractor (ESS) or Site Admin should be contacted to find out whether rooms are currently occupied and what shift any occupants are working. Dorm occupants should be given 24 hours warning that their sinks will be inoperable during the sampling event. Sampling events should be scheduled during working hours whenever possible.

If kitchen prep sinks are being sampled it is necessary to notifying the Camp Contractor (ESS) ahead of time and arrange a sampling event at a time that will cause the least amount of disruption of kitchen routines.

Mill lunchroom sampling needs prior notification to Mill manger and foreman. The sink, water bottle fill, and soda fountain are all on the same line and all are disabled during sampling. The Mill orders bottled drinking water and likes to fill containers before the drinking water is shut off for 6 hours. Pre-notification is appreciated by the Mill.

Screens are **not** removed from the faucet at time of sampling. Screens are not required and may not be installed, if however, they are present, leave in place. Faucets that do contain screens need to be cleaned as part of a regular maintenance program. However, cleaning should **not** be done within 30 days of the sampling event. Removal or cleaning of screen may create particles of loose metal that may contaminate samples during collection.

The sample site will need to be flushed in preparation for the sampling event. Confirm that the hot water handle is securely closed. The cold water should then be run for a minimum of five minutes. Water bottle fill stations require the front panel be taken off (4 screws removed) and the carbon filter removed. The water then needs to run for a minimum of five minutes as well. The selected sampling sites (faucets or water bottle fill stations) are securely taped off so that there is no easy access to faucet handles. "Do Not Use Water" signs are also hung on them. If needed, block off area with small barriers to assure no accidental contact with water bottle fill stations.

5.4 Sampling

Lead and copper samples are collected as "First Draw" samples; water is collected after the minimum 6-hour waiting period is complete. As with all sampling, field data sheets are prepared and ready for use at time of sampling and all data should be recorded in the current Environmental sampling logbook. Note the time flushing is completed on the field data sheet Drinking Water Pb & Cu Field Data Sheet-Lower Camp_1 or Drinking Water Pb & Cu Field Data Sheet-Permanent Camp_1 (see attachments). The sample needs to be collected within 6 to 8 hours of this time. Exactly 6 hours being the optimum time of collection.

After the required time has elapsed the sample can be collected by placing the sample bottle directly under the tap (or fountain on the water bottle fill stations) and the cold water turned on until the bottle is filled. The sample bottle will contain a small amount of nitric acid as a preservative, so follow all safety precautions and other sampling protocols, such as wearing sampling gloves and safety glasses, while collecting samples. Review all sampling procedures as outlined in the Pogo Quality Assurance Plan (QAP), sections 3 and 4, before the sampling event, if unfamiliar with them. The QAP also lists sample bottle type, preservative requirements, and hold times (Section 20, of Pogo QAP). Section 8 of the Pogo Mine Monitoring Plan also outlines the sampling requirements for lead and copper for the drinking water systems.

The date and time the sample is collected is recorded on Drinking Water Field Data Sheet-Pb & Cu_2 (see attachments) along with amount of time water stood in pipes and faucets before the First Draw was collected. It is also noted if any plumbing repairs or replacements have occurred since the last sampling event, this should also be noted on the Chain of Custody (COC).

A signed sampler affidavit (supplied by the laboratory) must accompany every lead and copper sample bottle along with the COC. Dates, times, location, and sample collector's signature are required (see attachments).

If samples are collected from the public water system for other purposes, and are not first draw samples, they need to be clearly marked as "Special Samples" on the COC. This is required so that ADEC does not include the results of analysis in the 90th percentile calculations.

After samples are collected, the bottles are kept cold in refrigerator until they are shipped, following standard transportation procedures (Section 4, Pogo QAP) procedures.

6. MONITIORING AND CHECKING

Field quality control (QC) samples include field blanks, equipment rinsate blanks, and field duplicate samples. Refer to the *Pogo QAP*, Section 5.1.3, for a description of common field QC samples, the associated collection method, and the applicable QC sample frequency.

7. MAINTENANCE AND CALIBRATION

No maintenance or calibration is required for this activity.

8. RECORDS

Record Description	Record Location / Retention Responsibility	Minimum Retention Time
Chain of Custody, Affidavit and Analytical Results	Environmental Archives / Environmental Manager	5 years
Field Data Sheet	Environmental Archives / Environmental Manager	5 years

9. DEPARTURES FROM PROCEDURE

9.1 Notifications

During sample collection, if any unusal circumstances occur, notification of supervisor is required immediately.

9.2 Environmental and Legal Consequences

Non-compliance with Pogo's environmental permits or state regulations, could have a potentially adverse effect to the environment. A permit exceedance may lead to Notice of Violation, or a Compliance Order by Consent.

9.3 Consequences to Employees

Failure to follow this procedure could result in unsafe practices or conditions contributing to an incident possibly resulting in chronic health effects. In some instances, requirements will dictate variances from this procedure. However, any variance must always be viewed with caution and possible contingencies accounted for. A variance shall only be given through management.

Failure to follow this procedure may result in an adverse effect to the environment which could lead to civil and/or criminal penalties for the company and those involved. Procedural failures may also adversely affect company performance records and NSR's public image.

10. RELATED DOCUMENTS

Document Name	Document Number
ADEC Pogo Lower Camp 2012 WTP Final Approval to Operate	
ADEC Pogo Permanent Camp WTP Final Approval to Operate	
QAP - Quality Assurance Plan	PGO-ENV-039-PLA
Pogo Mine Monitoring Plan	PGO-ENV-011-PLA
40 CFR 141.86	
ADEC Monitoring Summary for Pogo Lower Camp (annual)	
ADEC Monitoring Summary for Pogo Permanent Camp (annual)	

11. APPENDICES

Appendix I - Pogo Mine Sampling Field Data Sheet PWSID#372643

Appendix II - Pogo Mine Sampling Field Data Sheet PWSID#372685

Appendix III - Lead and Copper First Draw Sampling Procedure and Affidavit

Appendix IV - Chain of Custody Template

11.1 Appendix I - Pogo Mine Sampling Field Data Sheet PWSID#372643

Pogo Mine Sampling Field Data Sheet

Lower Camp PWSID#	**372643**	**Date/ Arrival time**	**Shut-Off Time:**	**First Draw Sample Time:**	**Water sat unused for: hh:mm**
EDMS Site Number	**DS029 PWTP#3**				
EDMS Site Number	**DS031 E-wing, Room E-24**				
EDMS Site Number	**DS080 Kitchen Prep Sink**				
EDMS Site Number	**DS082 Men's Dry (middle back sink)**				
EDMS Site Number	**DS084 Men's Dorm Shower Sink**				
EDMS Site Number	**DS085 Women's Shower Sink**				
Profile	Drinking Water Pb & Cu				

Field Preserved Affidavits for each site prepared	

Field Equipment	Bottles	Gloves	Cooler	Signs	Caution Tape	PPE

Notes/Comments	
Field Team Members Signatures	

References: Drinking Water Lead and Copper Sample Collection SWP
Pogo QAP
Monitoring Summaries for Pogo (ADEC)

11.2 Appendix II - Pogo Mine Sampling Field Data Sheet PWSID # 372685

Pogo Mine Sampling Field Data Sheet

Permanent Camp PWSID#	**372685**	**Date / Arrival Time**	**Shut-Off Time:**	**First Draw Sample Time:**	**Water sat unused for: hh:mm**
EDMS Site Number	**Special Sample-PWTP#2**				
EDMS Site Number	**DS056 Admin Lunch Room**				
EDMS Site Number	**DS057 Truck Shop Lunchroom**				
EDMS Site Number	**DS059 Mill Lunchroom**				
EDMS Site Number	**DS060 Kitchen Prep Sink**				
EDMS Site Number	**DS063 Chateau Lunchroom**				
Profile	Drinking Water Pb & Cu				

Field Preserved	
Affidavits for each site prepared	

Field Equipment	Bottles	Gloves	Cooler	Signs	Caution Tape	PPE

Notes/Comments	
Field Team Members Signatures	

Reference: Drinking Water Lead and Copper Sample Collection SWP
Pogo QAP
Monitoring Summaries for Pogo (ADEC)

11.3 Appendix III - Lead and Copper First Draw Sampling Procedure and Affidavit

Pollen Environmental, LLC.
Pouch 340135 Prudhoe Bay, AK. 99734 3536 International Street Fairbanks, AK. 99701
(907)659-2324 Phone (907)659-2325 Fax (907)479-8368 Phone (907)452-6853 Fax
www.pollenenv.com

Lead and Copper First Draw Sampling Procedure

This procedure must be followed exactly as described below. Any deviation to this procedure could result in non-acceptance and resamples would be needed. This form is required for each sample.

RULES:

Important! If any plumbing repairs or replacements have been done in the home or building since the previous sampling event, the water system operator must be contacted prior to sampling to determine if an alternative sample site needs to be established.

Samples may be collected either by an employee, operator, or the customer, **making sure that the proper sampling protocol is always followed.** Samples must be collected after the water has stood motionless in the home, apartment, or non-residential building for at least six hours. A good way to do this is to collect samples either early in the morning or in the evening upon returning from work. Samples collected from a residence must only be collected from the cold-water kitchen tap or the cold-water bathroom sink tap. Nonresidential samples must be collected from interior taps that are regularly used for drinking water consumption. ***Samples collected from other taps, such as outside spigots, lab sinks, and mop sinks, are not acceptable for lead and copper monitoring.***

PROCEDURE:

1. A one liter nalgene sample container is required for this analysis. Sample containers can be provided by Pollen Environmental. Proper sampling containers are required for samples to be valid.
2. Select a kitchen or bathroom cold-water faucet for sampling. If you have a point of use filter on your kitchen tap, collect your sample from a tap (e.g. bathroom or tap that is regularly used for drinking water consumption) that is not attached to the point of use device, if possible.
3. After a minimum of 6 hours, during which there is no water used in the home or building, collect your sample.
   -Do not remove the aerator prior to sampling.
   -Place the opened sample bottle below the faucet and open the cold water tap as you would to fill a glass of water.
   -Fill the sample bottle to the neck of the bottle and turn off the water.
   -Hand tighten the cap on the sample bottle.
4. Review the sample label and paperwork to ensure that all information is correct and completely filled out. Return samples and forms to the public water system.

Address/System Name: _____ **Sample Location:** _____

Water was last used: Date & Time: _____

Sample Collected: Date & Time _____

Total time water set in pipes: Hours: _____ **Minutes:** _____ **(Must be at least 6 hours)**

Signature: _____ **Date:** _____

I have read and understood the directions above and have taken the sample in accordance with this procedure.

Accuracy, Precision, Professional Service
Pollen Environmental, LLC

11.4 Appendix IV – Chain of Custody template

Northern Star (Pogo) LLC Chain of Custody	Page of
	# of Coolers:

Company Name: **Northern Star (pogo) LLC**	Contact Name: Phone:	Laboratory Name: **Pollen Environmental, LLC**
Report Mail Address: ***3205 International Street Fairbanks, Alaska 99701***	Invoice to: Pogo.ap@nsrltd.com P.O.#:	Mail Adddress: **3205 International Street, Fairbanks AK 99701**
Email: pogoenvironment@nsrltd.com	**Turnaround Time for Results (TAT)** X **Standard** ____ **Expedited**	Lab Phone: **907 479-8368**
		APDES Permit #:
		Public Water System (PWS) ID#:

WO#		**Requested Analysis/Method:**
Lab ID #:		

Client Sample Identification / Location	Date Sampled	Time Sampled	Matrix (S-DW-WW-Other)	No. of Containers	Pb & Cu Lot #: Pres: None								Field Preserved

Relinquished by:	Date	Time	Received by:	Date	Time
Relinquished by:	Date	Time	Received by:	Date	Time
Relinquished by:	Date	Time	Received by:	Date	Time

Section To Be Completed by Laboratory

Custody Seal Intact? Y / N _____
Samples On Ice? Y / N _____
Receipt Temperature: _____°C
Signatures Complete? Y / N _____
Signatures Match? Y / N _____
Add'l Notes: _____

Name of Sampler: (printed)

Version 1.0 G:\Enviro\Private\Sampling\COC Forms_Profiles

1. PURPOSE

The purpose of this procedure is to establish a standard method for conducting annual fish tissue sampling at Pogo Mine in accordance with AS 16.05.930 and to meet requirements set forth by ADEC in Pogo Mine's APDES Permit No. AK0053341, Section 1.5.5.

2. SCOPE

APDES Permit No. AK0053341, Section 1.8.8.: "The Permittee shall collect a minimum of ten juvenile Chinook salmon at Station SW01 and ten juvenile Chinook salmon at Station SW12. Salmon shall be collected in late fall, prior to freeze up. A whole-body metals analysis shall be conducted on each fish, and the concentrations of antimony, arsenic, cadmium, copper, lead, mercury, nickel, selenium, and silver shall be recorded. This record, including electronic copies of the raw data from each sample, shall be submitted with the Annual Report (see Permit Part 1.9)."

3. DEFINITIONS AND ACRONYMS

ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
COC	Chain of Custody
EPA	Environmental Protection Agency
QAP	Quality Assurance Plan
MRL	Method Reporting Limit
SWP	Safe Work Procedure
QA/QC	Quality Assurance / Quality Control

4. RESPONSIBILITY

Role	Key Responsibilities
Environmental Manager	Environmental Manager is responsible for permit provisions and requirements, as well as any updates or renewals associated with the permit and any required notifications to the state or federal agencies.
Environmental Coordinator/Specialist	Prepare and apply for Fish Resource Permit, obtain quote and acquire purchase order for analytical work, arrange for helicopter or boat logistics as needed, assist with sampling.
Environmental Technician	Perform fish tissue sampling, prepare COC and ship samples, prepare and take care of sampling equipment.
Pogo Expeditor	Pogo Expeditor is responsible for delivering the APDES Outfall samples to the laboratory designated by the Environmental Department in a timely manner.

5. PROCEDURE

5.1 Preparations

1. The fish tissue sampling does not occur until late September; however, preparations need to begin in July or August. Read through fish resource permit policy and requirements found at G:\Enviro\Private\4. Reports\ADFG. Once familiar with permit requirements prepare fish resource permit application which is also found in the same location. Previous permits can be found in previous year's folders for reference. A timeline for the fish sampling activity should lie within a time frame of September 15th – October 15th or as close as possible to these dates. The completed permit application should be submitted on or before August 1.
2. Request a quote for analytical work to be done through Test America Laboratories, Inc. Kathy Kreps at Test America's Tacoma Lab has been our project manager.

   Kathy Kreps, Manager of Project Management
   Eurofins Test America
   5755 8th Street East
   Tacoma, WA 98424

   Phone: (253) 932-2310
   Kathy.kreps@testamericainc.com

   Use the following guidelines for quote preparation:

Fifteen juvenile Chinook will be collected from two locations. The 10 largest Chinook from each location will need a whole-body analysis as individual samples. The remaining 5 smaller Chinook from each location will be homogenized into a QA/QC composite sample and analysed.

Our fish tissue analyses are covered under Profile 8 of the Pogo Sample Profiles. The following table includes a list of analytes, MRLs, reporting units, analytical methods, and holding times required by the Pogo QAP. The analysis is a whole-body analysis of a minimum of twenty juvenile Chinook salmon plus two composite Chinook samples, for a total of 30 separate analyses. The fish sample will be approximately 2.8 to 3.8 grams wet weight. See **Table 1** below.

Table 1: Profile 8 Annual APDES Fish Tissue

Note: fish sample will be approximately 2.8 to 3.8 grams wet weight				
Parameter	**MRL**	**Units**	**Method**	**Holding Time**
Weight	0.1	grams	Standard Method	NA
Sample/Composite Preparation	-	-	Appendix J (EPA, 2000b)	-
Antimony, Total	0.05	Wet, mg/kg	EPA 200.8	180
Arsenic, Total (inorganic)[1]	0.5	Wet, mg/kg	EPA 200.8	180
Cadmium, Total	0.05	Wet, mg/kg	EPA 200.8	180
Copper, Total	0.1	Wet, mg/kg	EPA 200.8	180
Lead, Total	0.02	Wet, mg/kg	EPA 200.8	180
Mercury (methyl mercury)[2], Total	0.05	Wet, mg/kg	EPA 1631 or EPA 7471A	28
Nickel, Total	0.1	Wet, mg/kg	EPA 200.8	180
Selenium, Total	0.5	Wet, mg/kg	EPA 7740 (GFAA) or EPA 7741 (HGAA)	180
Silver, Total	0.02	Wet, mg/kg	EPA 200.8	180

[1] Total inorganic arsenic rather than total arsenic should be determined. For this application, it will be assumed that all arsenic is inorganic.

[2] Because most mercury in fish and shellfish tissue is present primarily as methylmercury and because of the relatively high cost of analyzing for methylmercury, it is recommended that total mercury be analyzed, and the conservative assumption be made that all mercury is present as methylmercury. This approach is deemed to be most protective of human health and most cost-effective (EPA, 2000).

3. Prepare a purchase order request based on the quote from Eurofins TestAmerica.
4. Prepare boat for sampling if river conditions allow safe use instead of using a helicopter, or
5. Prepare a purchase order for helicopter services (if river conditions are unsafe for the boat) for three days, Monday through Wednesday on one of the last two weeks of September. Keith Warren at Aurora Aviation has been our pilot.

   Aurora Aviation, Keith Warren
   6192 Remington Road
   PO Box 110
   Delta Junction, Alaska 99737

   Phone: (907) 895-1850
   auroraaviationservices@yahoo.com
6. Arrange for three or four 7 oz packages of salmon roe to be purchased from Sportsman's Wearhouse (delivered by Pogo Expeditor the week before the fish tissue sampling if necessary). Good quality commercial eggs are also available locally at sporting goods stores in Fairbanks. The eggs should be in good condition, free of dyes, and moist.

5.2 Sampling

Note: Permit regulations ask that the traps must not be left to soak for more than 24 hours while collecting fish samples. Fish sampling has priority over other environmental department assignments other than actual emergencies or unsafe conditions occurring. Please use all other available resources (other Departments, asking for more time for other projects etc.) before delaying trap collection.

1. The Fish Resource Permit will specify a Fish and Game Biologist who must be contacted for final authorization prior to any collection activities. The date and time of this contact must be recorded and included in collections reports.
2. Remove all minnow traps and bait containers from storage in the connex several days before sampling begins. Count out at least 30 traps and make sure all have closure snap and tie rope. Make

sure traps are in good condition (e.g. no tears in the mesh, dents, or loose seams). Put them together to make two stacks of at least 15. One stack will be used at SW01 and one will be used at SW12. Count the bait containers to make sure there are at least 30 (one per trap). Take the entire bag with you for spares.

3. Make sure that each trap is labelled and includes permittee's name, address, telephone number, and permit number.
4. If using non-sterilized or non-commercially packaged eggs, they must be disinfected as follows. Otherwise, skip this step. Remove one package of salmon eggs and place into a plastic sealable container. Salmon eggs used as bait in traps must either be; sterilized commercial eggs or, if raw, be disinfected prior to use. A 10-minute soak in 1/100 Betadine solution or some other iodophor disinfectant is adequate. Pour betadine over the eggs and soak for 10 minutes. After 10 minutes pour off the betadine and seal container of eggs for use in the field.
5. Make sure you have the following items before loading into the helicopter or boat:
   - 30 minnow traps with tie ropes, closure snaps, and labels
   - 1 or 2 package(s) of commercial or disinfected salmon eggs for bait
   - 1 bag of bait containers
   - 1 roll of flagging tape to locate individual traps
   - Field Data sheets or notebook to indicate specific location of each trap
   - Zip lock bags for specimens (individually labelled for each site, 30 in total for chinook.)
   - Fish measuring board
   - Nitrile gloves
   - Signed copy of Fish Resource Permit
   - Waders and boots
   - Life Vest
   - GPS
   - GPS Emergency "Spot" Tracker – recommended
   - Bear defence, shotgun and/or spray
6. Field crews must consist of at least two personnel. Crews should exercise best judgement on whether an additional safety officer / bear guard should accompany the team.
7. The first location to set traps is located near SW12. Its coordinates are near latitude 64.36722 longitude -144.93222. Separate all 15 traps at the sample site. Open the bait container and place a small amount (about the size of a small walnut shell) of salmon eggs into each of 15 bait containers. Place one bait container into each trap. Secure your life vest and then set all traps in slow water areas, pools, and slack water near sloughs or off the main channel where there are logs, stumps, roots, and other types of cover. These are locations smolt will stop to rest in and find their way into the traps. Any large puddles in sloughs can also contain juvenile salmon that were landlocked after high water. Avoid fast flowing areas to prevent fish mortality, if they are trapped in a fast current, the fish will work too hard to swim the current and lower their chance of survival.
8. Make sure all traps are **labelled, flagged, and tied securely to nearby brush or rocks**. Be sure to draw a good sketch map or take photos of the site with the location of each trap so that you can easily retrieve ALL the traps the next day. Keep track of how many traps you set. Record the site location as latitude and longitude on field data sheets.
9. If high water has changed the river channel you may need to move up or down stream slightly to find a suitable location to lay the traps. It is preferable to move SW01 location up stream and SW12 location anywhere downstream of Central Creek to maintain separation between background fish sampling above the mine site and fish tissue metal concentrations below the mine site.
10. Move to sample site SW01 and repeat the same procedure. SW01 is located near latitude 64.48472 longitude 144.87500. The traps must not soak more than twenty-four hours, so it is important to set the traps in the afternoon the day before sampling and then check them late the following morning or early afternoon.
11. When checking traps after the overnight soak, collect all the traps and bring to a central location for processing. Any empty traps can be left on shore while traps with fish need to be left in the water near the processing location.
12. If possible, have one member of the sample team act as a note taker, recording the site location, time, trap number, fish number, species, and length of each individual fish.
13. The Fish Resource Permit will specify how many Chinook salmon may be measured before release and how many may be retained for metals analysis. Take careful notes to ensure that sampling activities remain within these limits.

14. The fish handler should wear nitrile sampling gloves. Open one trap and transfer all fish into a bucket or container for temporary storage. Measure the Chinook salmon by picking up the specimen and holding it in your closed hand until it calms, usually a few seconds. Measure the fish on a fish measuring board, measuring the total length from the tip of its nose to the fork of its tail with its tail slightly compressed along the midline. Record this number on the field data sheet along with the time, which trap it came from, and which fish it was in that trap.
15. The Pogo QAP specifies that 15 fish voucher specimens with a length between 72 and 93 should be retained. The first 15 Chinook salmon in this range should be retained. Place the voucher specimen fish in a zip lock bag and humanely dispatch it. If greater than 10 Chinook over 72mm are collected, but an additional five fish in that size range are not available, smaller fish may be used for the QC composite sample purposes. The last five fish will still be bagged separately but will be composited at the lab during analysis.
16. Measured fish that are not large enough for sample retention should be temporarily placed in a separate bucket or container. These fish may be retrieved and used for QC composite samples F01-Comp01 to F01-Comp05, if more appropriate voucher specimens are not found. Once 15 fish have been bagged, additional fish may be measured and directly released.
17. Chinook caught at SW01 will be numbered as F01-01…F01-15 and chinook caught at SW12 will be numbered as F12-01…F12-15. For each sample site (SW01 & SW12) a gallon Ziploc bag should be labelled with name of sample site and date. Inside of this the individual Ziploc bags containing single fish should be placed. Each bag labelled with the fish number, date, time and initial of sampler. The two gallon-sized Ziploc bags (one for each sample site) should be frozen as soon after sampling as possible.
18. The Fish Resource Permit will describe how to document non-target fish captured in traps. Non-target fish may include slimy sculpin, trout, bourbot, and grayling.
19. If enough salmon aren't caught at a site on the first day, the traps will need to be re-baited and set again to be checked the next morning. The same procedure will then be followed for identifying and releasing non-target species and taking samples of Chinook salmon. This procedure will need to be repeated until the appropriate number of fish are captured.
20. ADF&G may request additional genetic tissue sampling. If so, half of the fish caudal (tail) fin needs to be clipped before placing the fish in the sample bag. This needs to be done for at least 30 fish.
21. Clean, dry, and store the traps out of the weather in the environmental connex. Wash all bait containers and egg sterilization containers before storage. Dry waders, boots, and life vest before putting them away. Put all sampling gear into a labelled box in the environmental building for easy access the following year. Do any boat cleaning and repair as necessary.

5.3 Shipping Samples and Reporting

1. Fill out COC using forms for Test America, Tacoma found at: G:\Enviro\Private\5. Sampling\COCs\Test America Fish Tissue. Be sure COC has current information and update completely, including PO#, and sampler's name as well as sample, time, date etc. Be sure to scan copies before sending shipment out with expeditor, they will be needed to forward to the lab.
2. If the samples are completely frozen, they can be shipped out to the lab on Tuesday once arrangements have been made. Ensure that the lab in Tacoma receives the GoldStreak air bill number as soon as possible and email it along with a copy of the COC to the lab as soon as it is available from the expeditor. Otherwise, the sample can be shipped out the following week if they are kept frozen. Holding time is 28 days (for mercury).
3. A report of collection activities, referenced to the fish resource permit number, must be submitted to the Alaska Department of Fish and Game, Division of Sport Fish HQ within 30 days after the expiration of the permit.

   Attn: Permit Coordinator
   ADF&G, Division of Sport Fish
   333 Raspberry Road
   Anchorage, AK 99518-1565

   Dfg.dsf.permitcoordinator@alaska.gov

   The report must summarize the number of fish captured by date, location (provide GPS coordinates and datum or a map), and by species, and the fate of those fish. Fish length, weight, sex, and age data should be included if collected. Copies of previous reports can be found at: G:\Enviro\Private\4. Reports\ADFG\Fish Tissue; and used for reference. The department also requests to have their ARP excel spreadsheet filled out. There is a copy found in the previous year's folder.
4. A completion report (abstract/background/methods/data/analysis), if not submitted with the collection report described above, must be submitted to the department within six months of the

expiration of the permit. Data from such reports are considered public information. Include all analytical data results in the agency *Annual Water Quality Monitoring Summary*.

6. MONITORING AND CHECKING

Field quality control (QC) samples include field blanks, equipment rinsate blanks, and field duplicate samples. Refer to the *Pogo QAP*, Section 5.1.3, for a description of common field QC samples, the associated collection method, and the applicable QC sample frequency.

7. MAINTENANCE AND CALIBRATION

Calibration of instruments used in collecting field parameters (i.e. YSI Meter) is performed before every sampling event (refer to *Water Meter Calibration SWP*). Maintenance is performed at regular intervals recommended by the manufacturer. Calibration and maintenance are documented on the *Pogo Mine YSI Meter Calibration Form*, the *Pogo Mine Hach Turbidimeter Calibration Form*, and the *Instrument Maintenance Form*.

8. RECORDS

Record Description	Record Location / Retention Responsibility	Minimum Retention Time
Annual Fish Resource Permit application	Environmental Archives / Environmental Manager	5 years
Annual Completion Report of Collection Activities for Fish Resource Permits	Environmental Archives / Environmental Manager	5 years
ADF&G Permit Catch Data, excel spreadsheet, frpSF20XX-XXX	Environmental Archives / Environmental Manager	5 years
Fish Tissue Sampling Field Data Sheets	Environmental Archives / Environmental Manager	5 years
Pogo Mine YSI Meter Calibration Form	Environmental Archives / Environmental Manager	5 years
Pogo Mine Hach Turbidimeter Calibration Form	Environmental Archives / Environmental Manager	5 years
Instrument Maintenance Form	Environmental Archives / Environmental Manager	5 years

9. DEPARTURES FROM PROCEDURES

9.1 Notifications

During sample collection, if any unusual circumstances occur, notification of supervisor is required immediately.

9.2 Environmental and Legal Consequences

Non-compliance with Pogo's environmental permits such as APDES Permit No. AK0053341 could have a potentially adverse effect to the environment. A permit exceedance may lead to Notice of Violation, or a Compliance Order by Consent.

9.3 Consequences to Employees

Failure to follow this procedure could result in unsafe practices or conditions contributing to an incident possibly resulting in injury. In some instances, situations will dictate variances from this procedure. A variance shall only be given with approval from the Environmental Manager.

Failure to follow this procedure may result in an adverse effect to the environment which could lead to civil and/or criminal penalties for the company and those involved. Procedural failures may also adversely affect company performance records and NSR's public image.

10. RELATED DOCUMENTS

Document Name	Document Number
Annual Permit SF20XX-XXX Fish Resource Permit	
ADEC APDES Permit	
Pogo Mine Monitoring Plan	PGO-ENV-011-PLA
QAP Quality Assurance Project Plan	PGO-ENV-039-PLA
Water Meter Calibration SWP	PGO-ENV-037-SWP

11. APPENDICES

Appendix I - Fish Tissue Field Data Sheet

Appendix II - Sampling Field Data Sheet

Appendix III - Chain of Custody Template

11.1 Appendix I - Fish Tissue Field Data Sheet

	Pogo Mine Fish Tissue Sampling Field Data Sheet						
Arrival Time:				Channel Depth:			
EDMS Site Number	**SW01**			Flow Conditions:			
Date					**Latitude:**	**N 64.48472**	
Time					**Longitude:**	**W 144.87500**	
Profile	**13s (Surface Water)**						
Duplicate Sample Indentifier				Time			
Blank Sample Identifier				Time			
Field Preserved	**Yes**						
Field Filtered							
Parameters Measured in the Field							
Filtered at Field Lab		Time					
Parmeters Measured at Field Lab		Time					
Temperature				°C			
DO-Dissolved Oxygen				mg/L			
pH				s.u.			
Specific Conductance				µS			
Turbidity				NTU			
Appearance							
Field Conditions	Indoors	Temperature		Skies		Wind	
	N/A						
Field Equipment	YSI Meter	Gloves	Bottles	Coolers	Dip Stick	DI Water	PPE
Notes/Comments							
Field Team Members Signatures							

Fish Number	Date/Time	Length (cm)	Weight (g)	Notes
F01-01				
F01-02				
F01-03				
F01-04				
F01-05				
F01-06				
F01-07				
F01-08				
F01-09				
F01-10				
F01-Comp01				
F01-Comp02				
F01-Comp03				
F01-Comp04				
F01-Comp05				

11.2 Appendix II – Sampling Field Data Sheet

	Pogo Mine Sampling Field Data Sheet						
Arrival Time:				Channel Depth:			
EDMS Site Number	**SW12**			Flow Conditions:			
Date					**Latitude:**	**N 64.36722**	
Time					**Longitude:**	**W 144.93222**	
Profile	**13s (Surface Water)**						
Duplicate Sample Indentifier				Time			
Blank Sample Identifier				Time			
Field Preserved	**Yes**						
Field Filtered							
Parameters Measured in the Field							
Filtered at Field Lab		Time					
Parmeters Measured at Field Lab		Time					
Temperature				°C			
DO-Dissolved Oxygen				mg/L			
pH				s.u.			
Specific Conductance				µS			
Turbidity				NTU			
Appearance							
Field Conditions	Indoors	Temperature		Skies		Wind	
	N/A						
Field Equipment	YSI Meter	Gloves	Bottles	Coolers	Dip Stick	DI Water	PPE
Notes/Comments							
Field Team Members Signatures							

Fish Number	Date/Time	Length (cm)	Weight (g)	Notes
F12-01				
F12-02				
F12-03				
F12-04				
F12-05				
F12-06				
F12-07				
F12-08				
F12-09				
F12-10				
F12-Comp01				
F12-Comp02				
F12-Comp03				
F12-Comp04				
F12-Comp05				

11.3 Appendix III - Chain of Custody Template

Northern Star (Pogo) LLC Chain of Custody

Page of

# of Coolers:

Company Name: **Northern Star (Pogo) LLC**	Contact Name: Phone:	Laboratory Name:
Report Mail Address: ***3205 International Street*** ***Fairbanks, Alaska 99701***	Invoice to: pogo.ap@nsrltd.com **P.O. #:**	Mail Adddress:
Email: pogoenvironment@nsrltd.com	**Turnaround Time for Results (TAT)** _X_ **Standard** ____ **Expedited**	Lab Phone: **APDES Permit #:** AK0053341 **Public Water System (PWS) ID#:**
Special Instructions/Comments:	**Requested Analysis/Method:**	**Work Order #:**

Lab ID#													
Client Sample Identification / Location	**Date Sampled**	**Time Sampled**	**Matrix (S-DW-WW-Other)**	**No. of Containers**									**Field Preserved**

Relinquished by:	Date	Time	Received by:	Date	Time
Relinquished by:	Date	Time	Received by:	Date	Time
Relinquished by:	Date	Time	Received by:	Date	Time

Name of Sampler: (printed)

Version 1.0 G:\Enviro\Private\Sampling\COC Forms_Profiles

Section To Be Completed by Laboratory

Custody Seal Intact? Y / N _____

Samples On Ice? Y / N _____

Receipt Temperature: _____°C

Signatures Complete? Y / N _____

Signatures Match? Y / N _____

Add'l Notes: _____

1. PURPOSE

The purpose of this Safe Work Procedure (SWP) is to ensure that members of the Environmental Department uniformly, and safely, calibrate the YSI meter prior to the collection of field parameters to ensure consistent and representative data.

2. SCOPE

The Environmental Department is responsible for collecting compliance water samples in accordance with the schedule provided in the Waste Management Permit 2018DB0001 and the Pogo Mine Monitoring Plan. Field parameter/data collection with a correctly calibrated water quality meter and turbidimeter is required as described in the *Pogo Quality Assurance Plan, December 2019 (QAP)*. Calibration of pH, specific conductance, dissolved oxygen, and a barometric pressure and temperature check are part of the YSI meter calibration and maintenance protocol. Calibration of turbidity is part of the Hach 2100Q calibration and maintenance protocol. Also included are guidelines for downloading the temperature datalogger (and management of the data) for the Environmental Field Lab refrigerator. This is to ensure that collected samples, stored there awaiting shipment, are remaining within the required temperature range.

3. ROLES AND RESPONSIBILITIES

Role	Key Responsibilities
Environmental Manager	Environmental Manager is responsible for overseeing the correct and timely sampling requirements, including field parameters collected with the YSI meter, of all applicable permits.
Environmental Personnel	Environmental personnel are responsible for following this SWP and performing calibration before collecting any field parameters with the YSI meter.

4. DEFINITIONS AND ACRONYMS

ADEC	Alaska Department of Environmental Conservation
APDES	Alaska Pollutant Discharge Elimination System
BP	Barometric Pressure
DI	Deionized water
DO	Dissolved Oxygen
NIST	National Institute of Standards and Technology
QAP	Quality Assurance Plan
SWP	Safe Work Procedure
mmHg	Millimetres of Mercury

5. PROCEDURE

While handling reagents or solutions used for calibration, sampling gloves and safety glasses are required. General laboratory hygiene should be followed (no eating, drinking, or smoking, etc.) Use reagents in a well-ventilated room and avoid breathing any fumes or vapors from the reagents.

5.1 YSI Professional Plus Water Meter

Calibration for temperature, pH, Conductivity, and Dissolved Oxygen (DO) are required before every sampling event that includes these field parameters.

Before beginning actual calibration, turn on YSI.

1. Check Battery level, if less the ¼ charge replace batteries.

Check Time and Date (set if necessary).

Use the Pogo Mine YSI Meter Calibration Form (see attachment) to record every calibration performed on YSI meter. Always make sure the calibration solutions used are listed at bottom of the sheet along with their expiration dates (to ensure no expired solutions are used for calibration). If a new bottle of calibration solution is needed, a new calibration form should be used and filled out appropriately.

5.2 Conductivity

1. Press the Cal key.
2. Highlight the Conductivity and press enter. A second menu will offer the option of calibrating Specific Conductance, Conductivity, or Salinity. Highlight and select Specific Conductance. Calibrating one automatically calibrates the other two. An additional sub-menu will require you to select the calibration units, all Pogo Conductivity units are to be collected and recorded as uS/cm.
3. Place the calibration standard into a clean, dry or pre-rinsed container.
4. Immerse the probe into the solution, making sure the sensor and thermistor are adequately immersed. Allow at least one minute for temperature to stabilize.
5. For any of the parameters, enter the calibration solution value by highlighting Calibration Value at the top of the screen using the arrow keys, then pressing enter. Continue using the alpha/numeric screen and the arrow keys to enter the known value. Once you have entered the value of the calibration standard, highlight <<<ENTER>>> and press enter ENTER on the keypad.
6. Wait for the readings to stabilize, highlight Accept Calibration and press enter ENTER to calibrate.

Record data collected during calibration on the Pogo Mine YSI Calibration Form.

5.3 Temperature Check

The temperature sensor is not standardized. However, it should be checked against a National Institute of Standards and Technology (NIST) traceable thermometer. Record the NIST thermometer identification number and calibration date on the Pogo Mine YSI Calibration Form.

1. Place the probe and the NIST-traceable thermometer in a container of water.
2. Allow both devices to stabilize (approximately 20 to 30 seconds).
3. If the temperature reading recorded from the YSI is within ±4°C of the NIST thermometer reading, apply a correction factor equal to the difference between the NIST thermometer and YSI reading as follows.
   i. Calculate correction factor as temperature measured by:(NIST) thermometer reading) subtract (temperature measured by the YSI).
   ii. Record the difference as the correction factor on *the Pogo Mine YSI Calibration Form* in the following format: "add 0.2°C to each reading" or "subtract 0.2°C" from each reading" so that there is no uncertainty as to the use of the correction factor.
   iii. Clean and properly store the NIST-traceable thermometer.
   iv. Apply this correction factor to temperature measurements recorded by that YSI meter during both standardization and field measurements.

Alternatively, if the temperature reading of the YSI is not within ± 4°C of the NIST thermometer reading, remove the YSI from service, tag as "do not use," and return to manufacturer for maintenance.

5.4 pH Calibration

Use room temperature pH calibration fluids (they may be stored in the refrigerator but allow to warm up before using).

If there is more than a 10-degree temperature difference from 200 C standard temperature for the buffer solutions, a corrected pH value is used (listed on the back of the buffer solution bottle) when calibrating the YSI meter; this corrected value is also recorded on the calibration form under "Temp Corrected pH".

- Perform a 3-point calibration in the following order:
  - 7.0 buffer,
  - 4.01 buffer,
  - 10.1 buffer.

1. Press the Cal key.
2. Highlight **ISE (pH)** and press enter ENTER.
3. A sub-menu will appear allowing for the number of points to be taken during calibration. The message will show ready for point 1. The auto-buffer recognition will determine which buffer solution the meter is in.
4. Immerse the probe into the solution making sure the thermistor and temp probe are fully covered in solution, allow for at least one minute for the temperature to stabilize.

5. Highlight **Calibration Value** and press enter  , use the keypad to enter the value of the calibration standard and press enter  .
6. Once the readings stabilize, highlight **Accept Calibration** and press enter  to calibrate.
7. Rinse the probe with DI water and continue to the next point and repeat steps 4-7. After the last point is calibrated press the Cal  key to complete the calibration.

Record data collected during calibration on the *Pogo Mine YSI Calibration Form*.

Once calibration is complete perform a post calibration verification check on the pH 4 and pH 10 buffer solutions (see section 6.4). Record the values in the Final Reading column on the calibration form. The acceptable standardization range for pH is ±0.05 standard unit (s.u.) of the known standard values. Instruments that do not meet the standardization criteria should be removed from service, tagged as "do not use," and returned to the manufacturer for maintenance.

For troubleshooting tips use this weblink: https://www.ysi.com/File%20Library/Documents/Tips/YSI-Professional-Plus-Calibration-Tips.pdf

5.5 pH / ORP Combination Sensor Calibration – use when requested

The pH/ORP combination sensor is installed on YSI PP2. Before calibrating the ORP sensor, follow the instructions in section **6.5** to calibrate pH first. Always calibrate pH before ORP to make sure the sensor is working. The ORP calibration should be verified every day the instrument is used. However, a new ORP sensor may be capable of holding its calibration for several days. Calibrate the pH/ORP sensor with Hanna Instruments 240 mV ORP Solution for Platinum and Gold Electrodes.

1. Press the Cal  key on the **YSI**.
2. Highlight **ISE (ORP)** and press enter  .
3. A sub-menu will appear, scroll up and highlight the Calibration value selection and hit  .
4. On the next screen, enter the calibration standard value (240 mV) then hit  .
5. Immerse the probe in the 240 mV ORP solution and wait for the YSI meter readings to stabilize.
6. Record the initial ORP and temperature readings on the calibration form. Highlight **Accept Calibration** and hit  .
7. Remove the probe from the ORP Solution and re-submerge it. Allow the probe readings to re-stabilize on the YSI meter. Record the actual calibration value on your calibration form.
8. If you receive a warning message stating that the calibration is questionable, do not continue with the calibration. Instead, select 'No' and investigate what is causing the questionable results. If you accept a questionable calibration, your ORP readings will be erroneous. Typical causes for this error message include: incorrect Sensor/Port setup in the instrument, a dirty sensor or bad calibration solution.
9. For troubleshooting tips use this weblink: https://www.ysi.com/File%20Library/Documents/Tips/YSI-Professional-Plus-Calibration-Tips.pdf

5.6 Dissolved Oxygen Calibration

1. To begin, make sure the YSI is on or turn the YSI on. Remember that if the DO is calibrated in % units it automatically calibrates in mg/L as well.
2. Place a small amount of water (1/8 inch) in the calibration/transport cup and screw it on the probe. Disengage a thread or two to ensure atmospheric venting. Make sure YSI meter is on for at least 10 minutes prior to beginning DO calibration, the DO probe needs to polarize. Make sure the DO and temperature sensors are not immersed in the water.
3. Press the Cal  key, Highlight **DO** and press enter  .
4. Highlight **DO%**, then press enter  .
5. Verify the barometric pressure displayed is accurate. Check the barometric pressure against the airport weather station. The airport weather station web address is https://app.konectgds.com/kiosk/3af0c101-d047-4855-944c-977c7cdd7dd4. The weather station records in millibars, to begin calibration however it needs to be converted to mmHg by multiplying the millibars by 0.75006 mmHg to get mmHg. Highlight the mmHg value and press enter  . Using

the alpha numeric keyboard type in the mmHg value obtained from the weather station conversion.

highlight Accept Calibration and press enter 

. Record the percentage DO value.

Record data collected during calibration on the *Pogo Mine YSI Calibration Form.*

5.7 Check Calibration

The "Check Calibration" column on the *YSI Meter Calibration Form* is used to indicate whether the YSI instruments have accepted calibration within the range required by our regulations.

- pH checks are performed after calibration is complete.
- Place probe in 4.01 buffer and reading should be ±0.05 or between 3.96 and 4.06.
- Place probe in 10.01 buffer and reading should be ±0.05 or between 9.96 and 10.06.

If calibration on any parameter is unsuccessful:

- Clear all files by resetting the meter to default. This will reset the meter to a factory setting.
- Thoroughly clean the probe and all sampling containers using DI water. Note: do not use Q-Tips, cleaners, or other detergents unless you have been trained in YSI deep cleaning and maintenance.
- Confirm that the probe components and the cord are not loose or damaged.
- Record all non-calibrations and what actions were taken on calibration forms.
- Attempt a new calibration. If the YSI fails a second calibration, remove the YSI from service, tag as "do not use," and return to manufacturer for maintenance.

5.8 Field Maintenace

On a semi-annual basis a more extended cleaning and instrument check is recommended. Record date of maintenance and person performing maintenance/cleaning on Instrument Maintenance Log (see attachment).

1. Temperature Check: Compare YSI reading to a calibrated/certified thermometer (NIST-traceable thermometer) reading. If temperature is not reading correctly (within 4 degrees C) Tagout the equipment and prepare to ship out for repair or replace with new probe. YSI meter needs to be taken to manufacturer's technician for calibration.
2. Barometric Pressure Check: Check barometric pressure of the YSI meter against the barometer at the Pogo Airport Weather Station. If the pressure varies significantly tagout the equipment and prepare to ship out for repair or replace with new probe. YSI meter needs to be taken to manufacturer's technician for calibration.
3. General care of probes includes:
   - Remove probes from bulkhead, check for signs of water.
   - Replace O-rings if water is present.
   - Wipe off any old grease and dry bulkhead and sensor ports.

Clean each probe, but with caution, do not get water or detergent on the bulkhead sensor interface.

4. DO Probe: replace membrane if it looks clouded over. Sand dielectric probe and rinse with DI water, replace O-ring if necessary.
5. Conductivity/Temperature Probe: Use Alconox/Liquinox soap on test tube brush to scrub inside sensor tunnel 15-20 times. Remove any tarnish on external sensor as well. Use a green scrubby pad and soap to clean body of probe.
6. pH Probe: Use Scrubbing Bubbles cleaner and cotton swabs to clean glass bulb, rinse with tap water, repeat until bulb is clean. Use green scrubby pad and Bubbles to clean body of probe.

Do not put too much pressure on glass bulb, it is extremely fragile.

When all the probes are clean make sure everything is dry, add new grease, re-attach probes and rinse with water.

5.9 Storage of YSI Meter

Use buffer solution 4.01 to store pH probe between sampling events, only a small amount is needed in transportation cup; probes do not need to be covered with solution. Out-of-date buffer solution can be used for this. While in the field, or collecting samples, probes just need to stay damp. DI water used to rinse probes between sample collections is generally sufficient.

Don't screw on the transportation cup too tightly, it damages the threads!

5.10 Turbidimeter Calibration

The Hach 2100Q field turbidity meter or equivalent field instrument shall be calibrated quarterly and receive a calibration verification check prior to the first use each day that the field turbidity meter is used. Set calibration reminder repeat in the calibration options menu. A factory calibration will be performed once per year.

If a daily verification check fails to meet the acceptance criteria of ± 10% of known turbidity standard value, the turbidity meter will need to be recalibrated prior to use. Document all re-calibrations and if the meter is sent out for maintenance on the calibration form.

During calibration, three turbidity standards (20, 100 and 800 NTU) shall be used. Calibration shall start with the 20 NTU standard and then proceed in ascending order from lowest to known highest turbidity standards. Acceptance criteria during calibration is ± 10% of known turbidity standard value. All attempts to calibrate need to be recorded on the calibration form. If it fails a second re-calibration let the manager know and send out for maintenance.

After the calibration, a verification check shall be performed using the 10 NTU turbidity standard. If the value is outside of the acceptance criteria of ± 10% of known turbidity standard value, a recalibration must be conducted.

To calibrate the turbidimeter:

1. Push the calibration key to enter calibration mode. Follow the instructions on the display
2. Insert the first known turbidity solution and close the lid with diamond or orientation mark aligned with the raised orientation mark in front of the cell compartment
3. Push the Read key and wait for the result to show on the screen
4. Record the reading on the calibration log
5. Repeat steps 1-4 with the other known turbidity solutions

Smudges, dust and debris on the calibration standard vials can impact the readings. Use care when handling the calibration standard vials and wipe clean with a Kimwipe or clean rag prior to calibration.

6. MONITIORING AND CHECKING

As per the *Pogo QAP*, internal auditing of sample collection takes place at regular intervals. Calibration of the YSI meter is performed before each sampling event. Collection of field parameters (pH, conductivity etc.) is performed during sample collection, and any unusual circumstances noted on the *Sample Field Data Sheets*.

6.1 Refrigerator Temperature Datalogger

The refrigerator in the Environmental Field Lab is used for sample storage prior to shipment. A continuous, battery powered datalogger, recording a single temperature reading every hour, monitors the interior temperature. Visual checks on the temperature logger should be done before sampling events to make sure the refrigerator is maintaining a constant temperature above 0° C and below 6° C (32.0 to 42.8 Fahrenheit). Never let samples freeze. The datalogger should be downloaded weekly to keep a close watch on the refrigerator temperatures and trends. Any temperatures out of the desired range are checked against the sampling schedule to ascertain if stored samples were subjected to higher or lower temperatures than desired. However, while reviewing data, take into consideration that when samples are first introduced into the refrigerator a temperature stabilization period may be required.

6.1.1 ONSET HOBOwear Data Logger Software Install and Data Download Process

To download the ONSET HOBOware datalogger software follow the link below. Keep in mind that you may need to request help from the IT department for administrative access.

Link: https://www.onsetcomp.com/hoboware-free-download

To download datalogger temperature data:

1. Connect with micro USB to computer,
2. Open the HOBOware application on your computer.
3. The HOBOware data screen will have a row of buttons on the top left of the page. Select the **Stop Logger** option and it will prompt you with a yes or no option to stop the logger, select **Yes**. Look at the data logger screen, it should read **Stop**.
4. Next, find the **Readout** button on the top left of the screen. A window will appear to save the file. Save the file with the date that the logger was last downloaded to the current date (12.3.19.hobo to

12.10.19.hobo). Make sure the file is being saved in Refrigerator Temp Logs on the G Drive: G:\Enviro\Private\5. Sampling\Refrigerators Temp Logs. When file is ready to be saved, click save.

5. Another window will appear, and it will ask you if you want to plot the data, select **Yes**.
6. Look at the data to see if there are any outliers in the data. Outliers can be from the refrigerator being opened, the datalogger being removed from the refrigerator and downloaded, a large sample event, placement of the logger in the fridge, stacking the freezer with water bottles to be frozen in the freezer, or refrigerator failure. If temperatures are above 6° C check the temperature dial in the refrigerator, check the placement of the datalogger, look at the sample schedule and try to figure out what happened and if there were any samples in the refrigerator during that time. If there is something to note, open the file for the datalogger download and add a note. Here are a couple of examples: (12.3.19.hobo to 12.10.19 surface water sampling.hobo) or (12.3.19.hobo to 12.10.19 battery replaced.hobo).
7. When all the data has been checked, click the **Start Logging** button on the top right of the HOBOwear window. Another window will appear to name the new file and set the parameters. The parameters should log temperatures every minute, this is an auto setting that should already be selected. This screen will also allow you to name to file with the current date. When the datalogger is ready to launch click the **Start** button on the bottom right of the window. The datalogger screen should say that it is logging, and it will display the current temperature.
8. Place the datalogger in the refrigerator, it is best to place the logger in a central location to get the best representation of the refrigerator temperature.

7. MAINTENANCE AND CALIBRATION

Water Quality Meter maintenance and calibration, by manufacturer qualified representatives/technicians is performed at regular intervals as recommended by the manufacturer, or more frequently as required. Calibration and maintenance are documented on the *Pogo Mine YSI Meter Calibration Form*, *Pogo Mine Hach Turbidimeter Calibration Form* and the *Instrument Maintenance Log*.

8. RECORDS

Record Description	Record Location/ Retention Responsibility	Minimum Retention Time
Pogo Mine YSI Meter Calibration Form	Environmental Archives / Environmental Manager	5 years
Pogo Mine Hach Turbidimeter Calibration Form	Environmental Archives / Environmental Manager	5 years
Field Instrument Maintenance Form for hand-held instruments	Environmental Archives / Environmental Manager	5 years
Environmental Lab Refrigerator Datalogger Temperature Records	Environmental Archives / Environmental Manager	5 years

9. DEPARTURES FROM PROCEDURE

This SWP was written to comply with applicable laws and regulations pertaining to the collection of compliance water samples and associated field parameters at Pogo Mine, as per the *Pogo Quality Assurance Plan, December 2019*.

9.1 Notifications

9.1.1 Internal Notifications

If YSI meter fails to calibrate despite several attempts following the guidelines in this procedure, and after field maintenance is performed, the Environmental Manager shall be notified, and arrangements made to send the YSI or Turbidimeter Meter out for repair by manufacturer qualified technicians.

9.1.2 External Notifications

None required.

9.2 Environmental and Legal Consequences

Non-compliance with calibration requirements in the *Pogo Quality Assurance Plan, December 2019*, (included, by reference, in the *APDES Permit Number AK0053341 and the Waste Management Permit 2018DB0001)*, could have a potentially adverse effect on the data integrity.

9.3 Consequences to Employees

Failure to follow this procedure could result in unsafe practices or conditions contributing to an incident possibly resulting in injury. In some instances, situations will dictate variances from this procedure. A variance shall only be given with approval from the Environmental Manager.

Failure to follow this procedure may result in an adverse effect to the environment which could lead to civil and/or criminal penalties for the company and those involved. Procedural failures may also adversely affect company performance records and NSR's public image.

10. RELATED DOCUMENTS

Document Name	Document Number
ADEC Waste Management Permit 2018DB0001	
Pogo Mine Monitoring Plan	PGO-ENV-011-PLA
Pogo QAP - Quality Assurance Plan	PGO-ENV-039-PLA
YSI Professional Plus User Manual	
YSI Professional Plus Quick-Start Guide	

11. APPENDICES

Appendix I - Pogo Mine YSI Meter Calibration Form

Appendix II - Pogo Mine Hach Turbidimeter Calibration Form

Appendix III - Instrument Maintenance Log

11.1 Appendix I - Pogo Mine YSI Meter Calibration Form

Pogo Mine YSI Meter Calibration Form

YSI Meter Serial Number*		YSI Temp	NIST Temp	NIST - YSI = corr. factor	Correction factor ("add ?? degrees or subtract ?? degrees from reading.") (±4 °C= remove for maintenance)	

Calibration Date		Sensor	Buffer Conc.	At Temp	Initial reading	Instrument Reading Final	Actual Temp		Temp Corrected pH	Check Calibration	Calibrated? Y/N
Calibration Time		Specific Conductance	1413 uS/cm	@ 25°C			@	°C	NA		
		pH	7.00	@ 25°C			@	°C		NA	
Location-Lab		pH	4.01	@ 25°C			@	°C		pH between 3.96 and 4.06?	
		pH	10.01	@ 25°C			@	°C		pH between 9.96 and 10.06?	
Location-Field		NO3-	1 mg / L	@ 25°C			@	°C		* = +/- 10% of reading or 2mg/L-N, whichever is greater	
		NO3-	100 mg / L	@ 25°C			@	°C		* = +/- 10% of reading or 2mg/L-N, whichever is greater	
Calibrated by Initals		D.O.	_____ mm Hg	@ 25°C			%	°C	NA	* = +/- 10% of reading or 2mg/L-N, whichever is greater	
		ORP	240mV	@ 25°C			@	°C		* = +/- 10mV	

*Serial Numbers: Meter#1: **17L102649** Meter#2: **18E101077** Meter#3: **18K100422** Meter #4: 18K100423

Calibration Solution Info	Conc. of Buffer	Manufacturer/Accuracy	Lot #	Exp. Date
Confidence Solution	YSI 5580	YSI Inc		
Specific Conductivity	1.413 @ 25°C	Oakton		
NO3-	1 mg/L @ 25°C	YSI Inc ± 10% or 2mg/L		
NO3-	100 mg/L @ 25°C	YSI Inc ± 10% or 2mg/L		
ORP	240mV @ 25°C	Hanna		
pH	7.00 @ 25°C	Oakton; ±0.01		
pH	4.01 @ 25°C	Oakton; ±0.01		
pH	10.01 @ 25°C	Oakton; ±0.02		

Maintenance	
Date Battery Replaced:	Date Probe Replaced:

11.2 Appendix II - Pogo Mine Hach Turbidimeter Calibration Form

		TURBIDIMETER CALIBRATION			
		Standard NTU Value	Reading	Calibrated? Y/N	Maintenance
Turbidimeter ID		10.0			Date :
Calibration Date					Maintenance Performed:
Calibration Time		20.0			
Location-Lab		100.0			
Location-Field		800.0			
Calibrated by					
Turbidimeter ID		10.0			Date :
Calibration Date					Maintenance Performed:
Calibration Time		20.0			
Location-Lab		100.0			
Location-Field		800.0			
Calibrated by					
Turbidimeter ID		10.0			Date :
Calibration Date					Maintenance Performed:
Calibration Time		20.0			
Location-Lab		100.0			
Location-Field		800.0			
Calibrated by					
imeter Serial Number		10.0			Date :
Calibration Date					Maintenance Performed:
Calibration Time		20.0			
Location-Lab		100.0			
Location-Field		800.0			
Calibrated by					
Turbidimeter ID		10.0			Date :
Calibration Date					Maintenance Performed:
Calibration Time		20.0			
Location-Lab		100.0			
Location-Field		800.0			
Calibrated by					

Meter 1 SN: ***16030C048119*** *Meter 2 SN:* ***17040C057188*** Meter 3 SN: **18090C069100**

Calibration Solution	Manufacturer	Lot #	Exp. Date
10			
20			
100			
800			

11.3 Appendix III - Instrument Maintenance Log

Instrument Maintenenace Log			
Instrument	**Date**	**Maintenance Perfomed**	**Person/Company**

1. PURPOSE

The purpose of this SWP is to ensure that Alaska Pollutant Discharge Elimination System (APDES), outfall samples are collected safely and that they are representational and uncontaminated.

2. SCOPE

The Environmental Department is responsible for collecting the samples in accordance with the schedule provided in the APDES Permit AK0053341 and the Pogo Mine Monitoring Plan. Outfall samples must be collected according to US Environmental Protection Agency (EPA) and the Alaska Department of Environmental Conservations (ADEC) requirements in order to maintain compliance with Pogo's permits.

3. DEFINITIONS AND ACRONYMS

ADEC	Alaska Department of Environmental Conservation
APDES	Alaska Pollutant Discharge Elimination System
COC	Chain of Custody
DMR	Discharge Monitoring Report
EDMS	Environmental Data Management System
EPA	Environmental Protection Agency
QAP	Quality Assurance Plan
MWTP#3	Mine Water Treatment Plant #3
SWP	Safe Work Procedure
ORTW	Off River Treatment Works
STP	Sewage Treatment Plant

4. ROLES AND RESPONSIBILITIES

Role	Key Responsibilities
Environmental Manager	Environmental Manager is responsible for APDES Permit provisions and requirements, as well as any updates or renewals associated with the permit and any required notifications to the state or federal agencies.
Environmental Personnel	Environmental personnel are responsible for following this SWP while collecting all APDES Outfall samples.
Water Operators	Water Operators are responsible for operating and maintaining the water treatment plants and STP in accordance with Pogo's SWPs and policies and in compliance with Pogo's permits.
Pogo Expeditor	Pogo Expeditor is responsible for delivering the APDES Outfall samples to the laboratory designated by the Environmental Department in a timely manner.

5. PROCEDURE

5.1 Sampling Sites

APDES Outfall sample sites at Pogo were selected in consultation with EPA and ADEC. APDES Permit AK 0053341 identifies the compliance points as:

- NPDES001B (Figure 1)
- OUTFALL001 (Figure 2)
- OUTFALL002 (Figure 3)
- STP002 (Figure 4)
- OUTFALL011 (Figure 5)

Other sample points that are not required by permit:

- WTP-FEED2 (Figure 6)
- WTP-FEED1 (Figure 7)

The facility discharges to the Goodpaster River from locations OUTFALL001 and OUTFALL002. Outfall 001 is the discharge point for treated mine water and mine-contacted storm water and is located at latitude 64°28'12" N, and longitude 144°55'03" W. Outfall 002 is the discharge point for treated domestic wastewater and is located at latitude 64°26'36" N, and longitude 144°56'30" W. Outfall 011 is the discharge point from MWTP#3 that mixes with influent river water at the Off River Treatment Works (ORTW). NPDES 001B is a natural condition sample taken from the Goodpaster River influent to the ORTW.

WTP-FEED2 is influent to Mine Water Treatment Plant #3 (MWTP3) from 1230 sump underground, and WTP-FEED1 is an influent from the RTP head tank. Neither are a compliance points, however samples are collected upon occasion when more water quality data is desired.

Figure 1. NPDES001B sample port

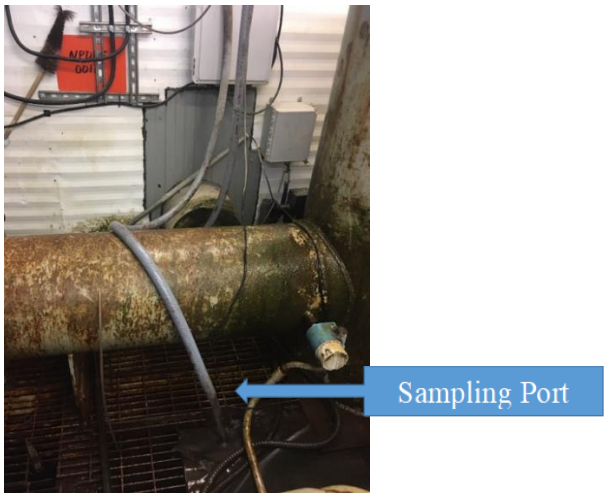


Figure 2. OUTFALL001 sample port

Figure 3. OUTFALL002 sample port after UV disinfection

Figure 4. STP002 sample site, influent tank at Sewage Treatment Plant

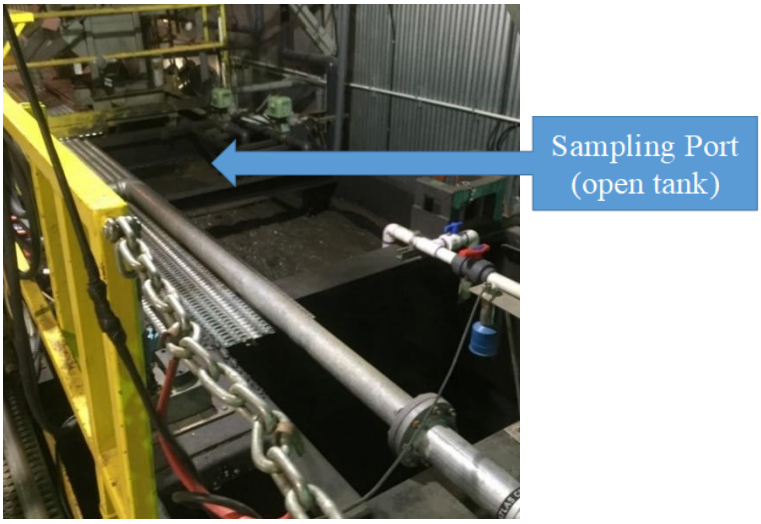


Figure 5. OUTFALL011 sample port at turbidimeter

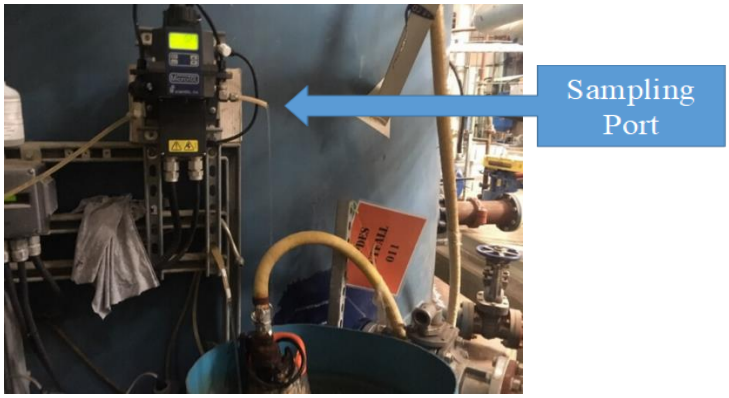


Figure 6. WTP-FEED2 sample port at MWTP3 U/G water influent pipe

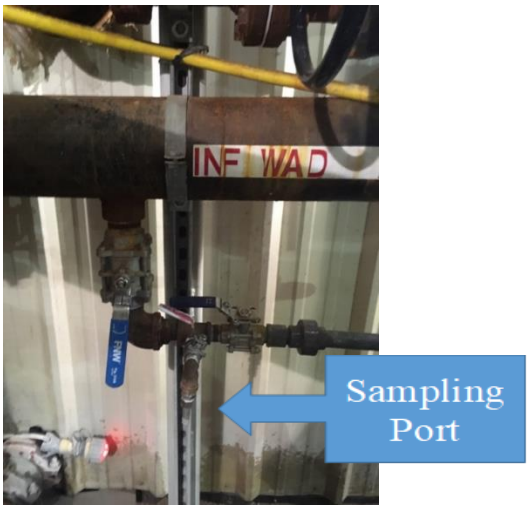


Figure 7. WTP-FEED1 sample port at MWTP#3 RTP head tank water influent pipe

5.2 Sampling Schedule

EDMS, the Environmental Data Management System, contains the current sampling schedule, refer to this for detailed weekly sampling schedule, including which laboratories will receive samples.

- NPDES001B is sampled weekly with a 10a profile and monthly with a 10b profile, only turbidity is required by permit, other parameters are for internal monitoring purposes.
- OUTFALL001 is sampled weekly with a 10a profile and monthly with a 10b profile. Chronic Whole Effluent Toxicity testing is conducted annually.
- OUTFALL002 is sampled monthly with a 12a profile (Pollen)
- STP002 is sampled quarterly with a 12b profile. (Pollen)
- OUTFALL011 is sampled weekly with an 11a profile and quarterly with an 11b profile.
- WTP-FEED2 is sampled identically to OUTFALL011, for internal monitoring purposes.
- WTP-FEED1 is sampled when requested for internal monitoring purposes.

5.3 Preparations for Sampling

5.3.1 Field Data Sheets and COCs

Field Data Sheets are designed specific to each sample site and are kept in the Field Lab file cabinet. They can be partially filled out prior to field work. A clipboard and pen are also recommended. If errors are made in the field a single line though the error and the sampler's initials next to it are required by law. The correction can be written next to the lined-out item.

In addition to field data sheets, a paginated sampling field notebook is required for sampling. Record date, location, arrival time, weather conditions (if applicable), and sample profile. Field parameters should be identical between the field notebook and field data sheets.

COCs can be prepared on the computer ahead of time and printed out, leaving only the sampling time to be filled in after the sampling events. Alternately, if time allows, COCs can be filled out on the Field Lab computer and printed out ready to sign. Be sure to sign, date, and record the time of relinquishment to the Expeditor. After the Expeditor signs, dates, and records the time on the COCs, copy all the COC's before giving the Expeditor the originals Send the labs an email with a PDF of the signed COCs.

5.3.2 Field Data Sheets and COCs

Sample bottle labels can be prepared before the sampling event, but the date and time must remain blank until the sample is actually collected. Sample bottle sets are organized differently according to which laboratory will receive the samples.

Samples analyzed by **Pollen Environmental** (OUTFALL002, STP002, and Drinking Water) are individual bottles, pre-preserved. Use the *Sampling Key* to prepare profile sets for sample collection.

Samples analyzed by **Energy Labs** (the metals portion of Outfall 002, other Outfall samples, Surface water, Groundwater etc.), use profiles that come assembled in Ziploc bags, however, preservative is included in separate vials with color-coded caps.

Place sampling gloves into a large Ziploc bag in each cooler. Gloves are necessary to prevent contamination whenever handling sample bottles, including labeling, collecting samples, and when adding preservatives. Gloves and safety glasses are required when handling preservatives as per Pogo policy; they provide eye and skin protection while handling preservatives.

5.3.3 Instrument Calibration

Calibrate the YSI meter and Turbidimeter immediately prior to sample collection (as described in the *Water Meter Calibration SWP*).

5.4 Sampling

Review all sampling procedures as outlined in the *Pogo Quality Assurance Plan (QAP),* sections 3 and 4, before the sampling event. The *QAP* also lists sample bottle type, preservative requirements, and hold times (Section 20, of *Pogo QAP*).

It is important to consider the order of sample collection each time multiple samples are collected. Samples should be arranged so that they are collect at the cleanest locations first and the most impacted samples should be collected last. The order samples should be collected at our APDES locations is as follows:

1. NPDES001B
2. Outfall001
3. Outfall011
4. WTP-Feed2
5. WTP-Feed1 (if requested)
6. Outfall002

NPDES001B/OUTFALL001/OUTFALL011/WTP-FEED2/WTP-FEED1

1. Bring the entire bottle set over to the sample point and then put sample collection gloves on to prevent contamination. Be sure to put on a clean pair of gloves before collecting a sample from a new location.
2. Open each bottle and immediately fill with water from the sample collection point and add preservative if required. Preservative caps are color coded to match the sample bottles that require preservation. Snug the lid onto the bottle after it is filled and preservative (if required) is added.
3. After all bottles are filled, write sample time and date on the bottle labels.
4. Fill the transportation cup at sample site to measure field parameters with YSI meter and remove sample gloves.

5. Document sample collection info and field parameters on a field data sheet and the current Environmental sampling logbook.

Outfall002 / STP002

1. Notify the Potable Water Operator on duty in advance that you will need their assistance to collect samples at the Sewage Treatment Plant (STP). Ensure that the plant is discharging before sample collection. The Outfall002 sample is collected monthly and the STP002 sample is collected quarterly. Outfall002 is located on the clean side of the STP and STP002 is located on the dirty side of the STP. The potable water operators are there to assist with sample collection and procedures.
2. It is generally recommended to wear gloves when entering the STP, however, a new set of gloves should be donned just prior to collecting sample.
3. Bring the entire bottle set (in a Ziploc bag) over to the sample point and then put on clean sample collection gloves on to prevent contamination. Fill out time and date just prior to filling bottles to prevent handling contaminated bottles after they are filled.
4. Open each bottle and immediately fill with water from the sample collection point. Snug the lid onto the bottle after it is filled. Do not overfill bottles because they are pre-preserved.
5. Water Operators will generally collect the STP002 sample from the influent tank if it is requested. It is wise to pre-label this bottle with date and time before handing it to Water Operator in a Ziploc bag to prevent handling a contaminated bottle after the sample is collected.
6. Document sample collection on a field data sheet and the current Environmental sampling logbook.
7. Field parameters are not required for STP sampling.

5.5 Sample Custody and Shipping

After samples are collected, the bottles are kept cold in refrigerator until they are shipped, following standard transportation procedures (see Section 4, *Pogo QAP* procedures). A laboratory specific Chain of Custody Form (COC) and custody seals are included in every shipment documenting samples to all laboratories.

Pollen Environmental destined coolers can be taped shut and two custody seals affixed before the Expeditor takes possession of cooler.

When packing samples for transportation to Energy Labs, line cooler with plastic bag (drum liner) and place all samples, temperature control bottle, ice, and gel ice in the bag. Make sure an address label is on each cooler. After the Expeditor sighs COCs, they should be placed inside the cooler. Coolers should be taped closed in the Environmental field lab with custody seals attached (The air cargo handlers do not sign COCs). The Expeditor should have all other account info for shipping samples via Goldstreak, but the information is on a printed form and copies are kept in the field lab if needed. The Expeditor will affix "cool" and "this side up" stickers when the cooler is dropped off for shipment.

6. MONITORING AND CHECKING

Field quality control (QC) samples include field blanks, equipment rinsate blanks, and field duplicate samples. Refer to the *Pogo QAP*, Section 5.1.3, for a description of common field QC samples, the associated collection method, and the applicable QC sample frequency.

7. MAINTENANCE AND CALIBRATION

Calibration of instruments used in collecting field parameters (i.e. YSI Meter) are performed before every sampling event (refer to Water Meter Calibration SWP). Maintenance is performed at regular intervals recommended by the manufacturer. This includes maintenance done by Environmental personnel on a monthly basis and an annual maintenance/calibration by manufactures' representative. Calibration and maintenance are documented on the *Pogo Mine YSI Calibration Form, the Pogo Mine Hach Turbidity Calibration Form,* and the *Instrument Maintenance Log.*

8. RECORDS

Record Description	Record Location/ Retention Responsibility	Minimum Retention Time
Chain of Custody and Analytical Results	Environmental Archives / Environmental Manager	5 years
Sampling Field Data Sheets	Environmental Archives / Environmental Manager	5 years
Pogo Mine Hach Turbidity Calibration Form	Environmental Archives / Environmental Manager	5 years
Pogo Mine YSI Meter Calibration Form	Environmental Archives / Environmental Manager	5 years
Instrument Maintenance Form	Environmental Archives / Environmental Manager	5 years

9. NOTIFICATIONS

9.1 Internal Notifications

Notify a supervisor immediately if field parameters are outside APDES permit effluent limitations (i.e. the pH at Outfall 001).

9.2 External Notifications

Exceedances of the effluent limitations of the APDES permit may require immediate reporting to ADEC, other exceedance require monthly reporting on the DMR.

10. ENVIRONMENTAL AND LEGAL CONSEQUENCES

Non-compliance with Pogo's environmental permits such as *APDES Permit Number AK0053341* could have a potentially adverse effect to the environment. Non-compliance with the Pogo QAP, or this SWP could result in loss of data integrity.

11. CONSEQUENCES TO EMPLOYEES

Failure to follow this procedure could result in unsafe practices or conditions contributing to an incident possibly resulting in injury. In some instances, situations will dictate variances from this procedure. A variance shall only be given with approval from the Environmental Manager.

Failure to follow this procedure may result in an adverse effect to the environment which could lead to civil and/or criminal penalties for the company and those involved. Procedural failures may also adversely affect company performance records and NSR's public image.

12. RELATED DOCUMENTS

Document Name	Document Number
ADEC Waste Management Permit 2018DB0001	
Pogo QAP- Quality Assurance Plan	PGO-ENV-039-PLA
Water Meter Calibration SWP	PGO-ENV-037-SWP

13. APPENDICES

Appendix 1 - APDES Outfall Field Data Sheet

Appendix 2 - Chain of Custody Template

13.1 Appendix 1 - APDES Outfall Field Data Sheet

Pogo Mine Effluent Sampling Field Data Sheet

Arrival Time:			
EDMS Site Number		Discharge in progress?	
EDMS Sample Identifier			
Date			
Time			
Profile			
Duplicate Sample Indentifier		Time	
Blank Sample Identifier		Time	

Field Preserved			
Field Filtered			
Field Parameters			
Lab- Preserved		Time	
Lab-Filtered		Time	
Lab-Parameters		Time	

References:

APDES Outfall Sample Collection SWP

Water Meter Calibration SWP

Temperature				°C
DO-Dissolved Oxygen				mg/L
N03-Nitrates				mg/L
pH				s.u. (two readings ±0.1)
Specific Conductance				µS
Turbidity				NTU
Appearance				

Field Conditions	Indoors	Temperature	Skies	Wind

Field Equipment	YSI #	Turbidimeter #	Gloves	Bottles	Coolers	Dip Stick	DI Water

Lifejacket	PPE

Notes/Comments	
If Sample Not Collected Give Reason	
Field Team Members Signatures	

Profile 13s SurfaceWater — Energy Lab

Sample Bottle	Preservative	Bottles	Analytes	Bottles Check
1	NaOh >12 (green)	500 ml, dark poly	WAD Cn	
2	HNO3, pH <2 (red)	250 ml, red lid	Sb, As, Cd, Cu, Fe, Pb, Mn, Ni, Se, Ag, Zn (dissolved metals)	
3	HNO3, pH <2 (red)	250 ml, red lid	Sb, Ca, Cr, Mg (total metals,) Hardness	
4	None	1 liter, white poly	Conductivity Solids, Total Dissolved Alkalinity, Chloride, Fluoride, Sulfate Turbidity, Total Dissolved Solids	
5	H2SO4, pH <2 (yellow)	250 ml, white poly yellow lid	Nitrogen as Nitrate + Nitrite	

Profile 10a Outfall001 & NPDES001B - weekly — Energy Lab

Sample Bottle	Preservative	Bottles	Analytes	Bottles Check
1	NaOh >12	500 ml, dark poly	WAD Cn	
2	HNO3, pH <3	250 ml, white poly red lid	Cu,Pb, Mn (total metals)	

Profile 10b Outfall001 & NPDES001B - monthly — Energy Lab

Sample Bottle	Preservative	Bottles	Analytes	Bottles Check
1	None	1 liter, white poly	Turbidity,	
2	HNO3, pH <2	250 ml,white poly red lid	Cd, Hg, Zn (total metals), Hardness	

Profile 11a Outfall011 & WTP-FEED2 - weekly — Energy Lab

Sample Bottle	Preservative	Bottles	Analytes	Bottles Check
1	NaOh >12	500 ml, dark poly	WAD Cn	

Profile 11b Outfall011 & WTP-FEED2 - quarterly — Energy Lab

Sample Bottle	Preservative	Bottles	Analytes	Bottles Check
1	None	1 liter, white poly	TDS, Sulfate,	
2	HNO3, pH <2	250 ml, white poly red lid	As,Cd, Cu, Fe, Pb, Mn, Hg, Se, Zn (total metals), Hardness	

Profile 12a Outfall002 - Monthly — Pollen

Sample Bottle	Pre-Preserved	Bottles	Analytes	Bottles Check
1	Na2S2O3	125 ml, clear poly	Fecal Coliform	
2	HNO3, pH <2	250 ml, white poly red lid	As,Cd, Cu, Pb, Mn, Hg, Zn (total metals), Hardness	
3	None	1 liter, white poly	BOD 5-day, TSS,	
4	H2SO4, pH <2	500 ml, white poly	Nitrate+Nitirate as N	

Profile 12b STP002 - Quarterly — Pollen

Sample Bottle	Pre-Preserved	Bottles	Analytes	Bottles Check
1	None	1 liter, white poly	BOD 5-day, TSS	

SW01	LC North Fork	RTP	Flume #1
SW12	LC South Fork	RTP-SCW 5	Flume #2
SW15	LCD	RTP-SCW 6	Flume #3
SW41	DRYTOE	RTP-SCW 7	Flume #4
SW45		RTP-SCW 8	
		RTP-SCW 9	

13.2 Appendix 2 - Chain of Custody Template

Northern Star (Pogo) LLC Chain of Custody	Page of
	# of Coolers:

Company Name: **Northern Star (Pogo) LLC**	Contact Name: Phone:	Laboratory Name:
Report Mail Address: ***3205 International Street*** ***Fairbanks, Alaska 99701***	Invoice to: pogo.ap@nsrltd.com **P.O. #:**	Mail Adddress:
Email: pogoenvironment@nsrltd.com	**Turnaround Time for Results (TAT)** X **Standard** ____ **Expedited**	Lab Phone: **APDES Permit #:** AK0053341 **Public Water System (PWS) ID#:**
Special Instructions/Comments:	**Requested Analysis/Method:**	**Work Order #:**

Lab ID#													
Client Sample Identification / Location	**Date Sampled**	**Time Sampled**	**Matrix (S-DW-WW-Other)**	**No. of Containers**									**Field Preserved**

Relinquished by:	Date	Time	Received by:	Date	Time
Relinquished by:	Date	Time	Received by:	Date	Time
Relinquished by:	Date	Time	Received by:	Date	Time

Name of Sampler: (printed)

Section To Be Completed by Laboratory

Custody Seal Intact? Y / N _____

Samples On Ice? Y / N _____

Receipt Temperature: _____°C

Signatures Complete? Y / N _____

Signatures Match? Y / N _____

Add'l Notes: _____

Version 1.0 G:\Enviro\Private\Sampling\COC Forms_Profiles

1. PURPOSE

The purpose of this Safe Work Procedure (SWP) is to assure that Pogo personnel collecting compliance Flotation Tailing Interstitial Water and Solids samples (PC003 and PC003 Solids) samples are doing so safely and correctly.

2. SCOPE

This instruction includes the required quarterly sampling and analysis as required by the State of Alaska, ADEC Waste Management Permit 2018DB0001.

3. ROLES AND RESPONSIBILITIES

Role	Key Responsibilities
Environmental Manager	Environmental Manager is responsible for permit provisions and requirements, as well as any updates or renewals associated with the permit and any required notifications to the state or federal agencies.
Environmental Coordinator / Specialist	Contact labs and expediters, obtain quotes, and acquire PO for analytical work and transportation.
Environmental Technician	Prepare COCs, collect and ship samples, and prepare and take care of sampling equipment.
Pogo Expeditor	Responsible for delivering the samples to the correct laboratory in a timely manner and processing the COCs appropriately.

4. DEFINITIONS AND ACRONYMS

ADEC	Alaska Department of Environmental Conservation
AST	Aboveground Storage Tank
COC	Chain of Custody
DI	Deionized water
Met Lab	Metallurgical Lab
PO	Purchase order
psi	Pounds per Square Inch
QAP	Quality Assurance Plan
SWP	Safe Work Procedure

5. PROCEDURE

The Environmental Department is responsible for collecting a quarterly composite sample of flotation tailings solids (PC003 solids) and an interstitial water sample from the flotation tailings (PC003). The PC003 solid samples are each collected in a five-gallon bucket and stored until the last month of the quarter for consolidation.

- During the first two months of each quarter, a PC003 solids sample is collected by adding 3-liters of slurry to the labelled sample bucket. Document sample collection on the Pogo Mine Field Data Sheet (PC003 solids). The entire quarter's sampling is recorded on one data sheet – see attached. Store the bucket in a location where it will not freeze.
- During the last month of the quarter, the 3-liter sample is collected just prior to processing through the filter presses in the Met Lab.

The Environmental Department is also responsible for collecting PC003, the interstitial water from floatation tailings, on a quarterly basis. A flotation tailings slurry sample is collected during the third month of the quarter, usually during the second week of the month, and is immediately processed through the filter presses in the Metallurgical Lab (Met Lab). The water sample is then sent off site for analysis. At least six hours are required to completely process this sample, and 8-10 hours may be required if a duplicate interstitial water is scheduled.

5.1 PC003 Slurry Collection

The PC003 slurry is collected in the Filter Building/Paste Plant at the Flotation Tails Thickener Underflow Sample Port.

1) Sign in at the Mill Control Room.

2) Notify the Paste Plant Operator of the sampling event and met him/her at the sample location. To collect the PC003 sample, bring a 5-gallon bucket with a lid and a hose for connecting to the slurry line.
3) The Paste Plant Operator will help collect the sample and inform Environmental of any piping changes in the system to ensure the proper sample is collected. Fill the bucket 1/3-full of slurry for the first two monthly composite samples. Fill the bucket at least 2/3-full for the final month of the composite sample and for the interstitial water sample. At least 4-gallons of slurry are needed to collect a single 13g Profile water sample for PC003. If a duplicate sample is required, bring an extra bucket and collect at least eight gallons of slurry.

5.2 PC003 Interstitial Water Collection

1) Prepare the filter press in the Met Lab by ensuring the press is clean. Wipe it down with water and paper towels and rinse each cylinder with DI water from the water line hanging near the filter press area.
2) Place a clean cloth filter on the base of the press.
3) Place a paper filter from the paper roll on top of the cloth filter at the base of the press.
4) Wet down the paper filter with DI water.
5) Place the metal cylinder on the wet paper filters with the back of the cylinder touching the two metal tabs. Ensure that the filters are exposed around the outside of the cylinder to prevent leaking.
6) Rinse down the sides of the cylinder with DI water.
7) Fill cylinder 2/3-full of slurry from a sample bucket.
8) Clean the top and sides of the cylinder with water and a paper towel so no spilled slurry is interfering with tightening the lid.
9) Screw press the lid down tight, making sure that there is a good seal all the way around the top.
10) Close the values on the cylinder lid and open the airline lever. Check for any air or water leaks and make sure the pressure stabilizes.
11) Route the collection hose from the filter press into a clean bucket underneath the table or fill sample bottles directly with gloved hands. Profile 13g is used for the PC003 interstitial water sample. Take YSI meter readings and complete the *Pogo Mine Field Data Sheet (PC003)*, see attached.
12) Water will continue to drip for approximately 30-45 minutes or longer. When the liquid has stopped dripping, turn off air pressure levers and release air pressure from the lid before opening it.
13) Excess solids and liquid can be poured into the sink in the Met Lab. Make sure to break up all large clumps and wash down the drain.
14) Take the cylinder off the platform and throw away the paper filter.
15) This process may need to be repeated if there is not enough interstitial water to complete the PC003 sample, or if a duplicate sample is required.
16) Leave filter presses clean and empty and clean all buckets, lids, counters, and sinks.
17) Sign out at the Mill Control Room.

5.3 PC003 Solids Collection

The PC003 solids samples are collected at the same site as the PC003 interstitial water samples in the Filter Building/Paste Plant, at the Flotation Tails Thickener Underflow Sample Port.

1) To collect PC003 solids, bring the labelled 5-gallon bucket and follow the same procedure as described previously. Only about 1/3 bucket of slurry is needed for the composite sample.
   a. The last monthly sample for the quarter is collected at the same time the PC003 interstitial water sample is collected.
2) The completed quarterly composite sample for PC003 solids needs to be mixed in the bucket with a spatula knife (borrowed from the Met Lab) before it is put into the filter press.
3) The same process is used to remove the water from the PC003 solids sample as described previously for the PC003 interstitial water sample.
   a. For PC003 solids, the water pressed off is later discarded – only the solids are collected for this sample.
4) PC003 solids are collected by scraping, with gloved hands, the dewatered solids into two clean 1-liter sized bottles with a spatula knife.

6. MONITORING AND CHECKING

Field quality control (QC) samples include field blanks, equipment rinsate blanks, and field duplicate samples. Refer to the Pogo QAP, Section 5.1.3, for a description of common field QC samples, the associated collection method, and the applicable QC sample frequency.

7. MAINTENANCE AND CALIBRATION

Calibration of instruments used in collecting field parameters (i.e. YSI Meter) is performed before every sampling event (refer to Water Meter Calibration SWP). Maintenance is performed at regular intervals recommended by the manufacturer. Calibration and maintenance are documented on the Pogo Mine YSI Meter Calibration Form, the Pogo Mine Hach Turbidimeter Calibration Form, and the Instrument Maintenance Form.

8. RECORDS

Record Description	Record Location/ Retention Responsibility	Minimum Retention Time
Chain of Custody and Analytical Results	Environmental Archives / Environmental Manager	5 years
Pogo Mine Field Data Sheet (PC003 solids)	Environmental Archives / Environmental Manager	5 years
Pogo Mine Field Data Sheet (PC003)	Environmental Archives / Environmental Manager	5 years
Pogo Mine YSI Meter Calibration Form	Environmental Archives / Environmental Manager	5 years
Pogo Mine Hach Turbidimeter Calibration Form	Environmental Archives / Environmental Manager	5 years
Instrument Maintenance Form	Environmental Archives / Environmental Manager	5 years

9. DEPARTURES FROM PROCEDURES

9.1 Notifications

During sample collection, if any unusual circumstances occur, notification of the Environmental Manager is required immediately.

9.2 Environmental and Legal Consequences

Non-compliance with Pogo's environmental permits such as the ADEC Waste Management Permit 2019DB0001 could have a potentially adverse effect to the environment. A permit exceedance may lead to a Notice of Violation, or a Compliance Order by Consent.

9.3 Consequences to Employees

Failure to follow this procedure could result in unsafe practices or conditions contributing to an incident possibly resulting in injury. In some instances, situations will dictate variances from this procedure. A variance shall only be given with approval from the Environmental Manager.

Failure to follow this procedure may result in an adverse effect to the environment which could lead to civil and/or criminal penalties for the company and those involved. Procedural failures may also adversely affect company performance records and NSR's public image.

10. RELATED DOCUMENTS

Document Name	Document Number
ADEC Waste Management Permit 2018DB0001	
Pogo Mine Monitoring Plan	PGO-ENV-011-PLA
QAP – Quality Assurance Plan	PGO-ENV-039-PLA
Water Meter Calibration SWP	PGO-ENV-037-SWP
Hazard Assessment, ENV-1 PC003 Sample	

11. APPENDICES

Appendix I - Pogo Mine Field Data Sheet (PC003 Solids)

Appendix II - Pogo Mine Field Data Sheet (PC003)

Appendix III - ALS Chemex Chain of Custody

11.1 Appendix I - Pogo Mine Field Data Sheet (PC003 Solids)

Pogo Mine Sampling Field Data Sheet

Arrival Time:	
EDMS Site Number	**PC003**
EDMS Sample Identifier	PC003
Date	
Time	
Profile	**13G**
Duplicate Sample Indentifier	
Blank Sample Identifier	

Time	
Time	

Field Conditions	Indoors	Temperature	Skies	Wind
	X			

Field Equipment	YSI Meter	Gloves	Bottles	Coolers	Dip Stick	DI Water	PPE

Notes/Comments	
Field Team Members Signatures	

11.2 Appendix II - Pogo Mine Field Data Sheet (PC003)

Pogo Mine Sampling Field Data Sheet

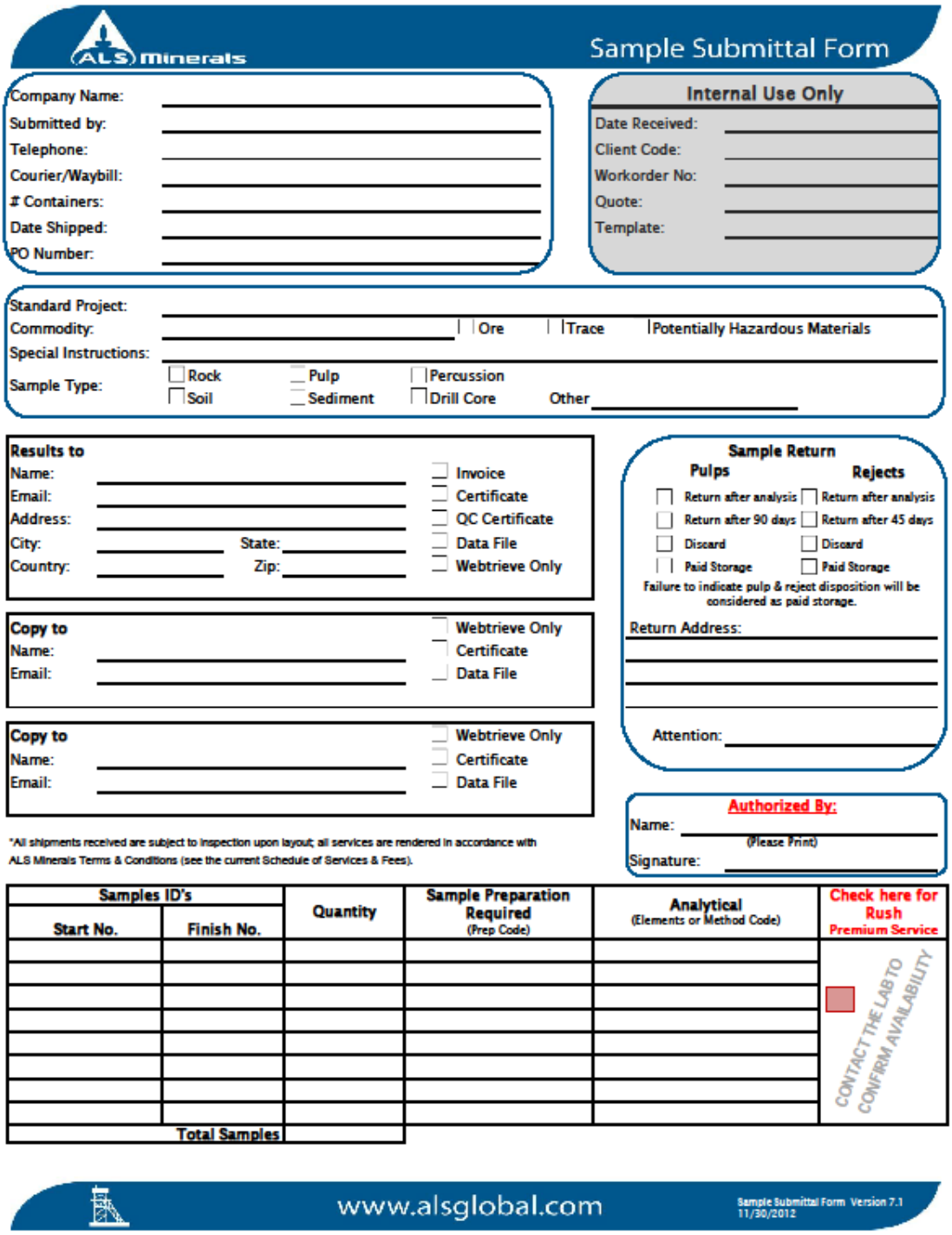
Arrival Time:			
EDMS Site Number	**PC003 SOLIDS (Float Tails)**		
EDMS Sample Identifier	PC003 SOLIDS	Month 2	Month 1
Date			
Time			
Profile	**PC003 Template (ALS CHEMEX Lab)**		
Duplicate Sample Indentifier		Time	
Blank Sample Identifier		Time	

Field Conditions	Indoors	Temperature	Skies	Wind
	X			

Field Equipment	YSI Meter	Gloves	Bottles	Coolers	Dip Stick	DI Water	PPE

Notes/Comments	
Field Team Members Signatures	

11.3 Appendix III - ALS Chemex Chain of Custody



ALS Minerals — Sample Submittal Form

Company Name: _____
Submitted by: _____
Telephone: _____
Courier/Waybill: _____
Containers: _____
Date Shipped: _____
PO Number: _____

Internal Use Only
Date Received: _____
Client Code: _____
Workorder No: _____
Quote: _____
Template: _____

Standard Project: _____
Commodity: _____ | Ore | Trace | Potentially Hazardous Materials
Special Instructions: _____
Sample Type: ☐ Rock ☐ Soil ☐ Pulp ☐ Sediment ☐ Percussion ☐ Drill Core Other _____

Results to
Name: _____
Email: _____
Address: _____
City: _____ State: _____
Country: _____ Zip: _____
☐ Invoice ☐ Certificate ☐ QC Certificate ☐ Data File ☐ Webtrieve Only

Copy to
Name: _____
Email: _____
☐ Webtrieve Only ☐ Certificate ☐ Data File

Copy to
Name: _____
Email: _____
☐ Webtrieve Only ☐ Certificate ☐ Data File

Sample Return

Pulps	Rejects
☐ Return after analysis	☐ Return after analysis
☐ Return after 90 days	☐ Return after 45 days
☐ Discard	☐ Discard
☐ Paid Storage	☐ Paid Storage

Failure to indicate pulp & reject disposition will be considered as paid storage.

Return Address: _____
Attention: _____

Authorized By:
Name: _____ (Please Print)
Signature: _____

*All shipments received are subject to inspection upon layout; all services are rendered in accordance with ALS Minerals Terms & Conditions (see the current Schedule of Services & Fees).

Samples ID's		Quantity	Sample Preparation Required (Prep Code)	Analytical (Elements or Method Code)	Check here for Rush Premium Service
Start No.	Finish No.				
					☐ CONTACT THE LAB TO CONFIRM AVAILABILITY
Total Samples					

www.alsglobal.com Sample Submittal Form Version 7.1 11/30/2012

1. PURPOSE

The purpose of this SWP is to assure that Pogo personnel coordinating the characterization waste rock from the mine are doing so safely and correctly.

2. SCOPE

This instruction includes the collection of waste rock from underground personnel, labelling of the samples, drop off at the assay lab, and characterization of the rock for use by surface personnel.

3. ROLES AND RESPONSIBILITIES

Role	Key Responsibilities
Environmental Manager	Environmental Manager is responsible for overseeing waste management as needed.
Environmental Personnel	Environmental personnel pick up samples daily from underground, drop off samples at assay lab, communicate waste rock characterization with applicable parties.
Underground Drill Operators	Underground drill operators are responsible for collecting homogenous, composite sample of drill cuttings at each waste rock heading.
Underground Haul Truck Drivers	Underground haul truck drivers are responsible for transporting waste rock to the surface and labelling each pile with a stake with blast day, heading and shift.
Engineering	Engineering is responsible for checking location and labelling of samples and emailing the daily waste sample spreadsheet to Environmental. Underground engineering personnel are responsible for characterizing waste rock samples using the benchtop XRF.
Geology Personnel	Geology is responsible for emailing Environmental the daily Ore characterizations. Underground geology personnel are responsible for characterizing waste rock samples using the benchtop XRF.
Assy Lab Personnel	Assay lab personnel are responsible for assaying waste rock samples using the benchtop XRF and updating LIMS database.
Surface Personnel	Surface personnel and operators are responsible for checking waste stockpiles with the daily ore and waste characterizations provided by Environmental. Surface operators then transport waste piles to the correct locations depending on classifications.

4. DEFINITIONS AND ACRONYMS

LIMS	Laboratory Information Management System
SWP	Safe Work Procedure
XRF	X-Ray Fluorescence

5. PROCEDURE

Time	Activity	Documentation
0600 - 0630	Environmental receives daily waste sample spreadsheet from Engineering.	Daily Waste Sample Sheet email.
0700 - 0900	Environmental delivers samples to the Assay Lab or underground group with portable XRF	Sample tags are created by Environmental and updated on Master Sludge Muck Sheet on the Enviro P Drive in the Muck Segregation folder. See section 6.3 for sample tag example.

Time	Activity	Documentation
0900 - 1500	Assay Lab analyzes samples for arsenic, sulfur, iron, and calcium using a benchtop XRF system or assigned underground personnel analyzes samples via portable XRF	Results are exported via LIMS and Environmental updates the Master Muck Sludge Sheet and Surface Ops Muck Haulage Sheet on the Enviro P Drive in the Muck Segregation folder.
1500 - 1530	Geology provides Environmental with daily ore and waste characterizations	Geology personnel send an email to Pogo Environmental.
1530 - 1600	Environmental updates the Master Muck Segregation Sheet and Surface Ops Muck Haulage Sheet and sends an email to Surface Crews	Email is sent to surface supervisors with ore and waste characterizations from Geology and Environmental.
1600 - 2100	Surface Operators print the daily email from Environmental. The operators use the sheet to match the waste characterizations with the stakes labelled by underground haul truck drivers to transport the waste rock appropriately.	Daily e-mail from Environmental Personnel is printed and used to characterize waste. Load counts are documented by the surface operators.

5.1 Waste Rock Sample Collection

Waste rock is collected from each waste heading in the mine by the drill operators. A handful of drill cuttings from each drill hole is placed in a sample bag and should weigh between 5-10 pounds (~10 handfuls). The goal is collection of a homogeneous, composite sample that is representative of the entire rock face. The sample bag should be labeled with the following:

- Name of sample collector
- Date
- Heading name
- Shift

The bag must be brought to the surface at the end of the shift by drill operators or shifters and left in a blue bucket labeled Waste Rock outside the shifter's office in the mine bullpen area.

Engineering checks samples for correct dates and locations then places the samples in the Environmental Samples bucket (shown below in section 6.2).

All waste rock that will be hauled out of the mine to the surface should be sampled for characterization.

5.2 Waste Rock Sample Verification

The Environmental Department is responsible for facilitating waste rock characterization for optimal use around the site. Every morning, Engineering emails Environmental an excel file, *NST_Pogo_UG_Waste_Samples,* that documents waste headings for the previous day. This spreadsheet shows the most recent waste rock sampling data and describes waste rock samples that need to be delivered to the Assay Lab.

Samples are placed by Engineering in the designated Environmental Samples collection bucket by 7:15 am for pick-up and delivery to the Assay Lab by Environmental.

Engineering will follow up with the underground shifters to identify any headings without samples and check origins of any unknown piles to ensure all waste rock is being characterized correctly.

5.3 Waste Rock Sample Documentation for Assay Lab

To document sample transferal, Environmental personnel give each sample bag a barcode from an assay book and delivers the samples for analysis. For benchtop XRF, the samples are set in trays to dry, then the Assay Lab runs each sample. Sample data is uploaded to the LIMS database, where it can be accessed and input into the Muck Log. Alternatively, a portabe XRF can be used to characterize the samples by collecting a representative sample of drill cuttings in a plastic snack Ziplock bag and running

the analysis five times. Mineralization of the rock is based on sulfur and arsenic content which determines whether the rock is red (mineralized) or green (non-mineralized). This information is then communicated to the surface crew for hauling and distribution.

5.3.1 Sample Labeling and Drop-Off at Assay Lab

After picking up the samples each day from the sample drop-off location, Environmental personnel should log the sample in the assay sample book with date, shift, and heading name. The perforated portion should be labeled with XRF. An example of an assay sheet can be found below.

The perforated portion should be torn out and placed in the sample bag with the rock sample. The bags should then be taken to the assay lab through the door on the southwest side of the building.

Once inside the assay lab, the samples are placed on trays and dried. The trays used for underground muck samples are under the first table on the left when walking through the door. Empty each sample into a tray, place the corresponding bag in the tray with the sample for drying, and make sure the barcode is on top and easily visible. Let the Assay Lab personnel know that samples were dropped off.

If the area to the left is full of trays, sample bags can be left on the floor next to the drying area. Make sure the perforated portion of the sheet and barcode is inside the bag. Let Assay Lab personnel know that a sample was dropped off.

Samples will be analyzed for XRF and uploaded into the LIMS database.

5.3.2 Waste Rock Sample Data Characterization

The Master Sludge Muck Sheet is in the following folder:

G:\Enviro\Public\Muck Segregation

Data from the Assay Lab database is updated using the LIMS system, which updates the Muck Segregation spreadsheet once the sample number and information is entered into the spreadsheet. Data from the portable XRF can be hand-entered into the spreadsheet. The spreadsheet is programmed to determine whether the sample is red rock (mineralized) or green rock (non-mineralized). Mineralization is based on the sulfur and arsenic content of the sample. If the sulfur content is greater than 0.5% or the arsenic content is greater than 600 ppm, the sample is characterized as red rock.

The Master Sludge Muck Sheet is linked to the Surface Ops Muck Haulage which automatically updates with new information. Environmental personnel are responsible for facilitating this information between all parties to ensure that the rock is characterized correctly. Surface personnel need to know the heading name and whether the heading is red or green rock so it can be distributed to the correct place for optimization of the waste rock system. An email is sent daily to the Surface Ops supervisors with a copy of the waste rock information for the day.

5.4 Geology Sample Data Characterization

The Geology Department manages all ore headings and piles. Each day, they are responsible for sending Environmental an email with a list of ore classifications for any piles in the temporary storage areas. These piles are classified as waste, ore, and stockpile. Environmental is responsible for transferring this information to the Surface crews in the same email as the waste rock information.

5.5 Surace Haulage

The Surface crew hauls muck piles daily during the restricted hours of 4:00 – 8:30 am and pm. It is important to send out the updated waste and ore characterization information prior to the haulage times. Underground haul truck drivers drop off the loads in designated temporary storage areas outside the portals. Each pile is marked with a stake that includes heading name, date, and shift. The loader operator is responsible for checking each staked pile with the printed waste characterization email and relaying

the proper location for the piles to the surface haul truck drivers. When not constrained by space limitations, muck piles must remain in place even when Assay Lab determinations are delayed. Surface Supervisors should call Environmental for red/green determination when muck piles are unknown and need to be moved. Engineering and geology can also be consulted about possible red/green determinations based on mining plan when analysis is not available.

6. RELATED DOCUMENTS

Document Name	Document Number
Surface Stockpile Ore Classification	

7. RECORDS

Record Description	Record Location / Retention Responsibility	Minimum Retention Time
Master Sludge Muck Sheet	\\nsrltd.com\Pogo\Dept\Enviro\Public\Muck Segregation / Environmental Department	Updated daily
Surface Ops Muck Haulage	\\nsrltd.com\Pogo\Dept\Enviro\Public\Muck Segregation / Environmental Department	Updated daily

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Document Distribution List

Northern Star (Pogo) LLC

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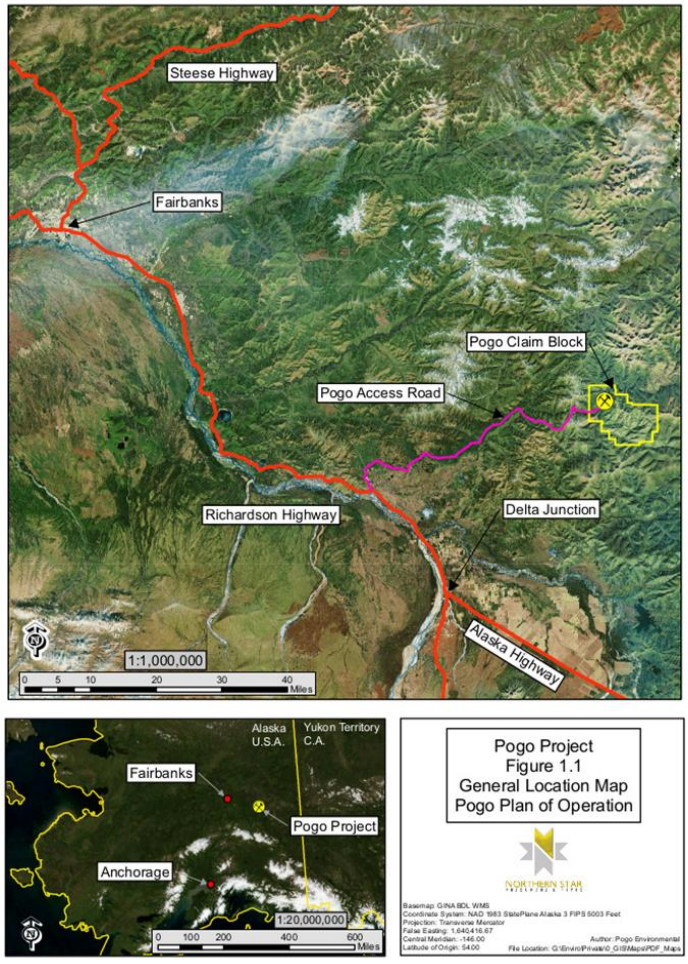
Definitions and Acronyms

EPA	Environmental Protection Agency
FIFO	First in First Out
LIMS	Laboratory Information Management System
LOTO	Lock Out Tag Out
PAL	Pogo Assay Lab
QA/QC	Quality Assurance / Quality Control
QAP	Quality Assurance Plan
QAO	Quality Assurance Officer
SWP	Safe Work Plan
TPR	Tons Per Day
WAD	Weak Acid Dissociable
XRF	X-Ray Fluorescence Spectrometer

1.0 Introduction

Northern Star (Pogo) LLC is the operator of the Pogo gold mine, located 38 miles northeast of Delta Junction, Alaska (see **Figure 1.1**). Pogo Mine is an underground mine that feeds gold ore to the mill at a rate of approximately 3,000 tons per day (tpd) and is permitted to feed gold ore at a rate of up to 3,500 tpd. The property produces between 380,000 to 400,000 ounces of gold annually.

Figure 1.1: Location and Access, Pogo Mine

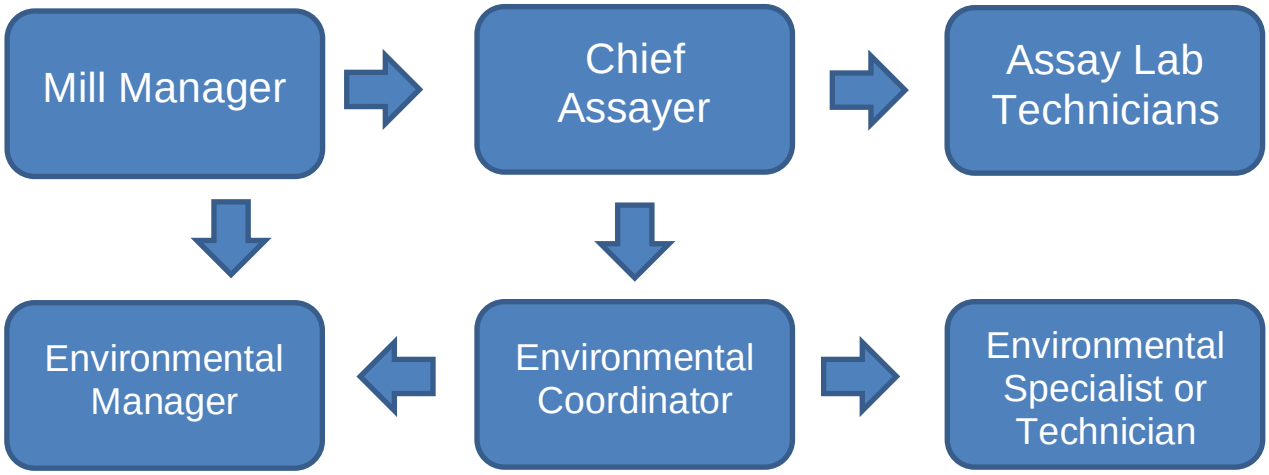


The Assay Lab team provides support to Pogo Operations groups. Samples which include solid, slurry, solution, and bullion are received, processed, and analytical results are reported out to various departments. Primary analyses include quantitative determination of gold, silver, WAD cyanide, base metals, and other elements. Information is used by technical staff to control metallurgical process kinetics and to support environmental monitoring of the process waste. A robust quality assurance / quality control system in place ensures sample integrity is maintained. Accuracy and precision limits are defined and measured for all processes using accepted statistical protocols. Periodic review of results, methods, and procedures leads to continuous improvement of the system.

2.0 Project Management

The primary goal of Northern Star (Pogo) LLC's Assay Laboratory Quality Assurance Plan (QAP) is to define, establish, and maintain an effective quality assurance system. It is designed to ensure that the needs of mine operations and other stakeholders are met while meeting statutory and regulatory requirements related to Pogo's operating permit.

Figure 2.1: Project Organizational Structure Flow Chart



2.1 Responsibilities

Mill Manager - is responsible for overseeing Assay Lab personnel in planning, coordinating, and controlling technical aspects of the project. Is responsible for monitoring the quality of the technical and managerial aspects of the project, implementing the QAP, implementing corrective measures, assuring efficiency, and overall accuracy of data produced, internally for mine operations, and externally for regulatory reporting.

Chief Assayer/Quality Assurance Officer (QAO) - oversees analytical chemistry and data management activities, and communicates directly with laboratory technicians and mill operators to coordinate field

sampling activities. They are responsible for QC of the analytical chemistry and data management documentation, and resolves problems that may occur with laboratories, field activities, and sampling activities in accordance with the QAP. They work directly with the Mill Manager. The QAO ensures that personnel assigned to the project are trained on the requirements of the QAP. They also review and verify non-conformance and corrective action reports, and conduct periodic quality assurance audits. The QAO has authority to halt work performed in accordance with the QAP in case of non-conformance or if minor problems are not corrected in a timely manner. The QAO is also responsible for maintaining all documentation required by the QAP.

Assay Laboratory Technicians – are responsible for following all safe work procedures for laboratory analysis and data management while meeting all QAQC requirements.

Environmental Manager - works directly with the Mill Manager to assure the required analytical data produced by the Assay Lab is reported to regulatory agencies as required. The Environmental Manager is responsible for maintaining communication with regulatory authority.

Environmental Coordinator – Responsible for periodic QAQC oversite (i.e. confirmation samples to third part laboratories) of regulatory related sampling and analysis performed by the Pogo Assay Lab.

Environmental Specialist/Technician – responsible for collecting, documenting and shipping QAQC samples to third party laboratories.

2.2 Data Quality Objectives

The project objective is to 1) Produce accurate analyses to determine mining priorities and enhance mineral process control based on metal content; 2) Produce accurate analyses for the monitoring of water from milling activities that affect water discharged to the Goodpaster River as well as from the paste backfill process before material is returned to underground. Based on the project objective, the primary data quality objectives of this project are as follows:

- Provide procedures for quality control beginning with sample collection and proceeding through data interpretation;
- Provide procedures to ensure that data are valid based on acceptable accuracy and precision limits.

3.0 Training

The Assay Lab provides training for all its employees. The training program is a five-step progression that requires a minimum 30 months to complete for entry level non-experienced individuals. Past experience determines the level at which new hires are placed.in the training program. See **Appendix A** for the Assay Lab Training Progression Criteria.

4.0 Documents and Records

Pogo Assay Lab ensures that the history of a sample is clearly evident in the retained records and can be independently reconstructed. Each sample will be documented to ensure that each analytical result belongs to a uniquely identified sample and to indicate the quality of that result.

All samples received by the Assay Lab, and the analytical results, are logged into the Laboratory Information Management System (LIMS). Most, if not all, sample results are then either exported to databases or copied into Excel spreadsheets when reported to other departments. These documents are also saved to the Pogo network on the G-Drive, and so have redundant digital backup.

There are a number of monthly logs that are filled out on a daily basis. At the end of the month these are scanned, copies provided to appropriate parties, and then saved electronically on G-drive. Hardcopies of logs, worksheets, and other miscellaneous documentation are kept for five years. All electronic copies are currently filed in perpetuity.

All reagent and liquid standard containers, or cases if received as such are marked with both date received, and date opened notations. Pogo uses FIFO (first in first out) method of stock rotation.

Laboratory waste disposal may involve handling hazardous materials. The proper procedures for waste disposal are given in **Appendix B: Table 4.0**: Laboratory Disposal Safe Work Procedures. This includes tracking and recording the amount of wastes disposed of and final disposal location. **Appendix B**: **Table 4.1** lists the records produced by the Pogo Assay Laboratory and the record locations.

5.0 Sampling

This section presents sample collection methodology, sample identification requirements, custody requirements, management and processing

5.1 Sample Collection Methodology

Operations groups that submit samples to Pogo's assay lab determine field sampling techniques and methods that best suit their needs.

There are a small number of daily mill process samples that are picked up in the field by lab staff. These samples are collected by mill operations process auto-samplers.

5.2 Sample Identification

Operations groups determine sample identification criteria that best suits their needs. Unique identifiers, dates, shifts, bar codes, and sample descriptions are most often used. The assay lab places controls on received samples to protect sample integrity, and to provide traceability. The LIMS system provides digital capture to meet requirements.

5.3 Custody

The assay lab takes temporary custody of samples upon physical arrival in the sample receiving area of the lab.

5.4 Sample Management and Processing

Samples of varying type are prepared for analysis using accepted methods and sample preparation equipment.

Appendix C: Table 5.0 lists the SWPs pertaining to sample preparation and handling in the Pogo Assay Lab.

Appendix C: **Tables 5.1 and 5.2** list sample processing procedures for the XRF and Fire Assay

- Operations groups with input from Pogo technical staff and assay lab determine sample retention time.

Operations groups with input from Pogo technical staff and assay lab determine appropriate sample disposal protocol.

5.5 Analytical Methods

- Operations groups determine type of determination required which best meets their needs.
- Assay lab with input from Pogo technical staff and the owning operations group determine appropriate method of analysis.
- The Pogo Assay Lab performs twenty different analyses.

Appendix C: **Table 5.3** lists all the SWPs associated with each type of analysis.

5.6 Quality Control

Quality control guidelines, in Table 1 thorough Table 5, ensure the results produced by the Pogo Assay Lab are accurate, precise, and reliable. Because continual improvement is required, tolerances are evaluated at stated intervals which provides a high degree of quality assurance.

See **Appendix C** for:

- **Table 5.4:** Sample Preparation QAQC
- **Table 5.5**: Fire Assay QAQC
- **Table 5.6:** Atomic Absorption QAQC
- **Table 5.7:** WAD Cyanide QAQC
- **Table 5.8**: Titration QAQC

5.7 Instrument Testing, Maintenance and Calibration

The Pogo Assay Lab follows the manufacturer's suggested maintenance activities and documents all maintenance. Each specific instrument has a unique description or code. This may include a manufacturer name, model number, serial number, inventory number, etc. Each unit is labeled accordingly.

All maintenance and repair performed for each instrument is logged, including routine cleaning procedures and solution or parts replacement for instrument probes. Included is the calendar date for the procedures performed, names of personnel performing the maintenance or repair tasks and any malfunctions necessitating repair or service.

Instrument calibration is performed on a regular basis and calibration records are kept on the field sheets, field logs or in a separate calibration log. The records must indicate the calibration method (or SWP), and the type of standard(s) (including the concentrations) that were used. Record each calibration check (initial, continuing or final) in the permanent field records (or calibration logs). See **Table 4.1:** Records Description and Retention.

Instruments that require calibration and maintenance are described in the list of SWPs in **Appendix C: Table 5.9**. Calibration and Maintenance Safe Work Procedures

6.0 Data Management

The primary goal is to ensure high quality and integrity of collected samples, precision and accuracy of the analyses, and the completeness of the data. Data that meets the QAP objectives and goals will be deemed acceptable. Data that does not meet objectives and goals will be reviewed on a case-by-case basis to ascertain usefulness. Rights to approve and release data is controlled in LIMS and is administered by the Chief Assayer.

Appendix D: Table 6.0 Data Management Safe Work Procedures lists the SWPs used for data management.

6.1 Data Validation and Usability

The Chief Assayer or designee is responsible for ensuring that results generated by the assay lab are reviewed prior to release. Controls in LIMS alert personnel when standard reference material and or blanks fall outside of quality control. Providing results that are as accurate as methods allow is accomplished by measuring known values included with every set of samples analysed at Pogo.

The assay lab uses an Excel worksheet tool to confirm that gold replicate assays meet mean deviance criteria. The Chief Assayer and senior staff use this tool for all mill and underground gold analyses. Failures require sample re-run. Controls in place also alert personnel when deviance hits 50% of threshold. This enables staff to identify trends or to assign preventive action prior to falling outside of limits. It also provides data that is used when adjusting control limits to enhance precision. This contributes to the continual improvement of the system.

6.2 Internal Auditing and Oversite

The Chief Assayer will periodically review and update the QAP at least annually, or as required.

The Chief Assayer is responsible for ensuring that the Mill Manager is informed of any nonconformance with the QAP, any response actions necessary to correct the noncompliance, the completion of the response actions and any updates to the QAP.

The Mill Manager is responsible to ensure that any response actions to address nonconformance with the QAP are timely completed and that appropriate resources are available. It is also the responsibility of the Chief Assayer to ensure that all appropriate staff read and comply with the QAP and that the QAP is regularly reviewed.

7.0 Reporting

The assay lab provides analytical data. Operating groups determine where and to whom this data is reported. The operating group and assay lab determine the most efficient means of reporting this information. Currently most reports are exported to a group's database or spreadsheet. Providing hard copies or other means of delivery is provided when it best meets the needs of the operations group.

8.0 References

Alaska Department of Environmental Conservation (2003c). Waste Disposal Permit 2018DB0001, Northern Star (Pogo) LLC May 24, 2018.

U.S. Environmental Protection Agency (2001). EPA Requirements for Quality Assurance Project Plans. EPA QA/R-5. Office of Environmental Information. EPA/240/B-01/003. March 2001.

9.0 Revisions

Figure 3.1: Table of Significant Changes

Change #	Change Requested By	Description	Affected Section

Appendix A – Assay Lab Training Progression Criteria

Assay Lab Training Criteria

Listed below are the duties and responsibilities expected of each level lab employee, as well as KPI's used to evaluate progress and encourage improvement.

Level 1: Assay Tech /Sample Preparation Entry Level (No previous lab experience)

1. Arrive to work on time, always punctual.
2. Understand NSR STARR core values.
3. Conduct sample preparation in a safe manner following lab SOP's and direction of trainer.
4. Prep all Mill, UG, Met and Exploration samples as instructed.
5. Run and report XRF analyses on Mill, UG, Met and Exploration samples.
6. Ensure adequate supplies are on hand for sample prep.
7. Create LIMS files and ACCURATELY enter sample ID's and data into LIMS and/or Excel files.
8. Consistently perform sample preparation at or under time deadlines.
9. Train as time permits in Fire Assay under the direction of Senior Level Assayer.
10. Recognize erroneous data and inform supervisor.
11. Demonstrate ability to ready sample preparation equipment for maintenance under direct supervision.
12. Keep a clean and organized work area.
13. No disciplinary actions for a period of 6 months.
14. Minimum time @ Level 1 requirement: 6 months.

Level 2 Assay Tech / Sample Preparer / Fire Assayer

1. Maintain all Level 1 applications above.
2. Effectively train entry Level 1 personnel.
3. Embrace NSR STARR core values.
4. Demonstrate mastery of sample prep area – consistent 90th percentile of samples turned around per shift.
5. Demonstrate consistent superior housekeeping expectations – always leave work area as one would like to find it.
6. Conduct QC on sample prep processes following lab SOP's.
7. Demonstrate ability to accurately fire assay and meet deadlines following SOP's under direct supervision.

8. Demonstrate ability to ready sample preparation equipment for maintenance independently.
9. Demonstrate ability to conduct maintenance on fire assay equipment under direct supervision.
10. Demonstrate knowledge and understanding of fire assay by completing a written assessment @ > 80%.
11. No disciplinary actions for a period of 6 months @ Level 2.
12. Minimum time @ Level 2 requirement: 6 months.

Level 3 Fire Assayer / Wet Lab

1. Maintain all Level 2 applications above.
2. Effectively train Level 1 and 2 personnel
3. Display a heightened awareness of NSR STARR core values.
4. Demonstrate active participation in NSR's hazard identification, JHA, strive for 5 meetings, and promote a robust safety culture.
5. Demonstrate ability to perform all wet lab activities following SOP's under direct supervision.
6. Demonstrate ability to run all fire assay samples, and all wet lab analyses independently.
7. Demonstrate an understanding of QA/QC protocols by passing a knowledge-based test at > 80%.
8. Demonstrate ability to conduct maintenance on fire assay equipment independently.
9. Demonstrate ability to perform PM's and troubleshooting of AA, XRF, and Leco instruments under direct supervision.
10. Demonstrate an understanding of planning and organizing workflow under direct supervision. Accept training from senior level staff – display accountability for team quality and production.
11. Complete performance based and written evaluations that demonstrates mastery of fire assay process, CN-free cyanide and WAD processes, and assay lab math knowledge.
12. No disciplinary actions for a period of 12 months @ Level 3.
13. Minimum time @ Level 3 requirement: 12 months.

Level 4 Senior Level Assayer / Lead if Applicable

1. Maintain all Level 3 applications above.
2. Effectively train level 1, 2 and 3 personnel.
3. Provide visible felt leadership by facilitating safety meetings and conducting AFL's.
4. Display strong decision-making ability by considering a.) safety, b.) environment, c.) quality, and d.) production implications.
5. Display a positive attitude and problem-solving ability to enhance team member's performance.
6. Demonstrate ability to organize and manage workflow independently.
7. Demonstrate ability to perform PM's and troubleshoot AA, XRF, and Leco instruments independently.

8. Demonstrate the ability to use statistical data to validate results.
9. Demonstrate ability to create new SOP's or improve those currently followed.
10. Effectively handle routine and non-routine events in the absence of the Chief Assayer.
11. Demonstrate ability to meet special assignment deadlines.
12. Display ability to bring a project to completion under supervision.
13. No disciplinary actions for a period of 6 months @ Level 4.
14. Minimum time @ Level 4 requirement: 6 months.

Level 5 Senior Level Assayer / Lead if Applicable

1. Maintain all Level 4 applications above.
2. Consistently meet time deadlines on all assignments.
3. Effectively train level 1, 2, 3 and 4 personnel.
4. Display ability to bring a project to completion independently.
5. Provide a positive influence on your team and others in the organization.

The descriptions and KPI's above do not necessarily include all duties and responsibilities for every Level. Value added skills not defined may also be considered during employee evaluations. NSR reserves the right to modify these duties and responsibilities at any time as the need arises.

Appendix B – Documents and Records

Table 4.0: Laboratory Disposal Safe Work Procedures

Assay Laboratory Disposal SWPs
PAL-030 Cyanide Waste Paper Disposal
PAL-035 Lead Waste Storage and Disposal
PAL-038 Reject Dumpster Disposal
PAL-041 XRF Pellet Disposal
Palletizing Hazardous Waste Containers for Off-Site Shipment SWP

Table 4.1: Records Description and Retention

Record Description	Record Location/ Retention Responsibility	Minimum Retention Time
Assay Lab Calibration Records	Pogo Network/Chief Assayer	5 years
Assay Lab Consumables Tracking	Pogo Network/Chief Assayer	5 years
Assay Lab Waste Disposal Records	Pogo Network/Chief Assayer	5 years
Gold Analysis - Gravimetric	Pogo Network/Chief Assayer	Hard Copy – 5 years Digital Record - perpetuity
Gold Analysis – Atomic Absorption	Pogo Network/Chief Assayer	Hard Copy – 5 years Digital Record - perpetuity
Silver Analysis – Atomic Absorption	Pogo Network/Chief Assayer	Hard Copy – 5 years Digital Record - perpetuity

Record Description	Record Location/ Retention Responsibility	Minimum Retention Time
Base Metals – XRF	Pogo Network/Chief Assayer	Hard Copy – 5 years Digital Record - perpetuity
Base Metals – Atomic Absorption	Pogo Network/Chief Assayer	Copy Hard – 5 years Digital Record - perpetuity
Carbon/Sulphur – XRF & Leco	Pogo Network/Chief Assayer	Hard Copy – 5 years Digital Record - perpetuity
WAD Cyanide - Colorimetric	Pogo Network/Chief Assayer	Hard Copy – 5 years Digital Record - perpetuity
Thiocyanate - Colorimetric	Pogo Network/Chief Assayer	Hard Copy – 5 years Digital Record - perpetuity
Cyanide - Titration	Pogo Network/Chief Assayer	Hard Copy – 5 years Digital Record - perpetuity
Sodium Hydroxide - Titration	Pogo Network/Chief Assayer	Hard Copy – 5 years Digital Record - perpetuity
Bullion - Gravimetric	Pogo Network/Chief Assayer	Hard Copy – 5 years Digital Record - perpetuity
Bullion – Atomic Absorption	Pogo Network/Chief Assayer	Hard Copy – 5 years Digital Record - perpetuity

Appendix C – Sample Management and Processing

Table 5.0: Sample Management Safe Work Procedures

Assay Laboratory Sample Management SWPs
PAL-005 Wet Screen
PAL-007 Mine Sample Preparation
PAL-009 Carbon Sample Prep
PAL-011 Mill Sample Preparation
PAL-014 Bullion AA Metals
PAL-019 Carbon Sample Prep
PAL-022 Mechanical Pipettor Operation
PAL-025 Loading Core Samples In the Drying Oven
PAL-027 Change P-10 Tank
PAL-029 PPE Requirements
PAL-033 Jones Riffle Operation
PAL-042 Refinery Steel Wool
PAL-045 WAD Cyanide Reporting
PAL-048 Round Robin Sample Analysis
PAL-051 Crusher Mesh Size
PAL-055 Pressure Filter Operation
Metallurgical and Assay Lab Storage and Utilization of Cyanide

Table 5.1: XRF Safe Work Procedures

Assay Laboratory XRF Safe Work Procedures
PAL-006 XRF Pellet Press
PAL-015 XRF Mill Samples
PAL-028 XRF Startup and Run
PAL-044 XRF Float and Feed
PAL-056 XRF Operation

Table 5.2: Fire Assay Safe Work Procedures

Assay Laboratory Fire Assay Safe Work Procedures
PAL-058 Fire Assay, Standard Preparation
PAL-010 Liquid Fire Assay Inquart
PAL-013 Bullion Fire Assay
PAL-026 Fire Assay
PAL-031 Assay Furnace LOTO (Lock-Out Tag-Out)
PAL-032 Fire Assay, Pulp Mettalics

Table 5.3: Analytical Methods Safe Work Procedures

Assay Laboratory Analytical Methods SWPs
PAL-001 Weak Acid Dissociable Cyanide
PAL-002 CN -1000PPM Solution
PAL-003 Rhodanine Indicator Solution
PAL-004 Phenolphthalein Indicator Solution
PAL-012 Silver Nitrate Titrating Solution 0.1N
PAL-016 Conductivity
PAL-017 Atomic Absorption Standards
PAL-018 Hydrochloric Acid Solution for Mill Caustic Titration
PAL-020 Colormetric Thiocynate SCN-
PAL-021 Chromotropic Acid Method for Nitrate Nitrogen
PAL-023 Preliminary Copper and Iron
PAL-024 Sulfite
PAL-039 Operation of Cyanide & Acid SpectrAA
PAL-046 Sample Reporting Limits
PAL-047 WAD Cyanide on Solid Material
PAL-049 Hardness, Total Calcium and Magnesium
PAL-050 Silica, Colormetric
PAL- 053 Titrations
PAL-054 Atomic Absorption Silver
PAL-057 Cyanide Distillation, Colormetric Finish

Table 5.4: Sample Preparation QAQC

Sample Preparation:	Tolerance	Method	Failure Action	Frequency
Moisture Content	0%	Watch-glass condensation	Return to drying oven	Daily – all samples
Crusher Product	85% -10 mesh	Screen analysis	Adjust crusher wear plates	Weekly
Pulp Product	90% -150 mesh	Screen analysis	Adjust timer – check pulverizer puck	Weekly

Table 5.5: Fire Assay QAQC

Fire Assay:	Tolerance	Method	Failure Action	Frequency
Flux/Crucible Contamination	+ / - 0.002 mg	Blank fusion	Re-run suspect batch	Every batch
*Fusion Accuracy / Precision	+ / - 3 STD	Certified Reference Material	Re-run suspect batch	Every batch
Pulp Balance	+ / - 0.100 g	Service-tech calibration	Re-calibrate / replace balance	Annual – (request as found/as left report)
Micro Balance	+ / - 0.002 mg	Service-tech calibration	Re-calibrate / replace balance	Annual – (request as found/as left report)
Micro Balance	+ / - 0.002 mg	In-house calibration wt. check	Run manual calibration – confirm tolerance met	Daily
**Fire Assay Accuracy/Precision	>95% confidence	Participate in SMA Round Robin	Internal investigation	Bimonthly

*NOTE: In-house standard is made from mill feed samples to account for Pogo unique matrix per SWP PA-058.

**NOTE: Society of Mineral Analyst's bi-monthly round robin is a quality assurance program whereby Pogo results are compared with those of approx. 50 North American production laboratories per SWP PA-48

Table 5.6: Atomic Absorption QAQC

Atomic Absorption	Tolerance	Method	Failure Action	Frequency
*Instrument Accuracy	+ / - 1%	Confirm conc. of known standards	Re-calibrate – trouble shoot instrument	Every set of solution analyses
Instrument Performance	+ / - 2%	Track instrument Cu absorbance	Optimize / trouble shoot instrument	Daily
Instrument Performance	Factory Specifications	Service-tech annual PM	Replace worn parts – replace instrument. Bring to factory tolerances	Annual – (request as found/as left report)
Pipette / Flask Accuracy	+ / 0.5%	Gravimetric check	Replace pipettor – volumetric flask	Weekly

*NOTE: Known working standards and QC standards are made up in-house using stock standards and class A glassware. C of A's of stock solutions are kept on file for one year.

Table 5.7: WAD Cyanide QAQC

WAD/CN-Colorimetric	Tolerance	Method	Failure Action	Frequency
Method / Instrument Accuracy	+ / - 1%	Confirm concentrations of known standards	Re-calibrate – trouble shoot	Every set of solution analyses
Method Interference	+ / - 0.5%	Track instrument blank absorbance	Optimize / trouble shoot instrument	Every set of solution analyses
Pipette / Flask Accuracy	+ / 0.5%	Gravimetric check	Replace pipettor – volumetric flask	Weekly

Table 5.8: Titration QAQC

Titration	Tolerance	Method	Failure Action	Frequency
Method Accuracy – CN - NaOH	+ / - 1%	Confirm concentrations of known standards	Re-analyse – trouble shoot titrant concentration / indicator	Weekly
Burette / Glassware Accuracy	+ / 0.5%	Gravimetric check	PM / replace burette – glassware	Weekly

Table 5.9: Calibration and Maintenance Safe Work Procedures

Assay Laboratory Calibration and Maintenance SWPs
PAL-036 Ohaus Explorer Pro Balance Calibration
PAL-037 Sartorius Micro-Balance Calibration
PAL-040 XRF Mini Maintenance Checks

Appendix D – Data Management

Table 6.0: Data Management Safe Work Procedures

Assay Laboratory Record Keeping and Data Management Safe Work Procedures
PAL-034 Save Core Results in LIMS
PAL-052 Archiving of Core Samples for Storage
PAL-043 LIMS OP