APPENDIX D

Meteorological Monitoring Plan

REPORT

Meteorological Monitoring Plan

Coffee Gold Mine

Prepared for:

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November 20, 2023

REVISION TRACKING LOG

Revision Tracking Log			
Version	**Date**	**Section Updated**	**Description of Update**
0	November 2023	-	First submission of the Meteorological Monitoring Plan
1			
2			

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LIST OF ACRONYMS AND ABBREVIATIONS

Acronym / Abbreviation	Definition
BCMOE	British Columbia Ministry of Environment
EMAMP	Environmental Monitoring and Adaptive Management Plan
HLF	Heap Leach Facility
IC	Intermediate Component
m asl	Metres Above Sea Level
QA/QC	Quality Assurance/Quality Control
SD	Snow Depth
SWE	Snow Water Equivalent
WMO	World Meteorological Organization
WUL	Water Use License

LIST OF SYMBOLS AND UNITS OF MEASURE

Symbol / Unit of Measure	Definition
◦C	Degrees Celsius
Cm	Centimeters
M	Meters
mb	Millibars
mm	Millimeters
m/s	Meters per Second
W/m^2	Watts per Square Meter

1.0 INTRODUCTION

This plan describes the meteorological monitoring for the Coffee Gold Project (the Project). Meteorological monitoring refers to the collection of high-quality and site-specific climate data, including air temperature, precipitation, wind speed and direction, relative humidity, atmospheric pressure, and solar radiation. The actual site-specific climate data will be reviewed against the climate projections for the Project area to allow for development of flexible responses to early signs of climate change.

This plan describes meteorological monitoring across all phases of the Project, including Baseline, Construction, Operations, Closure, and Post-closure phases. Data collected by the meteorological monitoring program will inform mine infrastructure design and will be a critical input to the management of mine infrastructure, such as sediment ponds, the Heap Leach Facility (HLF) and open mine pit dewatering.

This plan details routine climate monitoring as well as specific surveillance monitoring, and outlines both site-specific and regional climate data climate reporting and analysis and considers regional weather station records and climate change scenario outputs. The collection of meteorological data is closely tied to the monitoring of surface water hydrology, surface water quality, groundwater quantity and quality and air quality. The meteorological monitoring program is designed to capture temporal and spatial variability in key climate parameters at the site in such a way that these data can be robustly linked to the data collected by other monitoring programs is discussed further in the Environmental Monitoring and Adaptive Management Plan (EMAMP) summary document.

The reporting and analysis outputs described herein aim to manage risk and minimize residual environmental effects. The ongoing monitoring of site climate conditions will provide valuable updates to the site climate and hydrological models and will aid in the interpretation of the monitoring results from other monitoring programs (e.g., water quality, aquatic biota, Heap Leach and Process Facilities Plan).

Reference material used in the preparation of this plan includes:

- Water and Air Baseline Monitoring Guidance Document for Mine Proponents and Operators, B.C. Ministry of Environment, 2012
- Manual of Operational Hydrology in British Columbia, Water Management Branch of the BC Ministry of the Environment, 1991
- Snow Survey Sampling Guide, Water Management Branch of the BC Ministry of the Environment, 1981
- Snow Survey Sampling Guide, Soil Conservation Service of the United States Department of Agriculture. Agriculture Handbook Number 169, 1984
- Quartz Mining License Application Guide, Yukon Government Department of Energy, Mines and Resources, 2010
- Plan Requirement Guidance for Quartz Mining Projects, Yukon Water Board, 2013
- Water Management Standard, Newmont Corporation, 2020
- Water Management Standard Guideline, Newmont Corporation, 2020.

This plan is subject to regular updates, as may be necessary as mine design, construction activities and mine operations progress, and as monitoring results are collected and evaluated.

2.0 MONITORING LOCATIONS AND FREQUENCIES

A Campbell Scientific automated weather station was installed in July 2012 and is located roughly 5 km to the east of the main Project infrastructure (i.e., heap leach, pits, waste rock storage areas) at elevation 975 m asl (Figure 2-1). This is referred to as the KM 11 climate station, and data is downloaded manually on a monthly basis. A second automated weather station was installed at high elevation (~1,340 m asl) and adjacent the proposed heap leach pad footprint (i.e., ~400 m to the northwest of the HLF) in October 2018. This station is referred to as the Kona climate station, and is equipped with a satellite transmitter, which uploads the climate data to a web server on an hourly basis. This will allow real-time assessment of station performance, battery health and upper elevation climate conditions in support of exploration and mining operations.

In addition to these two fully instrumented climate stations, two tipping buckets have been deployed during the summer season to measure rainfall over a range of elevations. Snow courses were also established in 2012 at various elevations/aspects around the study site to measure snow accumulation and timing of snow melt (Figure 2-1). The details of the meteorological monitoring stations and snow courses are provided in Table 2-1.

Table 2-1 Meteorological Monitoring Station Locations

Station	Type	Parameters	Latitude (°N)	Longitude (°W)	Elevation (m asl)	Station	Type
IC-1.5_SS	Snow Course	SD, SWE, Density	62.915	-139.579	524	IC-1.5_SS	Snow Course
CC-EAST-1_SS	Snow Course	SD, SWE, Density	62.872	-139.394	1,220	CC-EAST-1_SS	Snow Course
KAM-WX_SS	Snow Course	SD, SWE, Density	62.873	-139.180	996	KAM-WX_SS	Snow Course
Mid-Elev-SS	Snow Course	SD, SWE, Density	62.894	-139.097	638	Mid-Elev-SS	Snow Course
KM 11	Climate Station	See Table 2-2	62.873	-139.180	975	KM 11	Climate Station
Kona	Climate Station	See Table 2-2	62.874	-139.434	1,340	Kona	Climate Station
Camp Tipping Bucket	Tipping Bucket Rain Gauge	Rainfall (event), Temperature	62.911	-139.070	430	Camp Tipping Bucket	Tipping Bucket Rain Gauge
High-Elevation Tipping Bucket	Tipping Bucket Rain Gauge	Rainfall (event), Temperature	62.888	-139.331	1,250	High-Elevation Tipping Bucket	Tipping Bucket Rain Gauge

Each meteorology station has wind sensors mounted on the tower at 10 m above the ground surface, with the sensors for other instruments set at 2 m above ground surface. Observations are recorded to a central datalogger, complete with all weather enclosure, battery pack, solar panel, and voltage regulator. Parameters measured hourly by the meteorology station are detailed in Table 2-2 and include:

- Air temperature (◦C) and relative humidity (%) data

- Wind speed (m/s) and direction (0-360 degrees) measurements, including wind gust data
- Incoming solar radiation (W/m2) and barometric pressure (mb) reading
- Measurements of precipitation (mm) at a tipping bucket gauge fitted with Alter shield and solid phase precipitation adaptor (KM 11 station), and a Geonor all season precipitation gauge (Kona station).

The KM 11 climate station data logger also generates daily data as follows, as well as 2-day, 3-day, 10-day and 30-day total precipitation (Table 2-2):

- Daily average air temperature and wind speed
- Daily maximum air temperature and wind speed
- Daily minimum air temperature
- Average daily relative humidity
- Total daily precipitation.

Table 2-2 Meteorological Monitoring Parameters, Units and Sampling Frequency

Variable	Code – KM11 Station	Code – Kona Station	Units	Sampling Frequency
Date, Time	**TIMESTAMP**	**DateTime**	**DD/MM/YYYY 00:00 AM/PM**	**Hourly**
Record Number	RECORD	N/A	RN	Hourly
Power Supply (12V - Average)	BattV_Avg	VB	Volts	Hourly
Air Temperature	Air_Temp_Avg	TA	◦C	Hourly
Relative Humidity	RH_Avg	RH	Percent	Hourly
Solar Radiation	SlrkW_Avg	SR	W/m^2	Hourly
Wind Speed (Average, blowing towards)	WS_ms_Avg	WSpd	m/s	Hourly
Maximum Wind Speed (blowing towards)	WS_ms_Max	PkWSpd	m/s	Hourly
Wind Direction	WindDir_D1_WVT	WDir	Deg	Hourly
Maximum Wind Speed - Wind Direction	WindDir_SD1_WVT	PkWDir	Deg	Hourly
Atmospheric Pressure	BP_mbar	BP	mbar	Hourly
Evapotranspiration	ET_mm	N/A	mm	Hourly
Date, Time	TIMESTAMP_DLY	N/A	DD/MM/YYYY 00:00 AM/PM	Daily
Record Number	RECORD_DLY	N/A	RN	Daily
Power Supply (12V - Minimum)	BattV_Min_DLY	N/A	Volts	Daily
Air Temperature, Daily Average	Air_Temp_Avg_DLY	N/A	◦C	Daily
Air Temperature, Daily Maximum	Air_Temp_Max_DLY	N/A	◦C	Daily
Time Stamp for Air_Temp_Max_DLY	Air_Temp_TMx_DLY	N/A	DD/MM/YYYY 00:00 AM/PM	Daily
Air Temperature, Daily Minimum	Air_Temp_Min_DLY	N/A	◦C	Daily
Time Stamp for Air_Temp_Min_DLY	Air_Temp_TMn_DLY	N/A	DD/MM/YYYY 00:00 AM/PM	Daily
Relative Humidity	RH_Avg_DLY	N/A	Percent	Daily
Precipitation	Rain_mm_Tot_DLY	N/A	mm	Daily
Wind Speed (Average, blowing towards)	WS_ms_Avg_DLY	N/A	m/s	Daily
Maximum Wind Speed (blowing towards)	WS_ms_Max_DLY	N/A	m/s	Daily
Time Stamp for WS_ms_Max_DLY	WS_ms_TMx_DLY	N/A	DD/MM/YYYY 00:00 AM/PM	Daily
2-day Total Precipitation	2-day_Precip	N/A	mm	Computed from Rain_mm_Tot_DLY
3-day Total Precipitation	3-day_Precip	N/A	mm	Computed from Rain_mm_Tot_DLY
10-day Total Precipitation	10-day_Precip	N/A	mm	Computed from Rain_mm_Tot_DLY
30-day Total Precipitation	30-day_Precip	N/A	mm	Computed from Rain_mm_Tot_DLY

Snow courses have been established at various elevations (i.e., low, mid, and high elevation), oriented to discern effects of aspect on local snow accumulation (Figure 2-1). Snow courses are surveyed at, or near, peak seasonal accumulation, as detailed in Table 2-3. Two tipping bucket rain gauges have also been installed at camp (430 m) and ridge-top (1300 m) to refine the precipitation elevation gradient (Figure 2-1). These gauges log precipitation events in 0.1 mm increments and are not set to log at specific time intervals.

Table 2-3 Snow Survey Monitoring Parameters, Units and Sampling Frequency

Variable	Code	Units	Sampling Frequency
Snow Depth	SD	cm	Monthly (12-day window centred on Jan. 1, Feb. 1, Mar. 1, and Apr. 1) at ridgetop, met station, mid-elevation, and valley bottom sites
Snow Water Equivalent	SWE	mm	
Snow Density	DEN	%	

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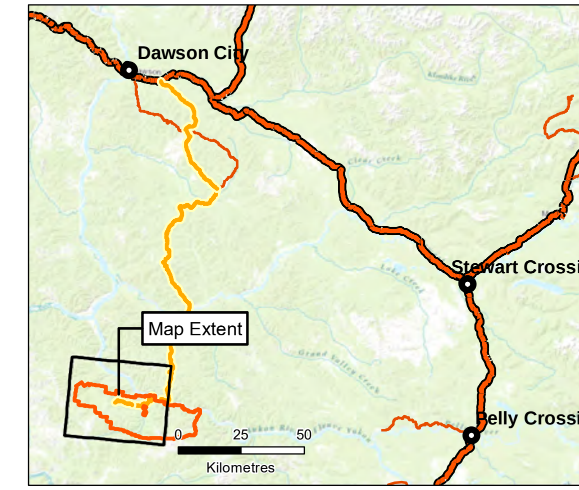
Weather Stations and Snow Course Locations, Coffee Gold Project



Legend

- Automated Weather Station
- Snow Course
- Tipping Bucket Rain Gauge
- Watercourse

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein..

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Kilometres

NAD 1983 UTM Zone 7N

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Figure 2-1	Date: Dec 2, 2021	Drawn by: AL	Reviewed: SJ

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3.0 MONITORING METHODOLOGY

The implementation of the meteorological monitoring plan is expected to remain consistent throughout the project lifespan. The collection of meteorological data is sensitive to site-scale changes (vegetation growth, shading, ground cover changes, etc.) and to changes in instrumentation and maintenance activities. As a result, consistency is of paramount importance, and every attempt will be made to ensure that the protocols and practices remain consistent throughout the project lifespan. The Kona meteorological station has been operated concurrently with the KM 11 station for 3+ years, to allow the records to be merged. It is anticipated that the older KM 11 meteorological station will be decommissioned once it reaches the end of its serviceable life, or, refurbished and moved to the Coffee Camp airstrip to better constrain orographic precipitation gradients and temperature lapse rates at the Project site.

All meteorological station sensors and snow survey equipment will be calibrated and maintained according to the manufacturer's specifications, and as detailed in Appendices A through C. Additionally, if issues are noted by site staff or external contractors then the affected equipment will be serviced as soon as possible, or a replacement found.

4.0 DATA ANALYSIS AND INTERPRETATION

Once data has been collected from the weather station, snow courses or tipping buckets, meteorological data is to be entered by the responsible site personnel into a standardized database. The database will be the primary record, and any adjustments or corrections that are performed on this data will be saved as separate files, to ensure that the original data records remain unaltered. All meteorological data and associated field notes will be stored in standard electronic format and backed up to a secondary server.

4.1 Document Control

The post-processing of meteorological data will typically be done in Microsoft Excel. Secondary processing steps will be undertaken for some of the regional or extreme event analyses and may require the use of distribution fitting software or another statistical software package.

Meteorological data will be archived on site computers and backed up to an external secondary server on at least a monthly basis.

The data collected by the meteorological program will be the property of Newmont but will be distributed as required by relevant permit and license conditions, in tabular, graphical and figure format, as required. Otherwise, dissemination of the data will be at Newmont's discretion.

4.2 Quality Assurance and Quality Control

The primary objective of data quality assurance and quality control (QA/QC) program is to ensure that the data collected by the site monitoring programs is both accurate and precise, and properly represents the parameters that the monitoring programs are intended to measure. This provides regulators, First Nations, the public and mine staff with confidence in the data collected by the monitoring programs, and thus in the conclusions and actionable responses drawn from these data.

The QA/QC program encompasses a range of actions, including:

- Regular checks and calibration of the instrumentation
- Automated error trapping and flagging for review in databases and spreadsheets
- Review of collected data by site environmental staff
- Periodic review, as necessary by external review by qualified professionals.

As the climate data is collected, it will be subject to several levels of review. The first will be done by site environmental staff and will involve checks for values that are outside seasonal norms, error codes, and trends in data that are not consistent with known site climatology (i.e., sensor drift, sensor failure). These will be flagged and noted in the original file, and all corrections will be saved to a secondary file with an appropriate label. Data QA/QC will consist of several steps.

1. Upon download of the data from dataloggers, include any error codes and note the condition of climate station and sensors. This includes riming on the wind, temperature and solar radiation sensors, accumulation of ice in the all-weather precipitation gauge, wire connections and general physical condition of the tower.

2. Make note of abnormal snow drifting at snow courses or melt patterns that could affect the data. Also make note of vegetation conditions that could adversely affect the data, such as additional forest canopy growth over the sampling sites.
3. Photocopy field notes once back in the office and transcribe all notes into the database.
4. Plot all parameters, and in a different file (keep the original file unaltered) remove false readings, flag anomalous readings for follow-up and note any changes made.
5. Flag missing data, and if possible, infill the missing data using relationships developed with other site stations. Note that this data is estimated.
6. As an additional check, the data will be cross-referenced between sources to confirm that accurate data is being collected, including:
   a. Compare monthly precipitation totals between rainfall gauges.
   b. Compare cumulative winter precipitation from the climate station gauge to corresponding snow water equivalent data from snow survey station(s).
   c. Compare temperature data between all site stations.

Any anomalies or errors that are unresolved should be noted in the internal quarterly and external annual reports, as this will provide context for any findings resulting from the monitoring program that may appear anomalous.

The second level of review will be undertaken by the qualified professionals employed by or engaged by Newmont to produce annual reports and any updated estimates for relevant climatic parameters (e.g., rainfall recurrence interval estimates). This review will initially compare the original data file to the corrected one provided by site staff to ensure consistency and accuracy in the QA/QC process. The second step will involve a comparison to past estimates, seasonal averages, etc. generated for site. The third and final step will involve the comparison of the site data to at least two regional climate stations/snow courses to confirm that the meteorological data collected at site is generally consistent with the regional values.

4.3 Data Analysis

Surveillance monitoring will form an integral component of the meteorological and broader site water monitoring plan. Careful tracking of the prevailing climate conditions will be necessary to manage water over time. Specifically:

- Internal quarterly reporting and annual external reports will make note of extended wetter or drier periods than normal (daily) at site:
  - Drier conditions may require make-up water to be sourced for heap leach irrigation.
  - Wetter conditions may trigger more frequent monitoring of event ponds, and provision of contingency measures if pond volumes increase rapidly beyond predicted levels.
  - Pit dewatering rates may need to increase under wetter conditions.
  - The effluent discharge regime may need to be adjusted if drier conditions are indicated (i.e., lower available dilution in receiving streams).
- Data from the site snow courses will provide critical information on the potential volume of water that will need to be managed (e.g., routed via diversions, captured by event ponds, pit inflow volumes, etc.) each freshet. Snow data will provide an indication of the timing and volume of the spring freshet in the receiving creeks, which will allow for additional water management

opportunities. It is expected that once sufficient data is available, predictive regression equations may be developed that employ data from the snow courses and precipitation gauge to predict seasonal runoff volumes, and potential heap leach facility infiltration volumes.

  - Snow course data (SWE specifically) will be plotted as a time series that includes all previous data collected, and against the cumulative precipitation totals for the winter. It will also be plotted against the nearest two operational snow courses run by Yukon Environment for comparison to the long-term record.
  - SWE values gathered at all site snow courses should be compared to the historical average for each station, and this information should be included in the quarterly reports for mine managers. If the current value is similar to a value from a previous year (e.g., if the March 1st SWE value at a station is similar to that collected in 2014, then the analogue year should be reported. This will allow mine operations managers to begin predicting the expected volumes of water to be handled during the upcoming freshet (pit dewatering, event pond management, etc.).

- The cumulative precipitation from the previous year (autumn in particular) will inform the relative risk of a large spring freshet. A wetter than average summer and/or autumn will lead to more saturated soil conditions going into winter, and thus a more rapid basin response during the following freshet season as less storage is available for snowmelt and spring rain events. Similarly, snowpack monitoring will provide information on the expected volume of water that will need to be managed during the subsequent freshet. This has relevance for the management of water in the event ponds, to ensure that any potential shortfall in emergency storage can be managed proactively.
- Continuous monitoring of the heap leach facility pond will be linked directly to precipitation/snowmelt totals to ensure that pond volumes can be predicted with a high degree of accuracy.

Heavy precipitation accumulation (e.g., 3- to 5-day totals) may trigger more frequent monitoring of pond volumes, sediment pond retention times and discharge rates, etc.

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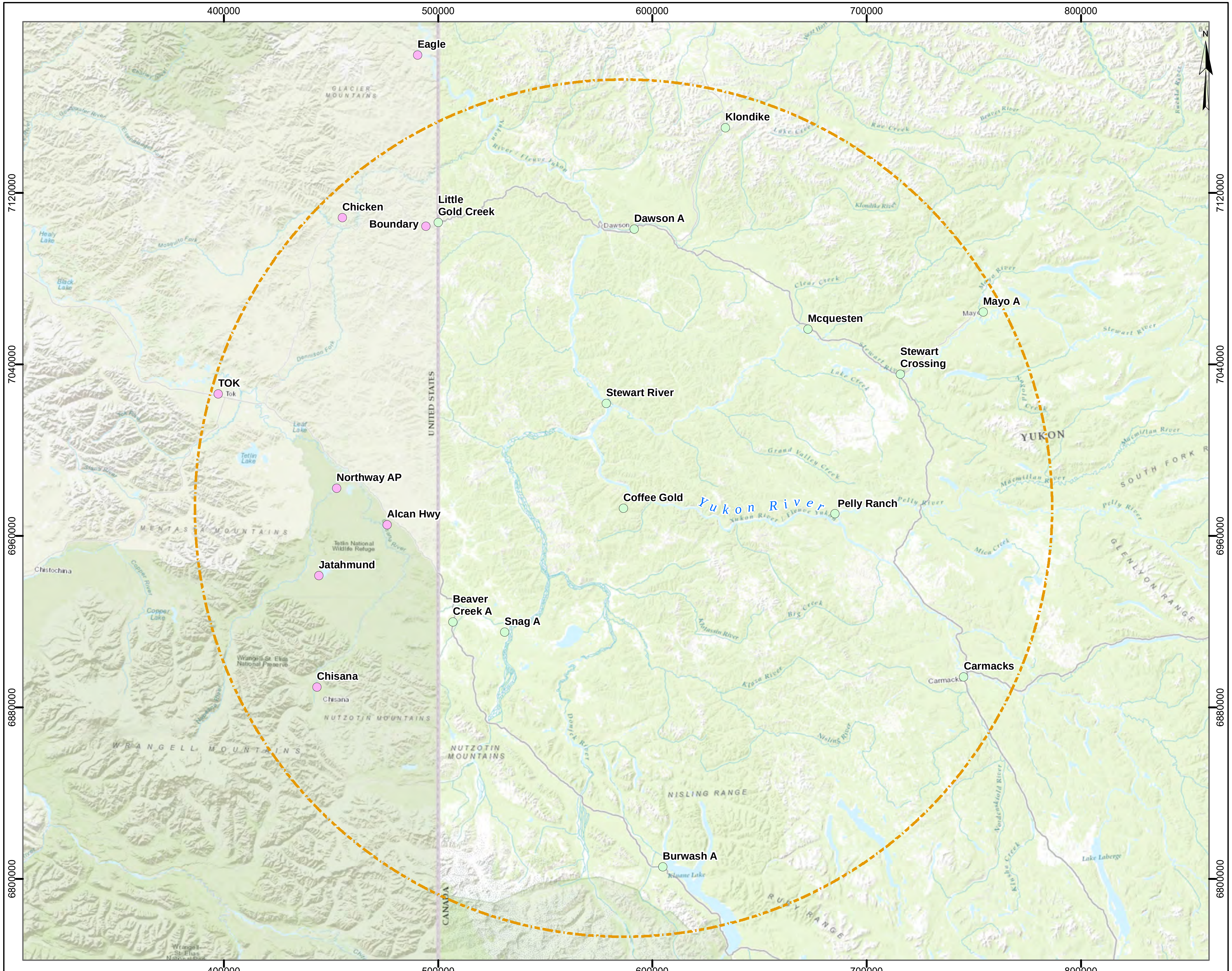
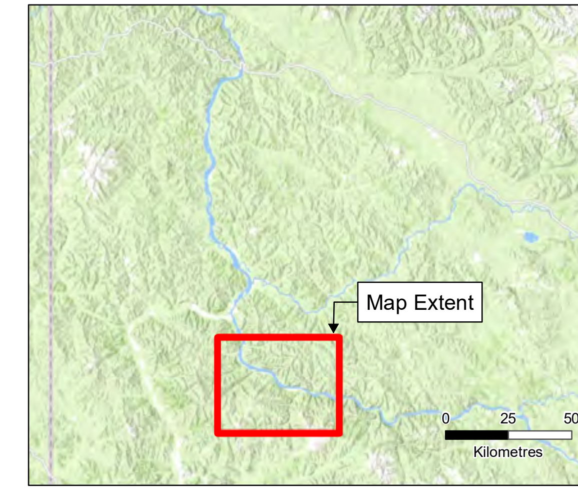
Regional Climate Stations





Legend

Regional Precipitation Stations

- Alaska
- Yukon
- 200KM Radius Around Coffee Gold

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein..

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Kilometres

NAD 1983 UTM Zone 7N

Page Size: 11" x 17"

Figure 4-1	Date: Dec 2, 2021	Drawn by: AL	Reviewed: SJ

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5.0 REPORTING AND ANNUAL REVIEW

Reporting of the data collected by the meteorological monitoring plan will be required for both site operational tracking and monitoring program refinement, and as conditions of the various operational permits and licenses. Internal reporting should be conducted quarterly, and external reporting annually, as detailed below.

5.1 Quarterly Data Reports

Monthly regulatory reports to meet Water Use License (WUL) requirements will summarize all data collected as part of the meteorology monitoring program. The quarterly data reports will help inform construction and operations activities, which are all affected in some way by the prevailing climatic conditions.

5.2 Annual Interpretive Reports

Annual regulatory reports to meet WUL requirements will encompass data from the meteorology, surface and ground water, heap leach and waste rock monitoring programs. These reports will summarize the data collected for the previous year in tabular and graphical format, as well as providing summary statistics (e.g., monthly rainfall and temperature summaries, precipitation (snow and rain) as a percent of the long-term average, discharge, and water quality, etc.). The annual report will summarize the data collected for the previous year in tabular and graphical format, as well as providing summary statistics (e.g., minimum, mean, and maximum temperatures, monthly rainfall totals, precipitation (snow and rain) as a percent of the long-term average, etc.).

In addition to the linkages with site water management activities the annual report will place the presented data into context with streamflow data for the receiving environment, sediment pond volumes and discharge rates, pit lake levels and volumes as present, operation of the heap leach facility, and so forth. Any significant changes to the monitoring network including instrumentation, location of monitoring points, etc. will be noted along with a rationale for the changes.

6.0 REFERENCES

BCMOE. 2012. Water and Air Baseline Monitoring Guidance Document for Mine Proponents and Operators. Prepared by the B.C. Ministry of Environment. 198 p.

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APPENDIX A
Meteorological Stations

1.0 APPENDIX A: METEOROLOGICAL MONITORING

1.1 Introduction

This document outlines the standard operating procedures (SOP) for maintaining and downloading climate data from the site climate station at the Coffee Gold Mine. These data form an important input into short-term (seasonal) and long-term (annual) water management activities at site. This document provides technical guidance for site staff responsible for collecting climate data, with the goal of ensuring that the data collected is accurate and adequately representative of the site climatic regime.

1.2 Responsibilities – Field Staff

Field staff are required to have the appropriate training and knowledge to undertake the maintenance of the tower and instrumentation and downloading of the site climate station data effectively. They must ensure the proper working order of all equipment, maintain the climate station site and ensure that all instruments are calibrated according to manufacturer specifications, take accurate and legible field notes, and enter the data into the database correctly once back in the office.

1.3 Responsibilities - Supervisors

Supervisors must ensure that field staff have the appropriate training, have access to reliable and functioning equipment, and that maintenance and downloads are carried out according to this SOP. Supervisors must also ensure that data is entered into the site database, and are responsible for review, QA/QC and trend analysis of the data. Included in this review is the identification of outliers and of results that are substantially lower or higher than normal for the parameter and month of interest, or that deviate from the tipping bucket rain gauge records (for rainfall, with orographic effects taken into consideration). These deviations have immediate water management implications (e.g., requirement for increased makeup water for HLF irrigation, or updates of design event criteria), and must be communicated to mine management.

1.4 Climate Station Location and Objectives

The climate station is located at 975 m, at KM 11 on the site access road (Table 1; Figure 1). A second automated weather station was installed at high elevation (~1,340 m asl) and adjacent the proposed heap leach pad footprint (i.e., ~400 m to the northwest of the HLF) in October 2018. This station is referred to as the Kona climate station, and is equipped with a satellite transmitter, which uploads the climate data to a web server on an hourly basis. The primary purpose of the climate stations are to provide baseline and operational information on the climate at the Project site, including the following parameters:

- Air temperature
- Relative humidity
- All season precipitation
- Solar radiation
- Barometric pressure
- Wind speed and direction.

The precipitation data collected by the all-weather gauge is augmented by the tipping bucket rain gauges (Appendix B) and the site snow courses (Appendix C).

Table 1 Meteorological Station Locations

Station	Type	Latitude (°N)	Longitude (°W)	Elevation (m asl)
KM 11	Climate Station	62.873	-139.180	975
Kona	Climate Station	62.874	-139.382	1,300

Figure 1 Coffee Gold KM 11 climate station.

1.5 KM 11 Climate Station Data Download Procedure

The step-by-step instructions for data downloads are provided here, but can also be downloaded from these links:

https://www.campbellsci.ca/downloads/pc200w

https://www.campbellsci.ca/videos/use-pc200w-to-send-a-program-and-collect-data-quickstart-part-4

- Upon arriving at site, make note of the time, general weather conditions, and condition of the tower, sensors, datalogger enclosure, precipitation gauge (including shield) and bear fence.
- Open the door of the data logger enclosure (Figure 2).

Figure 2 KM 11 Climate Station Datalogger Enclosure. RS232 port circled in yellow.

- Connect to the RS232 port with the 9-pin cable, connect to the RS232 port on the laptop or use a serial-USB converter to connect to a USB port on the laptop.
- Open PC200W software and select CR800Series datalogger (Figure 3). Then select “Connect” (Figure 4).

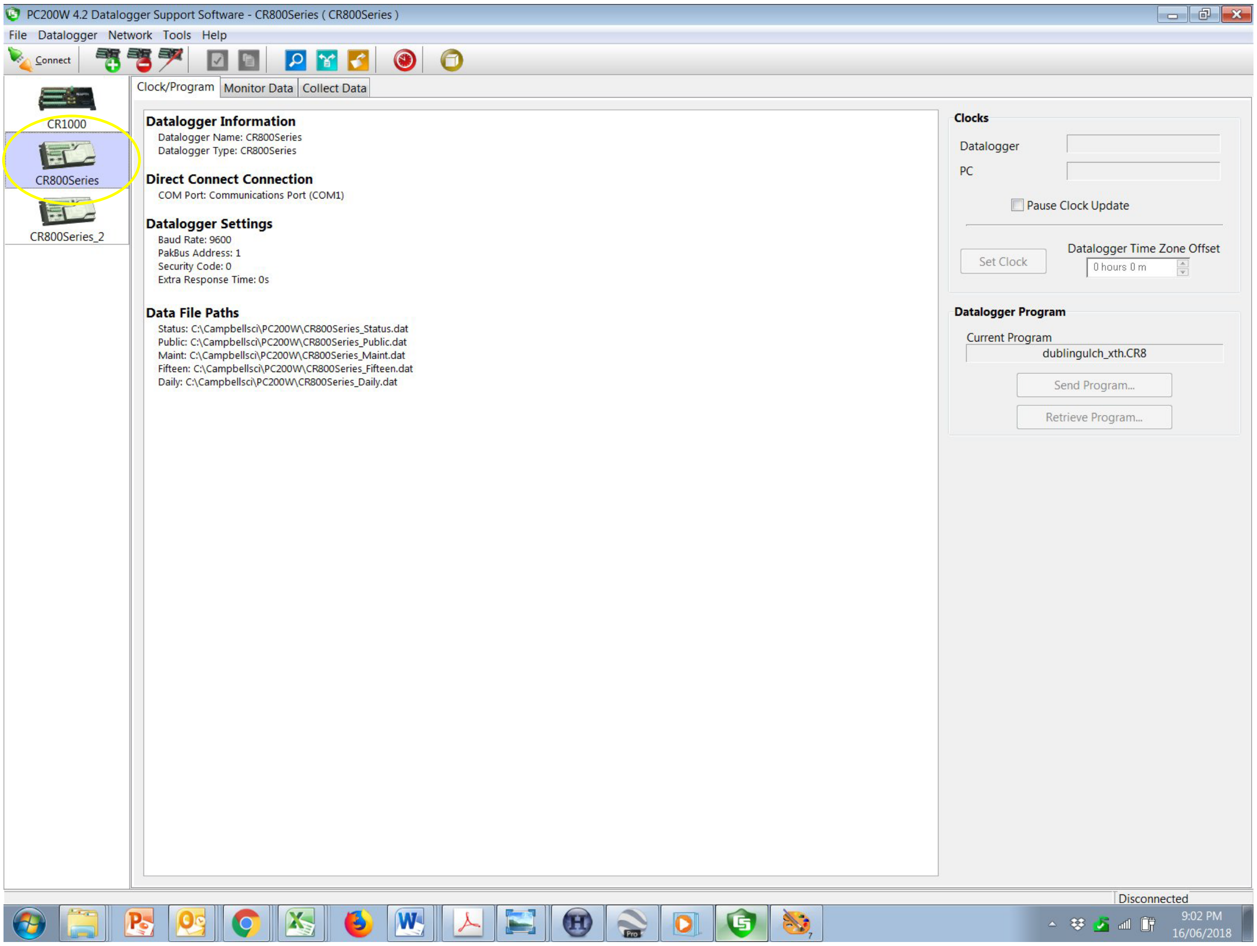

Figure 3 PC200W Software – Main Screen

- Datalogger and PC Time will activate. Set Clock if necessary.
- Then hit the Collect Data tab and select "append new data".
- Activate "view data" and check the values to ensure all sensors are working and that the logger has recorded the latest set of values.
- The file will be automatically saved in Program Files/Campbell Scientific/PC200W as a comma separated values file. Open in Excel.
- Hit "Disconnect" and remove the cable.

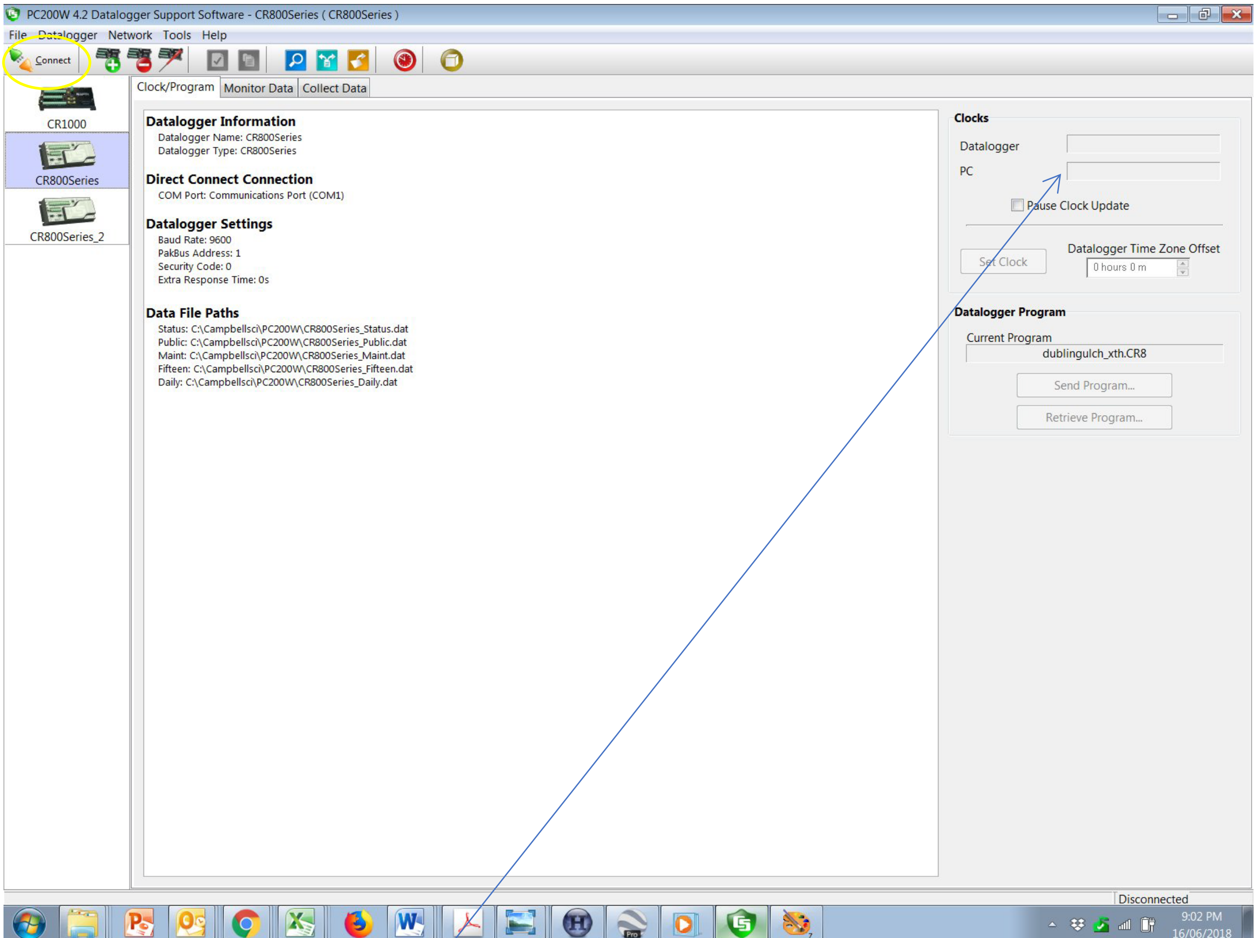

Figure 4 PC200W software – main screen

1.6 KM 11 Climate Station Maintenance

The steps listed below should be followed on every site visit.

- If the desiccant indicator is pink, replace desiccant package.
- Remove snow or frost from the solar panel with a soft brush.
- Check for frost on the anemometer and other sensors. (There is no safe way to remove frost up on the tower – it will naturally dissipate over time but make a note or take a photo if excessive frost is present).

1.6.1 Winter Precipitation Adaptor Installation

- The KM 11 station is supplied with a CS705 precipitation adapter. The adapter should be fitted onto the tipping bucket rain gauge in September when precipitation states changing from rain to snow pellets or snow.
- The manual for the CS705 is in the cooler with the components. If lost, go to the Campbell Scientific page and view online version. https://www.campbellsci.ca/cs705 The components shown below are stored in a Green Maxxam Cooler in the Environmental tent.

- Remove a section of wind screen to access the rain gauge (Figure 6).
- Assemble the precipitation adaptor and reservoir. Loosen the tipping bucket and lower the whole unit with the funnel connected, so that the top of the adapter matches the top of the wind shield.
- Fill the reservoir with non-toxic antifreeze until you hear the tipping bucket "tip". Volume is about 9.5 Litres. Mix 1:1 propylene glycol and de-natured ethanol and top up with light mineral oil to prevent evaporation of the ethanol. Unscented baby oil works.

CS705 Precipitation Adapter

2. Specifications

MODEL CS705 PRECIPITATION ADAPTOR

Material:	Black powder coated aluminum
Capacity:	8" of liquid @ -20°C operating temperature (assuming 1:0 starting ratio of anti-freeze : water).
Antifreeze Capacity:	~2.5 gallons.
Catch Tube Height:	10"
Catch Tube Orifice:	8.0" diameter
Antifreeze Reservoir Height:	14"
Antifreeze Reservoir Diameter:	8.25"
Total Weight (CS705 + Antifreeze):	~20#s

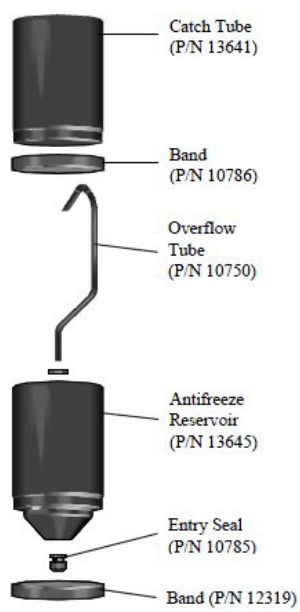

FIGURE 1. CS705 Exploded View

Figure 5 CS705 Manual front cover

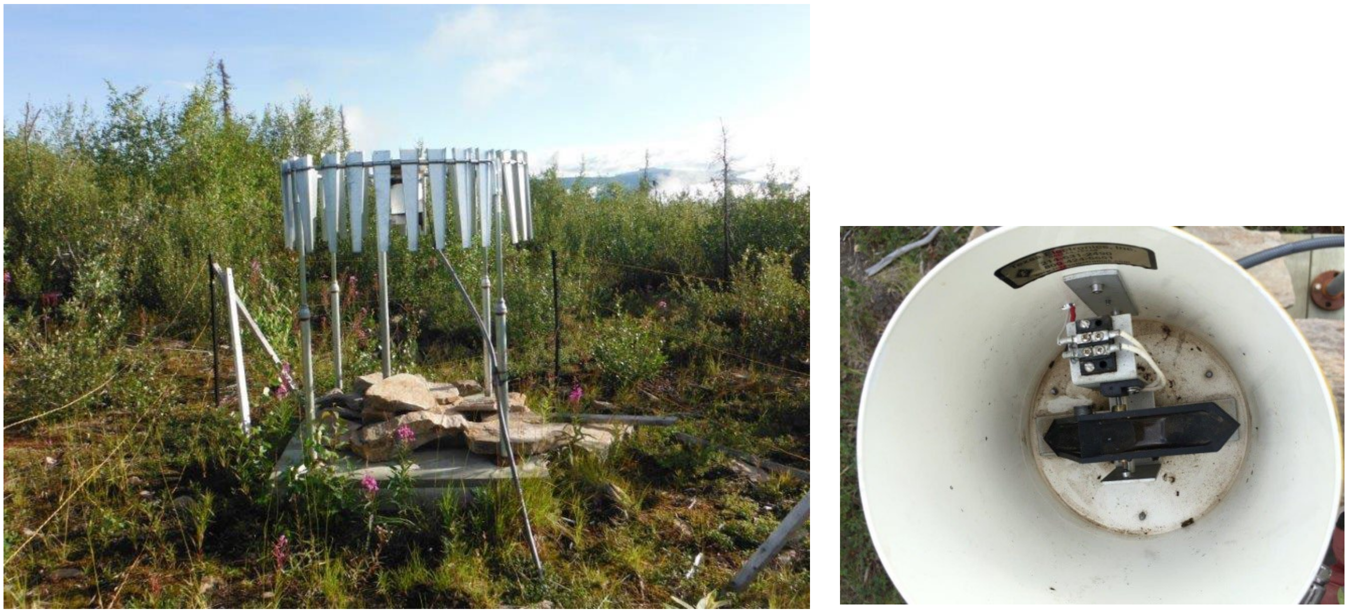

Figure 6 Precipitation gauge wind screen and plan view of tipping bucket

Figure 7 Precipitation gauge in winter

APPENDIX B
Tipping Buckets

1.0 APPENDIX B: TIPPING BUCKETS

1.1 Introduction

This document outlines the standard operating procedures (SOP) for installing tipping bucket rain gauges, and routine downloads and maintenance at the Coffee Gold Mine. These data form an important input into short-term (seasonal) and long-term (annual) water management activities at site. This document provides technical guidance for site staff responsible for collecting rainfall data, with the goal of ensuring that the data collected is accurate and adequately representative of the site precipitation regime.

1.2 Responsibilities – Field Staff

Field staff are required to have the appropriate training and knowledge to undertake the installation and maintenance of tipping bucket gauges effectively. They must ensure the proper working order of all equipment, maintain the gauge location, and ensure that it is calibrated according to manufacturer specifications, take accurate and legible field notes, and enter the data into the database correctly once back in the office.

1.3 Responsibilities - Supervisors

Supervisors must ensure that field staff have the appropriate training, have access to reliable and functioning equipment, and that installations and maintenance are carried out according to this SOP. Supervisors must also ensure that data is entered into the site database, and are responsible for review, QA/QC and trend analysis of the data. Included in this review is the identification of outliers and of results that are substantially lower or higher than normal for a gauge location, or that deviate from the climate station record. These deviations have immediate water management implications (e.g., requirement for increased makeup water for HLF irrigation, or updates of design event criteria), and must be communicated to mine management.

1.4 Tipping Bucket Locations and Objectives

The primary objective of the tipping bucket rain gauges is the monitoring of the orographic precipitation gradient at site. The tipping bucket rain gauges are intended to monitor rainfall only. The all-season precipitation gauge at the KM 11 climate station is configured to measure snowfall (Appendix A), and the snowpack depth, water equivalent and density will be monitored at the site snow courses (Appendix C). Currently, there are two tipping bucket rain gauges installed at site, summarized in Table 1, and Figures 1 and 2.

Table 1 Tipping Bucket Rain Gauge Locations

Station	Type	Parameters	Latitude (°)	Longitude (°)	Elevation (m asl)
Camp Tipping Bucket	Tipping Bucket Rain Gauge	Rainfall (event), Temperature	62.911	-139.070	430
High-Elevation Tipping Bucket	Tipping Bucket Rain Gauge	Rainfall (event), Temperature	62.888	-139.331	1,250

Figure 1 Camp Tipping Bucket Location

Figure 2 Upper Elevation (laydown) Tipping Bucket Location.

1.5 Installation

The rain gauges will be removed during the winter to prevent damage from snowloads, and melt/freeze cycles within the tipping mechanism. These installation instructions apply for the seasonal reinstallations, and also for installation of tipping bucket rain gauges at new sites.

Prior to installation, ensure that the HOBOWare software package is installed on the field laptop. This software is available free of charge from the HOBO website (http://www.hoskin.ca/).

- When installing tipping buckets in the spring (once significant snowfall has ceased for the year, usually in early May), follow these steps:
  - Tipping bucket is level (use levelling screws and bubble; Figure 3) and properly secured to the mount.
  - If the tipping bucket was stored with an elastic to prevent jostling during the winter, ensure that elastic is removed and secured out of the way of the bucket mechanism.
  - All cables are neatly coiled and stored in such a way so as not to interfere with the tipping bucket action. Test the tipping bucket to ensure that it moves freely.
  - Connect the communication cable to the USB port on the field laptop (Figure 4).
  - Open the HOBOWare software and go to Device → Launch to set-up the program (Figure 3). Set the logger to record rain events in millmetres, minimum, average and maximum temperature and the sum of rainfall at hourly intervals.
  - Test the tipping bucket to ensure that events are recorded correctly, using the Device → Readout function in HOBOWare. Note how many events comprised the test and the time in the field notes so that these can be removed from the final data set.
  - Check the battery voltage, and replace the 3V lithium battery annually, or if voltage drops below 2.7V.
  - Replace the enclosure and tighten the thumb screws to secure it.

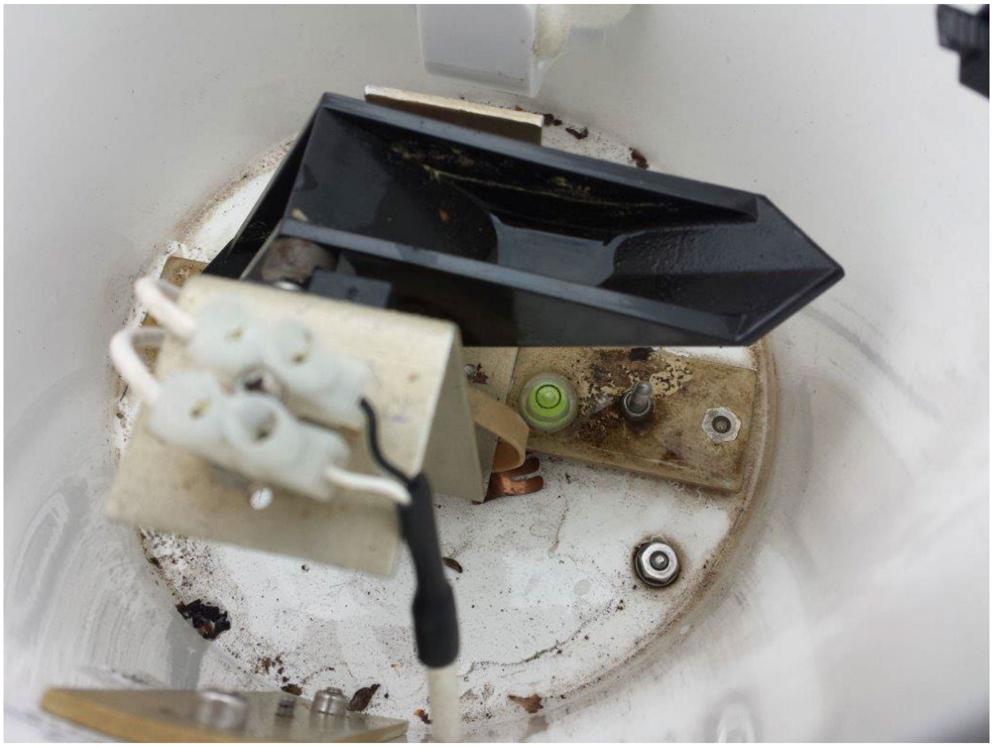

Figure 3 Levelling Bubble at Base of Tipping Bucket

Figure 4 HOBO Pendant Coupler

1.6 Routine Downloads

Data should be downloaded at least once a month during the period that the gauge is actively collecting data. Follow the steps below when downloading data.

- Remove the tipping bucket enclosure by loosening the thumb screws at the base
- Connect the communication cable to the USB port on the field laptop
- Open the HOBOWare software and go to Device → Readout to download the data (Figure 5). The screen shown in Figure 6 will appear – select “Don’t Stop” to keep the logger operating
- Download the data following the convention shown in Figure 7
- Plot the data in the HOBOWare screen to ensure that the data collected looks reasonable (Figure 8)
- Close the HOBOWare software and disconnect the cable
- Replace the enclosure and tighten the thumb screws to secure it.

Once the snowfall season begins (generally in early October), the tipping buckets should be downloaded a final time and decommissioned for the winter.

- Secure the tipping bucket mechanism so that it doesn’t tip
- Coil cable, and secure inside the enclosure
- Replace the enclosure, secure it using the thumb screws, and remove the unit from its pedestal for storage over the winter.

The manual for the RG3 or RG3-M tipping bucket can be downloaded from the Onset website, here: http://www.onsetcomp.com/support

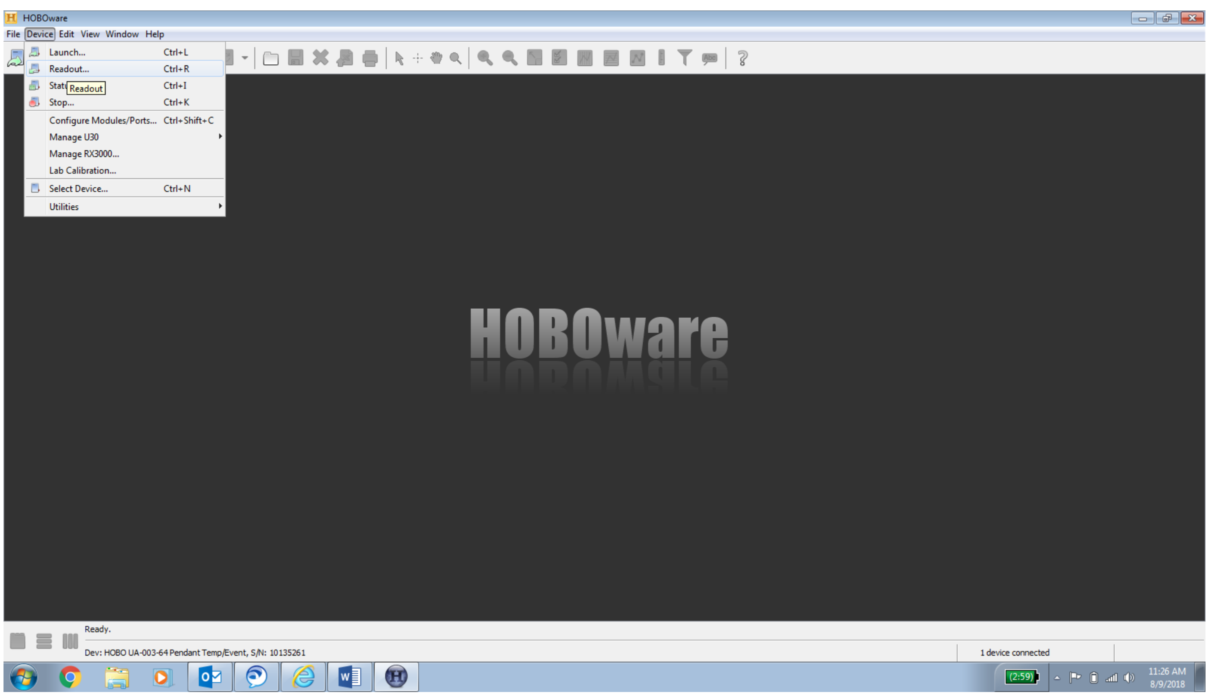

Figure 5 HOBOWare Main Screen

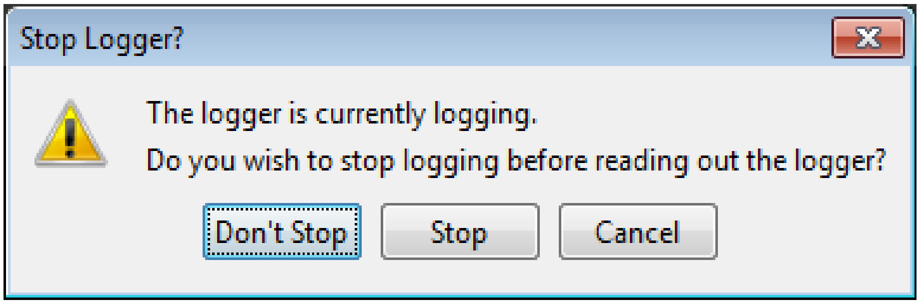

Figure 6 HOBOware – Currently Logging

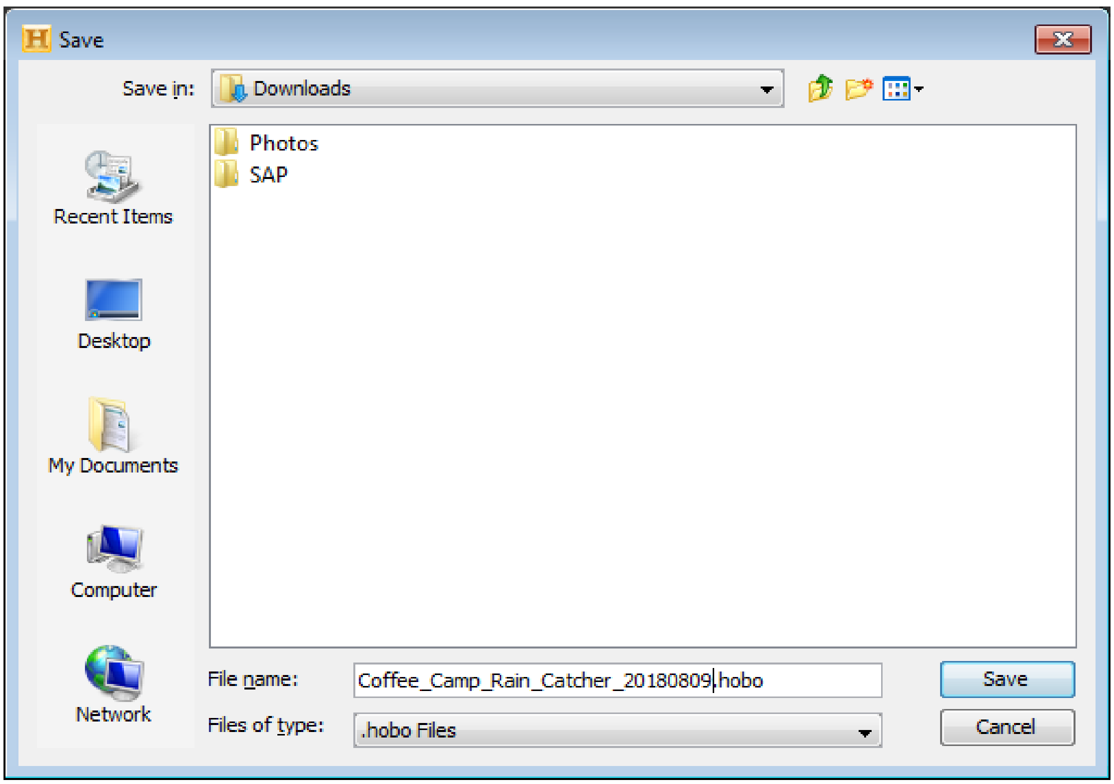

Figure 7 Tipping Bucket Rain Gauge File Naming Convention

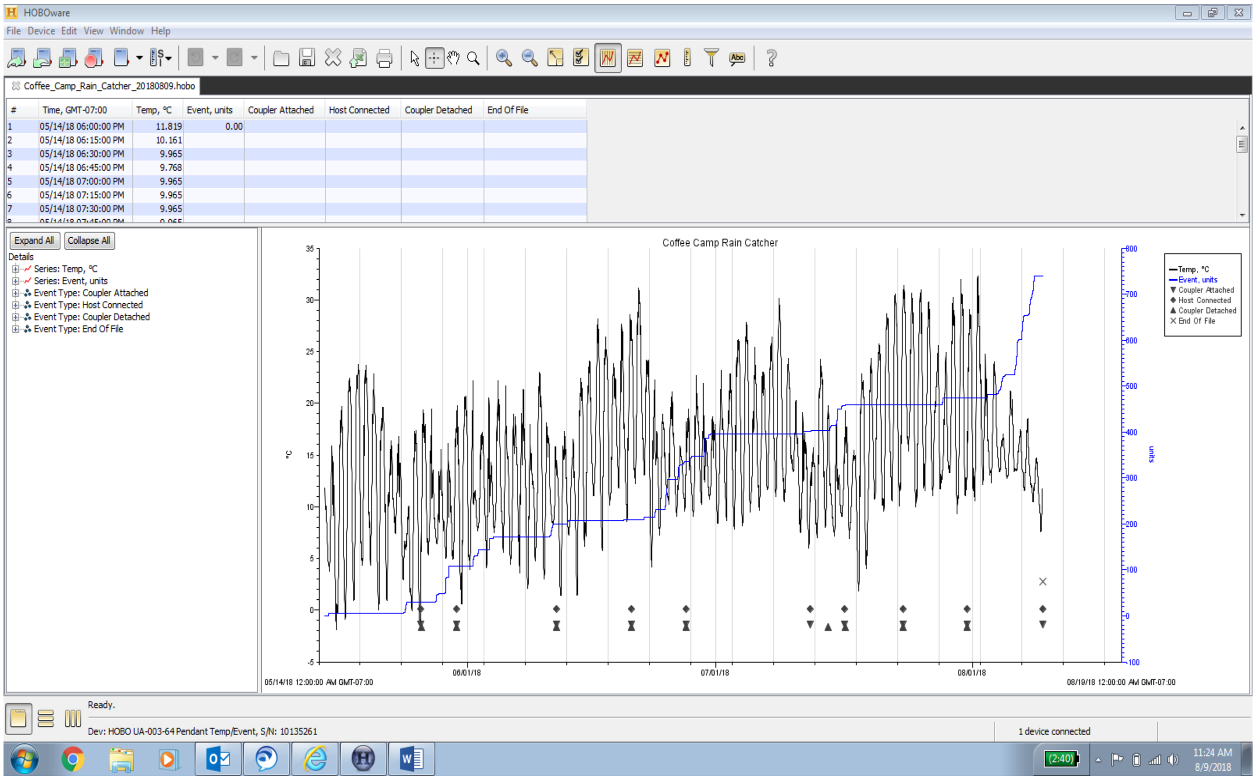

Figure 8 Data Plot Screen

APPENDIX C
Snow Courses

1.0 APPENDIX C: SNOW SURVEYS

1.1 Introduction

This document outlines the standard operating procedures (SOP) for conducting snow surveys at the Coffee Gold Mine. These data form an important input into short-term (seasonal) and long-term (annual) water management activities at site. This document provides technical guidance for site staff responsible for collecting snowpack data, with the goal of ensuring that the data collected is accurate and adequately representative of the snowpack conditions.

1.2 Responsibilities – Field Staff

Field staff are required to have the appropriate training and knowledge to undertake the snow surveys effectively. They must ensure the proper working order of all equipment, maintain the snow courses (e.g., brushing), take accurate and legible field notes, and enter the data into the database correctly once back in the office.

1.3 Responsibilities - Supervisors

Supervisors must ensure that field staff have the appropriate training, have access to reliable and functioning equipment, and that sampling is carried out according to this SOP. Supervisors must also ensure that data is entered into the site database, and are responsible for review, QA/QC and trend analysis of the data. Included in this review is the identification of outliers and of results that are substantially lower or higher than normal for a specific snow course and sampling period. These deviations have immediate water management implications (e.g., requirement for increased makeup water for HLF irrigation, or draindown of ponds prior to a larger than normal freshet) and must be communicated to mine management.

1.4 Snow Survey Locations and Objectives

The primary objective of snowpack monitoring with snow courses is to determine the amount of water stored in the snowpack, and thus the likely magnitude of water that must be managed by mine operations staff during the freshet season (generally mid-May to mid-June). This SOP presents the snow survey locations (Table 1; Figures 1-4), considerations for installing new snow courses, field methods and data entry and processing. The main references for snow course monitoring are listed below, and the information presented in these documents has been condensed in this appendix. Both documents should be reviewed in full by site environmental staff prior to sampling a snow course.

- *Snow Survey Sampling Guide*, Water Management Branch of the BC Ministry of the Environment, 1981, and
- *Snow Survey Sampling Guide*, Soil Conservation Service of the United States Department of Agriculture. Agriculture Handbook Number 169, 1984.

Table 1 Snow survey locations

Station	Type	Parameters	Latitude (°)	Longitude (°)	Elevation (m asl)
IC-1.5_SS	Snow Course	SD, SWE, Density	62.915	-139.579	524
CC-EAST-1_SS	Snow Course	SD, SWE, Density	62.872	-139.394	1,220
KAM-WX_SS	Snow Course	SD, SWE, Density	62.873	-139.180	996
Mid-Elev-SS	Snow Course	SD, SWE, Density	62.894	-139.097	638

Figure 1 **IC-1.5_SS snow course (early April 2015)**

Figure 2 **CC-East-1_SS snow course (early April 2015).**

Figure 3 **KAM-WX_SS snow course (early April 2015).**

Figure 4 **Mid-Elev_SS snow course (early April 2015).**

1.5 Sampling Schedule

All snow courses at site must be measured within a 10-day window, centred on the 1st of each month, in February, March, April and May. If snow persists in mid-May, an additional survey may be scheduled for May 15th for those snow courses with remaining snowpack.

1.6 Snow Course Characteristics

Snow courses are intended to provide point measurements of snowpack at a specific location, chosen to be representative of the local area snowpack. The measurements will not provide a spatial representation of the distribution of snow over the landscape, rather each snow course represents an index of the current years' snowpack, that can then be compared to the winter precipitation data from the KM 11 climate station (Appendix A), previous years snowpack data and the subsequent freshet magnitude and volume.

Each snow course consists of 10 sampling points, laid out in a transect at the desired location. Snow courses should be situated in an area that is not subject to development disturbance, dustfall (lowers the surface albedo and promotes melt), and not subject to wind redistribution effects (i.e., scouring or drifting). Generally, this means that snow courses are located in a forested area, with each sampling point located beneath a large opening in the canopy. In this way, the trees as a natural wind shield and improve the data quality.

The site snow course locations have been chosen to represent a range of elevations, as there is a notable winter orographic precipitation gradient of 8%/100 m elevation gain. As air temperatures during the freshet decrease with elevation, it is also important to capture the variation in melt at various elevations.

1.7 General Guidelines for Snow Course Installation

- Snow courses should be located in areas that are protected from snow redistribution (drifting, scouring, etc.). The best places are usually in an open mature forest, with the sampling stations located in canopy openings of 1-3 tree heights in diameter.
- Ideally, the snow course and sampling point #1 in particular, should be located near a good helicopter landing spot (if accessed by air), or near a road to limit the amount of travel time. Weather is often a consideration when conducting these surveys by helicopter in the winter, so fast access is preferable.
- Clear the shrubs on the ground at the sampling points, as these will hinder the measurements, and make it difficult to collect the dirt plug in the tube. This should be done each autumn prior to onset of first snowfall (Figure 5).
- Use a post pounder to drive the rebar into the ground at each sampling site and mark the top with a butter tag showing the sampling point #.
- Rebar stickup (above ground surface) should be at least 50 cm greater than the maximum expected snow depth. At ridgetop elevations, this is approximately 2.5 m.
- Make a field drawing of the layout of the sample sites (heading that you walk from site #1 though site #10) and note the compass bearing, UTM co-ords for sampling point #1, and elevation.
- Sites should be located 10 to 20 m apart and be located on level ground (or as near to level as possible).

- Once the site is installed, note the UTM co-ordinates and elevation of sampling point #1, and note the general azimuth heading that the snow course takes from that point.
- The snow course nomenclature for Coffee Gold is as follows:
  - Watershed-Specific Location_SS
  - Watershed is one of: Independence Creek (IC), Halfway Creek (HC), YT-24 (YT), Latte Creek (LC) or Coffee Creek (CC). Alternatively, if the snow course is located to capture a specific elevation (e.g., “Mid-Elev”) or a particular aspect (e.g., “E” = East), then use this identifier in place of the watershed identifier.

Figure 5 Example of marked snow survey sampling point. Note position in forest opening and cleared undergrowth at sampling point.

1.8 Sampling Procedures

Preparation

1. Check that all equipment is present in the carrying case
   a. Snow tubes with cutter bit
   b. Driving wrench
   c. Weigh scale
   d. Wrenches
   e. Silicone oil
   f. Rag and broomstick
   g. Plug knife

2. Check GPS (batteries, co-ordinates loaded).
3. Review SOP.
4. Leave snow survey kit outside for at least 30 minutes prior to initiating sampling. If tubes warm, snow will melt and re-freeze inside, making accurate sampling difficult to impossible. Always leave tubes in truck bed or cargo compartment of helicopter between snow courses.

At Snow Course:

Upon arriving at the snow course, note the date, time, and general weather conditions (precipitation rate, wind, cloud, temperature, etc.). Assemble the snow tubes and attach driving wrench, ensuring that enough snow tubes are used to capture the full snowpack depth. Take care not to touch the tubes with bare skin as frostnip could occur if temperatures are sub-zero, or conversely, body heat will warm the tube, which can cause the snow core to melt and refreeze inside the tube, making extraction difficult. When taking a snow core at each sampling point, the following steps should be taken, and the data entered into a field form as presented in Table 2.

1. Make note of the snow course ID, surveyors, snow surface conditions, weather conditions and any other items of interest.
2. Take a photo of the snow course to show the general conditions.
3. Leave tubes in the snow, and in the shade if possible while preparing, to ensure that they don't warm above 0°C.
4. Note the tare weight of the snow tubes (and driving wrench if used).
5. Drive the snow tube vertically into the snowpack at the sampling point, and twist tube clockwise to drive the cutter bit into the ground below. DO NOT pull the tube out and re-insert into same hole, or move the tube up and down, as this will alter the amount of snow collected.
6. Note the snow depth using the markings on the outside of the tube.
7. Withdraw the snow tube and check to ensure that a dirt plug was collected (confirming that entire snowpack was sampled and retained within the tube. If no plug was collected, repeat Steps 2 through 4 until it is.
8. Note the length of the dirt plug, and remove it from the tube, taking care not to remove any snow.
9. Calculate the snow depth without the dirt plug.
10. Note the core length inside the snow tube.
11. Weigh the tube with the core and note the weight. Take care not to tip the snow out of the top of the tubes while balancing the tube on the weigh scale.
12. Calculate the snow water equivalent (SWE) in centimetres.
13. Calculate the snow density in % (Density = SWE / Snow Depth w/o Plug)
14. Clean the snow tube thoroughly, using a rag to dry the inside if necessary, and repeat Steps 1 through 11 at the next sampling point.
15. Calculate the totals and averages for each column, and check to ensure that the values make sense, given the snow depth, winter precipitation measured to date, and expected range of densities.

16. Upon return to the office, enter the data into the standardized spreadsheet or database, and check the calculated snow depth, SWE and densities with what was calculated in the field.
17. Ensure that the data is reviewed and signed off before finalizing.
18. If snowpack conditions are such that individual cores are shallow (i.e., early, or late season, when snow depths are less than 50 cm), it may be more effective to conduct a bulk sample. The steps are the same as above, but instead of weighing each snow core at each sampling point, the core (minus dirt plug) is emptied into a pail, and a weight is taken for all 10 samples, then averaged. This method will reduce the relative error introduced when the proportion of total sample weight (tube plus core) is dominated by the snow tubes.

Table 1 Snow Survey Data Field Form. Gray shaded cells indicate that calculations are required.

Snow Course ID: Mid-Elev-SS								
Date and Time:								
Surveyors:								
Driving Wrench Used? (Y/N)								
Station No.	Snow Depth (cm)	Dirt Plug (cm)	Snow Depth w/o Plug (cm)	Core Length	Weight Tube and Core	Tube Tare Weight	SWE (cm)	Density (%)
1	38	3	35	28	21	12	9	26%
2	45	2	43	19	20	12	8	19%
3	50	2	48	33	22	12	10	21%
4	45	4	41	20	20	12	8	20%
5	43	2	41	24	20	12	8	20%
6	43	3	40	18	20	12	8	20%
7	36	3	33	17	19	12	7	21%
8	42	3	39	22	19	12	7	18%
9	42	1	41	17	19	12	7	17%
10	38	2	36	15	18	12	6	17%
Total	422	25	397	213	198	120	78	197%
Average	42.2	2.5	39.7	21.3	19.8	12	7.8	20%
Weather:								
Surface Snow Conditions				**Checked By:**				
Wet		Soft		**Field Notes:**				
Dry		Crusted						
Flat		Drifted						
Particulate		Patchy (bare ground)						
Sampling Conditions								
Easy	Moderate	Difficult						