EAGLE GOLD PROJECT

ENVIRONMENTAL MONITORING, SURVEILLANCE AND ADAPTIVE MANAGEMENT PLAN

VERSION 2020-01

FEBRUARY 2020

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Submission History

Version Number	Version Date	Document Description and Revisions Made
2013-01	Sept 2013	Original submission to the Department of Energy, Mines and Resources in support of an application for a Quartz Mining Licence allowing for preliminary construction activities.
2013-02	Dec 2013	Revisions made in support of an application to the Yukon Water Board for the amendment of Type B Water Use License QZ11-013. The amendment application considered the use of water and deposit of waste associated with preliminary construction activities and included the construction and operation of the Dublin Gulch Diversion Channel.
2014-01	Aug 2014	Revisions made in support of an application to the Yukon Water Board for a Type A Water Use License for the full Construction, Operation and Closure of the Project.
2015-01	Mar 2015	Revisions made to address comments received during the adequacy review of the application to the Yukon Water Board for a Type A Water Use Licence. Version 2015-01 was also submitted to the Department of Energy, Mines and Resources in support of an application for a Quartz Mining Licence allowing the full Construction, Operation and Closure of the Project.
2016-01	Mar 2016	Revisions made to address the conditions of the Type A Water Use License QZ14-041
2017-01	June 2017	Revisions made to address the conditions of the Quartz Mining Licence QML-0011 and act as a “subsequent revision” for QZ14-041
2018-01	Feb 2018	Revisions made to update certain monitoring methods and locations based on experience carrying out the construction phase monitoring program.
2018-02	Aug 2018	Revisions made to ensure consistency with water management plan.
2019-01	Apr 2019	Revisions made to incorporate additional experience executing the construction phase monitoring program, stakeholder comments and conditions of regulatory approvals for the project.
2019-02	Jun 2019	Revisions made to address comments from Yukon Government.
2020-01	Feb 2020	Revisions made to address the conditions of the Type A Water Use License QZ14-041-01.

Version 2020-01 of the Environmental Monitoring, Surveillance and Adaptive Management Plan (the Plan) for the Eagle Project has been revised in February 2020 to update Version 2019-02. The table below is intended to identify modifications to the Plan and provide the rationale for such modifications

Version 2020-01 Revisions

Section	Revision/Rationale
Environmental Monitoring, Surveillance and Adaptive Management Plan	▪ Change to document tense and schedule information throughout to acknowledge the commencement of operations and the status of various programs. ▪ Revisions to figures throughout to include additional monitoring locations detailed in WUL QZ14-041-01. ▪ Removal of detail regarding baseline conditions to acknowledge current status of the Project and to streamline the document.

Section	Revision/Rationale
	▪ Removal of all sections relating to construction phase monitoring to acknowledge the current status of the Project.
1.5 Adaptive Management Approach	▪ Inclusion of additional text to describe Project components that are considered within QZ14-041-1 to have a level of uncertainty. ▪ Included additional text describing Environmental Effects Monitoring under the *Metal and Diamond Mining Effluent Regulations*.
Table 2.3-1 Project Hydrology Stations during Operations and Closure	▪ Inclusion of additional monitoring locations as required by QZ14-041-1 (additions also reflected in associated figure). ▪ Revised frequencies at certain locations to comply with requirements of QZ14-041-1 and based on operational experience.
Table 2.3-2 Project Hydrology Stations During Post Closure	▪ Inclusion of addition monitoring locations as required by QZ14-041-1 (additions also reflected in associated figure). ▪ Revised frequencies at certain locations to comply with requirements of QZ14-041-1 and based on operational experience.
2.3.3 Frequency	▪ Additional text providing explanation for restrictions to winter freeze up sampling.
2.4.2 Operations, Closure and Post Closure	▪ Minor text revisions to reflect reduction in predicted Project impacts to flow based on additional characterization and modeling.
Table 2.4-1 Hydrology Adaptive Management Indicators Thresholds and Response	▪ Edits to performance threshold to better reflect monitoring frequency. ▪ Refinement of evaluation protocols based on additional monitoring locations and reconsideration of certain approaches due to operational experience. ▪ Refinement of notification protocols.
Table 3.3-1 Summary of Eagle Gold Project Surface Water Quality Parameter List and Sample Treatment Protocols	▪ Updated to reflect current sample treatment protocols and QZ14-041-1 parameter requirements.
Table 3.3-3 Surface Water Quality Monitoring Locations and Frequency - Operations and Active Closure	▪ Inclusion of addition monitoring locations as required by QZ14-041-1 (additions also reflected in associated figure). ▪ Revised frequencies at certain locations to comply with requirements of QZ14-041-1 and based on operational experience.
3.4 Active Closure	▪ Minor text revisions to improve readability.
Table 3.5-1 Surface Water Quality Monitoring Locations and Frequency - Late Closure Phase and Post-Closure	▪ Inclusion of addition monitoring locations as required by QZ14-041-1 (additions also reflected in associated figure). ▪ Revised frequencies at certain locations to comply with requirements of QZ14-041-1 and based on operational experience.
3.6.1	▪ Text revisions to improve readability.

Section	Revision/Rationale
Performance Objectives - Water Quality Criteria	
Table 3.6-1 Effluent Quality Standards for Authorized Discharge Locations	▪ Reconsideration of arsenic thresholds 1 and 2 based on comments from Yukon Government and planned work related to determination of arsenic toxicity levels in Haggart Creek.
Table 3.6.2 Adaptive Management Indicators, Thresholds and Responses for Discharge Locations	▪ Refinement of evaluation protocols based on additional monitoring locations and reconsideration of certain approaches due to operational experience. ▪ Inclusion of adaptive management actions for additional discharge locations that were defined in QZ14-041-1. ▪ Refinement of notification protocols.
Table 3.6-4 Adaptive Management Thresholds (mg/L) for the Protection of the Receiving Environment in Haggart Creek	▪ Reconsideration of WAD CN threshold 1 and 2 as the current water quality objective (threshold 3) is currently the lowest detection limit available through the offsite laboratory.
Table 3.6.5 Adaptive Management Indicators, Thresholds and Responses for Discharge Locations	▪ Refinement of evaluation protocols based on additional monitoring locations and reconsideration of certain approaches due to operational experience. ▪ Refinement of actions to correlate increased frequency to QZ14-041-1 frequencies and inclusion of acute toxicity testing for threshold 3. ▪ Refinement of notification protocols.
4.5 Adaptive Management	▪ Minor text revisions to reflect reduction in predicted Project impacts to flow based on additional characterization and modeling.
Table 5.2-1 Groundwater Quality - Monitored Parameters	▪ Updated to reflect QZ14-041-1 parameter requirements.
6.3.2 Additional Waste Rock Characterization	▪ Updated to reflect QZ14-041-1 sampling requirements.
6.3.3 Waste Rock Contact Water	▪ Revision of text to remove duplicative water quality sampling information that is already provided in Section 3.
Aquatic Environment	▪ Inclusion of text to acknowledge that the Project is now subject to the *Metal and Diamond Mining Effluent Regulations*.
Table 7.3-1 Stream Sediment Quality Parameters and Detection Limits	▪ Refinement of table to identify parameters specifically required by QZ14-041-1.
7.7 Management	▪ Minor text revisions for readability.
8.6 Late Closure Phase	▪ Update to frequency to align with QZ14-041-1.

Section	Revision/Rationale
8.7 Management	▪ Inclusion of addition description of analyses for diversity and density.
11.2 Methods	▪ Updates to sampling approach based on air emissions permit requirements.
11.2.1 Locations	▪ Updates to locations based on air emissions permit requirements.
11.2-2 Frequencies	▪ Updates to frequencies based on air emissions permit requirements.
11.2.3 Data Collection and Analysis	▪ Updates to data collection and analysis based on air emissions permit requirements.
12.3.1 Locations	▪ Updates to locations and model results based on air emissions permit application and permit requirements.
14 Noise	▪ Updates to reflect that the VGC commitment to initial start up monitoring has been completed.
16.2 Methods	▪ Inclusion of drone inspections for the open pit.
16.2.1 Locations	▪ Revisions to discussion of survey density.
17.1 Introduction	▪ Text revisions for readability.
17.2 Locations	▪ Inclusion of drone inspections for material storage and stockpile management areas. ▪ Inclusion of visual inspections of the 90-Day stockpile and reclamation stockpile locations.
18.1 Introduction	▪ Inclusion of text to recognize QZ14-041-1 requirements and current status of the HLF in-heap pond storage verification tests.
18.2.1 Surveillance and Response	▪ Text revisions to align with updates to the HLF Operations, Maintenance and Surveillance Manual and QZ14-041-1 requirements.
18.5 Adaptive Management	▪ Text revisions to align with updates to the HLF Operations, Maintenance and Surveillance Manual and QZ14-041-1 requirements.

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1 INTRODUCTION

1.1 PROJECT OVERVIEW

Victoria Gold (Yukon) Corp. (VGC), a directly held, wholly owned subsidiary of Victoria Gold Corp., operates a gold mine known as the Eagle Gold Mine (the Project) in central Yukon. The Project is located 85 km from Mayo, Yukon using existing highway and access roads. The Project involves open pit mining gold extraction using a three-stage crushing process, heap leaching, and a carbon adsorption, desorption, and recovery system over the mine life. Mine construction ed commence in August 2017, gold production commenced in September 2019 and phased construction of certain facilities will continue throughout the life of mine.

The open pit is developed using standard drill and blast technology. Ore is transported from the open pit by haul truck and delivered to the first stage crushing plant (the primary crusher), situated on the north side of the open pit rim. Waste rock is removed from the open pit by haul truck and delivered to one of two waste rock storage areas (Platinum Gulch or Eagle Pup WRSAs) or is used as haul road and infrastructure construction material. Figure 1.1-1 shows the General Site Arrangement for the Project.

Ore is crushed to a passing 80 percent (P80) particle size of 6.5 mm in a 3-stage crushing process. All three crushing stages are located north of the open pit. Ore is conveyed between the primary, secondary and tertiary crushing stations by covered conveyor or enclosed conveyor gallery. After the tertiary crushing stage, ore is transported by covered conveyor to the Heap Leach Facility (HLF) area where the ore is stacked on a lined solution collection pad via a series of portable conveyors and finally a radial stacking conveyor.

Process solution containing cyanide is applied to the ore to extract gold and then collected by the HLF leachate collection and recovery system. The HLF pad consists of a composite liner system in the upper and lower reaches of the facility. The HLF embankment impounds the lower section of the HLF pad, and forms an In-Heap Pond (essentially a saturated zone within the lower extent of the HLF) for primary storage of pregnant solution. Because the In-Heap Pond is saturated ore, there will not be open or exposed surface areas of liquid sodium cyanide solution during normal operations. A lined pond external to the HLF (the Events Pond – Figure 1.1-1) is available to temporarily store excess process solution during rare upset events, and/or freshet events as needed, and normal precipitation that occurs on the pond. The solution contained in the pond is recycled back into the heap leach circuit as required.

Gold-bearing “pregnant” solution (pregnant leach solution [PLS]) is pumped from the HLF to the gold recovery plant. Gold is recovered from the PLS by activated carbon adsorption and desorption, followed by electro-winning onto steel cathodes, and on-site smelting to gold doré. This process is referred to as the adsorption, desorption, and recovery (ADR) process. The gold-barren leach solution that remains after passing through the carbon columns is re-circulated back to the HLF.

1.2 PROJECT LOCATION AND BACKGROUND

The Project is located in central Yukon in the Traditional Territory of the First Nation of Na-Cho Nyäk Dun (FNNND), approximately 350 km north of Whitehorse, and 45 km north-northeast of the Village of Mayo (85 km using existing access roads). Ecologically the Project is situated within the Yukon Plateau North Ecoregion, in the

Boreal Cordillera Ecozone, which encompasses the Stewart, MacMillan and Pelly plateaus and southern part of the Selwyn Mountains. The majority of the Project site lies within the Dublin Gulch watershed. The Dublin Gulch watercourse is a tributary to Haggart Creek which flows to the South McQuesten River within the Stewart River sub-basin of the Yukon River Watershed. Elevations in the vicinity of the Project range from 765 m above sea level near the confluence of Dublin Gulch and Haggart Creek, to 1,525 m above sea level at the base of the Potato Hills, which forms the eastern boundary of the Dublin Gulch watershed.

Historically, Yukon and the Tintina Gold Belt specifically, has been a productive region for gold. The Dublin Gulch area has a rich history of exploration and mining since 1898. As a result, the Dublin Gulch watershed and the upper reaches of the Haggart Creek watershed have been heavily impacted by placer mining activity. The ecological function of the Project area has been altered by this previous activity and is documented via past environmental studies that date back to the mid-1990s. From extensive baseline work, the existing environmental and socio-economic conditions are well known and documented in the Project Proposal submitted to the Yukon Environmental and Socio-Economic Assessment Board (YESAB) in July 2011, and further updated in the applications for Water Use Licences QZ14-041 and QZ14-041-1 and as appendices to the annual reports required by QZ14-041-1 and Quartz Mining Licence QML-0011. Figure 1.2-1 provides a Property Location Map and Photo 1.2-1 depicts the site location and existing conditions including VGC's mining operations and historic placer mining areas.

Photo 1.2-1: Site Location

1.3 PROJECT SCHEDULE

Construction activities began in Q3 2017 with mechanical completion in Q2 2019. The Project was commissioned and the Operations stage of the Project began in Q3 2019. A summary of the Project schedule is provided in Table 1.3-1.

Table 1.3-1: Project Schedule

Phase	Schedule
Baseline Phase	Prior to commencement of construction
Construction (Development Phase)	Q3 2017 – Q2 2019
Operations (Production Phase) 10 years	Q3 2019 – Q1 2029
Reclamation and Closure	2030-2037
Post-Closure Monitoring	2037 +

1.4 SCOPE AND OBJECTIVES

VGC has updated this Plan to comply with the requirements of Quartz Mining Licence QML-0011 and Type A Water Use Licence QZ14-041-1, and to reflect the monitoring conditions and site experience gained to date. The plan includes environmental monitoring and surveillance objectives, work completed to date, methods, adaptive management, and reporting for environmental resources and Project facilities for the pre-construction, construction, operations, closure and post closure phases of the Project.

Due to the characteristic and idiosyncratic nature of delineating a study area for each discipline, Local Study Area (LSA) delineations may not be the same across all the disciplines; thus, the physical study areas as measured in square kilometers and reported below are generally unique to each discipline.

1.5 ADAPTIVE MANAGEMENT APPROACH

Adaptive management is a process for addressing uncertainty, but is not the basis for management of all project environmental components. Environmental management in general takes a systematic approach to continuous improvement of management policies and practices. Management of environmental components involves monitoring and ongoing comparison of environmental data with general expectations of performance. The environmental management plan for each component is described in the sections below, and generally includes:

- applicable environmental standards and environmental quality objectives;
- schedules for monitoring;
- sampling procedures;
- procedures for the comparison of monitoring results with applicable environmental standards and environmental quality objectives; and
- actions to be undertaken when requirements set out in regulations or approvals have not been met.

Adaptive management is another tool used to advance the continuous improvement of environmental management policies and practices for the mine. Adaptive management is focussed on those specific areas where uncertainty with regard to performance expectations exist, and provides a science-based learning process in which outcomes are used for evaluation and adjustment (Environment Canada 2009).

Systematically through the environmental assessment and licencing process, environmental and project performance areas of uncertainty have been identified. Ongoing work in accordance with conditions of the regulatory approvals have improved confidence in environmental and project performance areas.

VGC has developed other operational plans which function to adaptively manage project performance, for example, the HLF Operations, Management and Surveillance Manual, the HLF Contingency Water Management Plan and the HLF Emergency Response Plan that will guide management actions with regard to maintaining HLF storage capacity and addressing potential liner leakage. The Reclamation and Closure Plan research program addresses uncertainty with regard to the performance of passive treatment systems. Uncertainties which remain or Project components requiring further consideration as required by QZ14-041-1, are addressed using adaptive management described herein, and include:

- Surface Water Hydrology, and potential changes to hydrologic flow regime in Haggart Creek;
- Surface Water Quality predictions;
- Groundwater quality;
- HLF and Events Pond leak detection; and
- In-heap Pond Maximum Available Storage volume.

Adaptive management plans for these components are described in this plan and aim to minimize the potential for significant adverse effects on aquatic ecosystems. Adaptive Management Plans (AMP) for these areas include:

- Definition of the indicator(s) that describes the condition, and which is used as a trigger;
- Three thresholds with corresponding response plans
- Adaptive management measures to be taken should a threshold exceedance occur.

Results of the monitoring programs will be evaluated throughout all Project phases to determine if adverse environmental impacts occur or if there are unacceptable risks to facility and infrastructure. If the results indicate that there are no adverse environmental impacts, the frequency and length of monitoring and maintenance will be re-evaluated as needed and as authorized by the relevant regulatory authorities. Additional or alternative mitigation measures will be implemented to respond to negative trends that are observed or when performance objectives are exceeded. Trend analyses are an integral component of the adaptive management, as they provide data that can be used to help to forecast when specific thresholds might be reached or exceeded, which would trigger some form of mitigation. Trend analyses and threshold determinations are specific to each discipline, and are discussed in more detail within each section, if appropriate.

Performance objectives have been developed for each environmental resource or major Project facility. Performance objectives serve as thresholds to require mitigative action if exceeded. Action will also be taken if trends are observed that indicate a high likelihood of exceedance of an objective in the future.

The results of all monitoring, management and adaptive management contemplated in this plan will be provided to responsible regulators in monthly and annual reports. Annual reporting will include a summary of all data provided for each month and will include assessment of the adequacy and appropriateness of the various components of adaptive management with recommendations for modification as necessary.

Environmental Effects Monitoring (EEM) Studies as required by the *Metals and Diamond Mining Effluent Regulations* (MDMER) are not fully captured in this Plan. The results of the EEM studies required by the MDMER, will be provided to the appropriate federal and territorial agencies as required by the MDMER and by Quartz Mining Licence QML-0011 and Type A Water Use Licence QZ14-041-1.

Legend:

- Facility
- Site Power
- Reserved Area
- Watercourse - Perennial
- Watercourse - Ephemeral
- Watercourse - Intermittent
- Waterbody

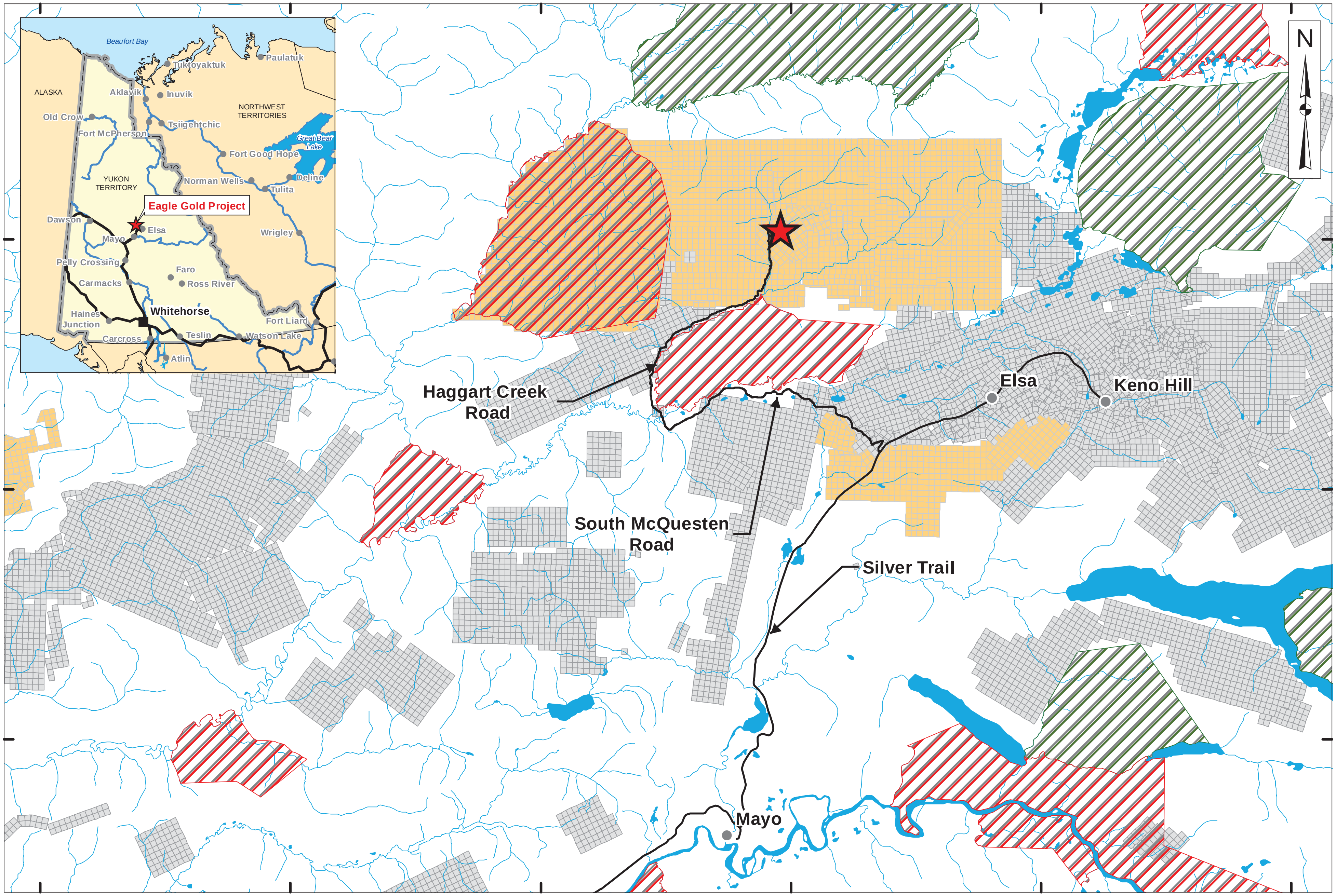
Victoria Gold Corp

0 125 250 500
Metres

Projection: NAD 83 UTM Zone 8N	Drawn By: HC
Date: 2020/02/01	Figure: 1.1-1

EAGLE GOLD PROJECT
YUKON TERRITORY

End of Mine Life
General Arrangement



Legend:

Eagle Gold Project	Town / Village	Category A Settlement Land
Victoria Gold Claims	Road	Category B Settlement Land
Other Claims	Watercourse	

Victoria GOLD CORP

0 3 6 12 Kilometres

Projection: NAD 83 Zone 8N	Drawn By: HC	EAGLE GOLD PROJECT YUKON TERRITORY	
Date: 2020/01/27	Figure: 1.2-1	Project Location	

WATER RESOURCES

2 SURFACE WATER HYDROLOGY

2.1 INTRODUCTION

The objective of the hydrology data collection program is to maintain streamflow records in the Project area to support continued water management design, update operational water balance and water quality models, as well as to facilitate reporting of flow data associated with QZ14-041-1 requirements. Hydrology data collection has been developed in accordance with accepted standardized practices and procedures, as outlined by the British Columbia Resource and Inventory Standards Committee (RISC) (2009).

2.2 BASELINE CHARACTERIZATION WORK

Historically, baseline hydrology information in the Dublin Gulch, Haggart Creek and Lynx Creek basins was collected in the Project area over two separate periods: from 1993 to 1996 and 2007 to 2017 (i.e., prior to the Project entering the Development Phase). Field methods and data summaries are provided in Stantec (2010a, 2011a and 2012a), Knight Piesold (2013), Laberge (2015) and Lorax (2016a and 2017a). The objective of the baseline program was to characterize the seasonal and annual streamflow trends in the Project area prior to Project development.

2.3 METHODS

The hydrology monitoring program continues to collect continuous streamflow data in the Dublin Gulch, Haggart Creek and Lynx Creek watersheds. This is achieved by maintaining automated hydrology stations and conducting manual stage and discharge measurements, as needed to meet licence conditions and to support water management activities.

New stations have been added to monitor for changes to watercourses and to comply with QZ14-041-1 licence conditions. During the operations phase of the Project, the hydrology program includes volumetric flow monitoring of internal water transfers between certain facilities and flow monitoring in the event of discharges to the environment.

2.3.1 General

The hydrology monitoring program uses the methods and analyses established during baseline characterization programs and will also follow the Guidance Document for Flow Measurement of Metals Mining Effluents (Environment Canada, Minerals and Metals Division 2001) for discharge locations.

For the hydrology data collection program, discharge measurements at hydrology stations are performed using either the velocity-area method with a current meter, flumes or salt dilution method with a conductivity probe (except for the internal water transfer monitoring sites equipped with flow meters). At automated hydrology stations, water level is recorded continuously with a pressure transducer and datalogger with discharge measurements conducted at a range of flows during scheduled site visits. Continuous data are preferable to characterize seasonal and inter-annual patterns. Instrumentation at automated hydrology stations are typically removed at the end of each open water season and re-installed prior to the freshet in the following year. Regular site visits to the stations are conducted to ensure the instrumentation is in good working order and to perform discharge measurements.

Site visits include the following general tasks:

- Perform routine maintenance on the station components and verify that no damage has occurred to the installation.
- Download stage data from datalogger, checking for any signs of instrumentation malfunction.
- Measure discharge at the designated cross-section or a suitable alternative section based on current flow conditions. Measure discharge to the highest degree of accuracy and confidence practicable. Perform a replicate measurement at frequency set out in QA/QC protocols.
- Record gauge height during site visit and estimate uncertainty.
- Record observations of any change in hydraulic control at the stream gauge site.
- Bench mark surveying conducted at each station on as-needed basis to verify staff gauge elevations and calibrate gauging instrumentation.
- Document all activities of the visit with concise field notes, including photos of relevant observations, as appropriate.

2.3.2 Locations

The station locations for the hydrology data collection program for each phase of the Project are shown in Figures 2.3-1 and Figure 2.3-2 and summarized in Table 2.3-1 and Table 2.3-2. The hydrology stations coincide with key monitoring locations for water quality.

Table 2.3-1: Project Hydrology Stations during Operations and Closure

Station	Location Description	Station Purpose	Coordinates (Zone 8)	
			North	East
W1[a]	Dublin Gulch above Stewart	Above Project Influence	7101545	460249
W26[a]	Stewart Gulch	Above Project Influence	7101443	460331
W21[a]	Dublin Gulch at mouth	Receiving Environment	7101261	458359
W4[a]	Haggart Creek below Dublin	Receiving Environment	7101223	458144
W22[a]	Haggart Creek above Project Influence	Above Project influence	7101378	458319
W5[a]	Haggart Creek above Lynx Creek	Receiving Environment	7095888	457814
W6[a]	Lynx Creek above Haggart Creek	Reference site	7095964	458099
W20[b]	Bawn Boy Gulch	Above Project Influence	7101961	461945
W23[b]	Haggart Creek below Lynx Creek	Receiving Environment	7095682	457790
W29[b]	Haggart Creek below Eagle Creek and Platinum Gulch	Receiving Environment	7099583	458225

Station	Location Description	Station Purpose	Coordinates (Zone 8)	
			North	East
W27[a]	Eagle Creek near Camp below Eagle Creek Pond	Receiving Environment	7100997	458235
W45[a]	Eagle Creek above Haggart Creek	Receiving Environment	7099684	458243
W39[c]	Haggart Creek above South McQuesten River	Receiving Environment	7086504	449780
W49[c]	South McQuesten River below Haggart Creek	Receiving Environment	7085495	449221
W99[a]	Haggart Creek above 15 Pup	Receiving Environment	7098180	458322
EPS[b]	Eagle Pup WRSA Seepage	Transfer between Engineered Structures	7100909	459834
PGS[b]	Platinum Gulch WRSA Seepage	Transfer between Engineered Structures	7099436	459281
PDI & PG PTS[b,g]	Platinum Gulch Ditch into Lower Dublin South Pond (Ditch/Pipe A; PG Passive Treatment System)	Transfer between Engineered Structures	7099523	459184
PS[d]	Open Pit Sump	Transfer between Engineered Structures	7099574	459536
OPP[h]	Open Pit Pond	Transfer between Engineered Structures	7099460	459359
OPPO[b]	Open Pit Pond Overflow	Transfer between Engineered Structures	7099460	459359
MWTP[e]	Mine Water Treatment Plant	Effluent Discharge to Haggart Creek	TBD	TBD
FT[e]	Mine Water Treatment Plant Finishing Tank	Transfer between Engineered Structures	TBD	TBD
LDSPI[e]	Lower Dublin South Pond Inflow	Transfer between Engineered Structures	7100824	458926
LDSP[e]	Lower Dublin South Pond Outflow	Effluent Discharge to Haggart Creek	7100857	458672
LDSP-UND[b]	LDSP Underdrain Outflow	Groundwater Outflow sourced upstream of LDSP	7100937	458570
CS-07[e]	Sediment Basin – below Ice Rich Storage Area	Effluent Discharge to Haggart Creek	7098627	458268
HLFUMV[a]	Heap Leach Facility Underdrain Monitoring Vault	Groundwater Outflow under HLF	7101298	459445
ADR Pad Ditch[f]	ADR Pad Ditch Outlet	Surface Water Collection Ditch	7101471	459043

a - Automated monitoring. Manual during freshet until loggers installed and monthly during winter
b - Manual monitoring on a monthly basis
c - Manual monitoring on a quarterly basis
d - Automated monitoring when dewatering
e - Automated monitoring when discharging
f - Manual monitoring on a daily basis when discharging
g - Platinum ditch intake converted to Platinum Gulch PTS when PG WRSA is progressively reclaimed
h - Quarterly manual water level measurement during active closure

Table 2.3-2: Project Hydrology Stations during Post Closure

Station	Location Description	Station Purpose	Coordinates (Zone 8)	
			North	East
W1[a]	Dublin Gulch above Stewart	Above Project Influence	7101545	460249
W26[a]	Stewart Gulch	Above Project Influence	7101443	460331
W21[a]	Dublin Gulch below Event Ponds	Receiving Environment	7101261	458359
W4[a]	Haggart Creek below Dublin	Receiving Environment	7101223	458144
W22[a]	Haggart Creek above Project Influence	Above Project Influence	7101378	458319
W5[a]	Haggart Creek above Lynx Creek	Receiving Environment	7095888	457814
W6[a]	Lynx Creek above Haggart Creek	Reference Site	7095964	458099
W20[b]	Bawn Boy Gulch	Above Project Influence	7101961	461945
W23[c]	Haggart Creek below Lynx Creek	Receiving Environment	7095682	457790
W29[c]	Haggart Creek below Eagle Creek and Platinum Gulch	Receiving Environment	7099583	458225
W27[a]	Eagle Creek near Camp below Eagle Creek Pond	Receiving Environment	7100997	458235
W45[a]	Eagle Creek above Haggart Creek	Receiving Environment	7099684	458243
W39[b]	Haggart Creek above South McQuesten River	Receiving Environment	7086504	449780
W49[b]	South McQuesten River below Haggart Creek	Receiving Environment	7085495	458243
W99[a]	Haggart Creek above 15 Pup	Receiving Environment	TBD	TBD
HLF_PTS_Inf[d]	Inflow to HLF Passive Treatment System	Transfer between Engineered Structures	459527	7101521
HLF_PTS[d]	Outflow of HLF Passive Treatment System	Effluent Compliance outflow to Haggart Creek	458865	7101260
LDSP_PTS_Inf[d]	Inflow to LDSP Passive Treatment System	Transfer between Engineered Structures	7100824	458926
LDSP_PTS[d]	Outflow of LDSP Passive Treatment System	Effluent Discharge to Haggart Creek	7100857	458672
PG-PTS[d]	Inflow from Platinum Gulch PTS to LDSP Passive Treatment System until discharge criteria allows direct discharge to Haggart Creek	Effluent Discharge to Haggart Creek	7099523	459184
OPPO[a]	Open Pit Pond Overflow	Transfer between Engineered Structures	7099460	459359
LDSP-UND[e]	LDSP Underdrain Outflow	Groundwater Outflow from LDSP	7100937	458570
HLFUMV[a]	Heap Leach Facility Underdrain Monitoring Vault	Groundwater Outflow under HLF	7101298	459445

a - Automated monitoring. Manual monitoring during freshet until loggers installed and monthly during winter
b - Manual monitoring on a quarterly basis
c - Manual monitoring on a monthly basis during first year of post closure and quarterly thereafter
d - Measurements taken weekly for 1 year and monthly thereafter if manual measurements only
e - Automated monitoring year round

2.3.3 Frequency

Hydrology stations are subject to winter freeze and therefore automated monitoring stations are only operated during the mostly ice-free portions of the hydrologic year. Periodic station visits are completed during ice-free periods to ensure quality data are collected, and to perform routine maintenance and discharge measurements; however, if the existing rating curves require additional quality points to establish a relationship between stage and discharge, more sampling visits are added. Discharge measurements that are to be used for rating curve development are conducted at times when the hydrologic control is unaffected by ice or snow. During freeze-up conditions and throughout winter, monthly measurements are conducted after the dataloggers have been removed, unless adverse weather conditions (e.g., extreme cold) present unsafe field conditions or if ice conditions would result in unreliable measurements.

The scope of monitoring increased during the operations phase and will continue through active closure, to verify and periodically update the site water balance model and determine if there are any impacts to flows from Project activities. As the Project transitions to a passive and long-term closure scenario, the scope of the program will be scaled back. The frequencies for hydrology monitoring are provided above in Tables 2.3-1 and 2.3-2.

2.3.4 Data Analysis and Reporting

Recorded water level and discharge measurement data is compiled and reviewed to ensure quality data collection and enable proactive solutions to causes of anomalous recorded water level or discharge readings. Thorough quality assurance and quality control (QA/QC) is completed on an annual basis with the goal of producing a meaningful and scientifically credible streamflow record.

To develop good quality measured streamflow records for each station, stage-discharge rating curves will be periodically reviewed and revised, as required. The rating curves for each station will be applied to the corrected continuous stage data to produce a continuous flow record for the ice-free season. The winter discharge measurements will be used to infill gaps (interpolate) in the flow record during the periods when the transducer sensors are not installed.

The following data will be included for each station in a summary report following each data collection year:

- corrected water level records;
- discharge measurements;
- rating curves;
- calculated maximum, minimum and mean monthly and annual flows; and
- hydrographs of daily streamflow records.

This data will be used to meet the reporting requirements of QZ14-041-1, and to inform operational water management during operations and post closure of mine facilities.

2.4 ADAPTIVE MANAGEMENT

2.4.1 Performance Objectives

Large variations in surface water flow due to the Project are not predicted for streams downstream of the site during normal operating conditions. The Project has been designed to manage non-contact water, sediment-laden water and contact water (as defined in the Water Management Plan), treatment effluent, and process solution storage for a wide range of climatic and operating conditions. Nevertheless, while minimal, residual risk remains with respect to water storage capacity and water management infrastructure. A significant increase or decrease in flow can be indicative of changes outside the expected range in flows that might be due to Project related activities. Threshold targets for both increased and decreased flow at each monitored station are heavily dependent on seasonal climatic, watershed and site-specific channel conditions, thus a three-tiered threshold system for flow or stage has been developed for the ice affected period of mid-October through April and for the open water period of May through mid-October.

2.4.2 Operations, Closure and Post Closure

Reduction in Flow

The LDSP is a two-stage settling pond and the outflow is controlled by a primary riser-pipe outlet to prevent the uncontrolled release of sediment-laden and contact water. Water released from the LDSP enters Ditch C which connects to Haggart Creek above hydrometric station W4. Surface water contributions reporting to the LDSP will consist of sediment-laden water and contact water (e.g. seepage and rock-drain flow) and includes input from Ditch A (extends up to and intercepts the PG WRSA) and Ditch B (formerly Eagle Creek and intercepts the EP WRSA), the 90-day Stockpile and water collected in the Open Pit. As a result, flows in the downstream section of Eagle Creek are reduced and the peak flows attenuated. Pond water is used for process make-up water, dust suppression or treated as needed and discharged to Haggart Creek.

Changes to Haggart Creek are not expected to be measurable downstream of Eagle Creek (i.e., at W29 and W99); however, there is the potential for a small reduction in overall flow in Haggart Creek as a result of the withdrawal of runoff for use as heap leach process water or dust suppression (from the Project catchment sub-basins directed to the LDSP and groundwater from open pit dewatering). Further, reduced recharge to groundwater in the HLF and WRSA footprints over time may cause a small reduction in baseflow to Haggart Creek. It is estimated from groundwater modeling that the mean monthly stream flow in Haggart Creek, as measured at station W5 (located above the confluence of Lynx Creek) may be reduced by less than 1% from May to October to up to 2% to 2.5% from December through April during mine operations, reclamation and closure and four years into post closure. Long term (>100 year) reduction in baseflow and increase in stream leakage are estimated to reduce stream flow at W5 by approximately 0.5% (BGC 2019).

A three-tiered threshold scheme has been developed for the adaptive management of surface water flow. The thresholds provided in Table 2.4-1 are different for the ice-free and ice-affected seasons, and are based on the median baseflows established for hydrometric stations W4 and W29 over the baseline period that encompassed the period August 2007 to August 2017. The table describes four types of responses (i.e., notification, review, evaluation and action) when each threshold is reached.

The thresholds are based on an assumed level of effect to the wetted useable area in the stream channel based on the measured flow reduction from the median monthly baseflows at Haggart Creek hydrometric stations W4 and W99 (for comparison to W29 baseline). While the affect of flow reduction, measured as a decrease in river stage, will be different for each channel reach due to varying width:depth ratios (as reflected in a stage rating curve, for example), generally streams with high width:depth ratios (such as Haggart Creek) have small changes in wetted useable area (or width) per unit decrease in flow. Thus, the three-tiered thresholds of 30%, 40% and 50% in reduction in flow from the median baseflow during the ice-free season reflect the affect of channel morphology on flow and wetted useable area.

There are no continuous flow data available to calculate mean flows during the ice-covered period of November through April. The available point data for the winter low flow period suggest that there is less overall year-to-year variation in these winter flows that are reflective of steadier groundwater-fed baseflows. The range in one standard deviation values for all the combined 2010 to 2012 Haggart Creek and Dublin Gulch flows (i.e., stations W1, W22, W4 and W5) ranged from 11% to 14% for the Nov-Dec period, and 13% to 19% for the Feb- Apr period. Thus, lower standard deviation derived values of 20% and 25% appear to be a better management threshold for the ice-covered season whilst also considering the accuracy of flow measurements in ice affected streams. These management thresholds will continue to be evaluated and modified as the hydrology database is extended during the project. Further, it should be recognized that the thresholds conditions are within the range of baseline conditions and likely do not represent conditions when negative effects would occur or be sustained.

Table 2.4-1: Hydrology Adaptive Management Indicators Thresholds and Response

Definition of Potential Significant Effect	An impairment of the ability of the Haggart Creek to sustain aquatic life (ultimately, the ability to sustain fish populations at levels similar to Project pre-development) due to a critical loss in wetted useable area in the channel.	
Indicator	**Performance Threshold**	**Response**
Percent reduction of flows compared to median monthly baseline flows in Haggart Creek at stations W4, and/or W29 (as described in the Eagle Gold	Threshold 1: Ice-free season: 30% of the median monthly baseline flow for two consecutive	**Notification:** ✓ Identified in Monthly Report to Yukon Water Board; ✓ Notify Internal Senior Management within 15 days after confirming threshold was reached and maintained.
		Review: ✓ Validate data entries and data processing; ✓ Confirm computations and results; ✓ Perform visual checks of gaging stations and assess station performance.

Definition of Potential Significant Effect	An impairment of the ability of the Haggart Creek to sustain aquatic life (ultimately, the ability to sustain fish populations at levels similar to Project pre-development) due to a critical loss in wetted useable area in the channel.	
Indicator	**Performance Threshold**	**Response**
Hydrology Baseline Report, Lorax 2018)	monitoring events Ice-covered season: 20% of median monthly baseflow for two consecutive monitoring events	**Evaluation:** ✓ Compare flows to baseline and to up or downstream stations (beyond Project influence) as appropriate; ✓ Examine meteorological record from site climate stations to identify magnitude and extent of dry period, if any; ✓ Assess whether the declines are associated with and can be attributed to a particular tributary (Dublin Gulch, Eagle Creek, etc.), instrumentation, engineering infrastructure or water use. ✓ If attributable to the Project, identify any trends (e.g., linear, non-linear) where flow declines are less than the normal rainfall-runoff or groundwater recession curve for Haggart Creek at W4 or W99; ✓ Estimate the time to reach Threshold 2 based on identified trends if any;
		Action: ✓ Make necessary adjustments to instrumentation or gauges if any; ✓ Examine upstream water conveyance infrastructure to assess whether impedances to surface water flow exist via ice dam, plug, bank failure or diversion ditch breach; ✓ Evaluate the magnitude of the impedance and assess whether it could contribute to reaching Threshold 1; ✓ Add an additional monitoring event following discovery.
	Threshold 2: Ice-free season: 40% of the median monthly baseline flow for two consecutive monitoring events Ice-covered season: 20% of median monthly	**Notification:** ✓ Notify Internal Senior Management that Threshold Level 2 AMP action plan has been initiated within 3 days after confirming Threshold 2 was reached and maintained; ✓ Provide summary of AMP notifications, reviews, evaluations and actions in monthly report.
		Review: ✓ Continue to perform reviews as per Threshold 1 as appropriate; ✓ Ensure equipment, instrumentation, gages and meters are functioning properly; ✓

<table>
<tr><th>Definition of Potential Significant Effect</th><td colspan="2">An impairment of the ability of the Haggart Creek to sustain aquatic life (ultimately, the ability to sustain fish populations at levels similar to Project pre-development) due to a critical loss in wetted useable area in the channel.</td></tr>
<tr><th>Indicator</th><th>Performance Threshold</th><th>Response</th></tr>
<tr><td rowspan="4"></td><td rowspan="2">baseflow for three consecutive monitoring events</td><td>Evaluation:
✓ Continue methods of evaluation initiated when Threshold 1 was reached;
✓ Conduct an additional monitoring event (including datalogger download) after 7 days to corroborate trend;
✓ Compare real-time hydrographic data from W4 and W99 to baseline hydrographs for W4 and W29 respectively.
✓ Identify any trends (e.g., linear, non-linear) where flow declines are less than the normal rainfall-runoff or groundwater recession curve for Haggart Creek at W4 or W99;
✓ Examine continuous groundwater level data in lower Dublin Gulch valley wells (e.g., BH-BGC11-72 and BH-BGC11-74) to ascertain if groundwater levels have decreased below established minimums for each well;
✓ Examine meteorological record from site climate stations to identify magnitude and extent of dry period, if any;
✓ Estimate the time to reach Threshold 3 based on any identified trends;
✓ Assess whether the declines can be isolated to a particular tributary (Dublin Gulch, Eagle Creek, etc.).</td></tr>
<tr><td>Action:
✓ Conduct additional surveys of gaging stations and remeasure;
✓ Make any necessary repairs to instrumentation, gauges or gaging station;
✓ Double monitoring frequency at W4 and W99;
✓ Re-examine upstream watercourses to assess conditions of water infrastructure and repair structures as necessary;
✓ Consider (quantify) the practicality of modifying water use practices (e.g., change source for process make-up, change source for dust suppression, change method of dust suppression) in reducing AMP threshold level;
✓ Identify critical aquatic habitat reaches in Haggart Creek susceptible to reduced fish passage during streamflow reductions including downstream reaches to W23.</td></tr>
<tr><td rowspan="2">Threshold 3:
Ice-free season: 50% of the median monthly baseline flow for 2 consecutive monitoring months

Ice-covered season: 25% of</td><td>Notification:
✓ Notify Internal Senior Management that Threshold Level 3 AMP action plan has been initiated within 1 day after confirming Threshold 3 has been reached and maintained;
✓ Provide phone notification with email back-up to EMR-CMI inspector and FN NND, within 3 days after confirming Threshold 3 has been reached and maintained;
✓ Provide summary of AMP notifications, reviews, evaluations and actions in monthly report.</td></tr>
<tr><td>Review:</td></tr>
</table>

Definition of Potential Significant Effect	An impairment of the ability of the Haggart Creek to sustain aquatic life (ultimately, the ability to sustain fish populations at levels similar to Project pre-development) due to a critical loss in wetted useable area in the channel.	
Indicator	**Performance Threshold**	**Response**
	median monthly baseflow for 2consecutive monitoring months	✓ Continue to perform reviews as per Thresholds 1 and 2 as appropriate; ✓ Conduct surveys using benchmarks to establish whether gaging station (if in ice-free season) has been affected. ✓ Expand surveillance of gaging station inspections to corroborate the effect from tributary watercourses.
		Evaluation: ✓ Continue methods of evaluation initiated when Threshold 2 was reached; ✓ Continue to conduct more frequent monitoring events as necessary to corroborate trend; ✓ Estimate the duration that Threshold 3 will be reached based on any identified trends; ✓ Conduct detailed water balance evaluations using recent site and regional meteoric data to characterize magnitude and extent of dry period, if any; ✓ Based on detailed analyses (including water balance computations), quantify the magnitude and extent of the effects on flow reduction from each potential water management infrastructure or systems, or water use that could be contributing to the streamflow reduction; ✓ Examine continuous groundwater level data in lower Dublin Gulch valley wells (e.g., BH-BGC11-72 and BH-BGC11-74) to ascertain if groundwater levels have decreased below established minimum thresholds for each well; ✓ Examine tributary (Dublin, Eagle, etc.) hydrographs, and quantify the possible magnitude and extent of declines that can be isolated to a particular tributary.
		Action: ✓ Conduct surveys of Haggart Creek channel during ice-free season, including critical reaches identified during Threshold 2 down to station W23, to quantify effect on wetted useable area; ✓ Conduct desktop review and analysis to describe Haggart Creek wetted useable area and possible effects due to longer term sustained reduction of streamflow; ✓ Continue increased monitoring frequency to an adequate level to fully characterize trends in W4, W99 and any identified tributary stations; ✓ Implement modifications to water use practices (e.g., change source for process make-up, change source for dust suppression, change method of dust suppression) quantified for Threshold 2.

Increase in flow

There is a very low risk of increases to flow larger than predicted by the stormwater and water balance modeling (due to the conservative nature of assumptions) due to effects from the Project; that is, it is unlikely that any water management infrastructure is undersized. Additionally, there is a very low probability that rare climatic events could increase flow exceeding treatment and storage capacity of the water management system for contact and non-contact water respectively.

A discussion of process solution storage capacity and upset events related to excess precipitation is provided in the Heap Leach Water Facility Contingency Water Management Plan and the Heap Leach Facility Operation, Maintenance and Surveillance Manual.

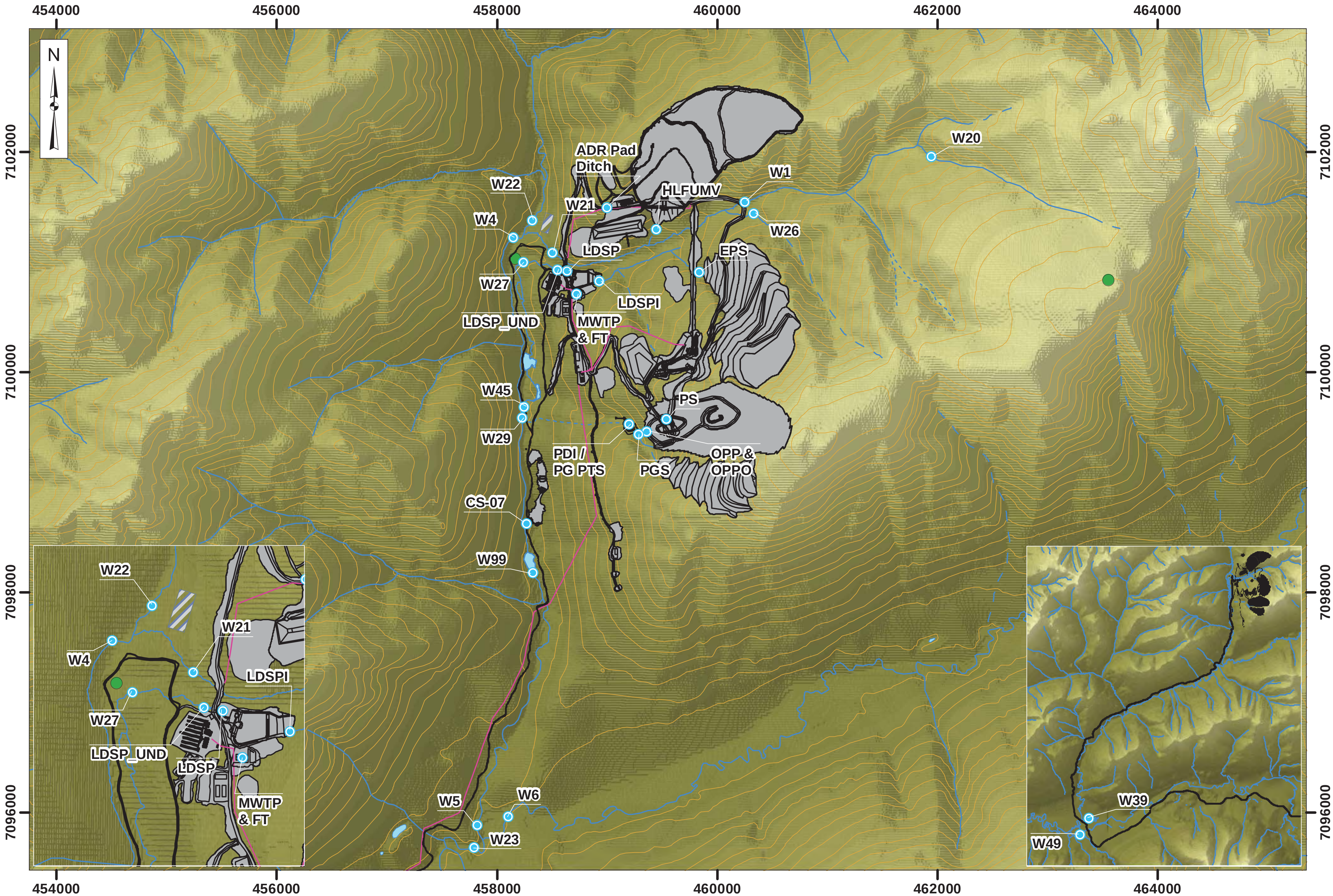
Design criteria for all water management structures (diversions, ditches, ponds, etc.) are contained in the Construction and Operations Water Management Plan. Precipitation events that exceed design criteria could result in damage to water conveyance infrastructure, physical instability of project facilities or the surrounding environment, or increased constituent loading in downstream watercourses if water treatment capacity is exceeded.

New water flow and flow paths

Existing water flow pathways on site and in the vicinity of the Project are well known. However new surface flow pathways are possible (i.e., licensed diversion or interceptor ditches) as a result of the construction and operation of Project facilities that trigger changes in hydrologic conditions in Project sub-basins. For example, waste rock storage areas will alter infiltration rates in the Eagle Creek and Platinum Gulch sub-basins that may result in seeps and springs adjacent to waste rock storage areas. Management measures will be implemented in the event new water flow pathways are established.

Management measures:

- Characterization and documentation of the new water flow pathway. This may include mapping the emergence of a seep and extent of the flow path, quantification of discharge (volume), water quality analysis (in-situ and ex situ laboratory analysis for metals and other constituents – discussed in following section), and physical attributes and stability of new flow path (contact with mined waste rock or overburden, facilities or otherwise, loose soils, gradient, risk of erosion, etc.).
- Design and construction of new water conveyance infrastructure if feasible. If surface water flows are creating erosion and sediment transfer, physical instability of existing watercourses or infrastructure or if water quality parameters exceed site specific objectives and are discharging to the environment new conveyance infrastructure will be designed and constructed to collect and convey water to the appropriate system prior to use or discharge.
    - If the flow consists of mine influenced contact water, channels or pipes to convey flows to process circuit or water treatment will be constructed to integrate with existing water management system.
    - If the flow consists of non-contact water, channels will convey flows to sediment control / detention system prior to discharge to area watercourses.
- Monitoring for additional new water flow and sources. While predicting new sources is not possible, routine monitoring of existing facilities and the site in general will provide the means of detection of new surface water flow paths. In addition to monitoring the new water flow any measurable scour, channelization, debris rafting and erosion rilling will be observed for.



Legend:

Hydrology Station	Facility	Watercourse (Perennial)
Climate Station	Site Power	Watercourse (Ephemeral)
Reserved Area	Contour (100ft)	Watercourse (Intermittent)

Victoria GOLD CORP

0 0.75 1.5
Kilometers

Projection: NAD 83 UTM Zone 8N

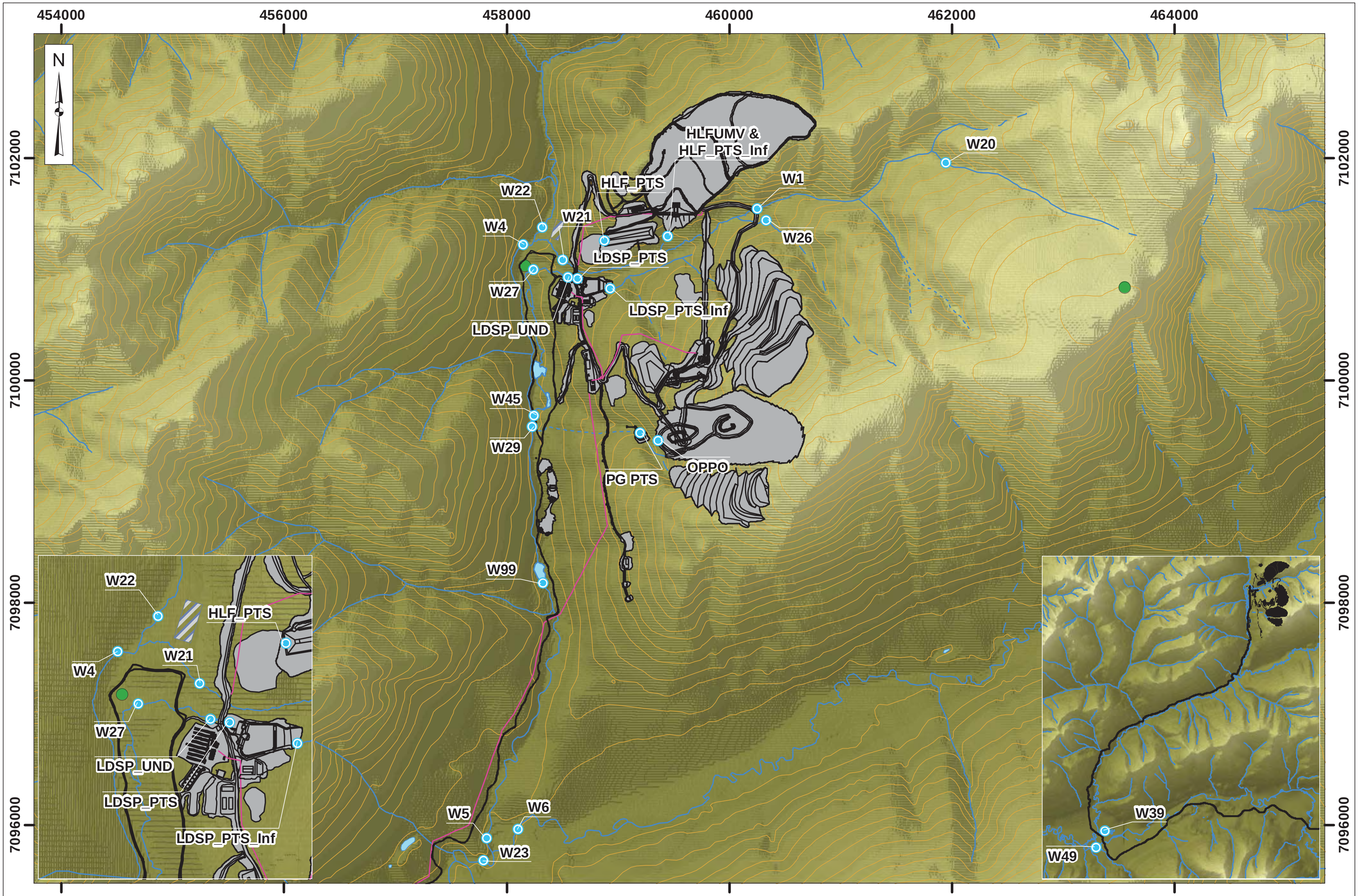
Drawn By: HC

Date: 2020/02/01

Figure: 2.3-1

EAGLE GOLD PROJECT
YUKON TERRITORY

Operations & Active Closure Phase Hydrology Monitoring Stations



Legend:

- Hydrology Station
- Climate Station
- Reserved Area
- Facility
- Site Power
- Contour (100ft)
- Watercourse (Perennial)
- Watercourse (Ephemeral)
- Watercourse (Intermittent)

Victoria GOLD CORP

0 0.75 1.5
Kilometers

Projection: NAD 83 UTM Zone 8N

Drawn By: HC

Date: 2020/02/03

Figure: 2.3-2

EAGLE GOLD PROJECT
YUKON TERRITORY

Post Closure Phase
Hydrology Monitoring Stations

3 SURFACE WATER QUALITY

3.1 INTRODUCTION

The surface water quality monitoring program includes monitoring of water quality of watercourses within the Project area at strategic locations and at water management facilities that will discharge to the environment. The water quality monitoring plan has been designed to meet the following objectives:

- Collect water quality data in the receiving environment at stations upstream and downstream of Project influences.
- Collect water quality data to verify compliance with the Effluent Quality Standards (EQSs) and monitor receiving environment Water Quality Objectives (WQOs) specified in QZ14-041-1.
- Provide a continuous water quality database to support adaptive management strategies to meet water quality compliance criteria and protect aquatic life.

Surface water quality monitoring has two main focuses: compliance monitoring and environmental effects monitoring. Environmental effects monitoring will focus on the following key Project watersheds, namely:

- Haggart Creek from below the confluence of Fisher Gulch to immediately downstream of the confluence of Lynx Creek;
- Dublin Gulch from Bawn Boy Gulch to its confluence with Haggart Creek;
- Eagle Creek;
- Lynx Creek; and
- South McQuesten River at the confluence of Haggart Creek

Compliance monitoring targets discharge locations and specific stream locations in the receiving environment. The water quality monitoring program will not be a static program; stations will be added or removed according to the conditions and adaptive management as required.

3.2 BASELINE CHARACTERIZATION WORK

Historic surface water quality monitoring in the Project area commenced in 1993 and continued until 1996. More continuous monitoring was initiated again in 2007 to establish a robust baseline water quality dataset. Water quality data collected since 2007 has focused on the monitoring of seasonal water quality in streams and rivers of the Project area using methodology consistent with environmental assessment standards under Yukon and federal legislation. Prior to 2011, generally monthly sampling occurred but was limited to the ice-free period of April to October; however, beginning in 2011, winter sampling commenced in January as sampling conditions allowed. Previous work is described in JWA (2008), Stantec (2011b), Stantec (2012b) and Lorax (2013 and 2017b).

The baseline water quality monitoring program targeted Project watersheds that have the potential to be affected by Project activities and included the Haggart Creek, Dublin Gulch and Eagle Creek drainages. Water quality monitoring stations in each of these basins were established to monitor seasonal water quality upstream and downstream of the Project activities. In addition, water quality monitoring stations were established in Lynx Creek, an undeveloped drainage basin to the immediate south of the local Project area, and selected as reference stations recognizing that Lynx Creek will not be affected by Project activities. Two sites were added in late 2011 at the confluence of Haggart Creek with the South McQuesten River to establish baseline conditions 20 km downstream in far field areas.

3.3 METHODS

3.3.1 Field Sampling and Protocols

The surface water quality monitoring program will continue to use the sampling methods and analyses established during baseline characterization programs for monitoring sites in the receiving environment. Specifically, water samples will be collected following the methods outlined in the 2013 British Columbia Field Sampling Manual, Ambient Freshwater and Effluent Sampling, Part E – Water and Wastewater Sampling. For stream sampling, water samples will be collected in mid-stream from below the surface film and facing upstream while wearing nitrile gloves. For effluent discharge locations, the Guidance Document for the Sampling and Analysis of Metal Mining Effluents (Environment Canada, Minerals and Metals Division 2001) will also be followed to meet licence conditions and the requirements of the *Metals and Diamond Mining Effluent Regulations.*

Samples will be collected in laboratory provided containers. Samples for dissolved parameters will be filtered within a few hours of collection, either in the field if conditions permit, or indoors in a clean environment. The volume of sample collected and the use of field preservatives, as needed will be dictated by the analytical laboratory responsible for completing the analyses. All samples and blanks will be kept cool after collection and shipped in coolers with ice packs to the laboratory. Table 3.3-1 provides a summary of preservatives and filter requirements for each parameter.

Table 3.3-1: Summary of Eagle Gold Project Surface Water Quality Parameter List and Sample Treatment Protocols

Preservative	Filter	Parameter(s)
None	NO	Physical (Specific conductance, hardness, pH, TSS, TDS, Turbidity) + Anions (Alkalinity, Br, Cl, F, SO4)
As required	As required	Total Organic Carbon, dissolved Organic Carbon
As required	As required	Nutrients (NH3-N, NO3-N, NO2-N, TKN, Total N, orth-PO4, total diss. PO4,)
HNO3	NO	Total Metals
HNO3	YES	Dissolved Metals
HCL	NO	Total Mercury
HCL 3	YES	Dissolved Mercury
NaOH	NO	Total CN, WAD CN
NaOH	NO	Cyanate*
NaOH	NO	Thiocyanate*

* Cyanate and thiocyanate sampling will be undertaken at W4 and W29 in accordance with QZ14-041-1.

3.3.2 Water Quality Parameter List and Detection Limits

The suite of water quality parameters monitored for the Project is essentially the same as used for baseline monitoring program. Although the list of compliance parameters varies through the project stages, the water quality monitoring program includes the analysis of physical parameters (pH, Specific Conductance, turbidity, TSS, TDS and hardness); field parameters (pH, specific conductance, turbidity, temperature, dissolved oxygen); total and dissolved organic carbon; cyanide species, major anions and nutrients (alkalinity, total nitrogen, total Kjeldahl nitrogen (TKN), ammonia-N, nitrate-N, nitrite-N, total dissolved phosphate-P, ortho-phosphate-P, , sulphate, bromide, chloride, fluoride); and, total and dissolved metals (Al, Sb, As, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Mo, Hg, Ni, , K, Se, Ag, Na, Sr, Tl, S U, Zn).

The analytical detection limit at the time of this writing for each parameter is summarized in Table 3.3-2. It is recognized that the detection limits can change over time based on technological improvements or may decrease for a particular sample due to available sampling volumes and/or concentrations of a particular parameter. The sampling, handling, and analytical detection limits are applicable to all monitoring phases.

Table 3.3-2: Water Quality Parameters and Detection Limits

Parameter		Units	Detection Limit	Parameter		Units	Detection Limit
Physical Parameters	Specific Conductance	µS/cm	2.0	Total and Dissolved Metals	Arsenic	mg/L	0.0001
	Hardness (as $CaCO_3$)	mg/L	0.5		Barium	mg/L	0.00005
	pH	—	0.1		Beryllium	mg/L	0.0005
	TSS	mg/L	3.0		Bismuth	mg/L	0.0005
	TDS	mg/L	10		Boron	mg/L	0.01
	Turbidity	NTU	0.1		Cadmium	mg/L	0.000017
Organic/ Inorganic Carbon	DOC	mg/L	0.5		Calcium	mg/L	0.05
	TOC	mg/L	0.5		Chromium	mg/L	0.0005
Major Anions and Nutrients	Alkalinity, Total (as $CaCO_3$)	mg/L	2		Cobalt	mg/L	0.0001
	Ammonia as N	mg/L	0.005		Copper	mg/L	0.0005
	Bromide	mg/L	0.05		Iron	mg/L	0.03
	Chloride	mg/L	0.5		Lead	mg/L	0.00005
	Fluoride	mg/L	0.02		Lithium	mg/L	0.005
	Nitrate (as N)	mg/L	0.005		Magnesium	mg/L	0.1
	Nitrite (as N)	mg/L	0.001		Manganese	mg/L	0.00005
	TKN	mg/L	0.05		Mercury	mg/L	0.00001
	Total Nitrogen	mg/L	0.0025		Molybdenum	mg/L	0.00005
	Ortho Phosphate as P	mg/L	0.001		Nickel	mg/L	0.0005
	Total Dissolved Phosphate as P	mg/L	0.002		Phosphorus – Total	mg/L	0.3

Parameter		Units	Detection Limit	Parameter		Units	Detection Limit
	Total Phosphate as P	mg/L	0.002		Potassium	mg/L	2
	Sulphate	mg/L	0.5		Selenium	mg/L	0.001
Cyanide	Cyanide, Weak Acid Dissociable	mg/L	0.005		Silicon	mg/L	0.05
Cyanide	Cyanide, Total	mg/L	0.005		Silver	mg/L	0.00001
Cyanide	Cyanate	mg/L	0.2		Sodium	mg/L	2
Cyanide					Sulphur	mg/L	0.50
Cyanide	Thiocyanate	mg/L	0.5		Strontium	mg/L	0.0001
Field Parameters	pH	—	0.01		Thallium	mg/L	0.0001
Field Parameters	Temperature	°C	0.1		Tin	mg/L	0.0001
Field Parameters	Conductivity	µS/cm	1		Titanium	mg/L	0.01
Field Parameters	Dissolved Oxygen	mg/L	0.01		Uranium	mg/L	0.00001
Total and Dissolved Metals	Aluminum	mg/L	0.003		Vanadium	mg/L	0.001
Total and Dissolved Metals	Antimony	mg/L	0.0001		Zinc	mg/L	0.003

3.3.3 Sampling Quality Assurance/Quality Control

Surface water quality samples are collected by appropriately trained environmental staff or subcontractors and be submitted to an independent, Canadian Association of Environmental Analytical Laboratories (CAEAL) accredited environmental laboratory with chain-of-custody forms. The quality assurance/quality control (QA/QC) program involves the analysis of field blanks and duplicates, laboratory replicates, and certified reference materials. All blank samples are composed of de-ionized water, of known composition, supplied by the analytical laboratory. Duplicates are obtained by collecting two samples at the same time from a single station for the purpose of monitoring natural variability. Field blanks are exposed to the same conditions and treatment as the water samples collected, and are intended to monitor any contamination that may occur in the field. Blanks for dissolved parameters are processed through filters to detect any contamination potentially introduced during the filtration process.

Trip blanks, field blanks and duplicates are submitted consisting of 10 % of the samples to evaluate the potential for sampling, transport or analytical biases in the results. These sample results are used together with the laboratories internal quality assurance / quality control program to evaluate the confidence in the surface water quality results and to identify outliers and false positives in the results.

Laboratory replicates, comprising sample splits, are analyzed to determine precision of the analytical techniques used. Method blanks will be analyzed to detect any contamination that may have been introduced due to the analytical equipment. Finally, certified reference materials are analyzed to determine the accuracy of the analytical techniques and equipment used.

The criterion used to determine the quality of duplicate QA/QC data is the relative percent difference (RPD), calculated as:

$$RPD = \left| 2 * \left(\frac{A - B}{A + B} \right) \right| * 100$$

Where A and B are duplicate samples, relative percent difference values are generally considered valid if they are less than 25%. However, relative percent difference values of up to 100% are considered acceptable at concentrations less than five times the detection limit. perations

Water quality monitoring for the Project during the Operations phase has expanded to address the performance of environmental mitigation systems, effluent quality standards, as well as receiving water objectives. During operations, excess water generated from the site which is not required for HLF operations and that does not meet effluent quality standards will be treated through a mine water treatment plant (MWTP) once it has been commissioned in accordance with QZ14-041-1, located adjacent to the LDSP (Figure 1.1-1). Effluent from the MWTP will be discharged to a Finishing Tank (FT) within the treatment facility prior to release to Haggart Creek; the finishing tank will facilitate sample collection and laboratory analyses, and provide data to ensure that the tank water meets effluent quality standards prior to discharge to Haggart Creek. The effluent discharge from the MWTP to the finishing tank will be routinely monitored during periods of MWTP operation in accordance with the terms on QZ14-041-1.

The excavation of the open pit will result in groundwater inflows as well as the accumulation of precipitation runoff from the pit walls entering the pit floor. This water will be removed via a pit sump and used in the process system. Monitoring of the pit sump water (station PS; Table 3.3-3 and Figure 3.3-1) will occur, for the purposes of establishing physical factors and controls on the quality of LDSP water to be used for process make-up, understanding continuing treatment requirements, and for developing a database to improve the accuracy of future pit lake water quality estimates for the closure period of the mine life.

The parameter list and detection limits monitored during the operations phase of the Project are outlined in Table 3.3-2.

3.3.4 Locations and Frequency

Table 3.3-3 provides a summary of each monitoring station, location, coordinates, and monitoring frequency for the operations phase of the Project. The analytical suite for this stage of monitoring includes those parameters identified in Table 3.3-2.

Table 3.3-3: Surface Water Quality Monitoring Locations and Frequency – Operations and Active Closure

Site	Location Description	Coordinates (Zone 8)		Sampling Frequency		
				Field Measurements	Laboratory Analysis	
		North	East	pH, Temperature, Dissolved Oxygen and Specific Conductance	Analytical Suite	48-Hour and 96-Hour LT50
W1	Dublin Gulch above Stewart	7101545	460249	M	M	-
W21	Dublin Gulch below Event Ponds	7101261	458359	M	M	-
W4	Haggart Creek below Dublin	7101223	458144	D, M	D[1], M[1]	-
W22	Haggart Creek above Project Influence	7101378	458319	M	M[2]	-
W5	Haggart Creek above Lynx Creek	7095888	457814	M	M[2]	-
W6	Lynx Creek above Haggart Creek	7095964	458099	M	M[2]	-
W20	Bawn Boy Gulch	7101961	461945	M	M	-
W23	Haggart Creek below Lynx Creek	7095682	457790	M	M[2]	-
W27	Eagle Creek near Camp below LDSP	7100997	458235	M	M	-
W26	Stewart Gulch	7101443	460331	M	M	-
W29	Haggart Creek below Eagle Creek & Platinum Gulch	7099583	458225	D, M	D[1], M[2]	-
W39	Haggart Creek above South McQuesten River	7086504	449780	Q	Q[2]	-
W45	Eagle Creek above Haggart Creek	7099684	458243	M	M	-
W49	South McQuesten River below Haggart Creek	7085495	449221	Q	Q[2]	-
W99	Haggart Creek above 15 Pup	7098180	458322	M	M[2]	-
EPS	Eagle Pup WRSA Seepage	7100909	459834	M	M	-
PDI & PG_PTS[5]	Platinum Gulch Ditch into Lower Dublin South Pond	7099523	459184	M	M	-
PGS	Platinum Gulch WRSA Seepage	7099436	459281	M	M	-
PS	Open Pit Sump	7099574	459536	M	M	-
MWTP	Mine Water Treatment Plant	TBD	TBD	D	D[2], W[2,3]	M
FT	Mine Water Treatment Plant Finishing Tank	TBD	TBD	D	D[2]	-
LDSPI	Lower Dublin South Pond Inflow	7100824	458926	D, M	D[2], M	M
LDSP	Lower Dublin South Pond Outflow	7100857	458672	D, W	D[2], W[2,3]	Md
CS-07	SG-G4 – below Ice Rich Overburden Storage Area	7098627	458268	Md	Md	-
OPP[6]	Open Pit Pond	7099460	459359	Q	Q	-
OPPO[6]	Open Pit Pond Overflow	7099460	459359	M	M	M
LDSP-UND	LDSP Underdrain Outflow	7100937	458570	M	M[3]	-

Site	Location Description	Coordinates (Zone 8)		Sampling Frequency		
				Field Measurements	Laboratory Analysis	
		North	East	pH, Temperature, Dissolved Oxygen and Specific Conductance	Analytical Suite	48-Hour and 96-Hour LT50
HLFUMV	Heap Leach Facility Underdrain Monitoring Vault	7101298	459445	C, D, W	D[4], M[2,3]	M
ADR Pad Ditch	ADR Pad Ditch Outlet	7101471	459043	D, M	D[2], M[2,3]	

1 – Laboratory analysis includes WAD, Total CN, Thiocyanate and Cyanate.
2 – Laboratory analysis includes WAD and Total CN.
3 – Calculation of un-ionized ammonia
4 - Laboratory analysis only includes WAD and Total CN - no other parameters required.
5 – Platinum ditch intake converted to Platinum Gulch PTS when PG WRSA is progressively reclaimed
6 – Closure phase only
C – Continuous monitoring for specific conductance; D – Daily when discharging; W – Weekly when discharging; M – Monthly; Md – Monthly when discharging; Q – Quarterly

3.3.5 Data Analysis and Reporting

As described previously, receiving environment surface water quality data collected during the operations phase of the Project will be compared to three key benchmarks:

- baseline water quality;
- surface water quality objectives in the receiving environment; and,
- operations and closure phase effluent quality standards specified in QZ14-041-1 as shown in Section 3.8.

Data will continue to be managed in a database and updated on a monthly basis following receipt of the final analytical reports from the laboratory (for any off-site analyses conducted). Monthly data will be tabulated and compared to existing baseline water quality for each Project receiving stream and QZ14-041-1 criteria.

Surface water quality monitoring QA/QC results for field blanks, filter blanks, field replicates, laboratory replicates, and certified reference materials will be reported for each month of the sampling program.

Monthly water quality monitoring updates will be prepared summarizing key monitoring results and analysis for the previous month. This information will be used by MWTP operators, provide compliance-related data for Yukon Government inspectors as required, and to fulfil the monthly and annual reporting requirements of QZ14-041-1. An annual water quality monitoring report will be prepared that provides a summary of the monitoring results and analyses with comparisons to the developing database for operations as well as baseline. Statistical analyses will be performed as needed on the monitoring data and compared directly to the baseline results to determine if any statistically significant changes have occurred to the receiving environment water quality.

3.4 ACTIVE CLOSURE

The active closure phase of the Project is defined as the period immediately following the cessation of economic gold recovery and the initiation of rinsing and neutralization of the HLF. Surface water quality monitoring during the early closure phase of the Project is largely unchanged from the operations phase monitoring (Table 3.3-3 and Figure 3.3-1).

Reclamation activities, including the placement of a cover on the Eagle Pup WRSA to reduce infiltration and encourage vegetation growth will be completed during the active closure phase. A cover will be placed onto the Platinum Gulch WRSA once the WRSA is decommissioned currently planned for after operations phase year 3 as part of progressive reclamation. Monitoring of the Eagle Pup Seepage (EPS) and Platinum Gulch Seepage (PGS) will continue to provide useful geochemical information on the long-term seepage and runoff water quality from these facilities to inform final mine closure planning. This data and data collected during operations will assist in the final design and operation of the proposed passive treatment systems at these locations.

Similarly, upon completion of active mining from the open pit, any groundwater inflow and precipitation runoff will be allowed to accumulate in the pit. The site Surface Water Balance Model (SWBM) estimates that the pit will fill in approximately eight years. The water quality of the accumulating open pit pond (OPPO), shown on Figure 3.3-1, will continue to be sampled on a quarterly basis as it fills to evaluate against predicted water quality and to make changes to passive treatment system design and other adaptive management measures if required. As the pit water deepens, samples will be collected at specified intervals (to be determined) to identify whether the pit lake will develop long-term stratification. Characterization of this water quality through time will assist in design of the Platinum Gulch passive treatment system. When the open pit fills, any open pit overflow (OPPO, Figure 3.3-1) will be monitored on a monthly basis.

3.4.1 Data Analysis and Reporting

Data analysis and reporting will follow the same protocols as outlined previously for the operations phase.

3.5 LATE AND POST-CLOSURE PHASE

The late closure phase of the Project is defined by the period when all reclamation and decommissioning activities are assumed to be complete; the HLF and WRSA covers are in place, the MWTP is no longer in operation and the HLF and LDSP passive treatment systems are in operation. Monitoring of the receiving environment in Haggart Creek and Dublin Gulch will continue at a reduced frequency. Monitoring during the late closure phase will focus on the passive treatment systems and their performance through routine sampling of inflow and outflow water to each system. Monitoring during the post-closure phase will focus on routine sampling of key compliance and environmental effects locations.

3.5.1 Locations and Frequency

Table 3.5-1 provides a summary of each monitoring station, location, coordinates, and monitoring frequency for the late closure phase of the Project; sampling locations are also depicted on Figure 3.5-1.

3.5.2 Data Analysis and Reporting

Data analysis and reporting will follow the same protocols as outlined previously for the operations and early closure phase.

Table 3.5-1: Surface Water Quality Monitoring Locations and Frequency – Late Closure Phase and Post-closure

Site	Location Description	Coordinates (Zone 8)		Sampling Frequency		
				Field Measurements	Laboratory Analysis	
		North	East	pH, Temperature, Dissolved Oxygen and Conductivity	Analytical Suite	48-Hour & 96-Hour LT50
W1	Dublin Gulch above Stewart	7101545	460249	Q	Q	
W21	Dublin Gulch below Event Pond	7101261	458359	M, Q[1]	M, Q[1]	
W4	Haggart Creek below Dublin	7101223	458144	M, Q[1]	M, Q[3]	
W22	Haggart Creek above Project Influence	7101378	458319	M, Q[1]	M, Q[4]	
W5	Haggart Creek above Lynx Creek	7095888	457814	M	M[5]	
W6	Lynx Creek above Haggart Creek	7095964	458099	M	M[5]	
W20	Bawn Boy Gulch	7101961	461945	Q	Q	
W23	Haggart Creek below Lynx Creek	7095682	457790	M, Q[1]	M, Q[4]	
W27	Eagle Creek near Camp below LDSP	7100997	458235	M, Q[1]	M, Q[1]	
W26	Stewart Gulch	7101443	460331	Q	Q	
W29	Haggart Creek below Eagle Creek & Platinum Gulch	7099583	458225	M, Q[1]	M, Q[3]	
W39	Haggart Creek above South McQuesten River	7086504	449780	Q	Q[5]	
W45	Eagle Creek above Haggart Creek	7099684	458243	M, Q[1]	M, Q[1]	
W49	South McQuesten River below Haggart Creek	7085495	449221	Q	Q[5]	
W99	Haggart Creek above 15 Pup	7098180	458322	M, Q[1]	M, Q[4]	
HLF_PTS_INF[8]	Inflow to HLF Passive Treatment System	7101521	459527	W, M[2]	W, M[6]	
HLF_PTS	Outflow of HLF Passive Treatment System	7101260	458865	W, M[2]	W, M[6,7]	M, Q[1]
LDSP_PTS_INF	Inflow to LDSP Passive Treatment System	7100824	458926	W, M[2]	W, M[6]	
LDSP_PTS	Outflow of LDSP Passive Treatment System	7100857	458672	W, M[2]	W, M[6,7]	M, Q[1]
PG-PTS	Inflow from Platinum Gulch PTS to LDSP Passive Treatment System and, when discharge criteria allow, direct discharge to Haggart Creek	7099523	459184	W, M[2]	W[6,7], M[2,7]	
OPPO	Open Pit Pond Overflow	7099460	459359	Q	Q[7]	Q
LDSP-UND	LDSP Underdrain Outflow	7100937	458570	Q	Q[5,7]	
HLFUMV	Heap Leach Facility Underdrain Monitoring Vault	7101298	459445	C, W, M[2]	W, M[6,7]	M, Q[1]

1 – Monthly for 1 year, quarterly thereafter
2 – Weekly for 1 year, monthly thereafter
3 – Monthly for 1 year, quarterly thereafter. Laboratory analysis includes WAD and Total CN, Thiocyanate and Cyanate
4 – Monthly for 1 year, quarterly thereafter. Laboratory analysis includes WAD and Total CN
5 – Laboratory analysis includes WAD and Total CN

6 – Weekly for 1 year, monthly thereafter. Laboratory analysis includes WAD and Total CN
7 – Calculation of un-ionized ammonia
8 – Monitoring requirement in QZ4-041-1 relates to surface water quality program but sampling point will be accessed via the closure drill casing utilized to perforate liner system and activate closure sump and piping network
C – Continuous monitoring for specific conductance; M – Monthly; W – Weekly; Q – Quarterly

3.6 ADAPTIVE MANAGEMENT

3.6.1 Performance Objectives – Water Quality Criteria

Water quality data is stored in a database that allows water quality to be tracked at each station for any sampling event and to examine trends over time. Using this method, parameters can be evaluated to monitor fluctuations from baseline to thresholds. The database allows for thresholds to serve as triggers for evaluation and action.

Adaptive management relating to surface water quality has been designed to guide management decisions arising from unexpected performance of the Project. This section provides trigger levels for management actions and potential management actions based on the results of monitoring activities.

Construction activities, including stream bank construction for diversions, have the potential to release sediment to streams and result in disturbance of aquatic habitat; however, standard erosion prevention and sediment control practices as described in the Water Management Plan will mitigate effects. Practices include constructing channels with check dams, sediment control ponds, sediment basins, exfiltration ponds, and silt fences, as well as through the stabilization of disturbed land surfaces, and re-establishment of vegetative cover as soon as practical post disturbance. All runoff from camp construction, site clearing and other soil and vegetation disturbance and stockpiling activities will be diverted to the sediment control facilities for settling or to exfiltration ponds/areas.

Runoff from areas disturbed by construction activities, and not controlled by local mitigation measures (e.g., sediment basins, silt fences, exfiltration areas) is considered to be sediment-laden water, except for diverted flows that have not been in contact with construction zones. In the event an adaptive management threshold for water quality is exceeded at effluent discharge locations, the following adaptive management measures, in addition to the adaptive management measures described in Section 3.7.2, will be considered:

- Inspection of exposed surfaces and application of additional erosion control methods.
- Inspection of upstream sediment control facilities to determine if functioning as designed.
- Repair of sediment control facilities if required.
- Increased water quality monitoring.
- Consideration of capital improvements and implementation including the following:
    - Additional source control measures such as mulching, filter logs, silt fence, surface roughening (rough and loose preparation), and vegetation establishment
    - Installation of additional sediment traps and sediment basins upstream of sediment control ponds
    - Installation of filter bags for localized sediment point sources and/or geotubes for treatment of runoff from larger areas

- o Addition of flocculants to sediment control ponds
- o Additional sediment control facilities and methods
- o Expansion of existing sediment control facilities and methods

3.6.2 Operations, Closure and Post Closure

There is potential for impacts to water quality in the receiving environment via discharged effluent that does not meet the licensed effluent quality standards. Water quality data is collected and evaluated to determine if adaptive management thresholds or effluent quality standards have been exceeded. Thresholds have been developed for discharge locations (Table 3.6-1) to achieve the receiving environment water quality objectives in Haggart Creek.

Table 3.6-1: Effluent Quality Standards for Authorized Discharge Locations

Parameter[1]	Threshold 1 Adaptive Management Concentration in a Grab Sample (mg/L)	Threshold 2 Adaptive Management Concentration in a Grab Sample (mg/L)	Threshold 3 Maximum Concentration in a Grab Sample (mg/L)
pH	6.5 – 8	6.5 – 8	6.5 – 8
Total Suspended Solids (TSS)	11.25	13.50	15.00
Sulphate	1387.5	1665.0	1850
Chloride	187.5	225.0	250
Nitrate-N	14.63	17.55	19.5
Nitrite-N	0.09	0.11	0.12
Ammonia-N	5.63	6.75	7.5
Total Cyanide	0.75	0.90	1.0
WAD Cyanide	0.0225	0.027	0.03
Aluminum (Dissolved)	0.3	0.36	0.4
Antimony	0.098	0.117	0.13
Arsenic[2]			0.053
Cadmium	0.00094	0.001125	0.00125
Copper	0.0195	0.0234	0.026
Cobalt	0.0195	0.0234	0.026
Iron	4.8	5.8	6.4
Lead	0.038	0.045	0.05
Mercury	0.00006	0.000072	0.00008
Manganese	5.78	6.93	7.7
Molybdenum	0.338	0.405	0.45
Nickel	0.375	0.450	0.50
Selenium	0.0188	0.0225	0.025
Silver	0.0075	0.009	0.01
Uranium	0.068	0.081	0.09
Zinc	0.173	0.207	0.23

1 – All concentrations are total values

2 - Adaptive management thresholds are being further investigated at this time and will be informed by toxicity test work to determine arsenic toxicity levels in Haggart Creek. MDMER discharge limits for arsenic are currently 1 mg/L thus Threshold 3 (i.e., QZ14-041-1 criteria) is considered extremely conservative and protective of the receiving environment.

Adaptive management measures that will be employed in the event these thresholds are reached are provided in Table 3.6-2.

Table 3.6-2: Adaptive Management Indicators, Thresholds and Responses for Discharge Locations

Definition of Potential Significant Effect	An impairment of the ability of Haggart Creek to sustain aquatic life (ultimately, the ability to sustain fish populations at levels similar to Project pre-development) due to sustained water quality above the site-specific water quality objectives for Haggart Creek.	
Indicator	**Performance Threshold**	**Response**
▪ pH ▪ TSS ▪ Sulphate ▪ Chloride ▪ Nitrate-N ▪ Nitrite-N ▪ Ammonia-N ▪ Total Cyanide ▪ WAD Cyanide ▪ Aluminum (Dissolved) ▪ Antimony ▪ Arsenic ▪ Cadmium ▪ Copper ▪ Cobalt ▪ Iron ▪ Lead ▪ Mercury ▪ Manganese ▪ Molybdenum ▪ Nickel ▪ Selenium ▪ Silver ▪ Uranium ▪ Zinc As defined in Table 3.6-1.	**Threshold 1:** Exceedance of threshold in two consecutive samples (routine or re-sample)	**Notification:** ✓ Identified, including trend analysis, in Monthly Report to Yukon Water Board; ✓ Notify Internal VGC Senior Management within 15 days of receipt of second sample. **Review** ✓ Review laboratory QA/QC report; ✓ Validate original result, or re-run sample if a laboratory error is indicated. **Evaluation** ✓ For exceedance at LDSP, compare with LDSPI and PDI & PG_PTS; use on-site TSS lab as initial indicator prior to receiving lab results, which may take up to a week longer; ✓ For exceedance at LDSP-UND, compare with LDPSs (internal VGC location); ✓ For exceedance at MWTP, compare with prior treatment batch process logs for dosing rate and reaction times; ✓ For exceedance at HLFUMV, compare with MW19-HLF1a/b, MWXX-HLF2a/b and MWXX-AG6 (groundwater wells); ✓ For exceedance at ADR Pad Ditch, inspect surface water management infrastructure; ✓ Conduct a trend analysis. **Action** ✓ Expedite results of a subsequent sample and review results to determine if the exceedance continues. If no follow up sample was collected during review, re-sample upon determination of initial results; ✓ Examine water management infrastructure linked to discharge location to assess whether they are performing as intended. ✓ Ensure flocculant use system at LDSP is operational to respond to a higher threshold as necessary. ✓ Actions will continue until performance thresholds are no longer exceeded.

Definition of Potential Significant Effect	An impairment of the ability of Haggart Creek to sustain aquatic life (ultimately, the ability to sustain fish populations at levels similar to Project pre-development) due to sustained water quality above the site-specific water quality objectives for Haggart Creek.	
Indicator	**Performance Threshold**	**Response**
		Notification ✓ Notify Internal Senior Management that Threshold Level 2 AMP action plan has been initiated within 3 days after confirming Threshold 2 has been reached and maintained; ✓ Provide summary of AMP notifications, reviews, evaluations and actions in monthly report.
		Review ✓ Review laboratory QA/QC report; ✓ Validate original result, or re-run sample if a laboratory error is indicated. ✓ Review laboratory results from all point sources contributing to discharge location (e.g., EPS, PS, PGS, etc.).
	Threshold 2: Exceedance of threshold in two consecutive samples (routine or re-sample)	**Evaluation** ✓ For exceedance at LDSP, compare with LDSPI and PDI & PG_PTS; use on-site TSS lab as initial indicator prior to receiving lab results, which may take up to a week longer; ✓ For exceedance at LDSP-UND, compare with LDPSs (internal VGC location). ✓ For exceedance at MWTP, compare with prior treatment batch process logs for dosing rate and reaction times. ✓ For exceedance at HLFUMV, compare with MW19-HLF1a/b, MWXX-HLF2a/b and MWXX-AG6 (groundwater wells). ✓ For exceedance at ADR Pad Ditch, inspect surface water management infrastructure. ✓ MWTP or PTS inspection to determine if system is functioning as intended. ✓ Conduct a trend analysis on discharge point and point sources. ✓ Examine water management infrastructure upgradient of the monitoring location(s) to assess whether they are performing as intended; ✓ Environmental Manager or designate will examine disturbance areas to determine if additional source control measures (i.e., the erosion control best management practices described in the Construction and Operations Water Management Plan) are required.
		Action ✓ If exceedance is in LDSP water, activate flocculant use system as metals closely correlated to suspended solids on the Project; ✓ For exceedance at LDSP-UND, determine if suitable pumps and pipe is available to recycle fluids to LDSP or the Events Pond;

Definition of Potential Significant Effect	An impairment of the ability of Haggart Creek to sustain aquatic life (ultimately, the ability to sustain fish populations at levels similar to Project pre-development) due to sustained water quality above the site-specific water quality objectives for Haggart Creek.	
Indicator	**Performance Threshold**	**Response**
		✓ For exceedance at MWTP, compare with prior treatment batch process logs for dosing rate and reaction times and schedule inspection by maintenance department; ✓ For exceedance at HLFUMV, ensure recycle system is operational and schedule inspection by maintenance department; ✓ For exceedance at ADR Pad Ditch, determine if suitable pumps and pipe is available to recycle fluids to LDSP of the Events Pond; ✓ Perform maintenance on MWTP or PTSs as necessary; ✓ Consider need for temporary re-routing of contact water from specific point sources identified during trend analysis; ✓ If Environmental Manager or designate examination determines a root cause for the exceedance, install additional source control measures; ✓ If Environmental Manager or designate examination does not determine a root cause for the exceedance, develop an investigation plan with Environmental Department and Site Operations Department; ✓ Actions will continue until performance thresholds are no longer exceeded.
	Threshold 3: Exceedance of maximum allowable concentration in single sample	**Notification** ✓ Notify Internal Senior Management that Threshold Level 3 AMP action plan has been initiated within 1 day after confirming Threshold 3 has been reached and maintained; ✓ Report unauthorized discharge to the 24-hour Yukon Spill Report number within 24 hours. ✓ Provide phone notification with email back-up to EMR-CMI inspector and FNNND Environmental Monitor, within 3 days after confirming Threshold 3 has been reached and maintained; ✓ Provide summary of AMP notifications, reviews, evaluations and actions in monthly report.
		Review ✓ Review laboratory QA/QC report; ✓ Validate original result, or re-run sample if a laboratory error is indicated.

Definition of Potential Significant Effect	An impairment of the ability of Haggart Creek to sustain aquatic life (ultimately, the ability to sustain fish populations at levels similar to Project pre-development) due to sustained water quality above the site-specific water quality objectives for Haggart Creek.	
Indicator	**Performance Threshold**	**Response**
		Evaluation ✓ MWTP or PTS inspection to determine if system is functioning as intended. ✓ Conduct a trend analysis on discharge point and point sources. ✓ Examine water management infrastructure upgradient of the monitoring location(s) to assess whether they are performing as intended; ✓ Environmental Manager or designate will examine disturbance areas to determine if additional source control measures (i.e., the erosion control best management practices described in the Construction and Operations Water Management Plan) are required.
		Action ✓ Immediately cease discharge if possible and if it would not lead to undue risk to critical infrastructure or greater environmental impacts; ✓ If toxicity sample was not taken with the initial sample, perform a toxicity test at discharge location, W4, W22 and W99. ✓ Consider recirculation of excess contact/process water within the HLF until repairs and adjustments are made to water management facilities to achieve licensed effluent concentrations; ✓ Consider rerouting contact water from Open Pit and Waste Rock Storage Areas from MWTP to the events pond and/or HLF for storage and recirculation temporarily; ✓ Consider suspension of Open Pit dewatering operations; ✓ Consider engaging a qualified third party to evaluation of potential effects to aquatic resources; ✓ Consider capital improvements to augment or replace existing treatment systems; ✓ Actions will continue until performance thresholds are no longer exceeded.

The lone exception to the values specified in Table 3.6-1 is the sediment control pond immediately down gradient of the Ice Rich Overburden Storage Area (i.e., the CS-07 discharge location) which has the discharge standards identified in Table 3.6-3 for the full life of the Project.

Table 3.6-3: CS-07 Effluent Quality Standards and Adaptive Management Thresholds

Parameter[1]	Maximum Monthly Mean Concentration	Maximum Concentration in a Grab Sample	Adaptive Management Concentration
Arsenic	-	0.50 mg/L	0.375 mg/L
Copper	-	0.30 mg/L	0.225 mg/L

Parameter[1]	Maximum Monthly Mean Concentration	Maximum Concentration in a Grab Sample	Adaptive Management Concentration	
Lead	-	0.20 mg/L	0.15 mg/L	
Nickel	-	0.50 mg/L	0.375 mg/L	
Zinc	-	0.50 mg/L	0.375 mg/L	
Total Suspended Solids (TSS)	15 mg/L	30.00 mg/L	11.25 mg/L	22.50 mg/L

1 – All concentrations are total values

Site specific water quality objectives and adaptive management thresholds for receiving environment water quality in Haggart Creek (at stations W4, W29, W99, W23, and W22 upgradient of Project influence (Figure 3.3-1)) have been developed (Table 3.6-4) to inform adaptive management actions as shown in Table 3.6-5. It is recognized that some of these thresholds may need to be adjusted, or may require different approaches, to better reflect the natural variability for specific parameters at certain stations (i.e., the natural range of arsenic varies considerably across the watercourses in the project site), and that operating experience obtained over the first year of production will help inform whether thresholds require adjustment.

Table 3.6-4: Adaptive Management Thresholds (mg/L) for the Protection of the Receiving Environment in Haggart Creek

Parameter		Threshold 1 75% of Water Quality Objective	Threshold 2 85% of Water Quality Objective	Threshold 3 Water Quality Objective
Dissolved Parameters	Sulphate	231.8	262.7	309
	Chloride	112.5	127.5	150
	Nitrate-N	2.3	2.6	3
	Nitrite-N	0.015	0.017	0.02
	Ammonia	0.848	0.961	1.13
	WAD Cyanide[1]	T3 only	T3 only	0.005
	Aluminum	0.075	0.085	0.1
Total	Antimony	0.015	0.017	0.02
	Arsenic	0.00638	0.00723	0.0085
	Cadmium	0.000148	0.000167	0.000197
	Copper	0.00375	0.00425	0.005
	Cobalt	0.0030	0.0034	0.004
	Iron	0.75	0.85	1.0
	Lead	0.00578	0.00655	0.0077
	Mercury	0.000015	0.000017	0.00002
	Manganese	0.878	0.995	1.17

Parameter		Threshold 1 75% of Water Quality Objective	Threshold 2 85% of Water Quality Objective	Threshold 3 Water Quality Objective
	Molybdenum	0.0548	0.0621	0.073
	Nickel	0.087	0.099	0.116
	Selenium	0.0015	0.0017	0.002
	Silver	0.00113	0.00128	0.0015
	Uranium	0.0113	0.0128	0.015
	Zinc	0.0285	0.0323	0.038

Note:

1. Adaptive management threshold for WAD Cyanide includes only Threshold 3 which is set to the detection limit.

Adaptive management measures that will be employed in the event these thresholds are reached are provided in Table 3.6-5.

Table 3.6-5: Adaptive Management Indicators, Thresholds and Responses for the Protection of the Receiving Environment in Haggart Creek

Definition of Potential Significant Effect	An impairment of the ability of Haggart Creek to sustain aquatic life (ultimately, the ability to sustain fish populations at levels similar to Project pre-development) due to sustained water quality above the site-specific water quality objectives for Haggart Creek.	
Indicator	**Performance Threshold**	**Response**
Aqueous concentrations at W4, W29, W99 and W23 for: Dissolved Parameters ▪ Sulphate ▪ Chloride ▪ Nitrate-N ▪ Nitrite-N ▪ Ammonia ▪ WAD Cyanide ▪ Aluminum Total ▪ Antimony ▪ Arsenic ▪ Cadmium ▪ Copper ▪ Cobalt	**Threshold 1:** Exceedance of threshold in two consecutive samples (routine or re-sample)	**Notification:** ✓ Identified in Monthly Report to Yukon Water Board; ✓ Notify Internal VGC Senior Management within 15 days of receipt of second sample. **Review** ✓ Review laboratory QA/QC report; ✓ Validate original result, or re-run sample if a laboratory error is indicated. **Evaluation** ✓ For exceedance at W4, compare with W22, W21 and any discharge results; ✓ For exceedance at W29, compare with W4, W22 and W45 results; ✓ For exceedance at W99, compare with W29, W4 and W22 and CS-07 discharge results; ✓ For exceedance at W23, compare with W5 and W6 results; ✓ For exceedance at W22, compare to baseline results; ✓ Conduct a trend analysis and comparison of observed and predicted water quality.

<table>
<tr><th>Definition of Potential Significant Effect</th><td colspan="2">An impairment of the ability of Haggart Creek to sustain aquatic life (ultimately, the ability to sustain fish populations at levels similar to Project pre-development) due to sustained water quality above the site-specific water quality objectives for Haggart Creek.</td></tr>
<tr><th>Indicator</th><th>Performance Threshold</th><th>Response</th></tr>
<tr><td rowspan="4">▪ Iron
▪ Lead
▪ Mercury
▪ Manganese
▪ Molybdenum
▪ Nickel
▪ Selenium
▪ Silver
▪ Uranium Zinc

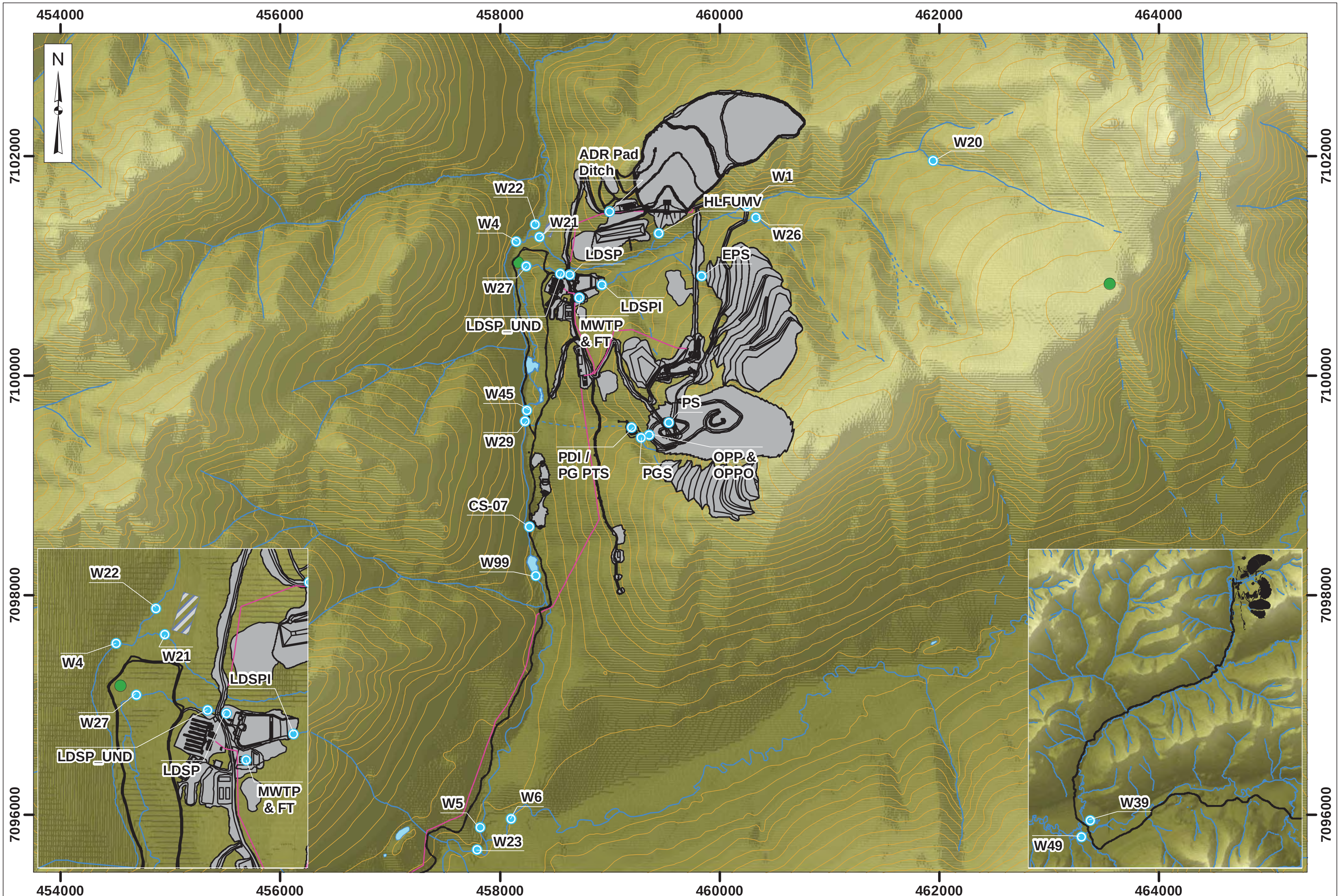
As defined in Table 3.6-4</td><td></td><td>Action
✓ If comparisons indicate that exceedance is due to Project influence then expedite results of a subsequent sample and review results to determine if the exceedance continues. If no follow up sample was collected during review, re-sample upon determination of Project influence;
✓ Examine water management infrastructure upgradient of the monitoring location(s) to assess whether they are performing as intended.
✓ Actions will continue until performance thresholds are no longer exceeded.</td></tr>
<tr><td rowspan="3">Threshold 2:

Exceedance of threshold in two consecutive samples (routine or re-sample) where evaluation indicates Project influence</td><td>Notification
✓ Notify Internal VGC Senior Management within 7 days of receipt of second sample;
✓ Provide summary of AMP notifications, reviews, evaluations and actions in Monthly Report to Yukon Water Board.</td></tr>
<tr><td>Review
✓ Review laboratory QA/QC report;
✓ Validate original result, or re-run sample if a laboratory error is indicated.</td></tr>
<tr><td>Evaluation
✓ For exceedance at W4, compare with W22, W21 and any discharge results;
✓ For exceedance at W29, compare with W4, W22 and W45 results;
✓ For exceedance at W99, compare with W29, W4, W22 and CS-07 discharge results;
✓ For exceedance at W23, compare with W5, W4, W22 and W6 results;
✓ For exceedance at W22, compare to baseline results;
✓ Conduct a trend analysis and comparison of observed and predicted water quality.
✓ Examine water management infrastructure upgradient of the monitoring location(s) to assess whether they are performing as intended;
✓ Environmental Manager or designate will examine disturbance areas to determine if additional source control measures (i.e., the erosion control best management practices described in the Construction and Operations Water Management Plan) are required.</td></tr>
</table>

Definition of Potential Significant Effect	An impairment of the ability of Haggart Creek to sustain aquatic life (ultimately, the ability to sustain fish populations at levels similar to Project pre-development) due to sustained water quality above the site-specific water quality objectives for Haggart Creek.	
Indicator	**Performance Threshold**	**Response**
		Action ✓ If comparisons indicate that exceedance is due to Project influence then expedite results of a subsequent sample and review results to determine if the exceedance continues. If no follow up sample was collected during review, re-sample upon determination of project influence; ✓ If discharge is not occurring, consider increase sampling frequency at W4, W29, W99 and W23 and the linked comparison sites based on the exceedance location to weekly; ✓ If Environmental Manager or designate examination determines a root cause for the exceedance, install additional source control measures; ✓ If Environmental Manager or designate examination does not determine a root cause for the exceedance, develop an investigation plan with the Environmental Department and Site Operations department; ✓ If trend analysis shows continually increasing concentrations, indicating a risk of exceeding site-specific water quality objectives within one year, then initiate Threshold 3 actions. ✓ Actions will continue until performance thresholds are no longer exceeded.
	Threshold 3: Exceedance of threshold in single sample	**Notification** ✓ Notify Internal Senior Management that Threshold Level 3 AMP action plan has been initiated within 1 day after confirming Threshold 3 has been reached and maintained; ✓ Provide phone notification with email back-up to EMR-CMI inspector and FNNND Environmental Monitor, within 3 days after confirming Threshold 3 has been reached and maintained for two successive sampling events; ✓ Provide summary of AMP notifications, reviews, evaluations and actions in monthly report.
		Review ✓ Review laboratory QA/QC report; ✓ Validate original result, or re-run sample if a laboratory error is indicated.

Definition of Potential Significant Effect	An impairment of the ability of Haggart Creek to sustain aquatic life (ultimately, the ability to sustain fish populations at levels similar to Project pre-development) due to sustained water quality above the site-specific water quality objectives for Haggart Creek.	
Indicator	**Performance Threshold**	**Response**
		Evaluation ✓ For exceedance at W4, compare with W22, W21 and any discharge results; ✓ For exceedance at W29, compare with W4, W22 and W45 results; ✓ For exceedance at W99, compare with W29, W4, W22 and CS-07 discharge results; ✓ For exceedance at W23, compare with W5, W4, W22 and W6 results; ✓ For exceedance at W22, compare to baseline results; ✓ Conduct a trend analysis. ✓ Examine water management infrastructure upgradient of the monitoring location(s) to assess whether they are performing as intended; ✓ Environmental Manager or designate will examine disturbance areas to determine if additional source control measures (i.e., the erosion control best management practices described in the Construction and Operations Water Management Plan) are required.
		Action ✓ If comparisons indicate that exceedance is due to Project influence then expedite results of a subsequent sample and review results to determine if the exceedance continues. If no follow up sample was collected during review, re-sample upon determination of project influence; ✓ If discharge is not occurring, increase sampling frequency at W4, W29, W99 and W23 and the linked comparison sites based on the exceedance location to twice as frequent as the defined WL frequency ✓ Sample for acute toxicity testing at the locations that exceeded WQOs; ✓ If Environmental Manager or designate examination determines a root cause for the exceedance, install additional source control measures; ✓ If Environmental Manager or designate examination does not determine a root cause for the exceedance, develop an investigation plan with environmental department and site operations department; ✓ Implement investigation plan; ✓ Consider revising water quality model and predictions ✓ If discharge is occurring, temporarily limit discharge to the adaptive management thresholds specified in Table 3.6-2 if safe to do so based on storage capacity and weather forecast; ✓ Consider recirculation of excess process water within the HLF until repairs and adjustments are made to water management facilities to achieve licensed effluent concentrations;

Definition of Potential Significant Effect	An impairment of the ability of Haggart Creek to sustain aquatic life (ultimately, the ability to sustain fish populations at levels similar to Project pre-development) due to sustained water quality above the site-specific water quality objectives for Haggart Creek.	
Indicator	**Performance Threshold**	**Response**
		✓ Consider rerouting contact water from Open Pit and Waste Rock Storage Areas from MWTP to the events pond and/or HLF for storage and recirculation temporarily; ✓ Consider suspension of Open Pit dewatering operations; ✓ Engage a qualified third party to conduct an evaluation of potential effects to aquatic resources; ✓ Consider capital improvements to augment or replace existing treatment systems. ✓ Actions will continue until performance thresholds are no longer exceeded.



Legend:

- Water Quality Station
- Climate Station
- Reserved Area
- Facility
- Site Power
- Contour (100ft)
- Watercourse (Perennial)
- Watercourse (Ephemeral)
- Watercourse (Intermittent)

Victoria GOLD CORP

0 0.75 1.5
Kilometers

Projection: NAD 83 UTM Zone 8N

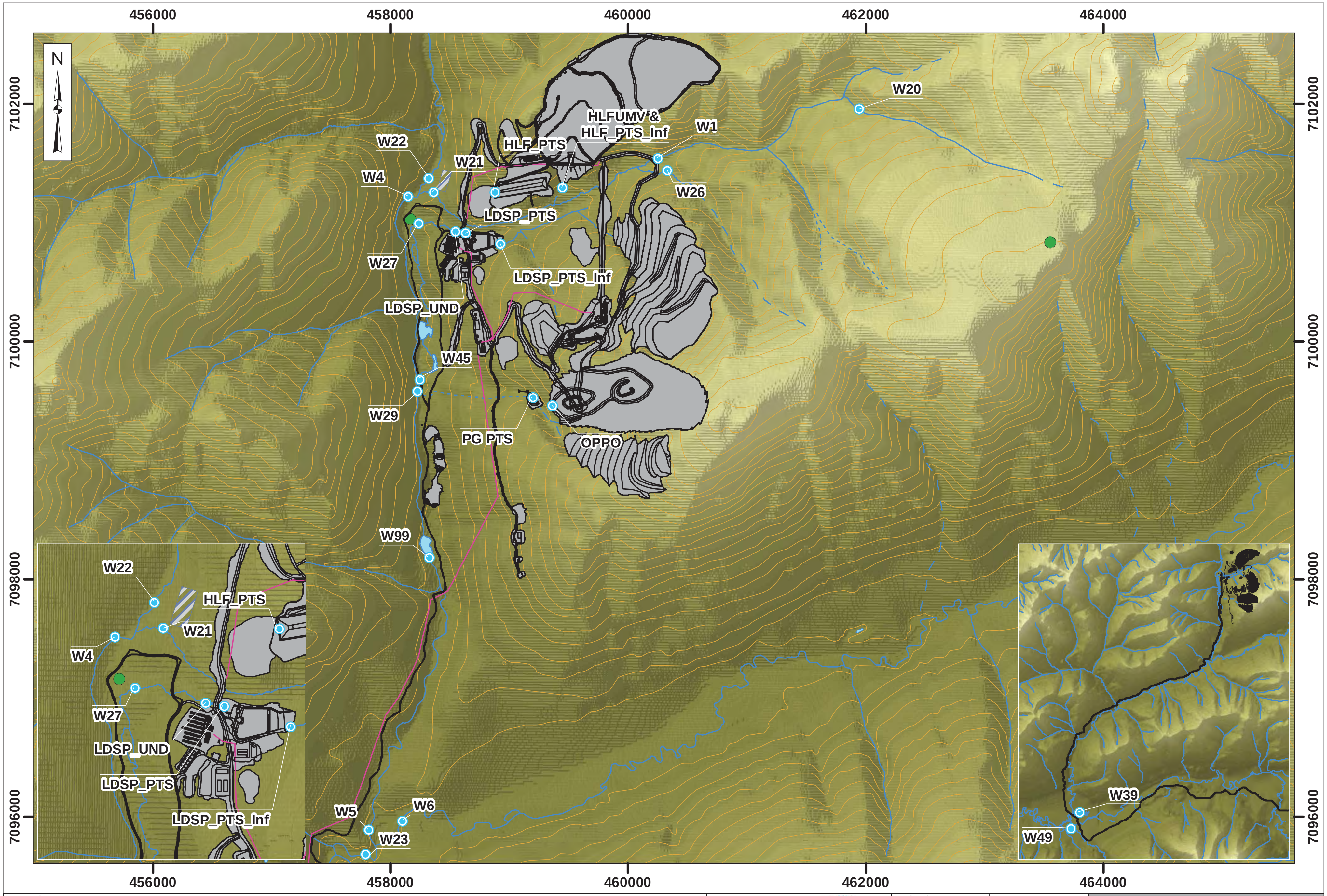
Drawn By: HC

Date: 2020/02/01

Figure: 3.3-1

EAGLE GOLD PROJECT YUKON TERRITORY

Operations & Active Closure Phase Surface Water Quality Monitoring Stations



Legend:

- Water Quality Station
- Climate Station
- Reserved Area
- Facility
- Site Power
- Contour (100ft)
- Watercourse (Perennial)
- Watercourse (Ephemeral)
- Watercourse (Intermittent)

Victoria Gold Corp

0 0.5 1
Kilometers

Projection: NAD 83 UTM Zone 8N

Drawn By: HC

Date: 2020/02/03

Figure: 3.5-1

EAGLE GOLD PROJECT
YUKON TERRITORY

Post Closure Phase Surface Water Quality Monitoring Stations

4 GROUNDWATER QUANTITY

4.1 INTRODUCTION

The objectives of the groundwater quantity monitoring program are to provide a continuous dataset to monitor Project effects on the occurrence and quantity of groundwater as the Project transitions from baseline characterization through construction, into operations and through closure.

The majority of the Project is situated within the Dublin Gulch basin, which is part of the Haggart Creek basin. To characterize the baseline groundwater for the Project, the site was divided into hydrogeologic zones (Stantec 2010c, 2011c, and 2012e). The zones have been named according to the primary watercourse draining each sub-catchment. The hydrogeologic zones used to characterize groundwater in the Project area include Eagle Pup and the Ann, Suttles, Olive, Bawn Boy, Platinum and Dublin Gulches. The groundwater monitoring program will continue to be used emphasizing the spatial zones where facilities are being constructed to monitor Project effects on the groundwater flow system. The zones requiring groundwater monitoring include:

- the Heap Leach Facility (HLF) area
- the Eagle Pup Waste Rock Storage Area (EP WRSA)
- the Platinum Gulch Waste Rock Storage Area (PG WRSA)
- the Event Pond
- the low pH treatment solids storage cells area
- the Truck Shop/Warehouse area, and
- the Lower Dublin South Pond.

4.2 BASELINE CHARACTERIZATION WORK

Historically, baseline hydrogeology data and information has been collected in the Project area for two periods: from 1995 to 1996 and 2009 to 2017. The more recent baseline hydrogeology data collection began in May 2009 with the installation of new monitoring wells in addition to identifying and then using historical wells that were established during the 1995-1996 period. The objective of the baseline programs was to characterize subsurface conditions, groundwater occurrence (including seasonal variability) and hydraulic properties. Hydrogeologic baseline data from previous site investigation programs are documented in Stantec (2010c, 2011c, 2012a and 2012e), BGC (2012a, 2012b, 2013, 2014 and 2019) and CoreGeoscience-Watterson (2016).

4.3 METHODS

4.3.1 Overview

The operations and closure/post closure monitoring programs will use single, nested (or coupled) monitoring well pairs to measure groundwater levels in the saturated materials at the site. Vibrating wire piezometers (VWPs) will also be used where only groundwater level information is required (Figure 4.3-1). The monitoring wells will also be used to collect groundwater quality samples (as per Section 5) for comparison against baseline conditions and adaptive management criteria.

Groundwater level measurements will be used to indirectly monitor changes in groundwater occurrence and quantity from baseline conditions. Groundwater levels (from wells) and pressure measurements (from VWPs) can be used, as necessary, to help estimate horizontal and vertical hydraulic gradients and potential changes in groundwater flow direction due to the construction or development of Project facilities.

The monitoring program for the Project is presented in two phases as follows:

- Operations Phase
- Closure and Post Closure Phases

4.3.2 Operations

Based on the existing baseline database, although there is some variability, groundwater levels generally do not vary substantially from quarter to quarter. Thus, quarterly monitoring during the operations phase is used to determine changes. Groundwater levels typically show systematic changes associated with break-up (e.g., in the Dublin Gulch valley recharging causes levels to increase relatively rapidly), followed by a slower and longer period of decreasing water levels throughout the year. Depending on site location and rock type, this observed pattern will vary somewhat. Thus, continuous monitoring (using transducers that are downloaded on a quarterly basis) will provide sufficient temporal coverage to characterize baseline trends, as well as the potential effects of operations on groundwater levels.

Due to construction activities, many of the pre-construction baseline monitoring wells were excavated or abandoned. Guidelines outlined in the ASTM 529999 (2012) Standard Guide for the Decommissioning of Groundwater Wells, Vadose Zone Monitoring Devised, Boreholes and other devices for Environmental Activities were followed and will continue to be followed, where applicable, and dictated by field conditions. Thus, new monitoring wells are required in certain areas where either a well was excavated or a well is required to monitor the potential effects from operation of a facility (e.g., down gradient of the HLF). Thus, the remaining monitoring network will be expanded with new well nests (two wells are proposed for each nest), each of which will comprise a shallow well screened in the surficial deposits (where thick enough) or shallow weathered bedrock, and a deeper well screened in bedrock. Monitoring well locations (Figure 4.3-1) will be located down gradient from each facility of interest to minimize the elapsed time prior to identifying trends. As required by QZ14-041-1 a monitoring well will also be located up gradient from the HLF.

Table 4.3-1 provides the new and existing monitoring well nest number, approximate screen depths for both wells in each nest, and the Project facility targeted for monitoring. Figure 4.3-1 depicts the groundwater monitoring network to be monitored during operations.

Table 4.3-1: Groundwater Monitoring Network for Measurement of Groundwater Levels and Groundwater Quality during Operations

Instrument ID	Facility	Periodic Water Level	Datalogger	Groundwater Sample Collected?	Rationale
BH-BGC11-73a/b/c	Open Pit	No	Yes	No	Nested Vibrating Wire Piezometers Upgradient of First Stage of Pit Development
PZXX-OP1a/b	Open Pit	No	Yes	No	Nested Vibrating Wire Piezometers Upgradient of Final Stage of Pit Development; location TBD
PZXX-OP2a/b	Open Pit	No	Yes	No	Nested Vibrating Wire Piezometer Upgradient of Final Stage of Pit Development; location TBD
PW-BGC11-02	Open Pit	Yes	No	No	Single Well Upgradient of First Stage of Pit Development
MWXX-OP1a/b	Suttles Gulch	Open Pit	No	No	Cross-gradient of Open Pit; location to be determined based on data from existing upgradient wells and construction/operation activity
MW19-PGW1a/b	PG WRSA	Yes	Yes	Yes	Couplet Wells Downgradient of PG WRSA and Open Pit
MW10-PG1	PG WRSA and Open Pit	Yes	Yes	Yes	Single well downgradient from PG WRSA and Open Pit
MW96-13a/b	EP WRSA	Yes	Yes	Yes	Evaluate groundwater level in EP WRSA footprint prior to/during loading material
MW96-14a/b	EP WRSA	Yes	No	No	Evaluate groundwater level in EP WRSA footprint prior to/during loading material
MW96-15b	EP WRSA	Yes	No	Yes	Single Well Downgradient of EP WRSA – couplet to MWXX-15aR
MWXX-15aR	EP WRSA	Yes	No	Yes	Single Well Downgradient of EP WRSA – couplet for MW96-15b
MW19-EPW1a/b	EP WRSA	Yes	Yes	Yes	Couplet Wells Downgradient of EP WRSA
MW10-AG3a	HLF	Yes	Yes	Yes	Single Well in Upper Part of Phase 1; will be decommissioned during development of Phase 1b
MW19-HLF1a/b	HLF	Yes	Yes	Yes	Couplet Wells Downgradient of HLF
MWXX-AG6R	HLF	Yes	No	No	Single Well Downgradient of HLF; couplet to MW10-AG6
MW19-DG6Ra/b	HLF	Yes	Yes	Yes	Couplet Wells Downgradient of HLF/Events Pond
MWXX-HLF2a/b	HLF	Yes	Yes	Yes	Couplet Wells Downgradient of HLF
MWXX-HLF3a/b	HLF	Yes	Yes	Yes	Couplet Wells Upgradient of Phase 1 and 2 of HLF
MWXX-HLF4a/b	HLF	Yes	Yes	Yes	Couplet Wells Upgradient and Cross gradient of Phase 2of HLF

Instrument ID	Facility	Periodic Water Level	Datalogger	Groundwater Sample Collected?	Rationale
MW19-EVP1a/b	Events Pond	Yes	No	Yes	Couplet Wells Downgradient of Events Pond
MW19-EVP2a/b	Events Pond	Yes	No	Yes	Couplet Wells Downgradient of Events Pond
MW18-DG2R	Lower Dublin South Pond	Yes	Yes	Yes	Single Well Upgradient of Lower Dublin South Pond
MW18-LDSP1	Lower Dublin South Pond	Yes	Yes	Yes	Single Well Downgradient of the Lower Dublin South Pond
MW19-LDSP2a/b	Lower Dublin South Pond	Yes	Yes	Yes	Couplet Wells Downgradient of the Lower Dublin South Pond
BH-BGC11-72	Lower Dublin Gulch	Yes	Yes	Yes	Single Well Downgradient of operations in Dublin Gulch near Haggart Creek
BH-BGC11-74	Lower Dublin Gulch	Yes	No	Yes	Single Well Downgradient of operations in Dublin Gulch near Haggart Creek
MWXX-LPH1	Low pH treatment solids storage cells	Yes	No	Yes	Downgradient of low pH storage area; location TBD
MWXX-LPH2	Low pH treatment solids storage cells	Yes	No	Yes	Downgradient of low pH storage area; location TBD
MW96-9b	N/A	Yes	Yes	No	Upper Dublin Gulch Basin – input for model calibration

4.3.3 Closure and Post Closure Monitoring

Groundwater monitoring locations during the closure and post closure phases of the Project (Figure 4.3-1) will generally be the same as those proposed for the operations phase, subject to modifications and changes associated with mine activity and/or introduced through adaptive management. For example, if groundwater monitoring indicates the need for additional wells down gradient of facilities to better monitor effects, they will be installed during operations as needed. The closure and post closure monitoring program will be adapted to groundwater flow patterns and conditions observed during active mining and to meet specific monitoring needs / objectives that will be refined as the mine decommissioning and reclamation plan is refined over the same period.

The post closure monitoring program for groundwater levels will continue for a period of five years after each major mine facility has been closed. For the initial two years of this period, groundwater monitoring instruments will be downloaded quarterly and compared to anticipated post closure conditions in each facility area to confirm that the reclamation in each area is performing as expected. Thereafter, groundwater monitoring instruments will be downloaded on a semi-annual basis. Once it is determined that the reclamation objectives for groundwater levels have been established, the monitoring well network will be decommissioned and the monitoring sites reclaimed in accordance with the Reclamation and Closure Plan.

4.4 DATA ANALYSIS AND REPORTING

Groundwater level measurements will indirectly monitor changes in groundwater occurrence and quantity from baseline conditions. Measurements will be used to estimate horizontal and vertical hydraulic gradients which will permit an independent assessment of potential changes in groundwater flow direction and flow rates.

Groundwater levels for each monitored instrument will be compiled, corrected for elevation and barometric pressure fluctuations (as needed depending on instrument type) and plotted versus time and climate data (precipitation and temperature). These hydrographs will be added to and compared with the existing baseline data set to assess potential changes associated with the Project. A data summary report will be prepared annually during operations, and for specific reporting periods as identified in the Reclamation and Closure Plan.

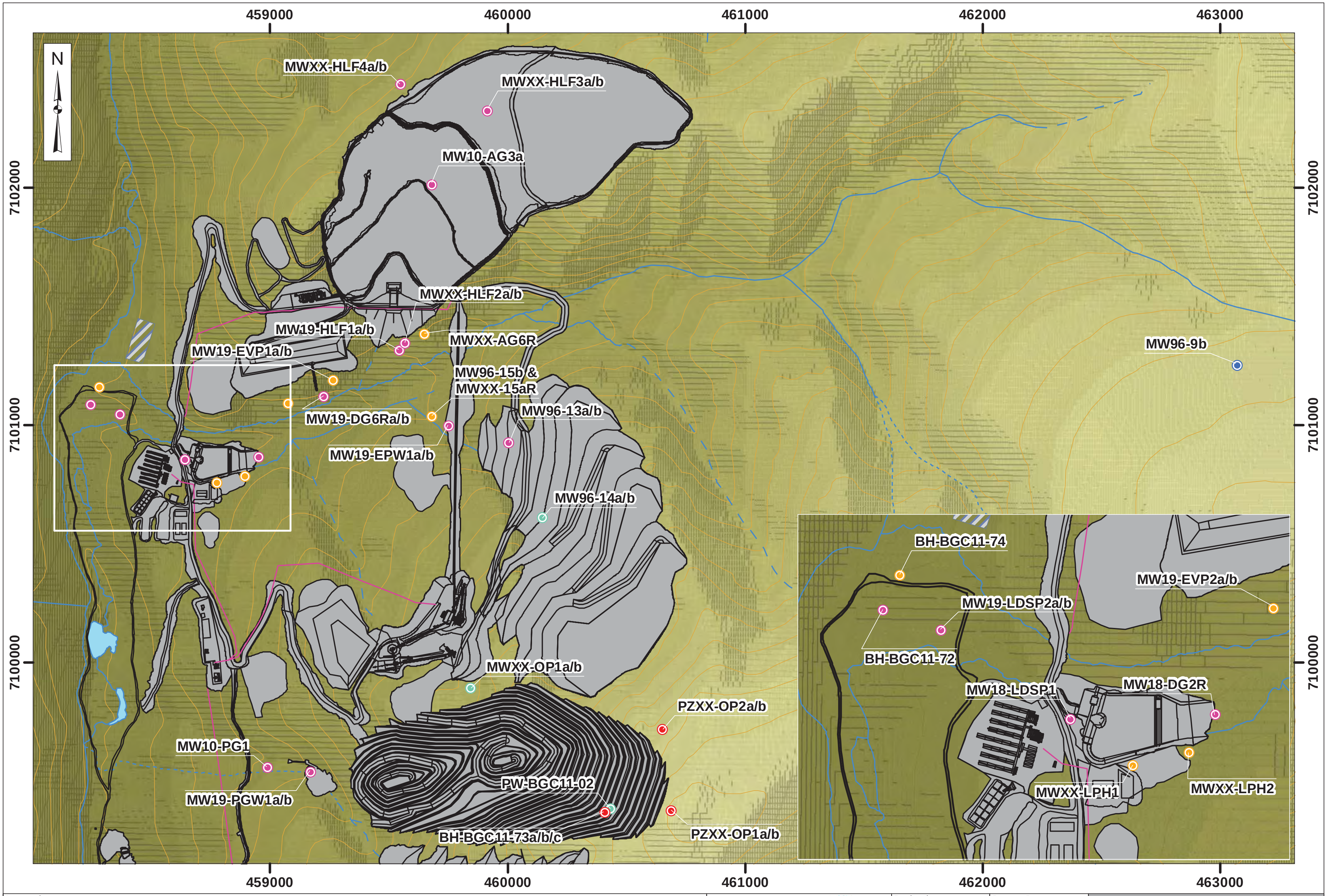
4.5 ADAPTIVE MANAGEMENT

A comprehensive Water Management Plan has been developed for operations and a separate plan has been developed as part of the Reclamation and Closure Plan. These discuss the management of process water supply, potable water supply, sediment and erosion control, treatment of mine water, and required diversions as a result of mine site infrastructure. As a result of the open pit advance, groundwater supply demands, and reduced recharge to the HLF and WRSA footprints, the mine development is simulated to cause a reduction in hydraulic heads (i.e., drawdown) in the project footprint. Based on groundwater modeling it is estimated that the mean monthly stream flow in Haggart Creek, as measured at station W5 may be reduced by less than 1% from May to October to up to 2% to 2.5% from December through April during mine operations. Long term (>100 year) reduction in baseflow and increase in stream leakage are estimated to reduce stream flow at W5 by approximately 0.5% (BGC 2019).

However, there are no local end users that would be affected by potential effects on hydrogeology resources. It is expected that changes to groundwater levels will not impact any other end users or surface water flow downstream of the Project. Rather it is indirect effects on other VCs such as hydrology, fisheries resources, wildlife, and aquatic biota that require monitoring. Consequently, monitoring of the Project's impact on groundwater quantity and potential indirect effects on other resources is described elsewhere in this monitoring plan.

Adaptive management thresholds for groundwater quantity have not been developed. However, groundwater levels will be monitored to compare to predicted (modeled) effects due to the loss of recharge in the HLF and waste rock storage areas.

The surface water hydrology adaptive management plan (Section 2.4, above) includes Haggart Creek flow reduction thresholds and responses to address these potential effects. The evaluation step of Thresholds 2 and 3 for surface water quantity includes the examination of wells BH-BHC11-72 and BH-BGC11-74 in the lower Dublin Gulch valley when assessing possible causes for flow reductions in Haggart Creek at hydrometric station W4. Evaluation will include a review and comparison of updated equipotential maps to discern changes in flow direction and/or gradients; adaptive management thresholds will be established as appropriate and if necessary, based on operating experience obtained over the first year of production.



Legend:

- Monitoring Well - Data Logger
- Monitoring Well - Data Logger & Water Quality
- Monitoring Well - Manual Read
- Monitoring Well - Manual Read & Water Quality
- Vibrating Wire Piezometers
- Facility
- Site Power
- Reserved Area
- Contour (100ft)
- Watercourse (Perennial)
- Watercourse (Ephemeral)
- Watercourse (Intermittent)

Victoria GOLD CORP

0 300 600
Meters

Projection: NAD 83 UTM Zone 8N

Drawn By: HC

Date: 2020/02/03

Figure: 4.3-1

EAGLE GOLD PROJECT YUKON TERRITORY

Operations, Closure & Post Closure Phase Groundwater Monitoring Network

5 GROUNDWATER QUALITY

5.1 INTRODUCTION

The objectives of the groundwater quality monitoring program are to provide a continuous baseline dataset and monitor Project effects on the quality of groundwater. As with the baseline characterization program, the groundwater quality monitoring program is integrated with the groundwater quantity monitoring program, and will utilize the wells described in Section 4.

The primary objective of the groundwater quality monitoring is the detection of process solution leakage from the HLF and Events Pond as well as seepage migration of contact water from WRSAs, the open pit, water management ponds and other infrastructure facilities that may indirectly result in effects on surface water.

5.2 BASELINE CHARACTERIZATION WORK

Previous work used as a basis to develop the groundwater monitoring plan for groundwater levels and quality are summarized in Section 4.

Groundwater quality parameters that will continue to be monitored during this program are summarized in Table 5.2-1.

Table 5.2-1: Groundwater Quality - Monitored Parameters

Parameter Set	Comment
Field parameters	Temperature, pH, specific conductance, turbidity
Laboratory physical parameters	Specific conductance, turbidity, TDS, TSS, pH
Anions	Cl, SO4, NO_3, NO, Total CN, WAD CN[1], Total Alkalinity/hardness, F, Br
Nutrients	Total-PO_4,
Carbon	Dissolved Organic Carbon, Total Organic Carbon
Dissolved Metals	ICPOES/MS + mercury, trace metals (Al, Sb, As, Ba, Be, B, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Hg, Mo, Ni, P, K, Se, Si, Ag, Na, Sr, Tl, V, U, Zn)

1 - Total and WAD CN is analyzed for all wells in the heap and events pond area (i.e., north of Dublin Gulch)

Previous work on groundwater quality monitoring is documented in the reports listed in Section 4.

5.3 METHODS

5.3.1 Field Sampling and Protocols

Groundwater quality sampling will be conducted according to the methods currently in use at the site[2], which are consistent with industry standard practice and ASTM D4448-01 Standard Guide for Sampling Ground-Water Monitoring Wells (Environment Yukon, 2011). The volume of sample collected and the use of field preservatives, as needed, (including the strength and the type of preservative to be used) will be dictated by the analytical

2 Well development and purging three well volumes using disposable inertial lift pumps (e.g. Waterra tubing and foot valve) followed by sample collection with filtering as required by parameter/analysis type.

laboratory responsible for completing the analyses. All samples and blanks will be kept cool after collection and shipped in coolers with ice packs to the laboratory.

5.3.2 Quality Control / Quality Assurance

Groundwater sampling will be conducted on an approximate quarterly basis, subject to access constraints and inclement weather limitations typical in northern mining sites. Groundwater samples will be collected by appropriately trained environmental staff or subcontractors and be submitted to an independent, Canadian Association of Environmental Analytical Laboratories (CAEAL) accredited environmental laboratory with chain-of-custody forms.

The quality assurance/quality control (QA/QC) program involves the analysis of trip blanks, field blanks and duplicates, laboratory replicates, and certified reference materials. All blank samples will be composed of de-ionized water, of known composition, supplied by the analytical laboratory. Duplicates will be obtained by collecting two samples at the same time from a single station for the purpose of monitoring natural variability. Field blanks will be exposed to the same conditions and treatment as the water samples collected, and are intended to monitor any contamination that may occur in the field. Blanks for dissolved parameters will be processed through filters to detect any contamination potentially introduced during the filtration process.

Trip blanks, field blanks and duplicates will be submitted for10% of total samples processed to evaluate the potential for sampling, transport or analytical biases in the results. These sample results will be used together with the laboratories internal quality assurance / quality control program to evaluate the confidence in the groundwater quality results and to identify outliers and false positives in the results.

5.3.3 Data Analysis

Laboratory results will be reviewed against baseline groundwater quality data for each hydrogeologic zone, or facilities area and QA/QC criteria to identify and eliminate false positives/negatives.

Chemical constituent concentrations for each sampled location will be maintained in an on-site database, and concentrations of regulated constituents and key indicator parameters will be plotted versus time to help identify temporal concentration trends. In general, these plots will show applicable standards and baseline concentrations for each regulated chemical constituent. Groundwater quality data will be submitted for regulator review together with groundwater quantity data as per QZ14-041-01 requirements.

5.3.4 Operations

Locations and Frequency

During operations, groundwater sampling will be conducted at the locations as provided in Table 4.3-1 on a quarterly basis. Parameters to be analyzed are listed in Table 5.2-1. Well locations are shown in Figure 4.3-1.

5.3.5 Closure and Post Closure

Groundwater quality sampling locations during the closure and post closure phases of the Project will generally be the same as those proposed for the operations phase, subject to modifications and changes introduced through adaptive management. The closure and post-closure monitoring program will be adapted to groundwater flow patterns and conditions observed during active mining and to meet specific monitoring needs / objectives that will be updated during Decommissioning and Reclamation planning. Monitoring frequency will generally be as proposed for the operations phase of the program and will continue as such until each facility is closed and successfully reclaimed (i.e. the Decommissioning and Reclamation plan has been successfully implemented).

It is assumed that the post closure monitoring program for groundwater quality will continue for a period of 5 years after each major mine facility has been closed. For the initial 2 years of this period, groundwater samples will be collected quarterly and compared to anticipated post closure conditions in each facility area to confirm that the reclamation in each area is performing as expected. Thereafter, groundwater sampling will occur on a semi-annual basis for the final 3 years, and, assuming conditions continue to meet reclamation objectives. Once it is determined that the reclamation objectives for groundwater levels have been established, the monitoring well network will be decommissioned and the monitoring sites reclaimed in accordance with the RCP.

5.4 ADAPTIVE MANAGEMENT

5.4.1 Operations

Management actions will be implemented for groundwater quality should the following events occur:

- Detection of concentration of total and/or WAD cyanide, if any.
- Increased concentrations of specific and important baseline water quality parameters that have been identified in water quality modeling (i.e., aluminum, arsenic, iron, selenium, etc.) that are within 10% of the 95th percentile baseline concentration for two consecutive sampling events. A more definitive list of important parameters and their specific thresholds will be developed based on experience gained in the first year of operations. The 95th percentile baseline values are those established for the particular parameter of interest during the baseline period (2009 - 2014) as summarized in CoreGeo/Watterson (2017). In the case of a new well, thresholds will be based on water quality chemistry as can be characterized from nearby wells in similar rock and groundwater hydrographic zones (sub-basins). In some cases, where a baseline value cannot be estimate, it will be more important to identify any trends in concentrations over time for the selected parameters of interest.
- It is recognized that thresholds may need to be adjusted, or may require different approaches, to better reflect the natural variability for specific parameters in certain wells or sub-basins (i.e., the natural range of arsenic varies considerably in groundwater wells across the project site), and that operating experience obtained over the first year of production will help inform whether thresholds require adjustment.
- In general, increasing or decreasing trends will be examined first visually, and then assuming a linear trend, if applicable to help forecast when certain thresholds could be exceeded. Data could also be evaluated using annual moving averages if the data set has a strong seasonal character, or a Mann-Kendall trend analysis if the data set is not normally distributed. Although less likely, and depending on the length of record and completeness of a particular water chemistry database for each well, it may be possible to assess whether any trend is non-liner. However, at this time, there is no need to be too prescriptive on the type of trend analysis that will be utilized, as it will largely depend on well-specific database and the parameters of interest.

Initial management measures that may be employed in the above-noted events or an increasing or decreasing trend in water chemistry is identified include:

- Cyanide detection (refer to Section 18, the HLF Emergency Response Plan, and/or Spill Response Plan for more detail):

  - HLF inspection for liner leaks
  - process solution systems for leaks
  - event ponds for leaks
  - ADR plant and cyanide storage area for discharge
- Inspect the LDSP liner for leaks (examine the LDSP underdrain water quality results)
- Install additional monitoring wells in specific areas to identify the extent of effect on groundwater chemistry (increase spatial well coverage)
- Increase monitoring frequency from quarterly to monthly to better characterize any trends
- Increased nitrogen and/or metal concentrations:
  - Inspection of contact water conveyance system for leaks
  - Inspection of waste rock storage area toe berms for seepage rates to estimate flow and potential metals loadings from facilities to groundwater

Management actions to assess potential effects (risks) or reduce concentrations of specific parameters might include:

- Capital improvements such as inter lift liner installation in WRSAs to limit infiltration of precipitation through waste rock that would then discharge to ground
- Utilize groundwater flow and transport modeling to assess whether the observed trends will have a downgradient effect on surface water quality
- Capital improvements such as expanding the low permeability liner into the forebay of the Lower Dublin South Pond
- Change to waste rock disposal sequencing to allow for early progressive reclamation on larger portions of waste rock storage areas that would include placement of store and release covers to limit infiltration precipitation and seepage to groundwater
- Install interceptor trenches in key locations and construct pump back systems that would eventually be tied into the proposed passive treatment systems.

6 GEOCHEMICAL MONITORING

6.1 INTRODUCTION AND OBJECTIVES

The geochemical monitoring program is intended to provide on-going characterization of rock excavated for construction purposes and to confirm the potential for acid rock drainage and metal leaching and resulting effects on contact water quality as mining progresses (SRK 2012, SRK 2014, Lorax 2014 and Lorax 2017c).

The geochemical monitoring program for construction rock has been designed to:

- Assess the potential for metal leaching and acidic drainage from excavated rock to determine if it is suitable for construction material;
- Verify geochemical predictions made during the mine planning phase;
- Assess the level of weathering-driven reaction products and their potential to migrate; and
- Evaluate the effectiveness of measures to prevent and control metal leaching and acidic drainage (if applicable).

6.2 BASELINE CHARACTERIZATION WORK

Geochemical characterization completed prior to mining indicates that the majority of the waste rock and ore from this site has a low sulphur content (typically less than 0.5%), and is predominantly non-acid generating. Additionally, the geochemical characteristics of the rock were relatively uniform, implying that a relatively moderate frequency of monitoring would be appropriate. Results of these evaluations have been provided in SRK (2014). Characterization of potential construction materials has also been completed (SRK 2012) and the report and methods to characterize construction materials were provided in an Appendix of the WUL application.

6.3 METHODS

6.3.1 Construction Rock

A number of potential borrow sources have been identified and utilized to support construction efforts for the Project as identified in BGC (2011). These include primarily placer tailings in the Dublin Gulch and Haggart Creek valleys and silt borrow sites near the existing camp and near the confluence of Platinum Gulch and Haggart Creek. Potential durable rock sources include the open pit pre-strip area, and a large bedrock knob (i.e., from the Ann Gulch central knob) In addition, there will has been some degree of cut and fill to support road construction on the site.

Previous geochemical characterization work to date indicates that it is reasonable to assume that rock sourced from pre-stripping of the open pit will not result in any metal leaching or acid rock drainage (ML/ARD) if used for construction (SRK 2014). Additionally, the placer tailings and other surficial materials proposed for use as borrow material or in cut and fill areas present a low risk for ML/ARD and are suitable for construction (SRK 2012). The only exception to this is the potential excavations within metasedimentary rock that are outside of the open pit limits, in which two out of five samples were identified as potentially acid generating. Geochemical monitoring has been, and will continue to be undertaken to verify these conclusions and to ensure that the characteristics of the construction materials are adequately documented and within licensed criteria for use.

The geochemical monitoring of surficial materials consists of the following:

- Visual inspection of the blasted rock to ensure that anomalously high concentrations of sulphide are not present.
- Grab samples representing each major excavation, with a separate bulk sample collected in each distinct geological formation encountered and/or from every 200,000 m^3 material moved.

The geochemical monitoring of bedrock materials consists of the following:

- Grab samples representing each major excavation, with a separate sample collected in each distinct geological formation encountered and/or from every 100,000 m^3 material moved. An exception is proposed for bedrock excavated from the open pit, which has been subject to extensive characterization demonstrating a low potential for ARD. Material excavated for use in construction will be sampled at a rate of one per every 250,000 m^3 of material moved.
- Samples will be sieved to obtain subsamples representing specific grain size distributions as follows:
  - Bulk sample
  - <2 mm fraction

Other aspects of the sampling and analysis will be the same for surficial materials and bedrock samples:

- The samples will be reduced to 1-2 kg in size using a riffle splitter prior to shipping to an accredited analytical laboratory for testing.
- Depending on the use or disposition of the material, test methods may include the following as recommended in MEND (2009) and summarized in Table 6.3-1:
  - Rinse pH and electrical conductivity (EC) on the <2 mm fraction
  - Modified Acid Base Accounting on the bulk sample and the <2 mm fraction
  - Metal analysis by ICP-MS following aqua regia digestion on the bulk sample and the <2 mm fraction
  - Leach extraction tests will be completed on every 5th sample using a 3:1 water to solid ratio on the <1 cm sample fraction

Table 6.3-1: Construction Rock Monitoring Test Methods and Detection Limits

Test	Parameter	Unit	Method Code [a]	Detection Limit
Modified Acid Base Accounting	Paste pH	Standard Units	Sobek	0.20
	Total Inorganic Carbon	%	SCB02V	0.01
	Equivalent $CaCO_3$	kg $CaCO_3$/t	Calculated	N/A
	Total Sulphur	%S	CSA06V	0.01
	Sulphate Sulphur	%S	CSA07V	0.01
	Sulphide Sulphur	%S	Calculated	N/A
	Acid Potential (AP)	kg $CaCO_3$/t	Calculated	N/A

Test	Parameter	Unit	Method Code [a]	Detection Limit
	Modified Neutralization Potential (NP)	kg $CaCO_3$/t	Modified NP	0.5
	Net NP	kg $CaCO_3$/t	Calculated	N/A
	NP/AP	Ratio	Calculated	N/A
	Fizz Test	Visual	Sobek	N/A
Low-Level Metals by Aqua Regia Digestion with ICP-MS Finish	Ag, Al, As, Au, B, Ba, Bi, Ca, Cd, Co, Cr, Cu, Fe, Ga, Hg, K, La, Mg, Mn, Mo, Na, Ni, P, Pb, S, Sb, Sc, Se, Sr, Te, Th, Ti, Tl, U, V, W, Zn	Ppm	IF-01	Various
Rinse pH and EC	pH	Standard Units		N/A
	EC	µS/cm		N/A
Shake Flask Extraction (3:1 water to solid ratio)	Ag, Al, As, Au, B, Ba, Bi, Ca, Cd, Co, Cr, Cu, Fe, Ga, Hg, K, La, Mg, Mn, Mo, Na, Ni, P, Pb, S, Sb, Sc, Se, Sr, Te, Th, Ti, Tl, U, V, W, Zn	Ppm	IF-01	Various

a - Method codes provided are those from SGS where baseline testing was completed.
N/A - Not Applicable

6.3.2 Additional Waste Rock Characterization

Where possible, the geochemical monitoring program will be tied to operational activities for ore versus waste identification. Therefore, it is useful to understand the analytical programs that are proposed for daily mining operations, summarized as follows:

- Assaying capability will be required once operations commence. Assaying may include a mobile or containerized lab whose equipment would be re-installed in the permanent facilities once constructed, or a program to build a lab utilizing modular or pre-engineered construction that would be extended to provide the additional facilities contemplated.
- The assay lab will use both fire assay and perform atomic absorption assay to support both mining and processing functions. It is estimated that up to 200 blast-hole samples will require gold assays each day using fire assay.
- Crushing equipment to prepare samples for metallurgical testing to be included with all appropriate dust controls.
- Plant ore head samples, process solution samples and carbon samples will require assaying as well as samples from the metallurgical laboratory. The laboratory will include crushers, pulverizers and all associated equipment, including dust collection and environmental safety controls for sample preparation through to fire assaying.
- Analysis will be primarily for gold and silver, however pH, cyanide, total and sulfide sulfur, as well as arsenic will be included.

Given the facilities that will be in place during operations to support ore and metallurgical analytical needs, it is anticipated that there will be capability for sulphur and arsenic on-site for waste rock analyses. The geochemical monitoring program will therefore take advantage of any on-site analyses and be augmented by off-site testing. The program will be staged, with more frequent monitoring and analysis in the early years of mining and likely scaled down as a better understanding and verification of the existing geochemical characterization database is developed.

On-site analysis, when available, will consist of the following:

- Blast-hole chip composites of waste rock and ore from each blast round in the open pit. Each composite sample will represent a maximum of 20% of the total blast holes be blast round.
- Geological logging of blast hole composites.
- Analysis for carbon, sulphur and arsenic.
- Results will be geospatially linked to the sample location from the pit, and if possible, to the area within the waste storage facilities and the HLF pad that it is placed.

Off-site analysis (accredited analytical lab) will consist of the following:

- Grab samples collected quarterly representing blasted waste, reduced to 1-2 kg in size using a riffle splitter prior to shipping to an accredited analytical laboratory for testing of the following methods as recommended in MEND, 2009.
    - Rinse pH and EC
    - Modified Acid Base Accounting (ABA) including a total sulphur, sulphate sulphur, fizz rating, modified Sobek neutralization potential and total inorganic carbon
    - Metal analysis by ICP-MS following aqua regia digestion
- Annual waste sampling from placed waste rock in the storage facilities (Eagle Pup and Platinum Gulch) consisting of collection of grab samples from waste produced in the previous calendar year. The number of samples will vary depending on production. One sample per million tonnes of waste produced be collected. Based on anticipated waste production as summarized in Table 6.3-2 this would result in an average of 9 samples per year (ranging from 2 to 15 depending on annual production).
- Samples will be sieved to collect samples representing specific grain size distributions as follows:
    - Bulk sample
    - <2 mm fraction
    - <1 cm fraction (including the < 2mm fraction)
    - The samples will be reduced to 1-2 kg in size using a riffle splitter prior to shipping to an accredited analytical laboratory for testing.
- Test methods will include the following as recommended in MEND (2009) and summarized in Table 6.3-1:
    - Rinse pH and EC on the <2 mm size fraction
    - Modified Acid Base Accounting including a total sulphur, sulphate sulphur, fizz rating, modified Sobek neutralization potential and total inorganic carbon on all three size fractions
    - Metal analysis by ICP-MS following aqua regia digestion on all four size fractions
    - Leach extraction analyses using a 3:1 water to solid ratio on the <1 cm sample fraction

Table 6.3-2: Anticipated Waste Rock Production and Proposed Annual Sample Size

	Y-1	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10
Annual Waste Production (MT)	2.1	6.9	14.1	12.1	15.3	10.0	7.7	7.8	9.3	11.9	2.1
Proposed Number of Annual Samples	2	7	14	12	15	10	8	8	9	12	2

6.3.3 Waste Rock Contact Water

In addition to monitoring of the solids geochemistry of waste produced, the seepage water quality monitoring program includes monitoring of seeps, if detected, at the toe of both waste facilities, in addition to the expected seepage where surface water flow currently exists in Eagle Pup and Platinum Gulch drainages. It is noted that these are not points of proposed compliance or discharge, but are monitored for internal trend monitoring. Proposed seep monitoring is provided in the surface water quality monitoring program in Section 3.

Monthly survey of waste facilities during ice-free months will also be conducted to observe for the development of new seeps. If any are identified, samples will be collected and submitted for routine analysis and seep locations detailed geospatially. If seep locations persist, they will be added to the routine seep monitoring program.

Additional characterization of waste rock contact water is currently being evaluated in the form of a field barrel monitoring program as follows:

- Field barrel monitoring is currently being conducted at least four times per year (during ice-free periods), and will continue through initial operations to expand the time trends until actual seepage database is adequate and can be related to the barrel data.
- Analysis currently includes hardness, pH, anions and nutrients (acidity, alkalinity, chloride, fluoride, nitrate, nitrite and sulfate) and dissolved metals.
- Replicate analyses are completed on one sample for each sampling campaign.

6.4 REPORTING

Results from the geochemical monitoring will be input to an environmental database. Review and reporting of the geochemical monitoring program will be submitted as required by QZ14-041-1 and QML-0011.

6.5 MANAGEMENT

6.5.1 Construction Rock

The objective for geochemical monitoring during construction is to identify rock or soils that possess relatively higher proportions of sulfide, and therefore could require placement and handling practices to prevent ARD and the associated release of metals into surface waters. ABA test work will be conducted on grab samples of excavated materials that will be sourced for construction at the rates described in Section 6.3.1. Testing will confirm that rock used as construction material will have an NP/AP ratio >3, a paste pH >5 and a total sulphur content <0.3%. Materials encountered that are not within this specification will be disposed of in the WRSAs for mixing/blending with low sulphide/neutralizing materials such that geochemical “hot spots” do not develop within the WRSAs.

Water quality monitoring data from receiving stream stations will be used to identify non-point sources of metal leaching from construction rock. In the event metal leaching is detected via increased metals concentrations in surface waters the following adaptive management measures may be employed:

- Source control options:
  - excavation of previously placed construction material if feasible
  - installation of limestone benches within fill areas or blending of non-PAG materials if acid generating rock is detected and if mitigation is feasible when compared to other methods
  - reducing precipitation infiltration via covers or other means of encapsulation as feasible
- Seepage collection and treatment via additional water management infrastructure (e.g. new contact water capture and conveyance infrastructure)

6.5.2 Operations and Post Closure

Characterization indicated that carbonates, predominantly calcite, were generally well in excess of sulphides. Calcite content was generally 1 to 4% (from X-ray diffraction) whereas sulphur was most often less than 0.5% (from Leco S and ICP-S). Static testing showed a predominance of non-acid generating material with the large majority of samples tested having a neutralization potential to acid potential ratio above 4. Acid rock drainage, or ARD, is therefore not anticipated for the Eagle Gold Project.

Kinetic testing based on humidity cell testing and a field barrel program indicate that, although pH conditions are expected to be neutral, some metal leaching may still occur. This may include leaching of sulphate, arsenic, cadmium, manganese, antimony, selenium and uranium, and potentially also fluoride, iron, lead, molybdenum, and zinc.

Seepage from WRSAs is expected to report to planned water management infrastructure and to ground. Seepage that reports to the rock drains at the toe of Eagle Pup and Platinum Gulch WRSAs will be collected and treated as contact water via active treatment at the mine water treatment plant. Post closure this seepage will be collected and treated semi-passively via the passive treatment systems as described by the Reclamation and Closure Plan. In the event seepage is not captured by the rock drains and reports to unplanned surface drainages that report to area watercourses it will be detected via surface water quality monitoring. In this case, the adaptive measures described for surface water quality will be employed as described previously. Management measures for seepage that is not collected will include inspection of the rock drains and water management infrastructure to determine if changes are required to capture all seepage from the facility.

AQUATIC ENVIRONMENT

This section describes the monitoring of stream sediments, benthic macroinvertebrates and fisheries. The following sections describe the objectives and methods for the monitoring of the aquatic environment.

On April 20, 2019, the Project became subject to the MDMER. In accordance with the MDMER, an EEM program is currently being developed for submission and execution as required under the MDMER. The monitoring scope, methods and frequencies being utilized in the current iteration of this Plan is considered interim until the finalization of the study design pursuant to the MDMER.

7 STREAM SEDIMENT

7.1 INTRODUCTION

The stream sediment monitoring program has been designed to provide data on pH and metal levels in the fine fraction of the stream sediments in watercourses of the study area. These parameters are relevant to toxicity and physical habitat requirements for benthos, fish eggs and juvenile fish. The objectives of the sediment monitoring program are to:

- Obtain data on sediment quality that can be used to evaluate changes related to all phases of the Project
- Provide ongoing data to support the refinement of future monitoring programs.

Sediment quality monitoring will focus on the following key Project watersheds (as shown in Figure 7.1-1), namely:

- Haggart Creek from below the confluence of Fisher Gulch to immediately downstream of the confluence of Lynx Creek;
- Dublin Gulch;
- Lower Eagle Creek; and
- Lynx Creek

7.2 BASELINE CHARACTERIZATION WORK

Sites sampled for sediment were selected based on geological and hydrological characteristics relative to proposed Project activities. Several sites were sampled between 1976 and 2010 in Haggart Creek, Dublin Gulch, Eagle Creek, and Lynx Creek drainage basins (Hallam Knight Piésold 1996; JWA 2008). Generally, sediment samples were co-located at water quality monitoring sites. The number of sites sampled in a given year varied, as did the number of replicates. The Geological Survey of Canada collected samples from 11 of the 26 sites in the watershed in 1976 and 1977 and re-analyzed them for a broad range of metals in 1989 and 1990 under the Canada Yukon Economic Development Program.

Mean metal concentrations are summarized by site in Table 7.2-1 for the 2007 – 2010 data. High levels of arsenic were reported at all sites sampled (higher than the CCME Probable Effects Level). Concentrations of arsenic in sediment were highest in Dublin Gulch (particularly near the confluence with Haggart Creek). Lynx Creek basin also had elevated arsenic concentrations despite being in an undisturbed basin, indicating that arsenic levels in the Project area are naturally elevated. Arsenic concentrations in sediments were lowest in Haggart Creek upstream of the confluence with Dublin Gulch and higher downstream of the Dublin-Haggart confluence than at other sites in that stream. Nickel concentrations were higher than the BC Interim Sediment Quality Guidelines (ISQG) at all sites sampled (there is no CCME guideline). Cadmium, chromium, copper, lead, mercury, and zinc were higher than their sediment quality guidelines at some sites.

There were no significant differences in cadmium, lead, nickel, and zinc concentrations among drainages. Concentrations of antimony, beryllium, molybdenum, thallium, and tin were at or close to the detection limit in all samples analyzed. Barium, cobalt, molybdenum, and vanadium were present at detectable levels; there is no Canadian Sediment Quality Guidelines available for these metals. Cadmium, lead, and selenium were at or close to the detection limit in all samples analyzed and were below the ISQG.

Table 7.2-1: Stream Sediment Metal Concentrations (mean values, N=3 to 11) (mg/kg), 2007 – 2010

Parameter	Guideline [1]		Haggart Basin					Dublin Basin				Eagle Cr	Lynx Basin	
	ISQG	PEL	W22	W4	W29	W5	W23	W20	W1	W26	W21	W27	W13	W6
No. samples			**6**	**8**	**8**	**6**	**3**	**3**	**11**	**6**	**6**	**11**	**3**	**3**
Antimony			< 10	< 10	10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Arsenic	5.9	17	**84.6**	**127**	**113**	**106**	**96.4**	**566**	**315**	**215**	**200**	**130**	**139**	**65.9**
Barium			158	154	62.8	139	219	219	165	115	129	163	228	194
Beryllium			< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	1.23	0.68	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Cadmium	0.6	3.5	< 0.50	< 0.50	< 0.50	<0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Chromium	37.3	90	14.5	17.1	14.3	19.7	23.0	21.7	30.8	16.8	18.4	14.3	23.2	20.2
Cobalt			13.6	14.9	12.5	11.6	12.7	8.4	12.2	6.9	8.6	9.5	10.9	10.1
Copper	35.7	197	21.7	23.7	23.8	26.1	29.0	12.3	20.0	12.9	21.3	27.4	23.8	22.8
Lead	35	91	< 30	< 30	33	< 30	< 30	< 30	< 30	< 30	32	< 30	< 30	< 30
Mercury	0.17	0.486	0.0721	0.0486	0.0284	0.0507	0.0574	0.0681	0.0366	0.0341	0.0311	0.0337	0.0547	0.0388
Molybdenum			< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	6.4	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0	< 4.0
Nickel[2]	16	75	**26.2**	**29.2**	**25.6**	**26.2**	**28.8**	**21.9**	**39.3**	**16.4**	**21.0**	**22.1**	**25.4**	**23.6**
Selenium	5	–	< 2.0	< 2.0	< 2.0	< 2	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Silver	0.5	–	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Thallium			< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tin			< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0.	< 5.0
Vanadium			22.8	24.8	13.6	23.9	36.0	36.3	33.8	26.0	26.2	22.8	37.9	33.4
Zinc	123	315	88.0	94.5	102	90.9	112	84.6	87.9	55.4	66.7	66.1	116	103

NOTE:

Bold numbers exceed ISQG, Shaded and bold numbers exceed PEL

1 - Derived from CCME (2002), except for nickel, selenium and silver (based on BC SQG as per Nagpal et al. 2006) because there are no CCME SQG for these parameters

2 - For nickel, BC SQG are for Lowest Effect Level and Severe Effect Level – BCSQG

7.3 METHODS

7.3.1 Field Collection

The stream sediment quality monitoring program described herein will continue to use the sampling methods and analyses established during baseline characterization programs. Specifically, sampling methods will be compatible with those described in the British Columbia Field Sampling Manual (2013) and includes input provided by Environment Canada – Yukon Branch on methods used in the Yukon. Stream sediment samples will be collected downstream of riffle habitat in depositional environments (e.g. pools) to obtain fine-grained sediment samples as practicable.

Triplicate samples will be collected from each site, with the first composite sample located at a downstream position and the others located consecutively upstream to avoid potential downstream sample contamination from disturbed substrate. Each sample will be a composite of five (5) samples collected from micro sites at each sample site. Fine sediment will be collected using methods that consider site conditions and water depth (e.g. 2" Lexan core tube, stainless steel trowel, glass jars, and gloved hands). Samples will be placed into acid-washed glass sediment sample bottles and kept cool prior to delivery to the analytical laboratory.

7.3.2 Laboratory

Sediment samples will be sieved in the laboratory for analysis of total metals of the fine fraction (< 63 µm). For elemental abundance, sediments samples will be fire dried and then digested in a nitric aqua regia cocktail (HCl and HNO_3) at 90ºC for 3-hours according to the BC Strong Acid-Leachable Metals (SALM) protocol to provide a measure of sediment components. Metals in the digest will then be measured using inductively coupled plasma mass spectrophotometry (ICP-MS) or optical emission spectrophotometry (ICP-OES), as appropriate. Mercury will be analyzed by cold vapour atomic fluorescence spectrophotometry (CVAFS).

Parameter List and Detection Limits

The suite of sediment parameters to be monitored for the Project has been established as part of the existing baseline monitoring program. The program includes the parameters listed with their detection limits in Table 7.3-1. Those specifically required by QZ14-041 are noted with an asterisk. The sampling, handling, preservation, parameter list and analytical detection limits are applicable to all monitoring phases.

Table 7.3-1: Stream Sediment Quality Parameters and Detection Limits (mg/kg)

Parameter	Detection Limits	Parameter	Detection Limits
pH	0.1	Magnesium, total	10
Total Organic Carbon*	N/A	Manganese, total*	0.2
Particle Size Distribution*	N/A	Mercury, total*	0.005
Aluminum, total	50	Molybdenum, total*	0.1
Antimony, total*	0.1	Nickel, total*	0.5
Arsenic, total*	0.05	Phosphorus, total	50
Barium, total	0.5	Potassium, total	100
Beryllium, total	0.1	Selenium, total*	0.1

Parameter	Detection Limits	Parameter	Detection Limits
Bismuth, total	0.10	Silver, total*	0.05
Boron, total	10	Sodium, total	50
Cadmium, total*	0.02	Strontium, total*	0.1
Calcium, total*	50	Sulphur, total*	100
Chromium, total*	0.5	Thallium, total	0.05
Cobalt, total*	0.1	Tin, total	0.2
Copper, total*	0.5	Titanium, total	1.0
Iron, total*	50	Uranium, total*	0.05
Lead, total*	0.1	Vanadium, total*	0.2
Lithium, total	2.0	Zinc, total*	1.0

* - Required by QZ14-041-1

Quality Assurance/Quality Control

QA/QC protocols comprise standard procedures in the field to avoid sample contamination, review of laboratory QA/QC (certified reference materials [CRM] and laboratory duplicates), and evaluation of the precision of field replicates. Quality assurance in the field will include cleaning the equipment (plastic collection pan, spatulas) with de-ionized water between sites, rinsing thoroughly with ambient water between replicates, and wearing nitrile gloves (clean gloves at each site) while sampling and preparing samples. Acid-washed glass sampling jars will be used for sediment sample collection. Upon collection, filled sample jars will be immediately placed in a clean cooler containing ice packs.

Laboratory QA/QC will include the use of certified reference materials including CRM standard MESS-2, marine sediment CRM for trace elements from National Research Council of Canada, and laboratory replicates. Field replicate samples will also be collected at each station as described above to provide information about the heterogeneity of the sediment within a site.

7.4 OPERATIONS PHASE

7.4.1 Locations and Frequency

The sediment quality monitoring program for the operations phase monitors sediment quality on a biennial basis. Figure 7.1-1 illustrates the operations phase sediment quality monitoring locations. The stream sediment quality monitoring program includes monitoring sites within key drainage basins. Table 7.4-1 provides a summary of each monitoring station, location, coordinates, rationale and monitoring frequency for the operations period.

Table 7.4-1: Operations Phase Stream Sediment Quality Monitoring Locations and Frequency

Site	Location Description	Coordinates		Rationale	Frequency Of Sampling
		Northing	Easting		
Haggart Creek Drainage Basin					
W22	Haggart above Dublin Gulch	7101377	458319	Above Project influence	Biennial
W4	Haggart below Dublin Gulch	7101223	458144	Below Project influence	Biennial

Site	Location Description	Coordinates		Rationale	Frequency Of Sampling
		Northing	Easting		
W29	Haggart below Eagle Creek	7099583	458225	Below Project influence	Biennial
W5	Haggart above Lynx Creek	7095887	457815	Below Project influence	Biennial
W23	Haggart below Lynx Creek	7095682	457790	Below Project influence	Biennial
Dublin Gulch Drainage Basin					
W1	Dublin Gulch above Stewart Gulch	7101545	460249	Above Project influence	Biennial
W26	Stewart Gulch	7101443	460331	Above Project influence	Biennial
Eagle Creek Drainage Basin					
W27	Eagle Creek	7100997	458235	Below Project influence	Biennial
Lynx Creek Drainage Basin					
W6	Lynx Creek above Haggart Creek	7095964	458099	Reference, No Project influence	Biennial

7.4.2 Data Analysis and Reporting

Sediment quality data collected during the operations phase of the Project is compared to two key benchmarks:

- pre-construction baseline sediment quality; and
- BC Interim Sediment Quality Guidelines (ISQG) (Nagpal et al. 2006).

Data is managed in a sediment quality database and updated on an annual basis following receipt of the final analytical reports from the laboratory. Data is tabulated and compared to existing baseline sediment quality for each station and ISQGs.

Sediment quality monitoring QA/QC results for field replicates, laboratory replicates, and certified reference materials are reported annually with the results of the program.

Annual sediment quality monitoring reports were prepared covering monitoring results and analysis for each year of the construction phase; reports were included in the annual report.

7.5 EARLY CLOSURE PHASE

During the early closure phase, the sediment quality monitoring program remains unchanged from that performed previously throughout operations.

7.5.1 Locations and Frequency

The sediment quality-monitoring program for the early closure phase will continue to monitor sediment quality as per the operations period on a biennial basis. Early closure phase sediment quality monitoring locations remain the same as described for operations (Figure 7.1-1 and Table 7.4-1).

7.5.2 Data Analysis and Reporting

Data analysis and reporting will follow the same protocols as outlined previously for the operations phase.

7.6 LATE CLOSURE PHASE

For the late closure phase of the Project, all reclamation and decommissioning activities are assumed to be complete; the MWTP is no longer in operation and the HLF, the Platinum Gulch, and the Lower Dublin South Pond passive treatment systems are in operation. Sediment quality monitoring of the receiving environment in Haggart Creek and Dublin Gulch will continue as per the previous mine phases. Monitoring during the late closure phase will focus on the passive treatment systems and their performance through biennial sampling of sediments within the passive treatment cells.

7.6.1 Locations and Frequency

Table 7.6-1 provides a summary of each monitoring station, location, coordinates, rationale and monitoring frequency for the late closure phase of the Project; sampling locations are also depicted on Figure 7.6-1. Key late closure phase sediment quality monitoring stations include:

- HLF PTS (sediment quality within the HLF passive treatment system); and
- LDSP PTS (sediment quality within the Lower Dublin South Pond passive treatment system).
- PG PTS (sediment quality within the Platinum Gulch passive treatment system).

Monitoring frequency for the closure phase sediment quality program will be biennial for a period of 5 years (i.e., years 1, 3 and 5) after inception of the passive treatment systems.

7.6.2 Data Analysis and Reporting

Data analysis and reporting will follow the same protocols as outlined previously for the operations and early closure phase.

Table 7.6-1: Late Closure Phase Stream Sediment Quality Monitoring Locations and Frequency

Site	Location Description	Coordinates		Rationale	Frequency of Sampling
		Northing	Easting		
Haggart Creek Drainage Basin					
W22	Haggart above Dublin Gulch	7101377	458319	Above Project influence	Biennial
HLF PTS	HLF passive treatment system	7101260	458865	PTS performance	Biennial
W4	Haggart below Dublin Gulch	7101223	458144	Below Project influence	Biennial
W29	Haggart below Eagle Creek	7099583	458225	Below Project influence	Biennial
W5	Haggart above Lynx Creek	7095887	457815	Below Project influence	Biennial
W23	Haggart below Lynx Creek	7095682	457790	Below Project influence	Biennial
Dublin Gulch Drainage Basin					
W1	Dublin Gulch above Stewart Gulch	7101545	460249	Above Project influence	Biennial
W26	Stewart Gulch	7101443	460331	Above Project influence	Biennial
Eagle Creek Drainage Basin					
W27	Eagle Creek	7100997	458235	Below Project influence	Biennial
LDSP PTS	LDSP passive treatment system	7100857	458672	PTS performance	Biennial
PG PTS	PG passive treatment system	7099523	459184	PTS performance	Biennial

Site	Location Description	Coordinates		Rationale	Frequency of Sampling
		Northing	Easting		
Lynx Creek Drainage Basin					
W6	Lynx Creek above Haggart Creek	7095964	458099	Reference, Below Project influence	Biennial

7.7 MANAGEMENT

Sediment quality guidelines provide scientific benchmarks, or reference points, for evaluating the potential for observing adverse biological effects in aquatic systems. The guidelines are derived from the available toxicological information according to the formal protocol established by the Canadian Council of Ministers of the Environment (CCME). Concurrently collected chemical and biological data (“co-occurrence data”) are evaluated from numerous individual studies to establish an association between the concentration of each chemical measured in the sediment and any adverse biological effect observed.

The CCME has established a Biological Effects Database for Sediments to calculate two assessment values. The lower value, referred to as the threshold effect level (TEL), represents the concentration below which adverse biological effects are expected to occur rarely. The upper value, referred to as the probable effect level (PEL), defines the level above which adverse effects are expected to occur frequently. By calculating TELs and PELs according to a standard formula, three ranges of chemical concentrations are consistently defined: (1) the minimal effect range within which adverse effects rarely occur (i.e., fewer than 25% adverse effects occur below the TEL), (2) the possible effect range within which adverse effects occasionally occur (i.e., the range between the TEL and PEL), and (3) the probable effect range within which adverse biological effects frequently occur (i.e., more than 50% adverse effects occur above the PEL). Due to high concentrations of naturally occurring arsenic in Project area sediment, which greatly exceeds the PEL at most sites, the dominant species of arsenic will be determined in future studies. If the dominant arsenic speciation is determined to be a biologically unavailable form, the threshold and PEL levels will be adjusted to better reflect potential effects.

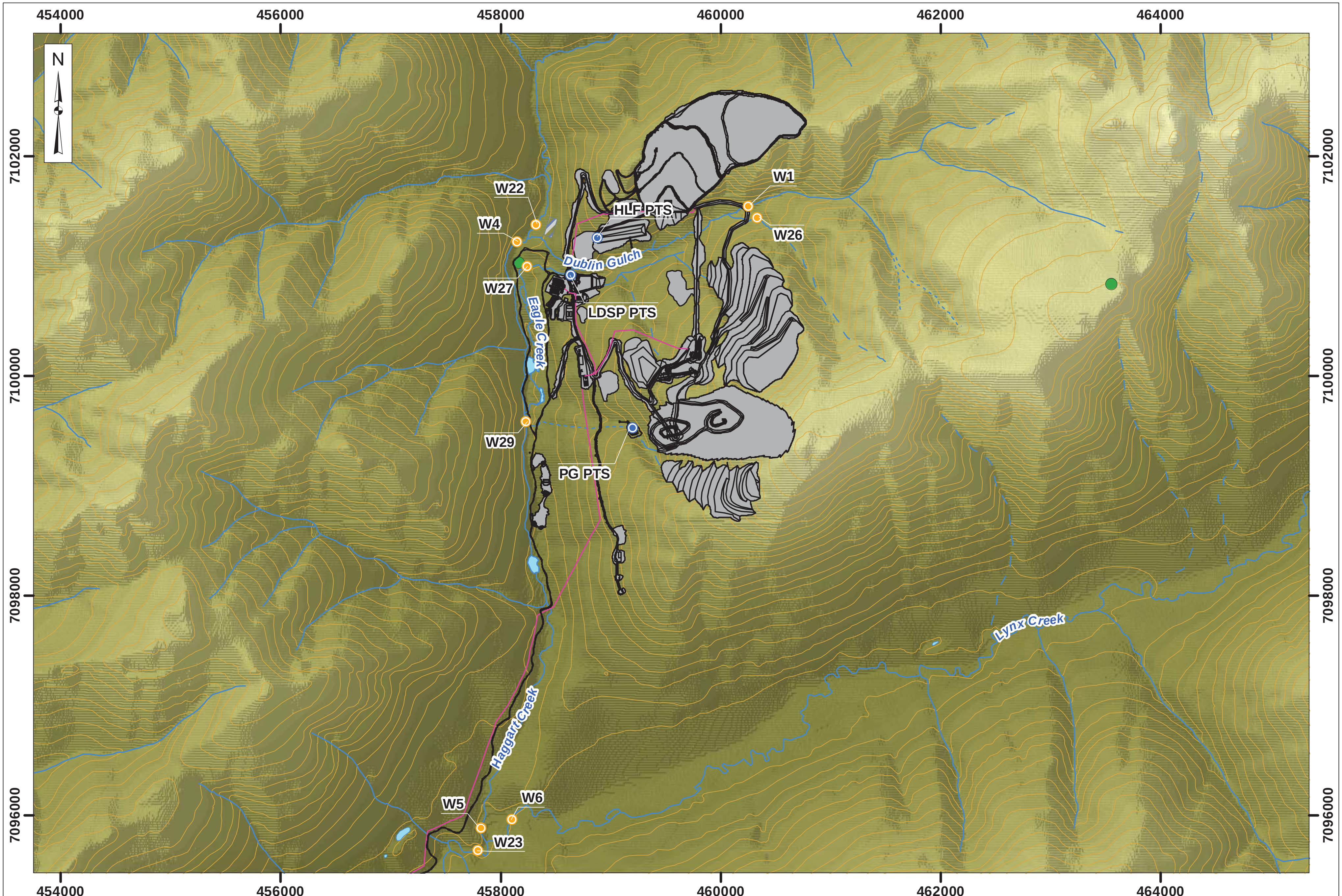
Baseline data for the Project includes metals concentrations that exceed PELs as provided by CCME. Adaptive management thresholds for sediment monitoring are initially set at 25% higher than mean baseline values for those parameters that currently exceed the PEL as a baseline condition. For those parameters that do not exceed PEL at baseline, the PEL will constitute the threshold for adaptive management.

In the event parameter concentrations exceed the PEL or for those select parameters exceed the PEL at baseline by 25%, the following adaptive management measures will be considered.

Measures that will be employed in the event these thresholds are reached include:

- Investigate for possible previously unidentified upstream sources, and if found develop appropriate mitigation to minimize source
- MWTP inspection during operations to determine if system is functioning as intended
- PTS inspection during early and post closure to determine if system is functioning as intended
- Repair MWTP components and/or adjust reagent dosages as necessary
- Perform maintenance on and/or modify passive treatment systems

- Verify on site analysis results with accredited laboratory results
- Re-sample and analyze after verification water treatment system functioning properly
- Consider need for temporary re-routing of contact water to suspend effluent discharge until licensed effluent concentrations are achieved prior to discharge. Examples of operational/ routing changes include:
  - Recirculation of excess process water within the HLF until repairs and adjustments are made to MWTP to achieve licensed effluent concentrations
  - Rerouting contact water from Open Pit and WRSAs from MWTP to events ponds and/or HLF for storage and recirculation temporarily
  - Suspend Open Pit dewatering operations
- Consider capital improvements to augment or replace existing treatment systems



Legend:

- All Phases Stream Sediment Monitoring Location
- Late Closure Phase Stream Sediment Monitoring Location
- Climate Station
- Facility
- Site Power
- Reserved Area
- Contour (100ft)
- Watercourse (Perennial)
- Watercourse (Ephemeral)
- Watercourse (Intermittent)

Victoria GOLD CORP

0 0.75 1.5
Kilometers

Projection:	Drawn By:	EAGLE GOLD PROJECT YUKON TERRITORY
NAD 83 UTM Zone 8N	HC	
Date: 2020/02/05	Figure: 7.1-1	Stream Sediment Monitoring Stations

8 BENTHIC MACROINVERTEBRATES

8.1 INTRODUCTION

The objectives of the benthic invertebrate monitoring program are to:

- Characterize community diversity and abundance during the transition from baseline through operation of the Project
- Determine variation relative to baseline data
- Provide supporting information for fisheries assessments and to comply with future MDMER requirements.

Environment Canada recommends that benthic invertebrates be used as the primary indicator organisms for use in monitoring effects on fish habitat (Environment Canada 2002).

8.2 BASELINE CHARACTERIZATION WORK

Previous benthic invertebrate monitoring occurred during the late summer low flow period in 1995 to 2010 in Haggart Creek, Dublin Gulch, Eagle Creek, and Lynx Creek drainage basins (Stantec (2011).

Baseline data indicate the presence of viable and diverse benthic invertebrate communities in all the watercourses monitored, including those with elevated arsenic levels. Differences in taxonomic richness and abundance, diversity, and evenness among sites and years were noted, and were related to the range of habitat characteristics, water quality and fish presence (predators) in the watercourses studied.

Variability within sites and among years in terms of abundance was observed, less so for other community characteristics. The number of organisms/m^2 tended to be higher at creek sites in Dublin Gulch and Eagle Creek drainage basins than in Haggart or Lynx Creek drainage basins. Taxon richness and diversity tended to be higher in Haggart and Lynx Creeks than the smaller tributaries, commonly noted when comparing larger and smaller streams. Pollution sensitive aquatic insects (Ephemeroptera, Plecoptera and Trichoptera [EPT], or mayflies, stoneflies and caddisflies) were abundant and diverse at all sites except Eagle Creek (W27) in 2010; abundance and diversity of these organisms are considered an indicator of good water quality and of food supply for fish. Numbers of EPT taxa were highest at sites in Haggart Creek and Dublin Gulch.

The predominant taxa were Ephemeroptera in all drainages except Eagle Creek and Plecoptera in all drainages, as well as pollution tolerant organisms (Chironomidae or midges and Oligochaeta or aquatic worms in all drainages). The changes noted for Eagle Creek (W27) between 2009 and 2010 (shift to lower richness, diversity, number of EPT taxa, Plecoptera abundance and increased chironomid abundance) reflect the changes in water chemistry (higher TSS and metals levels) and habitat quality over that period.

8.3 METHODS

8.3.1 Field Collection

Survey methods will be consistent with those recommended in the Metal Mining Guidance Document for Aquatics Effects Monitoring, Environment Canada, 2012 (EEM Guidance Document). Riffle zones will be sampled using a conventional stream bottom sampler (e.g., Surber, to allow comparisons to previous studies - 0.1 m^2 area, 300 µm mesh size). Sampling will occur along a longitudinal stretch of the stream that includes one pool/riffle sequence. Three replicates will be collected in each area with a minimum separation of three times the bank-full width (measured at the top of the bank) between stations where appropriate. If the habitat changes significantly at this distance, samples will be collected closer together. The objective is to characterize the benthic community at each site within the habitat characteristics of that site.

Samples will be collected in later summer/early fall to allow comparison of results to historical data to aid in the interpretation of results. Field notes will contain the following information and follow protocols as stipulated in the most current Metal Mining Environmental Effects Monitoring (EEM) Technical Guidance Document, including at a minimum:

- Coordinates of each of the three replicates
- Date and time of sample collection
- Field crew members, their affiliations and credentials
- Habitat descriptions including supporting environmental variables
- Type of sampler used including area and mesh size
- Sample IDs, # of jars per sample, preservation
- Any observations that will help in the interpretation of results

The water quality and sediment sampling programs will be coordinated with the benthic invertebrate sampling program as much as possible, so that the samples will be collected within the same time period and stream reach location and as dictated by the proposed sampling frequency for each program. Field measurements of water temperature, dissolved oxygen, pH, and conductivity will be conducted. Morphometric measurements of each sampling area will include bankfull width, wetted width, depth, and gradient. Canopy cover will also be estimated at each sampling area.

8.3.2 Data Analysis and Reporting

Benthic invertebrates will be enumerated and identified to the lowest practical level, usually genus. Taxonomic analysis will be carried out by a qualified taxonomic laboratory experienced with identification of invertebrates from northern streams.

Data from the taxonomic laboratory will be in the form of bench sheets and an electronic form (e.g. Excel workbook). Taxonomic references used for identification will be listed in the taxonomy laboratory report. Data for each replicate sample will include the number of organisms identified from each taxonomic category (minimum of Family). The method and level of sub-sampling that will be carried out during sorting and identification will be clearly identified.

Reporting will include the number of individuals counted as well as the conversion to number per sample. The number per sample will be standardized to number per square meter by dividing by the area sampled (e.g. 0.1 m^2 per set x 3 sets per replicate = 0.3 m^2 per replicate). These data will be used to calculate indices of community characteristics, which will be used to determine if there is an effect on benthic communities in receiving environments sampled.

The abundance data will be used to calculate the following endpoints for each area:

- Total invertebrate density for each replicate as well as arithmetic mean, standard deviation, median, minimum and maximum;
- Family density for each replicate as well as arithmetic mean, standard deviation, median, minimum and maximum;
- Family richness;
- Simpson's diversity index, or similar index;
- Simpson's evenness index, or similar index;
- Bray Curtis index, or similar index;
- Taxon (i.e., Family) proportion; and,
- Taxon (i.e., Family) presence/absence.

Calculation of total invertebrate density will include unidentified individuals. Individuals that cannot be identified to Family level will not be included in calculations of Family density or community descriptors. A large number of benthic invertebrate community descriptors exist. In general these include measures of the number of organisms present (i.e. density or abundance), the number of different taxa present (i.e. richness), and whether or not the community composition is dominated by a few taxa (i.e. diversity).

In addition, indicator taxa (taxa that are known to be sensitive or tolerant of stressors in general, or to a specific stressor such as metals) may be used to identify changes to the benthic invertebrate community. The federal MDMER requires reporting of total invertebrate density, taxon richness, Simpson's diversity index, and the Bray Curtis index (a measure of the similarity of the benthic community at a sample site to a reference site).

Total invertebrate density, Family richness, Simpson's evenness index, and Bray-Curtis index will be statistically analyzed using ANOVA (power of 0.1). If the ANOVA determines that a metric has a significant difference among stations, a multiple comparison test (e.g. Tukey test) will be used to determine if the exposure sites are significantly different from reference sites, which will be defined as an effect. The results of these analyses will be interpreted relative to the other endpoints listed above (e.g. diversity and Family density, proportion, and presence/absence) as well as supporting environmental variables measured at the time of sampling, results of fish surveys, and relative to historical sampling. In addition, the effect of outliers or extreme values, if any, on results will be evaluated.

8.4 OPERATIONS

During the operations phase, the benthic invertebrate monitoring program remains unchanged from that performed during baseline and during the construction phase. During operations, the MWTP will be discharging treated effluent upstream of station W4 in Haggart Creek at various times of the year dependent upon Project water demands. Therefore station W4 will be an important monitoring location for the aquatic monitoring program.

8.4.1 Locations and Frequency

The benthic invertebrate monitoring program for the operations phase continues to monitor key drainage basins, with a more focused monitoring program relative to the baseline program. Figure 8.4-1 illustrates the operations phase benthic invertebrate monitoring locations. Table 8.4-1 provides a summary of each monitoring station, location, coordinates, rationale and monitoring frequency for the operations period. The benthic invertebrate monitoring program for the operations phase will continue to monitor benthos as per the baseline period during the late summer/early fall on a biennial basis.

Table 8.4-1: Operations and Early Closure Phase Benthic Invertebrate Monitoring Locations and Frequency

Site	Location Description	Coordinates		Rationale	Frequency Of Sampling
		Northing	Easting		
Haggart Creek Drainage Basin					
W22	Haggart above Dublin Gulch	7101377	458319	Above Project influence	Biennial
W4	Haggart below Dublin Gulch	7101223	458144	Below Project influence	Biennial
W29	Haggart below Eagle Creek	7099583	458225	Below Project influence	Biennial
W5	Haggart above Lynx Creek	7095887	457815	Below Project influence	Biennial
W23	Haggart below Lynx Creek	7095682	457790	Below Project influence	Biennial
Dublin Gulch Drainage Basin					
W1	Dublin Gulch above Stewart Gulch	7101545	460249	Above Project influence	Biennial
W26	Stewart Gulch	7101443	460331	Above Project influence	Biennial
Eagle Creek Drainage Basin					
W27	Eagle Creek	7100997	458235	Below Project influence	Biennial
Lynx Creek Drainage Basin					
W6	Lynx Creek above Haggart Creek	7095964	458099	Reference, No Project influence	Biennial

8.5 EARLY CLOSURE PHASE

The benthic invertebrate monitoring program will remain unchanged from that performed previously throughout operations.

8.5.1 Locations and Frequency

The benthic invertebrate monitoring program for the early closure phase will continue to monitor benthos as per the operations periods on a Biennial basis (Table 8.4-1).

8.6 LATE CLOSURE PHASE

At the start of the late closure phase, all decommissioning and reclamation activities are assumed complete; the MWTP will no longer be in operation and the HLF, Platinum Gulch, and Lower Dublin South Pond passive treatment systems will be in operation. Benthic invertebrate monitoring of the receiving environment in Haggart Creek and Dublin Gulch will continue as per the previous Project phases. Monitoring during the closure phase will also focus on the passive treatment systems and their performance through biennial sampling of benthos immediately down gradient of the passive treatment systems.

8.6.1 Locations and Frequency

Table 8.6-1 provides a summary of each monitoring station, location, coordinates, rationale and monitoring frequency for the late closure phase; sampling locations are also depicted on Figure 8.4-1.

The benthic invertebrate monitoring stations will be monitored on a biennial basis during the late summer/early fall during the closure phase for a period of 5 years (i.e., post closure years 1, 3 and 5).

Table 8.6-1: Late Closure Phase Benthic Invertebrate Monitoring Locations and Frequency

Site	Location Description	Coordinates		Rationale	Frequency of Sampling
		Northing	Easting		
Haggart Creek Drainage Basin					
W22	Haggart above Dublin Gulch	7101377	458319	Above Project influence	Biennial
HLF PTS	HLF passive treatment system	7101260	458865	PTS performance	Biennial
W4	Haggart below Dublin Gulch	7101223	458144	Below Project influence	Biennial
W29	Haggart below Eagle Creek	7099583	458225	Below Project influence	Biennial
W5	Haggart above Lynx Creek	7095887	457815	Below Project influence	Bi-Annual
W23	Haggart below Lynx Creek	7095682	457790	Below Project influence	Biennial
Dublin Gulch Drainage Basin					
W1	Dublin Gulch above Stewart Gulch	7101545	460249	Above Project influence	Biennial
W26	Stewart Gulch	7101443	460331	Above Project influence	Biennial
Eagle Creek Drainage Basin					
W27	Eagle Creek	7100997	458235	Below Project Influence	Biennial
LDSP PTS	LDSP passive treatment system	7100857	458672	PTS performance	Biennial
PG PTS	PG passive treatment system	7099523	459184	PTS performance	Biennial
Lynx Creek Drainage Basin					
W6	Lynx Creek above Haggart Creek	7095964	458099	Reference, No Project influence	Biennial

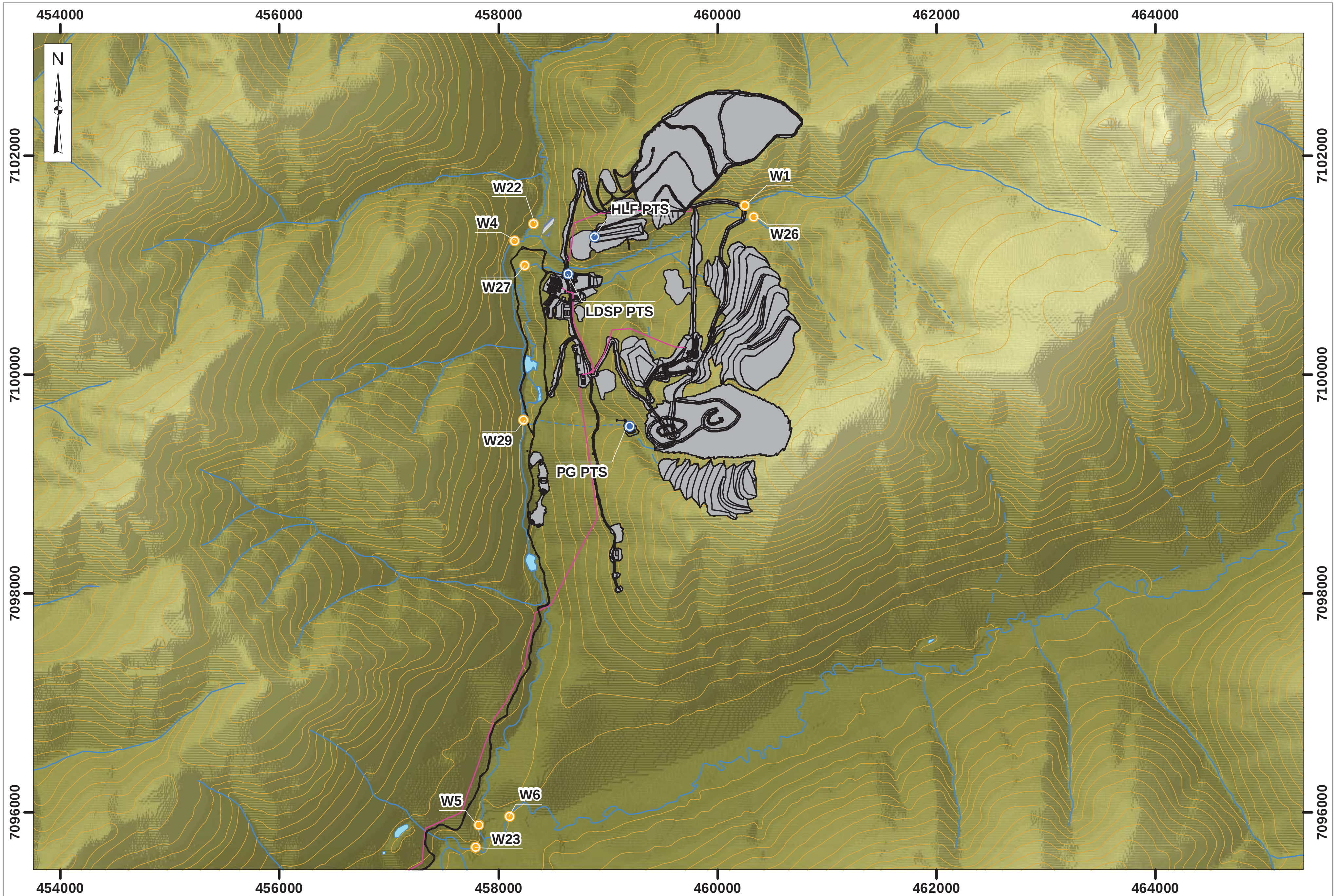
8.7 MANAGEMENT

Trends in benthic macroinvertebrate community composition will be used to determine Project effects. As discussed above, total invertebrate density, Family richness, Simpson's evenness index, and Bray-Curtis index will be statistically analyzed using ANOVA (power of 0.1). If the ANOVA determines that a metric has a significant difference among stations, a multiple comparison test (e.g. Tukey test) will be used to determine if the exposure sites are significantly different from reference sites, if suitable reference sites can be demonstrated. Temporal analyses will also be conducted to examine changes over time in taxonomic diversity and density. These analyses will be utilised to assess whether the Project has a significant influence on downgradient receiving environments.

In the event effects to benthic macroinvertebrates are observed, adaptive management measures that will be considered include:

- Comparison of data with changes to water quality and sediment data to determine if water chemistry is a factor in benthic macroinvertebrate changes

- Analysis of watershed changes to determine if any localized changes independent of the Project by placer mining upstream have resulted in impacts to benthic macroinvertebrate community structure
- Analysis of climate data to evaluate whether a major weather event occurred that could have caused a significant disruption to the benthic community (e.g., an intense rainfall-runoff event resulting in scouring, substrate disruption and dislodging invertebrates, with little time to recolonize)
- If effluent discharge meets regulated standards and receiving environment water quality objectives, re-evaluate water quality objectives to determine if effective to protect specific benthic macroinvertebrates and assemblages as required based on effects
- If receiving environment water quality objectives are not met:
    - Investigate for possible previously unidentified upstream sources, and if found develop appropriate mitigation to minimize source
    - Conduct MWTP inspection during operations to determine if system is functioning as intended
    - Repair MWTP components and/or adjust reagent dosages as necessary
    - PTS inspection during early and post closure to determine if system is functioning as intended
    - Perform maintenance on passive treatment systems
    - Consider temporary re-routing of contact water to suspend effluent discharge until licensed effluent concentrations are achieved prior to discharge. Examples of operational/ routing changes include:
        - Recirculation of excess process water within the HLF until repairs and adjustments are made to MWTP to achieve licensed effluent concentrations
        - Rerouting contact water from Open Pit and WRSAs from MWTP to events pond and/or HLF for storage and recirculation temporarily
        - Suspend Open Pit dewatering operations
    - Consider capital improvements to augment or replace existing treatment systems



Legend:

- All Phases Benthic Invertebrate Monitoring Location
- Late Closure Phase Benthic Invertebrate Monitoring Location
- Reserved Area
- Facility
- Site Power
- Contour (100ft)
- Watercourse (Perennial)
- Watercourse (Ephemeral)
- Watercourse (Intermittent)

Victoria GOLD CORP

0 0.75 1.5
Kilometers

Projection:	Drawn By:	EAGLE GOLD PROJECT YUKON TERRITORY
NAD 83 UTM Zone 8N	HC	
Date: 2020/02/05	Figure: 8.4-1	Benthic Invertebrate Monitoring Stations

9 FISH AND FISH HABITAT

9.1 INTRODUCTION

The Project may result in potential impacts to fish and fish habitat during construction through increased sediment loads and operations through post closure due to minor water quality degradation from water treatment effluent. In accordance with the MDMER, a study respecting fish tissue will be undertaken if the concentration of effluent in the exposure area is greater than 1% in the area located within 250 m of a final discharge point.

9.2 BASELINE CHARACTERIZATION WORK

Baseline fish and fish habitat information was gathered from existing consultant reports, government databases, and the results of field studies conducted for the Project prior to VGC’s claim ownership. Field studies were completed for watercourses located within the local Project area to obtain biophysical habitat data, determine fish presence and abundance, and characterize fish populations (i.e., size, age, and tissue metal concentrations). The fish and fish habitat study area (study area) included:

- All perennial watercourses in the Dublin Gulch watershed and lower Haggart Creek (below Dublin Gulch).
- Reference watercourses that would be uninfluenced by flows from the Dublin Gulch watershed (i.e., Iron Rust Creek, Lynx Creek, and upper Haggart Creek [above Dublin Gulch]).
- All perennial watercourses that cross or approach within 30 m of the site access road which parallels Haggart Creek.

9.2.1 Fish-bearing Watercourses

Field studies within the study area were completed from 2007 to 2011 (Stantec 2010e, Stantec 2011f).

Sampled watercourses were characterized as fish-bearing unless:

- Fish were not captured, despite the application of appropriate capture methods, during at least two different sampling periods, and;
- The watercourse had physical characteristics that could explain fish absence (i.e., gradient >20% or a permanent barrier to upstream fish passage where no perennial fish habitat exists upstream of the barrier).

Fish density per unit area was estimated for fish-bearing sites sampled in Dublin Gulch, Iron Rust Creek, Lynx Creek, and a subset of sites in Haggart Creek, using electrofishing via multiple-pass removal methods.

Of the 26 watercourses sampled in the study area, 14 were identified as fish-bearing or potentially fish-bearing and 12 were identified as non-fish-bearing. The 14 fish-bearing watercourses were:

- Three watercourses located within or immediately downstream of the proposed mine site footprint—Haggart Creek, lower reaches of Dublin Gulch, and the lower reaches of Eagle Creek (including a pond created for historic placer mining operations and its tributary stream).
- Two watercourses sampled as reference watercourses—Lynx Creek and Iron Rust Creek.

- Nine additional watercourses crossed by the site access road including: North Star, Bighorn, Cadillac, and Swede Creeks; the South McQuesten River, one unnamed tributary of Haggart Creek, and two unnamed tributaries of the South McQuesten River.

A summary of the data collected for all identified fish-bearing watercourses is presented in Stantec 2010e.

The 12 watercourses identified as non-fish-bearing were as follows:

- Two watercourses with barriers to upstream fish passage located within the footprint of the proposed mine site – Dublin Gulch (a gradient barrier located 1.5 km upstream of the confluence with Haggart Creek) and Eagle Creek (a perched culvert located 1.9 km upstream of the confluence with Haggart Creek).
- Seven tributaries to the non-fish-bearing upper reaches of Dublin Gulch and Eagle Creek—Suttles Gulch, Ann Gulch, Bawn Boy Gulch, Stewart Gulch, Olive Gulch, Cascallen Gulch, and Eagle Creek.
- Three watercourses with fish passage barriers that were located outside the Dublin Gulch and Eagle Creek watersheds: Platinum Gulch and three un-named watercourses tributary to Haggart Creek and crossed by the access road.

9.2.2 Fish Species Distribution

At least 10 fish species are known to occur in the South McQuesten River watershed, including Chinook salmon (*Oncorhynchus tshawytscha*), Arctic grayling (*Thymallus arcticus*), northern pike (*Esox lucius*), longnose sucker (*Catostomus catostomus*), Arctic lamprey (*Lampetra camtschatica*), burbot (*Lota lota*), slimy sculpin (*Cottus cognatus*), round whitefish (*Prosopium cylindraceum*), inconnu (*Stenodus leucichthys*), and lake whitefish (*Coregonus clupeaformis*).

No freshwater fish species on Schedules 1 or 2 of the Federal *Species at Risk Act* (SARA) were present in the South McQuesten River watershed or the entire Yukon Territory (GoC 2008). Haggart and Lynx creeks are both known to contain five fish species: Chinook salmon, Arctic grayling, round whitefish, burbot, and slimy sculpin (DFO 2010). Iron Rust Creek, Dublin Gulch and Eagle Creek are known to be inhabited by Arctic grayling and slimy sculpin (Hallam Knight Piésold 1996, DFO 2010).

The baseline field program for the Project captured five fish species from ten different watercourses. Arctic grayling were captured in nine watercourses and slimy sculpin were captured in seven. Burbot were captured in the South McQuesten River and lower Haggart Creek. Chinook salmon and longnose sucker were observed in the South McQuesten during a July 2009 snorkel survey.

Previous studies reported the presence of Chinook salmon (*Oncorhynchus tshawytscha*) in Haggart and Lynx creeks (Madrone 2006; Hallam Knight Piésold 1995, 1996; DFO 2010). In the 2007 to 2009, Dublin Gulch sampling programs, Chinook salmon were not captured at any of the Haggart and Lynx creek sites. Previous studies also reported the presence of Chinook salmon in the South McQuesten River, which was confirmed by the sighting of juvenile Chinook (est. age 1+) during a snorkel survey of the South McQuesten River at the access road crossing on July 23, 2009.

No adult Chinook spawners or evidence of spawning were observed in the South McQuesten River during the July 2009 survey.

9.2.3 Fish Relative Abundance

Arctic grayling and slimy sculpin were the only species caught during multiple-pass depletion surveys completed in Iron Rust Creek, Haggart Creek, Lynx Creek, and in Dublin Gulch. Both species were present in low densities in these watercourses. Mean Arctic grayling catch rate for all sites during all three electrofishing sampling programs was 1.6 fish/100 m^2, and mean catch rate for slimy sculpin for all sites was 2.9 fish/100 m^2. Slimy sculpin were caught at higher densities in Haggart Creek (4.3 to 6.0 fish/100 m^2) than in the other three watercourses (0.7 to 1.9 fish/100 m^2). There were no consistent differences in estimated Arctic grayling densities among the waterbodies sampled.

9.2.4 Habitat Usage

The majority of Arctic Grayling in the Project area are thought to overwinter in the South McQuesten River and migrate into Haggart Creek and its tributaries to rear during summer (Pendray 1983). The summer migration into Lynx Creek has been observed to occur during June and early July (Pendray 1983). The timing of outmigration to overwintering areas has not been observed for the Project Area; however, baseline assessment for this Project (Stantec 2010e) demonstrated that densities of Arctic grayling in Dublin Gulch were similar during July, August, and October, even though anchor ice was beginning to form on the stream margins during the October sampling program. This suggests that significant outmigration may not occur from Dublin Gulch until after October.

The documented capture of juvenile Arctic grayling in Haggart Creek during May, at a location 19 km upstream from the South McQuesten River (Pendray 1983), suggests that some Arctic grayling may overwinter in the Haggart Creek watershed. The baseline assessment for this Project did indeed document potential overwintering habitat (i.e., with residual pool depth ≥0.8 m) at sample sites in Lynx and Haggart creeks.

Furthermore, a large number of Arctic grayling were captured from a large pool on Haggart Creek in April 2008 (i.e., after freeze up but before breakup) (Stantec 2010b). It is assumed that this unnaturally large pool (1 ha in area and over 10 m deep) was created by placer mining operations and was not present during fish studies conducted in 1996 (Hallam Knight Piésold 1996). This pool created by placer mining and the South McQuesten River likely represent a short-term overwintering habitat for Arctic grayling in the study area. Field observations following the large magnitude break-up event on Haggart in May 2013 indicate that this pool has diminished in size (perhaps by one third of its area) due to rapid sedimentation that occurred during the high flows. Field observations made over the last several years indicate that the small delta is prograding downstream, and will continue to fill in the small pool over time. The quality of potential overwintering habitat in fish-bearing streams within the mine site footprint (i.e., Dublin Gulch and Eagle Creek) was however poor due to residual pool depths ≤0.3 m that most likely freeze to the bottom in winter.

Pendray (1983) observed that spawning by Arctic Grayling in this region occurred predominantly in the South McQuesten River during the last two weeks of May. He also identified a small area at the mouth of Haggart Creek as a probable spawning site. Since spawning occurs in late May, immediately after ice breakup, Arctic grayling that winter in the Haggart Creek watershed might also spawn in the Haggart watershed. The baseline fisheries assessment for this Project identified areas of good to excellent quality potential spawning habitat for Arctic grayling—with modest currents (0.5 – 1.0 m/s), depths of 0.1 – 0.4 m, and 2 – 4 cm diameter gravel (McPhail, 2007)—in Lynx, Haldane, Swede, and Haggart creeks. The quality of potential spawning habitat provided by fish-bearing streams within the mine site footprint (i.e., Dublin Gulch and Eagle Creek) was poor, primarily due to lack of suitable gravel.

As the majority of Arctic grayling in the study area are thought to overwinter and spawn in the South McQuesten River (Pendray 1983), Arctic grayling primarily use study area streams as summer rearing habitat. Good to excellent rearing habitat was present at sample sites in the South McQuesten River, Bighorn Creek, Haggart Creek, Haldane Creek, Lynx Creek, Iron Rust Creek, and North Star Creek. These sites had abundant complex cover and availability of pool, riffle, and run habitats. The quality of potential rearing habitat provided by fish-bearing streams within the proposed Project footprint (i.e., Dublin Gulch and Eagle Creek) was moderate, primarily due to lack of cover, high stream gradients, or insufficient channel depths.

9.3 METHODS

9.3.1 Survey Areas

Fish sampling and fish habitat assessments continue to be conducted annually in Q3. Sampling locations will include previously sampled locations on Iron Rust Creek station IR2, Haggart Creek stations HC1, HC2, and HC3, and Lynx Creek station L1. These sampling locations are consistent with reaches and locations sampled as part of the baseline surveys and include representative reaches that include all mesohabitat types present in the watercourse.

Figure 9.3-1 depicts the sampling locations for fish abundance and fish habitat.

9.3.2 Fish Abundance

Assessment of Arctic grayling utilization of habitat downstream of the Project will be accomplished through sampling of fish populations using standard collection methods (e.g., electrofishing, baited minnow traps, angling, seining), with the selection of methods depending on the characteristics of the sampled habitat type. Abundance estimates will be based on catch-per-unit of effort (CPUE) calculations. Relevant population data will be recorded for all captured fish including: species, weight, and length. Sampling locations will be delineated in the field and geo-referenced to facilitate sampling in multiple years.

The Metal Mining Guidance Document for Aquatic Environmental Effects Monitoring (EEM Guidance Document) (Environment Canada, 2012) states that a minimum of 100 individuals of the target species should be collected if non-lethal sampling is used. However, results from the baseline survey efforts indicate it is unlikely that this many individuals will be captured in any given reach. Instead of targeting one species, all fish (primarily Arctic grayling and slimy sculpin) that are encountered during the survey will be captured and length, weight and general condition data recorded.

9.4 REPORTING

Results of monitoring programs are compiled annually. All field data will be recorded in the field on modified RISC site cards, entered into a spreadsheet, and summarized in site summary tables.

9.5 MANAGEMENT

The objectives of the fish and fish habitat monitoring program are to assess the effect of effluent in the exposure area (Haggart Creek) and to document any changes to fish habitat downstream of the Project. Fish abundance and individual data and habitat characteristics will be collected and compared to baseline data to determine if there is an effect on fish populations as a potential result of the Project. This data will be used in combination with benthic macroinvertebrate, sediment, hydrology and water quality data to determine if there are Project effects on fish and fish habitat.

Construction of watercourse diversions, in-stream and stream bank construction, site grading, soil and overburden removal, and stockpiling of soils, could result in the release of sediment to streams which may have nominal effects to fish and fish habitat. All runoff from camp construction, site clearing and other soil and vegetation disturbance and stockpiling activities will be diverted to the sediment basins or the Lower Dublin South Pond prior to discharge to receiving streams (e.g., Eagle Creek, Dublin Gulch and Haggart Creek). The monitoring plans for benthic macroinvertebrates, stream sediment, water quality, and fish habitat will provide data to assess whether the standard erosion prevention and sediment control practices, as described in the Water Management Plan, are sufficient to minimize effects.

In addition to TSS monitoring, significant changes (primarily decreases) from the range of values established by the baseline program, in sediment chemistry, benthic community values and fish abundance may indicate effects from Project-related activities. These effects would be attributed to higher TSS, or a change in flow, both of which have proposed threshold values in in the water quality and hydrology sections, and so no additional thresholds are provided here (other than an observed trend away from baseline).

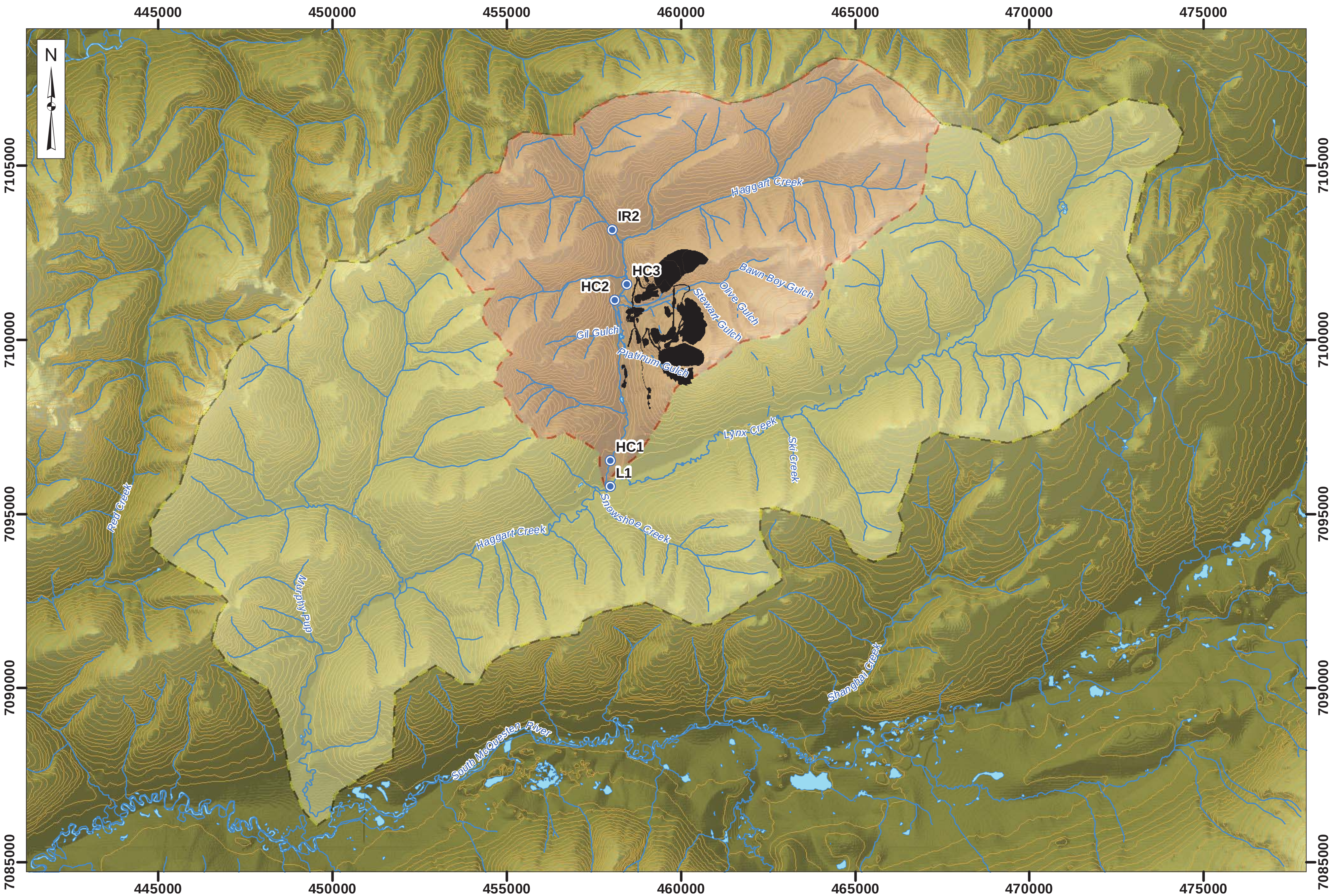
During operations, closure, and post closure potential effects to fish and fish habitat include:

- acute and chronic toxicity from exposure to mine effluent. Although not predicted, these effects could result via increased concentrations of metals, nutrients and total suspended solids
- sedimentation and degradation of habitat via changes to benthic macroinvertebrate community structure or spawning habitat that requires low concentration of fine material that can prevent spawning by infilling of gravels or suffocate eggs

The thresholds for these effects include any direct or indirect mortality of fish species downstream of the Project, and/or changes to fish abundance or community assemblage as well as changes to fish habitat as described in the hydrology, sediment and benthic macroinvertebrate sections. These effects will likely be detected via multiple monitoring described previously in this plan. If detected, effects will be addressed via management measures as described in previous sections in addition to the following:

- if mortalities are observed, tissue sampling and toxicology assessments will be conducted to determine the cause
- if chronic effects for individuals or changes to fish assemblages are observed a quantitative ecological risk assessment will be undertaken to identify exposure pathways, receptors and recommendations for mitigation measures
- if acute or chronic effects are observed while the effluent discharge standards and receiving water quality objectives are consistently met, these standards and objectives will be reviewed for efficacy. Sublethal and acute toxicity evaluations will provide context on potential mine effects. In the event standards and objectives are updated for the Project, additional water management infrastructure changes will be required to meet the new objectives
- if Project related low flows are observed to result in decreased habitat available, water management changes will be considered to restore flows to baseline conditions

- habitat restoration will be considered for areas observed to have increased sedimentation; restoration may involve sediment transport analysis to identify and mitigate upstream sediment sources or the addition of instream structures to increase scour to decrease sedimentation in various reaches valuable to fish



Legend:

- FishSamplingSites_Nov2008
- Local Assessment
- Regional Assessment
- Contour (100ft)
- Watercourse (Perennial)
- Watercourse (Ephemeral)
- Watercourse (Intermittent)

Victoria GOLD CORP

0 2.5 5 Kilometers

Projection:	Drawn By:	
NAD 83 UTM Zone 8N	HC	EAGLE GOLD PROJECT YUKON TERRITORY
Date: 2020/02/05	Figure: 9.3-1	Fish and Fish Habitat Monitoring Locations

METEOROLOGICAL AND ATMOSPHERIC

10 CLIMATE

10.1 INTRODUCTION

Two automated climate stations are currently operating in the Project area. The Potato Hills station (elevation 1420 m) was installed in 2007 and the Camp station (elevation 782 m) in 2009. The climate stations collect data for the following parameters:

- Air temperature
- Precipitation
- Wind speed and direction
- Barometric pressure,
- Snow depth, and
- Relative Humidity

Snow depth information has also been collected during winter with snow course surveys near both climate stations and west of lower Ann Gulch.

The objectives of the baseline climate monitoring program are to characterize the local atmospheric environment of the Project area, and to support hydrologic analyses and air quality assessments. The climate monitoring program, from the current pre-construction phase through the construction phase of the Project, will include the two existing climate stations, as well as the baseline snow course survey locations.

The objective of the ongoing climate monitoring program is to calibrate precipitation, snowmelt predictions and runoff patterns used in the water balance and water management design. It will also provide supporting information for air quality metrics related to the presence of Project facilities (e.g. site haul roads, crushing and screening plant, open pit, heap leach facility, refinery and waste rock storage areas, etc.).

10.2 BASELINE CHARACTERIZATION WORK

Historical climate data were initially collected intermittently in the area in 1979 to 1980, 1984 and 1993 to 1996. The more recent baseline climate monitoring program was initiated by VGC in August 2007 with the installation of the Potato Hills climate station (elevation 1420 m). This station is an ONSET Hobo operating system and records data at a 15-minute interval.

The second climate station, the Camp station was installed in August 2009 (initially at an elevation of 820 m, and then later moved in September 2010 to an elevation of 782 m during camp development activities), as a result of large differences in snow survey information collected in April 2009 near the Potato Hills station compared to the lower elevation area near the camp. The Camp station is a Campbell Scientific CR800 datalogger, which records data at a 15-minute interval.

Snow course surveys have been conducted during the late winter (generally in April) near the Camp and Potato Hills weather stations, beginning in 2009 and are ongoing. The snow courses collect snow depth, snow density and snow water equivalent (SWE) data.

Previous work on climate data and information are described in JWA (2008 and 2009), Stantec (2010a, 2011a and 2012b) Knight Piesold (2013), Lorax (2016b).

10.3 METHODS

The current climate stations will continue to collect data at 15-minute intervals for the parameters outlined above.

Snow course surveys will continue to be undertaken following the accepted sampling procedures and techniques used by Yukon Environment and outlined in the Ministry of Environment of British Columbia's document "Snow survey sampling guide" (MOE 1981). During the operations phase, the survey locations will include the HLF so estimates of snow water equivalent and refined sublimation rates can be developed for the heap leach water balance model and to assist with ongoing closure planning. During the operations phase of the Project, the survey locations will again be expanded to include both the EP WRSA and the PG WRSA. The goal of the expanded program will be to provide information to closure planners on snow distribution and sublimation of various slope aspects to support closure cover designs.

Net radiometers will be installed during the operations phase of the Project at the HLF and WRSAs to provide continuous net solar radiation measurements. The locations for the net radiometers (Figure 10.3-1) will provide data for north, west and south facing slopes that will be used to increase the confidence in current estimates of long-term performance for the proposed closure cover systems.

10.3.1 Locations

The locations of the current and ongoing climate stations are shown in Figure 10.3-1 and summarized in Table 10.3-1.

Table 10.3-1: Project Climate Station Locations

Site	Zone	Coordinates		Site Type
		North	East	
Potato Hills	8V	7100800	463550	Automated
Camp	8V	7101000	458200	Automated

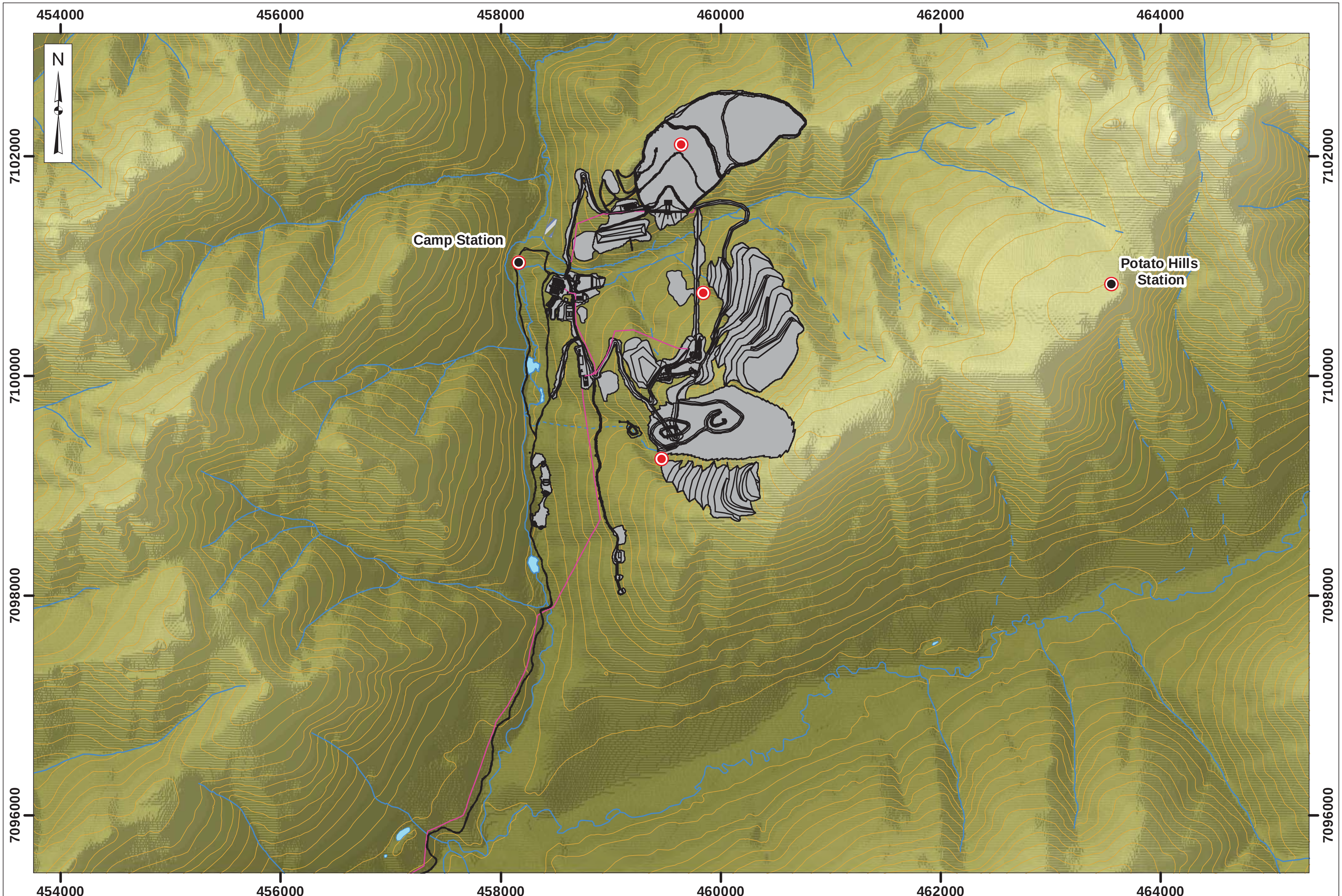
10.3.2 Frequency

The climate stations and net radiometers will be visited and data downloaded on a regular basis to ensure that all instrumentation is maintained and functioning properly. During the open water season the stations will be visited monthly concurrent with hydrology data collection. In the winter, the stations will be visited in conjunction with collection of snow course survey data, which will occur on a monthly basis from the beginning of March until the snow is gone by May or June.

10.3.3 Data Analysis and Reporting

The following climate data will be included for each station in the summary annual report following each data collection year:

- Monthly and annual recorded mean, minimum and maximum temperature
- Total monthly and annual precipitation, as well as estimated rainfall and snowfall amounts
- Maximum 24-hour precipitation totals for each month
- Monthly snowpack depth as well as estimated monthly snowmelt distribution
- Monthly average barometric pressure and relative humidity
- Monthly and annual recorded mean, minimum and maximum wind speed and direction
- Monthly and annual recorded mean, minimum and maximum net solar radiation
- Estimates of monthly sublimation and evaporation/evapotranspiration



Legend:

- Climate Station
- New Snow Survey Locations / Net Radiometer
- Reserved Area
- Facility
- Site Power
- Contour (100ft)
- Watercourse (Perennial)
- Watercourse (Ephemeral)
- Watercourse (Intermittent)

Victoria GOLD CORP

0 0.75 1.5
Kilometers

Projection:	Drawn By:	EAGLE GOLD PROJECT YUKON TERRITORY
NAD 83 UTM Zone 8N	HC	
Date: 2020/02/26	Figure: 10.3-1	Climate Monitoring Stations

11 AIR QUALITY

11.1 INTRODUCTION

Fugitive dust emissions will likely occur as a result of soil disruption through Project-related activities, most notably clearing, grading, drilling, blasting, loading/unloading. VGC is committed to applying industry standard best management practices to reduce Project emissions. VGC will manage construction in a way that minimizes dust emissions to the atmosphere and thus minimizes the potential for the ambient air quality standards to be exceeded and adopt a range of design and operational safeguards and procedures outlined in the Dust Control Plan for the Project to ensure that emission controls are working effectively.

Yukon Ambient Air Quality Objectives define maximum allowable limits, for particulate matter, carbon monoxide (CO), sulphur dioxide (SO_2) and nitrogen dioxide (NO_2). These standards are summarized in Table 11.1-1.

Table 11.1-1: Yukon Ambient Air Quality Standards[ab]

Parameter	Standard ($\mu g/m^3$)[c]	Standard (ppm)[d]	Standard (ppbv)[e]
Total Suspended Particulate (TSP)			
24–hour average	120		
Annual geometric mean	60		
Fine Particulate Matter ($PM_{2.5}$)			
24–hour average	28		
Annual mean (calendar year)	10		
Coarse Particulate Matter (PM_{10})			
24-hour average	50		
Nitrogen Dioxide (NO_2)			
1-hour average			213
24–hour average			106
Annual arithmetic mean			32
Carbon Monoxide (CO)			
1-hour average		13	
8-hour average		5	
Sulphur Dioxide (SO_2)			
1-hour average			172
24–hour average			57
Annual arithmetic mean			11
Ground Level Ozone (O_3)			
8-hour running average			63

NOTES:
a - The following standards are the maximum concentrations of pollutants acceptable in ambient air throughout the Yukon Territory. These standards will be used to determine the acceptability of emissions from proposed and existing developments.

b - All ambient air quality measurements will be referenced to standard conditions of 25 degrees Celsius and 101.3 kiloPascals.
c - ug/m^3 = micrograms per cubic meter
d - ppm = parts per million
e - ppbv = parts per billion by volume

Dispersion modeling results for the construction phase predicted that Project emissions of the Criteria Air Contaminants (CACs) would not exceed applicable regulatory objectives and standards with the exception of particulate matter. TSP will be the primary means of monitoring ambient particulate conditions because Yukon does not have dustfall standards and the specific correlation between dustfall and ambient TSP is not known.

Emissions from the gold recovery process have the potential to result in the release of SO_2, PM, and metals. These emissions have the potential to settle out over local soil, vegetation and water leading to increased metal concentrations in the environment.

An updated to the dispersion model to include potential emissions related to the gold recovery process, such as SO_2, PM, and metals such as arsenic, cadmium, chromium, mercury, and lead to comply with QML-0011 was provided to Yukon Government as part of an application for an air emissions permit. The model update is supported by a standalone Air Quality Monitoring Plan was contemplated in the Decision Document issued by the YESAB for the Project.

11.2 METHODS

The methods for air quality monitoring described below pertain to the monitoring of TSP via ambient air monitoring. For dust deposition, in addition to these methods, VVGC monitor metals content in soil and vegetation that will provide data that will be used to determine potential effects from dust deposition. The methods to monitor metal levels in vegetation and soils are described in Sections 12 and 13 respectively.

The air quality baseline data collection program records data continuously throughout operations. Three Beta-Attenuation Particulate Monitors (EBAMs) capable of monitoring continuous, real-time TSP, PM10, and PM2.5 ambient air quality data are installed near the Camp Station. Air quality monitoring began in 2018 and will continue throughout operations.

The *E* in EBAM indicates *Environment Proof Instrument*. They are specifically designed to function in hostile environments without additional protection and have an operating temperature range of – 30° C to 50° C. A winter enclosure was constructed around the instruments for additional protection from temperatures below – 30° C.

A Hi-Vol sampler will be installed at the air quality monitoring location nearest the accommodations complex to support TSP and metals monitoring. Furthermore, dustfall canisters are installed at five locations (Figure 11.2-1) to collect additional data on total metals concentrations. In addition to the EBAMs and dustfall stations, Passive Air Sampling Systems capable of testing nitrogen dioxide (NO_2) sulfur dioxide (SO_2) and Ammonia (NH_3) are installed adjacent to each existing dustfall stations.

11.2.1 Locations

The EBAM air quality system is located east of the lower camp climate station directly adjacent and west of the existing camp. Given the prevailing north by northeast (NNW) winds this location is suitable to detect TSP concentrations from the majority of Project activities.

Dustfall and passive air samplers are located are shown in Figure 11.2-1 and summarized in Table 11.2-1.

Table 11.2-1: Project Dustfall and Air Quality Station Locations

Passive Sampler	Dustfall	Coordinates		Location
		North	East	
AQ1	D1	7100818	463559	Exploration Road weather station
AQ2	D2B	7100976	458254	W27
AQ3	D3	7099088	460583	Above Eagle Pit
AQ4	D4	7097951	458436	Km 42 on the access rd.
AQ5	D5	7097734	458290	Rex Road
EBAM System	-	7101021	458237	West of camp

11.2.2 Frequency

EBAMs automate particulate measurement by continuously sampling and reporting concentration data and updating records. Ambient air is drawn into the EBAM via a dual diaphragm pump at a rate of 16.7 litres per minute. A separate EBAM instrument is required for each particle size: TSP, PM 10, and PM 2.5. The PM 10 and PM 2.5 instruments utilize inlet filters to isolate particulates smaller than 10 and 2.5 µg, respectively.

Remote communications are established and data is uploaded from the EBAMs directly to a cloud-based server. The server will be accessible via secure web interface for VGC personnel to review or inspect in real-time. Two webcams will be installed at the site to provide a visual, qualitative record of the atmospheric conditions at a given time.

Dustfall and passive air samplers are monitored monthly and every three months for particulates, NO_2, SO_2, NH_3, and total metals.as summarized in Table11.2-2.

Table 11.2-2: Project EBAM, Dustfall and Air Quality Monitoring Frequency

Location	Parameter	Sampling Method	Sample Frequency
EBAM	TSP, PM_{10}, $PM_{2.5}$	EBAM	Hourly
AQ1	Total Particulates, NO_2, SO_2, NH_3	Dustfall/ Passive	30 days
	Metals	Dustfall	91 days
AQ2	TSP	Hi-Volume	6 days
	Total Particulates, NO_2, SO_2, NH_3	Dustfall/Passsive	30 days
	Metals	Hi-Volume/ Dustfall	91 days
AQ3	Total Particulates, NO_2, SO_2, NH_3	Dustfall/ Passive	30 days
	Metals	Dustfall	91 days
AQ4	Total Particulates, NO_2, SO_2, NH_3	Dustfall/ Passive	30 days
	Metals	Dustfall	91 days
AQ5	Total Particulates, NO_2, SO_2, NH_3	Dustfall/ Passive	30 days
	Metals	Dustfall	91 days

11.2.3 Data Collection and Analysis

Designated VGC personnel will receive an automatically generated daily report summarizing ambient air quality for TSP, PM2.5 and PM10 data from the past 24-hours. Other air quality parameters such as SO2, NO2, dustfall and metals will be monitored on a monthly or quarterly basis as specified in the air quality permit issued for the Project. Quarterly reports will be generated to summarise and disseminate these results.

Annual reports will be produced which contain the recorded applicable air quality parameters concentrations with comparison to Yukon Ambient Air Quality Objectives. The reports will also contain the sampling QA/QC data recorded by the automated cloud-based system.

11.3 MANAGEMENT

Construction and operation activities, including general earthworks, road use, blasting, ore processing and overburden disposal will generate dust. Standard best practices for dust control include regular and periodic watering of haul and access roads, and pad work areas, and when very windy conditions are occurring, to minimize the road traffic. If observed air quality concentrations are within approximately 80% of the Yukon Air Quality Standards provided above in Table 11.1-1, the Environmental Department and Site Operations Department will work together to identify the cause of exceedance and take appropriate action to minimize the emission. If the TSP concentrations exceed 100 $\mu g/m^3$ 24-hour average or 50 $\mu g/m^3$ as an annual geometric mean, additional dust control mitigation measures will be implemented.

As part of management practices, inspections for fugitive dust generation will be conducted for site roads and all facilities that produce dust to determine the need for additional mitigation measures.

In addition to air quality sampling, dust control inspections will be conducted for site roads and facilities to determine the need for additional mitigation measures. If threshold levels for TSP are exceeded, VGC will take the following actions:

- Notify Environment Yukon and EMR of TSP exceedance and any changes to mitigation measures.
- Review all applicable air quality, meteorological data and metadata (e.g., records of Project activities during the exceedance period, inspection reports, field notes etc. and any other information that may be relevant) to determine reason for high TSP concentrations.
- Apply dust control contingency measures and modify or add mitigation measures to reduce dust emissions including:
    - Increase the watering rate of roads and exposed soils
    - Traffic and work reduction in areas where dust is generated
    - Review and potential revision of road speed limits and their enforcement
    - Use of dust suppressants on roads such as calcium chloride
    - Rescheduling of revegetation activities for disturbed areas so that they may be seeded as early as possible
    - Wind barrier (windrow) construction such as crushed rock, soil berms or fences upwind of roads and exposed areas. The following methods will be considered when placing barriers to prevent dust emissions:
        i. Wind barriers are most effective when placed perpendicular to the direction of the prevailing wind, but will have little or no effect when the wind direction is parallel to the barrier.

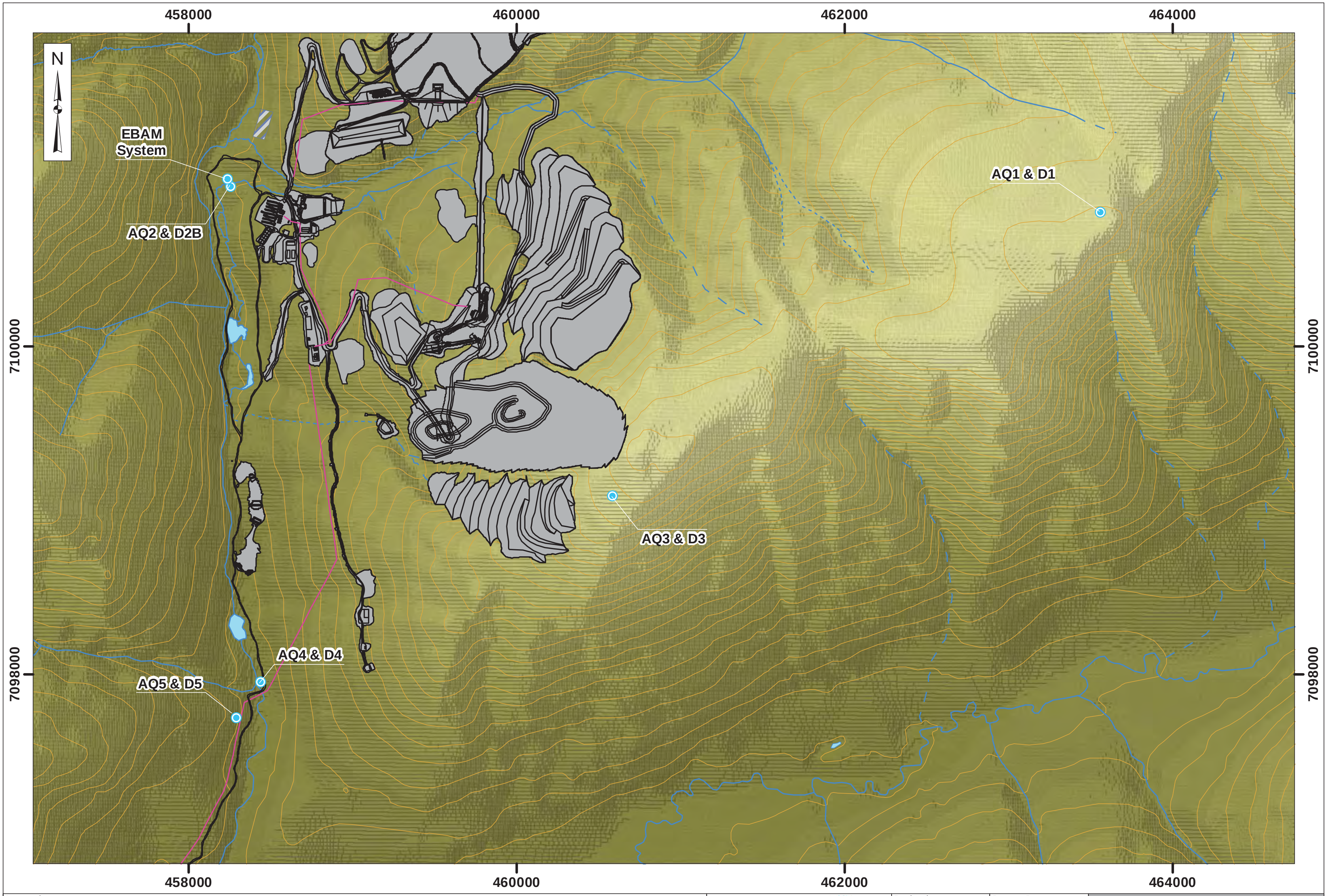
ii. When choosing wind barriers it has been observed that solid barriers provide Significant reductions in wind velocity for relatively short leeward distances, whereas porous barriers provide smaller reductions in velocity for more extended distances.

iii. Wind barriers should be at least 2 metres high.

iv. Screening material with a porosity of 50% is optimum for controlling dust.

- Reconfiguration or covering of stockpiles. Limit work to the downwind side of stockpiles. Uncovered stockpiles may need re-orientation to offer minimal cross-sectional area to prevailing winds.
- Construction of rock berm on portions of or around the open pit
- Limit material transfer points
- Pre-watering of areas prior to earthworks
- Review of dust control equipment, control measures and overall dust management plan for crushing facilities and baghouse

Ongoing dust control concerns and corrective actions will be periodically reviewed by the Environmental Manager to determine if additional contingency measures and/or Project design, or operational changes are required.



Legend:

Air Quality Monitoring Locations	Facility	Watercourse (Perennial)
Reserved Area	Site Power	Watercourse (Ephemeral)
	Contour (100ft)	Watercourse (Intermittent)

Victoria GOLD CORP

0 0.5 1 Kilometers

Projection:	Drawn By:	EAGLE GOLD PROJECT YUKON TERRITORY
NAD 83 UTM Zone 8N	HC	
Date: 2020/02/26	Figure: 11.2-1	Air Quality Monitoring Locations

TERRESTRIAL

12 VEGETATION

12.1 INTRODUCTION AND OBJECTIVES

The vegetation monitoring program has been designed to evaluate changes to vegetation during the life of the Project. The objectives of the vegetation monitoring program include:

- To measure plant metal uptake, and
- Help identify whether any trends in metal uptake could be attributed to site activities.

12.2 BASELINE CHARACTERIZATION WORK

A baseline vegetation assessment was completed in 2009 and 2010 (Stantec, 2011e). The baseline assessment included terrestrial ecosystem mapping, a rare plant survey and foliar sampling for the area of the Project, including the mine site and access road. Vegetation field surveys were undertaken in August 2009 to gather data necessary for the preparation of terrestrial ecosystem mapping and rare plant surveys. Establishment of baseline trace metals was undertaken by conducting foliar analysis of selected plant species at nine locations in and around the local study area. A second rare plant survey was conducted in July 2010 to capture earlier flowering plants.

Terrestrial ecosystem mapping was completed for an area of approximately 7,538 ha in the Project area. Ecosystem mapping was also prepared for a 1 km wide corridor along the 44.8 km long access road (4,580 ha). A Project specific ecosystem classification system, based on field data and literature review, was developed for the study areas. A total of 21 vegetated ecosystem units and nine non-vegetated units have been mapped in the study areas.

All foliar samples analyzed in 2009 contained metal concentrations below levels considered toxic for cattle.

12.3 METHODS

Permanent vegetation monitoring plots are established and annual sampling commenced in 2018. Vegetation monitoring plots utilize a consistent sample layout (Figure 12.3-1). Each plot has a center point established and four corner points 10 m from the center point in cardinal directions (half-inch diameter rebar metal rods (50 cm long) are used to mark center and corner points. At the time of establishment, an ecosystem plot was implemented which allows documentation of site conditions, terrain and soil, vegetation and wildlife sign. Data is recorded on BC MOF (1998) detailed ecosystem field data forms (FS882); information will follow standards in the Field Manual for Describing Terrestrial Ecosystems (BC Ministry of Environment, Lands and Parks and BC Ministry of Forests 1998).

Foliar samples of willow (note species), sedge, bluejoint and northern rough fescue are collected, as available, at the center and corner points within a 2 m diameter circle around each point. If those particular species are not available within the 2 m circle, then samples are taken from the nearest available specimens. Samples are collected, treated as tissue samples and sent directly to the selected laboratory for analysis.

12.3.1 Locations

Four permanent monitoring plots were established, one in each of four quadrants (D1-D4B) located in the Project area (Figure 12.3-2), as detailed in Table 12.3-1. Plot locations were selected in the field based on identification of pre-established ecosystem criteria (the dominant ecosystems, previously identified). Vegetation monitoring plots are established on the predominant slope, aspect and drainage position within each dominant vegetation ecosystem unit.

- Vegetation monitoring station D1 is co-located with the Potato Hills meteorological station.
- Vegetation monitoring station D2B is located near the Camp meteorological station. This station will be representative of the Project area boundary.
- Vegetation monitoring station D3 is located just southeast of the Project area above the open pit. This corresponds to the area of highest TSP concentrations and dustfall that were predicted by dispersion modeling.
- Vegetation monitoring station D4B is located approximately 1.5 km south of the camp, to the east of the access road near Km 42. This location is downwind of prevailing winds at the Camp meteorological station.

Table 12.3-1: Project Vegetation and Soil Monitoring Locations

Dustfall	Coordinates		Location
	North	East	
D1	7100818	463559	Potato Hills weather station
D2B	7100976	458254	W27
D3	7099088	460583	Above open pit
D4B	7097951	458436	Km 42 on the access rd.

12.3.2 Frequency

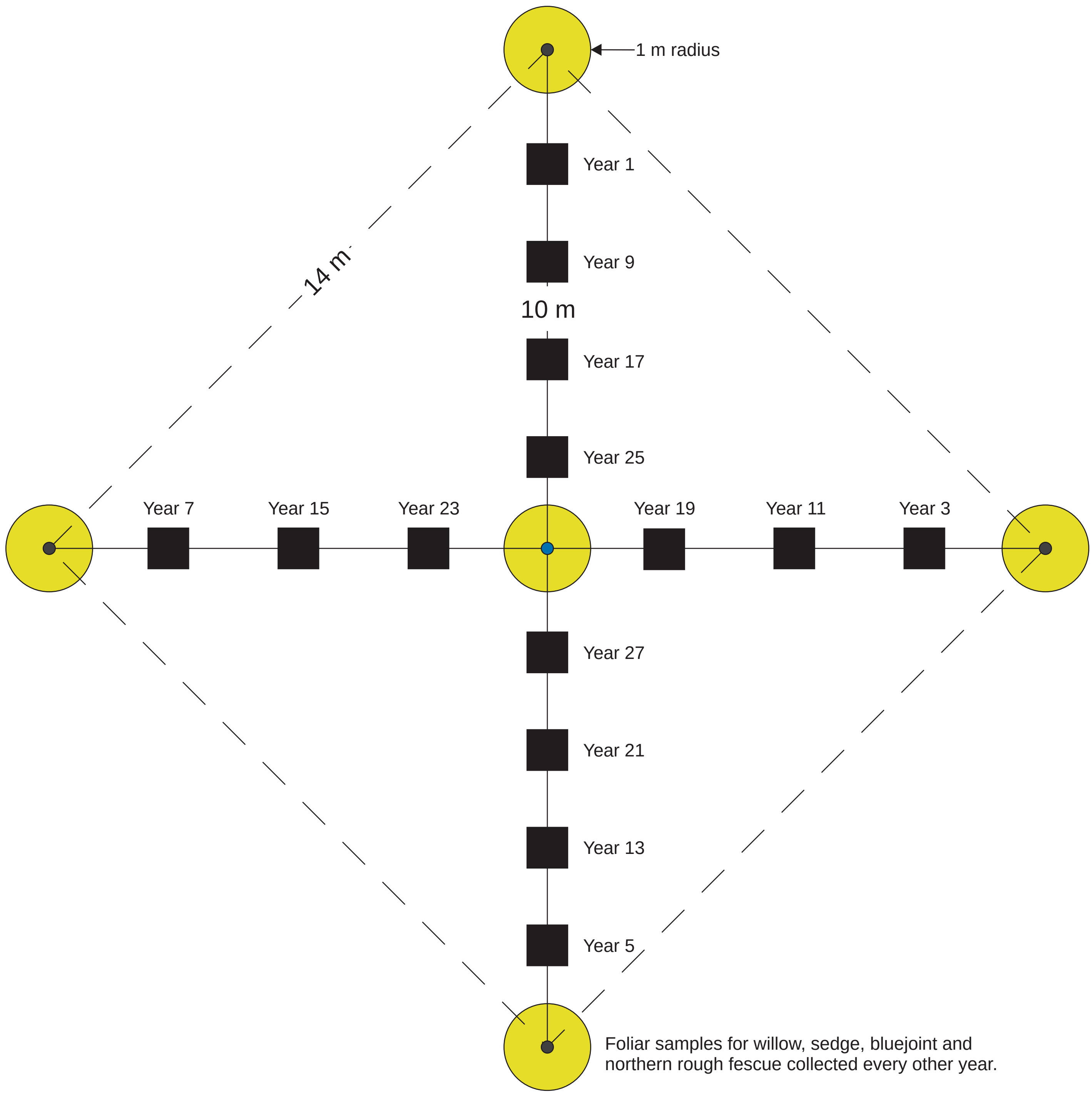
All permanent vegetation monitoring plots will be sampled once each year during the growing season (July and August) before leaves start to yellow.

12.3.3 Data Analysis

Vegetation species composition will be assessed to determine vegetative assembly and local ecosystem changes over the Project phases. Vegetation samples will be analyzed by an accredited laboratory for metals including mercury using inductively coupled plasma mass spectrometry (ICP-MS). Duplicates of selected vegetation samples and reference standards will also be completed for the purpose of QA/QC of laboratory analytical technique.

12.4 MANAGEMENT

In the event vegetation monitoring indicates that metals concentration in vegetation is significantly increasing, VGC will consider additional dust control contingency measures described by the Dust Control Plan to limit particulate matter settling on vegetation.



Legend:

1 m radius

Vegetation sample plot locations; painted ½ inch rebar to locate centre and corner plots; foliar samples collected every other year.

Soil sampling locations, surface horizon between 0 and 0.5 m depths; one sample every other year.

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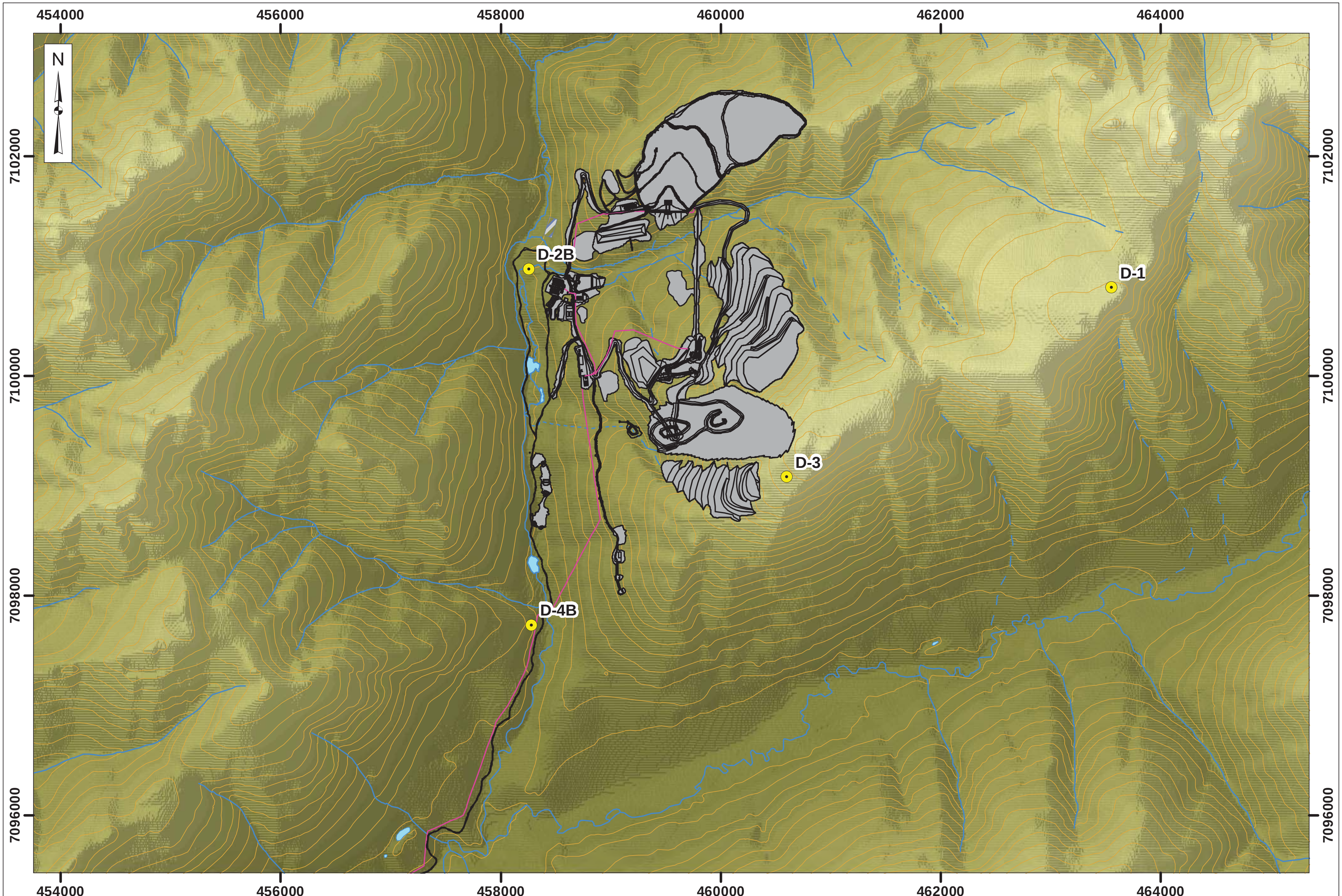
EAGLE GOLD PROJECT
YUKON TERRITORY

Vegetation and Soil Monitoring Plot Layout

Projection:	Drawn By:	Date:	Figure:
N/A	SS	2014/07/02	12.3-1



Legend:

- Vegetation & Soils Monitoring Locations
- Reserved Area
- Facility
- Site Power
- Contour (100ft)
- Watercourse (Perennial)
- Watercourse (Ephemeral)
- Watercourse (Intermittent)

Victoria Gold Corp

0 0.75 1.5
Kilometers

Projection: NAD 83 UTM Zone 8N

Drawn By: HC

Date: 2020/02/26

Figure: 12.-3-2

**EAGLE GOLD PROJECT
YUKON TERRITORY**

Vegetation and Soil Monitoring Locations

13 SOILS

13.1 INTRODUCTION AND OBJECTIVES

The soils monitoring program has been designed to evaluate changes to metal and nutrient levels in soils during the life of the Project as a result of dust deposition. Soils monitoring is undertaken in conjunction with the vegetation monitoring program. The objectives of the soil monitoring program include:

- To measure metal and nutrient levels in soils during operations, and
- Help identify whether any trends in trace metal and nutrient levels in soils could be attributed to site activities.

13.2 BASELINE CHARACTERIZATION WORK

Soil baseline studies were conducted during 2009. The background information, methods, and results for the study are presented in the Surficial Geology, Terrain and Soils Baseline Report (Stantec 2011g).

The soil baseline assessment included:

- Description of soil profiles within the LSA, RSA and RCSA, with a total of 142 plots;
- Sampling of soils at 16 locations in the LSA, with subsequent physical and chemical analysis;
- Description and mapping of soil map units for the RSA;
- Soil metals analysis; and
- Interpretation of soils for soil reclamation suitability.

Areas with known ore bodies often have mineralized soils present; as a result they can have naturally elevated concentrations of some metals. Total recoverable concentrations of 30 elements were determined for 19 surface soil samples. Analytical results were checked for exceedance of the Soil Quality Guidelines of the Canadian Council of Ministers of the Environment (CCME 1999) and the Yukon Contaminated Sites Regulation (Yukon CSR; YSR 2002).

Arsenic

The soil and overburden of the LSA are naturally enriched with arsenic (As), and most baseline samples collected have arsenic concentrations well above the CCME and Yukon CSR guidelines for Agriculture and Parkland soils.

When compared to the receptor-specific guidelines provided in the Yukon CSR, the natural arsenic content of the soils and overburdens in the footprint are above the values considered to pose a risk to livestock, soil invertebrates, plants, and even humans. More than half of the soil samples collected are above the 50-mg/kg guideline recommended to prevent toxicity to soil invertebrates and plants, and all but one are above the limit recommended to prevent illness in livestock ingesting soil while grazing.

The total As concentration in the soils exceeds the thresholds recommended for the protection of soil biota and vegetation by orders of magnitude. While baseline arsenic concentrations are naturally elevated in the soil, they are not elevated in the sampled vegetation. It is important to document these elevated pre-disturbance soil arsenic levels, so that post-closure soils analyses do not erroneously attribute elevated arsenic levels to the effects of

Project development. These elevated As levels will also require consideration in planning soil handling for reclamation, and for post-closure assessment of reclamation success.

13.3 METHODS

13.3.1 Soil Sampling

Soil samples are collected from the surface soil horizon at depths between 0 and 0.5 m, and carefully transferred from the metal shovel and/or split spoon sampler into clean, pre-labeled jars equipped with Teflon-lined lids. Soils collected are handled only with disposable gloves or clean stainless steel spoons. Soil remaining in the metal shovel and/or split spoon sampler is used to describe and develop a log of the soil characteristics and site stratigraphy for each sample location. To prevent cross-contamination at each sampling location, new nitrile sampling gloves are worn prior to collecting each soil sample.

13.3.2 Locations

Four permanent soil monitoring sampling locations were established in conjunction with the permanent vegetation monitoring plots as shown in Figure 12.3-2 and detailed in Table 12.3-1.

13.3.3 Frequency

Soil samples are collected in coordination with vegetation monitoring and will be collected once annually during the growing season (July and August).

13.3.4 Data Analysis

Soil samples will be analyzed for metals and nutrients using the methods outlined below. Ten percent of analyzed samples will be blind duplicates, as an assurance on analytical quality and consistency.

13.3.5 Test Method

pH in Soil or Solid – analysis will be performed based on procedures described in the “Manual on Soil sampling and Methods of Analysis” (1993) published by the Canadian Society of Soil Science. The test is performed using a deionized water leach with measurement by pH meter.

Particle Size Analysis – the particle size distribution will be determined in accordance with Methods of Soil Analysis Part 1-Physical and Mineralogical Methods (2nd Ed). UBC Methods Manual for Soil Analysis (1981) and Soil Sampling and Methods of Analysis (1993). The percentage gravel, sand, slit and clay will be determined by a combination of a standard dry sieve, wet sieve and pipetting techniques. Particle size limits used to define size fractions are based according to Canadian Soil Survey Committee (CSSC) and U.S. Department of Agriculture (USDA) classification scheme.

CSSC Textural Category – C Clay, S = Sand, SI Slit, L - Loam, CL Clay Loam, SC = Sandy Clay, SIL = Slit Loam, SIC - Silty Clay. LS = Loamy Sand, SL = Sandy Loam. HC = Heavy Clay, SCL - Sandy Clay Loam, SICL = Silty Clay Loam.

Silver–Inductively, Coupled Plasma Mass Spectrometry (ICP/MS).

Arsenic–Inductively Coupled Plasma Mass Spectrometry (ICP/MS).

Cadmium–Inductively Coupled Plasma Mass Spectrometry (ICP/MS).

Mercury–Cold Vapour Atomic Fluorescence.

Molybdenum–Acid digestion followed by determination using Inductively Coupled Plasma Mass Spectrometry (ICP/MS).

Strong Acid Leachable Metals in Soil –B.C. MOELP Method “Strong Acid Leachable Metals in Soil Version 1.0”. The method involves drying the sample at 60 C, sieving using a 2 mm (10 mesh) sieve and digestion using a mixture of hydrochloric and nitric acids. Analysis is performed using inductively Coupled Argon Plasma Spectroscopy (ICAP) or by specific techniques as described.

Selenium Inductively Coupled Plasma Mass Spectrometry (ICP/MS).

Thallium–Inductively Coupled Plasma Mass Spectrometry (ICP/MS).

Particle Size Analysis - Standard – according to the CSSC and USDA Classification schemes. Soil texture is determined according to CSSC definition of texture. The size fractions that are analyzed are 2.0, 0.250, 0.125, 0.053 and 0.002 mm. The % Sand, % Slit and % Clay are based on the <2 mm fraction of the sample by weight.

Total Nitrogen and Sulfur–combustion analyzer where nitrogen in the reduced nitrous oxide gas is determined using a thermal conductivity detector.

Available NO3 and Available NO2–Available Nitrate and Nitrite will be extracted from the soil sample using a dilute calcium chloride solution. Nitrate will be quantitatively reduced to nitrite by passage of the sample through a copperized Cadmium column. The nitrite (reduced nitrate plus original nitrite) is then determined by diazotizing with sulfanilamide followed by coupling with N-(1-naphthyl) ethylenediamine dihydrochloride. The resulting water-soluble dye has a magenta color which, is measured at colorimetrically at 520 nm.

Available P and Available K - Plant available phosphorus and potassium will be extracted from the soil using Modified Kelowna solution. Phosphorous in the soil extract is determined colorimetrically at 880 nm, while potassium is determined by flame emission at 770 nm.

13.4 MANAGEMENT

In the event monitoring data indicates that metals concentration in soil within the footprint or at sites established outside the Project footprint is increasing, VGC will engage additional dust control contingency measures described above in the Air Quality Section 11 to limit particulate matter settling on soils.

14 NOISE

14.1 INTRODUCTION

The objective of the noise monitoring program is to ensure that public users of the Haggart Creek Access Road (HCR) adjacent to the Project site are not at risk of exposure to high sound levels associated with blasting. The use and management of the South McQuesten Road and the Haggart Creek Road will be regularly monitored as described in the Traffic Management Plan, which will be amended, if warranted, to reflect changing conditions or uses of the roads.

The project design criteria and procurement policy are in accordance with the Yukon Occupational Health Regulations. For on-site personnel this requires that noise levels from any equipment shall not exceed 85 dBA at 1 metre, and noise level for control rooms and offices shall not exceed 60 dBA at 1 m.

The loudest source of noise during operations will be from the use of explosives. The maximum peak sound pressure level of 120 dB is the cautionary limit for blasting. Blasting will occur during quarry development and in the open pit throughout the operations phase of the Project and will be scheduled to occur once per day. Blasting will occur only during daylight hours.

The predicted peak sound level (PSL) at 500 m from the open pit is 196 dB. At 1.5 km from the open pit, noise from blasting is expected to be 92 dB north; 85 dB east; 82 dB south; and 103 dB west. These numbers are below the cautionary limit of 120 dB.

Within the site boundaries closest to the open pit, noise levels from blasting will likely be higher than 120 dB during blasting. On-site personnel may be potentially affected by noise from blasting without the proper safety measures in place. The health and safety of on-site personnel with respect to exposure to steady state or impact noise will be managed in accordance with the *Yukon Occupational Health and Safety* and *Regulations*.

By restricting access to the mine site at the gate house on the HCR immediately prior to the site entrance, recreational land users will not be present in the vicinity of the mine during blasting operations. However, the HCR is located directly adjacent to the mine site, and at the closest point, it is approximately 1000 m west of the open pit. Sound levels from blasting in the open pit will be between 196 dB and 103 dB. It is possible that noise levels could exceed 120 dB on the HCR closest to the open pit during blasting. Members of the public and uninformed mine personnel may be potentially affected by noise from blasting when traveling on the HCR.

A number of standard mitigation measures have been incorporated into the Project design to minimize noise including:

- Minimize effect of blasting noise on people and applying Yukon Occupational Health Regulations for employees
- Restrict access to the mine site so that public users are not present in the vicinity of the mine during blasting operations
- Limit blasting to the least noise-sensitive times of day (between 7:00 am and 10:00 pm)
- Locate major crushing equipment and other noise-generating equipment (e.g., blowers and air compressors, etc.) inside buildings wherever possible

- Perform regular inspection and maintenance of vehicles and equipment to ensure that they have high quality mufflers installed and worn parts replaced
- Follow posted vehicle speed limits
- Maintain site haul and secondary roads to minimize vehicle noise associated with vibration
- Turn off equipment when not in use and practical to do so

14.2 BASELINE CHARACTERIZATION WORK

A noise assessment was conducted as part of the Project Proposal developed under the *Yukon Environment and Socio-Economic Assessment Act* (YESAA) requirements.

Yukon has no specific regulatory guidance that relates to environmental noise effects on the general public. Hence, guidelines widely used in other jurisdictions where no provincial noise assessment regulations exist were considered. Following these guidelines, a study area, encompassing the Project footprint, the physical area occupied by the Project infrastructure, and an extension beyond the footprint boundary (the Project boundary) of approximately 2 km in all directions, was selected for the noise assessment. Predictions at 1.5 km from the Project boundary were compared to the regulatory noise criteria to evaluate Project compliance.

The maximum predicted daytime peak (instantaneous) sound level at 1.5 km from the Project boundary during blasting is approximately 104 dBA. All predicted peak sound levels at receptors located 1.5 km from the Project boundary are well below the cautionary limit of 120 dB, as specified by the Ontario Ministry of Environment (1978) *NPC-119 Blasting*.

Based on the results of the noise assessment, predicted sound levels at 1.5 km from the Project boundary are expected to remain within acceptable limits of the generally accepted criteria for ambient sound quality in Canada.

Sound monitoring on the Haggart Creek Road utilizing a 3M Sound Pro Sound Level Meter commenced in 2018 to determine peak sound levels due to pit blasting and to refine monitoring methods. Peak sound levels during the blasting activities captured was below the 120 dB cautionary maximum peak sound level for blasting and the guidance threshold of 110 dB.

14.3 METHODS

In accordance with term and condition #121 of the Decision Document, VGC monitored sound-levels related to blasting activities along the portion of the HCR that is within the 1.5 km boundary identified in the Noise Assessment Report. The monitoring conducted to date complied with regulatory requirements and VGC commitments. Any future sound level measurements will be conducted by using a Class 1 Sound Level Meter that has a dynamic range of at least 30 - 140 dB.

14.3.1 Location

Monitoring was completed at a fixed location on the HCR at the closest point to the open pit. If warranted by a noise complaint, VGC will conduct instantaneous monitoring at additional locations to be determined based on blasting locations.

14.3.2 Frequency

Sound monitoring was undertaken monthly for 3 months to determine if the peak sound levels on the Haggart Creek Road exceeded 120 dB during blasting. Sound levels did not exceed 120 dB during this period (and blasting operations did not vary) so monitoring and road restrictions during blasting were discontinued until warranted by a change in blasting procedures that may increase sound levels in the area or if warranted by a noise complaint.

14.4 DATA ANALYSIS AND REPORTING

As monitoring has been discontinued in accordance with VGC commitments during the YESAA process, no formal data analysis is required. Any future noise complaints received will be recorded and included in reporting required by the regulatory approvals for the Project and additional mitigation measures, or adaptive management strategies will be identified and implemented as required.

14.5 MANAGEMENT

If any regulatory these thresholds for sound are exceeded, or a noise complaint is received, the following measures will be considered:

- Reduce static noise from mobile mining and other heavy construction equipment and generators as much as possible through enclosures, mufflers and berms to block or deflect sound. Reduce idling as much as possible
- Addition of enclosures, berms, acoustic screening and shrouding for stationary sources
- Blasting will be limited to certain times of the day based on wildlife sensitivities if any are identified
- Strategic scheduling of noise events that limit certain activities to specific times of day
- House stationary sources in buildings
- To protect worker health:
    - Delineate and mark areas where noise is constant and more than 85 dBA
    - Provide and enforce the use of suitable hearing protection for all employees exposed to noise over 85 dBA, to be used in accordance with recommendations outlined in the Canadian Standards Association Standard Z.94.2-94, Hearing Protectors, where other mitigation and management options are not available or reasonable.

INFRASTRUCTURE AND FACILITIES

This section of the Plan describes the surveillance activities to monitor the physical performance of key mine infrastructure and of mine workings. Monitoring methods are described for the open pit, material management and storage facilities, and heap leach and process facilities. In addition, permafrost adjacent to facilities and infrastructure will be monitored to ensure changes in permafrost condition do not create instability for project infrastructure. Detailed methods are described in a separate section as well as within individual facilities monitoring sections below.

Additionally, and in accordance with QML-0011, annual physical stability inspections of all engineered structures by an independent engineer commenced in 2018 and will continue for the life of the Project. A key component of the annual physical stability inspection is the preparation of a written report by the inspecting engineer documenting the inspection results. The report includes a summary of the stability, integrity and status of all the inspected structures, works, and installations and recommendations for remedial actions to address any performance issues identified. VGC is required to take immediate steps to implement any of the recommendations for remedial action made as a result of the inspection.

15 PERMAFROST

15.1 INTRODUCTION

The Project site is located in a region of widespread discontinuous permafrost. Activities related to the Project have the potential to disturb permafrost. Permafrost monitoring is required to provide information to update engineering design, adaptively manage construction activities that may require the over-excavation of ice rich material, and minimize thawing and permafrost degradation wherever possible.

The permafrost monitoring plan includes the following:

- Visual Inspection,
- Subsurface Temperature Monitoring,
- Surface Water Quality Monitoring, and
- Climate Monitoring (addressed in Section 10).

Monitoring has included regular observation of subsurface temperatures at existing thermistor strings, as well as visual inspections of disturbed areas. Depending on the condition and location of existing thermistors, additional thermistor strings may need to be installed at selected facilities. In some cases, decisions on specific monitoring will be made as part of ongoing detailed engineering design.

15.2 BASELINE CHARACTERIZATION WORK

A total of thirteen thermistor strings were installed in test holes around the site between 2009 and 2012, as illustrated in Figure 15.2-1. These have been monitored since their installation (BGC 2012a), and will continue to be monitored as discussed below.

In addition to thermistor readings, subsurface data from 463 test holes with observations of the presence or absence of late summer frozen ground, which may be taken as a proxy for the probable presence of permafrost, has been compiled (see Frozen Materials Management Plan). These data provide a basis for inferring the spatial distribution of permafrost. The thermistor strings and other subsurface data show the sporadic presence of relatively warm permafrost (generally warmer than -1ºC) in selected areas of the site, and absence of permafrost elsewhere.

15.3 METHODS

Permafrost monitoring involves the following primary components:

- Visual inspection of selected engineered facilities, including cut or fill slopes greater than 3 m in height, will be inspected visually at regular intervals for signs of sloughing, slumping, settlement, tension cracks, rill or gully erosion, seepage or other evidence of permafrost degradation. Locations where water is ponding will also be noted since they represent heat sources that could potentially trigger subsurface thawing and instability. This information will inform mitigation strategies or design changes as described in the adaptive management program.
- Subsurface temperature monitoring: shallow and deep ground temperatures will be monitored using existing thermistors. The locations of thermistor monitoring correspond to those where visual monitoring

is required. Additional thermistors may need to be installed during operation and will be determined based on site observations and on as needed basis as part of finalizing designs.

- Surface water quality monitoring: runoff from engineered facilities will be monitored for increased turbidity. Changes in runoff water quality can be used as early indication of evolving issues (e.g. unknown ground disturbance associated with permafrost degradation) before they become more acute issues. Areas demonstrating elevated levels will be investigated by field reconnaissance, and may be further monitored through more frequent visual monitoring, if required, following any remedial efforts considered warranted.

15.3.1 Locations

Existing thermistors depicted on Figure 15.2-1 will be used to monitor permafrost conditions. Existing thermistors will be maintained where possible to identify thermal trends that may be occurring in response to ground disturbance. In some cases, thermistors may be destroyed by excavation activities that remove permafrost and ice-rich material; monitoring of the ground temperature in these areas will not be necessary. If thermistors are destroyed in areas adjacent to where permafrost will remain, they will be replaced. Although no such locations are currently envisaged, destroyed thermistors would be replaced with new thermistors, as deemed necessary and installed to an approximate 10 m depth, outside but close to the disturbance areas.

For monitoring during operations, new thermistors may be installed at specific locations where visual monitoring may be necessary to inform detailed design specifications and/or to monitor evolving conditions during operations, including for example:

- Diversion channels and cut slopes,
- Heap Leach Facility:
    - Heap Leach Embankment
    - Heap Leach Pad
- Reclamation Stockpiles,
- Temporary Ore Stockpile,
- Building Pad Fills, and
- Waste Rock Storage Areas.

15.3.2 Frequency

Thermistors will be monitored quarterly to capture the seasonal fluctuations of ground temperatures and to determine the presence of frozen ground and thickness of the active layer. Visual inspections and surface water quality monitoring will also be carried out during freshet, following prolonged rainy periods and during freeze-up.

15.3.3 Data Analysis

Data from thermistor readings will be plotted as profiles of temperature with depth and as profiles of temperature with time at selected depths noting the following:

- Range of ground temperature;
- Temperature of permafrost at depth;

- Thickness of the active layer;
- Identification of differences in ground temperature with respect to distribution of facilities within the site; and
- Identification of any trends within the ground temperatures with depth that could indicate potential warming.

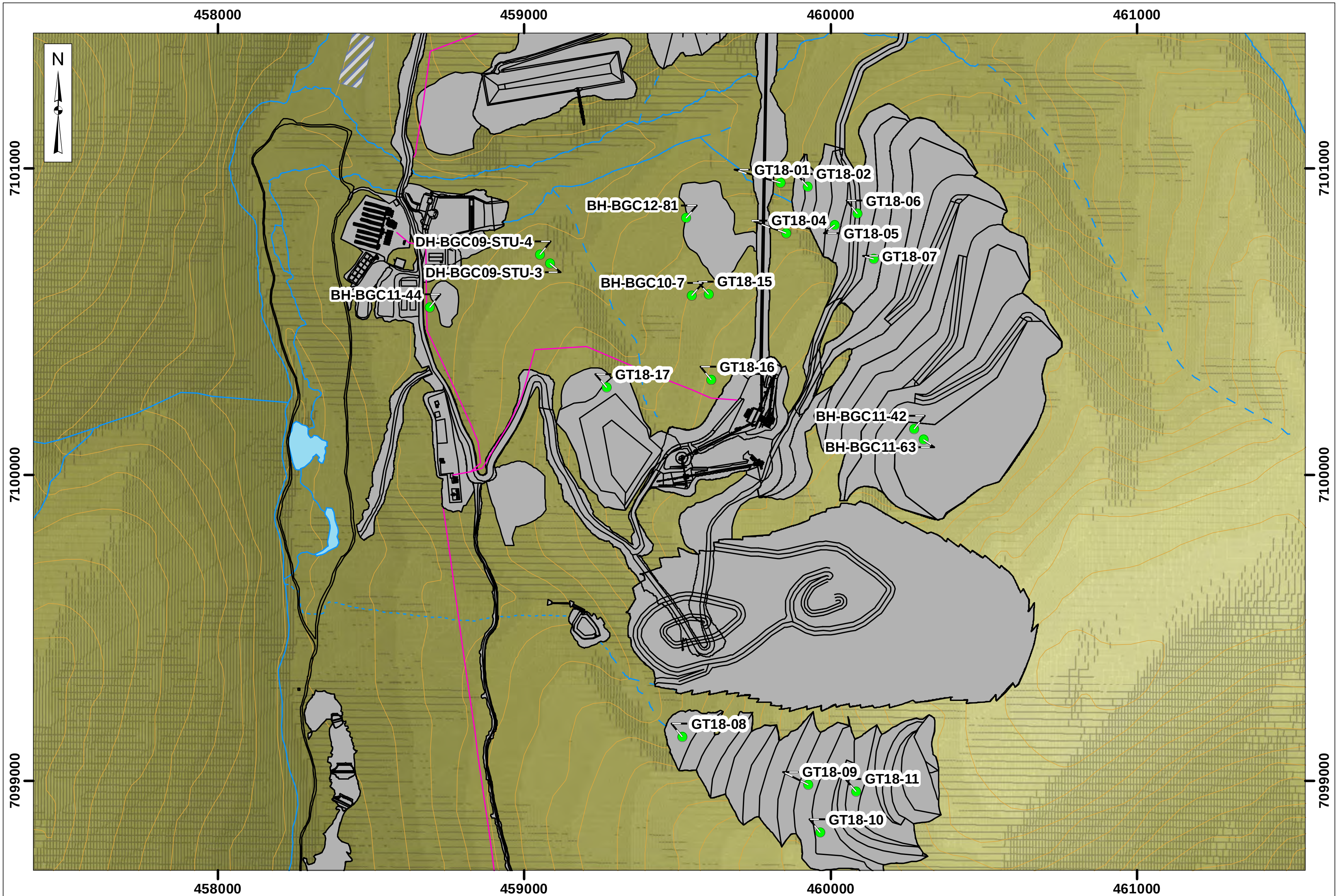
Data from visual inspections will be collected as photo log albums, indicating date, time and personnel responsible for data collection, accompanied by a written description of observations. Compiled records of visual observations will be reviewed for evidence of permafrost degradation warranting either more vigilant monitoring or remedial action (e.g. stabilization or excavation of permafrost).

Findings will be considered in the annual report, with an assessment of subsurface trends and conditions to determine the need for either more frequent monitoring or remedial effort.

15.4 ADAPTIVE MANAGEMENT

The following adaptive management measures may be undertaken in the event monitoring data indicate a measurable reduction in depth and thickness or increase in temperature of permafrost on site and if it may result in threat to infrastructure stability or water quality impacts via high turbidity:

- Increase the frequency of visual monitoring and/or add monitoring locations.
- Employ additional monitoring methods to help verify trends and associated risks to project infrastructure (e.g. additional monitoring specific to infrastructure such as stability monitoring for tension cracks in foundations, embankments, or mass ground movement).
- Place (additional) insulation over thawing permafrost areas.
- Adjust or modify water management infrastructure if heat transfer from the infrastructure could be the cause for permafrost warming, thaw and/or discharge of increased TSS. Options include:
    - Collection of seepage from thawing permafrost
    - Re-routing of conveyance system to treat seepage as required (e.g. settling of TSS)
    - Construction of additional sediment basin(s).
- Stabilize areas and infrastructure as necessary prior to failure due to permafrost changes (e.g. buttressing, earthworks etc.).
- Excavate permafrost (i.e., ice-rich material) and unstable areas.



Legend:

Thermistor
Reserved Area
Facility
Site Power
Contour (100ft)
Watercourse (Perennial)
Watercourse (Ephemeral)
Watercourse (Intermittent)

Victoria GOLD CORP

0 250 500
Meters

Projection: NAD 83 UTM Zone 8N

Drawn By: HC

Date: 2020/02/26

Figure: 15.2-1

EAGLE GOLD PROJECT
YUKON TERRITORY

Existing Thermistor Monitoring Network

16 OPEN PIT

16.1 INTRODUCTION

Gold-bearing ore and barren waste rock will be removed from the Eagle deposit by conventional drill, blast, shovel and truck mining. Over the life of the Project, the open pit will be advanced in stages with an ultimate pit size of approximately 1,300 m long and 550 m wide and approximately 67 ha. Based on the surface topography, the open pit will be scalloped-shaped with a lower west highwall. To maintain access to the primary crusher, a single ramp will spiral down to the bottom of the final pit. This ramp will also connect to the external access road that leads to the truck shop. No ramps will be maintained inside the final pit above the crusher elevation to minimize stripping requirements.

Geotechnical investigations to support the final open pit design were supported by field work undertaken in 2009, 2010 and 2011 and included geotechnical mapping, geotechnical drilling, oriented core measurements, one borehole televiewer survey, hydrogeologic (packer) testing, installation of borehole instrumentation to measure groundwater pressures and laboratory testing of rock core samples. These investigations are described in the Mine Development and Operations Plan, which provides a discussion of pit wall stability and slope design criteria.

During mining, ongoing monitoring of the pit wall will be required to:

- Maintain safe operational practices for personnel, equipment, and near-pit facilities.
- Provide advance warning of slope instability.
- Provide geotechnical information for slope designs to assist in making subsequent modifications, should they be required, to achieve the desired slope performance.

A well-developed risk management system, which includes active deformation monitoring, may allow additional optimization of the slope design during operation of the mine.

16.2 METHODS

The current state of practice for slope monitoring in open pit mines in North America is based on a multi-layered system, which in approximate order of sophistication and cost, may include:

- Visual or drone inspections
- Theodolites (robotic or manual) and a network of survey prisms
- Time domain reflectometry (TDR) cables
- Slope inclinometers
- Extensometers
- Fixed slope radar installations (e.g. IDS IBIS system)
- Mobile slope radar equipment (e.g. Reutech or GroundProbe)

Slope stability radar systems are not anticipated to be necessary unless significant instability develops and the threat of the instability on production warrants the high costs. Other monitoring systems may be required during operations depending on slope performance.

16.2.1 Locations

Survey prisms will be installed around the pit perimeter, including backsights (control points), to establish the survey monitoring system. These initial prisms could be monitored with a single theodolite surveying from two or three locations around the pit, either from within the pit or along the pit perimeter. Selected monitoring locations will be stable with good visibility of the prisms from these locations. During the development and expansion of the pit, additional prisms may be required, with higher prism density in the east wall.

Once areas of instability have been identified either through visual inspections or surveying, specific locations within the failure areas may require more detailed monitoring that will include installation of TDR cables, slope inclinometers, or extensometers to measure displacements across specific features such as shear zones or cracks.

16.2.2 Frequency

Visual inspections of the open pit slopes are undertaken daily to identify potential movement, to monitor the pit face for water seepage, and to identify productive drain holes (if and when they are installed). Additionally, regular drone surveys are undertaken to monitor pit walls for any potential movement. Monthly surveys will be carried out on the survey prisms until movements are detected. The robotic theodolite systems, if implemented, will survey the prism points on an hourly basis. Threshold values for wall movement will be set and alarms will be triggered if the wall movement exceeds the threshold limits. These inspections will be completed by the shift foreman, or someone at a similar level of responsibility with experience in the open pit development. Records of the results of these visual inspections will be maintained in shift log reports, along with daily and weekly records.

16.3 REPORTING

Annual reports will be prepared internally to document changes to pit wall stability, movement as observed and mitigation measures applied. A hazard map will be developed onsite to identify areas of rockfall risks and will be updated by the geotechnical engineer on an as needed basis.

16.4 MANAGEMENT

If movements are detected during the daily visual inspections or monthly surveys adaptive management measures will be considered and implemented, as necessary. This includes an increase in survey frequency from monthly to weekly. Once movement trends are established, movement rate thresholds can be developed which will trigger reductions/increases in the time intervals between readings. Depending on the proximity of the movements to personnel, equipment and infrastructure, survey monitoring frequency may have to be increased to as much as daily. This could include, although not anticipated to be needed, automation of the survey equipment due to the time requirements involved, or the purchase of more sophisticated equipment such as slope stability radar. Further, adjustment of controlled blasting techniques can be used to minimize damage to rock at limits of the pit and reduce the potential for pit wall movement. Scaling contractors will be employed to bring down high risk loose material identified through field inspections and will implement wall remediation measures as required.

If water is observed on pit walls or very productive horizontal drain holes are encountered, the mine engineer will determine the need for the installation of additional drain holes on specific geotechnical berms. If a single or series of previously productive horizontal drain holes show evidence of freezing or blockage during the winter period, then the mine engineer may direct mining staff to install heat tracing or heat tape to melt the obstruction where safe access is available.

17 MATERIAL STORAGE AND STOCKPILE MANAGEMENT AREAS

17.1 INTRODUCTION

Management plans have been developed which describes the types of waste rock and overburden including reclamation soil stockpiles, temporary ore stockpile, and the ice-rich overburden storage area (IROSA) that will be constructed and/or encountered on site, and how these materials will be characterized, segregated, and stored to ensure long-term chemical and physical stability. The plans provide details about the design, construction and operation of each waste rock and overburden storage facility, and summarizes closure strategies considered during the design, construction and operation of each facility. The plans include the following:

- Waste Rock and Overburden Facility Management Plan, and
- Frozen Materials Management Plan.

Throughout operations and open pit development, waste rock and stockpiles are scheduled in the following areas:

- Platinum Gulch Waste Rock Storage Area (PG WRSA),
- Eagle Pup Waste Rock Storage Area (EP WRSA),
- 90-Day Ore Stockpile, or
- Reclamation soil stockpiles as needed.

The objective of the monitoring and surveillance of the material storage and stockpile areas include:

- Detection of the movement and stability of the facilities based on visual or drone inspections and using various instrumentation and surveying, as applicable, to inform the mine engineer regarding the continued development of the facility, and
- Characterization of seepage water quality, runoff water quality and flow conditions to provide input to water management strategies including water treatment requirements, conveyance and storage needs, and sediment and erosion control practices.

17.2 METHODS

Visual inspections and drone surveys of the storage facilities and stockpiles are routinely completed by technical personnel at the mine. These inspections should include but not be limited to, the following:

- Inspection of the crest areas for any signs of deformation, instability, or erosion
- Inspection of the facility faces for any signs of deformation, instability, or erosion.
- Inspection of the toe areas for any signs of deformation, instability, or erosion, at a frequency determined by the results of crest and face monitoring.
- Inspection of the toe for any signs of seepage from the base, other than the rock drains at a frequency determined by the results of crest and face monitoring.

- Monitoring of water levels in existing piezometers adjacent to or within the facility footprints (details described above in Section 4).
- Inspection of the rock drain discharge areas at the toe of the WRSAs and notes made of water flow rates, and visual water quality.

These inspections are completed by the shift foreman, or someone at a similar level of responsibility with experience in storage facility construction.

The results of the visual monitoring and drone surveys provide insight on the physical performance of the storage areas and stockpiles over the course of operations. If instabilities are detected then various adaptive management practices, as described below, may be followed.

17.2.1 Locations

Visual inspections and drone surveys take place along the crest and toe areas of the waste rock storage area lifts. Visual inspections of the 90-Day stockpile and reclamation stockpiles take place along the crests and toes of the stockpiles.

Deformation monitoring using survey prisms will require set up of a survey station at a location that can clearly observe the crest and toe areas of the waste dumps. More specific deformation monitoring of unstable areas can be undertaken using wireline extensometers across specific cracks, or slope inclinometers installed through the waste rock into the foundation to monitor shearing in the foundation.

17.2.2 Frequency

Visual inspections of the crest areas of waste dumps are usually undertaken twice per shift or at least daily by the shift boss or foreman, if the waste dump is active. The toe areas of the waste rock storage areas and the rock drain discharge outlet should be inspected weekly once they are fully operational. Visual inspection of the temporary ore stockpile, reclamation soil stockpiles and the IROSA require less frequent monitoring, typically weekly during annual development (i.e., for the ore stockpile) and then monthly once the facility is established.

More detailed inspections of the WRSAs may be completed on a monthly basis by the mine's geotechnical engineer familiar with the technical aspects of the WRSA design, construction, and monitoring. More detailed inspections of the reclamation soil stockpile may be completed annually by the mine's geotechnical engineer.

17.3 REPORTING

Records of the visual inspections will be maintained in shift log reports, along with daily and weekly records detailing the location and type of materials placed in the WRSAs. Records of the daily, weekly, monthly and annual visual inspections should be maintained and complied annually, and incorporated into the annual independent review

17.4 MANAGEMENT

Management strategies are designed to address unexpected performance of rock and overburden management programs. In the event of instability, or poor performance (i.e. slumping of the crest, bulging of toe areas, erosion, etc.), which is affecting the ability of mining operations to place waste in the WRSAs or stockpile, or jeopardizes downhill working areas or roads, deformation monitoring of specific areas may be required. Numerous techniques are available to monitor the deformation. These include:

- Surveying of optical prisms installed at the surface of the facilities;
- Measurement of surface movements using wireline extensometers;
- Measurement of sub-surface movements using inclinometer casing.
- Radar or photogrammetric surveying

These techniques form the basis for most monitoring systems in place in North America. The frequency of the readings will depend on the magnitude of the movements and the potential consequences of a failure, with higher reading frequencies required for high consequence failures and accelerating movement rates. Site-specific monitoring frequencies and alarm trigger thresholds will be developed by the mine engineer as part of operating procedures for these areas.

18 HEAP LEACH AND PROCESS FACILITIES

18.1 INTRODUCTION

Regular surveillance is essential to ensure ongoing safety of the heap leach and process facilities and to identify areas requiring maintenance before problems and safety concerns develop. Behavior and performance of the facilities are assessed visually and through monitoring of instrumentation. More details on the surveillance process are described in the Heap Leach Facility Operations, Maintenance and Surveillance Manual (HLF OMS).

The purpose of an inspection program is to identify problems and/or unsafe conditions that are visually evident. Visual inspections are an integral part of proper maintenance and performance of monitoring programs for the heap leach and process facilities. Failure to correct identified maintenance and repair items, or potential adverse behavior, could result in unsafe conditions or lead to a failure of operating systems or cause an adverse environmental effect.

The construction and operation of the heap leach and process facilities is supported by specific plans and manuals that provide more detail with respect to scope, methods, locations, frequencies and responsibilities. The following section is intended to provide a basic overview; the following material provide more comprehensive information with respect to these facilities:

- Heap Leach Facility Operation, Maintenance and Surveillance Manual
- Heap Leach Facilities Contingency Water Management Plan
- Heap Leach and Process Facilities Emergency Response Plan
- Cyanide Management Plan, including:
    - Standard Operating Procedures
    - ADR Plant Operations Plan
    - ADR Plant Preventative Maintenance Plan

QZ14-041-1 includes a requirement for the development of thresholds and adaptive management actions for completing additional verification tests to confirm the In-heap Pond Maximum Available Storage volume and variation of hydraulic conductivity of the In-heap Pond. The timing requirement for the update to this plan does not allow for these items to be addressed as the verifications tests required by QZ14-041-1 are being developed, audited and instituted in accordance with other requirements in QZ14-041-1, the timing of which is contradictory to the update requirement for the Plan and thus will be addressed in future revisions to the EMSAMP.

18.2 HEAP LEACH FACILITY

18.2.1 Surveillance and Response

Routine and/or regular visual inspections of the HLF components listed in Table 18.2-1 are completed in accordance with required frequencies. During high water times (e.g., spring freshet, high rainfall, and flood events), daily or more frequent surveillance is undertaken to ensure the safe operation of pumping systems and/or spillway operations. Ideally the inspections are performed and recorded by the same person(s) to ensure that relevant incremental changes are observed between each inspection. The visual inspections are done for all components of the HLF, including the visible portions of the leach pad liner; leach pad embankment; stacked ore pile; accessible portions of the solution delivery and collection system including pipelines, drip emitters, pumps, tanks and other support facilities; conveyors, radial stacker; the Events Pond, and instrumentation as appropriate. Records are kept of all dam inspections and copies will be maintained on site for review during annual inspections.

Representative samples of the pregnant and barren solution are sampled on a quarterly basis and analyzed for constituents as determined by the Process Manager and the Environmental Manager.

The LDRS monitoring sumps are checked daily for the presence of solution. If solutions are present, they are sampled and analyzed for the presence of constituents as determined by the Process Manager and Environmental Superintendent. Contained solutions in any of the monitoring ports will be evacuated and measured for volume. All information is recorded for comparison with follow-up measurements, and for comparison with the alert levels for the In-Heap Pond and Events Pond.

Emphasis is placed on visual inspections of the HLF embankment. The following are items are examined during these inspections:

- evidence of settlement or subsidence on the embankment crest or slope;
- evidence of cracks or erosion on the embankment slope;
- bulging on the downstream slope which could indicate leakage; and,
- evidence of animal burrows or unusual vegetation patterns on the dam.

Monthly snowpack measurements are made on approximately five flat and sloped surfaces (or benches/lifts) of the heap leach facility, and by aspect. Each snow survey consists of a flat (leaching) surface and the adjacent slope, and each bench/slope is measured at a minimum of ten locations evenly spaced across each bench, with an average snowpack calculated for each area. The on-site weather stations at Camp and Potato Hills are used to measure any and all rainfall, including snowfall with respective density (water content).

All observations will be documented.

18.2.2 Locations and Frequency

Table 18.2-1 summarizes the routine surveillance requirements and responsibilities for the HLF

Table 18.2-1: Surveillance Requirements for the HLF

Surveillance	Frequency	Responsibility
Routine Inspection		
Embankment	Weekly by staff (Annually by Engineer)	Process General Foreman or alternate
Embankment Geotechnical Instrumentation (piezometers and inclinometer)	Continuous using wireless relays to office	Process General Foreman Process General Foreman
Pad Liner	Weekly	Process General Foreman or alternate
Stacked leach ore for stability	Weekly	Process General Foreman or alternate
In-Heap Pond Piezometers	Continuous using wireless relays to office	Process General Foreman
Solution collection and recovery system	Weekly	Process General Foreman or alternate
Leak Detection and Recovery System Monitoring Ports	Daily	Environmental Superintendent

Surveillance	Frequency	Responsibility
Heap leach pad vibrating wire piezometers	Daily during freshet or when solution inflow and outflow rates are not equalized (i.e., application and withdrawal rates altered for operational purposes or equipment malfunction/upset event) weekly during the remainder of the year.	Environmental Superintendent
Monitoring Vault	Weekly	Environmental Superintendent
Events Pond fluid levels	Daily if the desired available storage has been reached and weekly otherwise.	Environmental Superintendent
Events Pond liners	Weekly	Environmental Superintendent
Conveyors and radial stacker	Monthly	Crushing & Conveying Supervisor
Geochemical sampling of pregnant and barren process solution	Quarterly	Metallurgist
HLF and Dam Inspection by Engineer	Annually	Engineering of Record
Independent third-party physical stability inspection	Annually	Engineering Consultant
Event Driven Inspection	Following unusual event (e.g., heavy precipitation, freshet, earthquake)	Managers - Process, Maintenance, Health & Safety and Environmental
Comprehensive Review (Dam Safety Review)	No later than 5 years after construction and prior to decommissioning	Engineering Consultant
Instrumentation	Monthly and per Manufacturer Guidelines	Instrumentation Technician
General Visual Inspection of HLF Components and the Events Pond	Daily during the completion of standard work procedures	Environmental Superintendent and Coordinators and Health, Safety and Security Manager and Coordinator

18.3 PROCESSING FACILITIES (ADR PLANT)

18.3.1 Methods

On regular occasions the main components of the Adsorption Desorption Recovery (ADR) plant will be physically inspected.

The purpose of the physical inspection is to observe and record sufficient information to allow for the identification of areas, components, or issues that are not functioning as designed or could potentially require modification, repair, or rehabilitation.

Physical inspections consist of visual inspections conducted by a qualified and experienced engineer or technician. Inspection results and any repairs needed will be documented and retained. Should any component inspected be found to be sub-standard or repairs needed those repairs will be documented and recorded.

The main inspection area and information to guide the inspector are summarized in Table 18.3-1.

Table 18.3-1: ADR Facility Surveillance and Inspection Focus Areas

Facilities	Inspection Focus Area
Cyanide unloading and storage area	• maintenance of general housekeeping practices, presence of water or debris • proper segregated storage of incompatible materials • integrity and proper positioning and stacking of stored intermodal containers and IBCs • presence of properly rated fire extinguishers • functionality of fixed HCN alarms and video monitors • legibility of hazard warning signage • availability of Material Safety Data Sheets (MSDSs) for cyanide briquettes • cordoning of container unloading area during unloading operations, and restriction of access by unauthorized personnel • use of appropriate operator PPE during unloading operations • functionality of eyewashes/emergency showers and water supply line pressure • condition of emergency response equipment and first aid storage cabinets
Cyanide bag cutter arrangement, mixing and storage tanks, and secondary containments	• structural integrity, signs of corrosion, buildup of cyanide salts, or leakage (tanks, valves, pumps, and other piping system components) • structural integrity, cracks, spalling, or deterioration of concrete impoundments • functionality of fixed HCN alarms and video monitors • functionality of tank level indicators • condition of chain hoist and bag lifting bridle • functionality of eyewashes/emergency showers and water supply line pressure • temperature, cleanliness, and condition of cyanide antidote kits and first aid storage cabinets • condition of emergency response equipment and PPE • use of appropriate operator PPE during mixing operations • legibility of hazard warning and direction flow signage • integrity of lockout/tag-out mechanisms on major solution or containment drain valves • maintenance of physical separation from chemically incompatible materials • maintenance of general housekeeping practices, presence of spilled solution or debris
Incineration of cyanide packaging materials	• legibility of hazard warning signage • adequacy and integrity of security fencing, gate, and lock

Facilities	Inspection Focus Area
	• completeness of combustion of packaging residues • control of windblown debris outside of fenced area • evidence of animal intrusion
ADR plant and secondary containments	• structural integrity, signs of corrosion, buildup of cyanide salts, or leakage involving process solution storage tanks, valves, pumps, and other piping system components • structural integrity, cracks, spalling, or deterioration of concrete impoundments • management of fluids in impoundments • functionality of fixed HCN alarms and video monitors • functionality of tank level indicators • functionality of eyewashes/emergency showers and water supply line pressure • temperature and condition of cyanide antidote kits • condition of emergency response equipment and PPE • legibility of hazard warning and direction flow signage • integrity of lockout/tag-out mechanisms on major solution or containment drain valves • maintenance of physical separation from chemically incompatible materials • maintenance of good general housekeeping practices, including routine cleanup of spilled or leaked solution or debris
Pregnant and barren solution pipelines and pumping stations/ containments	• structural integrity, signs of corrosion, buildup of cyanide salts, or leakage (pipelines, valves, pumps, and other components) • structural integrity, cracks, spalling, or deterioration of concrete impoundments • functionality of eyewashes/emergency showers • temperature and condition of cyanide antidote kits • condition of emergency response equipment and PPE • legibility of hazard warning and direction flow signage • integrity of lockout/tag-out mechanisms on major solution or containment drain valves
HLF earthworks, risers, distribution lines, emitters, internal pond(s), and leak detection system	• signs of erosion, slumps, or cracks in earthworks or the ore pile • signs of pipeline/flange leakage, and associated ponding • signs of ponding on HLF surface; if present, adequacy of screening or other appropriate avian exclusion devices • signs of animal trails or intrusion • management of fluids in impoundments • functionality of leak detection system and maintenance of associated detection logs

Facilities	Inspection Focus Area
	• legibility of hazard warning and direction flow signage
External Events Pond and leak detection systems	• adequacy of available freeboard (comparison to surveyed markers) • tears or holes in liner material or signs of erosion or slumps in underlying earthworks • signs of pipeline/flange leakage, and associated ponding • adequacy of wildlife fencing and avian exclusion devices • signs of animal trails or intrusion • functionality of leak detection system and maintenance of associated detection logs • legibility of hazard warning and direction flow signage
Surface water interceptor ditches	• tears or holes in liner material (if lined) or signs of erosion, slumps, or cracks in earthworks • signs of animal trails or intrusion • signs of blockage or other surface runoff impediments

18.3.2 Location and Frequency

A summary of the inspection points and frequency of inspection to guide the inspector are detailed in the ADR Plant Operations Plan and the ADR Plant Preventative Maintenance Plan.

18.4 REPORTING

18.4.1 Documentation

Documentation of surveillance and inspection activities will be maintained by the Process Plant Manager and Environmental Superintendent and will include recording of:

- Routine visual observations (departures from normal conditions);
- Instrumentation monitoring and testing;
- Analyses and evaluations; and
- Reviews.

Documentation will include, as a minimum, the following:

- Routine inspection log;
- Surveillance network monitoring report
- Quarterly instrumentation reports;
- Annual engineering inspection reports;
- Biannual review of data and annual environmental monitoring and surveillance report
- Comprehensive dam safety report every seven years.

Documentation will include inspection reports, photographic and video records, incident reports, instrumentation readings, instrumentation plots, annual inspections and third-party reviews, so that they can be quickly retrieved for review and in case of an emergency.

18.4.2 Reporting

The Process Manager will review collected data records from facility monitoring and assess the need for maintenance activities or response. The reporting procedures for various levels of surveillance are dependent on whether:

- Performance meets design expectations,
- Conditions may require adjustment to design, operation, maintenance or surveillance,
- Potential Emergency Response Alert, or
- Data collection and surveillance for regulatory licences

Details of these reporting requirements are described in the HLF OMS Manual.

18.5 ADAPTIVE MANAGEMENT

Adaptive Management for the HLF is wholly considered by the HLF OMS Manual, the HLF Contingency Water Management Plan and the HLF Emergency Response Plan (ERP). The HLF ERP is designed to ensure that an adequate level of emergency preparedness and response is available in the event of an emerging, imminent or actual emergency scenario involving the HLF or associated structures. The HLF ERP is supplemental to the Eagle Gold Project Emergency Response Plan, and was developed based on the following guidelines:

- Dam Safety Guidelines (2007);
- International Cyanide Management (2012);
- Type A and B Quartz Mining Undertakings - Information Package for Applicants (2012);
- Plan Requirement Guidance for Quartz Mining Projects (2013).

QZ14-041-1 specifically requires thresholds and adaptive management actions for leak detection in the HLF underdrain monitoring vault (HLF UMV). The frequency and parameter list for the HLF UMV monitoring is provided in Section 2 and 3 of this plan. The adaptive management actions that would be considered for any detection of process solution within the HLF UMV is essentially identical to a detection of solution within the leak detection and recovery systems within the HLF and the Events Pond.

If process solution is detected within the HLF UMV, the Process Manager will consider the following responses:

- Increase visual monitoring frequency as directed by the Process Manager.
- Lower In-Heap Pond fluid levels to allow for determination of potentially impacted fluid elevation range and to reduce overall leakage volume.
- Increase monitoring frequency of underdrain vault and LDRS pump out rate.
- Increase sampling of underdrain monitoring vault and LDRS fluids.

  - o If PLS solution continues to be identified, temporarily cease solution application in affected area, drill and case borehole and pump bentonite or similar material to affected area for failure in HLF

- Increase sampling frequency of down gradient monitoring wells.
- Increase sampling frequency of surface water quality stations W21, W4, W99 and W5.
- Restrict leaching operations in affected area of liner failure in HLF
- Install interlift liner where practical
- Isolate leak if possible
- Unload ore and repair any damaged liner for failure in HLF
- Contain any spill of PLS to the greatest extent possible
- Report on sodium concentrations, specific conductance and flow rates as indicators of leakage and responses planned for upward trends.

As described above, a range of monitoring and inspections will be conducted to ensure that Project features operate as intended. Unusual conditions or emergency events are situations that are different from the normal or expected conditions of the HLF facilities. These unusual conditions may indicate problems needing further monitoring, inspection, or corrective measures or may indicate an emergency condition requiring emergency response.

Table 18.5-1 provides a description of the emergency levels which may be detected on the Project.

Table 18.5-1: Emergency Levels

Emergency Level		Description
1	Non-failure	Abnormal situation which has not threatened the operation, or structural integrity, of a system.
2	Potential failure developing	Abnormal situation which may eventually lead to a system failure but there is no immediate threat
3	Imminent or actual failure	Extremely urgent situation where a system failure is occurring or its failure is imminent

The following emergency scenarios were considered in the HLF ERP:

1. HLF foundation or slope failure
2. Overtopping of HLF
3. Ore heap slope failure
4. Events Pond foundation or slope failure
5. Overtopping of Events Pond
6. Failure of liner system
7. Failure of leak detection and recovery system

8. Failure of overliner drain fill
9. Failure of solution collection and delivery system
10. Catastrophic release of hydrogen cyanide from ADR plant or during transportation

For each scenario, the potential causes, preventative measures, detection methods, site response, emergency level classification, potential effects and follow up activities are described in the HLF ERP, along with VGC's internal and external communication protocols.

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