EAGLE GOLD PROJECT

ENVIRONMENTAL MONITORING, SURVEILLANCE AND ADAPTIVE MANAGEMENT PLAN

VERSION 2019-01

APRIL 2019

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DOCUMENT CONTROL

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.

Version 2019-01 of the Environmental Monitoring, Surveillance and Adaptive Management Plan (the Plan) for the Eagle Project has been revised in April 2019 to update Version 2018-02. The table below is intended to identify modifications to the Plan and provide the rationale for such modifications

Version 2019-01 Revisions

Section	Revision/Rationale
Environmental Monitoring, Surveillance and Adaptive Management Plan	▪ Change to document tense throughout to acknowledge the commencement of construction and the status of various programs. ▪ Revisions to figures throughout to include additional monitoring locations SGC has committed to installing.
1.5 Adaptive Management Approach	▪ Complete revision to describe the approach to adaptive management required by QML-0011 and incorporation of comments from stakeholders.
Table 2.3-1	▪ Inclusion of “station purpose” column. ▪ Minor text edits to better describe locations. ▪ Revision to station identifications based on comments received from stakeholders.

Section	Revision/Rationale
Project Hydrology Stations during Construction	
Table 2.3-2 Project Hydrology Stations During Operations and Closure	▪ Inclusion of "station purpose" column. ▪ Inclusion of W27, W45, W99, HLFUMV based on comments received from interveners on the amendment application QZ14-041-1. ▪ Correction to coordinates for W49. ▪ Minor text edits to better describe locations. ▪ Revision to station identifications based on comments received from stakeholders.
Table 2.3-3 Project Hydrology Stations During Post Closure	▪ Inclusion of "station purpose" column. ▪ Inclusion of W27, W45, W99, HLFUMV based on comments received from interveners on the amendment application QZ14-041-1.
2.4 Adaptive Management	▪ Complete revision to include three-tiered adaptive management approach as required by QML-0011. ▪ Text revision to better describe water management practices and site infrastructure.
Table 3.3-1 Summary of Eagle Gold Project Surface Water Quality Parameter List and Sample Treatment Protocols	▪ Based on comments received from stakeholders, inclusion of annotation to indicate that sampling for cyanate and thiocyanate will also be undertaken if cyanide destruction and subsequent discharge has taken place.
3.3.2 Water Quality Parameter List and Detection Limits	▪ Text revision to acknowledge that detection limits can change over time.
3.3.3 Sample Quality Assurance/Quality Control	▪ Minor text revision to better describe field practices for blanks and duplicates.
Table 3.4-1 Surface Water Quality Monitoring Locations and Frequency - Construction	▪ Revision to station identifications based on comments received from stakeholders.
Table 3.5-1 Surface Water Quality Monitoring Locations and Frequency - Operations and Active Closure	▪ Inclusion of W27, W45, W99, HLFUMV based on comments received from interveners on the amendment application QZ14-041-1. ▪ Correction to coordinates for W49. ▪ Revision to station identifications based on comments received from stakeholders. ▪ Based on comments received from stakeholders, inclusion of annotation to indicate that sampling for cyanate and thiocyanate will also be undertaken if cyanide destruction and subsequent discharge has taken place.
Table 3.7-1 Surface Water Quality Monitoring Locations and Frequency - Late	▪ Inclusion of W27, W45, W99, HLFUMV based on comments received from interveners on the amendment application QZ14-041-1. ▪ Correction to coordinates for W49. ▪ Revision to station identifications based on comments received from stakeholders.

Section	Revision/Rationale
Closure Phase and Post-closure	▪ Based on comment from stakeholder, clarification that monitoring of PG-PTS was not intended to cease once discharge was routed to Haggart Creek. ▪ Based on comments received from stakeholders, inclusion of annotation to indicate that sampling for cyanate and thiocyanate will also be undertaken if cyanide destruction and subsequent discharge has taken place. ▪ Inclusion of annotation to describe monitoring location for HLF_PTS_Inf.
3.8.1 Performance Objectives - Water Quality Criteria	▪ Inclusion of reference Yukon Water Board guidance document.
3.8.3 Operations, Closure and Post Closure	▪ Complete revision to include three-tiered adaptive management approach as required by QML-0011. ▪ Text revision to better describe water management practices and site infrastructure.
4.2 Previous Work	▪ Inclusion of reference to additional work to report on baseline information.
Table 4.3-1 Groundwater Monitoring Well Network - Construction	▪ Updates to “Comments and Construction Impacts to Well” column based on current well status.
4.3.3 Operations	▪ Minor text revisions to describe timing of new well installations.
Table 4.3-2 New Nested Operations Monitoring Wells	▪ Revision of naming convention for wells so that they are identified by the mine component they relate to and year (to be) installed to illustrate the schedule for installation through 2019. ▪ Reconsideration of proposed depths. ▪ Inclusion of additional proposed wells based on comments from stakeholders and from interveners on the amendment application QZ14-041-1.
Table 4.3-3 Proposed Groundwater Monitoring Network for Measurement of Groundwater Levels and Groundwater Quality During Operations	▪ Revision of naming convention to be consistent with Table 4.3-2. ▪ Inclusion of additional wells as suggested by stakeholders and from interveners on the amendment application QZ14-041-1.
4.3.4 Closure and Post Closure Monitoring	▪ Minor text revisions for readability.
4.5 Management	▪ Revision to section title to acknowledge that strategies are more appropriately considered ongoing management responses rather than and adaptive management to ensure that key areas of uncertainty requiring adaptive management receive the appropriate level of attention. ▪ Inclusion of cross reference to acknowledge that aspects of hydrology adaptive management interact with groundwater quantity monitoring.
5.3.2	▪ Minor text revision to better describe field practices for blanks and duplicates.

Section	Revision/Rationale
Quality Control / Quality Assurance	
5.3.3 Data Analysis	▪ Minor text revisions to update criteria that results will be compared to.
5.4 Management	▪ Revision to section title to acknowledge that strategies are more appropriately considered ongoing management responses rather than and adaptive management to ensure that key areas of uncertainty requiring adaptive management receive the appropriate level of attention.
5.4.2 Operations	▪ Complete revision to better describe management strategies.
6.5, 7.8, 8.8 and 9.5 Management	▪ Revision to section title to acknowledge that strategies are more appropriately considered management responses rather than and adaptive management to ensure that key areas of uncertainty requiring adaptive management receive the appropriate level of attention.
11 Air Quality	▪ Inclusion of result from update Air Quality Model (including emissions related to the gold recovery process) as required by QML-0011.
11.3 Management	▪ Revision to section title to acknowledge that strategies are more appropriately considered management responses rather than and adaptive management to ensure that key areas of uncertainty requiring adaptive management receive the appropriate level of attention. ▪ Minor text revisions to identify responsibility for management responses.
12.4, 13.4 Management	▪ Revision to section title to acknowledge that strategies are more appropriately considered management responses rather than and adaptive management to ensure that key areas of uncertainty requiring adaptive management receive the appropriate level of attention.
14.2 Previous Work	▪ Inclusion of discussion of sound monitoring undertaken in 2018.
14.5 Management	▪ Revision to section title to acknowledge that strategies are more appropriately considered management responses rather than and adaptive management to ensure that key areas of uncertainty requiring adaptive management receive the appropriate level of attention.
Infrastructure and Facilities	▪ Minor text revisions to describe the requirements of the annual independent physical stability inspection.
16.4, 17.4 Management	▪ Revision to section title to acknowledge that strategies are more appropriately considered management responses rather than and adaptive management to ensure that key areas of uncertainty requiring adaptive management receive the appropriate level of attention.
18.1 Introduction	▪ Reference to additional material relating to the monitoring, surveillance and adaptive management for the Heap Leach and process facilities.
18.2.2 Locations and Frequencies	▪ Updates to align with surveillance requirements described in facility specific plans and manuals.

Section	Revision/Rationale
18.3.1 Methods	▪ Updates to align with surveillance requirements described in facility specific plans and manuals.
18.5 Adaptive Management	▪ Updates to align with surveillance requirements described in facility specific plans and manuals.

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1 INTRODUCTION

1.1 PROJECT OVERVIEW

StrataGold Corporation (SGC), a directly held, wholly owned subsidiary of Victoria Gold Corp., has proposed to construct, operate, close and reclaim a gold mine in central Yukon. The Project is located 85 km from Mayo, Yukon using existing highway and access roads. The Project will involve 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. Stage 1 construction activities began in August 2017. Mechanical completion of remaining earthworks, infrastructure and commissioning is expected in Q2 2019 pending acquisition of regulatory approvals.

During operations, the open pit will be developed using standard drill and blast technology. Ore will be 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 will be 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 will be used as haul road and infrastructure construction material. Figure 1.1-1 shows the General Site Arrangement for the Project.

Figure 1.1-2 provides the overall process flow sheet for the Project. Ore will be crushed to a passing 80 percent (P80) particle size of 6.4 mm in a 3-stage crushing process. All three crushing stages will be located north of the open pit. Ore will be conveyed between the primary crushing station and the secondary and tertiary crushing stations by covered conveyor or enclosed conveyor gallery. After the tertiary crushing stage, ore will be transported by covered conveyor to the Heap Leach Facility (HLF) area where the ore will be stacked on a lined solution collection pad via a series of portable conveyors and finally a radial stacking conveyor.

Process solution containing cyanide will be applied to the ore to extract gold and then collected by the HLF leachate collection and recovery system. The HLF pad will consist 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. Lined ponds external to the HLF (the Event Pond – Figure 1.1-1) will be constructed for the life of the Project 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 will be recycled back into the heap leach circuit as required.

Gold-bearing “pregnant” solution (pregnant leach solution [PLS]) will be pumped from the HLF to the gold recovery plant. Gold will be 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 will be re-circulated back to the HLF.

1.2 PROJECT LOCATION AND BACKGROUND

The proposed 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 well 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 application for Water Use Licence QZ14-041 and as appendices to the annual reports required by QZ14-041 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 SGC's advanced exploration camp and historic placer mining areas.

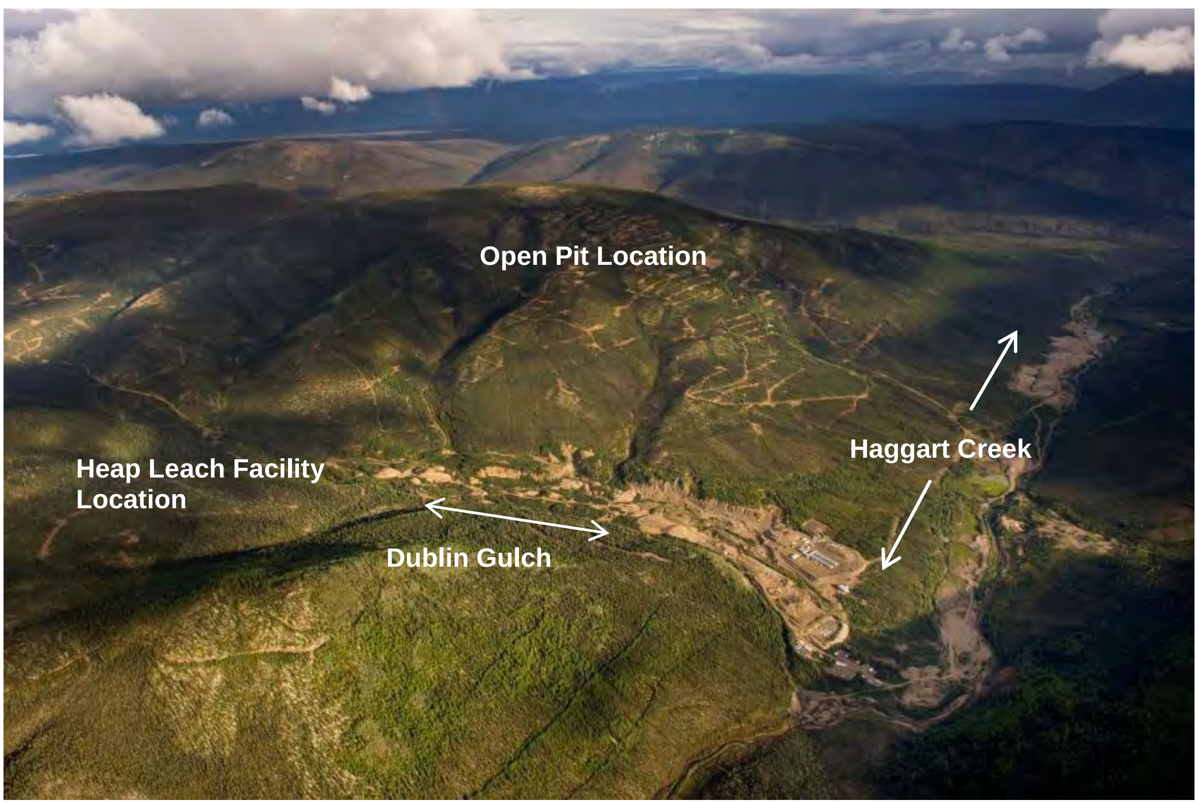


Photo 1.2-1: Site Location

1.3 PROJECT SCHEDULE

Construction activities began in Q3 2017 with mechanical completion expected in Q2 2019 pending acquisition of regulatory approvals. 2017 construction activities included camp expansion, access road and bridge upgrades, site road construction, water management pond construction, diversions and ditching, clearing and grubbing, civil earthworks, septic system upgrade, and borrow source development. The bulk of construction activities that remain will commence in early spring 2018 with a target construction completion date and mine commissioning in Q3 2019.

A summary of the Project schedule is provided in Table 1.3-1.

Table 1.3-1: Tentative Project Schedule

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

1.4 SCOPE AND OBJECTIVES

SGC has updated this Environmental Monitoring, Adaptive Management, and Reporting Plan to comply with the requirements of Quartz Mining Licence QML-0011 and Type A Water Use Licence QZ14-041, and to reflect the monitoring conditions and site experience gained after the first stage of construction. 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. For example, uncertainties with regard to groundwater baseline data are addressed by updating the groundwater model with additional data collected subsequent to licencing and calibration.

SGC has developed other operational plans which function to adaptively manage project performance, including 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 are addressed using adaptive management described herein, include:

- Surface Water Hydrology, and potential changes to hydrologic flow regime in Haggart Creek; and
- Surface Water Quality predictions.

Adaptive management plans for these two environmental components are described in this plan and aim to minimize the potential for significant adverse effects on the 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.

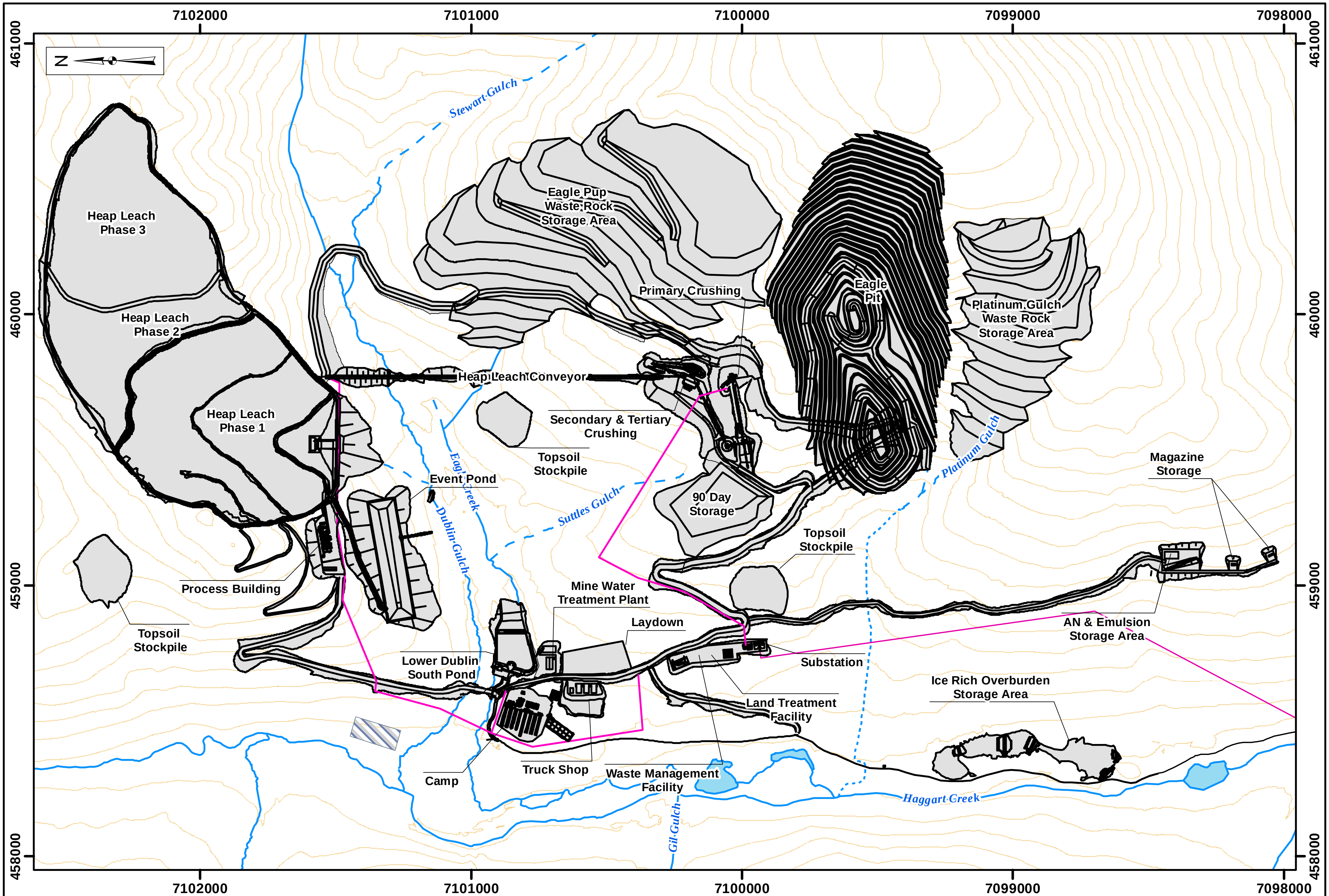
Results of the monitoring programs described in this report will be evaluated throughout all Project phases to determine if adverse environmental impacts occur or there are unacceptable risks to facility and infrastructure. If the results indicate that there are no adverse environmental impacts, the frequency and length of monitoring and maintenance would continue as planned. Additional or alternative mitigation measures will be implemented to respond to negative trends that are observed or when performance objectives are exceeded.

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 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 Studies as required by the *Metals Mining Effluent Regulations* (MMER) are not fully captured in this Plan. Once the monitoring programs required by the MMER have been approved by the Department of Fisheries and Oceans Canada, they will be provided to the Yukon Water Board and Yukon

Government and the results of the studies and programs will be included in the annual report required by Quartz Mining Licence QML-0011 and Type A Water Use Licence QZ14-041.



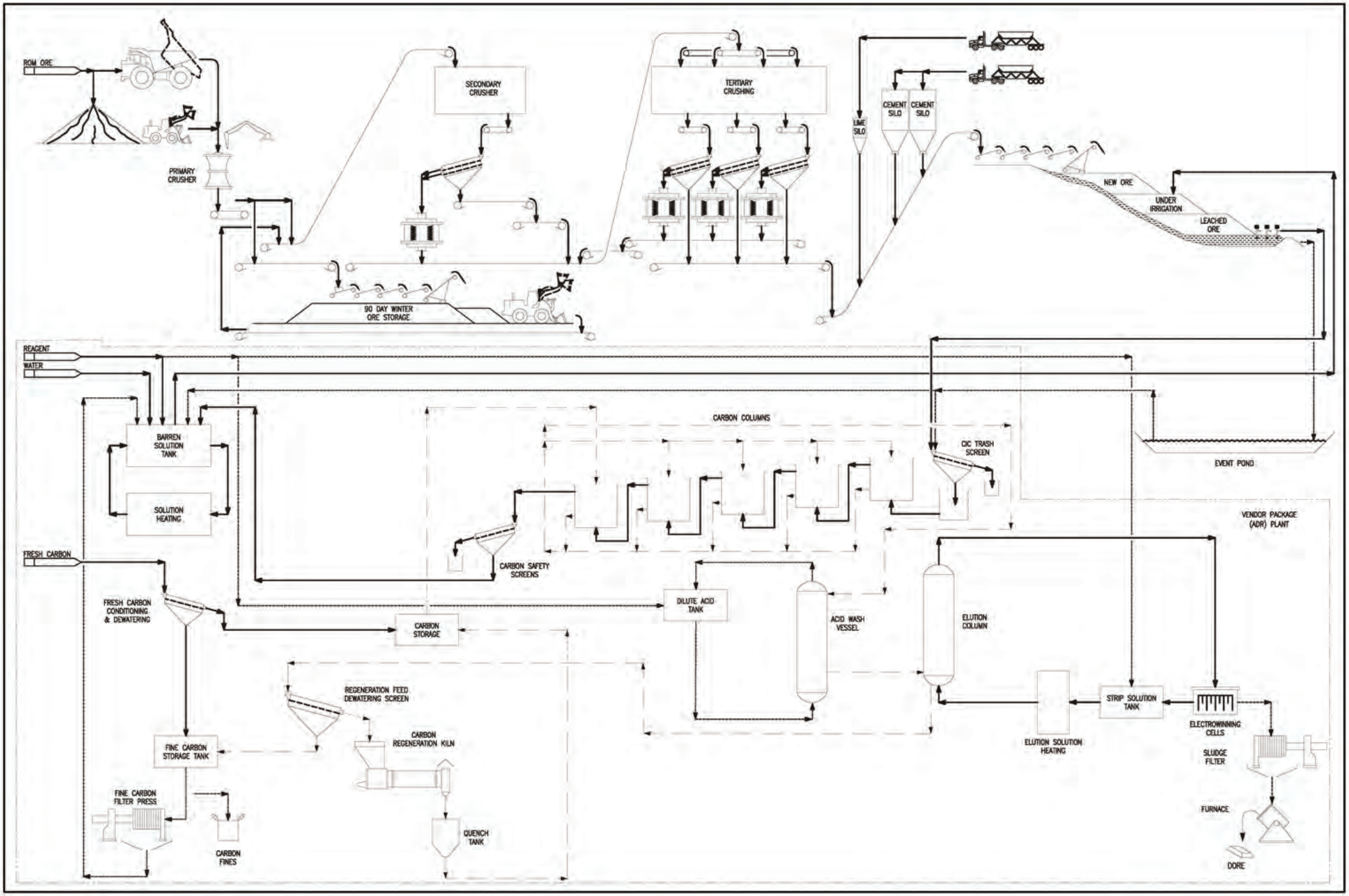
Legend:

- Facility
- Site Power
- Reserved Area
- Perennial
- Ephemeral
- Intermittent
- Waterbody
- Contour (25m)

StrataGold Corporation

0 125 250 500
Metres

Projection:	Drawn By:	EAGLE GOLD PROJECT YUKON TERRITORY
NAD 83 UTM Zone 8N	JK	
Date: 2019/04/10	Figure: 1.1-1	Site General Arrangement



Legend:

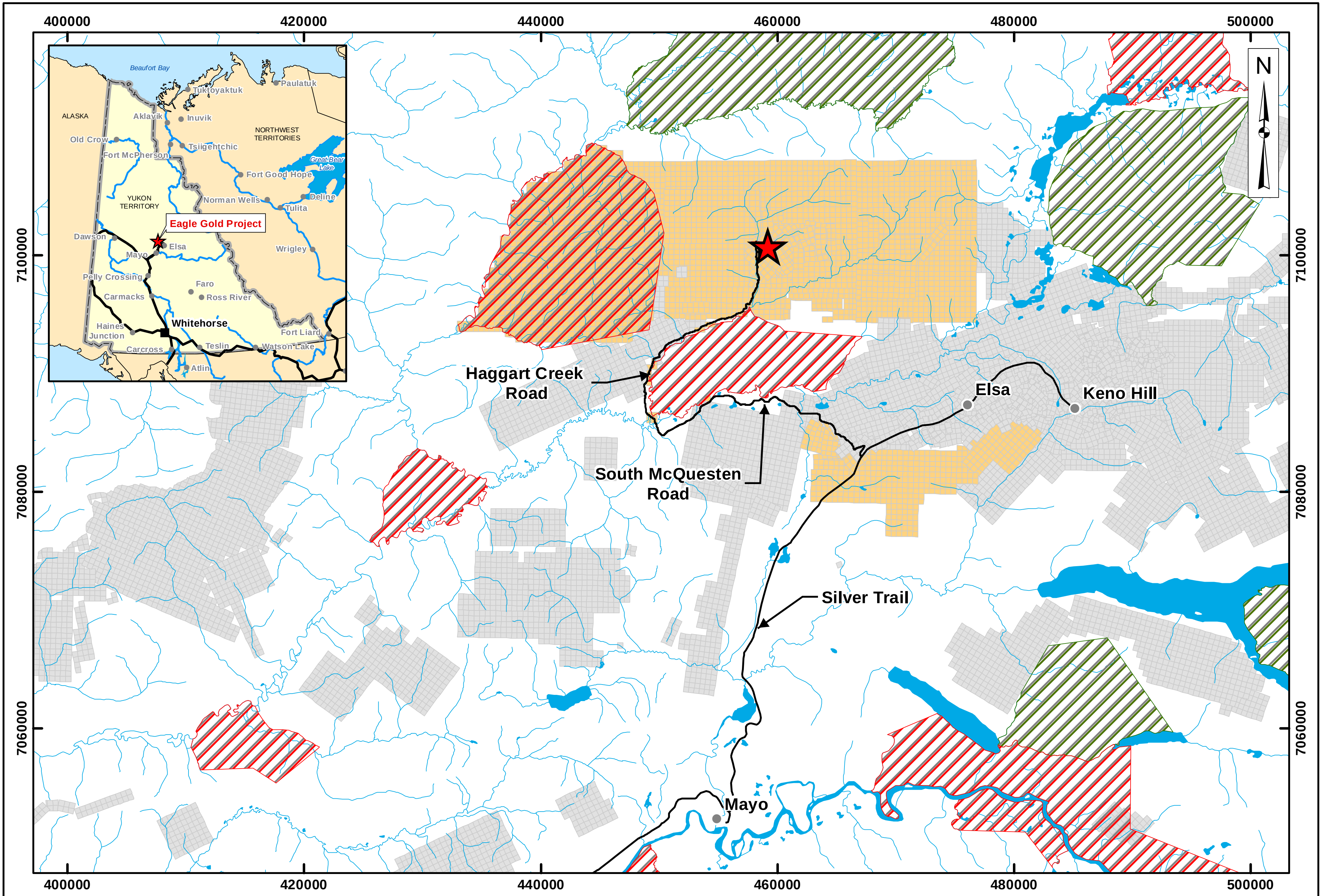
Process Solution Flowpath

Solution Flowpath Intermittent

Carbon Flowpath Intermittent

StrataGold Corporation

Projection:	Drawn By: HC	**EAGLE GOLD PROJECT YUKON TERRITORY**
Date: 2017/06/08	Figure: 1.1-2	**Process Flowsheet**



Legend:

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

StrataGold Corporation

0 3 6 12 Kilometres

Projection: NAD 83 Zone 8N

Drawn By: HC

Date: 2017/06/01

Figure: 1.2-1

EAGLE GOLD PROJECT
YUKON TERRITORY

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 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 PREVIOUS WORK

Historically, baseline hydrology information has been collected in the Project area for two periods: from 1993 to 1996 and 2007 to present. The more recent baseline hydrology data collection was established in August 2007 with the installation of automated and manual hydrology stations in the Dublin Gulch, Haggart Creek and Lynx Creek basins. 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. The automated station installations included a pressure transducer and datalogger to continuously measure water level during the open water season, whereas the manual stations included only point discharge measurements taken over a range of flows throughout the season.

The locations of the existing automated stations are summarized in the Table 2.2-1 and shown on Figure 2.2-1. These stations are typically removed at the end of each open water season (end of October or early November) and re-installed prior to the freshet in the following year. Discharge measurements at both the automated and manual stations were generally conducted using either the velocity-area method with a current flow meter, flumes/weirs or salt dilution method (mostly during freeze-up or under ice conditions) with a conductivity probe.

Table 2.2-1: Baseline Hydrology Automated Station Locations

Site	Location Description	Coordinates		
		Zone	North	East
W1	Dublin Gulch above Stewart Gulch	8	7101545	460249
W4	Haggart Creek below Dublin Gulch	8	7101223	458144
W5	Haggart Creek above Lynx Creek	8	7095888	457814
W6	Lynx Creek above Haggart Creek	8	7095964	458099
W22	Haggart Creek above Dublin Gulch	8	7101378	458319
W26	Stewart Gulch	8	7101443	460331
W27	Eagle Creek near camp	8	7100997	458235
W29	Haggart Creek below Eagle Creek	8	7099583	458225

2.3 METHODS

The hydrology monitoring program will continue to collect continuous streamflow data in the Dublin Gulch, Haggart Creek and Lynx Creek watersheds. This will be 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.

As construction continues new stations may be added to monitor for changes to watercourses and to comply with licence conditions. During the operations phase of the Project, the hydrology program will include volumetric flow monitoring of internal water transfers between certain facilities and discharges to the environment will also be included in the hydrology program.

2.3.1 General

The hydrology monitoring program will use 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 will be 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 which will be equipped with flow meters). At automated hydrology stations, water level will be 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 will be conducted to ensure the instrumentation is in good working order and to perform discharge measurements.

Site visits will include the following general tasks:

- Perform routine maintenance on the station components and verify that no damage has occurred to the installation. All components will be in good working order.
- 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 will be 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 to Figure 2.3-3 and summarized in Table 2.3-1 to Table 2.3-3. The stations in Haggart Creek were chosen to coincide with key monitoring locations for water quality.

Table 2.3-1: Project Hydrology Stations during Construction

Station	Location Description	Station Purpose	Coordinates (Zone 8)	
			North	East
W1[a]	Dublin Gulch above Stewart	Above Project influence	7101545	460249
W21[d]	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[b]	Haggart Creek below Lynx Creek	Receiving Environment	7095682	457790
W26[a]	Stewart Gulch	Above Project Influence	7101443	460331
W27[a]	Eagle Creek near Camp below LDSP	Receiving Environment	7100997	458235
W29[a]	Haggart Creek below Eagle Creek and Platinum Gulch	Receiving Environment	7099583	458225
W39[c]	Haggart Creek above South McQuesten River	Receiving Environment	7086504	449780
W45[a]	Eagle Creek above Haggart Creek	Receiving Environment	7099684	458243
W49[c]	South McQuesten River below Haggart Creek	Below Project Influence	7085495	449221
EPS[d]	Eagle Pup WRSA Seepage (Ditch/Pipe B)	Transfer between Engineered Structures	7100909	459834
PDI[d]	Platinum Gulch Ditch into Eagle Creek Pond (Ditch/Pipe A)	Transfer between Engineered Structures	7099523	459184
LDSPI[d]	Lower Dublin South Pond Inflow	Transfer between Engineered Structures	7100824	458926
LDSP[d]	Lower Dublin South Pond Outflow	Effluent Discharge to Haggart Creek	7100857	458672
CS-01[d]	Sediment Basin – below lower Process Access Road	Effluent Discharge to Haggart Creek	7101146	458528
CS-03[d]	Sediment Basin – below Truck Shop	Effluent Discharge to Haggart Creek	7100380	458476
CS-06[d]	Sediment Basin - below AN/Emulsion access and storage area	Effluent Discharge to Haggart Creek	7098410	458407
CS-07[d]	Sediment Basin – below Ice Rich Storage Area	Effluent Discharge to Haggart Creek	7098627	458268

[a] Automated monitoring. Manual monitoring weekly during freshet until loggers installed and twice a month during winter
[b] Manual monitoring on a monthly basis
[c] Manual monitoring on a quarterly basis
[d] Station may be either manual or automatic. Measurements taken weekly when discharging if manual measurement only

Table 2.3-2: 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[i]	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[c]	Bawn Boy Gulch	Above Project Influence	7101961	461945
W23[c]	Haggart Creek below Lynx Creek	Receiving Environment	7095682	457790
W29[a]	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[d]	Haggart Creek above South McQuesten River	Receiving Environment	7086504	449780
W49[d]	South McQuesten River below Haggart Creek	Receiving Environment	7085495	449221
W99[a]	Haggart Creek above 15 Pup	Receiving Environment	TBD	TBD
EPS[e]	Eagle Pup WRSA Seepage (Ditch/Pipe B)	Transfer between Engineered Structures	7100909	459834
PGS[e]	Platinum Gulch WRSA Seepage (Ditch/Pipe A)	Transfer between Engineered Structures	7099436	459281
PDI & PG PTS[j]	Platinum Gulch Ditch into Lower Dublin South Pond (Ditch/Pipe A; PG Passive Treatment System)	Transfer between Engineered Structures	7099523	459184
HLFUMV[g]	Heap Leach Facility Underdrain Monitoring Vault	Transfer between Engineered Structures	7101298	459445
PS[f]	Open Pit Sump	Transfer between Engineered Structures	7099574	459536
MWTP[g]	Mine Water Treatment Plant	Transfer between Engineered Structures	TBD	TBD
FT[g]	Mine Water Treatment Plant Finishing Tank	Transfer between Engineered Structures	TBD	TBD
LDSPI[g]	Lower Dublin South Pond Inflow	Transfer between Engineered Structures	7100824	458926
LDSP[g]	Lower Dublin South Pond Outflow	Effluent Discharge to Haggart Creek	7100857	458672
CS-07[e]	Sediment Basin – below Ice Rich Storage Area	Effluent Discharge to Haggart Creek	7098627	458268
OPP[i]	Open Pit Pond	Transfer between Engineered Structures	7099460	459359

Station	Location Description	Station Purpose	Coordinates (Zone 8)	
			North	East
OPPO[c]	Open Pit Pond Overflow	Transfer between Engineered Structures	7099460	459359

[a] Automated monitoring. Manual monitoring weekly during freshet until loggers installed and twice a month during winter
[b] Manual monitoring on a monthly basis during closure
[c] Manual monitoring on a monthly basis
[d] Manual monitoring on a quarterly basis
[e] Station may be either manual or automatic. Measurements taken monthly when discharging if manual measurement only
[f] Automated monitoring when dewatering
[g] Automated monitoring when discharging
[h] Manual monitoring on a daily basis when discharging
[i] Manual measurement of water level
[j] Platinum ditch intake converted to Platinum Gulch PTS when PG WRSA is progressively reclaimed

Table 2.3-3: 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	Stewart Gulch	Above Project Influence	7101443	460331
W21[i]	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[c]	Bawn Boy Gulch	Above Project Influence	7101961	461945
W23[b]	Haggart Creek below Lynx Creek	Receiving Environment	7095682	457790
W29[a]	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[c]	Haggart Creek above South McQuesten River	Receiving Environment	7086504	449780
W49[c]	South McQuesten River below Haggart Creek	Receiving Environment	7085495	458243
W99[a]	Haggart Creek above 15 Pup	Receiving Environment	TBD	TBD
HLFUMV[b]	Heap Leach Facility Underdrain Monitoring Vault	Transfer between Engineered Structures	459445	7101298
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

Station	Location Description	Station Purpose	Coordinates (Zone 8)	
			North	East
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[c]	Open Pit Pond Overflow	Transfer between Engineered Structures	7099460	459359

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

2.3.3 Frequency

Hydrology stations are subject to winter freeze and therefore automated monitoring stations will only be operated during the mostly ice-free portions of the hydrologic year. Three site visits per year per station will be 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 will be added. Discharge measurements that are to be used for rating curve development will be conducted at times when the hydrologic control is unaffected by ice or snow. During freeze-up conditions and throughout winter, two measurements per month will be conducted after the dataloggers have been removed, unless adverse weather conditions (e.g., extreme cold) present unsafe field conditions.

In accordance with the conditions of Water Use Licence QZ14-041, hydrology monitoring in the receiving environment was undertaken prior to the commencement of construction activities for the Project. When construction activities commenced in August 2017, the scope of the monitoring program continued to encompass the same discharge points. The scope of monitoring will increase during the operations and active closure phases to include transfer points between engineered facilities to verify and periodically update the site water balance model. 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 to 2.3-3.

2.3.4 Data Analysis and Reporting

Recorded water level and discharge measurement data will be 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) will be 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, 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 Construction

The construction of watercourse diversions is predicted to have nominal effects to water flow in Haggart Creek downstream of the Project. Currently, during construction, the Lower Dublin South Pond (LDSP) is the collection point for runoff (sediment-laden water) from disturbed areas. The LDSP is a two-stage settling pond and the outflow is controlled by a primary riser-pipe outlet to prevent the release of sediment-laden water, prior to discharge to Haggart Creek above hydrometric station W4. Surface water contributions that report to the LDSP consist of Ditch A (extends up to and intercepts upper Platinum Gulch) and Ditch B (formerly Eagle Creek). As a result, flows in the downstream section of Eagle Creek will be reduced and the peak flows will be attenuated.

During construction, the LDSP collects sediment-laden water from construction areas in the upstream catchments generally south of Dublin Gulch. This excludes construction activities associated with the HLF system (e.g., in the Ann Gulch watershed), which are self-contained using exfiltration ponds. LDSP water has been used for dust suppression during construction. When necessary, pond water will be discharged to Haggart Creek when it meets discharge criteria.

Continuous streamflow monitoring in Dublin Gulch, Eagle Creek and Haggart Creek provides data to examine potential effects of construction activities on flow. In the event of measurable and significant changes in water flow at Haggart Creek hydrometric stations W4 and W29[1] (where water quality objectives have been established) that cannot be attributed to seasonal or natural climatic variability, the three-tiered adaptive management plan described below will be initiated.

2.4.3 Operations, Closure and Post Closure

Reduction in Flow

During operation, the LDSP will collect sediment-laden water and contact water (e.g. seepage and rock-drain flow) from the EP WRSA, the PG WRSA, the 90-day Stockpile and water collected in the Open Pit. Pond water will be used for process make-up water, used for 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); however, there is the potential for a very 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 very 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 approximately 1% from May to October to up to 3% to 6% from December through April during mine operations. During active, passive and post closure, the reduction in baseflow and increase in stream leakage are estimated to reduce stream flow at W5 by less than 1% to 2% from May through November, and by 2% to 5% from December to April (BGC 2014).

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 W29. 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,

[1] Hydrometric station W29 is being relocated downstream due to channel instabilities and difficulties in maintaining stage control

lower standard deviation derived values of 15%, 20% and 25% appear to be a better management threshold for the ice-covered season. 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 existing 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 Hydrology Baseline Report, Lorax 2018)	Threshold 1: Ice-free season: 30% of the median monthly baseline flow for seven consecutive days Ice-covered season: 15% of median monthly baseflow for seven consecutive days	**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.
		Evaluation: ✓ Compare to baseline and with up or downstream stations as appropriate; ✓ 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 W29; ✓ Estimate the time to reach Threshold 2 based on identified trends if any; ✓ Assess whether the declines are associated with and can be isolated to a particular tributary (Dublin, Eagle, etc.), instrumentation, engineering infrastructure or water use.
		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 during the month.
	Threshold 2: Ice-free season: 40% of the median monthly baseline flow for	**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 email notification to EMR-CMI inspector and FN NND after confirming threshold percent reduction and duration within 7 days after confirming threshold was reached and maintained; ✓ Provide summary of AMP notifications, reviews, evaluations and actions in monthly report.

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**
	14 consecutive days Ice-covered season: 20% of median monthly baseflow for 14 consecutive days	**Review:** ✓ Continue to perform reviews as per Threshold 1 as appropriate; ✓ Ensure equipment, instrumentation, gages and meters are functioning properly; ✓ Conduct surveys using benchmarks to establish whether gaging station (if in ice-free season) has been affected.
		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 W29 to baseline hydrographs; ✓ 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 W29; ✓ Examine continuous groundwater level data in lower Dublin Gulch valley wells (e.g., BH-BGC11-72) 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; ✓ Conduct high level water balance evaluations and to assess whether water management infrastructure or systems or changes in water used could be contributing to the streamflow reduction. Possible causes are increased process water demand, reduced groundwater recharge from process water demands; ✓ Assess whether the declines can be isolated to a particular tributary (Dublin, Eagle, etc.).

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**
		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 W29; conduct additional monitoring at key tributary gauging stations identified above; ✓ 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; ✓ Conduct desktop review and analysis to describe Haggart Creek wetted useable area and possible effects due to longer term sustained reduction of streamflow; ✓ Identify critical aquatic habitat reaches in Haggart Creek susceptible to reduced fish passage during streamflow reductions including downstream reaches to W23.
	Threshold 3: Ice-free season: 50% of the median monthly baseline flow for 21 or more consecutive days Ice-covered season: 25% of median monthly baseflow for 21 or more consecutive days	**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. **Review:** ✓ Continue to perform reviews as per Thresholds 1 and 2 as appropriate; ✓ 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

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**
		water management infrastructure or systems, or water use that could be contributing to the streamflow reduction; ✓ 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; ✓ Continue increased monitoring frequency to an adequate level to fully characterize trends in W4, W29 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 not very likely 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 Management Contingency Plan.

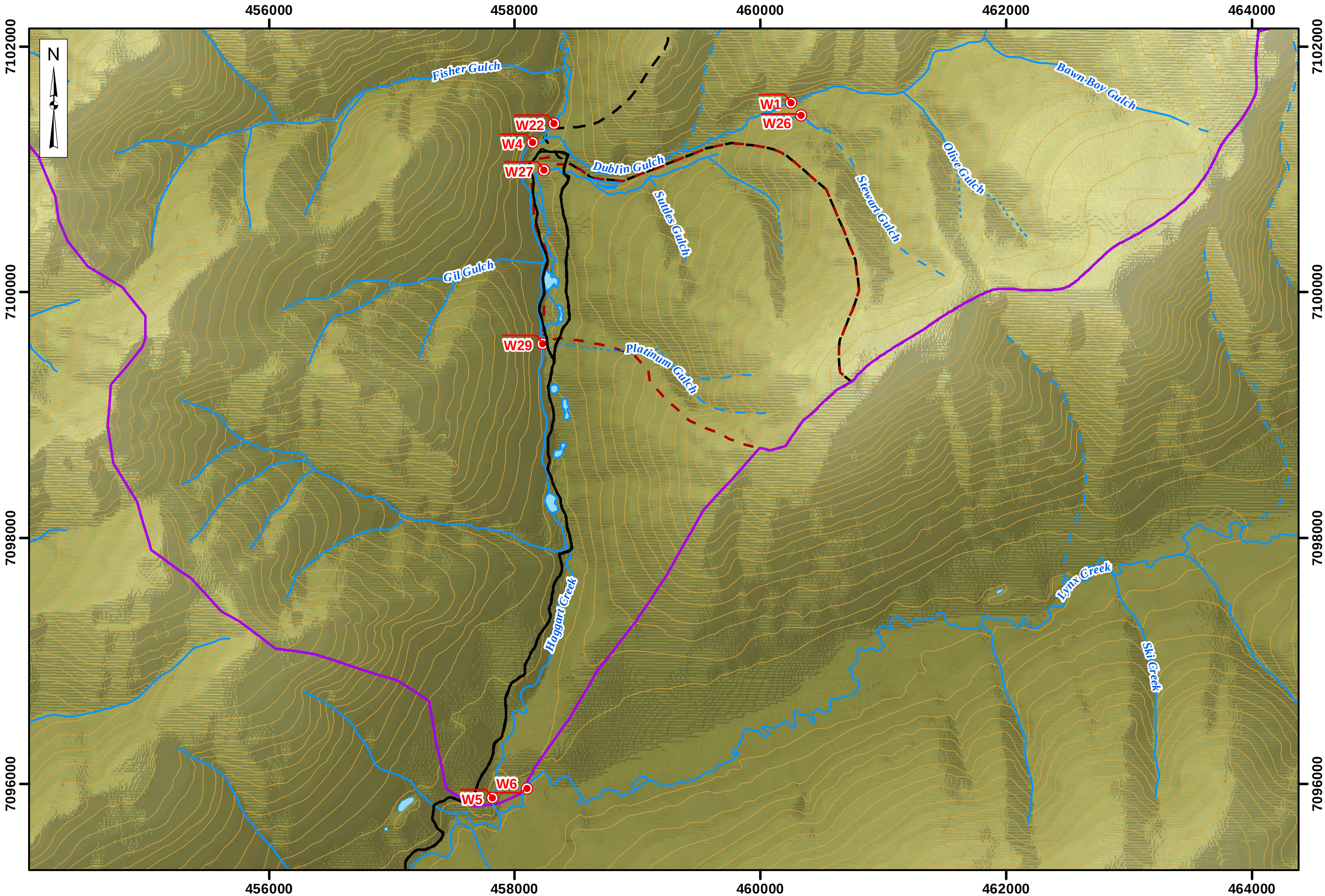
Design criteria for all water management structures (diversions, ditches, ponds, etc.) are contained in the Construction and Operations Water Management Plan. Precipitation events that exceed design criteria could result in damage to water conveyance infrastructure, physical instability of project facilities 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 identified.



Legend:

Hydrometric Monitoring Station	Dublin Gulch Basin
Eagle Project Access Road	Eagle Creek Basin
Contour (100ft)	Upper Haggart Creek Basin
Perennial	
Ephemeral	
Intermittent	

StrataGold Corporation

0 0.25 0.5 1
Kilometers

Projection: NAD 83 UTM Zone 8N

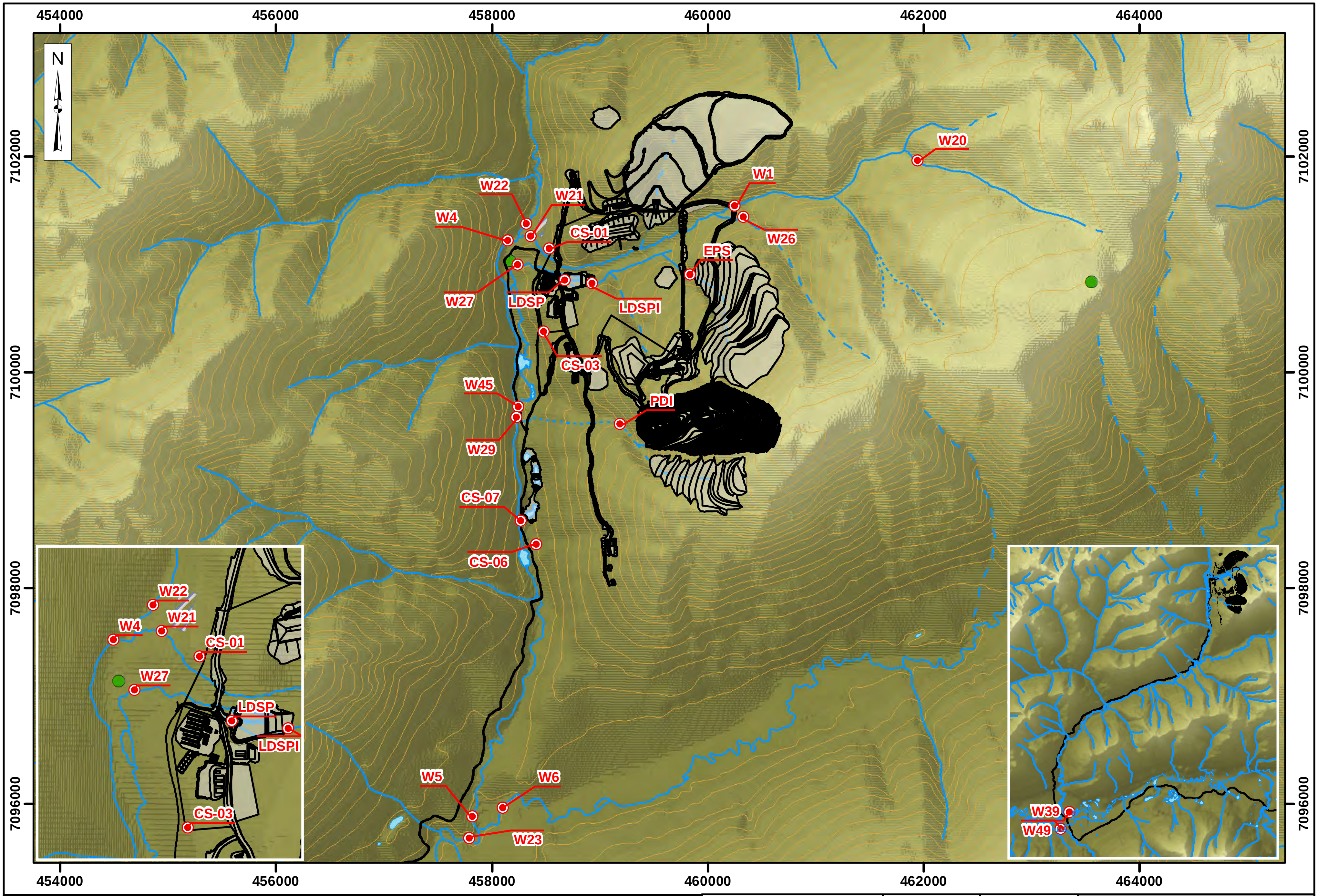
Drawn By: HC

Date: 2017/06/06

Figure: 2.2-1

EAGLE GOLD PROJECT
YUKON TERRITORY

Baseline Phase Hydrology Monitoring Stations



Legend:
- Hydrometric Monitoring Station
- Climate Station
- Reserved Area
- Contour (100ft)
- Perennial
- Ephemeral
- Intermittent

StrataGold Corporation

Projection: NAD 83 UTM Zone 8N

Drawn By: JK

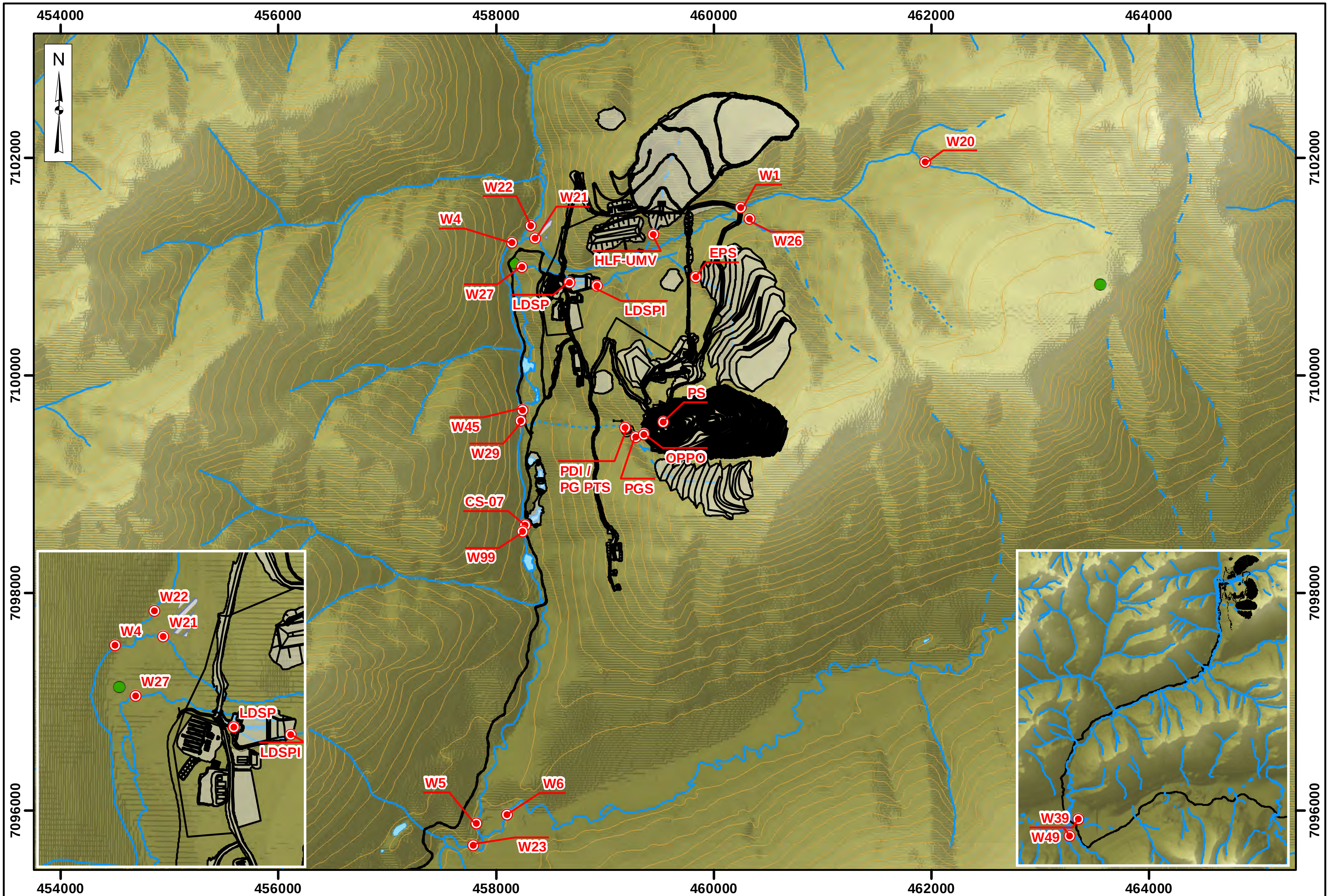
0 0.75 1.5 Kilometers

Date: 2019/04/10

Figure: 2.3-1

EAGLE GOLD PROJECT
YUKON TERRITORY

Construction Phase Hydrology Monitoring Stations



Legend:

- Hydrometric Monitoring Station
- Climate Station
- Facility
- Reserved Area
- Contour (100ft)
- Perennial
- Ephemeral
- Intermittent

StrataGold Corporation

0 0.75 1.5
Kilometers

Projection: NAD 83 UTM Zone 8N

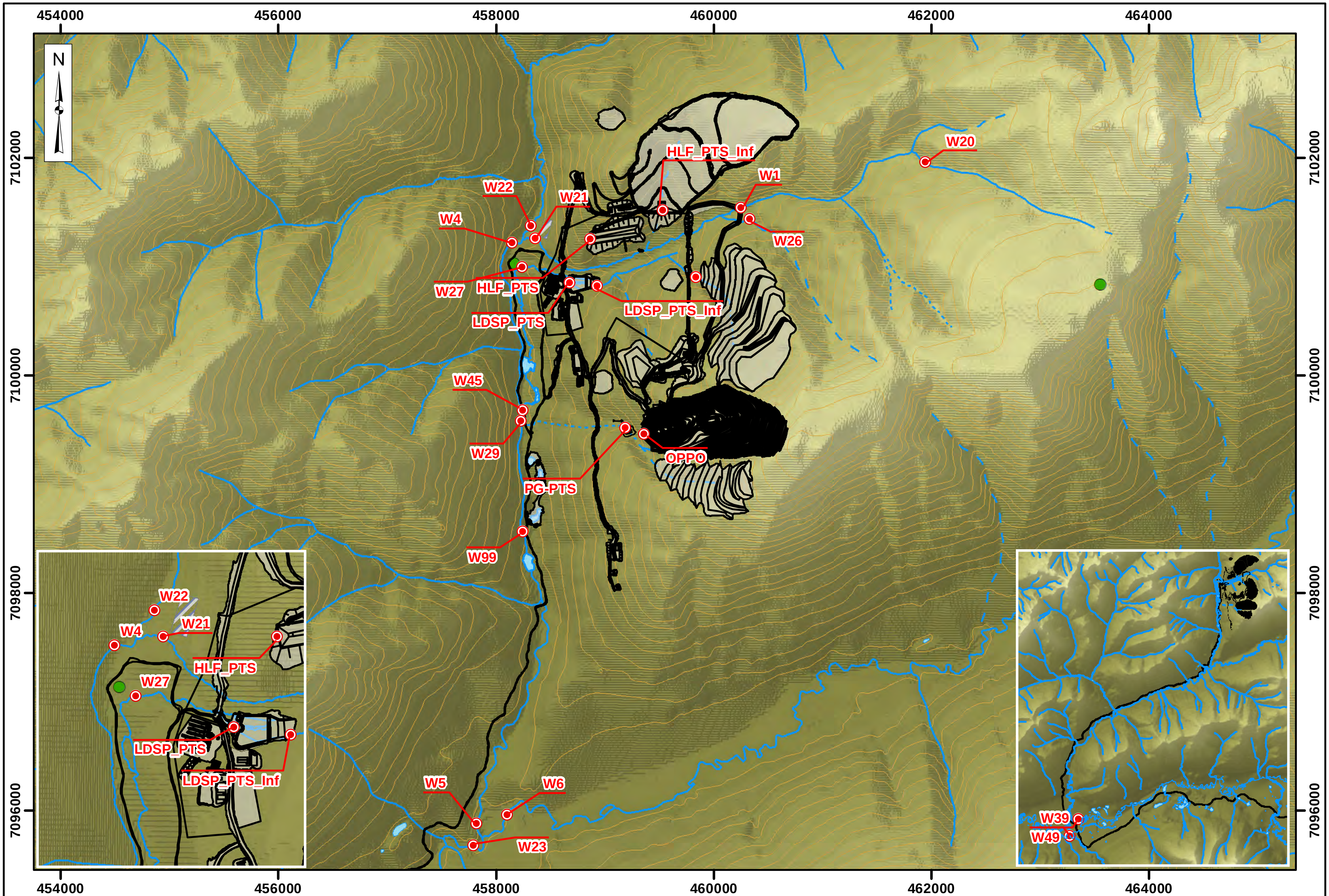
Drawn By: JK

Date: 2019/04/10

Figure: 2.3-2

EAGLE GOLD PROJECT
YUKON TERRITORY

Operations & Active Closure Phase Hydrology Monitoring Stations



Legend:

- Hydrometric Monitoring Station
- Climate Station
- Facility
- Reserved Area
- Contour (100ft)
- Perennial
- Ephemeral
- Intermittent

StrataGold Corporation

0 0.75 1.5 Kilometers

Projection: NAD 83 UTM Zone 8N

Drawn By: JK

Date: 2019/04/10

Figure: 2.3-3

EAGLE GOLD PROJECT
YUKON TERRITORY

Post Closure Phase
Hydrology Monitoring Stations

3 SURFACE WATER QUALITY

3.1 INTRODUCTION

The surface water quality monitoring program during construction 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:

- Continue to collect water quality data in the receiving environment as the Project transitions from construction to operations at stations upstream and downstream of Project influences.
- Collect water quality data to verify compliance with the discharge criteria specified in QZ14-041.
- 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. 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 will target 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 PREVIOUS 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. 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.

Table 3.2-1 provides details of the completed baseline water quality monitoring program including the location, rationale and number of samples collected for the period of 2007 to 2016 for each station. Figure 3.2-1 illustrates these baseline surface water quality monitoring station locations.

Table 3.2-1: Baseline Water Quality Site Locations, Rationale and Number of Sampling Dates, 2007–2016

Site	Location Description	Coordinates		Rationale	No. of Samples
		Northing	Easting		2007 to 2016
Haggart Creek Drainage Basin					
W22	Haggart above Dublin Gulch	7101377	458319	Above Project influence	55
W4	Haggart below Dublin Gulch	7101223	458144	Below Project influence	47
W68	Haggart upstream of Gill Gulch	7100482	458175	Below Project influence	1
W29	Haggart below Eagle Creek	7099583	458225	Below Project influence	48
W5	Haggart above Lynx Creek	7095887	457815	Below Project influence	32
W23	Haggart below Lynx Creek	7095682	457790	Below Project influence	38
W39	Haggart above South McQuesten River	7086504	449780	Far field Below Project	12
Dublin Gulch Drainage Basin					
W20	Bawn Boy Gulch	7101961	461945	Above Project influence	16
W1	Dublin Gulch above Stewart Gulch	7101545	460249	Above Project influence	58
W26	Stewart Gulch	7101443	460331	Above Project influence	32
W32	Ann Gulch	7101211	459412	Below Project influence	1
W21	Dublin Gulch above Haggart Creek	7101261	458359	Below Project influence	45
Eagle Creek Drainage Basin					
W9	Eagle Pup	7101052	459630	Below Project influence	36
W10	Suttles Gulch	7100841	459161	Below Project influence	10
W61	Eagle Creek below Suttles Gulch	7100895	459139	Below Project influence	12
W27	Eagle Creek midway	7100997	458235	Below Project influence	49
W67	Platinum Gulch at road	7099624	458896	Below Project influence	2
W45	Eagle Creek above Haggart Creek	7099684	458243	Below Project influence	17
Lynx Creek Drainage Basin					
W13	Lynx Creek above Ray Creek	7098295	464770	No Project influence	3
W6	Lynx Creek above Haggart Creek	7095964	458099	No Project influence	28
LC1[a]	Upper basin of Lynx	7103295	470813	No Project influence	1
LC2[a]	Upper basin of Lynx	7101698	469571	No Project influence	1
LC3[a]	Upper basin of Lynx	7101702	469572	No Project influence	1

Site	Location Description	Coordinates		Rationale	No. of Samples
		Northing	Easting		2007 to 2016
LC4[a]	Upper basin of Lynx	7099942	467979	No Project influence	1
LC5[a]	Upper basin of Lynx	7099927	467974	No Project influence	1
LC6[a]	Upper basin of Lynx	7099997	467888	No Project influence	1
LC7[a]	Upper basin of Lynx	7104354	471115	No Project influence	1
South McQuesten Drainage Basin					
W49	South McQuesten below Haggart Creek	7085495	449221	Far field below Project	21

NOTES:
Source: Lorax 2017b
No sampling occurred in 2015
[a] One-time Upper Lynx Creek sampling (7 stations) collected on August 20, 2012 to provide additional water quality characterization of reference stream

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 appropriate 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 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 in coolers 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 (conductivity, hardness, pH, TSS, TDS, Turbidity) + Anions (Alkalinity, Br, Cl, F, SO4)
HCl	YES	Total Organic Carbon, dissolved Organic Carbon
None	YES	Nutrients (NH3-N, NO3-N, NO2-N, TKN, Total N, dissolved orth-PO4, total diss. PO4, Total PO4)
HNO3	NO	Total Metals
HNO3	YES	Dissolved Metals

HNO3	NO	Total Mercury
HNO3	YES	Dissolved Mercury
NaOH	YES	Total CN, WAD CN
NaOH	YES	Cyanate*
HNO3	YES	Thiocyanate*

* Cyanate and thiocyanate sampling will be undertaken if adaptive management threshold for Total and WAD CN are reached at specific monitoring locations in the receiving environment or if CN destruction and subsequent discharge has taken place.

3.3.2 Water Quality Parameter List and Detection Limits

The suite of water quality parameters to be 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, conductivity, turbidity, TSS, TDS and hardness); field parameters (pH, conductivity, 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, total phosphate-P, sulphate, bromide, chloride, fluoride); and, total and dissolved metals (Al, Sb, As, Ba, Be, Bi, B, Cd, Ca, Cr, Co, Cu, Fe, Pb, Li, Mg, Mn, Mo, Hg, Ni, P, K, Se, Si, Ag, Na, Sr, Tl, Sn, Ti, U, V, 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	Conductivity	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

Parameter		Units	Detection Limit	Parameter		Units	Detection Limit
	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
	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, Total	mg/L	0.005		Silver	mg/L	0.00001
	Cyanate	mg/L	0.2		Sodium	mg/L	2
					Sulphur	mg/L	0.50
	Thiocyanate	mg/L	0.5		Strontium	mg/L	0.0001
Field Parameters	pH	—	0.01		Thallium	mg/L	0.0001
	Temperature	°C	0.1		Tin	mg/L	0.0001
	Conductivity	μS/cm	1		Titanium	mg/L	0.01
	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
	Antimony	mg/L	0.0001		Zinc	mg/L	0.003

3.3.3 Sampling Quality Assurance/Quality Control

Surface water quality 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 field blanks and duplicates, laboratory replicates, and certified reference materials. All blank samples will be composed of distilled de-ionized water, of known composition, supplied by the analytical laboratory. Field replicates 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 field duplicates will be submitted for every sampling event 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 surface water quality results and to identify outliers and false positives in the results.

Laboratory replicates, comprising sample splits, will be 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 will be 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.

3.4 CONSTRUCTION

3.4.1 Locations and Frequency

The surface water quality monitoring program for the construction phase will focus on environmental effects monitoring and compliance monitoring associated with QZ14-041.

Figure 3.4-1 illustrates the construction phase surface water quality monitoring locations. Table 3.4-1 provides a summary of each monitoring station, location, coordinates and monitoring frequency for the construction period.

Table 3.4-1: Surface Water Quality Monitoring Locations and Frequency – Construction

Site	Location Description	Coordinates (Zone 8)		Sampling Frequency			
				Field Measurements		Laboratory Analysis	
		North	East	Turbidity	pH, Temperature, Dissolved Oxygen, Turbidity and Conductivity	Turbidity and Total Suspended Solids	Full Analytical Suite
W1	Dublin Gulch above Stewart	7101545	460249	-	M	-	M
W21	Dublin Gulch at mouth	7101261	458359	-	M	-	M
W4	Haggart Creek below Dublin	7101223	458144	-	M	-	M
W22	Haggart Creek above Project Influence	7101378	458319	-	M	-	M
W5	Haggart Creek above Lynx Creek	7095888	457814	-	M	-	M
W6	Lynx Creek above Haggart Creek	7095964	458099	-	Q	-	Q
W20	Bawn Boy Gulch	7101961	461945	-	M	-	M
W23	Haggart Creek below Lynx Creek	7095682	457790	-	M	-	M
W26	Stewart Gulch	7101443	460331	-	M	-	M
W27	Eagle Creek near Camp	7100997	458235	-	M	-	M
W29	Haggart Creek below Eagle Creek and Platinum Gulch	7099583	458225	-	M	-	M
W39	Haggart Creek above South McQuesten River	7086504	449780	-	Q	-	Q
W45	Eagle Creek above Haggart Creek	7099684	458243	-	M	-	M
W49	South McQuesten River below Haggart Creek	7085495	449221	-	Q	-	Q
EPS	Eagle Pup WRSA Seepage	7100909	459834	D	Md	Wd	Md
PDI	Platinum Gulch Ditch into Lower Dublin South Pond	7099523	459184	D	Md	Wd	Md
LDSPI	Lower Dublin South Pond Inflow	7100824	458926	D	Md	Wd	Md
LDSPO	Lower Dublin South Pond Outflow	7100857	458672	D	Md	Wd	Md
CS-01	Sediment Basin - below Lower Process Access Road	7101146	458528	D	Md	Wd	Md

Site	Location Description	Coordinates (Zone 8)		Sampling Frequency			
				Field Measurements		Laboratory Analysis	
		North	East	Turbidity	pH, Temperature, Dissolved Oxygen, Turbidity and Conductivity	Turbidity and Total Suspended Solids	Full Analytical Suite
CS-03	Sediment Basin – below Truck Shop	7101146	458476	D	Md	Wd	Md
CS-06	Sediment Basin - below south infrastructure	7098410	458407	D	Md	Wd	Md
CS-07	SB-G4 – below Ice Rich Overburden Storage Area	7098627	458268	D	Md	Wd	Md

D - Daily when discharging
M - Monthly
Md - Monthly when discharging
Q - Quarterly
Wd - Weekly when discharging

3.4.2 Data Analysis and Reporting

Surface water quality data collected during the construction phase of the Project will be compared to three key benchmarks:

- baseline water quality;
- surface water quality objectives in the receiving environment derived from baseline water quality and predicted Project impacts; and,
- construction phase effluent quality standards specified in QZ14-041 as shown in Section 3.8.

Data is managed in a water quality database, which is updated on a monthly basis following receipt of the final analytical reports from the laboratory. Data is also tabulated and compared to existing baseline water quality for each Project receiving stream and the QZ14-41 criteria for the construction phase to assess whether any statistically significant changes have occurred to the receiving environment water quality

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

3.5 OPERATIONS

During the operations phase, water quality monitoring for the Project will be 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), 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.

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 3.5-1 and Figure 3.5-1) 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.

3.5.1 Locations and Frequency

Table 3.5-1 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 3.5-1: 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 Conductivity	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	M, D	M, D[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	M, D	M, D[1]	-
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	TBD	TBD	M	M[2]	-
EPS	Eagle Pup WRSA Seepage	7100909	459834	M	M	-
PDI & PG_PTS[4]	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	-
HLFUMV	Heap Leach Facility Underdrain Monitoring Vault	7101298	459445	M	M[1]	-
MWTP	Mine Water Treatment Plant	TBD	TBD	D	D[2]	-
FT	Mine Water Treatment Plant Finishing Tank	TBD	TBD	D	D[2]	M
LDSPI	Lower Dublin South Pond Inflow	7100824	458926	D	D[2]	M
LDSP	Lower Dublin South Pond Outflow	7100857	458672	D	D[2]	M
CS-07	SG-G4 – below Ice Rich Overburden Storage Area	7098627	458268	Md	Md	-
OPP[3]	Open Pit Pond	7099460	459359	Q	Q	-
OPPO[3]	Open Pit Pond Overflow	7099460	459359	M	M	M

1 – Laboratory analysis includes WAD and Total CN. Thiocyanate and Cyanate added if adaptive management thresholds reached or if CN destruction and subsequent release has taken place.

2 – Laboratory analysis includes WAD and Total CN.

3 – Closure phase only

4 - Platinum ditch intake converted to Platinum Gulch PTS when PG WRSA is progressively reclaimed

D – Daily when discharging

M – Monthly
Md – Monthly when discharging
Q – Quarterly

3.5.2 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 as shown in Section 3.8.

Data will 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 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. 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.

3.6 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 3.5-1 and Figure 3.5-1).

Reclamation activities, including the placement of an infiltration cover on the Eagle Pup WRSA will be initiated and likely 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 3.5-1, 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 (meromictic). 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 3.5-1) will be monitored on a monthly basis.

3.6.1 Data Analysis and Reporting

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

3.7 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.

3.7.1 Locations and Frequency

Table 3.7-1 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 3.7-1.

3.7.2 Data Analysis and Reporting

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

Table 3.7-1: 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]	

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
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	TBD	TBD	M, Q[1]	M, Q[4]	
HLF_ PTS_INF[7]	Inflow to HLF Passive Treatment System	7101521	459527	W, M[2]	W, M[5]	
HLF_ PTS	Outflow of HLF Passive Treatment System	7101260	458865	W, M[2]	W, M[6]	M, Q[1]
HLFUMV	Heap Leach Facility Underdrain Monitoring Vault	7101298	459445	W, M[2]	W, M[5]	-
LDSP_ PTS_Inf	Inflow to LDSP Passive Treatment System	7100824	458926	W, M[2]	W, M[2]	
LDSP_PTS	Outflow of LDSP Passive Treatment System	7100857	458672	W, M[2]	W, M[2]	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, M[2]	
OPPO	Open Pit Pond Overflow	7099460	459359	Q	Q	Q

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 added if adaptive management thresholds reached
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 - Monitoring 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
M – Monthly
W – Weekly
Q – Quarterly

3.8 ADAPTIVE MANAGEMENT

3.8.1 Performance Objectives - Water Quality Criteria

Water quality data will be 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 will allow for thresholds to serve as triggers for notification and action.

Based on the Type A and B Quartz Mining Undertakings Information Package for Applicants (Yukon Water Board, 2012), 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.

3.8.2 Construction

There is potential for construction activities, including stream bank construction for diversions, 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 be sufficient to minimize effects. Practices will 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. To ensure the protection of the receiving environment and compliance with QZ14-041, adaptive management thresholds have been developed so that mitigation measures can be implemented such that effluent discharged during the construction phase does not exceed the values shown in Table 3.8-1 nor have a pH less than 6.0 or greater than 9.5.

Table 3.8-1: Construction Phase 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	
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

In the event the above adaptive management threshold is exceeded at effluent discharge locations (i.e. any sediment control pond with a discharge to surface watercourse that are beyond the last point of SGC control), the following adaptive management measures 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:

- o Additional source control measures such as mulching, filter logs, silt fence, surface roughening (rough and loose preparation), and vegetation establishment
- o Installation of additional sediment traps and sediment basins upstream of sediment control ponds
- o 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

3.8.3 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 will be collected and evaluated to determine if adaptive management thresholds or effluent quality standards have been exceeded. Thresholds have been developed for discharge locations (Table 3.8-2) to achieve the receiving environment water quality objectives in Haggart Creek. The lone exception to the values specified in Table 3.8-2 is the sediment control pond immediately down gradient of the Ice Rich Overburden Storage Area (CS-07) which will retain the discharge standards identified in Table 3.8-1 for the full life of the Project.

Table 3.8-2: 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	0.0398	0.0477	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

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)
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

Adaptive management measures that will be employed in the event these thresholds are reached are provided in Table 3.8-3

Table 3.8-3: 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	**Threshold 1:** Exceedance of threshold in two consecutive samples (routine or re-sample)	**Notification:** ✓ Identified in Monthly Report to Yukon Water Board; ✓ Notify Internal SGC 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; ✓ 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 within 24-hours; ✓ Examine water management infrastructure linked to discharge location to assess whether they are performing as intended. ✓ Ensure flocculant injection 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**
▪ Nickel ▪ Selenium ▪ Silver ▪ Uranium ▪ Zinc As defined in Table 3.8-2.	**Threshold 2:** Exceedance of threshold in two consecutive samples (routine or re-sample)	**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 phone notification with email back-up to EMR-CMI inspector and FNNND Environmental Monitor, within 7 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.). **Evaluation** ✓ For exceedance at LDSP, compare with LDSPI and PDI & PG_PTS; ✓ 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 injection system as metals closely correlated to suspended solids on the Project; ✓ Perform maintenance on MWTP or PTSs as necessary; ✓ Consider need for temporary re-routing of contract 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.

<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"></td><td rowspan="4">Threshold 3:

Exceedance of threshold in single sample</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;
✓ 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.</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
✓ 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.</td></tr>
<tr><td>Action
✓ Cease discharge;
✓ 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;
✓ Engage 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.</td></tr>
</table>

Site specific water quality objectives and adaptive management thresholds for receiving environment water quality in Haggart Creek (at stations W4, W29, W99 and W23 (Figure 3.7-1)) have been developed (Table 3.8-4) to inform adaptive management actions as shown in Tables 3.8-3:

Table 3.8-4: 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	0.0038	0.0043	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
	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

Adaptive management measures that will be employed in the event these thresholds are reached are provided in Table 3.8-5.

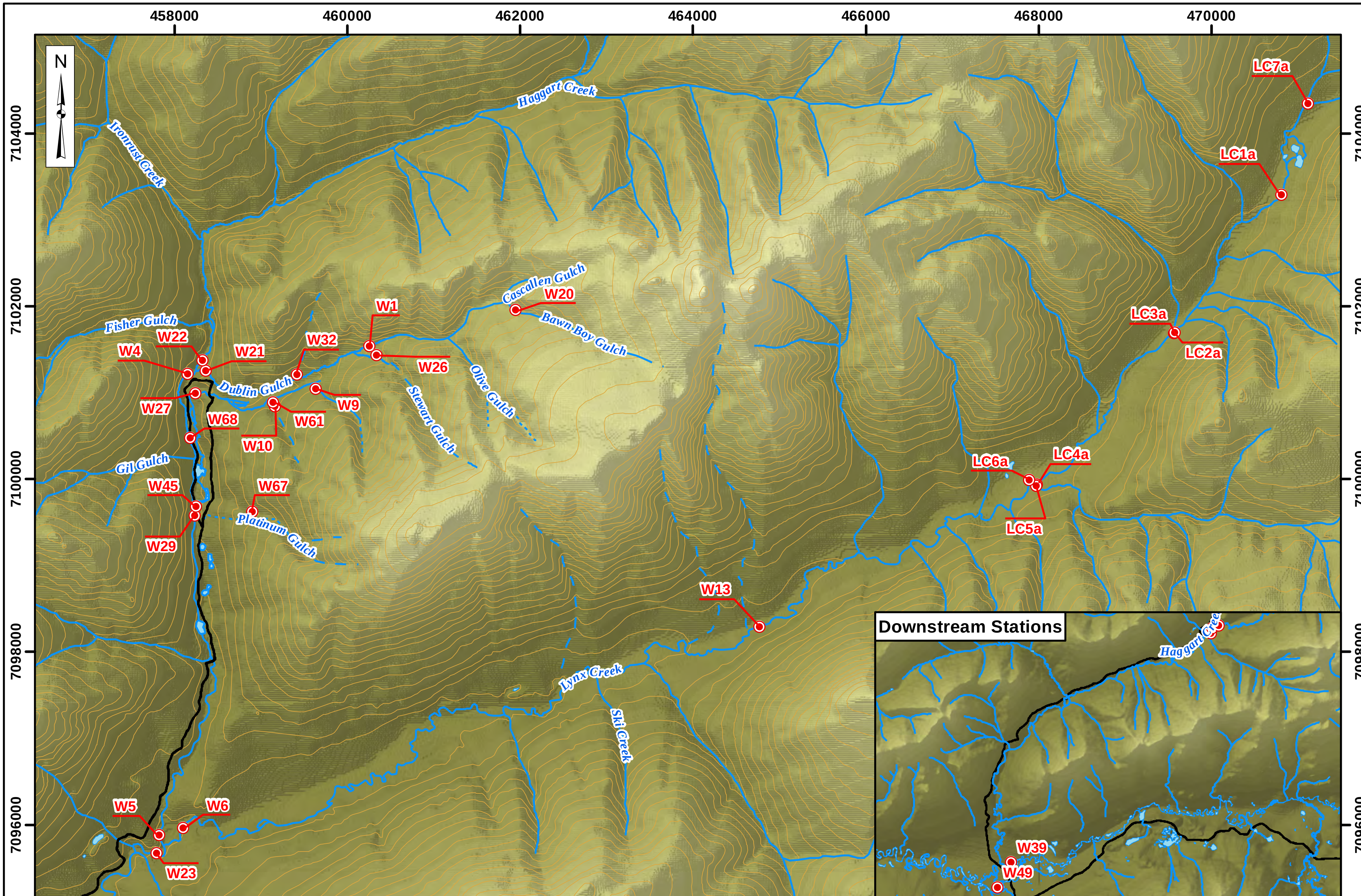
Table 3.8-5: Adaptive Management Indicators, Thresholds and Responses for the Protection of the Receiving Environment in Haggart Creek

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 and W23 for: Dissolved Parameters ▪ Sulphate ▪ Chloride ▪ Nitrate-N ▪ Nitrite-N ▪ Ammonia ▪ WAD Cyanide ▪ Aluminum Total ▪ Antimony ▪ Arsenic ▪ Cadmium ▪ Copper ▪ Cobalt ▪ Iron ▪ Lead ▪ Mercury ▪ Manganese ▪ Molybdenum ▪ Nickel ▪ Selenium ▪ Silver ▪ Uranium Zinc As defined in Table 3.8-4	**Threshold 1:** Exceedance of threshold in two consecutive samples (routine or re-sample)	**Notification:** ✓ Identified in Monthly Report to Yukon Water Board; ✓ Notify Internal SGC 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 and W45 results; ✓ For exceedance at W99, compare with W29 and CS-07 discharge results; ✓ For exceedance at W23, compare with W5 and W6 results; ✓ Conduct a trend analysis.
		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 within 24-hours; ✓ 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.
	Threshold 2: Exceedance of threshold in two consecutive samples (routine	**Notification** ✓ Notify Internal SGC Senior Management within 7 days of receipt of second sample; ✓ Provide email notification to EMR-CSI inspector and FNNND environmental monitor within 7 days of receipt of second sample; ✓ Provide summary of AMP notifications, reviews, evaluations and actions in Monthly Report to Yukon Water Board.

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**
	or re-sample) where evaluation indicates Project influence	**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 and W45 results; ✓ For exceedance at W99, compare with W29 and CS-07 discharge results; ✓ For exceedance at W23, compare with W5 and W6 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 within 24-hours; ✓ 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 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.

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**
	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; ✓ 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.
		Evaluation ✓ For exceedance at W4, compare with W22, W21 and any discharge results; ✓ For exceedance at W29, compare with W4 and W45 results; ✓ For exceedance at W99, compare with W29 and CS-07 discharge results; ✓ For exceedance at W23, compare with W5 and W6 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.

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 discharge is not occurring, increase sampling frequency at W4, W29, W99 and W23 and the linked comparison sites based on the exceedance location to daily; ✓ 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; ✓ If discharge is occurring, temporarily limit discharge to the adaptive management thresholds specified in Table 3.8-2 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; ✓ 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 Monitoring Station
- Eagle Project Access Road
- Contour (100ft)
- Perennial
- Ephemeral
- Intermittent

StrataGold Corporation

0 0.375 0.75 1.5
Kilometers

Projection: NAD 83 UTM Zone 8N

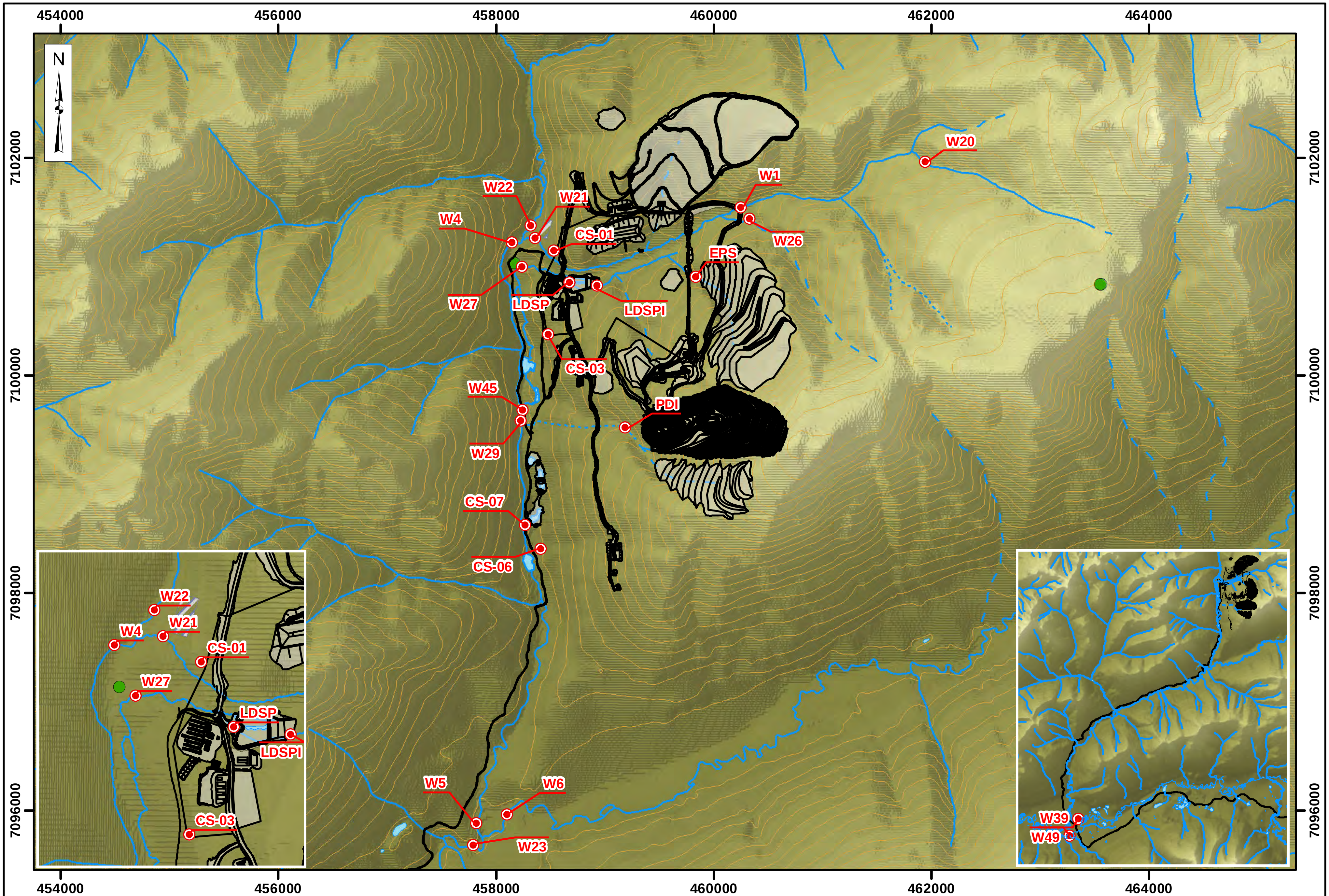
Drawn By: JK

Date: 2019/04/12

Figure: 3.2-1

EAGLE GOLD PROJECT YUKON TERRITORY

Baseline Surface Water Quality Monitoring Stations



Legend:

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

StrataGold Corporation

0 0.75 1.5
Kilometers

Projection: NAD 83 UTM Zone 8N

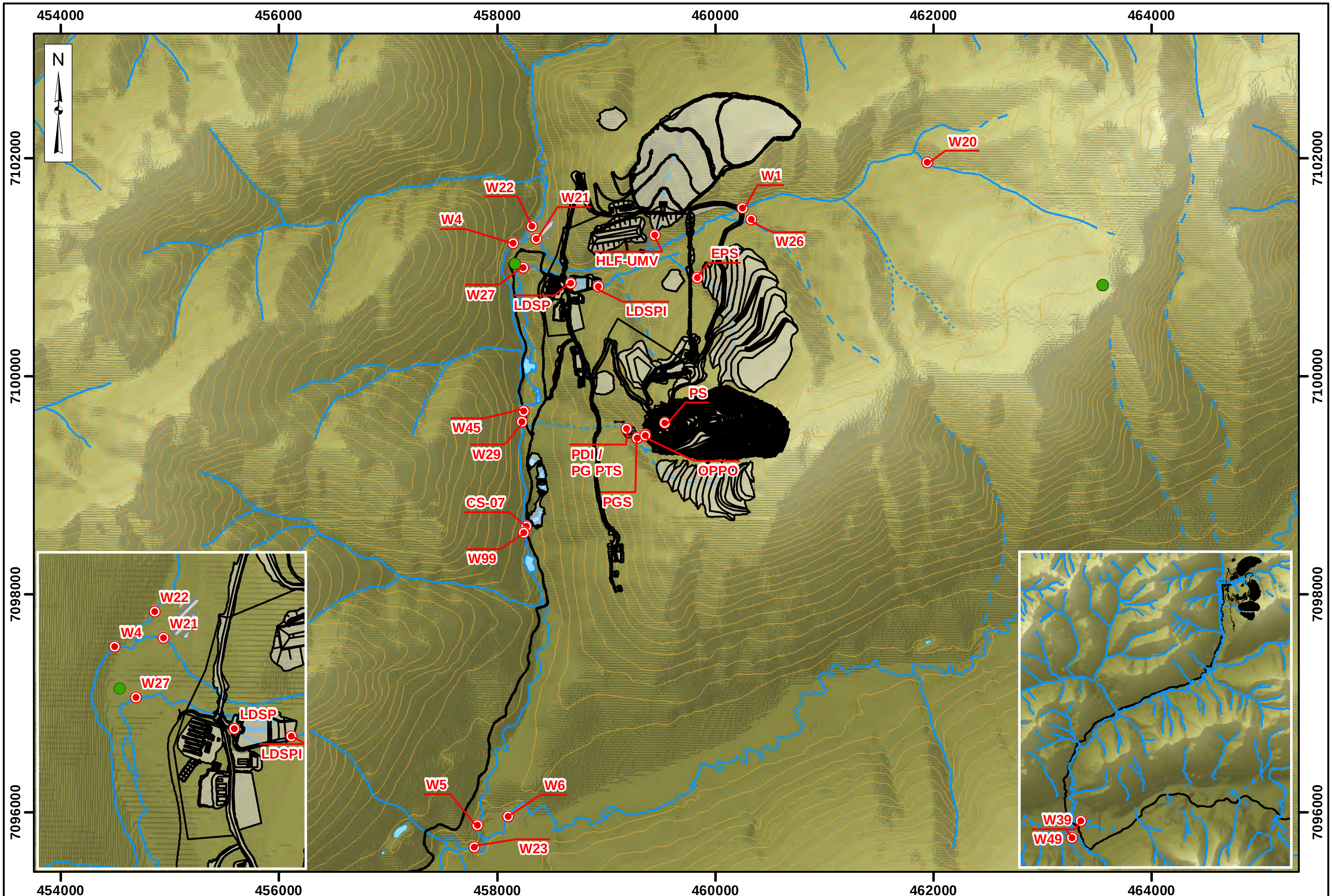
Drawn By: JK

Date: 2018/04/12

Figure: 3.4-1

**EAGLE GOLD PROJECT
YUKON TERRITORY**

Construction Phase Surface Water Quality Monitoring Stations



Legend:

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

StrataGold Corporation

Projection: NAD 83 UTM Zone 8N

Drawn By: JK

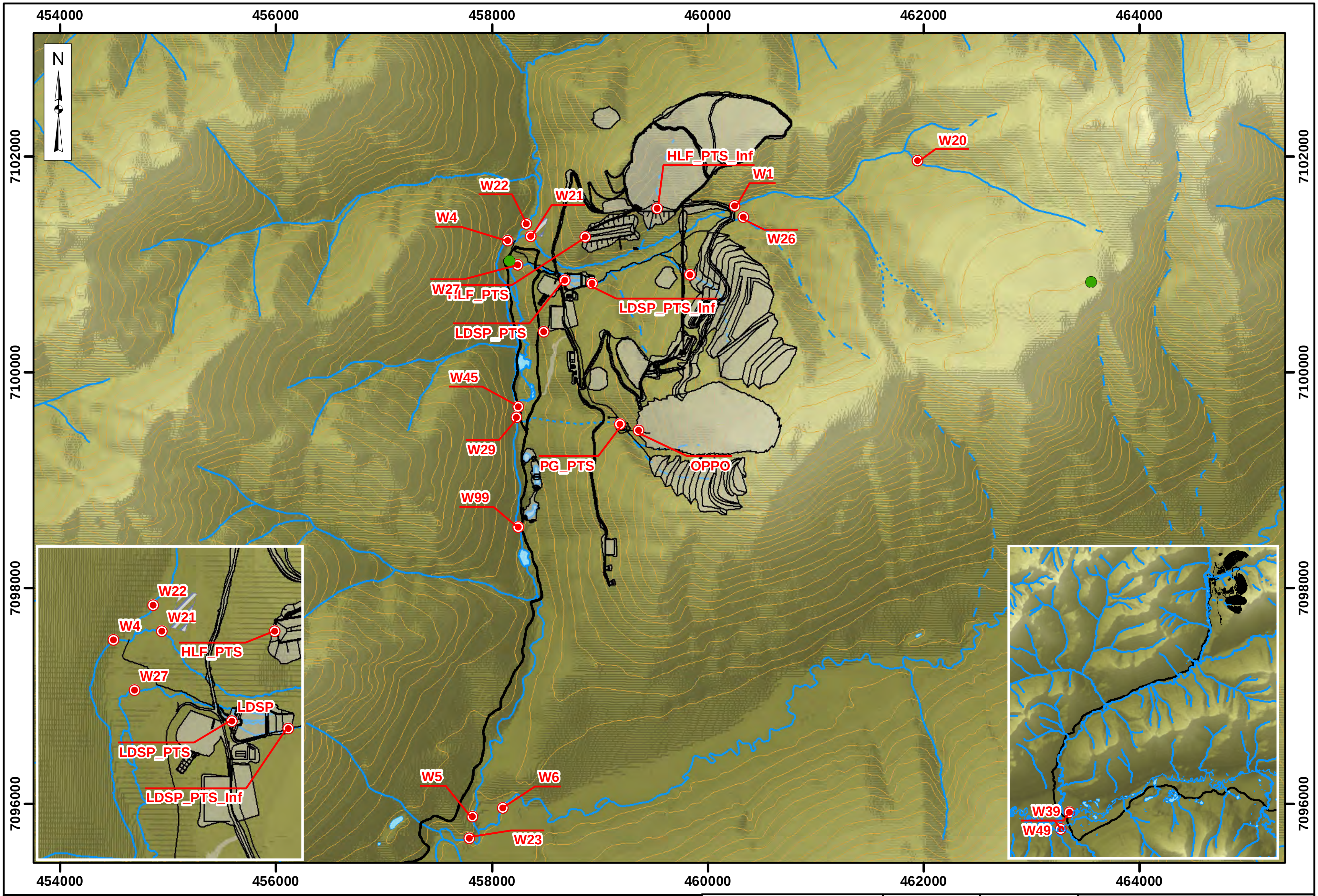
0 0.75 1.5 Kilometers

Date: 2019/04/12

Figure: 3.5-1

EAGLE GOLD PROJECT
YUKON TERRITORY

Operations & Active Closure Phase Surface Water Quality Monitoring Stations



StrataGold Corporation

Projection: NAD 83 UTM Zone 8N	Drawn By: JK	**EAGLE GOLD PROJECT YUKON TERRITORY**	
0 0.75 1.5 Kilometers	Date: 2019/04/12	Figure: 3.7-1	**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 baseline dataset and to monitor Project effects on the occurrence and quantity of groundwater as the Project transitions from baseline characterization through construction and into operations.

The majority of the Project will be situated within the Dublin Gulch basin, which is part of the Haggart Creek basin (Figure 4.1-1). To characterize the baseline groundwater for the Project, the site was divided into hydrogeologic zones (Stantec 2010, 2011, and 2012b). 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 that will continue to be used during construction emphasizes the spatial zones where facilities are being constructed to monitor Project effects on the groundwater flow system. The zones requiring groundwater monitoring are depicted in Figure 4.1-1 and 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 area, and
- the Lower Dublin South Pond.

4.2 PREVIOUS WORK

Historically, baseline hydrogeology data and information has been collected in the Project area for two periods: from 1995 to 1996 and 2009 to present. 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 and 2014) and CoreGeoscience-Watterson (2016).

4.2.1 Baseline Monitoring Program

Prior to the start of construction, there were approximately 99 monitoring wells, standpipe piezometers, vibrating wire piezometers and aquifer test wells installed throughout the Project area (Figure 4.1-1). This total includes 10 nested well pairs (i.e. 20 of the 99 wells), 13 vibrating wire piezometer installations (with between one and three pressure transducers installed at each location), four pumping test wells and 62 standpipe piezometers/monitoring wells. Of these, 20 (including four nested pairs – or eight wells) were completed in Stewart, Bawn Boy and Olive

Gulches up gradient from the immediate proposed Project area (Figure 4.1-1). Potable water supply wells (current and historic) used to supply the exploration program and the existing camp are not included in this total.

Monitoring wells that were used to collect the 2011 and 2012 baseline water level data are summarized in Table 4.2-1, indexed by catchment area. These wells are highlighted in green (manual monitoring) and yellow (datalogger and pressure transducer) in Figure 4.1-1.

Groundwater quantity data and information have been described in Stantec (2010c, 2011c and 2012c) and BGC (2013). Continuous water level measurements were collected across the site at nine monitoring wells equipped with dataloggers and pressure transducers as indicated in

Table 4.2-1 and Figure 4.1-1. Four of the dataloggers were installed in 2010, and five additional dataloggers were installed in 2011. Monitoring has continued since then. Instantaneous water levels were also collected periodically from many other wells in 1995, 1996, and from 2009 until 2012.

Table 4.2-1: Pre-Construction Groundwater Monitoring Well Network Used for Baseline Data Collection

Instrument ID	Catchment	Facility	Data Logger Installation Date
MW10-AG3a	Ann Gulch	Heap Leach	31-May-10
MW10-AG5	Ann Gulch	Heap Leach	-
MW10-AG6	Ann Gulch	Heap Leach	-
DH95-152	Dublin Gulch	Lower Dublin South Pond	-
MW09-DG1	Dublin Gulch	Heap Leach	16-May-10
MW09-DG2	Dublin Gulch	Lower Dublin South Pond	-
MW09-DG4	Dublin Gulch	Mine Site	1-Apr-11
MW09-DG5	Dublin Gulch	Mine Site	-
MW10-DG6	Dublin Gulch	Heap Leach	1-Apr-11
MW10-OBS1	Dublin Gulch	Lower Dublin South Pond	-
MW10-OBS2	Dublin Gulch	Mine Site	-
MW10-PG1	Platinum Gulch	PG WRSA	19-May-11
MW96-19	Suttles Gulch	Open Pit	27-May-10
MW09-Stu2	Suttles Gulch	General Dublin Gulch valley	-
MW96-12a	Eagle Pup	EP WRSA	-
MW96-12b	Eagle Pup	EP WRSA	-
MW96-13a	Eagle Pup	EP WRSA	19-May-11
MW96-13b	Eagle Pup	EP WRSA	19-May-11
MW96-8	Bawn Boy Gulch	Background	-
MW96-9a	Bawn Boy Gulch	Background	-
MW96-9b	Bawn Boy Gulch	Background	27-May-10
DH95-150	Stewart Gulch	Background	-
MW09-OG3	Olive Gulch	Background	-

NOTES:

Existing monitoring network is shown on Figure 4.1-1

Nested ground water wells are indicated by a and b distinction

Sources: Stantec (2012e) Eagle Gold Project, Environmental Baseline Data Report: Hydrogeology 2011-2012 Update; BGC (2013) Eagle Gold Project, 2012 Groundwater Data Report

4.3 METHODS

4.3.1 Overview

The proposed 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. VWPs are highlighted in red in Figure 4.1-1. 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 proposed monitoring program for the Project is presented in three main phases as follows:

- Construction Phase
- Operations Phase
- Closure and Post Closure Phases

4.3.2 Construction

Due to construction activities, many of the pre-construction monitoring wells will be 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 will be followed, where applicable, and dictated by field conditions. Additional wells will be drilled and installed in key locations prior to operations. During construction, groundwater level monitoring will occur at specified locations for the given rationale at the frequency as summarized in Table 4.3-1 and depicted on Figure 4.3-1.

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 construction phase will be 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 construction on groundwater levels.

Table 4.3-1: Groundwater Monitoring Well Network – Construction

Instrument ID	Facility	Datalogger [1]	Groundwater Level Sample Frequency [2]	Groundwater Quality Sample Frequency	Rationale	Comments and Construction Impacts to Well
MW10-AG6	Heap Leach	Equipped	Downloaded quarterly	Quarterly	Evaluate seasonal flow in HLF embankment area	Will not be excavated during construction and will remain throughout operations and post-closure.
MW10-AG3A	Heap Leach	Equipped	Downloaded quarterly until decommissioned during construction	Quarterly	Evaluate seasonal water level variability and infiltration rates in the Ann Gulch basin (HLF area) within the Phase 1 footprint	Will be excavated during construction.
MW10-AG3B	Heap Leach	None	Quarterly	No	Evaluate depth to the water table in the Ann Gulch basin (HLF area) within the Phase 1 footprint	Decommissioned and excavated during construction activities.
BH-BGC11-26	Heap Leach	Equipped	Downloaded quarterly	Quarterly	Evaluate seasonal water level variability and infiltration rates in the Ann Gulch basin (HLF area) above the Phase 1 footprint	Well not performing as anticipated; will be decommissioned in 2020. A relocated replacement well (MW19-HLFa/b) is planned for 2019.
MW10-DG6	Heap Leach	Equipped	Downloaded quarterly	Quarterly	Evaluate seasonal water level variability in the Eagle Creek basin	Well damaged during construction activities, will be replaced during spring 2019. New well will remain throughout operations and post-closure.
MW10-OBS1	Lower Dublin South Pond	Equipped	Downloaded quarterly	Quarterly	Evaluate vertical and seasonal flow in Eagle Creek Pond area	Well is subject to interference by Project infrastructure; will be relocated and replaced (MW19-LDSP2a/b) during spring 2019. New well will remain throughout operations and post-closure.
MW96-15	EP WRSA	Equipped	Downloaded quarterly	Quarterly	Evaluate vertical and seasonal flow in EP WRSA area	Will not be excavated during construction and will remain

Instrument ID	Facility	Datalogger [1]	Groundwater Level Sample Frequency [2]	Groundwater Quality Sample Frequency	Rationale	Comments and Construction Impacts to Well
						throughout operations and post-closure.
MW96-13A	EP WRSA	Equipped	Downloaded quarterly until decommissioned	Quarterly	Evaluate vertical and seasonal flow in the EP WRSA area during construction	Location will be covered during year 3 of operations
MW96-13B	EP WRSA	Equipped	Downloaded quarterly until decommissioned	No	Evaluate vertical and seasonal flow in EP WRSA area during construction	Location will be covered during year 3 of operations
MW96-14B	EP WRSA	None	Quarterly until decommissioned	No	Evaluate seasonal flow and vertical gradients in EP WRSA area	Location will be covered during year 3 of operations
MW96-17A	Open Pit	Equipped	Downloaded monthly or as pre-stripping conditions dictate	No	Evaluate seasonal water level patterns in the Open Pit during initial depressurization	Was decommissioned during open pit pre-stripping activities
MW96-17B	Open Pit	None	Monthly until decommissioned during pre-stripping	No	Evaluate seasonal water level patterns in the Open Pit during initial depressurization	Was decommissioned during open pit pre-stripping activities
09-BGC-GTH2a	Open Pit	Equipped	Downloaded monthly or as pre-stripping conditions dictate	No	Measure deep water pressures in pit walls during depressurization	Was decommissioned during open pit pre-stripping activities
10-BGC-GTH-05	Open Pit	Equipped	Downloaded monthly or as pre-stripping conditions dictate	No	Measure deep water pressures in pit walls during depressurization	Was decommissioned during open pit pre-stripping activities
10-BGC-GTH-06	Open Pit	Equipped	Downloaded monthly or as pre-stripping conditions dictate	No	Measure deep water pressures in pit walls during depressurization	Was decommissioned during open pit pre-stripping activities
10-BGC-GTH-07	Open Pit	Equipped	Downloaded monthly or as pre-stripping conditions dictate	No	Measure deep water pressures in pit walls during depressurization	Was decommissioned during open pit pre-stripping activities
10-BGC-GTH-08	Open Pit	Equipped	Downloaded monthly or as pre-stripping conditions dictate	No	Measure deep water pressures in pit walls during depressurization	Was decommissioned during open pit pre-stripping activities

Instrument ID	Facility	Datalogger [1]	Groundwater Level Sample Frequency [2]	Groundwater Quality Sample Frequency	Rationale	Comments and Construction Impacts to Well
10-BGC-GTH-10	Open Pit	Equipped	Downloaded monthly or as pre-stripping conditions dictate	No	Measure deep water pressures and vertical gradients in pit during depressurization	Was decommissioned during open pit pre-stripping activities
BH-BGC11-74	Lower Dublin Gulch	Equipped	Downloaded quarterly	No	Evaluate flow near Haggart Creek and long-term change in water table	Will not be excavated during construction – will remain throughout operations and post-closure
MW10-PG1	PG WRSA	Equipped	Downloaded quarterly	No	Consistency with ongoing baseline and evaluate flow downgradient from PG WRSA and Open Pit	Will not be excavated during construction – will remain throughout operations and post-closure
BH-BGC11-72	Lower Dublin Gulch	Equipped	Downloaded quarterly or as construction conditions dictate	No	Evaluate flow near Haggart Creek and evaluate long term change in water table	Will not be excavated during construction – will remain throughout operations and post-closure

[1] Dataloggers: column indicates wells that currently have dataloggers installed and wells that will not have loggers installed

[2] Frequency: for wells that will be excavated as a result of construction this column provides the monitoring frequency as stated until well excavation

4.3.3 Operations

After construction is complete for each facility, new monitoring wells will be 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 by 9 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 4.3-2) will be located immediately down gradient from each facility of interest to minimize the elapsed time prior to identifying trends. As required by QZ14-41 a monitoring well will also be located up gradient from the HLF. Quarterly monitoring of groundwater wells will continue during operations.

Table 4.3-2 summarizes the proposed new monitoring wells to be drilled and installed during spring 2019, and the proposed new nested monitoring wells that will installed at a later date. Table 4.3-2 provides the monitoring well nest number, approximate screen depths for both wells in each nest, and the Project facility targeted for monitoring. Table 4.3-3 and Figure 4.3-2 depict the proposed groundwater monitoring network that will be used during operations.

Table 4.3-2: New Nested Operations Monitoring Wells

Well ID	Zone	Mine Component	Purpose	*Proposed Depth A	*Proposed Depth B
Monitoring Wells to be Drilled in 2018/2019 Prior to Operations					
MW19-PGW1a/b	Platinum Gulch	PG WRSA	Downgradient of PG WRSA and Open Pit	12 m	30 m
MW19-HLF1a/b	Ann Gulch	HLF	Downgradient of HLF	7 m	20 m
MW19-DG6R	Dublin Gulch	HLF	Downgradient of HLF; to replace the damaged MW10-DG6	7 m	20m
MW19-HLF2a/b	Ann Gulch	HLF	Upgradient of HLF (to be used instead of BH-BGC11-26)	10 m	30 m
MW19-EVP1a/b	Dublin Gulch	Events Pond	Downgradient of Events Pond	10 m	25 m
MW19-EVP2a/b	Dublin Gulch	Events Pond	Downgradient of Events Pond	10 m	25 m
MW19-EPW1a/b	Eagle Pup	EP WRSA	Nested Wells downgradient of EP WRSA	10 m	25 m
MW19-LDSP2a/b	Eagle Creek	Lower Dublin South Pond	Downgradient of LDSP; to replace MW10-OBS1; which is subject to interference by the water supply well and is not nested	10 m	30 m
Monitoring wells – Drilling and Installation Date to Be Determined					
MWXX-OP1a/b	Platinum Gulch	Open Pit	Cross-gradient of Open Pit; location to be determined based on data from existing upgradient wells and construction/operation activity	10 m	30 m
PZXX-OP1a/b	Suttles Gulch	Open Pit	Nested Piezometers upgradient of final pit wall	75 m	150 m
PZXX-OP2a/b	Suttles Gulch	Open Pit	Nested Piezometers upgradient of final pit wall	75 m	150 m
MWXX-HLF3a/b	Ann Gulch	HLF	Upgradient of Phase 3 of HLF; location to be determined based on confirmation of HLF Phase 3 footprint, field reconnaissance during ice-free season and physiographic conditions	10 m	30 m
MWXX-LPH1a/b	Dublin Gulch	Low pH treatment solids storage cells	Downgradient of proposed storage cells; location to be determined when and if storage cells will be used and on the location of the storage cells	10 m	30 m
MWXX-LPH2a/b	Dublin Gulch	Low pH treatment solids storage cells	Downgradient of proposed storage cells; location to be determined when and if storage cells will be used and on the location of the storage cells	10 m	30 m

NOTE:
Depths are estimated and will need to be modified in the field based on the geology and depth to water table encountered during drilling activities.

Table 4.3-3: Proposed 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	Platinum 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	Nested 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
MW96-14	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
MW19-EPW1a/b	EP WRSA	Yes	Yes	Yes	Nested 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	Nested Wells Downgradient of HLF
MW19-AG6R	HLF	Yes	No	No	Single Well Downgradient of HLF
MW19-DG6R	HLF	Yes	Yes	Yes	Nested Wells Downgradient of HLF
MW19-HLF2a/b	HLF	Yes	Yes	Yes	Upgradient of HLF Phase 1 and 2 of HLF
MWXX-HLF3a/b	HLF	Yes	Yes	Yes	Upgradient of HLF Phase 3 of HLF
MW19-EVP1a/b	Events Pond	Yes	No	Yes	Nested Wells Downgradient of Events Pond
MW19-EVP2a/b	Events Pond	Yes	No	Yes	Nested Wells Downgradient of Events Pond

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

4.3.4 Closure and Post Closure Monitoring

Groundwater monitoring locations during the closure and post closure phases of the Project (Figure 4.3-2) 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 post construction, annually during operations, and for specific reporting periods as identified in the Reclamation and Closure Plan.

4.5 MANAGEMENT

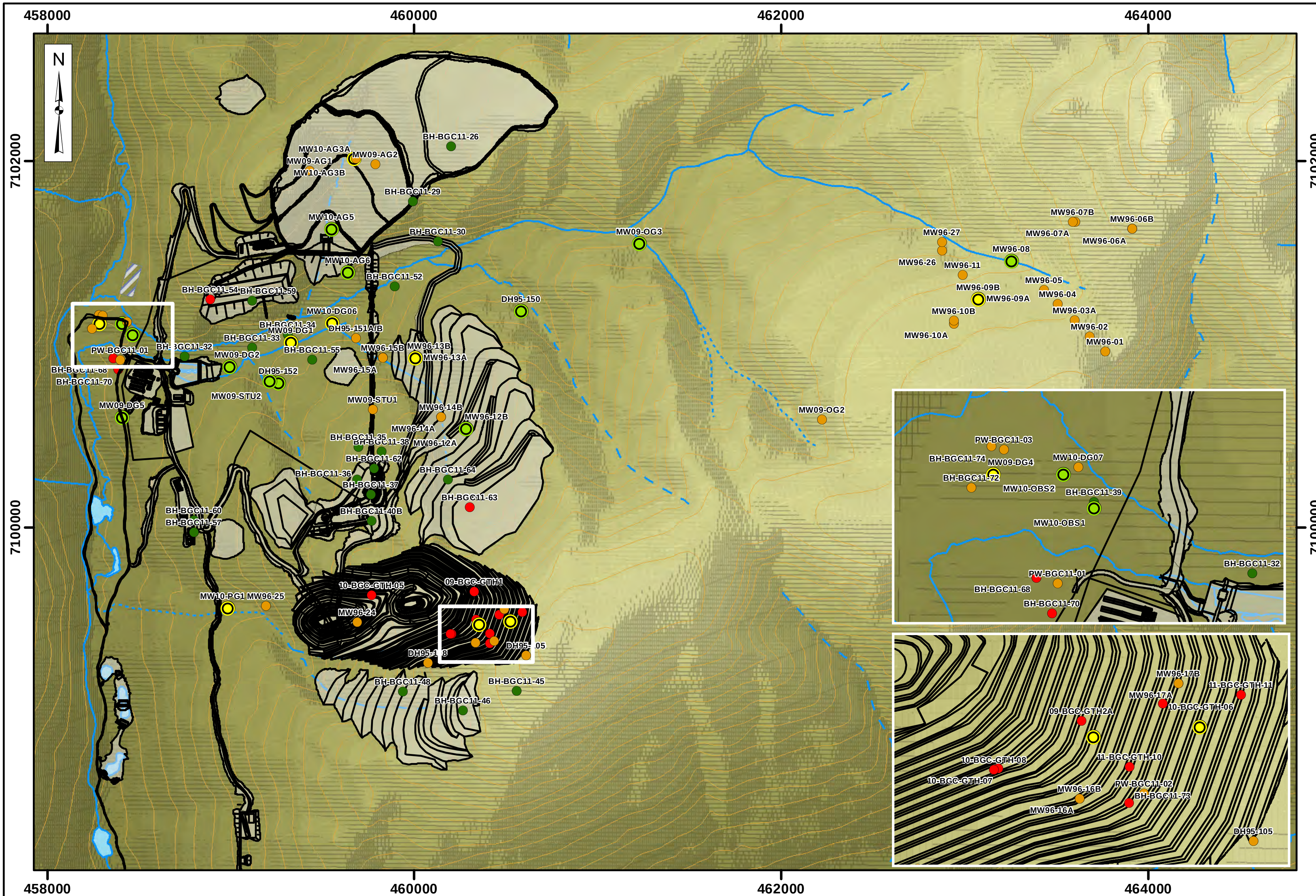
Most of the groundwater monitoring wells will be used to examine effects that are predicted to occur during operations and are or will be located to collect groundwater level data in the areas associated with facilities that will be built during late construction and commissioned at the start of operations. Thus, in practice the monitoring program during construction is designed to maintain a continuous data record from baseline and into operations. Although the groundwater monitoring will assist construction engineering management there is no particular environmental effects threshold for groundwater levels that will cause a change in the construction process. Nevertheless, the existing water supply well is completed in the lower Dublin Gulch valley aquifer, and groundwater level monitoring results will be examined periodically to see if activities will affect production in the water supply well. If so, then alternate water supplies will be considered (e.g., drill a second potable well outside the Dublin Gulch valley and/or bring in potable water for drinking and use one of the other two wells completed in the lower bedrock aquifer for all other purposes).

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 approximately 1% from May to October to up to 3% to 6% from December through April during mine operations. During active, passive and post closure, the reduction in baseflow and increase in stream leakage are estimated to reduce stream flow at W5 by less than 1% to 2% from May through November, and by 2% to 5% from December to April.

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.



Legend:

- Reserved Area
- Monitoring Well
- Monitoring Well - Data Logger
- Monitoring Well - Manual Read
- BGC Vibrating Wire
- BGC Standpipe Piezometer
- Contour (100ft)
- Perennial
- Ephemeral
- Intermittent

StrataGold Corporation

Projection: NAD 83 UTM Zone 8N

Drawn By: JK

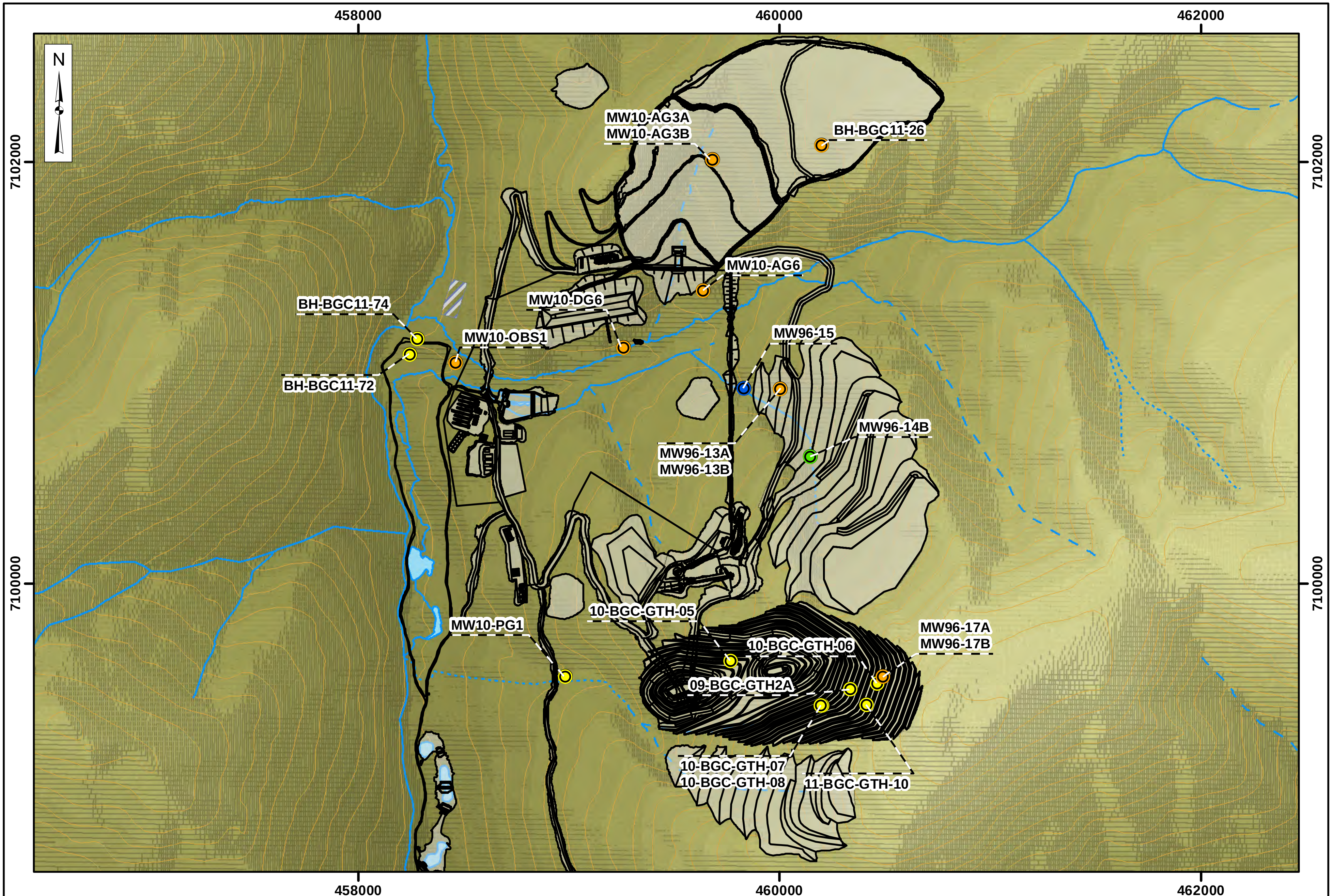
0 400 800
Meters

Date: 2019/04/10

Figure: 4.1-1

EAGLE GOLD PROJECT
YUKON TERRITORY

Pre-Construction Groundwater Monitoring Network



Legend:
- Monitoring Well - Data Logger
- Monitoring Well - Data Logger & Water Quality Sampling
- Monitoring Well - Manual Read
- Monitoring Well - Manual Read & Water Quality Sampling
- Facility
- Reserved Area
- Contour (100ft)
- Perennial
- Ephemeral
- Intermittent

StrataGold Corporation

0 350 700
Meters

Projection: NAD 83 UTM Zone 8N

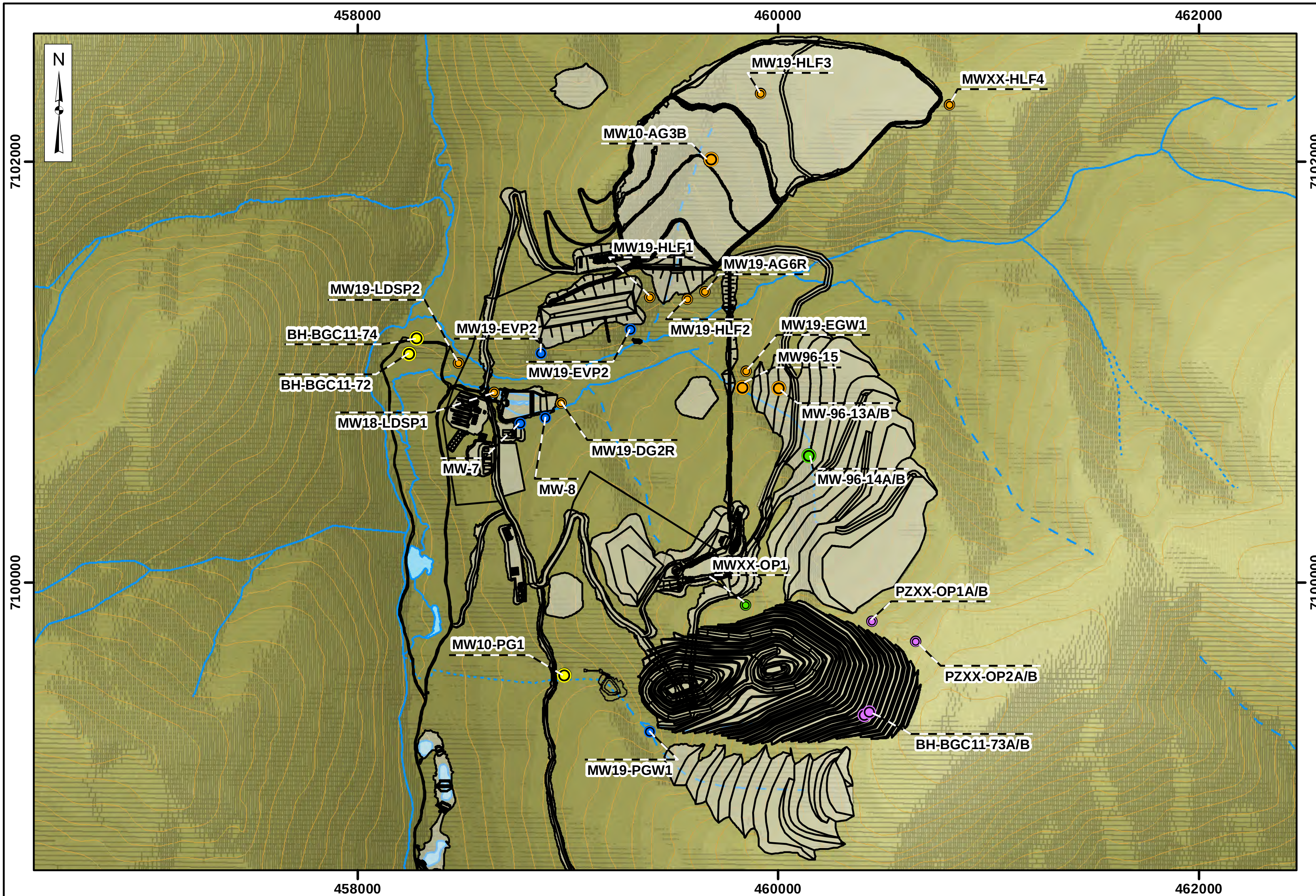
Drawn By: JK

Date: 2019/04/10

Figure: 4.3-1

EAGLE GOLD PROJECT
YUKON TERRITORY

Construction Phase Groundwater Monitoring Network



Legend:

- Vibrating Wire Piezometer
- Monitoring Well - Data Logger
- Monitoring Well - Data Logger & Water Quality Sampling
- Facility
- Monitoring Well - Manual Read
- Monitoring Well - Manual Read & Water Quality Sampling
- Contour (100ft)
- Perennial
- Ephemeral
- Intermittent

StrataGold Corporation

0 350 700
Meters

Projection: NAD 83 UTM Zone 8N

Drawn By: JK

Date: 2019/04/10

Figure: 4.3-2

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 the Project transitions from baseline conditions through construction and operations. 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 PREVIOUS 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 monitoring stations sampled are summarized in Table 5.2-1.

Table 5.2-1: Previous Groundwater Quality Monitoring Program Wells

Drainage Sub-basin	MWID	Continuous Data logger deployed
Ann Gulch	MW10-AG3a	Yes
	MW10-AG5	No
	MW10-AG6	No
Dublin Gulch	DH95-152	No
	MW09-DG1	Yes
	MW09-DG2	No
	MW09-DG4	Yes
	MW09-DG5	No
	MW09-DG6	Yes
	MW10-OBS1	No
	MW10-OBS2	No
Platinum Gulch	MW96-23	No
	MW10-PG1	Yes
Suttles Gulch	MW96-19	Yes
	MW09-STU2	No
Eagle Pup	MW96-12a	No
	MW96-12b	No
	MW96-13a	Yes
	MW96-13b	Yes

Drainage Sub-basin	MWID	Continuous Data logger deployed
Bawn Boy Gulch	MW96-8	No
	MW96-9a	Yes
	MW96-9b	Yes
Stewart Gulch	DH95-150	No
Olive Gulch	MW09-OG3	No

Groundwater quality parameters that were monitored during baseline characterization and that will continue to be monitored during this program are summarized in Table 5.2-2.

Table 5.2-2: Groundwater Quality - Monitored Parameters

Parameter Set	Comment
Field parameters	temperature, pH, conductivity, turbidity
Laboratory physical parameters	temperature, conductivity, turbidity, TDS, TSS, pH
Anions	Cl, SO4, NO_3, NO, CN[2], Total Alkalinity
Nutrients	TKN, NH_3, T-Nitrogen, Total-PO_4, Dissolved-PO_4, Ortho-PO_4
Carbon	Dissolved Organic Carbon, Total Organic Carbon
Total 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)
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)

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[3], 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 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.

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[2] Total Cyanide was analyzed from early baseline studies and discontinued after years of no detection. Total and WAD Cyanide will be analyzed in groundwater samples upon the commencement of use of cyanide for the Project.

[3] 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.

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 distilled de-ionized water, of known composition, supplied by the analytical laboratory. Field replicates 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 field duplicates will be submitted for every sampling event 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. Subsequently, results will be compared applicable permit discharge or monitoring criteria.

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 on an annual basis or in accordance with permit requirements.

5.3.4 Construction

Locations and Frequency

During construction groundwater sampling will continue to occur on a quarterly basis at the locations provided in Table 4.3-1. The addition of the wells in Table 4.3- in the preceding section sometime prior to operation will replace some of the excavated or abandoned wells due to construction. The parameter set that will be analyzed is summarized in Table 5.2-2. Well locations are shown in Figure 4.3-1.

5.3.5 Operations

Locations and Frequency

Much of the baseline monitoring well network at the Project has been decommissioned as part of construction activities (discussed in Section 4). As such, during operations, groundwater sampling will be conducted at the locations as provided in Table 4.3- on a quarterly basis. Parameters that will be analyzed are listed in Table 5.2-2. Well locations are shown in Figure 4.3-2.

5.3.6 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 MANAGEMENT

5.4.1 Construction

Described groundwater monitoring wells are or will be located in specific areas designed to collect groundwater chemistry data in the areas associated with facilities that will be built and then commissioned for operations. Thus, in practice the monitoring program during construction is designed to maintain a continuous (on a quarterly sampling frequency) groundwater chemistry data record from baseline and into operation, and will serve to identify or help characterize any trends prior to operations.

5.4.2 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
- Detection of hydrocarbons
- 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 25% of the maximum baseline concentration for two consecutive sampling events. The maximum baseline values are those established for the particular parameter of interest during the baseline period (2009 - 2014) for either the specific well of interest, or in the case of a new well, 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.

- Increased or decreased moving average concentrations of specific parameters of interest will be computed. In general, increasing or decreasing trends will be examined first assuming a linear trend. 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.

Initial management measures that will 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)
- Hydrocarbon detection: Inspection of fuel storage tanks and areas and other areas/facilities where hydrocarbons are used or stored to determine if spills or leaks are contaminating groundwater
- 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 tranches 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 during the construction process and to confirm the results of the assessment of the potential for acid rock drainage and metal leaching and resulting effects on contact water quality as mining progresses from that work developed in support of the Project as reported in 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 PREVIOUS 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) to be cut and excavated during the first phase of the heap leach pad subgrade development. In addition, there will be 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 are 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. To address uncertainties in the evaluations, further investigations may need to be undertaken within these 'other' metasedimentary areas to evaluate their suitability for construction purposes if these areas are designated as potential construction rock sources. 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.
- Test methods will 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

Test	Parameter	Unit	Method Code [a]	Detection Limit
	Acid Potential (AP)	kg $CaCO_3$/t	Calculated	N/A
	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 will consist of the following:

- Blast-hole chip composites from each blast round in the open pit.
- Geological logging of blast hole composites.
- Analysis for 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 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 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 includes the following:

- Sample collection monthly during ice-free months when flow is measurable and emanating from the toe of the Eagle Pup and Platinum Gulch WRSAs. Samples will be analyzed for full chemistry: total suspended solids, total dissolved solids, oxygen reduction potential, pH, alkalinity, acidity, nitrogen species, sulphate, chloride, fluoride, total and dissolved metals (Table 6.3-3).
- Flow measurements every two weeks when flow is occurring and if flow is measurable at each seep collection point.
- Monthly survey of waste facilities during ice-free months for 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.

Table 6.3-3: Geochemical Water Monitoring Parameters and Corresponding Detection Limits

Physical Parameters	Detection Limit(mg/L)	Total and Dissolved Metals		Detection Limit (mg/L)
Temperature	1	Aluminum	(Al)	0.0002
Conductivity	1	Antimony	(Sb)	0.00002
Hardness	0.5	Arsenic	(As)	0.00002
Total Suspended Solids	4	Cadmium	(Cd)	0.000005
Total Dissolved Solids	10	Calcium	(Ca)	0.05
pH	0	Chromium	(Cr)	0.0001
Turbidity	0.1	Cobalt	(Co)	0.000005

Physical Parameters	Detection Limit(mg/L)	Total and Dissolved Metals		Detection Limit (mg/L)
DOC	0.5	Cobalt	(Co)	0.000005
Major Anions		Copper	(Cu)	0.00005
Alkalinity-Total	0.5	Copper	(Cu)	0.00005
Acidity-Total	0.5	Iron	(Fe)	0.001
Bromide	0.1	Iron	(Fe)	0.001
Chloride	0.5	Lead	(Pb)	0.000005
Fluoride	0.01	Magnesium	(Mg)	0.05
Sulphate	0.5	Manganese	(Mn)	0.00005
Nutrients		Mercury	(Hg)	0.00001
Ammonia Nitrogen	0.005	Molybdenum	(Mo)	0.00005
Nitrate Nitrogen	0.002	Nickel	(Ni)	0.00002
Nitrite Nitrogen	0.002	Phosphorus	(P)	0.002
Dissolved Ortho-Phosphate	0.001	Potassium	(K)	0.05
Total Phosphate	0.005	Selenium	(Se)	0.00004
		Silicon	(Si)	0.1
		Silver	(Ag)	0.000005
		Sodium	(Na)	0.05
		Strontium	(Sr)	0.00005
		Thallium	(Tl)	0.000002
		Vanadium	(V)	0.0002
		Zinc	(Zn)	0.0001

6.4 REPORTING

Results from the geochemical monitoring will be input to an environmental database. Annual review and reporting will be prepared at which time the monitoring program will be reviewed and amendments proposed as required.

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.

7 STREAM SEDIMENT

7.1.1 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 7.2-1), 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 PREVIOUS WORK

Sites sampled for sediment were selected based on geological and hydrological characteristics relative to proposed Project activities. A total of 26 sites were sampled between 1976 and 2010: ten in Haggart Creek, eight in Dublin Gulch, three in Eagle Creek, and five in Lynx Creek drainage basins. The September 2009 campaign sampled six previously monitored stations and one new station established at W29. Sampling in August 2010 was conducted at a total of eight stations, four of which were newly established at W72, W73, W74 and W75 in Haggart and Eagle Creek drainages.

Stream sediment sample locations for the previous work completed to date are shown in Figure 7.2-1 and details of the stations are summarized in Table 7.2-1. Generally, sediment samples were co-located at water quality monitoring sites, while six stations did not coincide with water quality monitoring (e.g. stations 51, 62, 63, 64, 72 through 75). 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.

First Dynasty Mining Ltd. collected six replicate samples from four sites on Haggart Creek and one site on Dublin Gulch in 1993 and 1995 (Knight Piésold 1996). Eleven sites in the four drainages were sampled for the Project in September 2007 (JWA 2008). Seven additional sites were sampled in 2009 and 2010 to provide either confirmatory data for sites considered most relevant to proposed mine activities or new data for ponds on Haggart and Eagle Creeks that provide depositional habitat on those drainages (higher potential for sediment accumulation).

Table 7.2-1: Baseline Site Locations, Rationale, and Number of Stream Sediment Sampling Dates, 1976 – 2010

Site	Location Description	Coordinates		Rationale	No. of Samples 1976 to 2010
		Northing	Easting		
Haggart Creek Drainage Basin					
W2	Above Iron Rust Creek	7102902	458442	Above Project influence	2
W3	Lower Iron Rust Creek	7102895	458173	Above Project influence	1
W7	Above Fisher Gulch	7102608	458302	Below Project influence	1
W22	Haggart above Dublin Gulch	7101377	458319	Above Project influence	4
W4	Haggart below Dublin Gulch	7101223	458144	Below Project influence	4
W29	Haggart below Eagle Creek	7099583	458225	Below Project influence	2
W5	Haggart above Lynx Creek	7095887	457815	Below Project influence	4
W23	Haggart below Lynx Creek	7095682	457790	Below Project influence	1
Dublin Gulch Drainage Basin					
W20	Bawn Boy Gulch	7101961	461945	Above Project influence	2
W30	Lower Cascallen Gulch	7102209	461877	Above Project influence	1
W51	Below Bawn Boy Gulch	7102039	461638	Above Project influence	1
W8	Below Olive Gulch	7101619	461122	Above Project influence	2
W1	Dublin Gulch above Stewart Gulch	7101545	460249	Above Project influence	3
W36	Upper Stewart Gulch	7101346	460485	Above Project influence	1
W26	Stewart Gulch	7101443	460331	Above Project influence	2
W21	Dublin Gulch above Haggart Creek	7101261	458359	Below Project influence	3
W74	Inlet Pond Haggart Creek	7098330	458287	Below Project influence	1
W75	Outlet Pond Haggart Creek	7098200	458312	Below Project influence	1
Eagle Creek Drainage Basin					
W27	Eagle Creek midway	7100997	458235	Below Project influence	3
W72	Inlet Pond Eagle Creek	7099890	458361	Below Project influence	1
W73	Outlet Pond Eagle Creek	7099730	458312	Below Project influence	1
Lynx Creek Drainage Basin					
W62	Lynx Creek above Skate Creek	7101138	468945	No Project influence	1
W63	Lynx Creek below Skate Creek	7099580	467310	No Project influence	1
W13	Lynx Creek above Ray Creek	7098295	464770	No Project influence	1
W64	Lynx Creek below Ski Creek	7097774	462796	No Project influence	1
W6	Lynx Creek above Haggart Creek	7095964	458099	No Project influence	1

Mean metal concentrations are summarized by site in Table 7.2-2 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 7.2-2: Stream Sediment Metal Concentrations (mean values, N=3 to 11), 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.

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 sampling downstream 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 analysis of pH and total metals including Sb, As, Ba, Be, Cd, Cr, Co, Cu, Pb, Mo, Hg, Ni, Se, Ag, Tl, Sn, U, V, Zn. The analytical detection limits for each parameter are summarized in Table 7.3-1. 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

Parameter	Detection Limits
pH	0.1
Antimony, total	10
Arsenic, total	5
Barium, total	1
Beryllium, total	0.5
Cadmium, total	0.5
Chromium, total	2
Cobalt, total	2

Parameter	Detection Limits
Copper, total	1
Lead, total	30
Mercury, total	0.005
Molybdenum, total	4
Nickel, total	5
Selenium, total	2
Silver, total	2
Thallium, total	1
Tin, total	5
Uranium, total	0.05
Vanadium, total	2
Zinc, total	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 CONSTRUCTION

7.4.1 Locations and Frequency

The stream sediment quality monitoring program for the construction phase continues to monitor sediment quality in key drainage basins; however, a more focused monitoring program has commenced related to the baseline program. Figure 7.4-1 illustrates the construction phase sediment quality monitoring locations. Table 7.4-1 provides a summary of each monitoring station, location, coordinates, rationale and monitoring frequency for the construction period.

The sediment quality monitoring stations have been sampled in the late summer on an annual basis during construction.

Table 7.4-1: Construction 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	Annual
W4	Haggart below Dublin Gulch	7101223	458144	Below Project influence	Annual
W29	Haggart below Eagle Creek	7099583	458225	Below Project influence	Annual
W5	Haggart above Lynx Creek	7095887	457815	Below Project influence	Annual
W23	Haggart below Lynx Creek	7095682	457790	Below Project influence	Annual
Dublin Gulch Drainage Basin					
W1	Dublin Gulch above Stewart Gulch	7101545	460249	Above Project influence	Annual
W26	Stewart Gulch	7101443	460331	Above Project influence	Annual
Eagle Creek Drainage Basin					
W27	Eagle Creek	7100997	458235	Below Project influence	Annual
Lynx Creek Drainage Basin					
W6	Lynx Creek above Haggart Creek	7095964	458099	Reference, No Project influence	Annual

7.4.2 Data Analysis and Reporting

Sediment quality data collected during the construction phase of the Project has been 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 will continue to be reported annually with the results of the program.

Annual sediment quality monitoring reports are prepared covering monitoring results and analysis for each year of the construction phase; reports have been, and will continue to be, included in the annual report. Statistical analysis is performed on the monitoring data and compared directly to the baseline results to determine if any statistically significant changes have occurred to the receiving environment sediment quality.

7.5 OPERATIONS PHASE

During the operations phase, the sediment quality monitoring program remains unchanged from that performed during construction.

7.5.1 Locations and Frequency

The sediment quality-monitoring program for the operations phase will continue to monitor sediment quality as per the construction period on a biennial basis. Figure 7.4-1 illustrates the operations phase sediment quality monitoring locations. Table 7.5-1 provides a summary of each monitoring station, location, coordinates, rationale and monitoring frequency for the operations period.

Table 7.5-1: 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
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

7.5.2 Data Analysis and Reporting

Data analysis and reporting of sediment quality will be as described for the construction phase of the Project.

7.6 EARLY CLOSURE PHASE

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

7.6.1 Locations and Frequency

The sediment quality-monitoring program for the early closure phase will continue to monitor sediment quality as per the construction and operations periods on a biennial basis. Early closure phase sediment quality monitoring locations remain the same as described for operations (Figure 7.4-1). Table 7.6-1 provides a summary of each monitoring station, location, coordinates, rationale and monitoring frequency for the operations period.

7.6.2 Data Analysis and Reporting

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

Table 7.6-1: Early 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
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

7.7 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 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 annual sampling of sediments within the passive treatment cells.

7.7.1 Locations and Frequency

Table 7.7-1 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 7.7-1. 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).

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.

7.7.2 Data Analysis and Reporting

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

Table 7.7-1: 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
Lynx Creek Drainage Basin					
W6	Lynx Creek above Haggart Creek	7095964	458099	Reference, Below Project influence	Biennial

7.8 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

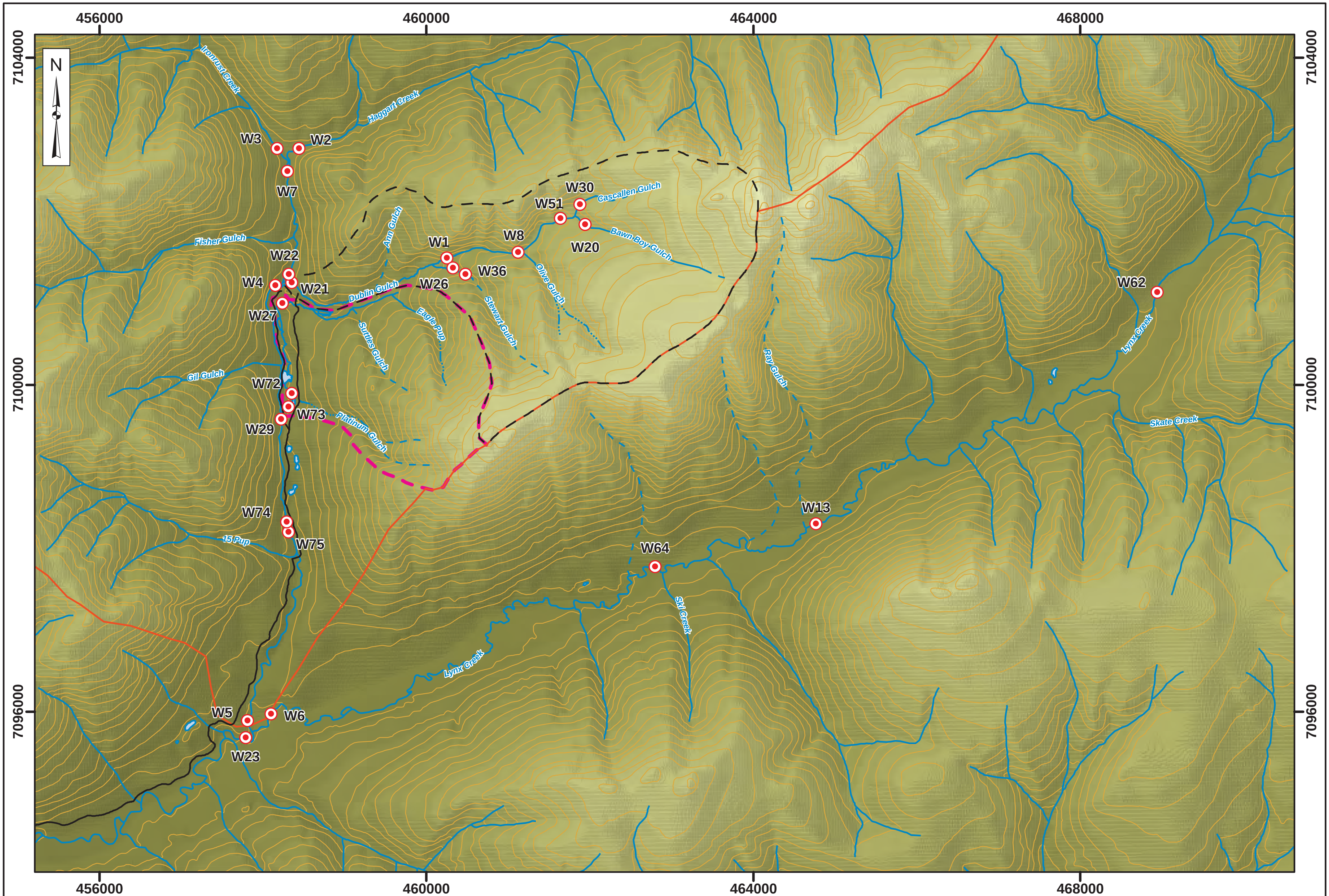
PEL), and (3) the probable effect range within which adverse biological effects frequently occur (i.e., more than 50% adverse effects occur above the PEL). Due to the naturally very high arsenic in sediment, that greatly exceeds the PEL at most sites, the dominant species of arsenic will be determined. If it is not bioavailable, then the threshold and PEL levels will be adjusted to better reflect potential effects.

Baseline data for the Project includes metals concentrations that exceed Probable Effects Levels as provided by CCME. Adaptive management thresholds for sediment monitoring are initially set at 25% higher than median 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:

Sediment Monitoring Station	Watercourse (ephemeral)	Dublin Gulch Basin Boundary	Waterbody
Watercourse (perennial)	Eagle Project Access Road	Eagle Creek Basin	
Watercourse (intermittent)	Contour (100ft)	Upper Haggart Creek Basin Boundary	

StrataGold Corporation

0 0.75 1.5
Kilometres
Scale = As Shown

Projection: NAD83 UTM Zone 8N

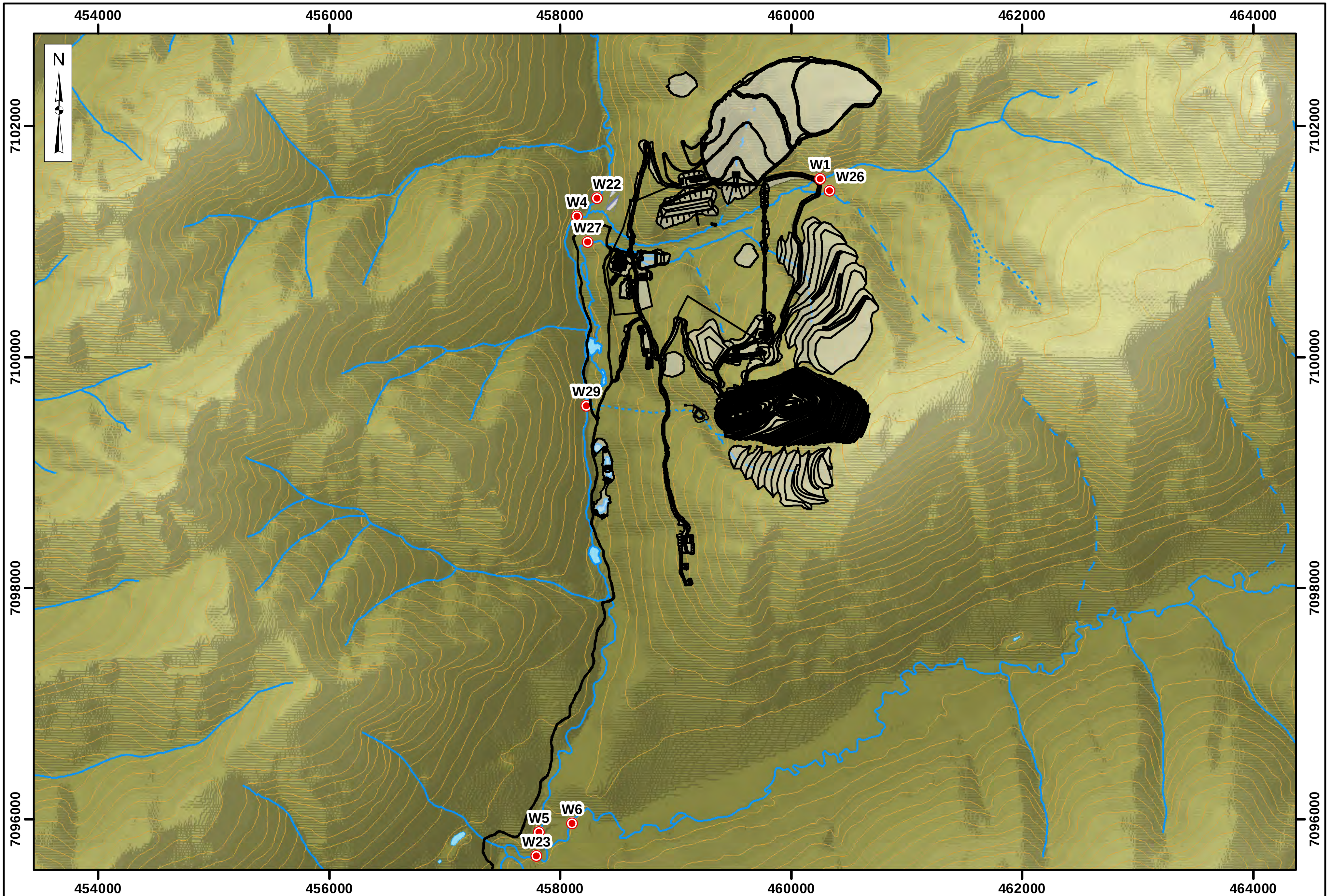
Drawn By: SS

Date: 2014/07/02

Figure: 7.2-1

EAGLE GOLD PROJECT
YUKON TERRITORY

Stream Sediment Monitoring Stations - Baseline



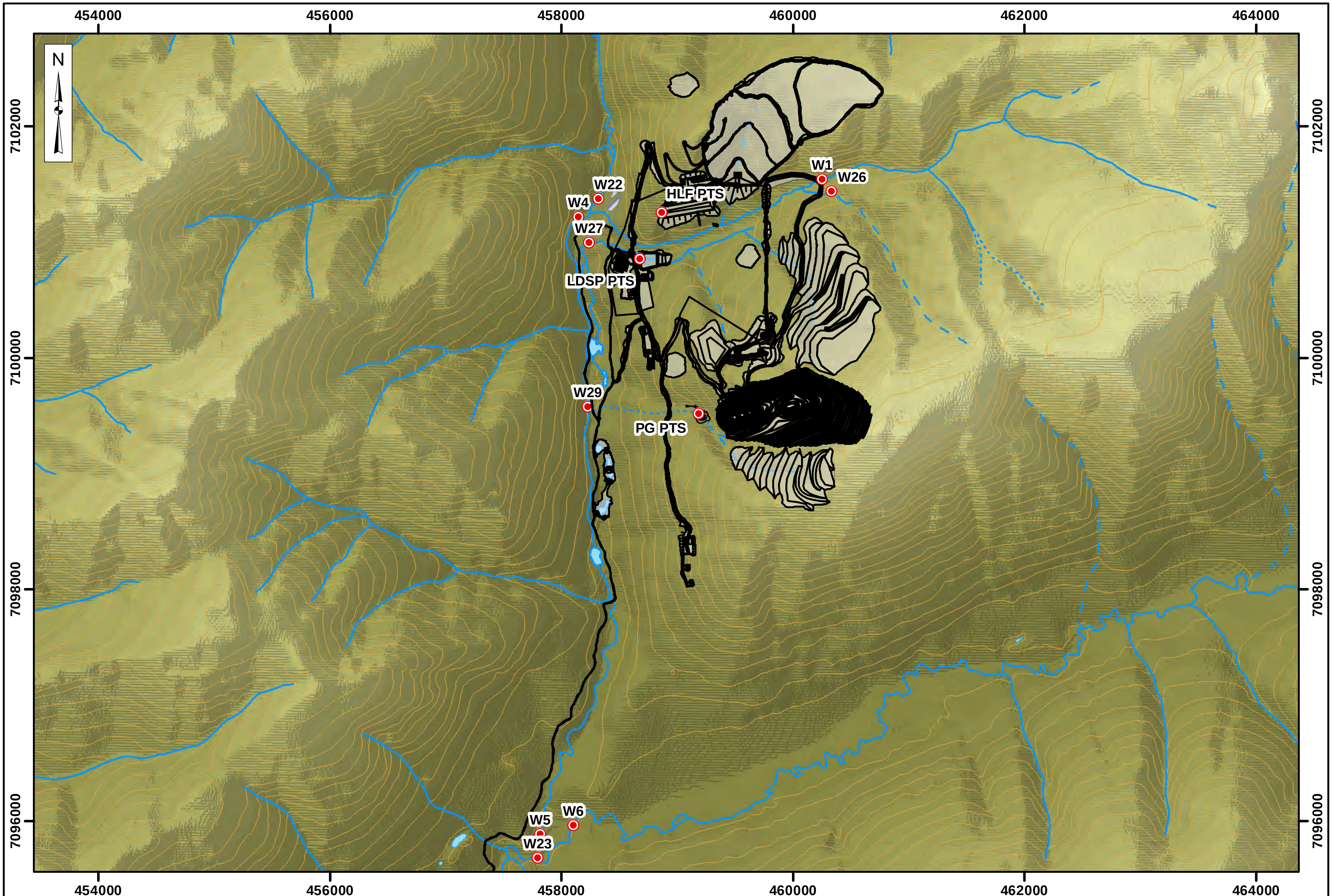
Legend:

- Stream Sediment Monitoring Location
- Facility
- Reserved
- Contour (100ft)
- Perennial
- Ephemeral
- Intermittent

StrataGold Corporation

0 600 1,200
Meters

Projection:	Drawn By:	EAGLE GOLD PROJECT YUKON TERRITORY
NAD 83 UTM Zone 8N	JK	
Date: 2018/04/12	Figure: 7.4-1	Construction, Operations & Early Closure Phase Stream Sediment Monitoring Stations



Legend:

- Stream Sediment Monitoring Location
- Facility
- Reserved Area
- Contour (100ft)
- Perennial
- Ephemeral
- Intermittent

StrataGold Corporation

Projection: NAD 83 UTM Zone 8N	Drawn By: JK	EAGLE GOLD PROJECT YUKON TERRITORY	
0 600 1,200 Meters	Date: 2019/04/12	Figure: 7.7-1	Late Closure Phase 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 and through construction of the Project
- Determine variation relative to baseline data
- Provide supporting information for fisheries assessments and to comply with future MMER 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 PREVIOUS WORK

Previous benthic invertebrate monitoring occurred during the late summer low flow period in 1995 (11 sites), 2007 (11 sites), 2009 (7 sites), and 2010 (7 sites), at sites shown in Figure 8.2-1 (Stantec (2011). Samples were collected from riffle habitat to target the preferred habitat of the more sensitive benthic invertebrate species (Table 8.2-1). In 1995, a Hess sampler (250 µm mesh; 0.096 m^2 sampling area) was used to collect three replicate samples from riffle habitat at each site (Hallam Knight Piésold 1996). In 2007, 2009, and 2010, a Surber sampler (250 µm mesh size; 0.093 m^2 area) was used to collect five replicate samples from riffle habitat at each site. Five replicate samples at least 15 m apart were collected at each site. Invertebrates were identified to the lowest practical level (genus for most insects including chironomids, family or order for other organisms, species or phylum in some cases). The size fraction analyzed was 500 µm in 2007, 2009, and 2010, rather than 250 µm in 1995.

Table 8.2-1: Benthic Invertebrate Sample Locations, 1995, 2007, 2009, and 2010

Site	Location	Dates Sampled			
		11 – 16 Aug 1995	11 – 20 Sept 2007	14 – 15 Sept 2009	18 – 19 Aug 2010
Haggart Creek Drainage Basin					
W2	Haggart above Iron Rust Creek	✓			
W3	Lower Iron Rust Creek	✓			
W7	Haggart below Iron Rust Creek	✓			
W11	Lower Fisher Gulch	✓			
W22	Haggart above Dublin Gulch		✓	✓	✓
W4	Haggart below Dublin Gulch	✓	✓		
W29	Haggart below Eagle Creek			✓	✓
W5	Haggart above Lynx Creek	✓	✓	✓	✓
W23	Haggart below Lynx Creek		✓		✓
Dublin Gulch Drainage Basin					
W20	Bawn Boy Gulch		✓		

Site	Location	Dates Sampled			
		11 – 16 Aug 1995	11 – 20 Sept 2007	14 – 15 Sept 2009	18 – 19 Aug 2010
W8	Dublin below Olive Gulch	✓			
W1	Dublin above Stewart Gulch	✓	✓	✓	✓
W26	Stewart Gulch	✓		✓	
W21	Dublin above Haggart Creek		✓	✓	✓
Eagle Creek Drainage Basin					
W9	Eagle Pup	✓	✓		
W10	Suttles Gulch		✓		
W27	Eagle Creek			✓	✓
Lynx Creek Drainage Basin					
W13	Lynx above Ray Creek		✓		
W6	Lynx above Haggart Creek	✓	✓		

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 MMER 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 CONSTRUCTION

8.4.1 Locations and Frequency

The benthic invertebrate monitoring program for the construction phase continues to monitor key drainage basins, with, a more focused monitoring program relative to the baseline program. Figure 8.4-1 illustrates the construction phase benthic invertebrate monitoring locations. Table 8.4-1 provides a summary of each monitoring station, location, coordinates, rationale and monitoring frequency for the construction period.

The benthic invertebrate monitoring stations are monitored on an annual basis during the late summer/early fall during construction.

Table 8.4-1: Construction 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	Annual
W4	Haggart below Dublin Gulch	7101223	458144	Below Project influence	Annual
W29	Haggart below Eagle Creek	7099583	458225	Below Project influence	Annual
W5	Haggart above Lynx Creek	7095887	457815	Below Project influence	Annual
W23	Haggart below Lynx Creek	7095682	457790	Below Project influence	Annual
Dublin Gulch Drainage Basin					
W1	Dublin Gulch above Stewart Gulch	7101545	460249	Above Project influence	Annual
W26	Stewart Gulch	7101443	460331	Above Project influence	Annual
Eagle Creek Drainage Basin					
W27	Eagle Creek	7100997	458235	Below Project influence	Annual
Lynx Creek Drainage Basin					
W6	Lynx Creek above Haggart Creek	7095964	458099	No Project influence	Annual

8.5 OPERATIONS

During the operations phase, the benthic invertebrate monitoring program remains unchanged from that performed during construction. 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.

8.5.1 Locations and Frequency

The benthic invertebrate monitoring program for the operations phase will continue to monitor benthos as per the construction period during the late summer/early fall on biennial basis. Figure 8.4-1 illustrates the operations phase benthic invertebrate monitoring locations. Table 8.5-1 provides a summary of each monitoring station, location, coordinates, rationale and monitoring frequency for the operations period.

Table 8.5-1: Operations 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

Site	Location Description	Coordinates		Rationale	Frequency Of Sampling
		Northing	Easting		
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

8.6 EARLY CLOSURE PHASE

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

8.6.1 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 8.6-1 provides a summary of each monitoring station, location, coordinates, rationale and monitoring frequency. Locations remain the same as those proposed during operations.

Table 8.6-1: 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

8.7 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 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 annual sampling of benthos immediately down gradient of the passive treatment systems.

8.7.1 Locations and Frequency

Table 8.7-1 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 8.7-1.

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 8.7-1: Late Closure Phase Benthic Invertebrate Monitoring Locations and Frequency

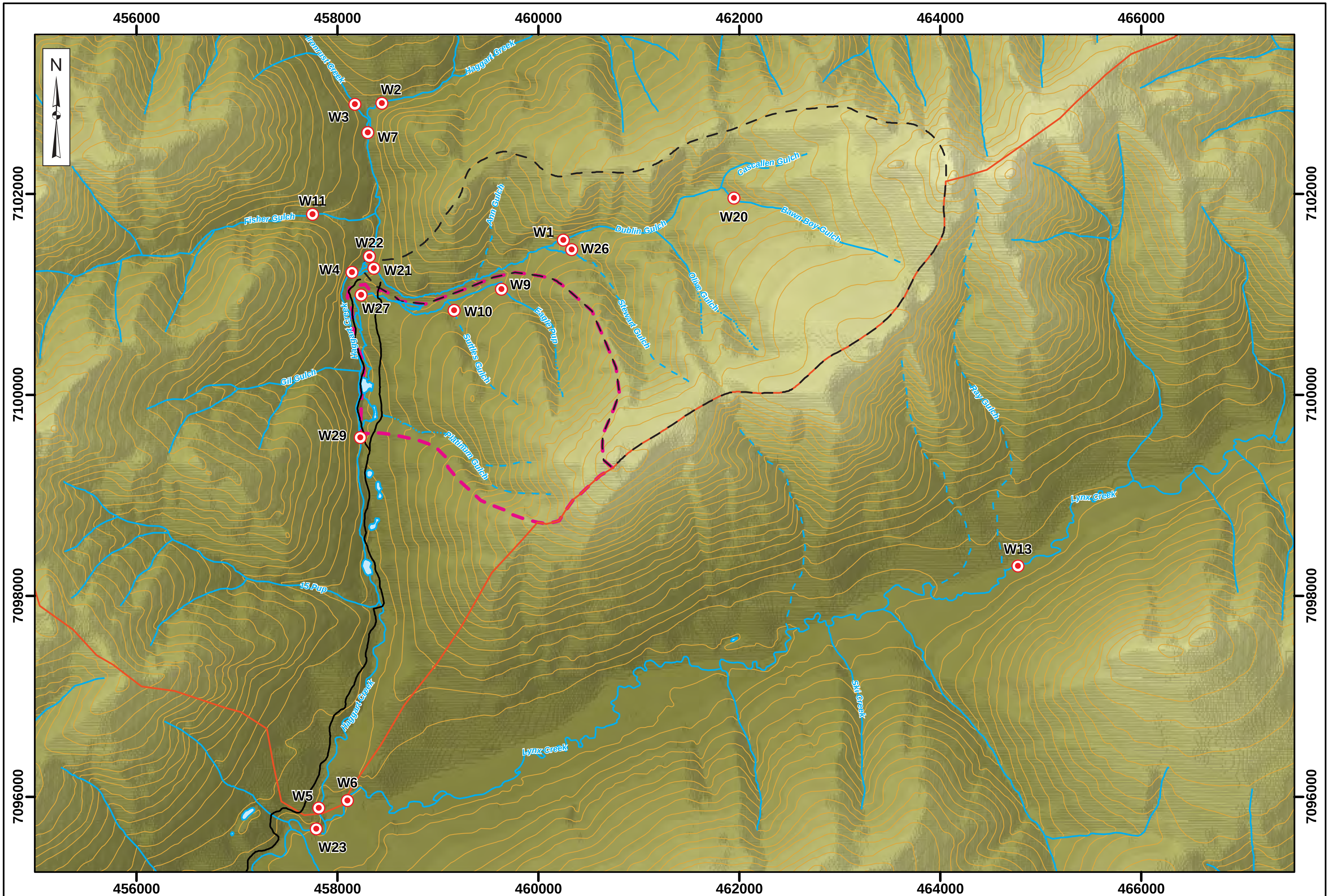
Site	Location Description	Coordinates		Rationale	Frequency of Sampling
		Northing	Easting		
Haggart Creek Drainage Basin					
W22	Haggart above Dublin Gulch	7101377	458319	Above Project influence	Biennial
HLF PTS	HLF passive treatment system	7101260	458865	PTS performance	Biennial
W4	Haggart below Dublin 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

8.8 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, which will be defined as an effect.

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 effluent discharge does not meet regulated standards and receiving environment water quality objectives:
  - 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:

- Benthic Invertebrate Monitoring Station
- Watercourse (perennial)
- Watercourse (intermittent)
- Watercourse (ephemeral)
- Eagle Project Access Road
- Contour (100ft)
- Dublin Gulch Basin Boundary
- Eagle Creek Basin
- Upper Haggart Creek Basin Boundary
- Waterbody

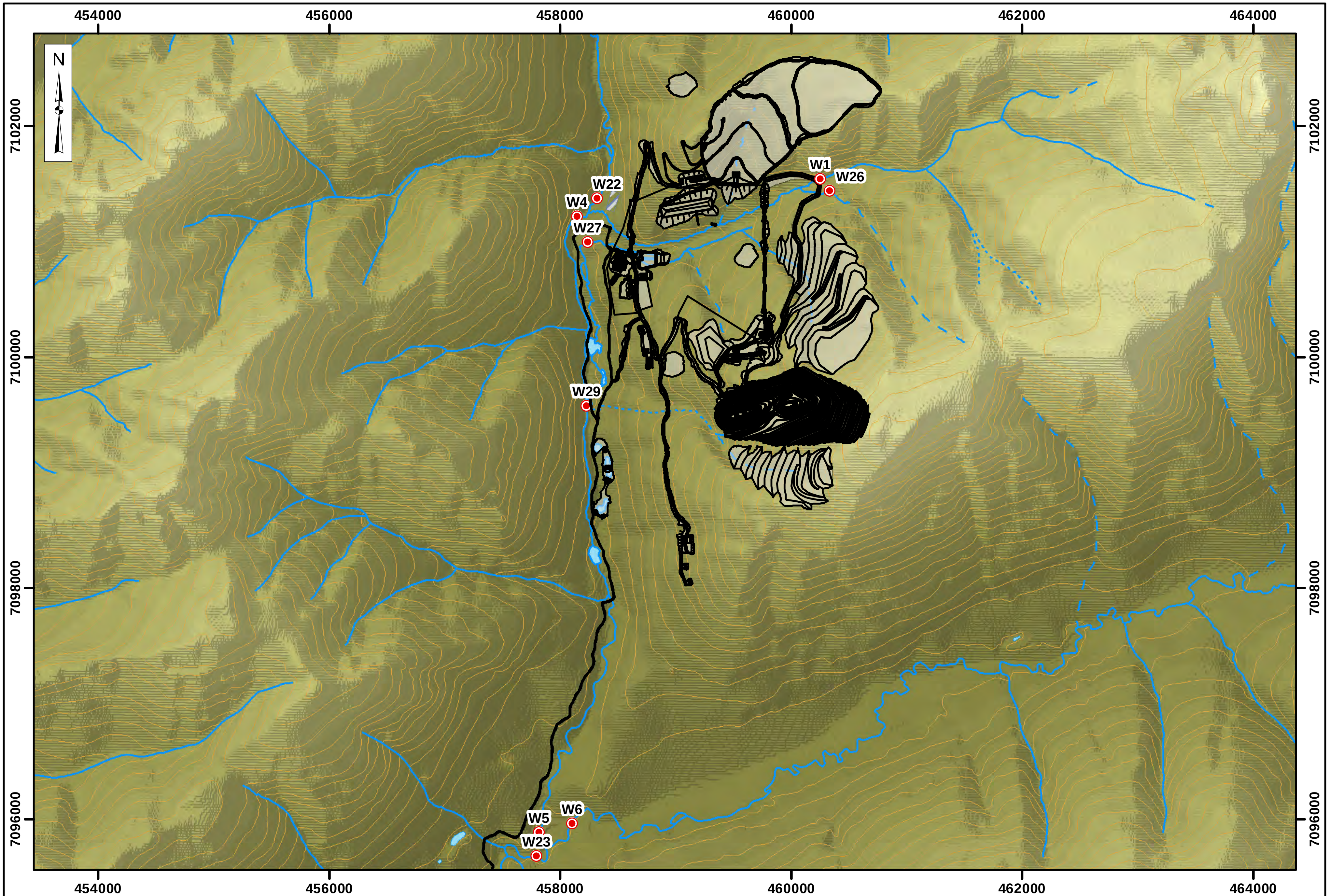
StrataGold Corporation

0 0.5 1
Kilometres
Scale = As Shown

Projection:	Drawn By:
NAD83 UTM Zone 8N	SS
Date:	Figure:
2014/07/02	8.2-1

EAGLE GOLD PROJECT
YUKON TERRITORY

Benthic Invertebrate Monitoring Stations - Baseline



Legend:

- Benthic Invertebrate Monitoring Location
- Facility
- Reserved Area
- Contour (100ft)
- Perennial
- Ephemeral
- Intermittent

StrataGold Corporation

Projection: NAD 83 UTM Zone 8N

Drawn By: JK

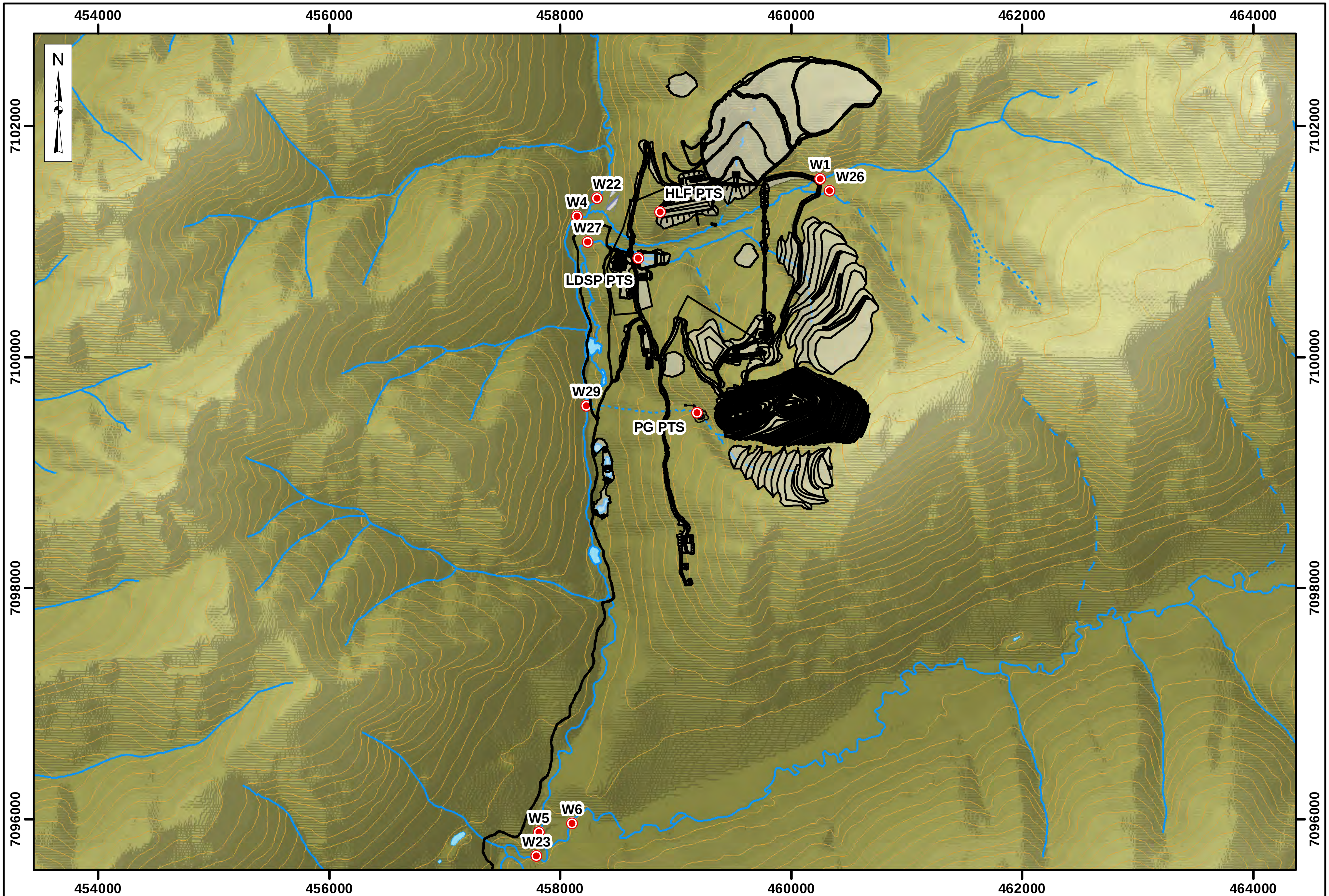
0 600 1,200
Meters

Date: 2019/04/12

Figure: 8.4-1

EAGLE GOLD PROJECT
YUKON TERRITORY

Construction, Operations & Early Closure Phase Benthic Invertebrate Monitoring Station



Legend:

- Benthic Invertebrate Monitoring Location
- Facility
- Reserved Area
- Contour (100ft)
- Perennial
- Ephemeral
- Intermittent

StrataGold Corporation

Projection: NAD 83 UTM Zone 8N

Drawn By: JK

0 600 1,200 Meters

Date: 2019/04/12

Figure: 8.7-1

EAGLE GOLD PROJECT
YUKON TERRITORY

Late Closure Phase Benthic Invertebrates 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 MMER, 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 PREVIOUS 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 SGC'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 over four sampling periods (August 2007, October 2007, April 2008, and July 2009) and included 59 sample sites, located on 28 mapped or field identified watercourses. Of the 28 watercourses sampled, 13 are crossed by the access road, 13 are within or immediately downstream of the Project, and two are within reference watercourses. Detailed results from the 2007-2009 Fish and Fish Habitat Baseline Program are provided in *Eagle Gold Project Environmental Baseline Report: Fish and Fish Habitat* (Stantec 2010e).

Figure 9.2-1 depicts the fish sampling sites and fish bearing water courses in the immediate Project area. Additional sites sampled throughout the Haggart Creek watershed are described in the 2011 Fish and Fish Habitat baseline report (Stantec 2011f).

Sampled watercourses were characterized as non-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 – Upper Dublin Gulch (a gradient barrier located 1.5 km upstream of the confluence with Haggart Creek) and Upper 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 July or August. 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 will 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 any effect on fish populations as a 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 construction activities. These effects would be attributed to higher TSS or turbidity, 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).

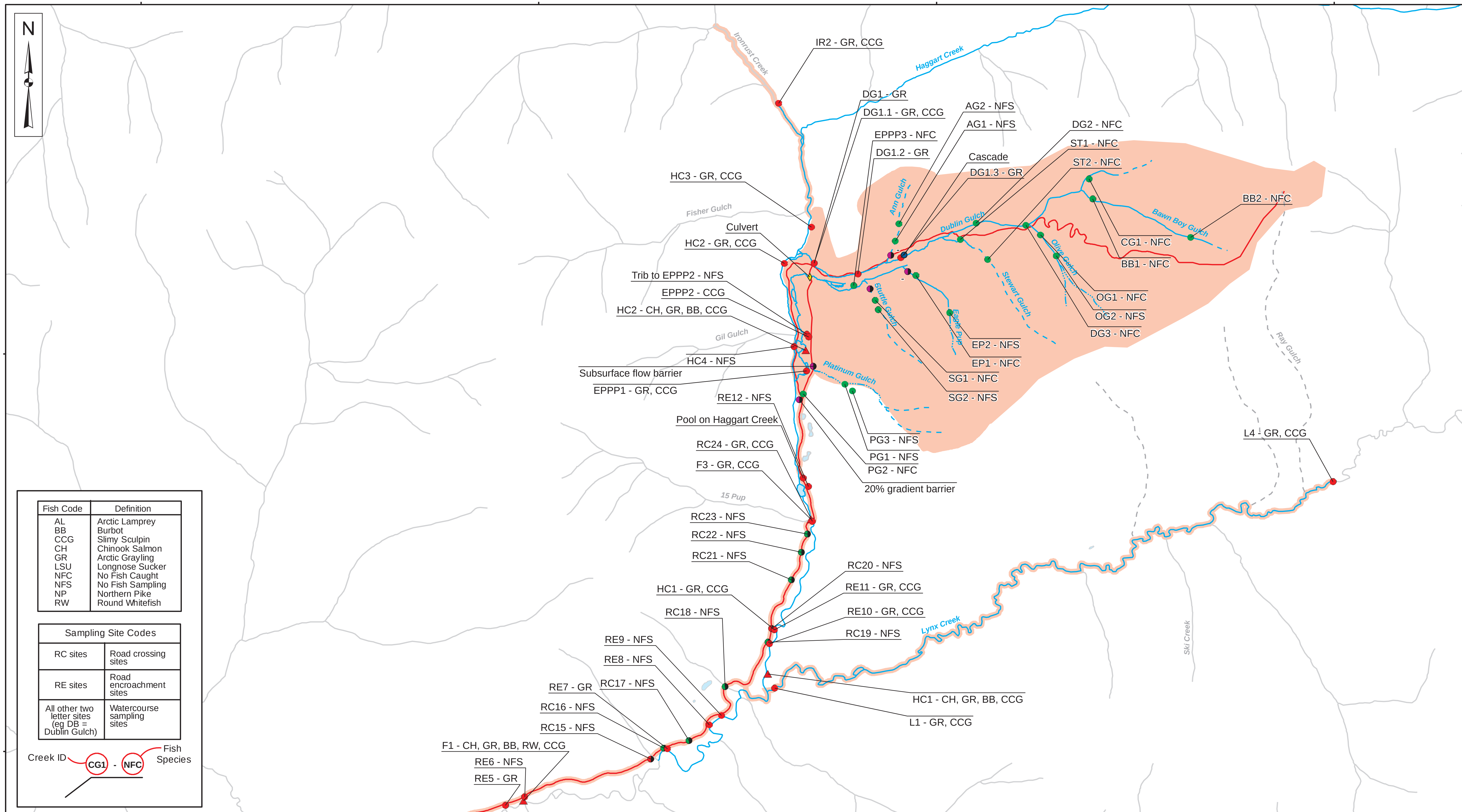
During operations, closure, and post closure potential effects to fish and fish habitat include:

- 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. 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 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



Fish Code	Definition
AL	Arctic Lamprey
BB	Burbot
CCG	Slimy Sculpin
CH	Chinook Salmon
GR	Arctic Grayling
LSU	Longnose Sucker
NFC	No Fish Caught
NFS	No Fish Sampling
NP	Northern Pike
RW	Round Whitefish

Sampling Site Codes	
RC sites	Road crossing sites
RE sites	Road encroachment sites
All other two letter sites (eg DB = Dublin Gulch)	Watercourse sampling sites

LEGEND

Hallam Knight Piesold Ltd. Sampling (1996)
- Fish bearing
- Non fish bearing

Stantec Sampling
- Fish bearing
- Fish bearing (inferred)
- Non fish bearing
- Non fish bearing (inferred)
- Cascade barrier
- Culvert barrier
- Gradient barrier

Watercourse
- Fish bearing (perennial)
- Non-fish bearing (perennial)
- Non-fish bearing (intermittent)
- Non-fish bearing (ephemeral)
- Unsampled (perennial)
- Unsampled (ephemeral)

- Fish and Fish Habitat Local Study Area
- Road - Gravel
- Waterbody

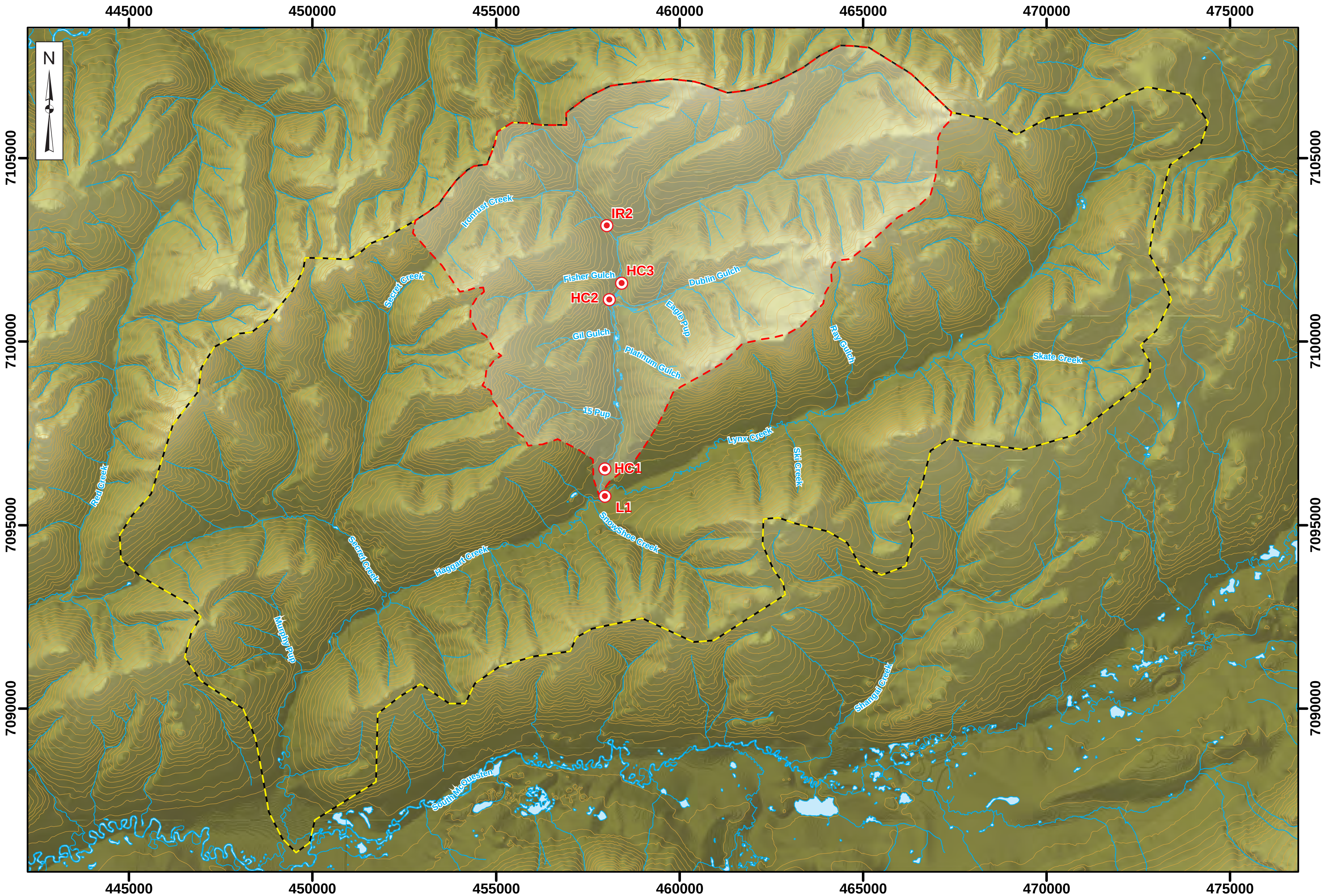
StrataGold Corporation

0 1 2
Kilometres
Scale = As Shown

PROJECTION	DRAWN BY
NAD83 Zone 8N	SS
DATE	FIGURE
2014/07/02	9.2-1

EAGLE GOLD PROJECT YUKON TERRITORY

Fish and Fish Habitat Baseline Sampling Sites in Immediate Project Area



Legend:

- Fish Habitat Monitoring Station
- Watercourse
- Contour (100ft)
- Water Quality Local Assessment
- Water Quality Regional Assessment

StrataGold Corporation

0 1.5 3
Kilometres
Scale = As Shown

Projection: NAD83 UTM Zone 8N	Drawn By: SS	EAGLE GOLD PROJECT YUKON TERRITORY
Date: 2014/07/02	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
- Rainfall (tipping bucket)
- 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 air quality information once Project facilities (e.g. site haul roads, crushing and screening plant, open pit, heap leach facility, refinery and waste rock storage areas, etc.) are in place.

10.2 PREVIOUS 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 SGC in August 2007 with the installation of the Potato Hills climate station (elevation 1420 m). This station is an ONSET Hobo operating system and currently 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) 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 construction phase, the survey locations will be expanded to 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

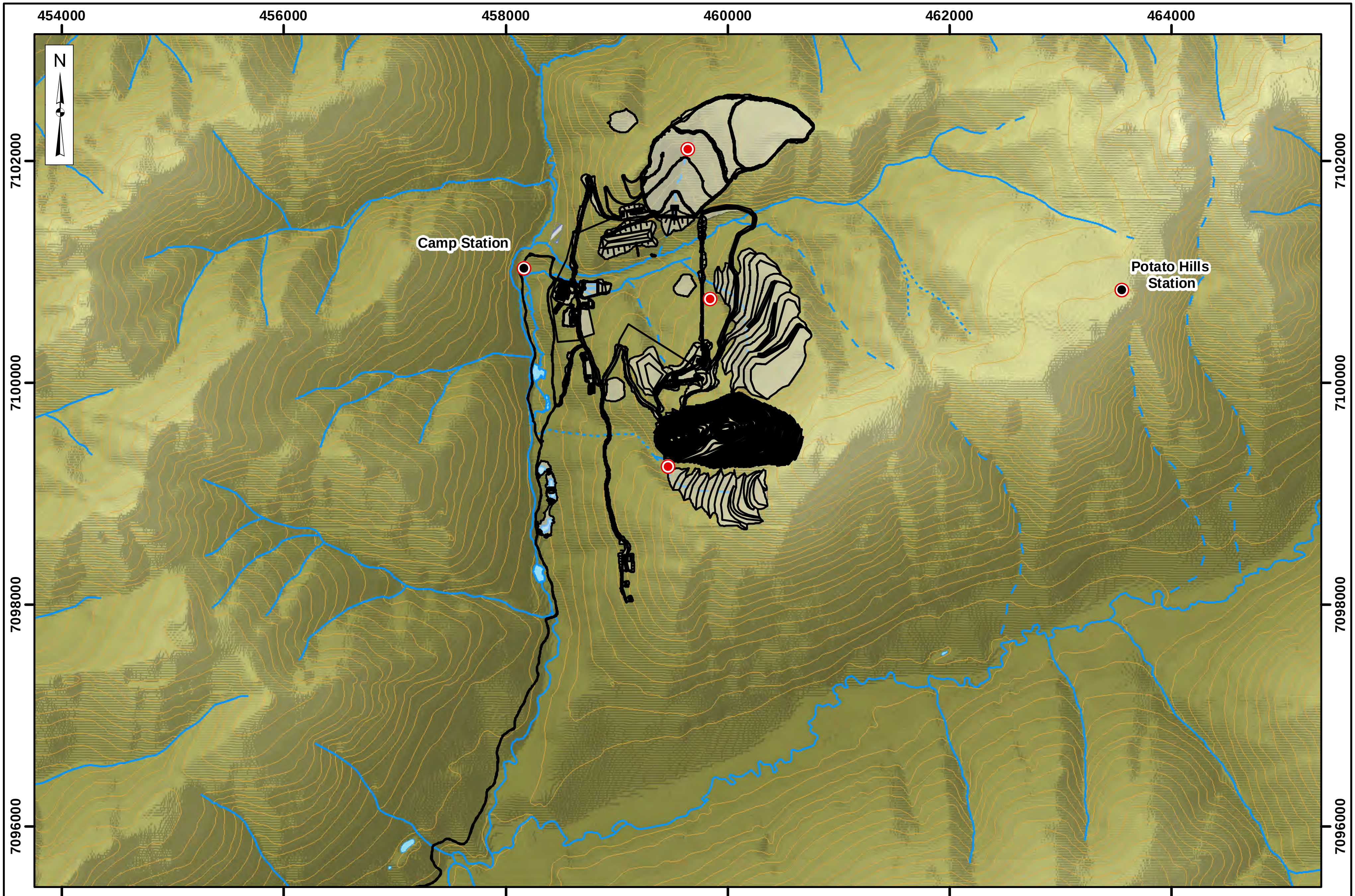
The climate stations and net radiometers will be visited and data downloaded on a regular basis to ensure that all instrumentation is maintained and functioning properly. During the open water season the stations will be visited 3-4 times, concurrent with hydrology data collection. In the winter, the 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
- Facility
- Reserved
- Perennial
- Ephemeral
- Intermittent
- Contour (100ft)

StrataGold Corporation

Projection: NAD 83 UTM Zone 8N

Drawn By: JK

0 0.75 1.5 Kilometers

Date: 2019/04/12

Figure: 10.3-1

EAGLE GOLD PROJECT YUKON TERRITORY

Climate Monitoring Locations

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. SGC is committed to applying industry standard best management practices to reduce Project emissions. SGC 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 (µg/m³)[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. Increased dustfall during construction may occur during periods of high ambient TSP concentrations. 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 has been completed. The worst-case representative operating scenario was developed based on the maximum expected production (i.e., Y4) and assumed emission sources operating concurrently at their individual maximum rates of production. As such, results presented in Table 11.1-2 represent the upper bound estimate of air emissions. At the perimeter of the mine claim boundary, TSP, PM10 and PM2.5, gaseous Contaminants of Potential Concern (COPCs) (NO2, SO2, CO, HCN and NH3), and metals are predicted to be well below air quality criteria.

Table 11.1-2: Year 4 Maximum Predicted Concentrations of COPCs Due to Emissions from Normal Operations

COPC	Averaging Period	Criteria (µg/m^3)[c]	Maximum at Perimeter of Mine Claim Boundary	
			Max Predicted Conc. (µg/m³)	% of Criteria
Particulate				
TSP	24-hour (Max)	120	35.5	30%
	Annual (Average)	60	2.9	5%
PM_{10}	24-hour (Max)	50	27.2	54%
$PM_{2.5}$	24-hour (Max)	27	4.8	18%
	Annual (Average)	8.8	0.8	9%
Gasses				
CO	1-hour (Max)	14,885	151.1	1%
	8-hour (Max)	5,725	106.3	2%
SO_2	1-hour (99th Percentile)	183	1.7	1%
	24-hour (Max)	149	1.1	1%
	Annual (Average)	13	0.02	<1%

COPC	Averaging Period	Criteria (µg/m³)[c]	Maximum at Perimeter of Mine Claim Boundary	
			Max Predicted Conc. (µg/m³)	% of Criteria
NO_2	1-hour (99th Percentile)	113	26.5	23%
	24-hour (Max)	199	35.3	18%
	Annual (Average)	32	1.5	5%
HCN	24-hour (Max)	8	1.71	21%
NH_3	24-hour (Max)	100	0.0007	<1%
Metals				
As	24-hour (Max)	0.3	0.0175	6%
Cd	24-hour (Max)	0.025	0.00003	<1%
Cr	24-hour (Max)	0.5	0.0060	1%
Cu	24-hour (Max)	50	0.0015	<1%
Hg	24-hour (Max)	2	0.000001	<1%
Ni	24-hour (Max)	0.2	0.0012	1%
	Annual (Average)	0.04	0.0001	<1%
Pb	24-hour (Max)	0.5	0.0014	<1%
Zn	24-hour (Max)	120	0.0050	<1%

The model update will be provided to Yukon Government as part of an application for an air emissions permit, prior to any gold recovery process being undertaken. The model update will be supported by a standalone Air Quality Monitoring Plan as 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, SGC will be monitoring 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 is planned to record data during construction and operations. Three Beta-Attenuation Particulate Monitors (EBAMs) capable of monitoring continuous, real-time TSP, PM10, and PM2.5 ambient air quality data will be 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 will be constructed around the instruments for additional protection from temperatures below – 30° C.

In addition to the EBAMs, a Maxxam Passive Air Sampling System capable of testing NO_2, SO_2, and Ammonia will be installed adjacent to the EBAMs. Furthermore, dustfall canisters will be installed at four locations (Figure 12.3-2) to collect additional data on total metals concentrations.

11.2.1 Locations

The air quality sampler will be located at the lower camp climate station directly adjacent and west of the existing and future camp. Given the prevailing NNW winds this location is suitable to detect TSP concentrations from the majority of Project activities.

11.2.2 Frequency

EBAMs automate particulate measurement by continuously sampling and reporting concentration data and updating records once every minute. 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.

Satellite communications will be established and data will be uploaded from the EBAMs directly to a cloud based server at a rate of one record per minute. The server will be accessible via secure web interface for SGC 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.

11.2.3 Data Collection and Analysis

Designated SGC personnel will receive an automatically generated daily report summarizing ambient air quality data from the past 24-hours. Outliers, invalid data, or exceedance values will send out an alert to designated SGC Personnel and be addressed in an immediate manner. Automated weekly reports will be produced to summarize statistical analysis of results, as well as automatic QA/QC tests of all incoming data.

Annual reports will be produced which contain the recorded TSP, PM 10, and PM 2.5 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 µg/m^3 24-hour average or 50 µg/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, SGC will take the following actions:

- Notify Environment Yukon and EMR of the 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.

TERRESTRIAL

12 VEGETATION

12.1 INTRODUCTION AND OBJECTIVES

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

- To measure plant metal uptake during construction,
- Establish monitoring sites that will be monitored during future activities, and
- Help identify whether any trends in metal uptake could be attributed to site activities.

12.2 PREVIOUS WORK

A baseline vegetation assessment was completed in 2009 and 2010 (Stantec, 2011e). The baseline assessment includes terrestrial ecosystem mapping, a rare plant survey and foliar sampling for the area of the proposed 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. Foliar samples of commonly occurring shrubs, grasses or sedges were collected at nine sites for metals analysis. 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.

12.2.1 Trace Metal Concentrations in Vegetation

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. Species sampled included: willow (*Salix* spp.), sedge (*Carex* spp.), bluejoint (*Calamagrostis canadensis*) and northern rough fescue (*Festuca altaica*). All metal levels were analyzed using inductively coupled plasma mass spectrometry (ICP-MS).

The dietary tolerances of wild ungulates for the elements considered are not known due to the difficulties associated with sampling large populations of wild mammals. Consequently, the dietary guidelines established for domestic cattle have been used to predict effects on wild ungulates. All elements were below toxic levels for dietary intake by cattle for all sites and species based on dietary guidelines outlined in Puls (1994).

Barium concentration was high, but not toxic/excessive, in grasses at one site (ELG-10) and willows at another (EGL-50). Phosphorus and potassium concentrations were deficient for all sites and species. Moose are present and forage in the Project study areas year-round, and Caribou are known to be occasionally present (Stantec, 2011b).

12.3 METHODS

Permanent sample sites have been established and sampling on vegetation monitoring plots 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) have been 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 will be 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 will be 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 will be taken from the nearest available specimens. Samples will be collected, treated as tissue samples and sent directly to the selected laboratory for analysis.

12.3.1 Locations

Four permanent monitoring plots were established (site D4 may however be relocated for the 2019 sampling season to be more representative of site conditions), one in each of four quadrants (D1-D4) located in the Project area (Figure 12.3-2). Plot locations will be selected in the field based on identification of pre-established ecosystem criteria (the dominant ecosystems, previously identified). Vegetation monitoring plots will be established on the predominant slope, aspect and drainage position within each dominant vegetation ecosystem unit.

- Vegetation monitoring station D1 will be co-located with the Potato Hills meteorological station.
- Vegetation monitoring station D2 will be located at or near the Camp meteorological station and location of the Partisol Air Quality Sampler. This station will be representative of the Project area boundary.
- Vegetation monitoring station D3 will be located below the hilltop just southeast of the Project area. This corresponds to the area of highest TSP concentrations and dustfall that were predicted by dispersion modeling.
- Vegetation monitoring station D4 will be approximately 1.5 km south of the camp, to the east of the access road. This location is downwind of prevailing winds at the Camp meteorological station.

12.3.2 Frequency

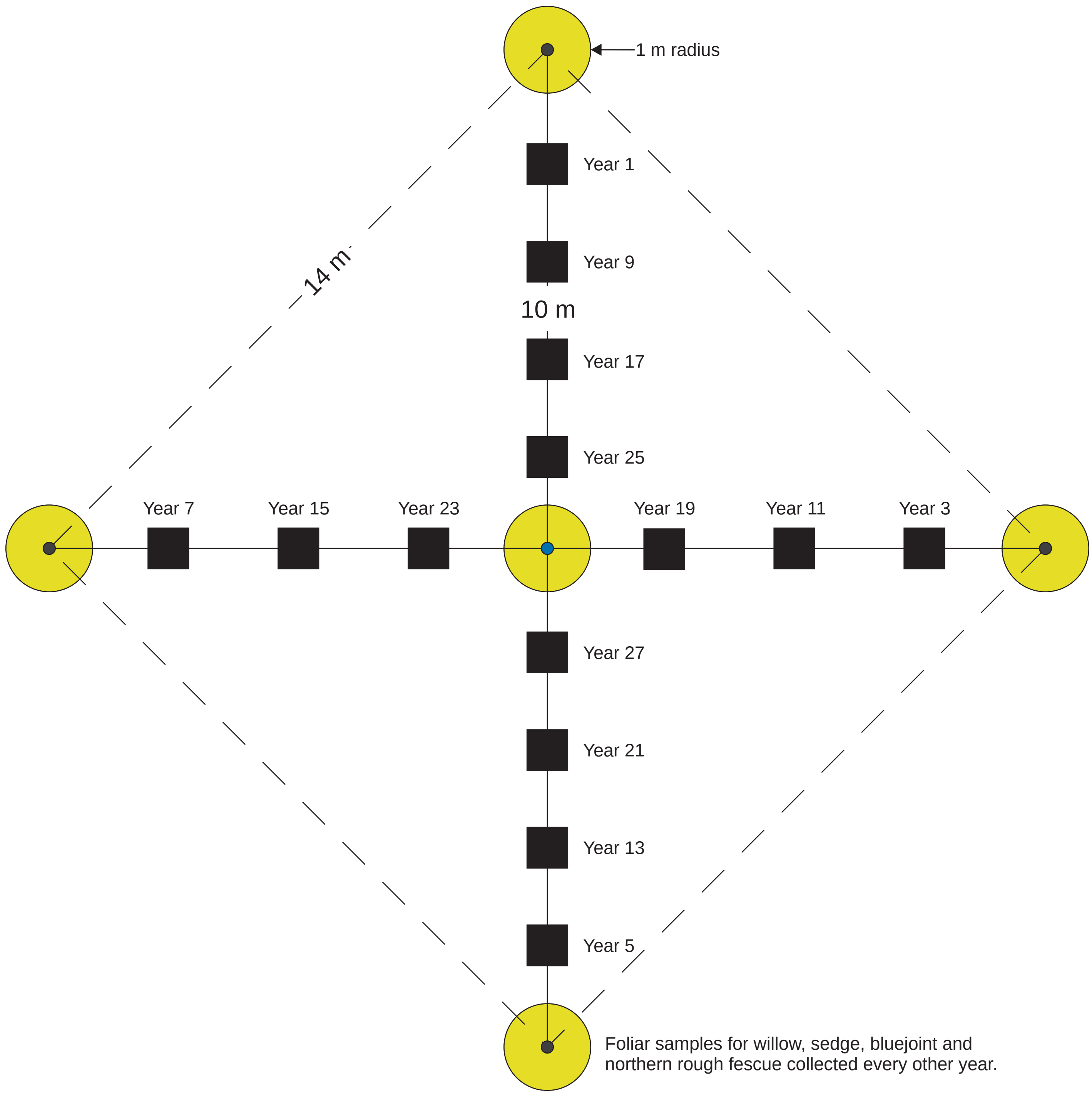
All permanent vegetation monitoring plots will be sampled once each year during the growing season (July and August) before leaves start to yellow.

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, SGC 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.

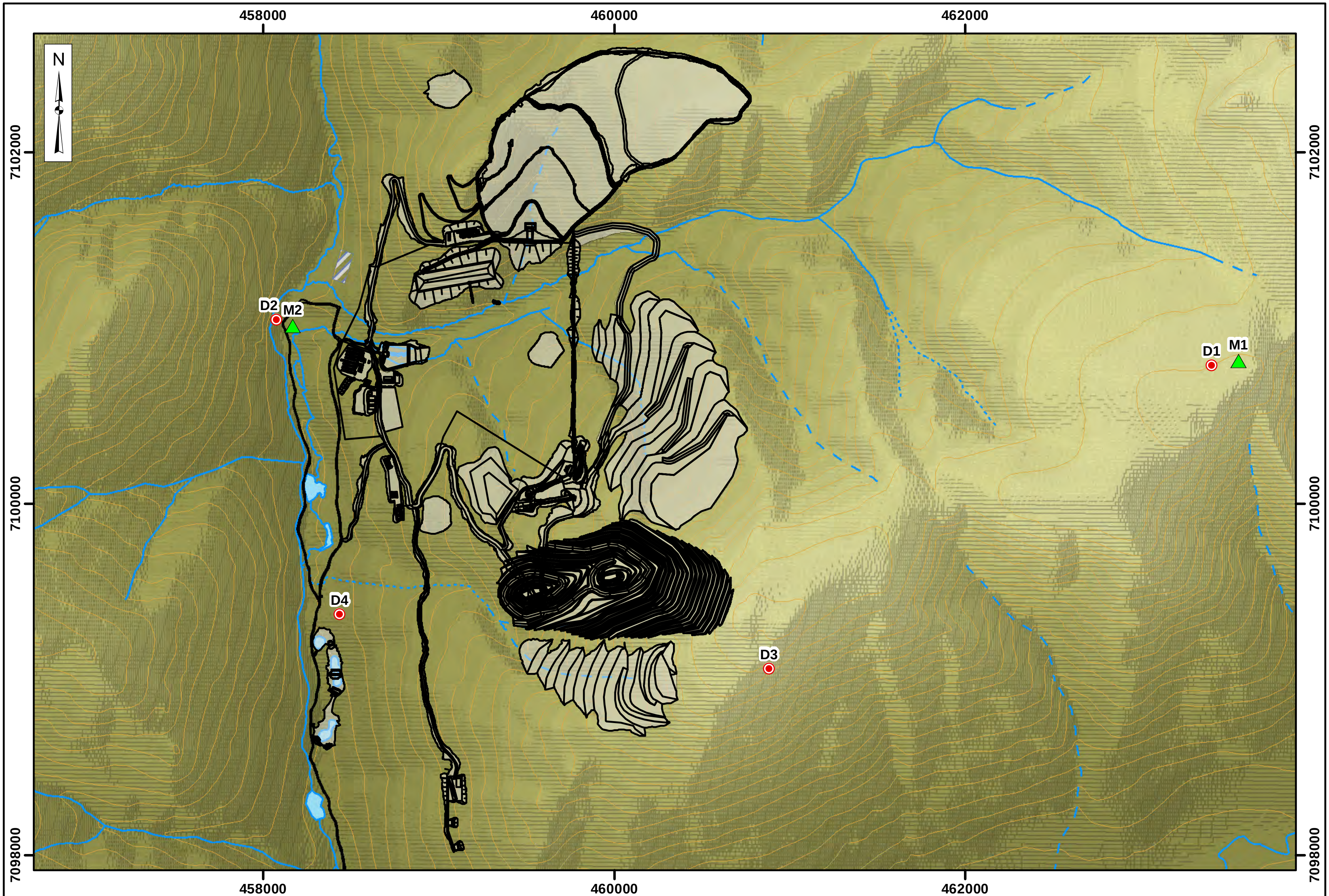
Soil sampling locations, surface horizon between 0 and 0.5 m depths; one sample every other year.

StrataGold Corporation

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:

- Dustfall Station
- Meteorological Station
- Facility
- Reserved Area
- Contour (100ft)
- Perennial
- Ephemeral
- Intermittent

StrataGold Corporation

Projection: NAD 83 UTM Zone 8N	Drawn By: JK	**EAGLE GOLD PROJECT YUKON TERRITORY**	
0 400 800 Meters	Date: 2019/04/12	Figure: 12.3-2	**Vegetation and Soil Monitoring Locations**

13 SOILS

13.1 INTRODUCTION AND OBJECTIVES

The soils monitoring program has been designed to provide data to determine changes to metal and nutrient levels in soils adjacent to the mine as a result of dust deposition. Soils monitoring will be undertaken in conjunction with the vegetation monitoring program to evaluate if Project activities are resulting in increased trace metal and nutrient levels in soils.

13.2 PREVIOUS 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). For the purposes of the environmental assessment, the Project area was divided into three study areas defined by the proposed development footprint and by terrain features. The local study area (LSA) encompasses the proposed development area, and is 1,606 hectares in size. The LSA is the Dublin Gulch watershed, with extensions to capture proposed development footprint outside the watershed at the northwestern corner (near Ann Gulch), and north of the confluence of Dublin Gulch and Haggart Creek. The regional study area (RSA) encompasses the 1,606 ha LSA plus an additional 5,932 ha surrounding the LSA, for a total of 7,538 ha. The RSA provides broader context for the LSA, and provides baseline information for the vegetation and wildlife disciplines. The RSA is defined by the heights of land to the west and east of the Dublin Gulch watershed, and by Haggart Creek to the north and Lynx Creek to the south. The road corridor study area (RCSA) encompasses the proposed road upgrade corridor for the South McQuesten Road (SMR) and the Haggart Creek Access Road (HCAR). This corridor is approximately 44.8 km long and 1 km wide (500 m either side of the road centreline), or 4,579 ha.

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.

All soils were described according to the Canadian System of Soil Classification (Soil Classification Working Group 1998). Soil samples were taken at various depths (linked to horizon designation) to a maximum depth of 50 cm. Lab analysis of soils included: particle size (fine [<2 mm] and coarse [>2mm]) and pH. Soil map units were mapped and described to characterize topsoil depths and 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).

The results of the baseline soil elemental analyses show arsenic was naturally above all guideline values for this parameter in almost all soil and overburden samples. For the remainder of the analyzed elements, three soil samples, and four overburden samples, had Cd, Cu, Pb, Mo, Ni, or Se concentrations which were equal to or exceeded the lowest of the soil quality guidelines, which was often the CCME agriculture guideline limit. Table 13.2-1 and Table 13.2-2 are reproduced from Appendix 6 of the Eagle Gold Project Proposal to provide the soil and overburden baseline data set for samples that exceeded guidelines. Further detail is provided in the Environmental Baseline Report: Surficial Geology, Terrain, and Soils (Stantec 2011c).

Table 13.2-1: Surface Soil Sample Metal Exceedances

Sample	Depth (m)	Element	Concentration (mg/kg)	Guideline Limit (mg/kg)	Guideline
EGL8 NT-1	0 – 0.04	Cd	1.4	1.4	CCME Agriculture
EGL17 NT-1	0 – 0.06	Ni	54	50	CCME Agriculture, Parkland
HL6-8 S1	0.3	Se	1.3	1	CCME Agriculture, Parkland

Table 13.2-2: Overburden Sample Metal Exceedances

Sample	Depth (m)	Element	Concentration (mg/kg)	Guideline Limit (mg/kg)	Guideline
P4 S2	1.8 – 2	Cu	81	63	CCME Agriculture, Parkland
		Se	1	1	CCME Agriculture, Parkland
WR3 S1	2	Mo	5.7	5	CCME and Yukon CSR Agriculture
HL5-7 S3	2.2 – 2.5	Pb	85.8	70	CCME Agriculture
		Mo	7.8	5	CCME and Yukon CSR Agriculture
HL6 -1 S3	5 – 5.5	Ni	57	50	CCME Agriculture, Parkland
WR1 S3	6	Cu	84	63	CCME Agriculture, Parkland
		Se	1.2	1	CCME Agriculture, Parkland

A set of 18 historic soil samples from 1995 were also collected and analyzed for total Cu, Fe, Pb, Zn, Mo, and Hg; and evaluated against the above guidelines (full soil analysis results, see Appendix B). All samples were found to be below guideline limits for the assessed elements.

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. Only two of the soil samples, and none of the overburden samples, had a total arsenic concentration below CCME and Yukon CSR summary guidelines (12 and 15 mg/kg, respectively). The mean concentration of As in soils (0 – 50 cm depth) was 193 mg/kg, with a range of 2.4 to 880 mg/kg. In overburden, the mean As concentration was 320 mg/kg, ranging from 23.7 to 1350 mg/kg.

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 will be 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 will be 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 (site D4 may however be relocated for the 2019 sampling season to be more representative of site conditions), one in each monitoring quadrant (D1-D4). Plot locations will be selected in the field based on identification of pre-established ecosystem criteria (the dominant ecosystems, previously identified). Vegetation monitoring plots will be established on the predominant slope, aspect and drainage position within each dominant vegetation ecosystem unit.

- Soil and vegetation monitoring station D1 will be located adjacent to the Potato Hills meteorological station.
- Soil and vegetation monitoring station D2 will be located at or near the Camp meteorological station and location of the Partisol Air Quality Sampler. This station will be representative of the Project area boundary.
- Soil and vegetation monitoring station D3 will be located below the hilltop just southeast of the Project area. This corresponds to the area of highest TSP concentrations and dustfall that were predicted by dispersion modeling.
- Soil and vegetation monitoring station D4 will be approximately 1.5 km south of the camp, to the east of the access road. This location is downwind of prevailing winds at the Camp meteorological station.

Based on the results of the updated operations phase dispersion model, soil monitoring sites outside of the Project footprint will be selected in areas with a predicted 10% increase in arsenic, to monitor for element concentrations, in particular arsenic, in soil and foliage. These monitoring sites will be established during the construction phase (to establish baseline conditions) and continue until the end of mining operations.

13.3.3 Frequency

Soil samples will be 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, SGC 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 construction and 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 construction in the development of the open pit, development of infrastructure pads, and quarry development. Blasting will occur in the open pit throughout the operations phase of the Project and will be scheduled to occur once per day at shift change or lunch break. 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 and restrict public access to the mine site
- 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
- Restricting access to the mine site so that recreational land users are not present in the vicinity of the mine during blasting operations

14.2 PREVIOUS 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. Baseline ambient sound levels of 35 dBA Leq(9) nighttime and 45 dBA Leq(15) daytime were applied for the assessment. Sound level modeling was conducted using the software CADNA/A Version 4.0 (DataKustik GmbH (DataKustik) 2009) for Project construction, operations, blasting, and decommissioning. Predictions at 1.5 km from the Project boundary were compared to the regulatory noise criteria to evaluate Project compliance.

The construction-related noise limits for residential areas are 65 dBA Leq(12) for daytime, 60 dBA Leq(4) for evening, and 55 dBA Leq(8) for nighttime and all day for Sundays and holidays set by Environment Canada (1989) *Code of Practice*. Because the Project construction equipment will be operating continuously, the focus was to assess the effects of construction noise in relation to the most stringent regulatory criteria (nighttime limit of 55 dBA Leq(8)).

During construction and decommissioning, the maximum predicted nighttime sound level will be 42 dBA Leq(8) and the maximum cumulative predicted nighttime sound level, including ambient baseline sound levels, will be 43 dBA Leq(8). This is less than the Environment Canada (1989) *Code of Practice* nighttime limit of 55 dBA Leq(8) for construction-related noise. Therefore predicted noise levels during the construction phase are well below generally accepted regulatory criteria.

Permissible sound levels (PSLs) are 50 dBA Leq(15) for operations during daytime and 40 dBA Leq(9) for operations during nighttime, respectively. During Project operations, the maximum predicted daytime sound level is 41 dBA Leq(15). The maximum cumulative predicted daytime sound level, including ambient baseline sound levels, is 46 dBA Leq(15), which is less than the daytime PSL of 50 dBA Leq(15). During Project operations, the maximum predicted nighttime sound level associated with the Project alone is 36 dBA Leq(9). The maximum cumulative predicted nighttime sound level, including ambient baseline sound levels, is 39 dBA Leq(9), which is lower than the PSL of 40 dBA Leq(9). Therefore, predicted noise levels during the operation phase are within the generally accepted applicable regulatory criteria in Canada.

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 during construction, operation, and decommissioning phases 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 construction level blasting and to refine monitoring methods. Peak sound levels during the blasting activities captured was 100.6 dB. This is 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, SGC will monitor 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. Should noise levels on the HCR exceed 110 dB, SGC will use personnel to control and inform traffic on this portion of the HCR during blasting events until such time as the noise monitoring demonstrates blasting noise at the HCR is consistently below 110 dB.

Prior to scheduled blasting events, a technician will travel to the monitoring locations and record sound levels during blasting. Sound levels will be measured using a Class 1 Sound Level Meter that has a dynamic range of at least 30 - 140 dB.

14.3.1 Location

Monitoring will be completed at several fixed locations on the HCR closest to the open pit. Additionally, SGC will conduct instantaneous monitoring at specific locations to be determined based on blasting locations during construction if outside of the open pit area or, if warranted by a noise complaint.

14.3.2 Frequency

Sound monitoring will be initially undertaken monthly for a minimum of 3 months to determine if the peak sound levels on the Haggart Creek Road exceed 110 dB during blasting. In the event sound levels exceed 110 dB during blasting, monitoring will continue during blasting activities to ensure access road restrictions are necessary. If sound levels do not exceed 110 dB during this period and blasting operations do not vary, monitoring and road restrictions during blasting will be 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

Recorded sound levels will be collected and stored in an electronic database. Data reports will be made available upon request. Any noise complaints received will be recorded and included.

Based on the results of the monitoring additional mitigation measures, or adaptive management strategies will be identified and implemented as required.

14.5 MANAGEMENT

The adaptive management thresholds for noise generated by the Project at the 1.5 km radius are 50 dBA Leq(15) for operations during daytime and 40 dBA Leq(9) for operations during nighttime, respectively. The threshold during blasting is 110 dB. If these thresholds are exceeded 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. These 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 engineer that conducted the inspection documenting the results of the inspection. 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. SGC 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. Construction, operation and closure of the mine 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).

Baseline 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 the thermistor after construction, additional thermistor strings may need to be installed at selected facilities. In some cases, decisions on specific monitoring will be made as part of detailed engineering design.

15.2 PREVIOUS 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 until mine construction begins.

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 will involve the following primary components:

- Visual inspection during construction 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. A record will be prepared for every inspection and compared to previous observations to assess ongoing degradation. 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 construction 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 construction-related ground disturbance. It is expected, however, that many of the existing thermistors will be destroyed during construction. 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 construction and 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 continue to be monitored, four times a year to capture the seasonal fluctuations of ground temperatures and to determine the presence of frozen ground and thickness of the active layer.

Quarterly monitoring of thermistors installed in key facilities to assess trends in changes on permafrost will be undertaken during the construction and operations phases. 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.

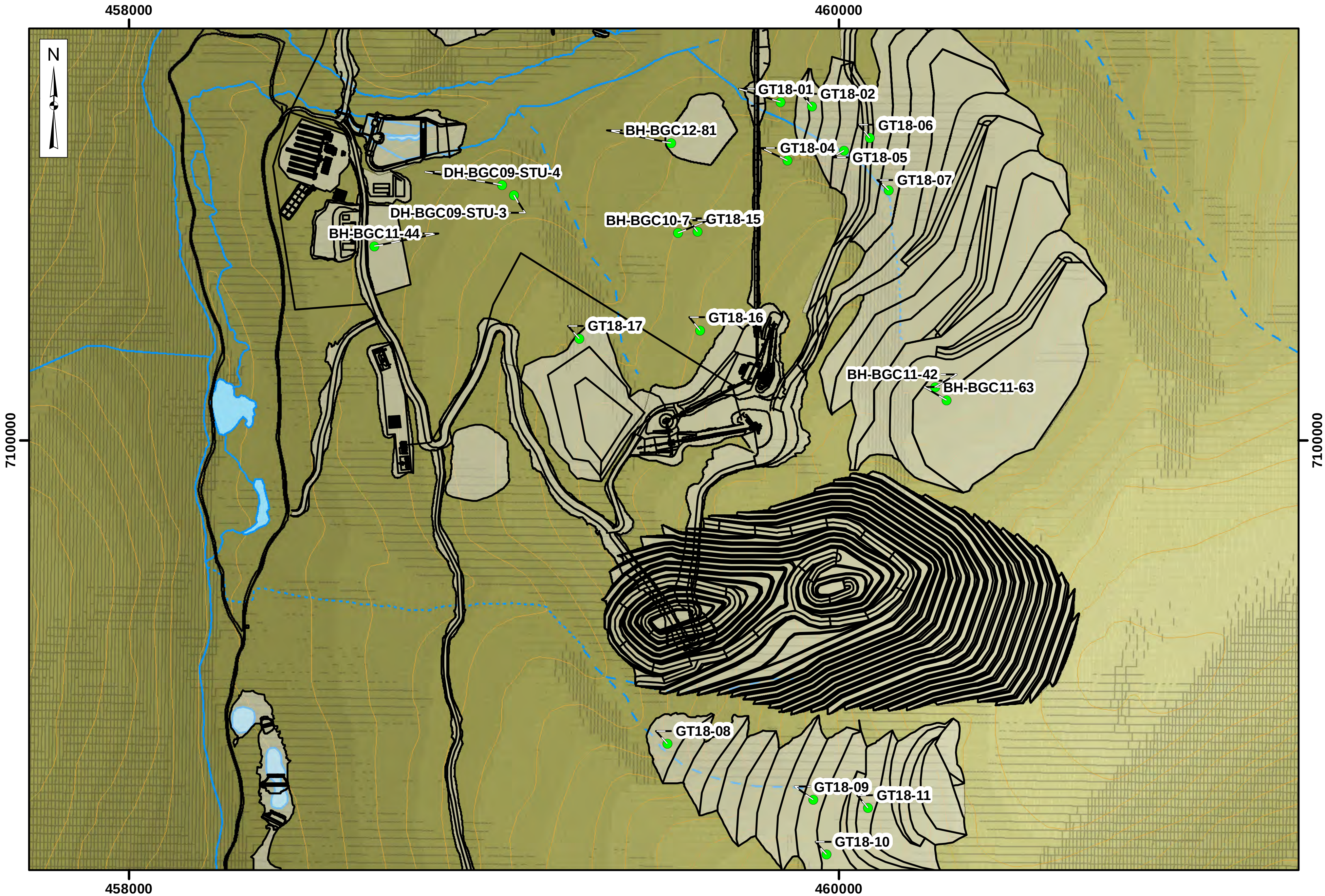
Data from visual inspections will be collected as photo log albums, indicating date, time and personnel responsible for data collection, accompanied by a written description of observations. Compiled records of visual observations will be reviewed for evidence of permafrost degradation warranting either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

Data and findings will be presented in an annual data report, with a detailed assessment of subsurface trends and conditions carried out 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	Contour (100ft)
Facility	Perennial
Reserved Area	Ephemeral
	Intermittent

StrataGold Corporation

0 200 400
Meters

Projection: NAD 83 UTM Zone 8N

Drawn By: JK

Date: 2019/04/12

Figure: 15.2-1

EAGLE GOLD PROJECT
YUKON TERRITORY

Existing Thermistors - 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 three major 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 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

Approximately 40 prisms will be installed around the pit perimeter, including three backsights (control points), during the mine start-up to establish the initial 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, another 250 to 400 prisms may be required, with higher prism density in the east wall. The prism density is planned to have 20 m vertical and 50 m lateral spacing, and will be installed on the final wall only.

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 will be undertaken daily to identify potential movement, to monitor the pit face for water seepage, and to identify productive drain holes. 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 a weekly 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 plan provides 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.

Upon the commencement of open pit development, waste rock is scheduled for disposal in one of two areas:

- Platinum Gulch Waste Rock Storage Area (PG WRSA), or
- Eagle Pup Waste Rock Storage Area (EP WRSA)

The WRSAs are located within a short haul distance from the open pit; they will provide adequate capacity for waste rock over the life of the mine. Waste rock will be hauled from the pit via strategically positioned egress points. As part of the mine plan, the upper internal pit ramp will ultimately be mined out and external ramps will be constructed to access the upper lifts of the WRSAs. Further, as part of project development, a temporary ore stockpile will be constructed adjacent to and downhill from the crushing facilities, reclamation soil stockpiles will be developed along the main east west haul road, and the IROSA will be built along the Haggart Creek valley.

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 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 of the storage facilities and stockpiles should be 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 will be 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 will 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 will take place along the crest and toe areas of the waste rock storage area lifts. 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. 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 Operations, Maintenance and Surveillance Manual for the Heap Leach Facility (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

18.2 HEAP LEACH FACILITY

18.2.1 Inspection Methods

There are four types of HLF inspections summarized in Table 18.2-1:

- Routine inspections
- Annual inspections,
- Event-driven inspections, and
- A comprehensive Dam Safety Review

Routine Inspections

Routine and/or regular visual inspections will be completed weekly. The visual inspections will be 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 and agglomeration facilities; the two event ponds, and instrumentation as appropriate.

The leach pad leak detection and solution collection system monitoring ports will be monitored daily, including sampling and analyses, flow rates and volumes as required. The presence of process solution in any of the ports is expected but excess volume is a potential indication of a leak in the heap leach pad liner. All observations will be documented.

Annual Inspections

Annual inspections are intended to be part of a more thorough review of the condition of the facility, and are carried out by a qualified engineer, experienced with the design and maintenance of the HLF. The annual inspections will be conducted by July 1st and will include the following items:

- Visual inspection of the HLF and dam by the engineer, including taking appropriate photographs of the observed conditions;
- Review whether or not recommendations from previous year's inspection(s) have been addressed, and any incidents or actions arising from those previous recommendations;
- Review of instrumentation and monitoring data; and
- An evaluation and interpretation of the structural performance of the embankment and related components, and identify any potential safety deficiencies or recommended items that need to be addressed in the coming year,

The results of the inspection and review will be documented and kept as a permanent record until operations are complete.

Event-Driven Inspections

As part of standard adaptive management practices, special inspections will be carried out if any of the following events occur:

- Unusual events such as an earthquake or large precipitation event;
- Unusual operating events such as rupture of a pipeline or a power loss that lasts longer than 8 hours;
- Slide of the stacked leach ore;
- Unusual observations such as cracks, excessive settlements, sinkholes, large slope or foundation deformations in the embankment; or
- Instrument readings that deviate from historical trends, or are within site specific designated "alert" action levels.

Special inspections after unusual events are necessary to evaluate whether there has been any damage requiring correction, any safety measures or special operating procedures that need to be implemented.

Comprehensive Dam Safety Review

The Canadian Dam Association, Dam Safety Guidelines (CDA, 2007) recommend a comprehensive dam safety review be carried out every seven years during operations, prior to decommissioning and following closure. As required by QZ14-041, SGC will undertake a comprehensive dam safety review every five years after construction of the facility and prior to final closure. The comprehensive review provides independent verification of:

- Safety and environmental performance of the HLF facility, including the embankment;
- Adequacy of the surveillance program;
- Adequacy of delivery of OMS requirements;
- Design basis with respect to current standards and possible failure modes; and
- Compliance with new engineering standards (including analysis to confirm if necessary).

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)	Crushing & Conveying General Foreman or alternate
Pad Liner	Weekly	Crushing & Conveying General Foreman or alternate
Stacked leach ore for stability	Weekly	Crushing & Conveying General Foreman or alternate
Solution collection and recovery system	Weekly	Process General Foreman or alternate
Leak Detection and Collection System Monitoring Ports	Daily	Process General Foreman
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.	Process Supervisors
Monitoring Vault	Weekly	Process General Foreman
Embankment geotechnical instrumentation	Weekly	Crushing & Conveying General Foreman
Events Pond fluid levels	Daily if the desired available storage has been reached and weekly otherwise.	Process Supervisors
Events Pond liners	Weekly	Process General Foreman
Conveyors and radial stacker	Monthly	Crushing & Conveying Supervisor
Geochemical sampling of leach ore	Quarterly	Metallurgist
Geochemical sampling of pregnant and barren process solution	Quarterly	Metallurgist
HLF and Dam Inspection by Engineer	Annually	Engineering of Record

Surveillance	Frequency	Responsibility
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 Manager 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

Facilities	Inspection Focus Area
	• 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 • completeness of combustion of packaging residues • control of windblown debris outside of fenced area • evidence of animal intrusion

Facilities	Inspection Focus Area
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 • legibility of hazard warning and direction flow signage
External Events Pond and leak detection systems	• adequacy of available freeboard (comparison to surveyed markers)

Facilities	Inspection Focus Area
	• 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 Frequency

Table 18.3-2 below provides a summary of the inspection points and frequency of inspection to guide the inspector.

Table 18.3-2: ADR Facility Inspection Frequency

Inspection Area	Frequency
Reagent Storage Area	Annually
Carbon Column Area	Annually
Barren Solution Tank	Annually
Fuel Oil Tank	Annually
ADR Carbon Tank	Annually
Carbon Area Sump	Annually
Electro-winning Area Sump	Annually
Sodium Cyanide Mixing Tank	One time per six months
Sodium Cyanide Holding Tank	One time per six months
Acid (HCl) Mix Tank	One time per six months
Sodium Hydroxide Mix Tank	One time per six months
Sodium Cyanide Delivery Pipelines	One time per month
Acid Delivery Pipelines	One time per month
Sodium Cyanide Isotainers, Full Containers	One time per month
Sodium Cyanide Isotainers, Empty Containers	One time per month
Hydrochloric Acid Full Containers	One time per six months
Hydrochloric Acid Empty Containers	One time per six months
Sodium Hydroxide Full Containers	One time per six months
Sodium Hydroxide Empty Containers	One time per six months

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 Plant 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
- the standard Environmental Monitoring and Reporting

Details of these reporting requirements are described in the OSM Manual.

18.5 ADAPTIVE MANAGEMENT

Adaptive Management for the HLF is wholly considered by the HLF Operations, Maintenance and Surveillance 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 Plan 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).

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 SGS's internal and external communication protocols.

Monitoring of settlement pins will be conducted semi-annually. Areas showing instability or poor performance will be monitored in a more frequent basis.

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