



EAGLE GOLD PROJECT

RECLAMATION AND CLOSURE PLAN

Version 2014-01

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List of Acronyms and Abbreviations

ADR.....	adsorption, desorption and recovery
ARD.....	acid rock drainage
CCBA	Comprehensive Cooperation Benefit Agreement
CSL	Contango Strategies Limited
CWTS.....	constructed wetland treatment system
DGDC.....	Dublin Gulch diversion channel
DRP.....	Decommissioning and Reclamation Plan
EMR	Yukon Government Department of Energy, Mines, and Resources
FN	First Nations
FNNND.....	First Nation of Na-Cho Nyäk Dun
ha	hectares
HLF	heap leach facility
HRT	hydraulic retention time
KPL	Knight Piésold Ltd.
LSA	local study area
m	metres
m ²	square metres
m ³ /ha.....	cubic metres per hectare
ML	metal leaching
MLU.....	Mining Land Use
MWh/y.....	megawatt hours per year
NSR.....	net smelter return
PLS	pregnant leach solution
Project.....	Eagle Gold Project
PTS	passive treatment system
QMA	<i>Quartz Mining Act</i>
QML	quartz mining licence

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RoW	right of way
RRC	removal rate coefficient
RSA.....	regional study area
SCP	seepage collection pond
SGC	StrataGold Corporation
UTM	Universal Transverse Mercator
VIT.....	Victoria Gold Corp.
WMP	water management plan
WRSA	waste rock storage area
WUL	Water Use Licence
MWTP	mine water treatment plant
YESAA	<i>Yukon Environmental and Socio-economic Assessment Act</i>
YESAB	Yukon Environmental and Socio-economic Assessment Board
YG	Yukon Government
yrs	years
YT.....	Yukon Territory
YQMA.....	Yukon Quartz Mining Act
YWA.....	Yukon Waters Act
YWB.....	Yukon Water Board

1 INTRODUCTION

StrataGold Corporation (SGC), a directly held, wholly owned subsidiary of Victoria Gold Corp. (VIT), has proposed to construct, operate, close and reclaim a gold mine in central Yukon. The Eagle Gold Project (“the Project”) is located 85 km from Mayo, Yukon using existing highway and access roads (Figure 1-1). The Project (Figure 1-2) will involve open pit mining at a production rate of approximately 10 million tonnes per year (Mt/y) ore, at an average strip ratio (amount of waste: amount of ore) of 1.45:1.0 and gold extraction using a three stage crushing process, heap leaching, and a carbon adsorption, desorption, and recovery system over a 10 year mine life.

Construction of the mine is planned to occur over two years, Year -1 and Year -2, pending issuance of required licences and permits. The construction phase is divided into two stages to accommodate permitting assumptions and seasonal constraints.

This *Reclamation and Closure Plan* (RCP) addresses the long-term physical and chemical stability of the site, including reclamation of surface disturbances from existing development. A program is presented for site management and monitoring both during implementation of closure and after decommissioning and reclamation measures are completed.

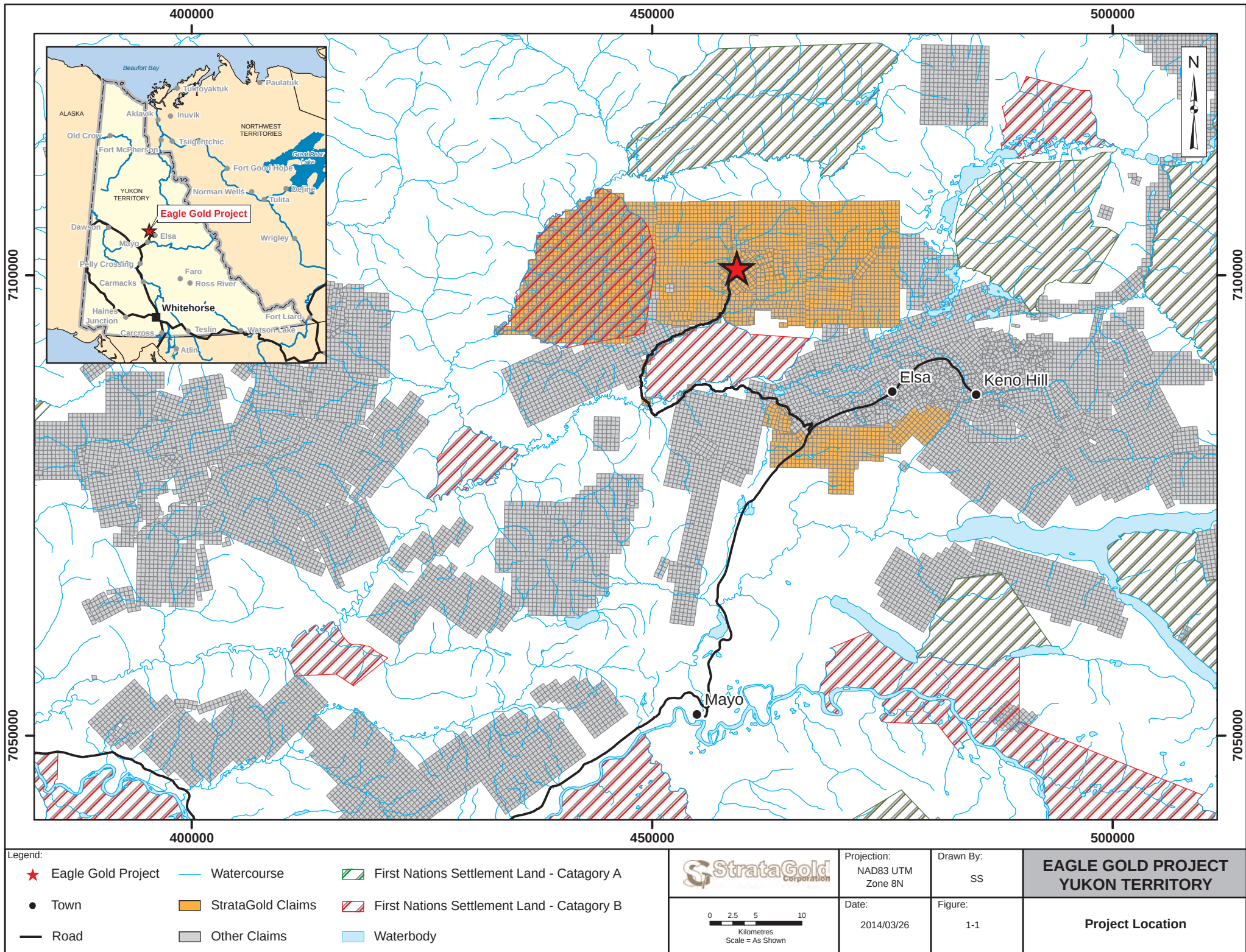
1.1 SCOPE OF THE RECLAMATION AND CLOSURE PLAN

The Eagle Gold Project is subject to approvals under the following:

- Yukon Waters Act (YWA), which covers the administration of Type A and B Water Use Licences (WUL)
- Yukon Quartz Mining Act (YQMA), which covers the administration of the Quartz Mining Licence (QML)

The YWA and YQMA require the submission and approval of a RCP before a licence can be issued. The QML is divided into two parts: Part 1 Site Development and Part 2 Mine Construction and Operation.

This RCP has been specifically scoped to fulfill the requirements for the above approvals through utilization of the EMR and Yukon Water Board (YWB) guidance document *Reclamation and Closure Planning for Quartz Mining Projects: Plan Requirements and Closure Costing Guidance*, released August 2013. This guide provides overall guidance about expected processes for developing RCPs and performance outcome for reclamation and closure. This RCP should be considered as a living, dynamic document that will be refined throughout mine planning, development and operation.



2 RECLAMATION AND CLOSURE PLANNING

The overall strategy for the RCP is to provide the proposed approach to decommission mine features, reclaim landforms, and provide a monitoring program to conduct until mitigation measures have achieved the closure objectives. The focus of the RCP is to guide the return of the site to appropriate and functional ecosystems, similar to predevelopment conditions, while meeting key end land use objectives. The objectives of the RCP are to address water quality, physical stability (stable landforms), land use, aesthetics, and public health and safety.

Since 2009, VGC has worked with stakeholders (e.g., FNNND, YG) to refine the project, and then develop closure objectives and proposed closure methods for the Project site, and this dialogue is ongoing in the context of further refinements of objectives and reclamation research programs. Section 2.1 below presents a brief outline of the current status of reclamation and research planning for the Project site and Section 10 outlines the ongoing and planned reclamation research for SGC's closure planning.

The following closure objectives and closure measures are based on previous experience and standard practices, as well as the Yukon Mine Site and Reclamation Closure Policy Financial and Technical Guidelines (Yukon Government 2008). The technical guidelines provide mining proponents with direction on reclamation and closure objectives, which must or should be considered. The guidelines present three elements: purpose, objectives and practice. The practices outlined include reference to principal legal requirements, policy detail pursuant to the Yukon Mine Site Reclamation and Closure Policy, and possible strategies for achieving the desired objectives.

2.1 STATUS OF RECLAMATION AND CLOSURE PLANNING

Figure 2-1 below illustrates that the closure planning for mining projects is a continuum, and that the details contributing to closure implementation strategy, including level of design, should increase as a mine moves through the mine life cycle.

An important component of the reclamation planning process is ongoing reclamation research with the objective of developing the methods required to implement a successful reclamation program. Reclamation research will focus primarily on the key closure methods proposed for the site:

- Soil Covers;
- Revegetation;
- Groundwater Attenuation; and
- Passive Water Treatment.

The relative success of these specific closure methods at the Project site compared with expectations derived from evidence documented from other applications and projects in other similar sites will be dependent on a number of site-specific conditions. A reclamation research program has been developed and initiated to provide proof of concept for these techniques in the Project setting. Major elements of the reclamation and closure research programs are presented in Section 10 below.

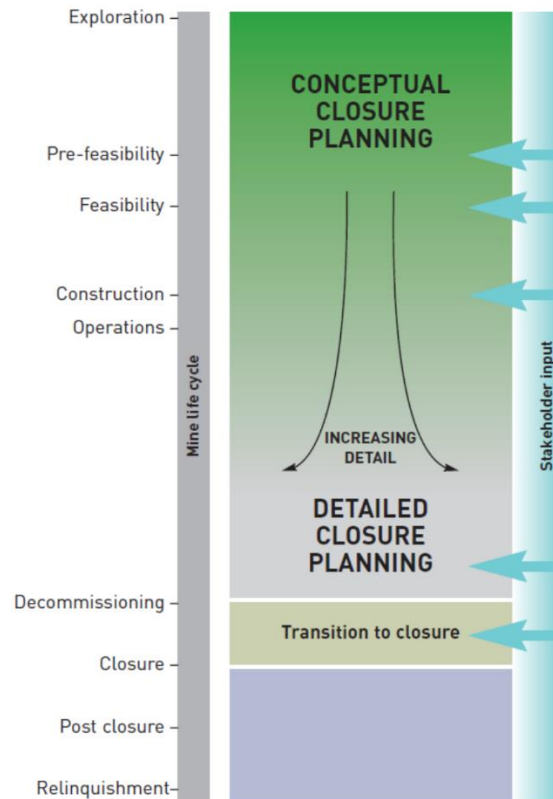


Figure 2-1: Continuum of Closure Planning Relative to Mine Life Cycle

2.2 CLOSURE OBJECTIVES, PRINCIPLES AND REGULATORY GUIDANCE

Principles and approaches for reclamation planning from the recently published Reclamation and Closure Planning for Quartz Mining Projects guidance document (Yukon Government 2013) are incorporated into Section 3.0. To achieve its purpose, the guide has the following objectives:

- Describing the context for mine closure planning in the Yukon, and the rationale for requirements to submit RCPs and liability estimates;
- Describe the principles, philosophy and broad objectives for closure planning for Yukon mining projects;
- Describe the information expectations for RCPs and liability estimates; and
- Identify key sources of additional guidance for preparing RCPs and liability estimates

The guidance document includes: methods for developing fundamental reclamation and closure objectives, methods for conducting community and regulatory engagement, reclamation and closure principles and principles for estimating liability. The intent of this section is to present the closure goals, objectives, and criteria for reclamation and closure of the SGC Mine, in the context of closure planning that is objectives-based.

Table 2-1 below includes reclamation and closure objectives to be achieved during all stages of reclamation and closure projects in Yukon and their accompanying value. Information from this table has been incorporated into the development of closure objectives in Section 3.

Table 2-1: Fundamental Mine Reclamation and Closure Objectives (YG 2013)

Value	Reclamation and Closure Objectives
Physical Stability	All mine-related structures and facilities are physically stable and performing in accordance with designs. All mine-related structures, facilities and processes can withstand severe climatic and seismic events.
Chemical Stability	Release of constituents and waste products from mine related waste materials occurs at rates that do not cause unacceptable exposure in the receiving environment.
Health and Safety	Reclamation eliminates or minimizes existing hazards to the health and safety of the public, workers and area wildlife by achieving conditions similar to local area features. Reclamation and closure implementation avoids or minimizes adverse health and safety effects on the public, workers and wildlife.
Ecological Conditions and Sustainability	Reclamation and closure activities protect the aquatic, terrestrial and atmospheric environments from mine-related degradation and restore environments that have been degraded by mine-related activities. The mine site supports a self-sustaining biological community that achieves land use objectives.
Land Use	Lands affected by mine-related activities (e.g., building sites, chemical and fuel storage sites, roads, sediment ponds, waste rock storage areas, etc.) are restored to conditions that enable and optimize productive long-term use of land. Conditions are typical of surrounding areas or provide for other land uses that meet community expectations.
Aesthetics	Restoration outcomes are visually acceptable.
Socio-economic Expectations	Reclamation and closure implementation avoids or minimizes adverse socio-economic effects on local and Yukon communities, while maximizing socio-economic benefits. Reclamation and closure activities achieve outcomes that meet community and regulatory expectations.
Long-term Certainty	Minimize the need for long-term operations, maintenance and monitoring after reclamation activities are complete.
Financial Considerations	Minimize outstanding liability and risks after reclamation activities are complete.

2.3 FIRST NATION OF NA-CHO NYAK DUN ENGAGEMENT

VGC and its subsidiary SGC have engaged in a wide range of consultation activities and have made early and ongoing consultation with the First Nation of Na-Cho Nyak Dun (FNNND) a priority to ensure an opportunity for input at all key stages of Project development. A number of workshops on mine closure and reclamation have been conducted along with site visits.

VGC and the FNNND entered into a Cooperation and Benefits Agreement (CBA) that applies to exploration and mine development conducted by VGC within the FNNND Traditional Territory. Details and objectives of the CBA is presented below in 2.4.1 Comprehensive Cooperation and Benefits Agreement.

2.4 STAKEHOLDER ENGAGEMENT

As mentioned above, VGC has consulted with FNNND and also engaged with the Village of Mayo, local trappers, the Mayo District Renewable Resource Council, Yukon Conservation Society, local outfitters, and placer mine operators. To ensure consistent and frequent communication, VGC has produced eight newsletters which were sent to the general public with the objective of keeping all informed of Project developments.

Consultation efforts carried out have been well received and well attended. FNNND and the community response to the Project have generally been positive and opportunities for potentially affected parties to raise concerns, and for VGC to respond directly, have been a fundamental component of the consultation program.

On January 21, 2011, the YESAB Executive Committee determined that VGC met the statutory requirement under Section 50(3) of YESAA to consult with the FNNND. VGC has continued to engage in consultation with interested stakeholders subsequent to submission of the Eagle Gold Mine Project Proposal.

2.4.1 Comprehensive Cooperation and Benefits Agreement

VGC and the FNNND signed a comprehensive Cooperation and Benefits Agreement (CBA) on October 17, 2011. The CBA replaced an earlier Exploration Cooperation Agreement and applies to the Eagle Gold Mine development and exploration activities conducted by VGC anywhere in FNNND Traditional Territory located south of the Wernecke Mountains.

The objectives of the CBA are to:

- Promote effective and efficient communication between VGC and the FNNND in order to foster the development of a cooperative and respectful relationship and FNNND support of VGC's exploration activities and the Project.
- Provide business and employment opportunities, related to the Project, to the FNNND and its citizens and businesses in order to promote their economic self-reliance.
- Establish a role for the FNNND in the environmental monitoring of the Project and the promotion of environmental stewardship.
- Set out financial provisions to enable the FNNND to participate in the opportunities and benefits related to the Project.
- Establish a forum for VGC and the FNNND to discuss matters related to the Project and resolve issues related to implementation of the CBA.

2.4.2 Community Meetings

Various community meetings, workshops and open houses have been held with the FNNND leadership, staff, and citizens as well as the Village of Mayo leadership, residents, and other interested parties. These sessions provided Project updates as well as specific presentations on key aspects of the Project. In general, meetings and workshops have been attended by VGC corporate executives and have included a presentation followed by a formal question and answer session. Participants also had the opportunity to provide written comments on comment cards.

Summarization of community meetings and open houses held to date can be found in *Community Meetings of the Eagle Gold Project Type A water Use Licence Application*.

2.4.3 Meetings with FNNND

Meetings with the FNNND Chief and Council, FNNND executive, management, and staff have taken place on a regular basis beginning prior to the submission of the Eagle Gold Mine Project Proposal. Formal meetings with the FNNND have also been held post-submission of the Project Proposal. Summarization of meetings with the FNNND can be found in *Meetings with the FNNND of the Eagle Gold Project Type A Water Use Licence Application*. In addition to these meetings, representatives from the FNNND have participated in or been invited to participate in ongoing environmental baseline monitoring conducted at Dublin Gulch for the Eagle Gold Project. VGC appreciates the participation and support provided by the FNNND to the baseline data collection that includes climate, hydrology, hydrogeology, and water quality.

2.4.4 Guided Site Tours

Since the submission of the Project Proposal in December 2010, VGC has sponsored three guided site tours for the FNNND leadership, elders, youth and staff, Village of Mayo, and the Mayo Renewable Resource Council. The purpose of the tours was to gain a better understanding of existing exploration activities at Dublin Gulch, existing conditions of the Project site, and the location of proposed Project facilities and components. While each tour was unique, each provided the tour group with an overview presentation and the opportunity to view the site from a variety of vantage points with description from VGC management of the construction, operation and closure of the Project. After the tours, the group reconvened for questions, answers, and comments. Tours were held on August 4, August 25, and September 11, 2011.

2.4.5 Meetings with Regulatory Agencies

Engagement with assessors, federal and territorial regulators, and other agencies have been regular, pro-active, and ongoing since the submission of the Eagle Gold Mine Project Proposal. A key objective of VGC's regulatory engagement approach has been to ensure an understanding of assessment and licensing requirements and expectations. Ongoing discussions with YESAB and decision bodies have been conducted to support each stage of the assessment of the Project Proposal. Summarization of meetings with regulators can be found in *Meetings with Regulatory Agencies of the Eagle Gold Project Type A water Use Licence Application*.

3 CLOSURE OBJECTIVES AND DESIGN CRITERIA

3.1 RECLAMATION AND CLOSURE OBJECTIVES

An objectives-based approach has been adopted for the development of SGC's RCP. In an objectives-based approach, the closure goal is supported by closure principles that guide the selection of clear closure objectives for all project components. For each closure objective, proponents propose a set of closure options that could achieve the objective, and a selected closure activity is chosen from these options. Closure criteria measure whether the selected closure activity achieves the specific closure objective.



Figure 3-1: Objectives-based Approach to Closure and Reclamation Planning (from MVLWB/AANDC 2013)

Details defining an objectives-based approach, adapted from the MVLWB/AANDC (2013) are presented below and in some instances where information has been gathered from additional authors, sources are cited.

3.1.1 Closure Goal

The closure goal is the guiding statement and starting point for closure and reclamation planning. Establishment of goals are meant to ensure the long-term success of the program by developing a clear and executorial plan. The closure goal is met when the proponent has satisfied all closure objectives.

For the Eagle Gold Project, the closure goal at all mining operations is to return the mine site and affected areas to viable and, wherever practicable, self-sustaining ecosystems that are compatible with a healthy environment and with human activities.

3.1.2 Closure Principles

Closure principles guide the selection of closure objectives. Four core closure principles applicable to the SGC project include:

- physical stability;
- chemical stability;
- no long-term active care requirements; and
- future use (including aesthetics and values).

3.1.3 Closure Objectives

Closure objectives are statements that clearly describe what the selected closure activities aim to achieve. They must be achievable and allow for the development of measurable closure criteria. Objectives are short-term concrete stepping stones toward achieving a goal and should be specific, appropriate and realistic (Huggard and Nadeau 2013). Selected closure objectives found in the Yukon Mine Site and Reclamation Closure Policy – Financial and Technical Guidelines (2008) directly relate to the closure goal and closure principles required for a RCP.

Component-specific closure objectives, categorized under the four closure principles presented above, are intended to be objectives-based and non-prescriptive. The purpose of implementing performance-based objectives is to encourage research and innovation resulting in cost-effective applications while ensuring public health and safety and environmental protection are met (YG 2008).

3.1.4 Closure Options and Selected Closure Activity

Closure options are potential activities that proponents could take to ensure that progressive and post-closure reclamation meets the stated closure objectives. These should utilize and adhere to the best available practices and technologies suitable to the site for each of the mine components.

Closure activities are chosen based on the closure options for each project component and outlines specific actions and measures to be undertaken. Established literature, bench scale, or pilot testing should support the activity so that stakeholders can be reasonably assured that the option will be successful. Reclamation research (detailed below) also provides certainty to planning appropriate activities. The selected closure activity may change prior to the final RCP based on factors such as environmental considerations, stakeholder input, the availability of new technologies/practices, the results of environmental monitoring programs, or the results of specific reclamation research.

3.1.5 Closure Criteria

Closure criteria are standards that measure the success of selected closure activities in meeting closure objectives. Also referred to as targets (Doran 1981), closure criteria should be clearly established to evaluate

reclamation and restoration projects (Ruis-Jaen and Aide 2005) by meeting the closure objectives for each project component. Closure criteria should be measurable, realistic, and achieved within a specified time frame (Huggard and Nadeau 2013) to ensure successful reclamation of project components. Closure criteria can be site-specific or adopted from provincial/territorial/federal standards and can be narrative statements or numerical values.

3.1.6 Reclamation Research

Studies and investigations which are aimed at providing site-specific performance information, proof of concept and ultimately design refinement for closure measures are best referred to as reclamation research. Reclamation research includes engineering studies and/or focused research undertaken with the intention of reducing uncertainties to an acceptable level. It is the results of targeted reclamation research programs which provide the technical basis for mitigation and reclamation technologies that will be incorporated into both primary closure and contingency planning.

3.1.7 Closure Monitoring

Major mine monitoring programs typically consists of three phases:

- Assessment – Baseline conditions of ecosystems that will potentially be affected by the project (complete);
- Operational – confirms or refutes accuracy of predictions on project effects that were made during the environmental assessment; and
- Transition/Post-Closure – monitoring that begins with the start of the approved decommissioned and reclamation activities, and carries on into the post-closure period (outlined in this RCP)

Defining monitoring needs during the initial phase of a project will ensure that measurable targets are relevant to achieving the overarching goals of the closure plan. Monitoring of closure components at the Eagle Project will continue until such a time that closure objectives have been met.

3.1.8 StrataGold Reclamation and Closure Objectives

The goal of the SGC RCP is to return the mine site and affected areas to viable and, wherever practicable, self-sustaining ecosystems that are compatible with a healthy environment and with human activities. This goal guides the selected closure scenario for the SGC site through the above mentioned objectives-based closure planning method. Fundamental closure planning objectives developed by Yukon Government (2013) in the Reclamation and Closure Planning for Quartz Mining Projects have been used to guide the development of detailed objectives that are site-specific, defined by factors that include environmental conditions, site conditions and community expectations.

These clearly defined closure objectives and tangible criteria against which to measure performance are presented in Tables 3-1 and 3-2.

Detailed site-specific objectives presented in Tables 3-1 and 3-2 are defined by factors that include environmental conditions, site conditions and community expectations. They were developed to address

Section 3: Closure Objectives and Design Criteria

physical stability, chemical stability, health and safety, ecological conditions and sustainability, land use, aesthetics, socio-economic expectations, long-term certainty and financial considerations.

Table 3-1: Summary of Decommissioning and Reclamation Planning for Mine Components

Fundamental Objective ¹	Physical Stability	Health and Safety Physical Stability Chemical Stability	Physical Stability Chemical Stability	Physical Stability Chemical Stability	Health and Safety	Land Use Health and Safety	Health and Safety
Component-Specific Activities	Water Retention and Water Conveyance Structures	Open Pit	Waste Rock Storage Areas and Temporary Stockpiles	Heap Leach Facility	Mine Infrastructure	Roads and Other Access	Temporary Closure Site Conditions
Closure Objectives	Ensure decommissioning of, or upgrades to, water retention and sediment control structures, and appurtenances, in such a way that drainage at, and adjacent to the site, is stable in the long term. Convey flows into and throughout the mine footprint, and off of the site in a controlled, stable fashion under a reasonable range of anticipated conditions.	Ensure physical and chemical stability of decommissioned pit in accordance with designs. Able to withstand severe climatic and seismic events. Protect humans and wildlife from topographic hazards associated with pit and pit lake.	Ensure long-term physical stability to minimize erosion, subsidence or slope failure. Able to withstand severe climatic and seismic events. Ensure long-term chemical stability such that runoff and seepage quality meets water quality criteria.	Ensure drain-down and cyanide destruction are conducted in controlled manner. Ensure long-term physical stability to minimize erosion, subsidence or slope failure. Able to withstand severe climatic and seismic events. Ensure long-term chemical stability such that runoff and seepage quality meets water quality criteria; if required, contingency measures to be implemented.	Remove potential threats to public health and safety. Decommission facilities in a safe manner. Ensure physical stability of any remaining structures.	Remove access to project areas that were not accessible before project initiation. Re-establish access for NND to specific areas (TBD). Re-establish NND access through project site to traditional hunting grounds. Minimize, eliminate or manage invasive species colonization at linear features in closure. Provide for public safety	Ensure public health and safety and protection of the environment in the event of a temporary closure and to manage risks associated with potential abandonment of site
Closure Measures	Convert ponds to passive treatment systems (Eagle Pup, Platinum Gulch and Lower Dublin South) as needed. Maintain suitable gradients to permit flow and reduce infiltration and erosion. Design facilities to minimize contact of surface flow with mine influenced soils. Dublin Gulch Diversion Channel, initially built for operations, to be armoured at appropriate times/locations for long-term closure. Modifications of flow patterns at site to achieve enhanced stability or accommodate water quality or other objectives.	Safety berm highwalls and control access to pit. Engineer controlled outflow from pit lake.	Engineer graded slopes during operations that have stable configurations and meet closure criteria. Engineer waste covers to reduce infiltration, encourage vegetation growth and minimize erosion. Provide engineered covers in combination with passive treatment systems to yield water quality acceptable for discharge.	Heap drain-down and transition period (additional gold recovery) planned and managed and fully integrated with water management plan. Cyanide destruction using in-situ biological treatment during rinsing stage. Rinsing and recirculation to enhance degradation of cyanide and neutralization of heap solution. Progressively building closure cover (and re-grading as necessary) during rinsing stage. Converting Events Pond to passive treatment system. Complete cover with enhanced engineered improvements to minimize infiltration	Mine site structures not required will be decommissioned and removed (partially or completely). Foundations demolished and buried. Pad areas re-graded as necessary, scarified and re-vegetated	Identify key or essential roads in coordination with NND. Develop a plan to minimize the advance of invasive species. Decommission, scarify and vegetate non-essential roads to provide a means of protection to public safety and encourage development of wildlife habitat	Care and maintenance of facilities. Site water and solution management/treatment as required.

¹ Reclamation and Closure Planning for Quartz Mining Projects: Plan Requirements and Closure Costing Guide (2013), Government of Yukon.

Section 3: Closure Objectives and Design Criteria

Fundamental Objective ¹	Physical Stability	Health and Safety Physical Stability Chemical Stability	Physical Stability Chemical Stability	Physical Stability Chemical Stability	Health and Safety	Land Use Health and Safety	Health and Safety
Component-Specific Activities	Water Retention and Water Conveyance Structures	Open Pit	Waste Rock Storage Areas and Temporary Stockpiles	Heap Leach Facility	Mine Infrastructure	Roads and Other Access	Temporary Closure Site Conditions
Closure Criteria/(Objectives)	The design flow at closure for all ditches, channels and other structures on site (storage ponds, spillways, culverts) is selected as the 100-year flood. Calculations are based on the 100-year storm event calculated over a time of concentration specific to each catchment (generally varying between 30 and 60 minutes for the Victoria Gold site). Ditches and channels for water conveyance will have a trapezoidal cross-section. They may be lined or unlined depending on the longitudinal slopes and associated flow velocities. Lining will consist of rip rap, grouted rip rap or synthetic liners. Maximum slopes are not to exceed 10% when possible. For steeper slopes, larger rip rap or energy dissipation structures will need to be put in place to avoid erosion. Culverts and pipes for seepage flows will be sized to accommodate the 1:100 year flood. Culvert minimum diameters are set at 750mm. Pipes will be buried to avoid freezing.	Open pit floor area will be flooded to 925 masl elevation. The open pit disturbance area will be 80 ha. The perimeter and upper benches within the overburden layer will be re-sloped and re-vegetated. Geochemical characterization of rock indicates that they will not be acid generating. Although neutral pH metal leaching of arsenic and antimony has been identified as a potential, in open pit wall run-off, water quality modeling has indicated that direct discharge of pit lake water to Haggart Creek can occur.	At closure the PG WRSA will have side slopes of 2.4H:1V, and maximum thickness of 35m. Valley bottom drainage under the dump at approximately 21° in WRSA footprint. At closure the EP WRSA will have an side slopes of 2.5H:1V, and maximum thickness of 140m. Valley bottom drainage under the dump ranges from 8° to 25°.	There are three stages in the HLF closure process: • residual leaching, • cyanide destruction rinsing, and • draindown The HLF is the last feature to be reclaimed as the cyanide destruction and rinsing processes will take ~2 years, following mining cessation, ore placement and additional time for gold recovery. The construction of an enhanced store-and-release cover will start when cyanide destruction is complete (meets criteria), Seepage will be treated in a passive system constructed down gradient of the facility (converted from the Events Pond).	Decommissioning and demolition of mine infrastructure will ensure physical stability and remove potential hazards /threats to the public safety and health. Will include: Decommissioning of facilities in a safe manner; Ensuring physical stability of any remaining structures; Removal/proper disposal of hazardous reagents, chemicals and materials: Removal and decommissioning mechanical, electrical equipment and motors; Demolition of steel structures: Removal of concrete slabs; Bulk earthworks will be completed, foundations broken up and buried in situ; Foundations with rebar will be left in place.	The Haggart Creek Access Road will remain. Potato Hills access will be preserved (requested by FNNND), as well as other mine access roads associated with on-going and historical exploration activities that are covered under separate permit authorizations. All unnecessary culverts will be removed and stream channels stabilized.	Operation/Closure criteria apply.

Table 3-2: Summary of Decommissioning and Reclamation Planning for Valued Components

Fundamental Objective ²	Health and Safety Physical Stability	Health and Safety Physical Stability Chemical Stability	Physical Stability	Physical Stability Ecological Conditions and Sustainability	Ecological Conditions and Sustainability	Aesthetics	Socio-economic Expectations
Valued Components	Terrain Stability	Soils	Watercourses	Aquatic Resources	Vegetation/Wildlife Habitat	Paleontological, Cultural and Heritage Values	Socio-economic benefits and effects
Closure Objectives	Remaining terrain should present no more significant hazard to people and wildlife by achieving conditions similar to local features. Ensure physical stability such that slopes, excavations and other disturbed lands are in a conditions that will limit the incidence of soil erosion, slumping and other instabilities that are likely to impede re-vegetation of a reclaimed site, pose a threat to public safety, lead to wildlife mortality, or cause excessive sediment loads to enter nearby water bodies. Can withstand severe and climatic seismic events	Minimize exposure to and mobilization of substances that pose a risk to human health and environment through physical and chemical stability of remaining soils	Ensure long-term stability for natural and created watercourses so that erosion and sediment processes are within a natural and acceptable condition	Minimize exposure to and mobilization of substances that pose a risk to aquatic resources through physical and chemical stability. Ensure long-term solutions rely on passive treatment technologies. Provide for functioning aquatic habitats similar to or improved from current conditions.	Ensure long-term physical stability that allows for successful re-vegetation. Encourage natural development of native species and communities. Return temporarily developed land to sustainable wildlife habitats.	Ensure protection of geological values and heritage features associated with mine site.	Reclamation and closure implementation avoids or minimizes adverse socio-economic effects on local and Yukon communities, while maximizing socio-economic benefits. Reclamation and closure activities achieve outcomes that meet community and regulatory expectations; maximizing benefits for NND businesses and citizens
Closure Measures	Re-grading of pads and facilities as necessary. Utilize safety berms where appropriate. Develop an inventory of site pre-disturbance, or a terrain disturbance registry to be populated during life of mine; develop a terrain hazard reduction plan to include registry from which hazard mitigation can be measured against. Develop engineered soil covers that reduce erosion potential, while accounting for precipitation patterns, infiltration capacity, cover depth, cover materials erosion sensitivity, optimal rooting depths of grasses and woody species prescribed for re-vegetation. Consider natural (bioengineered) and synthetic controls where erosion potential may still exist	Conduct site contamination assessment at initiation of closure activities. Develop site remediation plan that could include excavation, landfilling or land treatment, in-situ immobilization or amelioration.	Establish stable hydraulic geometries. Establish native species to enhance bank and floodplain stability. Where appropriate, rehabilitate disturbed watercourses to achieve characteristics similar to pre-disturbance conditions. Compensate for disturbed water courses as required under applicable legislation.	Utilize active water treatment technologies during transition to permanent closure. Progressively develop passive treatment technologies as facilities close, which will provide applicable results to improve designs. Integrate as appropriate various passive treatment technologies (bioreactor, engineered wetlands, in heap treatment) to address challenges with site-specific terrain conditions. Use results from progressive reclamation opportunities to refine and improve the methods for engineering a soil cover that minimizes metal leaching. Compensate for disturbed habitat as required under applicable legislation	Establish self-propagating early seral native plant communities. Encourage opportunities for progressive reclamation over the project life. Preparation and use of soil salvage location to store approximately 1,500,000 m³ of salvaged top soil and organics for reclamation. Develop growth media borrow locations. Develop re-vegetation plans according to prescriptions which include native species. Develop and implement invasive plant species SOPs. Ensure that synthetic liners or other materials that may entrap wildlife are not exposed.	Heritage Impact Assessment and Heritage Conservation Plan. Sites of significant heritage value identified and included in historic sites registry.	

² Reclamation and Closure Planning for Quartz Mining Projects: Plan Requirements and Closure Costing Guide (2013), Government of Yukon.

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Fundamental Objective ²	Health and Safety Physical Stability	Health and Safety Physical Stability Chemical Stability	Physical Stability	Physical Stability Ecological Conditions and Sustainability	Ecological Conditions and Sustainability	Aesthetics	Socio-economic Expectations
Valued Components	Terrain Stability	Soils	Watercourses	Aquatic Resources	Vegetation/Wildlife Habitat	Paleontological, Cultural and Heritage Values	Socio-economic benefits and effects
Closure Criteria	Terrain of limited stability (e.g. permafrost, steep slopes, or wetlands) will be given special attention, and protected where possible.	Climate and resulting permafrost (discontinuous) are largest influences on soil development Soil is limited for reclamation suitability primarily by high coarse-fragment content, due to development of soils from weathered bedrock. Average rooting depths are 50 cm, but can reach depths of over 120 cm. Baseline arsenic levels are naturally high in the soil, but do not limit soil reclamation suitability. The majority of the soil textures in the area are sandy-silt to silty-sand loam matrix with angular or tabular coarse fragments ranging from gravels to boulders. Soil types within the property that can be used as store and release covers for the HLF and WRSAs include: - Locally sourced compacted colluvium and placer tailings mixture over compacted waste rock or HLF. - A cap will be placed over the colluvium. - The cap will be seeded with species suitable for the aspect that the structure is facing.	Conveyance courses (channels and ditches) will be constructed with trapezoidal channel shape, sized to 1 in 10 year 24 hour storm for lined channels and 1 in 100 year 24 hour storm capacity for ditches. They will be lined with rip rap to minimize erosion and reduce flow velocity.	The mine site supports a self-sustaining biological community that achieves land use objectives. Reclamation and closure activities will protect the aquatic environment from mine-related degradation and restore environments that have been degraded by mine-related activities.	Closure activities will be conducted to promote ecological sustainability of re-vegetated areas to ensure (for example): - Vegetation growth in conveyance channels will minimize channel erosion and provide habitat for aquatic species - Vegetation growth on waste areas (HLF and WRSAs) will be sustainable and provide sufficient evapotranspiration to minimize infiltration into the capped waste deposit.	Closure activities will be conducted to restore the sites to a aesthetic consistent with surrounding areas.	Closure activities will be performed in a manner consistent with Stratagold benefit agreements with FNNND, and where possible utilize local and Yukon businesses in the performance of the work.

3.2 DESIGN CRITERIA

Reclamation and closure planning has been guided by many design criteria, ranging from regulatory and guidance based-criteria, constraints imposed by the project location and history, and criteria established through consultation with stakeholders.

Design criteria that are relevant to closure are presented in this section by closure component, including the applicable geotechnical, hydrologic, and/or water quality criteria for that component. Each section also includes references to the guidance documents, reports and analysis that support the design criteria.

3.2.1 Open Pit

A range of geologic, economic and geotechnical inputs were used to develop the final open pit design for the Project to maximize value while minimizing potential risk.

Over the life of the Project, the open pit will be advanced in four major stages, with an ultimate pit size of approximately 1,420 m long and 780 m wide. The minimum elevation of the pit is 847.5 masl and there will be a maximum crest elevation of approximately 1,409 masl, giving the pit a depth of 562 m along the east highwall. Based on the surface topography, the open pit is scalloped-shaped with a lower west highwall. The west highwall crest elevation is approximately 925 masl, giving the west highwall a height of approximately 77 m. 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.

During a pre-production period, a total of 4.8 Mt of waste material will be mined and this material will be used to develop haul roads, the HLF embankment and for other construction purposes. Following the pre-production period, ore production will increase to the nominal production rate of 29,500 t/d.

Using the designed phases and cut-off grade strategy, a detailed production schedule was developed. Operational constraints were added to ensure realistic mining sequences with scheduling conducted quarterly for the first two years of production, and then annually.

Further detail, including design criteria for the open pit is provided in the *Mine Development, Operations and Material Management Plan*.

3.2.2 Waste Rock Storage Area

Geotechnical design criteria selected for the WRSAs are based on those recommended by the Yukon Water Board (2009), the British Columbia Mine Waste Rock Pile Research Committee (1991), and the technical experts responsible for the design as shown in Table 3-3.

Table 3-3: Geotechnical Design Criteria

Criteria	Description
Static Factor of Safety – short term (mine operations)	1.3
Static Factor of Safety – long term (post-closure)	1.5
Pseudo-static Factor of Safety – short and long term	1.1

Section 3: Closure Objectives and Design Criteria

Criteria	Description
Design Earthquake Return Period	1-in-475-year event
Overall Slope Angle	2.5H:1V

Based on an evaluation of the potential seismic activity for the project site, the seismic design event utilized for the WRSAs design is an earthquake with a 1-in-475-year return period that generates a peak horizontal ground acceleration (PGA) of 0.14 g.

3.2.3 Heap Leach Facility

There are currently no published international standards for the design and construction of a heap leach facility. Nevada State Guidelines provide minimum standards for heap leach facilities and have been adopted for the Project. North American standards for the design of embankment dams were used where applicable, specifically the Canadian Dam Association guidelines. Table 3-4 summarizes the main technical and permitting requirements for the State of Nevada for the key elements of the HLF design.

Table 3-4: Summary of Design Requirements for the State of Nevada

Heap Leach Feature	Description
Leach Pad	System must have containment capability equal to or greater than that of a composite liner consisting of a synthetic liner over one foot of compacted soil at a permeability of 1×10^{-6} cm/s or 1×10^{-5} cm/s if a leak detection system is used beneath portions of the liner with the greatest potential for leakage. Synthetic liners must be rated as having resistance to fluid passage equal to a permeability of less than or equal to 1×10^{-11} cm/s.
Solution Ponds	System must have a primary synthetic liner and a secondary liner that meet the above-described liner specifications. The synthetic liners must be separated by a fluid transmission layer which is capable of transmitting leaked fluids at a rate that will ensure that excessive head will not develop on the secondary liner.
Solution Management and Containment	Process components must be demonstrated to have the capacity to “withstand” the runoff from a 100-year, 24-hour precipitation event. In addition, facility fluid management systems must demonstrate the capability of remaining “fully functional and fully contain all process fluids including all accumulation resulting from a 25-year, 24 hour precipitation event. The foregoing standards are minimal and additional containment capacity may be required if surface water bodies or human populations are in close proximity to the facility, or if groundwater is shallow.
Foundations	Consider static / dynamic loads and differential movement or shifting

Heap Leach Feature	Description
Construction QA/QC	Regulations require that each applicant develop and carry out a quality assurance and quality control program for liner construction. A summary of the QA/QC program must be submitted with as-built drawings after construction has been completed.
Neutralization/Detoxification of Spent Ore	Spent ore, whether it is to be left on pads or removed from a pad, must be rinsed until it can be demonstrated either the remaining solid material, when representatively sampled does not contain levels of contaminants that are likely to become mobile and degrade the waters of the state under the conditions that will exist at the site, or, the spent ore is stabilized in such a manner as to inhibit meteoric waters from migrating through the material and transporting contaminants that have the potential to degrade the waters of the state.

3.2.3.1 Design Basis

The Yukon Water Board Licensing Guidelines for Type A Quartz Mining Undertakings provide specific guidance for selected mine site earthworks facilities, as follows:

“General: Type A quartz mining undertakings may vary significantly in their magnitude and in the potential environmental effects associated with them. The guidelines contained in this document assume the development of a mine with significant potential environmental impacts such as those resulting from acid rock drainage or the failure of a large tailings impoundment. Projects such as this are considered to fall into the Very High Consequence of Failure category described in the Canadian Dam Safety Guidelines (January 1999). In situations where this category is not appropriate for some reason, the Board is prepared to consider well developed and documented justification for the use of alternative consequences of failure criteria developed in accordance with the Canadian Dam Safety Guidelines.”

Further, specific design guidance is included as follows:

- The design, construction, operation, maintenance and surveillance of dams and associated water management structures should be carried out in a manner which is consistent with the recommendations contained in the Canadian Dam Safety Guidelines (January 1999) for the Very High Consequence Category, unless compelling reasons consistent with the Canadian Dam Safety Guidelines for a lower consequence category are provided.
- Long-term dams and associated water management structures should be designed to withstand the Maximum Credible Earthquake (MCE) and pass the Probable Maximum Flood (PMF). Shorter term structures may be built to lesser standards but a compelling rationale for the selected criteria must be provided.
- Heaps should be designed to have a minimum factor of safety under static loading of 1.3 for short term cases (i.e. within the mine life) and 1.5 for long term cases (i.e. abandonment) as described in the Investigation and Design of Mine Dumps (British Columbia Mine Dump Committee, 1991). The factor of safety for dams should be as recommended in the Canadian Dam Safety Guidelines (January 1999).

- Designs for dams and associated water management structures, rock dumps, and heaps should recognize the probable presence of permafrost and should include appropriate measures to manage permafrost and maximize the stability of the structures consistent with recommendations contained in the Canadian Dam Safety Guidelines (January 1999).

Although the 1999 CDA are referenced, the latest version of the CDA guidelines (2007) was used for the Project.

Tetra Tech performed a dam breach analysis to determine the hazard classification of the confining embankment in accordance with CDA dam classification guidelines. The results indicate the confining embankment can be classified as a high hazard dam. Results from the dam breach analysis and inundation mapping show that loss of human life or damage to public and commercial facilities are unlikely in the event of a dam breach. However, the dam breach may cause significant damage to fish and wildlife habitat downstream of the embankment considering the potential for release of cyanide solution from upstream of the heap confining embankment. The dam breach analysis report is presented as an appendix to Appendix A in the *Heap Leach and Process Facilities Plan*.

3.2.3.2 Design Criteria

The parameters and criteria are presented in the *Heap Leach and Process Facilities Plan*. The following appendices in Appendix A of the *Heap Leach and Process Facilities Plan* provide rationale for geotechnical design criteria: Appendix C (Site Seismic Hazard Analysis), Appendix J (HLF Stability Analyses), Appendix K (Liquefaction Analysis), and Appendix M (Settlement Analysis), and the Eagle Gold – Geotechnical Design Basis for Mine Site Infrastructure in the Project Proposal (BGC 2011). Ore parameters were taken from Eagle Gold Project Report of Metallurgical Test Work (KCA 2012).

3.2.4 Water Management Facilities

For the purpose of the Water Management Plan, the Project area has been subdivided into a number of hydrologic watersheds and sub-watersheds. The watershed boundaries are based on the proposed end of mine topography. During construction and particularly prior to installation of diversion channels, some of the watershed areas reporting to the sediment control ponds are larger than the areas calculated during operations. Therefore, to ensure that the SCPs are capable of storing runoff during the entire life of the Project, they were sized to store the 10-year 24-hour event from their largest respective contributing area.

A risk-based approach was used to select appropriate design storm events for water management facilities. This approach weighs the likelihood of failure, versus the consequence of failure, on a case-specific basis. Design storm events were developed by assessing the annual recurrence of precipitation events of a given magnitude, as described in the *Water Management Plan*.

Design storm events are used as input parameters in most rainfall-runoff type storm water models (e.g., HEC-HMS, HydroCAD, TR-55). Design criteria for various design elements are listed in Table 3-5.

Section 3 Closure Objectives and Design Criteria

Table 3-5: Water Management Design Criteria

Infrastructure Element	Design Element	Design Basis Criteria
Unlined Diversion or Collection Ditches	Design Storm Event	1 in 10-year, 24-hour
	Maximum Depth (mm): Type 1 or 2	300
	Minimum Width (mm): Type 2	500
	Minimum Grade (%): Type 1 or 2	1.00
	Maximum Grade (%): Type 1 or 2	1.70
	Maximum Side Slopes: Type 1 or 2	3H:1V
	Maximum Velocity (m/s): Type 1 or 2	1.5
Lined Diversion or Collection Ditches	Design Storm Event	1 in 10-year, 24-hour
	Maximum Depth (mm)	500
	Minimum Grade (%): Type 3 / Type 4	1.00 / 0.50
	Maximum Grade (%): Type 3 / Type 4	4.5 / 15
	Maximum Side Slopes: Type 3 / Type 4	2.5H:1V / 1H:1V
	Maximum Velocity (m/s): Type 3 / Type 4	2.33 / 4.0
Lined Diversion or Collection Channels	Design Storm Event	1 in 100-year, 24-hour
	Minimum Depth (mm)	500
	Minimum Width (mm)	1000
	Minimum Grade (%)	1.00 / 0.50
	Maximum Grade (%): Type 3 / Type 4	4.5 / 11
	Maximum Side Slopes: Type 3 / Type 4	2.5H:1V / 1H:1V
	Maximum Velocity (m/s): Type 3 / Type 4	2.75 / 5.0
Culverts	Minimum Diameter (mm)	750
	Design Storm Event (Areas < 1 ha)	1 in 10-year, 24-hour
	Design Storm Event (Areas > 1 ha)	1 in 100-year, 24-hour
	Design Storm Event (at stream conveyances and downstream of sediment ponds)	1 in 200-year, 24-hour

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Infrastructure Element	Design Element	Design Basis Criteria
	Maximum HW/Diameter Ratio	2.0 for less than 1.0 m 1.5 for greater than 1.0 m
	Minimum Grade (%)	0.5
	Minimum Velocity (m/s)	1.0
	Maximum Velocity (m/s)	4.0
Temporary Sediment Control Ponds and Exfiltration Areas	Design Storm Event (storage)	1 in 10-year, 24-hour
	Design Storm Event (overflow spillway)	1 in 100-year, 24-hour
	Depth Requirements (m):	
	Minimum Dead Storage (sediment)	0.5
	Maximum Dead Storage (sediment)	50% of Total Depth
	Minimum Live Storage (liquid)	1.5
	Minimum Freeboard (100-year event)	0.5
Permanent Sediment Control Ponds	Design Storm Event (storage)	1 in 10-year, 24-hour
	Design Storm Event (overflow spillway)	1 in 200-year, 24-hour
	Depth Requirements (m):	
	Minimum Dead Storage (sediment)	0.5
	Maximum Dead Storage (sediment)	50% of Total Depth
	Minimum Live Storage (liquid)	1.5
	Minimum Freeboard (200-year event)	0.5
	Dewatering (pumping capability)	Full Dewater in 24 hours

4 EXISTING ENVIRONMENT DESCRIPTION

Please refer to Section 3 of the Project Environment, of *the Eagle Gold Project Type A Water Use Licence Application* for a summary of existing conditions for bio-physical and socio-economic components (e.g., wildlife, water quality, employment and economic opportunities) of the Project.

5 PROJECT DESCRIPTION

Please refer to Section 4 of the *Eagle Gold Project Type A Water Use Licence Application* for a detailed description of the Project.

6 TEMPORARY CLOSURE

6.1 DEFINITIONS AND TEMPORARY CLOSURE OBJECTIVES

Mine closure refers to the cessation of mining operations. Temporary closure is defined in the Yukon Mine Site Reclamation and Closure Policy (Financial and Technical Guidelines) as closure that exceeds six months and is not expected to last longer than five years and can include both planned and unplanned closure (Yukon Government 2006). Yukon Government's guidance on the development of Reclamation and Closure Plans (2013) elaborates further:

Temporary closure is a closure in which mining related activities cease with the intent of resuming activities in the near future. Temporary closures may be planned or unplanned and could arise from a variety of circumstances including financial challenges, design failures, extreme climatic conditions, etc. Temporary closures may last for weeks, or could extend for years. Maximum durations of temporary closure periods are frequently defined in QMLs and WLs. At the conclusion of a defined temporary closure period, proponents will be required to implement permanent closure measures. In the event of a temporary closure, a full review of the RCP as well as liability estimate and security may be undertaken.

This section describes the measures and activities that will be undertaken for the Project in the event of a temporary closure, and how protecting public health and safety, and the environment will be accomplished. It presents fundamental and site-specific reclamation and closure objectives for temporary closure, and demonstrates how they will be met. The main activities would focus on site stabilization and safety, followed by care and maintenance of all site facilities and routine monitoring until production recommences or full closure is implemented. Depending on the reasons for a temporary cessation of mining operations, the process facilities can be expected to continue to recirculate solutions and recover gold until all economically recoverable gold is processed.

For purposes of this temporary closure plan, temporary closure refers to a suspension of mining activities for more than 6 months but less than five years, and/or temporary closure applies to the Eagle Project when gold recovery becomes uneconomic, i.e., no longer covers the cost of recirculation of solutions.

There are certain general objectives that are paramount during temporary closure:

In general, temporary closure plans must focus on ensuring public health and safety, protecting the environment and managing risks associated with potential abandonment of a site. (Yukon Government 2013)

The sections following identify the fundamental and site-specific closure and reclamation objectives that are relevant to mine components and values during a potential temporary closure of the Project, with associated temporary closure measures planned to ensure these objectives are met.

6.2 TEMPORARY CLOSURE MEASURES

6.2.1 Physical Stability

Temporary closure objectives are to ensure that all mine-related structures and facilities are physically stable and performing in accordance with designs and that all mine-related structures, facilities and processes can withstand severe climatic and seismic events.

6.2.1.1 Open Pit

A geotechnical engineer will be retained to conduct water management and physical stability monitoring at the Open Pit. The pit will be allowed to fill with water to a pre-determined level during temporary closure. This level will depend on the pit geometry at the time of temporary closure. After the pit has filled to this level, water will be conveyed via ponds and ditches to treatment throughout the temporary closure.

6.2.1.2 Waste Rock Storage Areas and Temporary Ore Stockpiles

Temporary closure objectives for the WRSAs include:

- Ensure short-term physical stability to minimize erosion, subsidence or slope failure;
- Ensure short-term chemical stability such that runoff and seepage quality meets water quality criteria; and
- Ensure water management remains operational to convey runoff water to water treatment as required.

The following actions will be undertaken during operations to reduce the risk of WRSA physical instability at any point following their construction, including a temporary closure:

- maintain sloped grading and bench surfaces to minimize surface water infiltration and erosion of downstream slopes;
- continue with waste rock and heap leach facility management plan to store waste and ore in a chemically stable manner; and
- maintain surface water collection ditches and the SCP to control surface drainage.

During a temporary closure, WRSA inspections will be carried out by a geotechnical engineer on the predetermined schedule, as laid out in the operating licenses. Any repairs or maintenance of the facility, or improvements to runoff, erosion and sediment control will be undertaken on recommendation from the inspections.

6.2.1.3 Mine Infrastructure

The physical stability of the fuel and explosives facility will be maintained by a senior operator throughout the temporary closure. Controlling site access and ensuring the security of the fuel and explosives facilities will be of paramount importance.

6.2.1.4 Heap Leach Facility

The Heap Leach Facility (HLF) includes primarily the leach pad, embankment and process ponds. Temporary Closure Objectives for the HLF will ensure short-term physical stability to minimize erosion, subsidence or slope failure.

There are three factors influencing physical stability of the HLF that will be addressed during temporary closure. These factors are: 1) upslope runoff interception, 2) runoff, erosion and sediment control and 3) dust control. The upslope runoff interception ditches, which route water around the HLF will be maintained by the site caretaker as necessary during temporary closure. This will help to reduce the volume of water introduced into the HLF and limit the volume of water that requires storage and treatment. Precipitation may contribute to runoff, erosion and sediment concerns, which will be monitored and controlled by the site caretaker as required.

6.2.1.5 Water Management Facilities

Temporary closure objectives for water management facilities will ensure short-term physical stability to maintain site-wide water management.

To maintain physical stability throughout temporary closure, sediments will be excavated from ditches, sediment basins and ponds as required. Snow and aufeis will also be removed from the ditches and ponds if accumulation is hindering the performance of the facilities. Ditches will be inspected for physical integrity.

Visual inspections of the water management facilities will be undertaken as required by the operating licences.

6.2.2 Chemical Stability

Temporary closure objectives are to achieve chemical stability such that runoff and seepage quality meet water quality criteria, and manage release of constituents at rates that do not cause unacceptable exposure in the receiving environment.

6.2.2.1 Waste Rock Storage Areas and Temporary Ore Stockpiles

Temporary closure objectives for the WRSAs will ensure short-term chemical stability such that runoff and seepage quality meet water quality criteria.

Chemical stability of the runoff and seepage from the WRSAs will be maintained through the continued implementation of the water management plan. Visual monitoring of seepage and runoff water quality as per licensed monitoring programs, and water treatment if necessary by the MWTP, will be implemented as required.

6.2.2.2 Heap Leach Facility

With regard to chemical stability, the HLF includes the leach pad and process pond. Temporary Closure Objectives for the HLF are to achieve chemical stability such that runoff and seepage quality meet water quality criteria.

Chemical stability of the HLF will be maintained and monitored during temporary closure. The site caretaker will be responsible for monitoring and maintenance of the HLF and pond leak detection and recovery systems including emptying the leak collection sumps as required. Drainage from the leak collection sumps will be

recycled back into the solution inventory. The groundwater monitoring wells will be maintained throughout temporary closure to enable ongoing monitoring as required by operational licences.

Water management and leaching from the HLF are concerns during temporary closure. For the period required during any temporary closure, a senior operator will continue to operate HLF pumping, irrigation, solution collection and storage, reagent addition and gold recovery facilities, and maintain the HLF as a zero discharge facility. The site caretaker will assist with maintenance of the HLF pumping, irrigation, solution collection and storage facilities as required during temporary closure.

6.2.2.3 Mine Infrastructure

Site infrastructure, including buildings and process machinery, will be emptied/drained of hazardous reagents and process fluids where appropriate and stabilized for temporary closure based on recommendations from mechanical and chemical suppliers, contractors and engineers. This includes the proper storage on site or removal of all hazardous wastes, including waste hydrocarbons, coolants, lubricants, reagents, and process chemicals.

6.2.2.4 Water Management Facilities (Ponds and Ditches)

Temporary closure objectives for water management facilities are to achieve chemical stability and operation of groundwater and surface water resources.

The site caretaker will also be responsible to monitor for seepage from the WRSAs, ensuring that it is conveyed to and collected in ponds and monitor water quality as required. Drainage from the WRSAs will be collected and treated by the MWTP as required to meet effluent discharge limits and water quality objectives.

6.2.3 Health and Safety

Temporary closure objectives are to eliminate or minimize existing hazards to the health and safety of the public, workers and area wildlife by achieving conditions similar to local area features or preventing access to areas that are not reclaimed.

6.2.3.1 Open Pit

Pit development will cease in a temporary closure situation. The key temporary closure goal for the Open Pit relates to the protection of human health and safety, and therefore access control is the key temporary closure measure. Areas of particular concern for the public, if any, will be bermed or fenced and posted with warning signs.

6.2.3.2 Heap Leach Facility

If the HLF is not in use for a sufficient amount of time for dust to become a concern, dust control will be carried out by the site caretaker.

6.2.3.3 Mine Infrastructure

Structures and facilities that will require attention and monitoring during a temporary closure at the Project will consist of:

- process offices;
- lab;
- shops and warehouse;
- process plant site;
- primary, secondary and tertiary crusher facilities;
- laydown area;
- gatehouse;
- main sub-station;
- camp/recreation area;
- water treatment plant and water tanks; and
- over land conveyors.

Temporary closure objectives for these facilities will be to remove potential threats to public health and safety and to maintain the physical stability and operational capacity of any remaining structures and assets. The process plant and related facilities will be secured. Gold and non-essential chemicals will be removed from the site. All essential chemicals will remain onsite will be securely stored within double containment. The site caretaker will conduct weekly visual inspections of the buildings and solution containment areas. The caretaker will also secure the buildings and maintain the equipment required for solution recirculation and treatment. The solution treatment plant and required chemicals will be maintained.

Infrastructure that is not listed above as mine facilities and ancillary facilities; but exists within the mine footprint, and infrastructure outside the mine footprint (e.g., transmission line and access road upgrades) will also require maintenance throughout a temporary closure.

The bulk explosives inventory will be removed from site and explosives storage containers and facilities will be inspected regularly. Hazardous wastes that will be removed from site include coolants and lubricants. All hazardous fluids will be drained from non-essential machinery and mining equipment based on recommendations from mechanical and chemical suppliers, contractors and engineers.

6.2.3.4 Mine Water Treatment Plant

The appropriate management of site water and solutions is critical to meeting the objective of protecting human health and safety and the environment in the event of a temporary closure. All water management facilities, including the use of the mine water treatment plant, will be managed as if operations were continuing. A detailed description of the management of water during the operational period can be found in the *Eagle Gold Project Water Management Plan*. Linkan (2014) summarizes the design and operating approach of the MWTP.

The temporary closure objective at the Mine Water Treatment Plant will be to maintain equipment performance throughout the temporary closure period. This will be achieved by securing the buildings and maintaining the equipment required for solution recirculation and treatment. Water quality systems will be monitored as required in the operating licences.

6.2.4 Ecological Conditions and Sustainability

Temporary closure objectives are to protect the aquatic, terrestrial and atmospheric environments from mine-related degradation and ensure that the mine area supports a self-sustaining biological community that achieves land use objectives outside of the area of disturbance.

6.2.5 Land Use

Temporary closure objectives are to ensure that lands affected by mine-related activities (e.g., building sites, chemical and fuel storage sites, roads, sediment ponds, waste rock storage areas, etc.) do not cause adverse conditions that prevent productive long-term use of land, i.e., conditions which are typical of surrounding areas or provide for other land uses that meet community expectations.

The access road system will require periodic visual inspections. Private contractors will be retained to complete maintenance of surface drainage infrastructure, culvert repair or road grading as required. Other miscellaneous infrastructure buildings will be secured and structural inspections and maintenance will be provided by the caretaker as necessary.

6.2.6 Aesthetics

Temporary closure objectives are integrated to encourage any restoration activities that are performed are visually acceptable.

However, aesthetics will not be a primary management driver for temporary closure because the mine is primarily being managed so that mining activities can recommence within 5 years or less.

6.2.7 Socio-economic Expectations

Temporary closure objectives also include minimizing or preventing adverse socio-economic effects on local and Yukon communities, while maximizing socio-economic benefits.

Temporary closure will be performed by local workers that already were working at the mine, or by local contractors performing the required site management and maintenance work.

6.2.8 Site Management

Access control, security and site care and maintenance are key to meeting the critical temporary closure objectives of protecting human health and safety and the environment. The Care and Maintenance Program is the program where a reduced workforce will inspect and maintain property assets, restrict access to mine site locations, manage site chemical and explosive storage, continue to implement the site WMP, and continue with the operational environmental monitoring for applicable elements. The Care and Maintenance Program will be implemented once the transition from operating mine to suspended activities is achieved. Transition activities before the Care and Maintenance Program is initiated will include:

- Complete all necessary outstanding repairs; and
- Winterize seepage collection systems, mobile equipment, buildings and other site infrastructure.

The temporary decommissioning and closure activities will only be conducted to a level such that all infrastructure, process and mining facilities are stable for a period of up to five years and such that full operations can be resumed in a timely manner should the decision be made to resume production. To meet these objectives of temporary closure, the essential equipment and assets will remain onsite or readily available through contract services to maintain infrastructure and facilities. All hazardous materials will either be removed from site and/or stored in a safe and secure manner with primary and secondary containments as required to ensure compliance with applicable regulations.

Full-time care and maintenance staff will be housed onsite in the main camp to provide security, control site access and monitor site activities. Access to the site will be restricted and enforced on a 24 hour per day basis. Restricted access consists of a vehicle gate at the entrance to the property.

Two caretakers will work different rotations to provide site security and monitoring. These two individuals are in addition to the reduced operations staff. Site equipment and vehicles will be kept onsite for the use of both the operations staff and caretakers. Contingency equipment (dozer/loader) will also remain onsite or readily available through contract services should earthworks be required during the temporary closure phase.

During temporary closure, the security gates on the access road will be locked with warning signs clearly posted at the gates and at key locations around the property indicating risk of entry. All site buildings will be kept locked and secured. The main access road will be maintained for access by the caretakers and operations staff with equipment retained onsite (grader/loader) or readily available through contract services.

The caretakers and operations staff will be responsible for a variety of activities including, but not limited to, the following:

- supporting site inspections, security controls, first aid, emergency response and communications;
- supporting water management, MWTP operations, sample collection and site monitoring;
- supporting site monitoring and sample collection to ensure compliance with regulatory requirements;
- ensuring critical process equipment such as pumps, generators and some mobile equipment are maintained in operating condition;
- providing for snow removal and road access;
- In conjunction with SGC's corporate office conducting any relevant administrative responsibilities.

It is currently planned that multiple staff will cover duties on a 24-hour basis as required.

6.2.9 Financial Considerations

Minimize outstanding liability and risks while the site is in temporary closure.

6.2.9.1 Entire Site

Financial considerations include:

- Transition to the Care and Maintenance Program which includes essential site repairs, if any, and winterization of seepage collection systems, mobile equipment, buildings and other site infrastructure.

Section 6: Temporary Closure

This will only be conducted to a level such that all infrastructure, process and mining facilities are stable for a period of up to five years and such that full operations can be resumed in a timely manner should the decision be made to resume production. To meet these objectives of temporary closure, the essential equipment and assets will remain onsite or readily available through contract services to maintain infrastructure and facilities.

- All hazardous materials will be secured at site including with primary and secondary containments as required to ensure compliance with applicable regulations.
- Full-time care and maintenance staff will be housed onsite in the main camp to provide security, control site access and monitor site activities. Access to the site will be restricted and enforced on a 24 hour per day basis. Restricted access consists of a vehicle gate at the entrance to the property.
- Two caretakers will work different rotations to provide site security and monitoring. These two individuals are in addition to the reduced operations staff. Site equipment and vehicles will be kept onsite for the use of both the operations staff and caretakers. Contingency equipment (dozer/loader) will also remain onsite or readily available through contract services should earthworks be required during the temporary closure phase.
- The main access road will be maintained for access by the caretakers and operations staff with equipment retained onsite (grader/loader) or readily available through contract services.
- The caretakers and operations staff will be responsible for a variety of activities including, but not limited to, the following:
 - supporting site inspections, security controls, first aid, emergency response and communications
 - supporting water management and gold recovery, MWTP operations, sample collection and site monitoring
 - supporting site monitoring and sample collection to ensure compliance with regulatory requirements
 - ensuring critical process equipment such as pumps, generators and some mobile equipment are maintained in operating condition
 - providing for snow removal and road access
 - In conjunction with SGC's corporate office conducting any relevant administrative responsibilities.
- It is currently anticipated that multiple staff will cover duties on a 24-hour basis as required.

Table 6-1 presents a summary of the care, maintenance and monitoring activities of the various project components which would occur in the case of a temporary closure.

Table 6-1: Summary of Care and Maintenance Activities and Monitoring During Temporary Closure

Facility	Area	Care and Maintenance Activities	Monitoring Activities	Monitoring Frequency
Open Pit	Physical Stability	Site inspection for stability	Visual inspections as outlined in operating	Weekly
	Water	Allow the pit to fill to pre-determined level		

Facility	Area	Care and Maintenance Activities	Monitoring Activities	Monitoring Frequency
	Management	depending on pit geometry at the time of closure, then continue to convey water via ponds and ditches to treatment, as necessary	licenses	
Waste Rock Storage Areas and Temporary Ore Storage Area	Physical Stability	Site inspection for stability	Visual inspections as outlined in operating licenses Water quality and systems monitoring as outlined in licenses	Weekly
	Chemical Stability	Continue to convey water to treatment Maintain groundwater and surface water quality monitoring stations		
	Water Management	Erosion and sediment control of WRSA surface; rock drain outlet maintenance	Visual inspections as outlined in operating licenses	Weekly – more frequent during freshet as needed
Heap Leach Facility	Physical Stability	Dublin Gulch Diversion Channel and Events Pond maintenance Interceptor ditches maintenance Runoff, erosion and sediment control Dust control	Visual inspections as outlined in operating licenses	Following major rain events and freshet
	Chemical Stability	Maintain groundwater monitoring wells and LDRS sump integrity	Water quality and systems monitoring as outlined in licenses	Weekly to monthly
	Leaching and Process Recovery System	Maintain process water management including HLF pumping, HLF irrigation, solution collection and storage, reagent addition and gold recovery facilities	Water quality and systems monitoring as outlined in licenses	Ongoing for the term of temporary closure
Water Management Facilities (Ponds and Ditches)	Physical Stability	Excavating sedimentation in ditches and ponds; Snow and aufeis removal as necessary	Visual inspections as outlined in operating licenses	Following major rain events and freshet
	Chemical Stability	Maintain groundwater and surface water quality monitoring stations	Water quality and systems monitoring as outlined in licenses	Weekly to monthly
Mine Water Treatment Plant	Equipment Performance	Secure buildings and maintain equipment for solution recirculation and treatment	Water quality and systems monitoring as outlined in licenses	Daily
Infrastructure Buildings, Equipment and Pads	Physical Stability	Secure buildings and provide maintenance; Conduct any sediment and erosion control measures as needed	Visual inspections	Quarterly and following freshet and major rain events
Main Access Road, haul roads secondary roads	Physical Stability	Maintain surface drainage, culvert repair, bridge maintenance, road grading and snow removal	Visual inspections	Quarterly and following freshet and major rain events
Entire Site	Security	Secure buildings and provide	Visual inspection	Ongoing

Facility	Area	Care and Maintenance Activities	Monitoring Activities	Monitoring Frequency
		maintenance; Continue to restrict access to site; Remove non-essential chemicals and explosives from site. Remove all gold from site. Safely store in secure double containment area all essential chemicals		
	Reporting	Documentation of care and maintenance activities	Not applicable	As required by licenses

6.3 TEMPORARY CLOSURE CRITERIA

The site temporary closure criteria are to maintain water management, and as required, discharge water to meet the effluent quality standards of the project. The water quality treatment and discharge criteria for the MWTP (Table 6-2) are the same in temporary closure as they are during operations. Their derivation is summarized in Lorax (2014a).

Table 6-2: Effluent Water Quality Standards for Temporary Closure

Parameter	MWTP Proposed Effluent Quality Standards (Phase 2 to Phase 6)
pH	6.5 to 8
TSS	15
SO ₄	2000
Nitrate-N	30
Nitrite-N	0.2
NH ₃ -N	15
CN _{WAD}	0.05
Al (diss)	1.6
Sb	0.24
As	0.09
Cd	0.0028
Cu	0.04
Co	0.04
Fe	11
Pb	0.1
Hg	0.00012
Mn	18
Mo	1

Parameter	MWTP Proposed Effluent Quality Standards (Phase 2 to Phase 6)
Ni	0.5
Se	0.07
Ag	0.02
U	0.2
Zn	0.5

Discharge at these concentrations is shown to be protective of in-stream water quality in Haggart Creek at W29.

6.4 MONITORING

Monitoring activities for the site will follow licensed surveillance programs as described in the *Environmental Monitoring and Adaptive Management Plan*. These may include, but are not limited to the following:

- Regular inspections of the site to observe and document the condition of any changes to site security, public safety measures, and mine infrastructure
- Documentation of potential environmental or public health and safety issues
- Routine physical stability monitoring
- Routine chemical stability monitoring
- Regular water quality and flow monitoring
- Monitoring of existing climatic conditions will continue with operation of the onsite weather station(s)
- No regular air monitoring is planned; however, visual monitoring of the crushing facility, waste rock storage areas, open pit and HLF conducted daily and weekly.
- Regular inspections of the HLF/ponds and the LDRS including emptying of leak collection sumps, as applicable
- Submittals of inspection and monitoring reports on a regular basis as required
- Response to any security/safety breaches as required.

Site inspections and monitoring will likely be conducted by vehicle when seasonally possible. Some areas of the site may be inaccessible in winter as snow removal will not be reasonable in some locations. Inspection results will be documented and submitted on a regular basis, or as required. Reports of changes to the physical status of any part of the site may warrant a follow-up investigation by the appropriate personnel. Some elements of the monitoring program such as geotechnical and structure inspections and non-routine water quality and biological monitoring, will be conducted by appropriate professionals. The results of these inspections will be included in annual reports and other required submittals.

6.5 NOTIFICATION AND REPORTING

If a temporary closure is triggered, a notice will be provided within seven days of making the decision to temporarily close the project (or as the authorizations dictate) to the appropriate authorities stating the following:

- The nature and reason for the temporary closure;
- The anticipated duration of the temporary closure;
- Actions planned to maintain compliance with project permits and plan approvals; and
- Any event which would reasonably be anticipated to result in the resumption of mining or the permanent closure of the mine.

7 PROGRESSIVE RECLAMATION

Reclamation, closure planning, and implementation will provide for progressive reclamation to the greatest extent practical during mining operations. Progressive reclamation is often implemented during operations (or after construction) to reduce the amount of financial security required to be provided and maintained by SGC.

7.1 PLATINUM GULCH WASTE ROCK STORAGE AREA

Bottom-up construction of the Platinum Gulch WRSA to its final configuration will enable progressive reclamation during construction of the WRSA. Progressive reclamation will help to reduce dust and infiltration of precipitation and runoff through the cover as well as minimize the visual footprint of the WRSA sooner. For safety reasons, such as falling rock onto worksite below, remediation will be started toward the end of the Platinum Gulch WRSA 3 year lifespan.

When initiated, reclamation of the 38.9 hectare (benches ~18 ha and side slopes ~20 ha) footprint of Platinum Gulch WRSA will require the construction of an engineered cover. Cover material (Knight Piésold 2013b; Okane 2014) will consist of locally sourced mixtures of colluvium and placer tailings placed to a 0.3 m depth over the compacted waste rock. A 0.2 m cover of previously stockpiled topsoil during WRSA construction soil will cover the colluvium. The cap will be re-vegetated with plant species suitable for the west facing aspect of the Platinum Gulch WRSA.

7.2 EAGLE PUP WASTE ROCK STORAGE AREA

The Eagle Pup WRSA will be closed during the first year of closure; however, progressive reclamation may be performed on areas where final contour has been achieved to help reduce dust and minimize infiltration of precipitation and enhance runoff from the covered areas as well as minimize the visual footprint of the WRSA sooner.

7.3 ICE-RICH OVERBURDEN STORAGE AREA

Since most or all of the IROSA will be essentially non-active during all of operations, the surface area will be re-vegetated early on during operations to minimize the potential effects of sediment movement during rainfall-runoff and/or freshet, and maximize the effect of infiltration. Depending on soil volume requirements for reclamation, some of the IROSA soils may be utilized, and so these areas will need to be reclaimed again.

8 FINAL RECLAMATION AND CLOSURE MEASURES

8.1 CLOSURE SCHEDULE

Due to the longer term process to draindown the HLF, the decommissioning and closure process of the Eagle Gold Project will take several phases over a number of years to complete. The following outlines the activities that are planned to occur for each phase.

Phase 1 – 3 (~Years 1 to 9): Active mining.

Phase 4 (~Year 10): Termination of mining and ore production, but continued irrigation of the ore stack for gold production; managed recirculation of the heap solution inventory; open pit begins to fill; begin building cover on EP WRSA; decommission crushers, some mine roads, temporary ore stockpile, explosives and magazine storage facilities; begin construction of passive treatment system (PTS) for Eagle Pup WRSA seepage. Gold recovery during this period covers all heap solution management costs.

Phase 5 (~Years 11 to 12): Termination of gold production and beginning of rinsing and cyanide destruction; managed pump-back of heap drain-down solution inventory – no heap discharge to treatment; closure of EP Pond; LDSP (EP) and PG PTSs in place; LDSP (EP) PTS discharge to DGDC when discharge criteria are met; PG PTS discharge to Haggart Creek when discharge criteria are met; open pit still filling; decommission ADR; begin building cover on specific sections of the HLF, if feasible.

Phase 6 (~Years 13 to 19): Controlled drain-down of heap (drain-down solution split into two flows: managed pump-back of heap drain-down solution inventory with proportion sent to MWTP. Enhanced evaporation and snowmaking in winter may be incorporated as part of solution management during this phase, and other may be infiltrated to create in-heap bioreactor); begin conversion of Events Pond into PTS - when HLF seepage rate and concentration criteria are met - change from active treatment to passive treatment; open pit fills in about eight years – afterwards flow allowed to drain to Haggart Creek (via PTS if necessary); complete building cover on HLF; complete any required stabilization of DGDC; decommission truck shop and reduce camp size, and decommission remaining access roads.

Phase 7 (~Years 20 to TBD): Decommission MWTP; all passive treatment systems in place; uncontrolled drain-down of heap – until seepage rate meets meteoric input; close substation and most of the camp infrastructure. Begin post closure monitoring and maintenance.

Phase 8 (~Years TBD): Post-closure monitoring and maintenance – all project facilities closed except that which is needed to support monitoring programs and PTS maintenance, as needed.

8.2 ORGANIZATION, SITE ACCESS & SECURITY

A number of personnel will be required on site to implement the various decommissioning and closure tasks. Generally, these tasks entail closure of mine workings, regarding of waste rock and overburden piles, decommissioning of the HLF and WTP, salvage and removal of infrastructure, equipment and reagents, decommissioning of access roads and reclamation and revegetation of disturbed lands. These activities would be undertaken on a seasonal basis and directed by and onsite manager responsible for decommission and

reclamation of the VIT mine. During site decommissioning, it is anticipated that at least a portion of the existing camp accommodations would remain on site to support site personnel. It is anticipated that during the initial post-closure phase, site security requirements will continue with a caretaker remaining on site following seasonal closure of the site. A site inspection schedule will continue for the period of closure implementation (Phases 4 to 7) and then move into a post-closure monitoring period (Phase 8). Security personnel will no longer be required once decommissioning and reclamation activities are completed on the property. Once the majority of physical reclamation works are performed on the site, the number of employees or contractors required will be reduced. SGC is committed to having FNNND members employed during implementation of the RCP and will continue to work with FNNND to optimize long term closure monitoring requirements.

Controlled access will be maintained during implementation of the post-closure monitoring phase. Decommissioning and reclamation of haul and site access roads will occur once closure measures have been completed at each facility and site access is no longer required.

Prior to decommissioning activities are completed onsite, and following a period of post-closure monitoring, SGC and FNNND will confirm which access roads are to remain open as determined by previous consultation processes.

8.3 SUPERVISION AND DOCUMENTATION OF WORK

All decommissioning and reclamation works will be supervised to ensure that works are constructed according to their design and that the work is properly carried out and documented. The project manager or the construction supervisor will be responsible for supervising all closure works. Daily inspection procedures would be completed to document work progress, deficiencies and completion. Existing plans for spill response or other site internal procedures for fuel handling, waste disposal, fire control and suppression, health and safety and environmental management systems would be used, developed and followed as necessary.

Environmental inspections and tests conducted prior to the implementation of closure measures will be used to confirm areas requiring clean up.

Plans for all earth works and inspections will be prepared and submitted to the YWB and EMR for review prior to construction. These plans would be submitted in a timely manner to facilitate agency review and Board approval prior to implementation. A competent engineer following standard quality control and assurance procedures will inspect and document this construction work. As-built plans and drawings will be completed and the results of the closure work that has been performed on the facilities documented in a final RCP report. This report would then be submitted to the YWB, EMR and appropriate regulatory agencies upon completion of closure activities.

A competent environmental practitioner following standard quality control and assurance procedures will design, direct and document all restoration work. A summary report of the works will then be prepared and submitted to the YWB, EMR and appropriate regulatory agencies upon completion of closure activities.

Upon completion of the decommissioning and reclamation works, a final site plan report (summary text and drawings) will be prepared to outline the facilities or works remaining on the site following closure. This plan will identify the location of buried concrete structures or scrap and landfill disposal areas. It is expected that this plan would accompany an Application for a Certificate of Closure under the Yukon Quartz Mining Act.

8.4 MINE RECORDS

As noted in the previous section, all decommissioning and reclamation works will be documented. Active Mining period records showing the extent of mine workings would be retained by SGC. Other site records, files and plans will also be archived at the site. Where plans or drawings are required for mine safety reasons, these plans would also be submitted to government mine safety offices. As-built reports for structures completed for closure and the final site closure report will be retained for record by SGC and submitted to government agencies and boards as required.

8.5 ESTIMATED AREAS OF DISTURBANCE AT END OF MINE LIFE

The estimated areas of disturbance and approximate dimensions at the end of the projected mining activities include:

- Open Pit: W: 780 m x L: 1,420 m, D: 562 m along east highwall, 75 m along west highwall, 85 ha.
- Heap Leach Facility: 107.2 ha with approximate dimensions of 520m x 1,980 m, average vertical thickness of heap is 55 m, with a maximum height of 150 m. The heap embankment west of the heap will have a surface area of 5.4 ha. The HLF will have one event pond with the following capacity:
 - Event Pond below the HLF embankment with approximately 204,000 m³ storage capacity with 1.5m of freeboard to the pond; and
 - The pond volume at the spillway invert is approximately 255,000 m³.
- Waste Rock Storage Areas
 - Platinum Gulch WRSA 13.7 Mt of waste rock with a final footprint of 38 ha.
 - The Platinum Gulch Pond for seepage and runoff collection will have a total storage capacity of 10,420 m³.
 - Eagle Pup WRSA 118.7 Mt of waste rock with a final footprint of 94 ha.
 - The Eagle Pup Pond for seepage and runoff collection will have total storage capacity of 12,300 m³.
- For both WRSAs, overall slope angle of 2.5H:1V with construction in 45m lifts

Table 8-1: Estimated Area of Disturbance at End of Mine Life

Component	Maximum Estimated Area of Disturbance (ha) Life of Mine	Maximum Estimated Area of Disturbance (ha) End of 2 nd year of Operations
Open Pit	82.1	49.5
Heap Leach Facility		
Embankment	10.8	10.8
Phase 1	45.7	45.7
Phase 2	46.8	46.8
Phase 3	40.8	0

Section 8 Final Reclamation and Closure Measures

Component	Maximum Estimated Area of Disturbance (ha) Life of Mine	Maximum Estimated Area of Disturbance (ha) End of 2 nd year of Operations
Events Pond	8.5	8.5
Industrial Infrastructure		
Crushing and Conveying Facilities (including temporary facility)	19.5	19.5
Truck Shop and Fuel Storage	9.9	9.9
Laydown and Camp Area	9.5	9.5
Process Facility, Substation and Water Treatment Plant	12.0	12.0
Explosives Facilities	2.5	2.5
Landfill and Land Treatment Facility	1.6	1.6
Waste Rock and Overburden Storage Areas		
Eagle Pup Waste Rock Storage Area	94.0	60.0
Platinum Gulch Waste Rock Storage Area	38.0	37.5
Reclamation Stockpiles	18.4	18.4
Ice Rich Overburden Storage Area	5.6	5.6
Water Management Structures		
Lower Dublin North Pond	1.0	1.0
Lower Dublin South Pond	2.7	2.7
Eagle Pup Pond	1.7	1.7
Platinum Gulch Pond	1.2	1.2
Dublin Gulch Diversion Channel	12.4	12.4
Off-Site Infrastructure		
Transmission Line Corridor	16.8	16.8
Miscellaneous Sites and Facilities		
On-Site Access and Haul Roads	51.2	51.2
Borrow Pits	8.0	8.0
Gate House and Truck Scale	1.4	1.4
Temporary Ore Stockpile	16.9	16.9
Total Estimated Area of Disturbance	559	451.1

Based on the earthworks materials take-off estimates, a total of approximately 1.6 Mm³ of excess cut, including topsoil, frozen (ice-rich and non-ice-rich) and non-frozen overburden soils will be stored in the various designated reclamation stockpiles. This is expected to satisfy the overall requirement for closure covers, which is currently estimated at approximately 1.5 Mm³.

8.6 CLOSURE WATER MANAGEMENT PLAN

8.6.1 Closure Objectives

8.6.1.1 Water Quality Objectives

As with the operational strategy for managing water, mine site water quality will be managed to keep, where possible, unaffected water from contacting mine waste, by the use of covers and diversion ditches. The effluent

quality objectives development was based on the premise that seepage from the HLF and WRSAs, and overflow from the Pit Lake are the primary sources of mine affected water (Lorax 2014b). Other non-contact water will be conveyed off the mine site into Dublin Gulch Diversion Channel (DGDC) and Haggart Creek Sediment basins and sediment control ponds will be in place until reclamation objectives (e.g., during construction of covers) are achieved and runoff can be discharged directly to receiving waters. Thus the performance of the covers, sediment control structures, the passive treatment systems, and the water conveyance features all work together to achieve the water quality objectives.

8.6.1.2 Water Conveyance Objectives

The objectives for the design of the water conveyance features are to convey affected seepage to the PTS sites without comingling with other unaffected surface runoff, and to convey otherwise unaffected water away from mine contact areas. The primary affected water conveyance features are:

- From the In-Heap Pond to a PTS converted from the Events Pond; a HDPE buried pipe will convey water from the Closure Sump into the Heap PTS.
- From the Eagle Pup seepage emergence point, a buried pipe and open channel ditch combination will be used to convey water to the LDSP area, where the LDSP will be converted to a PTS as a series of lined facilities.
- Continue to convey Platinum Gulch seepage to the seepage collection pond, which will be converted to a PTS; pit overflow water (when the pit is filled) will be conveyed either to the PTS or directly to the receiving environment (Haggart Creek) when discharge criteria are met.
- Based on source terms characterization and water quality modeling, the Pit Lake is not expected to require any additional treatment other than the natural beneficial processes of direct precipitation on the lake and the physical process of the lake, i.e., settling and ultimately biological processes as the lake becomes active biologically. Thus, the overflow from the Pit Lake will be conveyed in an open and stable channel down to Haggart Creek.

There will be some conveyance features that route water from disturbed areas, but are not expected to require treatment in closure as the reclaimed areas become vegetated and sediment load is decreased by the formation of the reclamation cover. These areas include:

- Water shedding off covers
 - On both sides of the heap, runoff from the cover will be conveyed into sediment basins and the LDNP, as needed until the cover is stable and then into the DGDC, and Haggart Creek.
 - On both sides of the Eagle Pup WRSA, runoff from the cover will be conveyed into a sediment basin until the cover is stable and then into the DGDC.
 - On the south side of the Platinum Gulch WRSA, runoff from the cover will be conveyed into a sediment basin until the cover is stable and then into the Haggart Creek, joining with the overflow from the pit and the treated water from the Platinum Gulch PTS.
- Water collected from disturbed areas including the reclamation and temporary ore stockpile areas.

Discharge from the Pit Lake and the PTS systems will be conveyed in open channels to discharge locations in Haggart Creek or DGDC.

8.6.2 Transition Strategy

During operations, reclamation research will be performed at the full/demonstration scale at the PG WRSA to evaluate and determine operating performance of covers and PTS. Discharge from this feature will be initially sent to the operational water/makeup water in the LDSP until meeting discharge criteria. At closure, with the PTS meeting discharge water quality criteria, this discharge will be routed into the channel established for the runoff from the PG PTS.

When the in-heap cyanide destruction process is completed, the Events Pond will be converted into a PTS, specifically a CWTS. The closure sump will be activated to drain in a controlled manner to the CWTS located in the Events Pond. While the CWTS is coming up to full performance and not yet meeting water quality discharge criteria, a pump will be activated to send the CWTS flow to the MWTP. When the CWTS is meeting discharge criteria consistently for a year, it will be allowed to discharge from the CWTS into a channel to the LDNP, and join with the runoff from the heap and undisturbed areas, and ultimately into Haggart Creek.

During operations, seepage collected in the Eagle Pup seepage collection pond will be pumped to the LDSP and ultimately to the MWTP. During early closure Eagle Pup WRSA seepage will be conveyed in a ditch/piped channel (as described above) and flow via gravity to the LDSP, which will have been converted to a PTS (CWTS). Discharge will continue to be sent to the MWTP until the outflow meets discharge criteria, after which it will be allowed to discharge into the DGDC.

The MWTP will be operational as long as the heap drain-down and the Eagle Pup WRSA seepage requires treatment, and while the CWTSs are becoming active. After the PTS systems are fully operational the MWTP will be held on standby for a period of one year, at which time it will be decommissioned along with any other MWTP unnecessary infrastructure – see Section 8.9.

8.6.3 Water Conveyance Network

An extensive water conveyance network will be constructed during operations to safely route water around the main mining components. Details for the water management infrastructures for operations is presented in the *Operations Water Management Plan* (OWMP). The proposed network at closure will incorporate the existing conveyance channels as described in the OWMP (upgrades required in certain locations) complemented with new channels to accommodate the closure objectives.

Five different type cross-sections have been designed for operations and presented in the OWMP to accommodate various gradients and volumes of flow, depending on which ditch or channel is considered.

Type 1 and Type 2: Unlined ditch with triangular (Type 1) or Trapezoidal (Type 2) cross-section for small watersheds limited to channel slopes of 1 to 2%;

Type 3: Lined ditch with riprap with a D_{50} of 150 mm for larger watersheds, with channel slopes between 2 and 5%;

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Type 4: Lined ditch with grouted riprap or shotcrete for slopes between 6 and 15%. Alternatively, larger riprap with a D_{50} between 300 and 500 mm could also be used and allow for energy dissipation with flow through the riprap.

Corrugated half pipe – CHP (or Culvert Lined Ditch): Lined ditch with a steel half pipe to protect against high velocities, in terrain that is steeper than 15%. This cross-section is to be used in steep reaches or for spillways.

Details of the various cross-sections are shown in Figure 8-1 and Figure 8-2, as presented in the OWMP.

The various ditches and channels that compose the water conveyance network for operations are described below. Numerous sediment ponds and energy dissipation basins are included in the design to avoid significant erosion and sediment deposition in at-risk locations.

1) Conveyance channels

A series of diversion ditches, collection channels, and culverts have been designed for operations to intercept non-contact and sediment-laden water.

a. Diversion ditches

Diversion ditches will be constructed up-gradient of disturbed areas to intercept clean surface water runoff. A diversion ditch is a channel lined with vegetation, riprap, or other flexible, erosion resistant material. The main design considerations are the design flow and velocity of the water expected in the channel. During construction and operations, the ditches will be sized to convey the 10-year 24-hour peak storm for the estimated watershed size, with diversion ditches located upslope of key mine infrastructure sized to convey the runoff from a 100-year 24-hour storm event. Diversion ditch design for operations is shown in Figure 8-1. The majority of diversion ditches that will be required at closure are Type 3 ditches, with the following characteristics, shown in Table 8-2, from the OWMP.

Table 8-2: Diversion Ditch Design Criteria for Operations

Water Management Design Criteria		
Infrastructure Element	Design Element	Design Basis Criteria
Lined Diversion Ditches	Design Storm Event	1 in 10-year, 24-hour
	Maximum Depth (mm)	500
	Minimum Grade (%) Type 3 / Type 4	1.00 / 0.50
	Maximum Grade (%): Type 3 / Type 4	4.5 / 15
	Maximum Side Slopes: Type 3 / Type 4	2.5H:1V / 1H:1V
	Maximum Velocity (m/s): Type 3 / Type 4	2.33 / 4.0

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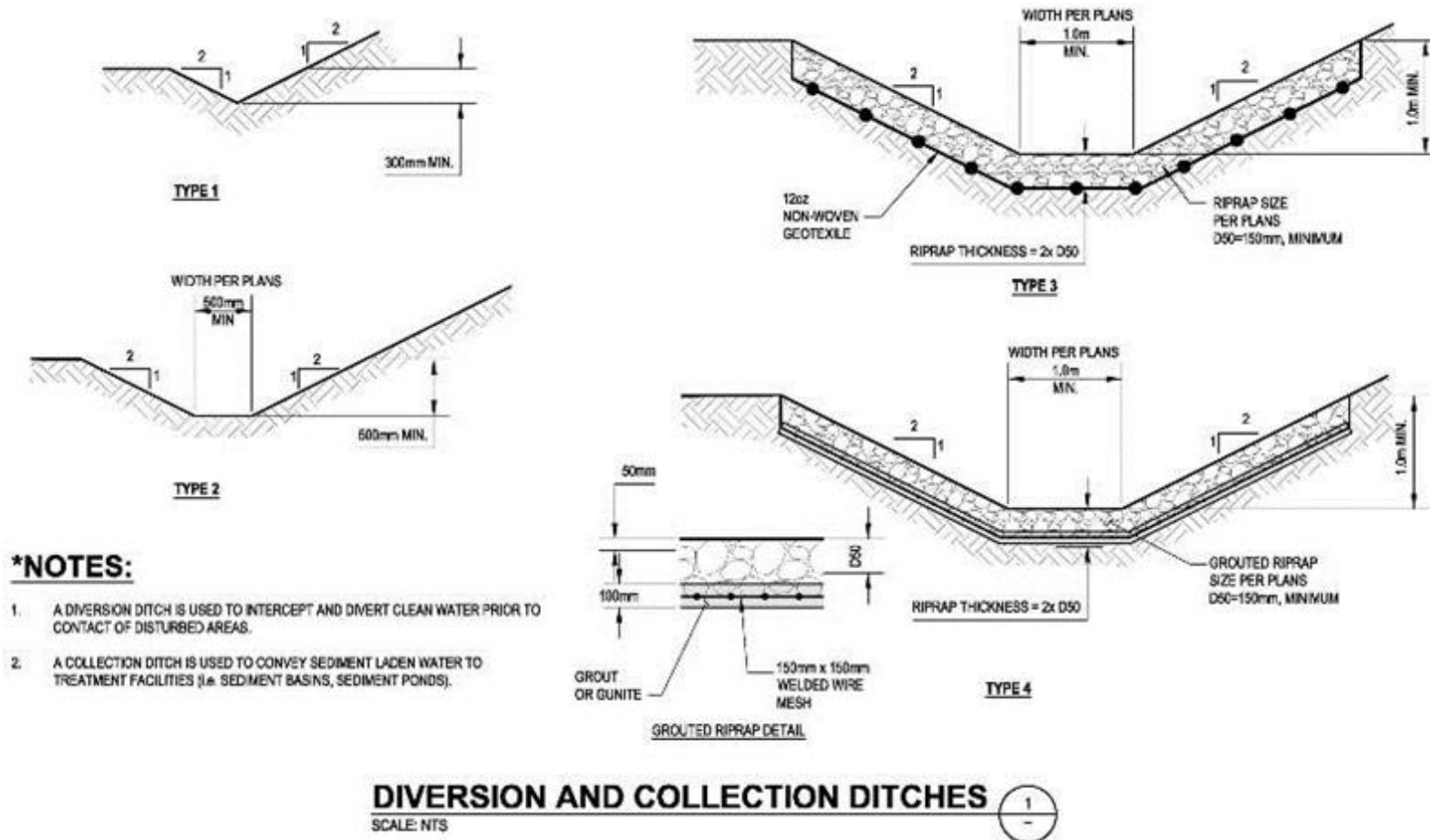


Figure 8-1: Diversion and Collection Ditch Types Used in Operations Surface Water Management

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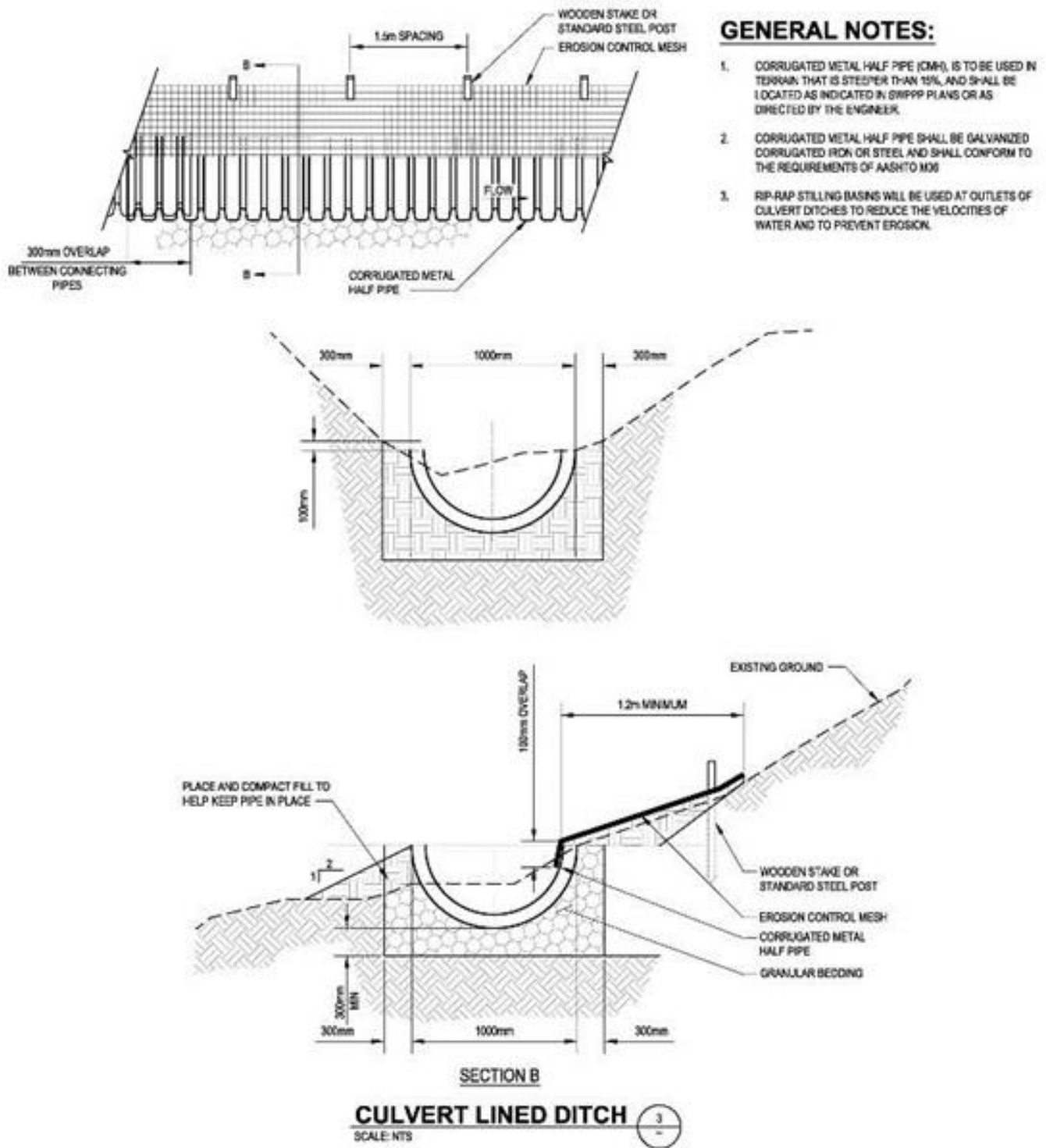


Figure 8-2: Culvert Lined Ditch Designs for Operations Surface water Management

b. Collection channels

A collection channel intercepts sediment-laden water runoff from disturbed areas and diverts it to a stabilized area where it can be effectively managed. Collection channels will be used within construction areas to collect runoff and convey it to the appropriate sediment control measures. During construction and operations, collection channels will be sized to convey the runoff from a 100-year 24-hour storm event assuming that the entire footprint area has been disturbed and contributes sediment-laden runoff to the seepage collection and recycle ponds. Collection channel design for operations is shown in Figure 8-1. The majority of collection channels that will be required in closure are Type 3 ditches, with the following characteristics, shown in Table 8-3, from the OWMP.

Table 8-3: Collection Channels Design Criteria for Operations

Water Management Design Criteria		
Infrastructure Element	Design Element	Design Basis Criteria
Lined Collection Channels	Design Storm Event	1 in 100-year, 24-hour
	Minimum Depth (mm)	500
	Minimum Width (mm)	1000
	Minimum Grade (%)	1.00 / 0.50
	Maximum Grade (%): Type 3 / Type 4	4.5 / 11
	Maximum Side Slopes: Type 3 / Type 4	2.5H:1V / 1H:1V
	Maximum Velocity (m/s): Type 3 / Type 4	2.75 / 5.0

c. Culverts

During construction and operations, culverts will be sized to convey the 100-year 24-hour storm event peak flow for small watersheds and the 200-year 24-hour peak storm event for stream crossings. In general, while variations may occur due to site-specific conditions, it is assumed that culverts will be installed at a slope of 2% with an inflow along a smooth headwall. A small energy dissipater or stilling basin will be constructed upstream of each culvert to reduce sedimentation. The culvert will consist of corrugated metal pipe or corrugated polyethylene tubing installed according to the manufacturer's specifications to accommodate the anticipated vehicle loading and to prevent crushing. Standard culvert details can be seen in Figure 8-2, while Table 8-4 shows culvert design criteria.

Table 8-4: Culvert Design Criteria for Operations

Water Management Design Criteria		
Infrastructure Element	Design Element	Design Basis Criteria
	Minimum Diameter (mm)	750

Water Management Design Criteria		
Infrastructure Element	Design Element	Design Basis Criteria
Culverts	Design Storm Event (Areas < 1 ha)	1 in 10-year, 24-hour
	Design Storm Event (Areas > 1 ha)	1 in 100-year, 24-hour
	Design Storm Event (at stream conveyances and downstream of sediment ponds)	1 in 200-year, 24-hour
	Maximum HW/Diameter Ratio	2.0 for less than 1.0 m 1.5 for greater than 1.0 m
	Minimum Grade (%)	0.5
	Minimum Velocity (m/s)	1.0
	Maximum Velocity (m/s)	4.0

For closure, an updated conveyance network is proposed. The proposed water conveyance network at closure is presented in Figure 8-3. This network is based on the structures already in place during operations, with upgrades at closure, complemented with additional structures needed at closure to meet the water management closure objectives. Table 8-5 summarizes the ditches and channels that are required at closure, and if they are new or existing ones that may need to be updated.

Table 8-5: Ditches and Channels Required at Closure

Ditch name	Ditch type	Total Length (m)	Average slope (%)*	Status
C1	contact with cover	2200	20 (40)	Existing
C2	contact with cover	1200	20	Existing
C3	contact with cover	910	15	Existing
C4	contact with cover	1930	5 (25)	New
C5	contact with cover	1660	25	New
NC1	non-contact; disturbed	2030	6	Existing
NC2	non-contact; disturbed	670	4	Existing
S1	seepage	1150	5	Existing - pipe to be added
S2	seepage	650	30	Existing pipe installed during embankment construction
S3	seepage	310	10 (50)	New
S4	seepage	350	15	New
T1	treated	1100	15	New
T2	treated	500	5 (20)	Existing
T3	treated	100	1	New
T4	treated	90	20	New
U2	unimpacted	2500	3	Existing
U3	unimpacted	1350	4	Existing

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Ditch name	Ditch type	Total Length (m)	Average slope (%)*	Status
U4	unimpacted	1200	3	Existing
U5	unimpacted	520	2 (10)	Existing

*Number in parenthesis is the slope of a short but steeper reach

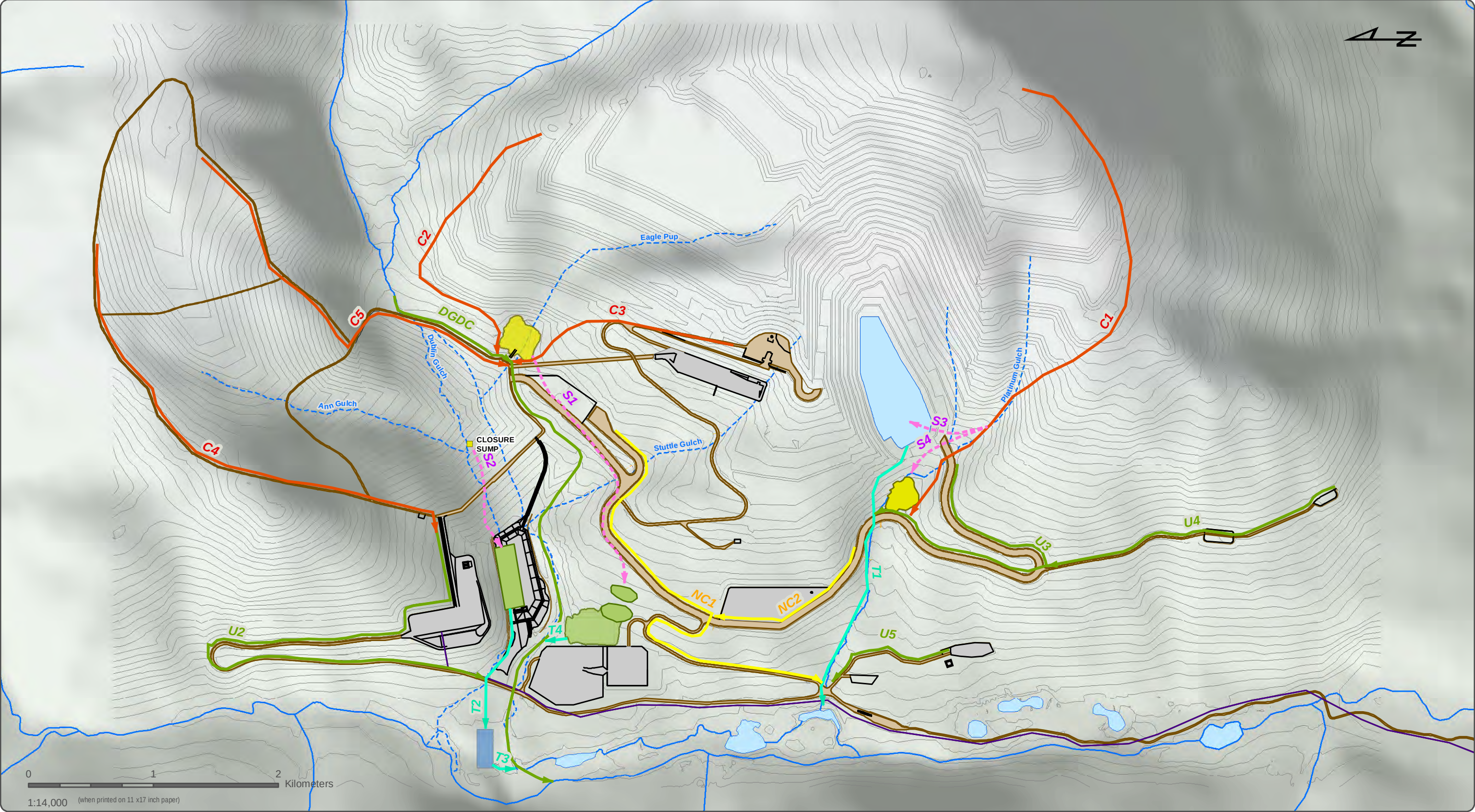
It is expected that approximately 5,000 m of new ditch will be required, and up to 6,000 m of ditches may need to be upgraded to safely convey the 1:100 year flood. All structures will be sized for the 100 year flood based on a 24 hours rainfall event. This is the same methodology that was used for design for operations. Lined diversion ditches and culverts that were sized for the 1:10 year flood will be upgraded for closure. For sediment ponds, calculations will be made using a volume-based approach that considers the hydrograph related to the 1:100 year flood 24 hour rainfall event.

Most of the new ditches that will be built at closure will require cross-sections similar to the Type 3 and Type 4 cross sections that were designed for operations. Some diversion ditches will have higher design flows in closure than during operations, and these ditches will be lined ditches where there are longitudinal slope of more than 2% for all catchment areas. For any new ditches or ditches have expanded purposes due to changes in flow management during closure, Type 3 cross-sections are proposed for slopes between 2 and 5% and Type 4 cross-sections are proposed for slopes between 5 and 15%. For ditches that require expansion or upgrading to accommodate the expanded flow requirements, it is currently expected that these ditches will be raised or widened by 0.5 m to accommodate the design flow. For new ditches on steeper slopes, a trapezoidal cross-section with larger riprap with a D_{50} varying between 300 and 500 mm is proposed instead of the CHP. The base width of the different ditches and channels will vary between 1 and 2 m depending on the calculated design flow for a given catchment.

For closure, existing diversion ditches and collection channels will be consolidated and rip rap will be added to ensure integrity of the channel, if required. Riprap with a $D_{50} = 150$ mm is generally selected (Type 3 or Type 4 cross-sections) but larger rip rap may be required in steeper reaches.

Additional energy dissipation basins will be required at the toe of steep reaches for the new ditches. At this stage, we estimated that three new basins will be required. Approximate dimensions are to be 5 m by 5 m, with a minimum water depth of 1m. Erosion protection is to be ensured with riprap material with a D_{50} between 300 and 500 mm depending on the ditch considered. Existing sediments ponds and energy dissipations basins will be consolidated if needed and will be upgraded where necessary.

The main component to be added at closure will be pipes to convey seepage flows from the HLF and the WRSAs (Eagle Pup and Platinum Gulch). Normal seepage flows for each component have been calculated to reach maximum values varying between 10 and 25 L/s (Lorax 2014c). Pipes of 150 mm diameter (6 inch) are proposed to convey seepage flows to the PTS. Such pipes have an average capacity of up to 50 L/s under normal operating conditions, thus will be adequate for the flows calculated for closure. It is proposed that the pipes be buried by at least 1 m of material to prevent them from freezing. A minimum slope of at least 5% will be set to ensure adequate flow velocities. For the Eagle Pup pipe, the pipe will be placed within a berm on the edge of the ditch, such that if there is any excess flow during high flow events it would be conveyed within the ditch to the passive treatment system. A typical cross-section of this ditch and pipe combination is presented in Figure 8-4.



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Datum: NAD 83; Map Projection: UTM Zone 8N

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- Collection Point
- Diverted Watercourse
- Watercourse
- seepage
- unimpacted
- contact with cover
- non-contact; disturbed
- treated

- Treatment System/Pond
- Constructed Wetland

Victoria
GOLD CORP



ACCESS

EAGLE GOLD PROJECT

FIGURE 8-3

CLOSURE WATER MANAGEMENT NETWORK

JULY 2014

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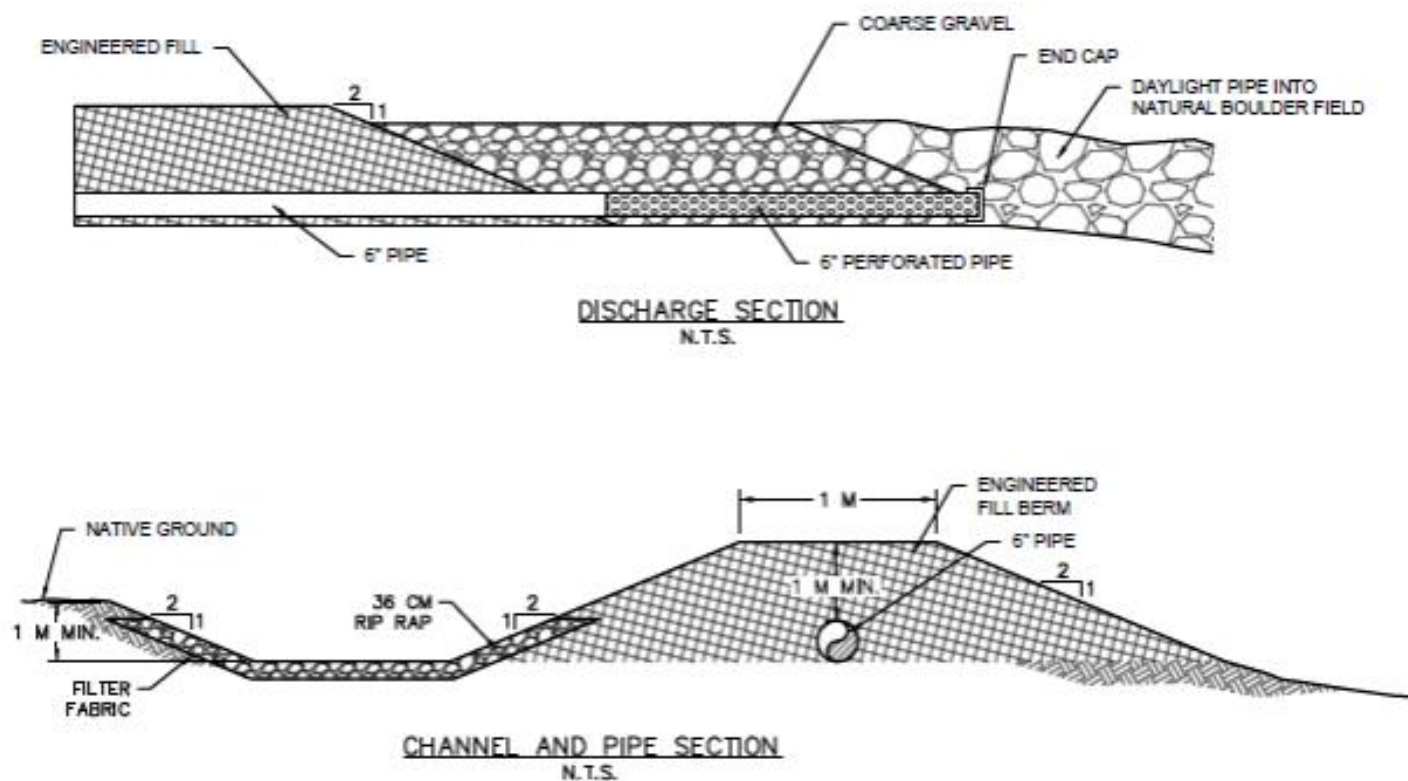


Figure 8-4: Typical Ditch and Pipe Cross-Section for Conveying EP Seepage to the PTS

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Profiles for each of the seepage ditch and pipe combo were developed to determine the slopes that will be encountered. There is no limitation in slope that the pipe can withstand, while for the ditch portion, a design will have to be finalized at closure to account for the updated predictions of additional seepage flows. Longitudinal profiles for all four seepage ditch and pipe combos (S1 to S4) are presented below. They were extracted from the end of mine life topography using ArcGIS tools.

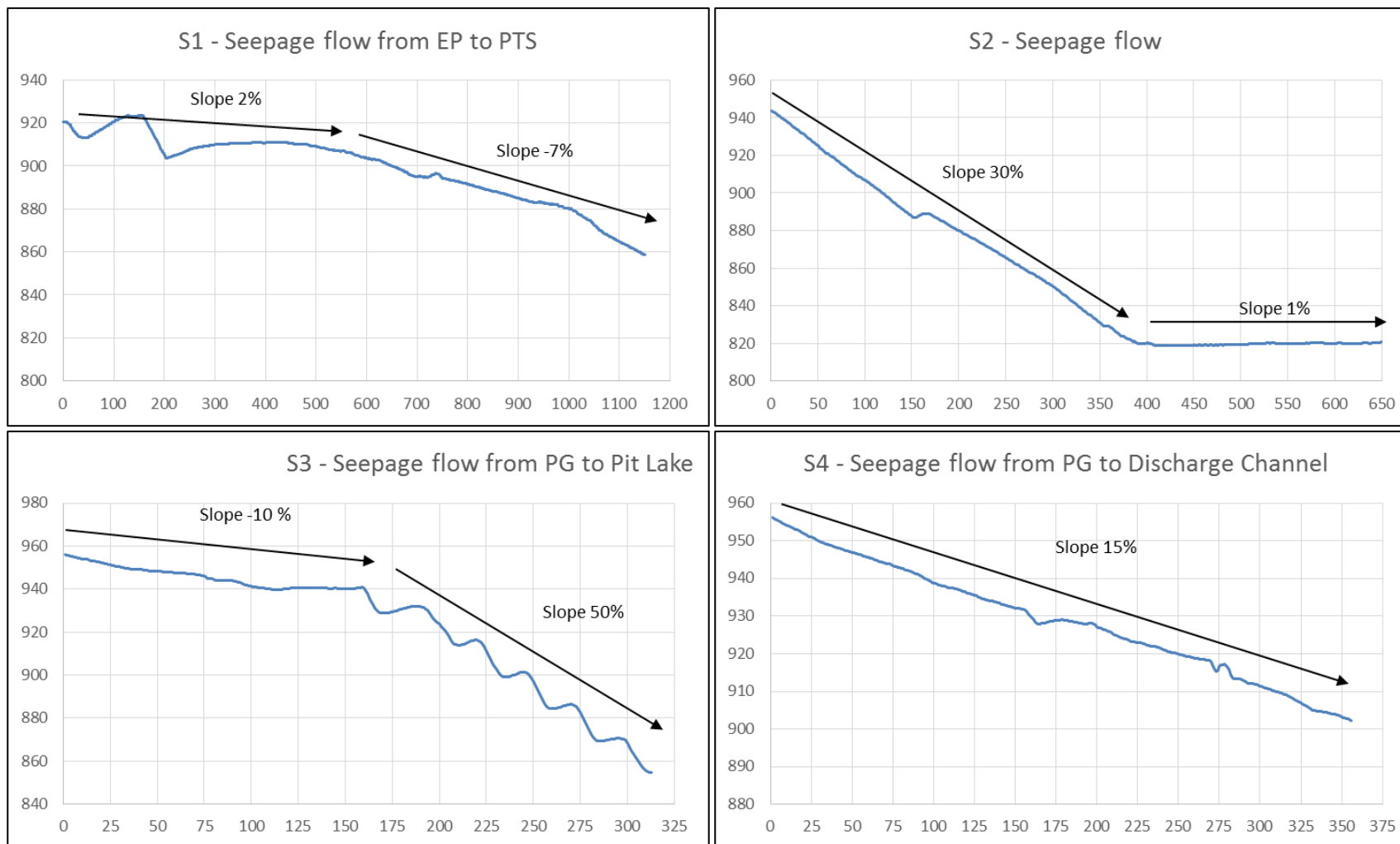


Figure 8-5: Seepage Flow Ditch and Pipe Combos Longitudinal Profiles

8.7 OPEN PIT

8.7.1 Closure Objectives and Criteria

Closure objectives for the Open Pit are to secure the pit to protect human health and safety, and to manage water flow from the pit into Haggart Creek in accordance with water quality guidelines and water management design criteria.

8.7.2 Closure Measures

Upon cessation of mining, the pit pumps and pipe column will be removed and any other related infrastructure will be cleaned up. Access to the pit will be secured by placement of boulders across roadways, and signage will be used to warn about the presence of highwalls. A safety berm will have been installed around the highwall in operations that will prevent unintended access to the pit by snow machines or other cross terrain vehicles. After approximately eight years, outflow from the pit will flow through engineered structures to into the Platinum Gulch conveyance channel.

The approximate timing of the Pit and Pit Lake development is outlined below:

- Years 1 to 10 pit inflows pumped to PG Pond and ultimately to LDSP
- Years 10 to 18 open pit is filling and no discharge occurs
- After Year 18 open pit discharges directly and untreated to Haggart Creek (i.e., no PTS is required for pit discharge).

8.8 HEAP LEACH FACILITY

8.8.1 Closure Objectives and Criteria

Closure objectives for the HLF include:

- conducting drain-down and cyanide destruction activities in a controlled manner to achieve and maintain chemical stability of heap effluent;
- performing grading and cover placement in a manner that will achieve long-term physical stability including minimizing erosion, subsidence or slope failure;
- incorporating design criteria and attributes in the initial design so that the HLF is able to withstand severe climatic and seismic events;
- achieving long-term chemical stability such that runoff and seepage quality meet water quality criteria; and
- implementing appropriate contingency measures as required.

Water quality criteria for the heap were derived by first determining water quality objectives for the receiving environment, as described in Lorax (2014d), and for the heap the relevant objectives are for water in Haggart Creek, specifically at Station W29. Lorax (2014a) derived water quality criteria for the heap and other site

sources that would be protective of Haggart Creek water quality. Table 8-6 provides the water quality criteria that are the maximum concentrations of discharge that are still protective of water in Haggart Creek.

Table 8-6: Heap Leach Facility Effluent Quality Standards

Parameter	HLF PTS Effluent Quality Standards
pH	6.5 to 8
TSS	15
SO ₄	2500
Nitrate-N	85
Nitrite-N	1.7
NH ₃ -N	34
CN _{WAD}	0.09
Al (diss)	4.2
Sb	0.3
As	0.16
Cd	0.006
Cu	0.16
Co	0.11
Fe	27
Pb	0.16
Hg	0.00029
Mn	37
Mo	2.2
Ni	0.5
Se	0.14
Ag	0.02
U	0.39
Zn	0.5

Source: Lorax 2014a.

Comparison of the predicted source water quality of the heap at final draindown (i.e., influent into any passive treatment system) shows that the main water quality parameters of potential concern that would drive water treatment requirements are nitrate, CN(wad), As, Sb, Pb, Hg, and Se, and these parameters require treatment prior to release to Haggart Creek. Thus the closure measures are designed to address these parameters either by treatment within the heap ore column, in the in-heap pond, or in the passive treatment system to be constructed in the Events Pond.

8.8.2 Closure Measures

The HLF will be the last feature to be reclaimed as the cyanide destruction and rinsing processes will take approximately two years, following the cessation of active mining and placement of ore. The construction of a hybrid (enhanced store-and-release) cover system will commence once WAD cyanide concentrations meets discharge criteria, and seepage from the facility will be treated with a passive treatment system constructed down gradient of the facility. These measures are detailed below. There are essentially three stages in the closure process:

- residual leaching,
- cyanide destruction and rinsing, and
- draindown.

The phases of heap operation and their timing is outlined in Section 8.1.

8.8.2.1 Residual Leaching

After the last ore materials are placed, transition to a residual leaching period will commence. During this phase, diffusion of the cyanide solutions into the heap materials continues and recovery of gold from the heap drainage continues until it is decided that it is economically beneficial to transition to the rinsing and cyanide destruction phase. The exact duration of this residual leaching phase cannot be determined in advance (which will be a cost-benefit tradeoff of commodity prices, operational and overhead costs, and other site-specific factors), but for purposes of cost estimation, a duration of one year is assumed. During this residual leaching phase the crushing and stacking equipment is decommissioned, and the primary activities are movement of pipes and leaching equipment around the heap to maintain optimal leach phasing.

8.8.2.2 Cyanide Destruction and Rinsing

As the economic recovery of precious metals from the heap is reaching the transition point where the net economic benefits of gold recovery diminishes, the heap operations will transition to a cyanide destruction and rinsing stage. This stage refers to the destruction of cyanide within the solution, such that it is no longer acutely toxic from the toxicity of cyanide, and the term “rinsing” refers to the continued application of solutions that are low in cyanide concentration to the heap to flush out areas with higher concentrations. During this time there will continue to be recovery of gold-bearing solutions collected in the bottom of the heap.

This phase will appear similar to the residual leaching phase, in that the primary activities will be movement of pipes and leaching equipment around the heap as necessary to continue to deliver solutions to the heap. However, the solutions added to the top of the heap will no longer have cyanide present in them, because the biochemical treatment of the heap solutions will remove the active cyanide from solution. This will be achieved by adding sugar solutions (sugar solution with reducing sugars, typically molasses or corn syrup are the most cost effective) to the barren solution exiting the gold recovery circuit, where any residual free or reactive cyanide forms biochemically react with the sugar molecule, forming cyanohydrin. The rate of sugar solution added to the barren solution is designed to both react residual cyanide in the barren solution, as well as cyanide in the pores of the heap. Thus the treatment is achieved both in barren pond prior to circulation up to the heap, as well as within the heap, which is termed in situ treatment.

This process is similar to what was done at the Brewery Creek Heap Leach Facility to detoxify the solution inventory to close the heap, and also was successfully pilot tested for the Eagle heap materials (Tetra Tech 2014, Cyanide Destruction Column Studies Report). The heap treatment column test was able to achieve reduction of 16 mg/L WAD cyanide to less than the detection limit (0.025 mg/L) with a sustained application of a mixture of sugars and trace phosphate. This experience and experience elsewhere forms the basis for the application approach and dosing rate for the biochemical treatment reagents.

In situ cyanide destruction treatment is a biologically mediated process in which a supplemental reduced carbon syrup (above what is required to directly react with residual cyanide in the barren solution) is added to the heap to degrade cyanide and to facilitate microbial growth within the heap. The reduced carbon promotes a direct consumption of free cyanide and some weak cyanide complexes within the pore water solutions in the heap, which leads to the creation of non-toxic cyanohydrins in the heap. Subsequent degradation of the cyanohydrins and other nitrogen forms is supported by excess carbon (over and above what is required to react with free and weak complexes of cyanide) because the additional carbon supports microbial growth and formation of a fine biofilm on the heap particles that incorporates the reduced nitrogen compounds (cyanohydrins, ammonia). In some cases the sugar solutions are amended with other nutrients, including phosphate or phosphoric acid, and/or other trace biochemical nutrients to enhance microbial growth. The addition of sugar solutions in the barren solution is performed in phases through the same equipment used to leach the heap, i.e., barren solution tank, pumps, piping, and buried drip emitters. Thus the only equipment required to detoxify the heap will be a heated storage tank located at the ADR and metering pump to deliver sugar solutions into the barren solutions as it is recirculated. The size of the reducing sugars mix tank will be sufficient to hold approximately 60 m³ of sugar solution.

Depending on the thickness of the areas on the heap, the particular area where the barren solutions amended with reagents will be added will have solution added by drip emitter onto a specific area of the heap for a period of approximately 60 days. This period of time will allow for the sugars/nutrient mixture to react with cyanide in pore waters in that area and biochemically degrade the cyanide species. Each zone in the heap will have solutions applied to that area such that the sugars/nutrients mixture to break through to the base of the heap. Over the subsequent 'rest period' where solutions are not being applied, the residual pore waters will continue to be biologically treated by the native microbes growing in the heap pores and on the surfaces of the heap materials supported by the sugars and nutrients delivered in the initial solution application period. The solution delivery will be accomplished in phases across the heap, similar to the leaching process, with approximately 12 areas successively treated, for a total period of treatment in the heap of approximately two years. During this time period the flow rates and the areas under solution application will be managed to deliver the solutions at the appropriate strength to the area under solution application until breakthrough of reactive sugars is achieved throughout the leach column, then the area under solution application will be moved to a new area, until the entire heap has received solutions that are amended with the appropriate amount of sugars/nutrients. During this two year period, the costs of recirculating solutions will be offset by continued precious metals recovery, so that the only additional costs for closure in this phase is the cost of the sugars/nutrient solutions. This approach is consistent with the treatment of the Brewery Creek mine, as well as several other heap leach facilities that have been treated using a biological treatment process that rely upon reducing sugars (Harrington and Levy 1999; Harrington 2002; Brewery Creek Mine Decommissioning and Reclamation Plan, 2002).

8.8.2.3 Formation of In Heap Pond Bioreactor

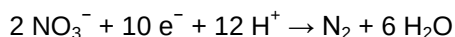
When the cyanide concentrations have decreased in the In-Heap Pond such that the heap outflow to the ADR is consistently below the required free cyanide concentrations, the treatment strategy will shift to a strategy that will stabilize and further improve the water quality from within the heap for water quality constituents beyond cyanide. As described in Lorax (2014b), after cyanide has been degraded the heap drain down water will still be elevated in nitrate, metals and metalloids (As, Pb, Hg, Se and Sb), and these parameters will require treatment prior to release to Haggart Creek. While the biochemical degradation of cyanide with sugars does not rely on the formation of a reducing condition within the heap pores, the treatment of these constituents will be based on reductive precipitation of metals within the saturated zone within the heap as well as the continued microbial degradation of cyanide destruction byproducts (ammonia and thiocyanate) within the unsaturated heap column.

This subsequent phase of in situ treatment will provide a further treatment of constituents within the In-Heap Pond, as well as decreasing metals concentration to sufficient levels to either directly discharge, or at least provide water that is of sufficiently good quality to only require polishing in a passive treatment system (described below). As soon as the cyanide concentrations have decreased to less than the required free cyanide concentrations, heap drain-down will begin.

The saturated in-heap pond will be transformed to become strongly reducing by the addition of alcohol and trace nutrients designed to support biochemical processes that will remove these constituents requiring treatment within the in-heap pond. The processes that will be used to remove/treat these constituents are described below for each constituent potentially requiring treatment:

Nitrate

The predicted source concentration prior to treatment for nitrate is 250 mg/L (Lorax, 2014b). Denitrification is the process where microbes oxidize organic carbon as an electron donor (alcohol is a preferred organic carbon substrate to support denitrification) and reduce nitrate and nitrite to nitrogen gas N_2 , which is the gas that comprises approximately 79% of the earth's atmosphere.



Microbes that perform denitrification are found nearly universally (ubiquitous) in soils and rocks. The Tetra Tech (2014) cyanide destruction column studies report on Eagle project materials showed that the addition of alcohol to the heap materials supported denitrification (initial concentration: 1.3 mg/L; final concentration 0.3 mg/L), and also importantly that ammonia was also removed (60.3 mg/L initial concentration; final concentration 0.79 mg/L).

Trace Metals and Metalloids (antimony, arsenic, lead, mercury, selenium)

The heap detoxification column study was operated to simulate unsaturated portions of the HLF, with the primary objective to degrade cyanide. The heap columns were not saturated and consequently the highly reducing conditions necessary to achieve sulfate reduction, which will be readily accomplished in the saturated heap column in the in-heap pond, were not achieved in the heap detox columns. However, metals that are of potential concern were reduced, including antimony (41% decrease), arsenic (83% reduced), selenium (68% reduced), and mercury (86% reduced). Lead concentrations did not decrease, but instead increased somewhat, consistent with the lack of sulfate reducing conditions.

With the utilization of the in-heap pond as a sulfate-reducing bioreactor, heavy metals concentrations are expected to be substantially reduced. For instance, the Yankee heap in Nevada was treated using a similar process, where organic carbon was recirculated onto the heap (Harrington, 2002). In leach extractions of heap materials using the meteoric water mobility procedure test, arsenic concentrations decreased from 1.85 mg/L to 0.32 mg/L, and mercury concentrations decreased from 0.5 mg/L to 0.00067 mg/L. Similarly, at the Couer Rochester Stage 1 heap (which similarly had an in-heap pond) selenium decreased from 0.107 mg/L to 0.01 mg/L, and mercury decreased from 0.0114 mg/L to 0.0007 mg/L (all results were composites of sonic drill cores removed from the heap before and after in-heap treatment, then leached using the MWMP procedure).

8.8.2.4 Drain-down

The heap drain-down and transition period (during which there will still be additional gold recovery) will be planned and managed to fully integrate with the site water management plan. The overall solution inventory will be decreased by processing water through the mine water treatment plant (MWTP) and/or the heap PTS for discharge. Depending on the flow rates achieved through the MWTP, the PTS, and the effectiveness of the cover system that is being built on the heap, the actively treated drain-down period will vary, but is expected to be a minimum of five years and as much as ten years of active treatment in the MWTP. During this time the following activities will occur:

The transition to heap drain-down will occur with the perforation of the sump and activation of the closure sump. The transition from cyanide destruction to draindown will include the following steps:

- Discharge of water from the closure sump to the MWTP at a controlled rate consistent with the capacity of the MWTP to treat and discharge the water (20 lps; Linkan 2014).
- Discharge of some water from the closure sump to a contingency passive treatment system/CWTS to be built in the Events Pond location.
- When either
 - The heap is sufficiently drained and is discharging below WUL discharge criteria, or
 - The passive treatment system is treating all of the remaining flow at the design capacity and achieving discharge criteria
 - Then the MWTP can be turned off and decommissioned.

During the draindown period, the solutions that are recirculated back up into the heap will have organic carbon sources amended into them. This draindown in situ treatment period will switch from a sugar-based solution to an alcohol-based solution, with the purpose of creating sulfate reducing conditions within the saturated zone of the heap, i.e., the in heap bioreactor described above. This will allow for the heap drainage to continue to improve ultimately to achieve water quality consistent with that observed in alcohol fed bioreactors. In these conditions, reduction in metal concentrations is also commonly observed as result of the reducing conditions established during microbial metabolic processes, because many metals are less soluble in a reduced state (chromium, copper, selenium, uranium, for instance). Other metals that preferentially sorb to iron or manganese oxides in a more neutral pH range created during the detoxification process will generally decrease, including trace metals such as arsenic and antimony. Metals that form insoluble sulfides will also become substantially treated. It is expected that at the end of the recirculation and draindown period that the heap solutions can

either be directly discharged in accordance with the site discharge criteria, or that the PTS will be able to polish it using primarily aerobic processes, as described below.

8.8.2.5 HLF Passive Water Treatment

As described above, the main constituent that will not be completely treated prior to discharge from the heap is arsenic, which is conservatively estimated to be reduced in the heap but still remain at 0.5 mg/L. As described above, several in situ heap treatment sites have had arsenic concentrations after treatment of 0.3 mg/L. Thus the passive treatment system is primarily being designed to remove arsenic, and because of its similar removal processes, antimony is also expected to be further reduced by passage through the CWTS.

Several passive treatment technologies have been evaluated for potential application for late closure and post-closure water treatment technologies for the Eagle Gold Project. Preliminary studies and planning suggested that Constructed Wetland Treatment Systems (CWTS) would best fulfill the site-specific objectives for passive treatment at the Eagle Gold site, based on the information available at the time; however, a hybrid Passive Treatment System (PTS) comprised of a biochemical reactor (BCR), permeable reactive barrier (PRB), or zero valent iron (ZVI), followed by a CWTS may be optimal. Thus, the PTS design has been further refined, and is described here.

Based on predicted water qualities and quantities, there are slight variations in the proposed PTSs for the HLF and waste rock storage area (WRSA) water sources. Using the predicted closure water quality, all CWTSs were sized according to plausible removal rate coefficients (RRC). The RRC is a way of expressing the rate of water treatment, based on treatability of the compound and hydraulic retention time. In Equation 1 (below), the first order RRC has been reconfigured to calculate from t (hydraulic retention time; HRT), allowing the use of C_i (initial concentration), C_f (final, desired concentration), and k (removal rate constant) to be used to size the wetlands accordingly. Although it is recognized that the treatment rate of a range of element concentrations varies in a CWTS, the predicted inflow and desired outflow concentrations for this system are in a range that allow a first order RRC to be loosely applied. During the reclamation research program for the PTS, this will be further refined and confirmed, so that the final CWTSs will be shown to be sufficiently sized.

The RRCs used to size the wetlands for this project were developed using two different scenarios. The first scenario for RRC calculation is based on a pilot-scale CWTS with similar arsenic concentrations as those predicted for the Eagle Gold Project. This water has undetectable iron concentrations, and a water temperature of approximately +20°C to 25°C. This RRC was then adjusted based on the principals of Arrhenius' equation, dividing the rate by half to adjust for each 10 degrees of temperature decrease. This is a conservative estimate, since the CWTS is designed such that aeration and sorption will be the initial form of treatment, and this type of CWTS is therefore less influenced by temperature than other types of CWTS (such as those designed for municipal water and sewage, which are treating for high biological oxygen demand). After sorption, the slower process of biomineralization can occur, but this only needs to occur at a rate such that all sorption sites are not used within a given year, as the organic matter from the vegetation that dies off and becomes litter in the CWTS will provide sorption sites for the subsequent year(s). A review of these processes is found in Lizama et al, (2011).

A second scenario for RRC calculation was also applied, based on another pilot-scale study performed by Contango for a PTS in the Northwest Territories that has similar arsenic concentrations as is predicted for the HLF and WRSA seepage. In this pilot scale system iron was present which enhances treatment by providing

another removal process that is iron-coprecipitation based, in addition to the sorption by detritus and biomineralization. Iron-coprecipitation is also a well-known phenomenon in wetlands (Lizama, 2011). In this pilot system, when operating with water temperatures between +0.5°C and +4°C, the removal rate was triple that of the system that did not have iron in it that was operating at +20°C, despite other water parameters being the same. The size of CWTS required under both scenarios is presented in Tables 8-7 and 8-8.

In an accreting CWTS, it is the removal rate that is key for determining size, while aspects such as total loading are secondary. The logic for this rationale is that loading can only be of concern after it is confirmed that it is thermodynamically possible to remove the compound from the water and load into the sediment. As both the RRC and loading generally follow a function that is exponentially decreasing (sometimes even logarithmically decreasing), it must be realized that building the system larger than appropriate can be detrimental to the system rather than beneficial due to thermodynamic minimums and concentration of compounds through evaporation. In other words, a larger CWTS of the same design as a smaller one will not necessarily produce better water quality.

Secondary to determining size based on RRC's, the sizing must be confirmed based on overall loading of compounds into the sediments of the CWTS, while accounting for accretion. All CWTSs have had loading rates to sediments calculated accounting for accretion, and in all cases the predicted average sediment concentrations of the CWTS are within the range of existing baseline concentrations previously measured on site (Appendix F– Soil metal data in Stantec 2011c).

Equation 1. Removal Rate Coefficient (RRC) calculation rearranged to solve for HRT

$$k = \frac{-\ln(C_f/C_i)}{t}$$

$$t = \frac{-\ln(C_f/C_i)}{k}$$

Although both iron and manganese can carry out precipitation reactions with arsenic, the predicted concentrations of both manganese and iron in the HLF and WRSA drainage are insufficient by themselves to solely treat the predicted concentrations of arsenic. It is anticipated that with iron addition, concentrations as low as 0.015 mg/L can be achieved, but long-term operational maintenance by the addition of iron will be minimized by the use of iron rich materials in wetland construction. When wetland treatment is based on biological processes only, concentrations closer to the EQS are predicted. Further evaluation of this process will be performed in the piloting phase to determine whether adding iron within the conveyance channels both upstream and between the cells of the CWTS will improve the treatment capacity, or if it may be mixed directly into the CWTS substrates. Sources of iron and manganese that will be included in the CWTS include the soils used for plant growth media, rock used in riprap within the seepage collection ponds and seepage conveyance channels, and during the initial phase of CWTS, iron could also be added in liquid form to enhance the initial removal rates while plant growth is occurring. All CWTSs have been sized to meet EQSs without the assumption of added iron, but predicted outflow concentrations have been provided for both scenarios with and without added iron.

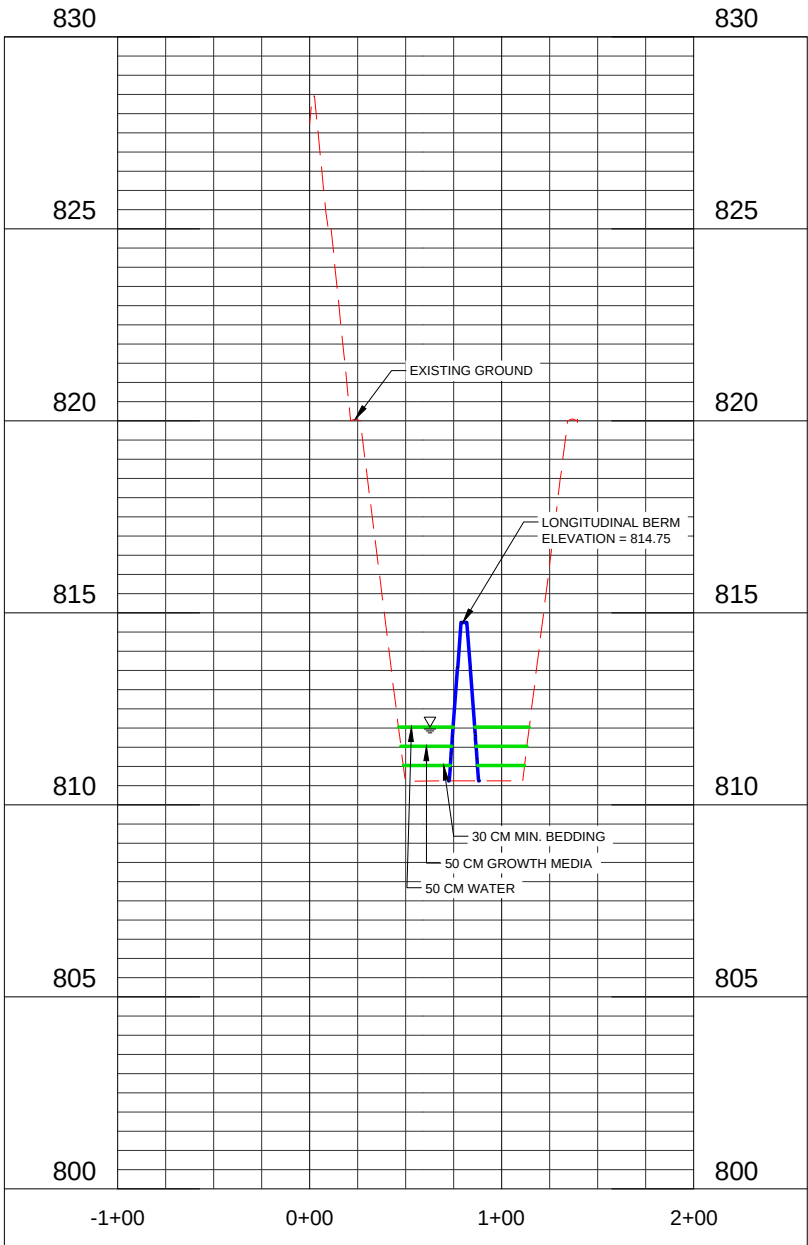
Section 8: Final Reclamation and Closure Measures

The proposed passive water treatment systems were designed to meet discharge criteria during events of average flow and 75th percentile concentrations predicted for post-closure conditions (Lorax 2014b). Based on water quality and site-specific considerations, the HLF PTS has been conceptualized as a four-step treatment train conceptually shown in Figures 8-6 and 8-7.

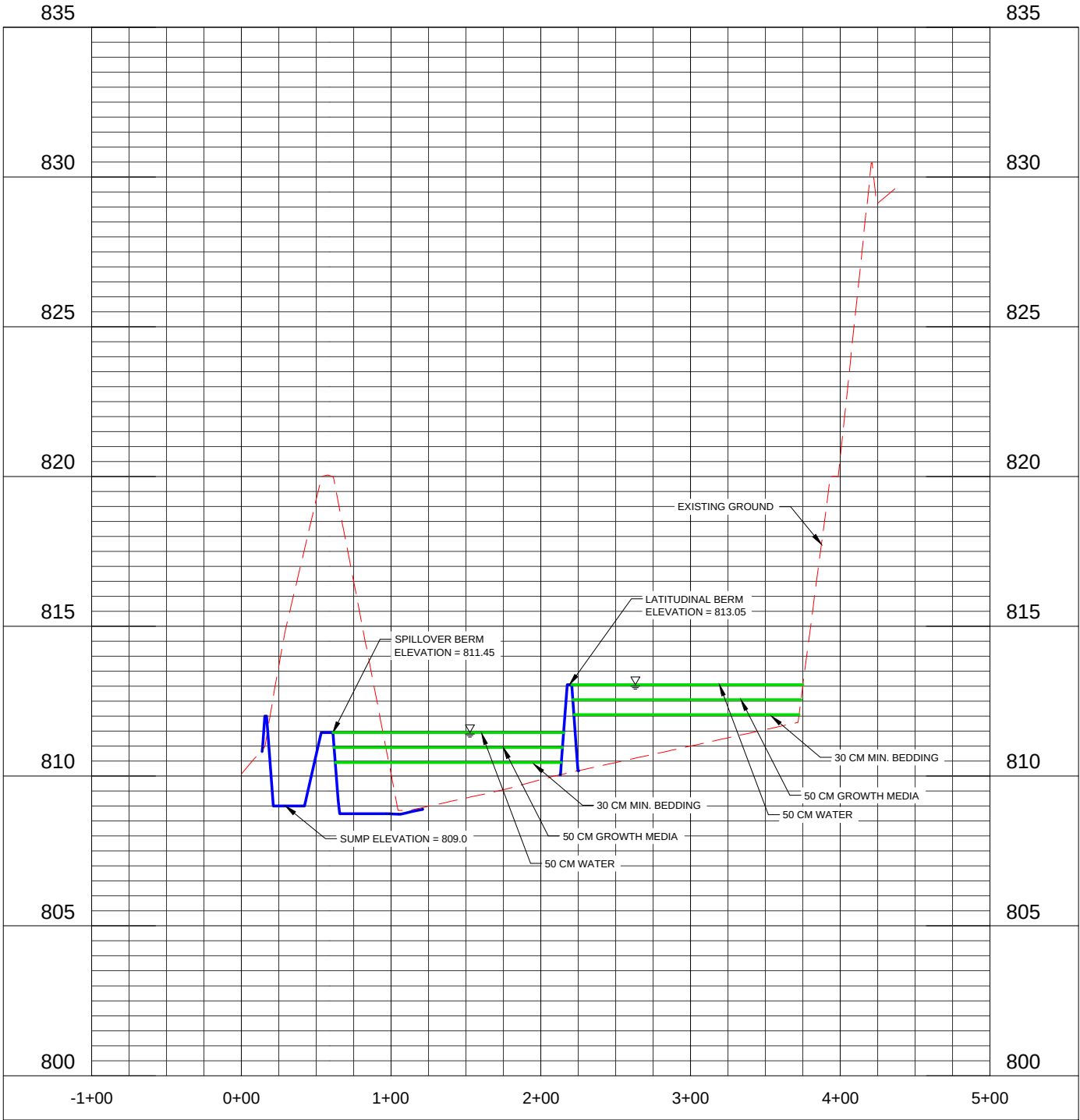
1. The HLF liner to the sump will be perforated through the access piping built into the heap and sump during construction, allowing seepage to flow via gravity at a controlled rate from the sump to the PTS. A valving system within the head works of the piping can then be used to control the drainage rate to the PTS, or alternatively recycle some portion of the heap drainage by pump back onto the heap surface and eventually via percolation to the HLF In-Heap Pond, which will be dosed with an organic material (such as ethanol). This recirculation of heap drainage into the base of In-Heap Pond zone will support the operation of the anaerobic bioreactor within the saturated portion of the heap. For the HLF, the bioreactor in the In-Heap Pond will be responsible for carrying out the majority of water treatment, especially during the draindown period and before the cover system is fully operational.
2. The seepage will leave the anaerobic bioreactor in the In-Heap Pond and discharge through a rip-rap lined cascade to re-aerate and precipitate elements as oxides. A preference will be given to rip-rap rock that contains iron or manganese oxides to help facilitate the formation of Fe and Mn surface coatings on the rip-rap that will enhance removal of As, Sb and Se.
3. The seepage will enter the area of the Events Pond, which will now be repurposed into a series of CWTS cells. The CWTS will bring water that has been largely treated by the bioreactor down to concentrations acceptable for discharge. The CWTS is designed to mineralize and sequester elements into the sediments in a benign manner through sorption, coupled biogeochemical reactions and accretion.
4. The treated water will exit the CWTS into a retention basin that will provide a mixing point for the water exiting all parallel replicate systems in the CWTS, and serve as a monitoring point for water prior to discharge into the LDNP and ultimately Haggart Creek.

The first two stages of the PTS are closure aspects that have been designed into the operational phases of the facility (sump and Events Pond). For the purposes of this RCP, the CWTS has been sized in two ways, the first way is based on an assumption of complete treatment in the CWTS with the operation of bioreactor not continued, while the second way assumes that the predicted sizing accounts for the expected performance of the bioreactor. The reduction of constituents in bioreactors is based on prior experience at other heap leach facilities (Harrington, 2002), but also synthetic water tests have been performed at Yukon College, where alcohol-fed sulfate-reducing columns decreased arsenic concentrations to less than 0.1 mg/L and selenium concentrations were decreased from 0.3 mg/L to less than 0.01 mg/L.

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Figure 8-7 EVENT POND SECTIONS	

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Conceptual design criteria for HLF CWTS component of PTS include:

- Cells will be between a 1:3 to 1:4 width to length ratio
- There will be a minimum of two replicated systems in parallel; each system will have one entry and one exit point
- Each system will have multiple cells in a series to achieve the needed HRT
- In between all cells, there will be an access berm of sufficient width for personnel to walk to conduct monitoring and sampling, and as needed, a berm of sufficient size for a light vehicle to travel to support maintenance activities as necessary
- Each aerobic cell will be able to accommodate 45cm of soil, a 30cm water depth, and an additional 30cm freeboard. Each anaerobic cell will be built in the same way, but capable of accommodating 100cm water depth.
- There will be a retention/equalization basin prior to flow into the PTS and a collection basin at the outflow.
- Flow channels from retention basin into CWTS cells, between cells within a series, and from the CWTS into the outflow basin will span the entire cell width and will be lined with riprap
- The embankments of the wetlands will be a 2:1 - 3:1 slope.
- Bottoms of wetland cells are level, but there must be a height difference between the first and second cells to provide aeration of the water.
- Cells will be constructed with approximately 45 cm of soil, composed of a sand/gravel mixture for aerobic cells and possibly amended with iron bearing material. If anaerobic cells are deemed appropriate, finer soils may be needed, and amended with organic materials from site (such as wood chips).
- Cells should be lined with locally derived fine-grained materials to minimize leakage to or from surrounding sediments
- The CWTS will be planted with local plants, for which a nursery may be needed to propagate sufficient quantities.

Table 8-7: Sizing of HLF CWTS to Meet Year-Round PTS Outflow Goal of 160 µg/L Arsenic (Lorax 2014a)

	Size based on LDSP area
CWTS Hectares	2.4
Average Sediment Concentration (mg/kg) ¹	512

¹Calculated for once water chemistry is stabilized in 2028.

NC - no calculation, distributed through CWTS and conveyance channel.

Table 8-8: Predicted HLF CWTS Performance for Arsenic Treatment Compared to Effluent Quality Criteria (mg/L)

Size	Maximum Predicted Source Term in Heap	Bioreactor outflow/CWTS inflow	Maximum CWTS outflow			HLF EQS for Arsenic
			No Added Iron	With Iron	Added	
2.4 ha	8.6	0.5	0.16	0.015-0.16		0.16

Table 8-9: HLF PTS Effluent Quality Standards

Parameter	HLF PTS Effluent Quality Standards
pH	6.5 to 8
TSS	15
SO ₄	2500
Nitrate-N	85
Nitrite-N	1.7
NH ₃ -N	34
CN _{WAD}	0.09
Al (diss)	4.2
Sb	0.3
As	0.16
Cd	0.006
Cu	0.16
Co	0.11
Fe	27
Pb	0.16
Hg	0.00029
Mn	37
Mo	2.2
Ni	0.5
Se	0.14
Ag	0.02
U	0.39
Zn	0.5

8.8.2.6 Earthworks / Recontouring

Heap Leach material will be placed at the final grade during active use so no final regrading will be required during closure.

8.8.2.7 Final Reclamation Measures for HLF

Engineered Cover

The HLF is a component of the Project that requires a cover design based on using locally available materials that limits infiltration to the greatest extent possible. In addition to limiting infiltration, another objective of the cover is to provide a stable growth medium to allow for revegetation. The benefit of a reduced infiltration cover is a reduction in seepage volumes which will minimize the total loadings from in-heap leaching processes, and thus limit the required treatment in the heap PTS.

The proposed cover to be used during closure is a store and release cover, which reduces infiltration into the underlying material by storing precipitation (similar to a sponge) in the rooting zone of the cover material and then releasing some of the water back to the atmosphere through evapo-transpiration from vegetation. The cover comprises a thick layer of material placed in a loose state and revegetated with selected local species that have high moisture uptake characteristics. A similar store and release cover system was constructed at a similar open pit-heap leach gold mine project (Brewery Creek, YT) that was closed and reclaimed.

Two stages of modelling were conducted to aid in further evaluation of cover system designs for closure of the proposed HLF at the Project site. The first series of models used The Hydrologic Evaluation of Landfill Performance (HELP) 3.90 D Model (2011) to inform the model design and estimate infiltration through the cover (Knight Piesold, 2013). The preliminary results from this modelling were considered during the cover system design work supporting the current design.

The currently proposed closure cover system design, referred to as the 'Base Case', is a 0.2 m thick layer of topsoil underlain by a 0.3 m thick layer of placer tailings / colluvium. The most recent work further assessed the anticipated hydrological performance of the base-case cover system design and provides recommendations to improve predicated long-term performance from a net percolation reduction perspective. This was accomplished by completing the following work, as detailed in OKC (2014):

- Reviewed pertinent background information and compiled key inputs for soil-plant-atmosphere (SPA) numerical modelling;
- Developed conceptual model of hydrological performance of the base case cover system design;
- Conducted Base Case and sensitivity analysis numerical simulations of cover system performance using the SPA model VADOSE/W; and
- Developed recommendations for future studies to reduce uncertainties in the current cover system design and identified potential opportunities for improvements in cover system performance using locally available materials.

The objectives of the SPA numerical modelling of the Base Case were to improve the confidence in the mean and range of net percolation rates for the Base Case cover system for input to environmental loading and water treatment assessments, and to assess the:

- Influence of potential textural heterogeneity of locally available cover construction materials on cover system performance;
- Influence of the saturated permeability of underlying waste materials on cover system performance;

Section 8: Final Reclamation and Closure Measures

- Influence of various vegetation conditions on cover system performance;
- Influence of slope angle on cover system performance (i.e. difference in water balance fluxes for the bench plateaus compared to the bench faces);
- Influence of slope aspect on cover system performance; and to
- Examine the available water holding capacity (AWHC) for various cover configurations to avoid creating a 'false' drought condition for the anticipated climax vegetation cover.

In total, 43 long-term simulations were completed to determine the sensitivity of the Base Case due to variations in materials, climate, and/or vegetation. The simulations were also completed to determine what, if any, improvements could be made to the Base Case cover system design. All the scenarios were initially completed without vegetation present so that changes in performance could be directly correlated to changes in materials or climate. Vegetation was then included to further evaluate select scenarios. Finally, the Base Case results presented in the previous section showed little difference in performance between the WRSAs and HLF simulations. The results of these simulations can be summarized as follow:

- 1.) Slope aspect and gradient have the largest effect on NP rates estimated for both WRSAs and HLF. The added solar radiation on south facing slopes results in a higher AET rate, further drying out the cover in the summer months. In contrast, the north-facing aspect has substantially less solar radiation available to evaporate or transpire water stored in the cover profile. This increases the observed NP rate. A 2:1 slope gradient will result in a larger volume of runoff during the spring melt and high intensity rainfall events.
- 2.) Virtually no difference exists in predicted NP rates resulting from the use of different materials on-site. Cover system scenarios that used only colluvium or tailings (rather than the 2:1 mix) produced nearly identical NP rates as the 2:1 colluvium-tailings mixture. Layered cover systems of the two materials also produced similar NP rates. Based on these results, there is no advantage, from a NP perspective, to mixing the tailings and colluvium into a single cover system material based on the estimated hydraulic properties of the two material types.
- 3.) Thickening the cover system provides no reduction in the NP rate, and actually results in an increase in NP. NP rates do not decrease because the energy available for evaporation is low, which creates relatively low hydraulic gradients for removing water from the cover system. Hence, evaporation alone can only remove water stored nearer the surface. The model estimates a slight increase in NP with increased cover thickness because the underlying waste rock is a textural discontinuity, which creates a capillary barrier inhibiting NP and keeping water closer to the surface. When the depth of the capillary barrier is increased by increasing the thickness of the cover system, the percolating water is able to get to depth more easily, which increases NP.
- 4.) The presence of vegetation is vital to hydrological performance of the cover system. The NP rate is reduced by 10% or more for both the WRSAs and HLF when a forest canopy is present. A large part of the improvement from the forested cover system scenario comes from the improvement of AET via canopy interception. The forest canopy intercepts precipitation on the foliage, which reduces the

amount of water that infiltrates into the cover system. This intercepted water is then evaporated or sublimated from a location more exposed to solar radiation and wind compared to surface.

- 5.) The model estimates that the current cover system design adequately meets the water storage requirements for vegetation. Over an 80-year simulation period there were only seven periods when the cover system water volumes dropped near or below the acceptable limit. These are periods when vegetation would be at risk; but it must be noted that the model inputs were set to permit forest vegetation to be capable of removing water up to a suction of 2,500 kPa (based on research of tree species), and that VADOSE/W does not account for all plant survival mechanisms (e.g. dormancy).
- 6.) In general, material properties that lowered the k_{sat} of various materials resulted in slightly lower NP rates, while increasing the k_{sat} slightly increased NP rates. By increasing or decreasing the k_{sat} of the topsoil by one order of magnitude, the average NP rate varied from 35% to 29% of annual precipitation, respectively. It is essential that thorough testing be completed to verify the hydraulic properties of local topsoil material because its k_{sat} is showing to have the largest influence on predicted NP rates. Decreasing the waste material k_{sat} also had an effect on the observed NP rate; however, increasing the k_{sat} of the waste material had little effect on the NP rate. The effect of varying the k_{sat} of the tailings-colluvium material was also analyzed; however, no difference in the water balance was observed when the material's k_{sat} was varied by one order of magnitude.

Based on the modelling of the Base Case a profile schematic of the cover that would be placed over the HLF is shown below as Figure 8-8. This conceptual design schematic shows the profile of the cover for the flat areas on the plateaus and benches, as well as the profile for the inter-bench slopes.

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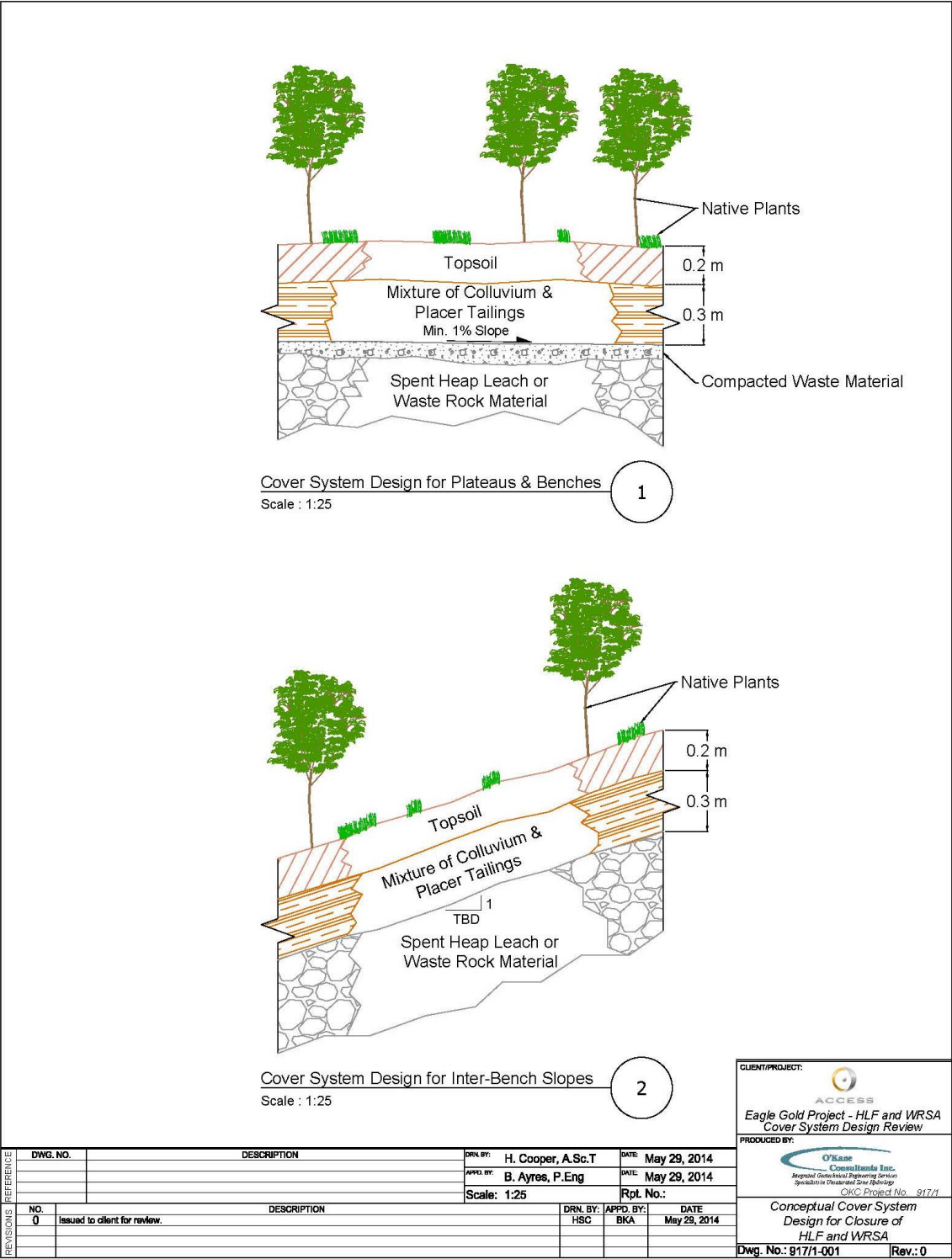


Figure 8-8: Conceptual HLF and WRSA Cover Design Drawings

HLF Revegetation

The revegetation program will include sowing of native grasses and forb seeds that are adapted to the specific elevation and aspect of the HLF. Results from reclamation research trials currently underway will guide and inform the plant selection process to ensure long-term physical stability and natural development of native plant species, assemblages and communities at the site.

8.9 EAGLE PUP WASTE ROCK STORAGE AREA

8.9.1 Closure Objectives and Criteria

Closure objectives for the Eagle Pup WRSA are to ensure long-term physical stability to minimize erosion, subsidence or slope failure; ensure long-term chemical stability such that runoff and seepage quality meets water quality criteria and that area is able to withstand severe climactic and seismic events.

Water quality criteria from Lorax (2014a) are provided in Table 8-10.

Table 8-10: Eagle Pup WRSA PTS Effluent Quality Standards

Parameter	WRSA PTS Effluent Quality Standards
pH	6.5 to 8
TSS	15
SO ₄	2000
Nitrate-N	30
Nitrite-N	0.5
NH ₃ -N	13
CN _{WAD}	not applicable
Al (diss)	0.61
Sb	0.2
As	0.15
Cd	0.001
Cu	0.012
Co	0.046
Fe	8.6
Pb	0.05
Hg	0.00014
Mn	9.4
Mo	0.84
Ni	0.29
Se	0.06
Ag	0.02

Parameter	WRSA PTS Effluent Quality Standards
U	0.15
Zn	0.05

Based on a review of the source term predictions for Eagle Pup, during long-term closure only arsenic (0.58 mg/L) is significantly above the EQS criterion of 0.15 mg/L, while mercury (0.00017 mg/L), antimony (0.38 mg/L), and uranium (0.196mg/L) are slightly above of the EQS criteria of 0.00014 mg/L, 0.20 mg/L and 0.15 mg/L, respectively, and so will require treatment in the PTS for Eagle Pup WRSA.

8.9.2 Closure Measures

Initiatives taken during the operations phase will include the construction of engineered graded slopes that have stable configurations to meet closure criteria.

Closure measures undertaken to achieve the above objectives will include installation of engineered waste covers to reduce infiltration, encourage vegetation growth and minimize erosion. Engineered covers will be combined with passive treatment systems to yield water quality that is acceptable for discharge.

8.9.2.1 Passive Water Treatment

The passive water treatment system for the EP WRSA was designed to meet discharge criteria during events of average flow and 75th percentile predicted for post-closure conditions. The CWTS design, sizing, and predicted outflow concentrations were developed as described for the HLF PTS, in section 8.8. Based on water quality and site-specific considerations, the EP WRSA PTS has been conceptualized as a six-step treatment train.

1. Part of the existing seepage collection system at the EP WRSA will be redone to function as a sedimentation and equalization basin, smoothing out peaks in water chemistry, located higher up the hill right at the toe of the WRSA to allow for gravity drainage to the EP PTS.
2. The new sedimentation/equalization basin also have a section that will contain organics to provide some pre-treatment as a subsurface flow bioreactor.
3. A rip-rap lined channel will then be used to convey water from the new seepage collection pond to the constructed wetland treatment system (CWTS). This channel will provide aeration to precipitate elements as oxides. A preference will be given to riprap rock that contains iron or manganese oxides to help facilitate the formation of Fe and Mn surface coatings on the rip rap that will enhance removal of As, Sb and Se.
4. Water will enter an equalization basin prior to the CWTS. This will again serve for flow equalization, dampen flow velocity from the channel, and provide water retention if maintenance is needed on the CWTS.
5. The CWTS will be replicate cells designed in parallel to mineralize and sequester elements into the sediments in a benign manner through coupled biogeochemical reactions and accretion.

6. Water will exit the CWTS into a retention basin that will provide a mixing point for the water exiting all parallel replicate systems in the CWTS, and serve as a monitoring point for water prior to entering receiving water bodies.

The first two stages of the PTS are based on repurposing of elements already necessary to the site during operations (LDSP). For the purposes of this RCP, the CWTS has been sized as though it is a stand-alone PTS, and the bioreactor and aerating conveyance channel are added treatment beyond what has been calculated for the CWTS.

Table 8-11: Sizing of EP CWTS to Meet Year-Round PTS Outflow Goal of 0.15 mg/L Arsenic (Lorax 2014a)

	Without Added Iron
Hectares	2.21
Average Sediment Concentration (mg/kg)	870

NC - no calculation, distributed through CWTS and conveyance channel.

Table 8-12: Predicted EP CWTS Performance for Arsenic Treatment Compared to Effluent Quality Criteria (mg/L)

Size	Maximum Predicted Arsenic Source Term	Maximum CWTS Outflow		EP EQS for Arsenic
		Without Added Iron	With Added Iron	
2.21 ha	0.58	0.15	0.015-0.15	0.15

8.9.2.2 Earthworks

The Eagle Pup WRSA will be constructed so that the final landform will be at the design criteria for slopes. However, at closure, some fraction of the WRSA will be re-graded (for purposes of cost estimation, 10%) to tie the sides of the dump into the surface water management features/ditches. The flat areas will be compacted to enhance the performance of the cover, primarily by the wheel pressure of the dump trucks. However, again some fraction of the WRSA will be compacted in the areas where grading is being performed or areas that were not compacted by wheel traffic. This preparation will allow for the cover to be placed efficiently across the entire dump, by placing cover material on higher benches and pushing the material down toward the lower bench.

8.9.2.3 Cover Construction

A store-and-release cover made up of 0.5 m thick cover constructed with locally available top soil and tailings/colluvium will cover the Eagle Pup WRSA. The modelling and design work conducted for this facility is the same as the Base Case described in Section 8.8 Heap Leach Facility Closure Measures: Cover Construction. Modelling and sensitivity analyses conducted (O'Kane 2014) found very little difference in the performance of the Base Case cover design whether it was covering heap or waste rock materials.

8.9.2.4 Revegetation

The revegetation program will include sowing of native grasses and forb seeds that are adapted to the specific elevation and aspect of the store-and release cover. Results from reclamation research trials currently underway will guide and inform the plant selection process to ensure long-term physical stability and natural development of native plant species, assemblages and communities at the site.

8.10 PLATINUM GULCH WASTE ROCK STORAGE AREA

8.10.1 Closure Objectives and Criteria

Closure objectives for the Platinum Gulch WRSA are to ensure long-term physical stability to minimize erosion, subsidence or slope failure; ensure long-term chemical stability such that runoff and seepage quality meets water quality criteria and that area is able to withstand severe climactic and seismic events.

Water quality criteria for Platinum Gulch WRSA from Lorax (2014a) are provided below:

Table 8-13: Platinum Gulch WRSA PTS Effluent Quality Standards

Parameter	WRSA PTS Effluent Quality Standards
pH	6.5 to 8
TSS	15
SO ₄	2000
Nitrate-N	30
Nitrite-N	0.5
NH ₃ -N	13
CN _{WAD}	not applicable
Al (diss)	0.61
Sb	0.2
As	0.15
Cd	0.001
Cu	0.012
Co	0.046
Fe	8.6
Pb	0.05
Hg	0.00014
Mn	9.4
Mo	0.84
Ni	0.29
Se	0.06
Ag	0.02

Parameter	WRSA PTS Effluent Quality Standards
U	0.15
Zn	0.05

Based on a review of the source term predictions for the Platinum Gulch WRSA, only arsenic (0.58mg/L) will require treatment in the PTS for Platinum Gulch WRSA.

8.10.2 Closure Measures

8.10.2.1 Passive Water Treatment

The PTS for the PG WRSA was designed to meet discharge criteria during events of average flow and 75th percentile predicted for post-closure conditions. The CWTS design, sizing, and predicted outflow concentrations were developed as described for the HLF PTS, in section 8.8. Based on water quality and site-specific considerations, the PTS for the PG WRSA has been conceptualized as a four-step treatment train.

1. Part of the existing seepage collection pond at the PG WRSA will be repurposed to function as a sedimentation and equalization basin, smoothing out peaks in water chemistry.
2. Flow from the seepage collection pond will then flow through a brief rip-rap lined channel to convey water from the repurposed SCP to the CWTS. This channel will provide aeration to precipitate elements as oxides. A preference will be given to riprap rock that contain iron or manganese oxides to help facilitate the formation of Fe and Mn surface coatings on the rip rap that will enhance removal of As.
3. The CWTS will be designed to mineralize and sequester elements into the sediments in a benign manner through coupled biogeochemical reactions and accretion.
4. Water will exit the CWTS into a retention basin that will provide a mixing point for the water exiting all parallel replicate systems in the CWTS, and serve as a monitoring point for water prior to entering receiving water bodies.

The first two stages of the PTS are based on repurposing of elements already necessary to the site during operations (PG Pond). For the purposes of this RCP, the CWTS has been sized as though it is a stand-alone PTS, and the bioreactor and aerating conveyance channel are added treatment (redundancy) beyond what has been calculated for the CWTS.

During operations, the PG WRSA seepage will go to the PTS, then be routed to the LDSP as make up water. This PTS that will be functional during operations for treatment of the PG seepage will be part of the reclamation research plan, serving as the on-site demonstration. During the initial closure phases, this discharge may be routed to the pit, or may be discharged to Haggart Creek after treatment in the PG PTS. In long-term closure, the treatment required at the PG WRSA is dependent on water quality, and may involve routing to the pit, or treatment in the PTS. Currently both options are in consideration, and serve as a contingency to one another.

Table 8-14: Sizing of PG CWTS to Meet Year-Round PTS Outflow Goal of 0.150 mg/L Arsenic (Lorax 2014a)

	Without Added Iron
Hectares	0.66
Average Sediment Concentration (mg/kg)	855

NC - no calculation, distributed through CWTS and conveyance channel.

Table 8-15: Predicted PG CWTS Performance for Arsenic Treatment Compared to Effluent Quality Criteria (mg /L)

Size	Maximum Predicted Arsenic Source Term	Maximum CWTS Outflow		PG EQS for Arsenic
		Without Added Iron	With Added Iron	
0.66 ha	0.58	0.15	0.015-0.15	0.15

8.10.2.2 Earthworks

The Platinum Gulch WRSA will be constructed so that the final landform will be at the design criteria for slopes. However, at closure, some fraction of the WRSA will be regraded (for purposes of cost estimation, 10%) to tie the sides of the dump into the surface water management features/ditches. The flat areas will be compacted to enhance the performance of the cover, primarily by the wheel pressure of the dump trucks. However, again some fraction of the WRSA will be compacted in the areas where grading is being performed or areas that were not compacted by wheel traffic. This preparation will allow for the cover to be placed efficiently across the entire dump, by placing cover material on higher benches and pushing the material down toward the lower bench.

8.10.2.3 Cover Construction

A store-and-release cover made up of 0.5 m thick cover constructed with locally available top soil and placer tailings/colluvium will cover the Platinum Gulch WRSA. The modelling and design work conducted for this facility is the same as the Base Case described in Section 8.8 Heap Leach Facility Closure Measures: Cover Construction. Modelling and sensitivity analyses conducted (O'Kane 2014; Appendix D) found very little difference in the performance of the Base Case cover design whether it was covering heap or waste rock materials.

8.10.2.4 Revegetation

The revegetation program will include sowing of native grasses and forb seeds that are adapted to the specific elevation and aspect of the store-and release cover. Results from reclamation research trials currently underway will guide and inform the plant selection process to ensure long-term physical stability and natural development of native plant species, assemblages and communities at the site.

8.11 TEMPORARY ORE STOCKPILES AND PADS

8.11.1 Closure Objectives and Criteria

Closure objectives for ore stockpiles will ensure long-term physical stability to minimize erosion or slope failure. After all the required material is used from the reclamation stockpiles and the ore stockpile, these areas will be re-graded and re-vegetated for long term physical stability, and to ensure long-term chemical stability such that runoff and seepage quality meets water quality criteria.

8.11.2 Closure Measures

8.11.2.1 Earthworks

The ore stockpile will be scraped to collect, as much as practical, any residual ore materials, which can be added to the HLF (which will still be in gold recovery mode), and the area contoured to allow drainage to occur, according to the design criteria. Approximately 0.2 m of growth medium will be placed to allow revegetation to occur.

8.11.2.2 Revegetation

The revegetation program will include sowing of native grasses and forb seeds that are adapted to the specific elevation and aspect of the store-and release cover. Results from reclamation research trials currently underway will guide and inform the plant selection process to ensure long-term physical stability and natural development of native plant species, assemblages and communities at the site.

8.12 INDUSTRIAL INFRASTRUCTURE

8.12.1 Closure Objectives and Criteria

The objectives for decommissioning and demolition of the mine infrastructure are to ensure physical stability and to remove any potential hazards and threats to the public safety and health. This includes:

- Decommissioning of facilities in a safe manner
- Ensuring physical stability of any remaining structures

8.12.2 Closure Measures

8.12.2.1 ADR Process Facility

The process facilities will be set on concrete pads and foundation bases to support the ADR plant, recovery plant, admin facility and assay lab. Internal equipment will be supported on steel frames along with elevated concrete piers.

The decommissioning and demolition of the ADR facility will include:

- Removal and proper disposal of hazardous reagents, chemicals and materials
- Decommissioning of mechanical equipment

- Removal of mechanical equipment
- Removal of electrical equipment, motors and controls
- Demolition of steel structures
- Demolition of concrete slabs

The process facility will be cleared, bulk earthworks will be completed and the foundations will be broken up and buried in situ. Any foundations with rebar will be left in place.

Table 8-16: ADR Facility Infrastructure Demolition Summary

Infrastructure			Material Handling		
Buildings / Areas	Building Type	Size	Equipment	Structural Components	Hazardous Materials
ADR plant / Administration Facility	Pre-engineered steel building	42.3m x 17.9m	Carbon columns Screens Tanks Pumps Misc. equipment	Concrete foundation Concrete grade wall Structural steel columns Elevated concrete floors	Insulation Reagents Chemicals
Recovery plant	Pre-engineered steel building	102m x 35m	Refinery Carbon regen kiln Electrowinning cells Misc. equipment	Concrete foundation Concrete grade wall Structural steel frame, steel grits and purlins Insulated metal wall panels Metal standing seam room system	Insulation Reagents Chemicals
Assay lab	Pre-fabricated modular structure	38m x 18m	Lab equipment Chemical disposal equipment HVAC	Wood framing Insulated metal clad walls Ethylene propylene monomer roofing on plywood	Insulation Reagents Chemicals

8.12.2.2 Mine Water Treatment Plant

The mine water treatment plant consists of standard process equipment (tanks, filters, pumps) housed inside a pre-engineered building on a concrete foundation. Once heap drain down is complete and water quality criteria are achieved, the water treatment plant will be decommissioned and removed. It is anticipated that significant value will be retained in the WTP process equipment. For closure costing purposes, decommissioning and demolition of the water treatment plant includes:

- Removal and proper disposal of hazardous reagents, chemicals and materials
- Decommissioning of mechanical equipment
- Removal and salvage of mechanical equipment
- Removal of electrical equipment, motors and controls
- Demolition of steel structures

- Removal/demolition of concrete support and foundation

Table 8-17: Water Treatment Plant Demolition Summary

Infrastructure			Material Handling		
Buildings / Areas	Building Type	Size	Equipment	Structural Components	Hazardous Materials
Water Treatment Plant	Pre-engineered steel building	44.2m x 24.4m	Tanks Pumps Filters Misc. equipment	Concrete foundation Concrete grade wall Structural steel columns	Insulation Reagents Chemicals

8.12.2.3 Crushing and Conveyance Facilities

The crushing and conveyance facilities will consist of two crushing building and a series of conveyance systems connecting the two buildings. The crushing facilities will be set on concrete foundations along with the internal supporting steel structures.

The decommissioning and demolition of the crushing buildings will include:

- Disconnection of power supply
- De-dusting of the area via certified and safe methods
- Decommissioning and disassembling of all conveyor components
- Removal / demolishing any structural supports
- Removal / demolishing any concrete supports

The decommissioning and demolition of the conveyance systems will include:

- Disconnection of power supply
- Decommissioning and disassembling of all conveyor components
- Removal / demolishing any structural supports
- Removal / demolishing any concrete supports

Table 8-18: Crushing and Conveyance Infrastructure Demolition Summary

Infrastructure			Material Handling		
Buildings / Areas	Building Type	Size	Equipment	Structural Components	Hazardous Materials
Primary crushing building	Concrete construction	38 m x 19m	Primary crusher Primary apron feeder Secondary feed conveyor	Concrete walls, foundations Steel platforms Rebar	Dust

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Infrastructure			Material Handling		
Buildings / Areas	Building Type	Size	Equipment	Structural Components	Hazardous Materials
Secondary crushing building	Pre-engineered steel building	30 m x 21 m	Secondary crusher Feed conveyors Transfer conveyors Dust collectors Plate work 25t overhead crane	Concrete foundation Concrete grade wall Elevated concrete piers Structural steel frame, steel grits and purlins Insulated metal wall panels Metal standing seam room system	Dust
Conveying / (No building)	n/a	n/a	Overland conveyors Grasshopper conveyors Radial stackers	n/a	Dust

8.12.2.4 Power Generation and Transmission Infrastructure

A 45 km long power supply line at 69 kV will be supplied from the Yukon Energy Corporation power grid, via a tap point approximately 25 km southeast of the property. The power line will be supported on wooden poles constructed parallel to the road access and running to the mine site substation and all the facilities. Power will be distributed via two step down substations and to all the process control, instrumentation and communication systems. Closure costs are not included for dismantling and removal of the transmission infrastructure as these assets will be owned by Yukon Energy Corporation.

The decommissioning and demolition of the power distribution infrastructure will include:

- De-energizing the main power line and ensuring all power lines are grounded
- Securing any crossings of transmission lines and road
- Disconnection of conductors from insulators, and winding the conductors on reels to be transported off site
- Disassembling of supporting structures from their foundations
- Dismantling of all cross arms, fittings, insulators, pole hardware and guys to be transported offsite
- Removal of grounding rods, grounding wires, and guy anchors
- Backfilling of foundation anchor holes
- Removal and disposal of materials off site
- Demolition of substations foundations, concrete buried in situ. Any concrete with rebar will be left in place.

Table 8-19: Power Generation and Transmission Infrastructure Demolition Summary

Infrastructure			Material Handling		
Buildings / Areas	Building Type	Size	Equipment	Structural Components	Hazardous Materials
Power line	n/a	45 km	45 km of 69 kV power line Anchors Power line hardware	Wooden poles	
69 kV substation	n/a	n/a	Vendor supplied unit Electrical rooms Conductors Insulators Transformers	Concrete foundation Concrete Containment area	
25 kV substation	n/a	n/a	Vendor supplied unit Electrical rooms Conductors Insulators Transformers	Concrete foundation Concrete Containment area	
Overhead power lines	n/a	n/a	25 kV power lines Anchors Power line hardware	Wooden poles	

8.12.2.5 Explosives and Magazines

At closure, unused explosives that remain on site will be returned for credit and the explosives magazines and other equipment will be returned to the explosives supplier. The magazine is a vendor supplied skid trailer that will be transported offsite during closure.

8.12.2.6 Truck Shop

Maintenance on heavy duty equipment including haul trucks, loaders and dozers will be completed within an insulated truck shop complete with an overhead crane and support equipment. Once active mining is complete and the majority of the large mining fleet is no longer required, the truck shop will be dismantled.

The decommissioning and demolition of the truck shop will include:

- Removal and proper disposal of hazardous reagents, lubes/oils, chemicals and materials
- Decommissioning of mechanical equipment
- Removal of mechanical equipment, overhead crane
- Removal of electrical equipment, motors and controls
- Demolition of steel structures
- Demolition of concrete slabs

Table 8-20: Truck Shop Infrastructure Demolition Summary

Infrastructure			Material Handling		
Buildings / Areas	Building Type	Size	Equipment	Structural Components	Hazardous Materials
Truck shop and mine dry	Pre-engineered steel building	126 m x 21 m	Wash bay with pressure washer Repair bays Electrical equipment Mechanical equipment Compressor 20t overhead crane	Concrete foundation Concrete grade wall Elevated concrete piers Structural steel frame, steel grits and purlins Insulated metal wall panels Metal standing seam room system	Insulation Solvents

8.12.2.7 Fuel Storage Tank Area

Diesel will be delivered via trucks to two large storage tanks located near the truck shop, and then pumped to local tanks close to the ADR plant and the primary crushing plant. Propane will be stored local to the camp facilities.

Table 8-21: Fuel Storage Tank Area Infrastructure Demolition Summary

Infrastructure			Material Handling		
Buildings / Areas	Building Type	Size	Equipment	Structural Components	Hazardous Materials
Diesel storage	n/a	2 x 750,000 Tanks 2 x 100,000 L Tank	Tanks Pumps	Concrete foundations Concrete containment areas	Diesel sludge
Propane	n/a	3 x 5000 gal Tanks	Tanks Pumps	Concrete foundations Concrete containment areas	Propane

8.12.2.8 Equipment

There will be limited fixed or mobile equipment on site at the end of mine life when reclamation measures are complete. Any equipment present at closure not being used by on-going exploration activities will be removed from the site and either sold or salvaged. Equipment that cannot be sold or salvaged will be hauled off site to a licensed landfill.

8.12.2.9 Industrial Reagents and Hazardous Products

Any remaining industrial reagents or hazardous products will either be returned to the supplier or disposed of by a licensed third party contractor.

8.12.2.10 Water Supply and Wastewater Structures

Water management systems will be implemented to include a series of diversion ditches for both contact and non-contact water with series of ponds and pumps. The associated infrastructure include mine water treatment plants, cyanide destruction facilities and potable and sewage treatment structures. The potable and sewage treatment structures are part of the camp and will be removed with the camp facilities.

The fresh water and firewater systems will be removed at closure if exploration activities are no longer anticipated. This would include the dismantling of the potable water treatment plant and distribution system.

8.13 WATER MANAGEMENT STRUCTURES

8.13.1 Closure Objectives and Criteria

As stated in the Yukon Mine Site and Reclamation Closure Policy Financial and Technical Guidelines (Yukon Government, 2008), the main closure objective is “to ensure decommissioning of water retention and sediment control structures, and the appurtenances, in such a way that drainage at, and adjacent to the site, is stable in the long term.” Closure objectives will also ensure flows are conveyed into and throughout the mine footprint, and off of the site in a controlled, stable fashion under a reasonable range of anticipated conditions.

8.13.2 Closure Measures

8.13.2.1 Dublin Gulch Diversion Channel

Initial construction of the Dublin Gulch diversion channel (DGDC) for operations will be re-armoured at appropriate locations so that it is acceptable for long-term closure. Flow patterns may be slightly modified along specific reaches to achieve and enhance stability and/or accommodate water quality and other objectives. The DGDC facilities will be designed to minimize contact of surface flow with mine influenced soils.

8.13.2.2 Sediment and Erosion Control Structures

As described in Section 8.5, existing sediment and erosion control structures will be utilized in the transition to permanent closure, with new sediment control structures to accommodate any new surface water features added. As the covers and reclaimed areas reach maturity, the need for and reliance upon sediment control structures and certain built watercourses will no longer be necessary.

8.13.2.3 Lower Dublin South Pond

In preparation for closure, the conversion of the Lower Dublin South pond to a PTS will occur as needed. The majority of the LDSP will be used for construction of a CWTS, and the downgradient end will be used as a final sedimentation and settlement pond for the catchment around the LDSP prior to discharge into the DGDC.

8.13.2.4 Lower Dublin North Pond

In preparation for closure, the conversion of the Lower Dublin North Pond to an equalization basin and a settling pond for water conveyance ditches and the Heap PTS will occur. It is possible that the entire LDNP will be used as a final sedimentation and settlement pond for the catchment area around the LDNP prior to discharge into Haggart Creek which will be required during the transitional period when covers and reclamation activities are

being implemented. As the LDNP is substantially larger than what is necessary for use as a settling basin, which will allow the upper end of the LDNP to be used for construction of a CWTS if additional area is needed to achieve water quality criteria. In any case, the height of the pond will be reduced so that it will not be a significant water retaining pond, but rather a pond designed to pass runoff events with sufficient settlement to remove suspended solids.

8.13.2.5 Eagle Pup Pond

In preparation for closure, the Eagle Pup WRSA will have a new small seepage collection pond located higher up-gradient. The collection pond will be divided, with some portion used to provide some flow equalization for the CWTS, and a portion of it is repurposed as a buried bioreactor, as described under the Eagle Pup PTS section. The Eagle Pup Pond will be decommissioned after the collection pond construction area is stable and resistant to erosion.

8.13.2.6 Platinum Gulch Pond

In preparation for closure, the conversion of the Platinum Gulch Pond to a PTS will occur as described under the Platinum Gulch PTS section.

8.13.2.7 Events Pond

In preparation for closure, after cyanide concentrations in the heap discharge meet criteria, the Events Pond will be repurposed for use as a PTS as described under the HLF PTS section.

8.14 HAGGART CREEK ACCESS ROAD

At closure, the Haggart Creek Road will be left in place for future access to the property by the public and existing users.

8.14.1 Access Control

The main access road will remain gated and locked during the active reclamation activities. Access to the mine site will remain restricted and all visitors will be required to sign in and out at the gate house. Once the reclamation activities have been completed, the gate, gate house, and fencing will be removed.

8.14.2 Closure Objectives and Criteria

The responsibility for maintaining the existing Haggart Creek Access Road will be returned to Yukon Government to allow public access to meet the following closure objectives: physical stability, ecological viability and sustainability.

8.14.3 Closure Measures

The Haggart Creek Access Road will remain at closure; however site access and haul roads constructed as part of Stage 1 Construction will be reclaimed. Access to the Potato Hills will be preserved (as requested by the FNNND), as well as other mine access roads associated with on-going and historical exploration activities that are covered under separate permit authorizations. The on-site access and haul roads constructed as part of

Stage 1 Construction will be re-contoured, scarified, and revegetated. All culverts associated with these roads that are not used for other purposes will be removed and the stream channels will be stabilized.

8.15 CAMP

8.15.1 Closure Objectives

The closure objective is to remove camp facilities to achieve physical stability, ecological viability and sustainability.

8.15.2 Closure Measures

Prior to the development of the construction camp, topsoil will be salvaged and stockpiled locally in windrows adjacent to the disturbance site in designated soil stockpile areas or in the reclamation material stockpiles. Species inventory will be conducted and based on results ecosystem units will be recorded to guide future reclamation efforts. Measurement of pre-disturbance soil depths will take place to ensure soil replacement during reclamation will be to the same depth that was originally salvaged from the disturbance site.

Once the site is no longer required for mine operations or exploration activities, all equipment and structures will be removed; the septic system will be pumped of contents broken down and backfilled; the area will be re-contoured to original grades and topography and pre-mining drainage patterns will be restored to the extent feasible and practical. Salvage soil material will be spread directly by dozer pushing from the windrow berms. Salvaged soil that has been stored in designated stockpiles will be hauled by dump trucks and placed at the disturbance sites to be spread by dozer to the original soil depth as discussed previously.

Once the disturbance area becomes available for permanent reclamation, it will be revegetated with plant species that are typical of the projected post closure ecosystem (Stantec 2011b), generally native trees and shrubs. Interim reclamation, weed control and surface erosion control of the site will be achieved by seeding with native grass, legume and forb species as listed in Section 10, Table 10-1 and Table 10-2. A native seed collection program is being developed and implemented during the life of the mine to ensure availability of stock.

8.16 EXPLORATION SITES AND TRAILS

The majority of the exploration sites and trails will be removed or encompassed within the planned works. However, any exploration sites and trails required for ongoing exploration activities will remain available for future use. Yukon Government currently holds a bond from SGC for costs associated with reclamation of exploration programs.

8.17 SOLID WASTE STORAGE AREA

8.17.1 Closure Objectives and Criteria

The closure objective is to achieve physical and chemical stability, ecological viability and sustainability of decommissioned solid waste storage area.

8.17.2 Closure Measures

All solid waste will be removed to landfill or removed to appropriate offsite licensed landfill.

8.18 LANDFILL

8.18.1 Closure Objectives and Criteria

An onsite landfill will provide a place to remove potential threats to public health, decommission facilities in a safe manner, and ensure physical stability.

The closure objectives are to achieve physical and chemical stability, ecological viability and sustainability.

8.18.2 Closure Measures

Landfill areas compacted and capped.

8.19 LAND TREATMENT FACILITY

8.19.1 Closure Objectives and Criteria

An onsite land treatment facility will provide a place to remove potential threats to public health, decommission facilities in a safe manner, and ensure physical stability.

The closure objectives are to achieve physical and chemical stability, ecological viability and sustainability.

8.19.2 Closure Measures

The proposed land treatment facility (LTF) will be a permitted facility to treat hydrocarbon contaminated soil. Contaminated solids from fuel/oil spills during operations will be treated in this facility to appropriate levels of remediation before being used as industrial fill as per regulatory requirements.

The closure of this facility is subject to the submission of a formal Closure Plan to YG, along with sampling results which demonstrate the final concentrations of contaminants in the soil being treated. It is expected that upon final closure of the entire site, dismantling and decommissioning activities may reveal or result in soil contamination requiring the relocation of contaminated soil to the LTF and an undetermined number of months of treatment to achieve desired remediation levels. As such, the LTF Closure Plan and final sampling results will be prepared and submitted sometime after final closure of the mine site has begun.

Generally, once the desired contaminant levels have been reached in the final volumes of treated soil, and the Closure Plan has been approved by YG, the soils will be spread at approved locations at the site, recontoured in place and revegetated. If required, additional overburden may be hauled and used as cover material and growth media for revegetation.

8.20 BORROW PITS

8.20.1 Closure Measures

The majority of the borrow pits are located within the footprint of other infrastructure components (i.e. HLF and the open pit) and therefore closure measures described for each respective facility will negate the need for additional measures. Borrow pits that are not located beneath infrastructure components will be stabilized and re-contoured, covered with growth media, and re-vegetated.

8.20.2 Borrow Materials Planning

- Rip-rap will be produced from clean mine rock that meets rip-rap design criteria which may include evaluation for freeze-thaw, soundness, wet abrasion, dry abrasion, and absorption.
- Stockpiles will be created during the initial construction activities, where overburden materials will be stripped and segregated, and placer materials will be collected and placed.
- In general, three main reclamation materials are anticipated to be used as cover soil or construction materials during closure. The types and estimated materials availability and use are summarized in Knight Piesold (2013a):
 - Colluvium: ~275,000 m³
 - Placer Tailings: ~550,000 m³
 - Topsoil: ~765,000 m³

9 PERFORMANCE UNCERTAINTY AND RISK MANAGEMENT

9.1 FAILURE MODES EFFECTS ANALYSIS (FMEA)

Closure and reclamation plans comprise a series of designs with drawings and specifications that define what will be constructed, and coupled with an operating plan that describes how the constructed facilities will operate.

The purpose and intent of the FMEA is to:

1. address risk of designs and operating procedures not achieving the design intent; and
2. minimize fiscal and environmental risk failure associated with complex, long term performance of engineered systems assembled to achieve closure.

The facilities that were considered to have a potential for high consequence failures were associated with the HLF. The FMEA process has been performed for the following components:

- HLF confining embankment
- In-Heap Pond
- Events Pond
- Liner System
- Leachate Detection/Recovery System
- Overliner Drain Fill
- Solution Collection and Delivery System
- Ore Heap
- Dublin Gulch Diversion Channel

As these components will by en large continue to be relied upon in some capacity into closure, the FMEA process has informed the closure plan development, especially in the area of heap-based events or water management events around the heap.

The FMEA consequence-severity definitions that were used covered the following categories:

- Biological Impacts and Land Use
- Regulatory Impacts and Closure
- Public Concern and Image
- Health and Safety

Specific failure modes and their effects on the mine site components evaluated led to recommendations for quality control and for potential contingency responses. Some of these have been considered and incorporated

in the Environmental Monitoring, Surveillance and Adaptive Management Plan, and others are more focused on operational responses that will ensure that the facility is constructed and operated within the design criteria, which is reflected in the OMS manual specifically around the HLF.

10 RECLAMATION AND CLOSURE RESEARCH PROGRAMS

SGC will undertake reclamation and closure research programs prior to decommissioning. The research programs will be initiated to support the closure measures and will be implemented, as appropriate, during temporary closure, after construction, and/or after mining operations have commenced. Currently, several closure and reclamation research programs are planned, including engineered cover designs and test plots, growth media and revegetation trials, passive treatment research and natural groundwater attenuation programs.

10.1 ONGOING REVEGETATION TRIALS

Lebargue Environmental Services (2012) conducted vegetation trials at the Peso Mineral Exploration Site, located on claims independent of the project site to test the viability of incorporating biochar and other soil amendments into the Eagle Gold Project. The objective of the revegetation program at Peso is to test the viability of incorporating biochar and other soil amendments into the site with a goal of creating an ultimate reclamation and revegetation plan which will be transferable to the Reclamation and Closure Plan as required by the *Quartz Mining and Yukon Waters Acts and Regulations*.

The Peso site, located approximately 6.5 km west of the Eagle Gold camp at Dublin Gulch was originally staked in 1910 with extensive exploration occurring from 1961 to 1965. Two disturbed areas on this site, which have not revegetated since 1962, were selected for vegetation trials: an old trench and the waste rock dump.

Laboratory analysis results from both sites indicate mineralized soil with little to no nutrient value. The waste rock soil pH is 2.6 and the trench site soil pH is 5.2. Although some of the soil characteristics at Peso are different from the majority of the Eagle Gold Project site soils, which are less mineralized with neutral to slightly alkaline attributes, the Peso site represents a higher elevation site and will remain undisturbed for the duration of the long term monitoring program.

Several plant species were chosen for the reclamation seed mix due to their tolerances to acidic, low nutrient levels, drought and/or heavy metal conditions in the growth medium and are presented in Table 10-1 and Table 10-2 below. Seeds, hand collected from local alder and hedysarem, were also added to the seed mixture.

Table 10-1: Peso Waste Rock Site Selected Seed Mix for Reclamation

Botanical Name	Common Name
<i>Festuca ovina</i>	Sheep Fescue
<i>Deschampsia caespitosa</i>	Tufted Hairgrass
<i>Poa glauca</i>	Glaucous bluegrass
<i>Agrostis scabra</i>	Tickle Grass

Table 10-2: Peso Trench Site Selected Seed Mix for Reclamation

Botanical Name	Common Name
<i>Festuca ovina</i>	Sheep Fescue
<i>Deschampsia caespitosa</i>	Tufted Hairgrass
<i>Poa alpine</i>	Alpine bluegrass

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Botanical Name	Common Name
<i>Trisetum spicatum</i>	Spike Trisetum

Three blocks consisting of five 1m x 1m plots were established at each site during the summer of 2012. A total of 30 plots were seeded with various amendments at the Peso site in the fall of 2012. Amendments included:

- none,
- compost and biochar,
- compost, biochar and leonardite,
- compost, biochar and dolomite, and
- compost, biochar, dolomite and leonardite.

Dolomite was added to the waste rock dump plots only.

Monitoring of the plots in July and September of 2013 revealed all seeded plots with no treatments supported no to very sparse, stressed growth. Overall, the plots with the amendments 'biochar and compost' provided the most robust and dense growth. As this was the first season, few grasses were mature enough for positive identification. However, Alpine Bluegrass and Tufted Hairgrass were identified on the trench sites and Glaucous Bluegrass and Tickle Grass were identified on the waste rock sites. *Alder* and *hedysarum* seedlings were noted on most plots. Monitoring will continue in 2014 and 2015.

Three other candidate sites (boreal high, boreal low and riparian) were also identified within the project areas and may be utilized for future revegetation trials.

10.2 ENGINEERED COVERS

The currently planned end land-use for the reclaimed HLF and WRSA at the Project site is natural habitat (wilderness). Key design objectives for the HLF / WRSA closure cover systems include long-term geotechnical and geomorphic stability, as well as providing a medium for sustainable growth of native plants. Another key function of the HLF / WRSA closure cover systems is to reduce long-term net percolation rates to the greatest extent possible using locally available materials for cover system construction. Passive treatment systems will be designed and implemented to handle resultant environmental loadings from the HLF and WRSA post-closure seepage.

OKC (2014)³ completed an assessment of the anticipated hydrological performance of a base-case cover system design; the base-case is detailed in Section 8.8. An 80-year climate database comprised of daily records using local and regional meteorological data was used to estimate hydrological performance of the base-case cover system design as well as variations to the base-case design. Some of the key factors influencing performance of the proposed HLF / WRSA cover system design are as follows:

³ OKC (O'Kane Consultants Inc.). 2014. Eagle Gold Project – Further Assessment of Closure Cover System Designs for Heap Leach Facility and Waste Rock Storage Areas. Report no. 917/1-01 submitted to Access Consulting Group, April 28, 2014.

- Hydraulic properties of candidate cover system materials;
- Hydraulic properties of HLF and WRSA waste materials;
- Slope aspect (i.e. solar radiation input and snowpack accumulation / melt); and
- Slope gradient.

Various research programs are recommended for the Project site to reduce uncertainties surrounding the key factors influencing performance of the base-case cover system design, based on the results of the 2014 VADOSE/W numerical modelling program. The following research programs are proposed:

10.2.1 Material Characterization Program for Candidate Cover System Materials

Stantec (2011a) conducted a growth media survey for suitable salvage material based on reclamation suitability of soil and terrain conditions. A soil suitability rating system, originally developed by Alberta Agriculture, Food and Rural Development (AAFRD 1987) and the British Columbia's Mines Act (MEMPR 2006), was modified to reflect the presence of large stones and boulders as they are not accounted for in the Alberta rated system but needed to be accounted for the Project. Additional modifications to account for steep or unstable slopes were considered for safety (2011a).

Reclamation suitability ratings of good or fair were designated as soils suitable for reclamation requiring minimal preparation while soils rated as poor (coarse fragments resulting in limited reclamation properties) were regarded as suitable if amended significantly or if higher rated media was available. Soil containing less than 15% by volume cobbles or boulders, with up to 50% total coarse fragments were rated good or fair for reclamation. Rating of poor or unsuitable soils was based on stoniness.

Since chemical properties were not deemed to be the most limiting factor for suitability (Stantec 2011a), criteria was based on the most limiting soil physical properties of soil texture, coarse-fragment content, and stoniness.

Several geotechnical investigations have been completed to support design of infrastructure required for the Project operation. While samples of various local materials have been submitted for geotechnical laboratory testing, limited testing has been completed on candidate materials for cover system construction to quantify hydraulic properties that will control performance of the cover system. In addition, additional soil fertility analyses on local materials is needed before cover system construction.

Preliminary plans indicate that the test pit program include the collection of samples and profile logging of viable sources of the following candidate cover system materials:

- Topsoil,
- Colluvium, and
- Placer tailings.

If the current geotechnical database does not have the required information, between 7 and 10 samples of each material type would be collected and submitted for basic geotechnical testing including water content and particle size distribution (PSD) analyses. The exact number of samples collected would depend on the heterogeneity of the materials encountered during the field investigation. Following a review of the PSD test results, a select number of duplicate samples would be submitted for hydraulic characterization including

saturated permeability and moisture retention testing. The results of this test work would allow refinement of the currently estimated hydraulic properties for cover materials simulated in the 2014 VADOSE/W modelling program, and subsequent increase in the confidence of current estimates of long-term cover system performance.

Representative samples of potential cover materials would also be submitted for soil fertility examination, including analyses for sodium adsorption ratio (SAR), pH and EC, organic carbon, exchangeable K, Ca, Mg, macronutrients, and micronutrients. The results of this test work will aid in determining fertilizer requirements for revegetation of the cover systems, and may show that a particular borrow source is chemically unfavorable to support growth of native plants.

10.2.2 Material Characterization Program for HLF and WRSA Waste Materials

Current estimates of long-term cover system performance for the Project site are based on estimated particle size distributions for the spent heap leach and waste rock material. Once these materials become available, representative samples would be collected and submitted for geotechnical characterization, including analyses for particle size distribution, water content, standard Proctor compaction, saturated permeability, and moisture retention.

Spent heap leach and waste rock materials may have a propensity to break down when exposed to the atmosphere and when mechanical energy is applied. A pilot-scale field compaction trial would be conducted to determine the extent to which the waste material can be compacted, thereby reducing its permeability. Large vibratory rollers may be able to reduce the saturated permeability of surface waste material on flatter areas of the HLF and WRSA, such as plateau areas and benches, by one to two orders of magnitude. The intent is to limit net percolation during relatively short-duration seasonal events when the storage capacity of the growth medium layer may be exceeded. Compaction field trials could be carried out once spent heap leach and waste rock stockpiles are established, and materials have been exposed to ambient conditions for several years. The test program would involve permeability and density testing of pre-compacted surfaces, followed by compaction with appropriate equipment and subsequent permeability and density testing of post-compacted surfaces. The technical feasibility and costs associated with reducing the permeability of flatter areas on the HLF and WRSA could then be weighed against the anticipated benefits of reduced net percolation and leachate to passively treat.

10.2.3 Hydrological and Meteorological Monitoring on Various Slope Aspects

Given the relatively high latitude of the Project site, slope aspect and angle highly influences the amount of solar energy and resultant potential evapotranspiration (PET) applied to various areas of the site. For an exposed plateau or east- or west-facing slope, OKC (2014) estimated average annual PET to be about 370 mm/yr. However, PET was estimated to be 60% less on north-facing aspects and 50% more on south-facing aspects, resulting in average annual PET rates for these two aspects of about 150 mm/yr and 560 mm/yr, respectively. In short, slope aspect is a critical factor at northern latitudes that will influence long-term net percolation rates realized through the reclaimed HLF and WRSA landforms.

Preliminary plans indicate that net solar radiation and snowpack monitoring be conducted on various slope aspects of natural landforms on the Project property over a 2 to 3 year period. Net solar radiation measurements can be continuously collected using net radiometers. Snow surveys could be used on various

slope aspects just prior to and during the spring-melt period to quantify differences in snowpack depth and snow-water equivalent. Site-specific net radiation and snowpack measurements on various slope aspects would increase the confidence in current estimates of long-term performance for the proposed HLF / WRSA closure cover system.

10.2.4 Performance Monitoring of Cover System Field Trials

Information and data gathered during construction and monitoring performance of cover system field trials would substantially increase the level of confidence in estimates of long-term performance for the ultimate HLF and WRSA closure cover systems. Ideally, data obtained from completing the first three research programs would be used to update current models of cover system performance, which would inform on the optimum cover system design to be trialed at the Project site. Two field trials of the preferred cover system design would be established on a WRSA, one on the plateau and one on an inter-bench slope. Instrumentation would be installed in each cover trial to quantify key surface water and energy balance fluxes, which will enable a better understanding of spring snowmelt conditions on two very different slope angles. The mine plan has identified Platinum Gulch WRSA as being a suitable location to receive progressive reclamation measures. As such this WRSA will be a suitable location for testing the proposed cover system.

The purpose of a cover system field trial program is summarized in the Covers in Cold Regions Guidance Document prepared by MEND (MEND, 2012)⁴:

- 1) Evaluate construction methodologies and equipment in support of finalizing the full-scale cover system design;
- 2) Obtain performance monitoring data for calibration of numerical models such as VADOSE/W;
- 3) Develop an understanding of key characteristics and processes that control cover system performance; and
- 4) Track evolution of the trialed cover systems in response to various site-specific physical, chemical, and biological processes.

As noted in MEND (2012), performance of cover system field trials should be monitored for a minimum of 2 to 3 years prior to proceeding with final design of the full-scale cover system, and ideally up to 5 years to capture climatic variability over the monitoring period. The monitoring data would provide data to characterize the variability in thermal and hydraulic field responses which will improve the calibration of the initial VADOSE/W models, thereby improving confidence in the predicted long-term performance of the final cover system design.

10.3 PASSIVE WATER TREATMENT

A passive water treatment system is proposed to treat mine waters upon closure. While the predicted water chemistries and site layout are conducive to passive water treatment, it is recognized that additional research will be required to optimize and confirm the PTS design and size. Despite being best available estimates for the

⁴ MEND (Mine Environment Neutral Drainage). 2012. Cold regions cover system design technical guidance document. Canadian Mine Environment Neutral Drainage Program, Project 1.61.5c, March.

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sizing of the CWTS component of the PTS for closure, these are not site-specific and require further refinement and optimization through controlled pilot-scale testing and on-site demonstration. For this reason, a conservative size estimate has been included in the site plan and budgets at this early point of closure planning, with the understanding that these will be revisited once the PTS designs are refined.

The objective of this PTS reclamation research program is therefore to refine, optimize and remove uncertainties associated with the removal rate coefficients and thermodynamic minimums possible for the water predicted at closure for the Eagle Gold Project. More specifically, the proposed program contains four overriding objectives:

1. Refine the PTS or combination of PTSs for post-closure water treatment
2. Scientifically test and optimize PTS configurations
3. Validate function of PTS in cold climate
4. Demonstrate function of the system on site prior to closure

These four objectives will be met through a multi-phase research program. The phases of research for the PTS include bench/laboratory/pilot (controlled environment and/or outdoor cold-climate at CSL's dedicated PTS facilities), and demonstration (small-scale, on-site during operations). The purposes of each phase are outlined in Table 10-3.

Table 10-3: CWTS phased development.

Aspects and Parameters Related to Different Constructed Wetland Scales	Pilot (CSL facilities)	Demo (on site)	Full
Test various water chemistries and formulations	+		
Test different sediment makeups	+		
Test different plant efficacies/properties	+		
Environmental parameter control	+		
Develop flow rates and water depths (HRT)	+		
Develop rate coefficients and kinetics	+		
Intensive monitoring	+	+	
Determine parameters for proper sizing	+	+	
Measure removal extent	+	+	+
Evaluate cold weather performance	+	+	+
Compare demo/full scale data to pilot data (e.g., rate coefficients)		+	+
Confirm removal rates/extents		+	+

*if performed outdoors.

10.3.1 Methods

The final design will be comprehensive and based on sound scientific principles (biogeochemistry, pilot studies, etc.). PTSs can be developed from concept to sustained performance using a phased approach as described in the following sections. An overall schedule of the program is shown in Section 10.3.2.

10.3.1.1 Phase 1: Updating Information for Final Design

1. Continued characterization of water requiring treatment; comparing initial predictions with actual performance and reviewing if the initial plan needs adjustment
2. Confirmation of targeted constituents and performance goals
3. Characterization of existing wetlands systems in site vicinity to guide plant selection and water management approaches
4. Site assessment for implementation of CWTS

In Phase 1, the following list of information will be gathered from site operations monitoring programs and used for the design basis of the PTS. Additionally, potential borrow sites for hydrosols and wetland plants will be identified. Plants may be collected from site for use in Phase 2, if appropriate.

- Intrinsic Factors
 - Concentration and identity of constituents that will require a decrease in concentration
 - Flow rates
 - Fluctuations in concentrations and flow rates
 - Cation/anion balance
 - Conductivity
 - Alkalinity
 - Hardness
 - pH
 - Concentration of Sulfate
 - Concentration of Iron and Manganese
 - Nutrient availability (N,P,K and micronutrients such as Cu, Se)
- Extrinsic Factors
 - Receiving system limits (water quality objectives, mixing zones)
 - Soils
 - Geology
 - Topography
 - Constructability

- Sources of organic material
- Depth to groundwater (hydrogeologic regime: recharge or discharge area)
- Vertical and/or lateral proximity to permafrost
- Duration of operation required
- Wildlife deterrence
- Climatic
 - Geographic location (lat/long)
 - Aspect (i.e., north- or south-facing)
 - Seasonal distribution of Rainfall
 - Character of Storm events
 - Snowfall
 - Freshet (break-up) character
 - Freeze-up character
 - Growing season
 - Temperatures (max, min, mean)
 - Growing-degree days
 - Evaporation and evapotranspiration
- Putative evidence of system functionality at site
 - Information gathered on existing wetland systems near the site
 - Types of native plant species
 - Redox in natural wetlands
 - Soil chemistry (total organic content, nutrient levels, etc.)
 - Identify mechanisms in existing wetlands near the site to sequester constituents that will require a decrease in concentration
 - E.g., oxic or anoxic As removal pathways
 - Accretion rates
 - Availability and sources of local plants for CWTS planting

10.3.1.2 Phase 2: Indoor Pilot Scale

1. Design of pilot scale PTS (one or more designs may be tested for optimization)
2. Assembly of indoor pilot scale PTS

3. Performance monitoring and stress testing of the indoor pilot scale PTS

In Phase 2, pilot scale systems will be designed and built in a year-round temperature controlled greenhouse. At times, bench or laboratory scale testing is used to aid in the design of the pilot scale PTS. At pilot scale, there are typically two to four treatment cells in a series, two replicates of each system, and 2-4 different system designs tested (a total of 8-32 cells). For this phase, simulated water will be created with chemical characteristics similar to that predicted to occur post closure. These systems will be run for a minimum of 6 months and maximum of 2 years, depending on the extent of optimization and/or stress testing to be performed. A PTS such as a BCR may be used as a pre-treatment step and will be evaluated in line with any other components of the PTS (e.g., a CWTS). During Phase 2, explanatory parameters will be assessed regularly.

10.3.1.3 Phase 3: Outdoor Pilot Scale

Depending on data from Phase 2, it may be possible to skip this phase and proceed directly to on-site demonstration.

1. Assembly of outdoor pilot scale PTS in a cold climate environment (based on information gathered from indoor pilot scale findings)
2. Performance and seasonal monitoring of the outdoor pilot scale PTS

In Phase 3, the best performing systems from Phase 2 will be used for the design basis for outdoor pilot systems. Simulated discharge water will be used. Each treatment cell in the outdoor pilot-size system will contain approximately 500kg of hydrosoil, (total of approximately 2 tonnes per treatment system being tested) and will have 1,200-1,500 litres of simulated discharge water pass through per week. At a minimum, one treatment system will be tested in duplicate. Ideally, these systems will be built using hydrosoil from a borrow site near the Eagle Gold mine. These systems will be located outdoors, at a cold-climate PTS testing facility. These systems will be allowed to run for a minimum of 1.5 years, ideally 2-3 years to properly characterize spring thaw and winter freeze performance. During Phase 3, explanatory parameters will be assessed regularly (as in Phase 2).

10.3.1.4 Phase 4: On-site Demonstration Scale

1. Design of on-site demonstration scale PTS
2. Construction of demonstration scale PTS at the Eagle Gold site
3. Performance monitoring of demonstration scale PTS at site

In Phase 4, the demonstration-scale system will be built on site at the Eagle Gold mine and will be sized to allow adequate monitoring and testing for the implementation of the full-scale PTS. It is currently conceptualized that this will be implemented at the PG WRSA seepage collection area early in operations. The outflow from the demonstration PTS will be sent to the LDSP to be used as make-up water or to the WWTP to ensure all water that enters the receiving system has been treated by an approved system. During Phase 4, explanatory parameters will be assessed regularly (as in Phase 2 and 3).

10.3.1.5 Phase 5: Full-scale Implementation

1. Design of full-scale PTS

2. Construction bids, permitting and initiation
3. Construction
4. Planting and/or maturation
5. Acclimation and initial monitoring
6. Ongoing operation and periodic monitoring of PTS

In the final phase, the full-scale PTS will be built prior to or just after closure depending on the system to allow the system to stabilize and mature. Early commissioning of a full-scale PTS will provide additional confidence that the systems are functional and reliable. For the HLF, the PTS will be built as soon as water is available for that system, and the MWTP will remain functional until the PTS has matured, stabilized, and demonstrated an acceptable treatment performance for a designated period of time.

10.3.2 Schedule

A proposed schedule for implementation of the research program is shown below.

Table 10-4: Passive Treatment Research Program Implementation Schedule

Phase	Start Date	End Date
Phase 1: Information Gathering	September 2012	June 2014
Phase 2: Indoor Pilot Scale	July 2014	December 2016
Phase 3: Outdoor Pilot Scale	Jan 2017	June 2019
Phase 4: On-site Demonstration Scale	July 2020	December 2021
Phase 5: Full Scale Implementation	Jan 2021	Into post-closure

10.4 GROUNDWATER ARSENIC ATTENUATION STUDY

BGC (2014) prepared and calibrated a multi-purpose groundwater model, which has been used to determine the effects of mine operations on groundwater in the mine area. One purpose of the model was to evaluate the direction that seepage from the WRSAs might go, and the potential effect areas. The report states:

At the end of mine operations, seepage from the WRSAs and 100 day storage area is not simulated to migrate outside of the facility footprints. However, within the WRSA footprints, seepage may report to the underdrains. Seepage originating from the 100 Day Storage Area could migrate to Suttles Gulch. While results for the end of passive closure are similar, seepage is predicted to also migrate west of the 100 Day Storage Area and the Platinum Gulch WRSA where it could discharge to Haggart Creek.

This conclusion was based strictly on a particle-type analysis (“ModPath”) where a particle is modeled to move through groundwater based on hydrodynamic processes, but physical, chemical, or biological reactions that could cause a particular solute, such as arsenic or antimony, to migrate differentially as compared to a model particle, was not considered.

A review of groundwater quality data to current Yukon CSR AW standards identified by Stantec (June, 2012) showed dissolved arsenic exceedances in all Project sub-basins:

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Arsenic concentrations in Ann Gulch (MW10-AG5), Suttles Gulch (MW09-STU2) and Eagle Pup (MW96-13b) were 3 to 70 times higher than the CSR AW standard; whereas, arsenic concentrations in Platinum Gulch (MW10-PG1 and MW96-23) were 160 to 200 times higher than the CSR AW standard. The highest dissolved arsenic concentrations in the LSA occurred consistently in Platinum Gulch monitoring well MW10-PG1 and ranged from 7.98 mg/L to 9.62 mg/L in November 2011 and December 2012, respectively. These concentrations were approximately two times higher than dissolved arsenic values reported in Dublin Gulch well MW09-DG6, which ranged from 0.938 mg/L to 3.64 mg/L during 2011–2012, and approximately ten to one hundred times higher than concentrations reported in all other LSA sub-basins. Dissolved arsenic concentrations exceeding CSR AW standards were reported in monitoring wells completed in sand and gravel deposits, till deposits, phyllite metasediments and granodiorite bedrock units.

Across the site, dissolved arsenic in groundwater is consistently greater than the Yukon Contaminated Site Regulation for Freshwater Aquatic Life (Y-CSR AW) standards in six of the ten wells sampled and results for total arsenic were greater than the Canadian Council of Ministers of Environment for the protection of Freshwater Aquatic Life (CCME FW) guidelines in all ten wells sampled (BGC, 2012). Other metals also show elevations compared to guidelines, but not as consistently as does arsenic.

Current conditions show that arsenic concentrations significantly change as groundwater transitions from the Dublin Gulch into Haggart Creek. A preliminary evaluation of site chemistry may indicate that predictable chemical changes in major anions and cations as well as changes in iron and manganese concentrations correspond to changes in arsenic concentrations. Less apparent from the current data are trends that could imply causation with respect to solid phase aquifer changes, either from a source or a sink of arsenic or other constituents of interest.

The proposed research program would include the following activities:

- Utilize the existing groundwater information to establish the processes that could likely be controlling constituent migration. Geochemical modeling would be used to derive saturation indices that could indicate the sinks that are currently responsible for metals removal.
- Potential sources of constituents such as the WRSAs would be monitored to determine if the WRSAs are inducing chemistry changes in groundwater that could shift the chemical equilibrium to either favor or reduce the processes that are currently affecting arsenic or other metals' migration
- Known or modeled migration pathways would be further evaluated to determine if specific lithologies provide mechanisms that can be quantified to yield predictions of migration potential or reduction in migration potential under planned operating conditions.
- The extent to which seepage from WRSAs does not come to surface will be evaluated, and this work will determine rates of potential migration of constituents in the seepage so that the groundwater monitoring program will be refined.

11 MAINTENANCE

The closure measures are designed to minimize maintenance; however some facilities will require some minimal maintenance, which is expected to decrease over time as the combined systems work synergistically to achieve a stable, closed site. However, based on current understanding there will be some minimal requirement for maintenance.

Covers:

- All engineered covers will be monitored for erosion and if observed will be repaired and replanted.
- Additional riprap or localized repairs to remove sediment may be required in closure runoff ditches if a large storm occurs shortly after cover placement prior to vegetation establishment.

Passive Treatment Systems

- The In-Heap Pond bioreactor reactivity will be largely “charged up” by the in situ heap cyanide degradation initial treatment. Some alcohol will be added to the In-Heap Pond bioreactor as the pond is drained down. When the cover is fully functional, the need for continued maintenance in Phase 7 onward should decrease or be eliminated entirely.

Water Conveyance Features

- All ditches will be inspected and may require repairs or maintenance during the first few years post-reclamation while covers and vegetation are being established.
- Sediment settling ponds may require cleanout especially after a large storm just after covers have been placed.

Roads

- Site roads will be maintained to provide access to areas requiring inspection or other maintenance.

12 MONITORING

Monitoring programs may be organized by facility (e.g. PTSS, HLF, WRSA) or by discipline. Monitoring programs must be revised to be consistent with closure objectives defined in this Plan.

SGC has developed environmental monitoring methods for the construction, operations, closure and post closure phases of the Project to adhere to the terms and conditions in the YESAA Decision Documents and to meet the Yukon Water Board guidelines for Type A and B Quartz Mining Undertakings (February 2012) and the Plan Requirements for Quartz Mine Licensing from Yukon Government Energy Mines and Resources in coordination with the Yukon Water Board (August 2013).

Summarization of monitoring programs and methods can be found in *the Environmental Monitoring, Surveillance and Adaptive Management Plan*.

13 RECLAMATION COST ESTIMATE

13.1 END OF MINE LIFE COST ESTIMATE

The total cost of implementing the Reclamation and Closure Plan as outlined in this document is estimated at \$54,650,730. A summary of the RCP costs for both Year 2 of operations and the end of mine life (EOM) is presented in Table 13-1. This EOM cost estimate includes the full extent of build-out for the open pit, HLF, WRSAs and surface facilities. Direct costs for all of the reclamation tasks are based on 2014 dollars and total \$28.368 M for the EOM life cost estimate. Indirect costs are estimated at 10% of the direct costs and account for items such as design, permitting and ongoing activities during the planning period. Indirect costs for EOM total \$2.863 M. Direct and indirect costs are then inflated 2% over the period of implementation. The EOM cost estimate includes \$3.78 M for inflation. The plan requires 7 years (Phase 6) to implement and complete followed by 15 years of late closure/post-closure monitoring and maintenance (Phase 7/8). The 7 year duration for implementation is driven by the time required to draindown the heap and establish a longterm drainage that can be managed passively. Terrestrial reclamation will be accomplished well before the 7 year timeframe.

Future long-term costs for solution draindown and long-term monitoring and maintenance are calculated on a Net Present Value (NPV) basis using a discount rate of 2.5%. The NPV of heap detox, water treatment and long-term monitoring for the EOM case totals \$12.24 M. A further 15% contingency is added (\$7.128 M) to the direct, indirect and NPV costs to determine the overall total of \$54.65 M.

The same approach is taken for the closure cost estimate at Year 2 which results in an estimated closure cost of \$30.86 M for the Year 2 case.

13.1.1 Reclamation and Closure Costing Tables

An MS-Excel spreadsheet model has been developed which mirrors the specific cost elements of the Yukon EMR and Water Board guidance document. Appendix A contains the detailed closure cost estimate tables for each of the specific tasks. The cost model tasks associated with the reclamation and closure of the Eagle Mine include the following:

T3	General and Administrative
T4	Exploration Disturbances
T5	Closure Planning
T6	Pit
T7	Heap Leach Facility
T8	Waste Rock Storage Areas
T9	Surface Facilities
T10	Surface Facilities
T11	Waste Disposal and Remediation

- T12 Landfills
- T13 Roads and Trails
- T14 Water Management

13.2 BASIS OF COST ESTIMATE

The basis of the cost estimate for the Eagle Gold Project assumes the use of third party contractors and equipment for implementation of major earthworks and terrestrial tasks. Many of the reclamation tasks may be implemented in-house but the assumption of third party contractors is consistent with the guidance document. The cost model contains a drop down menu that allows the selection of various pieces of equipment, labour categories and custom rates depending on the specific task. For the basis of the cost estimate, standard equipment types are included that are locally available (i.e. D-9 dozer, CAT 235 excavator). Third party rates have been established using a combination of hourly rates in the feasibility study, published rates for Yukon contractors as well as experience using local contractors.

A discussion of the major cost drivers for each of the task elements is provided below.

T3 General and Administrative

This task accounts for typical G&A costs that are not directly associated with individual reclamation and closure tasks. Line items include light vehicles, power and heat not directly associated with heap pumping, site security, travel and camp accommodations. Contractor costs such as profit and insurance are included in the specific unit rate for equipment.

T4 Exploration Disturbances

No costs are included for this task as it is assumed that exploration disturbance is already bonded for or will be within the footprint of other areas that will be reclaimed elsewhere.

T5 Closure Planning

Lump sum costs for closure planning is included and accounts for an update to the closure plan, detailed design of the passive treatment systems, engineered cover evaluations and site contamination surveys.

T6 Pit

Reclamation tasks for the open pit include removing pumps, placing boulders in the pit entrance to prevent entrance from vehicles in the long-term and establishing rip-rap water conveyance channels. Equipment hours for these tasks are based on experience and the feasibility costs for producing rip-rap material.

T7 Heap Leach Facility

The primary tasks associated with closure and reclamation of the HLF include placement of the soil cover over the HLF surface (0.3 m colluvium, 0.2 m overburden/topsoil) and addition of detoxification reagents. A custom rate has been calculated for haulage and placement of cover material based on feasibility cost estimates and productivities. The majority of the costs associated with the HLF closure is the reducing sugars and nutrients required for cyanide destruction as well as alcohols and nutrients for heap bioreactors. Unit costs per ton of

reagents including freight are based on recent quotations and other project experience. Dosage rates are based on testwork and experience at other heap leach detoxification projects.

T8 Waste Rock Storage Areas

The majority of the costs associated with the WRSAs is for the haulage and placement of a soil cover over the Eagle Pup and Platinum Gulch WRSA surfaces. A custom rate based on haulage distance, productivity and feasibility costs has been used for the calculation of cover construction. Additional costs for construction and/or improvement ditches between the WRSA drain outlets and the inlets to the PTSs are included based on estimated equipment hours for construction.

T9 Surface Facilities

Demolition costs for the surface facilities are calculated based on the assumption that no salvage value is credited against the cost of demolition. The majority of the costs for demolition is for general and skilled labour along with support equipment (crane, excavators). The estimated hours are based on experience elsewhere in dismantling an ADR plant at Brewery Creek. It is likely that significant salvage value will be realized in the facilities but the estimated hours assume that only minimal equipment is salvaged. Certainly in Year 2 the ADR plant, crushing plant and other facilities will have significant value, likely exceeding the cost of demolition.

T10 Infrastructure

Infrastructure remaining in addition to the surface facilities primarily consists of modular camp buildings and mobile containers (explosives magazine). Costs for removal of these assets are based on labour and equipment hours to disconnect services and haul away. A 0.2 m soil cover is placed over the area and costs for this task are based on a custom rate as previously discussed.

T11 Waste Disposal and Remediation

The majority of costs associated with this task include the management of hydrocarbon contaminated soils from sources such as around the fuel storage facility and truck maintenance shop. It is assumed that contaminated soils will be managed on site and no off-site transportation costs are necessary.

T12 Landfills

Costs to expand the operations landfill are included in the closure cost estimate to account for the larger capacity necessary for non-salvaged materials buried during demolition. Once the landfill is full, it will be covered with a soil cover, recontoured and revegetated.

T13 Roads and Trails

Closure costs for the roads and trails take into account the equipment and labour costs to recontour road crests, scarify the surface and revegetate. Costs for removal of culverts are included along with standard erosion control measures.

T14 Water Management

The major cost driver for water management is electrical power costs to recirculate the heap solution inventory during Phase 6 (i.e., the ~7 year actively managed draindown period). Electrical power costs are based on the heap draindown curve derived in Mines Group (2014). The maximum solution pumping power draw is from four

Section 13: Reclamation Cost Estimate

1120 kw motors operating during Phase 6. The electrical power load was factored down each year based on the draindown curve. The electrical power cost of \$0.11/kw was used to calculate the annual costs. A factor is applied to the connected motor load to account for a reduced power draw since solution will not be primarily pumped to the top of the heap as is the case during operations.

Section 13 Reclamation Cost Estimate

Table 13-1: Summary Table of Estimated Closure Costs

Description of Cost	Estimated Cost Year 2	Estimated Cost EOM
Closure Implementation		
T3 General & Administration	\$1,385,565	\$3,172,881
T4 Exploration Disturbances		
T5 Closure Planning	\$260,000	\$260,000
T6 Pit	\$55,358	\$55,358
T7 Heap Leach Pad	\$2,950,549	\$12,358,649
T8 Waste Dumps	\$2,906,897	\$3,623,053
T9 Surface Facilities	\$2,936,606	\$2,936,606
T10 Infrastructure	\$752,958	\$752,958
T11 Waste Disposal and Remediation	\$103,295	\$115,795
T12 Landfills	\$131,422	\$131,422
T13 Roads & Trails	\$428,620	\$428,620
T14 Water Management	\$1,990,563	\$4,802,940
Sub-total	\$13,901,833	\$28,638,282
Indirect Costs (%)	10%	10%
Indirect Costs	\$1,390,183	\$2,863,828
Cost Inflation	\$764,601	\$3,780,253
Total Closure Implementation Costs	\$16,056,617	\$35,282,363
T15 Care, Maintenance, and Monitoring Costs (Phase 6, 7/8)		
Onsite Management	\$1,680,000	\$1,680,000
Transport Costs	\$69,375	\$69,375
Water Treatment Costs (Phase 6)		
Active Treatment		
Capital Costs	\$3,996,916	\$3,996,916
Capital Replacement Costs	\$695,961	\$695,961
Operating Costs	\$6,659,905	\$6,659,905
Passive Treatment (Phase 7-8)		
Capital Costs	\$250,000	\$250,000
Capital Replacement Costs	\$22,500	\$22,500
Operating Costs	\$225,000	\$225,000
Reclamation & Closure Research Plan (Post Closure I-II)	\$75,000	\$75,000
Monitoring & Reporting	\$3,856,428	\$3,856,428
Post Closure I-II Maintenance	\$112,500	\$112,500
Sub-Total	\$17,643,585	\$17,643,585
Sub-Total NPV (2.5% DROR)	\$9,798,354	\$11,127,283
Indirect Costs (%)	10%	10%
Indirect Costs	\$979,835	\$1,112,728
Total (NPV)	\$10,778,189	\$12,240,011
Total Closure Costs	\$26,834,806	\$47,522,374
Contingency Allowance	15%	15%
Contingency Amount	\$4,025,221	\$7,128,356
Total Closure Costs (Plus Contingency)	\$30,860,027	\$54,650,730

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APPENDIX A

Cost Estimate: Current Liabilities

Appendix A1

SteveJan Consultants Inc. Reclamation Cost Estimate
for VIT's Proposed Advanced Exploration Program at
the Dublin Gulch Site

Appendix A2

Victoria Gold Corp., Dublin Gulch – LQ00303,
Security Evaluation, May 4, 2011

APPENDIX A1

SteveJan Consultants Inc. Reclamation Cost Estimate
for VIT's Proposed Advanced Exploration Program at
the Dublin Gulch Site



SteveJan Consultants Inc.
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CANADA
Tel/Fax: 250-382-0585
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MEMORANDUM

Date: February 2, 2011

Subject: Reclamation Cost Estimate for Victoria Gold Corp's Proposed Advanced Exploration Program at the Dublin Gulch Site

Background

- The site has had exploration activities dating back 40-50 years through to the present;
- Site exploration activity is currently authorized under Class 3 Operating Plan Approval LQ00090 (original dated July 26, 2002, last amended March 2005), and currently set to expire July 25, 2012;
- Original approval had a number of terms and conditions, a number of which included:
 - o (5) Annual report requirement to indicate reclamation work undertaken and planned for following year, also to include exact location of drill sites (36);
 - o (19) Trenching to not exceed 5000m³ per claim per year or 10000m³ per claim over the duration of the duration of the program;
 - o (20) Machine excavated trenches are to be backfilled, overburden and bedrock first followed by vegetative mat;
 - o (41) Criteria to include when building new trails;
 - o (52) Fuel storage limited to 19 barrels per location. No secondary containment is required if limited to that number;
 - o (53) If fuel in storage exceeds 4000L a secondary containment facility must be constructed;
- Amendment (March 2005) to LQ00090 includes permissions for:
 - o New trails and possibly new access roads on claims;
 - o 270 additional drill holes;
 - o Add 40 km of line cutting with an average width of 2 m and up to 50 clearings per claim;
 - o Add up to 30 new trenches.
- Current Advanced Exploration Program Approval Application process for Class 3 / 4 Quartz MLU Approval, under review by the YESAB Designated Office as project number 2010-0226:
 - o Project Proposal document including QMLU Approval application, dated Oct. 11, 2010 and associated appendices;
 - o Additional information document, dated Dec 14, 2010 based on request from YESAB;
 - o On Dec. 22, 2010 YESAB deemed the proposal adequate. This was accompanied by a Public Notice with a Project Scope, which announced a Jan. 14, 2011 deadline for submission of comments on the project.

APPENDIX A2

Victoria Gold Corp., Dublin Gulch – LQ00303, Security
Evaluation, May 4, 2011

**Victoria Gold Corp.
Dublin Gulch – LQ00303
Security Evaluation
May 4, 2011**



Background: The Dublin Gulch property has been explored for many years and there are many disturbances on site from this historical work. Throughout the 1980's and 90's a number of exploration and mining companies explored Dublin Gulch including Canada Tungsten Mining Corporation, Queenstake Resources Ltd., First Dynasty Mines Ltd. and later New Millennium Mining. Victoria Gold has been operating under StrataGold's Class 3 MLU approval LQ00252 at the Dublin Gulch property and has now applied for a ten year Class 4 program. To date the claims remain in StrataGold's name.

Government of Yukon requires security on Class 4 operations and to this end we have hired a consultant to prepare a desktop assessment for security. The consultant, Steve Januszewski, did fly the site at an earlier date.

Recommendation: The SteveJan Consultants Inc. assessment can be divided into four parts: camp, roads and trails, trenching and drill sites. The reclamation for trenching and drilling is proposed to be ongoing, so these numbers will not be included at this time. The proponent has made a case that since the camp is modular and situated on tailings that the risk is less than would normally be expected. We have concurred with this assertion. No risk assessment was done for this project, as the company has currently submitted for an executive committee assessment under YESAA for a production licence. The exploration security is deemed to be a short-term and interim measure as it will be partially or totally rolled over to production when that permit is issued.

It is proposed to ask for 100% of the restoration costs for the proposed trails and roads or one hundred and forty-nine thousand dollars (\$149,000.) as per section 2 of the "Reclamation Cost Estimate for Victoria Gold Corp's Proposed Advanced Exploration Program at the Dublin Gulch Site" dated February 2/2011. The breakdown of these costs is attached for the company to review.

Recent Site Work:

- 2006 work-unknown;
- 2007 work-unknown;
- 2008 work - 2008 Post-Season Report shows the work that year included:
 - o 9 trenches (1206 m³)-all have been filled and contoured back into surrounding terrain;
 - o 53 drill sites, each being 500 m², so a total of 26,500 m².
 - o New access road to 1) Mar Tungsten – 3.84 km x 2.5 m width = 9600 m², to Eagle Zone .33km x 2.5 m = 825 m². For a total of 10,425 m²;
 - o No roads were upgraded;
 - o Total of 190 soil samples collected for geochemistry. There was no clearing or other environment impacts associated with the sampling;
 - o Reclamation-rubbish and debris from all 53 drill sites was removed. Sumps were backfilled;
- 2009 work-unknown; and
- 2010 work-unknown

Assumptions

The following assumptions were utilized in the preparation of the attached reclamation cost estimate for the proposed Dublin Gulch exploration program:

- The majority of the material utilized in this cost estimate report is based on information provided in the YESAB On-Line Registry under Project No. 2010-0226. This was supplemented by a brief helicopter flight over the site in September of 2008. The author has not been at the site;
- The cost estimate is considered to be a first-order desk-top undertaking;
- Equipment unit cost rates are based on numbers available from *Third Party Equipment Rental Rates April 1, 2010 – March 31, 2011* by Yukon Highways and Public Works where available. Mayo and Carmacks have contractors and are approximately 60 and 250 km away, respectively. Otherwise, unit costs and rates are based on experience of the author;
- No provision has been included for the possibility of requiring water quality monitoring nor for any acid rock drainage monitoring or mitigation measures at the site, based on information provided in the documents reviewed;
- Progressive reclamation will be undertaken at the site with reclamation of drill sites, trenches and trails once they are no longer required;
- No mob and demob costs have been included for equipment and manpower to undertake the closure tasks outlined in this report;
- A provision of 7% has been added to each of the area costs for project management. This includes design, site supervision, survey control and related costs for undertaking the tasks;
- A contingency of 15% of the final sub-total cost has been added, as is typical in preliminary cost estimates for sites such as this;
- The modular camp buildings are understood to already be on site and only need to be moved to the new location. Therefore only one set of buildings and associated components with a capacity of 100 persons will require decommissioning at the time of project closure.
- The proposed Membrane BioReactor treatment plant is an enclosed unit that is contained within a sea-can which can be easily decommissioned and hauled off-site when no longer required and whose only outside component will be the discharge field for the effluent;

- One water well and pumping system located adjacent to Dublin Gulch will be utilized for camp water. It and several temporary drill water supply pumps will need to be decommissioned at the end of the program;
- There is anticipated to be a minimum of buried components associated with the project and therefore none have been included here;
- It is expected that a quantity of debris from decommissioning the camp and associated buildings will require removal to an off-site landfill, likely in Mayo;
- Various un-used drummed and bagged products (Jet fuel, lubricants, oils, settling aids, etc) will be removed to off-site, most likely to their suppliers, with the only cost being removal to offsite, likely Mayo for pick-up;
- The upgraded access road to the site will be left in its proposed upgraded condition as the road pre-exists the proposed exploration program and the road also provides access to other exploration sites and active placer mine sites;
- Site roads and trails will require some bulldozer/excavator work to re-contour cut banks and fill slopes as well as to re-contour and scarify the road/trail surfaces. Some areas will also require revegetation and may also require additional erosion protection;
- It is understood that no bridges will be required to be constructed along the site roads and trails to undertake the exploration program. Thus no provision has been included for removal of any bridges on the site;
- Only a small number of the nearly 2,000 claims comprising the site will have exploration drill sites and trenches installed;
- Exploration trenches will be backfilled with stockpiled fill and overburden materials and revegetated, where required. This report assumes sufficient fill and overburden materials will have been stockpiled immediately adjacent to the trenches so no haulage of these materials is required (especially from off-site); and
- The areas where cut lines will be required for geo-physics will require no reclamation work.

Basis for Numbers

The following explanations provide information in support of the numbers utilized in the attached cost estimate table:

- Camp Area:
 - The disturbance area of the new camp site and outlying facilities (incl. helicopter pad, office complex, storage sheds, etc) is estimated at 0.6 ha based on information provided. This report assumes an additional disturbance area of 0.4 ha for the previous camp site and associated facilities which will likely remain at the time of program completion as well as other new areas (e.g., maintenance shop). Therefore a total disturbance area of 1.0 ha has been utilized;
- Road s and Trails:
 - An estimated 50% of the proposed new roads and trails on site (i.e., 50% of 100 km) will require scarification to encourage revegetation at the time of project completion;
 - An estimated 25% of the roads and trails on site (i.e., 25% of 100 km) will require revegetation. A 7.5 m width has been used for the disturbed corridor width based on the extra areas (beyond 5m road crest width) associated with a large number of cut banks and fill slopes that will be required to be re-contoured and then re-vegetated to achieve overall slope of 2:1 (or less) of the hillsides on which the trails were constructed;
 - An estimated total of 50 culverts along the 100 km of new site roads and trails will require removal after completion of the exploration program;

- Drill Sites:
 - The exploration program proposal calls on an average of 8 drill sites per claim. And there are close to 2000 claims within the project site. However, only a small percentage of these will likely be drilled. This report assumes that only 5% of the claims will have drill sites. Thus, there could be a total of 800 drill sites utilized. This report estimates 100 of those will remain un-reclaimed at the end of the 10 year exploration program, which will require decommissioning and reclamation. It is also estimated that none of the 800 drill sites will have been revegetated at the time of program closure. This report assumes that 25% of them will require revegetation and that the average area of each drill site will be 1000 m²;
- Trenches:
 - Of the total of 200 proposed trenches through the course of the 10 year exploration program this report estimates ~30 will remain to be backfilled and revegetated at the end of the exploration program. However, it also estimates that only half of all the trenches will have been already revegetated and thus 100 backfilled trenches will also require revegetation (for a total of 130 trenches to be revegetated).

Conclusions and Recommendations

The report provides a first order closure and reclamation cost estimate of \$467,000 for the proposed exploration program at the Dublin Gulch site. It includes a provision of 15%. There has been no provision provided for the pre-existing disturbances at the site due to the significant amount of historical exploration and placer mining undertakings over the years.

A comprehensive ground level site inspection of the entire project area (i.e., historically disturbed areas and areas proposed for the new exploration program) should be undertaken to enable a more accurate closure cost estimation.

<Original signed by>

S. Januszewski, P. Eng
SteveJan Consultants Inc.

Table 1 - Unit Costs

EQUIPMENT RATES		
Bulldozer-small (Cat D6)	\$160	per hr
Bulldozer-medium (Cat D8)	\$270	per hr
Haul Truck-off-road (Cat 740)	\$275	per hr
Haul Truck-on-road (tandem)	\$130	per hr
Excavator-medium (Cat 325)	\$170	per hr
Grader-medium (Cat 14H)	\$250	per hr
Loader-medium (Cat 988B)	\$190	per hr
Loader-small (Cat 950)	\$140	per hr
Tractor Trailer (lowbed)	\$160	per hr
Crane-medium (20 ton capacity)	\$160	per hr
Hiab Flatdeck truck	\$160	per hr
Pickup Truck	\$2,500	per month
Support Equipment	N / A	lump sum

PERSONNEL RATES		
Blaster	\$60	per hr
General Labourer	\$45	per hr
Trades Labourer	\$80	per hr
Site Supervisor	\$95	per hr
Technician	\$75	per hr
Design Engineer	\$130	per hr
Environmental Scientist	\$95	per hr
Project Manager	\$9,700	per month
Camp Labourer	\$4,000	per month
Site Caretaker	\$6,100	per month
Environmental Monitor	\$6,000	per month
Analytical Costs	N / A	Unit cost
Misc.	N / A	lump sum

REVEGETATION RATES		
Revegetation Seed Mix	\$13	per kg
Revegetation Seed Mix - 50kg/ha	\$510	per ha
Fertilizer	\$1	per kg
Fertilizer - 250kg/ha	\$250	per ha
Tree Seedlings	\$1,750	per ha (1,000 seedlings per ha)
Seed/Fertilizer Application	\$1,500	per ha
Erosion Barrier	\$3	sq m
Revegetation cost per ha. Including application cost	\$2,260	per ha

WATER TREATMENT RATES		
Pumping	N / A	cu.m
Reagent Addition	N / A	cu.m
Water treatment	N / A	cu.m
Sludge disposal	N / A	lump sum
Contingency Treatment Measures	N / A	lump sum

CONTRACTOR UNIT RATES & CAMP COST		
Excavation of Soil	\$5	cu.m
Supply and place Geotextile	\$5	sq m
Load, haul and place soil cover	\$5	cu.m
Haul & Place rock cover	\$7	cu.m
Drill, Blast and Screen Rip Rap	\$22	cu.m
Load and Haul Rip Rap	\$10	cu.m
Place Riprap	\$3	cu.m
HDPE Liner incl installation	\$10	sq m
Erosion barriers-installed	\$3	sq m
Freight run to Whitehorse	\$1,500	per load
Camp Cost	\$100	per day per person
Power and Heat	\$5,500	per month
Sundry equipment maintenance	\$5,000	yearly
General Administrative expenses	\$2,000	per month
Employee Transport Costs	\$3,000	per month

Table 2- Reclamation Costs Estimate for Proposed Adv. Exploration Program
Victoria Gold Corp.-Dublin Gulch Site

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Cost	Cost	Total Cost
1	Camp Area						
	Remove salvageable materials	General Labourer	per hr	8	\$45	\$360	
		Trades Labourer	per hr	4	\$80	\$320	
		988B Loader	per hr	8	\$190	\$1,520	
	Prepare modular trailers & remove from site	General Labourer	per hr	64	\$45	\$2,880	
		Trades Labourer	per hr	32	\$80	\$2,560	
		Bulldozer-medium (Cat D8)	per hr	8	\$270	\$2,160	
	Dismantle other buildings & structures	General Labourer	per hr	40	\$45	\$1,800	
		Trades Labourer	per hr	24	\$80	\$1,920	
		325 Excavator	per hr	8	\$170	\$1,360	
		988B Loader	per hr	8	\$190	\$1,520	
	Decommission MBR treatment plant & discharge field	General Labourer	per hr	16	\$45	\$720	
		Trades Labourer	per hr	8	\$80	\$640	
		Bulldozer-small (Cat D6)	per hr	4	\$160	\$640	
		325 Excavator	per hr	4	\$170	\$680	
		Tractor Trailer (lowbed)	per hr	4	\$160	\$640	
	Decommission water supply wells, pumping systems and storage tanks	General Labourer	per hr	16	\$45	\$720	
		Trades Labourer	per hr	8	\$80	\$640	
		Tractor Trailer (lowbed)	per hr	8	\$160	\$1,280	
		325 Excavator	per hr	4	\$170	\$680	
	Remove non-burnable solid waste to offsite landfill		lump sum	1	\$5,000	\$5,000	
	Remove fuel & propane tanks to off-site	Clean/purge tanks for transport	lump sum	1	\$2,000	\$2,000	
		Trades Labourer	per hr	8	\$80	\$640	
		Tractor Trailer (lowbed)	per hr	16	\$160	\$2,560	
		325 Excavator	per hr	4	\$170	\$680	
			lump sum	1	\$2,000	\$2,000	
	Recontour & scarify area	Bulldozer-small (Cat D6)	per hr	12	\$160	\$1,920	
	Revegetate	Revegetation cost per ha. Including application cost	per ha	1.0	\$2,260	\$2,260	
	Misc. materials & supplies	Misc.	lump sum	1	\$1,000	\$1,000	
	Project Management	7% of Total Cost	%		7.00%	\$2,877	\$41,100
	Sub-Total						\$44,000
2	Roads & Trails						
2.1	Main Access Road (Haggart Crk Rd.)						
	Install earthen barrier to prevent vehicular access to site on main access road	325 Excavator	per hr	4	\$170	\$680	
2.2	Site Roads & Trails (100 km)						
	Scarify road & trail surfaces (50% of above)	Bulldozer-small (Cat D6)	per hr	250	\$160	\$40,000	
	Re-contour banks & slopes for 2:1, as req'd	Bulldozer-small (Cat D6)	per hr	100	\$160	\$16,000	
	Remove culverts & install swales (-50)		each	50	\$500	\$25,000	
	Restoration of ford areas across 5 on-site streams		each	5	\$2,000	\$10,000	
	Erosion barriers/water bars/silt traps		each	5	\$1,000	\$5,000	
	Revegetate 25 km of roads & trails	Revegetation cost per ha. Including application cost	per ha	18.8	\$2,260	\$42,375	
	Project Management	7% of Total Cost	%		7.00%	\$9,734	\$139,055
	Sub-Total						\$149,000
3	Drill Sites						
	Recontour & scarify last 100 drill sites @ 1000 m2 apiece	Bulldozer-small (Cat D6)	per hr	600	\$160	\$96,000	
	Revegetate 200 drill sites	Revegetation cost per ha. Including application cost	per ha	20	\$2,260	\$45,200	
	Project Management	7% of Total Cost	%		7.00%	\$9,884	\$141,200
	Sub-Total						\$151,000
4	Trenches						
	Backfill last 30 trenches	325 Excavator	per hr	150	\$170	\$25,500	
		Bulldozer-small (Cat D6)	per hr	150	\$160	\$24,000	
	Revegetate 130 of 200 trenches	Revegetation cost per ha. Including application cost	per ha	3.9	\$2,260	\$8,814	
	Project Management	7% of Total Cost	%		7.00%	\$4,082	\$58,314
	Sub-Total						\$62,000
5	Miscellaneous Components						
	Environmental monitoring	Not Applicable					
	Mob & Demob	Not Applicable					
	Contractor Overheads	Not Applicable					
	Permitting, insurance, bonds	Not Applicable					
	Project Management	7% of Total Cost	%		7.00%	\$0	\$0
	Sub-Total						\$0
	Final Sub-Total						\$406,000
	Contingency	15% of Final Sub-Total			15.00%		\$61,000
	Exploration Program Reclamation - Total Estimated Cost						\$467,000

APPENDIX B

Detailed Closure Cost Estimate: End of Stage 1
Construction

TABLE B.1

**STRATAGOLD CORPORATION
EAGLE GOLD PROJECT**

**UNIT RATE COST TABLE
EQUIPMENT RATES**

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Equipment	Rate	Unit
Bulldozer - Small (i.e. CAT D6 or similar)	\$160	per hr
Tandem Dump Truck	\$130	per hr
CAT 330 Excavator (or similar)	\$240	per hr
CAT 330 Excavator with Hammer (or similar)	\$275	per hr
16H Grader (or similar)	\$300	per hr
Tractor Trailer (lowbed)	\$130	per hr
Pickup Truck	\$2,500	per month

I:\1\01\00290\08\A\Report\Report 5, Rev 0 - QML Part 1\End of Construction Stage Rev 0 July 30, 2013.xlsx]Equipment

NOTES:

1.EQUIPMENT RATES ARE BASED ON RATES PUBLISHED IN THE THIRD PARTY EQUIPMENT RENTAL RATES BOOK GOVERNMENT OF YUKON, 2013) AND EXPERIENCE ON SIMILAR PROJECTS.

0	01AUG'13	ISSUED WITH REPORT VA101-00290/8-5	JSP	RWT	DG
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TABLE B.2

**STRATAGOLD CORPORATION
EAGLE GOLD PROJECT**

**UNIT RATE COST TABLE
PERSONNEL RATES**

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Position	Rate	Unit
General Labourer	\$45	per hr
Site Supervisor	\$95	per hr
Project Manager	\$9,700	per month
Camp Labourer	\$4,000	per month
Trades Labourer	\$90	per hr
Site Caretaker	\$6,100	per month
Environmental Monitor	\$90	per hr

I:\1\01\00290\08\A\Report\Report 5, Rev 0 - QML Part 1\End of Construction Stage Rev 0 July 30, 2013.xlsx\Personnel

NOTES:

1. UNIT RATES ARE BASED ON RATES USED FOR SIMILAR PROJECTS IN THE YUKON.

0	01AUG'13	ISSUED WITH REPORT VA101-00290/8-5	JSP	RWT	DG
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TABLE B.3

**STRATAGOLD CORPORATION
EAGLE GOLD PROJECT**

**UNIT RATE COST TABLE
REVEGETATION RATES**

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Task/Activity	Rate	Unit
Revegetation Seed Mix (50kg/ha)	\$510	per ha
Fertilizer (250 kg/ha)	\$250	per ha
Revegetation Cost (including application cost)	\$2,500	per ha

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NOTES:

1. UNIT RATES ARE BASED ON RATES USED FOR SIMILAR PROJECTS IN THE YUKON AND PREVIOUS EXPERIENCE ON SIMILAR PROJECTS.

0	01AUG'13	ISSUED WITH REPORT VA101-00290/8-5	JSP	RWT	DG
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TABLE B.4

**STRATAGOLD CORPORATION
EAGLE GOLD PROJECT**

**UNIT RATE COST TABLE
CONTRACTOR AND CAMP RATES**

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Contractor Unit Rates and Camp Costs	Rate	Unit
Load, Haul and Place Soil	\$6.50	cu.m
Freight Run to Whitehorse	\$1,500	per load
Camp Cost	\$55	per day per person

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NOTES:

1. UNIT RATES ARE BASED ON RATES USED FOR SIMILAR PROJECTS IN THE YUKON.

0	01AUG'13	ISSUED WITH REPORT VA101-00290/8-5	JSP	RWT	DG
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TABLE B.5

**STRATAGOLD CORPORATION
EAGLE GOLD PROJECT**

**RECLAMATION AND CLOSURE
END OF CONSTRUCTION STAGE I - COST SUMMARY**

WORK SHEET TITLE	COST
COST SUMMARY	
General and Administration	\$ 1,196,000
Mine Workings - Open Pit	\$ 1,272,550
Waste Rock Areas	\$ 105,925
Heap Leach Facility	\$ 737,645
Surface Facilities - Mine Area	\$ 88,400
Surface Facilities - Processing Facilities	\$ 388,880
Major Water Storage Ponds	\$ 678,725
Infrastructure	\$ 730,330
Waste Disposal/Remediation	\$ 62,200
Roads and Trails	\$ 187,950
Quarries and Borrow Pits	\$ 128,800
Sediment and Erosion Control	\$ 23,600
Monitoring and Reporting	\$ 225,000
Subtotal	\$ 5,826,005
5% Tax	\$ 291,300
10% Contingency	\$ 582,700
Total	\$ 6,700,100

I:\1101\00290\08\A\Report\Report 5, Rev 0 - QML Part 1\End of Construction Stage Rev 0 July 30, 2013.xlsx]Summary

NOTES:

1. UNIT RATES ARE BASED ON RECOMMENDED RATES PROVIDED BY IN THE DRAFT PLAN REQUIREMENTS FOR QUARTZ MINE LICENCING (GOVERNMENT OF YUKON, 2012) AND FEASIBILITY STUDY (WARDROP, 2012)

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TABLE B.6

STRATAGOLD CORPORATION
EAGLE GOLD PROJECT

RECLAMATION AND CLOSURE COSTING
END OF CONSTRUCTION STAGE I - GENERAL AND ADMINISTRATION

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Task / Component	Comment	Quantity	Unit	Unit Rate	Cost
General and Administration					
Mob/Demob		1	L.S.	\$ 60,000	\$ 60,000
Materials and Services	Power, insurance and miscellaneous supplies	1	L.S.	\$ 50,000	\$ 50,000
Project Management, Engineering and Supervision	12% of direct costs	-	%	12%	\$ 528,700
Vehicles for Management and Supervisors	Pickup Truck (2)	12	month	\$ 5,000	\$ 60,000
Camp Costs	Daily camp costs	4,380	per person per day	\$ 55	\$ 240,900
Site Caretaker	Site supervision and security	24	month	\$ 6,100	\$ 146,400
	Pickup Truck	12	month	\$ 2,500	\$ 30,000
Road Maintenance	\$2,000 per month (maintained 8 months per year for 5 years)	5	L.S.	\$ 16,000	\$ 80,000
Total					\$ 1,196,000

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NOTES:

1. UNIT RATES ARE BASED ON RECOMMENDED RATES PROVIDED BY IN THE DRAFT PLAN REQUIREMENTS FOR QUARTZ MINE LICENCING (GOVERNMENT OF YUKON, 2012) AND FEASIBILITY STUDY (WARDROP, 2012)
2. QUANTITIES ARE BASED ON THE NEATLINE AREAS CALCULATED FROM FIGURE 1.4-1

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TABLE B.7

**STRATAGOLD CORPORATION
EAGLE GOLD PROJECT**

**RECLAMATION AND CLOSURE COSTING
END OF CONSTRUCTION STAGE I - MINE WORKINGS - OPEN PIT**

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Task / Component	Comment	Quantity	Unit	Unit Rate	Cost
Open Pit					
Load, Haul and Place Growth Media	Area of 821,000 m ² with 0.2 m depth	164,200	m ³	\$ 6.50	\$ 1,067,300
Revegetate Disturbed Area	Seed and fertilize	82.1	ha	\$ 2,500	\$ 205,250
Total					\$ 1,272,550

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NOTES:

1. UNIT RATES ARE BASED ON RECOMMENDED RATES PROVIDED BY IN THE DRAFT PLAN REQUIREMENTS FOR QUARTZ MINE LICENCING (GOVERNMENT OF YUKON, 2012) AND FEASIBILITY STUDY (WARDROP, 2012)
2. QUANTITIES ARE BASED ON THE NEATLINE AREAS CALCULATED FROM FIGURE 1.4-1
3. ASSUMES THAT THE PIT QUARRY WALLS AREA STABILIZED AND THE BORROW SITE IS CONTOURED DURING QUARRYING OPERATIONS

0	01AUG'13	ISSUED WITH REPORT VA101-00290/8-5	JSP	RWT	DG
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TABLE B.8

**STRATAGOLD CORPORATION
EAGLE GOLD PROJECT**

**RECLAMATION AND CLOSURE COSTING
END OF CONSTRUCTION STAGE I - WASTE ROCK AND OVERBURDEN AREAS**

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Task / Component	Comment	Quantity	Unit	Unit Rate	Cost
Ice Rich Material Stockpile					
Revegetate Stockpile	Seed and fertilize	9.6	ha	\$ 2,500	\$ 24,000
Subtotal					\$ 24,000
Overburden Stockpile					
Revegetate Disturbed Area	Seed and fertilize	32.8	ha	\$ 2,500	\$ 81,925
Subtotal					\$ 81,925
Total					\$ 105,925

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NOTES:

1. UNIT RATES ARE BASED ON RECOMMENDED RATES PROVIDED BY IN THE DRAFT PLAN REQUIREMENTS FOR QUARTZ MINE LICENCING (GOVERNMENT OF YUKON, 2012) AND FEASIBILITY STUDY (WARDROP, 2012)
2. QUANTITIES ARE BASED ON THE NEATLINE AREAS CALCULATED FROM FIGURE 1.4-1
3. ASSUMES THAT THE OVERBURDEN AND ICE RICH PILES WILL BE CONSTRUCTED/LEFT STABLE AT CLOSURE AND NO RECOUNTING IS NECESSARY

0	01AUG'13	ISSUED WITH REPORT VA101-00290/8-5	JSP	RWT	DG
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TABLE B.9

STRATAGOLD CORPORATION
EAGLE GOLD PROJECT

RECLAMATION AND CLOSURE COSTING
END OF CONSTRUCTION STAGE I - HEAP LEACH FACILITY

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Task / Component	Comment	Quantity	Unit	Unit Rate	Total
Heap Leach Facility					
Re-Contour Disturbed Area	Embankment area and spillway	5.4	ha	\$ 10,700	\$ 57,780
Load, Haul and Place Growth Media	Embankment and pad area (438,4550 m ² with 0.2 m depth)	87,710	m ³	\$ 6.50	\$ 570,115
Revegetate Disturbed Area	Embankment and pad area	43.9	ha	\$ 2,500	\$ 109,750
Total					\$ 737,645

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NOTES:

1. UNIT RATES ARE BASED ON RECOMMENDED RATES PROVIDED BY IN THE DRAFT PLAN REQUIREMENTS FOR QUARTZ MINE LICENCING (GOVERNMENT OF YUKON, 2012) AND FEASIBILITY STUDY (WARDROP, 2012)
2. QUANTITIES ARE BASED ON THE NEATLINE AREAS CALCULATED FROM FIGURE 1.4-1
3. ASSUMES THAT THE HEAP LEACH PAD AREA WILL NOT NEED TO BE RECONTOURED AT CLOSURE

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TABLE B.10
STRATAGOLD CORPORATION
EAGLE GOLD PROJECT
RECLAMATION AND CLOSURE COSTING
END OF CONSTRUCTION STAGE I - SURFACE FACILITIES - MINE AREA

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Task / Component	Comment	Quantity	Unit	Unit Rate	Cost
Laboratory Analysis for Soils	Analytical costs	3	L.S.	\$ 500	\$ 1,500
Haul Contaminated Soils to Land Treatment Facility	Excavator	2	hrs	\$ 240	\$ 480
	Tandem haul truck	2	hrs	\$ 130	\$ 260
Foundation Demolition (Diesel Storage, Truck Shop and Propane Farm)	Excavator with hammer and general labourer	40	hrs	\$ 320	\$ 12,800
Re-Contouring and Scarification		2.8	ha	\$ 10,700	\$ 29,960
Load, Haul and Place Growth Media	28,000 m ² with 0.2 m depth	5,600	m ³	\$ 6.50	\$ 36,400
Revegetate Disturbed Area	Seed and fertilize	2.8	ha	\$ 2,500	\$ 7,000
Total					\$ 88,400

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NOTES:

1. UNIT RATES ARE BASED ON RECOMMENDED RATES PROVIDED BY IN THE DRAFT PLAN REQUIREMENTS FOR QUARTZ MINE LICENCING (GOVERNMENT OF YUKON, 2012) AND FEASIBILITY STUDY (WARDROP, 2012)
2. QUANTITIES ARE BASED ON THE NEATLINE AREAS CALCULATED FROM FIGURE 1.4-1

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TABLE B.11

STRATAGOLD CORPORATION
EAGLE GOLD PROJECT

RECLAMATION AND CLOSURE COSTING
END OF CONSTRUCTION STAGE I - SURFACE FACILITIES - PROCESS FACILITIES

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Task / Component	Comment	Quantity	Unit	Unit Rate	Cost
Process Facilities					
Foundation Demolition (Crushers, Conveyor, Process Facilities)	2 Excavators with hammers and 2 general labourers	100	hrs	\$ 640	\$ 64,000
Re-Contouring		12.4	ha	\$ 10,700	\$ 132,680
Load, Haul and Place Growth Media	124,000 m ² with 0.2 m depth	24,800	m ³	\$ 6.50	\$ 161,200
Revegetate Disturbed Area		12.4	ha	\$ 2,500	\$ 31,000
Total					\$ 388,880

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NOTES:

1. UNIT RATES ARE BASED ON RECOMMENDED RATES PROVIDED BY IN THE DRAFT PLAN REQUIREMENTS FOR QUARTZ MINE LICENCING (GOVERNMENT OF YUKON, 2012) AND FEASIBILITY STUDY (WARDROP, 2012)
2. QUANTITIES ARE BASED ON THE NEATLINE AREAS CALCULATED FROM FIGURE 1.4-1

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TABLE B.12
STRATAGOLD CORPORATION
EAGLE GOLD PROJECT
RECLAMATION AND CLOSURE COSTING
END OF CONSTRUCTION STAGE I - WATER MANAGEMENT INFRASTRUCTURE

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Task / Component	Comment	Quantity	Unit	Unit Rate	Cost
Lower Dublin North Pond					
Removal of Infrastructure and Liner	General labourer	10	hrs	\$ 45	\$ 450
	Excavator	10	hrs	\$ 240	\$ 2,400
Haul Waste to Landfill	Tandem axle haul truck	2	hrs	\$ 130	\$ 260
Breaching and Re-Contouring		1	ha	\$ 10,700	\$ 10,700
Load, Haul and Place Growth Media	10,500 m ² with 0.2 m depth	2,100	m ³	\$ 6.50	\$ 13,650
Revegetate Disturbed Area	Seed and fertilize	1	ha	\$ 2,500	\$ 2,500
Subtotal					\$ 29,960
Lower Dublin South Pond					
Removal of Infrastructure and Liner	General labourer	15	hrs	\$ 45	\$ 675
	Excavator	15	hrs	\$ 240	\$ 3,600
Haul Waste to Landfill	Tandem axle haul truck	2	hrs	\$ 130	\$ 260
Breaching and Re-Contouring		3.6	ha	\$ 10,700	\$ 38,520
Load, Haul and Place Growth Media	35,800 m ² with 0.2 m depth	7,160	m ³	\$ 6.50	\$ 46,540
Revegetate Disturbed Area	Seed and fertilize	3.6	ha	\$ 2,500	\$ 9,000
Subtotal					\$ 98,595
Platinum Gulch Pond					
Removal of Infrastructure and Liner	General labourer	10	hrs	\$ 45	\$ 450
	Excavator	10	hrs	\$ 240	\$ 2,400
Haul Waste to Landfill	Tandem axle haul truck	2	hrs	\$ 130	\$ 260
Breaching and Re-Contouring		2	ha	\$ 10,700	\$ 21,400
Load, Haul and Place Growth Media	19,900 m ² with 0.2 m depth	3,980	m ³	\$ 6.50	\$ 25,870
Revegetate Disturbed Area	Seed and fertilize	2	ha	\$ 2,500	\$ 5,000
Subtotal					\$ 55,380
Diversion and Collection Ditches					
Decommission Collection and Diversion Ditches	Approx. 20 km will be reclaimed as part of the road decommissioning. This includes removal of culverts, resloping, and revegetating of ditches.	N/A	N/A	N/A	-
Removal of Approx. 2 km of Corrugated Steel Half-Pipe	Excavator	20	hrs	\$ 240	\$ 4,800
	Tractor trailer (lowbed) for off-site salvage	30	hrs	\$ 130	\$ 3,900
Subtotal					\$ 8,700
Dublin Gulch Diversion Channel					
Backfill Diversion Channel	Assume Bulking Factor of 30% - Excavated Volume = 495,329 m ³ . Minus volume of topsoil excavated 27,482 m ³ Assume 10% of channel is backfilled to restabilize channels from Eagle Pup and Suttles Gulches	32,749	m ³	\$ 6.50	\$ 212,870
Engineering of Armouring for Restabilization of Channels	Engineering support	1	L.S.	\$ 25,000.00	\$ 25,000
Armouring for Restabilization of Channels	10,000 m ² with 0.3 m depth	3,000	m ³	\$ 12.00	\$ 36,000
Re-contour Channel		8.1	ha	\$ 10,700	\$ 86,670
Load, Haul and Place Growth Media	81,000 m ² with 0.2 m depth	16,200	m ³	\$ 6.50	\$ 105,300
Revegetate Disturbed Area	Seed and fertilize	8.1	ha	\$ 2,500	\$ 20,250
Subtotal					\$ 486,090
Total					\$ 678,725

NOTES:

1. UNIT RATES ARE BASED ON RECOMMENDED RATES PROVIDED BY IN THE DRAFT PLAN REQUIREMENTS FOR QUARTZ MINE LICENCING (GOVERNMENT OF YUKON, 2012) AND FEASIBILITY STUDY (WARDROP, 2012)
2. QUANTITIES ARE BASED ON THE NEATLINE AREAS CALCULATED FROM FIGURE 1.4-1 AND EXCAVATION VOLUMES PROVIDED FOR THE DUBLIN GULCH DIVERSION CHANNEL IN THE STAGE 1 CONSTRUCTION PLAN (SGC, 2013)

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TABLE B.13

STRATAGOLD CORPORATION
EAGLE GOLD PROJECT

RECLAMATION AND CLOSURE COSTING
END OF CONSTRUCTION STAGE I - INFRASTRUCTURE

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Task / Component	Comment	Quantity	Unit	Unit Rate	Total
Guard House and Area					
Removal of Salvageable Equipment	General labourer	10	hrs	\$ 45	\$ 450
	Trades labourer	5	hrs	\$ 90	\$ 450
Removal of Building and Fence	Tandem haul truck 1 load, tractor trailer (lowbed) 1 load (10 hrs per load)	10	hrs	\$ 260	\$ 2,600
	Excavator	4	hrs	\$ 240	\$ 960
Foundation Demolition	Excavator with hammer and general labourer	20	hrs	\$ 320	\$ 6,400
Re-Contour and Scarify Area	Bulldozer and grader	8	hrs	\$ 460	\$ 3,680
Load, Haul and Place Growth Media	25,200 m ² with 0.2 m depth	5,040	m ³	\$ 6.50	\$ 32,760
Revegetate Disturbed Area	Seed and fertilize	2.5	ha	\$ 2,500	\$ 6,250
Subtotal					\$ 53,550
Camp Facilities and Laydown Area					
Remove Salvageable Materials	General labourer	40	hrs	\$ 45	\$ 1,800
	Trades labourer	20	hrs	\$ 90	\$ 1,800
	Excavator (demolition and loadings)	16	hrs	\$ 240	\$ 3,840
Prepare and Remove Modular Buildings from Site	General labourer	100	hrs	\$ 45	\$ 4,500
	Excavator	10	hrs	\$ 240	\$ 2,400
	Tractor trailer (lowbed)	80	hrs	\$ 130	\$ 10,400
Dismantle Other Buildings and Infrastructure	General labourer	40	hrs	\$ 45	\$ 1,800
	Trades labourer	20	hrs	\$ 90	\$ 1,800
	Excavator	10	hrs	\$ 240	\$ 2,400
Decommission Pumping and Distributing Systems and Storage Tanks	General labourer	24	hrs	\$ 45	\$ 1,080
	Trades labourer	24	hrs	\$ 90	\$ 2,160
	Excavator	8	hrs	\$ 240	\$ 1,920
Decommission Water Supply Wells	Fill with concrete	2	each	\$ 2,000	\$ 4,000
Decommission Water Treatment Plant	General labourer	20	hrs	\$ 45	\$ 900
	Trades labourer	10	hrs	\$ 90	\$ 900
	Excavator	8	hrs	\$ 240	\$ 1,920
	Tractor trailer (lowbed)	10	hrs	\$ 130	\$ 1,300
Removal of Salvageable Equipment and Materials	Tandem haul truck 1 loads (10 hrs per load)	10	hrs	\$ 130	\$ 1,300
Removal of Waste to Landfill	Tandem axle haul truck	2	hrs	\$ 130	\$ 260
Scarify Area	Grader	12	hrs	\$ 300	\$ 3,600
Re-contour Area	Bulldozer	20	hrs	\$ 160	\$ 3,200
Load, Haul and Place Growth Media	90,000 m ² with 0.2 m depth	18,000	m ³	\$ 6.50	\$ 117,000
Revegetate Disturbed Area	Seed and fertilize	9	ha	\$ 2,500	\$ 22,500
Subtotal					\$ 192,780
Electrical Infrastructure - Emergency Gensets, Main Substation, Transmission Lines					
Removal of Transmission Lines Along Haggart Creek Road (~44km)		44	km	\$ 11,000	\$ 484,000
Subtotal					\$ 484,000
Total					\$ 730,330

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NOTES:

- UNIT RATES ARE BASED ON RECOMMENDED RATES PROVIDED BY IN THE DRAFT PLAN REQUIREMENTS FOR QUARTZ MINE LICENCING (GOVERNMENT OF YUKON, 2012) AND FEASIBILITY STUDY (WARDROP, 2012)
- QUANTITIES ARE BASED ON THE NEATLINE AREAS CALCULATED FROM FIGURE 1.4-1

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TABLE B.14

STRATAGOLD CORPORATION
EAGLE GOLD PROJECT

RECLAMATION AND CLOSURE COSTING
END OF CONSTRUCTION STAGE I - WASTE DISPOSAL/REMEDIATION

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Task / Component	Comment	Quantity	Unit	Unit Rate	Cost
Miscellaneous Solid Waste, Hazardous Waste and Contaminated Soils					
Landfill	Placement of 1 m thick colluvium cap over landfill. Assume 10% (0.12 ha) of total landfill volume utilized at end of Stage 1 Construction	1,200	m ³	\$ 6.50	\$ 7,800
	Placement of geomembrane including 10% for overlap	1,320	m ²	\$ 20	\$ 26,400
Revegetate Disturbed Area	Seed and fertilize	1.2	ha	\$ 2,500	\$ 3,000
Hazardous Waste Disposal	Off-site disposal	1	L.S.	\$ 5,000	\$ 5,000
Contaminated Soils	Off-site disposal	1	L.S.	\$ 20,000	\$ 20,000
Total					\$ 62,200

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NOTES:

- UNIT RATES ARE BASED ON RECOMMENDED RATES PROVIDED BY IN THE DRAFT PLAN REQUIREMENTS FOR QUARTZ MINE LICENCING (GOVERNMENT OF YUKON, 2012) AND FEASIBILITY STUDY (WARDROP, 2012)
- QUANTITIES ARE BASED ON THE NEATLINE AREAS CALCULATED FROM FIGURE 1.4-1

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TABLE B.15

**STRATAGOLD CORPORATION
EAGLE GOLD PROJECT**

**RECLAMATION AND CLOSURE COSTING
END OF CONSTRUCTION STAGE I - ROADS AND TRAILS**

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Task / Component	Comment	Quantity	Unit	Unit Rate	Cost
Site Access and Haul Roads					
Removal of Culverts	Removal of culvert to off-site location, and resloping of banks and armouring of channel in culvert location	15	each	\$ 3,000	\$ 45,000
Re-Contour Road and Drainage Ditches	Grader	200	hrs	\$ 160	\$ 32,000
Stabilize Cut/Fill Slopes	Excavator	80	hrs	\$ 240	\$ 19,200
Revegetate	Seed and fertilize	36.7	ha	\$ 2,500	\$ 91,750
Total					\$ 187,950

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NOTES:

1. UNIT RATES ARE BASED ON RECOMMENDED RATES PROVIDED BY IN THE DRAFT PLAN REQUIREMENTS FOR QUARTZ MINE LICENCING (GOVERNMENT OF YUKON, 2012) AND FEASIBILITY STUDY (WARDROP, 2012)
2. QUANTITIES ARE BASED ON THE NEATLINE AREAS CALCULATED FROM FIGURE 1.4-1

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TABLE B.16

**STRATAGOLD CORPORATION
EAGLE GOLD PROJECT**

**RECLAMATION AND CLOSURE COSTING
END OF CONSTRUCTION STAGE I - QUARRIES AND BORROW PITS**

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Task / Component	Comment	Quantity	Unit	Unit Rate	Cost
Stabalize slopes	Excavator	20	hrs	\$ 240	\$ 4,800
Load, Haul and Place Growth Media	80,000 m ² with 0.2 m depth	16,000	m ³	\$ 6.50	\$ 104,000
Revegetate Disturbed Area	Seed and fertilize	8	ha	\$ 2,500	\$ 20,000
Total					\$ 128,800

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NOTES:

1. UNIT RATES ARE BASED ON RECOMMENDED RATES PROVIDED BY IN THE DRAFT PLAN REQUIREMENTS FOR QUARTZ MINE LICENCING (GOVERNMENT OF YUKON, 2012) AND FEASIBILITY STUDY (WARDROP, 2012)

2. QUANTITIES ARE BASED ON THE NEATLINE AREAS CALCULATED FROM FIGURE 1.4-1

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TABLE B.17

STRATAGOLD CORPORATION
EAGLE GOLD PROJECT

RECLAMATION AND CLOSURE COSTING
END OF CONSTRUCTION STAGE I - SEDIMENT AND EROSION CONTROL

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Task / Component	Comment	Quantity	Unit	Unit Rate	Cost
Sediment and Erosion Control					
Installation of Sediment and Erosion Control Measures		1	L.S.	\$ 20,000	\$ 20,000
Removal of Sediment and Erosion Control Measures	General Labourer	80	hrs	\$ 45	\$ 3,600
Total					\$ 23,600

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NOTES:

1. UNIT RATES ARE BASED ON RECOMMENDED RATES PROVIDED BY IN THE DRAFT PLAN REQUIREMENTS FOR QUARTZ MINE LICENCING (GOVERNMENT OF YUKON, 2012) AND FEASIBILITY STUDY (WARDROP, 2012)
2. QUANTITIES ARE BASED ON THE NEATLINE AREAS CALCULATED FROM FIGURE 1.4-1

0	01AUG'13	ISSUED WITH REPORT VA101-00290/8-5	JSP	RWT	DG
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

TABLE B.18

STRATAGOLD CORPORATION
EAGLE GOLD PROJECT

RECLAMATION AND CLOSURE COSTING
END OF CONSTRUCTION STAGE I - MONITORING AND REPORTING

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Task / Component	Comment	Quantity	Unit	Unit Rate	Cost
Monitoring					
General Site Monitoring and Reclamation	Monitoring 3 times per year (spring, summer and fall) for 5 years	15	Each	\$ 15,000	\$ 225,000
Total					\$ 225,000

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NOTES:

1. UNIT RATES ARE BASED ON RECOMMENDED RATES PROVIDED BY IN THE DRAFT PLAN REQUIREMENTS FOR QUARTZ MINE LICENCING (GOVERNMENT OF YUKON, 2012) AND FEASIBILITY STUDY (WARDROP, 2012)
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0	01AUG'13	ISSUED WITH REPORT VA101-00290/8-5	JSP	RWT	DG
REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D

APPENDIX C

Detailed Closure Cost Estimate:
Year 2 and End of Mine Life

Summary Table of Estimated Closure Costs

Description of Cost	Estimated Cost Year 2	Estimated Cost EOM
Closure Implementation		
T3 General & Administration	\$1,385,565	\$3,172,881
T4 Exploration Disturbances		
T5 Closure Planning	\$260,000	\$260,000
T6 Pit	\$55,358	\$55,358
T7 Heap Leach Pad	\$2,950,549	\$12,358,649
T8 Waste Dumps	\$2,906,897	\$3,623,053
T9 Surface Facilities	\$2,936,606	\$2,936,606
T10 Infrastructure	\$752,958	\$752,958
T11 Waste Disposal and Remediation	\$103,295	\$115,795
T12 Landfills	\$131,422	\$131,422
T13 Roads & Trails	\$428,620	\$428,620
T14 Water Management	\$1,990,563	\$4,802,940
Sub-total	\$13,901,833	\$28,638,282
Indirect Costs (%)	10%	10%
Indirect Costs	\$1,390,183	\$2,863,828
Cost Inflation	\$764,601	\$3,780,253
Total Closure Implementation Costs	\$16,056,617	\$35,282,363
T15 Care, Maintenance, and Monitoring Costs (Phase 6, 7/8)		
Onsite Management	\$1,680,000	\$1,680,000
Transport Costs	\$69,375	\$69,375
Water Treatment Costs (Phase 6)		
Active Treatment		
Capital Costs	\$3,996,916	\$3,996,916
Capital Replacement Costs	\$695,961	\$695,961
Operating Costs	\$6,659,905	\$6,659,905
Passive Treatment (Phase 7-8)		
Capital Costs	\$250,000	\$250,000
Capital Replacement Costs	\$22,500	\$22,500
Operating Costs	\$225,000	\$225,000
Reclamation & Closure Research Plan (Post Closure I-II)	\$75,000	\$75,000
Monitoring & Reporting	\$3,856,428	\$3,856,428
Post Closure I-II Maintenance	\$112,500	\$112,500
Sub-Total	\$17,643,585	\$17,643,585
Sub-Total NPV (2.5% DROR)	\$9,798,354	\$11,127,283
Indirect Costs (%)	10%	10%
Indirect Costs	\$979,835	\$1,112,728
Total (NPV)	\$10,778,189	\$12,240,011
Total Closure Costs	\$26,834,806	\$47,522,374
Contingency Allowance	15%	15%
Contingency Amount	\$4,025,221	\$7,128,356
Total Closure Costs (Plus Contingency)	\$30,860,027	\$54,650,730

Closure Unit Rates

Equipment Rates		
Equipment	Unit Rates	Per Unit
D9H Dozer	\$350	per hr
Wheel Loader (939 or equivalent)	\$345	per hr
Loader (PC3000 or equivalent)		
General Purpose Loader (Cat 416 E or equivalent)		
Haul Truck (Komatsu HD 1500-7 or equivalent)	\$286	per hr
Track Dozer (570 HP or equivalent)	\$215	per hr
Drill Rig (DR 500 or equivalent)		
Grader (Cat 140K or equivalent)		
Water Truck (52,994 L 550 HP)		
D6D Dozer	\$200	per hr
Haul Truck D250E	\$250	per hr
Tandem Haul Truck	\$150	per hr
Cat 235 Excavator	\$250	per hr
Cat 235 Excavator w hammer	\$275	per hr
Cat 16H grader	\$250	per hr
988B Loader	\$200	per hr
Tractor Trailer (lowbed)	\$180	per hr
30 ton Crane	\$190	per hr
Hiab Flatdeck truck	\$160	per hr
Cat 950 loader	\$155	per hr
Vibratory Roller	\$150	per hr
Pickup Truck	\$2,500	per mo
Personnel Rates		
Personnel	Unit Rates	Per Unit
Blaster	\$68	per hr
General Labourer	\$52	per hr
Trades Labourer	\$91	per hr
Site Supervisor	\$110	per hr
Design Engineer	\$149	per hr
Environmental Scientist	\$110	per hr
Project Manager	\$10,670	per mo
Camp Labourer	\$4,400	per mo
Site Caretaker	\$6,710	per mo
Environmental Monitor	\$5,500	per mo
Revegetation Rates		
	Unit Rates	Per Unit
Revegetation Seed Mix	\$17.50	per kg
Revegetation Seed Mix - 50kg/ha	\$875	per ha
Fertilizer	\$1.10	per kg
Fertilizer - 250kg/ha	\$275	per ha
Tree Seedlings (1,000 seedlings per ha)	\$2,000	per ha
Seed/Fertilizer Application	\$1,700	per ha
Erosion Barrier	\$3	per sq.m
Revegetation cost per ha. Including application cost	\$2,850.00	per ha
Passive/Heap In Situ Treatment		
	Unit Rates	Per Unit
Custom Rate: Heap Leach Recirculation Cost--Reagent Delivery		per day
In Situ Treatment Reagent--Reducing Sugars and Nutrients	\$1,600	per ton
In Situ Treatment Reagent--Alcohols and Nutrients	\$1,800	per ton
Fertilizer - 250kg/ha		per ha
Wetland plants (4,000 seedlings per ha)	\$8,000	per ha
Seed/Fertilizer Application		per ha
Contractor Unit Rates & Camp Costs		
	Unit Rates	Per Unit
Custom Rate A (Load, haul, place soil cover Heap)	\$2.62	per cu.m
Custom Rate B (Load, haul, place soil cover Eagle Pup)	\$3.62	per cu.m
Custom Rate C (Load, haul, place soil cover Platinum Gulch)	\$4.71	per cu.m
Custom Rate D (Load, haul, place wetland soil in CWTS)	\$2.62	per cu.m
Custom Rate E (Load, haul, place soil cover IROSA)	\$4.71	per cu.m
Custom Rate F (surface flow contact water buried 6 inch HDPE in lined ditch)		per m
Produce rip-rap	\$15.00	per cu.m
Load, haul and place rip-rap	\$15.00	per cu.m
Deliver and install geosynthetic membrane on prepared foundation	\$20.00	per sq.m
Poured Concrete		per cu.m
Unit Basis (footing burial)	\$5.00	each
GeoWeb - GW30V3	\$5.60	per sq.m
GeoWeb - GW30V4	\$7.10	per sq.m
GeoWeb - GW30V6	\$10.60	per sq.m
Freight run to Whitehorse	\$1,200.00	per load
Camp Cost	\$55.00	per day per person
Site Security Cost		per month
Power and Heat	\$19,440.00	per month
Employee Transport Costs	\$7,500.00	per month

Notes:

1) Custom Rates A through F developed specifically for Eagle Project, taking into account such factors as haul distance, grade, machinery req`d, time reqd, etc.

2) Unit rates for GeoWeb materials are provided by a licensed vendor and are considered conservative costs which include delivery and installation.

General and Administration Costs

[illegible]

Exploration Disturbances

Assumption is that all exploration disturbance is already bonded for or else will be within the footprint of other areas that will be reclaimed elsewhere

Closure Plan Development - Phase 4

Item No.	Work Item Description	Equipment / Labour	Units	Unit Rates	Quantity Year 2	Quantity EOM	Cost Year 2	Cost EOM
3.1	Closure Specific Studies and Field Trials							
	Update closure plan every two years	Engineering/Design	I.s.	\$30,000	1	1	\$30,000	\$30,000
	Passive Treatment Detailed Plan	Engineering/Design	I.s.	\$100,000	1	1	\$100,000	\$100,000
	Engineered Cover Evaluations	Engineering/Design	I.s.	\$75,000	1	1	\$75,000	\$75,000
	Site contamination surveys (pre \$35K, post \$20K)		I.s.	\$55,000	1	1	\$55,000	\$55,000
						Sub-Total	\$260,000	\$260,000
	Closure Plan Development							
Total Estimated Cost for Closure Plan Development							\$260,000	\$260,000
Notes:								

Open Pit, Estimated Closure Costs - Phase 6

[illegible]

Heap Leach Facility, Estimated Closure Costs

[illegible]

Waste Rock and Overburden Dumps - Phase 2 (PG WRSA) and Phase 6

[illegible]

ADR & Ancillary Facilities, Estimated Closure Costs - Phase 6 and 7

Item No.	Work Item Description	Area (ha) / Length (m)	Equipment / Labour	Units	Unit Rates	Quantity Year 2	Quantity EOM	Cost Year 2	Cost EOM
ADR AND ANCILLARY FACILITIES									
9.1	Buildings and Structures Demolition								
	Remove salvageable equipment		General Labourer	hrs	\$52.00	1344	1344	\$69,888	\$69,888
			Trades Labourer	hrs	\$91.00	504	504	\$45,864	\$45,864
			30 ton Crane	hrs	\$190.00	84	84	\$15,960	\$15,960
	Decontaminate Building-hosing and clean-up		Trades Labourer	hrs	\$91.00	168	168	\$15,288	\$15,288
	Dismantle Buildings		General Labourer	hrs	\$52.00	5376	5376	\$279,552	\$279,552
			Trades Labourer	hrs	\$91.00	4032	4032	\$366,912	\$366,912
			Cat 235 Excavator	hrs	\$250.00	210	210	\$52,500	\$52,500
			30 ton Crane	hrs	\$190.00	672	672	\$127,680	\$127,680
	Concrete Demolition		Blaster	hrs	\$68.00	0	0	\$0	\$0
			Cat 235 Excavator w hammer	hrs	\$275.00	252	252	\$69,300	\$69,300
			D9H Dozer	hrs	\$350.00	168	168	\$58,800	\$58,800
	Misc. Supplies & Tools		Misc.	I.s.	\$15,000.00	1	1	\$15,000	\$15,000
	Scrap haul to solid waste facility		Cat 235 Excavator	hrs	\$250.00	168	168	\$42,000	\$42,000
			Haul Truck D250E	hrs	\$250.00	168	168	\$42,000	\$42,000
	Haul and place overburden for revegetation (0.2 m thickness)	12	Custom Rate A (Load, haul, place soil cover Heap)	cu.m.	\$2.62	24000	24000	\$62,880	\$62,880
	Revegetate	12	Revegetation cost per ha. Including application cost	ha	\$2,850.00	12	12	\$34,200	\$34,200
	Project Management & Engineering		7% of Total Cost	%	7.00%			\$84,052	\$84,052
Sub-Total								\$1,381,876	\$1,381,876
9.2	Fuel Storage Area								
	Cleanout tanks-remove sludge, pressure wash		General Labourer	hrs	\$52.00	504	504	\$26,208	\$26,208
			Removal to Licensed facility	I.s.	\$12,500.00	1	1	\$12,500	\$12,500
	Remove bulk fuel storage and piping facilities		General Labourer	hrs	\$52.00	756	756	\$39,312	\$39,312
			Trades Labourer	hrs	\$91.00	336	336	\$30,576	\$30,576
			30 ton Crane	hrs	\$190.00	84	84	\$15,960	\$15,960
			Support Equipment	I.s.	\$7,500.00	1	1	\$7,500	\$7,500
			Cat 235 Excavator	hrs	\$250.00	0	0	\$0	\$0
			General Labourer	hrs	\$52.00	0	0	\$0	\$0
			Tractor Trailer (lowbed)	hrs	\$180.00	0	0	\$0	\$0
	Fold and Bury Liner		Cat 235 Excavator	hrs	\$250.00	48	48	\$12,000	\$12,000
			D9H Dozer	hrs	\$350.00	24	24	\$8,400	\$8,400
	Project Management & Engineering		7% of Total Cost	%	7.00%			\$10,672	\$10,672
Sub-Total								\$163,128	\$163,128
9.3	Reagents Removal and Cleanup								
	Load and return extra reagents/chemicals		General Labourer	hrs	\$52.00	96	96	\$4,992	\$4,992
			Support Equipment	I.s.	\$2,500.00	1	1	\$2,500	\$2,500
			Disposal Cost-bulk materials	I.s.	\$5,000.00	1	1	\$5,000	\$5,000
			Disposal Cost-lab pacs	pallets	\$2,000.00	5	5	\$10,000	\$10,000
	Removal of drums, steel, oils, glycol & batteries etc.		Contractor quote	I.s.	\$50,900.00	1	1	\$50,900	\$50,900
	Project Management & Engineering		7% of Total Cost	%	7.00%			\$5,137	\$5,137
Sub-Total								\$78,529	\$78,529
9.4	Reclaim Crusher Area and Screening Area (19.5 ha)								
	Test soils for contamination		Environmental Scientist	hrs	\$110.00	20	20	\$2,200	\$2,200
			Analytical Costs	I.s.	\$6,000.00	1	1	\$6,000	\$6,000
	Haul any contaminated soils to Land Treatment Facility		Cat 235 Excavator	hrs	\$250.00	40	40	\$10,000	\$10,000
			Haul Truck D250E	hrs	\$250.00	40	40	\$10,000	\$10,000
	Haul any ore contaminated soils to heap		Load, haul & place mat'l on heap	cu.m.	\$10.00	100	100	\$1,000	\$1,000
	Re-contour area and slopes to bury footings and establish drainage		D9H Dozer	hrs	\$350.00	60	60	\$21,000	\$21,000
	Haul and place overburden cap (0.5m thickness)	19.5	Unit Rate	cu.m	\$5.50	97500	97500	\$536,250	\$536,250
	Project Management & Engineering		7% of Total Cost	%	7.00%			\$41,052	\$41,052
Sub-Total								\$627,502	\$627,502
9.5	Truck Shop Area (s 6.9.7)								
	Remove salvageable equipment		General Labourer	hrs	\$52.00	504	504	\$26,208	\$26,208
			Haul Truck D250E	hrs	\$250.00	0	0	\$0	\$0
			Trades Labourer	hrs	\$91.00	84	84	\$7,644	\$7,644
	Dismantle buildings		General Labourer	hrs	\$52.00	2100	2100	\$109,200	\$109,200
			30 ton Crane	hrs	\$190.00	168	168	\$31,920	\$31,920
			Cat 235 Excavator	hrs	\$250.00	120	120	\$30,000	\$30,000
	Haul building pieces off site - equipment		Tractor Trailer (lowbed)	hrs	\$180.00	168	168	\$30,240	\$30,240
	Scrap haul to site landfill		Haul Truck D250E	hrs	\$250.00	24	24	\$6,000	\$6,000
			Cat 235 Excavator	hrs	\$250.00	24	24	\$6,000	\$6,000
	Excavate & haul contaminated materials to site LTF		Misc.	I.s.	\$6,250.00	1	1	\$6,250	\$6,250
	Bury footings - haul and place fill, locally sourced		Unit Basis (footing burial)	each	\$5.00	300	300	\$1,500	\$1,500
	Recontour		D9H Dozer	hrs	\$350.00	24	24	\$8,400	\$8,400
	Haul and place overburden for revegetation (0.2 m thickness)	9.9	Custom Rate A (Load, haul, place soil cover Heap)	cu.m.	\$2.62	19800	19800	\$51,876	\$51,876
	Revegetate	9.9	Revegetation cost per ha. Including application cost	ha	\$2,850.00	9.9	9.9	\$28,215	\$28,215
	Project Management & Engineering		7% of Total Cost	%	7.00%			\$18,435	\$18,435
Sub-Total								\$361,888	\$361,888
9.6	Water Treatment Plant								
	Remove salvageable equipment		General Labourer	hrs	\$52.00	672	672	\$34,944	\$34,944
			Haul Truck D250E	hrs	\$250.00	0	0	\$0	\$0
			Trades Labourer	hrs	\$91.00	252	252	\$22,932	\$22,932
	Dismantle buildings		General Labourer	hrs	\$52.00	2100	2100	\$109,200	\$109,200
			30 ton Crane	hrs	\$190.00	168	168	\$31,920	\$31,920
			Cat 235 Excavator	hrs	\$250.00	120	120	\$30,000	\$30,000
	Haul building pieces off site - equipment		Tractor Trailer (lowbed)	hrs	\$180.00	168	168	\$30,240	\$30,240
	Scrap haul to site landfill		Haul Truck D250E	hrs	\$250.00	24	24	\$6,000	\$6,000
			Cat 235 Excavator	hrs	\$250.00	24	24	\$6,000	\$6,000
	Excavate & haul contaminated materials to site LTF		Misc.	I.s.	\$6,250.00	1	1	\$6,250	\$6,250
	Bury footings - haul and place fill, locally sourced		Unit Basis (footing burial)	each	\$5.00	300	300	\$1,500	\$1,500
	Recontour		D9H Dozer	hrs	\$350.00	24	24	\$8,400	\$8,400
	Haul and place overburden for revegetation (0.2 m thickness)	2	Custom Rate A (Load, haul, place soil cover Heap)	cu.m.	\$2.62	4000	4000	\$10,480	\$10,480
	Revegetate	2	Revegetation cost per ha. Including application cost	ha	\$2,850.00	2	2	\$5,700	\$5,700
	Project Management & Engineering		7% of Total Cost	%	7.00%			\$20,117	\$20,117
Sub-Total								\$323,683	\$323,683
Total Estimated Cost in Reclaiming Mill and Ancillary Facilities								\$2,936,606	\$2,936,606

Infrastructure, Estimated Closure Costs, Phase 6/7

Item No.	Work Item Description	Area (ha) / Length (m)	Equipment / Labour	Units	Unit Rates	Quantity Year 2	Quantity EOM	Cost Year 2	Cost EOM
MISCELLANEOUS SITES AND FACILITIES									
10.1	Mine Camp and Related Infrastructure								
	Disconnect Services		Trades Labourer	hrs	\$91.00	336	336	\$30,576	\$30,576
	Remove salvageable equipment		General Labourer	hrs	\$52.00	1008	1008	\$52,416	\$52,416
	Dismantle buildings		General Labourer	hrs	\$52.00	2016	2016	\$104,832	\$104,832
			Cat 235 Excavator	hrs	\$250.00	252	252	\$63,000	\$63,000
	Haul scrap to Solid Waste Facility		Haul Truck D250E	hrs	\$250.00	84	84	\$21,000	\$21,000
			Cat 235 Excavator	hrs	\$250.00	84	84	\$21,000	\$21,000
	Site Clean-Up		General Labourer	hrs	\$52.00	672	672	\$34,944	\$34,944
	Haul and place overburden for revegetation (0.2 m thickness)	12.5	Custom Rate A (Load, haul, place soil cover Heap)	cu.m.	\$2.62	25000	25000	\$65,500	\$65,500
	Revegetate	12.5	Revegetation cost per ha. Including application cost	ha	\$2,850.00	12.5	12.5	\$35,625	\$35,625
	Project Management & Engineering		7% of Total Cost	%	7.00%			\$27,529	\$27,529
								Sub-Total	\$456,422
10.2	Explosive / Magazine Storage Facility								
	Remove salvageable equipment		General Labourer	hrs	\$52.00	72	72	\$3,744	\$3,744
			Trades Labourer	hrs	\$91.00	72	72	\$6,552	\$6,552
	Dismantle buildings		General Labourer	hrs	\$52.00	48	48	\$2,496	\$2,496
			Cat 235 Excavator	hrs	\$250.00	24	24	\$6,000	\$6,000
	Disconnect Services		Trades Labourer	hrs	\$91.00	24	24	\$2,184	\$2,184
	Crane services		30 ton Crane	hrs	\$190.00	48	48	\$9,120	\$9,120
	Haul scrap to Solid Waste Facility		Haul Truck D250E	hrs	\$250.00	24	24	\$6,000	\$6,000
	Haul and place overburden for revegetation (0.2 m thickness)	2.5	Custom Rate A (Load, haul, place soil cover Heap)	cu.m.	\$2.62	5000	5000	\$13,100	\$13,100
	Revegetate	2.5	Revegetation cost per ha. Including application cost	ha	\$2,850.00	2.5	2.5	\$7,125	\$7,125
			Cat 235 Excavator	hrs	\$250.00	24	24	\$6,000	\$6,000
	Project Management & Engineering		7% of Total Cost	%	7.00%			\$4,362	\$4,362
								Sub-Total	\$66,683
10.5	Electrical Dismantle and Remove								
	Power line and distribution owned by Yukon Energy, no closure costs associated with VIT								
								Sub-Total	\$0
10.6	Conveyor Dismantle and Remove								
	Remove salvageable equipment		General Labourer	hrs	\$52.00	1344	1344	\$69,888	\$69,888
			Trades Labourer	hrs	\$91.00	1008	1008	\$91,728	\$91,728
	Crane services		30 ton Crane	hrs	\$190.00	280	280	\$53,200	\$53,200
	Project Management & Engineering		7% of Total Cost	%	7.00%			\$15,037	\$15,037
								Sub-Total	\$229,853
Total Estimated Cost in Reclaiming Miscellaneous Sites and Facilities								\$752,958	\$752,958
Note:									

Waste Disposal / Remediation - Phase #

[illegible]

Landfills - Phase 6 and 7

Item No.	Work Item Description	Area (ha) / Length (m)	Equipment / Labour	Units	Unit Rates	Quantity Year 2	Quantity EOM	Cost Year 2	Cost EOM
12.1	Expansion of Facility to Accommodate Closure Phase Debris								
	Expand landfill		Cat 235 Excavator	hr	\$250.00	252	252	\$63,000	\$63,000
			General Labourer	hr	\$52.00	252	252	\$13,104	\$13,104
			Vibratory Roller	hr	\$150.00	36	36	\$5,400	\$5,400
								\$0	\$0
	Project Management & Engineering		7% of Total Cost	%	7.00%			\$5,705	\$5,705
Sub-Total								\$87,209	\$87,209
12.2	Operation During Closure Phase								
								\$0	\$0
								\$0	\$0
								\$0	\$0
								\$0	\$0
								\$0	\$0
								\$0	\$0
								\$0	\$0
								\$0	\$0
	Project Management & Engineering		7% of Total Cost	%	7.00%			\$0	\$0
Sub-Total								\$0	\$0
12.3	Final Closure								
	Prepare detailed closure plan		Misc	l.s.	\$2,000	1	1	\$2,000	\$2,000
	Characterize final waste area		Misc	l.s.	\$2,000	1	1	\$2,000	\$2,000
	Remove recyclables and special waste materials		Tractor Trailer (lowbed)	hrs	\$180.00	24	24	\$4,320	\$4,320
	Final Compaction & Grading		D9H Dozer	hrs	\$350.00	36	36	\$12,600	\$12,600
	Haul and cover with adjacent fill and place overburden cap		Cat 235 Excavator	hrs	\$250.00	24	24	\$6,000	\$6,000
			Haul Truck D250E	hrs	\$250.00	24	24	\$6,000	\$6,000
	Compaction of cover		D9H Dozer	hrs	\$350.00	24	24	\$8,400	\$8,400
	Revegetation							\$0	\$0
	Project Management & Engineering		7% of Total Cost	%	7.00%			\$2,892	\$2,892
Sub-Total								\$44,212	\$44,212
Total Estimated Landfill Costs								\$131,422	\$131,422

Notes:

Roads & Trails, Estimated Closure Costs - Phase 6-8

Item No.	Work Item Description	Area (ha) / Length (m)	Equipment / Labour	Units	Unit Rates	Quantity Year 2	Quantity EOM	Cost Year 2	Cost EOM
13.1	On Site Access and Haul Roads (s 8.13.3) (51.2ha)	51.2							
	Recontour crests		Cat 235 Excavator	hrs	\$250.00	512	512	\$128,000	\$128,000
	Scarify surfaces		Cat 16H grader	hrs	\$250.00	210	210	\$52,500	\$52,500
	Revegeate		Revegetation cost per ha. Including application cost	ha	\$2,850.00	51	51	\$145,920	\$145,920
	Project Management & Engineering		7% of Total Cost	%	7.00%			\$22,849	\$22,849
Sub-Total								\$349,269	\$349,269
13.2	Culverts								
	Culvert excavation		Cat 235 Excavator	hrs	\$250.00	200	200	\$50,000	\$50,000
	Culvert removal		General Labourer	hrs	\$52.00	192	192	\$9,984	\$9,984
	Recontour slopes and drainage		D9H Dozer	hrs	\$350.00	36	36	\$12,600	\$12,600
	Stabilize slopes		General Labourer	hrs	\$52.00			\$0	\$0
	Silt Curtains (20m ² per crossing)		Erosion Barrier	sq. m.	\$3.00	300	300	\$900	\$900
	Enviro matting (15m ² per crossing)		Enviro matting	sq. m.	\$3.00	225	225	\$675	\$675
	Project Management & Engineering		7% of Total Cost	%	7.00%			\$5,191	\$5,191
Sub-Total								\$0	\$0
Total Estimated Cost for Closure of Roads & Trails								\$428,620	\$428,620
Note:									

Water Management, Estimated Closure Costs - Phase 6

Item No.	Work Item Description	Length (m)	Equipment / Labour	Units	Unit Rates	Quantity Year 2	Quantity EOM	Cost Year 2	Cost EOM
14.1	Upgrade Site Diversions								
	Raise and/or widen operational 1:10 year ditches							\$0	\$0
				I.s.	\$75,000	1	1	\$75,000	\$75,000
								\$0	\$0
								\$0	\$0
								\$0	\$0
	Project Management & Engineering		7% of Total Cost	%	7.00%			\$5,250	\$5,250
Sub-Total								\$80,250	\$80,250
14.2	Groundwater Wells - Decommissioning								
	Production Wells			I.s.	\$3,600	4	12	\$14,400	\$43,200
	De-Watering Wells			I.s.	\$3,600	4	12	\$14,400	\$43,200
	Infiltration Wells			I.s.	\$3,600.00	4	12	\$14,400	\$43,200
								\$0	\$0
								\$0	\$0
	Project Management & Engineering		7% of Total Cost	%	7.00%			\$3,024	\$9,072
Sub-Total								\$46,224	\$138,672
14.3	Pumping - Phase 6								
						Ave kw Pumps	Ave kw Pumps		
	Year 1 Heap Recycle/Draindown		Electrical power costs to recirculate heap solution inventory and managed draindown	\$/kw	\$ 0.11	992	2,128	\$1,413,910	\$3,033,677
	Year 2 Heap Recycle/Draindown			\$/kw	\$ 0.11	365	784	\$347,276	\$745,114
	Year 3 Heap Recycle/Draindown				\$ 0.11	209	448	\$23	\$319,334
	Year 4 Heap Recycle/Draindown				\$ 0.11	-	168	\$0	\$119,750
	Year 5 Heap Recycle/Draindown				\$ 0.11		84		\$79,834
	Year 6 Heap Recycle/Draindown				\$ 0.11		67		\$63,867
	Year 7 Heap Recycle/Draindown				\$ 0.11	-	56	\$0	\$53,222
	Project Management & Engineering		7% of Total Cost	%	2.5%			\$44,030	\$110,370
Sub-Total								\$1,805,239	\$4,525,168
14.4	Ponds								
								\$0	\$0
								\$0	\$0
								\$0	\$0
								\$0	\$0
								\$0	\$0
	Project Management & Engineering		7% of Total Cost	%	7.00%			\$0	\$0
Sub-Total								\$0	\$0
14.5	Construction of New Drainage Channels and Diversions for Closure								
	Contour ditching (m)		Cat 235 Excavator	hrs	\$250.00	100	100	\$25,000	\$25,000
	Provision for ditching rip-rap		Produce rip-rap	cu.m.	\$15.00	1,000	1,000	\$15,000	\$15,000
			Load, haul and place rip-rap	cu.m.	\$15.00	1,000	1,000	\$15,000	\$15,000
								\$0	\$0
								\$0	\$0
	Project Management & Engineering		7% of Total Cost	%	7.00%			\$3,850	\$3,850
Sub-Total								\$58,850	\$58,850
14.6	Sediment Ponds								
								\$0	\$0
								\$0	\$0
								\$0	\$0
								\$0	\$0
	Project Management & Engineering		7% of Total Cost	%	7.00%			\$0	\$0
Sub-Total								\$0	\$0
Total Estimated Cost for Water Management								\$1,990,563	\$4,802,940
Note:									

Item No.	Work Item Description	Equipment / Labour	Units	Quantity (EOM)	Unit Rates	Annual Cost	Cost Year 2	Cost EOM	NPV Year 2	NPV EOM
15.1	Onsite Management									
	Project Management and Engineering - Included in PME Costs in each Closure Component									
	Pickup truck Phase 7/8	Light truck	monthly	180	\$2,000	\$2,000	\$360,000	\$360,000		
	Sundry equipment maintenance Phase 7/8	Unit Cost Basis	annually	15	\$10,000	\$10,000	\$150,000	\$150,000		
	Power and heat Phase 7/8	Unit Cost Basis	monthly	180	\$5,000	\$60,000	\$900,000	\$900,000		
	General Administrative expenses Phase 7/8	Unit Cost Basis	monthly	180	\$1,500	\$18,000	\$270,000	\$270,000		
	Camp Costs Phase 7/8	Unit Cost Basis	man-day	-	\$55	\$0		\$0		
	Subtotal - Phase 7/8								\$739,497	\$549,857
	Subtotal - Phase 7/8 Onsite Management:					\$90,000	\$1,680,000	\$1,680,000	\$739,497	\$549,857
15.2	Transport Costs									
	Employee transport costs Phase 7/8	Unit Cost Basis	monthly	180	\$500	\$6,000	\$63,152	\$69,375		
	Subtotal - Phase 7/8:					\$0	\$63,152	\$69,375	\$45,576	\$36,657
	Subtotal - Onsite Management:					\$0	\$63,152	\$69,375	\$45,576	\$36,657
15.3	Water Treatment Costs									
	Active Treatment (Phase 6)									
	Capital Costs	Misc.	annually	1	\$3,996,916	\$3,996,916	\$3,996,916	\$3,996,916	\$3,532,691	\$2,899,444
	Capital Replacement Costs	Misc.	annually	7	\$99,423	\$99,423	\$298,269	\$695,961	\$257,249	\$469,389
	Operating Costs	Misc.	annually	7	\$951,415	\$951,415	\$2,854,245	\$6,659,905	\$2,461,707	\$4,491,751
	Passive Treatment (Phase 7/8)									
	Capital Costs	Misc.	annually	1	\$250,000	\$250,000	\$250,000	\$250,000	\$210,316	\$156,382
	Capital Replacement Costs	Misc.	annually	15	\$1,500	\$1,500	\$22,500	\$22,500	\$15,624	\$11,617
	Operating Costs	Misc.	annually	15	\$15,000	\$15,000	\$225,000	\$225,000	\$156,240	\$116,173
	Subtotal:						\$7,646,930	\$11,850,282	\$6,633,827	\$8,144,756
15.4	Reclamation & Closure Research Plan (Long Term Funding)									
	Reclamation & Closure Research Plan	Misc.	annually	5	\$15,000	\$15,000		\$75,000		
	Subtotal:							\$75,000	\$63,133	\$51,816
15.5	Monitoring & Reporting									
	Disbursements (non-labour/non-analytical)	Misc.	annually							
	Water Quality Monitoring									
	Phase 6	Misc.	annually	1	\$157,935	\$157,935	\$473,805	\$1,105,545	\$408,644	\$745,631
	Phase 7/8	Misc.	annually	1	\$157,935	\$157,935	\$1,421,415	\$1,381,931	\$1,035,925	\$751,445
	Sediment Monitoring:									
	Phase 6	Misc.	annually	7	\$1,272	\$1,272	\$3,816	\$8,904	\$3,291	\$6,005
	Phase 7/8	Misc.	annually	15	\$1,272	\$1,272	\$13,992	\$10,176	\$9,982	\$5,452
	Biological Monitoring (Benthos):									
	Phase 6	Misc.	annually	7	\$1,272	\$1,272	\$3,816	\$8,904	\$3,291	\$6,005
	Phase 7/8	Misc.	annually	15	\$1,272	\$1,272	\$13,992	\$10,176	\$9,982	\$5,452
	Site groundwater monitoring									
	Phase 6	Misc.	annually	7	\$41,785	\$41,785	\$125,355	\$292,495	\$108,115	\$197,272
	Phase 7/8	Misc.	annually	15	\$41,785	\$41,785	\$376,065	\$428,296	\$274,076	\$230,913
	Geotechnical Inspections:									
	Phase 6	Misc.	annually	7	\$15,000	\$15,000	\$45,000	\$105,000	\$38,811	\$70,817
	Phase 7/8	Misc.	annually	15	\$15,000	\$15,000	\$195,000	\$150,000	\$137,927	\$79,434
	Reclamation Inspections:									
	Phase 6	Misc.	annually	7						
	Phase 7/8	Misc.	annually	15	\$10,000	\$10,000	\$70,000	\$80,000	\$45,613	\$40,90

APPENDIX D

O’Kane Consultants Inc. – Eagle Gold Project – Further
Assessment of Closure Cover System Designs for
Heap Leach Facility and Waste Rock Storage Areas

April 28, 2014

Jim Harrington
Access Consulting Group
#3 Calcite Business Centre, 151 Industrial Road
Whitehorse, YK Y1A 2V3

Mr. Harrington:

Re: Eagle Gold Project – Further Assessment of Closure Cover System Designs for Heap Leach Facility and Waste Rock Storage Areas

O'Kane Consultants Inc. (OKC) was retained by Alexco Environmental Group (AEG) in February 2014 to aid in furthering the development of cover system designs for closure of the proposed heap leach facility (HLF) and waste rock storage areas (WRSAs) at Victoria Gold's Eagle Gold Project (EGP) in the Yukon. The currently planned end land-use for the reclaimed HLF and WRSAs is natural habitat (wilderness). Aside from being geotechnically and geomorphically stable and providing a medium for sustainable growth of native plants, a key design objective for the HLF / WRSA closure cover system is to reduce long-term net percolation rates to the greatest extent possible using locally available materials for cover system construction. Passive treatment systems will be designed and implemented to handle resultant environmental loadings from the HLF and WRSAs post-closure. This letter report documents the work completed by OKC for this project.

Project Objectives and Work Scope:

The overall objective of this project was to aid in further development of cover system designs using locally available materials for closure of the proposed HLF and WRSAs at the EGP site. The currently proposed closure cover system design, referred to as the 'base case' cover system design, is a 0.2 m thick layer of topsoil underlain by a 0.3 m thick layer of placer tailings / colluvium. The specific objectives of this project were to further assess the anticipated hydrological performance of the base case cover system design and provide recommendations to improve its predicated long-term performance from a net percolation reduction perspective.

The following tasks were completed to address the above project objectives:

- Project orientation including review of pertinent background information and compilation of key inputs for soil-plant-atmosphere (SPA) numerical modelling;
- Development of a conceptual model of hydrological performance of the base case cover system design;
- Base case and sensitivity analysis numerical simulations of cover system performance using the SPA model VADOSE/W¹; and

¹ Geo-Slope International Ltd. 2013. Vadose Zone Modelling with VADOSE/W: An Engineering Methodology. September 2013 Ed.

- Development of recommendations for future studies to reduce uncertainties in the current cover system design and identify potential opportunities for improvements in cover system performance using locally available materials.

SPA numerical modelling was completed with the following outcomes in mind:

- Improved confidence in the mean and range of net percolation rates for the base case cover system for input to environmental loading and water treatment assessments;
- Influence of potential textural heterogeneity of locally available cover construction materials on cover system performance;
- Influence of the saturated permeability of underlying waste materials on cover system performance;
- Influence of various vegetation conditions on cover system performance;
- Influence of slope angle on cover system performance (i.e. difference in water balance fluxes for the bench plateaus compared to the bench faces);
- Influence of slope aspect on cover system performance; and
- Examination of the available water holding capacity (AWHC) for various cover configurations to avoid creating a 'false' drought condition for the anticipated climax vegetation cover.

Conceptual Model of Hydrological Performance:

A conceptual model of hydrological performance of closure cover systems for the EGP site was developed prior to the start of SPA numerical modelling. This required consideration of the following water balance fluxes:

- precipitation (Ppt),
- potential evapotranspiration (PET),
- actual evapotranspiration (AET),
- runoff (RO),
- sublimation (Sub), and
- net percolation (NP).

The average precipitation for the EGP site is estimated to be 492 mm/yr with a range from 262 mm/yr to 694 mm/yr, based on the 80-year historic climate database developed for this project (see Attachment A for further details). The average annual estimate is similar to that developed by KP².

Given the relatively high latitude of the EGP site, slope aspect and angle highly influences the amount of solar energy and resultant PET applied to various areas of the site (MEND, 2012)³. Hence, for an exposed plateau (i.e. a flat area with no slope influences) or east- or west-facing slope, average annual PET is estimated to be 372 mm/yr with an annual range from 196 mm/yr to 1,413 mm/yr. However, PET is estimated to be 60% less on north-facing aspects and 50% more on south-facing aspects; resulting in average annual PET rates for these two aspects of 149 mm/yr and 558 mm/yr, respectively.

² KP (Knight Piesold Ltd.). 2013. *Victoria Gold Corp. Eagle Gold Project – Hydrometeorology Report*. VA101-290/6-8. Prepared for Victoria Gold Corp., August 30.

³ MEND (Mine Environment Neutral Drainage). 2012. *Cold regions cover system design technical guidance document*. Canadian Mine Environment Neutral Drainage Program, Project 1.61.5c, March.

In general, the ratio of annual AET to precipitation ranges from 40 to 60% for study areas similar to the EGP site (Kane and Yang, 2004)⁴. This results in a typical AET:PET ratio of 50 to 70%. However, it must be noted that results for north or south aspects may be outside of the general ranges. Also note that forest canopy interception, which is not calculated by the VADOSE/W model, is included as part of the AET results in this report by using the estimation method described in Attachment A.

Runoff to precipitation ratio for northern sites typically has an increasing trend with increasing latitude (Kane and Yang, 2004). A runoff rate of 5 to 20% of precipitation is expected for the EGP site given the latitude at which the site is located combined with the locally available materials for the base cover system design and the range of vegetation conditions.

Sublimation and redistribution of snow constitutes a significant portion of the water balance in several seasonally snow-covered areas of the Canadian North such as the EGP site (Pomeroy *et al.*, 1995)⁵. Snow interception and sublimation are important hydrological processes that occur as a result of complex mass and energy exchanges. Sublimation of snow intercepted in the vegetation canopy can be as high as 25 to 45% of annual snowfall (Pomeroy and Gray, 1995)⁶. Comparing the EGP site to other northern sites at a similar latitude, a sublimation rate of 25 to 35% of annual snowfall is expected (Kane and Yang, 2004). This corresponds to a sublimation rate of approximately 10 to 15% of total annual precipitation.

NP is a vital component of the water balance for northern climates. Previous modelling completed by KP (2013) determined that the long-term NP rate for the current or base case cover system design would be between 18 and 32% of annual precipitation. NP is functionally halted during the winter months due to frozen ground conditions. In general, the majority of NP at the EGP site occurs during spring melt. Through the summer months, NP rates are lower due to the store and release function of a vegetated soil profile. NP rates generally increase in the fall due to lower PET rates.

A typical annual water balance for the site estimated using VADOSE/W is shown in Figure 1, and demonstrates that the VADOSE/W model estimates conform to the conceptual model.

⁴ Kane, D. and Yang, D. 2004. Northern Research Basins Water Balance. International Association of Hydrological Sciences. Oxfordshire, United Kingdom.

⁵ Pomeroy, J., Hedstrom, N., and Parviainen, J. 1995. *The Snow Mass Balance of Wolf Creek, Yukon: Effects of Snow Sublimation and Redistribution*. National Hydrology Research Center. Environment Canada: Saskatoon.

⁶ Pomeroy, J.W. and Gray, D.M. 1995. *Snow Accumulation, Relocation and Management*. NHRI Science Report No. 7. Environment Canada: Saskatoon. 144 pp. (Available from NWRI, Saskatoon)

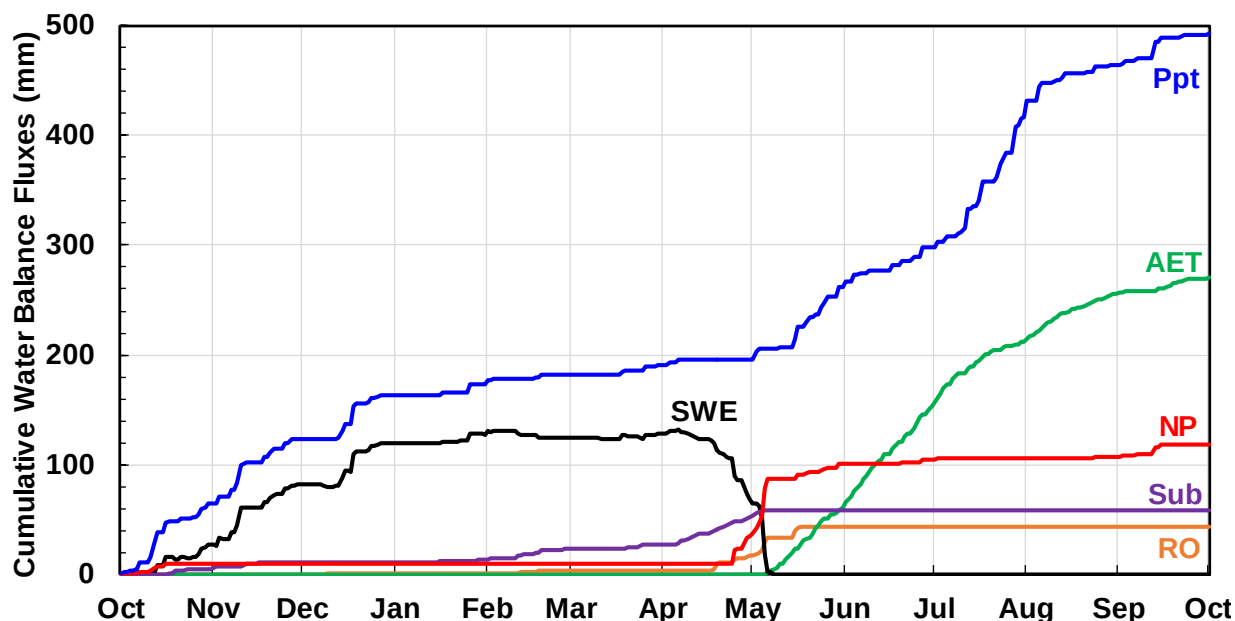


Figure 1 Typical annual water balance fluxes for the EGP site for an east/west bench during an average precipitation year.

Preliminary Estimates of Long-Term Cover System Performance:

The currently proposed closure cover system design, referred to as the ‘base’ cover system design, consists of a 0.2 m thick layer of topsoil underlain by a 0.3 m thick layer of placer tailings / colluvium. Tables 1 and 2 provide preliminary estimates of average annual long-term water balances (i.e. post-closure and once climax forest vegetation has established). A description of the model inputs used for the simulations is provided in Attachment A. All modelling completed for this project used the computer modelling program VADOSEW Version 8.12.3.7901⁷.

As shown in the sensitivity analysis section of this report, little can be done to improve performance of the current cover system design based on current knowledge of waste materials and candidate cover materials. Also, the current estimates for east-, west-, and north-facing slopes have AET:PET ratios at or above the typical maximum of 70% stated for the conceptual model. Hence, minimal potential exists for reducing NP rates via increasing AET, which means the store-and-release component of the cover system design cannot be improved upon with any design changes. The only other method to reduce NP is to increase lateral flow (i.e. runoff or interflow) by including a low permeability layer (saturated hydraulic conductivity (k_{sat}) less than 1×10^{-7} cm/s), but such a layer cannot be constructed from site materials; this would require the import of sodium bentonite for admixing to local sandy materials or the use of a geomembrane product.

⁷ Geo-Slope International Ltd. 2013. GeoStudio 2012. Version 8.12.3.7901. Online. www.geo-slope.com.

Table 1

Average annual water balance fluxes predicted for base case cover system design on WRSAs
(values in percent of annual precipitation with mm/yr in brackets).

Aspect	East / West		North		South		Conceptual Model
Angle	Benches /Plateaus	2H:1V	Benches	2H:1V	Benches	2H:1V	
RO	9% (44)	14% (69)	9% (44)	15% (74)	9% (44)	12% (59)	5% – 20%
AET	55% (271)	53% (261)	27% (133)	26% (128)	59% (290)	58% (285)	40% – 60%
Sub	12% (59)	12% (59)	12% (59)	12% (59)	12% (59)	12% (59)	10% – 15%
NP	24% (118)	21% (103)	52% (256)	47% (231)	20% (98)	18% (89)	15% – 45%

*RO: Runoff; AET: Actual Evapotranspiration; Sub: Sublimation; NP: Net percolation.

Table 2

Average annual water balance fluxes predicted for base case cover system design on HLF
(values in percent of annual precipitation with mm/yr in brackets).

Aspect	East / West		North		South		Conceptual Model
Angle	Benches /Plateaus	2H:1V	Benches	2H:1V	Benches	2H:1V	
RO	9% (44)	14% (69)	9% (44)	15% (74)	9% (44)	12% (59)	5% – 20%
AET	56% (276)	54% (266)	26% (128)	25% (123)	60% (295)	58% (285)	40% – 60%
Sub	12% (59)	12% (59)	12% (59)	12% (59)	12% (59)	12% (59)	10% – 15%
NP	23% (113)	20% (98)	53% (261)	48% (236)	19% (93)	18% (89)	15% – 45%

*RO: Runoff; AET: Actual Evapotranspiration; Sub: Sublimation; NP: Net percolation.

It must be emphasized that the values provided in Tables 1 and 2 are averages, but that the components of the water balance will vary greatly from year-to-year, and (as shown in Figure 1) during any given year. As shown in Figures 2 and 3, annual NP at the EGP site can range anywhere from 0 to 500 mm for a given year depending on climate, slope angle and aspect, underlying material, and antecedent moisture conditions. Figures 2 and 3 also provide an estimate of the probability of a given NP rate being exceeded during any given year. For example, there is a 20% probability (i.e. 1-in-5 years) that annual NP rate through a cover system overlying waste rock on a south-facing slope aspect will be greater than 140 mm/yr. Equations for the trendlines in Figures 2 and 3 are provided in the footnotes.

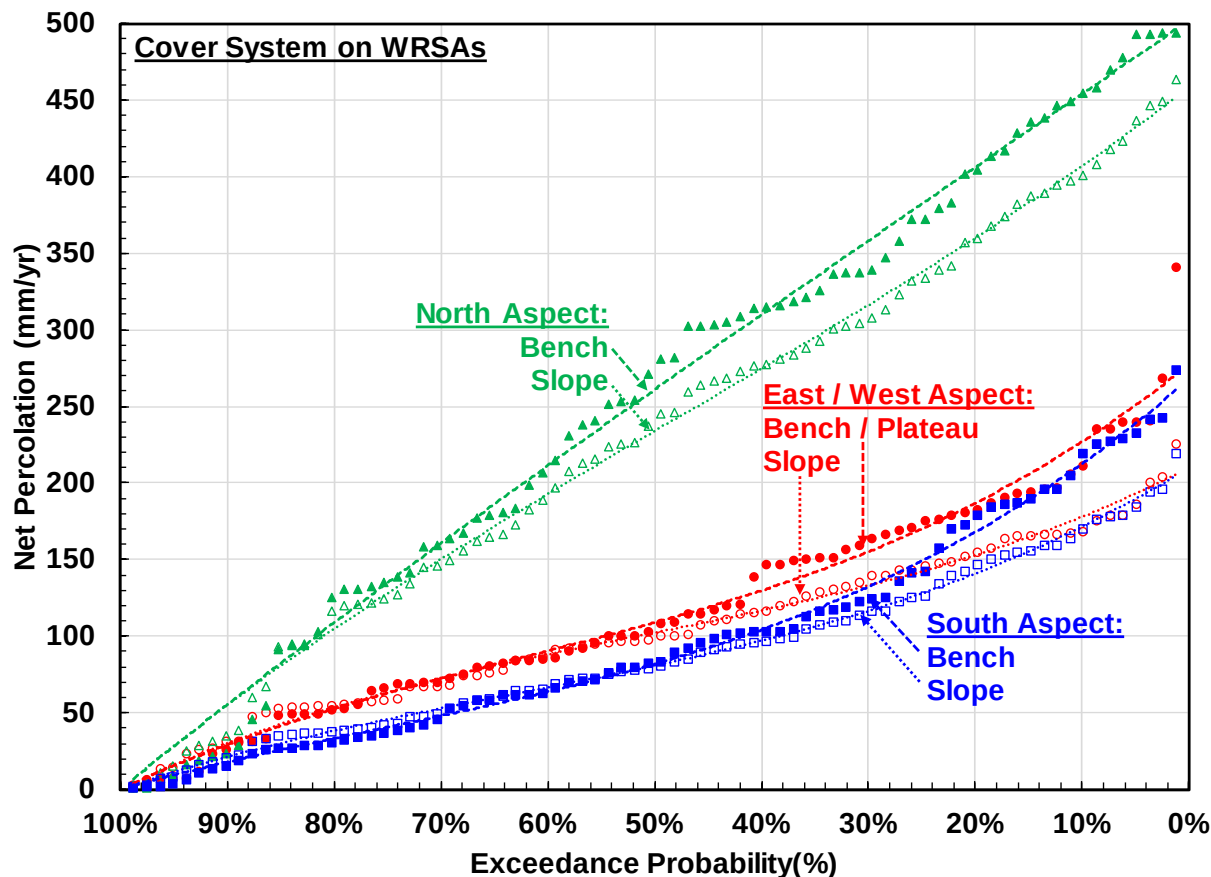


Figure 2 Exceedance probability for annual net percolation through the base case cover system design on WRSAs⁸.

⁸ Equations for trendlines fitted to data in Figure 2 (equations provide estimate of annual net percolation rate (NP in mm/yr) for a given exceedance probability (x)):

$$\begin{aligned} \text{NP (WRSA North Aspect – Bench)} &= 40.0041311586974(1-x)^3 - 99.5768877417431(1-x)^2 + 561.738884175022(1-x) \\ \text{NP (WRSA North Aspect – Slope)} &= 206.353645699448(1-x)^3 - 327.934585562733(1-x)^2 + 580.167973306423(1-x) \\ \text{NP (WRSA East / West Aspect – Bench/Plateau)} &= 334.907229739852(1-x)^3 - 383.091823084556(1-x)^2 + 325.661910099225(1-x) \\ \text{NP (WRSA East / West Aspect – Slope)} &= 280.502595140468(1-x)^3 - 409.768319621682(1-x)^2 + 339.373074364743(1-x) \\ \text{NP (WRSA North Aspect – Bench)} &= 272.348822876258(1-x)^3 - 199.583918676042(1-x)^2 + 195.342583203572(1-x) \\ \text{NP (WRSA North Aspect – Slope)} &= 242.715256690288(1-x)^3 - 267.520494862459(1-x)^2 + 234.753215517809(1-x) \end{aligned}$$

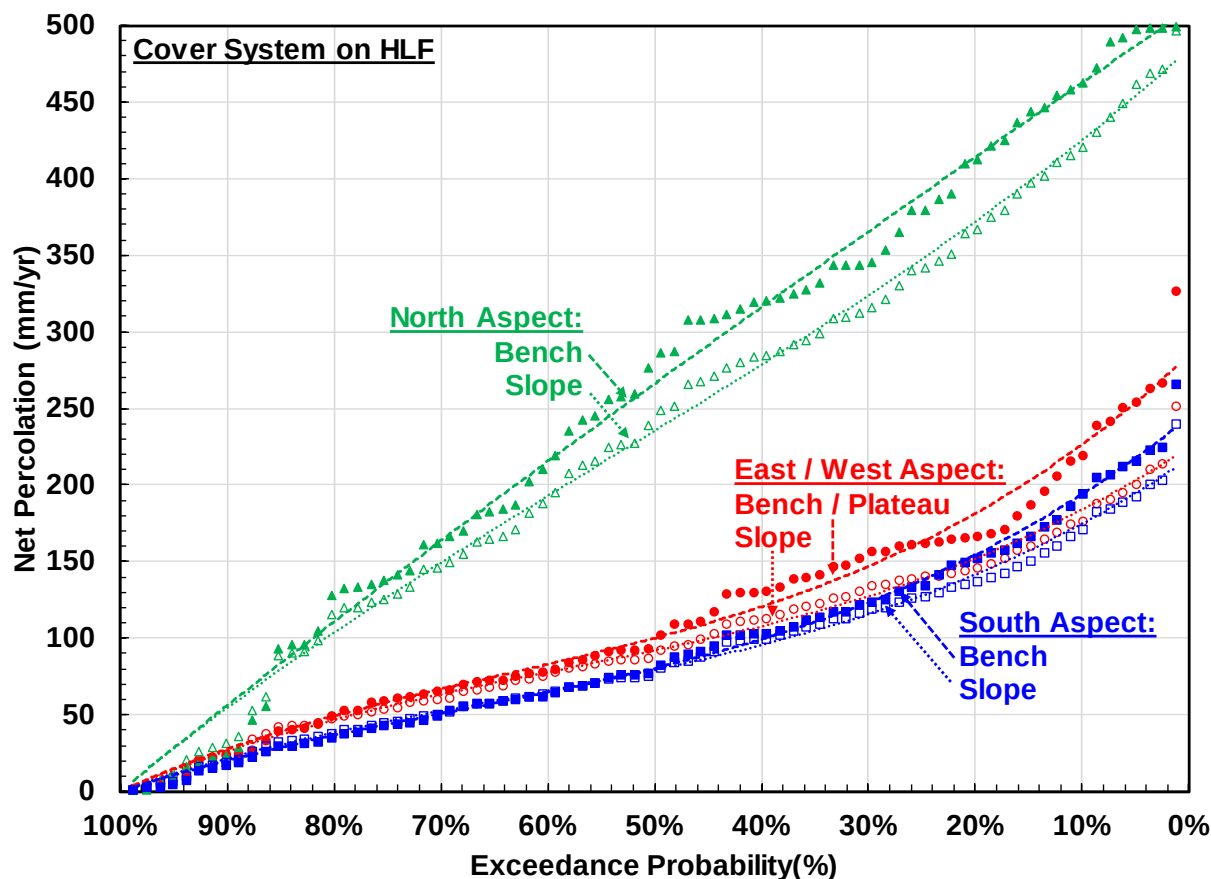


Figure 3 Exceedance probability for annual net percolation through the base case cover system design on HLF⁹.

The model results presented prior to this point are estimates of long-term cover system performance, i.e. post-closure once a climax forest vegetation has established on the cover system. Water balance fluxes will vary greatly at different pre- and post-closure stages of the EGP operation. Tables 3 and 4 provide predicted water balance fluxes for different pre- and post-closure stages of the WRSAs and HLF, respectively. The first stage is a pre-closure scenario when the closure cover system is not in place; the NP rate on WRSAs for this case is estimated to be 49% of annual precipitation. The NP rate is estimated to drop to 36% on WRSAs when the cover system is initially constructed, but before vegetation establishment. Once vegetation is established, the NP rate further drops to 28% and 24% of annual precipitation for a grasses & shrubs and climax forest vegetation scenario, respectively. Table 4 shows a similar trend for predicted NP rates for the base case cover system design on the HLF.

⁹ Equations for trendlines fitted to data in Figure 3 (equations provide estimate of annual net percolation rate (NP in mm/yr) for a given exceedance probability (x)):

$$\begin{aligned} \text{NP (HLF North Aspect – Bench)} &= 31.272632650886(1-x)^3 - 89.742473682767(1-x)^2 + 569.412107857963(1-x) \\ \text{NP (HLF North Aspect – Slope)} &= 230.751591012202(1-x)^3 - 318.847922658053(1-x)^2 + 572.512360031695(1-x) \\ \text{NP (HLF East / West Aspect – Bench/Plateau)} &= 401.880632485379(1-x)^3 - 433.796816800299(1-x)^2 + 316.593775515019(1-x) \\ \text{NP (HLF East / West Aspect – Slope)} &= 310.161269957891(1-x)^3 - 383.422721152048(1-x)^2 + 298.154325857064(1-x) \\ \text{NP (HLF North Aspect – Bench)} &= 297.902638452382(1-x)^3 - 279.853973662612(1-x)^2 + 226.194792839713(1-x) \\ \text{NP (HLF North Aspect – Slope)} &= 282.980662582457(1-x)^3 - 307.881636956547(1-x)^2 + 242.043952583721(1-x) \end{aligned}$$

Table 3

Average annual water balance fluxes predicted for WRSA base case cover design at different pre- and post-closure stages
(values are in percent of annual precipitation for a plateau or bench section of an east- or west-facing slope aspect).

Stage	1: pre-closure	2: closure	3: vegetation established	4: climax vegetation	Conceptual Model
Cover	None	Base	Base	Base	
Vegetation	None	None	Grasses & Shrubs	Forest	
RO	5%	10%	9%	9%	5% – 20%
AET	34%	44%	50%	55%	40% – 60%
Sub	12%	12%	12%	12%	10% – 15%
NP	49%	34%	28%	24%	15% – 45%

*RO: Runoff; AET: Actual Evapotranspiration; Sub: Sublimation; NP: Net percolation.

Table 4

Average annual water balance fluxes predicted for HLF base case cover design at different pre- and post-closure stages
(values are in percent of annual precipitation for a plateau or bench section of an east- or west-facing slope aspect).

Stage	1: pre-closure	2: closure	3: vegetation established	4: climax vegetation	Conceptual Model
Cover	None	Base	Base	Base	
Vegetation	None	None	Grasses & Shrubs	Forest	
RO	5%	10%	9%	9%	5% – 20%
AET	37%	42%	51%	56%	40% – 60%
Sub	12%	12%	12%	12%	10% – 15%
NP	46%	36%	28%	23%	15% – 45%

*RO: Runoff; AET: Actual Evapotranspiration; Sub: Sublimation; NP: Net percolation.

Analysis of Alternate Cover System Designs and Sensitivity to System Variations:

In total, 43 long-term simulations were completed to determine the sensitivity of the base cover system design due to variations in materials, climate, and/or vegetation. The simulations were also completed to determine what (if any) improvements can be made to the base case cover system design. All the scenarios were initially completed without vegetation present so that changes in performance could be directly correlated to changes in materials or climate. Vegetation was then included to further evaluate select scenarios. Finally, the base case results presented in the previous section showed little difference in performance between the WRSAs and HLF simulations. Hence, all sensitivity scenarios were simulated with a cover system overlying waste rock unless otherwise noted. Tornado plots of net percolation predictions for the WRSAs and HLF scenarios simulated are provided in Figures 4 and 5, respectively, followed by detailed analyses.

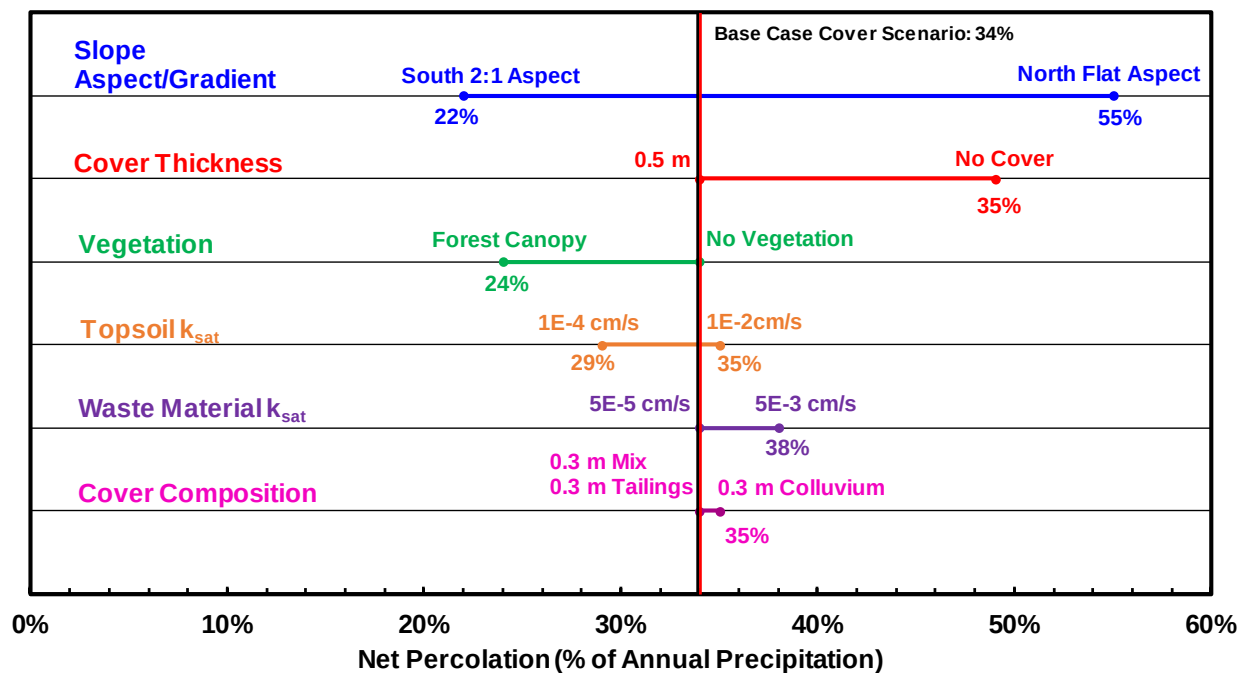


Figure 4 Tornado plot for WRSA cover system net percolation predictions.

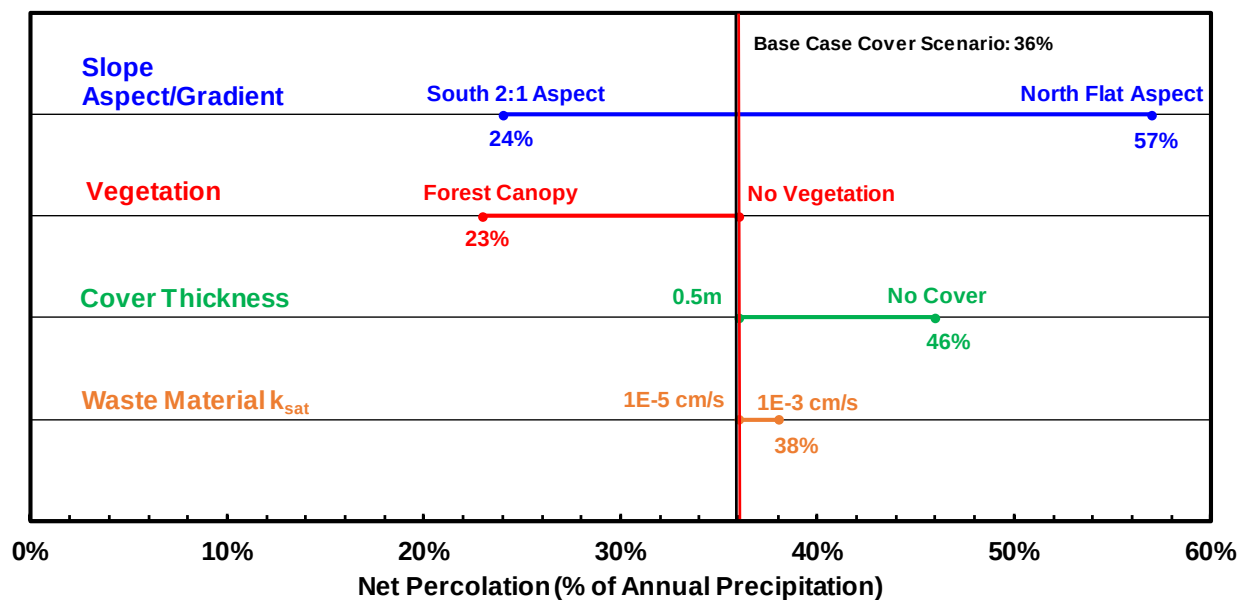


Figure 5 Tornado plot for HLF cover system net percolation predictions.

Slope aspect and gradient have the largest effect on NP rates estimated for both WRSAs and HLF. The added solar radiation on south facing slopes results in a higher AET rate, further drying out the cover in the summer months. In contrast, the north-facing aspect has substantially less solar radiation available to evaporate or transpire water stored in the cover profile. This increases the observed NP rate. A 2:1 slope gradient will result in a larger volume of runoff during the spring melt and high intensity rainfall events.

Table 5 shows predicted average annual NP rates for eight cover system scenarios with varied layer thickness and composition. The majority of the cover thickness and composition scenarios were completed for the WRSAs only. The HLF only compared the uncovered waste material to the base cover system. For the WRSAs, three thicknesses of the tailings-colluvium mix were evaluated to determine if additional storage capacity would improve cover system performance. The materials that comprise the cover system were also varied to determine the effect of different compositions.

Table 5
Average annual NP rates predicted for varying cover thickness and composition scenarios
(values in percent of annual precipitation).

<i>Layer 1</i>		<i>Layer 2</i>		<i>Layer 3</i>		<i>Net Percolation</i>
<i>Material</i>	<i>Thickness (m)</i>	<i>Material</i>	<i>Thickness (m)</i>	<i>Material</i>	<i>Thickness (m)</i>	
TPSL	0.2	MIX	0.3	-	-	34%
TPSL	0.2	MIX	0.5	-	-	35%
TPSL	0.2	MIX	0.7	-	-	35%
TPSL	0.2	TLS	0.3	-	-	34%
TPSL	0.2	CLVM	0.3	-	-	35%
TPSL	0.2	TILL	0.3	-	-	35%
TPSL	0.2	TLS	0.1	CLVM	0.2	35%
TPSL	0.2	CLVM	0.2	TLS	0.1	35%

*TPSL: topsoil; MIX: tailings-colluvium mix; TLS: tailings; CLVM: colluvium; TILL: till; WR: waste rock.

Virtually no difference exists in predicted NP rates resulting from the use of different materials on-site. Cover system scenarios that used only colluvium or tailings (rather than the 2:1 mix) produced nearly identical NP rates as the 2:1 colluvium-tailings mixture. Layered cover systems of the two materials also produced similar NP rates. Based on these results, there is no advantage, from a NP perspective, to mixing the tailings and colluvium into a single cover system material based on the estimated hydraulic properties of the two material types.

Without vegetation to remove water from depth, thickening the cover system provides no reduction in the NP rate, and actually results in an increase in NP. NP rates do not decrease because the energy available for evaporation is low, which creates relatively low hydraulic gradients for removing water from the cover system. Hence, evaporation alone can only remove water stored nearer the surface. The model estimates a slight increase in NP with increased cover thickness because the underlying waste rock is a textural discontinuity, which creates a capillary barrier inhibiting NP and keeping water closer to the surface. When the depth of the capillary barrier is increased by increasing the thickness of the cover system, the percolating water is able to get to depth more easily, which increases NP.

As shown in the previous section, the presence of vegetation is vital to hydrological performance of the cover system. The NP rate is reduced by 10% or more for both the WRSAs and HLF when a forest canopy is present. A large part of the improvement from the forested cover system scenario comes from the improvement of AET via canopy interception. The forest canopy intercepts precipitation on the foliage, which reduces the amount of water that infiltrates into the cover system. This intercepted water is then evaporated or sublimated from a location more exposed to solar radiation and wind compared to surface.

Vegetation requires water to be readily available for root uptake for establishment and survival. When a material dries below a point at which plants are unable to remove water, the material is said to be at its permanent wilting point (PWP). The PWP is generally defined to occur at a suction of 1,500 kPa. At the other end of the range is the field capacity (FC) of the soil. FC is defined as the water content held in the soil after excess water has drained away and the rate of downward movement has decreased. FC is generally stated to occur at a suction of 33 kPa for finer soils and 10 kPa for coarser materials. FC and PWP define the upper and lower limits, respectively, that a growth material is able to supply water for root uptake. Hence, the difference between FC and PWP defines a soil's AWHC (i.e. $AWHC = FC - PWP$).

Figure 6 shows the estimated amount of water stored within the base case cover system design during the 80-year simulation period for three scenarios: base cover system on WRSA; base cover system on HLF; and, a cover system consisting of 0.2 m of topsoil overlying 0.3 m of till (referred to in Figure 6 as till cover system) overlying WRSA. Till was chosen for the third simulation as it has the highest AWHC of all the potential cover materials considered in this study. The cover system water volume for all three scenarios is estimated to almost always stay within or above the AWHC range. There are only seven periods when the cover system water volumes drop near or below the PWP line. These are periods when vegetation would be at risk; but it must be noted that the model inputs were set to permit forest vegetation to be capable of removing water up to a suction of 2,500 kPa (based on research of tree species), and that VADOSEW does not account for all plant survival mechanisms (e.g. dormancy). Hence, the model estimates that the current cover system design adequately meets the water requirements for vegetation.

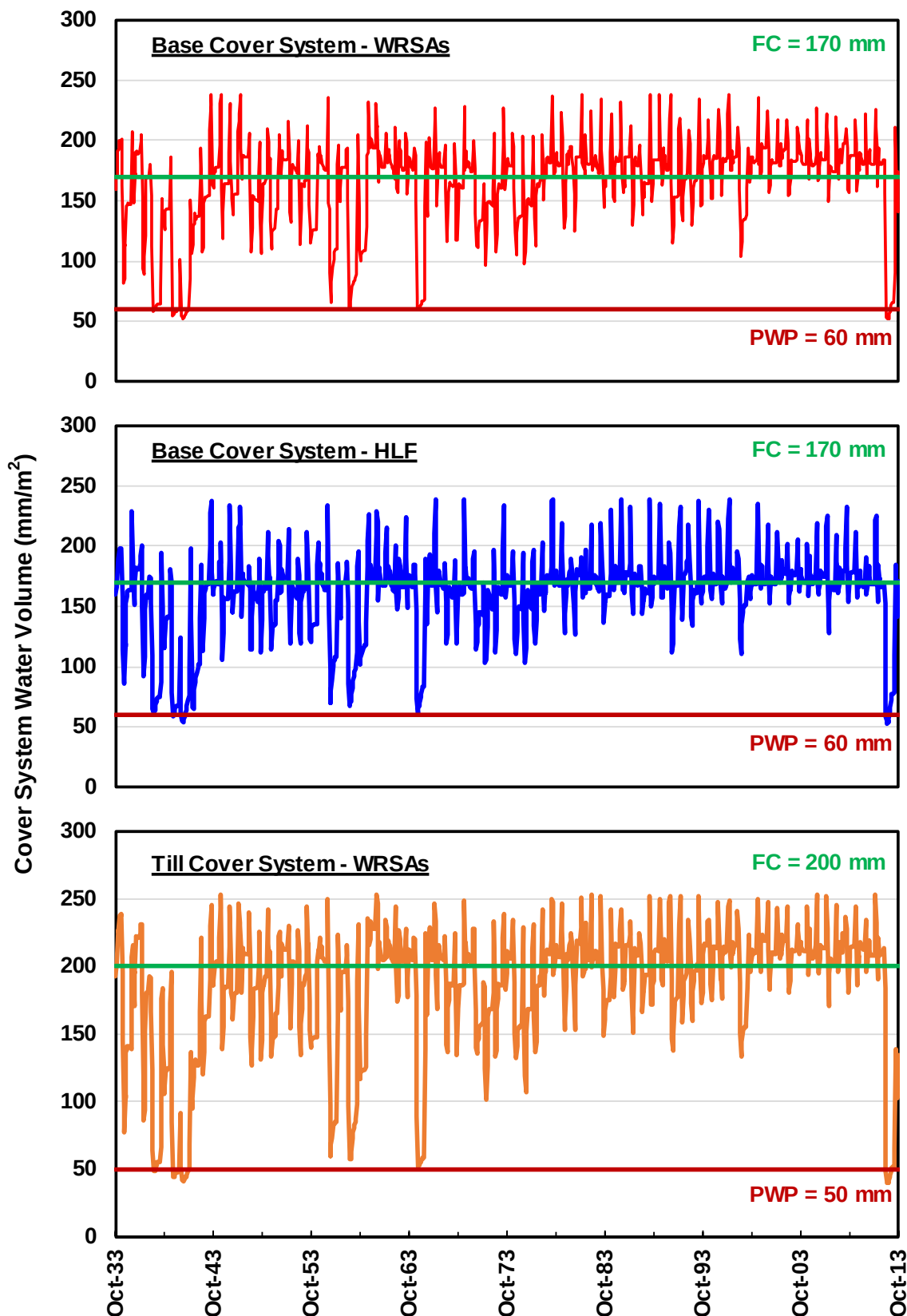


Figure 6 Cover system water volumes estimated during 80-year simulations for three scenarios (from top to bottom): base cover system on WRSAs and HLF and till cover system on WRSAs.

The material properties of the cover system materials were also varied. In general, scenarios that lowered the k_{sat} of various materials resulted in slightly lower NP rates, while increasing the k_{sat} slightly increased NP rates. Table 6 shows predicted average annual water balance fluxes for six cover system scenarios that varied the material properties of the cover system materials.

Table 6
Average annual water balance fluxes predicted for the varied material properties scenarios
(values in percent of annual precipitation).

<i>Waste Material</i>	<i>Waste Rock</i>	<i>Waste Rock</i>	<i>Waste Rock</i>	<i>Waste Rock</i>	<i>Heap Leach</i>	<i>Heap Leach</i>
<i>Modification</i>	<i>Waste Rock k_{sat} increased by 10x</i>	<i>Waste Rock k_{sat} decreased by 10x</i>	<i>Topsoil k_{sat} increased by 10x</i>	<i>Topsoil k_{sat} decreased by 10x</i>	<i>Heap Leach k_{sat} increased by 10x</i>	<i>Heap Leach k_{sat} decreased by 10x</i>
Runoff	10%	10%	8%	15%	10%	10%
AE	43%	44%	45%	44%	40%	42%
Sublimation	12%	12%	12%	12%	12%	12%
Net Percolation	35%	34%	35%	29%	38%	36%

The k_{sat} of the topsoil proved to be an influential property during the sensitivity analysis. By increasing or decreasing the k_{sat} of the topsoil by one order of magnitude, the average NP rate varied from 35% to 29% of annual precipitation, respectively. It is essential that thorough testing be completed to verify the hydraulic properties of local topsoil material because its k_{sat} is showing to have the largest influence on predicted NP rates. Decreasing the waste material k_{sat} also had an effect on the observed NP rate; however, increasing the k_{sat} of the waste material had little effect on the NP rate. The effect of varying the k_{sat} of the tailings-colluvium material was also analyzed; however, no difference in the water balance was observed when the material's k_{sat} was varied by one order of magnitude.

One sensitivity that was not included in the above tornado plot is climate change. Climate change predictions for Mayo, YT predict an increase in monthly air temperature and precipitation¹⁰. The 100-yr average temperature increase is predicted to be between 3 and 6°C, whereas annual precipitation is estimated to increase by 15 to 35%. This increase would have a substantial effect on hydrological cover system performance at the EGP site. Hence, simulations were completed with no ground freezing effects simulated and with the historic climate database adjusted to mid-range climate change estimates (i.e. temperature increase of 4°C and precipitation increase of 25%). Table 7 provides the average water balances for these scenarios (note that the results are stated as a percent of average annual historic precipitation (492 mm/yr) but the climate change scenario has an average annual precipitation rate of 615 mm/yr).

¹⁰ Scenarios Network for Alaska & Arctic Planning. 2013. *Community Charts: Mayo, YT*. Version 1.219. Online. www.snap.uaf.edu.com

Table 7
Average annual water balance fluxes predicted for the base case and climate change scenarios
(values in percent of annual historic precipitation with mm/yr in brackets).

Scenario	Runoff	AE	Sublimation	Net Percolation
Base Case	10% (49)	44% (215)	12% (59)	34% (169)
No Ground Freezing	0% (4)	42% (205)	12% (55)	46% (228)
Climate Change	4% (21)	51% (251)	7% (34)	63% (311)

The majority of runoff from the base case scenario is generated during the spring melt. The frozen ground encourages runoff because the water cannot easily infiltrate due to ice blocking soil pores. When the cover is not able to freeze to a suitable depth due to increased air temperature, spring melt waters are able to infiltrate rather than runoff. The increased infiltration rate contributes to a rise in NP. These scenarios illustrate the advantage of a frozen cover at the EGP site and the risk of its loss due to climate change. The deep frost penetration allows the cover system to limit NP despite the coarser textured locally available material. If the climate change prevents the cover system from freezing to a suitable depth, geosynthetic products would have to be used to limit NP.

Future Studies Recommended to Further WRSA / HLF Closure Cover System Design:

The 2014 EGP modelling program completed by OKC relied on estimated material properties. In order to increase the confidence in the predicted water balance components (especially NP), further study of the EGP site and locally available materials should be completed. Studies recommended by OKC are as follows:

- Material characterization program potential cover materials and waste materials (when they become available), including:
 - o hydraulic conductivity,
 - o moisture retention, and
 - o geochemical properties;
- Construction and monitoring of cover system field trials to provide field performance data under local climatic conditions;
- Monitoring of climate conditions on various slope aspects to improve estimates of such climate variables as net radiation, snow distribution and sublimation, which vary greatly with aspect; and
- Potentially expanded borrow source search for till or lower permeability materials for use in the cover system design.

Closure:

Thank you for the opportunity to assist AEG with closure planning at Victoria Gold's Eagle Gold Project. Please do not hesitate to contact the undersigned should you have any questions.

Sincerely,

Brian Ayres, M.Sc., P.Eng.
Senior Geotechnical Engineer

cc: Scott Keesey and Leia Fougere – Access Consulting Group
Robert Shurniak and Kent Schapansky – O'Kane Consultants Inc.

Attachment A: Key Inputs for 2014 VADOSE/W Modelling Program

ATTACHMENT A

**Key Inputs for 2014 VADOSE/W Modelling Program
for EGP HLF / WRSA Closure Cover Design Assessment**

Preliminary Cover System Modelling Inputs

Before SPA numerical modelling was undertaken the model inputs needed to be clearly defined. These inputs can be placed into five categories: geometry; material properties; initial conditions; upper boundary conditions; and lower and side boundary conditions. A brief description of these model inputs is presented in the following sections. SPA modelling was completed using the software VADOSE/W.

Geometry (Cover System Profile Designs):

The 'base' cover system design consists of a 0.2 m thick layer of topsoil underlain by a 0.3 m thick layer of placer tailings / colluvium. Variations to this design were simulated as part of the sensitivity analysis as described in the main body of the report.

Material Properties:

Seven materials were defined for the OKC modelling program: waste rock, colluvium, heap leach, placer tailings, topsoil, till, and a tailings-colluvium mix. A large database of particle size distributions (PSDs) completed by BGC from a variety of borehole and test pit locations were provided to OKC¹¹¹²¹³¹⁴. These PSDs were the basis for the estimates of all material properties for all but one of the materials; no PSD data was available for the topsoil material. Topsoil material properties were developed by comparing a variety of topsoil materials from the OKC material database from similar sites to images of topsoil from EGP. The estimated porosity, saturated hydraulic conductivity (k_{sat}), as well as the percent sand and fines for each of the materials is given in Table A-1.

Table A-1
 Summary of basic material properties for SPA modelling.

Material Type	Porosity (m ³ /m ³)	k_{sat} (cm/s)	Particle Size Distributions (Minimum – Maximum (Average))		
			% Coarse (>4.75 mm)	% Sand (4.75–0.075 mm)	% Fines (<0.075 mm)
Waste rock	0.30	5.0X10 ⁻⁴	34 – 60 (44)	22 – 43 (30)	16 – 44 (26)
Colluvium	0.33	5.0X10 ⁻⁵	12 – 60 (40)	18 – 53 (36)	4 – 45 (24)
Heap Leach	0.31	1.0X10 ⁻⁴	15 – 50 (33)	20 – 63 (35)	16 – 58 (42)
Tailings	0.26	5.0X10 ⁻⁴	25 – 75 (49)	19 – 61 (39)	5 – 19 (12)
Topsoil	0.59	1.1X10 ⁻³			
Till	0.45	1.0X10 ⁻⁴	0 – 33 (11)	5 – 40 (22)	40 – 95 (67)
Tailings-Colluvium Mix (1:2)	0.40	5.0X10 ⁻⁴	6 – 68 (34)	27 – 71 (48)	4 – 45 (18)

¹¹ BGC. 2010, Appendix B – Laboratory Reports, from *Eagle Gold Project Site Facilities Geotechnical Investigation Factual Data Report*. Prepared for Victoria Gold Corp., March

¹² BGC. 2011, Appendix G – Laboratory Reports, from *2010 Geotechnical Investigation for Mine Site Infrastructure Factual Data Report*. Prepared for Victoria Gold Corp., November

¹³ BGC. 2012a, Appendix L – Laboratory Reports, from *2011 Geotechnical Investigation for Mine Site Infrastructure Factual Data Report*. Prepared for Victoria Gold Corp., January

¹⁴ BGC. 2012b, Appendix K – Laboratory Reports, from *2012 Geotechnical Investigation for Mine Site Infrastructure Factual Data Report*. Prepared for Victoria Gold Corp., November

In order to complete the proposed SPA modelling, additional properties or functions needed to be estimated. The required properties or functions for each material in the modelling program are as follows:

- moisture retention curve (MRC - suction versus volumetric water content);
- hydraulic conductivity function (k-function - suction versus hydraulic conductivity);
- thermal conductivity function (volumetric water content versus thermal conductivity); and
- volumetric specific heat function (volumetric water content versus volumetric specific heat).

The MRC, or soil-water characteristic curve, is a continuous function relating energy and the state of water, and hence describes the water content of a material as a function of soil suction, or negative pore-water pressure. The MRC for each of the materials used during the OKC modelling program are shown in Figure A-1.

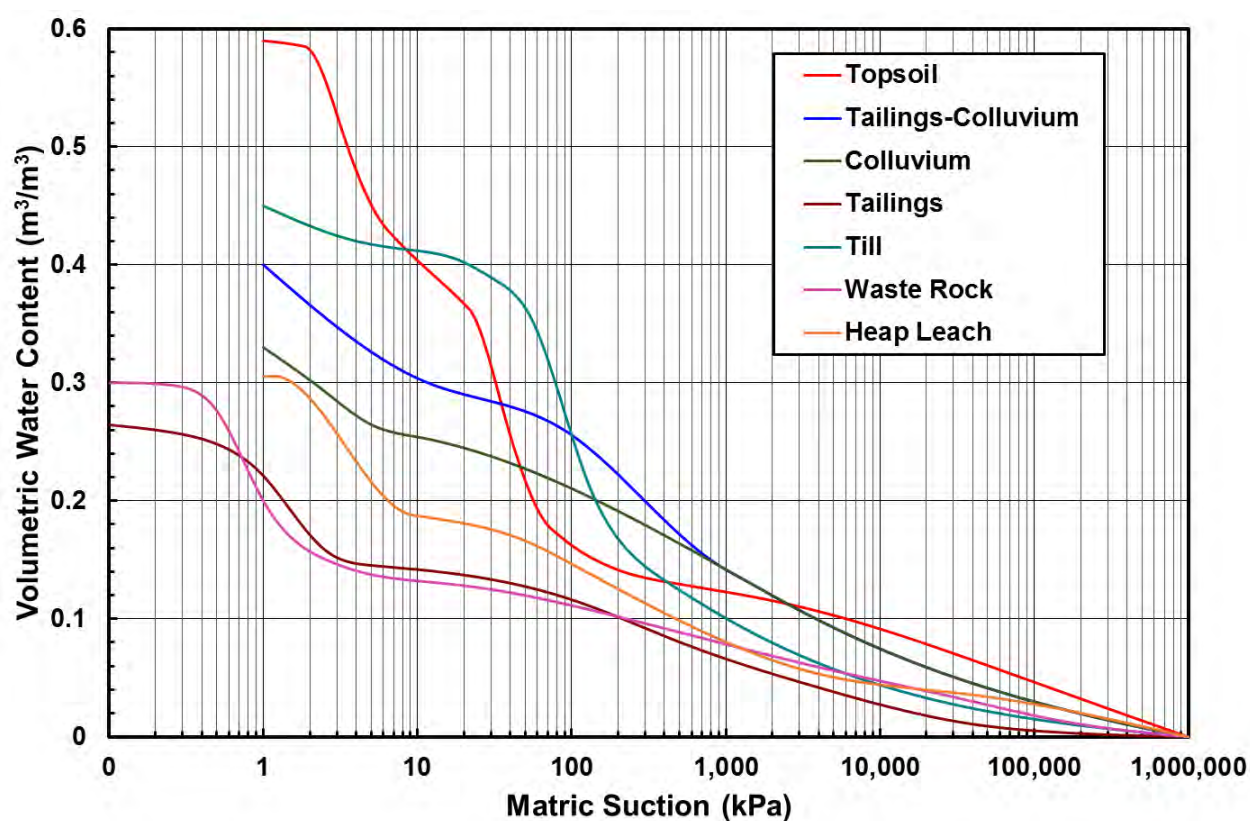


Figure A-1 Moisture retentions curves for all materials used during the OKC modelling program.

Hydraulic conductivity is a measure of the ability of a material to transmit water, and is a maximum for saturated materials. The k-function for each material was estimated from its MRC and k_{sat} using the Fredlund *et al.* method¹⁵. The k-function for each of the materials used during the OKC modelling program are shown in Figure A-2.

¹⁵ Fredlund, D.G., Xing, A., and Huang, S. 1994. Predicting the permeability function for unsaturated soils using the soil-water characteristic curve. Canadian Geotechnical Journal, Vol. 31, pp. 533-546.

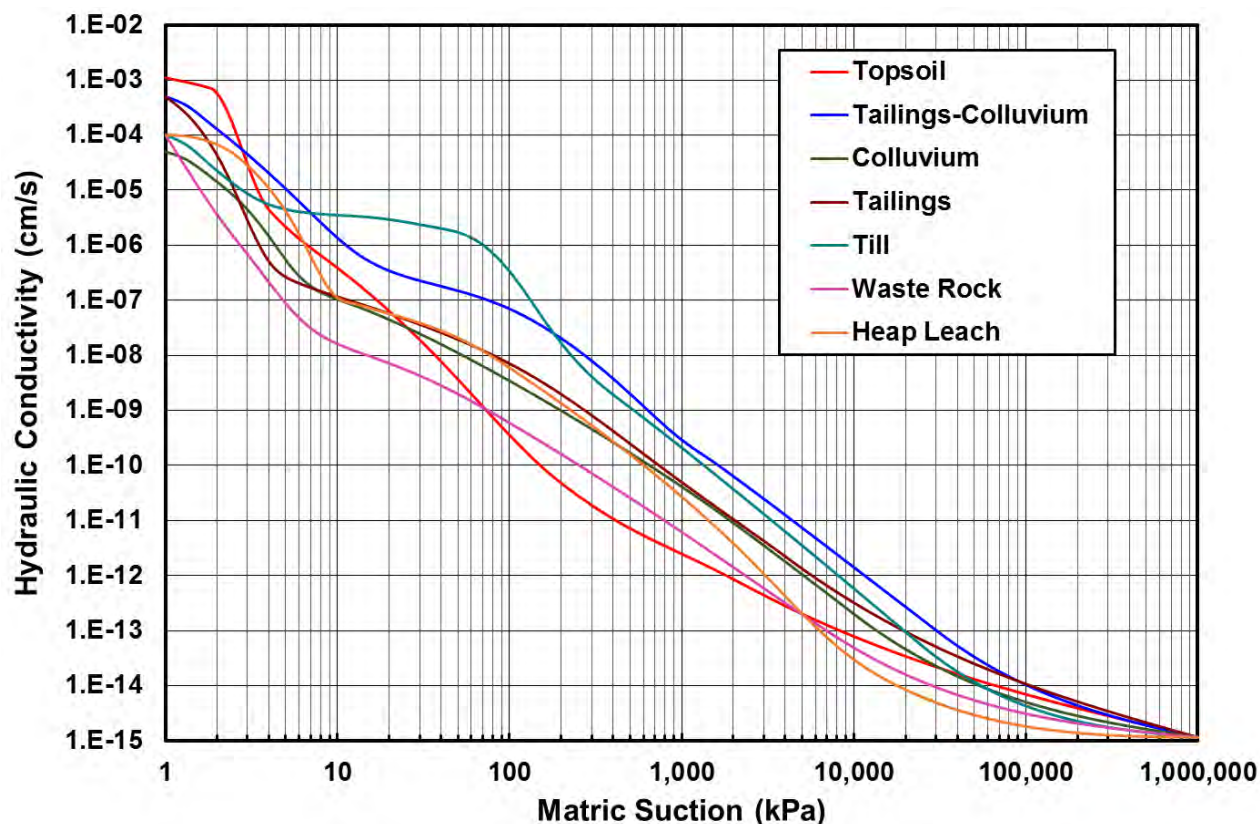


Figure A-2 Hydraulic conductivity function for all materials used during the OKC modelling program.

Thermal conductivity characterizes the ability of a soil medium to transmit heat by conduction. It is defined as the quantity of heat that will flow through a unit area of a soil medium of unit thickness in unit time under a unit temperature gradient. The thermal conductivity functions for all the materials were estimated by VADOSEW using the Johansen method¹⁶.

The heat capacity of a material is defined as the quantity of heat required to raise the temperature of the material by a unit degree. A volumetric specific heat function describes the relationship between volumetric water content and volumetric specific heat. The volumetric specific heat functions for all the materials were estimated by VADOSEW using the deVries method¹⁷.

¹⁶ Johansen, O. 1975. *Thermal Conductivity of Soils*. Ph.D. Thesis, (CRREL Draft Translation 637, 1977), Trondheim, Norway.

¹⁷ de Vries, D.A. 1963. *Thermal properties of soils*. Physics of Plant Environment, W.R. Van Wijk (ed.), North Holland Pub. Co., pp. 382.

Upper Boundary Conditions:

The upper boundary conditions required for the VADOSE/W model can be divided into two parts: climate and vegetation. Details regarding the model inputs developed for each are described below.

Climate:

Due to the lack of a long-term data record available for the EGP site, a synthetic climate database was required to proceed with the proposed modelling program. This database consisted of adapting data from several locations. The climate of the EGP site is characterized by long, dry winters and short, warm, wet summers. Local conditions vary due to the variation of elevations found throughout the site.

The elevation of the HLF ranges from approximately 875 to 1,175 masl, and the WRSA's range from approximately 950 to 1,400 masl. This means there is the potential for significantly different climatic conditions at varying elevations on the landforms. For the purposes of OKC's initial cover design modelling, a reference elevation of 1,175 masl was used to develop the base synthetic climate database. All parameters of the synthetic climate database were corrected to this elevation.

The climate data for the OKC modelling program consist of the synthesis of data from three weather stations. Data from two of the stations were provided by AEG. These are the Potato Hills and Camp stations located at the EGP site. These two stations have excellent data quality, but have only operated for a short period. The third station, located at Mayo, Yukon Territory (approximately 85 km south of EGP), is operated by Environment Canada and has long-term data ranging from 1925-2012. Table A-2 summarizes data available for each station. The "Missing Records" column in Table A-2 only lists dates of large sections of missing data. Information from the Hydrometeorology Report prepared by Knight Piésold was also considered while constructing the synthetic climate database¹⁸.

¹⁸ Knight Piésold. 2013, *Hydrometeorology Report*. Prepared for Victoria Gold Corp., August.

Table A-2
 Summary of data used for climate database development.

Potato Hills Station: N 64°02' W 135°44' elevation 1420 masl		
Parameter	Period of Record	Missing Records
Daily Rainfall (mm)	August 14, 2007 – December 31, 2011	-
Daily Maximum Temperature (°C)	August 14, 2007 – December 31, 2012	42 missing entries
Daily Minimum Temperature (°C)	August 14, 2007 – December 31, 2012	42 missing entries
Daily Maximum Relative Humidity (%)	August 14, 2007 – December 31, 2011	37 missing entries
Daily Minimum Relative Humidity (%)	August 14, 2007 – December 31, 2011	37 missing entries
Daily Average Wind Speed (m/s)	August 14, 2007 – December 31, 2011	-
Daily Average Net Radiation (W/m ²)	August 14, 2007 – December 31, 2011	-
Camp Station: N 64°01' W 135°51' elevation 782 masl		
Parameter	Period of Record*	Missing Records
Daily Rainfall (mm)	August 25, 2007 – September 15, 2013	January 1, 2013 – May 20, 2013
Daily Maximum Temperature (°C)	August 25, 2007 – September 15, 2013	January 1, 2013 – May 20, 2013
Daily Minimum Temperature (°C)	August 25, 2007 – September 15, 2013	January 1, 2013 – May 20, 2013
Daily Maximum Relative Humidity (%)	August 25, 2007 – September 15, 2013	January 1, 2013 – May 20, 2013
Daily Minimum Relative Humidity (%)	August 25, 2007 – September 15, 2013	January 1, 2013 – May 20, 2013
Daily Average Wind Speed (m/s)	August 25, 2007 – September 15, 2013	January 1, 2013 – May 20, 2013
Mayo Airport Station: N 63°37' W 135°52' elevation 504 masl		
Daily Precipitation (mm)	June 1, 1925 – December 31, 2012	March 1, 1946 – March 31, 1946 April 1, 1989 – April 30, 1989 January 1, 1995 – February 28, 1995 April 1, 1995 – December 31, 1995
Daily Maximum Temperature (°C)	January 1, 1925 – December 31, 2012	January 2, 1948 – January 1, 1956 August 1, 1960 – September 4, 1962 August 1, 1963 – September 1, 1977
Daily Minimum Temperature (°C)	January 1, 1925 – December 31, 2012	January 2, 1948 – January 1, 1956 August 1, 1960 – September 4, 1962 August 1, 1963 – September 1, 1977
Daily Maximum Relative Humidity (%)	April 2, 1940 – December 31, 2012	January 2, 1948 – January 1, 1956 August 1, 1960 – September 4, 1962 August 1, 1963 – September 1, 1977
Daily Minimum Relative Humidity (%)	April 2, 1940 – December 31, 2012	January 2, 1948 – January 1, 1956 August 1, 1960 – September 4, 1962 August 1, 1963 – September 1, 1977
Daily Average Wind Speed (m/s)	January 2, 1934 – December 31, 2012	January 2, 1948 – January 1, 1956 August 1, 1960 – September 4, 1962 August 1, 1963 – September 1, 1977

One important parameter that was not available for the Camp or Mayo Airport station is net radiation (NR). This is a vital input for VADOSE modelling to predict potential evapotranspiration (PET) and resultant actual evapotranspiration (AET). For these two stations, NR was calculated using an analytical spreadsheet. This calculation uses the daily maximum and minimum temperature and relative humidity (RH) together with the latitude and elevation of the site to determine the estimated NR. The spreadsheet was first calibrated comparing the measured NR at the Potato Hills station and the calculated NR. The calibration data were then used to predict NR for both the Camp and Mayo Airport Stations.

Climate data obtained from the three stations was thoroughly reviewed with any questionable or incomplete data removed from the record. An equation was developed from the data set for each parameter at each station to provide average conditions for any given day of the year. The equations were obtained by fitting trendlines through daily average graphs for each climate input. Missing data from each station was filled using these average values. The datasets were then compared and adjusted to be representative of the assumed elevation.

The adjusted Mayo Airport data was used as the template for the synthetic climate database. Due to the sparse data available before 1933, the database was reduced to the period between 1933 and 2013, resulting in an 80-year synthetic climate database. Several large gaps in the adjusted Mayo Airport data were filled using either the adjusted data from other stations, or the developed average year. A summary of the average monthly values from the synthetic climate database is provided in Table A-3. The mean annual precipitation for the 80-year climate database is 492 mm, which is similar to the mean annual precipitation noted by Knight Piésold ¹⁹.

Table A-3
 Monthly average climate for the long-term synthetic climate database.

Month	Average Temperature		Average RH	Monthly Precipitation	Average Daily Wind Speed	Average Net Radiation
	Daily High	Daily Low				
	°C	°C				
January	-15.7	-23.7	65	34	1.6	-1.2
February	-10.6	-20.4	63	29	1.8	0.3
March	-7.5	-18.3	58	26	2.3	4.6
April	1.8	-7.9	55	24	2.3	10.4
May	9.5	-1.0	37	37	2.2	14.3
June	15.2	3.8	49	52	1.8	17.2
July	16.0	4.8	55	65	1.8	16.1
August	14.1	2.8	62	60	1.8	12.1
September	9.2	-2.4	66	49	1.6	5.3
October	-3.6	-10.0	73	42	1.6	1.2
November	-12.7	-19.5	73	38	1.6	-0.6
December	-15.7	-23.3	71	36	1.0	-1.3

¹⁹ *Op. Cit.*

Vegetation:

VADOSE/W incorporates vegetation affects using a nodal vegetative uptake source term that is combined with a surface energy term based on canopy cover²⁰. The amount of actual nodal root uptake depends also on root depth and density, and water stress (negative pore water pressure).

Lack of available plant water and/or high evaporative demands will cause most plants to biologically react by closing stoma, reducing transpiration, and reducing metabolic reactions²¹. Under continued and increasing stress the plant will reach its wilting point. The wilting point results in leaf drop and tissue death. In VADOSE/W the user must implement a plant moisture limiting function, which determines the percentage decrease in the plants' ability to draw water as the negative pore-water pressure increases in unsaturated ground.

The leaf area index (LAI) is used by VADOSE/W to reduce the amount of net radiation intercepting the soil surface, which in turn reduces the computed actual evaporation. In other words, LAI controls how the energy at the surface is partitioned between that available for direct evaporation from the soil and that which is available to the plants in their attempt to transpire water. VADOSE/W uses Equation 1 to determine how much energy is intercepted by the plant canopy:

$$I = -0.21 + 0.7 \times LAI^{1/2} \quad [1]$$

where:

I = percent of net radiation intercepted by the plant canopy, and

LAI = leaf area index.

Hence, the model estimates that the canopy intercepts all energy if LAI is greater than 3.0 (i.e. all energy is applied to transpiration) and does not intercept any energy if LAI is less than 0.1 (i.e. all energy is used for evaporation).

If the soil is saturated, the full amount of energy will be applied to the roots according to the root depth and root distribution functions. In VADOSE/W, two root distribution functions are available: triangular and rectangular. A triangular distribution will potentially draw more water near the surface, whereas a rectangular distribution will potentially draw the same amount of water over the full root depth. If the soil is partially saturated, then the actual transpiration value is further reduced according to the plant moisture limiting function entered by the user.

Three vegetation sequences were chosen that represent different timeframes of the reclamation process: bare ground, grasses and shrubs, and mature forest. Each sequence has a significantly different influence on cover system performance. The bare ground sequence also serves as a baseline for comparing cover systems' performance once vegetation has established.

²⁰ Tratch, D. 1996. *Moisture uptake within the root zone*. M.Sc. Thesis, Department of Civil Engineering, University of Saskatchewan, Saskatoon, Saskatchewan, Canada.

²¹ Saxton, K.E. 1982. *Mathematical modelling of evapotranspiration on agricultural watersheds*. In Modeling Components of the Hydrologic Cycle. Singh, H. (ed.), May 18 - 21, 1981. pp. 183-203.

The grasses and shrubs sequence consists of the application of a rectangular rooting depth of 0.3 m as specified by Access Consulting Group²². The plant limiting moisture function for this sequence is shown in Figure A-3.

The final vegetation sequence consists of the application of a mature forest to the modelled sites. The mature forest models were simulated with a triangular rooting depth of 0.5 m. The plant limiting moisture function of this sequence is shown in Figure A-3. A canopy interception (CI) rate of up to 1 mm per rainfall event is assumed when simulating the mature forest. This accounts for rainfall that it collected on the forest canopy, and evaporates before ever reaching the cover system. When applying the canopy interception, a proportional amount of net radiation is also removed during rainfall days to account for the energy required to evaporate the intercepted rainfall.

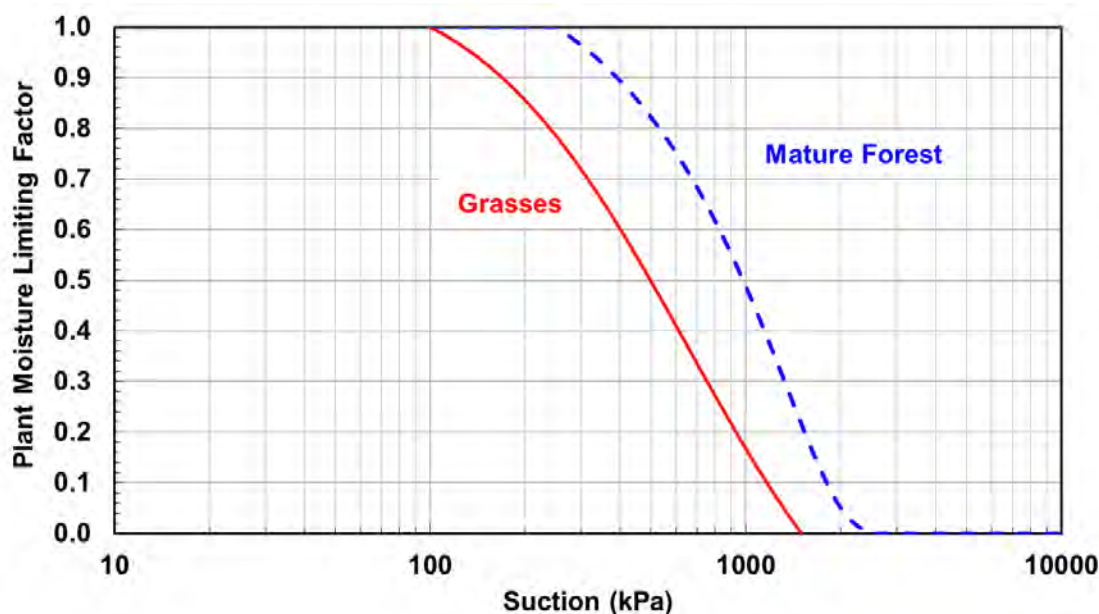


Figure A-3 Plant limiting moisture function for the grasses and mature forest vegetation sequences.

Lower and Side Boundary Conditions:

The lower boundary of each SPA model was simulated as a unit hydraulic gradient at the base of the waste material. This boundary condition simulates the water table to be well below the base of the cover system. A unit hydraulic gradient boundary condition assumes that at the lower boundary the soil suction (and, as a result, water content and hydraulic conductivity) are constant with depth. When this is the case, the total head equals the gravitational head causing a unit hydraulic gradient. In other words, a unit hydraulic gradient represents a location in the modelled profile where water movement is controlled mainly by gravity.

The sides of the 1D models was simulated as no flow boundaries for all simulations.

²² Access Consulting Group. 2013. *Memorandum: 2012 Dry Stack Tailings Facility Cover Trial*. Prepared for Victoria Gold Corp., March.