EAGLE GOLD PROJECT

Project Proposal for Executive Committee Review

PURSUANT TO THE YUKON ENVIRONMENTAL AND SOCIO-ECONOMIC ASSESSMENT ACT

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EXECUTIVE SUMMARY

Project Overview

Victoria Gold Corp (VIT) proposes the Eagle Gold Project (the Project) involving the design, construction, operation, closure, and reclamation of a gold mine in central Yukon. Economic opportunity created by the Project will benefit the Yukon Territory and the First Nation of Na-Cho Nyäk Dun (FNNND) as a whole, as well as their citizens individually. VIT is a publicly traded Canadian exploration company with projects in Canada and the United States. The company is primarily engaged in acquisition, evaluation, exploration, and development of gold properties with a view to commercial production. The benefits of the Project will be achieved in an environmentally and socially responsible manner while meeting VIT's corporate objectives.

The proposed Project is located in central Yukon in the Traditional Territory of the FNNND, approximately 350 km north of the Yukon capital of Whitehorse, and 45 km (85 km by existing access roads) north-northeast of the Village of Mayo. Ecologically the Project is situated within the Yukon Plateau North Ecoregion, in the Boreal Cordillera Ecozone which encompasses the Stewart, MacMillan and Pelly plateaus and southern part of the Selwyn Mountains. The majority of the Project site lies within the Dublin Gulch watershed. The Dublin Gulch stream is a tributary to Haggart Creek which flows to the South McQuesten River within the Stewart River sub-basin of the Yukon River Watershed. Elevations in the vicinity of the Project range from 765 m above sea level near the confluence of Dublin Gulch and Haggart Creek, to 1,525 m above sea level at the base of the Potato Hills, which forms the eastern boundary of the Dublin Gulch watershed.

Historically, Yukon and the Tintina Gold Belt specifically, has been a productive region for gold. The Dublin Gulch area has a rich history of exploration and mining since 1898. As a result, Dublin Gulch watershed and the upper reaches of the Haggart creek watershed have been heavily impacted by placer mining activity. The ecological function of the Project area has been altered by this previous activity and is well documented via past environmental studies that date back to the mid 1990s. From this extensive baseline work, the existing environmental and socio-economic conditions are well known and documented in the Project Proposal.

The Life of Mine Plan (LOMP) for the Project indicates that Mineral Reserves of 66 million tonnes of ore, at an average grade of 0.82 g/t Au, will be mined over eight years starting in 2013, pending receipt of required licenses and permits. Recovered gold from production is projected to total 1,254,000 ounces. Capital costs for construction are estimated to total C$281 million, including a contingency of C$38 million. Cash costs are projected to average US$503 per ounce. At a gold price of US$900 per oz, the Project is estimated to generate a pre-tax net present value of C$78 million, at a discount rate of 7.5%, and has a pre-tax internal rate of return of 15%. The Project offers a strong combination of positive mineral indicators, a desirable location with road and power access, and a strong, experienced management team.

Project Description and Schedule

The proposed Project is comprised of an open pit mine and associated mine features, improvements to the Haggart Creek road, and a 45 km, 69 kV transmission line.

The Project is planned to have a 20-month construction phase, a 7.3-year active mining phase, and a 10-year closure and reclamation phase, followed by a post-closure monitoring phase. The Project will involve open pit mining at a production rate of approximately 9 million tonnes per year ore and a waste to ore strip ratio of 1:1. The open pit will be developed using standard drill and blast technology. Ore and waste rock will be removed from the open pit by haul truck. Ore will be delivered to the primary crusher, while waste rock will be delivered to one of two Waste Rock Storage Areas or used as haul road and infrastructure construction fill. Ore will be crushed by a primary, secondary and tertiary crusher at three separate locations during a 3-stage process at a rate of 26,000 tonnes per day. The first two crushing stages are located on the north rim of the open pit, while the third crushing stage is located closer to the heap leach facility embankment. During this process ore will be transported by a covered conveyor from crusher to crusher until it reaches the heap leach facility area where it is stacked on a lined solution collection pad.

Gold extraction will utilize sodium cyanide heap leaching technology. This technology is time-tested and is proven to be safe and effective in northern climates. Similar technology was employed in Yukon at the Brewery Creek mine in the late 1990s, and has been employed successfully in other cold climates such as the United States of America (Alaska) and Russia. Process solution containing cyanide will be applied to the ore to extract gold and then collected in a solution collection system. Gold bearing solution will be processed via conventional gold recovery methods at an onsite adsorption, desorption, and recovery facility. Process solution can be temporarily stored in two lined ponds (Events Ponds) with a leak detection and recovery system. The Project will include office and camp facilities for 190 persons outfitted with appropriate potable water, wastewater treatment, and fire suppression systems. A mine water treatment plant will be constructed to treat water to meet appropriate water quality criteria for discharged effluent to Haggart Creek. Any excess process water (e.g., produced during drain-down of the heap leach facility as part of the mine closure activities) will be conveyed to the cyanide detoxification facility prior to treatment in the mine water treatment plant. This will enable efficient destruction of residual cyanide and prevent release of it to the environment.

The Project also includes minor upgrades of the existing access road and a new 45 km, 69 kV transmission line routed along the existing South McQuesten and Haggart Creek Roads to connect the Project to the Yukon Energy Corporation grid. Fuel Storage facilities will be constructed to allow for full operation for 30 days without refueling in the event of an unplanned power failure.

The closure and reclamation phase of the Project will focus on fostering the return of the site to appropriate and functional ecosystems, similar to pre-development that meet the key end-land use objectives of wildlife and vegetation resources. A conceptual closure and reclamation plan has been developed as part of the Project Proposal to meet the information requirements and regulatory expectations for assessment under YESAA. The plan was completed with consideration of key elements required under the *Yukon Mine Reclamation and Closure Policy* and related Technical Guidelines. Consistent with Yukon regulatory and policy requirements, a comprehensive Reclamation and Closure plan will be submitted as part of the application for the issuance of Water and Quartz Mining Licenses. This comprehensive and detailed plan will be prepared as required to meet all Yukon regulatory, licensing, and policy requirements, including determination of financial security.

After construction and operations phases have been completed, the Project plan includes a 10-year closure and reclamation phase during 2021 – 2030, followed by a post-closure monitoring phase during 2030 – 2035.

Regulatory and Policy Context

The proposed Project's assessment is subject to the *Yukon Environmental and Socio-economic Assessment Act* (YESAA). The Yukon Environmental and Socio-economic Assessment Board's Executive Committee will conduct the review. The proposed Project will be subject to additional federal and territorial legislation, and will require a number of permits and approvals. Prominent among these are the requirements for a Quartz Mine License under section 135 of the Yukon's *Quartz Mining Act*, and a Type A Water License under sections 6 (1) and 7(1) of the *Waters Act* (Yukon). The full list of applicable legislation and approvals will be clarified and finalized with regulatory agencies as the Project proceeds to the permitting processes.

Engagement with assessors, federal and territorial regulators, and other agencies has been regular and ongoing during development of the Project Proposal. VIT's key objective in regulatory engagement has been to ensure an understanding of assessment and licensing requirements and expectations. Discussions have been held with assessors and regulators to gather information, clarify process, and seek guidance on scoping and information required for development of the proposal. Regulatory engagements have included discussions with YESAB, meetings with Yukon Government Departments, workshop style meetings with federal and territorial agencies, and focused discussion with specific agencies. In addition, Yukon Government has recently established the Major Mines Coordinating Committee for the proposed Project, to provide a coordinated Yukon Government regulatory forum for the Project. VIT will continue regular communications with agencies as the Project progresses.

Consultation

The *Yukon Environmental and Socio-Economic Assessment Act* requires proponents submitting a proposal to the Executive Committee to consult any First Nation or the residents of any community in which the project is either located or might have significant environmental or social economic effects.

VIT and its immediate predecessor (now a wholly owned subsidiary of VIT) have engaged in a wide range of consultation activities. In May, 2008, StrataGold entered into an Exploration Cooperation Agreement with the FNNND for the Dublin Gulch project. The agreement obligations were transferred to VIT when it acquired StrataGold. Upon acquisition of StrataGold in June 2009, VIT began a broad and proactive consultation and engagement program including the FNNND, the Village of Mayo, stakeholders, and regulatory agencies.

VIT has made early and ongoing consultation with the FNNND and the Village of Mayo a priority to ensure an opportunity for input at all key stages of Project Proposal development. To ensure traditional knowledge is incorporated into the assessment, VIT conducted an extensive traditional knowledge and use study. In addition, a number of workshops on topics such as the use of cyanide in gold mining, and mine closure and reclamation have been conducted along with site visits. VIT has also engaged with local trappers, the Mayo District Renewable Resource Council, Yukon Conservation Society, local outfitters, and placer mine operators. To ensure consistent and frequent communication, VIT produced four newsletters which were sent to the general public in 2009/10 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, but some specific concerns have been raised. Examples involve the proposed Project's potential effects on wildlife (particularly moose), traditionally collected plants, water quality, air quality, permafrost, employment opportunities, and the effect of the influx of workers on community life and stability. Opportunities for potentially affected parties to raise concerns, and for VIT to respond directly, have been a fundamental component of the consultation program. The concerns raised also informed the Project Proposal's assessment of potential effects. In most cases, VIT has incorporated measures to address comments and concerns in the design of the Project. For other cases, VIT is carefully tracking comments raised for further follow up and discussion.

The most prominent concern has surrounded the use and transportation of cyanide. Both VIT and Yukon Government responded directly and comprehensively to this concern. The Yukon Government sponsored workshops in Mayo and Whitehorse that explained the use of cyanide in mining processes, providing examples of where it has been used successfully and safely in other areas of the world. VIT also presented a separate workshop in Mayo on the heap leach process proposed for the Project, and arranged tours to both the Project site and to the Fort Knox mine in Alaska, which currently uses a cyanide heap leach process. In addition to these efforts, several FNNND and Mayo residents are familiar with the use of cyanide via previous employment at the United Keno Hill Mining and Brewery Creek projects. This local knowledge, combined with the information provided in workshops and on site visits, as well as VIT's commitments to safe handling of the cyanide and the environmental protection on site, has eased public concern. To address remaining concerns, another workshop on cyanide use in mining is planned for 2011.

Assessment of Potential Effects

Assessment Methods

The assessment of the Project's potential environmental and socio-economic effects used a framework that addresses the requirements of environmental assessment legislation across Canada, including YESAA. The methods are based on a structured approach corresponding to YESAB's approach, which first assesses potential Project-specific effects and then potential cumulative effects. The steps involved are:

1. Identification of Valued Environmental and Socio-economic Components (VCs) relevant to the Project and the assessment. VC selection was based on information derived from consultations with the FNNND, other governments, regulators, and communities; as well as the professional knowledge of the proponent and the assessment team.
2. Examination of possible interactions between the Project and VCs with a focus on identifying potential effects of concern to be carried forward for assessment.
3. An assessment of the significance of the residual effects that remain after mitigations to avoid or lessen the effects has been applied.
4. An assessment of the significance of potential cumulative effects arising from Project effect interactions with other projects.
5. Development of recommendations for monitoring and adaptive management of residual Project-specific and cumulative effects.

The following sections contain an overview of the assessment of potential Project effects on each VC—seven bio-physical VCs and five socio-economic VCs. The assessment overviews are preceded by a summary of the closure and reclamation plan because the plan is a principal mitigation for all VCs.

Reclamation Plan

The ultimate goal of the Project's proposed closure and reclamation program is return of the site to a functional ecosystem, similar or better than pre-development conditions.

VIT's overall strategy for the closure is to decommission and reclaim mine features, and to monitor mitigation measures to ensure they achieve required outcomes. Key objectives of the plan include:

- Address FNNND and stakeholder priorities and concerns, and demonstrate that future risks and liabilities associated with the post-closure site have been eliminated or controlled to an acceptable level
- Prevent invasive plant establishment
- Re-establish the productive land use to a level of value for wildlife habitat comparable to baseline conditions
- Restore the landscape so that it is visually comparable to the undisturbed surrounding area
- Ensure long term physical stability of the mine facilities, and ensure that the site poses minimal risk to the public and native fauna

Protect aquatic resources and site water quality during and after closure. The Project Proposal contains a conceptual closure and reclamation plan to provide the level of detail necessary for the assessment under YESAA. A comprehensive and detailed Closure and Reclamation Plan will be prepared as required to meet all Yukon regulatory, licensing and policy requirements, including determination of financial security.

Bio-Physical Valued Components

Seven bio-physical VCs were selected for assessment—Surficial Geology, Terrain, and Soils; Air Quality; Water Quality and Aquatic Biota; Fish and Fish Habitat; Vegetation Resources; Wildlife Resources; and Heritage Resources.

Surficial Geology, Terrain, and Soils

Surficial geology, terrain, and soils are closely interrelated and are considered as a single VC for the Project Proposal. Combined they are the building blocks that shape the landscape and ecosystems that support a broad array of biological, cultural, and societal functions and values. The Project has the potential to affect this VC because the mining operations and its supporting activities will involve land clearing, alteration of underlying soil and subsoil resources, and changes to local landscape features. These potential effects are of concern to government, communities, non-governmental organizations, Yukon residents, and First Nations as the effects on this VC have the potential to affect vegetation, wildlife habitat, and hydrology.

Surficial geology for the Project is of concern because overburden will be used as a potential growth medium for reclamation when there is insufficient soil. Consequently potential effects on surficial geology are assessed with the assessment of effects on soils. The key issue for terrain is adverse change in terrain stability. This potential environmental effect is measured by the increased risk of debris flows, slumps, earth flows, permafrost thaw, and other events collectively known as mass wasting. The key potential environmental effect for soils (and by association, surficial geology) is adverse change in soil reclamation suitability as measured by changes in soil physical and chemical properties.

The majority of terrain stability issues, including all those within the mine features area, have been addressed through mine design and risk management. The only terrain stability issue not adequately addressed is associated with melting of permafrost in cleared areas outside of the designed mine features areas. Areas of potential terrain instability have been identified and either avoided or stabilized, and margins of safety have been developed to assure that any mass wasting event will not occur within the mine design area. Monitoring and adaptive management will be applied to address any remaining issues involving permafrost in cleared areas.

Proven best management practices will be employed to salvage soils and store soils for reclamation and to protect from compaction and erosion those soils remaining in place. Any shortages in soils will be compensated for with overburden resources. The potential for metal loading of soils from dust created by the Project was considered. This potential effect will be monitored and adaptive management steps taken if loading unexpectedly appears to have the potential to affect wildlife or vegetation health.

VIT and its consultants have determined that, with the implementation of proposed mitigation measures, no significant effects on Surficial Geology, Terrain, and Soils will occur as a result of the Project.

Air Quality

The atmosphere is an important pathway for the transport of contaminants to the freshwater, terrestrial, and human environments. Consequently, air quality has an intrinsic importance to the health and well being of humans, wildlife, vegetation and other biota. Since there are no existing industrial activities near the Project site, existing air quality is influenced by surrounding natural sources and contributions from long-distance transport of air contaminants. Project activities will result in the release of Criteria Air Contaminants, substances that are regulated by Environment Canada and Health Canada. The potential Project effect on air quality was determined by comparing predicted Criteria Air Contaminants concentrations against the national regulatory objectives (National Ambient Air Quality Objectives and the Canada Wide Standards). A Criteria Air Contaminants emissions inventory was developed to characterize the Project emissions likely to result in an air quality effect, dispersion modeling was used to assess the potential effects on the receiving environment, and maximum predicted ground-level concentrations were compared to the applicable regulatory objectives. The primary Project sources of Criteria Air Contaminants include diesel engine exhaust (from vehicles and equipment), fugitive dust emissions (from surface soil disruption), and point source emissions from the adsorption, desorption, and recovery facility. During both construction and operations, the majority of the Project emissions will consist of total suspended particulates and 2.5 µm particulate matter ($PM_{2.5}$). Of all Criteria Air Contaminants considered in this assessment, only the 24-hour predicted maximum TSP and $PM_{2.5}$ concentrations exceeded applicable regulatory objectives, and this occurs at or very near the mine site. It is predicted that a very small area outside of the Project site will have concentrations of airborne total suspended particulates that exceeds regulatory objectives. Emission rates are estimated based on a combination of emission factors, engineering estimates, and manufacturer's specifications and are typically representative of maximum possible values. The effect of wet scavenging (natural dust suppression by rain and snow) was not included in this assessment, and there is a high degree of confidence that emissions are being over-estimated. If wet scavenging is considered, actual exceedances of ambient regulatory objectives are unlikely. Residual effects are minimal and will be significantly reduced with natural dust suppression, the fugitive dust control plan, and the combustion source control plan. Concentrations of Criteria Air Contaminants above the regulatory objectives are expected to be very rare, local, short in duration and reversible.

VIT and its consultants have determined that, with the implementation of proposed mitigation measures, no significant effects on Air Quality will occur as a result of the Project.

Water Quality and Aquatic Biota

Water quality and aquatic biota was selected as a VC because of their importance in maintaining functioning of the aquatic environment downstream of mining activities; this is recognized through regulatory considerations (water license, water quality guidelines), and First Nation and community interests. Mining activities can result in the discharge of metals, nutrients, sediment, and other constituents (e.g., sulphate, cyanide) to area streams as a result of soil and rock disturbance and processing of ore. These can lead to toxicity or nutrient enrichment for aquatic life. The effects assessed were diversion of clean water around the project facilities and discharge of effluent or seepage to Haggart Creek or Dublin Gulch during operation and closure. To mitigate these effects, the Water Management Plan includes sediment and erosion control measures, conservative sizing of water management structures, routing of clean water around the project facilities, and routing of water from waste rock storage areas and the heap leach facility through a mine water treatment plant prior to release of effluent to Haggart Creek. The conceptual closure and reclamation plan describes further mitigations that may be required as adaptive management to further protect water quality and aquatic biota. At closure, the heap leach facility will be rinsed and drained, at which time a cyanide detoxification plant will remove cyanide and ammonia from discharges. Because of the conservative nature of the predictions (worst case predictions), it is likely that water quality will be improved from modeled predictions; however, additional mitigation during closure is included as adaptive management. Additional mitigation measures that may be required pending monitoring include constructed wetlands at the base of the waste rock storage areas and heap leach facility and improved soil covers on facilities that limit net precipitation infiltration. As a result of these mitigation measures, discharges from the mine facilities are predicted to meet effluent criteria described in the Metal Mining Effluent Regulation; water quality in Haggart Creek and Dublin Gulch is predicted to meet required water quality guidelines for the protection of aquatic life, or to meet site specific objectives for parameters such as arsenic that exceed guidelines in the baseline condition.

VIT and its consultants have determined that, with the implementation of proposed mitigation measures, no significant effects on Water Quality and Aquatic Biota will occur as a result of the Project.

Fish and Fish Habitat

Fish and Fish Habitat was selected as a VC because fish are an important indicator of overall aquatic health and have substantial recreational and food value to both First Nation and other users. In addition, the *Fisheries Act* establishes regulatory requirements for the protection of fish and fish habitat. By including fish and fish habitat as a VC, potential effects from the Project are assessed within the requirements of the *Fisheries Act*. By identifying important fish habitat potentially affected by the Project and developing mitigation measures to protect these resources, the overall ecological function of the affected aquatic ecosystems can be assessed as part of the Project Proposal.

The Project will be located in the Haggart Creek which supports Arctic grayling and slimy sculpin. Haggart Creek discharges to the South McQuesten River over 20 km downstream of the Project site. The South McQuesten River supports Chinook salmon along with a host of other species.

Key issues for fish and fish habitat are related to construction and operation activities that alter or remove key components of fish habitat, change base flows, introduce substances into watercourses that are deleterious to fish, or cause the direct mortality of fish. Potential effects to fish habitat availability and fish mortality were considered during the assessment of Project interactions with fish and fish habitat. The primary changes in fish habitat structure will be from the diversion of Dublin Gulch into the proposed Dublin Gulch Diversion Channel and the infilling of existing watercourses to accommodate Project facilities. Project activities have the potential to increase the risk of fish mortality in fish-bearing watercourses due to the physical harming of fish or the introduction of deleterious substances in to fish-bearing watercourses.

A suite of mitigation measures will be implemented to minimize or avoid effects on the availability of fish habitat and fish mortality. Principle among these mitigation measures are those incorporated directly into Project design which include; minimizing riparian clearing, incorporating fish habitat features into the Dublin Gulch Diversion Channel design, conducting instream works during least risk periods, and incorporating a mine water treatment plant capable of meeting water quality guidelines for aquatic life. In addition, best management practices will be implemented to manage effects and avoid adverse effects on fish habitat. As a final mitigation measure, fish habitat compensation will off-set any loss of habitat that occurs as a result of mine infrastructure construction and water diversions. Dublin Gulch is the only fish-bearing watercourse that lies within the footprint of the mine. The remaining watercourses inside the perimeter of the mine footprint are non-fish bearing. An authorization under the *Fisheries Act* for the harmful alteration disruption or destruction of fish habitat as a result of the Project will be required by Fisheries and Oceans Canada. A fish habitat compensation plan has been developed to address predicted harmful alteration, disruption or destruction to fish habitat losses resulting from the development of the Project. The primary objectives of the plan are to increase the net productivity of fish habitat in the Haggart Creek watershed, and to design a compensation strategy that reflects the intent of DFO's policy for the management of fish habitat.

VIT and its consultants have determined that, with the implementation of proposed mitigation measures, no significant effects on Fish and Fish Habitat will occur as a result of the Project.

Vegetation Resources

Vegetation is a pillar to ecosystem function, sustainable wildlife populations, and the direct provision of services to humans such as plants used for traditional use. For these reasons and the potential effects that the Project may have, Vegetation resources was selected as a VC.

Three potential environmental effects were considered during the assessment of Project interactions with vegetation:

- Loss of vegetation (due to clearing and grubbing)
- Changes in abiotic conditions necessary for the sustainability of plant communities or vegetation
- Changes in the structure or composition of vegetation communities.

The effects of these changes were considered for five key indicators: rare plants, wetland ecosystems, riparian ecosystems; old forest, and traditional use plants (i.e., berry potential).

Quantitative thresholds have not been established for determining the significance of effects on vegetation. However, a qualitative determination of the significance of Project effects on the sustainability of vegetation communities is possible, considering both the measurement and characterization of residual effects on key indicators and applying the professional experience and judgment of the assessment team.

While potential Project effects on some of the indicators were adverse (i.e., wetlands and old growth forest) the effects were low in magnitude and geographic extent. In most cases it is predicted that the effects to Vegetation resources will be reversible with implementation of the closure and reclamation plan, and where this was not the case, the affected area is predicted to be negligible relative to the surrounding area.

The combined residual effect of the Project on vegetation is characterized as low magnitude, negative, long term to far future, local, and mainly reversible at post-closure. In conclusion, VIT and its consultants have determined that, with the implementation of proposed mitigation measures, no significant effects on Vegetation Resources will occur as a result of the Project.

Wildlife Resources

The Project will interact with wildlife, an important resource for the FNNND, Environment Yukon, Environment Canada, and Yukon stakeholders. Wildlife Resources were therefore selected as a VC. Potential effects on wildlife habitat, mortality risk, and movement were assessed. The Project will implement a suite of mitigation measures described in detail in the Project Proposal. Past placer mining operations have resulted in altered habitat within the proposed Project footprint. However, habitat in the 900 km^2 area surrounding the proposed Project footprint is 99% unaltered natural habitat. There are no Environment Yukon identified Wildlife Key Areas in the vicinity of the proposed Project (the closest is 55 km northeast of the proposed mine). The habitat potentially affected by the Project is typical and abundant in the area, and negligible in amount compared to that in the surrounding area. At closure the Project will result in loss of 0.01 ha of wetlands, 9 ha of riparian areas and 91 ha of old forest. Moose will lose 244 ha of winter feeding and 865 ha of winter shelter habitat, while grizzly bear will lose 865 ha of fall feeding habitat and gain 385 ha of spring feeding habitat. Given the extent of these habitats in surrounding areas, these changes in habitat are not significant in terms of their effects on the viability of wildlife populations.

For potential effects on mortality, the Project will implement 14 mitigation measures to reduce mortality risk from Project related encounters with wildlife, and two mitigation measures to facilitate wildlife movement over or around potential Project related barriers. Combined with the fact that the Project will not increase linear feature density (important to species such as grizzly bears) the Project is not expected to pose a substantial mortality risk or impediment to wildlife movement. The effects of the Project on the sustainability of wildlife populations are considered not significant. The Project will support monitoring to ensure mitigation measures are effective and to promote adaptive management.

VIT and its consultants have determined that, with the implementation of proposed mitigation measures, no significant effects on Wildlife Resources will occur as a result of the Project.

Heritage Resources

Heritage resources are records of scientific or cultural value due to their archaeological, palaeontological, ethnological, prehistoric, historic, or aesthetic features. The upland areas that will be affected by the Project are rugged, mountainous, unfossiliferous, and are of low archaeological potential. Placer gold mining activities along Dublin Gulch and Haggart Creek have completely removed the source-site for fossils and have disturbed most other high potential paleontological deposits and pre-contact archaeological sites. The exception is a few un-mined pockets along Dublin

Gulch and Ann Gulch. There are also more than a dozen historic structures (cabins) in the vicinity of Dublin Gulch, and three pre-contact and historic archaeological sites along the South McQuesten Road. Information loss through disturbance of heritage resources might affect current understanding of past use and culture at the local and regional levels of knowledge; however, with the implementation of codified protection practices, no Project activity will cause effects of concern to heritage resources. All pre-contact archaeological and historic sites along the access road will be avoided, and for any historic structures at Dublin Gulch that cannot be avoided, all mitigation requirements from the Government of Yukon – Paleontology Program will be followed. The FNNND has confirmed that to their knowledge there are no heritage sites or special places in the immediate vicinity of the Project. VIT has entered an agreement with the FNNND that, among other things, sets out a process and procedure that VIT will follow in the event any heritage resource is discovered. VIT has also implemented a discovery protocol to recover and quickly report the chance discovery of heritage resources during Project activities.

VIT and its consultants have determined that, with the implementation of proposed mitigation measures, no significant effects on Heritage Resources will occur as a result of the Project.

Socio economic Valued Components

Five Socio-economic VCs were selected for assessment to capture the objectives and concerns expressed by the FNNND and the Village of Mayo. The five VCs are: Employment and Economic Opportunities; Traditional Activities and Culture; Community Vitality; Human Health and Well-being; and Infrastructure and Services. For all socio-economic VCs, VIT and its consultants have determined that with implementation of the proposed mitigation measures Project potential effects will not be adversely significant. In most cases the effects will be positive. VIT will cooperatively develop a process for confirming socio-economic indicators, and reporting on and responding to monitoring results. To support this, VIT proposes establishing a committee of representatives of the FNNND, VIT and VoM to engage in ongoing dialogue that will inform VIT of any potential adverse social effects resulting from the Project. Representatives of the RCMP, Yukon College, and responsible government agencies would be invited to attend or provide input as appropriate.

Employment and Economic Opportunities

Five components of employment and economic opportunity were evaluated in the assessment of the proposed Project's potential effects on this VC. These components are: Employment Opportunities; Contracting Opportunities; Royalties and Taxes; Effects from Expenditures; and Effects on Other Local and Regional Activities. The preponderate effect of the Project on each of these components is positive. During the full life of the Mine the Project will provide employment opportunities locally, in the Yukon, and in Canada. VIT will take steps to enhance potential benefits going to the local community. For example, VIT will strive to hire as many FNNND citizens, other local and Yukon residents as practical as well as providing employment training programs. VIT will also produce a Business Opportunities pamphlet and structure contracts to a size where practical that will allow for local contracting opportunities.

Traditional Activities and Culture

To evaluate the interaction between the Project and Traditional Activities and Culture, potential effects on Subsistence Harvesting, Language Preservation and Revitalization, Other Cultural Activities, and Heritage Sites and Special Places were assessed. The assessment concluded that overall either there would be no Project potential effects, or the effects would be negligible. There will be no effects on language, cultural activities, or heritage sites. To address concerns about mine traffic interfering with subsistence harvesting along the access road, VIT will make road improvements, institute radio-controlled access to portions of the road, and build pull-off or parking areas along the road. VIT will also develop a policy restricting Project-related employees and contractors from hunting and fishing while on the job at any time throughout the life of the Project. For reclamation, a re-vegetation program using indigenous flora will be implemented. Potential effects on registered trapline concessions will be addressed through continued discussions with concession owners and if needed compensation to owners under the *Wildlife Act*. VIT will also provide cultural awareness training for all employees.

Community Vitality

Population and Demographics, Local Educational Facilities and Services, Crime, and Community involvement were examined for assessing Project potential effects on Community Vitality. The Project will be a fully self-contained camp operation, with employees from Mayo being transported to and from Mayo, and those from outside of the area being transported to and from Whitehorse. Consequently there will be no direct effect of the Project on the population of the area. There could be an indirect effect, if increased business in the Mayo area due to the Project resulted in some movement into the area. With increased employment opportunity, there may also be less incentive for people to leave. Unless families move into the Mayo area due to increased business opportunities, the Project is also not expected affect enrolment at the local elementary school. A moderate increase in demand at the Mayo campus of Yukon College is expected. VIT is committed, though, to providing support for programs and initiatives at both J.V. Clark Elementary School and the Mayo campus of Yukon College. Crime is not expected to be affected due to the mitigations and commitments that VIT will put in place. All employees will be transported directly to the Project and housed on-site to restrict unwanted access to Mayo. VIT will implement a substance control policy for mine employees. This policy may include mandatory pre-employment testing and random drug testing during employment for all mine employees. The substance control policy will include human resource protocols for employees found consuming alcohol or drugs on site, found to be under the influence of alcohol or drugs, or otherwise failing a drug test. Policies and procedures will also be established with respect to the use of local roads and highways. In addition, cultural awareness training for all Project employees will reduce the potential for conflict.

Human Health and Well-being

Local Health and Social Facilities and Services, and Mental Health and Addiction are the two components of Human Health and Well-being evaluated in determining potential effects of the proposed Project on the VC. With the mitigation measures that VIT will have in place, no direct adverse Project effects for either component were found. VIT will establish an Emergency Response Plan for the Project and have on-site first-aid and trained emergency personnel to provide primary care. Employees and their families will have access to benefits programs provided by VIT.

Infrastructure and Services

Facilities for emergency services, landfill, sewage lagoons, child care, roads, the Mayo Airport, and electrical power supply were considered in assessing potential effects of the proposed Project on Infrastructure and Services. Effects on emergency services were determined to be minor. VIT will have on-site personnel with first aid training and on site security that will alleviate the need for either outside medical or police services. Effects on landfill could be substantial, but can be adequately addressed with planning. VIT will engage with the Village of Mayo to discuss anticipated waste volumes and determine the availability and best options for appropriate waste management facilities and programs. Being a self contained camp, the Project will not have measurable adverse effects on either the sewage lagoons or the availability of child care services in the Village of Mayo. The Project will have negligible adverse effects on the capacity and safety of roadways. Speed limits will be enforced for all Project vehicles. VIT will ensure trucking/hauling contractors have appropriate driver training, radio contact capabilities, vehicle maintenance requirements, and spill response capabilities; and will ensure all hazardous materials are transported and handled in accordance with the *Transportation of Dangerous Goods Act* and Regulations. A Project benefit will be that VIT will work with the Department of Highways and Public Works to ensure both public and private portions of the access road are properly maintained and upgraded. Project use of the airport will not tax the facility's capacity. The current airport usage is less than a third of what it was in 1981. Regarding the Project's electrical power demands, the resulting increase in electrical loads on the existing electrical transmission system is within existing installed capacity, and the Yukon Energy Corporation has stated that it does not anticipate changes in the reliability of power supply to existing customers as a result of power needs of the Project.

Bio-Physical and Socio-Economic Cumulative Effects

The assessment of potential cumulative effects was conducted for all bio-physical and socio-economic VCs. Each assessment begins with a screening that involves determining whether or not all three of the following conditions are met:

1. The Project results in a demonstrable or measurable residual effect on the VC.
2. The Project-specific residual effect on the VC does or is likely to act in a cumulative fashion with the effects of past, existing, or future projects and activities in the area (i.e., there is a temporal and spatial overlap of effects).
3. There is a reasonable expectation that the Project's contribution to cumulative effects will affect the viability or sustainability of the VC.

The cumulative effects assessment proceeded beyond the screening assessment-level for an effect only when all three conditions are met.

The proposed Project is located in an isolated area. Aside from placer mining the closest industrial activity; an exploratory drilling program, is 19 km away. The next closest industrial activity is 35 km away. Activities in the vicinity of the Project in addition to placer mining include hunting, fishing, trapping, plant gathering, and outfitting. For the bio-physical VCs, the isolation of the area makes it highly unlikely that residual effects resulting from the Project could interact with effects of any other projects or activities (screening condition 2 above) except for placer mining, fishing, hunting trapping and plant gathering. For these exceptions, with mitigations in place there is not a reasonable expectation that the Project's contribution to cumulative effects could affect the viability or sustainability of any of the bio-physical VCs.

For the Socio-economic VCs, distance from the Project is not as critical a factor in determining whether or not cumulative effects with other projects and activities could occur. For example the increased tax revenue that could be derived from the Project could have Yukon-wide positive effects. As another example, competition among distant projects could occur for works in a limited workforce environment. Consequently, for the socio-economic VCs there were substantial cumulative effects predicted. Overall it has been determined that socio-economic cumulative effects will result in positive outcomes. The predicted potentially adverse effects can be readily mitigated if they occur. Most noteworthy, the Project, in combination with other Projects in the local area and Yukon, will result in significant positive cumulative effects on employment, contracting, taxation and royalties. The competition for the eligible labor pool may result in capacity challenges for local organizations or businesses, but improved capacity and skills development of both individual workers and contractors will result from the combined market produced by the Project and other mining projects in the region.

A summary of residual effects is provided in Section 6.4 – 6.11. VIT is not aware of any industrial or other activity with which the Eagle Gold Project would interact to create significant cumulative effects that are adverse.

Accidents and Malfunctions

In addition to the potential effects of normal Project implementation on the VCs, the potential effects of accidents and malfunctions were also assessed. The potential for accidents and malfunctions exists with every project. They can be due to design and construction errors, human error, and natural events such as storms and earthquakes. While the potential for accidents and malfunctions can never be eliminated, their likelihood can be reduced to a minimum with careful planning, precautionary design that anticipates and addresses potential causes, and protocols that assure proper implementation. Potential effects can also be minimized with anticipatory planning and policy, procedures, personnel, and equipment for immediate response and subsequent remediation work.

The assessment of effects arising from potential accidents and malfunctions related to the Project focused on seven possible events:

- Transportation accident
- Hazardous materials spill
- HLF breach
- Slope failure (open pit and waste rock storage areas)

- Water conveyance and storage infrastructure failure
- Power failure
- Fire and/or explosion.

The selection of these events was based on input from consultations, regulators, and the public and also on the professions judgment of VIT and its contractors of what events were most like to create effects of concern. In most cases Project design and Project-specific mitigations took into account the potential for these events and eliminated or reduced the risk of a potential effect event to a level that would not be of concern. Other identified potential effects were judged to be adequately addressed through the application of codified practices and industry accepted best management practices.

In those cases where the potential for effects of concern could not be eliminated, it was found that the likelihood of the event occurring could be reduced to a level where they were unlikely to very unlikely to occur during the life of the Project. In tandem with this, VIT's commitment to the development of a Project-specific emergency response plan for all reasonably foreseeable potential accidents and malfunctions is a key mitigation to limiting potential effects in the case an event would occur. With implementation of the proposed mitigation measures and the likelihood of event occurrence reduced to unlikely or very unlikely, VIT and its consultants have determined that accidents and malfunctions do not pose a significant threat to the VCs assessed in the Project Proposal.

Climate Change Considerations

Quantitative information is presented regarding proposed CO_2 emissions from the Project; however, methods are not available to assess the Project's actual contribution or effects on climate change in conjunction with carbon outputs from other sources. The assessment consequently focussed: (1) on options available for carbon management in the context of the Project; and (2) on VIT's ability to meet both current regulatory and policy direction, as well as commitments to carbon management should these directives change.

The emission of greenhouse gases has been a consideration since the beginning of Project design. The proposed design and operation of the Project is consistent with existing mines in Yukon and Canada, and complies with all existing federal and territorial regulatory requirements. VIT has also incorporated climate change considerations into its Project planning. An example of this is VIT's consideration of two scenarios for power sources. The first scenario, Option 1, was based on 100% diesel generated power. The second scenario, Option 2, was a combination of diesel generated power during construction and power supplied by the Yukon Energy Corporation electrical transmission grid for the remainder of the Project's life. Option 2 includes installation of a new transmission line from the existing transmission line that follows the Silver Trail Highway. Option 2—Power provided by the Yukon Energy Corporation transmission grid was determined to be the most economically and environmentally favourable option. Grid power is favourable over diesel power generation from an environmental perspective, as increased diesel emissions from diesel generators will result in increased GHG emissions.

With electrical power from the grid being the principal source of power, the primary Project-related sources of green house gases include some use of diesel generators, and the exhaust of equipment and vehicles. Emission of greenhouse gases during the Project's operations phase will represent a

2.2% per year increase for Yukon measured against its 2008 emissions levels, and a 0.001% increase per year measured against Canada's 2008 emission.

VIT is committed to further minimize the Project's contribution to emissions by using Best Available Technology Economically Achievable to: meet or exceed relevant regulatory emission standards for all mine equipment; enforce low speed limits; ensuring all mine equipment is properly tuned and maintained; and reducing vehicle idling times. In addition, the Yukon government is considering reporting territorial greenhouse gas emissions through the "Climate Registry" in an effort to reduce its operational emissions (Yukon Government 2009). If the registry becomes active, VIT will support territorial initiatives to minimize greenhouse gas emissions during the Construction and Operations phases of the Project.

Conclusion

The Eagle Gold Project Proposal benefited from consultations with the FNNND and the Village of Mayo, and from the guidance of Yukon Government agencies. Consultations helped define the potential effects of concern and provided local knowledge for understanding what changes would be significant. The ongoing availability and responsiveness of agency representatives facilitated development of the proposal and an understanding of what was required for producing a complete and sound assessment.

The selection of all VCs was done with consultation and guidance from a variety of sources including the FNNND, YESAB, and Yukon Government. Avoiding or mitigating adverse effects from the outset was a primary concern driving Project design. In all cases adverse effects that could not be avoided could be mitigated to the point that the residual effect was not significant.

Consequently, for all of the bio-physical VCs there the Project produces no significant effects. A major mitigation achieving this end is the Project's closure and reclamation plan which will return the site to a landscape comparable to the surrounding area and that supports ecological functions equivalent to or greater than that at the site prior to the Project. One of the most important issues was water quality. Extensive design work and mitigations have been planned to assure that potential mine discharges, sediment load, metal leaching, and acid rock drainage are either avoided or treated so that water quality is maintained.

Extensive planning has also gone into assuring that the Project does not have negative effects on the local communities and lives of individuals in the area. The Project will not have adverse effects on the areas infrastructure and roads; medical, fire, police, electrical power, and educational services; nor on community vitality. The Project will have positive effects on employment opportunities, and contracting opportunities; and on the royalties and taxes collected. VIT is committed to assuring that the local community shares in the opportunities the Project provides, but the Project will benefit both local and regional economies.

As described in detail throughout the Project Proposal, VIT believes that the proposed Project can be completed in an environmentally and socially responsible way that is technically achievable using proven technology. VIT appreciates the opportunity during the forthcoming review process to hear and respond to questions, and in the process to make the proposed Project a better Project.

COMMITMENTS TABLE

Bio-Physical VCs—Table of Commitments

No	Commitment	Section
Surficial Geology, Terrain, and Soils		**6.4**
1	VIT will complete geotechnical investigations as part of detailed mine planning during the permitting stage, prior to construction. Once exact locations for Project infrastructure have been identified, qualified professionals will carry out on-site terrain stability assessments in areas identified as having potential terrain stability issues.	6.4.6 6.4.7
2	VIT will establish a program to monitor permafrost conditions adjacent to cleared areas within the Project footprint once mine infrastructure is constructed. Downslope movement and soil moisture will be monitored. Monitoring frequency will be sufficient to assess the effects of freshet, large storm events, and other weather conditions that may affect terrain stability.	6.4.6 6.4.7
3	A qualified environmental professional/technician with appropriate knowledge and training will monitor Project construction and closure activities. The professional/technician will: 1) ensure that soil material suitable for reclamation is salvaged and stored; and 2) evaluate topsoil volumes, based on soil stockpile dimensions, to determine whether there is sufficient material for reclamation. If a shortage is calculated, additional areas of overburden salvage will be identified. If the quality of topsoil does not meet the requirements of the Closure and Reclamation Plan (Appendix 24), additional areas of soil salvage will need to be identified.	6.4.6
4	Soil stockpiles will be checked regularly, after storm events, and during/following freshet to ensure vegetation cover is maintained and erosion control measures are effective.	6.4.6
5	VIT will monitor the effectiveness of soil mitigation to evaluate compaction, rutting, drainage and recontouring prior to revegetation.	6.4.6
6	VIT will conduct visual inspections of vegetation vigour and cover density to assess soil fertility once vegetation is established. If soil fertility has been diminished from baseline conditions, foliar analysis will be required to determine the fertilizer amendments that may be required.	6.4.6 6.4.7
7	VIT will implement a monitoring program (e.g., for vegetation vigour and growth, soil moisture and groundwater levels) in areas outside the mine footprint that are expected to be affected by changes in groundwater levels. These monitoring sites will be established prior to the commencement of construction activities (to establish baseline conditions) and continue through the post-closure monitoring phase.	6.4.6 6.4.7
8	VIT will establish long-term soil and vegetation monitoring sites, outside the Project footprint, to monitor for element concentrations, in particular arsenic, in soil and foliage. These monitoring sites will be established prior to construction activities (to establish baseline conditions) and continue until Year 8 of operations (when dusting is complete). Approximately 10 sites will be established throughout the area of predicted arsenic exceedance from metal loading.	6.4.6 6.4.7
9	VIT will implement an Erosion and Sediment Control Plan for the footprint area during construction, operations and closure and reclamation (Environmental Management Plans – Appendix 30).	6.4.7

No	Commitment	Section
Water Quality and Aquatic Biota		**6.5**
10	VIT's environmental managers will be familiar with relevant territorial and federal acts and regulations pertaining to protection of water quality and fish habitat in relation to mine activities.	6.5.9
11	During operations and closure, VIT will comply with Yukon and federal requirements for monitoring and reporting. This includes the requirements of the Metal Mining Effluent Regulations for effluent characterization (chemistry, acute and chronic toxicity tests) and receiving environment conditions (environmental effects monitoring programs).	6.5.9
12	If indicated by monitoring of heap seepage quality and quantity during closure, VIT will extend the use of the cyanide detoxification plant and mine water treatment plant for the time required to allow Water Quality Guidelines or Site Specific Water Quality Objectives to be met. This will provide an interim solution while the heap continues to drain and while other mitigation measures, if needed, are developed.	6.5.9 6.5.10
13	VIT will assess the need for, and will select additional mitigations to meet regulatory water quality standards, based on an adaptive management approach. Possible options include: a) Using constructed or engineered wetland systems (e.g., a semi-passive anaerobic wetland) downgradient of the heap and waste rock storage areas to reduce arsenic, nitrogen and phosphorus levels. b) Developing a lower permeability reclamation cover for the waste rock storage areas. For example, decreasing net infiltration through the cover from 20% to 10% of Net P would provide a 50% reduction in seepage volumes and loads of arsenic, other metals, and nutrients. c) Further review of alternative approaches to heap detoxification used at other closed mines (e.g., at Brewery Creek nutrients were added to the heap to detoxify cyanide and reduce levels of metals and ammonia).	6.5.9
14	VIT will implement codified erosion prevention and sediment control practices and the Water Management Plan (Appendix 18) to prevent sediment release during construction (sediment control ponds).	6.5.10
15	VIT will construct and maintain a sewage treatment plant (packaged membrane biological reactor) sized for the maximum construction workforce, with effluent quality to meet the requirements of the Yukon Water Board.	6.5.10
16	VIT will construct and maintain diversion channels to keep non-contact water away from mine activities. These will be built with erosion protection measures and designed to convey large runoff volumes. Design criteria will be determined based on water license requirements.	6.5.10
17	Sediment control ponds will be constructed and maintained to allow fine sediments to settle out. The ponds will be sized for a 1:100 year 24-hour flood event. Monitoring of total suspended solids and/or turbidity at the outflows will be conducted prior to release.	6.5.10
18	VIT will construct a mine water treatment plant for use during operations and early closure. The plant effluent will meet Metal Mining Effluent Regulations (MMER) criteria (not acutely toxic to fish, well below MMER criteria concentrations) and effluent quality criteria will be set so that metals and other parameters meet Water Quality Guidelines or Site Specific Water Quality Objectives in Haggart Creek. The criteria for nitrogen and phosphorus will be set to prevent eutrophication in Haggart Creek.	6.5.10
19	Groundwater wells downstream of the waste rock storage areas will be monitored to assess accuracy of predictions of effects on groundwater quality.	6.5.10

No	Commitment	Section
Air Quality		**6.6**
20	VIT will develop and implement a Fugitive Dust Control Plan (Environmental Management Plans – Appendix 30). The plan will include the following measures: a) Manage all land clearings to minimize disturbances b) Construct haul roads with very low silt content material c) Enforce low speed limits for all mobile mine equipment d) Apply water to open surfaces and heavily used roads (in the summer months) e) Control active pit haul roads and active customer haul roads by periodically wetting surfaces using a water truck f) Water inactive roads to suppress dust if there is visible evidence of fugitive dust emissions (e.g., dust clouds resulting from wind) g) Water active roads, in hot, dry conditions, at least once every three hours unless meteorological conditions (e.g., rain, frozen surfaces, etc.) are adequate to suppress dust to a degree that is equivalent to 3-hour periodic watering h) Record fugitive dust suppression activities daily using a fugitive dust suppression log i) Establish a PM monitoring system with one monitor located in both the northwest and southeast perimeter of the mine site j) Make available the fugitive dust suppression log to authorized Yukon's representatives upon request.	6.6.2.2 6.6.5
21	VIT will develop and implement a Combustion Source Control Plan (Environmental Management Plans – Appendix 30). The plan will include the following measures: a) Use diesel fuel with low sulphur content following Canadian Tier 4 regulation b) Enforce low speed limits for all mobile mine equipment c) Ensure all mine equipment is properly tuned and maintained d) Reduce vehicle idling times e) Maintain a criteria air contaminants emission inventory and make available to authorized Yukon's representatives.	6.6.5

No	Commitment	Section
Fish and Fish Habitat		**6.7**
22	VIT will provide qualified environmental managers who will be familiar with relevant territorial and federal acts and regulations pertaining to instream construction activities related to fish and fish habitat protection.	6.7.7
23	The following are commitments of particular importance to fish and fish habitat: a) During construction, inspection and monitoring of suspended sediments will be required within Project area watercourses to ensure sediment and erosion control measures have been implemented effectively and are functioning in accordance with regulatory requirements and commitments in the Erosion and Sediment Control Plan (Environmental Management Plans – Appendix 30) b) During operations and closure, monitoring will be conducted periodically to confirm that reclamation efforts and environmental protection measures, such as sediment and erosion control provisions, are properly maintained and functioning until no longer required. c) Once mitigation measures are no longer required, the VIT environmental manager will ensure that non-biodegradable materials are removed and disposed of in an appropriate manner. d) During operations and closure, water quality monitoring programs will comply with Metal Mining Effluent Regulations' requirements for effluent characterization and receiving environment conditions.	6.7.7
24	VIT will compensate for lost fish habitat where a harmful alteration, disruption or destruction (HADD) is unavoidable by: a) Developing a Fish Habitat Compensation Plan (Appendix 23) for Fisheries and Oceans Canada (DFO) approval b) Conducting post-construction follow-up studies on fish and fish habitat to assess effectiveness of compensation works as detailed in the Preliminary Fish Habitat Compensation Plan. c) Designing channel diversions to include streamside vegetation and functioning riparian areas.	6.7.7
25	VIT will implement the following measures to control soil erosion and leaks from equipment into fish habitat: a) Minimize the extent of clearing, grubbing, and grading adjacent to watercourses to that required for safe vehicle access and construction activities b) Restrict vehicle and construction traffic in the vicinity of water courses to existing roads, and restrict crossing to existing bridges where possible, using appropriate temporary crossing methods where needed (e.g., temporary bridges) c) Flag environmentally sensitive areas before clearing and construction begins near watercourses d) Re-vegetate where soil stabilization and erosion control is required e) Protect stockpiles from erosion with tarps, sumps, or berms f) Stage the timing of activities for construction within 16 m of all watercourses and retain buffer zones until construction activities begin to limit time of bank and soil exposure g) Maintain 30 m riparian buffer between mine components (including temporary work spaces and stockpiles) and fish-bearing watercourses h) Implement a rigorous erosion and sediment control program including sediment and erosion control ponds sized to 1:100 year flood event i) Monitor total suspended solids and turbidity levels from sediment control ponds prior to release j) Ensure industrial equipment operating near fish-bearing watercourses is in good working order and free of leaks	Table 6.7-6

No	Commitment	Section
26	VIT will take the following actions to minimize effects of instream work: a) Isolate all instream works within fish-bearing water courses or non-fish-bearing water courses where instream works have the potential to affect fish-bearing waters downstream b) Time instream and riparian construction activities to avoid high risk weather and flow conditions c) Time construction activities to avoid key fish migration periods d) Construct new habitat, where appropriate, to facilitate fish passage e) Place material and instream structures in a manner that does not inhibit fish passage or impede migration, and prevent the formation of fish barriers when conducting instream works f) Minimize the time that instream works occur g) Conduct instream work on fish-bearing watercourses during established Least Risk Periods where practicable to avoid conflicts with critical life-history stages h) Ensure instream work does not occur in spawning areas if conducted outside of established Least Risk Periods i) Manage flow diversions and water extraction to ensure adequate flows are maintained for fish passage j) Conduct fish salvages before isolating channels for instream work or diversion and prior to infilling watercourses for mine development k) Re-introduce flows to isolated watercourses immediately downstream of isolated areas to avoid fish stranding l) Dissipate discharge water energy where flows are re-introduced to fish-bearing watercourses	
27	Follow Fisheries and Oceans Canada (DFO)'s Freshwater Intake End-of-Pipe Fish Screen Guideline when placing intakes for pumps in fish-bearing water courses	Table 6.7-7
28	Incorporate recommendations from DFO's Guidelines for the Use of Explosives in or near Canadian Fisheries Waters to the greatest extent possible where blasting in or near fish-bearing watercourses	Table 6.7-7
29	Conduct blasting in any dewatered works areas and within established Least Risk Periods to minimize fish mortalities	Table 6.7-7

No	Commitment	Section
Vegetation Resources		**6.8**
30	VIT makes the following monitoring commitments: a) Include results of revegetation monitoring in Annual Reclamation Reports submitted to Yukon Energy, Mines, and Resources. b) Work with the First Nation of Na-Cho Nyäk Dun to incorporate traditional environmental knowledge in reclamation programs and investigate opportunities to involve community members in monitoring programs c) Conduct vegetation sampling in conjunction with soils sampling during all Project phases to monitor the extent and effects of metals loading as a result of dust deposition. d) Develop a monitoring plan (during the permitting process to monitor trace elements in vegetation and to further define the baseline trace element concentration in species used by First Nations and wildlife. Continue monitoring throughout the operations phase to validate the predictions for soils metals loading made by the dust dispersion model. e) Reclamation research and monitoring—a reclamation research program will be established during the operations phase with the purpose of establishing trials on the Platinum Gulch waste rock storage area. This program will investigate various planting and seeding practices appropriate to site-specific closure issues and end land-use objectives, including the use of native and traditional use species. Reclamation monitoring will be continued in the closure and post-closure phases with the purpose of assessing reclamation success.	6.8.7 6.8.8
31	VIT makes the following commitments to mitigate against invasive species: a) Vegetation communities adjacent to Project disturbance will be monitored throughout all Project phases to ensure that populations of invasive plant species are promptly identified as they become established and that appropriate control measures are applied in a timely manner. b) Follow guidelines to prevent the introduction and spread of invasive plants as per the Invasive Plants Management Plan during all Project phases (Appendix 24 – Eagle Gold Preliminary Closure and Reclamation Plan) c) Minimize the extent of grubbing, soil stripping, and the removal of shrubs and herbaceous species, where possible, to reduce the area of bare ground potentially subject to invasive plant establishment d) Mitigate against the establishment of invasive species and reduce erosion potential by re-establishing native vegetation on disturbed areas as soon as possible e) Ensure that construction equipment is clean and free of soil and seeds before mobilizing to the Project site f) Use native species, to the greatest extent possible, during all Project phases, but most specifically during closure and reclamation phases to revegetate disturbed sites	6.8.8 6.8.4.2

No	Commitment	Section
32	VIT makes the following commitments to minimize potential effects of clearing on vegetation resources: a) Flag and stake known rare plant locations near the maximum disturbance boundary and instruct equipment operators to avoid these areas. Conduct regular monitoring of these sites during construction and operations. b) Reduce vegetation loss in areas around the footprint perimeter by adhering closely to construction plans, and avoiding off-site machine use. c) Clear the necessary trees and tall shrubs within the transmission line RoW during periods when the ground is frozen and snow-covered to minimize the disturbance to low shrubs, the moss layer, and topsoil. d) Minimize the extent of grubbing, stripping, and the removal of shrubs and herbaceous species where possible. e) When clearing is required, retain the humus layer and vegetation root mat, when possible. f) Revegetation of disturbed soils where appropriate to encourage slope stability and minimize soil degradation and erosion.	6.8.2.2 6.8.4.2
33	VIT makes the following commitments to minimize potential effects on wetlands and riparian areas: a) Minimize disturbance in sensitive areas by implementing best management practices including the creation and maintenance of buffer zones around riparian and wetland ecosystems. b) Maintain existing drainage patterns to and from wetlands in areas outside of the disturbance footprint. c) When clearing is required, retain the humus layer and vegetation root mat to the extent practical, to reduce the potential for soil erosion and deposition in riparian and wetland ecosystems. d) Employ hand cutting of vegetation near access road and transmission line stream crossings to reduce disturbance to riparian areas during construction of the transmission line.	6.8.2.2 6.8.4.2
34	VIT commits to the following to mitigate the potential of dust and consequent metal loading on vegetation resources: a) Adherence to the Fugitive Dust Control Plan (Environmental Management Plans – Appendix 30) b) Sampling of vegetation (plant tissue) within the area of predicted metals loading to the east of the mine site. Additional dust mitigation measures will be applied if soil monitoring confirms the predicted loading increase (>10% increase above the baseline).	6.8.3.2

No	Commitment	Section
Wildlife		**6.9**
35	VIT will implement annual aerial mapping of winter moose distribution within 5 km of the access road and mine site and in adjacent control areas. This will be conducted before construction (in 2011 and 2012), during construction, and during mine operations, to allow assessment of displacement and population reduction resulting from mine activities, and adaptive management measures if negative effects occur.	6.9.7
36	VIT commits to the following monitoring of wildlife resources: a) VIT will track and report all wildlife incidents to the authorities as appropriate (e.g., wildlife vehicle collisions, nuisance wildlife occurrences, bear encounters or problem bears). During construction and operations, the environmental manager will document observations of species at risk and the five focal species used in this assessment (moose, grizzly bear, American marten, Olive-sided Flycatcher, Rusty Blackbird) on the access road and immediately around the mine site. If requested by the Yukon Government, an annual report will be prepared to summarize any observed trends and any changes to the Wildlife Protection and Management Plan that have been implemented as a result of these observations (Environmental Management Plans – Appendix 30). b) Close collaboration with both the First Nation of Na-Cho Nyäk Dun and the Yukon Government to understand harvest rates of moose in Game Management Subzones adjacent to the mine site and proposed access route c) Monitor the implementation of all mitigation measures and make adjustments where necessary.	6.9.7 Table 6.9-15
37	VIT commits to the following measures to mitigate the potential effects of the access road and Project-related traffic on wildlife resources: a) Monitoring of volume and type of vehicle traffic along the access road b) Monthly monitoring of snow depths along the access route to the mine and at the mine site c) Share information to minimize the risk of vehicular collisions with wildlife. VIT will: a) promote proactive radio communication among users of the access road to convey safety information, including sightings of large wildlife species along the road; b) provide and maintain signage where problems are most likely to occur, reminding drivers to be vigilant for wildlife and give them the right of way; and c) verbally report collisions and/or carcasses of ungulates and other large animals observed on and in the vicinity of the Project site and along the access road to the Environmental Manager, Mine Manager or designate(s) as soon as possible to ensure prompt removal. Near misses and collisions that result in the death or injury of an ungulate or other large animal must be reported as soon as possible. Measures will be developed in coordination with overall road planning with Yukon Government Highways and Public Works. d) Implement speed limits to minimize dust and reduce wildlife collisions. The proposed maximum speed limit will be 60 km/h on the access road where speed limits are not designated by Highways and Public Works or a road design engineer e) Provide and encourage the use of personnel transportation (busing) to the mine site, minimizing opportunities for wildlife vehicular collisions.	6.9.7 Table 6.9-15

No	Commitment	Section
38	VIT will implement the following clearing practices to minimize potential effects on wildlife: a) Minimize Project footprint. Site clearing will be minimized to only the area needed to safely construct and operate the Project. Before clearing, wildlife habitat features (e.g., mineral licks, dens, nest trees, snags, rocky outcrops, small ponds/seepages) will be identified and evaluated to determine if they can be maintained. Even if small, these patches will benefit wildlife and contribute to reclamation. b) Clear vegetation outside of the breeding bird windows. Where this is not possible, VIT will consult with the appropriate regulators (Yukon Government, CWS) and develop management strategies. These strategies are likely to include surveying the area to be cleared for nests a maximum of one week prior to clearing. Bird nests will be identified and protected until nesting has completed.	Table 6.9-15
39	To minimize aircraft overflight disturbance, Project-related aircraft activity will follow flight restrictions agreed to with Yukon Government. This may include minimum flight altitudes and flight paths to avoid sensitive habitats during specific times of year.	Table 6.9-15
40	Implement a progressive Closure and Reclamation Plan (Appendix 24). VIT will: a) revegetate reclamation areas with native species consistent with surrounding vegetation, except where regulatory agencies indicate that natural succession is preferable; and b) maximize use of direct placement techniques (minimizing stockpiling) to minimize the loss of biological activity in reclamation capping materials.	Table 6.9-15
41	VIT will enact a policy that restricts employees, management, and contractors from possessing firearms throughout the life of the Project. The policy will include additional restrictions pertaining to hunting and fishing, also to be in effect throughout the life of the Project.	Table 6.9-15
42	VIT will implement the following measures to minimize problem wildlife-human interactions: a) Develop a problem wildlife prevention and response plan as part of the Wildlife Protection and Management Plan (Environmental Management Plans – Appendix 30). This will include implementation of a Bear Aware Program as a standard part of the health and safety orientation and will make supporting materials (e.g., pamphlets, videos) readily available on site. The plan will be designed with guidance from Yukon Government and their "Guidelines for Industrial Activity in Bear Country" and will include food and waste storage protocols to avoid attracting wildlife (primarily bears) that could become a nuisance. b) Manage vegetation to reduce effects on wildlife. VIT will: a) minimize or eliminate the use of vegetation attractive to bears and ungulates (e.g., legumes) in seeding mixtures used along roadsides; b) cut brush early in the growing season, before it becomes an attractant to large wildlife species; and c) use manual clearing rather than herbicides in vegetation management activities.	Table 6.9-15
43	VIT will reduce bird mortality risk along the transmission line RoW by following existing design guidelines such as the Avian Protection Plan Guidelines and Suggested Practices for Avian Protection on Power Lines.	Table 6.9-15
44	To reduce wildlife mortality in the Heap Leach Facility area, events ponds and ditches, VIT will: a) fence and control (minimize) the growth of vegetative cover at any mine site location with compromised water quality (e.g., event ponds); b) not reclaim event pond shorelines; c) use BirdBalls or a reasonable alternative to deter waterfowl or other birds from landing on ponds that would pose a health risk to them (e.g., containing the heap leach pregnant solution); and (d) design ditches and sediment ponds to reduce potential for entrapment of wildlife.	Table 6.9-15
45	Follow VIT procedures and regulatory requirements for the safe and prompt clean up of any chemical spills.	Table 6.9-15

No	Commitment	Section
Heritage Resources		**6.10**
46	VIT is committed to the protection of heritage resources and will implement a Heritage Resources Protection Plan (Environmental Management Plans – Appendix 30) and a Fossil and Artifact Discovery Record (Appendix 32) to recover and quickly report the chance discovery of heritage resources during Project activities.	6.10.3
47	For those heritage resource sites that cannot be avoided during construction, VIT will follow mitigation measures as required by the Department of Tourism and Culture.	
Socio-economic		**6.11**
48	VIT will cooperatively develop a process with FNNND, VoM, the Yukon Government and others for confirming socio-economic indicators, reporting and responding to monitoring results. Key socio-economic indicators for the Project will be monitored by VIT	
49	VIT will strive to hire as many FNNND citizens, other local and Yukon residents as practical	6.11.2
50	VIT will provide advice, expertise, mentorship and program development assistance to employment training programs, to be developed by Yukon College, the FNNND, and the Yukon Mine Training Association.	6.11.2
51	VIT will offer summer employment aimed at students who are returning to school	6.11.2
52	VIT will develop a Business Opportunities pamphlet.	6.11.2
53	VIT will establish a database of local and Yukon businesses.	6.11.2
54	VIT will seek to 'right-size' contracts where practical to facilitate greater access for local contracting opportunities.	6.11.2
55	VIT will assist in facilitating the exchange of information between parties who are interested in possible joint ventures.	6.11.2
56	VIT will continue to communicate its plans and timing of proposed activities to other resource users (e.g. trappers, outfitters, quartz and placer miners, and known subsistence harvesters).	6.11.2
57	VIT will commit to provide employment and business opportunities to qualified FNNND citizens, the Na-Cho Nyäk Dun Development Corporation, other local or Yukon businesses.	6.11.2
58	VIT will provide advice, expertise, mentorship and program development assistance as it relates to educational programs, to be developed by Yukon College, the FNNND, the Yukon Mine Training Association, and potentially other organizations.	
59	VIT will engage with FNNND, Yukon College, MTA, and the Yukon Government to promote mining-related training programs.	
60	VIT has committed to a range of safety and health measures to ensure the well-being of workers at the Project.	
61	Commitments related to Wildlife, Vegetation Resources, and Fish and Fish Habitat are relevant in terms of potential effects on 'Other Local or Regional Economic Activities' (e.g. outfitting, tourism, trapping and maintenance of traditional subsistence lifestyles).	6.11.3
62	Improvements and radio-controlled access for a portion of the South McQuesten Road in a fashion that minimizes the loss or disruption of access to	6.11.3

No	Commitment	Section
	subsistence harvesting areas.	
63	VIT will provide Cultural Awareness Training for all employees.	6.11.3
64	VIT will provide opportunities for FNNND citizens to participate in ongoing environmental monitoring activities	6.11.3
65	VIT will hire a community liaison person	6.11.5
66	VIT will provide support for programs and initiatives at both J.V. Clark School and the Mayo campus of Yukon College	6.11.5
67	VIT will have all employees transported directly to the Project and housed on-site to restrict unwanted access to Mayo.	6.11.5
68	VIT will encourage its employees, who are residents of Mayo, to continue or initiate involvement in community activities or organizations.	6.11.5
69	VIT will have on-site first-aid and trained emergency personnel to provide primary care.	6.11.5
70	VIT will establish an Emergency Response Plan for the Project	6.11.5
71	Employees and their families will have access to benefits programs.	6.11.5
72	VIT will make known the government and community agencies that are taking the lead on prevention, awareness, and treatment programs for mental health and addictions	6.11.5
73	VIT will work with the Mayo Health Centre to provide drug testing services.	6.11.5
74	VIT has committed to a range of safety and health measures to ensure the well-being of workers at the Project.	6.11.5
75	VIT will work with Mayo Health Centre to discuss all necessary staffing and equipment to meet Project needs.	6.11.5
76	VIT will have an employment policy that will ensure the health and safety requirements of the company.	6.11.5
77	VIT will provide life and employment skills (e.g. budgeting and finances; dealing with rotational shifts and family challenges) opportunities for Project employees.	6.11.5
78	VIT will work with FNNND and VoM to develop contingency plans to address accommodation needs of Project employees due to weather or other emergencies.	6.11.5
79	VIT will work with emergency service providers (RCMP, fire department, ambulance service) to identify training and equipment required.	6.11.6
80	VIT will implement best practices and policies with respect to health and safety and for transportation (e.g. speed, safe driving practices).	6.11.6
81	VIT will provide on-site security to alleviate potential demand for RCMP services.	6.11.6
82	VIT will engage with the VoM to discuss anticipated waste volumes and determine the availability of appropriate waste management facilities and programs.	6.11.6
83	No public vehicle access will be allowed at the mine site—Emergency response organizations that service the access road will be trained in terms of the types of materials transported and appropriate response.	6.11.6

No	Commitment	Section
84	Prior to commencement of radio control use on the HCR, a Radio Use Policy will be established.	6.11.6
85	VIT will perform regular maintenance on the HCR to ensure safety, maintain road condition.	6.11.6
86	VIT will utilize the International Cyanide Management Code to guide the use and management of cyanide at the Project.	6.11.6
87	VIT plans to transport employees travelling from Whitehorse to Mayo using chartered aircraft and bus services.	6.11.6
88	VIT will investigate opportunities for ‘flight sharing’ that would allow local residents, on a user pays basis.	6.11.6
89	VIT will engage with FNNND, VoM, YG and others to determine if upgrades to the Mayo airport facilities or services are needed.	6.11.6
90	VIT will meet the design criteria of Yukon Energy Corp. in design of the transmission line to supply the Project.	6.11.6
91	VIT will discuss any specific needs that may result from the Project with program and service delivery agencies, both the FNNND, and VoM. Collectively VIT, FNNND, and VoM may engage in discussions with the Yukon Government as appropriate on matters of shared interest	6.11.6
92	VIT will ensure that the presence and use of firearms are restricted on the Project site. The restrictions will extend to employees, management and contractors. In addition VIT will develop a policy restricting Project-related employees and contractors from hunting and fishing while on the job at any time throughout the life of the Project.	6.11.3
93	VIT will implement a substance control policy for mine employees. This policy may include mandatory pre-employment testing and random drug testing during employment for all mine employees. The substance control policy will include protocols for how VIT will deal with employees found consuming alcohol or drugs on site, found to be under the influence of alcohol or drugs, or otherwise failing a drug test.	6.11.5
Carbon Management		**7**
94	VIT will work with the federal and territorial governments to meet the greenhouse gas targets contained within their respective plans. To achieve this VIT commits to : a) Using best available technology economically achievable to meet or exceed relevant regulatory emission standards for all mine equipment b) Enforcing low speed limits for all mobile mine equipment c) Ensuring all mine equipment is properly tuned and maintained d) Reducing vehicle idling times e) Supporting territorial initiatives to minimize greenhouse gas emissions during the construction and operations phase of the Project.	7
Accidents and Malfunctions		**8**
95	VIT is committed to worker and public health and safety. Through compliance with the *Worker’s Compensation Act* and Regulations, the *Occupational Health and Safety Act*, and the *Public Health and Safety Act,* VIT will ensure its operations are conducted to minimize risk through training, awareness, and continuous improvement. VIT works to instil a culture of safety throughout all levels of the organization and will make safety the top priority at the mine site. Worker health and safety will form a component of the detailed Occupational Health and Safety Plan developed as part of the Quartz Mining License application (Environmental Management Plans – Appendix 30).	8.1.1.2
96	VIT will have on-site personnel with emergency first-aid training to provide primary care in the event of an accident, and will establish an Emergency	8.2.1.1

No	Commitment	Section
	Response Plan for the Project (Appendix 33). VIT will ensure first responders with training specific to hazardous materials used for the Project (e.g., cyanide) are on hand at the mine site at all times. All employees will be WHMIS (Workplace Hazardous Materials Information System) trained.	8.2.2.1
97	VIT will implement the following to maximize road and transport safety: a) Work with the Department of Highways and Public Works to ensure both public and private portions of the access road are properly maintained and upgraded as required b) Enforce speed limits for all Project vehicles c) Ensure trucking/hauling contractors have appropriate driver training, radio contact capabilities, vehicle maintenance requirements, and spill response capabilities d) Ensure all hazardous materials are transported and handled in accordance with the Transportation of Dangerous Goods Act and Regulations e) Require bulk carriers to carry two-way radios to communicate with the mine site f) Post signage along Haggart Creek Road (a two-way, one-lane radio controlled access road with regular vehicle pull-outs to allow passing) and ensure non-Project traffic is aware of radio protocols g) Identify wildlife migration corridors and crossings along the road and provide signage in high risk areas h) Plow wildlife crossing and escape points in the access road snow banks (i.e., 0.5 m or less at regular intervals).	8.2.1.1
98	VIT commits to the following spill prevention and response measures: a) If there is any doubt regarding the size of a spill, material involved, and whether it is reportable, VIT will err on the side of caution and report the spill. b) Caches of spill response materials will be placed along the access road as required by the Spill Contingency Plan (Appendix 30), including at the Haggart Creek crossing. c) Project staff will have appropriate emergency response and spill contingency training and knowledge. Equipment, materials, and procedures will be maintained to limit the consequences of releases to the environment through prompt containment and clean-up. d) Fuels, hydrogen peroxide, and other hazardous liquids will be transferred from tanker trucks to storage tanks by enclosed lines, hoses, and pumps equipped with pressure transducers and volume counters to ensure tanks cannot be overfilled. e) No lubrication, refueling or maintenance of equipment will occur within 30 m of wetlands or watercourses. f) All fuelling and lubrication of construction equipment will be carried out in a manner that minimizes the possibility of spills. All containers, hoses, and nozzles will be free of leaks and all fuel nozzles equipped with functional automatic shut-offs g) Where stationary equipment cannot be relocated more than 30 m from a watercourse, it will be situated in a designated area that has been bermed and lined with an impermeable barrier with a holding capacity equal to 125% of the largest tank within the berm. h) Equipment operators will be appropriately trained in spill response procedures and carry spill kits capable of handling spills on land and water.	8.2.2.1 Table 8.1-1

No	Commitment	Section
99	VIT commits to the following cyanide-specific measures for preventing vehicle accidents and spills in the transport and handling of cyanide: a) Cyanide briquettes will be transported in bulk super sacs designed to protect the product from moisture. Super sacs will be contained within wooden boxes to protect them during transport. b) A pilot vehicle will lead cyanide shipments from Mayo to the mine site. c) Cyanide shipments will be tracked using GPS. d) A certified cyanide transporter will be used and appropriate driver training, radio contact capabilities, vehicle maintenance, and emergency clean-up kits will be ensured. e) A Cyanide Transportation Management Plan will be developed as part of the Environmental Management Plans (Appendix 30) outlining contractor responsibilities, emergency response procedures, and training requirements. f) Sodium cyanide will be mixed with water in a well-ventilated area and maintained at a high pH to prevent the evolution of hydrogen cyanide gas. g) Cyanide solution will be applied to the heap using buried drip emitters, minimizing the potential for solution to escape to the environment.	8.2.2.1
100	VIT will store and handle explosives in accordance with a magazine license issued by Natural Resources Canada. Explosives and blast caps will be stored in separate facilities, away from operational areas.	8.2.2.1
Noise		**Appendix 10**
101	VIT is committed to managing noise issues and to promptly responding to any reasonable noise complaint. To meet its commitment, VIT will: a) Develop a Noise Abatement Plan (Environmental Management Plans – Appendix 30) b) Minimize the effects of blasting noise on people by applying British Columbia Occupational Health and Safety Regulations (Part 7) for employees and restricting public access to the mine site c) Limit noisy activities (including blasting) to the least noise-sensitive times of day (between 7:00am and 10:00pm) d) Locate all stationary construction or mining equipment (i.e., crushers, compressors, and generators) as far as practicable within Project boundary e) Locate major crushing equipment and other noise-generating equipment (e.g., blowers and air compressors, etc.) inside buildings wherever possible f) Perform regular inspection and maintenance of vehicles and equipment to ensure that they have high quality mufflers installed and that worn parts are replaced g) Follow posted vehicle speed limits h) Maintain Project roads to minimize vehicle noise associated with vibration i) Turn off equipment when not in use and when practical to do so j) Ensure, by restricting access to the mine site, that recreational land users are not present in the vicinity of the mine during blasting operations	Appendix 10; 4.2

No	Commitment	Section
Conceptual Closure and Reclamation Plan		**Appendix 24**
102	In developing the Closure and Reclamation Plan, VIT will: a) Use Guidelines for Reclamation/Revegetation in Yukon as a guide for selecting appropriate candidate reclamation species to be assessed by seeding/planting trials. b) Take measures that will reduce the likelihood of plant infestations from occurring and actively manage infestations that may become established on mine operations areas. c) Address invasive plant establishment through the development and implementation of an Invasive Plant Management Program that will be conducted over the mine Project life	Appendix 24; 2.2 2.6 2.6.1
103	In the event that invasive plant populations do become established on the mine site or associated disturbances, VIT will utilize one or a combination of methods (pulling, mowing or cutting, burning, herbicide spraying, biological control) to control these infestations. VIT will liaise with Yukon Invasive Species Council (YISC), Environment Yukon (EY) and other proponents to keep informed of invasive plant species and management strategies in the region. VIT will focus its invasive plant management activities on species that have been categorized by YISC and EY as species of concern, species that are listed for Yukon as noxious weeds, and invasive plant species that pose a threat to humans, animals, or ecosystems.	Appendix 24; 2.6.4
104	VIT will maintain responsibility for the operation of the Project and all environmental programs and reclamation activities on site. The Environmental Manager will maintain overall responsibility for all environmental issues on site. The Chief Environmental Scientist will be responsible for ensuring that all environmental monitoring and reclamation programs are carried out during construction, operations and closure. These programs will be implemented with the use of additional staff, consultants, and contractors where necessary.	Appendix 24; 2.7
105	During construction, an environmental monitor will be on site to monitor activities and to verify compliance with the provisions of all applicable permits, licenses and approvals. The environmental monitor will: a) Conduct monitoring programs as required under the respective permits, licenses, and approvals, and report the results of such programs, as required b) Ensure that soil salvage and replacement activities are completed appropriately to meet reclamation objectives c) Ensure that vegetative erosion control cover is established on soil stockpiles and on any other areas of disturbance, as appropriate d) Provide direction and recommend implementation measures aimed at avoiding or minimizing adverse environmental effects e) Implement erosion control measures such as installation of riprap, erosion control blankets, silt fences and filter fabrics.	Appendix 24; 2.7
106	VIT will implement an Adaptive Management Plan under the CRP. As soon as reclamation areas become available, VIT will establish a variety of trials to evaluate closure protocols and systems. Trials will include: a) Re-vegetation– Testing plant species suitable for reclamation in the Project footprint and testing vegetation establishment/growth on various topsoil depths and waste rock material. b) Engineered Cover System– Methods of reducing net infiltration of precipitation via engineered cover design systems c) Passive Treatment System– Demonstration of effectiveness of passive treatment systems constructed downstream of the WRSAs and HLF. Information obtained will be used to adjust reclamation activities or methods that will be best suited for reclaiming remaining mine disturbance	Appendix 24; 2.8 Appendix 36

No	Commitment	Section
	areas.	
107	VIT will maintain financial security acceptable to the Yukon government during temporary closure.	Appendix 24; 2.10.3
108	The Haggart Creek Road will remain in place at closure. Following closure of the HLF and site facilities, the main access road within the Project footprint will be permanently closed and reclaimed. However, it is proposed that a single lane road will remain to provide access to the Potato Hills. The road will be left in a semi-permanent, deactivated condition which will allow the road to remain passable and be environmentally stable.	Appendix 24; 3.6
109	VIT will monitor wildlife use/response to reclaimed areas within the mine site footprint	Appendix 24; 5.6
Environmental Management Plans		**Appendix 30**
110	VIT is committed to developing and implementing Environmental Management Plans (Appendix 30) with the following components: a) Introduction b) Erosion and Sediment Control Plan c) Fugitive Dust Control Plan d) Combustion Source Control Plan e) Vegetation Management Plan f) Wildlife Protection and Management Plan g) Environmental Monitoring Plan h) Schedule of Environmentally Sensitive Activity i) Heritage Resources Protection Plan j) Traffic and Access Management Plan k) Occupational Health and Safety Plan l) Cyanide Management Plan m) Spill Contingency Plan n) Noise Abatement Plan o) Waste Management Plan p) Water Management Plan q) Closure and Reclamation Plan r) Construction Quality Assurance	Appendix 30

No	Commitment	Section
Qualitative Human and Ecological Health Assessment		**Appendix 31**
111	VIT will monitor metals in surface water and soils during mine operations, and in surface water post-closure, to ensure that concentrations do not pose a health risk to humans or fish and wildlife. Mitigation measures will also be required to prevent potential exposure of humans or wildlife to contaminated surface water in the pit lake post-closure.	Appendix 31; 7
Emergency Response Plan		**Appendix 33**
112	VIT is committed to developing and implementing an Emergency Response Plan (ERP). The ERP will provide risk management planning and contingency response measures to address accidents, malfunctions, and emergencies that may arise at the mine site during any Project phase. The ERP will also establish notification responsibilities and response procedures in the event of an emergency.	
	The ERP will include the following commitments:	
	a) VIT will require that all personnel and contractors be familiar with the ERP and emergency response procedures. Personnel will also be made aware of the location of equipment to be used in emergency response, and will be asked to report any concerns regarding emergency response preparedness to their supervisor. VIT will provide and maintain cyanide exposure specific first aid equipment at areas where cyanide may be present.	Appendix 33; 1, 3.2
	b) VIT will review and revise the ERP regularly and following any incident to ensure the relevant information remains current, comprehensive, and effective (e.g., contact information of responders, Materials Safety Data Sheets [MSDSs] etc.)	Appendix 33; 1.2
	c) VIT will periodically test the ERP to ensure its effectiveness during an emergency. The nature and timing of tests, along with the outcomes, will be recorded and used to inform modifications to the ERP. Random, unannounced emergency drills may be carried out from time to time to ensure preparedness of response crews.	Appendix 33; 1.2
	d) Members of the Emergency Response Team (ERT) will have access to and be familiar with MSDSs and workplace hazardous materials information system (WHMIS) sheets for all chemicals and hazardous substances transported, stored, and used on-site.	Appendix 33; 1.3
	e) Resource inventories of personnel, equipment, first aid kits, spill kits, and clean-up materials will be maintained on-site and updated regularly. These inventories will also contain information on external resources available off-site (e.g., RCMP, fire department, other mining establishments in the vicinity).	Appendix 33; 1.4
	f) All staff on site will receive basic training, including environmental awareness, general emergency response, spill contingency measures, and communication procedures. Truck drivers transporting hazardous materials will also receive additional training on spill response, hazardous material handling, and emergency driving techniques. All security personnel will be trained in first aid.	Appendix 33; 1.6, 3.2
	g) Periodic inspections will be carried out to verify that all emergency response equipment is available and in good repair. The inspections will check that records of maintenance and repairs for each piece of equipment are current, repairs are complete, and that appropriate recommendations have been made. Inspections will also be carried out at all facilities involved in the handling or storage of hazardous materials or waste streams. An inspection reporting schedule and location checklist will be provided by a designated manager at the mine site.	

ABBREVIATIONS AND ACRONYMS

% .... percent
~ .... approximately
< .... less than
> .... greater than
µ .... micro
µg/m³ .... micrograms per cubic metre
µg/L .... micrograms per litre
µm .... micrometre
µS/cm .... microsiemens per centimetre (measure of conductivity)
AAFRD .... Alberta Agriculture, Food and Rural Development
ABA .... acid base accounting
ADR .... adsorption, desorption and recovery
AG .... Ann Gulch
AGBRP .... Alberta Grizzly Bear Recovery Plan
ALS .... ALS Laboratory Group
ANFO .... ammonium nitrate-fuel oil
AP .... acid potential in kg $CaCO_3$/t equivalent
APLIC .... Avian Power Line Interaction Committee
APP .... Avian Protection Plan
ARD .... acid rock drainage
As .... arsenic
asl .... above sea level
BATEA .... Best Available Technology Economically Achievable
BC MoF .... British Columbia Ministry of Forests
BC .... British Columbia
BEC .... biogeoclimatic ecosystem classification
BGC .... BGC Engineering Ltd.
BH .... borehole

BMP .... Best Management Practice

BP .... before present

BS .... black spruce-sphagnum ecosystem unit

$CaCO_3$ .... calcium carbonate

CACs .... criteria air contaminants

CAO .... Chief Administrative Officer

CBA .... comprehensive Cooperation Benefit Agreement

CCME .... Canadian Council of Ministers of the Environment

CCRP .... Conceptual Closure and Reclamation Plan

CCTV .... close-circuit television

Cd .... cadmium

CEAA .... *Canadian Environmental Assessment Act*

CEGEP .... Collège d'enseignement général et professionnel

CF .... sedge fen or meadow ecosystem unit

CH_4 .... methane

cm .... centimetre

CO .... carbon monoxide

CO_2 .... carbon dioxide

COSEWIC .... Committee on the Status of Endangered Wildlife in Canada

CPP .... corrugated polyethylene pipes

CPR .... cardio-pulmonary resuscitation

CRA .... Canada Revenue Agency

CRM .... certified reference materials

CRP .... Closure and Reclamation Plan

CSR .... Contaminated Sites Regulation

Cu .... copper

CV .... coefficient of variation

CVAFS .... cold vapour atomic fluorescence spectrometry

CWB .... Community Well Being Index

CWS ..... Canadian Wildlife Service
DAB ..... Development Assessment Branch
dB ..... decibels
dBA ..... A-weighted decibels
DCZ ..... desirable clear zone
DDH ..... diamond drill hole
DEM ..... digital elevation model
DFO ..... Fisheries and Oceans Canada
DG ..... Dublin Gulch
DGDC ..... Dublin Gulch diversion channel
DH ..... drill hole
DO ..... dissolved oxygen
DOC ..... dissolved organic carbon
EAMP ..... Environmental Assessment and Major Projects
EC ..... Environment Canada
ECDEV ..... Yukon Department of Economic Development
ECO ..... Yukon Executive Council Office
ECP ..... Eagle Creek Pond
EDRR ..... early detection and rapid response
EEM ..... environmental effects monitoring
EEP ..... environmental emergency plan
EFD ..... extreme-value frequency distribution
EGL ..... Eagle Gold Local (sampling site)
ELC ..... ecological land classification
EMR ..... Yukon Department of Energy, Mines, and Resources
ENSO ..... El Niño Southern Oscillation
EOSD ..... Earth observation for sustainable development of forests
EP ..... Eagle Pup
EPP ..... Environmental Protection Plan

EPT .... Ephemeroptera, Plecoptera, and Trichoptera

ERCB .... Energy Resources Conservation Board

ERP .... Emergency Response Plan

ERT .... Emergency Response Team

ET .... evapotranspiration

ETM+ .... Landsat-7 Enhanced Thematic Mapper

EY .... Environment Yukon or Department of Environment, Yukon Government

f asl .... feet above sea level

FASSY .... Fetal Alcohol Syndrome Society of Yukon

FMA .... FMA Heritage Inc.

FN .... First Nations

FNNND .... First Nation of Na-Cho Nyäk Dun

ft .... feet

GA .... grass-herb

GB .... gravel bar ecosystem unit

g/t .... grams per tonne

GDP .... Gross Domestic Product

GHG .... greenhouse gas

GLC .... ground level concentrations

GMA .... Game Management Area

GMZ .... Game Management Zone

GPS .... Global Positioning System

GSC .... Geological Survey of Canada

GWh .... gigawatt hours

GWP .... global warming potential

ha .... hectares

HADD .... harmful alteration, disruption or destruction

HC .... Health Canada

HCR .... Haggart Creek Road

HD-MAPP .... high definition mapping and applications

HDPE .... high density polyethylene

HKP .... Hallam Knight Piésold

HLF .... heap leach facility

HLP .... heap leach pad

hp .... horsepower

HPA .... Habitat Protection Area

HPGR .... high pressure grinding rolls

HPW .... Yukon Department of Highways and Public Works

HRIA .... Heritage Resource Impact Assessment

HSS .... Yukon Department of Health and Social Services

HV .... high voltage

HVAAS .... hydride vapour atomic absorption spectrophotometry

IBA .... Impact and Benefit Agreement

ICP .... atomic emission spectrophotometry

ICP-MS .... inductively coupled plasma mass spectrophotometry

ICP-OES .... inductively coupled plasma optical emission spectrophotometry

ICP-S .... inductively coupled plasma spectrophotometry

ICSP .... Integrated Community Sustainability Plan

IDF .... Intensity-Duration-Frequency

IEE .... Initial Environmental Evaluation

in .... inches

INAC .... Indian and Northern Affairs Canada

IPCC .... Intergovernmental Panel on Climate Change

IRR .... internal rate of return

ISQG .... Interim Sediment Quality Guideline

JWA .... Jacques Whitford AXYS Ltd.

K .... hydraulic conductivity

ka BP .... thousand years before present

Ka .... kiloannum (one thousand years)

KCA .... Kappes Cassiday & Associates

km .... kilometres

km/km^2 .... kilometres per square kilometres

km^2 .... square kilometres

kt .... kilotonne (thousand tones)

kV .... kilovolt

kW .... kilowatt

LAA .... local assessment area

LCRS .... leak collection and recovery system

LDRS .... leak detection and recovery system

LEAA ....

Leco-S .... automated sulfur analyzer

LEL .... least effects level

Leq .... equivalent continuous sand level

LiDAR .... Light Detection and Ranging

LOEC .... lowest observed effort concentration

LOMP .... Life of Mine Plan

LSA .... local study area

LWD .... large woody debris

m asl. .... metres above sea level

m .... metres

m^2 .... square metres

m^3/ha .... cubic metres per hectare

m^3/hr .... cubic metres per hour

m^3/s .... cubic metres per second

m/s .... metres per second

Ma BP .... million years before present

Ma .... megaannum (one million years)

MA .... herbaceous dominated marsh

MAR .... mean annual runoff

MBCA .... *Migratory Birds Convention Act*

mbg .... metres below ground

MDRRC .... Mayo District Renewable Resources Council

MEMPR .... Ministry of Energy, Mines and Petroleum Resources

meq .... milliequivalent

mg/kg/wl .... milligrams per kilogram per week

mg/L .... milligrams per litre

mg/m^2 .... milligrams per square metre

ML .... metal leaching

mm .... millimetre

MMCC .... Yukon Government Major Mines Coordinating Committee

MMBtu/hr .... million British thermal units per hour

MMER .... Metal Mining Effluent Regulations

Mo .... molybdenum

MoE .... Ministry of Environment

MoF .... Ministry of Forests (BC)

MRDI .... Mineral Resource Development Inc.

MSDS .... Materials Safety Data Sheet

Mt .... megatonnes (million tonnes)

Mt/y .... megatonnes per year

MTA .... Yukon Mine Training Association

MW .... monitoring well

MWh/y .... megawatt hours per year

MWTP .... mine water treatment plant

N/A .... not applicable

N .... nitrogen

N_2O .... nitrous oxide

NA. .... data not available

NAPS........ National Air Pollution Surveillance Network

NBCC .... National Building Code of Canada

ND .... not detected

NFD .... normal-value frequency distributions

Ni .... nickel

NM .... not measured

NND........ Na-Cho Nyäk Dun

NNDFN........ First Nation of Na-Cho Nyäk Dun

NNL .... no net loss

NO_2........ nitrogen dioxide

NOEC .... no-observed effort concentrations

NP .... neutralization potential in kg $CaCO_3$/t equivalent

NP/AP........ neutralization potential to acid potential ratio

NPV .... net present value

NRC........ National Research Council

NS .... not specified

NTS .... National Topographic System

NTU .... nephelometric turbidity unit

NWT .... Northwest Territories

OHL .... overhead line

OG........ Olive Gulch

OW .... open water ecosystem unit

PAG........ Potential Acid Generation

PAH .... polycyclic aromatic hydrocarbons

Pb .... lead

PEL........ probable effects level

PFS .... prefeasibility study

PG .... Platinum Gulch

PH .... poplar-horsetail ecosystem unit

pH .... potential of hydrogen (measure of acidity)

PHT .... Potato Hills Trend

PIL .... Project Inclusion List

PLS .... pregnant leach solution

PM .... particulate matter

$PM_{2.5}$ .... particulate matter with diameter < 2.5 microns

PMF .... probable maximum flood

PoEs .... pathways of effects

PPE .... personal protective equipment

Project .... Eagle Gold Project

PVC .... polyvinyl chloride

QA/QC .... quality assurance/quality control

QMA .... *Quartz Mining Act*

QML .... quartz mining license

R .... R-value (measure of thermal resistance – insulation)

RAA .... regional assessment area

RCMP .... Royal Canadian Mounted Police

RCSA .... road corridor study area

RI .... river ecosystem unit

RIC .... Resource Inventory Committee (British Columbia)

RIRGS .... reduced intrusion related gold system

RISC .... Resource Information Standards Committee

RoW .... right of way

RPD… .... relative percent difference

RSA .... regional study area

RTC .... Registered Trapline Concession

SARA .... *Species at Risk Act*

SARPR .... Species at Risk Public Registry

SBA .... Silt Borrow Area

SCP .... sediment collection pond

SCS .... Site Construction Supervisor

SD .... standard deviation

Se .... selenium

SE .... standard error of the mean

SEEA .... Socio-economic Effects Assessment

SEIA .... Socio-economic Impact Assessment

SES .... Site Environmental Supervisor

SH .... spruce-horsetail ecosystem unit

SIBEC .... Site Index using Biogeoclimatic Ecosystem Classification

SIL .... survey intensity level

SMA .... Special Management Area

SMR .... South McQuesten Road

SMU .... soil map unit

SO_2 .... sulfur dioxide

SoG .... snow on ground

SQG .... sediment quality guideline

SRC .... Site Response Coordinator

SRK .... SRK Consulting (Canada) Inc.

SS .... soil stockpile

SS WQO .... Site-specific Water Quality Guideline

SSS .... Site Safety Supervisor

STU .... Stuttle Gulch

SWBR .... surface water balance model

SWE .... Snow Water Equivalent

SWRPA .... Scott Wilson Roscoe Postle Associates Inc.

t/d .... tonnes per day

t/h .... tonnes per hour

TAC .... Transportation Association of Canada

TC .... Transport Canada

TDGA .... *Transportation of Dangerous Goods Act*

TDGR .... Transportation of Dangerous Goods Regulations

TDR .... Technical Data Report

TDS .... total dissolved solids

TEM .... Terrestrial Ecosystem Mapping

TK .... traditional knowledge

TKN .... Total Kjeldahl Nitrogen

TOC .... total organic carbon

TS .... terrain stability

TSM .... terrain stability mapping

TSP .... total suspended particulates

TSS .... total suspended solids

TWBS .... Yukon Water Board Secretariat

UFA .... umbrella final agreement

USFWS .... United States Fish and Wildlife Service

UTM .... Universal Transverse Mercator

VC .... valued component

YCS .... Yukon Conservation Society

VIT .... Victoria Gold Corp.

VoM .... Village of Mayo

VC .... Valued Component

WA .... *Waters Act*

WAD .... weak acid dissociable

WCB .... Workers Compensation Board

WG .... willow-groundsel ecosystem unit

WH .... willow-horsetail ecosystem unit

WHMIS .... Workplace Hazardous Materials Information System

WKA .... wildlife key areas

WL .... water license

WMP .... Water Management Plan

WNW .... west northwest

WQG .... water quality guideline

WQM .... water quality model

WRSA .... waste rock storage area

WS .... willow-sedge ecosystem unit

WSC .... Water Survey of Canada

WWTP .... waste water treatment plant

XRD .... X-ray diffraction

YBS .... Yukon Bureau of Statistics

YEC .... Yukon Energy Corporation

YES .... Yukon Engineering Services

YESAA .... *Yukon Environmental and Socio-economic Assessment Act*

YESAB .... Yukon Environmental and Socio-economic Assessment Board

YG .... Yukon Government

YGS .... Yukon Geological Survey

YISC .... Yukon Invasive Species Council

yrs .... years

YSRC .... Yukon Spills Report Centre

YT .... Yukon Territory

YWB .... Yukon Water Board

YWBS .... Yukon Water Board Secretariat

YWCHSB .... Yukon Workers' Compensation Health and Safety Board

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1 INTRODUCTION

1.1 Project Overview

1.1.1 Project Purpose

The purpose of the Eagle Gold Project (the Project) is to design, construct, operate, close, and reclaim a gold mine in central Yukon. The Project will create economic opportunity that will benefit Yukon and the First Nation of Na-Cho Nyäk Dun (FNNND) as a whole and its citizens and members individually while meeting the corporate objectives of Victoria Gold Corp. (VIT) in an environmentally responsible way.

On August 11, 2010, VIT completed a Pre-Feasibility Study (PFS document [Scott Wilson Mining 2010]) of the Project. The PFS includes an updated Mineral Resource estimate and a first time estimate of Mineral Reserves. Mineral Resource and Mineral Reserves in the PFS conform to NI 43-101 Standards of Disclosure for Mineral Projects. The PFS was led by Scott Wilson Mining and covered geology, resource estimation, mine design, heap leach facility design, cost estimation, and financial analysis. Kappes Cassiday & Associates (KCA) carried out metallurgical testwork, process design, and process cost estimation. BGC Engineering Inc. (BGC) carried out geotechnical field investigation for open-pit slopes; and for infrastructure requirements and design of the open-pit slope angles. Stantec provided advice on environmental and permitting issues. In the opinion of Scott Wilson Mining and based on National Instrument 43-101 Standards of Disclosure, the PFS document (Scott Wilson Mining 2010) indicates that positive economic results can be obtained for the Project with a scenario that includes open-pit mining, three-stage crushing to an 80% particle size (P80) of 5 mm, and sodium-cyanide heap leaching followed by a carbon adsorption desorption recovery gold recovery process.

1.1.2 Project Location and Key Components

The Project is a proposed gold mine using conventional heap leach and open pit operations with an eight year mine life. The Project is located in central Yukon approximately 45 km north-northeast of the village of Mayo and 350 km north of Whitehorse, and 700 m and 1,300 m above sea level. The Property is accessible via the Silver Trail and the existing South McQuesten and Haggart Creek Roads. The total driving distance from Mayo is approximately 85 km.

Key components of the Project include:

- Mineral Reserves of 66 Million tons of ore, at a grade of 0.82 grams of gold per ton, containing 1.8 Million ounces
- A 9.1 Million tons of ore mined per annum with an eight-year mine life
- Open pit mining of a primary gold deposit with a final open pit footprint of approximately 70 ha
- Two waste rock storage areas

- Gold extraction using a three stage crushing process, heap leaching, and a carbon adsorption, desorption, and recovery system
- Heap leaching process using sodium cyanide solution applied year round
- Access by existing highway and unpaved roads
- Power supplied for operations by the Yukon Energy Corporation transmission grid.

A detailed description of these components is provided in Section 5.

1.1.3 Project Economics

The Life of Mine Plan (LOMP) for the Project indicates that Mineral Reserves of 66 million tonnes of ore, at an average grade of 0.82 g/t Au, will be mined over eight years, starting in 2013 pending receipt of required licenses and permits. Recovered gold from production is projected to total 1,254,000 ounces. Capital costs for construction are estimated to total C$281 million, including a contingency of C$38 million. Cash costs are projected to average US$503 per ounce. At a gold price of US$900 per oz, the Project is estimated to generate a pre-tax net present value (NPV) of C$78 million, at a discount rate of 7.5%, and has a pre-tax internal rate of return (IRR) of 15%.

1.1.4 Labour Force

During the construction phase, the Project will create direct employment opportunities for approximately 415 people. It is currently estimated that operations of the Project will require the services of between 339 and 384 employees dependent on projected annual mine output. During operations, the majority of Project personnel are scheduled to work 12-hour shifts on a rotation of two weeks on and two weeks off.

The reclamation and closure workforce required during decommissioning of the Project will include a combination of VIT employees and construction contractor skilled and unskilled labour. Exact closure workforce requirements have not been determined, however staff requirements during reclamation are likely to initially be around 200, which will decrease over time as reclamation objectives are met and site moves to a monitoring stage.

1.1.5 Project Benefits

The Project offers a strong combination of positive mineral indicators, a desirable location with road and power access, and a strong, experienced management team. Historically, Yukon has been a productive region for gold. The Project is situated within the “Dublin Gulch Property” which hosts Mineral Indicated Resources estimated to be 154 Mt, at a grade of 0.65 g/t Au, containing 3.2 Moz[1] (Scott Wilson Mining 2010). Mineral Reserves for the Project are estimated to be 66 Mt, at a grade of 0.82 g/t Au, containing 1.8 Moz (Scott Wilson Mining 2010). VIT believes that the outlook for gold

[1] All resources are classified as Indicated, and were estimated at a cut-off grade of 0.21 g/t Au. Mineral Resources were constrained within a pit shell, generated at a gold price of US$1,050 per oz (Scott Wilson Mining 2010).

demand is positive for the long term. The Project provides significant opportunity for VIT, its shareholders, local First Nations, local communities, and Yukon to benefit from the Project's development.

1.2 Proponent Information

1.2.1 Proponent

VIT is a Canadian exploration company with projects in Canada and the United States. The company is primarily engaged in acquisition, evaluation, exploration, and development of gold properties with a view to commercial production. VIT is incorporated in British Columbia and is a reporting issuer in British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick, Nova Scotia, Prince Edward Island and Newfoundland. The company's head office is located in Toronto with regional offices in Vancouver, Whitehorse and Reno.

Victoria Gold Corp. – Assessment Representatives

Mr. Todd Goodsell, Environmental Manager of VIT is the primary contact for the Project Proposal during assessment by the Yukon Environmental and Socio-economic Assessment Board (YESAB).

Todd Goodsell, Environmental Manager
Victoria Gold Corp.
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Mr. Mark Ayranto, Vice President of Yukon Projects is an officer of VIT and the company representative responsible for overall development of the Eagle Gold Project. Mr. Ayranto is the secondary contact for the Project Proposal during assessment by the Yukon Environmental and Socio-economic Assessment Board (YESAB). Mr. Ayranto joined the VIT management team in 2009. Previously he held the role of Vice President Corporate Development with StrataGold Corporation and has been involved with the Project for four years. As the Vice President of Yukon Projects, Mr. Ayranto holds the overall responsibility for the Project and matters discussed within this Project Proposal.

Mark Ayranto, Vice President, Yukon Projects
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1.2.2 Project Related Experience

The Project has involved significant effort over many years on the part of many contractors, leading consulting firms, specialists and supporting companies. The following provides a brief description of the team assembled for the Project.

1.2.2.1 Victoria Gold Corp.

VIT has assembled a Project team with a depth of experience in regulatory permitting and northern mine development and operations. Members of the team include:

John McConnell, President and Chief Executive Officer is a Professional Mining Engineer with extensive operating experience. During John's career he has worked for Placer Development Limited, Cominco Ltd., Strathcona Mineral Services, Breakwater Resources, De Beers Canada Inc., and most recently was President and CEO of Western Keltic Mines Inc. John is also a Director of Silver Eagle Mines Inc.

Mark Ayranto, Vice President Yukon holds an MBA and is a biologist with 20 years of resource development experience in Northern British Columbia and the Yukon. He previously held the position of Vice President, Corporate Development with StrataGold Corporation.

Todd Goodsell, Environmental Manager has over 15 years of professional experience. Mr. Goodsell was previously employed by Stantec Consulting, Ltd. as a Fisheries biologist and Project Manager. Todd has managed environmental assessments and permitting for projects across multiple industries, providing a knowledge base for environmentally responsible project development. He has been involved with the Project for over four years.

Hugh Coyle, Lands and Permitting Manager has been involved with the Project since 2005 in the management of claims, quartz leases and exploration permitting.

Mike Padula, Project Manager is a Project Management Professional with over 20 years experience. Most recently, he worked for Western Keltic Mines as Engineering Manager. Previously, Mike worked for De Beers Canada on the Snap Lake Project where he established the project's business development office, negotiated impact benefit agreements and was a senior memober of the owner's project management team.

Letha McLachlan, Q.C., Legal Counsel specializes in environmental law, aboriginal law and resource regulation in the context of resource regulation. Letha was Chair of the federal Environmental Assessment Review Panel that reviewed the BHP Diamonds Project to construct and operate Canada's first diamond mine in the Northwest Territories. Most recently, Letha advised the Joint Review Panel for the proposed Mackenzie Gas Project in the Northwest Territories.

Lenora Hobbis has extensive experience in the successful management and delivery of cold region mining-related project control services with the De Beers Canada Inc. Snap Lake Diamond Project, and most recently for the Kutcho Copper Project of Western Keltic Mines Inc.

1.2.2.2 Stantec

Stantec has assembled a team that includes professionals based in Yukon and British Columbia that has substantial experience from completion of environmental assessments in the Canadian north.

Nick Poushinsky is a Senior Principal with Stantec and has over 25 years experience in the socio-economic and environmental fields coupled with academic appointments at universities in the USA and Canada and government service to the Deputy Minister level. Dr. Poushinsky has led numerous Impact and Benefit Agreement negotiations between resource developers and First Nations in the Canadian north.

Glenn Barr is a Senior Mining Specialist with 15 years of experience in the mining and metal refining industry, most recently performing a lead role in project evaluation at a major mining company.

Jeff Brokaw is a Senior Environmental Scientist whose background includes a doctorate in ecology and over 20 years of environmental assessment work in Canada and the United States.

Wendy Donnithorne is a Senior Consultant with eight years of policy experience with the federal and Yukon governments focused primarily on Yukon policy and regulations for resource development post-Devolution, assessment under the *Yukon Environmental and Socio-economic Assessment Act*, and Yukon land claims. For the last two years Ms. Donnithorne has worked on a number of northern resource development projects as a policy and regulatory consultant.

1.2.2.3 Additional Project Consultants

VIT and Stantec have drawn on support from a variety of specialists with environmental and engineering technical expertise. A brief description of these professionals follows. Detailed authorship information for each section of the Project Proposal is provided in Appendix 1.

BGC Engineering is an international consulting firm specializing in geotechnical and water resources engineering and applied earth sciences. Core services are in mining, energy and transportation. BGC's mine engineers are known for their common-sense approach and have delivered innovative, practical and cost-effective mining solutions to many northern and cold climate projects including: Donlin Creek – Alaska, Nanisivik Mine Closure – Nunavut, Mackenzie Gas Project – Northwest Territories, and the Faro Mine Closure – Yukon.

DPRA Canada Inc. is an international planning and management firm with experience in northern project Socio-Economic Impact Assessment, Consultation, Aboriginal Development Services, Health, Stakeholder Engagement and Communications, Strategic Planning, Organizational Management, and Information Technology.

Kappes Cassiday Associates (KCA) specializes in the development, engineering and implementation of extractive metallurgical processes for the mining industry. KCA is known as an industry leader in gold and silver heap leach design, having been involved in heap leaching since the 1970s. Recent projects include: Ocampo – Mexico, Pinos Altos Project – Mexico, and Itos Project – Bolivia.

Laberge Environmental Services is a small locally owned and operated business in Whitehorse, Yukon. The principals Ken Nordin, Bonnie Burns and Stuart Withers have been engaged in environmental science and technology in the Yukon for over thirty years. Laberge Environmental Services was contracted by Stantec to assist with collection and management of environmental data and logistics in support of environmental baseline studies and the Project Proposal.

SRK Consulting is an independent, international consulting practice that provides focused advice and solutions to clients, mainly from earth and water resource industries. For mining projects, SRK offers services from exploration through feasibility, mine planning, and production to mine closure. Formed in 1974, SRK now employs more than 1,000 professionals internationally in 43 permanent offices on six continents.

URS-Scott Wilson Mining is a fully integrated engineering, construction and technical services organization with the capabilities to support every stage of the project life cycle. URS-Scott Wilson was retained by VIT to provide specialized services in the fields of northern mine engineering and design, and mineral resources and reserve estimation and audit. Relevant northern project experience includes the Diavik Diamond Mine – Northwest Territories and Lac des Iles Mine – Ontario.

YES Group-Yukon Engineering Services Yukon Engineering Services was formed in 1986. YES Group was retained by VIT to provide specialized services in the fields of GPS control, topographic survey and engineering evaluation of the Project access road.

1.2.3 Corporate Policies on the Environment and Sustainable Development

VIT is committed to exploring for, building, operating and closing mines in an environmental, socially and financially responsible manner.

VIT commits to the following principles to ensure environmental stewardship:

- Comply with applicable legal requirements
- Work to reduce or avoid potential environmental impacts through effective management, the wise use of resources, pollution prevention and other appropriate mitigative measures
- Establish and review environmental objectives and targets
- Seek continual improvement in our environmental performance through regular review and improvement of our operational procedures
- Ensure that employees and contractors are aware of the environmental stewardship policy, understand it, are aware of their roles and responsibilities, and have the appropriate training to do their work
- Make the environmental stewardship policy available to the public through our website.

VIT acknowledges that its activities can impact the environment, thus it is our intention to act responsibly by demonstrating stewardship of the environment. VIT believes that environmental stewardship is not just a matter of “doing the right thing” but that there is also a business case for doing so and that it will create value for our shareholders.

1.3 Project Background

1.3.1 Exploration and Ownership History

The Dublin Gulch area has a rich history of exploration and mining since 1898. Dublin Gulch is a watercourse that discharges to Haggart Creek which is a major tributary to the South McQuesten River. Exploration and placer mining began on Haggart Creek in 1895. In 1896, Thomas Haggart built cabins on the then Nelson Creek and in Dublin Gulch. Nelson Creek was renamed Haggart Creek in 1898. Haggart Creek and its tributaries near Dublin Gulch were prospected and mined by multiple claim owners using relatively small operations (pick and shovel and small placer workings) until the late 1930s when larger mechanized equipment was brought to the area (Mayo Historical Society 1999). Mining in the Dublin Gulch area was suspended in the early 1940s during World War II and restarted shortly after the war's end. Mining operations on Haggart Creek from 1953 – 1958 used heavy duty equipment including draglines. It was determined that much of the area was mined out in a few years for larger-scale placer operations, and smaller scale prospecting and mining resumed for the next several decades (Mayo Historical Society 1999). Dublin Gulch was placer mined from 1899 – 1978 by various placer operations using small and heavy duty equipment. Dublin Gulch was first placer mined in 1899 by John L. Suttles. In 1904, tungsten was identified in placer concentrates. Several hard rock mining claims were staked on Dublin Gulch in 1907 including the Carscallen, and the VIT claims. The Olive claim near the headwaters of Dublin Gulch was staked in 1908 by Robert Fisher. The Geological Survey of Canada (GSC) discovered *in situ* scheelite in Dublin Gulch in 1916 (Wardrop 2009), and during World War II, miners on Dublin Gulch received preferential treatment with respect to heavy equipment parts and road maintenance due to strong demand for tungsten for the manufacture of munitions. During the 1940s scheelite concentrate from Dublin Gulch was shipped to the Mines Branch in Ottawa. In 1942, a federal government grant enabled construction of the South McQuesten Road and the Bailey bridge over the South McQuesten River.

In 1977, Queenstake staked the Mar claims in the Ray Gulch area to cover a tungsten bearing skarn. This property was optioned to CanTung, which explored for gold and tungsten during 1977 – 1986 which led to the discovery of the Eagle Zone 3 km southwest of the original tungsten occurrences. CanTung produced a resource estimate for the tungsten skarn zone. In 1991, the property was acquired by Ivanhoe Goldfields, who carried out exploration work based on a "Fort Knox-type" intrusive-hosted gold exploration model. Ivanhoe Goldfields continued exploratory work on the Eagle Zone via drilling, trenching, soil sampling, geophysical surveys, baseline environmental monitoring, as well as mineralogical and metallurgical studies.

In 1994, First Dynasty Mines Ltd. (First Dynasty) acquired the property through its acquisition of Ivanhoe Goldfields, and undertook further exploration work on Eagle Zone. In 1996, First Dynasty formed New Millennium Mining Ltd. (New Millennium), and transferred Dublin Gulch to the new entity to continue exploration work. In 1997, Mineral Resource Development Inc. (MRDI) produced a historic, non-43-101 compliant resource estimate for Measured and Indicated Resources totalling 88.8 Mt at 0.698 g/t Au and Inferred Resources of 106 Mt at a grade of 0.345 g/t Au. This estimate was subject to a feasibility study completed in 1997. In June 2002, First Dynasty changed its name to Sterlite Gold Limited (Sterlite).

In October 2004, StrataGold purchased the Dublin Gulch and Clear Creek gold properties from Sterlite. In 2006 Wardrop Engineering Inc (Wardrop) produced a 43-101 resource estimate for StrataGold consisting of an Indicated Resource totaling 66.5 Mt grading 0.92 g/t and an Inferred Resource totalling 14.4 Mt grading 0.80 g/t based on historic drilling and StrataGold's 2005 drill campaign. StrataGold conducted further drilling on Eagle from 2006 – 2008 and Wardrop completed an updated NI 43-101 Mineral Resource estimate on the Eagle Zone Deposit in January 2009 adding 37% to the Indicated Resource for a total of 2.69 million ounces of gold averaging 0.849 g/t gold. This Mineral Resource estimate incorporated 13,057.65 m of drilling from 2006 – 2008 into the previously-stated resource estimate. In 2008 StrataGold commissioned SRK to complete a Preliminary Assessment for tungen on the MarTungsten deposit (now Wolf Tungsten). SRK estimated an Indicated Resource of 12.7 Mt grading 0.31% WO_3 and an Inferred Resource of 1.3 Mt grading 0.30% WO_3, an 11 year mine life, 15.5% IRR and NPV of $24mm at an 8% discount rate.

In June 2009, through a Plan of Arrangement, StrataGold was acquired by VIT who quickly embarked on further exploration, a Pre-feasibility Study by SWRPA and completion of the environmental baseline data to support a Project Proposal conducted by Stantec.

Work in 2009 focused on gathering further information on the Eagle Zone by drilling deep exploration holes into the deposit and it was found that mineralisation extends to considerable depths beyond the present pit bottom models.

Further field work around Olive and Shamrock, two targets identified within the Dublin Gulch property and approximately 2.5 km NE of the Project identified a continuous, structurally controlled corridor of mineralisation, collectively called the 'Potato Hills Trend'. The Steiner Zone (north of Eagle Zone) was also drilled and initial results show it bears a similarity to the Potato Hills Trend and could be a westerly extension of the Eagle Zone.

1.3.2 Previous Environmental Approval Applications

The proposed Project, under previous ownership, was known as the "Dublin Gulch Project" and in the mid- to late-1990s proceeded to initial assessment and regulatory review under the *Canadian Environmental Assessment Act* (CEAA) as was required at the time. Since that time, environmental assessment and regulatory responsibilities in Yukon have changed significantly, due to Devolution of regulatory responsibilities to Yukon Government, and implementation of the YESAA process. A brief history of the Dublin Gulch Project with respect to previous approval processes follows.

During the 1990s a comprehensive environmental baseline data collection program to support environmental assessment and approvals was conducted by First Dynasty Mines Ltd. In 1995, a project proposal for the development of the Dublin Gulch Project was filed by New Millennium Mining Ltd. (with the Department of Indian and Northern Affairs (INAC) pursuant to the CEAA for review.

Under CEAA, the Dublin Gulch Project was designated as requiring a full Initial Environmental Evaluation (IEE) also known as a "Comprehensive Study". As the Responsible Authority, INAC (through its Regional Environmental Review Committee), issued a detailed Terms of Reference to New Millennium Mining Ltd. for the preparation of an IEE. A Project Management Team for the project was then formed in 1996 which included representatives of INAC, FNNND and Yukon Government (YG) to provide a more inclusive team and as an interim measure to implementation of the YESAA process. As a result of these efforts, a Draft Comprehensive Screening Report was issued by DIAND in 1998 and a number of regulatory information requests were made, although the Draft Comprehensive Screening Report was not finalized. A final determination under CEAA was not made based on the draft Comprehensive Screening Report and New Millennium did not proceed further with the proposed project and the assessment process.

Upon acquisition of the Dublin Gulch property and its underlying mineral rights, StrataGold engaged in development of an environmental baseline program to support a socio-economic and environmental effects assessment to be submitted under YESAA. There was considerable socio-economic and environmental baseline work conducted and data collected in support of the IEE by previous owners. In 2006 Madrone Environmental Services Ltd. completed a Gap Analysis to assess the adequacy of these data and establish additional information requirements to complete a Project Proposal under the YESAA. In 2007, StrataGold contracted Jacques Whitford AXYS (now Stantec) to engage in baseline studies to collect outstanding data identified in the 2006 Gap Analysis.

VIT recognizes that although the IEE was submitted and a Comprehensive Draft Screening Report was issued in 1998, the Project is significantly different from the Dublin Gulch Project. Therefore, this Project Proposal reflects the updated baseline data and the assessment of potential socio-economic and environmental effects associated with the Project and its design, not the previous Dublin Gulch Project. In addition, baseline studies and the Project Proposal have been prepared to meet YESAA requirements specifically as opposed to pre-YESAA and pre-Devolution regulatory requirements.

Exploration work within the quartz claims and leases owned by VIT is subject to the Mining Land Use Regulations of the Yukon *Quartz Mining Act* and is currently carried out under a Class III Mining Land Use Permit (LQ00090) that is valid until July 25, 2012.

In December 2010, VIT submitted a Project Proposal to the Mayo Designated Office for Evaluation of VIT's proposed advanced exploration program, including a 100 person camp, and related activities (Project #2010-0226). That Evaluation is now complete, and required applications for a Class IV Mining Land Use Permit (through the Department of Energy, Mines and Resources) and a Type B Water License (through the Yukon Water Board) are currently in the final stages of review by regulatory agencies.

The advanced exploration camp will be impacted by the activities contemplated in this Project Proposal for the Eagle Gold Project, primarily with respect to the camp location and required infrastructure.

Section 5.4.2.3 describes the proposed mine site accommodations including the transition between the exploration camp and permanent camp facilities. It is anticipated that the advanced exploration camp will be disassembled, moved, and that some of the infrastructure may be used as permanent facilities.

Exploration activities on the greater Dublin Gulch Property will continue during the construction and operations phase of the Eagle Gold Project, therefore an alternate exploration camp in addition to facilities for construction and operations personnel may be required, the location of which is to be determined. Some of the advanced exploration camp infrastructure may therefore be used to support a relocated exploration camp. Details of infrastructure required to support both the mine site facilities as proposed in this Project Proposal and the advanced exploration camp will be refined as planning progresses.

Activities proposed in this Project Proposal will be subject to applicable legislation, authorizations and permits as outlined in Table 1.4-1.

As noted above, the current location of the advanced exploration camp has been assessed by the YESAB Mayo Designated Office and is currently being permitted. Amendments to exploration permits will likely be required for relocation of the advanced exploration camp if necessary in the future. In addition, a separate assessment under YESAA for relocation of the exploration camp may be required independent of this Project Proposal, depending on whether there is a need for a relocated additional exploration camp. Any assessment and permitting requirements beyond the scope of this Project Proposal for ongoing exploration activities will be clarified with the responsible agencies to ensure requirements are met for the independent activities defined by the Eagle Gold Project and advanced exploration works.

1.3.3 Consultation and Regulatory Engagement

In May, 2008, StrataGold entered into an Exploration Cooperation Agreement with the FNNND for the Dublin Gulch project. The obligations as outlined in the agreement were transferred to VIT through the acquisition of StrataGold. Upon acquisition of StrataGold in June 2009, VIT quickly began a broad and proactive consultation and engagement program including the FNNND, the Village of Mayo (VoM), stakeholders and regulatory agencies in development of this Project Proposal.

VIT has made early and ongoing consultation with the FNNND and the community of Mayo a priority to ensure an opportunity for input at all key stages of Project Proposal development. In addition, a number of workshops, including information regarding the use of cyanide in gold mining, closure and reclamation, and site visits have been conducted. VIT has also engaged with local trappers, the Mayo District Renewable Resource Council, Yukon Conservation Society, local outfitters and placer mine operators. Detail on methods, timing and analysis of these consultation activities is included in Section 2 of this Project Proposal.

A summary of regulatory engagement is provided below.

1.3.3.1 Regulatory Engagement

Engagement with assessors, federal and territorial regulators, and other agencies has been regular and ongoing during development of the Project Proposal. A key objective of VIT’s regulatory engagement approach has been to ensure an understanding of assessment and licensing requirements and expectations. Ongoing discussions have therefore been held with assessors and regulators to gather information, clarify process and seek guidance on scoping and information required for development of the proposal.

Regulatory engagements have included discussions with YESAB, meetings with Yukon Government Departments, workshop style meetings with federal and territorial agencies, and focused discussion with specific agencies. In addition, Yukon Government has recently established the Major Mines Coordinating Committee for the Project, to provide a coordinated Yukon Government regulatory forum for the Project. VIT will continue regular communications with agencies as the Project progresses.

Key objectives of VIT's regulatory engagement program have been to:

- Provide opportunities for open and regular communications
- Clarify assessment and licensing requirements and expectations
- Confirm relevant policies, applicable permits and licenses
- Gather available information
- Seek regulatory feedback and input on baseline reports and other Project information
- Provide updates as planning has progressed
- Identify potential information gaps or concerns early in the development of the proposal.

Regulatory engagements have included:

- Formal presentations and updates
- Circulation of environmental and socio-economic baseline studies
- Circulation of Project information
- Meetings and workshops with multiple agencies
- Site visits
- Ongoing communications and discussions.

Table 1.3-1 identifies key formal meetings, workshops, and organized site visits with agencies.

Table 1.3-1: Formal Meetings, Workshops and Site Visits

Date(s)	Participant(s)	Topic or Purpose
September 30, 2009	Minister and Senior officials of Energy Mines and Resources (EMR); VIT; Stantec	Introduction of Project and VIT officials
September 30, 2009 and October 2	Yukon and Federal Agencies (EMR, Executive Council Office (ECO), Environment Yukon (EY), Highways and Public Works (HPW), Economic Development (ECDEV), Bureau of Statistics (YBS), Environment Canada (EC), Yukon Water Board Secretariat (YWBS); VIT; Stantec	Introduction of Project and VIT officials. Included presentation of Project, baseline studies and work to date, engagement approach, timelines, and process. September 30 meeting included YG Senior Officials (Deputy Ministers and Directors). October 2 meeting included management and technical staff.

Date(s)	Participant(s)	Topic or Purpose
September 4, 2009	YESAB; VIT	Introduction of Project and VIT officials to YESAB and assessment staff
September 3, 2009	Fisheries and Oceans Canada (DFO), EY; VIT; Stantec	Project Introduction, fisheries and habitat, Fish Habitat Compensation Plan
November 30, 2009 **May 20, 2010** **August 25, 2010** **November 15, 2010**	DFO MPO Vancouver, VIT	Project Introduction, assessment process, FA process Project site visit focused on fisheries, fish habitat, and proposed Fish Habitat Compensation Plan
March 22, 2010 **May 5, 2010** **July 29, 2010** **September 7, 2010**	Yukon Energy Corporation, VIT, Stantec	Project energy needs, transmission line routing and design, ownership and maintenance.
March 22, 2010	Yukon Highways and Public Works, VIT, Stantec	Projected traffic and access road use, access road maintenance and upgrades
March 31, 2010	Yukon Environment, YESAB, DAB, VIT, Stantec	Wildlife: Baseline study design and proposed methods for effects assessment
June 9, 2010	Multiple Yukon and federal agencies, YWBS; YESAB and other agencies; VIT; Stantec	Cyanide (CN) Workshop: organized by EMR, facilitated by Dirk van Zyl to provide regulators and agencies with technical information on CN heap leach processes
June 10, 2010	Yukon Agencies (EMR, ECO, DAB, YWBS); VIT; Stantec	Project update, and discussion on key regulatory and licensing processes and requirements regulatory engagement approach
June 10, 2010	Environment Canada, VIT Canada Wildlife Service, VIT	Project baseline studies, participation in environmental assessment process, proposed site visit
August 5, 2010	YG Major Mines Coordinating Committee (MMCC); VIT; Stantec	Initial meeting of the working group to introduce members and discuss group Terms of Reference and process forward
August 25, 2010	DFO; VIT; Stantec	Project site visit focused on fisheries, fish habitat, and proposed Fish Habitat Compensation Plan

Date(s)	Participant(s)	Topic or Purpose
September 30 and October 1, 2010	EY, EMR, ECO, EC, YESAB, YWBS; Stantec; VIT	Water Regulators Workshop and site visit (MMCC, Federal agencies, YESAB). Workshop presentations on technical water baseline information, methodology, and modeling approach; provided opportunity for feedback on information presented, and assessment and license information requirements. Site visit included guided full tour of the Project site for regulators and agencies to review the proposed site layout, infrastructure design and locations, key water courses, existing site conditions (previous placer workings), and data collection locations.
November 18, 2010	Transport Canada	Information requirements for determination of Decision Body status under NWPA, participation in YESAB EA process.

Table 1.3-2 lists ongoing regulatory engagement by agency and general topics of discussion. In some cases discussions were combined with multiple agencies where there were common interests.

Table 1.3-2: Ongoing Regulatory Engagement

Regulatory Agency	Purpose or Topic of Discussions
YESAB	Feedback and guidance on YESAA process and Executive Committee Screenings; Project updates; information and scoping requirements; assessment methodologies; proposal content and format
Highways and Public Works	Proposed upgrade and use of existing access roads
Development Assessment Branch, Executive Council Office	Circulation of information, feedback on regulatory requirements and policy and YG process with respect to YESAA
Energy Mines and Resources	Regulatory requirements for major mines, including license applications and process, Yukon government policy, closure and reclamation requirements
Environment Yukon	Fish, wildlife and water resources; habitat and key wildlife species; monitoring requirements and programs
Tourism and Culture	Heritage resources
Yukon Energy Corporation	Project energy requirements; proposed transmission line route, and connection to the Yukon power grid
Yukon Water Board Secretariat	Water license application requirements and process
Fisheries and Oceans Canada	Fish and fish habitat; proposed Fish Habitat Compensation Plan
Environment Canada	Wildlife, migratory birds, water resources and climate
Transport Canada	*Navigable Waters Protection Act*, requirements and process
Natural Resources Canada	Explosives regulation and use

Assessor and regulatory agency input has been invaluable towards scoping of the Project Proposal and supporting studies and investigations.

Particular effort has been made to clarify information requirements in development of the Project Proposal. Along with ongoing communications, meetings, and workshops, specific YESAB feedback was requested on the following topics:

- Environmental and socio-economic baseline study design and reports
- General process and timeline information
- Format and content of the Project Proposal (annotated Table of Contents)
- Access road upgrades and information requirements
- Valued Environmental and Socio-economic Components
- Cumulative effects assessment and methodology
- Key wildlife species and proposed assessment methodology
- Accidents and malfunctions assessment
- Qualitative Human Health and Ecological Risk Assessment
- Water balance model scenarios.

1.4 Required Authorizations and Regulatory Approvals

1.4.1 YESAA Screening Requirements

The Project is subject to assessment in accordance with Section 47(2)(*c*) of the *Yukon Environmental and Socio-economic Assessment Act* (YESAA) as follows:

> *47 (2) An activity listed under paragraph (1)(a) – and not excepted under paragraph (1)(b)—is subject to assessment if proposed to be undertaken in Yukon and if (c) an authorization or the grant of an interest in land by a government agency, an independent regulatory agency, municipal government or first nation is required for the activity to be undertaken;*

The relevant provision(s) from the *Assessable Activities, Exceptions and Executive Committee Projects Regulations* (Project Regulations), applicable legislation, regulations and required permits are identified in sections 1.5.2 and 1.5.3 below.

The Project is assessable under Schedule 3 Item 3(b) of the Project Regulations, which requires an Executive Committee Screening for the:

> *Construction, decommissioning or abandonment of (b) a gold mine with an ore production capacity of 300 t/day or more.*

1.4.2 Applicable Legislation, Regulations, and Permits

The Project will be subject to federal and territorial legislation, and will require a number of permits and approvals.

1.4.2.1 Quartz Mine License

The Project will require a Quartz Mine License under section 135 of the Yukon's *Quartz Mining Act* (QMA), as it will meet the definitions of "development" and "production" under Section 129(1) of the Act which states:

> *"development" means the construction of a facility or work for the production of minerals, but excludes the construction of a facility or work for the sole or principal purpose of assessing land for its suitability for the production of minerals*
>
> *"production" means taking a mineral from the land, or treating a mineral that has been taken from the land, if done for commercial purposes, but excludes an exploration program*

The Quartz Mine License is administered by the Yukon Government, Department of Energy Mines and Resources.

1.4.2.2 Type A Water License

The Project will require a Type A Water License under sections 6 (1) and 7(1) of the *Waters Act* (Yukon) with respect to the mine operations for the use of water and deposit of waste, respectively, and for undertakings related to Project design (water course diversion and watercourse training and crossings).

Section 12(1) of the Act together with Section 7 and Schedule 7 (Column 4) of the Waters Regulation specifically requires a Type A License in relation to quartz mining undertakings with respect to:

> *"direct water use for "…production and milling at a rate of 100 tonnes of ore per day or for production leaching"*

The Water Licence process is administered by the Yukon Water Board.

In addition to the Quartz Mining License and the Type A Water Licence, the Project will require a number of other approvals and must be in compliance with applicable legislation. Table 1.4-1 lists applicable legislation, regulations and approvals anticipated for the Project, including the Quartz Mining License and the Type A Water License identified above.

This list will need to be clarified and finalized with regulatory agencies as the Project proceeds to the permitting processes.

Where additional policies or regulatory guidance have been used in development of the Project Proposal, they are identified in specific sections of the Environmental and Socio-economic Effects Assessment (i.e., the Yukon Government Climate Change Action Plan is referred to in Section 7 – Carbon Management Effects Assessment).

Table 1.4-1: Applicable Legislation, Regulations, and Permits

Applicable Legislation/Regulations	Permit – Approval	Responsible Agency
Quartz Mining Act	Quartz Mining License	Energy Mines and Resources, Yukon Government
Waters Act Waters Regulation	Water License – Type A	Yukon Water Board
Fisheries Act Metal Mining Effluent Regulations	Section 35(2) Authorization	Fisheries and Oceans Canada
Navigable Waters Protection Act	Section 5(2) Approval – to be determined	Transport Canada
Yukon Public Utilities Act	Energy Certificate and Operating Certificate	Yukon Government
Highways Act Highways Regulations	Work in Highway Right of Way Permit, Access Permit	Highways and Public Works, Yukon Government
Territorial Lands (Yukon) Act Land Use Regulations Quarry Regulations	Land Use Permit Quarry Permit Timber Permit	Energy Mines and Resources, Yukon Government
Environment Act Air Emission Regulations Special Waste Regulations Solid Waste Regulations Storage Tank Regulations	Air Emissions Permit Special Waste Permit Storage Tank Systems Permit	Environment Yukon, Yukon Government Community Services, Yukon Government
Forest Protection Act Forest Protection Regulations	Burning Permit	Community Services, Yukon Government
Highways Act Bulk Commodity Haul Regulations Highways Regulations	Highways Hauling Permit	Highways and Public Works, Yukon Government
Yukon Historic Resources Act	Archaeological Sites Permit	Tourism and Culture, Yukon Government
Public Health and Safety Act Sewage Disposal System Regulations	Permit to install a sewage disposal system	Health and Social Services, Environmental Health Services, Yukon Government
Dangerous Goods Transport Act	Permit – certificate for transport of dangerous goods	Highways and Public Works, Yukon Government
Explosives Act and Regulations	Blasting permit, Magazine License, Factory License, ANFO Certificate, Purchase and Possession Permit, Permit to Transport Explosives	Natural Resources Canada, Explosives Regulatory Division and Minerals and Metals Sector
Occupational Health and Safety Act Occupational Health & Safety Regulations	Blaster's Permit	Workers' Compensation Health and Safety Board
Species at Risk Act	N/A	Environment Canada
Wildlife Act	N/A	Environment Yukon, Yukon Government

Applicable Legislation/Regulations	Permit – Approval	Responsible Agency
Canadian Environmental Protection Act	N/A	Environment Canada and Health Canada
Migratory Birds Convention Act Regulations Respecting the Protection of Migratory Birds	N/A	Environment Canada
Building Standards Act Electrical Protection Act	Building Permit, Plumbing Permit	Community Services, Building Safety, Yukon Government
Gas Burning Devices Act	Gas Installation Permit Gas Burning Devices Permit	Community Services, Building Safety, Yukon Government
Boiler and Pressure Vessel Act	Pressure Vessel Boiler Permit	Community Services, Building Safety, Yukon Government
Yukon Public Health and Safety Act Regulations Respecting Public Health	Compliance with Public Health Regulations	Health and Social Services, Environmental Health Services

1.5 The Organization and Layout of the Project Proposal

The Project Proposal consists of two volumes. Volume 1 responds to the information and assessment requirements identified in the “Proponent’s Guide to Information Requirements for Executive Committee Project Proposal Submissions” (YESAB 2005). To the extent practical, considering the specifics of the proposed Project, the volume follows the format and suggested table of contents presented in the YESAB Proponent’s Guide. VIT appreciates the guidance provided by YESAB in establishing the format and content of the first volume.

Volume 1 first presents an executive summary that follows the format proscribed by the Proponent’s Guide. The executive summary provides an overview of the proposed Project, the regulatory and policy context, potential effects, proposed mitigations, and assessment of the significance of residual effects. Following the executive summary is a table identifying each of VIT’s commitments to ensure that the Project is environmentally and socio-economically sound. The Project Proposal sections following the preface materials provide details on the information, the methods, and the findings summarized in the executive summary.

Volume 2 contains the Project Proposal’s appendices. The appendices contain materials and information that support the conclusions made in the Project Proposal. The majority of the appendices contain the detailed baseline studies, and the technical modeling methods and data output utilized in the assessments presented in Volume 1. Other appendices identify the principal authors for each section of the Project Proposal, the environmental assessment methods used in determining the significance of potential Project-specific and cumulative effects, and the information provided and received during consultations and open houses with FNNND, the VoM, and others.

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2 FIRST NATIONS, OTHER GOVERNMENT, AND COMMUNITY CONSULTATIONS

2.1 Introduction

This section of the Project Proposal provides an overview of the approach and results of consultation with the FNNND, the Village of Mayo (VoM), and other interested parties. Additional detail and copies of the materials used in the consultation events are provided in Appendix 2 (First Nation, Other Governments, and Community Consultation).

In general terms, consultation is the process that a proponent follows to inform and consult with those who may be affected by—or have an interest in—the potential project or development. This includes the mandated consultation activities with affected First Nations and any nearby communities (under the *Yukon Environmental and Socio-Economic Assessment Act* as set out in Section 50[3]). It also includes the interactions with any individual property owners or land users (e.g., trappers, outfitters), interested organizations (e.g., Yukon Conservation Society [YCS]), and discussions with government regulators as the Project evolves.

This section documents the consultation activities for the Project with respect to consultation with the FNNND, the VoM and other interested stakeholders. Information on engagement with regulatory agencies is set out previously in Section 1.3.3.

2.1.1 Consultation Requirements

The *Yukon Environmental and Socio-Economic Assessment Act* (YESAA), Section 50(3) states the following with respect to First Nation and community consultation:

> *Before submitting a proposal to the Executive Committee, the proponent of a project shall consult any first nation in whose territory, or the residents of any community in which, the project will be located or might have significant environmental or social economic effects.*

This report describes how VIT has notified, consulted with, and engaged with the FNNND, the VoM, and others during the development of the Project Proposal. This report also documents how the consultations have helped to shape the Project.

2.1.2 Consultation Overview

VIT has conducted a consultation program to engage with the FNNND, the VoM, local residents and other stakeholders with regard to the proposed Project. Since November 2009, VIT held 19 formal information and consultation events. In addition, meetings were held with several small groups and individuals and with regulators, and four newsletters were produced and sent to the general public.

Prior to the submission of this Project Proposal, a wide range of consultation and engagement activities were undertaken, as described below and in Appendix 2.

The Yukon Environmental and Socio-economic Assessment Board (YESAB), in reviewing the Project Proposal, will be looking to ensure:

- That the consultation which was conducted with FNNND and the VoM was adequate and effective
- That VIT listened and responded to the issues raised during the consultation
- That VIT made adjustments to the planning process or the Project Proposal (where appropriate) as a result of the consultation.

Following submission of the Project Proposal, YESAB will conduct their formal First Nation and public consultation review process during their assessment. During that process, VIT and their consultants may be asked to respond to queries or concerns. VIT will continue meetings with FNNND on ongoing issues, including negotiating the details of a comprehensive Cooperation and Benefits Agreement (CBA). In addition, VIT will continue to engage in discussions with VoM and other stakeholders as appropriate.

2.2 Identification of Parties to be Consulted

The primary parties to be consulted for the Project were identified by VIT, under the guidance of YESAB. Parties identified were the FNNND—within whose traditional territory the Project is located—and the VoM and its residents, due to the close proximity of the community to the site of the proposed Project (YESAA, Section 50[3]).

Other parties consulted include the general public (residents of Mayo and communities of Keno City, Pelly Crossing, Carmacks, and Whitehorse), local organizations and service providers.

2.3 Parties Provided with Notice of Project

In addition to ongoing meetings and interactions with regulatory agencies, as part of the consultation program, VIT initiated notification and discussion of the Project with the following parties:

- Chief Simon Mervyn – Chief, FNND
- Anne Leckie – Executive Director, FNND
- Pete and Mary Beattie – Registered Trapline Concession holder
- Bernard Menelon – Registered Trapline Concession holder
- Jim Shockey – Guide Outfitting Concession holder
- Alan Young – Guide Outfitting Concession holder
- Frank Taylor – Placer Claim holder
- Brian Zaluski – Placer Claim holder

- Barb Shannon – Executive Director, MDRRC
- Mayor Scott Bolton – Village of Mayo
- Keno City
- Village of Carmacks
- Pelly Crossing
- Stewart Crossing
- Silver Trail Chamber of Commerce
- Silver Trail Tourism Association
- Yukon Chamber of Mines
- Yukon Conservation Society
- Yukon Mine Training Association.

2.4 Consultation Approach

The Project consultation program had four goals:

To conduct adequate, socially responsible consultation

To ensure that the FNNND and the VoM have sufficient opportunity to consider all aspects of the Project and participate in a fully informed dialogue with VIT

To submit the Project Proposal with the support of the FNNND[2] and the VoM

To work with the FNNND to provide opportunities for the First Nation to benefit from Project-related resource development activities on their traditional lands—both through various socio-economic opportunities and the provisions of a CBA.

VIT has worked closely with FNNND and key stakeholders, and reached out broadly to other stakeholders.

The consultation approach used for this Project consisted of four key steps:

- Provision of information to all interested stakeholders
- Receipt of comments and input through a number of forums and techniques
- Response to questions and concerns provided by stakeholders
- Demonstration of how the interaction between VIT, FNNND, the VoM, and the other stakeholders and the public has modified the planning process, or the Project Proposal.

[2] Chief Mervyn, on behalf of the FNNND, has provided a letter of support (dated November 17, 2010) for the Project.

2.5 Public Consultation Plan

VIT produced a consultation plan leading up to the submission of the Project Proposal. The FNNND leadership and their staff collaborated with VIT to develop and formulate those activities that were to form the basis of the consultation events identified in the plan. Subsequently, a formal meeting was held with the FNND leadership to seek endorsement of the sequence and scheduling of events identified within the consultation plan.

The Public Consultation Plan consisted of a description of activities and events (e.g., various workshops, open houses, site visits, and meetings), a schedule of such events, a public consultation notification protocol, consultation support activities, communication tracking, reporting, project management and coordination, and a consultation framework for the FNNND.

In producing the Public Consultation Plan, VIT was cognizant of the duty to consult as defined in Section 3 of the YESAA, i.e.,

> *. . . the duty to consult shall be exercised*
>
> *(a) by providing, to the party to be consulted,*
>
> *(i) notice of the matter in sufficient form and detail to allow the party to prepare its views on the matter,*
>
> *(ii) a reasonable period for the party to prepare its views, and*
>
> *(iii) an opportunity to present its views to the party having the duty to consult; and*
>
> *(b) by considering, fully and fairly, any views so presented.*

In implementing this Public Consultation Plan, VIT has:

- Worked to ensure that YESAA consultation requirements are addressed
- Responded to information requests
- Kept the FNNND, VoM and other stakeholders informed of progress
- Provided opportunities to comment
- Tracked all consultation activities
- Tried diligently to consider all comments and information received in consultations fully and fairly.

In terms of consultation with the FNNND, activities have been framed using FNNND's "*Guiding Principles towards Best Practices Codes for Mineral Interests within First Nation of Na-Cho Nyäk Dun Traditional Territory*" guide, with the primary goal being "to ensure [a] long term relationship built on a basis of mutual trust, respect and understanding regarding our rights, culture, values, and traditions" (FNNND 2008c). To meet this goal, the FNNND have established six objectives, all of which require parties to work together in order to meet the interests of both the FNNND and the proponent. The six objectives are as follows:

Keeping the commitment strong

Sharing information

Engaging in open consultation

Creating opportunities and building capacities

Protecting environmental integrity

Reviewing and developing policy.

2.6 Consultation Techniques

A number of consultation techniques have been used for the Project, respecting the requirements of and guidance set out in:

1. The *Yukon Environmental and Socio-Economic Assessment Act* (YESAA)
2. The YESAB Proponent's Guide to Information Requirements for Executive Committee Project Proposal Submissions
3. The Na-cho Nyäk Dun First Nation Cooperative Engagement Process
4. *Guiding Principles towards Best Practices Codes for Mineral Interests within First Nation of Na-Cho Nyäk Dun Traditional Territory*.

The main consultation techniques have been community meetings, open houses, and workshops in Mayo. The community meetings and workshops were more formal sessions on specific topics or with agendas for discussion. The open houses were more informal and provided the opportunity for individuals to review informational storyboards and to engage in one-on-one discussions with representatives of VIT or their consultants.

Prior to each consultation event, notification has been provided in the form of posters, flyers, and (in some cases) radio and newspaper advertisements. In addition, Project newsletters have been distributed to better inform the public about the Project and how to participate in the consultation process.

Other forms of consultation have included individual meetings with community and FNNND government representatives, and site visits to the Project site and the Fort Knox gold mine in Alaska.

2.7 Consultation Events to Date

From the time that the consultation activities were initiated in November 2009 until the time of this report (December 2010), a total of 19 consultation events have taken place. Some of the events were to introduce the Project and provide updates; other events were in response to issues and concerns raised by community members, such as the heap leach process, accidents and malfunctions, socio-economic opportunities, and closure and reclamation workshops. This does not include distribution of newsletters, engagement with regulators (which is described in previous Section 1.3.4) or a range of specific meetings with the FNNND, VoM, and other interested parties. These 19 events are summarized in Table 2.6-1. Details are provided in Appendix 2.

Table 2.6-1: Consultation Events to Date

Quarter and Year	Community Meetings or Open Houses	Government Meetings	Other Meetings and Contacts	Newsletters
Q2 2009			**May 5, 2009:** Meeting (FMA Heritage, YESAB)	
Q3 2009				
Q4 2009	**November 3, 2009:** Project Introduction **December 2**, 2009: Project Update	**November 4, 2009:** Meeting (FNNND Managers and Staff) **December 1, 2009:** Project Introduction (VoM Council)		Eagle Gold Project Update Newsletter (No. 1) Posters (in Mayo)
Q1 2010				Eagle Gold Project Update Newsletter (No. 2)
Q2 2010	**May 3, 2010:** Project Update **June 10, 2010:** Proposed Heap Leach Process and Cyanide Management	**August 3, 2010:** Review of Public Consultation Schedule and Approach (FNNND) **September 22, 2010:** Review and Confirmation of Socio-Economic Baseline Report (FNNND, VoM)		Potato Hills Press Newsletter(No. 3)
Q3 2010	**September 21, 2010:** Socio-Economic Opportunities Workshop **September 26 – 30, 2010:** Council and Elders Site Tour—Eagle Gold and Fort Knox (FNNND)			Potato Hills Press Newsletter (No. 4)

Quarter and Year	Community Meetings or Open Houses	Government Meetings	Other Meetings and Contacts	Newsletters
Q4 2010	**November 3, 2010:** Closure and Reclamation Workshop **November 4, 2010:** Accidents and Malfunctions Workshop **November 29, 2010:** Pre-Submission Open House in Mayo **November 30, 2010:** Pre-Submission Open House in Keno City **November 30, 2010:** Pre-Submission Open House in Pelly Crossing **December 1, 2010:** Pre-Submission Open House in Carmacks **December 2, 2010:** Pre-Submission Open House in Whitehorse		**October 27, 2010:** Project Briefing (Yukon Conservation Society)	

Representatives of VIT, as well as their consultants (Stantec, DPRA, and Research Northwest) have attended the consultation events.

Following is a description of each type of consultation activity that has been conducted for the Project.

2.7.1 Community Meetings, Workshops, and Open Houses

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

All meetings to date have been documented with a combination of photos, storyboards, meeting minutes, sign-in sheets, or comment cards. A selection of this material is located in Appendix 2.

The community meetings and open houses are summarized in Table 2.6-2.

Table 2.6-2: Community Meetings and Open Houses to Date

Date	Location	Community or Organization	Purpose
November 3, 2009	Mayo	Community of Mayo, FNNND	Open House to introduce the Project to the community
December 2, 2009	Mayo	Community of Mayo, FNNND	Open House to provide an update on the Project
May 3, 2010	Mayo	Community of Mayo, FNNND	Open House to provide Project Overview and update
June 10, 2010	Mayo	Community of Mayo, FNNND	Open House to provide a presentation on the Heap Leach Process
September 21, 2010	Mayo	Community of Mayo, FNNND	Socio-Economic Opportunities Workshop*
November 3, 2010	Mayo	Community of Mayo, FNNND	Closure and Reclamation Workshop*
November 4, 2010	Mayo	Community of Mayo, FNNND	Accidents and Malfunctions Workshop*
November 29, 2010	Mayo	Community of Mayo, FNNND	Pre-Submission Open House
November 30, 2010	Keno City	Community of Keno City	Pre-Submission Open House
November 30, 2010	Pelly Crossing	Community of Pelly Crossing, Selkirk First Nation	Pre-Submission Open House
December 1, 2010	Carmacks	Community of Carmacks, Little Salmon Carmacks First Nation	Pre-Submission Open House
December 2, 2010	Whitehorse	Community of Whitehorse, FNNND in Whitehorse	Pre-Submission Open House

NOTE:

* Each of these workshops had an open house linked with the workshop, i.e., the workshop had a set time and agenda, while the open house was a drop-in to review displays and engage with staff one on one.

VIT has primarily focused on consultation with FNNND (as the Project is located on FNNND traditional territory), the Village of Mayo, and residents and organizations that are local to Mayo. Open houses were held in the communities of Carmacks and Pelly Crossing, because they are located along the access route from Whitehorse to the Project, and in Whitehorse because a number of FNNND citizens reside there.

2.7.2 Guided Site Tours

VIT sponsored two guided site tours for a group of seven FNNND Elders and staff, in order for them to see first-hand an operating mine, and to make comparisons with the Project. These Elders then shared their experiences with other Elders who were unable to attend the site tours. The first site tour was of the Fort Knox gold mine in Alaska (operated by Kinross Gold) on September 26, 2010. The Fort Knox site tour was preceded by a presentation and dinner in Mayo on September 26, 2010, hosted by VIT. The presentation provided an overview of the entire gold mining process: open pit methods, heap leaching using sodium cyanide, and reclamation as well as Project-specific information (Project timelines, permitting and approvals status). The second site tour was of the Project site, which was held on September 30, 2010.

Each site tour began with health and safety orientations and a review of the itinerary. While each tour was unique, generally each provided the tour group with an opportunity to view the site from a distance, as well as up close in the processing facilities. After the tours, the group reconvened for questions, answers, and comments.

2.7.3 Meetings with First Nation of Na-Cho Nyäk Dun and Village of Mayo

Meetings with the FNNND Chief and Council, FNNND executive, management, and staff have taken place since 2009, immediately following VIT's acquisition of the Project property.

Meetings held with Village of Mayo representatives included the Mayor, Councillors (December 1, 2009 meeting only), and CAO.

These meetings are summarized in Table 2.6-3.

Table 2.6-3: Meetings with FNNND and VoM Government Officials to Date

Date	Location	Government	Purpose
May 5, 2009	Mayo	FNNND	Traditional Knowledge study design and identification of participants
November 4, 2009	Mayo	FNNND Managers and Staff	Introduction to the Project
November 9, 2009	Mayo	FNNND Chief and Council	Update on the Project
December 1, 2009	Mayo	Village of Mayo representatives (council)	To provide progress on Project
August 3, 2010	Mayo	FNNND	To review Public Consultation schedule and approach
September 22, 2010	Mayo	FNNND	To review Socio Economic Baseline Report*
September 22, 2010	Mayo	VoM	To review Socio Economic Baseline Report*

NOTES:
* As reviewed and modified, the Socio-Economic Baseline Report was deemed accurate and appropriate

2.7.4 Meetings with Others

In addition, VIT has met 28 times with other stakeholders who are interested in the Project. This includes the Mayo District Renewable Resource Council (MDRRC), the Yukon Conservation Society, Midnight Sun Outfitters, and individual trappers and placer miners. These meetings are noted in Appendix 2.

2.7.5 Traditional Knowledge and Use Study

Under YESAA, Traditional Knowledge is a fundamental consideration for the assessment of proposed projects. In developing the Project Proposal, VIT worked closely with the FNNND to design and complete a Traditional Knowledge and Use Study Report.

The Executive-Committee level project screening requirements specify the proponent must:

- Identify the Yukon First Nation Traditional Territory or territories within which the Project falls
- Describe baseline conditions and assess effects to First Nation's land and resource use
- Apply Traditional Knowledge in the scoping of VCs, and in the development of monitoring and adaptive management planS
- Demonstrate how Traditional Knowledge was considered in the preparation of the Project Proposal.

The Traditional Knowledge and Use (TKU) Study Report was completed using information from meetings and interviews with Citizens of the FNNND between 2009 and 2010. The collection of FNNND Traditional Knowledge (TK) was facilitated by FMA Heritage Inc. (a Stantec subsidiary) in collaboration with FNNND Heritage Department staff.

TK information provided by the FNNND has been carefully considered and incorporated into the design of the Project and throughout the various Valued Component assessments in the Project Proposal. The TKU Study has been referenced throughout the assessment as appropriate to indicate where specific information has been used. At the request of the FNNND, the report is being held in confidence.

Should the Executive Committee determine this TKU Study Report is considered confidential, YESAB has developed procedures to manage and protect confidential information.

2.7.6 Discipline Interviews

VIT has conducted a number of interviews with various parties as part of the socio-economic baseline study and the TKU study, as follows:

- Interviews conducted in connection with the socio-economic effects assessment (28 interviews)
- Interviews conducted in connection with the TKU Study (11 interviews).

2.7.7 Newsletters and Other Information

VIT has provided various forms of information to the public and stakeholders. To date four newsletters have been circulated by mail to all residents in Mayo and the FNNND citizens. Notices of specific consultation events were posted in the local communities of Mayo, Keno City, Pelly Crossing, and Carmacks. Project-related information has also been posted on the VIT website (http://www.victoriaresourcecorp.com). A selection of this material is located in Appendix 2.

2.8 Review Timelines

Background documents that were prepared with inputs from citizens of the FNNND and Mayo residents were submitted in draft to the FNNND and VoM for review and comment. Identified modifications were made before the reports were finalized. The Traditional Knowledge Use study was available for about 10 weeks for review; the Socio-Economic Baseline was available for review for two weeks.

2.9 Key Concerns Raised during Consultation

Based on the feedback received from the consultation activities to date (November 2009 to December 2010), a large number of concerns have been raised by event participants. Of these, 11 stand out as being key concerns. The eleven key concerns are grouped into two categories of environmental concerns and socio-economic concerns, as follows.

Environmental Concerns

- Cyanide heap leach process and cyanide management
- Potential impacts on wildlife and the hunting and trapping of wildlife by local residents
- Accidents and malfunctions
- Monitoring mine impacts
- Potential impacts on fish, fish habitat, and fishing activities by local residents.

Socio-economic Concerns

- Potential impacts on transportation infrastructure and traffic
- VIT compensation, contributions, and supports to the community or FNNND mine-related employment and economic opportunities
- Training and mentoring of local population in relation to mine employment
- Economic development and supporting local businesses
- Alcohol and drug use and testing.

2.9.1 Cyanide Heap Leach Process and Management

Concern over the cyanide heap leach process and the management of cyanide has been the most frequently identified environmental issue to date. Questions pertaining to the general risks of cyanide usage, accidents and spills, the location of the heap leach facility, volumes of cyanide, transportation of cyanide briquettes, and potential environmental impacts, among others, were expressed at open house sessions and meetings.

In response to concerns voiced by the FNNND, Village of Mayo, and Mayo District Renewable Resources Council, two specific events were planned and carried out in order to provide more detailed technical information on the proposed heap leach process and management of cyanide.

On June 9, 2010, a workshop and community session sponsored by Yukon Energy, Mines and Resources featured a presentation by Dr. Dirk van Zyl (Norman B. Keevil Institute of Mine Engineering, University of British Columbia). In Dr. van Zyl's presentation, experiences with heap leaching and cyanide management in the context of gold mining operations elsewhere in the world were shared. The meeting also included an introduction to the risk assessment and effects assessment for accidents and malfunctions with specific attention to the use of cyanide for the Project.

The following day (June 10, 2010) VIT held a Community Open House in Mayo, attended by 34 participants. In addition to display panels providing Project details, a presentation covered the following topics:

- Transportation of Cyanide to the Project
- Use of Cyanide at the Project
- Heap Leaching Overview
- Heap Leach Facility Details
- Gold Recovery
- Closure and Reclamation
- Accidents and Malfunctions.

Two additional opportunities were provided through the FNNND Council and Elders Meeting and Project Presentation on September 26, 2010 and on the tours of the Fort Knox and the Eagle Gold projects on September 28 and 30, 2010, respectively. During the site visit to Ft. Knox, operated by Kinross Mining near Fairbanks Alaska, Council members, Elders and FNNND staff were able to tour an operating heap leach facility and raise questions and concerns related to how a similar operation would be situated for the Project. Upon returning to Mayo, many of the same participants in the Fort Knox tour participated in a tour of the Project, where they were shown the specific location of the proposed Heap Leach Facility, and accompanying facilities. During this tour participants were again able to raise questions and concerns related to the operation of a heap leach facility.

2.9.2 Wildlife

Concerns raised during consultations included: potential impacts on wildlife with respect to maintaining traditional ways of life (hunting and trapping) and the current trend of increasing difficulty in hunting moose. The threat of increased access to traditional hunting areas via mine roads, and the potential for increase in number of hunters (i.e., Project employees) were voiced. Community members do not want the Project to interfere with local hunting in the area. Some concern was also voiced over the need to keep the environment clean for wildlife and to protect wildlife from the mine site and its operations.

The FNNND and local residents were also concerned about a possible increase in trapping pressure due to the mine and emphasized that they do not want the Project to interfere with local trapping in the area. The need for compensation for losses in trapping earnings (due to the Project) was also raised.

2.9.3 Accidents and Malfunctions

Spills, accidents, and related issues, such as emergency response and emergency preparedness training and planning, were voiced during consultations. In general, participants were concerned with what plans the Project has made in terms of accidents and malfunctions, and how Project managers would work with local stakeholders to prevent spills and accidents, as well as mitigate the effects of actual events. More specifically, questions and answers regarding the threat of earthquakes, the history of spills and leaks related to heap leaching at other mines, the potential for spilled cyanide to enter the food chain, groundwater monitoring, and long-term planning for worst-case scenarios were provided at these sessions. In order to address these concerns, VIT held a workshop on accidents and malfunctions on November 4, 2010, in Mayo. A presentation was given with regards to the specific accident and malfunction plans for the Project and many questions and concerns were noted and responded to.

2.9.4 Monitoring

Groundwater, fish, and other environmental component monitoring, and the need for baselines in these areas, were noted as concerns by participants. The effects of previous placer mining in the area have been long-term, and participants are seeking to ensure that further degradation does not occur. FNNND citizens requested independent, third party involvement in monitoring activities.

2.9.5 Fish and Fish Habitat

Participants raised their concerns regarding the loss of fish habitat due to the Project footprint in Dublin Gulch, as well as evidence of changes to Arctic graylings. The potential for increased fishing pressure by Project employees was also noted.

2.9.6 Transportation Infrastructure and Traffic

Concern over the Project’s possible effects on roads, bridges, and traffic volumes was raised numerous times. The number of trucks traveling to the Project site, the need for road and bridge upgrades to handle the traffic volume, appropriate road signage, and requests to build pull-offs near the South McQuesten River were some of the specific issues raised.

A number of concerns related to the increasing frequency of flights in and out of the Mayo airport were also raised. Residents generally saw increasing air traffic as a benefit. The benefits would include the potential to return scheduled air service to Mayo, the ability to reduce the time for medical travel into Whitehorse, and the ability to receive important goods and supplies at times when road travel was less reliable.

2.9.7 Compensation

Questions regarding compensation were raised in the context of those with traplines located on the Project site, as well as for hunters and fishers in the area. VIT prepared a land tenure and use study in the area, in order to determine recreational and other users. Other questions regarding whether FNNND would receive monetary compensation in relation to the Project were asked.

2.9.8 Employment

Questions regarding employment at the Project and specifically the number of available jobs, types of jobs, hiring quotas, and timing of those job opportunities for FNNND and local citizens were raised over the course of public consultation sessions. Specific questions and concerns about background checks for mine employees, shift rotations, contingency plans for shift changes, employee transportation, and employee housing at the site camp and in Mayo were raised and addressed by VIT.

The workshop on Socio-economic Opportunities held on September 21, 2010 provided responses to many of these questions.

2.9.9 Training and Mentoring

Training programs with Yukon College and the Yukon Mine Training Association (MTA) as well as summer work programs for youth at the Project were brought up by participants. In particular, FNNND staff and management noted training challenges, such as the need to have completed higher academic levels as prerequisites to trades and technical training. FNNND citizens suggested the following in terms of institutionalizing training in the area: establish a training committee composed of FNNND, VIT, MTA, and Yukon College “separate from the existing Silver Trail training process,” establishment of a permanent mine training centre (with MTA) in Mayo, and VIT sponsorship of student scholarships.

2.9.10 Economic Development

Several ideas were shared during consultations to date regarding opportunities for the local community and FNNND to participate in economic development initiatives with the Project. Environmental monitoring, Project contracting, and sub-contracting were noted.

The Socio-economic Opportunities Workshop and Open House held in Mayo on September 21, 2010, provided details to the community on VIT contracting process and procedures, employment, business opportunities, and service requirements. Over 20 people were present for the presentation, which was followed by a dinner and open house.

2.9.11 Alcohol and Drugs

The issue of drug and alcohol use and their relation to employee drug testing and zero-tolerance policies were raised by participants at several consultation events. In particular, the role and availability of counselling and treatment options were noted as necessary aspects to job retention, as substance abuse and addictions have been identified as issues in the community.

The potential for partnering with FNNND to address these issues has been raised.

2.10 Analysis of Key Concerns: Differences and Similarities

Consultation efforts carried out have been well received and attended. The Project has been generally received positively by the FNNND and the community. Although there was no direct opposition to the proposed Project concept, some specific concerns have been raised in relation to certain components of the Project.

Since the Project was proposed in 2009 and focussed consultation efforts commenced, there have been many comments and various concerns raised through the meetings, open houses, and other consultation activities. Opportunities for potentially affected parties to raise concerns, and for VIT to respond directly to these Project-related concerns, have been a fundamental component of the consultation program. In some cases, VIT has been able to incorporate measures to address comments and concerns in the design of the Project. In other cases, VIT is carefully tracking comments raised for further follow up and discussion.

One concern in particular has been raised around one component of the Project; in relation to the use the use and transportation of cyanide. Both VIT and the Yukon Government responded directly and comprehensively to this concern that was raised early in the Project introduction and consultation sessions. The Yukon Government sponsored a workshop with Dr. Dirk van Zyl (Norman B. Keevil Institute of Mine Engineering, University of British Columbia). Based on Dr. van Zyl's experience, he explained the use of cyanide in mining processes, providing examples of where it has been used successfully/safely in other areas of the world.

In addition, VIT presented a separate workshop in Mayo on the heap leach process proposed for use in the Project, and arranged tours to both the Project site and the Fort Knox mine in Alaska that currently uses a heap leach process.

There were several FNNND and Mayo residents who had worked with cyanide at the Brewery Creek mine or who were familiar with its use during operations and closure. This helped people to better understand the role of cyanide in mining. This local knowledge, combined with the technical expertise of Dr. van Zyl and the VIT commitments to safe handling of the cyanide and the environmental protection on site, has helped to increase the level of comfort of people who had previously opposed the proposed gold production process.

Another cyanide workshop is planned for 2011 to further discuss any remaining concerns people may still have.

2.11 Commitments and Adjustments

The following table provides a general summary of the concerns raised through public consultations and the corresponding commitments and adjustments that have been made by VIT. Three broad categories of concern are presented here. Specifically: 1) Traditional Land Use and Culture; 2) Employment/Economic Opportunities; and 3) Cyanide Use/Transport. A detailed list of concerns and responses from public open house forums and meetings is noted in Appendix 2.

Further commitments and adjustments that have been made are noted in other sections of the Project Proposal.

Table 2.11-1: Selected VIT Commitments

No.	Concerns	VIT Commitment
1	**Traditional Land Use and Culture** 1. Concern regarding hunting, fishing and gathering pressures	1. VIT will ensure that the presence and use of firearms are restricted on the Project site. The restrictions will extend to employees, management and contractors. In addition VIT will develop a policy restricting Project-related employees and contractors from hunting and fishing while on the job at any time throughout the life of the Project.
	2. Concern regarding traffic hazard	2. VIT will consider including a parking area near the S. McQuesten Bridge.
	3. Concern regarding independent, third party environmental monitoring	3. VIT will invite FNNND community members, through its appropriate government department, to be involved with environmental monitoring from now until after closure.
	4. Concern regarding loss of traditional resources in Project area	4. To the extent practical and where feasible, VIT will work toward the goal that community members' traditional use activities can be carried out comfortably.
2	**Employment/Economic Opportunities** 1. Need for accessible business information	5. VIT will maintain a registry of local and Yukon businesses.
	2. Concern regarding small and medium sized enterprises	6. VIT will make efforts to right-scale contracts in order to make it possible for local companies to be competitive. ▪ VIT and their contractors will hire as many local residents as possible. ▪ Easy Commute—Employees will be flown to Mayo and be bussed to site on regularly scheduled charters. ▪ Time at Home—Employees will operate in a rotating schedule which will allow for more time with family and a good work/life balance.
	3. Concern regarding employment of local and Yukon residents	7. VIT will discuss possible training courses and other opportunities with Yukon College and Yukon Mine Training Association.
	4. Concern regarding employability of local residents	8. VIT will Include training, mentoring and stay in school programs.

No.	Concerns	VIT Commitment
3	**Cyanide Use/Transport** 1. Concern for safe use of cyanide in the heap leach process	1. There will be multi-engineered layers to contain leach solution. ▪ There will be several layers of liners, made of both synthetic and natural materials ▪ Leak detection and recovery systems will be integrated into the liners. ▪ All staff working with the heap leach process will be properly trained and equipped. ▪ Monitoring of ground and surface water will be undertaken; VIT will invite FNNND community members, through its appropriate government department, to be involved with environmental monitoring from now until after closure. ▪ VIT will be transparent with results of the monitoring program, sharing information with FNNND.
	2. Concern for safe transport of cyanide	2. Cyanide will be in a solid (briquette) form. It will be shipped in sealed bags. ▪ A pilot vehicle will accompany truck shipments in inclement weather between Mayo and site. ▪ All emergency response personnel will be properly trained and equipped in the unlikely event of a spill.

2.12 Photos of Selected Consultation Activities

Photo 2.5-1: Meeting with Village of Mayo, and First Nation of Na-Cho Nyäk Dun, November 3, 2009

Photo 2.5-2: Presentation to Village of Mayo and First Nation of Na-Cho Nyäk Dun, November 3, 2009

Photo 2.5-3: Mayo Open House, December 2, 2009 at Old Government Building

Photo 2.5-4: Discussions during Mayo Open House, December 2, 2009 at Old Government Building

Photo 2.5-5: FNNND Site Tour (Fort Knox), September 28, 2010

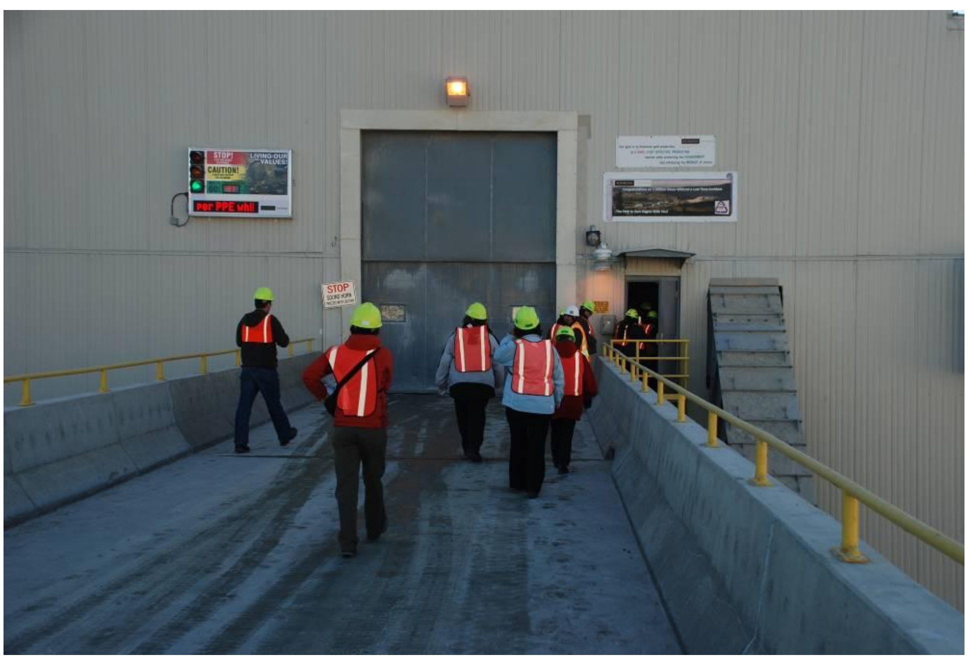

Photo 2.5-6: Entering Processing Facility, Site Tour (Fort Knox), September 28, 2010

3 PROJECT LOCATION

3.1 Geographic Location

The Project is located in central Yukon in the Traditional Territory of the FNNND, and within the Stewart River sub-basin of the Yukon River Watershed.

Near the confluence of Haggart Creek and Dublin Gulch, the Project site is approximately 45 km north-northeast of the Village of Mayo (by flight) or approximately 85 km by existing access roads. The Project is approximately 350 km north of the Yukon capital of Whitehorse (Figure 3.1-1).

The Project is situated within the Yukon Plateau North Ecoregion, in the Boreal Cordillera Ecozone which encompasses the Stewart, MacMillan and Pelly plateaus and southern part of the Selwyn Mountains (Smith, et al. 2004; refer to Section 4, Figure 4.1-1).

The majority of the Project site lies within the Dublin Gulch watershed. Dublin Gulch is a second order stream that is a tributary to Haggart Creek which flows to the South McQuesten River. Elevations in the vicinity of the Project range from 765 m above sea level (m asl) near the confluence of Dublin Gulch and Haggart Creek, to 1,525 m asl at the base of the Potato Hills (which forms the eastern boundary of the Dublin Gulch watershed) (Figure 3.1-2).

3.1.1 Legal Land Description

The Project site is located on National Topographic System (NTS) map sheet 106D04.

The site is situated within the “Dublin Gulch Property” which refers to a large contiguous block of 1912 quartz claims, 10 quartz leases, one crown grant and 125 placer claims held by VIT. The Dublin Gulch Property is rectangular in shape and extends approximately 26 km in an east-west direction and 13 km in a north-south direction. The centre of the property is located at 7,100,950N, 463,750E (NAD 83, Zone 8). The geographic coordinates are 64°02’00” N latitude and 135°44’31” W longitude. The Dublin Gulch Property is indicated on NTS map sheets 105M/13, 105M/14, 106D/3, 106D/4, 115P/16 and 116A/1.

The Project site including the access road and the larger Dublin Gulch property are shown in Figure 3.1-2.

3.2 Study Area Boundaries

Stantec, with the assistance of EDI Environmental Dynamics Inc. (EDI), was retained by VIT to prepare a report that identifies and describes land tenure and associated land uses in the vicinity of the Project, consistent with the YESAB “Proponent’s Guide to Information Requirements for Executive Committee Project Proposal Submissions”. Much of the information that follows has been excerpted from the “Land Tenure and Land Use Report” prepared by EDI in July 2010 and attached as Appendix 3.

The Land Tenure and Land Use Report contains additional information not included here in Section 3, but that has been used to support other sections and components of the Project Proposal. In addition, several updates with respect to claims ownership and activity are noted below, which have been identified since the time the original Land Tenure and Land Use Report information was compiled.

Multiple study areas have been delineated for the Project Proposal and the supporting socio-economic and environmental baseline studies and effects assessments. For the purposes of summarizing land tenures and land use relevant to the Project, a Local Study Area (LSA) and Regional Study Area (RSA) were defined in the Land Use and Land Tenure Report.

Local Study Area (LSA)

The LSA with respect to land tenures and land use identifies specific land uses and land parcels that may be directly affected by the Project. The LSA encompasses specific surface and sub-surface tenures, including quartz and placer claims, Settlement Land, adjacent developments, and outfitting and trapline concessions (Figures 3.1-2, 3.1-3, 3.1-4, 3.1-5). The LSA includes a 500-m buffer on both sides of the access road (SMR and HCR) and the Dublin Gulch watershed.

Regional Study Area (RSA)

The RSA for the purposes of land tenure and use information provides the regional context within which proposed Project activities can be considered. It encompasses broader land uses such as recreational sport fishing and hunting areas, FNNND Settlement Lands, trapline and outfitting concessions, Game Management Areas, water licenses and historical, existing or proposed developments. The boundaries of the RSA used for land use and land tenure enclose an area within a 50 km radius of the Project Site (Figure 3.1-4).

3.3 Land Tenure and Land Uses

Land tenure in the RSA and LSA is composed of Yukon Government crown land, FNNND Settlement Lands, various mining claims and leases, and trapline and outfitting concessions. Other identified land uses include fishing, outdoor recreation and wilderness tourism activities.

3.3.1 Access Road and Highway Use

The Project Property is located approximately 85 km northeast of Mayo via existing roads. Access to the Project site is from the Silver Trail (Highway 11) onto the existing South McQuesten Road (SMR) and Haggart Creek Road (HCR). Together, the SMR and HCR comprise a 45 km road divided by the South McQuesten River (SMR = km 0 to 22.9 between the Silver Trail and the South McQuesten River and HCR = km 23 to 45 between the river and the Project site). Both are public roads, regulated under the Yukon *Highways Act;* however, the SMR is only maintained during summer by the Yukon Government Department of Highways and Public Works (HPW), whereas the HCR is considered a “public unmaintained” road. Currently, snow is not cleared from the SMR or HCR in winter and maintenance of this portion of the road has been conducted on an as needed basis by

VIT or placer operators in the area. Figure 3.1-2 depicts the existing alignment of the SMR and HCR. Further information on the SMR and the HCR is included in Section 5 of the Project Proposal.

3.3.2 Mineral Rights

3.3.2.1 Mineral Rights and Activity in the Regional Study Area

The RSA lies within the Mayo Mining District, which has over a century of mineral exploration and extraction history, and continues to be a major mining region in Yukon. There are numerous active and inactive quartz and placer claims in the RSA, most of which are concentrated around Elsa, Keno City, and within the LSA. For reference, Table 16, Appendix 3 lists active quartz claims identified in the RSA.

3.3.2.2 Mineral Rights in the Local Study Area

Within the LSA, there are 336 active quartz claims. These are owned primarily by VIT through StrataGold Corporation (a wholly owned subsidiary of VIT), but claims are also owned by Alexco Keno Hill Mining Corp., Bob Cofer, and Elsa Reclamation and Development Company Ltd. There are also 10 quartz mining leases within the LSA, all owned by VIT. Active quartz claims and leases in the LSA are listed in Tables 3 and 4 of Appendix 3.

There are 145 active placer claims within the LSA, 56 expired (as of the time of information collected for this Project Proposal). Of those placer claims, 112 are held by VIT. Since 1978, approximately 110,000 ounces of placer gold has been recovered from this area and it has experienced significant placer workings. Placer claims are located in Haggart Creek, between Lynx Creek and Ironrust Creek, and in Dublin Gulch to the mouth of Stewart Gulch, as well as 60% of Dublin Gulch above Stewart Gulch. Other placer claims exist on Olive Gulch, Fisher Gulch, Gill Gulch, 15 Pup and Secret Creek. Table 5 of Appendix 3 provides a listing of placer claims within the LSA for further reference.

All VIT claims and leases are currently recorded in the name of StrataGold Corporation and in good standing until their respective renewal dates which range from 2011 to 2027.

3.3.3 Land Tenure

Figure 3.1-3 illustrates claim and lease ownership and property title within and adjacent to the Project boundary.

The Project is located primarily on territorial (crown) lands. VIT (via StrataGold Corporation) holds a 100% interest in all the quartz and placer claims and leases comprising the Project site with the exception of the “Olive Grant”, a land parcel with fee simple title, otherwise known as the “Olive Claim” (Yukon Certificate of Title 2005Y0022). The Olive Claim is owned in 7/8 undivided interest by StrataGold Corporation and 1/8 undivided interest by G. William Vivion. The Certificate of Title provides for the right to all minerals within the meaning of the regulations for the disposal of quartz mining claims, (except for all placer mines already located or which may be found to exist upon the parcel).

In addition, the most recent mapping of claims information in the area of the Project indicates a small overlap on the north-east side of the Project perimeter with a placer claim not owned by VIT. The overlap area is proposed to be used for soil salvage and storage. The claim is listed as Oct1, jointly owned by W.Malaky, R.Berdahl, and V.Evans, and shown with respect to the Project boundary on Figure 3.1-3. This placer claim and overlap is being followed up with the claim holders and Energy Mines and Resources, Yukon Government, to identify any implications for the Project, the claim holders and the area usage.

Exploration work within the quartz claims and leases owned by VIT is subject to the Mining Land Use Regulations of the *Quartz Mining Act* and is carried out under a Class III Mining Land Use Permit (LQ00090) that is valid until July 25, 2012.

In addition, VIT, through its predecessor StrataGold, has established an Exploration Cooperation Agreement with the FNNND to explore the Eagle Zone and other regional land holdings. The agreement, dated May 21, 2008, is for a three year term with an option for an additional three years.

VIT was provided an independent opinion by Davis LLP, dated April 16, 2010, which is in agreement with the above land tenure information. Additional information is noted above that has been collected or clarified since that time.

There are no known or mapped airstrips, or other land tenure dispositions in the RSA.

3.3.4 Protected Areas

There are no parks or protected areas within the RSA or LSA. The Historic Sites Unit of the Yukon Government Department of Tourism and Culture identified several sites within the RSA and LSA as heritage resources under the *Historic Resources Act*. For a detailed description and location of each historic site or heritage resource please refer to Figure 3-2 of Appendix 4 (Historical Resources Baseline Report).

3.3.5 Management Areas

There are no Special Management Areas (SMA) or Habitat Protection Areas (HPA) identified in the RSA. No Forest Management Plan has been developed in the area. VIT understands that while there is some merchantable timber in creek valleys and alongside hills, there is no great volume, and overall forest resources are considered of low value (Price 2009, pers. comm. and Therriault 2009, pers. comm).

The Yukon *Wildlife Act* Regulations divide the territory into Game Management Areas (GMA) of Zones and Subzones which each have unique license requirements, seasonal restrictions and bag limits. The Project lies within Game Management Area Zone 2, Subzone 2-62, with adjacent Subzones of 2-58 to the south, 2-59 to the west, 2-61 to the north, 2-63 to the northeast, and 4-05 to the east (Figure 3.1-4).

Moose is the main species hunted in the area (O'Donoghue 2009b, pers. comm.) and an important traditional food for the FNNND, as well as the most commonly harvested species in the Yukon

(EY 2000). The South McQuesten River Valley is an important moose harvesting area. In the past, there has been a voluntary closure on moose harvesting in the McQuesten Lake area, east of the LSA, to alleviate hunting pressure on the local population (O'Donoghue 2009b, pers. comm.). Aside from big game, waterfowl are hunted in the spring and fall on the lakes and river wetlands (Bleiler, et al. 2006).

3.3.6 Registered Trapline Concessions

There are 333 Registered Trapline Concessions (RTCs) in Yukon. RTCs provide exclusive rights to the concession holders to trap furbearers within their respective areas. The LSA overlaps with RTC 81 and 84 and 85. Adjacent concessions 39, 43, 44, 66, 71, 82 and 85 are located within the RSA Traplines are illustrated in Figure 3.1-5. The SMR and HCR access roads provide access to many of the RTCs, and snow machines are the primary mode of travel. Lynx and marten are considered the most valuable furbearer species for trapping in the area, but wolverine, wolf and beaver are also important (O'Donoghue 2009b, pers. comm.).

3.3.7 Outfitting Concessions

Yukon Outfitting Concessions provide exclusive rights to the concession holders to outfit hunting to non-residents in their respective areas. Figure 3.1-6 depicts the location of the Project and outfitting concessions within the RSA. These have been identified as Midnight Sun Outfitting Ltd. (Concession #4) (Midnight Sun Outfitting Ltd. 2009), and Rogue River Outfitters Limited (Concession #7). The RSA borders Concession #5.

Concession #4 is held by Midnight Sun Outfitting Ltd. and covers an area of approximately 31,000 km^2. This includes the watersheds of the Wind, Hart, Klondike, Little Wind, and McQuesten Rivers. Trips are conducted from late-July to early-October. In addition Midnight Sun Outfitting Ltd. offers fishing and other wilderness adventures (e.g., canoeing, rafting, heli-hiking).

Concession #7 held by Rogue River Outfitters Ltd. also covers approximately 31,000 km^2 and extends towards the Yukon/Northwest Territories border (Shockey 2009). Operations begin in late-July and end in October.

3.3.8 Fishing

Traditionally within the RSA, the FNNND community members settled in fish camps in the summer and caught salmon along the Stewart and McQuesten rivers. Chinook salmon (*Oncorhynchus tshawytscha*) is the most important regional salmonid species, but chum salmon (*O. keta*) have also been harvested. In 2008, the FNNND reported a 50% decline in Chinook salmon harvest compared to 1998 – 2007 averages (Yukon River Joint Technical Committee 2009). Due to conservation concerns, the Yukon domestic and recreational salmon fisheries were closed in 2008 and various closures occurred in 2009 as well.

There is limited specific information on adult salmon in the South McQuesten River; however, there have been accounts of observations and catch of adult Chinook above the South McQuesten River Bridge in the past (von Finster 2009, pers. comm.).

Previous studies reported the presence of Chinook salmon in Haggart Creek downstream of the proposed Project site (Madrone 1996; Hallam Knight Piésold 1995, 1996e, 1996f). Those studies also reported the presence of Chinook salmon in the South McQuesten River, which was confirmed by the sighting of juvenile Chinook (est. age 1+) during a snorkel survey at the access road crossing on July 23, 2009. During the snorkel survey, no adult spawning Chinook or Chinook reds were observed which could be attributed to the timing of the survey, or low to nil spawner returns. Chinook salmon were not captured at any of the Haggart Creek sites between the Project site and the South McQuesten River during any of the four sampling programs conducted as part of the Eagle Gold Project Baseline Fish and Fish Habitat Assessment (Appendix 5).

Arctic grayling (*Thymallus arcticus*), lake trout (*Salvelinus namaycush*) and Northern pike (*Esox lucius*) are the most widespread and popular sport fishing species in the region. Grayling fishing commonly occurs on Haggart Creek, either downstream of the confluence with Lynx Creek, or at the South McQuesten River bridge (Hallam Knight Piésold Ltd. 1996a). Pre-spawning concentrations of grayling are often fished through the ice each spring by local residents (Bleiler, et al. 2006). Proctor Lake and Haldane Creek are also used for grayling fishing (Alexco Keno Hill Mining Corp. 2009).

Northern pike fishing is popular at Halfway, McQuesten, and Hanson lakes, while lake trout fishing is limited to the larger regional lakes like Minto and Mayo. Haldane Lake, located 9 km northeast of Elsa on the McQuesten Lake Road has been stocked with rainbow trout (*Oncorhynchus mykiss*) since 1982; most recently in June 2006 (EY 2008). Hanson Lakes, just south of McQuesten Lake, were also stocked beginning in 1965, but stocking has since ceased.

Within the RSA (larger Mayo area) five domestic fishing licenses were issued for the 2009 – 2010 season (Thompson 2009, pers. comm.), which provide for subsistence fishing in winter of local area trappers. There are no domestic fishing licenses within the LSA. In addition, there are no commercial fisheries indicated in the RSA.

3.3.9 Plant Gathering

Historically, First Nations peoples regularly harvested and consumed various plants and berries as part of their subsistence lifestyle. Berries and other plants still remain an important part of the diet, with blueberries and cranberries topping the list of the most commonly consumed traditional plant foods, (Traditional Knowledge and Use Study [Stantec 2010]). There are good quality berry picking locations within the RSA, especially in the valley bottoms adjacent to Haggart Creek and the South McQuesten River (Hallam Knight Piésold Ltd. 1996a). Plants for medicinal purposes are also important to the FNNND. Much of the specific information on locations is held as traditional knowledge. Plant gathering is also pursued by non-First Nation peoples as more of a recreational activity.

3.3.10 Water Users

Water licences are issued by the Yukon Water Board, an independent administrative tribunal established under the Yukon *Waters Act*, for a variety of undertakings including placer and quartz mining, municipal use, agriculture, recreation, and hydroelectric development.

For the purposes of identifying water license holders in the area, watercourses within the LSA were reviewed. These water courses include:

- Haggart Creek
- Lynx Creek
- Platinum Gulch
- Fisher Gulch
- Ann Gulch
- Stuttle Gulch
- Dublin Gulch
- Ray Gulch
- 15 Pup
- Gil Gulch
- Ironrust Creek
- Eagle Pup
- Stewart Gulch
- Olive Gulch
- Cascallan Gulch
- Bawn Boy Gulch

Based on the above list which was reviewed in July 2010, no active Type A or B water licenses were identified. The closest water license identified at that time was for placer mining (Class 4) on Secret Creek, also known as Swede Creek, located approximately 10 km south of Dublin Gulch (Leary and Logan 2009, pers. comm.).

The environmental assessments in Section 6 of the Project Proposal with respect to water quality, water quantity and rate of flow of waters have concluded that with mitigations, there will be no significant Project related effects to waters downstream of W29 on Haggart Creek or upstream of the Project footprint at W22. As a result, water users up and downstream of those points are not predicted to be affected by the Project. For reference please see Figure 2.1-1 of the Water Management Plan (Appendix 18).

3.3.11 Outdoor Recreation

There are numerous opportunities for outdoor recreation in the RSA. There is an extensive network of rough roads and trails around Keno City and Elsa that provide easy backcountry access in all seasons. Several of these trails and routes are documented in tourism and recreation pamphlets and books. Many rivers in the area are accessible by road (i.e., McQuesten and Stewart Rivers), while other more remote rivers (i.e., Upper Stewart and Hess Rivers) require air access.

There are no campgrounds within the LSA. There is one Yukon Government campground in the RSA at Five Mile Lake, just south of Wareham Lake on the Silver Trail. Also within the RSA are the Keno City Campground in Keno City, the McIntyre Park Campground along the Mayo River and the Gordon Park Campground in the Village of Mayo.

3.4 Traditional Territory

The Traditional Territory of the FNNND covers an area of 162,456 km^2, with 131,599 km^2 in Yukon and 30,857 km^2 in Northwest Territories (FNNND 2009a). Through the FNNND Final Agreement, signed in 1993, 4,739.68 km^2 of Traditional Territory lands were allocated to settlement land, with

2,407.88 km^2 designated as Category A, and 2,332.27 km^2 as Category B (FNNND 2009b). Category A settlement lands are those lands where the FNNND has ownership of both the surface and subsurface land and resources, including any minerals; all staking, exploration, and mining activity is governed by FNNND for new mineral interests. Category B settlement lands are lands where FNNND has ownership of resources on the surface; subsurface resources, and associated new and existing staking, exploration, and mining activities are governed by the Yukon Government.

There are several FNNND settlement land parcels located within the RSA (Figure 3.1-4), and one within the LSA (Block NND R-20B). This Category B land parcel is approximately 4,367 ha, and is located southeast of Haggart Creek, north of South McQuesten River, south of Snowshoe Creek, and west of Shanghai Creek (Figure 3.1-2)

3.4.1 Yukon First Nation Rights

The YESAB *Proponent's Guide to Information Requirements for Executive Committee Project Proposal Submissions* with respect to Land Tenure information indicates that Project Proposals should identify:

> *"any other formalized First Nation rights to access land and resources…including land claims, aboriginal rights for hunting and harvesting rights, resource access rights and co-management agreements" (YESAB 2005 p.12).*

FNNND Settlement Land with respect to the Project location is described above.

The First Nation of Na-Cho Nyäk Dun Final Agreement provides for a comprehensive set of rights and obligations across a range of matters with respect to Settlement Land and the FNNND Traditional Territory. Provisions with respect to FNNND harvesting and wildlife rights within their Traditional Territory are set out in Chapter 16 (Fish and Wildlife) of the Final Agreement. Final Agreements also speak to trapping, access to land for harvesting and commercial harvesting.

First Nation Water Rights

Chapter 14 of the First Nation of Na-Cho Nyäk Dun Final Agreement sets out specific rights granted to the FNNND and Yukon Indian Persons with respect to water. Provisions under 14.8.0 of the Final Agreement provide the right to the FNNND to have water which is on or flowing through or adjacent to their Settlement Land remain substantially unaltered as to the quality, quantity and rate of flow including seasonal flow.

As noted above with respect to water users, the assessments undertaken in the Project Proposal with respect to water quality, water quantity and rate of flow of waters have concluded that with mitigations, there will be no significant Project related effects to waters downstream of Haggart Creek [W29] including waters on or adjacent to FNNND Settlement Land.

Other matters addressed in the FNNND Final Agreement include (but are not limited to) Forestry, Water, and Heritage Resources. Matters such as wildlife and heritage resources have been assessed in Section 6 of the Project Proposal to evaluate potential effects as a result of the Project.

3.5 Yukon Land Use Planning Region

3.5.1 Consistency with Regional Land-use Plan

The proposed Project is located within the Northern Tutchone Planning Region. This is a proposed Yukon Planning Region which captures the Traditional Territories of the Na-cho Nyäk Dun, Little Salmon Carmacks and Selkirk First Nations. There is currently no Regional Land Use Plan in place or under development for the Northern Tutchone Planning Region at this time.

3.6 Consistency with Other Plans

Three Plans were identified as applicable to the Project area and reviewed in development of the Project Proposal:

- 2008 – 2013 Community-based Fish and Wildlife Work Plan
- Village of Mayo Integrated Community Sustainability Plan, 2006
- Na-Cho Nyäk Dun, Integrated Community **Sustainability Plan, 2008.**

2008 – 2013 Community-Based Fish and Wildlife Work Plan

There have been four community-based wildlife management plans developed for the FNNND Traditional Territory. These plans have been collaboratively developed between the Mayo Renewable Resource Council (MDRRC), FNNND, and Environment Yukon.

The most recent of these is the 2008 – 2013 Community-Based Fish and Wildlife Work Plan. Previous plans include the 2002 – 2007 Fish and Wildlife Management Plan, the 1993 – 1996 Integrated Big Game Management Plan and the 1997 – 2000 Integrated Wildlife Management Plan.

The 2008 – 2013 Work Plan continues the approach of previous plans, by identifying and addressing community concerns about moose, caribou, bears, wolves, and fish populations along with habitat, harvest, and wildlife viewing, and providing guidance for wildlife and habitat management issues. Solutions for each concern are discussed and commitments and timelines are set by each partner.

In review of the Work Plan, VIT believes the proposed Project is consistent with the Plan objectives and strategies, and that the Project Proposal and approach supports a number of specific Work Plan elements including:

- Management of harvest of moose and maintenance of moose population health
- The need for baseline information on important habitats of fish and wildlife
- A need to advocate wildlife values in land use applications
- Support for monitoring and stewardship activities.

These elements are reflected in the Project Proposal with the baseline studies conducted in preparation of assessment information, the Valued Components (VCs) selected, and the mitigations and monitoring proposed. In particular, wildlife species selected as VCs determined in consultation with the Environment Yukon and the FNNND (including moose and grizzly) are identified as priorities in the 2008 – 2013 Work Plan, related to the elements identified above.

Other key concerns identified in the Work Plan include increased hunting pressure on wildlife populations (particularly on moose in the Mayo area), invasive plant species, and the need for water quality monitoring with respect to development activities. These issues have been identified and addressed in the Project Proposal as they relate to the Project with specific mitigation measures proposed in the relevant sections of the assessment.

Village of Mayo Integrated Community Sustainability Plan 2006

The Village of Mayo Integrated Community Sustainability Plan (the VoM ICSP) (VoM 2006a) was developed in part to meet the requirements of the Canada Yukon Gas Tax Agreement (signed in May 2005). The ICSP also includes elements of the Mayo Official Community Plan which was developed and approved by the community in 2004.

The VoM ICSP describes the vision, values and measures with respect to sustainability for the community. It includes goals and measures for employment and economic development, environment, well-being of residents, community development and infrastructure and heritage / historical resources.

In review of the VoM ICSP and based on consultations with the VoM, VIT believes that the Project Proposal is consistent with the plan’s objectives and has taken into account key objectives including:

- To provide opportunities for local entrepreneurship and employment and support for local training
- To encourage modest population growth for the community…to allow the VoM to maintain existing infrastructure and encourage future expansion of services in the community.

With respect to community population growth, VIT is proposing a self-contained camp to house employees at the Project site to avoid significant population increases and associated pressures on the community as a result of the Project.

In addition, a key measure included in the VoM ICSP is to “decrease waste entering the landfill”. The Project is currently designed to transport solid waste off-site for disposal. There have been early discussions between VIT and the VoM about the capacity of the community landfill to accept waste from the Project. In addition, VIT understands that VoM is working with Yukon Government to identify plans and options for the community landfill. VIT will continue discussions with the VoM and the Yukon Government to identify options and a waste management approach consistent with community objectives for the landfill.

The VoM ICSP along with community consultations were considered in detail as part of the socio-economic effects assessment (Section 6.11 of the Project Proposal). Details on specific effects on community infrastructure, employment, and economic opportunities are included in that section of the Project Proposal.

Na-Cho Nyäk Dun, Integrated Community Sustainability Plan, 2008

The Na-Cho Nyäk Dun Integrated Community Sustainability Plan or “Na-Cho Nyäk Dun Tan Sothan—A Good Path” (NND ICSP) was developed in 2008 (FNNND 2008d). Like the VoM ICSP described above, the NND ICSP is linked to the Canada Yukon Gas Tax Agreement and federal gas tax revenues. The NND ICSP was developed during the time that the NND Strategic Plan was being developed, and notes that it benefited from the broad NND objectives and long term goals being considered in the Strategic Plan.

The NND ICSP identifies the FNNND’s vision, value and goals with respect to sustainability. It includes goals and measures with respect to key values of the NND including conservation, environment, fish and wildlife, traditional language, heritage resources, community development and infrastructure, employment and economic opportunities, youth involvement and Good Governance.

The NND ICSP additionally identifies a number of projects aligned with FNNND sustainability objectives. Projects included are related to water and waste management including improved recycling facilities, energy efficiency and energy infrastructure, community and recreational infrastructure, and youth programs.

In review of the NND ICSP, and in consultation with the FNNND on the Project, VIT believes the Project Proposal is consistent with the NND ICSP and that the Project may support specific plan measures by providing economic and employment opportunities, support for training, and FNNND community development activities. Consultation activities (described in detail in Section 2 of the Project Proposal) with the FNNND have been done with respect to traditional and heritage uses and resources, environmental protection and fish and wildlife in development of the Project Proposal.

3.7 Figures

Please see the following pages.

Data Sources; Government of Canada, Victoria Gold Corp.

Stantec
4370 Dominion Street
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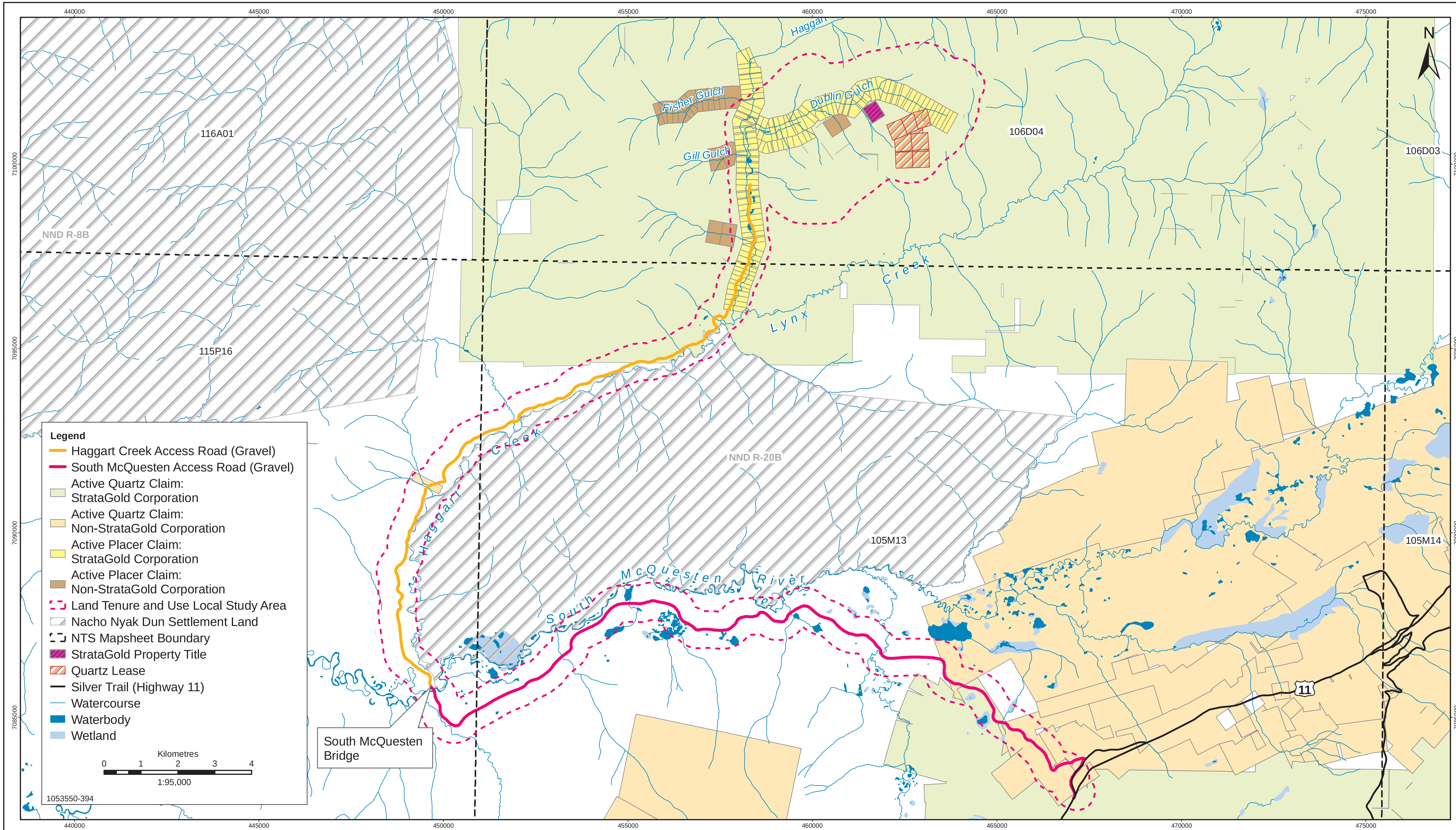
Victoria Gold Corp

GENERAL LOCATION MAP

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION: UTM - ZONE 8	DRAWN BY: LS
DATUM: NAD 83	CHECKED BY: RS
DATE: 8-November-2010	FIGURE NO. 3.1-1



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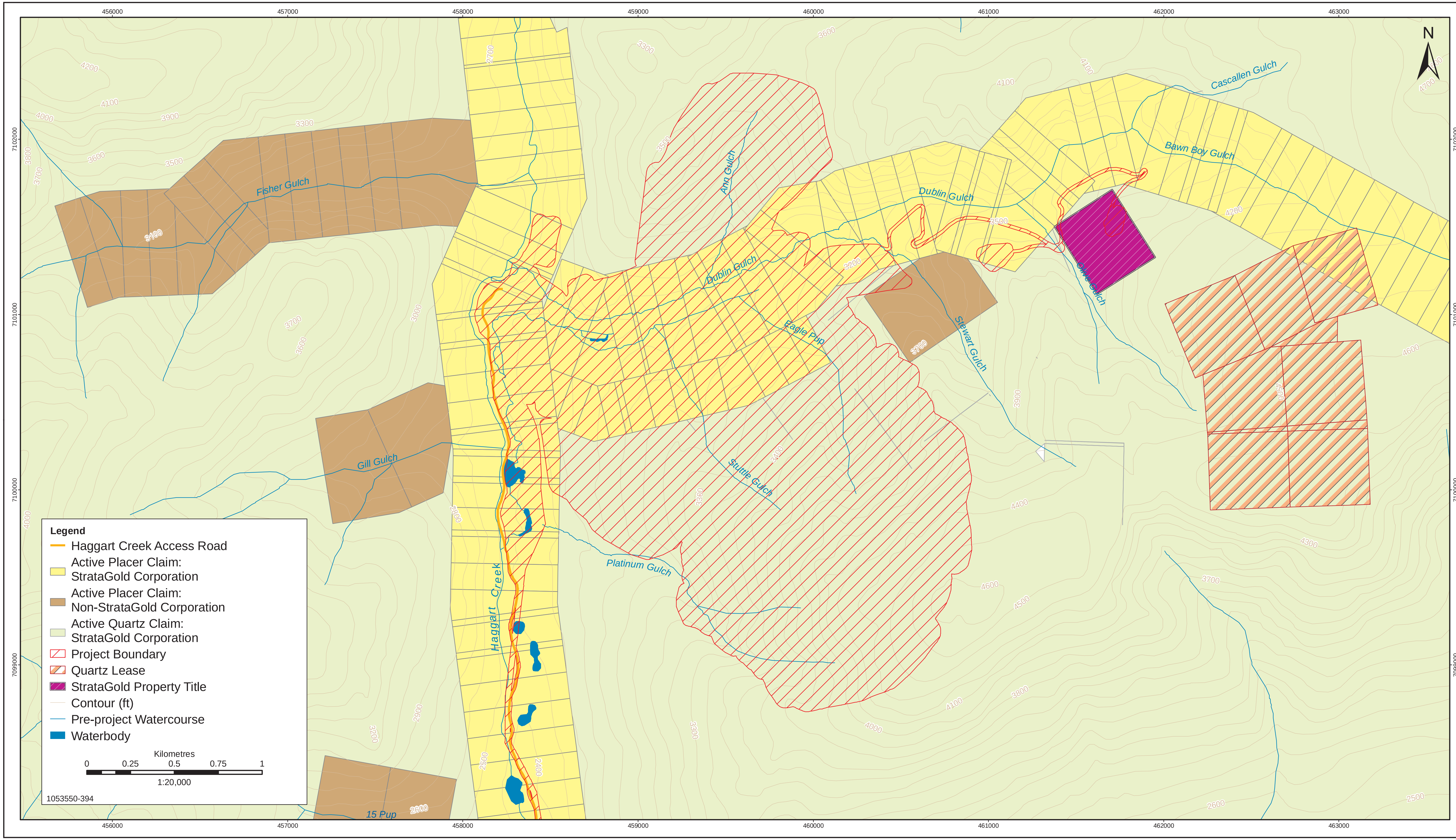
LAND USE - LOCAL STUDY AREA

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION UTM - ZONE 8	DRAWN BY LS
DATUM NAD 83	CHECKED BY RS
DATE 22-November-2010	FIGURE NO. 3.1-2



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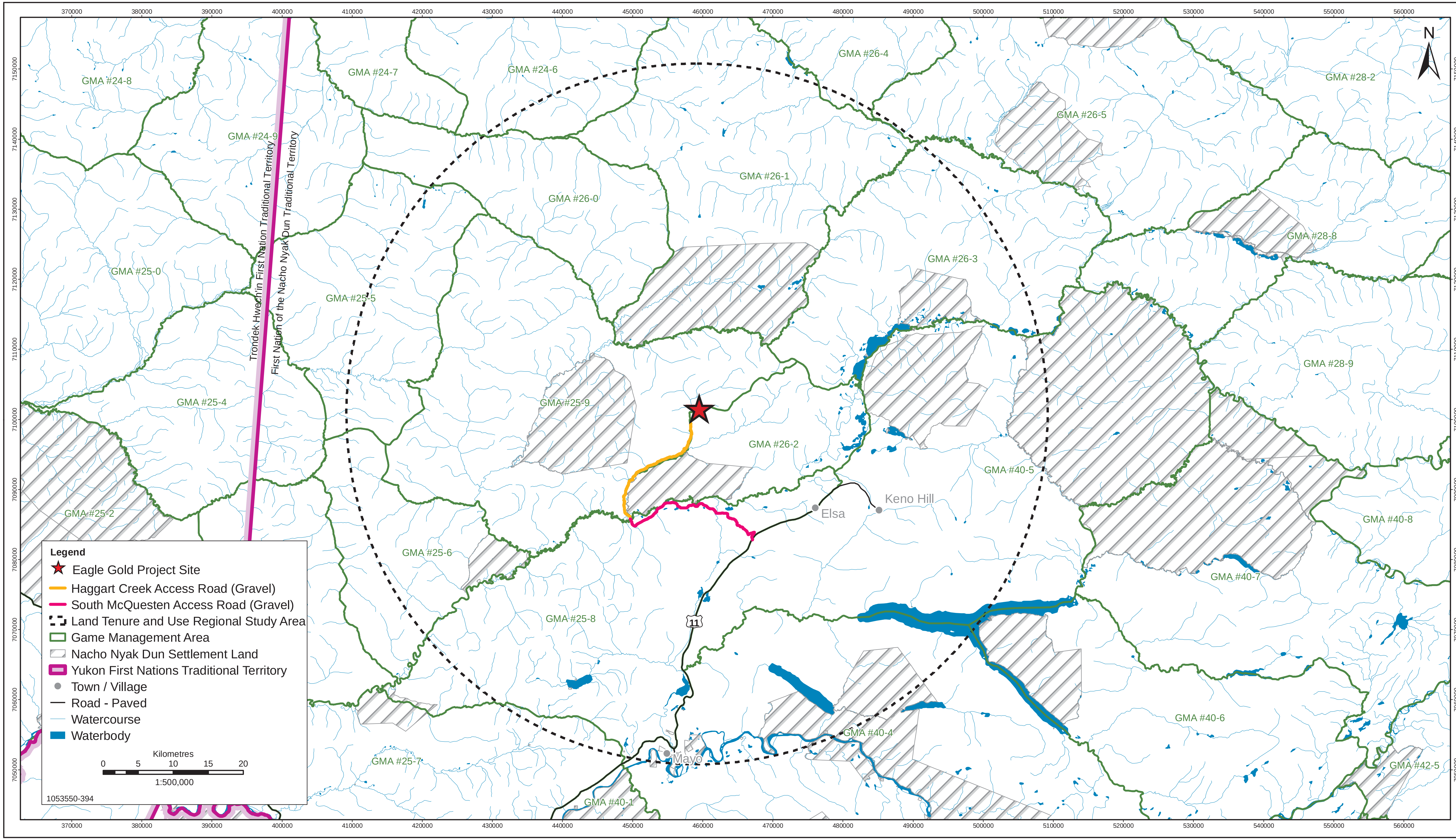
Victoria Gold Corp

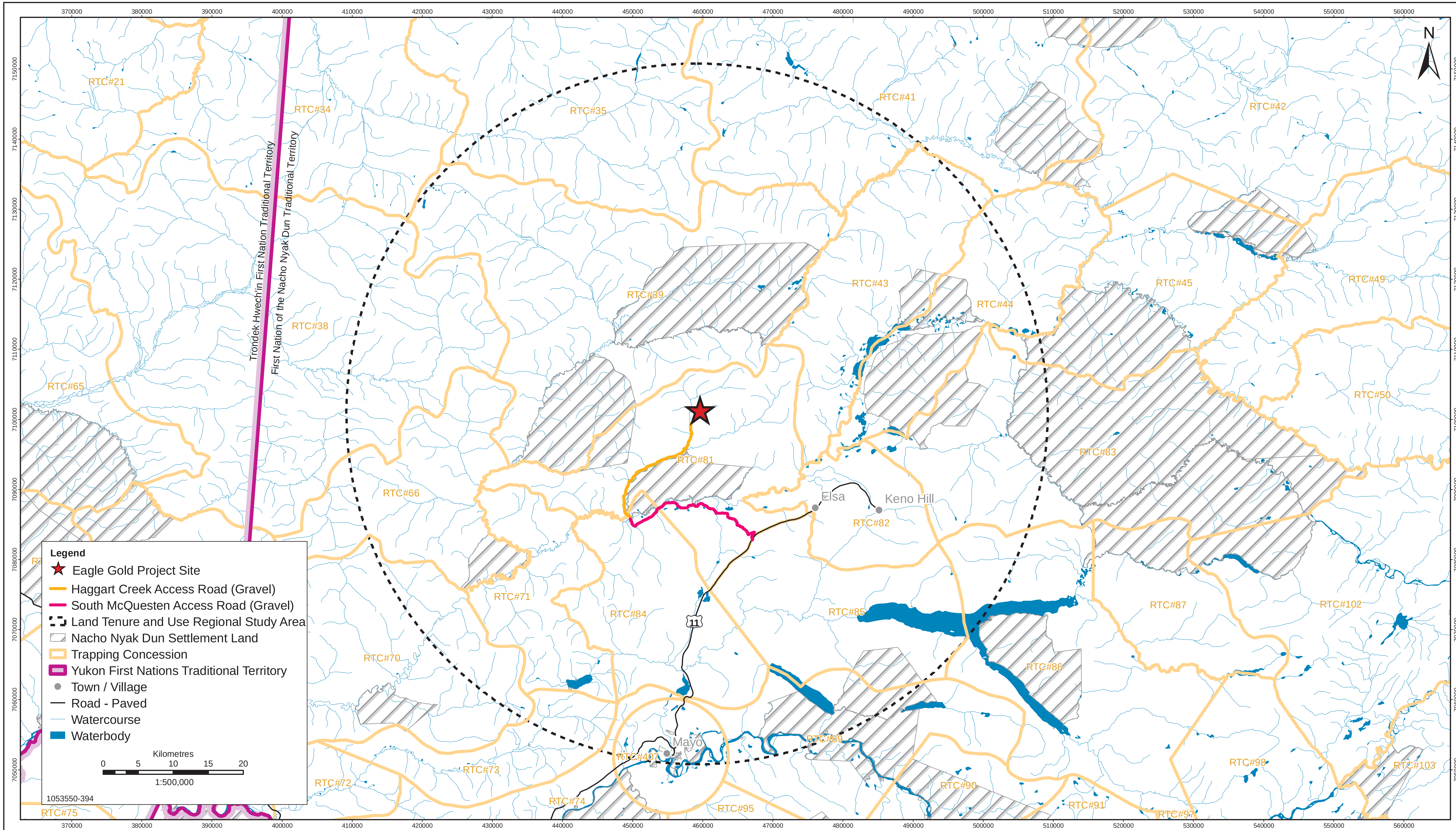
LAND TENURE WITHIN THE PROJECT PERIMETER

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION: UTM - ZONE 8	DRAWN BY: LS
DATUM: NAD 83	CHECKED BY: RS
DATE: 11-November-2010	FIGURE NO. 3.1-3



Stantec 4370 Dominion Street Burnaby, British Columbia V5G 4L7 Tel. (604) 436 3014 Fax. (604) 436 3752	Victoria Gold Corp	**PROJECT REGIONAL STUDY AREA OVERVIEW WITH GAME MANAGEMENT AREAS** EAGLE GOLD PROPERTY YUKON TERRITORY	PROJECTION: UTM - ZONE 8 DRAWN BY: LS DATUM: NAD 83 CHECKED BY: RS DATE: 11-November-2010 FIGURE NO. 3.1-4



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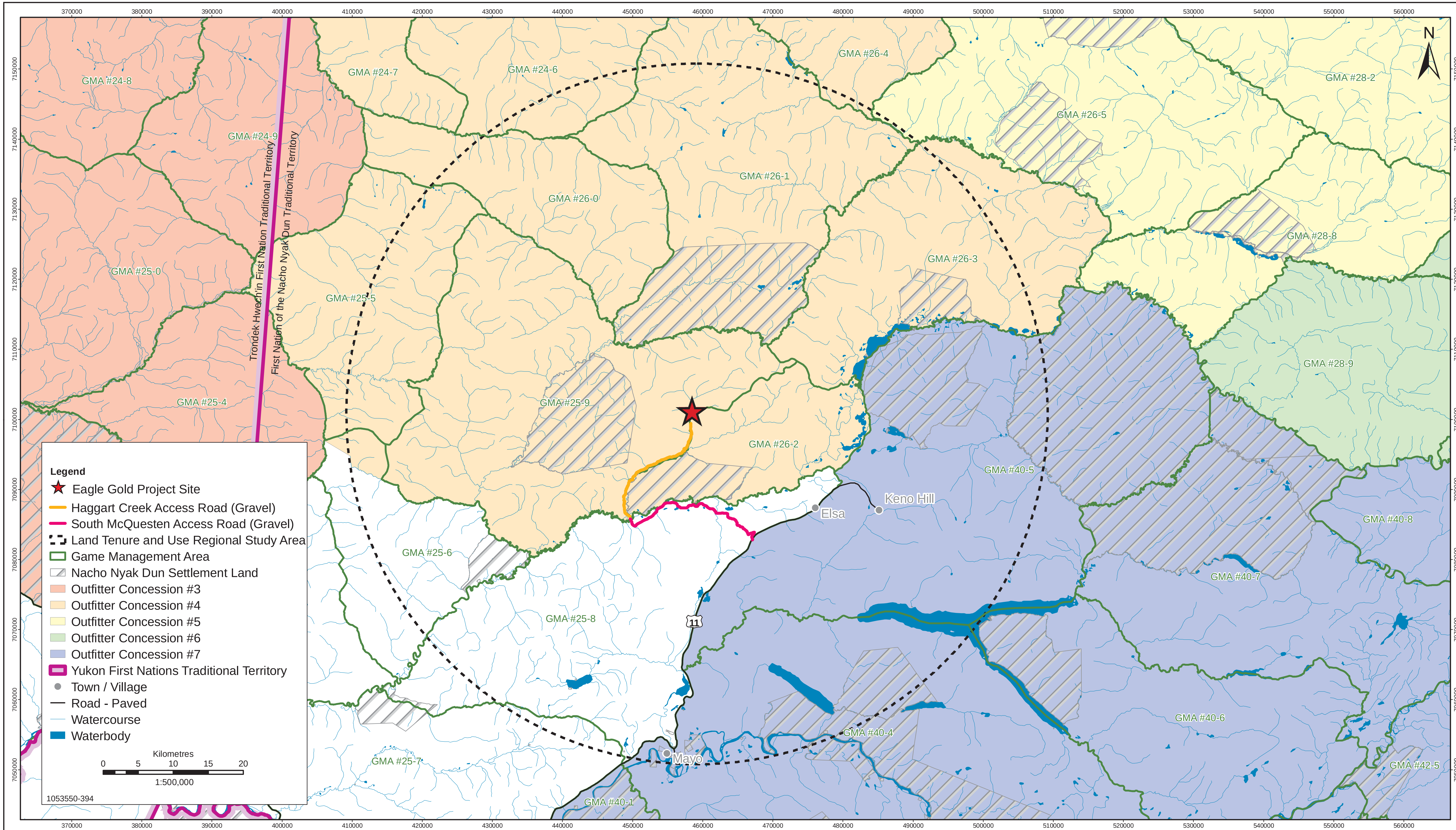
PROJECT REGIONAL STUDY AREA - TRAPPING CONCESSIONS

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION: UTM - ZONE 8	DRAWN BY: LS
DATUM: NAD 83	CHECKED BY: RS
DATE: 11-November-2010	FIGURE NO. 3.1-5



Data Sources; Government of Canada, Victoria Gold Corp.

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PROJECT REGIONAL STUDY AREA OVERVIEW WITH OUTFITTING CONCESSIONS

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION: UTM - ZONE 8	DRAWN BY: LS
DATUM: NAD 83	CHECKED BY: RS
DATE: 11-November-2010	FIGURE NO. 3.1-6

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4 DESCRIPTION OF EXISTING ENVIRONMENTAL AND SOCIO-ECONOMIC CONDITIONS

Section 4 presents summaries of existing conditions for bio-physical and socio-economic values (e.g., wildlife, water quality, employment and economic opportunities) that are of importance in considering potential environmental and socio-economic effects of the Project. Complete baseline reports for each of these values are appended to this Project Proposal. Information for the baseline reports was gathered through consultations with the FNNND, local communities, and government officials, as well as through literature reviews and field studies. Each value has a defined study area, the boundaries of which are based on the nature of the bio-physical or socio-economic value and how it may interact with potential effects as a result of the Project and potential cumulative effects of the Project with those of other projects and activities. Each value is distinct in how it might interact with the Project and potential cumulative effects. Consequently, for each value a study area is determined by the extent of potential effects for that value. The study areas for each value are defined below in the discussion of baseline conditions for each value.

4.1 Environmental Conditions

4.1.1 General Physiography

4.1.1.1 Regional Geography

The Project is situated within the Yukon Plateau North Ecoregion (Smith, et al. 2004). Nearly all terrain in this ecoregion lies 900 m above sea level (asl), with the majority between 1,200 and 1,700 m asl. The majority of the Project lies within the Dublin Gulch watershed, which flows into Haggart Creek, and eventually feeds into the McQuesten River. Elevations in the vicinity of the Project range from approximately 765 m asl near the confluence of Dublin Gulch and Haggart Creek, to about 1,525 m asl at the summit of the Potato Hills which forms the eastern boundary of the Dublin Gulch watershed. The Ecoregion is broken into tablelands by a network of deeply cut broad valleys. While some of these tablelands are remarkably level and non-dissected, with streams flowing at relatively gentle gradients in open valleys, the areas north of the McQuesten River (Project location), do not share these features. Instead the majority of Project area was un-glaciated during the last glacial dperiod (Bostock 1965), and has not been glaciated for more than 200,000 years (see the glacial limits on Figure 4.1-3 and 4.1-4). The Project area displays physiographic characteristics of the unglaciated areas of the region, with narrow, V-shaped valleys and rounded upland surfaces. The valleys are deep and narrow to the head of streams, where they rise steeply and end abruptly.

Despite the extensive time since glaciations, evidence of glacial-ice action is still visible. This historic glaciation is responsible for the formation of the tributaries of Dublin Gulch, including, from east to west, Cascallen, Bawn Boy, Olive, Ann, Stewart, Eagle, Stuttle and Platinum Gulches (Figure 4.1-3). Within these gulches the post-glacial terrain has been modified by gravity, water, and freeze-thaw mechanics, as evidenced by the many headscarps of landslides, and observed rock and debris slides. Most of the landslides are historic, but there are a few areas of ongoing rock fall that continue to modify the terrain, particularly in the Stewart, Bawn Boy, and Olive Gulches. These active areas of rock fall exist in the eastern portion of the LSA delineated for surficial geology; soils and terrain (see Section 4.1.2 and Figure 4.1-3).

4.1.1.2 Regional Vegetation and Wildlife

As discussed above, the proposed mine site is located in the Yukon Plateau-North Ecoregion. Within this ecoregion, the Project site is situated in the Boreal Cordillera Ecozone (Smith, et al. 2004; Figure 4.1-2). All of the Boreal Cordillera Ecozone in Canada occurs in Yukon and occupies approximately 12% (57,091 km^2) of the territory (Yukon Ecoregions Working Group 2004).

Vegetation within the Ecoregion varies from boreal forest to alpine ecosystems. Land in the vicinity of the Project is characterized by a combination of northern boreal forest and subalpine ridges and plateaus. The forested zone extends to approximately 1,225 m asl. The forested portion of the Ecoregion is characterized by a mix of coniferous, mixedwood, and deciduous patches at various successional stages due to forest fire. A recent fire (<10 years) occurred immediately to the south of Dublin Gulch on the south facing slope above Lynx Creek. Black spruce, white spruce, subalpine fir, Alaska birch, and trembling aspen are found on upland forested sites while balsam poplar is present on fluvial sites. Elevations above 1,225 m asl and up to about 1,400 m asl are characterized by discontinuous, open canopy subalpine-fir-dominated forest patches and by shrub-lichen dominated ecosystems. Old growth patches of forest are present within boreal and subalpine elevations of the local watersheds. Elevations above 1,500 m asl are dominated by ecosystems containing a mixture of shrubs, graminoids, herbs, bryophytes and lichens.

The Yukon Plateau-North Ecoregion provides habitat for a wide range of wildlife species that typically inhabit the central Yukon area. Species which have been documented or potentially occur in the area of the Project include mammals such as moose (*Alces alces*), woodland caribou (*Rangifer tarandus caribou)*, black bear (*Ursus americanus*), grizzly bear (*Ursus arctos*), wolverine (*Gulo gulo*), grey wolf (*Canis lupus*), red fox (*Vulpes vulpes*), American marten (*Martes americanus*), snowshoe hare (*Lepus americanus*), and red squirrel (*Tamiasciurus hudsonicus*). Moose are recognized as an important species for harvest by the FNNND. Moose were the most commonly detected wildlife species during 2009 baseline surveys and were observed in the widest range of habitat types. Game bird species include Spruce Grouse (*Canachites Canadensis*), Dusky Grouse (*Dendragapus obscures*), Ruffed Grouse (*Bonasa umbellus*), and three species of ptarmigan (*Lagopus* sp). Raptors present may include Golden Eagle (*Aquila chrysaetos*), Red-tailed Hawk (*Buteo jamaicensis*), Northern Hawk Owl (*Surnia ulula*), Great Gray Owl (*Strix nebulosa*), and Gyrfalcon (*Falco rusticolus*). A variety of passerine or songbird species are also present and include Dark-eyed Junco (*Junco hyemalis*), Gray Jay (*Perisoreus Canadensis*), Tree Swallow (*Tachycineta bicolor*), and Townsend's solitaire (*Myadestes townsendi*). Waterfowl species include Trumpeter Swan (*Cygnus buccinators*), Mallard (*Anas platyrhynchos*), and Canada Goose (*Branta Canadensis*).

4.1.2 Surficial Geology and Soils

4.1.2.1 Surficial Geology and Soil Classification

Objectives of the surficial geology mapping and soil classification programs were to characterize the Project baseline conditions; and to collect sufficient data for the assessment of potential Project effects for mitigation (reclamation) planning, and to support mine design (see Appendix 6 – Environmental Baseline Report: Surficial Geology, Terrain, and Soils). Collection of surficial geology and soils baseline data included three study areas: 1) a 1606 ha LSA that encompasses the Dublin Gulch watershed and its tributaries; 2) a 7538 ha RSA that encompasses the LSA and is defined by the heights of land to the west and east of the Dublin Gulch watershed, and by Haggart Creek to the north and Lynx Creek to the south; and 3) a road corridor study area (RCSA) that encompasses South McQuesten Road (SMR) and Haggart Creek Road (HCR). The RCSA is approximately 44.8 km long and 1 km wide (500 m either side of the road centerline), and encompasses 4579 ha. Figure 4.1-3 and Figure 4.1-4 show the Surficial Geology, Terrain, and Soils study areas.

Surficial Geology

Surficial geology mapping, soil classifications and reclamation ratings were completed at a scale of 1:10,000 for the LSA whereas a 1:20,000-scale was used for regional characterization of the RSA.

Surficial geology and terrain mapping form the basis of biophysical mapping. The bioterrain mapping employed in this study integrated surficial geology and terrain conditions (slope, landscape position, drainage, and geomorphic processes) with ecological factors (vegetation community and structure, and soil moisture and nutrient regimes), to produce stratified ecosystem units. This terrain mapping approach is based on BC terrain classification standards (Howes and Kenk 1997), and has been used in other mining projects completed in Yukon. The approach is effective in providing biophysical information for integrated resource management and land-use planning activities, and for cumulative effects management (Lipovsky and McKenna 2005).

The surficial geology of the Project study areas has been substantially affected by historic glaciation over 200,000 years ago, including two major glaciation episodes in the Quaternary period: the pre-Reid (~2.5 Ma-400 ka BP) and the Reid (~200 ka BP) (Bond 1997a; 1998a; b). Glacial limits are provided by Figure 4.1-3. In each case, ice likely originated from the Ogilvie and Wernecke mountains, with glaciation being most extensive during the pre-Reid period.

Preservation of pre-Reid glacial deposits and landforms is rare. A few intact deposits and diorite erratics at high elevation are the only records left (Bond 1998a). Sediment from the Reid glaciation is moderately preserved. Colluvium, alluvium, and small areas of shallow organics drape the Reid glacial sediments and the interglacial sediments throughout the area.

Dominant surficial materials within the LSA are weathered bedrock and colluvium. Competent bedrock outcrops are rare, as sufficient geologic time has passed to allow extensive weathering of exposed rock. In the larger RSA, the dominant material is colluvium, while along the McQuesten Road section of the RCSA, surficial materials are largely coarse-textured fluvial deposits due to the proximity of the road to the river.

Soils

For soil classification, soil map units were developed based on field data and terrain conditions reflective of dominant surficial material characteristics. A soil map unit is a, "…defined and named repetitive grouping of soil bodies occurring together in an individual and characteristic pattern over the soil landscape" (Gregorich, et al. 2001). In some instances, the soil map unit may consist of a single soil type, but more commonly consists of a dominant soil type with the inclusion of other types.

The largest influence on soil development in the area of the Project is climate, and the resulting permafrost which is present in substantial portions of the area. Despite over 200,000 years of soil development, pedogenic processes have been slow due to the cold climate and to the short growing season for vegetation, resulting in a predominance of ice-affected and relatively undeveloped soils (Cryosols and Brunisols).

Within the area of the Project, permafrost is present in the plateau and in the lower valley bottoms adjacent to Haggart Creek and Dublin Gulch. Permafrost was at times encountered within the upper 50 cm of the profile. In many instances, though, the presence of ice was not readily detected and the determination of the presence of permafrost relied heavily on evidence of cryoturbation and tilted trees; as well as on machine excavation of trenches, from which data on surficial material and bedrock depths to a 2 m depth were collected.

Non-frozen soils were also encountered in the area of the Project, including Brunisols, minor areas of Luvisols (on fine-textured till), and Gleysols (on poorly and imperfectly drained materials). 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 gravel to boulders.

4.1.2.2 Construction and Foundation Surficial Materials

A preliminary assessment on the availability of borrow materials was undertaken to support the 2010 Pre-Feasibility Study. As noted in this study, further work is required to confirm and quantify the materials and will be undertaken during a subsequent Project Feasibility Study planned for 2011.

The earthworks construction materials required for construction of the heap leach facility (HLF) can be grouped into three main sizes:

- Cobble/boulder
- Sand/gravel
- Silt/clay.

Cobble/boulder material has been selected as the primary material for construction of embankments due to its availability from previous placer mining activities on the Project site. Over 2 million cubic metres of this material will be required for the initial construction of the HLF.

Sand/gravel is required mainly for embankment drains, groundwater drains, and as part of the HLF leak detection and recovery system (LDRS). Suitable material has been identified in the lower Dublin Gulch, the majority of which will need to be excavated to form the diversion and ponds. For initial construction, approximately 200,000 m^3 of mainly coarse sand and fine gravel will be required for drainage use. Fine/medium sand material is required to protect the HLF liner, for which approximately 300,000 m^3 is required. The use of imported material may be required, however it is anticipated that a proportion of required imported material may be replaced with suitable ore material.

Clay/silt will be used where low permeability is required. A total of 250,000 m^3 is required for initial construction, the majority of which will be used in the HLF secondary lining system. A potential borrow area has been identified south of the lower Dublin Gulch, in the glacial tills.

Other activities, such as road construction and plant site area development, will result in the production of earthwork material that will be used where feasible in the initial construction, or will be stockpiled for future use.

4.1.2.3 Terrain Stability and Erosion Potential

Terrain Stability

Terrain stability was mapped and assessed for the LSA, the RSA, and RCSA (Figure 4.1-3 and 4.1-4) (and see Appendix 6). The purpose of terrain-stability mapping (TSM) in land-use and development planning is to identify areas of potential or active instability, where terrain conditions may be affected by existing and/or anticipated human activities. These areas include land on steep slopes, at slope breaks, along the base of slopes, and on colluvial and alluvial fans.

Terrain-stability classification utilizes a 5-class system, with classes based on site-specific terrain conditions (Table 4.1-1).

Table 4.1-1: Terrain Stability Classification

Terrain Stability Mapping Class	Definition
V	**Unstable terrain:** ▪ Contains existing rapid mass movement initiation zones ▪ Solifluction may occur
IV	**Potentially unstable terrain:** ▪ Contains areas where fine-textured colluvium, or weathered bedrock >70% ▪ May apply to glaciofluvial and fine-textured colluvium and weathered bedrock regions with slopes of 50 – 70%, typically rapid to well-drained. Contains areas where rubbly and/or blocky colluvial slopes >80% ▪ Contains areas where rockfall initiation is ongoing ▪ May contain areas where shallow surface landslides occur ▪ Solifluction may occur
III	**Moderately stable terrain:** ▪ Contains areas of slopes 40 – 60% with moderate to poor drainage ▪ Contains areas of slopes 20 – 40% with poor drainage and/or north-facing slopes where piping/water saturation may occur ▪ There is a potential for mass movement, though occurrences are infrequent ▪ Solifluction may occur

Terrain Stability Mapping Class	Definition
II	**Generally stable terrain:** ▪ Contains areas of slopes 40 – 60% that are well to rapidly drained ▪ Contains areas of slopes 15 – 40% that are imperfect to moderately-well drained ▪ Mass movement is unlikely to occur, with the exception of solifluction on north-facing slopes
I	**Stable terrain:** ▪ Contains areas of slopes 0 – 26% that are well to rapidly drained ▪ Contains slopes <15% that are very poor to moderately-well drained ▪ Potential for mass movement is negligible, though solifluction may occur on north-facing slopes, or slopes in the alpine
Solifluction	▪ Refers to the creep of unfrozen unconsolidated material, on moderately gentle to steep slopes

Approximately 70% of the area within the LSA and RSA represent stable and generally stable TSM classes (I and II). Over half of the area is classified as generally stable terrain (TSM class II). This class typically occurs on slopes with a gradient between 20 – 60%, depending on drainage and aspect. Stable (TSM class I) terrain is uncommon, and is found on flat-lying terrain on the Potato Hills plateau, as well as along portions of Platinum Gulch and Haggart Creek. Nearly a quarter of the LSA and RSA is mapped as moderately stable (TSM class III). These areas generally exhibit poorer drainage and are commonly found on valley walls of the many small watersheds.

Minor areas of the LSA (6%) and the RSA (9%) contain potentially unstable terrain (TSM class IV). Class IV terrain typically occurs on slopes with a gradient of 50 – 70%, although sometimes slopes in this class are steeper than 70% if draped by thin, well- to rapidly-drained material. Unstable terrain (TSM class V) is very limited in extent and covers only 3% of the LSA and 3% of the RSA. This class includes terrain on very steep slopes, as well as all rapid mass-movement initiation regions. In the LSA, this unstable terrain occurs mainly along the upper reaches of Eagle Pup, Stewart Gulch, Olive Gulch, Bawn Boy Gulch, and a lower section of Ann Gulch, with the largest unstable areas occurring within Dublin Gulch (see Appendix 6).

Almost 80% of the RCSA terrain is in the stable and generally stable classes (I and II). This terrain occurs on slopes less than 60% in the RCSA. The remainder of the RCSA is TSM class III to TSM class V. TSM class III terrain is found on the south and west side of Haggart Creek opposite Secret Creek. Isolated areas of potentially-unstable and unstable terrain occur mainly along Haggart Creek, on both sides of Secret Creek, and between Secret Creek and Lynx Creek on the north and west side of Haggart Creek Road (HCR).

Erosion Potential

Erosion potential for the Project is rated based on the risk of water (as opposed to wind) erosion. Wind erosion risk in the area is limited due to the high coarse fragment content in Project area soils, and is therefore not discussed further. Erosion by gravity is addressed in the sections on terrain stability and terrain hazards.

Erosion potential is assessed by the combined examination of a number of contributing factors including intensity and type of precipitation (rain versus snow) as well as slope gradient, length and uniformity. Erosion potential is lower in dissected terrain with short slope lengths as overland water flow velocity is reduced. For example, undulating terrain is at less risk of water erosion than uniform steep slopes. Soil physical properties such as texture, structure, coarse fragment content, depth of water-restricting layer, and subsoil permeability are also important factors. Within the Project area soils within areas of mass movement are at very high risk for erosion from both gravity and water.

The erosion potential related to climate (precipitation) is dependent on the annual balance between types of precipitation (rain versus snow), the intensity of rainfall events, and the rate at which snowmelt occurs. In the Project area, over half of the annual precipitation falls as rain, and over half of that occurs in June and into July/August, resulting in rapid stream-flow events. Total rainfall in the area ranges from 300 to 600 mm per year. This type of rainfall results in a moderate erosion-potential rating in an average precipitation year, however the rating may increase depending on weather variability (see Appendix 7 – Environmental Baseline Report: Climate; and Section 4.1.6.2 for more details on precipitation).

Slope analysis of the LSA was completed using Light Detection and Ranging (LiDAR) 10-metre contour intervals. The contour intervals were converted into slope classes, using ranges of gradient. For both the RSA and RCSA, less precision and accuracy is required, allowing for a simpler procedure in which a 20-foot contour interval from the Digital Elevation Model (DEM) was subdivided into the slope classes. Slopes greater than 60% are at very high risk for erosion, between 30 and 60% at high risk, between 9 and 15% at moderate risk, and less than 9% at low risk (Table 4.1-2).

Table 4.1-2: Slope Classes and Associated Erosion Potential

Slope Class	Slope Range (%)	Slope Description	Erosion Potential Rating for Slopes
1	0 – 2	Level	Low
2	>2 – 5	Nearly Level Slopes	Low
3	>5 – 9	Very Gentle Slopes	Low
4	>9 – 15	Gentle Slopes	Moderate
5	>15 – 30	Moderate Slopes	Moderate
6	>30 – 45	Strong Slopes	High
7	>45 – 60	Very Strong Slopes	High
8	>60 – 85	Extreme slopes	Very high
9	>85	Steep Slopes	Very high

Within the LSA, 70% of the slopes are between 15 and 30%. Gentle slopes that are less than 15% generally occur in the Potato Hills area. Very strong slopes and extreme slopes are at a higher risk of mass movement and water erosion—these slopes comprise 11% of the LSA, and are associated with side-walls within the upper reaches of Dublin Gulch, Bawn Boy Gulch, and Eagle Pup (Figure 4.1-3).

Approximately 66% of the RSA is comprised of moderate to strong slopes. The very-gentle to gentle slopes are primarily confined to the creek bottoms and are concentrated in the southern portion of the RSA.

In the RCSA slopes are mostly level to gentle, with 45% of the area at 0 – 2% slope where the road follows along the South McQuesten River. Extreme slopes (>60 to 85%) are also common in just under half of the RCSA, and mostly occur on the northern end and western side of HCR. These extreme slope areas are rated as having very high erosion potential.

Erosion potential is also affected by surficial-material, coarse-fragment content, and fine-fraction texture. Higher coarse-fragment contents result in lower erosion potential risk (Table 4.1-3).

Table 4.1-3: Erosion Potential by Coarse-Fragment Content

Percent Coarse-Fragment Content	Risk of Potential Erosion
<16%	Very high
16 – 30%	High
31 – 60%	Moderate
>60%	Low

Soil textures in the LSA are primarily sand and silt dominant loams which provide moderate to high risk of soil detachability (e.g., single sand grains or weakly held together soil particles detach more easily than bonded clay particles). However, these soil textures are at low risk for erosion due to moderate to high permeability, which reduces potential for overland flow. Restricting layers also influence erosion potential ratings, with shallow depths to a water-restricting layer such as bedrock increasing erosion potential. Areas at high risk are colluvial veneers over bedrock, which are found in the LSA, the RSA, and along the north side of the RCSA.

Compaction risk was not assessed for baseline conditions, as affected soils will be salvaged and either or both replaced and de-compacted during site decommissioning and closure. Therefore, under best management practices, compaction risk will be limited.

4.1.2.4 Considerations for Reclamation

A primary consideration for reclamation planning is the ability to salvage and stockpile adequate volume of soil and surficial materials to meet post-closure land-use and ecological objectives. In addition, the quality of soil and surficial materials has been determined by analysis of the properties of in-situ materials prior to project development. Volumes available for salvage are determined by the area of Project facility footprints and material requirements for other purposes (e.g., HLF preparation). Because the proposed Project is an open pit mine, volumes of potentially suitable non-soil material (overburden) will be stripped during mining, and available for reclamation. The purpose of the soil reclamation suitability mapping and collection of information on overburden properties is to identify all materials suitable for reclamation that supports the Soil Materials and Handling Plan.

Reclamation value of soils in the LSA is limited primarily by high coarse-fragment contents, and the proportion of large coarse fragments (boulders and cobbles). These limitations pose logistical challenges for salvage and replacement, and also suggest that the differences between in-situ soil materials and mine waste materials may be minimal, thus potentially reducing or eliminating the need for soil replacement during closure for some mine features.

Based on results of soil field and laboratory testing, soil chemical properties measured for the Project (pH, salinity, sodicity, and calcium carbonate) do not limit reclamation suitability. Soil pH (in water, and calcium chloride) was found to be within normal forest-soil range (tending toward neutral). Salinity tests on soils did not show limitations to vegetation growth. Field testing for carbonates in soil showed absent to weak reaction in the surface soil, although trench excavation observations suggest the presence of carbonates in tills below permafrost layers.

Elemental analyses of soil (<1 m) and overburden (greater than 1 m depth and shallower than 5 m depth) samples showed baseline exceedances of arsenic (As), and some samples showed some exceedances in cadmium (Cd), copper (Cu), lead (Pb), molybdenum (Mo), nickel (Ni), and selenium (Se) above recommended Canadian Council of Ministers of the Environment (CCME)(1999a) and Yukon Contaminated Sites Regulation (CSR) (2002) guidelines for Agriculture and Parkland soils, reflecting natural mineralization of these materials.

Nearly all soil and overburden samples collected as part of the baseline study exceeded guidelines of As. When compared to the receptor-specific Yukon CSR guidelines, the natural As concentration of the soil and overburden in the Project area is above a value considered to pose a risk to livestock, soil invertebrates, plants, and humans. More than half of the soil samples collected are above the 50 mg/kg guideline recommended to prevent toxicity to soil invertebrates and plants, and all but one are above the limit recommended to prevent illness in livestock ingesting soil while grazing. The elevated pre-disturbance soil arsenic levels are important to document, so that post-closure soils analyses do not erroneously attribute elevated arsenic levels to the effects of Project development, and provide an indication of which soils may be sensitive to soil metal loading from Project activities.

4.1.3 Bedrock Geology

4.1.3.1 Regional Geology

The Dublin Gulch property is underlain by Proterozoic to Lower Cambrian-age Hyland Group metasediments and the Cretaceous intrusive Dublin Gulch granodioritic stock. The stock has been dated at approximately 93 million years, and is therefore a member of the Tombstone Plutonic Suite. The Hyland Group is comprised of interbedded quartzites and phyllitic metasedimentary rocks. The quartzites are variably gritty, micaceous, and massive. Phyllitic metasediments are composed of muscovite-sericite and chlorite. Limestone units are a relatively minor constituent of this stratigraphic sequence and are not significant in the contact zone around the Eagle deposit. The metasedimentary rocks dip at various angles, although all generally dip to the North. Hyland Group rocks take on a more easterly and steeper dipping orientation north of an as yet undefined structure, probably a fault, which runs along the course of Dublin Gulch. Some vein associated mineralisation is found in the Hyland Group but again not in significant amounts in the area local to the Eagle Zone.

The Dublin Gulch stock is comprised of four phases, the most significant of which is granodiorite. Quartz diorite, quartz monzonite, leucogranite and aplite comprise younger intrusive phases that occur predominantly as dikes and sills and cut both the granodiorite and surrounding country rocks. The stock has intruded the Hyland Group metasediments near their contact with the underlying Upper Schist.

Mineralisation in the Eagle Zone consists of sheeted quartz vein systems of differing densities which host gold. Additional to this, disseminated, lower grade gold is found throughout the intrusive body and is associated with arsenopyrite mineralisation, with minor pyrite/pyrrhotite. A model for the mineralisation style was published by Craig Hart in 1999 which describes a 'Reduced Intrusion-Related Gold System (RIRGS) which also applies to the Fort Knox deposit in Alaska.

4.1.3.2 Deposit Geology

Geologically the deposit can be simplified and described as an intrusive suite, predominantly granodiorite in composition, emplaced within a metasediment package, predominantly phyllitic in nature. The granodiorite has been subdivided into three units, an oxidized unit, an altered unit and an unaltered unit. Alteration tends to be dominated by albite, potassium feldspar, sericite, carbonate and chlorite and only occurs very locally around veining. While mineralization is associated with the intrusive stock, it is not spatially limited to the intrusive. Gold-bearing veins are found in all of the main geological units including the metasediments.

Gold occurs primarily as pure gold and in association with very small amounts of metallic bismuth (Bi) and arsenopyrite (FeAsS). Other vein minerals include pyrite/marcasite (FeS_2) > pyrrhotite ($Fe_{1-x}S$) >> sphalerite ([Zn,Fe]S), chalcopyrite($CuFeS_2$), galena (PbS), molybdenite (MoS_2) and iron oxides/hydroxides as well as metallic bismuth, Pb-Sb-(Cu,Zn) sulphosalts (e.g., bournonite ($PbCuSbS_3$) and boulangerite ($Pb_5Sb_4S_{11}$) and tetrahedrite ($Cu_{12}Sb_4S_{13}$).

4.1.3.3 Future Reserves and Exploration Potential

The Eagle Zone represents less than 5% of the total area of the Dublin Gulch claim block, and so there is potential for other significant mineralisation in the same area. Several other intrusions are known including those at Rex-Peso, Skate Creek (Nugget), Lynx and East Potato Hills. Of these, Rex-Peso was a small scale producing silver mine up to the 1980s, although exact amounts of silver mined are unknown.

Lynx was explored in the past and most recently was drilled in 2007 by StrataGold Corp. No significant mineralization was found and the area has since declined in favourability.

Skate Creek (also known as Nugget) was visited in 2010 using a helicopter to access the remote location. The area was found to be a large Monzonite intrusion that sits within the Keno Hill Quartzites. Work was limited to a few surface samples and mapping, although there are some interesting geological comparisons to be made to the Alexco mine sites which are situated within

10 km to the south of Skate Creek. It is likely that this area will be a future focus for exploration although little is really known at this time of its full mineralogical and economic potentials.

Perhaps the most significant potential for future reserves and an obvious focus for exploration is the area to the north-east of the Eagle Zone, around the areas of Olive and Shamrock, discovered first as a geochemical anomaly and then followed up with a 30-hole drill program in 2010. Due to the polymetallic nature of the mineralisation in this area, it was differentiated from the 'standard' Eagle-style deposit and deemed the Potato Hills Trend (PHT).

The PHT is a new model that explains the presence of mineralised rocks both within and outside of the granodiorite body. The main focus of this is the Olive and Shamrock Zones, approximately 3 km north-east of the Eagle Zones. It has been noted here that the mineralisation is seen in a band in the Shamrock area, and then steps off into the country rock around the Olive and Catto targets.

The PHT appears to have formed during an extensional event around 87 Ma. The Dublin Gulch Stock had been emplaced at this time and was in a process of cooling, which had formed a mineral carapace in the contact zone with the country rock. The strain through the crustal extension produced shear forces that fractured this carapace thus allowing hydrothermal fluids to pass through and mineralise both the broken granodiorite and the surrounding country rocks. These fluids are thought to be later that those that formed the Au-rich sheeted veins seen in Eagle Zone, and as they were also cooler they carried deep-seated, polymetallic fluids up through the system, resulting in the high-sulphide content gold and silver rich veins.

Within the Trend itself, Shamrock is most similar to Eagle, representing a sheeted vein complex; Olive and Popeye the fractured granodiorite carapace and then in the area of Catto we see fluids passing into the country rock and mineralising the surrounding environment. It is likely the denudation of Shamrock and parts of Olive contributed gold stocks to the Dublin Gulch Placer deposits, rather than the Eagle Zone which has been the traditionally held source.

The PHT does also extend under Eagle Pup where the proposed Eagle Pup waste rock storage area is to be situated. As part of the 2010 drill program, several condemnation holes were drilled here and although mineralization with the right geochemical fingerprint were found, the grades were not significant and will not impact planning.

4.1.4 Acid Rock Drainage/Metal Leaching Potential

A geochemical characterization program to predict and quantify the acid rock drainage and metal leaching (ARD/ML) potential associated with the Project was completed by SRK Consulting (Canada) Inc. (SRK) as provided in detail in Appendix 8 – Eagle Gold Project Geochemical Characterization and Water Quality Predictions Report.

The work program included a review of assay data from the exploration drilling programs, static and kinetic testing on drill core, and data interpretation. Two main phases of investigation were utilized: studies completed in 1995/96 by Lawrence (1997) and the program initiated by SRK, starting in 2007 through to present. The sample set included material representative of the main rock units as described in Section 4.1.3.1 above; specifically metasediments, and the oxidized, unaltered and altered granodiorite units. The testing program is summarized in Table 4.1-1 below according to material type. Details pertaining to the methodologies used are provided in Appendix 8.

Table 4.1-1: Summary of Testing Program by Material Type

Sample Type	Estimated Tonnage (Million Tonnes)		Number of Samples Tested by Method				
	Waste	Ore	Acid Base Accounting	Whole Rock Analysis	Metals by ICP-MS	XRD/ Petrography	Kinetic Testing
Metasediment	34	30	101	62	77	3	4
Oxidized Granodiorite	9.0	11	57	47	35	2	3
Unaltered Granodiorite	23	18	66	56	51	2	3
Altered Granodiorite	1.0	6.9	69	50	54	3	7[a]
Metallurgical Composite (ore)			1	0	1	1	2[b]

NOTES:

[a] seven tests were conducted, including three individual samples, and one sample that was tested in quadruplicate with a duplicate standard humidity cell as well as two modified procedures.

[b] a standard humidity cell test was completed on the head sample, and a large scale modified kinetic test was completed on the on the same sample following metallurgical testing and detoxification procedures.

The results of the characterization program indicated that low pH seepage, or acid rock drainage (ARD), is not anticipated to occur at the Project. In the samples tested, the amount of carbonate minerals, predominantly calcite, were generally well in excess of sulphides. Calcite content was generally 1 to 4% (from XRD) whereas sulphur was most often less than 0.5% (from Leco S and ICP-S in the exploration drillcore database). Acid base accounting (ABA) results indicated a strong propensity towards non acid generating conditions with the vast majority of material tested (82% of samples) having a neutralization potential to acid potential ratio (NP/AP) above 4, the guideline for which material is typically considered to have no potential for acid generation (Price 1997). ABA results for each of the major rock types are shown in Figure 4.1-1 below. Statistical summaries provided in Appendix 8 show that there are no major differences in the ARD potential of the different rock types.

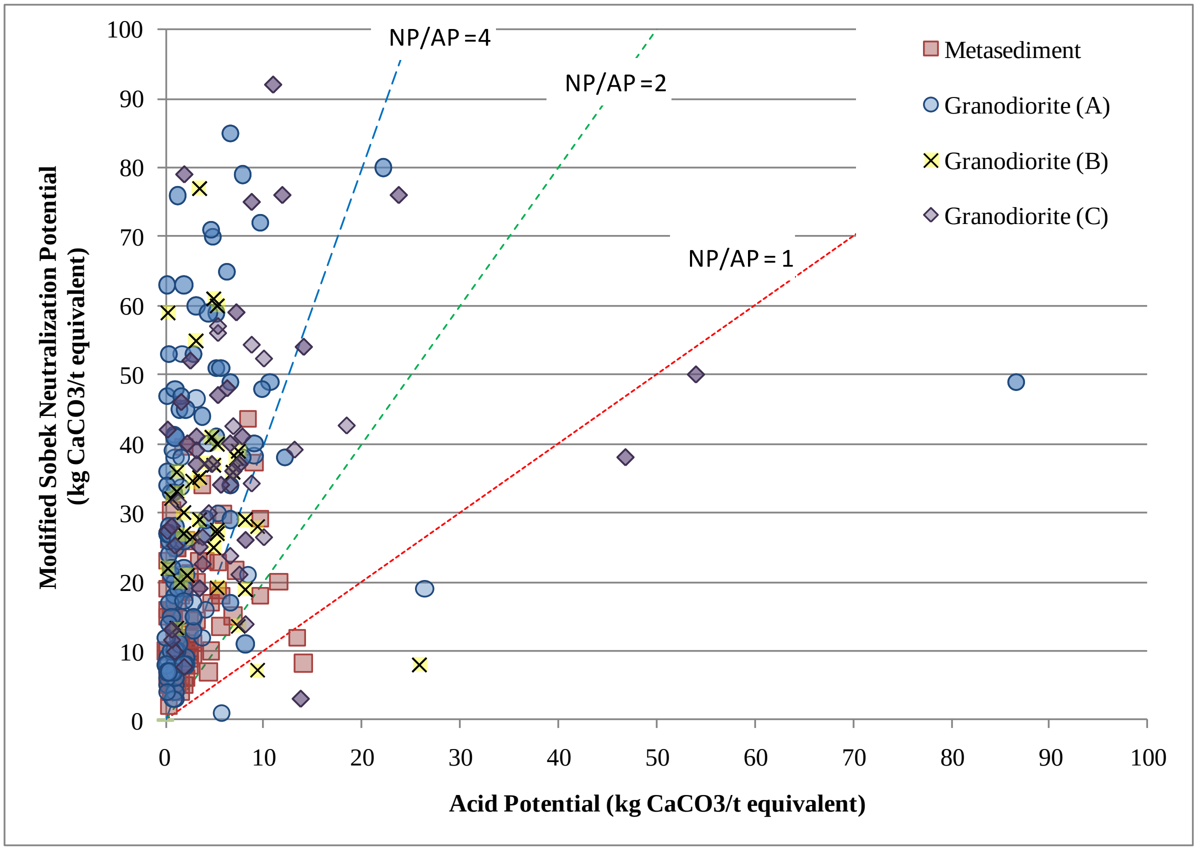

Figure 4.1-1: Acid Potential versus Modified Sobek Neutralization Potential

Solids characterization indicated consistently elevated arsenic, antimony, bismuth and gold associated with the Project rock types, and in some materials also boron (only in granodiorites) and tungsten (in metasediments and unaltered granodiorites). Other elements that were inconsistently elevated included cadmium, manganese, molybdenum, sulphur and zinc. This suite of parameters largely reflects the sulphur mineral suite present; namely arsenopyrite (As), metallic bismuth (Bi), sulphosalts and tetrahedrite (Sb +/- Pb, Cu and Zn), sphalerite (Zn, Cd), and molybdenite (Mo). Selenium and uranium may be present as substitution ions in these minerals or as unique minerals not previously described. In general, the mean values of these primary constituents of concern are similar between the material types; however the maximum values are often higher in the granodiorite, particularly where alteration is noted.

The potential for these constituents, and others, to leach as a result of weathering of the various rock types was assessed in the kinetic testing program detailed in Appendix 8. In all cases, calculations of depletion times indicated that NP would outlast sulphur supporting the classification of non acid generating potential for these materials. Humidity cell leachate quality from the standard cells typically reflected buffered pH values (7 to 8), generally low to moderately low concentrations of sulphate (typically <50 mg/L), and variable concentrations of parameters of interest for the Project, e.g., steady state arsenic and antimony concentrations ranged from 0.002 mg/L to 0.129 mg/L and 0.001 mg/L and 0.130 mg/L respectively. In some of the standard humidity cells, concentrations of fluoride (up to 0.158 mg/L) and uranium (up to 0.019 mg/L) were also considered marginally elevated (see Appendix 8).

Modified kinetic tests conducted on one sample and involving slightly larger apparatus and variable infiltration rates, produced leachate that typically had higher concentrations, though similar release rates (in mg/kg/wk) of the major constituents and many of the trace metals of interest (e.g., sulphate, calcium, magnesium, manganese, antimony etc.). This was not reflected in the data for arsenic however, in which case the concentrations were similar despite the test size or infiltration rate used, perhaps indicating a solubility control for As.

Estimates of metal leaching potential for the heap leach ore material relied in part on another modified kinetic test conducted by Kappes Cassidy and Associates (KCA) in a metallurgical column. The column first underwent cyanidation and detoxification testwork (discussed in Appendix 8) following which it was modified to approximate a large scale humidity cell to assess post-detoxification water quality. A split of the composite ore tested in the column, prior to cyanidation, was also included in the standard humidity cell program.

The key differences between these two tests were scale, water addition rates, and the effects of cyanidation. Both the column and the humidity cell reported buffered pH and in general higher concentrations were reported in the column leachate by approximately an order of magnitude (more for arsenic) than was measured in the humidity cell. Average concentrations of sulphate were of 50 mg/L and 580 mg/L for the cell and column respectively, arsenic concentrations averaged 0.02 and 1.05 mg/L, antimony was 0.05 to 0.8 mg/L, selenium varied from 0.002 to 0.04 mg/L, uranium from 0.01 to 0.14 mg/L and fluoride averaged 0.1 and 1.2 mg/L in the cell and column respectively. When release rates from both tests were calculated, variations were less. Most parameters showed similar release rates between the cell and the column. In general parameters associated to the release of metals by sulphide oxidation were slightly higher from the column, notably sulphate, arsenic, cadmium, iron and zinc; whereas those that are associated with the dissolution of carbonates tended to be slightly higher in the humidity cell, such as calcium and magnesium.

Data from the kinetic testing program were used to develop water quality predictions for each of the potential source areas on the site, i.e., the waste rock storage areas, open pit walls, and heap leach facility. Details on the prediction methods are described in Appendix 8. A brief summary and results of the predictions are provided in Section 6.5.1.11 of this Project Proposal. The predictions for the waste rock and pit-runoff quality were largely based on the release rates resulting from the kinetic testing program. Scale-up calculations were conducted using average steady state release rates for the main material types obtained from humidity cells, and included a series of assumptions to account for differences between the laboratory conditions and anticipated field conditions. Geochemical speciation software was utilized to assess solubility limits that may influence seepage chemistry and an extensive analog dataset for similar deposits was included in the assessment.

Waste rock and open pit wall run-off water quality was predicted largely based on the release rates resulting from the kinetic testing program described in Appendix 8. In brief, scale-up calculations were conducted using average steady state release rates for the main material types obtained from humidity cells, and included a series of assumptions to account for differences between the laboratory conditions and anticipated field conditions. Geochemical speciation software was utilized to assess solubility limits that may influence seepage chemistry and an extensive analog dataset for similar deposits was included in the assessment. Details on the prediction methods are provided in Appendix 8.

The results of the predictions indicate that contact water associated with the waste rock and open pit walls would be near neutral with respect to pH but with somewhat elevated concentrations of sulphate, arsenic, cadmium, manganese, antimony, selenium and uranium, and possibly fluoride, copper, iron, mercury, molybdenum, thallium and zinc.

Estimates of water quality from the HLF also incorporated the results of another modified kinetic test conducted on a composite ore sample in a metallurgical column following cyanidation and detoxification testwork conducted by KCA. Water quality associated with the heap leach facility during operations and detoxification/rinsing of the heap were approximated using the results of the metallurgical testwork. Based on that work (see Appendix C of Appendix 8), it would be expected that cyanide and soluble metal cyanide complexes would be at concentrations that would be unacceptable for direct discharge to the environment, and any excess water would likely require active water treatment. Following detoxification and rinsing of the facility, elevated levels of nitrogen species, sodium and residual cyanide complexes (cadmium, copper, nickel, silver, zinc, etc.) would be expected, but would likely decrease relatively quickly with replacement of pore volumes from the facility. Active water treatment would also be anticipated during this period. Concentrations of other trace elements that would be leached from the rock over time such as arsenic, antimony, selenium etc. would be expected to diminish more gradually, i.e., for several decades, with a gradual improvement occurring as the more reactive minerals are depleted from the rock. Over the long term in closure, the HLF drainage would be expected to be similar to that predicted for waste rock.

4.1.5 Terrain Hazards

Terrain hazards located in the Project area were identified based on terrain mapping completed in 2010, and include both historic and currently active hazards (see Appendix 6 – Environmental Baseline Report: Surficial Geology, Terrain, and Soils). The study areas for terrain hazards are identical to those used for the surficial geology and soils baseline study (Figures 4.1-3 and 4.1-4). The objectives of the terrain hazard assessment is to support Project engineering design so that natural geoprocesses are not accelerated or exacerbated beyond the natural conditions, and to reduce risks to Project infrastructure.

Terrain hazards for the study areas include slow mass movements (surficial slump, slide, soil creep and tension cracks), rapid mass movements (debris flows, rock falls and slides), bedrock slumps, seepage, inundation (flooding), gullies, watercourses, and permafrost (including nivation and solifluction).

The dominant terrain hazard (see Figure 4.3-7 in Appendix 6) in the LSA is a consequence of accelerated permafrost thawing. Permafrost is primarily concentrated in three locations: south of the confluence of Dublin Gulch and Haggart Creek, the plateau at the east end of the LSA, and a small area at the headwaters of Ann Gulch.

Isolated portions of the LSA are affected by seepage (see Figure 4.3-7 in Appendix 6). Seepage occurs mostly along Haggart Creek and the lower reaches of Stuttle and Platinum Gulches. Rapid mass movements are most common in the Eagle Pup basin where rock falls, rock slides, gully erosion, landslides, as well as solifluction at the higher elevations, and permafrost and seepage in the lower reaches occurs.

Gullies are at risk for small failures, primarily due to intense rain events resulting in high stream flow in ephemeral watercourses. Within the LSA, gullies exist in Eagle Pup, Cascallen Gulch, Stewart Gulch, Ann Gulch, and Platinum Gulch (see Figure 4.3-7 in Appendix 6). Eagle Pup contains the highest concentration of gullies in the LSA. In the RSA, gullies are found primarily in Gil Gulch, and north of Gil Gulch adjacent to Haggart Creek.

In the RSA, the dominant regional geomorphic process is also permafrost, including solifluction and nivation; comprising half the geomorphic processes in the area (see Figure 4.3-8 in Appendix 6). The RSA also has seepage, which is often associated with mid- and lower slopes, mostly feeding into Lynx Creek. Active, rapid mass movements also occur in the RSA (see Figure 4.3-7 in Appendix 6). These rapid mass movements occur as debris flows mostly in the Lynx Valley, but are also found as landslides and rockslides. Few areas in the RSA are subject to flooding. These areas of inundation occur along stream beds, are limited in extent, and are most commonly found along stretches of Lynx and Haggart Creek.

In the RCSA, the dominant geomorphic process is inundation, which correlates with the potential flooding of the Haggart Creek and South McQuesten River floodplains. Inundation becomes a terrain hazard when development occurs within the floodplain.

Areas in the RCSA experience active mass movements. Rapid mass movements are concentrated to the north and northwest side of HCR between Lynx Creek and Secret Creek, and are absent from the southern portion of the RCSA. There are small, isolated areas of active slow mass movements that are removed from the HCR alignment, as well as areas affected by seepage, found in the southern portions of the SMR, and areas adjacent to creeks and the South McQuesten River.

4.1.6 Climate

The Dublin Gulch area is characterized by a “continental” type climate with moderate annual precipitation and a large temperature range. Summers are short and can be hot, while winters are long and cold with moderate snowfall. Rainstorm events can occur frequently during the summer and may contribute between 30 to 40% of the annual precipitation. Higher elevations are snow-free by mid-June. Frost action may occur at any time during the summer or fall. The climate baseline report (Appendix 7 – Environmental Baseline Report: Climate) describes local and regional climate conditions and provides details of the study area, methods of analysis, and data sets for temperature, rainfall, wind direction, wind speed, relative humidity, and solar radiation.

Regional climatic data are available from several stations in the area which provide a long-term database (Figure 4.1-5). Historical climatic information of the Project site was available from 1993 – 1996. Climate data collection was renewed in August 2007 at the Potato Hills climate station site (1,420 m asl), a historic data collection site, and a second climate station (Camp station) was installed in August 2009 at the old climate station site near the existing camp (823 m asl) (Figure 4.1-6). Details regarding data collected by the climate stations are provided in Appendix 7.

Climatic baseline conditions are an important component for the air quality baseline (Section 4.1.7). Understanding both the existing climate and air quality helps establish the link between cause (emissions) and effect (resultant changes in air quality), and allows for an assessment of potential effects of the Project-related emissions on the existing environment. Baseline climate data supports analysis of many parameters, whereas the air quality data subset focuses on the wind regimes, temperatures, precipitation patterns, and the low-level atmospheric temperature structures. The wind regimes determine the amount and general direction of air contaminant dispersion, and how far and where the air-contaminants may deposit and accumulate. Temperatures and precipitation patterns determine the amount of natural dust-emissions suppression and air-contaminant scavenging. Low level atmospheric temperature profiles in concert with near surface winds determine the amount of vertical mixing.

4.1.6.1 Temperature

The mean annual temperature for 2008 was -4.2°C at the Potato Hills climate station. The mean July 2008 temperature was 10.4°C and the mean January 2008 temperature was -18.5°C. The maximum recorded temperature on site (Camp station) was 26.9°C in July and the minimum recorded temperature was -36.5°C in January. The recorded temperature range at the site is 63.4°C.

The terrain elevation for the Potato Hills station is approximately 600 m higher than the Camp monitoring station, an appreciable difference. During the period in which Potato Hills and Camp stations collected data simultaneously, Potato Hills reported colder temperatures than the Camp station for most of the time (see Figure 4-1 in Appendix 7), as is expected at higher elevation. However, autumn and winter temperature inversions do occur at the site, as expected in mountainous regions. Temperature inversions are important considerations for the Project site that is located in valley since air pollutants do not disperse as readily, and provide the possibility for greater pollution episodes and shorter length depositions.

Annually, spring thaws begin in April when daily maximum temperatures exceed 0°C, although daily mean temperatures may not rise above freezing until May. Annual maximums occur in July and daily mean temperatures begin to recede during late August and September. However, daily minimums may drop below freezing at night during August. Daily freezing conditions begin in October and annual minimums occur in January.

Long-term temperature data from Mayo demonstrate there has not been any long-term warming or cooling trend in the region over the last 80 years (see Figure 5-1 in Appendix 7). Over the period of record, the mean annual temperature at Mayo has fluctuated approximately 4°C. Over this period, there has been larger variability in annual minimum temperatures, while annual maximum temperatures have stayed relatively constant.

4.1.6.2 Precipitation

Long-term estimates of precipitation relied on analyses of regional climate data from stations in Mayo, Dawson, Klondike, Elsa, and Keno Hill. Details of this analysis are provided in Section 5.2 of Appendix 7. Comparison of Project site data to Mayo data demonstrated that the Potato Hills station received approximately 1.3 times more monthly precipitation. This reflects the orographic effect common to mountainous regions and is evident in the Project site precipitation estimates. The estimated mean annual precipitation at the Project site ranges from 389 mm to 528 mm based on the elevation range at the Project site. Rainfall, snowfall, and surface lying moisture and snow are natural dust suppressants. As such, the area is not prone to prolonged dusty periods.

Based on the regional and local data, monthly precipitation totals are highest in July and lowest in February. Snowfall begins in late September or October, and continues until May.

4.1.6.3 Snow Depth

Based on regression analysis of regional snowfall data, the estimated mean annual snowfall accumulation is 269 cm at Potato Hills and 190 cm at the Camp station. The largest accumulations occur during the period of November through January. Higher elevations have greater snowpacks. Snow depths are usually deepest in early April with snow persisting into May or June. Lower elevation snow depths are greatest in March with the snow gone by the start of May.

4.1.6.4 Wind Direction

The dominant wind direction (data during 2007 – 2009) at the Potato Hills station was west-northwest, and the mean wind speed for 2008 was 2.9 m/s. The dominant wind direction at the Camp station (data from August 2009 – October 2009) was from the north and mean wind speed was approximately 1.3 m/s. Winds less than 2 m/s are frequent, suggesting a high incidence of stagnant days.

The difference in dominant wind direction and mean wind speed between the stations reflects the local physiography of the Project site. The Camp station is relatively protected in the Haggart Creek valley, and winds appear to be funnelled down the valley axis, while the Potato Hills station is open to the prevailing winds.

Annually, the mean monthly wind speeds were greatest in the late winter and early spring, and lowest during the late summer and early fall months.

4.1.7 Air Quality

Air contaminants considered in the baseline study are divided into two categories: Criteria Air Contaminants (CACs) and greenhouse gases (GHGs).CACs include fine particulate matter ($PM_{2.5}$), sulphur dioxide (SO_2), nitrogen dioxide (NO_2) and carbon monoxide (CO). $PM_{2.5}$ is defined as particulate matter with a diameter of less than 2.5 microns. GHGs consist of carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). The latter two compounds are usually presented as CO_2 equivalent. A full discussion of the above CACs and GHGs is provided in Appendix 9 – Eagle Gold Project Technical Data Report: Air Quality. The prevailing scientific theory links increases in atmospheric concentrations of GHGs to alterations in the earth's climate. Current research has established a relationship between GHG increases and increases in temperature, moisture, and the occurrence of severe weather events such as drought, flood, and storms.

Little is known of the existing air quality regime in the Project area. The closest air-quality monitoring station is the Environment Canada (EC) National Air Pollution Surveillance Network (NAPS) station in Whitehorse, Yukon. Since Whitehorse has many more anthropogenic emission sources than the Project area, it is assumed to be non-representative of the Project area. There are no other industrial activities in the Project assessment area so any existing air contaminants will have natural sources or be the result of long distance importation[3]. Due to the remote location, gaseous air-contaminants should be minimal. Any baseline air-contaminants are likely to be $PM_{2.5}$ as only fine particulate matter will survive long range transport.

Data to establish baseline concentrations of fine particulate matter $PM_{2.5}$ has not been collected for the Project. However, based on data collected for mining projects throughout Canada and that the Project is located in a remote area, it is expected that the baseline $PM_{2.5}$ concentrations during summer months are at maximum, within a range of 2 to 3 µg/m^3.

Given the discussion above, the baseline Project-site air quality with respect to CACs and GHGs is considered pristine.

4.1.8 Noise Levels

Data to establish baseline sound levels have not been collected in or around the Project area. However, because the Project is located in a remote wilderness area, noise levels are assumed to be quiet and dominated by sounds of nature (e.g., wind, rustling of vegetation, chirping birds etc.). Based on the remote location of the Project, ambient night-time conditions (i.e., the existing acoustic environment) are expected to be similar to average night-time ambient sound levels for other remote rural areas. In the absence of an average night-time ambient sound level value for the Yukon, this assessment used Alberta's Energy Resources Conservation Board (ERCB) – Directive 038, night-time average rural ambient sound level of 35 dBA Leq(9) [4] (ERCB 2007). The ERCB (2007) recognizes that daytime ambient conditions are commonly 10 dB higher than night-time levels. As such, this assessment used an average daytime ambient sound level of 45 dBA Leq(15)[5]. The Eagle Gold Project Noise Assessment Report (Appendix 10) provides details of scoping and evaluation of potential Project effects.

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[3] Jenson, Environmental Programs Branch, Yukon, 2009, pers. comm.

[4] The A-weighted Leq (equivalent continuous sound level) is the average sound level (in decibels [dB]) over a specified period of time. The A-scale (presented as dBA) gives proportional weighting according to the sensitivity of the normal human ear at different frequencies of sound. The time period (in hours) is presented in brackets following the Leq. Thus, 35 dBA Leq(9) is the A-weighted 9-hour equivalent continuous sound level in decibels.

[5] The human ear begins to perceive a change in sound level when the sound level changes by 3 dB. Each 10 dB increase in sound is perceived as a doubling of loudness (Alton Everest 2001).

4.1.9 Vegetation

A vegetation baseline study is presented in Appendix 11 – Environmental Baseline Report: Vegetation. The information below summarizes this report. Vegetation baseline study areas are the same as those used for the Surficial Geology, Soils, and Terrain baseline study which consist of a LSA, a RSA, and a RCSA (Figure 4.1-3 and 4.1-4). For the purposes of the vegetation assessment presented in Section 6.9, the RSA and RCSA have been combined to form the Regional Assessment Area (RAA), while the Local Assessment Area (LAA) includes the baseline LSA and a buffered area adjacent to the proposed transmission line and access road.

4.1.9.1 Land Cover (Ecosystem Mapping)

Terrestrial ecosystem mapping was completed for an area of approximately 7,538 ha surrounding the proposed Project. This includes 1:10,000 scale mapping of the 1,606 ha LSA covering the area where mine disturbances are expected (excluding the required road upgrades) and the 7,538 ha RSA (Figure 4.1-3). The 1:20,000 RSA mapping is used to provide regional context to the vegetation assessment. Ecosystem mapping (1:20,000) was also prepared for the one kilometre wide RCSA along the 44.8 km long access road (4,580 ha) (Figure 4.1-4). A Project specific ecosystem classification system, based on field data collected in 2009 and literature review, was developed for the study areas. A completed description of the TEM methodology is provided in Appendix 11. The area occupied by each of the vegetated and non-vegetated ecosystem units summarized by ecological zone (i.e., Forested and Subalpine) for the study areas is provided in Table 4.1-4. A total of 21 vegetated ecosystem units and nine non-vegetated units were mapped. A description of the site characteristics and dominant species for these ecosystems is provided in the baseline report (Appendix 11).

Two ecological zones were delineated in the baseline study areas: the Subalpine zone and the Forested (Boreal) zone. The majority of Project activities occur in the Forested zone. The Subalpine zone, which covers 1,502 ha in the RSA, occurs on the ridge tops and high plateaus above approximately 1,225 m asl. Tree cover is discontinuous or absent at this elevation, and the vegetation is dominated by dwarf birch, willows, ericaceous shrubs, herbs, mosses, and lichens. The highest points within the three study areas is 1,520 m asl. These upper elevations are dominated by dwarf-shrub, heath and lichen communities.

The Forested zone (11,450 ha), which is part of the northern boreal forest (Boreal Cordillera Ecoregion), includes the valley bottoms, and the slopes of the mountains below the treeline. The elevation range of this zone in the three study areas is 600 m asl up to the Subalpine zone, about 1,225 m asl. Open canopy stands of black spruce are generally present on moist sites and on the lower portions of north facing slopes. However, coniferous dominated forests consisting of white and black spruce are found along creeks and rivers and on well drained sites. Ericaceous shrubs and feather mosses are most common in the understory of the coniferous forests. On the upper slopes, open subalpine fir stands are predominant with trees becoming smaller and more spread out with increasing elevation; the cover of willows, dwarf birch and ericaceous shrubs increase as the canopy opens. Mixed forests, consisting of white spruce, trembling aspen, and Alaska birch are also present on warm aspects or near-mesic sites that have been disturbed by forest fire. Small deciduous stands dominated by aspen (warm aspects) and Alaska birch are also occasionally present in the study areas.

Table 4.1-4: Summary of Mapped Ecosystem Units within the Project Study Areas

Ecological Zone	Map Code	Eagle Gold Ecosystem Name	LSA (ha)	RSA (ha)	RCSA (ha)	Totals (ha)
Forested	AK	Aspen – Kinnikinnick	13.7	63	47.7	124.4
Forested	AW	Alaska birch-White spruce-Willow	30.3	383.3	280.1	693.7
Forested	BL	Dwarf birch-Lichen	10.4	31.6	0.1	42.1
Forested	BS	Black spruce-Sphagnum	–	163.1	319.6	482.7
Forested	CL	Cliff	–	0.3	–	0.3
Forested	ES	Exposed Soil	2.7	0.3	–	3.0
Forested	FC	Subalpine fir-Cladina	353.6	1,363.7	59.7	1,777.0
Forested	FF	Subalpine fir-Feathermoss	95.9	729.8	41.5	867.2
Forested	FM	Subalpine Fir-Labrador tea	93.9	1,012.7	116.8	1,223.4
Forested	FP	Subalpine fir–Dwarf birch-Crowberry	61.6	128.7	0.4	190.7
Forested	GB	Gravel Bar	0.1	0.1	16.1	16.3
Forested	MA	Marsh	–	0.5	19.5	20.0
Forested	OW	Open Water	–	–	66.2	66.2
Forested	PD	Pond	–	–	1.9	1.9
Forested	PH	Balsam poplar-Horsetail	–	–	16.0	16.0
Forested	PM	Placer Mine	5.1	14.6	18.0	37.7
Forested	RI	River	0.1	30.2	75.4	105.7
Forested	RO	Rock Outcrop	3.1	23.2	0.4	26.7
Forested	SA	Dwarf birch-Northern rough fescue	35.3	93.4	–	128.7
Forested	SC	Black spruce-Cladina	–	18.0	401.5	419.5
Forested	SF	White spruce-Feathermoss	4.6	–	374.9	379.5
Forested	SH	White spruce-Horsetail	25.0	139.4	423.8	588.2
Forested	SL	Black spruce-Labrador Tea-Feathermoss	166.7	852.7	1,989.8	3,009.2
Forested	TA	Talus	4.4	5.6	–	10.0
Forested	WG	Willow-Groundsel	28.1	70.1	11.3	109.5
Forested	WH	Willow-Horsetail	10.5		35.8	46.3
Forested	WM	Willow-Mountain sagewort	–	67.3	–	67.3
Forested	WS herb stage	Willow-Sedge	0.4	8.3	15.1	23.8
Forested	WS shrub stage	Willow-Sedge	–	–	38.3	38.3

Ecological Zone	Map Code	Eagle Gold Ecosystem Name	LSA (ha)	RSA (ha)	RCSA (ha)	Totals (ha)
Subalpine	BL	Dwarf birch-Lichen	60.8	151.2	–	212.0
Subalpine	ES	Exposed Soil	0.1	0.4	–	0.5
Subalpine	FP	Subalpine fir–Dwarf birch-Crowberry	56.4	232.4	–	288.8
Subalpine	MM	Mountain heather meadow	4.0	33.8	–	37.8
Subalpine	MW	Mountain avens – Dwarf willow	7.3	32.6	–	39.9
Subalpine	RO	Rock Outcrop	–	11.1	–	11.1
Subalpine	SA	Dwarf birch-Northern rough fescue	249.2	176.7	–	425.9
Subalpine	TA	Talus	3.5	26.1	–	29.6
Subalpine	WG	Willow-Groundsel	11.8	–	–	11.8
Subalpine	WM	Willow-Mountain sagewort	25.9	0.3	–	26.2
Subtotals			**1,364.7**	**5,853.7**	**4.370.1**	**11,588.5**
Disturbances			241.3	78.4	210.5	530.2
Totals			**1,606.0**	**5,932.1**	**4,580.5**	**12,118.6**

4.1.9.2 Forest Productivity and Timber Volume

Forest productivity is measured by site index and was estimated for the forested portions of the LSA and RSA. Site index is based on the height and age of dominant trees making up the forest stand or site unit (i.e., ecosystem unit) (Natural Resources Canada 2009). In British Columbia, site index is a classification of dominant species given height potential (in metres) at a given reference age (typically 50 years). A site index estimate was prepared for each of the forested site units mapped in the LSA and RSA, and summarized into classes for interpretation. The site index classes are:

- Nil: – 0 (generally the non-forested ecosystems)
- Very Low: <5
- Low: 5 – 10
- Medium: 11 – 14
- High: 15+.

The site index number reflects the anticipated (or potential) tree height for the leading species at 50 years of age.

The estimated forest productivity of the LSA and RSA are present in Table 4.1-5. Moderate and low productivity forested sites are most common classes in the LSA and RSA. High productivity sites occupied only a small portion (2%) of both study areas. Non-forested ecosystems (i.e., nil productivity for commercial tree species) occupy about 36% and 30% of the LSA and RSA, respectively.

Table 4.1-5: Estimated Hectares by Site Index Class

Site Index Class	RSA		LSA	
	(ha)	(%)	(ha)	(%)
High (15+)	168	2%	27	2%
Moderate (11 – 14)	2,504	35%	463	34%
Low (5 – 10)	2,371	33%	378	28%
Very low (<5)	0	0%	0	0%
Nil (0)	2,175	30%	494	36%
Total[1]	**7,218**	**100%**	**1,362**	**100%**

NOTE:
[1] Area totals exclude the existing disturbances; RSA total includes the area within the LSA.

Timber volume of the forested ecosystem units were approximated based on mensurational and ecological data collected during 2009 field surveys and from literature for similar forest types. This information was combined with the ecosystem mapping database to approximate gross volume per hectare estimates within the mapping areas. The gross timber volumes were classified for interpretative purposes into volumes classes.

- Nil = 0-10 m^3/ha (includes the non-forested ecosystems)
- Very low = 11 – 74 m^3/ha
- Low = 75 – 174 m^3/ha
- Moderate = 175 – 289 m^3/ha
- High ≥290+ m^3/ha.

The approximations of gross timber volume by volume class for the LSA and RSA are presented in Table 4.1-6. The low volume class occupies 50 and 51% of the LSA and RSA, respectively. The nil class also occupies a substantial portion of both study areas—30% for the RSA and 36% for the LSA. This class is composed of non-forested ecosystems, including the subalpine area. The high volume class only occupies about 2% of each study area.

Table 4.1-6: Estimated Hectares by Timber Volume Class

Volume Class	RSA		LSA	
	(ha)	(%)	(ha)	(%)
High	155	2%	27	2%
Moderate	915	13%	122	9%
Low	3,671	51%	684	50%
Very low	303	4%	35	3%
Nil	2,175	30%	494	36%
Total[1]	**7,218**	**100%**	**1,362**	**100%**

NOTE:
[1] Area totals may vary from actual sums due to rounding.

Gross estimates of timber volumes, based on dominant trees species, canopy density (i.e., sparse, open, and dense) and stand age were estimated for each of the ecosystem units mapped within the LSA and RSA. A summary of gross timber volume estimates for the study areas is provided in Table 4.1-7. Average timber volume per hectare is approximately seven times greater in the RSA (138 m^3/ha) than in the LSA (18 m^3/ha). Per hectare volume estimates are lower in the LSA due to the greater proportion of this area being occupied by subalpine zone (non-forested units) and by a greater proportion of existing disturbances than found in the RSA as a whole. Total gross timber volume in the LSA is estimated at 28,699 m^3 over 1,112 ha.

Table 4.1-7: Summary of Estimated Timber Volume by Study Area

Study Area	Total Timber Volume (m^3)	Total Non-forested Area (ha)	Forested Area (ha)	Total Area (ha)	Average Volume/ha (m^3/ha)	Volume for Forested Areas (m^3/ha)
LSA	28,699	494	1,112	1,606	18	26
RSA	817,280	2,175	3,757	5,932	138	218
Totals	**845,979**	**2,669**	**4869**	**7,538**	**Avg: 112**	**Avg: 174**

A detailed discussion of the methods used to calculate site productivity and timber volumes as well as the study results is included in the baseline report (Appendix 11).

Metals in Vegetation

To characterize baseline levels of trace metal concentrations in vegetation, samples were collected and analyzed for a full suite of metals at nine locations in and around the LSA during the ecological mapping field survey. Samples consisting of leafy branches or stems and/or leaves were collected from willows species and graminoids at each site. All samples were analyzed using inductively coupled plasma mass spectrometry (ICP-MS) at CANTEST in Richmond, BC. Mercury concentrations were determined using Cold Vapour Atomic Absorption Spectrophotometry or Cold Vapour Atomic Fluorescence Spectrophotometry. A full summary of the analysis data is presented in Appendix 11.

Results of the analysis were compared to dietary tolerances of cattle based on thresholds outlined in Puls (1994). Tolerances of cattle were used since the dietary tolerance of wild ungulates is generally not known. All elements were below toxic levels for dietary intake by cattle for all sites and species sampled based on dietary guidelines. Barium concentration was high, but not toxic/excessive, in grasses at one site and willows at another. Phosphorus and potassium concentrations were deficient for all sites and all plant species.

4.1.9.3 Plant Communities and Assemblages

The area occupied by ecosystem units was summarized by various land cover types (or patches) for the study areas (Table 4.1-8). Coniferous dominated forest is the most common land cover type found in the LSA (45%), RSA (67%) and RCSA (65%). Dwarf birch dominated ecosystems are the next most common land cover type in the LSA and RSA. They occupy about 29 and 14% of these areas, respectively. These ecosystems dominate the ridge top and plateau found in the Subalpine zone. Disturbances, associated with exploration and previous mining activities cover about 15% of the LSA compared to about 1% of the RSA overall and 5% of the RCSA. Riparian areas (7%) and deciduous forest (3%) are the next most common land cover types in the LSA. Riparian areas are associated with Haggart Creek, Dublin Gulch and ephemeral streams found throughout the LSA. Wetlands are uncommon in the both the local and regional study areas, however they are the second most abundant cover type in the RCSA. Non-vegetated units such as rock, talus and exposed soil and dwarf shrub land-cover types each occupy less than one percent of the LSA. The dwarf shrub ecosystem types are found in the Subalpine ecozone.

Table 4.1-8: Ecosystem Category Summaries

Ecosystem Category	Map Codes	LSA		RSA		RCSA	
		(ha)	(%)	(ha)	(%)	(ha)	(%)
Conifer forest	FC, FF, FM, SC, SF, SL	714.8	45	3,976.9	67	2,984.2	65
Dwarf birch dominated	BL, FP, SA	473.8	29	813.8	14	0.5	<1
Riparian areas*	GB, PH, RI, SH, WG, WM	120.6	7	399.2	7	664.4	15
Deciduous forest	AK, AW, PH	44.0	3	446.3	8	343.8	8
Wetlands	BS, MA, OW, PD, WH, WS	10.8	<1	161.5	3	495.5	11
Rivers	RI	0.1	<1	30.2	<1	75.4	2
Rock/talus/exposed soil	CL, ES, RO, TA	13.8	<1	67.0	1	0.4	<1
Dwarf shrub	MM, MW	11.3	<1	66.4	1	0	0
Mining areas	PM	5.1	<1	14.6	<1	18.0	<1
Disturbances	Na	241.3	15	78.4	1	210.5	5

NOTE:

Only riparian ecosystems are listed in the table, although other ecosystems and non-vegetated units are present within the riparian corridors.

Old forest patches occupy about 14% of the LSA. These consist of ecosystems dominated by white or black spruce at lower elevations and ecosystems dominated by subalpine at higher elevations.

Rare plant surveys were conducted in 2009 and 2010 within the local study area and along specific sections of the road in 2010. One rare plant species, island purslane (*Koenigia islandica* L.), was identified at a single location in the LSA. A relatively small patch of this plant, covering about 2 m x 2 m was found in Bawn Boy Gulch.

4.1.9.4 Wetlands

Wetlands are uncommon in the LSA. These shrub and herb dominated wetlands cover about 10.8 ha (<1%) of the area.

Wetlands are more common in the RSA (3%). These wetlands are associated with the Lynx and Haggart Creek valley bottoms. The nearest major wetland complex identified by Smith, et al. (2004) is located at McQuesten Lake, approximately 25 to 30 km to the east-northeast of the Project.

Wetlands are most common in the RCSA (11%) largely due to the fact the access road is located in valley bottoms.

4.1.10 Wildlife

4.1.10.1 Abundance and Distribution of Habitat Types

The following section describes wildlife in the context of two study areas – an LSA, and an RSA. The area of the wildlife LSA is approximately 12,000 ha, and encompasses 500 m adjacent to each side of the access road, the proposed development footprint of the mine site, and the area adjacent to the mine (Figure 4.1-7). The RSA is approximately 90,000 ha (Figure 4.1-7). Centered over the LSA, the RSA was selected to encompass the range of a male grizzly bear and 2 female grizzly bears under suitable habitat conditions.

The RSA contains two ecological zones:

- The forested zone ranges from 600 m asl elevation to 1,225 m asl and includes the valley bottoms and the slopes of the mountains below the tree line. In the valley bottoms, forests are dominated by open canopy stands of black spruce (*Picea mariana*) with white spruce (*Picea glauca*) found along creeks and rivers. Lower forested habitats adjacent to riparian corridors are areas with high potential to support wildlife. In particular, both moose (*Alces alces*) and grizzly bear (*Ursus arctos*) are likely to use these areas seasonally at differing levels of intensity when forage opportunities are most abundant (e.g., seasonally ripe berries, newly emerged vegetation) or when shelter and insulation from winter weather is required. On the mid to lower slopes, continuous stands of subalpine fir (*Abies lasiocarpa*) occur along with minor components of white spruce, Alaska birch (*Betula neoalaskana*), trembling aspen (*Populus tremuloides*), and black spruce. On the upper slopes and up to tree line, open subalpine fir stands are predominant with trees becoming smaller and more spread out with increasing elevation.
- The subalpine zone occurs on the ridge tops and high plateaus above 1,225 m asl. Here tree cover is discontinuous or absent and the vegetation is dominated by scrub birch (*Betula glandulosa*), willows (*Salix* sp.), ericaceous shrubs, herbs, as well as mosses and lichens. The tree and shrub layers found in the subalpine zone are used by moose to support both feeding and cover from spring through fall. Elevations above 1,500 m asl are dominated by ecosystems containing a mixture of shrubs, graminoids, herbs, bryophytes, and lichens.

Terrestrial ecosystem mapping was completed for the LSA following standard methods (Resource Inventory Committee [RIC] 2002) (see Section 4.1.8). A total of 21 vegetated ecosystem units and nine non-vegetated units were mapped in the LSA. A description of the site characteristics and dominant species for these ecosystems is provided in Section 4.1.8 as well as the Vegetation Baseline Report (Appendix 11).

The forested and subalpine ecological zones are dominated by two ecosystem types within the LSA. Coniferous forest habitat dominates the LSA, covering 66% of the area. It is composed of primarily subalpine fir, white spruce, and black spruce. Dwarf birch (*Betula nana*) dominated ecosystems cover a smaller portion of the LSA (11%). They are represented by dwarf birch, alpine herbs and lichens. Little deciduous forest habitat occurs, covering only seven percent of the LSA. It is dominated by trembling aspen, Alaska birch, and balsam poplar (*Populus balsamifera*). These patterns influence the distribution of wildlife species, as described in the following sections.

4.1.10.2 Habitats of Special Interest

The Yukon Government has identified Wildlife Key Areas (WKAs), which are used by wildlife for critical life functions (Environment Yukon 2009a). This approach is particularly useful for species that use key areas seasonally (and less applicable to species that are generalists or widely distributed). WKAs have been identified throughout the Territory, although they do not reflect an exhaustive survey of habitat within Yukon.

The nearest WKA to the Project lies outside the RSA in the South McQuesten River and McQuesten Lake area. It includes summer nesting habitat for ducks in the wetlands upstream of McQuesten Lake; for Peregrine Falcon (*Falco peregrines anatum/tundrius*), Osprey (*Pandion haliaetus*), and Bald Eagle (*Haliaeetus leucocephalus*) on McQuesten Lake; and for Gyrfalcon (*Falco rusticolus*) and Golden Eagle (*Aquila chrysaetos*) immediately north of McQuesten Lake. Based upon local knowledge (Environment Yukon 2009a), late-winter moose range is identified approximately 55 kilometres northwest of the Project site, outside of the RSA. No WKA is recorded in the RSA or LSA (Environment Yukon 2009a). Information obtained via the Traditional Knowledge and Use Study (Stantec 2010) indicated that FNNND Settlement Lands south of the Project site and adjacent to the access road and the area north of the Project site near the Potato Hills provide important moose habitat at various seasons.

A number of important habitat types are present within the LSA (Figure 4.1-8). They are considered important based upon their relative scarcity within the LSA and their importance for wildlife species that are specialized or considered habitat type obligates. These habitats include:

- Old growth Forest
- Wetlands
- Riparian corridors
- Areas previously disturbed by fire.

Approximately 2,077 ha, or 18% of the LSA, is comprised of old growth coniferous forest. These forests consist of ecosystems dominated by white or black spruce at lower elevations and ecosystems dominated by subalpine fir at higher elevations. Old growth forest habitat is important for wildlife species such as American marten (*Martes americana*). Bears may use these areas for hibernation, with dens dug beneath the root wads of large trees. Moose may also seek out mature coniferous forest primarily to satisfy winter thermal requirements.

Wetlands are uncommon and account for approximately 6% of the LSA. They include sphagnum bogs, sedge fens, marshes, ponds, and areas of open water. The majority of wetlands in the LSA are adjacent to the access road, and are associated with the poorly drained valley bottoms along Lynx Creek, Haggart Creek, and portions of the South McQuesten River. While no wetlands have been identified as WKAs within the RSA or LSA, these ecosystems still play important roles, such as preferred feeding habitat for moose and grizzly bear as well as other wildlife species such as Rusty Blackbird (*Euphagus carolinus*). The access road, particularly along the first approximately 20 km leading from the Silver Trail Highway, parallels the South McQuesten River and associated wetlands. This area is known locally as an important calving and rutting area for moose (O'Donoghue 2010a, pers. comm.).

Riparian corridors and drainages account for approximately 10% of the LSA. They may be used as travel corridors for many species (including moose and grizzly bear) moving within and between habitat types. Riparian corridors are often attractive to these species as they provide food resources, protective cover, and relatively homogeneous topography, facilitating energy efficient movement. This is particularly true of riparian corridors found in the lower valley bottoms including Lynx Creek, Haggart Creek, and the South McQuesten River (Figure 4.1-8). Moose and grizzly bear may move between upper and lower elevation habitats seasonally as well as regular daily movements between forage resource areas and protective cover habitat. Helicopter-based wildlife surveys completed for the Project identified wildlife trails connecting forest habitat and distinct riparian and wetland habitats. Many of these appeared to have long term use, particularly by moose, and appeared to form connections between alpine or sub alpine habitats and lower elevation valley bottoms.

A relatively recent fire (<10 years) occurred immediately south of Dublin Gulch and on the south facing slope above Lynx Creek within the LSA (Figure 4.1-8). This area occupies 481 ha, or 4% of the LSA. Burned areas usually develop early successional vegetation (shrubs and herb species) preferred by grizzly bear and ungulates during early spring and summer. Other species, such as Olive-sided Flycatcher (*Contopus cooperi*), may use the abundance of dead snags for perching and foraging from and adjacent forest habitats for nesting.

4.1.10.3 Wildlife Resources

The RSA provides habitat for a wide range of wildlife species that typically inhabit the central Yukon area. In addition to those mentioned above, species which have been documented in the RSA and LSA include mammals such as woodland caribou (*Rangifer tarandus caribou)*, black bear (*Ursus americanus*), grizzly bear, wolverine (*Gulo gulo*), grey wolf (*Canis lupus*), red fox (*Vulpes vulpes*), American marten, snowshoe hare (*Lepus americanus*), and red squirrel (*Tamiasciurus hudsonicus*). Game bird species include Spruce Grouse (*Canachites Canadensis*), Dusky Grouse (*Dendragapus obscures*), Ruffed Grouse (*Bonasa umbellus*), and three species of ptarmigan (*Lagopus* sp). Raptors present may include Golden Eagle, Red-tailed Hawk (*Buteo jamaicensis*), Northern Hawk Owl (*Surnia ulula*), Great Gray Owl (*Strix nebulosa*), and Gyrfalcon. A variety of passerine or songbird species are also present. They include Dark-eyed Junco (*Junco hyemalis*), Gray Jay (*Perisoreus Canadensis*), Tree Swallow (*Tachycineta bicolor*), and Townsend's Solitaire (*Myadestes townsendi*). Waterfowl species include Trumpeter Swan (*Cygnus buccinators*), Mallard (*Anas platyrhynchos*), and Canada Goose (*Branta Canadensis*).

4.1.10.4 Species at Risk

Species at risk that may occur in the RSA are listed in Table 4.1-9. In Canada, the status of each species is provided by the *Species at Risk Act* (SARA); Species at Risk Public Registry (Government of Canada 2010) or the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2010).

Table 4.1-9: Species at Risk

Species	SARA[a]	COSEWIC
Mammals		
Grizzly bear *Ursus arctos*	No Status	Special Concern
Woodland caribou – northern mountain population *Rangifer tarandus caribou*	Special Concern	Special Concern
Wolverine *Gulo gulo*	No Status	Special Concern
Birds		
Canada Warbler *Wilsonia canadensis*	Threatened	Threatened
Common Nighthawk *Chordeiles minor*	Threatened	Threatened
Eskimo Curlew *Numenius borealis*	Endangered	Endangered
Horned Grebe *Podiceps auritus*	No Status	Special Concern
Olive-sided Flycatcher *Contopus cooperi*	Threatened	Threatened
Peregrine Falcon *Falco anatum* *Falco tundrius*	Special Concern Special Concern	Threatened Special Concern
Red Knot *Calidris canatus roseri* type	Threatened	Threatened
Rusty Blackbird *Euphagus carolinus*	Special Concern	Special Concern
Short-eared Owl *Asio flammeus*	No Status	Special Concern

NOTES:
[a] SARA listed species are those considered on Schedule 1 of the *Species at Risk Act*.
The *Yukon Wildlife Act* lists species as “specially protected”, including cougar, Gyrfalcon, Peregrine Falcon and Trumpeter Swan (Yukon Government 2010b). These species are afforded protection under the *Yukon Wildlife Act* because they are considered particularly susceptible to hunting pressure.

While the ranges of species listed in Table 4.1-9 overlap the LSA, species specific habitat requirements may not be met within the LSA. For example, there is little or no cliff nesting-habitat for Peregrine Falcon or tall grass habitat for Short-eared Owl in the LSA.

4.1.10.5 Abundance and Distribution of Major Wildlife Species

Baseline surveys conducted in 2009 included aerial and ground-based surveys, as well as incidental observations of wildlife species and wildlife sign (see Appendix 12 – Environmental Baseline Report: Terrestrial Wildlife, for more information). Baseline surveys confirmed the presence of 31 species of wildlife within the RSA. Information on species of management concern is summarized below.

Moose

While moose are not a species at risk, they are hunted and therefore important to both the FNNND and Environment Yukon.

Moose are recognized as an important species for harvest by local First Nations and are consistently reported within the LSA and portions of the RSA. Important calving and rutting areas within these areas have also been identified. Densities of moose in the Mayo area are close to 200 animals for every 1,000 km², which is above the Yukon average (Yukon Government 2003a). Farther north in the FNNND Traditional Territory, local knowledge acquired via the TKU Study and professional opinion suggest that moose densities are closer to 50 to100 animals per 1,000 km² (Yukon Government 2003a). One participant in the TKU Study indicated that Haggart Creek and other creeks in the Project area provide food and shelter for moose in the springtime.

Moose were the most commonly detected species during 2009 baseline surveys, accounting for 33% of all wildlife species observations (Appendix 12). Moose were detected across all surveys and in the widest range of habitat types indicating a relatively strong presence within the RSA. The majority of moose detections from late summer 2009 were in lower elevation forested habitat zones. Moose utilize low-elevation forested vegetation types in the RSA during much of the year, particularly in the winter. During the winter period (mid-December through late-April), moose requirements for suitable thermal and foraging habitat becomes increasingly important in order to survive harsh weather conditions. As such, winter thermal and winter feeding habitat life requisites are the focus for habitat modeling conducted for moose (Section 6-9 and Appendix 13 – Data Report: Wildlife Habitat Suitability Modeling).

In winter, moose are more likely to migrate to low elevation forest habitats and riparian areas associated with valley bottoms for optimal thermal shelter, ease of movement via lower snow accumulations in these areas and associated feeding opportunities. Moose surveys in 2006 confirmed this, finding moose concentrated along subalpine creek draws during winter months (Ward, et al. 2006). Habitats with closed canopies and south-facing slopes accumulate less snow, providing favorable thermal conditions (Moose Management Team 1996). Riparian forests with tall shrub vegetation provide winter browse, including woody twigs of poplar, birch, alder and willow (Environment Yukon 2009b).

During spring through fall, moose are more widely distributed and can occur in any of the vegetation types found in the RSA. During the rut and post-rut period (September through mid-November), moose prefer upper subalpine basins and use the tall shrub vegetation types and open-canopy subalpine fir forests. Alpine areas are infrequently used, likely due to the lack of cover and forage opportunities they provide for moose. In general, ideal habitat conditions contain a mosaic of habitat types, providing a combination of shelter, forage, or reproduction opportunities (Moose Management Team 1996).

The most recent surveys of moose, covering a 5,013 km² study area primarily south of the proposed Project site, found that areas which supported the highest numbers of moose concentrated on sub-alpine areas south of McQuesten Lake and the ridges around Williamson and Janet Lakes. Estimated moose densities were 205 per 1,000 km² (Ward et al. 2006). These results are similar to those of the 1998 survey (200 moose per 1,000 km². The sex ratio was low (43 bulls for every 100 cows), indicating potentially high levels of bull harvest (Ward, et al. 2006).

One Game Management Zone (GMZ 2, Subzone 2-62) overlaps the RSA. Harvest records between 1999 and 2008 for this subzone indicate a total reported average harvest of 2.1 moose annually within the management zone. Adjacent GMZ subzones report slightly higher harvest rates with an overall average of 3.65 moose per GMZ Subzone per year (Appendix 3 – Eagle Gold Project Land Tenure and Land Use Report). No harvest data for the RSA were available from the FNNND.

- As part of the assessment of Project effects (see Section 6) the habitat suitability of the LSA for moose was quantified. Moderate to moderately high rated habitat for moose winter feeding accounted for 28% (3,232.4 ha) of the LSA. These results indicate that much of the LSA is good habitat for moose, although winter feeding habitat may be more limiting that winter shelter. By virtue of vegetational structural stage, a much wider suite of potential thermal habitat is available compared to the values provided by these same structural stages for winter feeding requirements (Figure 4.1-9).
- Habitats rated as moderate to moderately high suitability for moose winter shelter accounted for 67% (7,769 ha) of the LSA. This is not surprising given the high coniferous forest cover present throughout the LSA. Winter shelter habitats were scattered throughout the entire LSA (Figure 4.1-10).

Woodland Caribou

The northern mountain population of woodland caribou was listed as a species of special concern under Schedule 1 of SARA in 2002 (Government of Canada 2010); however they are not included in the list of “specially protected” species by the Yukon Government.

All information suggests that the RSA receives low levels of caribou use and does not provide important habitat for this species. The closest woodland caribou herd to the Project is the Clear Creek Herd, followed by the Hart River and Bonnet Plume Herds (Environment Yukon 2009b). No WKAs for caribou occur within the RSA. Discussions with Yukon Environment staff familiar with the area noted that while woodland caribou are wide ranging, telemetry data indicate that the LSA is peripheral to the range of the Clear Creek herd (approximately 900 individuals) which is largely located on the opposite side of the North McQuesten River (O'Donoghue 2010a, pers. comm.). Hunting records between 1999 and 2008 indicate there were no caribou harvests in GMZ Subzone 2-62, which overlaps with the RSA. Overall, caribou harvest is low amongst adjacent GMZ Subzones with a rate of 0.13 caribou harvested per GMZ Subzone per year (Appendix 3).

Field surveys support the conclusion that caribou are present at low densities within the LSA. Only three caribou detections were recorded when combining all past and present data. All detections occurred within subalpine habitat types within the RSA. One scat detection in the LSA was likely linked to a single individual moving beyond "typical" herd boundaries. The FNNND report overall declines in the presence of caribou since the 1950s, although they were previously abundant in the Proctor Lake area.

Grizzly Bear

While grizzly bears in Canada have no status under SARA or the Yukon Government (Government of Canada 2010), they have been listed special concern by COSEWIC (2010). A species of special concern is stable but vulnerable to decline from inherent conditions such as a low reproductive rate, and vulnerabilities to human activities such as attraction to non-natural food sources that can result in mortality.

Grizzly bears are a wide ranging species that seasonally use a variety of habitat types. The RSA provides a variety of potentially attractive habitats for grizzly, including forested riparian gullies, marsh habitats and subalpine areas. Grizzly bears are omnivorous and opportunistic feeders, using a variety of foods according to seasonal accessibility.

Spring and fall feeding were selected as the critical life requisites used for grizzly bear habitat modeling as part of the assessment of Project effects (see Section 6). In spring, bears attempting to replenish energy resources used during hibernation, feed on roots of Eskimo potato (*Claytonia tuberosa*), horsetails (*Equisetum* sp.), and occasionally marmots and ground squirrels (Environment Yukon 2009b). Grizzly bears are important predators of young moose calves and often can take more than wolves do in the first few months following birth (Environment Yukon 2009b). In the fall, bears develop fat stores in preparation for hibernation by foraging on berries, ground squirrels, other small mammals, and salmonid species where runs are present.

Baseline data (Appendix 12) documented four detections of grizzly bear. Only one of these detections was in the LSA. The remaining three detections occurred in the larger RSA. This is not surprising as grizzly bears tend to generally avoid humans and associated disturbance. The LSA at baseline does reflect a modest disturbance regime with exploration activities, drilling, and the creation and maintenance of a secondary road. Additionally, the LSA specifically was not found to contain a seasonally attractive "magnet" food resource, such as spawning salmon or highly productive berry patches that tend to attract grizzly bears.

Harvest records for Game Management Subzone 2-62 indicate no grizzly bears were reported harvested in the RSA between 1999 and 2008. For the overall region, grizzly bear is the least harvested wildlife species with an annual average rate of 0.1 bears per GMZ Subzone per year (Appendix 3).

Quantitative assessments of baseline habitat availability, within the LSA for grizzly bear, were conducted in 2009 producing the following results:

- Moderate to moderately high rated habitat for grizzly bear spring feeding accounted for 16% (1,820 ha) of the LSA. These areas were primarily located on south facing, mid elevation slopes within the LSA and in habitats associated with wetland and riparian habitats along the access road (Figure 4.1-11).

- Moderate to moderately high rated habitat for grizzly bear fall feeding accounted for 21% (2,439 ha) of the LSA. Preferred habitats were located on upper to mid elevation forested slopes surrounding the mine site footprint. Minimal fall feeding habitat was identified along the access road corridor (Figure 4.1-12).

American Marten

The American marten is not listed as a species-at-risk by either Yukon Government or SARA (Government of Canada 2010). Although they are not a species of direct conservation concern, American marten provides significant economic and cultural value to local citizens, including the FNNND.

Marten in the northern boreal forest are closely associated with late successional coniferous stands, especially those dominated by spruce and fir, with complex structure near the ground (i.e., coarse woody debris) (Slough 1989; Buskirk and Powell 1994). Marten typically forage on small mammal species such as red-backed voles (*Clethrionomys rutilus*), birds and bird eggs, crowberries (*Empetrum nigrum*), and occasionally on grouse, ptarmigan, snowshoe hare and moose or caribou carrion when food becomes more scarce (Environment Yukon 2009b). Commonly reported refuge sites include ground burrows, rock piles and crevices, downed logs, stumps, snags, brush or slash piles and squirrel middens (Mech and Rogers 1977; Steventon and Major 1982; Buskirk and Powell 1994). Home range sizes are 2.0 to 15.7 km^2 for males and 0.8 to 8.4 km^2 for females (Strickland and Douglas 1987).

The FNNND identifies marten as present in, or in the vicinity of the RSA, concentrated in low elevational areas adjacent to riparian corridors. FNNND citizens report recent declines in the local marten population but suggest it might be part of a naturally fluctuating cycle for marten in the region (Stantec 2010). There were no marten detections during 2009 baseline surveys, however past data (Hallam Knight Piésold Ltd. 1994; 1996a) provided a total of ten detections not linked to any specific habitat type or precise locations. One registered trapline concession (RTC) overlaps the LSA, with an additional eight RTCs in proximity to the LSA and RSA (Appendix 3). On average 14 marten were harvested per RTC each year (Appendix 3).

The LSA contains habitat typically associated with this species. Old growth coniferous forest accounts for approximately 2,077 ha, or 18% of the LSA (Figure 4.1-8).

Olive-sided Flycatcher

Olive-sided Flycatcher is listed as Threatened on Schedule 1 of SARA (Government of Canada 2010) because of a widespread and consistent population decline over the past 30 years (COSEWIC 2007b). The rate of decline for the Yukon population is estimated at -0.2% per year between 1998 and 2008, lower than the -3.1% estimated national decline for the same period (Environment Canada 2009a).

Olive-sided Flycatcher range within the Yukon extends north to include the Yukon Plateau-North ecoregion (Yukon Government 2010b). Across its range, the flycatcher typically occurs in coniferous and mixed-coniferous forest (Altman and Sallabanks 2000, COSEWIC 2007b, Kotliar 2007). Clear-cuts and other young (0 to 10 years old) forests are used if they contain snags or residual live trees for singing and foraging perches (Altman and Sallabanks 2000, COSEWIC 2007b). Similarly, recent (0 to 30 years old) burns are considered important habitat (Boreal Avian Monitoring Project [BAMP] 2009), likely because of the creation of forest openings and edge habitat, as well as availability of snags and live trees (Altman and Sallabanks 2000; COSEWIC 2007b; Kotliar 2007). Deciduous forests are generally avoided.

A relatively recent fire (<10 years) occurred immediately south of Dublin Gulch and on the south facing slope above Lynx Creek (Figure 4.1-8). The area is approximately 481.5 ha in size and represents potential preferred habitat for this species within the LSA.

Olive-sided Flycatcher arrives in the Yukon in early May and departs late August. Breeding pairs typically establish territories at forest edges adjacent to clearings (ponds, lakes, rivers, and meadows), particularly where snags and tall trees are accessible for foraging and perching. Nests are constructed most often in coniferous trees, and the nest tree is usually in close proximity to forest openings.

Breeding has been confirmed in the region, including four Olive-sided Flycatcher detections in the period 2006 – 2010 on the annual Mayo Landing breeding-bird survey route (US Geological Survey [USGS] 2010). No Olive-sided Flycatchers were detected within the RSA during baseline surveys completed in 2009. However, these surveys were completed outside the breeding-bird nesting period.

Rusty Blackbird

Rusty Blackbird is listed as a species of Special Concern on Schedule 1 of SARA (Government of Canada 2010) because of a significant long-term and severe population decline (Savignac 2006). The national rate of decline for Rusty Blackbird is estimated at -6.9% annually during 1988 through 2008. The species appears to be declining faster in Yukon with population declines estimated at -9.1% annually for the same period (Environment Canada 2009b).

Rusty Blackbird is present in the Yukon primarily during the breeding season (early May through late August), although migrants and non-breeding birds may be present until late October and into winter (Semenchuk 1992; Federation of Alberta Naturalists [FAN] 2007). Its range extent includes the Yukon Plateau-North ecoregion, overlying both the LSA and RSA.

In Yukon, Rusty Blackbird nesting locations are closely associated with conifer forest wetlands, including bogs (with or without ponds), fens, muskegs, swamps and wet shrubby meadows (Yukon Government 2007, Avery 1995, Savignac 2006, Shaw 2006). It also uses shrubby riparian areas along the margins of lakes, beaver ponds, rivers, and creeks in coniferous and mixed wood forests (Semenchuk 1992, Avery 1995, Savignac 2006, FAN 2007). Wetlands and riparian areas combined account for approximately 15% of the LSA, or 1,818 ha of habitat potentially suitable for this species (Figure 4.1-8). Estimated Rusty Blackbird densities (Avery 1995) suggest this amount of potentially suitable habitat may support less than one Rusty Blackbird bird.

Two Rusty Blackbirds were observed most recently during the annual breeding-bird survey conducted at Mayo Landing in 2004 (USGS 2010). There were no recorded observations of Rusty

Blackbirds during 2009 baseline surveys within the LSA or RSA, although as mentioned above, these surveys were completed after the nesting period.

4.1.10.6 Ongoing Studies and Monitoring Programs

The FNNND compiles information on hunting by its citizens and Environment Yukon maintains records on non-Aboriginal hunting, although the Project does not have access to this information. Beyond this, there are no ongoing studies or monitoring programs.

The last large-scale inventory of ungulates (including moose) took place in November 2006 in a 5,013 km² study area mostly south of the mine site (O'Donoghue 2010a, pers. comm.). Environment Yukon has requested funding to repeat the 2006 surveys in 2011. Several studies were carried out in support of this Project in 2009, including late-winter aerial surveys, late-winter track surveys, summer aerial surveys, and summer ground-based surveys (see Appendix 12 for additional information). The Community-based Fish and Wildlife Management Plan for the FNNND Traditional Territory (2002 – 2007) describe numerous proposed monitoring programs addressing moose, caribou and grizzly bear. Most suggested programs focus on harvest data, and on collecting more accurate data on where animals are concentrated, and overall population estimates.

4.1.11 Water Resources

4.1.11.1 Hydrology

The hydrology of the region is generally characterized by large snowmelt runoffs during the freshet in May, which quickly taper off to low summer stream flows interspersed with periodic increases in stream flow associated with intense rainfall events during July and August. The pattern of low stream flows punctuated by high stream flows associated with rain fall events continues throughout the summer to autumn when freeze up begins in October. In larger streams, baseflows are maintained below river/creek ice throughout the winter by groundwater contributions. Smaller streams tend to dry up during the late summer or fall, as flow generally goes subsurface when the groundwater table drops to seasonally low levels. Aufeis (or overflow) ice may build in certain places of these streams if groundwater emerges from the channel during winter.

Waterbodies, Watercourses, and Drainage Basins

The hydrology LSA is located in the Dublin Gulch, Eagle Creek, and Haggart Creek (above the Lynx Creek confluence) drainage basins (Figure 4.1-13). The basin areas of these water bodies are 10.4 km^2, 4.7 km^2, and 98 km^2 respectively. The basins are characterized by high relief (750 to 800 m), steep gradients (mean gradient of 18%), and well-vegetated slopes. Summary data for each sub-basin in the LSA are included in the Environmental Baseline Report: Hydrology (Appendix 14).

Placer mining has been conducted in both Haggart Creek and the Dublin Gulch basins over the past century. In addition to the complete removal of the vegetation and overturning of the riparian area, the outcome of these operations has also resulted in the diversion of Eagle Pup and Stuttle Gulch drainages from the Dublin Gulch drainage basin. The confluence of Eagle Pup and Stuttle Gulch drainage forms Eagle Creek. Eagle Creek previously discharged to Dublin Gulch; however the historic placer operation re-routing results in discharge to Haggart Creek approximately 0.5 km downstream of Gil Gulch (Figure 4.1-13-A).

Dublin Gulch, Eagle Creek, and Haggart Creek are all perennial streams. Several of the tributaries in the Project area are intermittent streams (i.e., the stream becomes dry at sections along the water course where flow goes subsurface) or ephemeral streams (i.e., the stream channel has little to no groundwater storage and flow is in response to snowmelt or heavy rains). The upper sections of Platinum Gulch are channelized with sections of perennial stream flow. But, the lower sections of Platinum Gulch are dry during the summer months. Sections of Stewart Gulch are intermittent during the open-water season. Stuttle Gulch appears to be a dry channel for most of the year, although some sections have overland flow caused by permafrost melting from the adjacent slopes. Ann Gulch is a dry channel during most of the summer; in-channel observations of flow during and just after freshet indicate that the channel is wet in the late spring (e.g., May to June) as a result of snowmelt runoff.

Stream Flows

Stream flow data were collected in the LSA in 2007 through 2009 during the open-water season at continuously gauged stations and nine manually gauged stations. The gauging stations were distributed throughout the LSA above or below important stream confluences (Figure 4.1-13). The data is summarized in the Appendix 14. Stream flow monitoring continues at most of the stations.

The open-water season pattern is characterized by freshet-generated peak flow in May to early June, followed by a relatively rapid recession to low base flow throughout July and August. Heavy rain events caused short-term increases in stream flow with storm-event recessions being generally rapid in the late summer and fall, both reflective of low groundwater storage capacity of the basins. Winter flows, though not gauged, have been measured and observed by field personnel in Haggart Creek and lower Dublin Gulch and are the lowest flows of the year reflective of base flow contributions. Monthly summaries and hydrographs for the gauged streams are provided in Table A-4 of Appendix 14.

Peak to base flow ratios from data derived from the LSA indicate large annual variability (Section 5.1.3 of Appendix 14). For example, during the period 2007 to 2009, streams in the LSA have peak to base flow ratios ranging from 1 to 600. The variability reflects large variations in annual climate conditions, coupled with site-specific sub-basin characteristics that may be associated with, for example, permafrost distribution, depth of thaw, the timing of freshet, rainstorm events, and/or antecedent moisture conditions.

Flood Frequency

Flood flow estimates were derived for the streams in the LSA, based on regression estimates developed from regional hydrometric data (see Appendix 14). The regional hydrometric data were analyzed in HEC-SSP v1.1 using a log Pearson III distribution and flood flow rates and return intervals were calculated. The regional return interval series were plotted against drainage basin area to quantify the relationship between flood magnitude and drainage basin area. These functions were used to estimate flood magnitudes in the LSA.

The estimated 1:100 year 24-hour precipitation event for Dublin Gulch (at W21), Haggart Creek (at W5), Haggart Creek above Dublin Gulch (at W22), and Eagle Creek (at W27) are 4.7 m^3/s, 29 m^3/s, 21.5 m^3/s, and 2.4 m^3/s respectively (Figure 4.1-13). Details of the flood frequency analysis and different flood event scenarios are provided in Appendix 14.

4.1.11.2 Hydrogeology

The LSA for hydrogeology is the same as that described above for hydrology. The hydrogeology in the LSA was characterized in 1995 – 1996 and 2009 – 2010 and included drilling boreholes, installing monitoring wells, measuring depth to groundwater, conducting hydraulic tests, and sampling and analyzing for groundwater quality. The data obtained was used to identify local groundwater recharge and discharge zones, groundwater flow patterns, and to develop a conceptual hydrogeological model of the LSA. Appendix 15 – Environmental Baseline Report: Hydrogeology provides detailed methods and results of field studies conducted in 2009 and summarizes previous work by Hallam Knight Piésold (1996a, c) and GeoViro Engineering Ltd. (1996). The groundwater level and groundwater quality data collection program that began in 2009 is on-going.

Since 1995, depth to groundwater and groundwater samples have been collected from 49 different monitoring wells in eight sub-basins including Bawn Boy Gulch, Olive Gulch, Stewart Gulch, Eagle Pup, Stuttle Gulch, Platinum Gulch, Dublin Gulch, and Ann Gulch (Figure 4.1-14). The Eagle Pup, Stuttle, Platinum, Dublin and Ann Gulch basins will be affected by the Project. Within these basins a minimum of three monitoring well locations per sub-basin are being used to quantify groundwater flow and gradients, and to characterize local recharge and discharge areas. In general, of the three or more monitoring well locations in each sub-basin, two are located within a proposed Project facility footprint and at least one is down-gradient of a facility footprint.

Hydrogeologic Setting

There are two principal water-bearing units in the LSA: deeper relatively low permeability bedrock and the near-surface moderately permeable surficial deposits. Surficial material at the Project site consists of a thin veneer of organic soils underlain by colluviums (i.e., a loose heterogeneous mass of soil material), glaciofluvial (i.e., originating from rivers associated with glaciers) deposits, or till (a glacial deposit). Below these clastic (or transported broken fragments of rock) units are either metasedimentary or granodiorite bedrock, which is deeply weathered in places. The elongated granodiorite stock (ore bearing unit) has intruded the surrounding host metasediment. The surficial material thickness and physical properties varies significantly throughout the area. Recorded depths to bedrock in the Project area range from 0 m to greater than 20 m (Appendix 15).

The Dublin Gulch valley contains large amounts of fluvial (i.e., river deposited) materials that were considerably reworked by placer mining operations. Extensive stockpiles of placer deposits comprised of sub-rounded metasediment and granodiorite clasts, ranging in size from sands to boulders, and fine-grained material (i.e., that are located in former placer settling ponds) are present adjacent to the Dublin Gulch and Eagle Creek watercourses. A till blanket covered with a colluvial veneer is located along the south valley wall in Dublin Gulch valley and extends southward in the Haggart Creek valley. A recent alluvial (i.e., a water-laid clastic deposit) fan is present where Dublin Gulch meets Haggart Creek. Discontinuous permafrost is also present, especially on the north-facing slopes and affects the connectivity between the deep and shallow water-bearing zones in places.

Further details of the spatial distribution and characteristics of these materials are found in Appendix 6 – Environmental Baseline Report: Surficial Geology, Terrain, and Soils and Appendix 15.

Groundwater Occurrence

Generally groundwater has been observed deeper (approximately >6 m below ground) at higher elevations and shallow to artesian in lower elevations and in valley bottoms (Appendix 15). Springs and seeps have been observed in a few locations where valley bottoms have narrowed. These are typically associated with the re-emergence of a stream from channel deposits (i.e., a gaining reach). In these instances (e.g., Eagle Pup, Stewart Gulch), thin alluvium overlying shallow bedrock is the likely cause of the emergence. Groundwater levels within the lower Dublin Gulch valley have been observed to have seasonally delayed trends due to higher groundwater levels during spring freshet and/or associated with rainstorms and lower groundwater levels during dry summer periods.

Groundwater Flow

Groundwater flow in the bedrock occurs in fractures and fault zones, while preferentially flowing through more permeable (and porous) sediments within the surficial deposits. General orientation of groundwater flow contours mimic the topography of the Site as groundwater flows from the highest areas to lowest. Throughout most of the LSA the groundwater divides of each sub-basin approximately coincide with the surface water divides (i.e., groundwater from the Eagle Pup and Stuttle Gulch drain to Eagle Creek, while groundwater from Ann and Stewart Gulch Basins drain to Dublin Gulch). In the lower Dublin Gulch valley the groundwater divide between the Eagle Creek and Dublin Gulch basins is not clearly defined. Field observations suggest that at times the divide migrates across the valley so that groundwater from the Dublin Gulch basin may flow into Eagle Creek. This shifting is seasonal and also due in part to the variability in the timing of the freshet and/or rainfall events across the entire watershed.

Groundwater recharge occurs at higher elevations throughout the Dublin Gulch-Eagle Creek drainage basin and ultimately discharges to surface water (in some cases as seeps and springs) at lower elevations in the valley or directly to surface streams, or ultimately into Haggart Creek. The main groundwater flow in conjunction with the highest groundwater elevations is expected to occur during the snowmelt in late spring (e.g., May to June) after thawing of the shallow sediment.

Surface Water – Groundwater Connectivity

Base flow values represent the groundwater contributions to streams. Groundwater contributes to stream flows where the groundwater table elevation intersects the ground surface, typically these intersections are located in stream channel inverts (e.g., Eagle Pup appears in mid-channel where the valley is well confined by bedrock); however, they also appear as seepage from slopes within the placer deposits of the lower Dublin Gulch valley. Groundwater from the lower Dublin Gulch valley likely contributes a measureable portion of the baseflow to Haggart Creek. The baseflow contributions to the streams maintain flow during the drier months of the year (including winter flows).

Groundwater Flow Properties

During both the 1995 – 1996 and 2009 – 2010 field programs (see Appendix 15 for details), hydraulic tests were performed in monitoring wells completed in both the bedrock and surficial deposits to estimate hydraulic conductivity (or the ease with which water can move through pore spaces or fractures in saturated rock). Hydraulic conductivities ranged from 10 – 3 m/s to 10 – 7 m/s in the surficial material, and from 10 – 5 m/s – 10 – 8 m/s in the bedrock. The hydraulic conductivity of the colluvial, alluvial, and till deposits was generally higher than that of the placer material, and the variable hydraulic conductivity seen in the bedrock is typical of fractured crystalline rock, which showed decreasing hydraulic conductivity with depth. The test data did not demonstrate a measureable difference in the hydraulic conductivities of granodiorite and metasedimentary rock. This suggests that the flow properties of both rock types are similar.

Groundwater Quality

As groundwater flows though the rocks and sediments it assumes a continuously evolving characteristic chemical composition due to interactions with the surrounding geologic material. A groundwater sample’s concentration is a function of rock type, solution kinetics, water residence time, mixing, and groundwater flow patterns. The groundwater quality data suggests that the chemical composition of groundwater in the LSA depends on the local and upgradient rock-types.

Groundwater quality data were collected in 1995, 1996, 2009 and 2010 for many areas of the site including in Eagle Pup, Dublin, Stuttle, Ann, Stewart, Olive, Bawn Boy and Platinum Gulches. The discussion below summarizes findings reported in Appendix 15. The parameters analyzed included dissolved and total metals, nutrients, anions and other general parameters. All groundwater quality data were compared to Federal, Canadian Council of Ministers of the Environment (CCME) Canadian Water Quality Guidelines for the protection of Aquatic Life (CCME 2007), and to the British Columbia Contaminated Sites Regulation (CSR) Schedule 6 Generic Numerical Water Standards for the protection of Freshwater Aquatic Life (British Columbia Ministry of Environment [BC MoE] 2006).

The following parameters exceeded the CCME and/or CSR guidance parameters in the Project area: aluminum, arsenic, cadmium, copper, iron, lead, molybdenum, nickel, selenium, silver, and/or zinc (Appendix 15). The CSR guideline values apply to both surface and groundwater, whereas the CCME guidelines only apply to surface water. However, as groundwater ultimately discharges to surface water bodies, the CCME guideline values are included here for reference.

The exceedances do not imply that the groundwater at the site is currently contaminated; only that background concentrations of these parameters are higher than typically found in other natural sites in Canada, and merely reflect the natural geologic and hydrogeologic conditions within these specific areas of the LSA.

Comparison of the multiple years of groundwater data indicated that groundwater quality parameters were generally in the same range and that seasonal trends were not apparent over the years sampled.

The groundwater samples were classified based on their major ion chemical composition, taking into account the major anions and cations. Calcium is the dominating cation in most groundwater samples from the site; however, some sampling locations magnesium concentrations exceeded calcium. Carbonate was the dominating anion in all samples, and was particularly high in some samples.

One or more levels of the following total and/or dissolved levels of aluminum, arsenic, cadmium, copper, iron, lead, molybdenum, nickel, selenium, silver, and/or zinc exceeded either the CCME or BC MoE guidelines for the protection of aquatic life (CCME 2007; BC MoE 2006).

4.1.12 Aquatic Ecosystems and Resources

4.1.12.1 Overview of Baseline Conditions for Water Quality and Aquatic Ecology

Water, sediment, periphyton, and benthic invertebrate characteristics of watercourses in the LSA, which encompass the Haggart Creek, Dublin Gulch, Eagle Creek, and Lynx Creek basins, were studied during 1993 – 1996 and during 2007 – 2010, along with a 1976 – 1977 sediment survey. The Water Quality and Aquatic Biota Baseline Report (Appendix 16) provides detailed results of field studies conducted in 2007 – 2010 (JWA [now Stantec], 2008), 1993 – 1996 (Hallam Knight Piésold 1996e, 1996f) and sediment data from 1976/77. The TDR provides background information, methods, Quality Assurance/Quality Control (QA/QC), and results. The approach and results are briefly summarized in this section to provide a general description of baseline conditions.

The objectives of the water quality and aquatic ecology baseline study were to:

- Obtain baseline data on water quality and sediment that can be used to assess potential changes related to construction, operations, closure, and post-closure stages of the Project
- Identify parameters that may be present at elevated levels, and to use this information if needed to propose site-specific water quality objectives
- Provide baseline data that can be used to support future biological monitoring programs
- Measure abundance and diversity of the periphyton and benthic invertebrate communities, for comparison to future levels in potentially affected watercourses.

The design of the 2007 – 2010 monitoring program was based on issues identified in a gap analysis of the historic dataset (JWA 2007). The 2007 – 2010 program collected information on conditions in watercourses of the LSA using methods consistent with environmental assessment standards under Yukon and federal legislation. Water samples were collected August 2007 – June 2008, July – October 2009, and March – September 2010 to provide information on seasonal variability. Sediment samples were collected during September 2007, 2009, and 2010, periphyton were collected in August 2007, and benthic invertebrates were collected in September 2007, September 2009, and August 2010. Current and historic data were compared to provide information on temporal changes, given the area has been subject to intense historic placer mining activity. A baseline dataset useful for discriminating potential future Project effects from current conditions and historical activities was created.

Since 1993, samples have been collected from 34 sites in the four drainage basins in the study area (Figure 4.1-15). The Haggart, Dublin, and Eagle basins may be affected by the Project. Where possible, sites within these basins were selected upstream (reference) and downstream (exposed) of the proposed Project footprint. Lynx Creek is a neighbouring watershed unlikely to be affected by the Project.

A total of 426 water, 46 sediment, 22 periphyton, and 36 benthic invertebrate samples (not including replicates) were collected. Most of the watercourses, with the exception of Lynx Creek and Ironrust Creek, have been disturbed by placer mining activities over the past 100 years.

4.1.12.2 Water Quality

Baseline

Physical and chemical water quality parameters determine the physiological performance of aquatic organisms and influence characteristics at the population and community levels in terms of distribution, diversity, and density of biota. Because freshwater systems are complex, adaptive, and dynamic, the completion of an extensive water quality monitoring program is essential to distinguish natural variation over time and space from human-induced environmental changes. General water chemistry, nutrient, organic carbon content, cyanide, and metal levels were measured. These parameters are relevant to toxicity and habitat requirements for plants, algae, benthos, and fish.

Methods for collecting and analyzing water samples are summarized in the Water Quality and Aquatic Biota Baseline Report (Appendix 16). Water quality was assessed through field studies conducted since 1993 in the four main drainage basins (Figure 4.1-16).

Results for the 2007 to 2010 Program

General Chemistry

Conditions were circumneutral to basic at all sites, with mean pH ranging from 7.5 to 8.3. All sites, except those located in Dublin Gulch, exhibited a high acid buffering capacity, as indicated by high mean alkalinity (>75 mg/L), calcium (>35 mg/L), and hardness (>130 mg/L). Sites within the Dublin Gulch Creek watershed, with the exception of Stewart Gulch (W26), showed lower mean alkalinity (<55 mg/L) and softer water (<85 mg/L) than sites in the Haggart, Lynx and Eagle systems. At site W20 (Bawn-Boy Gulch), a calcium concentration of 7.4 mg/L was measured in June 2008, indicating moderate sensitivity to acid inputs.

The range of conductivity measured at sites W1 (24 to 136 µS/cm) and W20 (54 to 73 µS/cm) in the upper Dublin system tended to be much lower than at all other sites (51 to 464 µS/cm). These two sites were also distinct from the other sites in low sulphate (mean 12 and 5 mg/L, respectively, compared to 44 to 63 mg/L for other sites) and total dissolved solids (TDS) concentrations (mean 69 and 47 mg/L, respectively, compared to 171 to 217 mg/L for other sites).

Turbidity tended to be low (<3 NTU) in all drainage basins for most of the year. Higher readings were occasionally observed in spring at a number of sites including April 2008 at site W27 (Eagle Pup, 53 NTU) and June 2008 at site W23 (downstream on Haggart Creek, 23 NTU). For these dates, concurrent high levels of TSS (58 and 154 mg/L, respectively) and guideline exceedances for copper and iron at W27 and total aluminum, cadmium, copper, iron, and lead at W23 suggest sediment re-suspension. April samples were collected from under the ice. In 2010, elevated readings (>10 NTU) were also observed on 6 May (W27, 102 NTU; W29, 19 NTU), 22 May (W5, 15 NTU; W6, 15 NTU; W21, 10 NTU; W23, 11 NTU; W27, 177 NTU; W29, 49 NTU), July (W27, 12 NTU), and Aug (W27, 85 NTU). These readings were generally associated with higher TSS loads and guideline exceedances for aluminum, arsenic, cadmium, copper, and lead. The high turbidity observed at W27 and W29 was traced to a seep in the Stuttle Creek valley. Erosion and sediment control measures were implemented in late August and turbidity readings returned to normal levels by September.

Nutrients and Organic Matter

Nutrient levels tended to be low. Ammonia concentrations were below detection limits in about 80% of samples analyzed. Nitrate and total nitrogen levels were consistently higher in Eagle Creek, intermediate in Lynx and Haggart Creeks, and lower in Dublin Gulch. No clear inter-site difference in Total Kjeldahl Nitrogen (TKN) levels was observed.

Phosphorus concentrations (ortho-phosphate and total dissolved phosphorus) were highest at W26 (Stewart Gulch), with phosphate values in October 2007 ten times higher than the usually observed concentrations. These outliers were not compatible with the generally low trophic condition of the monitored streams, so are considered artifacts of sampling or analysis. Concentrations of ortho-phosphate, total dissolved phosphorus, and total phosphorus were generally lowest in Haggart Creek and were below detection limits in 65% of samples.

Mean dissolved organic carbon (DOC) levels also tended to be low (<6 mg/L) at all sites other than W32 (Ann Gulch, 23 mg/L) and W34 (Platinum Gulch, 15 mg/L) where only one and two samples, respectively, were recorded from these ephemeral streams.

Metals and Cyanide

More than 90% of samples analyzed for cyanide (total and weak acid dissociable) had levels below the analytical detection limit.

Several metals showed levels consistently below analytical detection limits. These include more than 75% of samples analyzed for beryllium, bismuth, boron, chromium, mercury (other than W32, only one sample), selenium, silver, thallium, tin, titanium, and vanadium at all sites. Aluminum, cadmium, copper, iron, lead, and zinc occasionally exceeded the guidelines, often associated with freshet and high TSS levels.

Total arsenic levels exceeded CCME and British Columbia (BC) guidelines for protection of aquatic life in most of the samples from the Dublin Gulch, Eagle Gold and Lynx Creek watersheds and some samples from sites in the Haggart Creek watershed. Mean arsenic levels were approximately an order of magnitude higher in Dublin Gulch (0.060 mg/L) and Eagle Creek (0.063 mg/L) than in Haggart Creek (0.006 mg/L) and lower Lynx Creek (0.007 mg/L).

Comparison of 2007 – 2009 Data versus Historical Data

Analytical results for 2007 – 2009 were generally in the range observed for 1993 – 1996 for general chemistry, nutrients, and organics. Variability was higher for 1993 – 1996 than for 2007 – 2009. Levels of TSS and some metals, including aluminum, arsenic, copper, iron, and lead, were up to ten times higher in 1995 and 1996 than other years, exceeding CCME guidelines in many cases.

Seasonal Variability

At most sites, levels of pH, alkalinity, hardness, conductivity, TDS, and nitrate tended to be lowest in May, at a time when high spring flows resulted in elevated TSS and metals (aluminum, arsenic, cadmium, copper, iron, lead). Sites W8 (upper Dublin) in July 1996 and W10 (lower Stewart Gulch) in May 1995 and 1996 had very high levels of TSS, aluminum, arsenic, cadmium, copper, iron, and lead. Placer mining is still active in the region and variable surface water quality over the years is likely related to the extent of mining in each drainage system.

Results of intensive sampling conducted over seven days in September 1995 and eight days in June 1996 suggest little short-term variability in routine water parameters (pH, alkalinity, hardness, sulphate, nitrate, and TDS). Variations in metal concentrations appeared to be related to TSS levels (Hallam Knight Piésold 1996e, 1996f).

4.1.12.3 Stream Sediments

The sediment assessment was designed to provide data on metal levels in the fine fraction of benthic sediments in the LSA watercourses. These parameters are relevant to toxicity and physical habitat requirements for benthos, fish eggs and juvenile fish. From 1976 through 2010, 26 sites were sampled: ten in Haggart Creek, eight in Dublin Gulch, three in Eagle Creek, and five in Lynx Creek systems. Sample locations are shown in Figure 4.1-17.

Results were compared with sediment quality guidelines for protection of aquatic life. Two levels were considered: the CCME Interim Sediment Quality Guidelines (ISQG), which represent the concentration below which adverse biological effects are expected to occur only rarely, and CCME Probable Effect Levels (PEL), which describe concentrations at which adverse effects are typically observed.

Results

Sediment from Dublin Gulch had substantially higher levels of arsenic than sediment in Haggart Creek and substantially lower levels of copper than sediment in Haggart Creek and Eagle Creek. Metal concentrations were typically lower in the Haggart and Lynx systems relative to Dublin and Eagle Creek, with the exception of W62 (upper Lynx) in 1976 – 77 when elevated levels of nickel, zinc, and copper were recorded. No consistent pattern of distribution of metals by year could be delineated, suggesting that baseline metal concentrations in sediments are relatively stable within each site over time.

Comparison with Guidelines

Individual measurements of antimony, barium, beryllium, bismuth, cobalt, iron, manganese, molybdenum, selenium, thallium, tin, tungsten, uranium, and vanadium did not exceed CCME guidelines at any monitored site over time. Cadmium, chromium, copper, lead, mercury, silver, and zinc levels exceeded guidelines in individual samples at only a few sites.

Nickel concentrations exceeded guidelines at most sites on each sample date. Nickel exceeded the ISQG in 70% of samples in 1976/77, 87% of samples in 1995, 91% of samples in 2007, 76% of samples in 2009, and 100% of samples in 2010 (not analyzed in 1993). Mean nickel levels exceeded the ISQG at all sites except W20, W30, W1, and W26 in the Dublin system and W64 in the Lynx system.

As with surface water, arsenic concentrations in sediment were higher, relative to guidelines, than other metals. Arsenic levels were higher than the PEL in all samples analyzed, with highest levels generally measured in the Dublin Gulch watershed, specifically at W20 in 2007 and W8 in 1995. Arsenic exceeded the PEL in every sample collected in 1995, 2007, 2009, and 2010 (not analyzed in 1976/77 and 1993).

Metals levels in sediments of these streams are consistent with a mineralized area. Some elevated levels may reflect previous disturbance during placer mining. Given the high background levels of these metals, the ISQG for metals such as arsenic, copper, lead, nickel, and zinc will not be attainable in these streams. Effects of elevated metal concentrations in sediment on aquatic life depend on their bioavailability and on metal speciation. The effects are difficult to predict due to complex bio-physico-chemical interactions, for example with organic matter, other metals (iron and manganese complexes), hardness, and pH.

4.1.12.4 Periphyton

The periphyton monitoring program was designed to provide baseline conditions for primary productivity and community diversity, to compare with future levels in potentially affected watercourses. Methods for the analysis of periphyton samples are summarized in the Water Quality and Aquatic Biota Baseline Report (Appendix 16). Samples were collected at sites in the Haggart, Dublin, Eagle Creek and Lynx basins (Figure 4.1-18) in 1995 and 2007. Samples were collected in August, during the low flow period, from defined areas of natural substrates, and analyzed for chlorophyll *a* and taxonomic characteristics.

Results

Chlorophyll *a* levels reported for the study streams varied widely within and among sites. The low mean levels (0.02 to 1.13 mg/m^2) suggest oligotrophic conditions compared with coastal and inland watercourses (e.g., maximum values of 35 mg/m^2 for Fording River, 45 mg/m^2 in lower Thompson River, 13.6 mg/m^2 in Lynn Creek [North Vancouver], 1.9 mg/m^2 in Carnation Creek in British Columbia [Nordin 1985]).

In 1995, the lowest chlorophyll *a* levels (0.04 to 0.06 mg/m^2) were recorded at W4 (Haggart downstream of Dublin Gulch), W8 (upper Dublin Gulch), and W1 (midway in Dublin Gulch). Highest levels (0.71 and 1.13 mg/m^2) were recorded at W26 (lower Stewart Gulch) and W6 (lower Lynx Creek). The low values were downstream of known placer mining activity at that time. No cell count data were provided in the 1995 analyses.

In 2007, the lowest chlorophyll a levels (0.02 to 0.12 mg/m^2) were reported at W10 (lower Stuttle Gulch), W13 (upper Lynx Creek) and W22 (Haggart upstream of Dublin Gulch) and the highest levels (0.85 and 1.12 mg/m^2) were reported at W1 (midway on Dublin Gulch) and W9 (Eagle Pup). Periphyton abundance ranged from 151,000 (W6, Lynx) to 2,680,000 cells/cm^2 (W20, Bawn Boy in Dublin).

The 1995 taxonomic analysis was semi-quantitative, while the 2007 analysis was quantitative and allowed calculation of various metrics. Taxon richness (number of taxa per site) varied from 37 to 68 species in 2007, with highest numbers reported for Haggart, above Dublin Gulch, and lowest numbers in Eagle Pup. Estimates from 1995 indicated fewer taxa (10 to 47 species per site). However, estimates from 1995 were made using different analytical methods, at a time of active placer mining.

Species diversity (index incorporating species richness and relative abundance) ranged from 0.44 to 0.79 in the 2007 samples, highest in Haggart and lowest in Eagle Creek and Lynx Creek). Evenness (index measuring the uniformity of a community) ranged from 0.48 in Bawn Boy Gulch to 0.80 in Haggart Creek above Lynx Creek and in lower Dublin Gulch.

The species reported are common in watercourses of western Canada (Stein and Borden 1979, Munro, et al. 1985). In Haggart Creek, diatoms and blue-green algae were the predominant taxa present at all sites in both 1995 and 2007, with a higher proportion of diatoms upstream and of blue-green algae downstream. In Dublin Gulch, Eagle Pup, and Stuttle Gulch, blue-green species were predominant. In Lynx Creek, predominant species were blue-green algae in 2007 and diatoms in 1995.

4.1.12.5 Benthic Invertebrates

The benthic invertebrate monitoring program was designed to characterize community diversity and abundance prior to Project development so that changes due to construction, operations, and closure can be evaluated, to assess variation relative to historic data and provide supporting information for fisheries assessments.

Methods for the analysis of benthic invertebrate samples are summarized in the Water Quality and Aquatic Biota Baseline Report (Appendix 16). Current and historic monitoring sites within the study area are shown on Figure 4.1-19. The 2007 to 2010 program was developed to provide comparison with sampling conducted in 1995 (Hallam Knight Piésold 1996e). Benthic invertebrates were sampled at sites in the Haggart, Dublin, Eagle, and Lynx basins during the summer low flow period in August 1995, September 2007, September 2009, and August 2010. Riffles were sampled to target the preferred habitat of the more sensitive benthic invertebrates.

Results

Sites in the Haggart system generally had the lowest abundance and among the highest richness, diversity, evenness, and EPT values. Mean proportions of Ephemeroptera (22 to 30%), Trichoptera

(1 to 5%), and Oligochaeta (22 to 31%) were similar across all sampling years. However, the mean proportions of Plecoptera (14 to 40%) and Chironomidae (4 to 23%) varied substantially over the years.

Sites in the Dublin basin generally had higher abundance and slightly lower richness, diversity, evenness and EPT taxa than at sites in the Haggart Creek system. Proportions of Ephemeroptera (18 to 26%) were similar to Haggart but proportions of Plecoptera (7 to 34%) were generally lower. Lower Plecoptera proportions in the Dublin system were accompanied by higher proportions of Chironomidae in 1995 and Oligochaeta in 2007 and 2010, both of which are considered tolerant of a wide range of conditions.

Relatively high abundance and lower richness, diversity, evenness, and number of pollution sensitive taxa (EPT, or Ephemeroptera, Plecoptera, and Trichoptera) were characteristic of sites in Eagle Creek (W9, W10, W27). Ephemeroptera and Trichoptera were generally absent. Diversity was low in 1995 with Chironomidae (88%) accounting for most of the organisms identified at W9.

Abundance and taxonomic indices were intermediate at W13 and W6 in Lynx Creek compared to the other systems.

Relatively low richness, diversity, evenness, and EPT, combined with higher proportions of tolerant groups (Chironomidae and Oligochaeta) in the more recent samples (2007, 2009, 2010) from the Eagle Creek system indicate that reduced habitat complexity, poor water and sediment quality, or both may be preventing many sensitive organisms (EPT) from colonizing these sites. Although arsenic concentrations in water and sediment were much higher in Eagle Creek than in Haggart and Lynx, concentrations were similar to those observed in Dublin Gulch, which did not exhibit low richness, diversity, evenness, and EPT. The results suggest that poor habitat (e.g., more homogenous substrate, more spates) is most likely responsible for the lower biotic indices.

Increased invertebrate abundance in Dublin Gulch and Eagle Creek systems in some years is likely due to the presence of tolerant organisms and the absence of predatory fish in the upper reaches of these systems.

4.1.12.6 Fish and Fish Habitat

Watershed Overview

The proposed Project mine site is situated in the Dublin Gulch watershed (Figure 4.1-20). Dublin Gulch flows into Haggart Creek, a tributary of the South McQuesten River. South McQuesten Road (SMR) and Haggart Creek Road (HCR) connect the proposed mine site to Highway 11 and parallel Haggart Creek and the South McQuesten River.

Much of the upper Haggart Creek watershed, including Dublin Gulch, has been heavily impacted by placer mining activity. Eagle Pup was historically a tributary of lower Dublin Gulch; however, placer mining activity has re-aligned the channel which now flows parallel to lower Dublin Gulch, and currently discharges into Haggart Creek downstream of the Dublin Gulch/Haggart Creek confluence (Figure 4.1-20) Haggart Creek's largest tributary, Lynx Creek, joins Haggart Creek downstream of Dublin Gulch and has not been subject to placer mining or any other land development activities. Ironrust Creek flows into Haggart Creek approximately 1.5 km upstream of the mine site and is similarly unaffected by development activities.

Baseline Study Methods

Baseline fish and fish habitat information was gathered from existing consultant reports, government databases, and the results of field studies conducted for the Project prior to VIT's claim ownership. Field studies were completed for watercourses located within the local Project area to obtain biophysical habitat data, determine fish presence and abundance, and characterize fish populations (i.e., size, age, and tissue metal concentrations). The fish and fish habitat study area (study area), shown in Figure 4.1-21 includes:

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

Although placer mining has occurred throughout the upper Haggart Creek watershed, including Dublin Gulch, it has not occurred in two of the reference watercourses: Ironrust and Lynx creeks.

Field studies within the study area were completed over four sampling periods (August 2007, October 2007, April 2008, and July 2009) and included 59 sample sites, located on 28 mapped or field identified watercourses. Of the 28 watercourses sampled, 13 are crossed by the access road, 13 are within or immediately downstream of the mine site footprint, and two within the reference watercourses (Figure 4.1-22, 4.1-23, and 4.1-24). Results from the 2007-2009 Environmental Baseline Report: Fish and Fish Habitat are provided in Appendix 5.

Sampled watercourses were characterized as fish-bearing unless:

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

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

Watercourse Fish-bearing Status

Of the 26 watercourses sampled in the study area, 14 were identified as fish-bearing or potentially fish-bearing and 12 were as non-fish-bearing (Table 4.1-10). The 14 fish-bearing watercourses were:

- Three watercourses located within or immediately downstream of the proposed mine site footprint—Haggart Creek, lower reaches of Dublin Gulch, and the lower reaches of Eagle Pup (including a pond created for historic placer mining operations and its tributary stream)
- Two watercourses sampled as reference watercourses—Lynx Creek and Ironrust Creek
- Nine additional watercourses crossed by the site access road including: North Star, Bighorn, Cadillac, and Secret creeks; the South McQuesten River, one unnamed tributary of Haggart Creek, and two unnamed tributaries of the South McQuesten River.

A summary of the data collected for all identified fish-bearing watercourses is presented in Table 4.1-10.

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

- Two watercourses with barriers to upstream fish passage located within the footprint of the proposed mine site—Upper Dublin Gulch (a gradient barrier located 1.5 km upstream of the confluence with Haggart Creek) and Upper Eagle Pup (a perched culvert located 1.9 km upstream of the confluence with Haggart Creek)
- Six tributaries to the non-fish-bearing upper reaches of Dublin Gulch and Eagle Pup—Stuttle Gulch, Ann Gulch, Bawn Boy Gulch, Stewart Gulch, Olive Gulch, Cascallen Gulch
- Four watercourses with fish passage barriers that were located outside the Dublin Gulch and Eagle Pup watersheds: Platinum Gulch and three un-named watercourses crossed by the access road (sample site numbers RC1, RC13, and RC16).

Table 4.1-10: Summary of Biophysical Habitat Characteristics for Fish-bearing Watercourses within the Project Area Potentially Impacted by the Project Footprint, or Road Upgrade Works

Watercourse (Site)	Mean Channel Width (m)	Mean Residual Pool Depth (m)	Mean Gradient (%)	Substrate (dominant/ subdom.)	Total Cover	Fish Species Captured or Observed	Mean Estimated Arctic Grayling Density (standard error) fish/100m^2	Mean Estimated Slimy Sculpin Density (standard error) fish/100m^2	Spawning Habitat Quality	Rearing Habitat Quality	Over wintering Habitat Quality
Reference Watercourses											
Ironrust Creek (IR2)	4.1	0.13	4	C, G	M	GR, CCG	0.2 (-)	0.7 (-)	Moderate	Good	Poor
Lynx Creek (L1, L4)	6.0 – 8.0	0.39 – 1.14	1	G, C	M – A	GR, CCG	1.0(0.3)	1.9 (-)	Moderate – Good	Good – Excellent	Moderate – Excellent
Dublin Gulch, Haggart Creek, and Eagle Pup Watercourses											
Dublin Gulch - below gradient barrier (DG1, DG1.1, DG1.2, DG1.3)	3.6 – 7.9	0.1 – 0.31	4 – 9	C,B	M – A	GR, CCG	2.2 (0.15)	1.5 (-)	Poor	Moderate	Poor
Eagle Pup Placer Pond 1	N/A	N/A	N/A	N/A	N/A	GR, CCG	N/A	N/A	Poor	Moderate	Poor
Tributary to Eagle Pup Placer Pond 2	0.75	0.05	12	C, F	A	CCG	N/A	N/A	Poor	Moderate	Nil
Eagle Pup Placer Pond 2	N/A	N/A	N/A	N/A	N/A	GR	N/A	N/A	Poor	Moderate	Poor
Haggart Creek (HC1)	11.3	0.78	3	C, G	N/A	GR, CCG	4.5 (-)	6.0 (-)	Moderate	Excellent	Good
Haggart Creek (HC2)	9.2	0.2	2	C, G	N/A	GR, CCG	0.4 (-)	4.3 (-)	Moderate	Moderate	Moderate
Haggart Creek (HC3)	6.47	0.63	2	C, B	A	GR, CCG	1.1 (-)	a	Moderate	Excellent	Good
Haggart Creek (HC4)	8.2	0.11	2.5	C, B	M	NFS	N/A	N/A	Nil	Poor	Nil
Haggart Creek (HC5)	17.7	0.63	1	F, G	M	GR,CCG, BB	N/A	N/A	Moderate	Moderate	Poor
Road Encroachment											
Haggart Creek Road Encroachments (RE1-RE12)	8.2 – 19.8	0.08 – 0.8	1 – 3	C, G	T – A	NFS	N/A	N/A	Good	Good – Excellent	Poor – Excellent
Watercourses Crossed by the Access Road											
Unnamed Wetland Crossed by Culvert (RC3)	–	–	0	O, F	A	NFS	N/A	N/A	Nil	Poor	Nil
Haldane Creek (RC5)	6.65	0.43	2	C, G	A	GR	N/A	N/A	Good	Excellent	Good
North Star Creek (RC6)	0.98	0	0.5	O, F	A	NFS	N/A	N/A	Nil	Good	Good
Unnamed Wetland Crossed by Culvert (RC8)	–	–	0	O, F	M	NFS	N/A	N/A	Nil	Poor	Nil
Bighorn Creek (RC 10)	2.6	0.37	3.5	C,G	A	NFS	N/A	N/A	Good	Excellent	Moderate
South McQuesten River (RC11)	38.8	1.08	1	G, F	A	CH, GR, BB, CCG,LSU	N/A	N/A	Excellent	Excellent	Excellent
Cadillac Creek (RC12)	8.4	0.1	8	C, G	T	NFS	N/A	N/A	Poor	Poor	Nil
Secret Creek (RC14)	28.6	0.4	1	F, O	T	GR	N/A	N/A	Good	Moderate	Moderate
Unnamed Culvert (RC15)	1.2	0.05	2	F, O	T	NFS	N/A	N/A	Nil	Poor	Nil
Haggart Creek (RC24)	12	0.18	2	C, G	T	GR	N/A	N/A	Excellent	Moderate	Poor

NOTES:
"–" = not applicable
N/A = data not available
NFS = no fish sampling
a = estimates could not be calculated from catch data

O = organics
F = fines
G = gravel
C = cobble
B = boulder

A = abundant (>20%)
M = moderate (5-20%)
T = trace (<5%)

CH = Chinook salmon
GR = Arctic grayling
CCG = slimy sculpin
BB = burbot
LSU = longnose sucker

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Fish Species Distribution

At least 11 fish species are known to occur in the South McQuesten River watershed, including Chinook salmon (*Oncorhynchus tshawytscha*), Arctic grayling (*Thymallus arcticus*), northern pike (*Esox lucius*), longnose sucker (*Catostomus catostomus*), Arctic lamprey (*Lampetra camtschatica*), burbot (*Lota lota*), slimy sculpin (*Cottus cognatus*), round whitefish (*Prosopium cylindraceum*), inconnu (*Stenodus leucichthys*), lake whitefish (*Coregonus clupeaformis*), and rainbow trout (*Oncorhynchus mykiss*) (DFO 2010). No freshwater fish species on Schedules 1 or 2 of the Federal *Species at Risk Act* (SARA) are present in the South McQuesten River watershed or the entire Yukon Territory (Government of Canada 2010). Haggart and Lynx creeks are both known to contain five fish species: Chinook salmon, Arctic grayling, round whitefish, burbot, and slimy sculpin (DFO 2010). Ironrust Creek, Dublin Gulch and Eagle Pup are known to be inhabited by Arctic grayling and slimy sculpin (Hallam Knight Piésold 1996f, DFO 2010).

The field program for this Project captured five fish species from ten different watercourses (Table 4.1-10). Arctic grayling were captured in nine watercourses and slimy sculpin were captured in seven. Burbot were captured in the South McQuesten River and lower Haggart Creek. Chinook salmon and longnose sucker were observed in the South McQuesten during the July 2009 snorkel survey.

Previous studies reported the presence of Chinook salmon (*Oncorhynchus tshawytscha*) in Haggart and Lynx creeks (Madrone 2006; Hallam Knight Piésold 1995, 1996e, 1996f; DFO 2010). In the 2007 to 2009 Dublin Gulch sampling programs, Chinook salmon were not captured at any of the Haggart and Lynx creek sites. Previous studies also reported the presence of Chinook salmon in the South McQuesten River, which was confirmed by the sighting of juvenile Chinook (est. age 1+) during a snorkel survey of the South McQuesten River at the access road crossing on July 23, 2009. No adult Chinook spawners or evidence of spawning were observed in the South McQuesten River during the July 2009 survey. However, Chinook spawners were observed in August 2009 adjacent to the South McQuesten River Bridge immediately downstream of the mouth of Haggart Creek by Stantec personnel (Gardner 2010, pers. comm.).

Fish Relative Abundance

Arctic grayling and slimy sculpin were the only species caught during electrofishing depletion surveys, which were completed in Ironrust Creek, Haggart Creek, Lynx Creek, and in Dublin Gulch. Both species were present in low densities in these watercourses. Mean Arctic grayling catch rate for all sites during all three electrofishing sampling programs was 1.6 fish/100 m^2, and mean catch rate for slimy sculpin for all sites was 2.9 fish/100 m^2 (Table 4.1-10). Slimy sculpin were caught at higher densities in Haggart Creek (4.3 to 6.0 fish/100 m^2) than in the other three watercourses (0.7 to 1.9 fish/100 m^2). There were no consistent differences in estimated Arctic grayling densities among the waterbodies sampled.

Habitat Usage

The majority of Arctic Grayling in the Project area are thought to overwinter in the South McQuesten River and migrate into Haggart Creek and its tributaries to rear during summer (Pendray 1983). The summer migration into Lynx Creek has been observed to occur during June and early July (Pendray 1983). The timing of outmigration to overwintering areas has not been observed for the Project Area; however, baseline assessment for this Project (Appendix 5) demonstrated that densities of Arctic grayling in Dublin Gulch were similar during July, August, and October, even though anchor ice was beginning to form on the stream margins during the October sampling program. This suggests that significant outmigration may not occur from Dublin Gulch until after October.

The documented capture of juvenile Arctic grayling in Haggart Creek during May, at a location 19 km upstream from the South McQuesten River (Pendray 1983), suggests that some Arctic grayling may overwinter in the Haggart Creek watershed. The baseline assessment for this Project did indeed document potential overwintering habitat (i.e., with residual pool depth ≥0.8 m) at sample sites in Lynx and Haggart creeks (Table 4.1-10). Furthermore, a large number of Arctic grayling were captured from a large pool on Haggart Creek in April 2008 (i.e., after freeze up but before breakup) (Appendix 5). It is assumed that this unnaturally large pool (1 ha in area and over 10 m deep) was created by placer mining operations and was not present during fish studies conducted in 1996 (Hallam Knight Piésold 1996e, 1996f). This pool created by placer mining and the South McQuesten River likely represent the most important overwintering habitat for Arctic grayling in the study area. The quality of potential overwintering habitat in fish-bearing streams within the mine site footprint (i.e., Dublin Gulch and Eagle Pup) was poor (Table 4.1-10) due to residual pool depths ≤0.3 m that most likely freeze to the bottom in winter.

Pendray (1983) observed that spawning by Arctic Grayling in this region occurred predominantly in the South McQuesten River during the last two weeks of May. He also identified a small area at the mouth of Haggart Creek as a probable spawning site. Since spawning occurs in late May, immediately after ice breakup, Arctic grayling that winter in the Haggart Creek watershed might also spawn in the Haggart watershed. The baseline fisheries assessment for this Project identified areas of good to excellent quality potential spawning habitat for Arctic grayling—with modest currents (0.5 – 1.0 m/s), depths of 0.1 – 0.4 m, and 2 – 4 cm diameter gravel (McPhail 2007)—in Lynx, Haldane, Secret, and Haggart creeks (Table 4.1-10). The quality of potential spawning habitat provided by fish-bearing streams within the mine site footprint (i.e., Dublin Gulch and Eagle Pup) was poor, primarily due to lack of suitable gravel (Table 4.1-10).

As the majority of Arctic grayling in the study area are thought to overwinter and spawn in the South McQuesten River (Pendray 1983), Arctic grayling primarily use study area streams as summer rearing habitat. Good to excellent rearing habitat was present at sample sites in the South McQuesten River, Bighorn Creek, Haggart Creek, Haldane Creek, Lynx Creek, Ironrust Creek, and North Star Creek (Table 4.1-10). These sites had abundant complex cover and availability of pool, riffle, and run habitats. The quality of potential rearing habitat provided by fish-bearing streams within the proposed Project footprint (i.e., Dublin Gulch and Eagle Pup) was moderate (Table 4.1-10), primarily due to lack of cover, high stream gradients, or insufficient channel depths.

4.1.13 Heritage Resources

Under Section 2 of YESAA, heritage resources are defined to include "*moveable works or records that due to their archaeological, palaeontological, ethnological, prehistoric, historic or aesthetic features are of scientific or cultural value*". Separate investigations were completed for historic and palaeontological resources and the existing conditions are summarized here. Results from the 2009 Eagle Gold Project Historical Resources Baseline Report are provided in Appendix 4 and results from the Historical Resources Impact Assessment (HRIA) for palaeontology are available in the Palaeontological Assessment – Eagle Gold Project (FMA 2010).

4.1.13.1 Historic Resources

Previous Studies

An archaeological and historic assessment was conducted in 1995 for the then-proposed Dublin Gulch Mine site (Greer 1995). The study included a field assessment on a large project area that encompassed the proposed mine location and several possible locations for heap leach facilities. During the studies, no archaeological or historic period sites were identified; all areas favourable for pre-contact human occupation were deemed to have been destroyed by the extensive placer mining activity in the area, and all structures identified within the Project area were all determined to be related to mining activities over the past 50 years.

A subsequent assessment of the access road to the Project site was conducted in 1996 for the South McQuesten and Haggart Creek roads (Greer 1996). During that study, archaeological and historic period sites along two possible routes were inventoried. No sites were identified along the Haggart Creek road and three sites of potential concern were located along the South McQuesten road. Subsequent to completion of those studies, VIT indicated that avoidance of all of these sites would be implemented during road design and construction. Sites identified along the South McQuesten roads include: "Big Dave Lookout" (KlTx-2) which contains both pre-contact archaeological deposits and historic deposits, a subsurface pre-contact archaeological site (KlTx-3), and a historic cabin site (KlTw-1) (see Figure 3-2 in Appendix 4).

A study conducted in several locations in Yukon by Thomas (2005) included several sections along the South McQuesten River. During Thomas's study, two of the above sites (KlTx-2 and KlTx-3) were revisited, and two sites (KlTx-4, a pre-contact archaeological site, and KlVa-1, a collapsed cabin) were newly recorded (see Figure 3-2 in Appendix 4).

Literature Review

Gold and Galena, the local history prepared for the community of Mayo, contains information specific to the mining history in the Dublin Gulch area (Mayo Historical Society 1999). Mining in Dublin Gulch started in 1899 and was largely continuous up to the present day. Numerous placer and hardrock mining were carried out by multiple operators in Dublin Gulch, with varying degrees of success. Of most significance to the Project area is Fred Taylor, who mined successfully for over 20 years and left his mark on the gulch in the form of structures which are still standing.

Current Studies

For the currently proposed Project, a historical resources field investigation was conducted in September 2009. The investigation was not an impact assessment, as the regulators had previously indicated that the 1995 and 1996 studies conducted by Greer were sufficient. However, observations made by Greer in 1995 as to the archaeological potential of the area were confirmed during the current study; those areas that would have had the potential to contain archaeological sites, such as the areas within proximity of Dublin Gulch and Haggart Creek, have been extensively reworked by the placer mining activities that have been ongoing since 1899. No undisturbed areas were observed in any locations that would have had moderate to high archaeological potential. Upland areas where the proposed Project mining would take place are rugged and mountainous, and are of low archaeological potential. The South McQuesten road was also observed during mobilization to and from the Project site. The road alignment and width has not changed since it was assessed by Greer in 1996.

During the 2009 field visit, several buildings perceived to be older than 45 years in age (the age at which abandoned structures are deemed to be historic sites in Yukon) were observed at three separate locations:

- Over 10 structures were observed east of the current camp location, on the north side of Dublin Gulch. Although many of the structures are related to mining activities in the 1970s, several of these structures appear to be over 50 years in age. One of the structures, a house, is illustrated in *Gold and Galena* in a photo dated to 1955, and is therefore more than 45 years old. The observed log cabins appear to predate the house.
- A single cabin was observed along the access road between the current camp and the 1970s camp previously listed. The cabin may be over 45 years in age.
- A single collapsed cabin was observed along Haggart Creek, northwest of the current camp. The cabin appears to be over 45 years.

4.1.13.2 Paleontological Resources

This section summarizes baseline conditions detailed in the HRIA (FMA 2010).

Literature Review

The area of the mine site is underlain by bedrock of the Upper Proterozoic to Lower Cambrian Hyland Group, consisting of metasedimentary rocks with granodiorite intrusions. The degree of metamorphism in the local bedrock precludes the preservation of fossils. Upland areas are covered in colluviums, and the Dublin Gulch valley is infilled with Pleistocene gravel (Bond 1997b). The gravel has been mostly reworked by placer gold mining; however, any intact remnants of the gravel have excellent potential to yield palaeontological resources. The gravel overlies glacial till of the Reid Glaciation (approximately 200,000 years old). This area was ice free during the last glaciation, known as the McConnell Glaciation (Bond 1999).

The Dublin Gulch area has yielded a significant Pleistocene vertebrate fossil locality (Harington 1996). This fossil site is significant as it is the only substantial Pleistocene record from the Mayo

District. The fossil material was collected during the mid-1970s during placer gold mining and includes small horse, bison, Dall sheep, caribou, moose, American lion and possibly mammoth. The predominance of horse and bison in the assemblage is typical of Yukon and Alaskan Pleistocene faunas. A date of 31,450 +/- 1,300 years was obtained from radiocarbon analysis of a horse metatarsal bone, which makes the fauna Middle Wisconsinan. All of the species found at the Dublin Gulch Pleistocene locality have also been reported at other Middle Wisconsinan sites south of the Arctic Circle in Yukon, such as Sixtymile (Harington 1997), Big Creek (Harington 1989), and Ketza River (Jackson and Harington 1991). The Middle Wisconsinan faunas suggest that a widespread grassland steppe was established in the central Yukon, although the presence of moose suggests a wetland component (Jackson and Harington 1991).

Previous Studies

The Dublin Gulch Pleistocene fossil locality was discovered as a byproduct of placer mining; therefore, little site information was recorded. Harington (1996) pieced together a possible stratigraphic succession based on records from earth scientists between 1916 and 1991, and concluded that the source layer for the fossils was likely from diamicton (i.e., unsorted gravel) just below the upper organic silt/colluvium layer. However, not all of the fossils may have come from the same unit. He determined that the fossils were collected over two years from a single cut at the “extreme left limit of the gulch at the upper end of claim 3” (Harington 1996: 354). Storer (1998: 1) later described the site location as the “left [south] side of Dublin Gulch, slightly downstream from Stuttle Gulch, more or less halfway between Eagle Pup and Haggart Creek”. Figure 4.1-25 shows the probable location of the Dublin Gulch Pleistocene fossil locality relative to the proposed Project development.

In the late 1990s, environmental impact assessments were completed for a previously proposed quartz mining operation at the Project site. These studies included a letter from Dr. John Storer, Yukon Palaeontologist, to the Department of Indian Affairs and Northern Development, regarding palaeontological impacts and mitigation (Storer 1998). Dr. Storer concluded that the Dublin Gulch fossil locality did not seem to be threatened directly by the Project; however, access road development and tailings ponds could be a concern. He recommended a palaeontological survey of the site, avoidance of the fossil locality by the development, and monitoring of any construction in the placer area and any construction at river cuts along Haggart Creek.

Current Studies

For the currently proposed Project, a HRIA for palaeontology was conducted in September 2009 (FMA 2010). Four days of field studies were conducted to investigate the Dublin Gulch Pleistocene fossil locality and to examine strata in and around the Dublin Gulch area and along the proposed access road.

Field surveys found that most of the valley fill at Dublin Gulch and Haggart Creek has been reworked by placer mining. There is no sign of any remaining source layer for the Dublin Gulch Pleistocene fossil locality, and no additional fossil vertebrate material was found. Organic layers at the top of the surficial sequence in Dublin Gulch contain plant and arthropod material and yielded conventional (calibrated) radiocarbon ages of approximately 10,000 to 13,000 years before present. These late Pleistocene to early Holocene dates indicate the sediments were deposited during climatic warming following the McConnell Glaciation. A large piece of wood recovered from intact surficial deposits along the access road yielded a conventional (calibrated) radiocarbon age of approximately 2,700 years before present, which is late Holocene.

Remnant intact surficial deposits that have not been disturbed by placer gold mining occur along the south side of Dublin Gulch (at a silt borrow site, north of the current confluence of Dublin Gulch and Haggart Creek at camp location), along Ann Gulch (at heap leach facility), and at Secret Creek (along access road). These deposits have high potential to contain palaeontological resources.

4.2 Socio-economic Conditions

4.2.1 Socio-economic Conditions—Introduction and Study Areas

The socio-economic conditions are described for two local and two regional study areas.

The Local Study Areas are:

- First Nation of Na-Cho Nyäk Dun (FNNND)
- Village of Mayo (VoM).

And the Regional Study Areas are:

- Whitehorse
- Yukon.

The emphasis in this discussion of socio-economic conditions is on the local study areas, the FNNND and VoM, where potential effects of the Project are anticipated to be most noticeable. The two regional study areas, Whitehorse and Yukon, are intended to provide context. Less detail is provided for the regional study areas, though socio-economic effects from the Project may be experienced in Whitehorse and at a territorial level. In a few instances, Canada-wide data are also presented for context.

The information for the FNNND and VoM has been organized to present the history and governance of each separately; as was done for environmental conditions (Section 4.1), the profile information is then presented in terms of five “Valued Components” (VCs). In some cases, information is presented that is applicable to both the FNNND and VoM; in other instances separate information is provided under each of the five VCs. The VCs are as follows:

1. Employment and economic opportunities
2. Traditional activities and culture
3. Community vitality
4. Human health and well-being
5. Infrastructure and services.

In this description of existing conditions, the "*Village of Mayo"* refers to the municipal government entity. The *First Nation of Na-Cho Nyäk Dun* refers to the First Nation as defined by the land claim and self-government agreement and includes the FNNND government and the NND citizens residing in Mayo and elsewhere in the Yukon and Canada.

The VoM and FNNND share history and geography, overlapping social, cultural, and economic interests, and a number of shared arrangements for the provision of services (as described in the FNNND and VoM Integrated Community Sustainability Plans (ICSP) (VoM 2006a; FNNND 2008d) and resource management (e.g., the Mayo District Renewable Resources Council [MDRRC]). The VoM and FNNND councils regularly hold "Joint Council" meetings to discuss issues of mutual interest and concern. So while they are profiled separately in terms of existing conditions, they are integrally linked by their shared history, geography, culture, and residents or citizens.

The profiles include information provided by Statistics Canada through the census (conducted at 5-year intervals, e.g., 1996, 2001, and most recently in 2006). As the last census was conducted in 2006, it must be noted that the most recent census data are now four years old, and for some indicators, data are even older. Census data specifically for FNNND is limited to the 1996 and 2001 census years; it is not available for 2006, due to changes in census parameters. The FNNND Census data include FNNND citizens resident in Mayo and elsewhere in Yukon and Canada. While this information is provided in the baseline report, it must be acknowledged that the relevance of data that is 10 years old or more may be questionable. The 2006 census data for Mayo does not distinguish FNNND citizens residing in Mayo. In addition, in some cases data are limited by the level of detail available (i.e., not all indicators are reported at the FNNND or VoM level; data may be rounded or suppressed by Statistics Canada due to small sample sizes), or the type of data collected in a given year. In some cases, supplementary information is available from other sources, including the socio-economic interviews conducted for the Project.

The Eagle Gold Project Socio-Economic Baseline Report, which provides additional detail on socio-economic conditions, is provided in Appendix 17.

4.2.2 First Nation of Na-Cho Nyäk Dun

4.2.2.1 Historical Background

The FNNND (which translates as "Big River People") represents the most northerly community of the Northern Tutchone language and culture group in the Yukon. In the Northern Tutchone language, the Stewart River is called Na Cho Nyäk, meaning "Big River". The FNNND is culturally affiliated with the Northern Tutchone people of the Pelly Selkirk, and the Carmacks Little Salmon First Nations; these three First Nations form the Northern Tutchone Tribal Council. The FNNND constitutes much of the community of Mayo, and their Traditional Territory covers 162,456 km^2 of land (131,599 km^2 in Yukon and 30,857 km^2 in Northwest Territories) (see Figure 4.2-1). Under the 1993 land claims agreement, the First Nation owns 4,739.68 km^2 of settlement lands (shown in Figure 4.2-1), and has received approximately $14.5 million in compensation, which has been put into an FNNND trust fund (FNNND 2010b).

Traditionally, FNNND citizens lived and trapped throughout the area surrounding Mayo.

FNNND citizens moved from the McQuesten area to “the Old Village” (located just west of the Mayo town site, two miles downstream on the Stewart River, as shown in Figure 4.2-2) in the early 1900s (Mayo Historical Society 1999; Bleiler, et al. 2006). In the 1950s, residents of the Old Village began moving into the village of Mayo, which is located within FNNND traditional territory.

4.2.2.2 Governance and Administration

As a self-governing First Nation (under the FNNND Final Agreement and Self-Government Agreements), the FNNND has the ability to make laws on behalf of their citizens and their lands. Figure 4.2-3 is an organizational chart showing the FNNND’s various departments and governance structures (FNNND 2008a).

The FNNND assumed self-government responsibility for program service delivery in several areas (e.g., housing, infrastructure). In June 2009, the FNNND signed an Intergovernmental Relations Accord with the Government of the Yukon, which states the identification of opportunities for cooperative health and social service delivery as a shared priority for fiscal year 2009 – 2010 (Intergovernmental Relations Accord 2009). A comprehensive 5-Year Capital Plan was prepared for the NND in 1995 by David Nairne & Associates. A situational analysis for a 2008 – 2013 Capital Plan was conducted for the FNNND by Inukshuk Planning & Development Ltd., in association with N.A. Jacobsen (Inukshuk and Jacobsen 2008). An Integrated Community Sustainability Plan (FNNND 2008d) describes FNNND’s vision and values, goals, and existing service agreements. The ICSP also provides inventories of skills and assets related to capital projects, social, health and cultural services, economy, environment, and capacity building and training.

Under their Final Agreement, FNNND owns the minerals under all Category A Lands (see Figure 4.2-1), and receives royalties from any mining on this land. For mining activity elsewhere in the FNNND Traditional Territory, including on Category B Lands, the FNNND Government shares in a portion of any mineral royalties collected by the Yukon Government.

The FNNND has recently negotiated a comprehensive Cooperation and Benefits Agreement with Alexco Resource Corp. (June 2010) for the company’s projects in the Keno Hill Silver District, and has an equity position in the Mayo B hydroelectric project that is currently under construction. YEC 2010). FNNND is also currently exploring opportunities with the North American Tungsten’s Mactung project (located in the northern part of FNNND’s Traditional Territory on lands shared with the Ross River Area Dena Council). In relation to the Dublin Gulch properties, the FNNND entered into an Exploration Cooperation Agreement in 2008 with the predecessor to VIT, StrataGold Corporation Ltd. VIT has honoured and implemented that agreement and, in the spring of 2010, concluded a Memorandum of Understanding with the FNNND for the negotiation of a comprehensive Cooperation and Benefits Agreement to address the company’s mining operations and production in that area (VIT 2010). The FNNND also entered an Exploration Cooperation Agreement with ATAC Resources in relation to the Rau Project in October (ATAC Resources Ltd. 2010) and, it is understood, is currently working on a Cooperative Exploration Agreement with Golden Predator (Leckie 2010, pers. comm.).

The Project lies within the Northern Tutchone Land Use Planning Region, one of eight planning regions in Yukon. The region includes the Traditional Territories of the FNNND, the Little Salmon Carmacks First Nation, and the Selkirk First Nation. Land use planning has not been initiated for the Northern Tutchone Planning Region. The northern portion of the FNNND's Traditional Territory is located in the Peel River Watershed Planning Region. A draft land use plan for that region (December 2009) is currently undergoing review and consultation. FNNND has noted that the protection of the Peel River watershed is a priority and is not open for mineral exploration or development (the Project is not located within the Peel Watershed). The lands in the southern portion of the Territory have already experienced mining development and other disturbances and are more suited to additional resource development activity.

4.2.3 Village of Mayo

4.2.3.1 Historical Background

The VoM is located 407 km north of Whitehorse and 235 km east of Dawson City. Mayo is situated at the confluence of the Mayo and Stewart Rivers within the traditional territory of the FNNND. Historically, the site of Mayo was used as a traditional camp by the FNNND.

Prior to becoming a service centre for significant mining activity in the area, Mayo was established as a river settlement as it was the farthest navigable point up the Mayo and Stewart rivers by steamboat. The permanent community of Mayo Landing was established in 1903 (Bleiler, et al. 2006), and was incorporated as a village in 1984.

4.2.3.2 Governance and Administration

The administration of the VoM consists of a mayor, a Chief Administrative Officer, and four councillors. For planning purposes, the VoM uses a population of 466 persons (although this figure includes those who live outside the village boundaries). This figure also includes both the Aboriginal population (FNNND citizens and other Aboriginal people) and the non-Aboriginal population. The village has an annual budget of approximately $3.4 million and employs seven full-time and two part-time staff. In the summer season, as many as 12 to 15 other individuals are employed by the village, including students.

Municipal priorities include completion of water line looping, establishing additional building lots, relocating and improving the recycling centre, and improving the landfill to meet new government requirements.

A new municipal building has been constructed, linked to a gymnasium, stage, kitchen facility, meeting hall, and curling rink.

Property taxes and grants in lieu provided by other levels of government comprise some of the municipal revenue of the VoM. Table 4.2-1 shows the VoM property taxes and grants in lieu for 2005 to 2010.

Table 4.2-1: Village of Mayo Revenue (2005 through 2010)

Year	Property Taxes and Grants in Lieu ($)
2005	$234,465
2006	$236,767
2007	$255,182
2008	$255,182
2009	$254,521
2010	$265,681

Source: Village of Mayo

4.2.4 Employment and Economic Opportunities

4.2.4.1 Local and Regional Economic Overview

Mining

The Mayo area, including the FNNND and the VoM, has a long-term history of resource development activity, including several "boom and bust" cycles associated with mining (Mayo Historical Society 1999; Aho 2006; Bleiler, et al. 2006). An initial wave of gold-related activities struck the Stewart River – Mayo River area in the 1880s and the early 1900s. Dublin Gulch, the location of the Project, was first placer mined in 1899 (Mayo Historical Society 1999). For a period in World War II, scheelite (tungsten bearing mineral) was recovered in the Dublin Gulch area to support the war effort. Placer mining continued at Dublin Gulch for a number of years. Throughout the 1980s and '90s a number of exploration and mining companies explored Dublin Gulch. VIT is the mining company now focused in Dublin Gulch.

Silver was of primary interest in subsequent surges in the 1920s, and during the 1950s – 80s. The Keno Hill silver camp was one of Canada's largest primary silver producers during its time from 1946 to 1989.

There are a number of quartz mining claims, exploration projects, and proposed mining projects in the region. Minerals of interest include gold, silver, zinc, lead, and copper. Today, the Mayo area is experiencing a surge in mineral exploration and development (e.g., Alexco Resource Corporation's proposed Bellekeno Mine [silver] and other Keno Hill Silver District interests; ATAC Resources' Rau Gold Project), and the Elsa Reclamation and Redevelopment Company's (a subsidiary of Alexco Resource Corp.) reclamation and closure of historical mines in the district.

Placer mining continues to be a major contributor to the economy of the area. The majority of Mayo area placer mining operations are family-run, some for three or more generations. Extensive placer workings are found in the area surrounding the Project on the Dublin Gulch and Haggart Creek drainages (described in more detail in Appendix 17), including a number of active and inactive claims.

Table 4.2-2 identifies the placer gold production rate in the Mayo region from 2004 to 2008. The production rate has been relatively stable with placer gold production lows reported in 2006 and 2008. Placer gold production has been concentrated in the Duncan and Lightning Creek watersheds (Zanasi and Research Northwest 2010).

Table 4.2-2: Placer Gold Production in the Mayo Region (2004 to 2008)

Year	Crude Ounces of Placer Gold
2004	2,502
2005	2,340
2006	1,471
2007	2,755
2008	1,396

Source: Zanasi and Research Northwest (2010)

Following the mining downturn in the 1980s, it was realized that diversification to include tourism, outfitting, recreation, and other economic activities would reduce Mayo's reliance on a mineral-based economy.

Outfitters and Tourism

In Yukon, a system of outfitting concessions provides each outfitter an exclusive area in which to guide clients. In the Project area, Midnight Sun Outfitting Ltd. occupies Concession #4, which covers approximately 31,000 km^2 and includes the watersheds of the McQuesten, Wind, Hart, and Little Wind rivers. The Project area is within the southern portion of Concession #4 (Appendix 17). Guided hunting trips are conducted from late July to early October; fishing and other wilderness adventures such as canoeing, rafting, and heli-hiking are also offered.

Rogue River Outfitters occupies concession number 7 which covers approximately 31,000 km^2 and is located to the south and east of the Project area (Appendix 17).

Tourism in the Silver Trail Tourism Region is a component of the local economy, but to a lesser extent than mining or government services. The area's natural beauty, mining history, and outdoor activities attract visitors from elsewhere in Yukon, Canada, and beyond. The number of tourists to Mayo varies between 1,000 and 2,000 people annually (VoM 2010). Substantially more visitors may use the Silver Trail Region and visit Keno City, Stewart Crossing, and the area.

Tourist services in and around Mayo include two motels, several bed and breakfasts, three campgrounds, a restaurant, two service stations, a store, and various businesses catering to wilderness tours and fishing. Helicopter, float-plane, and taxi services are also available. The floatplane base on the Stewart River serves as the access point to the Peel River watershed, which includes the Snake and Wind Rivers, as well as a Canadian Heritage river—the Bonnet Plume. This area attracts large numbers of wilderness travelers from around the world, as well as Yukoners.

There are opportunities for First Nations-based cultural and experiential tourism that have yet to be developed. The FNNND has plans to develop a cultural workspace in the former Legion Hall building on Front Street in Mayo and to eventually develop a cultural center to promote Northern Tutchone culture (FNNND 2007b).

Commercial Trapping

There are 333 Registered Trapline Concessions (RTCs) in the Yukon. The Project lies within Registered Trapline Concession (RTC) 81; the Haggart Creek Road bisects the RTC. RTC 84 and RTC 85 are located so the south of the Project and portions of these two RTCs are traversed by the South McQuesten Road (Section 3, Figure 3.1-5). Access to many of the RTCs in the site vicinity is by the South McQuesten Road, using snowmobiles or dog sled.

Fur harvesting data for the RTCs on and around the Project site are provided in Table 4.2-3 below. The most commonly harvested species for fur is marten.

Table 4.2-3: Fur Harvest Data for RTCs On or Adjacent to Eagle Gold Project (1997 to 2007)

Species	Year									
	1999	2000	2001	2002	2003	2004	2005	2006	2007	Total
Total	**235**	**172**	**88**	**65**	**186**	**102**	**322**	**106**	**128**	**1,404**
Number										
Arctic Fox	–	1	–	–	–	–	–	–	–	**1**
Beaver	1	20	14	–	33	–	11	–	–	**79**
Lynx	–	10	6	6	2	2	18	21	19	**84**
Marten	230	122	62	48	108	98	260	81	97	**1,106**
Mink	2	–	1	2	–	7	–	–	–	**18**
Muskrat	–	8	–	34	–	7	–	–	–	**49**
Otter	–	–	–	–	1	–	–	–	–	**1**
Red Fox	–	4	-	1	2	2	8	–	–	**17**
Squirrel	–	–	–	–	–	–	4	–	–	**4**
Weasel	1	–	–	–	–	–	3	–	–	**4**
Wolf	1	4	4	2	1	–	2	–	4	**18**
Wolverine	–	3	2	7	3	–	3	–	5	**23**

Source: Appendix 3: Eagle Gold Project Land Tenure and Land Use Report.

Commercial Fishing

Commercial fishing accounts for less than 10% of the fish harvested in Yukon, and is concentrated in the Dawson City area. Commercial licences are limited to the larger Yukon lakes, and target lake trout and whitefish (Appendix 17). There is no commercial fishing in the Mayo area or in the vicinity of the Project site.

Forestry and Agriculture

The Project area was historically used for fuel wood harvesting for the early Keno Hill mine operation (Appendix 17). Personal use permits are provided by Energy, Mines, and Resources (Yukon Government). There are no permits issued for the area at this time, but any fuel wood harvesting would be associated with small-scale mine and exploration activities rather than for residential and personal use (Appendix 17).

Minimal agricultural activity occurs in the area of the Project, although Minto Bridge Farms is located north of Mayo on the Silver Trail. The farm is a mixed operation and produces fresh vegetables, root crops, herbs, chickens, geese, ducks, and eggs.

Oil and Gas

There are several sedimentary basins in Yukon with potential for oil and gas deposits; however, none are within or adjacent to the Project area. As such, there is little potential for oil and gas development in the area, and there are no current licences or leases (Appendix 3 – Eagle Gold Project Land Tenure and Land Use Report).

The Peel Watershed is an area of cultural and environmental significance for NND and the surrounding First Nations. Chief Mervyn stated that the FNNND have taken a strong position that oil and gas development will not be allowed in the Peel Watershed (as noted earlier, the Project site is not within this watershed).

Local Services and Businesses

Mayo's economy is beginning to focus on the provision of various services, including government services, to its residents and to individuals living in the surrounding area (VoM 2006a). Tourism is becoming a growing segment of the local economy.

There are currently approximately 42 businesses in Mayo and the surrounding area. The services offered include contracting, accommodations, and food services. The annual Yukon Business Survey results from 2001 to 2008 for the VoM are summarized in Table 4.2-4. The number of employees in the Mayo region peaked in 2007, which correlates with a peak in placer gold production for that year.

Table 4.2-4: Number of Mayo Businesses and Employees (2001, 2003, 2006, 2007, and 2008)

Year	Number of Businesses Reporting	Number of Employees	Average Number of Employees
2001	38	75	2.0
2003	33	57	1.7
2006	35	67	1.9
2007	27	102	3.8
2008	44	79	1.8

Source: Zanasi and Research Northwest (2010).

Small businesses and entrepreneurs in the Mayo area (both FNNND and other) may need training and support to effectively take advantage of opportunities associated with increased development activity in the region.

The VoM currently has the following government services and facilities:

- The Yukon Liquor Corporation
- Department of the Environment Office
- Energy, Mines and Resources Office
- YESAB District Office
- Post Office.

High-speed internet service is available in VoM. Banking services are available four days a week.

The Silver Trail Chamber of Commerce and Tourism Association was established in 1978, and currently has approximately 25 members.

4.2.4.2 Yukon Economic Outlook

The Yukon Government released its annual "Economic Outlook" in May 2010 (ECDEV 2010). The 2010 report's optimistic outlook is consistent with the view of the Conference Board of Canada, which recently noted that the growing demand for metals, and the opening of two new Yukon mines, will be part of a "robust economic expansion" in the territory in 2010. Capstone Mining Corp's Minto copper mine is operational; Alexco Resource Corp.'s Bellekeno silver mine and Yukon Zinc's Wolverine mine are anticipated to be commissioned or begin operations in late 2010. Capital investment for mineral exploration has been high in Yukon in recent years and as a result the territory is one of North America's 2009 economic "bright spots" relative to current economic conditions elsewhere. The Conference Board is forecasting the territory's GDP to rise by 4.9% in 2010 (Conference Board of Canada 2010).

4.2.4.3 First Nation of Na-Cho Nyäk Dun Employment and Labour Force

Workforce by Industry for 2001

In 2001, "*Other services*", "*Health and education*", and "*Manufacturing, construction*" comprised the sectors with the greatest labour force activity for the FNNND (31.6%, 15.8%, and 15.8%, respectively). Males had the highest participation rates in "*Other services*" and "*Manufacturing, construction*" at 29.0% and 25.8% respectively. Females tended to participate the most in "*Other services*" (25.9%) and "*Health and education*" (22.2%)[6].

Workforce by Occupation for 2001

In 2001, "*Trades and related*" and "*Sales and service*", accounted for the top two occupations for the FNNND. Males continued to be most likely employed in "*Trades and related*", with an additional

[6] "This information is from Statistics Canada, and was collected as part of 2001 and 2006 Census data.

14.1% of males reporting this as their occupation in 2001 as compared to 1996. In the First Nation, 29.6% of females had an occupation in "*Sales and service*" and 23.1% had an occupation in "*Management*."

Labour Force Participation Rates

For 1996, the male labour force participation rate[7] for the FNNND was 7.8% higher than the female participation rate. In comparison to 1996 data, 2001 total population participation rates increased slightly (from 73.1% to 73.7%; an increase of 0.6%). Males continued to have a greater labour participation rate in comparison to females. The male labour participation rate (80.6%) was higher by 15.2% than the female labour participation rate (65.4%) for 2001.

In 2001, the FNNND participation employment rate of 73.7% was 1.4% higher than that of Whitehorse's Aboriginal participation rate of 72.3%, but lower than the Yukon's overall participation rate of 79.8%.

Labour Force Employment Rates

Employment rates[8] for the FNNND in 1996 were higher for males in the labour force (71.4%) than for females (62.5%). The total employment rate for the population 15 years and older was 65.4%. In 2001, the total employment rate was slightly higher, at 66.7%. Males maintained a higher labour force employment rate compared to females (74.2% and 57.7% respectively). The Aboriginal population employment rate was lower in Whitehorse (53.5%), but higher in Yukon overall at 70.6%.

Labour Force Unemployment Rate

Yukon's overall average unemployment rate of 6.8% for 2009 was up from its 2008 value of 5.0%. The 2009 average unemployment rate was well below the national average of 8.5% and among the lowest of all the provinces and territories (ECDEV 2010). Anecdotal evidence from community interviews indicates that there is a job available for anyone in the VoM or FNNND that wishes to work (DPRA 2010).

The unemployment rate[9] for FNNND, in 1996, was 10.5%. Females tended to have higher unemployment rates at 11.8% compared to males at 9.1%. Data are not available for 2006, but in 2001 FNNND unemployment was recorded at 9.5%, a 1.0% decrease from 1996. Both male and female members of the FNNND reported relatively similar unemployment rates, of 12.0% and 11.8%, respectively. It should be noted that in 2001, the unemployment rate for the FNNND was lower than Whitehorse's Aboriginal population unemployment rate of 26.0% and the Yukon's overall Aboriginal unemployment rate of 11.6%.

[7] Participation rates refer to the labour force in the week (Sunday to Saturday) prior to Census Day, expressed as a percentage of the population 15 years and over, excluding institutional residents (Census Dictionary 2001).

[8] Employment rates refer to the number of persons employed in the week (Sunday to Saturday) prior to Census Day, expressed as a percentage of the total population 15 years of age and over, excluding institutional residents (Census Dictionary 2001).

[9] Unemployment rates refer to the number of persons unemployed, expressed as a percentage of the labour force in the week (Sunday to Saturday) prior to Census Day, expressed as a percentage of the population 15 years and over, excluding institutional residents (Census Dictionary 2001).

It should also be noted that the employment and unemployment rates with Yukon were volatile from 2000 – 2010. This was likely a result of the closure of a number of mining operations in the area, and global economic influences. Further details on employment in the Yukon can be found in the "Yukon" section of the baseline study report.

4.2.4.4 Labour Force and Employment – Mayo

Workforce by Industry

In 2001, "*Public Administration*" and "*Construction*" comprised the industries with the greatest labour force activity within Mayo (26.2% and 19.0%, respectively). Males' participation rates were highest in "*Public Administration*" and "*Construction*" at 28.0% and 24.0%, respectively. Females' participation rates tended to be greater in "*Public Administration*" (29.4%) and "*Educational Services*" (17.6%).

In 2006, the labour force was not highly varied in terms of the industries in which people were employed. Half of the individuals working in Mayo reported working in the "*Public Administration*" industry—a 23.8% increase from 2001. The majority of males (56.3%) and 50% of females worked in the "*Public Administration*" industry.

Workforce by Occupation

In 2001, *"Trades, Transport, and Equipment and Related Occupations"* and *"Business, Finance, and Administration Occupations"* comprised the occupations with the greatest reported activity in Mayo. Males were most active in *"Trades, Transport, and Equipment Operators and Related Occupations"* and *"Occupations Unique to Primary Industry"* at 40.0% and 16.0%, respectively. Females in Mayo had the greatest presence in *"Business, Finance, and Administration Occupations"*, *"Sales and Service Occupations"*, and *"Social Science, Education, Government Service, and Religion"* at 29.4%, 29.4, and 23.5%, respectively.

In 2006, *"Sales and Service Occupations"* and *"Business, Finance, and Administration Occupations"*, accounted for the top two occupations in Mayo. Males continued to be most likely to be employed in *"Trades, Transport, and Equipment Operations and Related Occupations"*, although the percentage of males working in this occupation decreased by 15.0% between 2001 and 2006 (from 40.0% to 25.0%). In Mayo, 35.7% of females had an occupation in *"Business, Finance, and Administration Occupations"*.

Labour Force Participation Rates

In Mayo, for census year 2001, the male labour force participation rate was 83.3%, in comparison to the female participation rate of 61.5%. Between 2001 and 2006, total population participation rates increased by 3.2%, from 73.7% to 76.9%. Males continued to have a slightly greater (by 2.2%) labour participation rate than females.

Labour Force Employment Rates

Employment rates in Mayo, in census year 2001, were higher for males in the labour force (73.3%) than for females (57.7%). The total employment rate was 64.9%.

In comparison, the 2006 the total employment rate was slightly lower, at 64.1%. Males and females had relatively similar employment levels (60 males and 65 females indicated they were employed). Females had a higher employment rate at 72.2%, compared to males, who had an employment rate of 60.0%.

Labour Force Unemployment Rate

Yukon's average unemployment rate of 6.8% for 2009 was up from 5.0% in 2008. VoM's 2009 average unemployment rate is not available, but it is understood to be somewhat higher than the Yukon average. As stated earlier, anecdotal evidence from the census interviews indicates that there is a 'job available for anyone in the VoM or FNNND that wishes to work'.

Unemployment rates in Mayo, in 2001, were 11.9%; 15 males were unemployed and 10 females were unemployed. Males and females tended to have similar unemployment rates at 12.0% and 12.5%, respectively).

4.2.4.5 Income and Remuneration – First Nation of Na-Cho Nyäk Dun

In terms of income[10], the average total income in 1995 for the FNNND population 15 years and over was $24,104. Females earned an average income approximately $10,000 lower than their male counterparts. In the case of earnings, all persons with earnings earned an average of $23,625.

In 2000, the average income of the population 15 years and over was $25,027. The gender income gap narrowed in comparison to 1996, with males earning approximately $6,000 more than females. The average earnings were $24,273. In comparison, Yukon's population's average earnings were $31,526, while those of the entire Canadian population were $31,757. This shows that the FNNND population earnings are considerably lower than in the Yukon and Canadian populations overall.

4.2.4.6 Income and Remuneration – Mayo

Income data for Mayo in 2005 has been suppressed by Statistics Canada due to its small population size. In terms of income, in 2000 the median income for the total Mayo population 15 years and over was $19,051. Average earnings overall for Mayo residents in 2000 was $24,273, with males recording average earnings of $28,807 and females reporting average earnings of $18,969.

In the case of household income, total private households earned a median income of $39,980, while one-person private households earned a median income of $20,288, and two or more person private households had a median income of $54,400.

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[10] Earnings or employment income refers to "total income received by persons 15 years and over during calendar year 2005 as wages and salaries, net income from a non-farm unincorporated business and/or professional practice, and/or net farm self-employment income" (Source: Internet, http://www12.statcan.ca/census-recensement/2006/dp-pd/prof/92-591/details/page_Definitions.cfm?Lang=E&Geo1=PR&Code1=60&Geo2=PR&Code2=01&Data=Count&SearchText=Yukon%20Territory&SearchType=Begins&SearchPR=01&B1=All&Custom=&LineID=29000).

4.2.4.7 Economic Development – First Nation of Na-Cho Nyäk Dun

The Na-Cho Nyäk Dun Development Corporation is involved with a number of enterprises including the Mayo grocery store and restaurant, and a number of joint ventures and relationships with various companies that provide services to mining facilities. The joint ventures that service mining companies are well established and include services offered by ESS Support Services, a part of the larger Compass Group. ESS Support Services provides turnkey camp supply, camp management, and catering in remote locations (Zanasi and Research Northwest 2010). Shuttle service between Elsa and Mayo has been provided to Alexco Resources.

The FNNND has an interest in the expansion of the new housing subdivision near the government house (these are FNNND rather than private homes).

The FNNND currently has a regional partnership with other Northern Tutchone partners—the Selkirk, and the Carmacks Little Salmon First Nations. In addition to partnerships or joint ventures, the government of the NND sees value in encouraging individual entrepreneurs or individuals interested in starting their own businesses and joint ventures.

4.2.4.8 Employment – Whitehorse

In 2006, 73.1% of Whitehorse's total population 15 years of age and older was employed. For the same period, the unemployment rate was 7.3%. Males and females had similar employment levels in 2006, with 5,930 males employed and 5,990 females employed. The greatest portion (22.9%) of the total population in the labour force work was in the *'Public Administration'* industry, with 25.6% of females versus 20.1% of males working in this industry.

Individuals in Whitehorse 15 years and over with employment income reported a median 2005 income of $34,201. This is a higher median income compared to Yukon as a whole, where median income in 2005 was $31,525 and compared to Canada, where the median employment income was $25,615 for the same year.

4.2.4.9 Employment – Yukon

According to the Statistics Canada Labour Force Survey, for 2010, "there was little overall change in the Yukon labour market in the second quarter compared with a year earlier. The unemployment rate in the Yukon was 7.8%, little changed from a year earlier" (Yukon Bureau of Statistics 2010b). Yukon's own statistics (June 2010) show an unemployment rate which is closer in line with the national average of 7.9% (Yukon Bureau of Statistics 2010b). Yukon's unemployment rate in 2006 was 4.9%—far lower than the national rate of 9.4% that Statistics Canada recorded during its mid-May Census Day. This indicates that there are some discrepancies in the collection of labour force data within the Yukon, which could impact how statistics are interpreted. The YG collects statistical data monthly. Statistics Canada and Yukon government are addressing changes in methodology in January of 2011.

In 2006, 24.0% of the population worked in public administration related jobs. Sales and Service was the next largest occupation category at 23.1%. The median income in Yukon was $31,352—higher than the Canadian median income of $25,615. The average full-time worker (working year-round) earned about $37,908.

4.2.5 Traditional Activities and Culture

The FNNND has prepared a 5-year strategic heritage development plan (FNNND 2007a) that identifies priorities relating to traditional knowledge, language, heritage sites and special places, a cultural centre, governance policy and guidelines development. An implementation plan was also prepared. While FNNND staff noted that the plan is somewhat dated, it is still used as a planning guide by FNNND.

4.2.5.1 Subsistence Harvesting

At community meetings, FNNND citizens noted the importance of several areas in the vicinity of the Project for traditional activities including hunting, fishing, trapping, and gathering. FNNND elders and staff indicated that citizens still rely on traditional foods—berries, fish, moose, deer, small game, and birds—as a significant portion of their diet. These traditional foods are shared with those who may not be able to obtain it directly (e.g., single mothers, elders).

Hunting, fishing, and harvesting are also very important aspects of Northern Tutchone culture and diet, and for continued monitoring of the land. Northern Tutchone people have always relied heavily on the foods of the forests and the rivers. Moose, caribou, sheep, grouse and fish, as well as many types of plants and berries are harvested and preserved to last through the seasons.

Hunting

Elders have reported that the moose population in the Dublin Gulch area has been declining, likely due to the noise and activity in the area resulting from placer and quartz mining activity. The Project lease area, NND lands south of the lease area, and the Potato Hills have been identified as important moose habitat by elders. Local waterways, including the Mayo River and the South McQuesten River, are used for travelling and hunting.

Woodland caribou populations in the Project area have declined dramatically since the 1950s (Appendix 4 – Eagle Gold Project Historical Resources Baseline Report), a decline attributed by elders to overharvesting for the mining camps. Caribou typically are not found in the Project area; FNNND citizens harvest caribou to the east (Mount Patterson and Wernecke Mountains) and near Ethel Lake (to the south of Mayo), but a voluntary no-hunt policy is in place for Ethel Lake.

As indicated by the FNNND through the Traditional Knowledge Study conducted for the Project, Sheep have historically migrated through the Mount Haldane area, and occasionally tracks have been observed in Dublin Gulch. Deer populations are increasing in the area. As a result, so are cougars (Appendix 4). Both grizzly and black bears are known in the Project area, as are wolves. Grouse and ptarmigan are hunted in the Project area.

Fishing

The McQuesten, South McQuesten, Mayo (e.g., near the Wareham dam) and Stewart Rivers are used for fishing by FNNND citizens, as are many lakes in the area. Many families have fish camps set up along the Stewart River that have been used for generations. There is also a camp at Fraser Falls (northeast of Mayo) on the Stewart River that is used by several families as well as culture camps hosted by FNNND.

FNNND citizens gather at a large eddy beneath the Fraser Falls where salmon congregate and are easy to harvest, although the size of fish is reported by FNNND citizens to be smaller than in the past. With the construction of the Mayo hydroelectric plant, salmon disappeared from the Mayo River.

Previous studies have reported the presence of Chinook salmon rearing in Haggart Creek and the South McQuesten River. Salmon previously observed in Haggart Creek were juveniles (1+ years old) and were not of a suitable size for fishing. There is no known record of Chinook salmon presence in Dublin Gulch or its tributaries.

The Haggart Creek watershed provides habitat for Arctic grayling and a number of forage fish species. However the FNNND has not reported frequent fishing usage of Haggart Creek for Arctic grayling or any other species. People interviewed as part of the Traditional Knowledge Study for the Project reported that grayling populations have decreased in Haggart Creek.

Please see Section 6.7 for more information regarding fish distribution in the Project area.

Trapping

Registered Trapline Concessions (RTCs) adjacent to the Project are held by FNNND citizens, and provide both economic benefits as well as preservation of traditional activities. The Na-Cho Nyäk Dun Fish and Wildlife Planning Team (2008), note that fewer citizens are participating in trapping for a number of reasons, including higher fuel prices, lack of interest, and difficulty obtaining trap lines.

4.2.5.2 Language Preservation and Revitalization

As stated earlier, the FNNND represents the most northerly community of the Northern Tutchone language and culture group in the Yukon. There are currently several initiatives in the community to teach and promote language use. These include initiatives in the J.V. Clark School, daycare, the FNNND Government House, and the community. In addition to the regular curriculum, the school offers a Northern Tutchone curriculum. However, the school’s curriculum is dated and does not fully serve all grades (K through Grade 12). In the 2008 ICSP, the loss of the Northern Tutchone language and traditional practices were noted as major challenges.

In 2001, for both Yukon and the FNNND, English is the most commonly known language (approximately 80% for both). In FNNND, females were slightly more likely to have knowledge of Aboriginal language(s) compared to males (7.3% compared to 7.0%, respectively); this is consistent with Yukon as a whole. However, FNNND citizens were less likely than the overall Yukon Aboriginal self-identified population to understand, speak, or have knowledge of an Aboriginal language.

4.2.5.3 Other Cultural Activities

The FNNND also offers a number of “on the land” programs, including day-trips for medicine gathering, fishing and hunting camps for youth, and an archaeological camp, as well as some longer trips. Programs for jigging, beading, and other craft work are also offered.

Ongoing activities organized by the FNNND include:

- Traditional food lunches at the school
- Teacher cultural orientation
- Participation at other First Nation events (Moosehide Gathering, May Gathering)
- Traditional pursuits funding to assist people to get out on the land
- Old Village Day, Aboriginal Day, Self-Government Day
- Elders in the school and daycare.

Recent initiatives include:

- Renewed linkages with Fort Good Hope (NWT) families
- Hide tanning workshop
- Knife making workshop
- Wind River canoe trip.

Many of the First Nation arts and crafts are sold at Binet House and the NND office.

The FNNND has worked with the proponent and contractor for the Mayo B project in an effort to provide cross-cultural awareness and training, and events such as country food feasts.

In discussions with FNNND staff, it was noted that there is a need to further develop a traditional pursuit program for adults to further enhance the traditional culture in the community.

4.2.5.4 Heritage Sites and Special Places

Although the entire FNNND Traditional Territory is important, there are several noteworthy places which the Elders and community have identified through the strategic planning process. FNNND’s five-year strategic heritage development plan (FNNND 2007a) identifies priorities relating to heritage sites and special places. The Strategic Plan identified the following heritage sites of value to FNNND:

- Ethel Lake (southwest of Mayo)
- Old Village (just west of Mayo on the Stewart River, see Figure 4.2-2)
- Boats such as the *Yukon Rose*, *The Loon*, and *The Peter’s Boat*
- Lansing Post (Stewart River east of Mayo at Lansing Creek)
- Burial sites
- Foot trails
- Fraser Falls

- Old Revival Building in Mayo
- No Gold Creek (southeast of Mayo).

There are trails in the Potato Hills and in the South McQuesten River Valley that have been used by NND members for generations (Stantec 2010).

4.2.6 Community Vitality

Community vitality, for this report, consists of demographic trends, education levels, measures of community well being, levels and types of crime, range of volunteer organizations and community events, and types and extent of recreation and leisure activities within a community.

4.2.6.1 First Nation of Na-Cho Nyäk Dun Demographic Trends

Recent Population Trends

In December 2009, FNNND's population in the VoM was reported to be approximately 226 persons (approximately half of the VoM's total population of 453 in 2009)[11]. Between 2008 and 2009, the FNNND population in Mayo decreased by 2.8%. No births were recorded. Slightly less than 400 other FNNND citizens live in other parts of Yukon and elsewhere (FNNND 2008d). The total FNNND membership is currently 602 citizens (Appendix 4).

Age and Gender Distribution

The majority of the FNNND population was in the age range of 20 – 64, in both 2001 and 1996. The median age for the FNNND population in 2001 was 36.5 years. Males had a slightly higher median age of 37.3 years compared to 35.9 for females.

Mobility Status

Mobility status refers to the movement of individuals over the course of an allotted time period. The FNNND population is relatively stable compared to Yukon's total population. In 2001, 81.5% of Yukon's total population was non-movers over the previous one year compared to 94.5% of the FNNND population[12]. For 5-year mobility status, 51.3% of Yukon's total population was non-movers compared to 79.7% for the FNNND.

[11] This population estimate is based on the FNNND's statement that half of the population of Mayo reported by Yukon's Health Care Registration file are FNNND citizens.

[12] Statistcs Canada defines non-movers as "persons who, on Census Day, were living at the same address as the one at which they resided five years earlier"

4.2.6.2 Mayo Demographic Trends

Recent Population Trends

As of December 2009, Mayo's population was reported to be 453 persons[13]. Approximately half of those residents are FNNND citizens[14]. The population has decreased by 2.8% from 2008. Looking over the 10-year period from the end of 1999 to the end of 2009, the population of Mayo has remained relatively stable.

Age and Gender Distribution

Across the census years considered, the largest proportion of Mayo's population can be found in the 40 to 49 years of age category (for 2001 and 2006), or in the 25 to 54 years of age category (for 1996). Mayo tends to have a relatively equal gender distribution; however the number of males and females in the different age categories varies[15].

Mobility Status

In both 2001 and 2006, the majority of individuals were non-movers over the previous one year and over the previous five years. However, in 2006 a greater portion of the VoM population was classified as movers over the previous five years.

4.2.6.3 Whitehorse Demographic Trends

In June 2010, Whitehorse's population was 26,418 (Yukon Bureau of Statistics 2010a). The city's population has been increasing, with an increase in total population of 5.3% from December 2008 to December 2009.

The number of males and females in Whitehorse is generally evenly distributed with 49.2% of the total population being male and 50.8% of the total population being females. The percentage of the population of Whitehorse over the age of 15 years has increased by 7.4% from 1996 to 2009. This indicates a slightly aging population.

4.2.6.4 Yukon Demographic Trends

The Yukon population increased by 2.2% in 2009 to 34,124 (the sixth consecutive year of growth), and is anticipated to grow by 1% to 34,500 in 2010. The population in the Yukon has been increasing since 1961 when the population was 14,628.

Aboriginal peoples accounted for 25% of Yukon's total population in 2006. The majority of the Aboriginal population identifies as being part of the "North American Indian" cultural group.

[13] This population estimate is based on Yukon's Health Care Registration file and includes all persons who have reported their address as being in the Village of Mayo, therefore the number does not compare to the census population estimate.

[14] This population estimate is based on Yukon's Health Care Registration file and includes all persons who have reported their address as being in the Village of Mayo, therefore the number does not compare to the census population estimate.

[15] It should be noted that Statistics Canada has repeatedly changed how it presents age data. In IN 1996, the category was 25 to 54, In 2001, 25-44 and 45-54. In 2006, Statistics Canada began to "break down" age data into 5 year ranges eg 40 to 44 , 45 to 49, 50 to 54

Generally speaking, in 2006 there were equal numbers of men and women, but the oldest people in the territory were men. Based on the 2006 census, the largest age groups were persons in the 40 – 49 and 50 – 59 age ranges. Overall, the Yukon population over the age of 15 years increased by 4.5% from 1996 to 2009. This indicates an aging population, which is typical for small natural resource-based communities.

4.2.6.5 Education and Capacity Development (First Nation of Na-Cho Nyäk Dun and Mayo)

VIT conducted an education and training gap analysis as part of the Project. Community contacts have indicated that there is a relatively small pool of skilled labour resources within FNNND. Education and training are needed in a range of areas that will not only meet the needs of development projects, but provide legacy value in the long-term. FNNND citizens and Mayo residents need not only job and career training and education, but life skills training as well. Several of those interviewed for the socio-economic study noted the need for local people to establish long-term, year-round “careers” rather than just “jobs” that may be temporary or seasonal. However, some individuals continue to be interested in seasonal work rather than longer-term employment.

Students leaving the community for educational purposes often do not return; those with a desire to do so are faced with a housing shortage in the community.

Primary and Secondary Education

The J.V. Clark School in Mayo offers education up to grade 12. Approximately 10 years ago the school’s enrolment was estimated at 80 students; in 2010 there are 63 students. Approximately 70% of students are Aboriginal (mostly FNNND citizens, but also other First Nations). Enrolment has been declining; in the period 2004 through 2009 it declined by 23 students (88 students to 65 students).

Post Secondary Education

One of 13 Yukon College campuses is located in Mayo (with 1.6 full time equivalent staff). Co-located with the J.V. Clark School, the campus concentrates on distance education as well as the provision of local courses and career counselling. Students are typically from Mayo, but also Pelly Crossing and Dawson, as well as other communities. The funding for the Yukon College programs comes from the federal government (e.g., INAC), the Yukon Government, and the FNNND, as well as specific program funds that may come from other sources (including the Yukon Mine Training Association, industry, academia).

Educational Attainment – First Nation of Na-Cho Nyäk Dun and Mayo

The education statistics for FNNND in 2001 showed that the majority of those over the age of 15 years have a certificate, diploma or degree. 64.1% of FNNND residents over the age of 15 obtained a certificate, diploma or degree, with 35.9% not having a certificate, diploma or degree. In 2001, 66.7% of NND males and 38.5% of NND females had achieved a certificate, diploma or degree. By contrast, in 2001, 71.6% of Yukon residents over the age of 15 had obtained a certificate, diploma or degree. 74.6% of Yukon's male population and 80.0% of Yukon's female population had achieved a high school diploma or higher. Statistics for FNNND were not available for 2006.

Education statistics for 2006 showed that 64.1% of Mayo residents over the age of 15 have a high school diploma (or equivalent) and higher. Conversely, 35.9% of Mayo residents over the age of 15 do not have a "certificate, diploma or degree". The data indicates that males are slightly less likely than females to have a certificate, diploma or degree. Males have a greater portion of apprenticeship or trades certificates or diplomas compared to females (15.0% for males and none indicated for females). Females are more likely to have a university certificate, diploma, or degree compared to males (10.0% for males, 16.7% for females). By comparison, at the territorial level in 2006, 77.4% of Yukon's population over the age of 15 had a diploma, certificate or degree, 22.6% did not. Overall, 74.6% of Yukon males and 80.1% of Yukon females indicated they had at a post-secondary certificate, diploma or degree.

Educational Attainment – Whitehorse

Nearly 80% (79.6%) of the total population of Whitehorse has some form of formal education. Based on 2006 statistics, high school certificate or equivalent is most common in Whitehorse with 24.2% of the population indicating its attainment, followed by college, CEGEP or other non-university certificate or diploma at 20.8% and university certificate, diploma, or degree at 19.6%. Females are more likely than males to have attained higher formal education (6.1% more females earned college, CEGEP, and non-university certificates or diplomas than males, and 2.7% more females earned university diplomas and degrees than males) with the exception of apprenticeship or trades certificates or diplomas (where more than 2.5 times as many males earned a certificate or diploma than females).

4.2.6.6 First Nation of Na-Cho Nyäk Dun Community Well-being Index

The INAC Community Well-being Index (CWB) is used as a way to measure the general well-being of a community. The CWB is based on four primary indicators which include education, labour force activity, income, and housing conditions. The CWB score for Mayo (First Nation and non-First Nation population collectively) in 2006 was 79 (INAC 2010b), which is 22 points above the Canadian First Nation CWB average of 57 (INAC 2010a). In the territories (Yukon, Northwest Territories [NWT], and Nunavut) the average CWB scores for First Nation communities was 66 in 2006; higher than the overall Canadian average, but below the Mayo CWB score of 79 (INAC 2010a).

4.2.6.7 Spatial Price Index

An issue of concern is the high price of food and the impact it has on elders and individuals on social assistance, because they do not have the ability to travel to Whitehorse to shop as others do, and must rely on the one local grocery store in Mayo. The cost of living in Mayo is higher than in Whitehorse, and has been slightly increasing since 2008. The high cost of food reinforces the role of the traditional economy and traditional foods. A Spatial Price Index is a comparison of prices of a specific basket of goods and services in different localities. The spatial price index in Mayo (122.2 in

2010, with Whitehorse being 100) is the second highest for communities in Yukon (Old Crow is higher at 218.2 in 2010).

4.2.6.8 Crime

Approximately 40 criminal code offences are reported in Mayo each year, and the level of crime is seen to be less than elsewhere in the Yukon. In the past year, there appeared to be an increase in offences, perhaps 15%.

The Royal Canadian Mounted Police (RCMP) detachment in Mayo noted that alcohol is linked to many of the calls they respond to, including public intoxication, domestic and other assaults, break and enters, impaired driving, and bootlegging. While there is use of non-prescription drugs in Mayo, the RCMP viewed their use as having a less prominent role in social disruption than alcohol. Bootlegging, impaired driving and drugs were some of the main issues discussed at a May 10, 2010 community safety meeting in Mayo. This meeting was conducted independently of the Project and did not include involvement by VIT.

Data on the crime rate in Mayo for a six-year period (2003 – 2008) indicate that the total number of criminal code offences (excluding traffic violations) reached a peak in all types of crimes in 2006, and then decreased. The percentage of violent crimes within the VoM has declined over the years from almost 20% in 2003 and 2004 to just 8% of crimes in 2008. Property crimes have been slightly fluctuating over the six-year term.

The Mayo Interagency Group's feasibility study (Nota Bene Consulting Group 2008) identified youth crime as one of the key issues to be addressed in Mayo. For the Yukon, both the youth crime severity index and youth violent crime severity index increased substantially from 2008 to 2009, at a level similar to Nunavut, while the indices decreased for both the NWT and Canada as a whole. It is not clear how this might relate to youth crime in Mayo or to FNNND (local statistics are not available).

Crime in Whitehorse has been on an increase following a crime activity low in 2006. The percentage of violent crimes within the City of Whitehorse have remained relatively stable around 12.0% to 12.4% of all crimes since 2003 when violent crimes peaked for the reported six year period (2003 to 2008) at 13.7%. Property crimes on the other hand have been fluctuating over the same six year period with a high of 31.9% of crimes being property crimes in 2003 and a low of 19.4% of property crimes in 2008. *'Other criminal code crimes'* make up the majority of criminal offences in Whitehorse (68.2% in 2008).

4.2.6.9 Community Organizations and Events

There are several community events held throughout the year by the Village for its residents and surrounding communities. The FNNND prepares monthly calendars of events to inform residents. These include:

- Annual Art Fest and Marathon
- Winter Carnival
- Fireman's Ball (at Christmas time)

- Mayo Midnight Marathon
- Dances
- Halloween Party
- Canada Day celebrations.

The community enjoys a wide range of community organizations, including:

- Silver Trail Chamber of Commerce and Tourism Association
- Fly-by-Night Running Club
- Mayo Ranger Patrol and Mayo Junior Ranger Patrol
- Royal Canadian Legion
- Mayo Agricultural Society
- Mayo Historical Society
- Volunteer fire and ambulance services
- Mayo District Renewable Resources Council
- Mayo Aboriginal Women's Group
- Women's Interdenominational Group
- Mayo Community Club
- Mayo Carnival Society
- Stewart Valley Voice Newspaper
- Mayo Wellness Team
- Mayo Recreation Board
- Mayo Curling Club.

For a small community, the number of community events and organizations is relatively high.

4.2.6.10 Recreation and Leisure

Recreation Facilities and Programs

The VoM has two gymnasiums, an outdoor swimming pool, a tennis court, skateboard park, arena, curling rink, and a fitness facility (located at J.V. Clark School). Volleyball and horseshoe pits, a gazebo and playground are all within walking distance. There is also a Youth Centre. In addition, the VoM is redeveloping the baseball field and adding a sports court and sliding hill in 2010. One full-time employee is responsible for community and recreational facilities in Mayo. All of these facilities are available to residents and visitors free of charge (with the exception of swimming programs). Recreational programs are offered four nights a week.

Sport Hunting

Moose is the most commonly harvested big game species in the area. In the period 1999 through 2008, 218 moose, six grizzly bears, eight caribou, and 13 black bears were harvested (Appendix 17). Woodland caribou are harvested near Keno City, at Ethel Lake (southwest of Mayo), and along the Dempster Highway. FNNND has a voluntary "no-hunt" policy for caribou at Ethel Lake. Wildlife biologists familiar with the area noted that while woodland caribou are wide ranging, data indicate that the Project site is peripheral to the range of the Clear Creek herd which is largely on the opposite side of the North McQuesten River. This would explain why caribou hunting in the Project area has not been reported.

Sport Fishing

First Nations, residents and non-residents enjoy fishing as a popular year-round activity in the area, for subsistence and sport (Appendix 17). Arctic grayling fishing in the area has been declining in recent years. Yukon domestic and recreation salmon fisheries were closed in 2008 due to declining returns. Arctic grayling is the most popularly fished species in the area. Northern pike and lake trout are fished in the region's lakes.

Other Unorganized Recreation and Leisure

There is an extensive network of rough roads and trails around Mayo, Keno City and Elsa that provide back country access in all seasons to both residents and tourists (Appendix 17). Residents also utilize the local waterways for kayaking, canoeing and boating. Seasonal berry-picking and mushroom picking is enjoyed by some residents.

4.2.6.11 Cultural and Historical Places of Interest

The VoM has a rich history. The site of Mayo was used as a traditional camp by the FNNND. The Village is named after Alfred H. Mayo, who traded in Yukon before the Gold Rush of 1898 (Appendix 17). Prior to becoming a service centre for significant mining activity in the area, Mayo was established as a river settlement; as it was the farthest navigable point up the Mayo and Stewart rivers by steamboat. The permanent community of Mayo Landing was established in 1903 (Appendix 17), and was incorporated as a village in 1984.

Two well known cultural and historical features in the VoM include the TransCanada Prince of Wales Trail, and the Binet House Interpretive Centre and Museum. For further information on the culture and history of Mayo, the Mayo Historical Society is a local community group, and several books have documented the unique culture and history of the area (e.g., Mayo Historical Society 1999; Aho 2006; Bleiler, et al. 2006).

4.2.7 Human Health and Well-being (FNNND and Mayo)

4.2.7.1 Mayo Interagency Group and Local Health and Social Services

Health and social services in Mayo are administered by four levels of government: the FNNND, the VoM, the Yukon Government (YG), and the federal government. In 2002 the Mayo Interagency

Group, comprised of staff from each level of government was established to share information between the various service delivery providers.

In 2008, a feasibility study examining alternative social services delivery was prepared for the Mayo Interagency Group (Nota Bene Consulting Group 2008) with the objective of developing a long-term plan for an integrated health and social services delivery system that will address the gaps in services and meet the needs of Mayo area residents. The feasibility study included two primary recommendations:

1. Building community capacity and collaboration
2. Building capacity through training, education and underfilling (i.e., appointing a person who is not fully qualified at the time of interview) positions.

The FNNND (2008d) noted the need for the following programs or improvements: addictions prevention and treatment, home visits, after care, access to appropriate counselling, and nutrition and healthy lifestyle programming.

4.2.7.2 Local Health and Social Facilities

The Yukon Government is moving forward with plans to construct a regional hospital in Dawson City, which will serve the VoM and surrounding area communities. The official sod turning took place on June 23, 2010 (Yukon Health and Social Services 2010). Until it opens, patients requiring hospital care must travel to Whitehorse by road or plane.

Mayo Health Centre

Mayo has one health clinic serving its residents. The clinic currently has two nurses and one doctor. The doctor who serves the Mayo Health Centre is based in Mayo and services the communities of Pelly and Carmacks, which have their own clinics. The health clinic is open Monday to Friday from 8:30 am to 5:00 pm with telephone access for emergency or after-hours care. A third nurse on staff is seen as a priority need.

The clinic has an outpatient focus providing family health care, paediatric and prenatal care, chronic care, minor surgeries which can be performed under local anaesthetic, and initial acute care prior to patients' transfer to other locations. The Mayo Health Centre also provides facilities for a dentist, who visits the community once every three months for three to four consecutive days. In addition, the centre receives visiting specialized support programs on a rotational basis and as needed. Other resources available include a trauma room, x-ray facility, and a basic pharmacy that can supply emergency medications.

The Mayo Health Centre has recently been connected to an online x-ray service which allows for x-rays to be read by specialists in various major centres (such as Edmonton and Vancouver).

First Nation of Na-Cho Nyäk Dun Drop-in Centre

The FNNND Drop-in Centre, located in the former FNNND government building in Mayo, is a community resource providing counselling and training services. Until recently, the Centre employed one full-time counsellor. A consulting counsellor based in Dawson City visits Mayo on a monthly basis, and more frequently if needed. The Centre has identified a need for life skills training in the community as well as counselling to help individuals deal with various abuse issues and dysfunctional social behaviours.

Due to a lack of funding for renovations and operational costs, it was decided for the time being that the centre would be open only on an "as needed" or activity basis. FNNND departments are encouraged to use the centre, and other support agencies, when in town, are welcome to meet with clients at the centre.

4.2.7.3 Local Health and Social Services

The following permanent on-going health and social services are available in or to Mayo:

- Yukon Government Social Services – Social Assistance, Social Worker
- NND Social Services – Social Assistance, Home and Community Care, Alcohol and Drug Treatment Referrals
- Alcoholics Anonymous – Alateen – Telephone and internet meetings available daily
- Youth Centre (Monday, Thursday, Friday 3 – 6pm, Saturday and Sunday 1 – 6pm)
- Village of Mayo Recreation (Tuesday – Friday 7pm)
- Daycare (Monday – Friday, 8am – 5pm)
- Library (Monday – Wednesday 12:15 – 5:15, Thursday 12:15 – 4:15)
- Elders Beading Wednesday Night, recreation and cooking on Tuesday and Thursday afternoons
- CORE program – snowmobile, ATV, firearm, boating, first aid, bear aware safety courses for youth
- Breakfast for learning – provided by FNNND
- Meals on Wheels – provided by FNNND.

In addition, the following health and social services are available weekly or bi-weekly in or to Mayo:

- Nursing Station – Well Women Clinic (Monday 1 – 3pm)
- Prenatal Clinic (Tuesday 1 – 3pm)
- Well Baby Clinic and Adult Immunization (Wednesday 1 – 3pm)
- Footcare (Thursday 1 – 3pm)
- Telehealth AA group (Friday 1:30pm)
- Many Rivers – Lindsay Brown (every other week) plus now working on getting phone appointments set up with a female counselor
- Alcoholics Anonymous Meeting – Frank Paterson, (Wednesday at 7pm)
- Probation Services.

The Child Development Centre provides health and social services on a monthly basis in Mayo.

Several other health and social services are available in and to Mayo either on demand or through recent contracts:

- Mental Health Services – Brenda Baxter (Dawson) and Whitehorse Services
- Adult Protection Services
- Yukon Council on Disability (train and educate on how to work with disabilities or provide employment for persons with disabilities)
- Alcohol and Drug Services (Outreach worker – Sandra Armstrong; Prevention Worker – still to be determined)
- Yukon Government Health Promotion
- Mothers Against Drunk Driving Canada
- Yukon Government Healthy Families Worker
- Learning Disabilities Association of Yukon
- Fetal Alcohol Syndrome Society of Yukon (FASSY)
- Blood Ties Four Directions
- Northern Tutchone Council Crisis Services (Lois Joe)
- CrystalMeth BC and various other educational and prevention orientated organizations.

A wide array of health and social services are located outside Mayo but are available to Mayo residents. They include:

- Anti-Poverty Coalition
- Autism Yukon
- Blood Ties Four Directions
- Committee on Abuse in Residential Schools
- Canadian National Institute for the Blind
- Challenge
- Chronic Conditions Self Management Program
- Dawson Shelter
- Food for Learning
- Haines Junction Development Society
- Help and Hope Society – Watson Lake
- Hospice Yukon Society
- Kaushee’s Place – Women’s Transition House
- Mary House (Grocery Bag Service)

- Recreation and Parks Association
- Salvation Army (Shelter)
- Second Opinion Society
- Signpost Seniors
- Skookum Jim Friendship Centre
- Sports Yukon
- St. Elias Seniors
- Teegatha ‘O Zheh (a home for mentally disabled adults in Whitehorse)
- Teen Parent Access to Education Society
- United Way
- Victoria Faulkner Women’s Centre
- Yukon Association for Community Living
- Yukon Council on Aging
- Liard Basin Task Force Youth Intervention Worker.

4.2.7.4 Mental Health

There is no data on the extent of specific mental health issues in the FNNND and VoM. However, Mayo, like many First Nation communities, has been affected by residential school traumas and further traumatized by the fall-out from a residential school having been located within the local community. The extent of various mental health issues in the community could well be attributed to this experience. Some of the mental health issues are also linked to substance abuse and addictions.

4.2.7.5 Addictions

According to the alternative Social Services Delivery – Feasibility Study (Hume, et al. 2008):

> *The RCMP statistics [show] that the most frequent charges of violations cited were those that were ‘strongly alcohol related’. “Client statistics for April 2007 to March 2008 for the Health Centre show 8% (467 of 5828) of patient visits were directly related to alcohol consumption. Seventy-one (15%) of these alcohol-related patient visits were for those under the age of 30, and 396 (85%) alcohol related visits for those over the age of 30. The majority (85%) were identified as First Nations”* (Hume, et al. 2008, p. 10).

The current system for someone who is a registered First Nations person and serious about making positive changes, consists of a 6-step evaluation and treatment process that is government funded. YG alcohol and drug services do offer an intensive 28-day program in Whitehorse, but it is done in a very clinical setting, and only offers individual female or male sessions.

Hume, et al. (2008), when researching for The Mayo Alternative Social Services Delivery – Feasibility Study found the following:

> *According to statistics from the Mayo Health Clinic, from April 2007 to March 2008, there were 324 acute care visits related to mental health conditions. This includes people who were experiencing an acute breakdown or needing to have medications reviewed and changed. An additional 212 mental health visits were recorded under 'community health', which includes in-home support provided by nursing staff (p. 12).*

The 2008 feasibility study (Nota Bene Consulting Group 2008) noted that substance abuse is one of the key challenges in Mayo. Interviews with the RCMP and staff at the Mayo Health Centre both indicated that this is the case. Marijuana has been present for some time, but crack cocaine and ecstasy are now a concern. Combined with alcohol, this sets the stage for violence and addiction. Alcoholics Anonymous meetings are regularly held in Mayo. Several crisis lines are available should residents wish to use them (e.g., residential schools, victim services). During the interviews for the socio-economic study, it was noted that in some cases individuals are transitioning from substance abuse to gambling.

As shown in Table 4.2-5, liquor volume and sales in Mayo show an increasing trend from 2006 – 2007 to 2008 – 2009. The volume of liquor sold increased by 9.8% (i.e., 102 hectolitres) from 2006 – 2007 to 2008 – 2009.Expenditures on sales of liquor increased by 12.9% (i.e., $77,000) from 2006 – 2007 to 2008 – 2009.

Table 4.2-5: Liquor Sales in Mayo

Category	Mayo		
	2006/2007	2007/2008	2008/2009
	Hectolitres		
Volume of Liquor Sold	926	982	1,038
	Dollars ($)		
Sales of Liquor	$518,000	$572,000	$595,000

Source: Yukon Liquor Corporation (2008, 2009)

4.2.8 Infrastructure and Services (FNNND and Mayo)

4.2.8.1 Housing

The VoM and the FNNND are both faced with a shortage of available housing (FNNND 2008d). Land suitable for new housing is limited within the confines of the Village itself, although a new subdivision has been built near the FNNND Government House just outside Mayo.

Discussions with FNNND staff indicate that citizens who would like to return to Mayo are limited by the lack of housing; there is currently a waiting list of 70 for FNNND housing. FNNND has an inventory of approximately 90 homes; more than half of those are multi-family dwellings. Approximately 70% – 80% of the FNNND housing needs to be upgraded. The average repair cost to

FNNND houses in need of repairs was estimated in the 2007 Pilon inventory to be $15,000, with the renovation and repair estimates varying from a few thousand to over $50,000. The primary cause of disrepair is the constant problems associated with poor ground conditions, in particular permafrost (Inukshuk and Jacobsen 2008).

The VoM is experiencing a housing shortfall and requires more building lots for residential development. There is potential for six to eight new lots near the community arena as well as discussion of developing a country residential area in the future near 5 Mile Lake. The permafrost nature in the Village is a limiting factor. Looping of the water line is also a community requirement that is of consideration for the future. In 2006, approximately 42% (41.7%) of occupied dwellings within the village were privately owned. Rented dwellings and First Nations housing each account for 29.2% of private dwellings.

4.2.8.2 Emergency Services

VoM has an emergency plan and has welcomed the FNNND to participate in mock exercises. As of January 2008, there was no formal joint emergency preparedness plan in place (Inukshuk and Jacobsen 2008).

RCMP

The Mayo RCMP detachment has a normal staff level of three officers. The number of criminal call offences per year ranges between 30 to 40 and most of the offences in the Mayo area are alcohol-related. The Mayo RCMP patrols a large geographic area that includes Elsa, Keno City, Stewart Crossing, and north towards the Northwest Territories border, much of which is not accessible by vehicle.

Fire Department

The VoM has two fire trucks and one rescue truck (which is equipped with the Jaws of Life). The Fire Department is staffed with approximately 10 – 15 volunteers. There are only a small number of fire calls in the community, approximately two calls per month—many of which are false alarms and chimney fires—and about two calls a year for actual house fires. The Fire Department provides services to an area within a 5 km radius of Mayo. The Yukon Government provides support to the village’s fire department in the form of fire safety inspections, training assistance, and other expertise as required (Inukshuk and Jacobsen 2008).

Ambulance Service

Ambulance emergency services are provided through funding from the Yukon Government. Ten volunteers (drivers and trained attendants) staff the Ambulance Services in Mayo, with two staff on call at all times.

Services are not provided directly to mine sites, however, there is an understanding with the various mining operations that injured personnel transported by the proponent to a pre-determined location will be transported via Mayo ambulance service to the Mayo medical clinic or to the airport for evacuation to Whitehorse or other locations depending on the severity of injuries and treatment required.

4.2.8.3 Landfill and Recycling

A landfill located to the northwest of Mayo on the Silver Trail is operated by the VoM, servicing the community and FNNND, as well as placer miners in the area. Approximately 500 – 600 people use the landfill and generate 365 tonnes of garbage per year (Inukshuk and Jacobsen 2008). A lifespan of approximately 15 years was projected for the landfill in 2006 (VoM 2006a). The VoM is currently considering development of a Regional Landfill as a business opportunity.

A recycling depot offers limited services for the area. Improved recycling services have been identified as a priority by both FNNND (2008d) and the VoM (2006a). The community is building a new recycling depot, which is expected to be finished in June 2011.

4.2.8.4 Community Services and Public Works

Most village residences are serviced by piped water. The village water supply is a shallow, cold-water well (Inukshuk and Jacobsen 2008).

Most village residences are serviced by a gravity sewage collection system which is owned and operated by the VoM. The sewage lagoons, located to the northwest of Mayo, were built in 1990 and last modified in 1999. Residences not serviced by the VoM sewage system utilize in-ground septic systems.

For public works equipment, the FNNND has a one-ton truck used primarily for snow clearing. Mayo also has one backhoe with attachments. Public works that require the use of equipment in addition to what is owned by the VOM is carried out by local contractors as required.

4.2.8.5 Child Care

The Dunena Ko'Honete Ko Day Care in Mayo is funded by the FNNND, the Yukon Government, and the parents of attending children. The day care provides care for children from six months up to five years of age (up to the time they begin attending elementary school). The day care is licensed for 27 children; currently 16 children attend.

4.2.8.6 Transportation

There is one taxi service in Mayo and a private shuttle service that is available to take people to Whitehorse or Dawson City on request.

Road Transportation

In 1950, an all-weather road was completed from Whitehorse to Mayo. The principal road in the area is the Silver Trail (Highway 11) which begins at Stewart Crossing on the Klondike Highway, travels through Mayo, and leads to the communities of Elsa and Keno City. The FNNND is responsible for about 7 km of roads including those of the old village, the C 6 subdivision, and the access to the Lands and Resources office and General Assembly site. The roads appear to have been constructed to a minimal standard and there is not enough surface gravel to facilitate grading (Inukshuk and Jacobsen 2008).

Access to the Project from the Silver Trail will be via the existing South McQuesten Road (SMR) and the Haggart Creek Road (HCR) (YG # 325). Together, the SMR and HCR comprise a 45 km road, which is divided by the South McQuesten River. Both roads are public roads, regulated under the Yukon *Highways Act*; however, the SMR is maintained during summer only by the Yukon Government Department of Highways and Public Works (HPW), whereas the HCR is considered a "public unmaintained" road. Currently, snow is not cleared from the SMR or HCR in winter.

Airport

The Mayo Airport and Weather Centre operates 24-hours a day, 7-days a week. The airport is licensed by the Yukon Government Aviation and Marine Branch and is staffed by six employees, all of whom have their observer and communicator certificate. The length of the gravel runway is 4,836 feet with a good clear sight approach. It is able to handle large aircraft up to and including Hercules aircraft. In addition to the landing strip, there is a weather station and a small terminal building.

Airport traffic reached a high of more than 8,800 aircraft movements in 1981. This dropped to 2,500 by 1988 due to several mine closures. From March 2009 to March 2010, almost 2,700 aircraft movements were recorded for Mayo (Yukon Bureau of Statistics 2010c).

At the moment there are no scheduled flights to Mayo, although there is interest in encouraging scheduled flights approximately two days per week, and there have been discussions with Air North in this regard. Most of the current air traffic is related to mining and outfitting. Medi-vacs to Whitehorse also leave from the airport, which have averaged 24 trips per month (between August 2009 and July 2010).

The Yukon Government's forestry base initial attack station is located adjacent to the Mayo airport, as is a private seasonal helicopter base.

4.2.8.7 Hydroelectric Development and Energy Supply

The Project area, including Mayo, is within the Mayo-Dawson electrical grid, powered by the Mayo hydroelectric plant. YEC is currently constructing the Mayo Hydro Enhancement Project (Mayo B) and the second stage of the Carmacks-Stewart Transmission Project. The Mayo B Project will more than double the electrical capacity of the current Mayo plant, and the Carmacks-Stewart Transmission Project will connect the Mayo – Dawson grid with the Whitehorse – Aishihik – Faro grid (Appendix 17). The VoM also has back-up diesel generators that provide power to essential services during transmission line power outages.

The FNNND is completing the installation of a geothermal system to heat the administrative buildings and the nearby new residential area; this will supplement if not replace fossil fuel use.

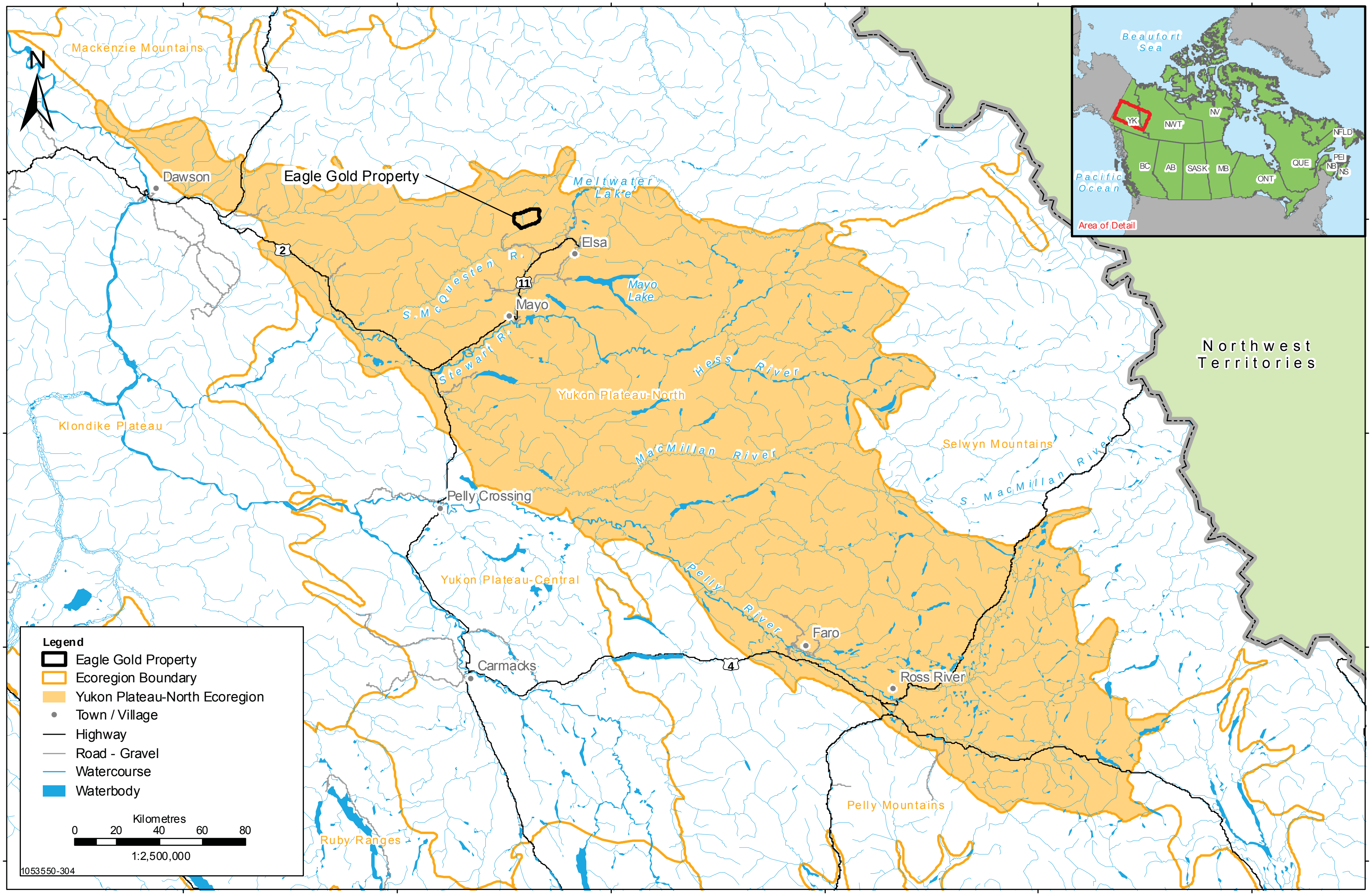
4.2.8.8 First Nation of Na-Cho Nyäk Dun Community Legacy Project

The FNNND is pursuing a Community Legacy Project in order to ensure that community benefits remain after various mining and other development projects are completed. In addition, the FNNND is seeking a level of ownership in a number of projects in the area.

The FNNND plans to build a number of facilities in the future. One potential development is a 14,000 square-foot 2-storey building in Mayo housing mixed use commercial activities on the first floor, possibly a restaurant and tourism office, and a residential second floor including an elder's lodge and a wellness drop-in centre. Improvements to the local store (owned by FNNND) are also under consideration.

4.3 Figures

Please see the following pages.



Data Sources: Government of Canada, Victoria Gold Corp.

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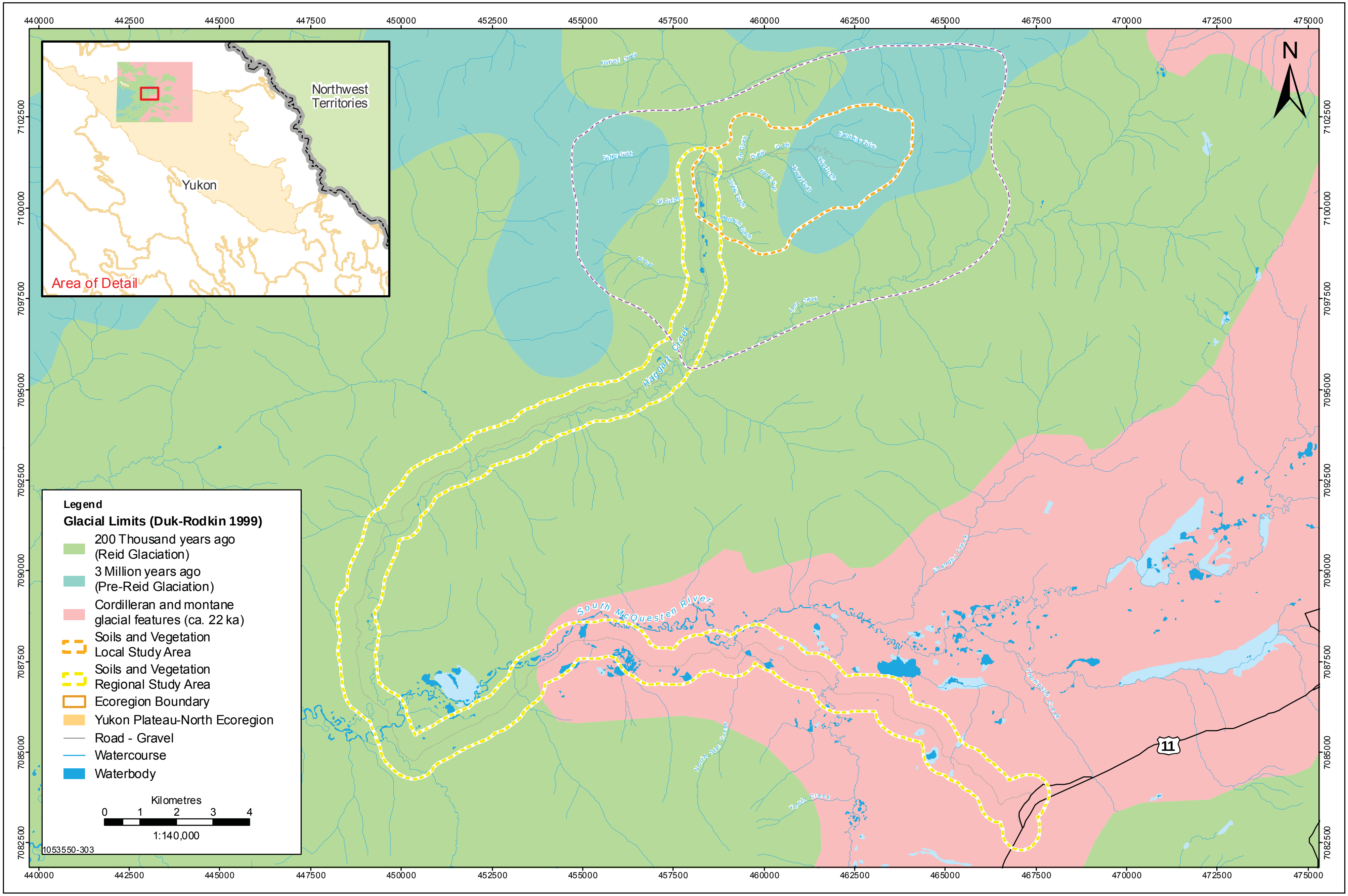
YUKON ECOREGIONS
EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION	DRAWN BY
UTM - ZONE 8	LS
DATUM	CHECKED BY
NAD 83	RS
DATE	FIGURE NO.
29-November-2010	4.1-2



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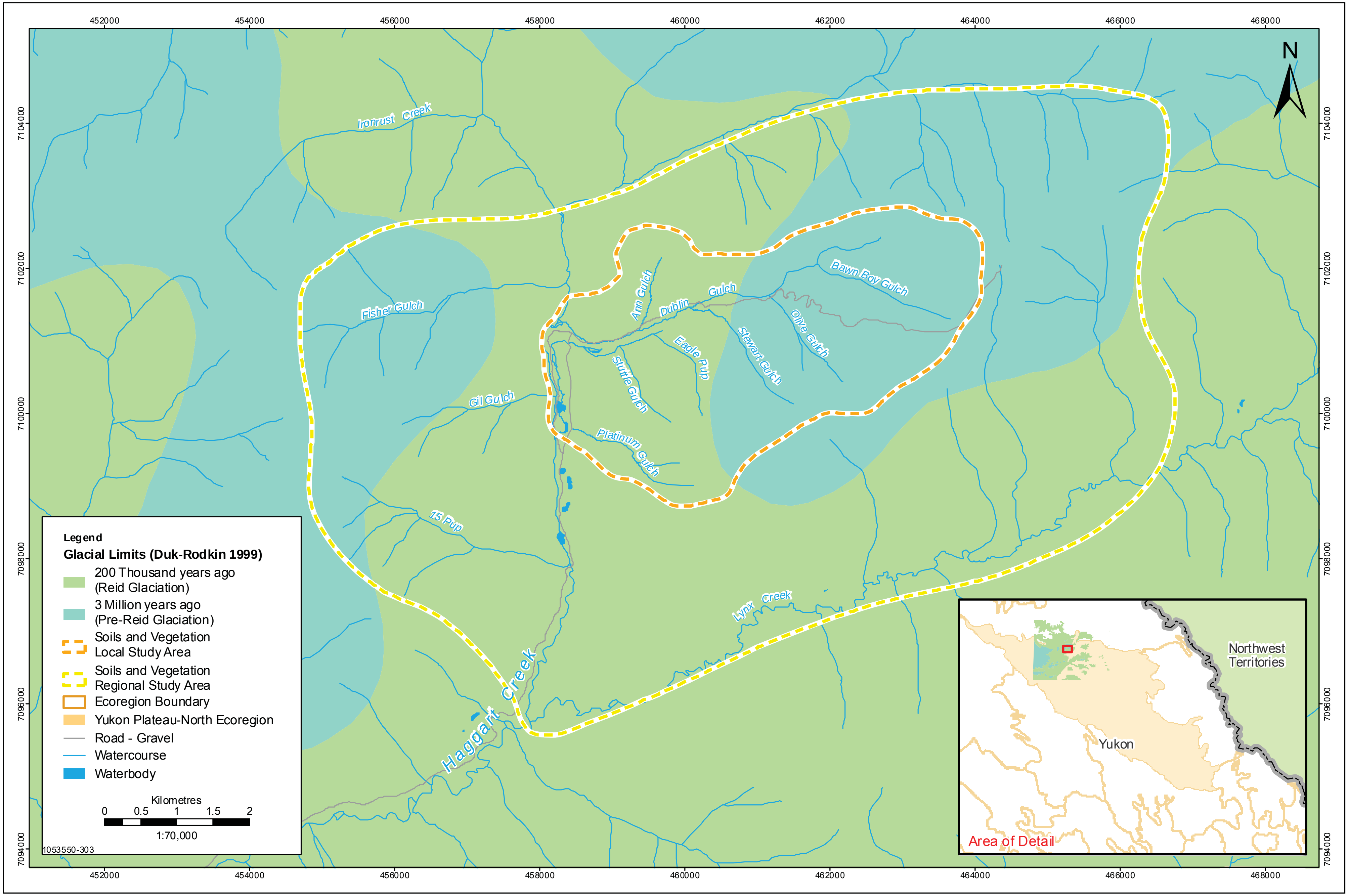
ROAD CORRIDOR STUDY AREA WITH GLACIAL LIMIT EXTENTS

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION: UTM - ZONE 8	DRAWN BY: LS
DATUM: NAD 83	CHECKED BY: RS
DATE: 29-November-2010	FIGURE NO.: 4.1-3



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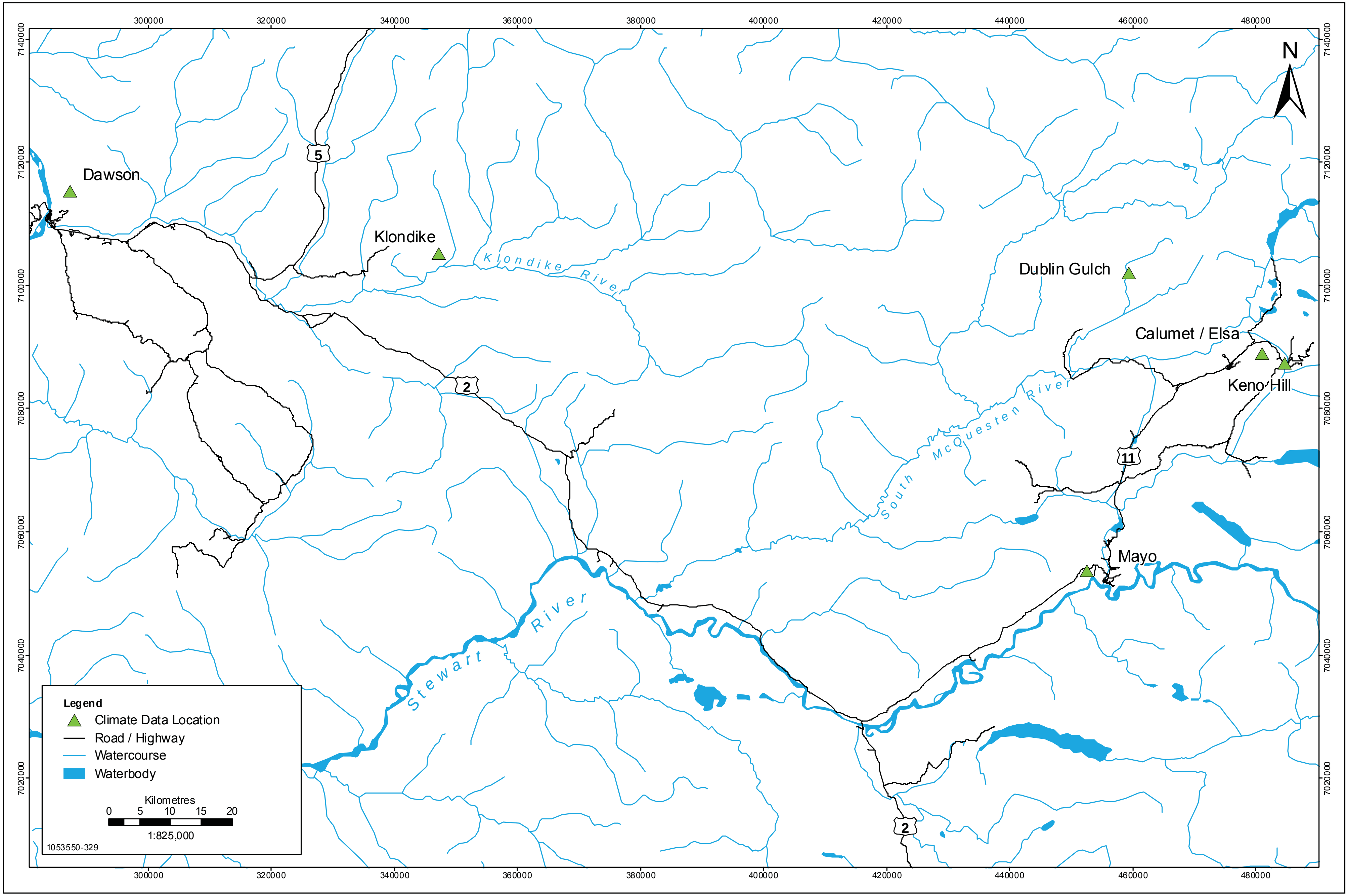
REGIONAL AND LOCAL STUDY AREAS WITH GLACIAL LIMIT EXTENTS

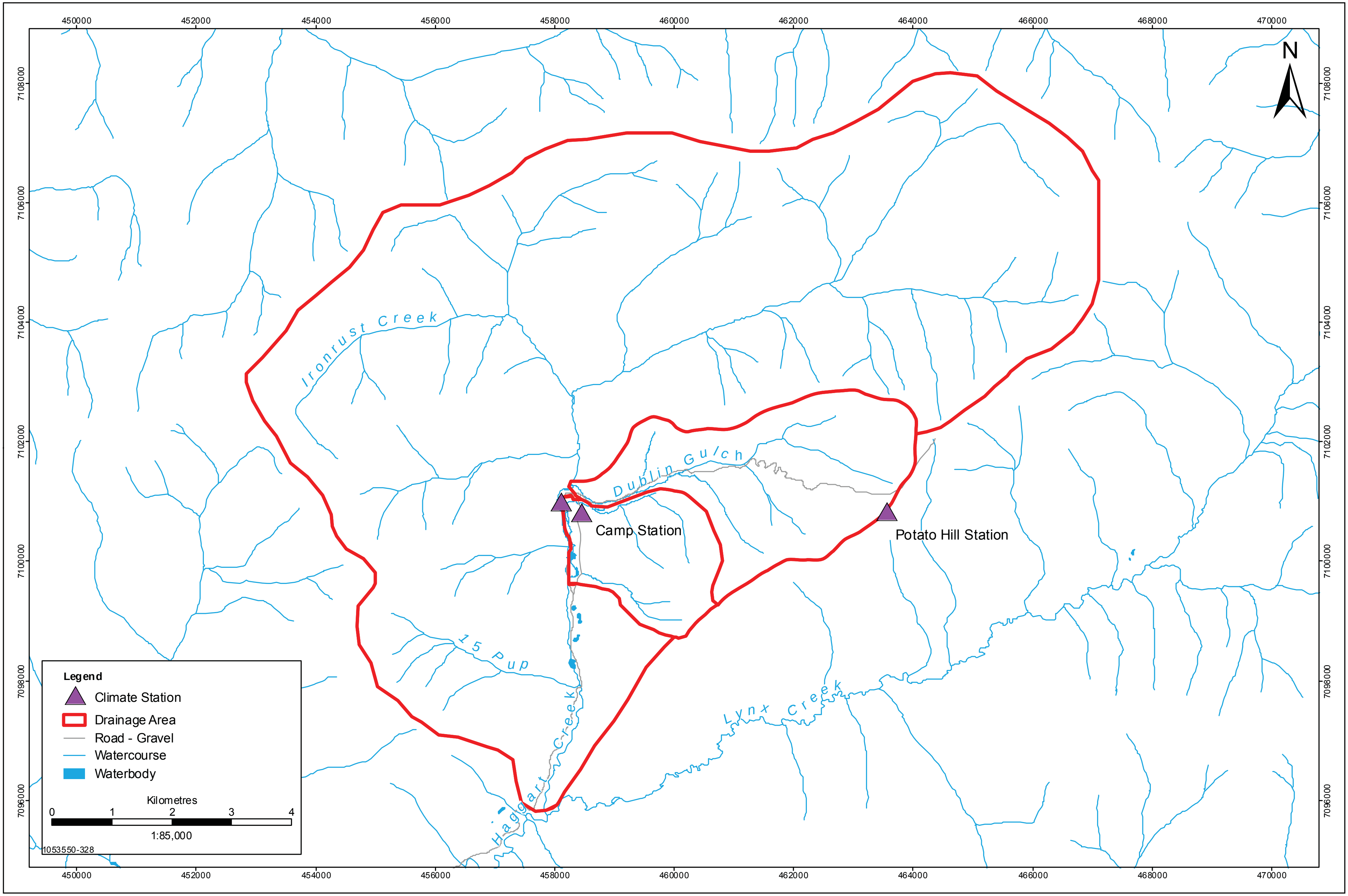
EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION: UTM - ZONE 8	DRAWN BY: LS
DATUM: NAD 83	CHECKED BY: RS
DATE: 29-November-2010	FIGURE NO.: 4.1-4



Data Sources: Government of Canada, Victoria Gold Corp.

Stantec 4370 Dominion Street Burnaby, British Columbia V5G 4L7 Tel. (604) 436 3014 Fax. (604) 436 3752	Victoria GOLD CORP	**CLIMATE REGIONAL STUDY AREA** EAGLE GOLD PROPERTY YUKON TERRITORY	PROJECTION UTM - ZONE 8 DATUM NAD 83 DATE 29-November-2010	DRAWN BY LS CHECKED BY RS FIGURE NO. 4.1-5



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CLIMATE STATION LOCATIONS

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION	DRAWN BY
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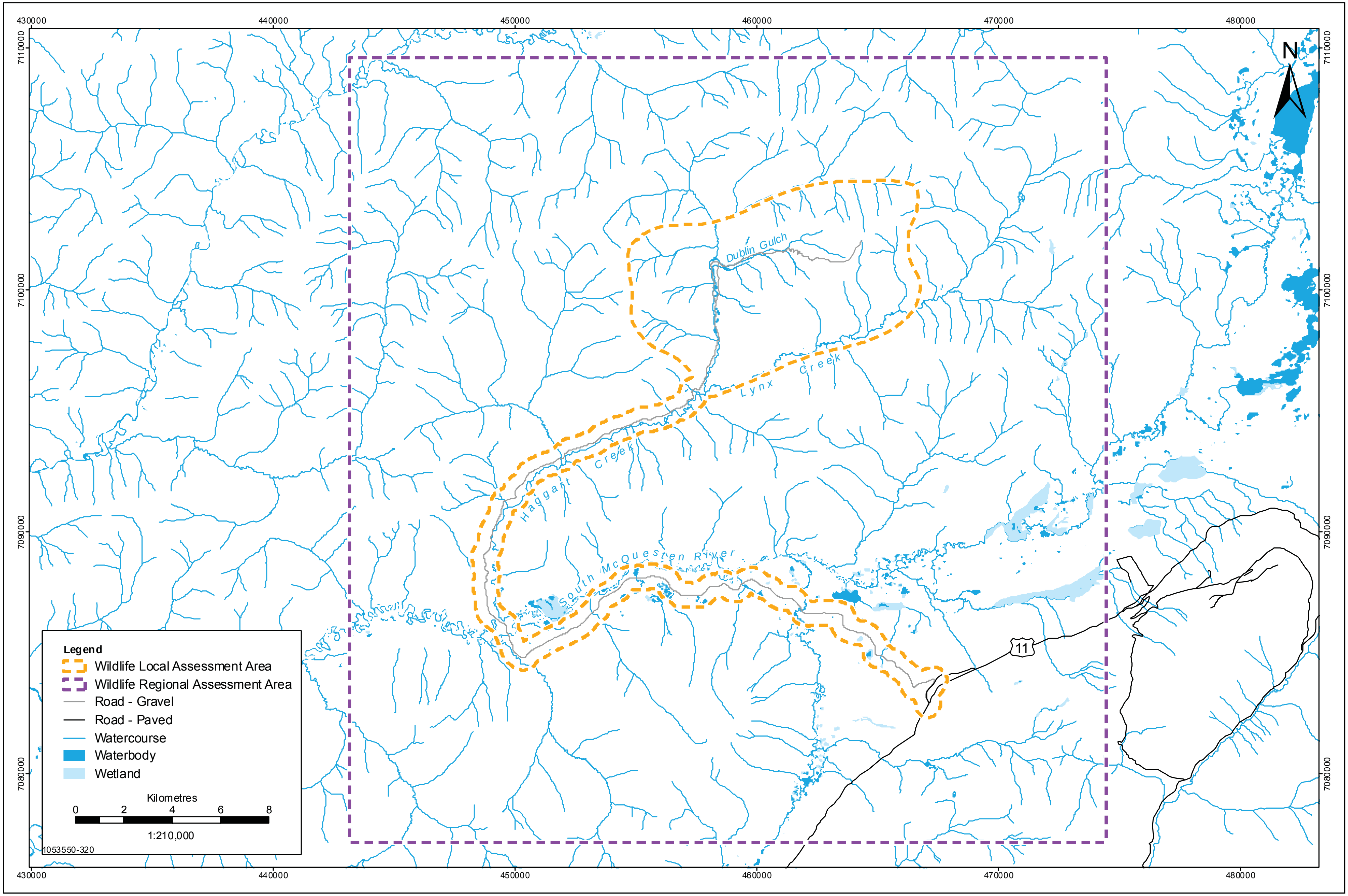
DATUM	CHECKED BY
NAD 83	RS
DATE	FIGURE NO.
29-November-2010	4.1-6



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WILDLIFE LOCAL AND REGIONAL STUDY AREAS

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION	DRAWN BY
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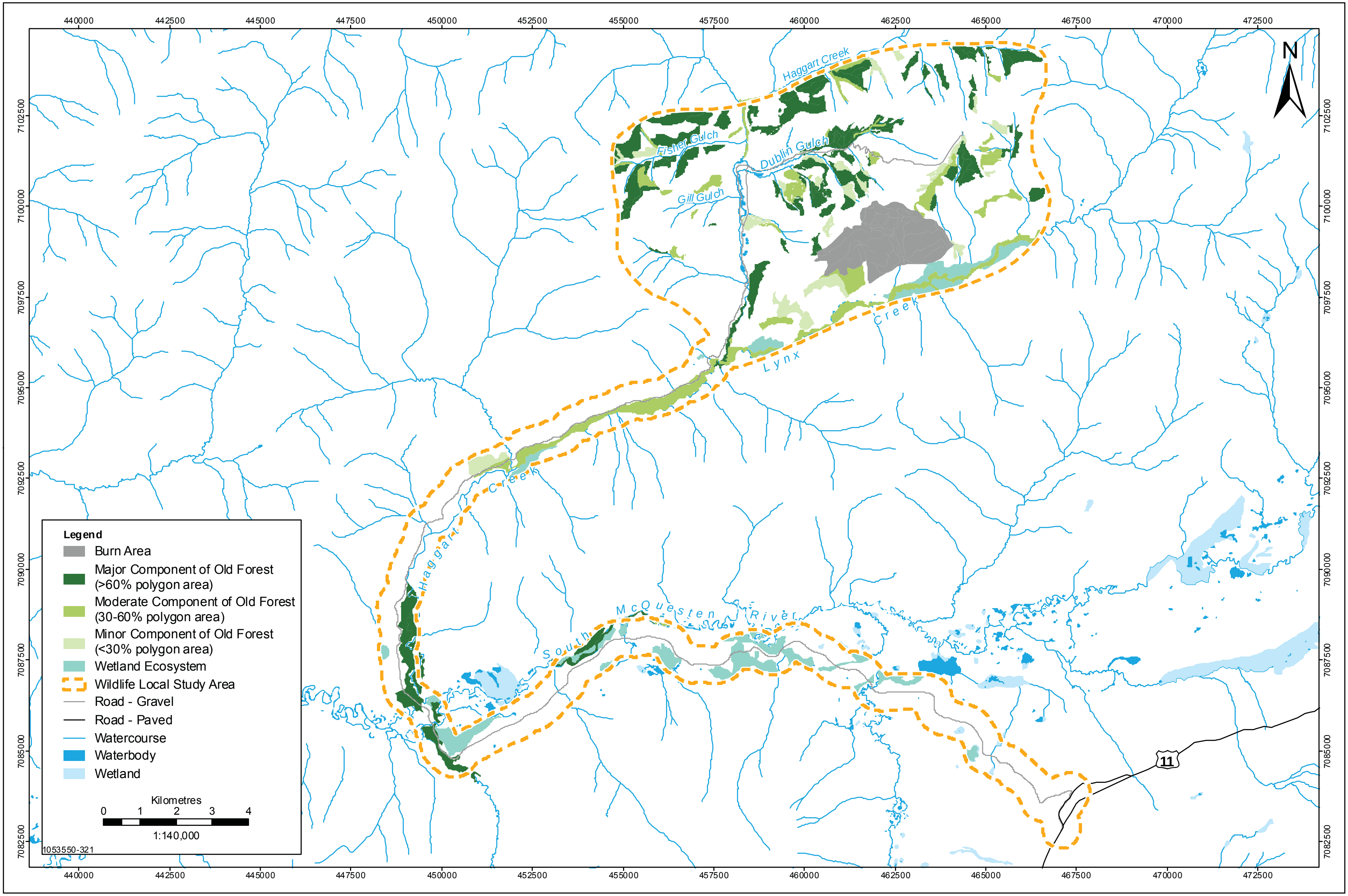
DATUM	CHECKED BY
NAD 83	RS
DATE	FIGURE NO.
29-November-2010	4.1-7



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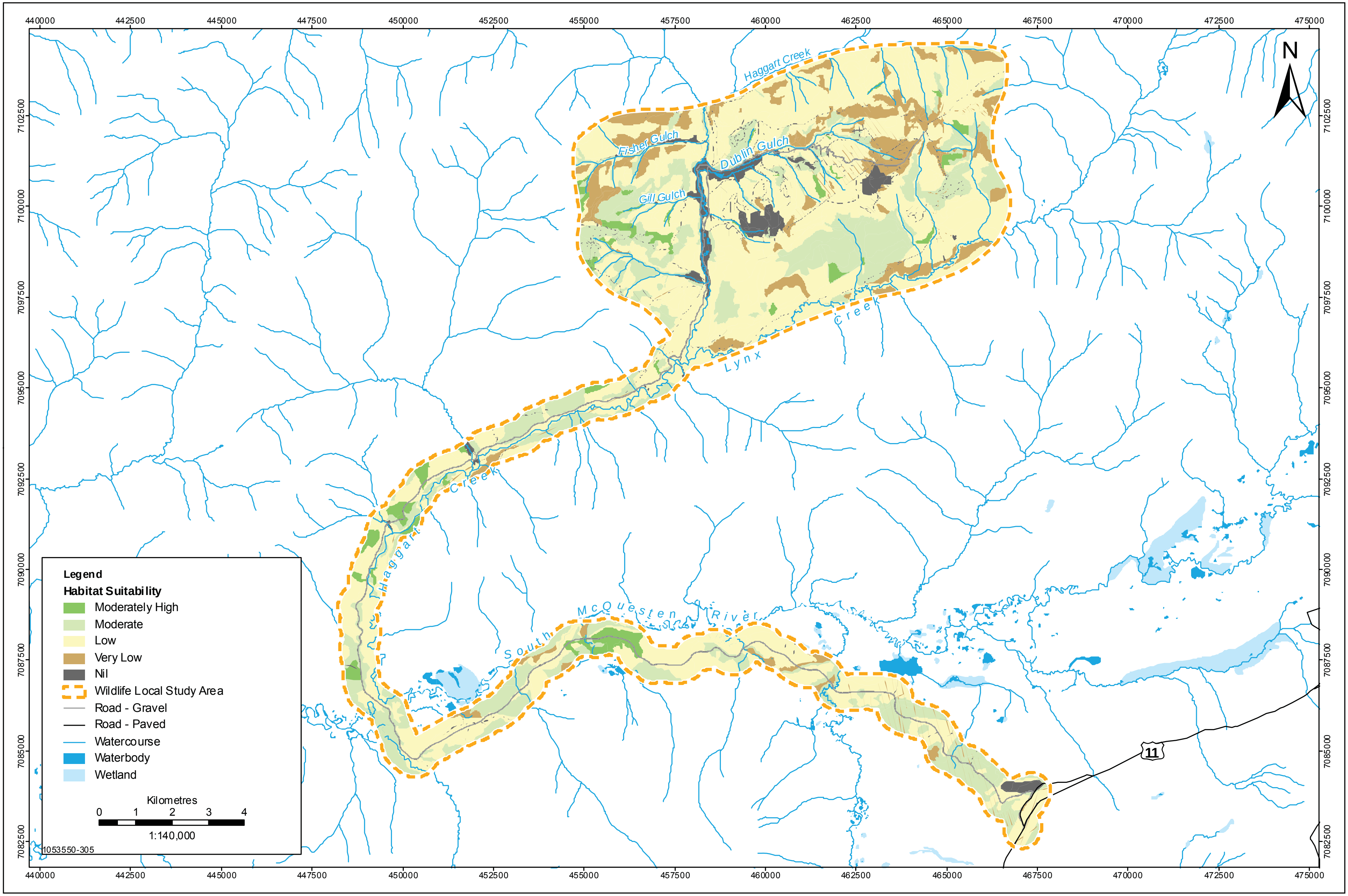
WILDLIFE HABITATS OF SPECIAL INTEREST WITHIN THE LOCAL STUDY AREA

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION UTM - ZONE 8	DRAWN BY LS
DATUM NAD 83	CHECKED BY RS
DATE 29-November-2010	FIGURE NO. 4.1-8



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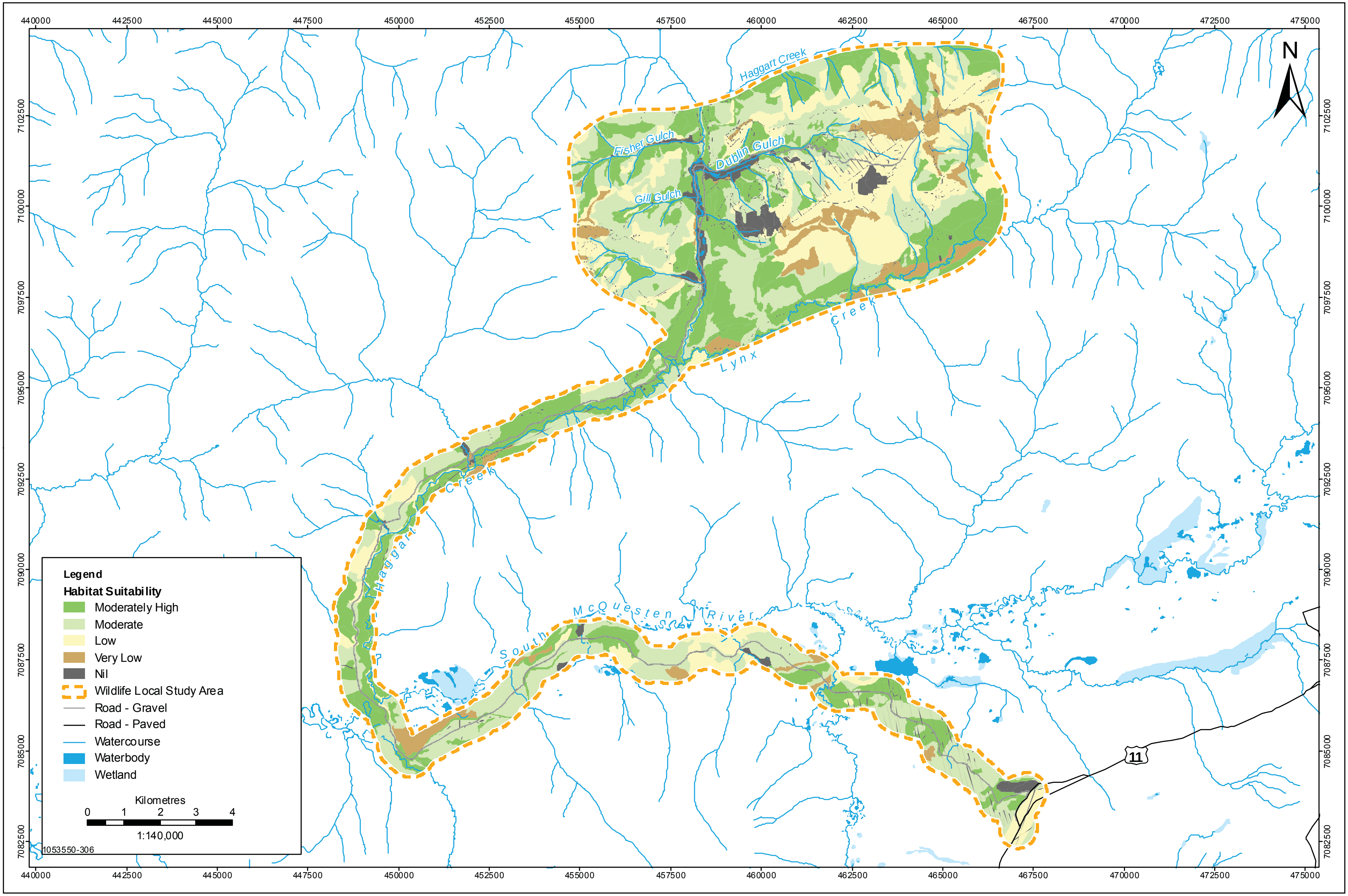
MOOSE WINTER FEEDING HABITAT SUITABILITY AT BASELINE

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION	UTM - ZONE 8	DRAWN BY	LS
DATUM	NAD 83	CHECKED BY	RS
DATE	29-November-2010	FIGURE NO.	4.1-9



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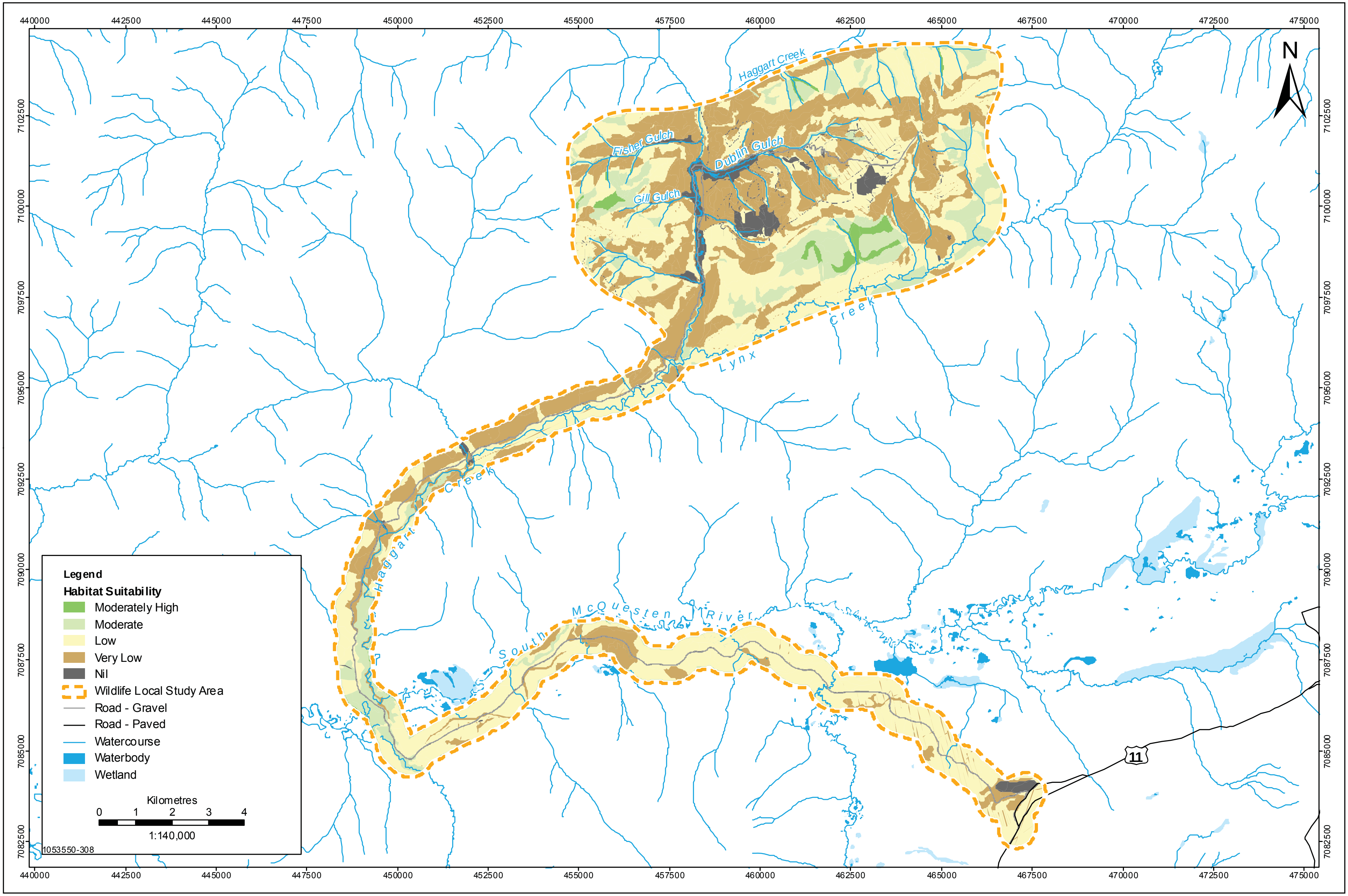
MOOSE WINTER SHELTER HABITAT SUITABILITY AT BASELINE

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION UTM - ZONE 8	DRAWN BY LS
DATUM NAD 83	CHECKED BY RS
DATE 29-November-2010	FIGURE NO. 4.1-10



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GRIZZLY BEAR SPRING FEEDING HABITAT SUITABILITY AT BASELINE

EAGLE GOLD PROPERTY
YUKON TERRITORY

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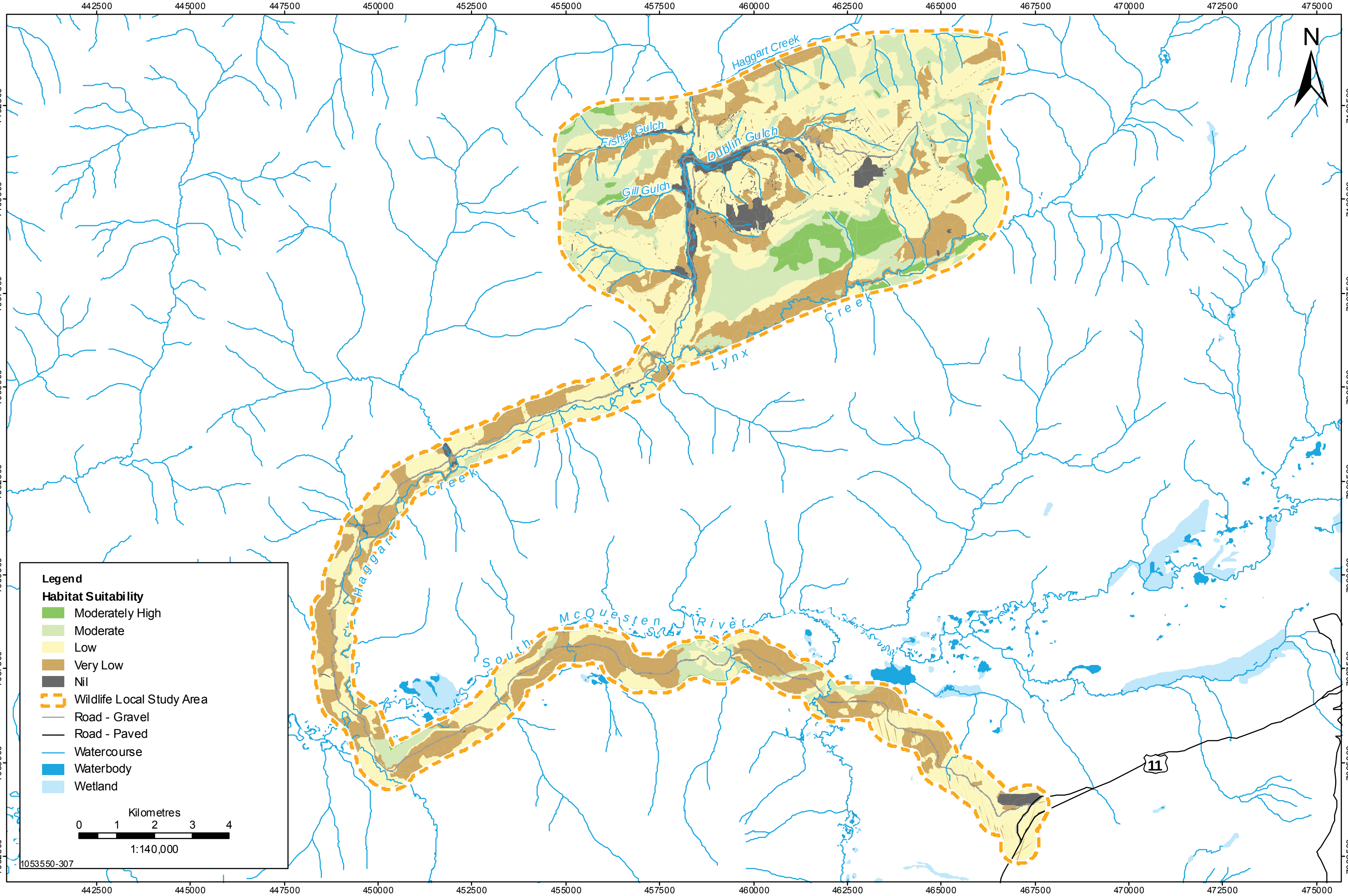
DATUM: NAD 83	CHECKED BY: RS
DATE: 29-November-2010	FIGURE NO.: 4.1-11



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GRIZZLY BEAR FALL FEEDING HABITAT SUITABILITY AT BASELINE

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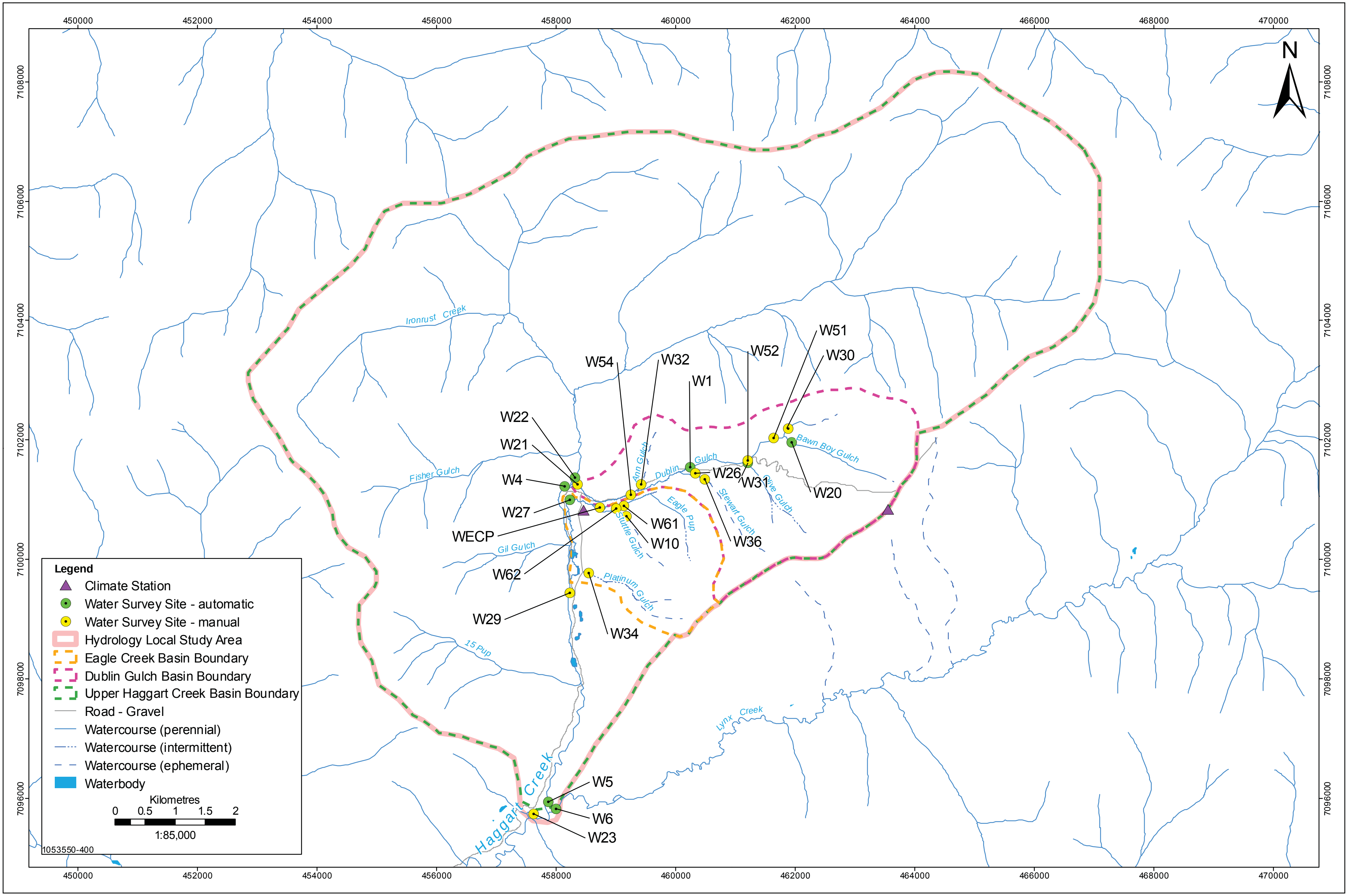
DATUM NAD 83	CHECKED BY RS
DATE 29-November-2010	FIGURE NO. 4.1-12



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HYDROLOGY LOCAL STUDY AREA AND SAMPLE LOCATIONS

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION UTM - ZONE 8	DRAWN BY LS
DATUM NAD 83	CHECKED BY RS
DATE 29-November-2010	FIGURE NO. 4.1-13

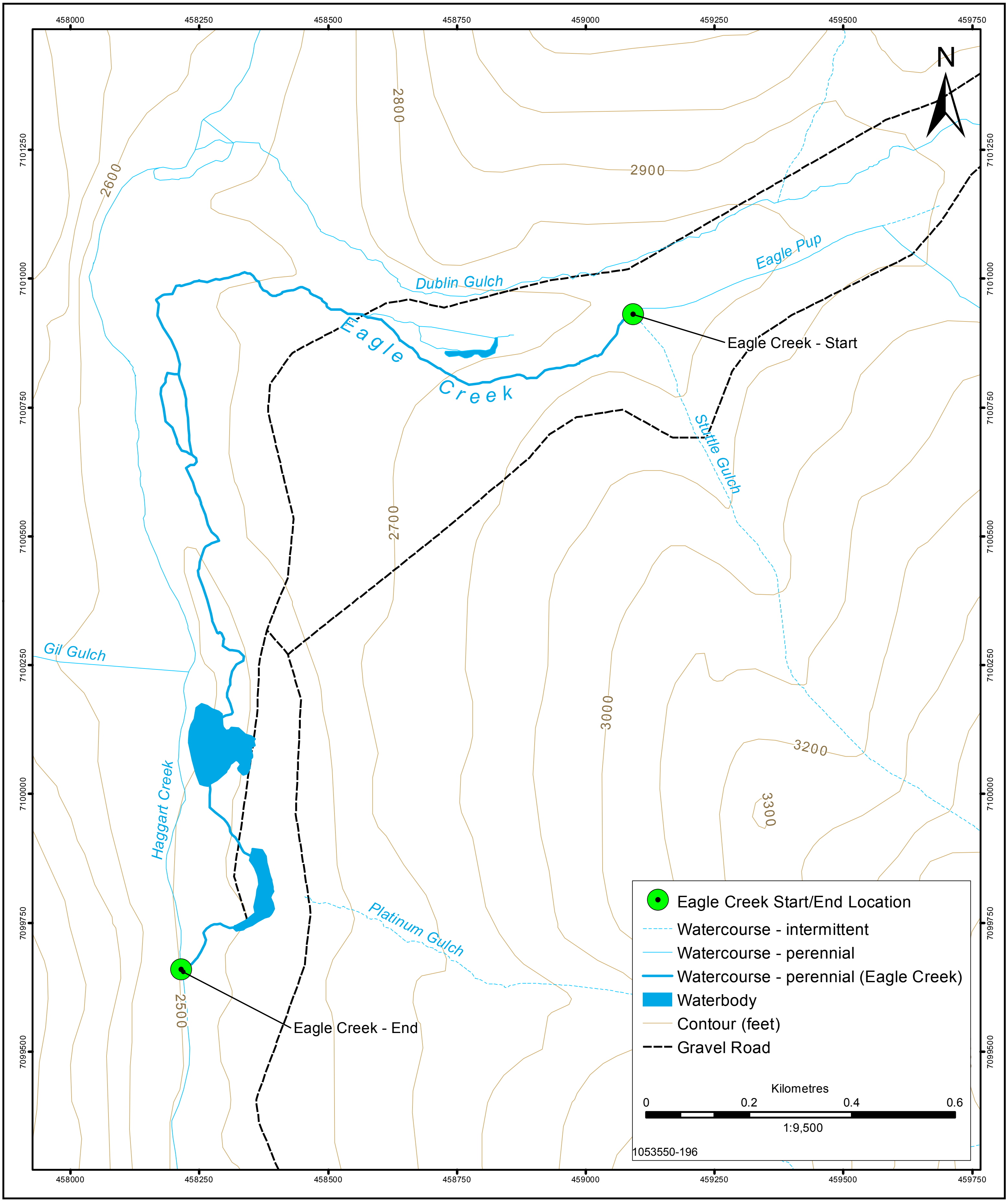

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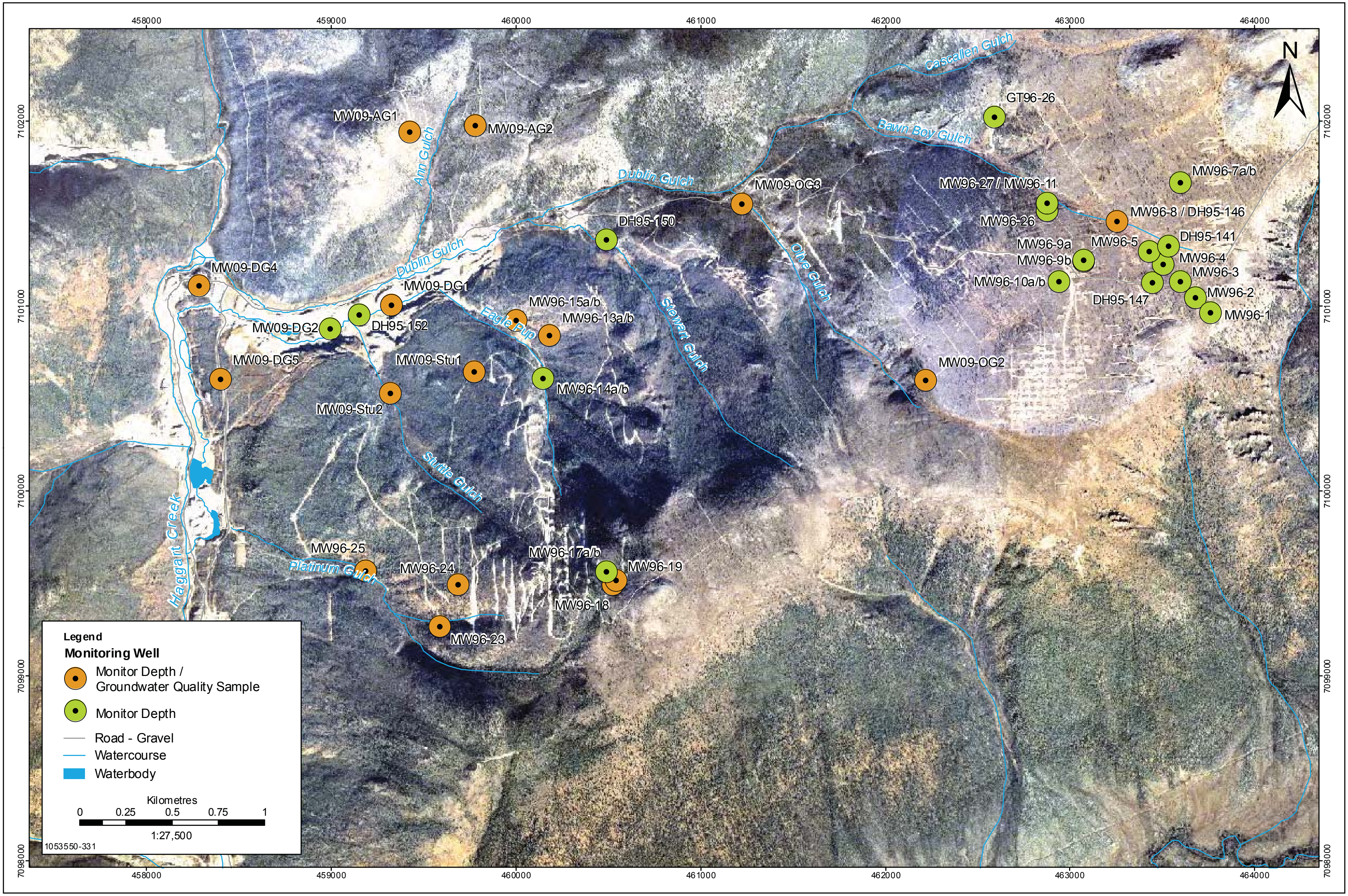
FIGURE 4.1-13-A
EAGLE CREEK

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION	UTM - ZONE 8	DRAWN BY	RS
DATUM	NAD 83	CHECKED BY	JB
DATE	29-June-2011	FIGURE NO.	4.1-13-A



Data Sources: Government of Canada, Victoria Gold Corp.

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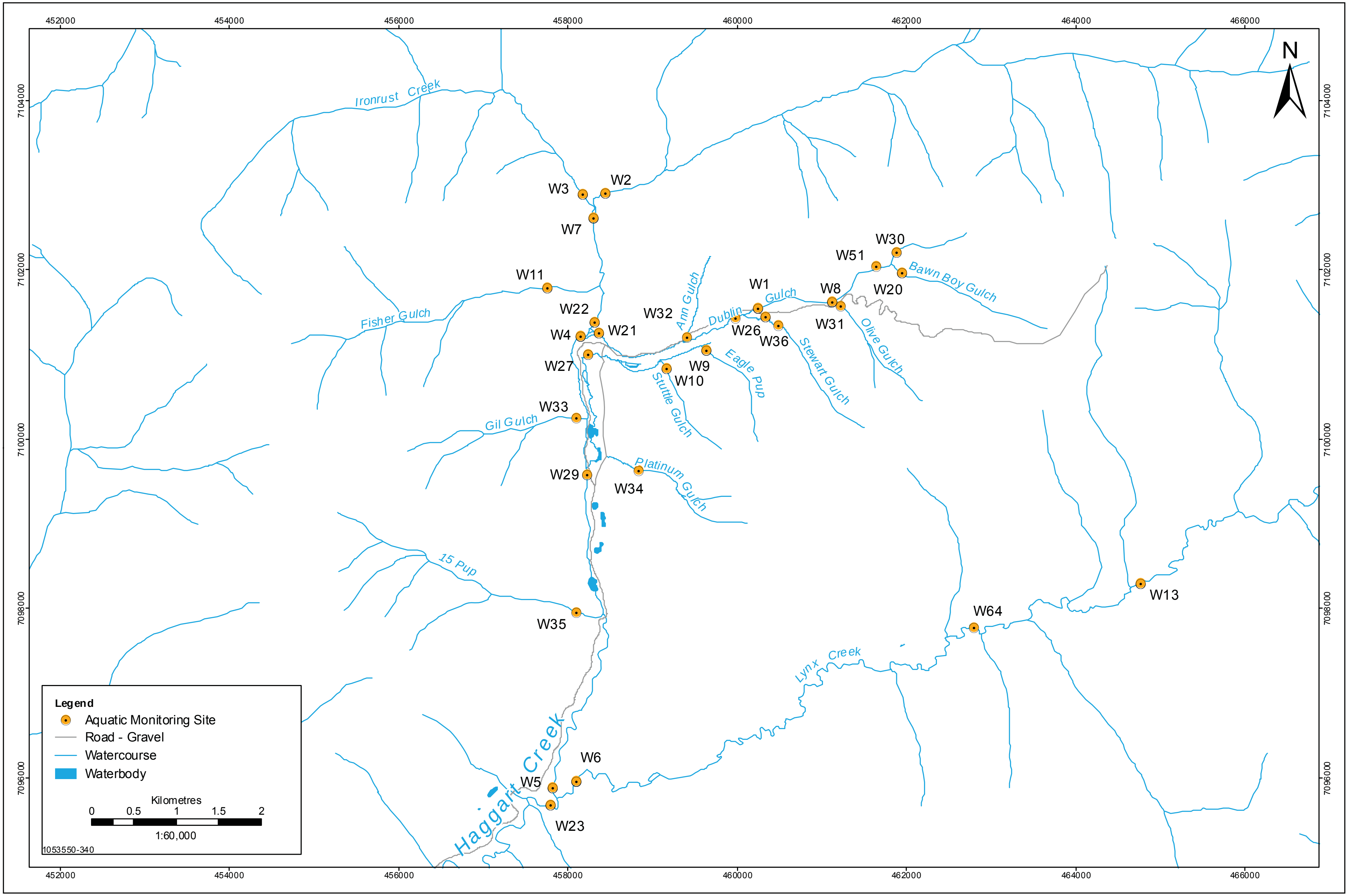
GROUNDWATER WELL SAMPLING LOCATIONS

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION UTM - ZONE 8	DRAWN BY LS
DATUM NAD 83	CHECKED BY RS
DATE 29-November-2010	FIGURE NO. 4.1-14



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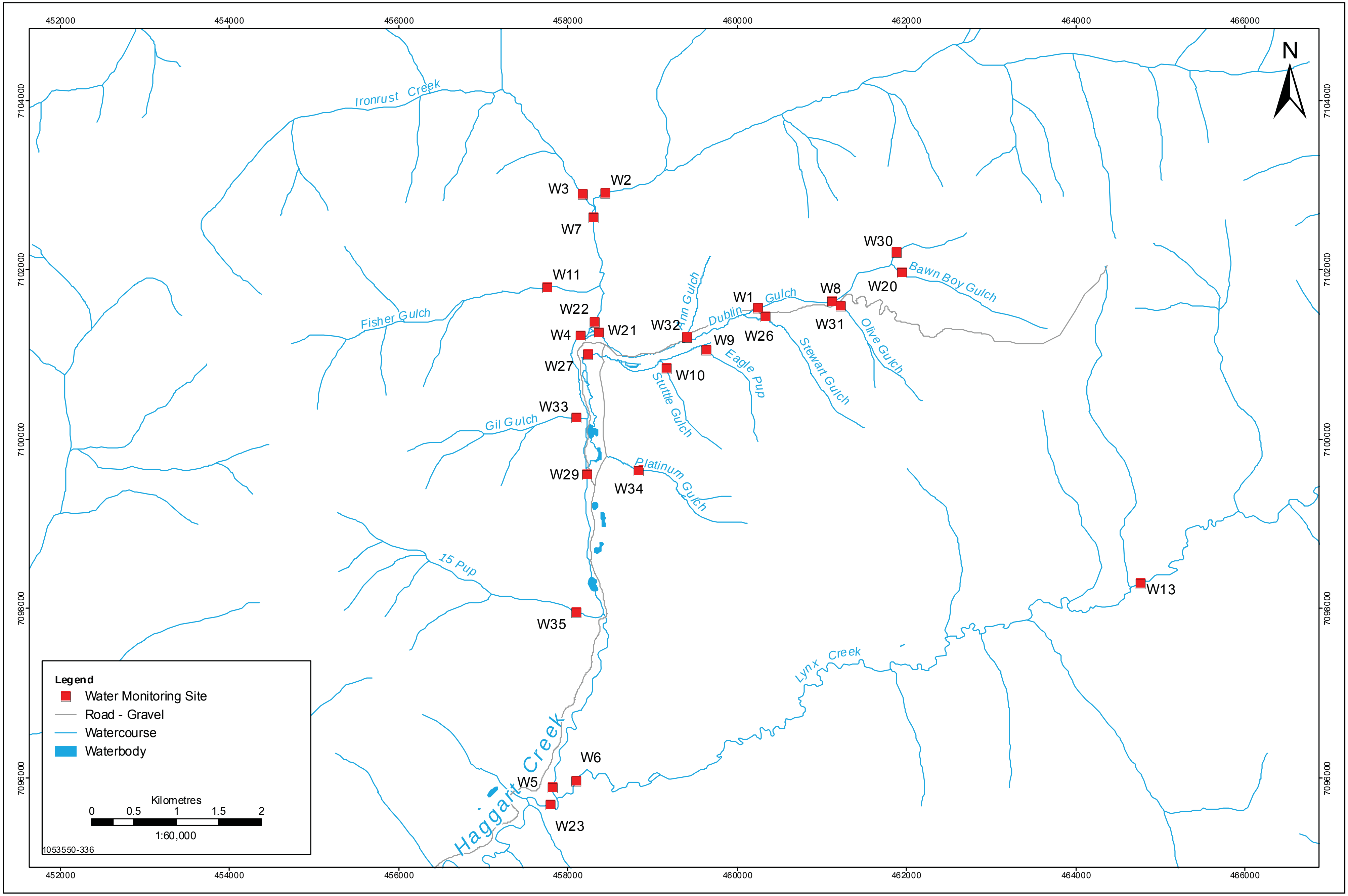
CURRENT AND HISTORIC AQUATIC MONITORING SITES

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION	DRAWN BY
UTM - ZONE 8	LS
DATUM	CHECKED BY
NAD 83	RS
DATE	FIGURE NO.
29-November-2010	4.1-15



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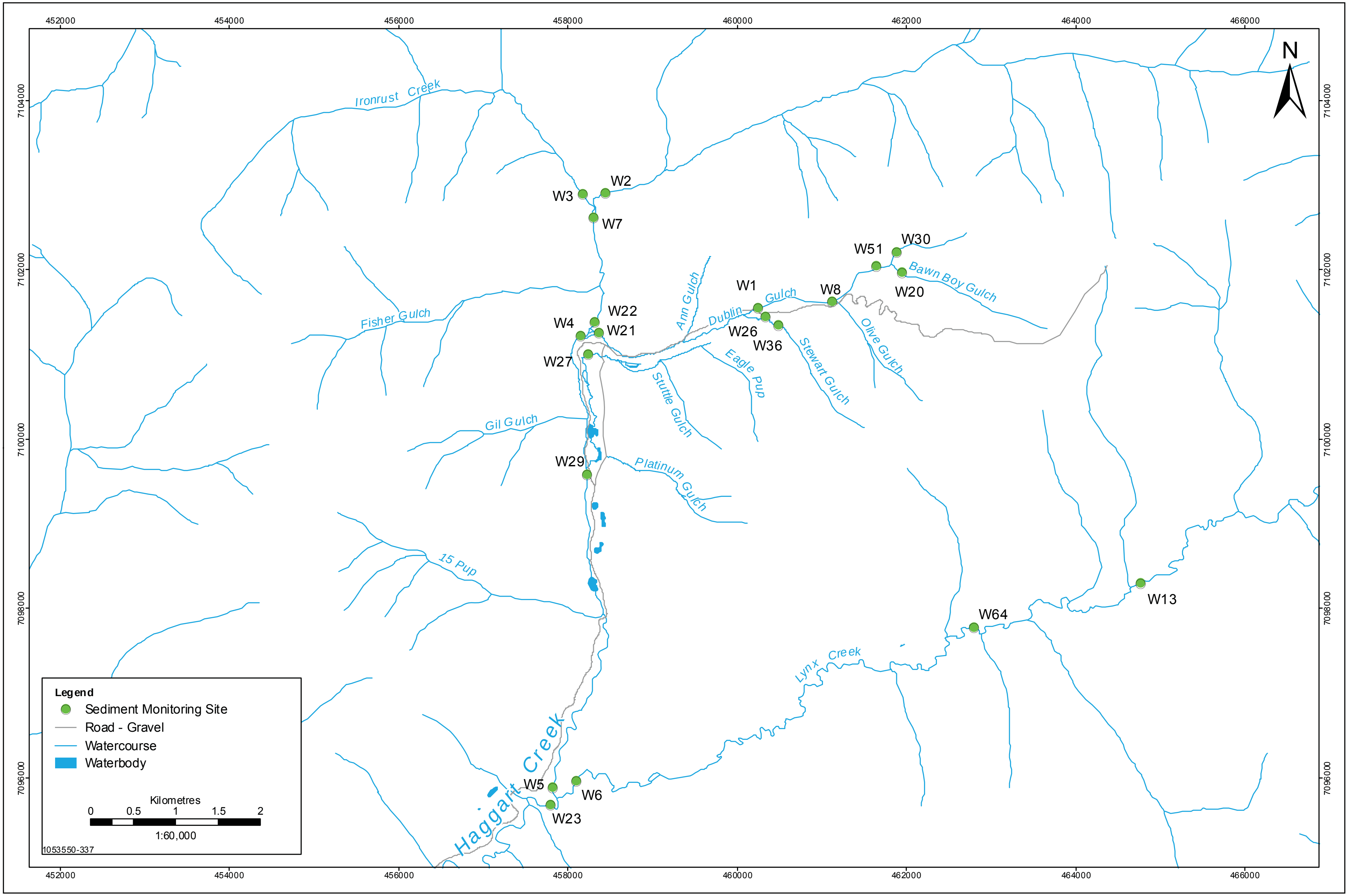
CURRENT AND HISTORIC WATER MONITORING SITES

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION: UTM - ZONE 8	DRAWN BY: LS
DATUM: NAD 83	CHECKED BY: RS
DATE: 29-November-2010	FIGURE NO. 4.1-16



Data Sources: Government of Canada, Victoria Gold Corp.

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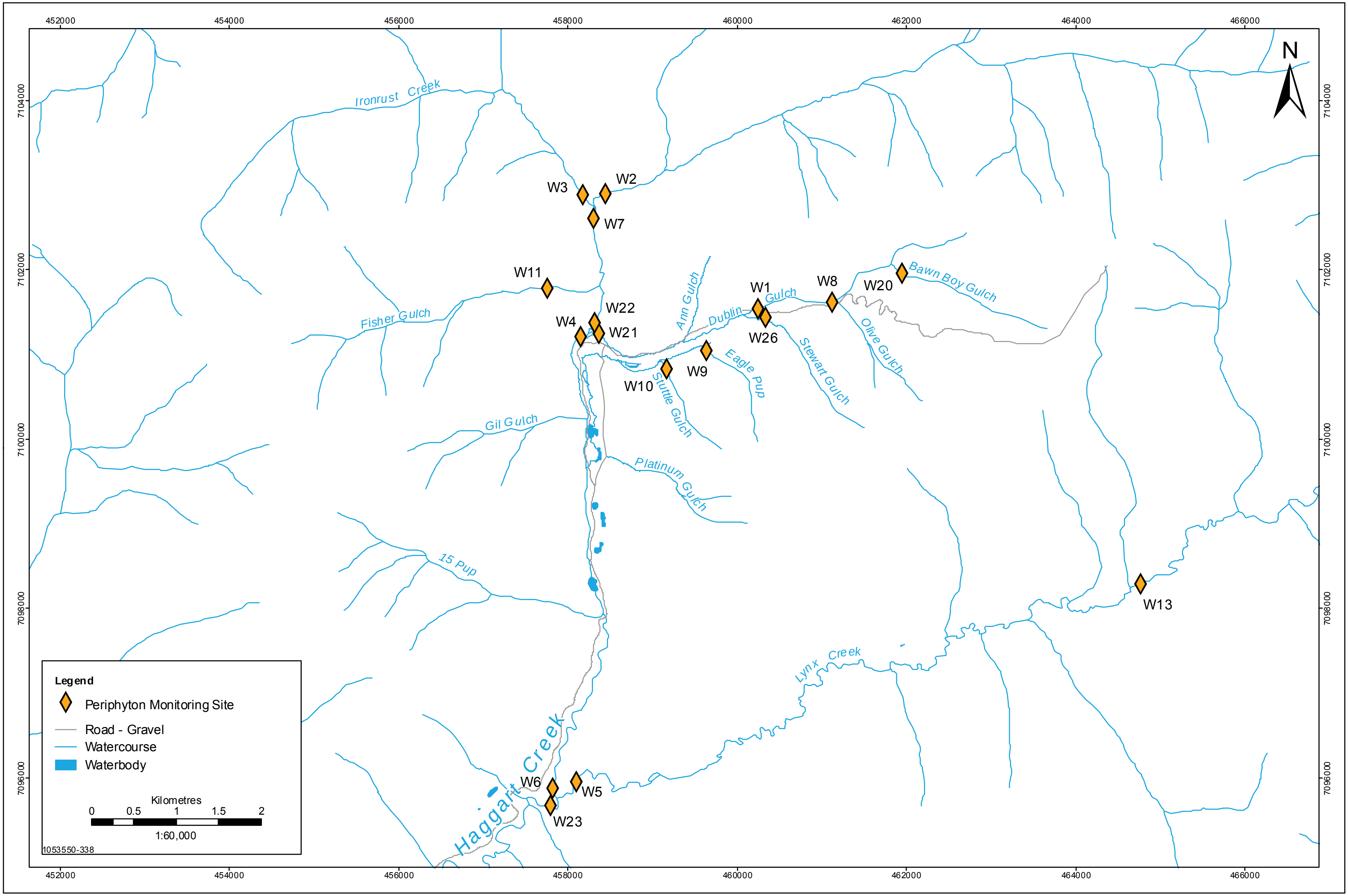
CURRENT AND HISTORIC SEDIMENT MONITORING SITES

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION UTM - ZONE 8	DRAWN BY LS
DATUM NAD 83	CHECKED BY RS
DATE 29-November-2010	FIGURE NO. 4.1-17



Data Sources: Government of Canada, Victoria Gold Corp.

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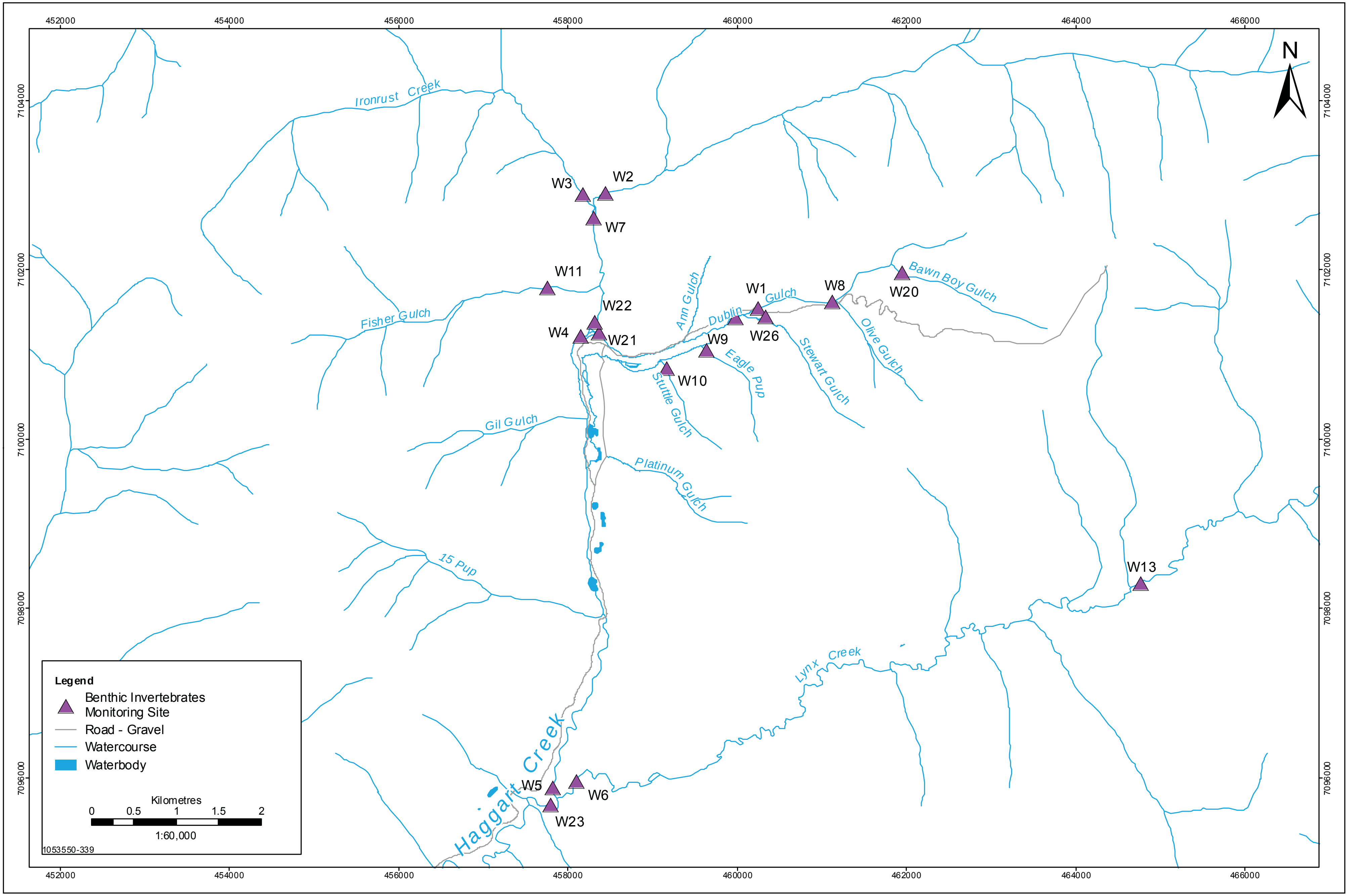
CURRENT AND HISTORIC PERIPHYTON MONITORING SITES

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION: UTM - ZONE 8	DRAWN BY: LS
DATUM: NAD 83	CHECKED BY: RS
DATE: 29-November-2010	FIGURE NO.: 4.1-18



Data Sources: Government of Canada, Victoria Gold Corp.

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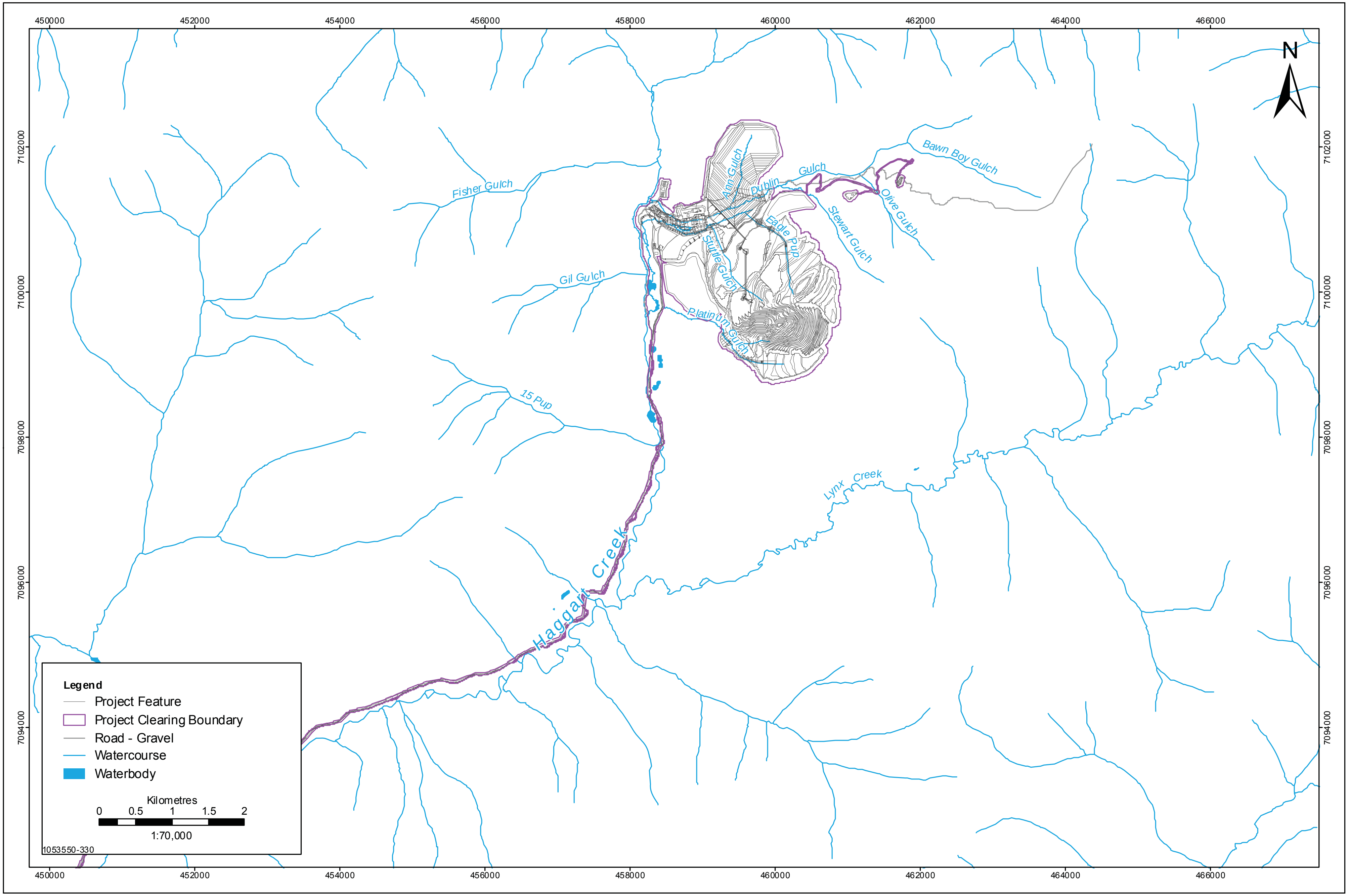
Victoria GOLD CORP

CURRENT AND HISTORIC BENTHIC INVERTEBRATES MONITORING SITES

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION: UTM - ZONE 8	DRAWN BY: LS
DATUM: NAD 83	CHECKED BY: RS
DATE: 3-November-2010	FIGURE NO.: 4.1-19



Data Sources: Government of Canada, Victoria Gold Corp.

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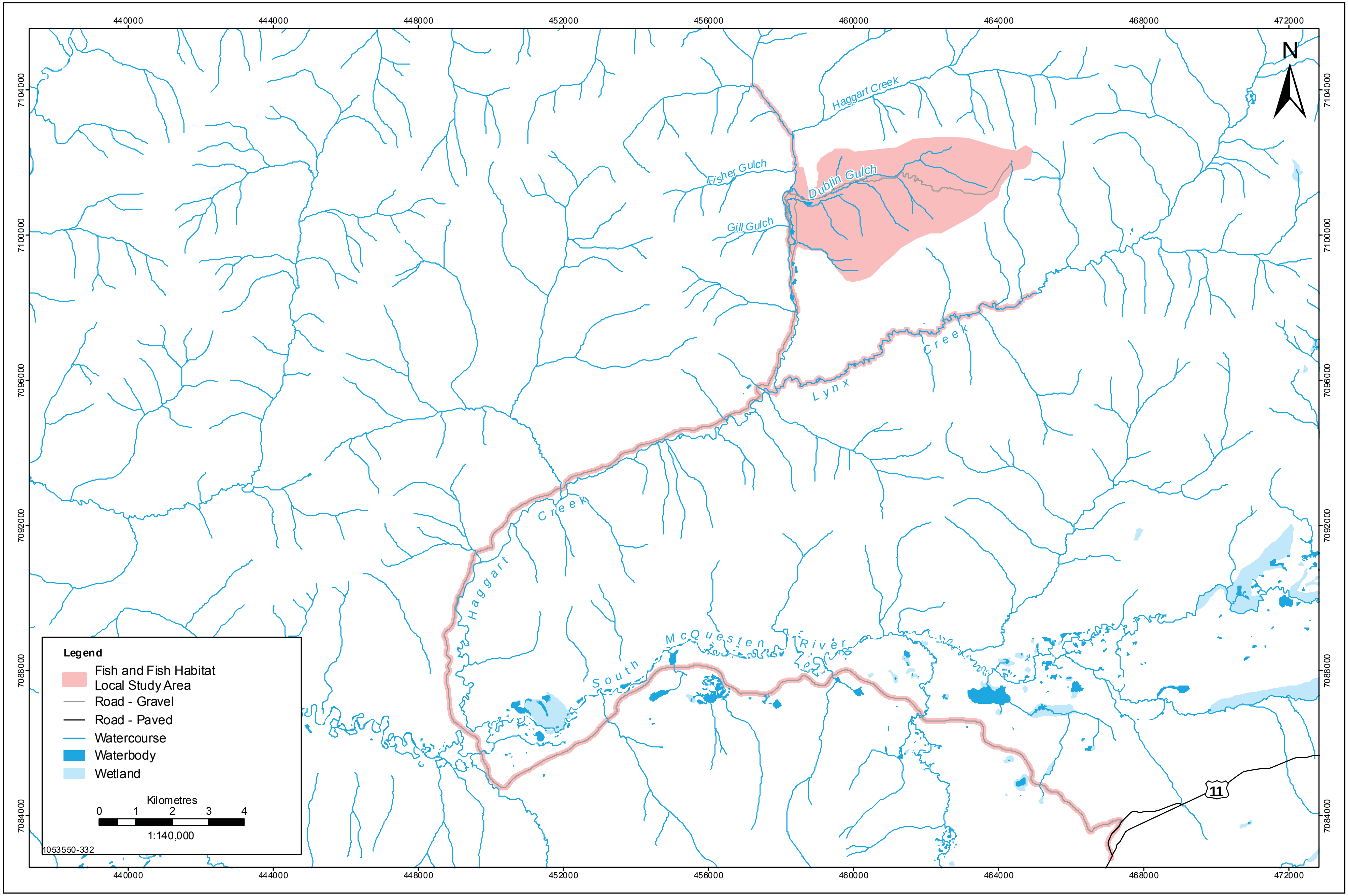
EAGLE GOLD MINE SITE LOCATION
EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION: UTM - ZONE 8	DRAWN BY: LS
DATUM: NAD 83	CHECKED BY: RS
DATE: 29-November-2010	FIGURE NO. 4.1-20



Data Sources: Government of Canada, Victoria Gold Corp.

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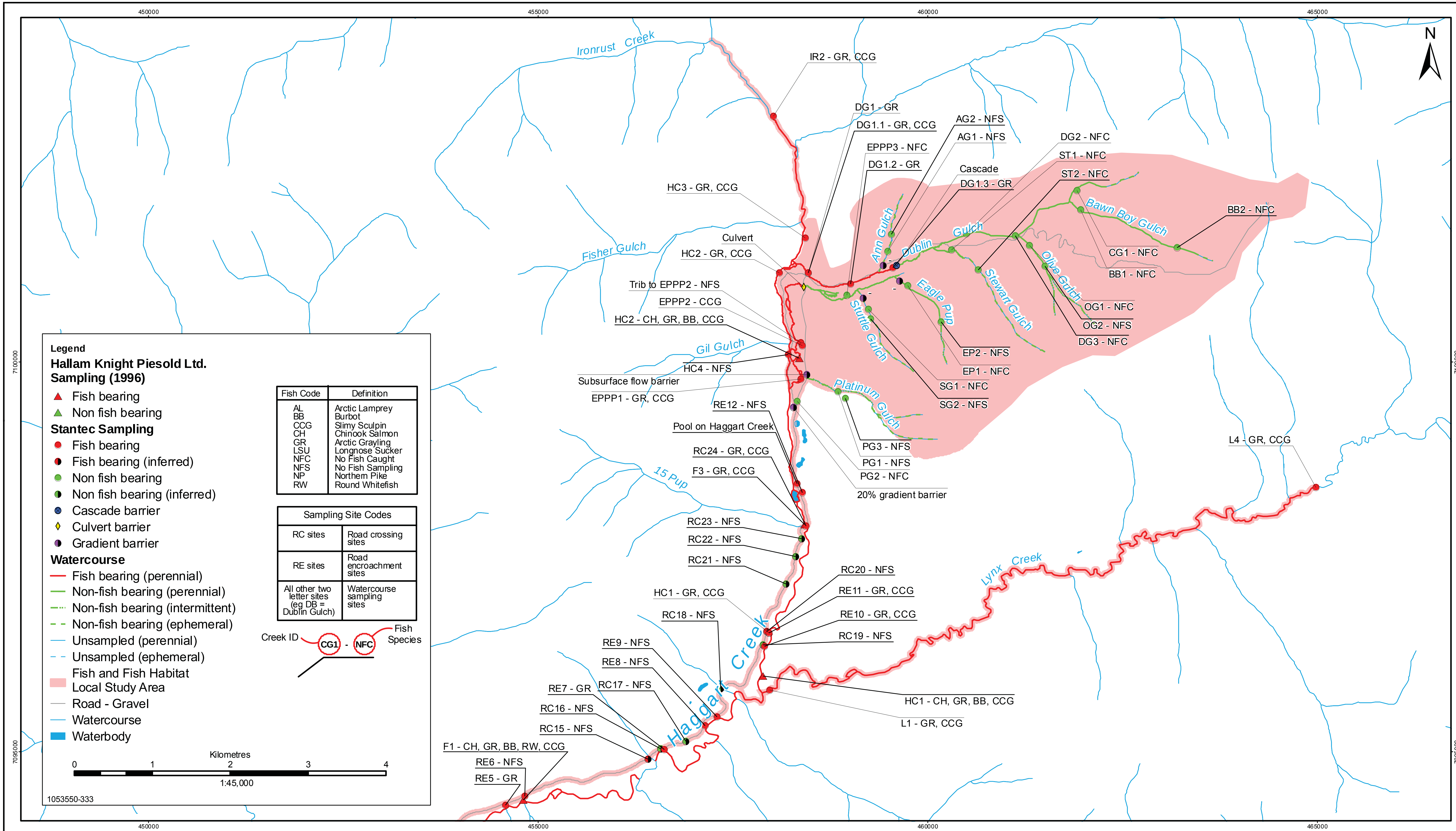
FISH AND FISH HABITAT LOCAL STUDY AREA

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION: UTM - ZONE 8	DRAWN BY: LS
DATUM: NAD 83	CHECKED BY: RS
DATE: 29-November-2010	FIGURE NO.: 4.1-2-1



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FISH AND FISH HABITAT STUDY AREA
SHEET 1 OF 3

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION	DRAWN BY
UTM - ZONE 8	LS
DATUM	CHECKED BY
NAD 83	RS
DATE	FIGURE NO.
29-November-2010	4.1-22

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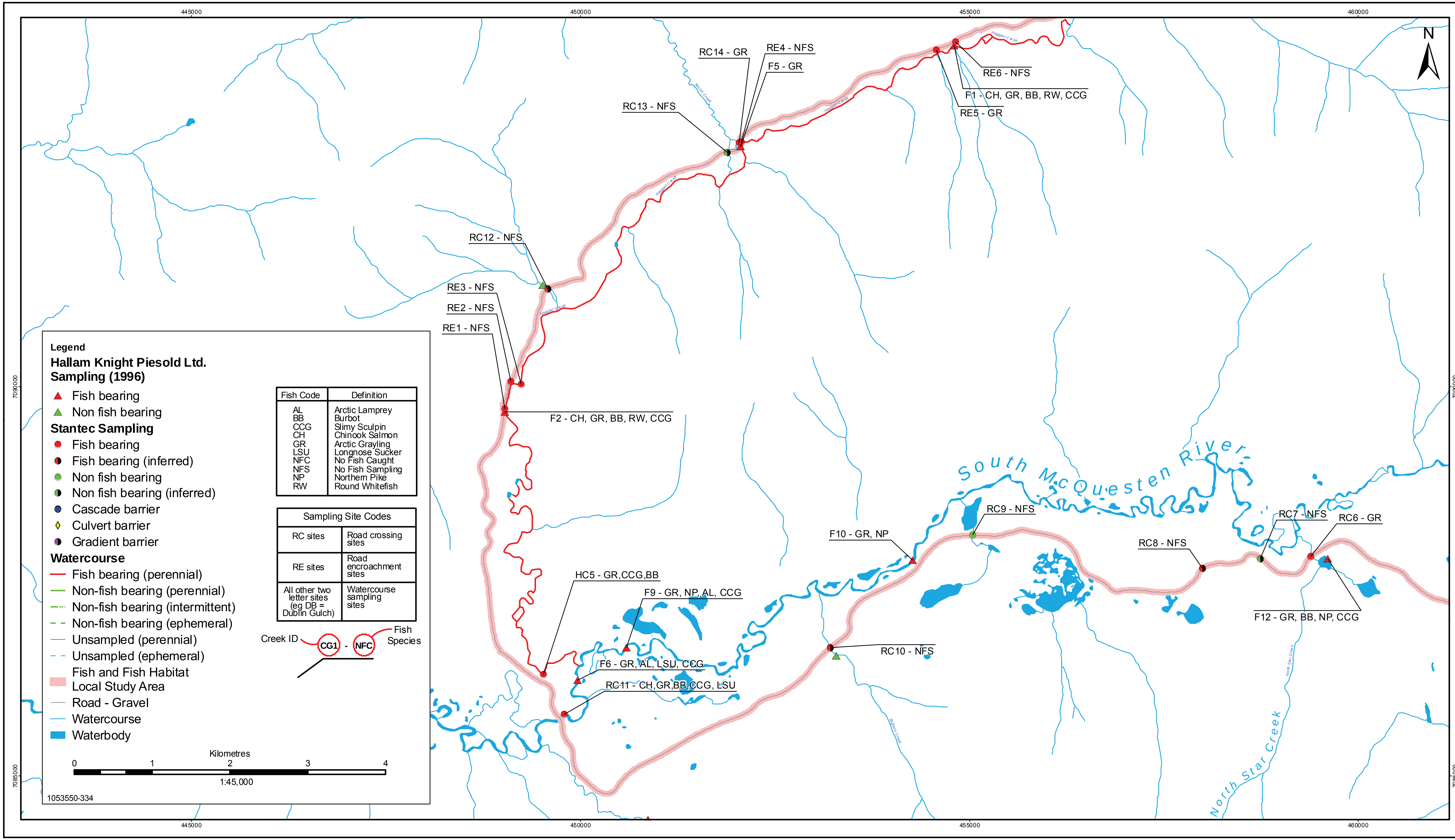

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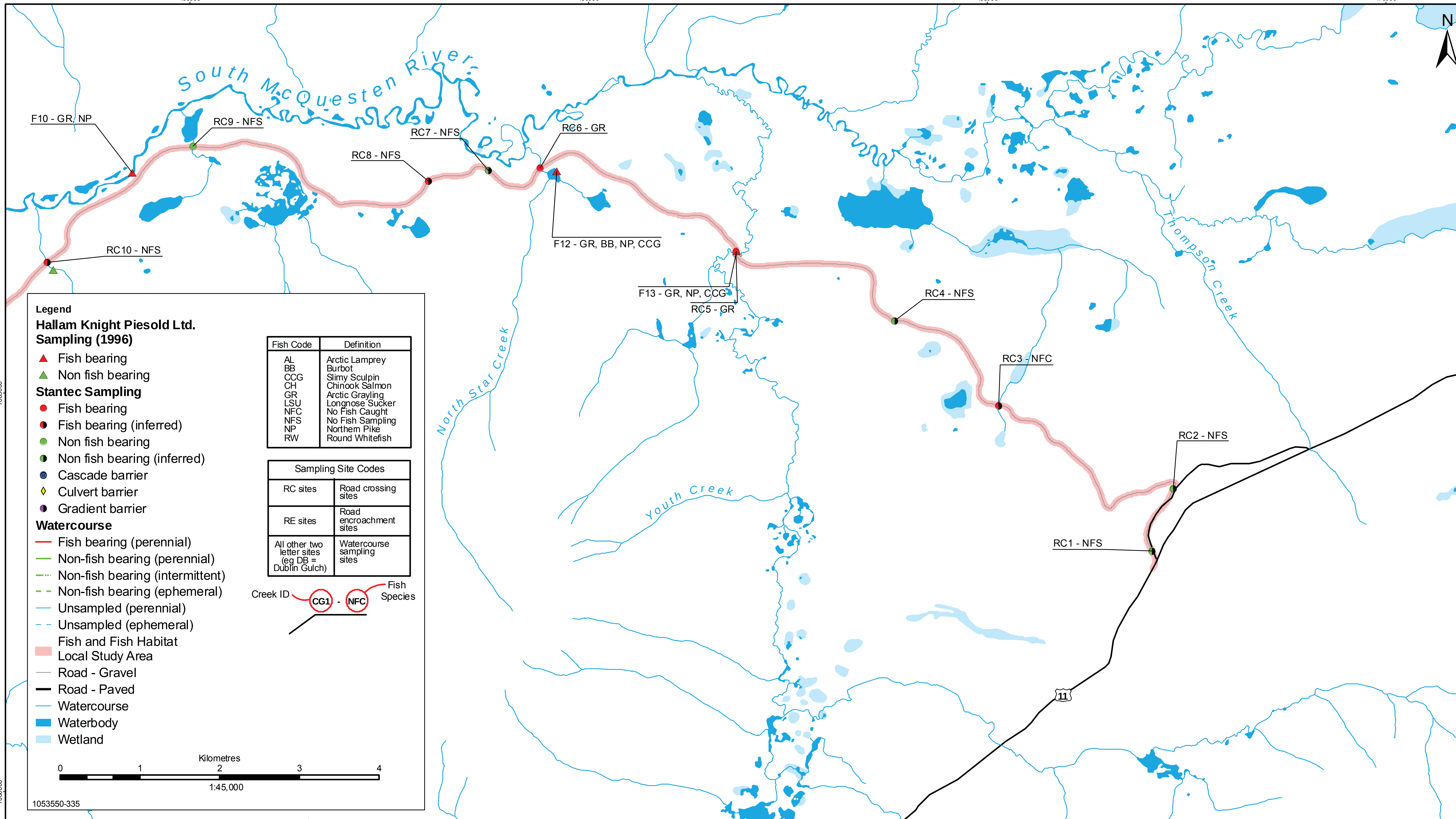
FISH AND FISH HABITAT STUDY AREA
SHEET 2 OF 3

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION: UTM - ZONE 8	DRAWN BY: LS
DATUM: NAD 83	CHECKED BY: RS
DATE: 29-November-2010	FIGURE NO. 4.1-23



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FISH AND FISH HABITAT STUDY AREA
SHEET 3 OF 3

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION UTM - ZONE 8	DRAWN BY LS
DATUM NAD 83	CHECKED BY RS
DATE 29-November-2010	FIGURE NO. 4.1-24

1051589_TEMPLATE_11x17Land.mxd

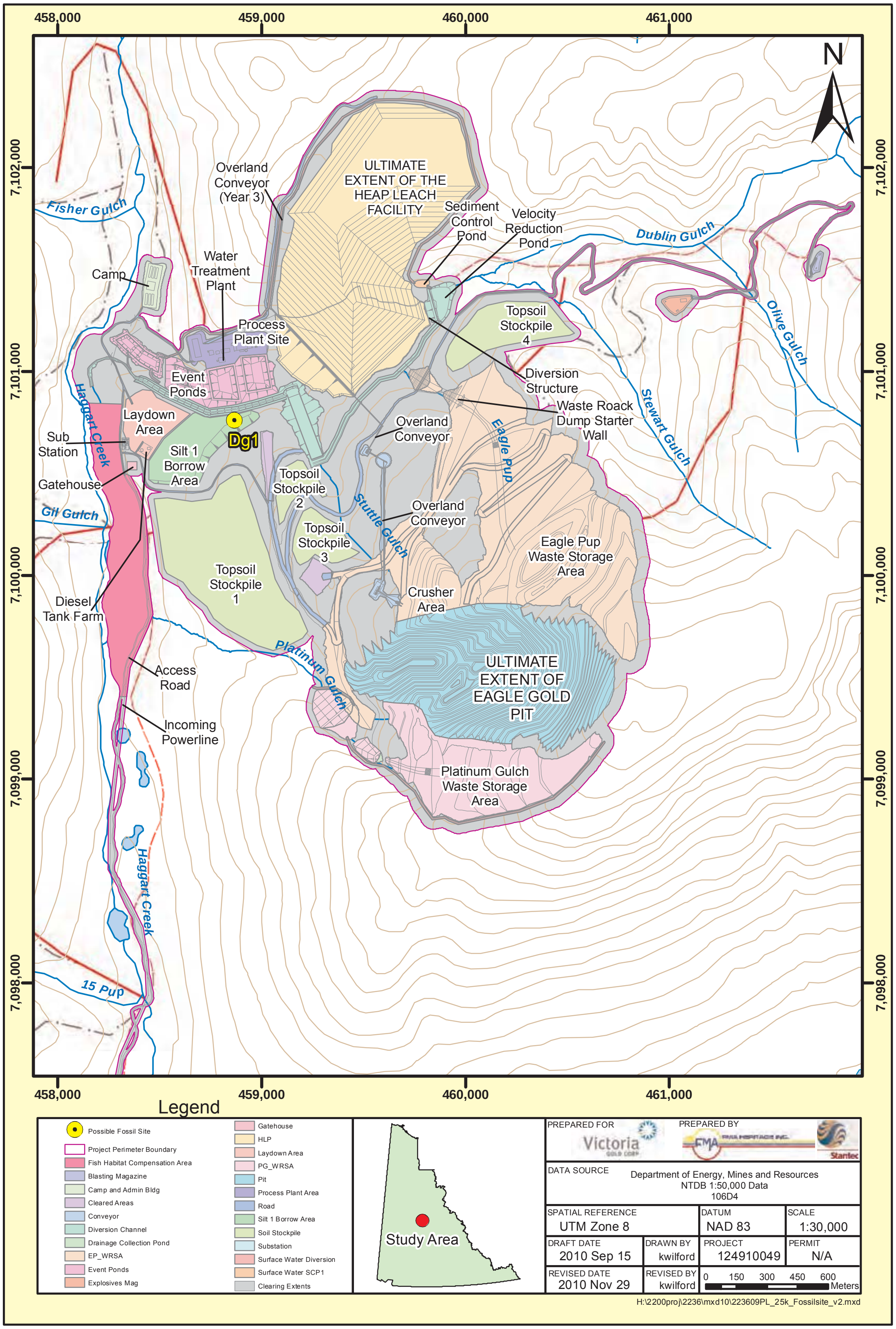
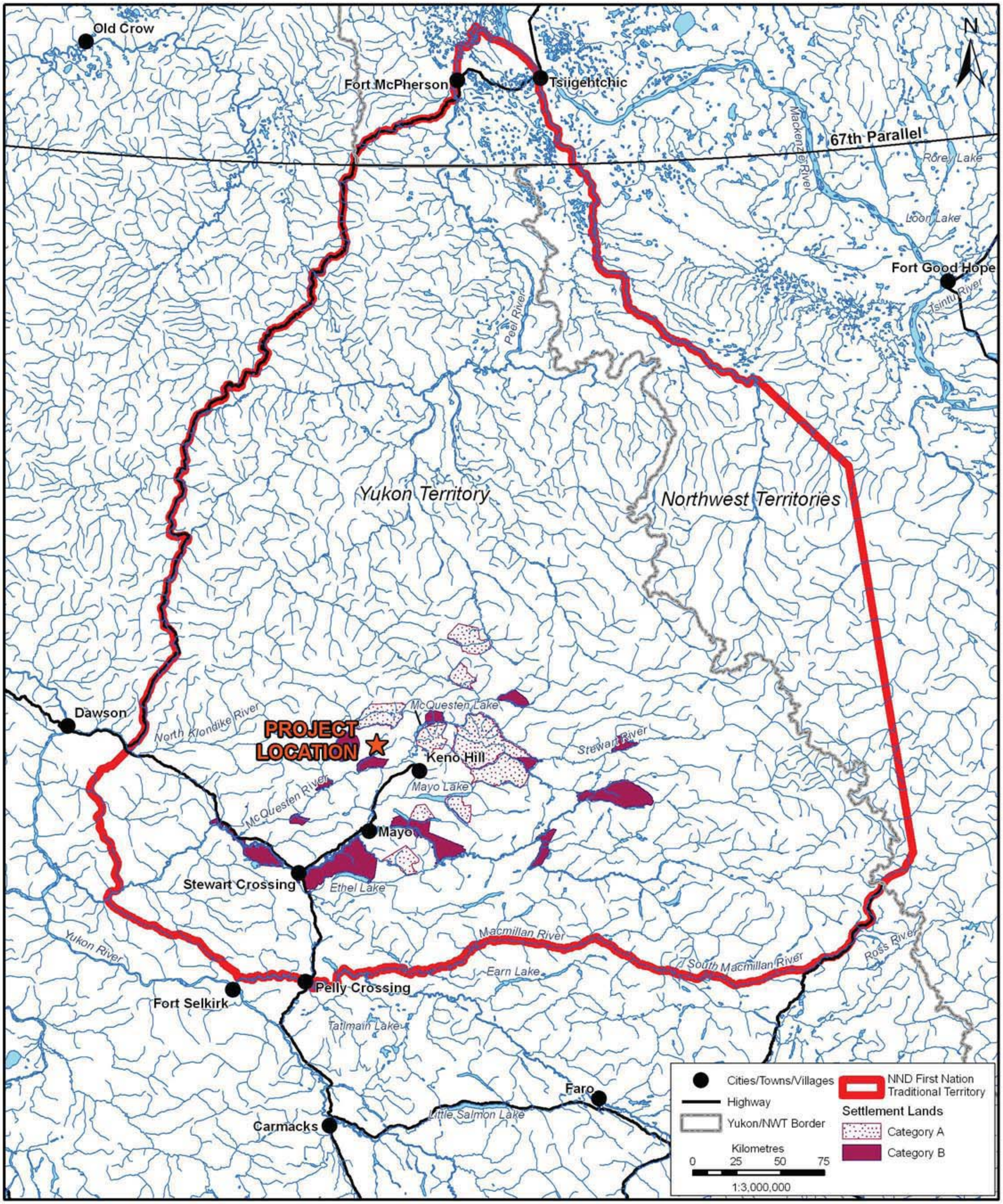


Figure 4.1-25: Possible Location of Dublin Gulch Pleistocene Fossil Locality



Source: Settlement Lands - Geobase

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NA-CHO NYÄK DUN TRADITIONAL TERRITORY

EAGLE GOLD PROJECT
YUKON TERRITORY

PROJECTION UTM - ZONE 8	DRAWN BY ML
DATUM NAD 83	CHECKED BY KD
DATE 26-May-10	FIGURE NO. 4.2-1

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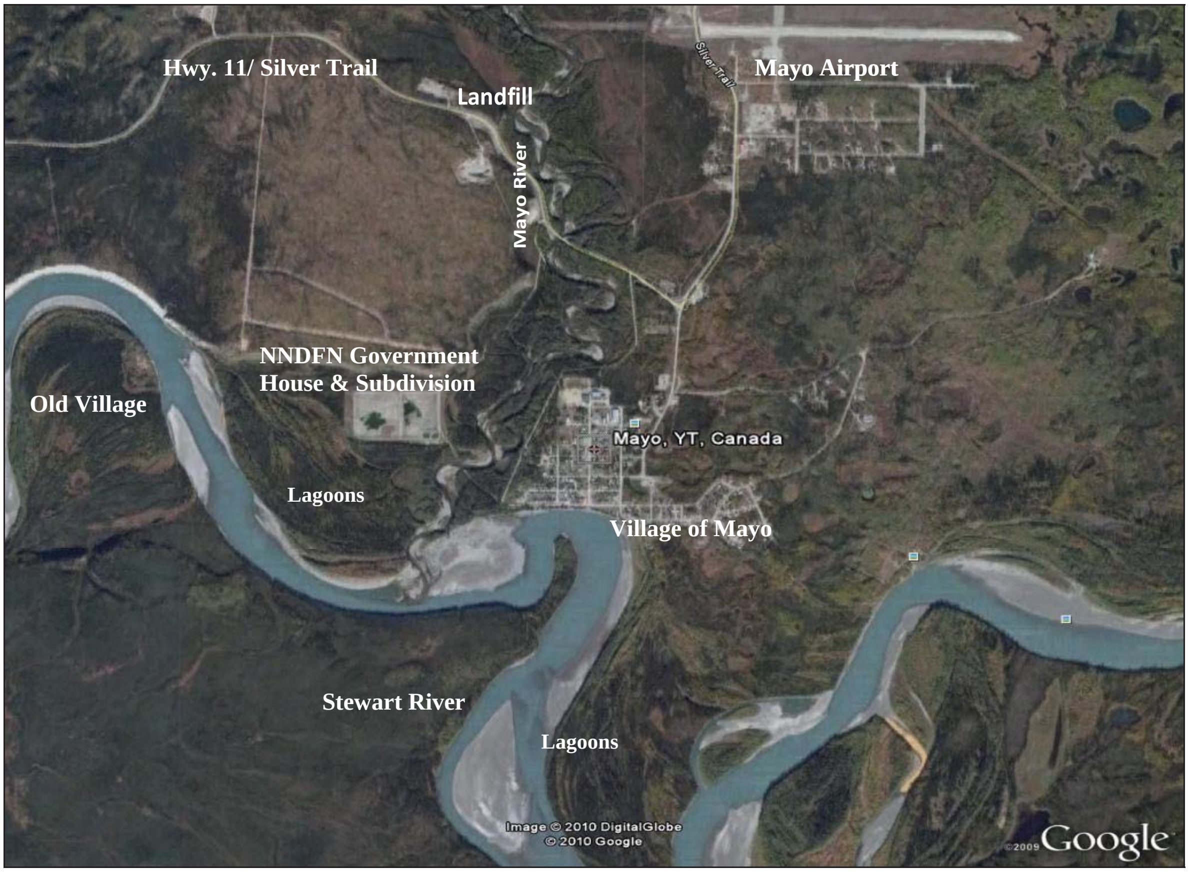
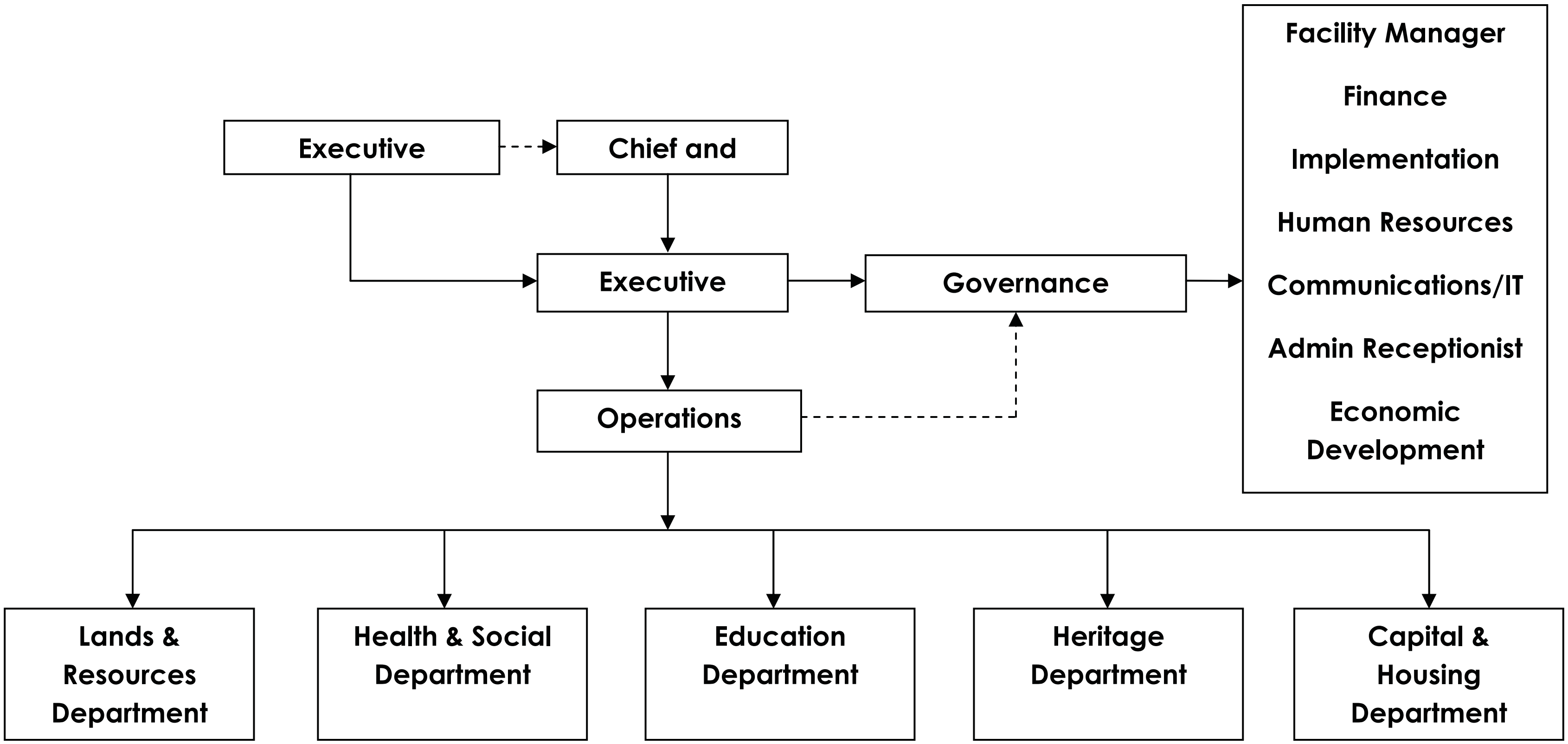


Figure 4.2-2: Mayo, Yukon

Figure 4.2-3: First Nation of Nacho Nyäk Dun Organization Structure Chart



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5 PROJECT DESCRIPTION

5.1 Project Identification

5.1.1 Principal Project

VIT proposes to develop a bulk tonnage, low grade, heap leachable gold deposit on its Eagle Gold property (Figures 5.1-1, 5.1-2). The proposed Project will involve open pit mining at a production rate of approximately 9 million tonnes per year (Mt/y) ore and an average strip ratio (amount of waste: amount of ore) of 1.04:1.00 over the 7.3 year production life of the mine. Current mineable reserves of leachable ore are 66 Mt at 0.82 grams per tonne (g/t) average head grade (number of grams of gold per tonne of ore). The open pit will be developed using standard drill and blast technology. Ore will be removed from the open pit by haul truck and delivered to the first stage crushing plant (the primary crusher), situated on the north side of the open pit rim. Waste rock will be removed from the open pit by haul truck and delivered to one of two waste rock storage areas (Platinum Gulch or Eagle Pup WRSAs) or will be used as haul road and infrastructure construction fill. Figure 5.1-3 presents the proposed general layout of the mine and infrastructure components of the Project. Figure 5.1-4 provides a flowsheet of the overall mining and heap leaching process.

Ore will be crushed to an average of 5 mm particle size in a 3-stage crushing process. The first two crushing stages (primary and secondary) will be located on the north rim of the open pit, while the third crushing stage (high pressure grinding rolls [HPGR]) will be located closer to the toe of the heap leach facility (HLF). Ore will be conveyed from the secondary crusher to the HPGR crusher by covered conveyor. After the HPGR crushing stage, ore will be transported by covered conveyor into the HLF area and will be stacked on the heap leach pad by radial stacking conveyor.

Gold extraction will utilize sodium cyanide heap leaching technology. Similar technology was employed in Yukon at the Brewery Creek mine in the late 1990s, and has been employed successfully in other cold climates such as the United States of America (Alaska) and Russia. Process solution containing cyanide will be applied to the ore to extract gold and then collected by the HLF leachate collection and recovery system.

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

A brief description of the components that comprise the Project follows. The information is broken down into two sections: Mine Components and Infrastructure Components.

5.1.1.1 Mine Components

Open Pit Mine: Gold-bearing ore and barren waste rock will be removed from the Eagle deposit by conventional drill, blast, shovel, and truck mining.

Crusher and Conveyor System: Ore will be delivered by haul truck to the first of three crushing plants, located on the rim of the open pit, at a rate of 26,000 tonnes per day (t/d). Ore will be crushed and then transported by covered conveyor to a building, where a second stage of crushing will occur. The secondary crusher product will be transported overland by covered conveyor to a crushed ore stockpile. Ore will be reclaimed from the stockpile and processed through a tertiary crushing circuit, and then transported by covered conveyor to the heap leach pad for stacking. The tertiary crushing circuit is also contained within a building.

Heap Leach Facility: Crushed ore will be delivered and stacked on a lined solution collection pad. Process solution containing cyanide will be applied to the ore to extract gold, and collected by the HLF pad leachate collection and recovery system (LCRS). The HLF pad will consist of a double liner system in the upper reaches of the facility, and a triple liner in the lower reaches of the facility. The lower section of the HLF pad acts as an ‘in-heap pond’ for primary storage of pregnant solution. The in-heap pond (essentially a saturated zone within the lower extent of the HLF) can contain up to 435,000 m^3 of pregnant solution, but will typically operate at approximately 60,000 m^3, less than 15% of total capacity. Because the in-heap pond is saturated ore, there will not be open or exposed surface area of liquid sodium cyanide solution during normal operations.

Waste Rock Storage Areas: Barren waste rock will be deposited in one of two waste rock storage areas (WRSAs) or utilized in the construction of various mine facilities. During the first three years of production, waste rock will be delivered to both Platinum Gulch WRSA and Eagle Pup WRSA. For the remainder of the life of the Project, waste rock will be trucked to the Eagle Pup WRSA.

Process Plant: Gold containing solution collected from the heap leach facility will be processed via conventional gold recovery methods. Gold-bearing solution will be pumped from the in-heap pond to the process plant via heat traced pipes. Solution will be recycled back to the HLF after gold recovery. The process plant area will be located at the toe of the heap leach facility, and will include a cyanide detoxification plant, which allows for solution treatment for removal of cyanide in the event that solution discharge from the operation is required.

Events Ponds: Several lined ponds (the Events Ponds) external to the HLF will be constructed for the life of the Project to temporarily store excess process solution during freshet and precipitation events. The solution contained in these ponds will be recycled back into the heap leach circuit as required. The ponds will be sized to contain peak intensity storm events as well as repeat wet years. The ponds will be constructed to include a leak detection and recovery system underneath the main liner system.

5.1.1.2 Mine Infrastructure Components

Buildings: The Project will include a 190 person camp and administration building, modular assay lab, mine truck shop, warehouse, fuel tank farm, and laydown area. The camp will consist of four to six modular dorm units, washroom facilities, a kitchen and dining area, a recreation complex, and laundry facilities. Administration, mine offices, and camp dry will be integrated into the camp complex. Potable water and waste water treatment services will be constructed as required for a facility of this size.

Fuel Storage Facilities: One large and one small storage facility will be constructed on site. Appropriate containment measures will be taken at each of the facilities. The largest storage facility will be located near the western end of Dublin Gulch, and will contain two 400,000 L tanks, sufficient for 30 days of operation without refuelling. The second, smaller fuel storage facility is planned for within the confines of the process plant area. Appropriate safety and protective measures will be taken at the storage facilities.

Fire Suppression System: Fire suppression water will flow by gravity through a pressurized main to the process facilities. Fire protection to the site and facilities will be provided by a standpipe outside, and two 100 mm diameter hose connections inside all of the heated buildings. The process offices, laboratory, and shop/warehouse will also be fitted with sprinkler systems. Portable fire extinguishers will be provided in all buildings.

Explosives Storage Facility: Two containers will be placed to house explosives components. Both of these structures will be located in the eastern reaches of the Dublin Gulch Valley. One building will house explosives, while the other will house blasting caps. Appropriate safety precautions will be taken in the construction and operation of these facilities.

Mine Water Treatment Plant: A mine water treatment plant (MWTP) will be constructed to treat contaminated surface and process water to a sufficient quality to be discharged to Haggart Creek without an adverse effect on local water quality. The water treatment process will involve several treatment technologies, possibly including ammonia removal, settling, pH adjustment, coagulation, filtration, and ion exchange.

5.1.2 Accessory Activities

Access Road: From Mayo, access to the Project site is along approximately 85 km of existing paved and gravel roads. Roads from Mayo to the site include the Silver Trail (Highway 11) and via the existing South McQuesten Road (SMR) and the Haggart Creek Road (HCR) (YG #325). All but the HCR is government maintained road. The HCR is currently wider than single lane and requires minor upgrades to support Project traffic volume and loads. As a result the HCR will be upgraded to a single lane, radio controlled gravel surface road with pullouts appropriately spaced. The HCR requires minor alignment and drainage upgrades, and will be maintained by VIT. Employees from Mayo and the surrounding communities will be transported to Mayo by a transfer van service utilizing upgraded existing roads. Employees from outside the local area will be flown in from Whitehorse to Mayo. All employees will be bussed the remaining distance to the mine site. Access to Mayo for freight and other deliveries is by government maintained public roads (Figure 5.1-5).

Transmission Line: Power to the site will be supplied by a new 45 km transmission line connecting to the Yukon Energy grid, routed along the access road (Figure 5.1-5). The 69 kV transmission line will feed a main substation on site. Power will be distributed at 13.2 kV via two sets of overhead lines. The first set of overhead lines will provide power to primary crushing, secondary crushing, conveying, and HPGR. The second set of overhead lines will provide power to the process plant and HLF. Each area will require an electrical room housing high voltage and low voltage equipment including indoor 13.2 – 4.16 kV and 13.2 – 575 kV step-down unit substations.

5.2 Technologies

The Project will utilize sodium cyanide heap leaching technology as a gold recovery process. Similar process technology was employed in Yukon at the Brewery Creek mine in the late 1990s, and has been employed successfully in cold climates elsewhere in the world.

Process solution containing cyanide will be applied to the ore once stacked on the HLF to extract gold, and collected by the HLF pad leachate collection and recovery system. As stated earlier, the pad will consist of a double liner system in the upper reaches of the facility, and a triple liner in the lower reaches of the facility. A leak detection and recovery system will be situated under the entire heap leach facility.

The HLF will be located within the Ann Gulch valley and extend into the Dublin Gulch valley and will include a leach pad with in-heap solution storage as well as external events ponds to contain solution in the event that higher than normal precipitation causes the in-heap storage capacity to be exceeded.

Gold-bearing “pregnant” solution (pregnant leach solution [PLS]) will be pumped from the heap to the gold recovery plant. Gold will be recovered from the PLS by activated carbon adsorption and pressurized caustic desorption, followed by electro-winning onto steel wool, and on-site smelting to gold bullion. This process is referred to as the adsorption, desorption, and recovery (ADR) process. The gold-barren leach solution that remains after passing through the carbon columns will be re-circulated back to the HLF. If leach solution cannot be recycled back to the HLF due to water balance constraints, the leach solution will be stored within the Events Ponds. If storage capacity within the Events Ponds is unavailable, then the solution will be processed through the cyanide detoxification plant and the MWTP prior to discharge to Haggart Creek.

5.3 Project Phases and Scheduling

The Project is planned to have a 20-month construction phase, a 7.3-year operations mining phase, and a 10-year closure and reclamation phase, followed by a post-closure monitoring phase. This schedule is provided in Table 5.3-1. Section 5.4 provides details of the construction phase of the Project. Section 5.5 provides details of the operations phase of the Project. Section 5.6 provides details of the closure and reclamation phase of the Project.

Table 5.3-1: Eagle Gold Overall Project Schedule

Phase	Period
Construction	Q1 2012 – Q3 2013
Operations	Q4 2013 – Q4 2020
Closure and Reclamation	Q1 2021 – Q4 2030
Post-closure Monitoring	2030 – 2035

5.4 Construction Phase

The construction phase of the Project will commence in the first quarter of 2012 and be completed by the third quarter of 2013, at which time the operations phase of the Project will begin. The anticipated duration of construction is approximately 69 weeks, over two summer construction periods. This assumes that major construction activities cannot be undertaken during the winter period from approximately October 29, 2012 through March 15, 2013.

Major construction activities completed in 2012:

- Site earthworks
- Confirmatory geotechnical drilling in selected plant site areas
- Construction of pond earthworks
- Construction of surface water management infrastructure
- Installation of the man camp
- Construction of camp water intake and distribution infrastructure
- Construction of concrete foundations
- Upgrading of the existing access road
- Stripping of leach-pad and events ponds sites
- Confirmatory geotechnical drilling in leach pad, events ponds, and WRSAs
- Construction of Dublin Gulch diversion channel
- Construction of HLF embankment
- Development of WRSAs
- Construction of fuel storage facility
- Removal of open pit overburden, and soil salvage
- Commencement of open pit pre-stripping.

Major construction activities completed in 2013:

- Installation of the process facilities, including crushers, HPGR, conveyors, and ADR plant
- Erection of all buildings
- Installation of power distribution facilities

- Development of soil salvage and storage sites
- Construction of power generation facilities
- Commissioning of facilities.

5.4.1 Mine Development

The majority of details provided in this section have been excerpted from the *Prefeasibility Study on the Eagle Gold Project, Yukon Territory, Canada* (PFS document) (Scott Wilson Mining 2010). Additional information can be attained through reference to the PFS. References to sections within the PFS have been provided to simplify searches for additional background information.

5.4.1.1 Construction Equipment

The following table identifies the required equipment and projected operating hours for the construction phase of the Project.

Table 5.4-1: Construction Equipment

Type	Description	Maximum Units Required	Total Unit Operating Time (hours)	Engine Type	Engine Size (hp)
Support Equipment (mainly for stockpiles, conveyors)					
Feller/Buncher	541	1	3,000	Diesel	305
Log Skidder	324D-FM	1	3,000	Diesel	200
HIAB Flat Bed Utility Truck	3/4t	1	5,261	Diesel	200
Track Dozer	D5N/D85	2	3,000	Diesel	310
Backhoe/Loader	CAT 93G	1	3,000	Diesel	300
Tandem Dump Truck	Various	4	3,000	Diesel	300
Wheel Loader	992G	1	1,500	Diesel	800
Mobile Crusher	HX	1	3,000	Diesel	420
Motor Grader	16H	1	1,500	Diesel	265
Wheel Tractor Scraper	CAT 613G	1	3,000	Diesel	193
Fork Lift	Manitou Mc	1	3,000	Diesel	50
Concrete Mixing Trucks	Various	2	1,500	Diesel	200
Mobile Crane	Terex	1	1,500	Diesel	300
Major Equipment					
Sandwick DX800 Drill	DX800	1	3,000	Diesel	225
Excavator	CAT 365	3	3,000	Diesel	400
Haul Truck	Art6x6	10	3,000	Diesel	400
Track Dozer	CAT D10	1	1,500	Diesel	580
Track Dozer	CAT D8	2	1,500	Diesel	310
Motor Grader	CAT 16H	1	1,500	Diesel	265
Light Vehicles	3/4t	20	3,000	Diesel	300

Type	Description	Maximum Units Required	Total Unit Operating Time (hours)	Engine Type	Engine Size (hp)
Support Equipment (mainly for roads, ADR, WRSAs)					
Wheel Loader	992G	1	1,500	Diesel	800
Track Dozer	D5N/D85	1	3,000	Diesel	310
Excavator	Hitachi EX1900-6	2	3,000	Diesel	1087
Personnel Carrier	3/4T	2	3,000	Diesel	300
Compactor	CS-573E	1	3,000	Diesel	150
Motor Grader	CAT16H	1	3,000	Diesel	265
Secondary Support Equipment					
Personnel Carrier	3/4t	2	3,000	Diesel	300
Flatbed Truck	3/4t	1	1,500	Diesel	215
Water Truck, 14,000 gal	773	1	3,000	Diesel	550
CAT 1.0 MW Generator (plant area)	–	1	8,760	Diesel	–
Portable CAT 0.25 MW Generator (pit development)	–	1	–	Diesel	–
Portable CAT 10 kW Generator (construction area)	–	10	–	Diesel	–

5.4.1.2 General Site Preparation

Mine site preparation activities include:

- Clearing of vegetation in select areas
- Clearing and grubbing of infrastructure locations
- Development of one or more construction silt borrow source sites
- Construction of gravel or concrete infrastructure pads
- Construction of various site roads, both for general access and for operations
- Preparation of a soil salvage location, to store salvaged top soil and organics for reclamation
- Development of a site staging/laydown area.

The following paragraphs provide details on the above mine site preparation activities.

Vegetation Clearing and Grubbing

Tree species that are present within the Project footprint include: black spruce, white spruce, subalpine fir, aspen, and Alaskan birch.

It is estimated that a volume of approximately 19,700 m^3 of salvageable timber will be available from areas cleared for Project activities. This includes about 15,300 m^3 of wood cleared and salvaged from 342 ha of forested land for mine site construction and 4,400 m^3 of wood associated with clearing of the land for the road and transmission corridor. Estimates of salvageable timber have been prepared through use of the terrestrial ecosystem mapping created for the Project. The area of the forested ecosystems that will be cleared as a result of Project construction activities was calculated from the mapping. Each mapping polygon within the mine clearing boundary was assigned with a crown closure class (i.e., sparse, open, dense) and a timber salvage class. Timber volume classes were also assigned to each ecosystem type based on structure, crown closure and the salvage class. Volume was then calculated by multiplying the areas (ha) of the ecosystems to be cleared with a timber volume (m^3/ha) related to crown closure and salvage potential. The current estimate is based on the assumption that trees >150 mm diameter at breast height (DBH) will be salvaged from stands with sparse, open and dense canopies.

Trees will be cleared and harvested using best management practices and methods suitable to the terrain and timber size. Trees less than <150 mm DBH and shrubs will be machine cleared and disposed as described in the Waste Management Plan. Areas containing suitable stands of salvageable timber (>150 mm DBH) will be identified and flagged prior to clearing.

Salvageable timber will be harvested by mechanical methods (i.e., feller bunchers; skidders; tracked bulldozers). Hand falling (chainsaws) may be used in specific areas (i.e., steep slopes, riparian areas). Timber will be removed from the cleared areas within the mine site, road, and transmission corridor and placed in an approved timber storage area (to be determined at a later date). Timber or fuel wood will be placed in the storage area until collected, removed or distributed based on the Timber Salvage Plan and/or Project Agreement referred to below.

A Timber Salvage Plan with more detail will be developed to meet regulatory requirements and for permitting. In developing the Timber Salvage Plan, VIT will work with the First Nation of Na-Cho Nyäk Dun (NNDFN), the Village of Mayo and the Yukon Government to explore potential business opportunities and to address local community access to timber salvaged from the Project activities.

Construction Borrow and Quarry Site Development and Waste Rock Management

Construction materials will be sourced from available placer spoils, overburden, silt borrow pits and rock excavations located on the Project footprint. Various types and quantities of granular borrow material are required for construction of the mine site facilities (PFS, SWRPA 2010):

- 564,000 m^3 of silt/fines for heap leach pad liner construction
- 2,240,000 m^3 of rock fill for heap containment dyke and diversion embankment, selected from durable waste rock from mining
- 330,000 m^3 of fine gravel/coarse sand for leachate detection and recovery system
- 883,000 m^3 of general fill and/or structural fill for various earthworks structures, including pond berms, building pads and similar structural applications
- 65,000 m^3 of transition zone gravel
- 49,000 m^3 of Type 2 drainage system material (described as silty colluvium)
- 26,000 m^3 of rip rap

- 4,000 m^3 of coarse concrete aggregate
- 2,000 m^3 of fine concrete aggregate.

Several potential sources of borrow material were identified in the mine site area as part of the PFS (SWRPA 2010), including potential silt borrow pits, the placer tailings in the Dublin Gulch valley bottom and proposed platform cuts into bedrock along sloping ground. These identified borrow areas are illustrated in Appendix 34. Potential additional borrow areas are also illustrated in Appendix 34.

Available data and terrain analysis suggests approximately 500,000 m^3 of silt is available on the east side of Haggart Creek, close to the mine site and within the current Project footprint. Preliminary calculations indicate that sufficient silt material will be available within the current Project footprint to satisfy the needs of the project.

The required quantities of rock fill can be sourced from operation of the open pit, from excavation of cuts for major facility platforms (i.e., plant site, crushers, HPGR and ore stockpile), and, if required, from development of a rock quarry east of the proposed heap leach facility within the Project footprint.

The remaining construction materials can be derived from other local sources, including placer tailings and overburden stripped during mine development. Some processing will be required to manufacture select materials, including crushing, screening and/or washing. It may not be possible to source concrete aggregate locally; this material may need to be imported from off-site. However, further testing of the placer tailings may identify materials suitable for use as concrete aggregate.

A complete analysis of borrow requirements and material availability is provided in Appendix 34. Further work is required at the feasibility study stage to confirm material availability.

The geochemical behaviour of rock sourced from the open pit has been addressed in a geochemical characterization program documented in Appendix 8. As discussed in Appendix 8, the rock associated with the Eagle Gold project is very low in sulphide content and is not acid generating; it does, however, exhibit characteristics prone to metal leaching at neutral pH. Both the granodiorite and metasediments are relatively consistent in geochemical behaviour, such that field-level rock characterization during construction is not required because rock segregation is not necessary. Further, except for the heap leach pad embankment, construction material quantities used at any one location will be relatively small so that the risks of metal leaching from large aggregate accumulations of construction material are not likely. In the event that a large volume of rock is to be used in any one area of the project (i.e., in addition to the waste rock storage areas and heap leach facility), water quality monitoring stations will be established, if not already in place, to monitor run off quality from the area or facility. If necessary, this water will be collected and conveyed to the mine water treatment facility to prevent any impact on water course areas. If this condition arises, specific actions will be added to the Project Closure and Reclamation Plan to address remediation of the facility prior to closure of the site.

If material is to be sourced from outside of the Project footprint, additional characterization of the proposed borrow area or material will be conducted to evaluate geochemical behaviour of the material prior to its transport and use. Criteria for acceptable material will be developed as part of the design engineering and required license applications for the Project.

Infrastructure Pads Construction

Construction of the infrastructure pads (crushers, process plant, camp, and administration buildings) will involve clearing the overburden soil and, if required, blasting the bedrock to below the desired HLF pad elevation. Gravel and broken blast rock fill will then be used to extend the desired pad width and to level the pad to the design elevation. The fill used to create the infrastructure pads will be placed and compacted to support foundations for buildings and some equipment. Slope angles will be determined during detailed design but will be in the order of 45° (1H:1V; 1 unit horizontal to 1 vertical) for rock cuts and approximately 18° (3H:1V) for rock fills. Infrastructure foundations will be cast directly onto the bedrock surface prior to the placement of the levelling fill.

Site Roads Construction

VIT will construct a network of access roads throughout the mine site. The site roads will connect the infrastructure pads, the proposed open pit, the Platinum Gulch and Eagle Pup WRSAs, the HLF, the explosives and blasting cap magazine, the silt borrow sites, process plant, and the accommodation facilities.

For site road construction, salvageable soils required for reclamation will first be stripped from the road footprint for stockpiling, followed by removal of any additional overburden material unsuitable for a road base. The road base and surface will be built up using local borrow or suitable material from mining operations, with culverts installed as required at a maximum spacing of 500 m. Road alignment and cross section design will vary, based on the largest intended vehicle and whether it is for one- or two-way traffic.

Design slopes of 1.5H:1V will be used for fill road construction when located directly above another travel-way, otherwise, as-dumped slopes at angle of repose are designed. Cut slopes in overburden, which are typically less than 5 m high, are designed at 56° (1.5H:1V). Cut slopes for temporary roads within the final open pit limits, which are typically greater than 10 m high and can exceed 20 m, are designed at 45 to 50 degrees (1H:1V to 1.2H:1V).

Soil Salvage Site Preparation

Soil will be salvaged from disturbed areas in the Project area and will be stockpiled in topsoil stockpiles located in the area between Stuttle Gulch and Eagle Pup. Approximately 1,500,000 m^3 of suitable material will be salvaged and stockpiled for reclamation purposes. Figure 5.4-1 illustrates the location of soil stockpiles.

Staging/Laydown Area Development

Construction of the staging area will be limited to removing vegetation cover in the area and levelling the ground surface. A gravel surface may be required, depending on local conditions. The staging area will be sized to accommodate the storage of construction material that is transported from the various vendors to the construction site. The staging area will be used until the end of the mine reclamation phase and then will be closed, reclaimed, and abandoned.

5.4.1.3 Open Pit Development

Conventional open pit methods are proposed for mining ore from the Project deposit. Over the life of the mine, the open pit is to advance in four phases, beginning with a starter pit (Phase 1), and followed by three push backs (Phases 2-4). Further detail on mine development is found in Section 5.5.1.1. Waste rock pre-stripping is scheduled to begin in 2012, primarily for the development of access roads. Waste rock will be cut from the Phase 1 and the Phase 3 open pit footprints and the ore stockpile/primary crusher plant area.

Mine access road construction will be completed during the first half of 2013, for the start of production mining operations.

Through the end of the construction phase, the total area stripped will be approximately 56 ha. The total area of pioneering benches developed within the final open pit limits will be approximately 21 ha. The total rock mined and delivered for construction of the HLF embankment will be 3.6 Mt. The total rock cut for road construction internal and external to the final open pit limits will be 2.2 Mt. Figure 5.4-2 illustrates the open pit area earthworks at the end of the construction phase.

Overburden and extremely weathered or altered material within the open pit are to be mined by ripping or excavation with bulldozers and backhoes, and stockpiled for use in reclamation at the end of the mine life.

Water collected within the open pit footprint will be gathered at a common open pit sump and transferred to the Mine Water Treatment Feed Pond by pump for use by the process plant or for treatment and release, as required. Contact water from the Platinum Gulch WRSA will be collected in the open pit sump as well. The open pit sump is not a permanent feature within the open pit, but instead is moved as the open pit is developed to accommodate adequate dewatering for operations. Further discussion on site water management can be found in the Water Management Plan (Appendix 18).

5.4.1.4 Crusher and Conveyor System Construction

As described in Section 5.4.1.2, construction of the crusher pads will involve clearing the overburden and soil and potentially blasting the bedrock to below the desired HLF pad elevation. Gravel and broken blast rock fill will be used to extend the desired pad width, level the pad to the design elevation, and support foundations for buildings and some equipment. Infrastructure foundations will be cast directly onto the bedrock surface prior to the placement of the levelling fill. Crushing equipment will be installed inside pre-engineered heated and insulated steel buildings.

Figures 5.4-3, 5.4-4, and 5.4-5 present construction details for primary and secondary crusher and conveyor systems. Figures 5.4-6 and 5.4-7 present construction details for the HPGR crusher and conveyor system.

5.4.1.5 Heap Leach Facility Construction

The HLF will consist of a combination valley and side-valley heap leach pad and multiple components described below. The HLF will extend from within the Dublin Gulch valley and up the

Ann Gulch valley. Dublin Gulch is a perennial second order stream whereas Ann Gulch is an intermittent and ephemeral first order stream that flows only during spring snow melt or significant precipitation events.

The HLF will be constructed in three phases.

Phase 1: construction, installation, and development of the following facilities to provide for two years of operations:

- Sediment control ponds and surface runoff diversions
- Confining embankment and liner ground
- Groundwater drainage system
- Pad liner system
- Leak detection and recovery system (LDRS)
- In-heap pond
- Events Ponds.

Phase 2: expansion to provide for three additional years of operations:

- Extension to the HLF (additional lined area).

Phase 3: expansion to provide for operations to closure in year 2021:

- Extension to the HLF (additional lined area).

Heap Leach Facility Construction Schedule

Overview

The target date for starting construction is April 1, 2012 and the target date for loading ore onto Phase 1 of the HLF is August 30, 2013. Use of leach solution will begin sometime before the end of 2013. The development of Phases 2 and 3 of the HLF are timed to be complete in the year prior to when ore is scheduled to be loaded on them.

Development of the permanent water management features of the Project are required to be done in parallel with the HLF development. Further details regarding these water management features are provided in the Water Management Plan (Appendix 18).

A Gantt chart detailing the construction schedule for the HLF is supplied below.

Rough Earthworks

Preparation of the ground for construction of HLF Phase 1 begins with snow management, clearing and grubbing (process of clearing the site of trees, stumps, and objectionable or spoil material) of the site to allow for installation of the confining embankment and the in-heap pond area. Once cleared and grubbed, topsoil will be stripped and stockpiled for later use in the Closure and Reclamation phase of the Project. During these activities, any materials identified to be suitable for use in the construction will be segregated and stockpiled when practicable.

Following topsoil stripping, the area will be assessed for any instances of permafrost with the intent to remove any such material and replace it with suitable fill.

For the embankment foundation, preparation beneath the embankment will consist of removing loose sand and gravel from the valley floor, potentially to bedrock at a depth of two to ten metres. For the abutments, topsoil will be removed and excavated down to competent material, to a depth of one to two metres, with isolated pockets of deeper loose material.

Work will start on April 2, 2012 and continue to early September 2012. This activity is for the most part not seasonally dependent save for dealing with permafrost.

Cushion Layer Material

Material, primarily ore, will be collected during the pit development and stockpiled for crushing and use as cushion material over the upper PVC liners of the HLF. A total of approximately 1,000,000 tonnes of ore will be required as cushion layer and placement of the crushed ore will begin in August 2013. Collection of cushion layer material will begin as soon as development on the ore zone of the pit begins.

This activity has no seasonal constraints.

Event Ponds

Preparation of the ground for construction of event ponds clearing and grubbing (process of clearing the site of trees, stumps, and objectionable or spoil material) of the site. Once cleared and grubbed, topsoil will be stripped and stockpiled for later use in the Closure and Reclamation phase of the Project. During these activities, any materials identified to be suitable for use in the construction will be segregated and stockpiled when practicable. This work will start in July 2012 and a small component may extend into early 2013 with a winter hiatus due to cold weather.

Following the previous steps, the subgrade will be leveled out and consolidated to provide a sound structure to build up from. Management of water and frozen ground/material will be a key item. This work will start in May 2012 and be completed within two months.

Silt layer placement begins in May 2013, with the onset of more favourable weather for dealing with fine and wet materials. Installation of the HDPE liners, LDRS, and gravel layers will continue through the summer with completion scheduled for September 2013.

Phase 1 HLF

Work on the detailed development of the HLF will begin April 2012 starting with development of surface runoff management systems required prior to freshet. Along with this will be the stockpiling of the appropriate construction materials such as silts and materials for the embankment.

Subgrade preparation will begin in mid summer 2012, once the Rough Earthworks have advanced sufficiently and continue until the onset of winter.

Work will recommence in April 2013 with the installation of the groundwater drainage systems and silt layer. The silt layer work will require the more amenable ambient and soil temperatures that can be expected during this time of year.

Installation of the remaining HLF components will continue throughout May to September 2013. This will allow for earthworks and liner placement in favourable conditions from both an efficiency and quality perspective.

The Phase 1 HLF facility will be ready to accept the cushion layer of ore starting late August 2013.

Some final aspects of the Embankment will carry over into 2014 though these items will not impact the ability for the HLF to accept cyanide leaching solution in late 2013.

Phase 2 and 3 HLF

Work on these phases of the project will start in April of 2014 and 2019, respectively. The construction will follow the same sequences identified above with work being completed within the calendar year that it was started.

Dublin Gulch Water Management Features

Dublin Gulch water management is critically linked to the completion of the HLF facilities given the required reorientation of Dublin Gulch. Further details regarding these water management features are provided in the Water Management Plan (Appendix 18).

The major areas that make up this component of the HLF development schedule are:

- Upper Section Velocity Reduction Pond/Embankment
- Upper Dublin Gulch Diversion Channel
- Lower Dublin Gulch Sediment Control Pond
- Lower Dublin Gulch Diversion Channel
- Lower Velocity Reduction Pond
- Energy Dissipation Structure.

Work on the Lower Dublin Gulch Sediment Control Pond needs to be completed prior to the onset of freshet in 2012 thus work must start at the beginning of April 2012. The more sensitive aspects of the construction (filter and drainage layer, and HDPE installation) will occur in the later portion of April and first part of May thus allowing for favourable installation conditions with respect to quality of work.

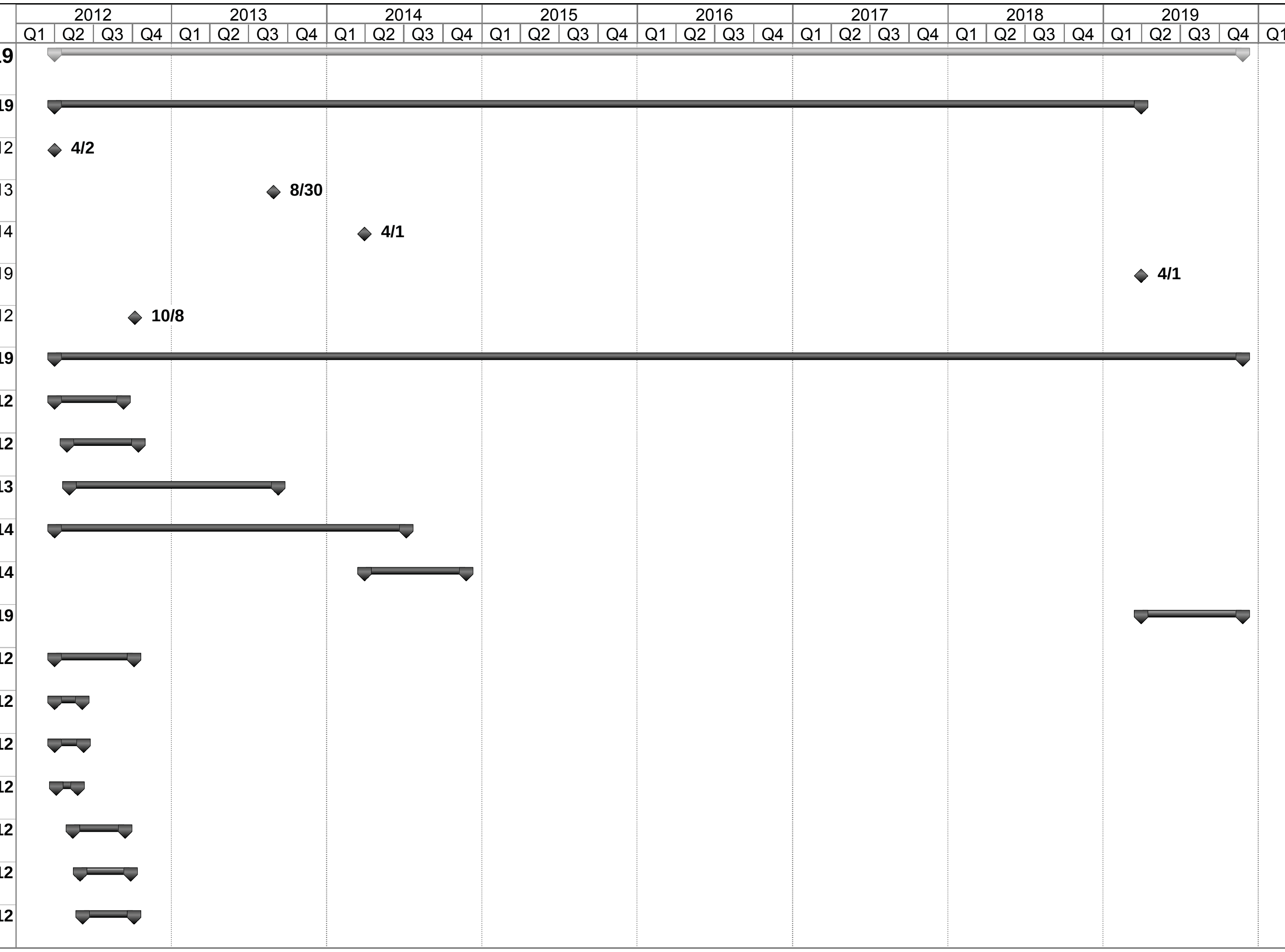
Work on the Upper Dublin Gulch Diversion Channel and Velocity Reduction Pond/Embankment need to start in April 2012, and be concluded by end of May 2012, to accommodate freshet.

Work on the Lower Dublin Gulch Diversion Channel, Lower Velocity Reduction Pond, and Energy Dissipation Structure will begin in late May to early June 2012. This timing will allow for the work to be completed in October 2012 which will then allow for all of the above components to be connected together before the end of 2012.

The same type of activities, materials, processes, quality control/quality assurance, and seasonal constraints described in the development of Phase 1 HLF are also applicable to the Dublin Gulch Water Management Features.

HEAP LEACH DEVELOPMENT SCHEDULE

ID	Task Name	Duration	Start	Finish
0	**HEAP LEACH DEVELOPMENT SCHEDULE**	**1996 days?**	**April 2, 2012**	**November 25, 2019**
1	**KEY TASKS & MILESTONES**	**1825 days**	**April 2, 2012**	**April 1, 2019**
2	Start Heap Leach Facility Construction	0 days	April 2, 2012	April 2, 2012
3	Deliver Ore to Heap Leach Pad	0 days	August 30, 2013	August 30, 2013
4	Start Stage 2 Construction	0 days	April 1, 2014	April 1, 2014
5	Start Stage 3 Construction	0 days	April 1, 2019	April 1, 2019
6	Connect Upper and Lower Diversion Channel - October 2012	0 days	October 8, 2012	October 8, 2012
7	**HEAP LEACH PAD**	**1996 days?**	**April 2, 2012**	**November 25, 2019**
8	**Rough Earthworks**	**116 days**	**April 2, 2012**	**September 10, 2012**
14	**Cushion Layer Material**	**120 days?**	**May 1, 2012**	**October 15, 2012**
16	**Event Ponds**	**351 days?**	**May 7, 2012**	**September 9, 2013**
25	**Phase 1 - Heap Leach Pad**	**591 days**	**April 2, 2012**	**July 7, 2014**
44	**Phase 2 - Heap Leach Pad**	**171 days**	**April 1, 2014**	**November 25, 2014**
60	**Phase 3 - Heap Leach Pad**	**171 days**	**April 1, 2019**	**November 25, 2019**
76	**Dublin Gulch Water Management Features**	**135 days?**	**April 2, 2012**	**October 5, 2012**
77	**Upper Section Velocity Reduction Pond/Embankment**	**47 days**	**April 2, 2012**	**June 5, 2012**
89	**Upper Dublin Gulch Diversion Channel**	**50 days?**	**April 2, 2012**	**June 8, 2012**
100	**Lower Dublin Gulch Sediment Control Pond**	**36 days**	**April 6, 2012**	**May 25, 2012**
109	**Lower Dublin Gulch Diversion Channel**	**89 days**	**May 15, 2012**	**September 14, 2012**
120	**Lower Velocity Reduction Pond**	**85 days**	**June 1, 2012**	**September 27, 2012**
132	**Energy Dissipation Structure**	**87 days**	**June 7, 2012**	**October 5, 2012**



Project: HEAP LEACH DEVELOPMEN
Date: May 19, 2011

Task | Progress | Summary | External Tasks | Deadline
Split | Milestone | Project Summary | External Milestone

The following paragraphs provide functional descriptions and design details on the main components of the HLF. The Events Ponds are described in Section 5.4.1.8.

Sediment Control Ponds and Surface Runoff Diversions Development

Collection and management of surface water runoff is required before construction of the HLF can commence. This will consist of sediment control ponds built downstream of areas affected by construction, diversion ditches to minimise the amount of water flowing across the construction areas, and other measures to mitigate sediment loads in downstream watercourses. Further details regarding surface water management are provided in the Water Management Plan (Appendix 18).

Confining Embankment and Liner Ground Preparation

Preparation of the ground for construction of the HLF will start with clearing and grubbing of the site. Soil identified as unsuitable for construction material will be removed and stockpiled. This will include topsoil, saturated ground, and permafrost soils. Topsoil will be stored for reclamation activities, and other materials will be stockpiled for conditioning/processing and used for construction material where practicable.

Following clearing and grubbing, the foundations will be prepared for either embankment construction or liner placement. Embankment preparation will require excavation down to suitable material, with the excavated material stockpiled for later use. To provide a satisfactory initial operational area that will confine the heap leach pad and in-heap storage pond, an embankment will be constructed at the base of the HLF in the Dublin Gulch valley. The embankment will be 50 m high and 560 m wide at the top, and will have a total fill volume of 2.2 million m^3. It will be constructed from selected durable waste rock from the mining process, placed on a suitable foundation, and have a filter zone on the upstream face to provide a transition to the sub-grade of the liner. Figure 5.4-8 provides construction details for the HLF embankment.

Preparation for liner placement will involve cut/fill (excavation, spreading, and compacting of the in-situ materials) to produce a suitable profile for the placement of the liner in flat panels.

In-Heap Pond

The HLF will receive crushed ore from the Open Pit for the purpose of extracting gold. Solution required for the HLF will be stored in two locations in addition to the storage tanks in the ADR facility. The Heap Pond (HP) will be the primary storage facility and located behind (or upstream) of the HLF embankment. Although the HP is labelled as a pond, it is actually the saturated portion of stacked ore behind the embankment (B in Figure 3.6-1) and there will be no exposed liquid solution. The maximum storage capacity of the HP is 435,000 m^3, although operationally it will be kept at approximately 60,000 m^3 at any one time during normal operations to allow for the design storm event inflow.

The solution level in the Heap Pond will be monitored with a pond-level instrumentation and a fluid-flow meter measuring solution going into (and out of) the ADR plant. Solution management operating systems including level and flow measurement will be incorporated with the process plant supervisory control and data acquisition (SCADA) systems to enable real time process information. Hence, solution flow into the Heap Pond and Events Ponds will be continuously calculated and monitored at all times, including during upset (i.e., 1:100 year storm events) for circuit balancing purposes.

The 1:100 year 24 hr design storm event (103.2 mm – see Section 3.4.3 of Appendix 21) would generate approximately 93.400 m^3 (conservatively assuming no evapotranspiration) at maximum build out (conservatively assuming the maximum footprint area of 904,820 m^2). The heap pad surface design (primarily slope controlled) will force most (~90%) of this volume to infiltrate and drain to the Heap Pond. This leaves at least 282,000 m^3 of working volume (i.e., 435,000 – 60,000 – 93,000 = 282,000) within the Heap Pond to provide for operational flexibility and/or to accommodate a short-period draindown (i.e., 7-day draindown is estimated to be approximately 188,000 m^3). The portion that does not infiltrate (10% or 9,340 m^3) will run off and flow to the Events Ponds.

The Events Ponds (or secondary storage facility) (A and B in Figure 3.7-1) will be located just down-gradient of the HLF and provide additional storage capacity for runoff, snowmelt, and any short-term sediment build-up, in addition to the leach solution and makeup solution. The combined maximum operating capacity of the Events Ponds will be approximately 175,000 m^3 (Table 3.1-1), while the combined maximum capacity with freeboard will be 229,000 m^3. The total combined capacity of the Heap Pond and Events Ponds will be 664,000 m^3.

During the freshet season, it is expected that there will be less control on runoff and so a larger portion of storm volume (perhaps as much as 25% or 23,400 m^3) plus some residual snowmelt (perhaps a volume equal to the runoff) will drain to the Events Ponds. Since almost all of the HLF will be south-facing, snowmelt timing is assumed to occur early during freshet, while the rates will not vary too much across the facility. In any case, all but 10% of the remaining snow volume is assumed to melt and contribute to flow during the month of May.

The design capacity of the Events Ponds accounts for rainfall and snowmelt generated events. In general, because the heap operates in a negative balance (see Section 6.2.3, Appendix 21) the Events Ponds are designed to capture all the residual pad runoff during freshet (i.e., May) plus additional runoff from upstream sources (i.e., sediment control ponds and open pit dewatering). It is assumed that the Events Ponds fill to the operating volume of 175,000 m^3 each freshet to provide make-up solution during the summer and fall. Thus, there is a built-in capacity to handle up to 52,000 m^3 if a large storm event occurred immediately after the Events Ponds were filled in May. This is easily enough to accommodate the runoff portion from the pad (e.g., 9,340 m^3) during the 1:100 year storm event.

Further, the Heap Pond will be equipped with three solution transfer pumps with two pumps operating under normal operating conditions and one pump as a standby. Each transfer pump will be designed with a capacity of 975 m^3/hr, so that the solution pumps will be operating at 1,950 m^3/hr or 46,800 m^3/day (with all three pumps operating: 2,925 m^3/hr or 70,200 m^3/day); this operating capacity could rapidly drain the Events Ponds, rather than recirculation from the Heap Pond, to provide additional capacity that might be needed to account for any sequence of events that might include additional rainfall following a 1:100 year event, or reduced capacity due to ice or sediment build-up in the Events Ponds. At the same time the Heap Pond would slowly rise during this short-term period (over the month), but the increase would be easily accommodated by the ~282,000 m^3 of working volume in the Heap Pond storage. Finally, additional capacity (i.e., 620 m^3/hr or 14,900 m^3/day) is provided by the mine water treatment and detoxification plants to help manage any residual volumes that may occur during peak intensities.

In summary, redundancies (in pumping capabilities) and excess storage capacities are an integral part of the HLF design to minimize the likelihood of accumulating high volumes of process leach solution in the Events Ponds and minimizing the volumes in Heap Pond storage. For example, the combined pumping rate of treatment and solution recycling (i.e., 61,700 m^3/day) is more than twice the total daily volume that is estimated to drain to the Events Ponds during a 1:100 year 24 hr storm during freshet (i.e., 23,400 m^3). Similarly, the Heap Pond will be managed to operate at relatively small volumes. This is partly due to the overall negative water balance of the HLF (see Section 7.7), but also by design. The available process leach solution will be constantly recycled, while total storage will generally range in volume between 100,000 m^3 and 235,000m^3, (i.e., 60,000 + 175,000). The only time it is expected to be significantly higher would be during draindown, when the recycling rate is reduced or stopped.

In the unlikely event that the Heap Pond and both Events Ponds are at full capacity (i.e., 664,000 m^3) when an additional storm event occurs, the options for mitigation and management of process solution would include:

- Continue treatment of excess solution through the Cyanide Detoxification Plant and the Mine Water Treatment Plant. Maximum treatment rate through the MWTP is 620 m^3/hr (14,880m^3/d), the 1 in 100 year, 24-hour storm event volume (including HLF runoff and runoff from other sources) could be treated and discharged within several days of occurring.
- Modification of the barren pipeline discharge point to allow process solutions to be pumped to a spray system on the top of the heap pad. The spray system would form snow during cold weather or encourage evaporation during warmer weather. This increased spray rate would reduce the amount of solution in the circuit, while the newly made snow would form short-term storage.
- Utilize all three transfer pumps to maximize solution recycling at 2,975 m^3/hr and ultimately utilize more of the large storage capacity of the unsaturated portion of the heap.
- Modification of water management pumps to reverse the flow from the Events Ponds back to the Open Pit for temporary storage of the excess solution. At maximum build-out the Open Pit is estimated to have a capacity of ~275,000 m^3.

If the unlikely event can be forecasted to occur with a month to spare, based on observed conditions (i.e., extremely deep snow during freshet with heavy rains forecasted, reduced storage capacities due to equipment shutdowns), an emergency onsite short-term storage pond with low permeability mine waste material could be constructed in a short-time period in the laydown area; this pond would be designed to contain only excess solution until capacity is recovered at a later time.

Groundwater Drainage System Installation

A groundwater drainage system will be installed beneath the lowest liner of the HLF to prevent the development of uplift pressures that could compromise the liner system. The drainage system will be a network of pipes placed in gravel-filled trenches and wrapped in geotextile. The pipe network will be constructed of 100 mm diameter slotted corrugated polyethylene pipes (CPP) placed in 300 mm high x 300 mm wide gravel-filled trenches, spaced at 25 m intervals. These trenches will feed down slope into 200 mm diameter high-density polyethylene HDPE un-perforated collector pipes in 1,200 mm high x 1,200 mm wide gravel-filled trenches, which in turn will feed into a 300 mm HDPE pipe. Layout of the groundwater drainage pipework is presented in Figures 5.4-9 and 5.4-10.

Groundwater collected in this system is at very low risk of coming in contact with pregnant solution, due to the HLF LDRS and multiple liner systems. Monitoring of flow quality and quantity will be done on a regular basis, to allow for early detection of affected groundwater. For this purpose, a sump will be installed at the embankment toe, with valves to isolate flow. Water that meets the effluent standards will be released via a pipeline to the Dublin Gulch Sediment Control Pond. If the water does not meet the required standards, it will be pumped to the Events Ponds to be used as process make-up water. If make-up water is not required, then the water will be processed through the cyanide detoxification plant and MWTP prior to discharge to Haggart Creek.

HLF Pad Liner System Construction

The heap leach pad will have a lining system to prevent loss of solution and contamination of groundwater. The final lining system will consist of a multiple composite polyvinyl chloride (PVC) liner system with leak detection and recovery systems (LDRSs) and leachate collection and recovery systems (LCRSs). The HLF liner system design will provide a double composite liner in the upslope area of the pad (above the in-heap pond maximum operating level), and a triple liner in the in-heap storage pond area. Details of the double and triple liner systems are provided in Figure 5.4-11.

HLF liner system in the upslope area will be comprised of the following elements from top to bottom:

- Cushion layer of 1 m thick ore, with leachate collection and recovery system (LCRS) pipework
- Primary composite liner system, comprising:
    - i. Primary 1 mm PVC geomembrane liner
    - ii. 300 mm thick compacted silt
    - iii. Geotextile separator
    - iv. Primary LDRS comprising 300 mm thick fine gravel to coarse sand with pipes:
        - Potential leakage through the primary liner into the LDRS in the upslope pad area will be minimized by provision of a closely spaced network of leachate collection interceptors (the LCRS). These drains effectively reduce the hydraulic head over the secondary liner. The layout of the LCRS pipework is presented in Figure 5.4-12.
        - As an added level of protection to prevent loss of solution contained within the in-heap storage pond area, an additional liner element will be installed above the primary composite liner. This additional element will be comprised of an upper 0.75 mm PVC geomembrane over a 300 mm thick compacted

upper LDRS gravel layer. This upper liner will serve to minimize the hydraulic head on the primary composite liner and therefore reduce the potential leakage rates into the primary LDRS.

Heap Leach Facility Liner Testing and Evaluation

A comprehensive laboratory testing program is being planned and developed for the liner system components to provide data for final selection of the liner system. Testing will be designed to determine, among other things, joint and low friction skin details and final liner strength and thickness details. Two liner systems will be tested in the liner system testing program. Liner Type 1 will represent the In-Heap Pond section of the pad in the lower reaches of the facility, and Liner Type 2 will represent the liner system in the upper reaches of the facility.

Subgrade Material Testing

The subgrade will be sourced from onsite silty materials and/or placer tailings deposits in the valley bottom and will require the following soil testing to be completed: Particle Size Distribution American Society for Testing and Materials (ASTM) D6913, Atterberg Limits ASTM D4318, Specific Gravity ASTM D854 and C127, Moisture-Density Relationship ASTM D698 and Direct Shear/Triaxial Shear Strength ASTM D3080 and D6528/D4767 and D2850.

A geosynthetic clay liner (GCL) may also be used in lieu of a 300 mm thick layer of compacted low-permeability material. If so, GCL will be placed underneath the geomembrane and will provide equal or greater protection than 300 mm of compacted material having a saturated hydraulic conductivity of no greater than 10^{-6} cm/sec.

Overliner (Cushion Layer) Material Testing

The overliner provides a layer of protection for the liner and a permeable layer for solution flow in addition to solution collection pipe protection. Due to the high normal loads anticipated and in order to perform trade-off cost studies related to geomembrane puncture resistance, a range of overliner particle sizes will be tested.

The overliner will be sourced from mine overburden/waste or a dedicated borrow quarry. Bulk samples will be crushed in the laboratory to produce three samples for testing with the following maximum particle size:

- Minus 1 inch (25 mm)
- Minus 1.5 inch (38 mm)
- Minus 2 inch (50 mm).

Each crushed sample will require the following testing to be completed: Particle Size Distribution ASTM D6913, Atterberg Limits ASTM D4318, Specific Gravity ASTM D854 and C127, Moisture-Density Relationship ASTM D698, Saturated Hydraulic Conductivity ASTM D2434 (12 inch), Direct Shear ASTM D3080 and D6528.

Crushed Ore Testing

The ore properties may vary over the life of the deposit. Each major ore type and agglomerated ore (if applicable) will require the following tests: Particle Size Distribution ASTM D6913, Atterberg Limits ASTM D4318, Specific Gravity ASTM D854 and C127, One Dimensional Compression ASTM D7012, Saturated Hydraulic Conductivity ASTM D2434 (12 inch), Load-Percolation, Direct Shear ASTM D3080 and D6528.

Geomembrane Liner Testing

The testing program will include tests necessary to prepare material prior to high-stress compression testing for liner puncture and interface shear testing between the interface of each component of the liner system. The following tests will be conducted to evaluate various liner systems and components: PVC Seam ASTM D7177, PVC Standard Specifications ASTM D7176, Large Scale Puncture Test, and Interface Shear Testing ASTM D5321.

The liner puncture testing shall include a total of 12 tests with loads of up to 150% of the maximum anticipated heap load. Liner Type 1 shall test two (2) liners; 1.0 mm PVC geomembrane liner and 0.75 mm PVC geomembrane liner. Liner Type 2 shall test two (2) liners; 1.0 mm PVC geomembrane liner and 0.75 mm PVC geomembrane liner. Each Type will be tested with three overliner material samples.

Based on the results, the laboratory puncture tests will used to determine the required liner thickness. Engineering calculations will be performed based on the properties of the chosen geomembrane thickness and results of interface shear testing, to verify performance under design conditions such as static slope stability, differential settlement and dynamic deformation under earthquake loading.

Liner leakage rates will be estimate based on industry accepted practice. Actionable leakage rates and alert levels will be calculated for each facility LDRS and procedures for corrective actions will be outlined in a contingency plan. The Nevada State Guidelines for flow rates from leak detection systems will be adhered to (Bureau of Mining Regulation and Reclamation, PERMIT LIMITATIONS FOR LEAK DETECTION SYSTEMS, December 23, 1991).

Leak Detection and Recovery System Installation

The performance of the HLF liner system, as measured in terms of preventing loss of solution into the ground, will be assessed by monitoring leak detection drains constructed below the liners. Separate LDRS will be installed below each liner, and all collected solution will be returned to the HLF.

The LDRS will consist of a series of 100 mm diameter pipes, within a 300 mm thick layer of 20 mm gravel, feeding to a 200 mm diameter collector pipe. Any leakage reporting to the drains flows to a sump below the in-heap pond, from where it will be pumped back to the HLF. Figure 5.4-13 shows the pipework details for the upper LDRS in the in-heap area of the HLF. Figure 5.4-14 provides pipework details for the primary LDRS underlying the entire HLF.

Geotechnical Design Basis for Heap Leach Facility Components

The geotechnical design basis for the HLF is presented in detail in Appendix 35, which describes the assumed geotechnical material properties, and presents the proposed methods for dealing with identified geological hazards, including permafrost processes. The HLF components will be constructed in an area that contains discontinuous permafrost, which may contain excess ice. Areas of permafrost with excess ice require treatment by stripping to encourage thawing and drainage, or excavation and removal to expose thaw stable soils before covering with the lining system and subsequently, leachable ore. Seismic design parameters are presented as peak ground accelerations for the Design Basis Earthquake (0.078 g) and Maximum Design Earthquake (0.10 g).

5.4.1.6 Waste Rock Storage Development

During the life-of-mine plan, waste rock is scheduled to go to one of five areas:

- Fill material for site road development
- Fill material for the HLF embankment
- Platinum Gulch WRSA
- Eagle Pup WRSA
- Pit back-filling during closure and reclamation activities.

The use of waste rock for road development or embankment rock fill is detailed earlier in Section 5.4.1.2. The following paragraphs provide additional details on the listed WRSAs.

Platinum Gulch Waste Rock Storage Area

The Platinum Gulch WRSA will reach its ultimate footprint of approximately 33 ha by the end of 2015, and will hold approximately 4.9 million loose cubic metres of waste rock with limited additional capacity available. Progressive reclamation will be employed on the Platinum Gulch WRSA, with reclamation completed by 2016.

The development of the Platinum Gulch WRSA will follow clearing and grubbing of the upper portion of Platinum Gulch and the construction of the Platinum Gulch drainage ditch. The ditch will convey surface water from the Platinum Gulch WRSA to the open-pit surface water sump. The sequence for the Platinum Gulch WRSA development will involve installation of the Platinum Gulch rock drain and the construction of a small starter embankment. Figure 5.4-15 provides construction details of the Platinum Gulch WRSA.

Eagle Pup Waste Rock Storage Area

The Eagle Pup Gulch WRSA will reach its ultimate footprint of approximately 80 ha at the end of Year 2020, immediately prior to closure. At this time, the WRSA will hold approximately 24.5 million loose cubic metres of waste rock and will have additional capacity if required.

The construction of the Eagle Pup WRSA will follow clearing and grubbing of the area and the construction of the Eagle Pup WRSA sediment collection pond (SCP) in the lower reaches of the

Eagle Pup drainage. The sequence for the Eagle Pup WRSA development will involve installation of the Eagle Pup rock drain and the construction of a starter embankment. Figure 5.4-16 provides construction details of the Eagle Pup WRSA.

Geotechnical Design Basis for Waste Rock Storage Areas

The geotechnical design basis for the WRSAs is presented in detail in Appendix 35, which describes the assumed geotechnical material properties, and presents the proposed methods for dealing with identified geological hazards, including permafrost processes. Both WRSAs will be constructed in an area that contains discontinuous permafrost, which may contain excess ice. Areas of permafrost with excess ice require treatment by stripping to encourage thawing and drainage, or excavation and removal to expose thaw stable soils before covering with waste rock. Seismic design parameters are presented as peak ground accelerations for the Design Basis Earthquake (0.078 g) and Maximum Design earthquake (0.10 g).

5.4.1.7 Process Plant Area Construction

The process plant site area will be located southwest of the HLF. It will be comprised of the following facilities:

- Laboratory building
- Process plant office building
- Process plant shop/warehouse building
- ADR building and reagent storage
- Cyanide detoxification plant
- Truck shop/mine equipment warehouse/cold storage building.

Figure 5.4-17 provides a general plan of the process plant area.

Depending on the size of some equipment, such as cranes and hoists, some foundations on bedrock may be required. If this is the case, these foundations will be placed directly on bedrock, and fill will be placed around them to level the pad to the design elevation. Foundations and the buildings will be on compacted fill placed to level the infrastructure pad to the design elevation.

Once the building shell is complete, the floor slabs will be poured, and equipment will be installed. Construction of the buildings will continue with the interior walls, electrical and mechanical systems, and interior finishing.

The following paragraphs provide additional details on the listed process plant facilities.

Laboratory Building

The modular metallurgical laboratory building will include a sample prep module, a wet lab module, and a fire assay module, all located within a pre-engineered 22 by 21 m building insulated to an R value (a measure of thermal resistance used in the construction industry) of 12.

Process Plant Office Building

The process plant office building will be a 4-module building, 18 by 14 m, with walls insulated to R-12, a wedged roof insulated to R-20, and vinyl flooring complete with R-20 insulation. Offices are included for the process manager, chief assayer, metallurgist, process maintenance general foreman, process general foreman, shift foreman, and planner. A meeting room, lunch room, common space, storage space, and lavatories will be included in the building.

Process Plant Shop/Warehouse Building

The process plant shop and warehouse building will be a fold-a-way type building, 43 by 18 m, insulated to R-12, and will include the mill shop, electric shop, and warehouse.

Adsorption, Desorption, and Recovery Building and Reagent Storage

The ADR building will be constructed on a 93 by 36 m concrete foundation and will contain:

- ADR process facilities
- Secure refinery area
- Control room for the process operations
- Reagents receiving and storage area
- Boiler room containing the heating solution boiler.

A 300 mm high curb-wall will contain spills or fugitive solutions within the building. Except for the barren solution tank, all solution tanks and associated pumps will also be located in this building. The heated barren-solution tank will be located just outside of the building, with pumps inside the building. Overflows and spills will report to a floor sump, which will gravity-drain to the events ponds through a 750 mm diameter HDPE pipe. The building will be of steel frame construction with insulated metal cladding. A plan view of the ADR building is provided in Figure 5.4-18.

Except for lime and cement, chemical storage will be indoors on concrete slabs located adjacent to the adsorption area in the ADR building. Sodium cyanide, caustic, hydrochloric acid and smaller quantities of other miscellaneous chemicals will be supplied and stored as tabulated below. Lime and cement will be delivered in bulk pneumatic trucks and stored in large silos adjacent to the reclaim conveyor. The table below lists the monthly usages and storage requirements for each chemical. The individual storage areas for major reagents are sized to contain a minimum of two weeks storage. Flux storage will be sized for shrink-wrapped 1 tonne pallet shipments. Concrete curbing will separate each of the chemical storage areas to prevent any interaction between chemicals and provide a minimum of 110% containment in case of spills.

Table 5.4-2: Reagent Storage Requirements

Item	Packaging	Daily Consumption	Recommended Minimum Storage
Sodium Cyanide	1,000 kg Bulk Bags Packed in Plywood Boxes	5,859 kg	2 weeks
Sodium Hydroxide	25 kg Bags	90 kg	2 weeks

Item	Packaging	Daily Consumption	Recommended Minimum Storage
Hydrochloric Acid (32%)	200 L Drums, or 1 m^3 Totes	454 L	2 weeks
Antiscalant, Leach	1 m^3 Totes	308 L	2 weeks
Antiscalant, Strip	200 L Drums	1.20 L	2 weeks
Lime (CaO)	Up to 24 t in Pneumatic Trucks	24 t	60 t
Cement*	20 to 30 t in Pneumatic Trucks	24 t	60 t
Fluxes	50 kg Bags	NA**	1 pallet
Hydrogen Peroxide (50%)	19 m^3 (5,000 gal) Tanker Truck	NA**	1 truckload
Copper Sulfate (Pentahydrate)	50 kg Bags	NA**	1 pallet

NOTE:
* Only required in first two years of operations
** Daily consumption varies, as required

Cyanide Detoxification Plant

The approach proposed for detoxification of the excess water from the heap leach facility is a two step cyanide removal process followed by air stripping. In the first step cyanide is oxidized to the much less toxic cyanate form. In the second step cyanate is hydrolyzed to ammonia. Air stripping will be used to remove the ammonia generated from cyanide destruction. The cyanide detoxification plant will be constructed in the process plant area. Effluent from the cyanide detoxification process will be reduced to the levels shown below:

- WAD Cyanide <0.2 mg/L
- Cyanate <1.0 mg/L
- Ammonia <1.0 mg/L.

Although the current process and site water balance have indicated that there will not be the need for a cyanide detoxification plant until closure and subsequent draindown of the HLF, the cyanide detoxification plant will be constructed at the start of the Project so that it is available for use in the event of any unanticipated conditions that require discharge from the HLF. The facility will be surrounded by concrete curbing to collect process solution and prevent release of solution. A schematic of the process is included as Figure 5.4-19.

Cyanide Oxidation

Hydrogen peroxide has been used widely in industry for cyanide detoxification. The process has the advantage over other techniques that use chlorine or sulphur dioxide in that no foreign ions are introduced into process solutions. The kinetics of oxidation are sufficiently fast that effective oxidation can generally be achieved in a few minutes. Hydrogen peroxide oxidizes cyanide to cyanate as follows:

$$CN^- + H_2O_2 \rightarrow CNO^- + H_2O$$

Although the stoichiometric usage is lower, in practice approximately 2 – 8 grams hydrogen peroxide is required per gram cyanide oxidized. To increase reaction rate copper sulfate is added as a catalyst to a concentration of 10 – 50 mg/L. The pH is controlled to 9.0 to 9.5 by caustic addition. In the alkaline solution, the other weak acid dissociable (WAD) metal cyanide complexes are oxidized to cyanate and metal hydroxides. The efficiency of hydrogen peroxide destruction has been demonstrated repeatedly, and it is well known that solutions containing >100 mg/L WAD cyanide or more, can be reduced to 0.2 mg/L within practical time scales.

Equipment required for the cyanide oxidation step includes a mixed reaction tank sized to provide reaction time of 10 minutes at design flow, a hydrogen peroxide storage tank and metering pumps, and a caustic storage tank and feed pumps. A clarifier will be provided downstream of the reaction tank to remove the metal hydroxide precipitates. Sludge pumps will transfer the solids from the clarifier to solids dewatering equipment that will process solids from the MWTP as well as the Cyanide Detoxification Plant. Metering pumps will also be provided for the copper sulphate solution that will be received and stored in totes. Instrumentation will include a pH meter, an ORP meter (to control hydrogen peroxide feed) and a cyanide analyzer.

Cyanate Hydrolysis

A second step will be included in the detoxification plant, to remove cyanate from solution. The addition of acid to the solution after hydrogen peroxide destruction of cyanide results in acid hydrolysis of cyanate. Cyanate ions undergo acid hydrolysis to form ammonia and carbon dioxide. This treatment method is capable of reducing cyanate levels to below 1 mg/L while forming carbon dioxide and ammonia.

$$CNO- + 2H2O \rightarrow CO2 + NH3 + OH-$$

Sulfuric acid addition is used to reduce the pH to speed the hydrolysis as needed depending on flow rate. At pH 2 the hydrolysis is complete in approximately 2 minutes. At pH 5 hydrolysis requires approximately 60 minutes to complete.

Equipment required for the cyanate hydrolysis step includes a mixed reaction tank sized to provide 20 minutes detention time at design flow and an acid storage tank and metering pumps. Instrumentation will include a pH meter.

Ammonia Stripping

Alkaline aeration (air stripping) will be incorporated to remove ammonia from solution. This process is proven to reduce ammonia levels to less than 1 mg/L. At low pH and temperature much of the ammonia will be in the form of ammonium ion in solution. In order to strip the ammonia it will first be converted to the ammonia form by increasing pH to 10.8 to 11.5 by addition of caustic.

$$NH4++ OH- \rightarrow H2O + NH3$$

The water to be treated will be pumped to the top of the stripper while air is drawn through openings at the bottom. The free ammonia (NH_3) will be stripped from the water into the air stream, then discharged to the atmosphere. The process requires no backwash or regeneration and because it is mechanical is relatively easy to startup and control. Because stripping efficiency is sensitive to air temperature (95% at 20 deg C, 75% at 10°C) the air will be preheated as required to prevent freezing of the stripper due to temperature drop (approximately 8°C) during operation. The effluent at the bottom of the stripper will be re-circulated back to the top for additional treatment as needed based on removal efficiency. Scale on the stripper will be removed by periodic hydraulic flushing. On a less frequent basis, acid treatment may be used for scale removal as needed to maintain process efficiency. The effluent of the stripping process will be pH adjusted by addition of sulfuric acid as needed.

Key design criteria for the ammonia stripping process will be as follows:

- Hydraulic Loading 0.1 – 0.2 L/min/m^3
- Air Flow 30 – 50 L/min/m^3
- Air Temperature 10 deg C (minimum)
- Wastewater pH 10.8 – 11.5 S.U.

Equipment for the ammonia stripping step will include the stripper and fan, recirculation pumps, and a heater for the air. Reaction tanks will be provided upstream and downstream of the stripper for pH adjustment. A clarifier will be provided between the upstream reaction tank and the stripper to remove the metal hydroxide solids that precipitate at the elevated pH. Sludge pumps will transfer the solids from the clarifier to the common solids dewatering process. Caustic and sulfuric acid will be fed from the same storage tanks used for cyanide oxidation and cyanate hydrolysis with additional metering pumps to deliver those chemicals to the ammonia stripping process reaction tanks.

Detoxification Process Effluent

The treated water from the Cyanide Detoxification Plant will be discharged to the Mine Water Treatment Plant (MWTP) feed pond where it will blend with water from the open pit and the waste rock storage areas. Excess feed pond water will receive additional treatment at the MWTP before being discharged to Haggart Creek.

Detoxification Process Solids

The Detoxification Plant will generate calcium carbonate sludge from both high pH steps. The sludge will also contain smaller amounts of metal hydroxides (lead, chromium, copper) as well as cupric ferrite and hydrozincite. See Appendix 20 for a discussion of management practices for these solids and the solids generated by the mine water treatment plant. Appendix 20 also includes annual sludge production volume estimates as well as estimated concentrations of deleterious substances in the sludge from each source.

Truck Shop/Warehouse/Cold Storage

To support the mining operations, an equipment-maintenance facility/warehouse building will be required. The equipment-maintenance facility building will be a single-storey building. Each bay in the building will have a drain connected to an oil/water separator and waste oils will be recycled or used in the waste oil heater.

5.4.1.8 Solution Ponds Development

To support the construction, mining, and process activities, various solution ponds will be created, as shown in Figure 5.1-3 and detailed in Figure 5.4-20. In particular, the following ponds are discussed:

- HLF Events Ponds
- MWTP Ponds
- Sediment Control Ponds.

Events Ponds

The events ponds will be in place by the end of 2012—prior to start of operations. The events ponds will be utilized for excess solution storage during storm events and for HLF drain-down during long term plant shutdown and final closure phases. Refer to the Water Management Plan (Appendix 18) for further details.

The events pond area will be stripped of vegetation down to mineral soil. The basin will be shaped, and the subgrade will be prepared to a smooth surface, free of protruding rocks, roots, etc. which could damage the liner.

The events ponds will be constructed from earthfill, using in-situ material where feasible, and imported or processed materials for specific zones. The liner system of the events ponds will comprise the following elements from top to bottom:

- Primary 2 mm thick HDPE geomembrane liner
- Primary LDRS geonet layer
- Secondary 1 mm thick HDPE geomembrane liner
- 500 mm thick compacted silt.

The resulting liner system will recover leakage along the low point of the embankment toe from a collection pipe and ditch which will drain to a sump.

The embankment for the events pond has the same structural section and foundation conditions as the confining HLF embankment. The requirements for foundation preparation with respect to the removal of ice rich permafrost will be the same. A drainage blanket will be constructed beneath the embankment to ensure that additional pore water from thawing is drained, thus avoiding increases in pore water pressure.

Mine-Water Treatment Plant Ponds

Two mine-water treatment plant ponds will be constructed to the west of the two events ponds. The first pond will receive effluent from the cyanide detoxification plant, the open pit sump, and the Eagle Pup SCP, and will act as a feed storage pond for the mine water treatment plant (MWTP). The second pond will receive treated solution from the MWTP and will act as a product storage pond. The ponds will be constructed of rockfill and will be HDPE-lined. Each pond has the capacity to store 13,500 m^3. For cross reference, some PFS drawings refer to these mine-water treatment plant ponds as “Polishing Ponds”.

Sediment Control Ponds

During the life of the Project, three SCPs will be constructed, along with several smaller, more temporary SCPs.

The first SCP (the Eagle Pup SCP) will be located at the base of the Eagle Pup WRSA. Its design includes an embankment constructed from rockfill, an HDPE lined pond, and a variable height decant. Eagle Pup SCP is designed to accommodate a 1:100 year 24-hour event, with a volume of 25,000 m^3. The Eagle Pup SCP will capture surface and ground water from Eagle Pup through a series of rock drains and surface ditches (Figure 5.4-16). The Eagle Pup SCP overflow will be transferred to either the Events Ponds or the Mine Water Treatment Plant Pond, as required. See discussion of the use of these ponds in section 5.5.4 and in the Water Management Plan (Appendix 18).

Non-contact runoff from within the Platinum Gulch drainage basin will be diverted away from the WRSA and conveyed to the Platinum Gulch Sediment Control Pond (PG SCP) (Figure 5.4-15). Eventually this water will drain to Haggart Creek, while all contact water (seepage and runoff) from the WRSA will be captured in a lined seepage collection pond (PG LSGP). The PG LSGP will be designed to store a 1:100 year 24-hour event with a peak flow of 1.5 m^3/s and will be fed by both the rock drain and runoff from the WRSA. The PG LSGP water will then be conveyed by a drainage ditch to the open pit sump.

The embankment for the PG SCP will be located approximately 300 m downstream of the base of the PG WRSA. The maximum volume of the PG SCP will be designed to hold 37,540 m^3 or the 1:100 year flood event. The PG LSGP will be smaller, as any overflow water will be captured by the PG SCP and all captured water will be continually conveyed to the open pit sump. Both ponds will be constructed to last until decommissioning in the Closure and Reclamation phase.

The third SCP (Dublin Gulch SCP) will be located at the western end of Dublin Gulch, near the confluence with Haggart Creek. Its design is an HDPE-lined pond constructed from appropriate rockfill. The Dublin Gulch SCP is designed to accommodate a 1:100 year 24-hour event, with a volume of 36,000 m^3. Figure 5.4-20 provides plan details on the Dublin Gulch SCP. If water quality guidelines can be achieved, the Dublin Gulch SCP will be operated for direct discharge to Haggart Creek, with optional decant to the Dublin Gulch diversion channel (DGDC – detailed in Section 5.4.4.1).

5.4.2 Mine Site Support Infrastructure

5.4.2.1 Access Road

Project Property is located off the Silver Trail (Highway 11), north east of Mayo, Yukon. Approximate driving distance to the Project site from Mayo is 85 km. Access to the Project site from the Silver Trail will be via the existing South McQuesten Road (SMR) and the Haggart Creek Road (HCR). Together, the SMR and HCR comprise a 45 km road, which is divided by the South McQuesten River. The section of the road between the Silver Trail and the South McQuesten River is referred to as the SMR (km 0 to 22.9), whereas the section of the road between the river and the mine site is referred to as the HCR (km 23 to 45). Both roads are public roads, regulated under the Yukon *Highways Act*; however, the SMR is maintained during summer only by the Yukon Government

Department of Highways and Public Works (HPW), whereas the HCR is considered a "public unmaintained" road. Currently, snow is not cleared from the SMR or HCR in winter. Figure 5.4-21 depicts the existing alignment of the SMR and HCR.

In 2009, HPW upgraded the SMR by completing brushing, grading, culvert installation, and miscellaneous drainage improvements. Due to these recent upgrades, the SMR is now structurally sufficient to meet the traffic and volume needs of the Project. Additional upgrades of the South McQuesten Bridge abutments and decking were completed in August 2010. As a result, the South McQuesten Bridge meets load capacity standards for a resource access road subject to seasonal restrictions. The South McQuesten Bridge is rated for 44 tonnes in summer and 40 tonnes for temperatures below -35°C.

Yukon Engineering Services (YES) was engaged by New Millennium Mining Ltd. in 1996 to investigate road access options to the mine property, and through that process produced the Dublin Gulch Access Road Design Brief Report (YES 1996). In the fall of 2009, YES was retained by VIT to provide recommendations with which VIT could approach HPW, regarding access requirements, permitting, and regulatory approvals. This updated road-design report is appended to the Project Proposal as the YES 2010 Eagle Gold Access Road Report (Appendix 19). Importantly, the 1996 Access Road design included upgrade to a double lane road from the Silver Trail to the previous Dublin Gulch Project site. The YES 2010 Eagle Gold Access Road Report (Appendix 19) provides engineering prescriptions to enable the safe and efficient use of the HCR for the Project. The 2010 Access Road design includes a single lane, radio controlled road which results in safe and efficient travel while fewer environmental impacts than the previous design. During an engineering evaluation in the fall of 2009, YES noted that the HCR showed signs of structural failures, poor drainage, and sub-standard geometry throughout. In general, the major issue for the HCR is drainage related. Maintenance of the road and drainage is required for current activities accessible by the HCR, are independent of the Project and will be undertaken in accordance with existing permits or independent assessment and permitting processes.

Access Road Upgrades

The following upgrades are proposed for the HCR in support of the Project:

- Upgrade from the existing one to two lane (depending on location) unimproved resource road to a two-way single-lane radio controlled resource access road utilizing the existing grade
- Realignment of three road sections
- Construction of a parking area at the South McQuesten River
- Construction of pullouts approximately 100 to 300 m along the grade to allow vehicles moving in opposite directions to pass each other and for vehicles to stop if necessary
- Signage in the parking area to describe road use protocol for drivers accessing the mine site as well as for the general public
- Signage along the road, including kilometre markers visible from both directions and speed limit signs.

Additional details regarding upgrade and operation of the HCR as a one-lane radio controlled access road are provided in Appendix 30 – Environmental Management Plans, Section 10 – Traffic and Access management Plan.

The following sections provide details on these upgrades. In addition, the potential effects on valued components resulting from changes in the use (e.g., traffic volume and access changes via snow clearing) of both the SMR and HCR are assessed in subsequent sections of this Project Proposal.

Realignment Upgrades

Three sections of the HCR have been identified as areas where horizontal and vertical alignment requires revision. These modifications will improve road safety, particularly during wet and frozen conditions. Engineering prescriptions for the three areas of major realignment include the reduction of road grades and the number of sharp curves. This will result in the need to add one new culvert and replace two existing culverts. A geotechnical investigation is planned for fall 2010 to examine soil and constructability issues and evaluate materials from the cuts for embankment construction, depth to bedrock, geochemical characterization, and the presence of permafrost areas.

Realignment Area #1—Km 25+800 to 26+500

This section of road, which currently dips down into a creek, has grades as steep as 15%, and curve radii of 26 m. The re-alignment will result in the removal of four curves and a reduction in the maximum gradient to 8.8%, with horizontal curves of 170 m, and a 300 m radius, eliminating the need for trucks to chain up in wet and frozen conditions (Figure 5.4-22). It is anticipated that one new culvert and one culvert replacement (2,000 mm) will be required, with rip-rap protection at inlet and outlet. The new culvert installation will be located in a seasonally dry channel and is required for drainage purposes. The replacement culvert is required for Secret Creek, just above where it enters Haggart Creek (see below description of culvert replacement). Realignment Area #1 requires approximately 5,300 m^3 of common excavation and 4,700 m^3 of fill material.

Realignment Area #2—Km 23+000 to 23+600

This section of road dips down into a creek and has grades as steep as 15%. A re-alignment and culvert replacement (1,200 mm) with rip-rap protection at inlet and outlet will be required (Figure 5.4-23). This culvert installation is for road drainage and will not affect a fish bearing watercourse. This revision would require approximately 14,000 m^3 of common excavation. Realignment Area #2 will result in a reduction in grade from the creek to the top of the hill, and will improve both sightlines and driving conditions.

Realignment Area #3—Km 19+400 to 20+500

This section of road rises up from the McQuesten River valley and winds up to the start of the Haggart River Valley (Figure 5.4-24). There are sharp curves with limited visibility and radii of 27 m. Improvements to this area would help large loads in wet and frozen conditions. The earthworks for this section would be 10,000 m^3 and realignment would require the installation of 2 – 600 mm culverts.

Radio Control One-lane Access Road Upgrades

It is proposed that the HCR become a two-way one-lane radio controlled access road. Currently the average width of the HCR is greater than a single lane but less than a standard two lane road in most locations. After upgrade, the width of the HCR will effectively be reduced from greater than 5 m to a total of 5 m. The 5 m width will include one 3 m travelled road lane and two 1 m shoulders. The design recommendations provided by YES considered specific geometric parameters and Transportation Association of Canada (TAC) design standards for Low Volume Roads (LVR 50), as well as acceptable engineering practices for two-way one-lane access roads.

Additional details regarding upgrade of the HCR from the existing road to a two-way one-lane radio controlled access road are provided in Appendix 30 – Environmental Management Plans, Section 10 – Traffic and Access management Plan. Prior to commencement of radio control use, information for procurement of suitable radio equipment will be provided to local residents and placer miners that do not have radio equipment.

South McQuesten Parking Area

The local residents and the FNNND have identified the need for a parking area at the South McQuesten Bridge that could accommodate five to six vehicles and be used for vehicle and trailer parking while locals access the river. An area on the north side of the South McQuesten River and the west side of the SMR will be cleared, filled and graded to provide the parking area.

Construction Staging Areas and Borrow Source Requirements

Construction staging areas and borrow sources will be required to support the above upgrades included in the scope of this Project Proposal.

Three locations have been identified for staging/laydown areas. Each staging area is delineated on Figure 5.4-21. The proposed staging areas include:

- **Station 16+950**—this staging area is located on the south side of the South McQuesten River and the west side of the SMR. This area will be re-graded and utilized as a parking area after completion of the road upgrades.
- **Station 26+000**—this staging area is located south of Secret Creek adjacent to the HCR. This area is currently void of vegetation and has been used in the past by placer miners as a camp.
- **Station 35+000**—this staging area is located north of where the HCR crosses Haggart Creek on the east side of the HCR. This area has been extensively placer mined in the past and has many cleared areas.

The objective of the subgrade design of the HCR is to take advantage of the side-hill terrain as much as possible so as to minimize the hauling of embankment material and, where possible, to strategically locate side-borrows (ditch widening) and quarries. Borrow material required to complete the construction will include:

- 10,000 m^3 of road base material for general upgrades and grade raising
- 10,000 m^3 of base material for pullouts

- 1,000 m^3 of culvert bedding material for culvert installation
- 16,000 m^3 of road surfacing material.

Materials needed for modification of the HCR will be taken from ditch cuts and side borrow cuts where the materials are usable, and borrow pits where the cut materials are waste.

Three sources of undisturbed native borrow have been identified along the road alignment (Appendix 34 – Borrow Evaluation Report, Drawing 02), and one source of re-worked placer tailings borrow. Borrow source requirements for the road are estimated at 37,000 m^3 for base, bedding and road surfacing material (Appendix 19, Section 8.2.1). The identified borrow areas contain more than sufficient materials for the identified road upgrades, with approximately 350,000 – 800,000 m^3 of undisturbed sand and gravel available among three undisturbed borrow areas, and an additional 100,000 – 300,000 m^3 of lower quality material available in a deposit of placer tailings at Secret Creek. Note that some processing (i.e., crushing, screening and/or washing) may be necessary to produce the required materials. Note also that further investigation (i.e., test pits) is required to confirm the spatial extent of available borrow.

The borrow material will be granular, any boulder or cobble material required will be sourced from existing, weathered placer mining spoils and therefore blasting rock will not be necessary. If rock is encountered at any of the three aforementioned realignment locations, designs will be revised to avoid the areas to avoid fracturing of rock. Geotechnically unsuitable cut material derived during road modification will be placed along the toe of constructed slopes to encourage vegetation, or used to recontour and reclaim exhausted borrow areas from previous road maintenance. Care will be taken to ensure that creek encroachment as a result of the modifications is avoided.

Geochemical characterization of the proposed borrow area or material will be conducted to evaluate geochemical behaviour of the material. Criteria for acceptable material will be developed as part of the design engineering of the Project.

The original road construction resulted in stretches of the HCR having steep slopes both above and below the road grade. These areas of the HCR, when not potentially corrected through realignments, will be modified such that the high side is pulled down to provide sufficient width for ditching, and where possible, pullouts. Where suitable, the pulled down material will be used as fill.

Traffic Volume

During construction, increased vehicle and truck traffic will be required for the Project on the SMR and HCR. The largest vehicles will be B-Train vehicles, trucks with long loads (steel members, crane components), and trucks with wide loads (truck boxes, tanks, pre-fabricated camp modules). Loads would be adjusted for seasonal load restrictions, and volumes would coincide with construction and operational needs.

Estimated Traffic Volume during construction (16 – 18 months):

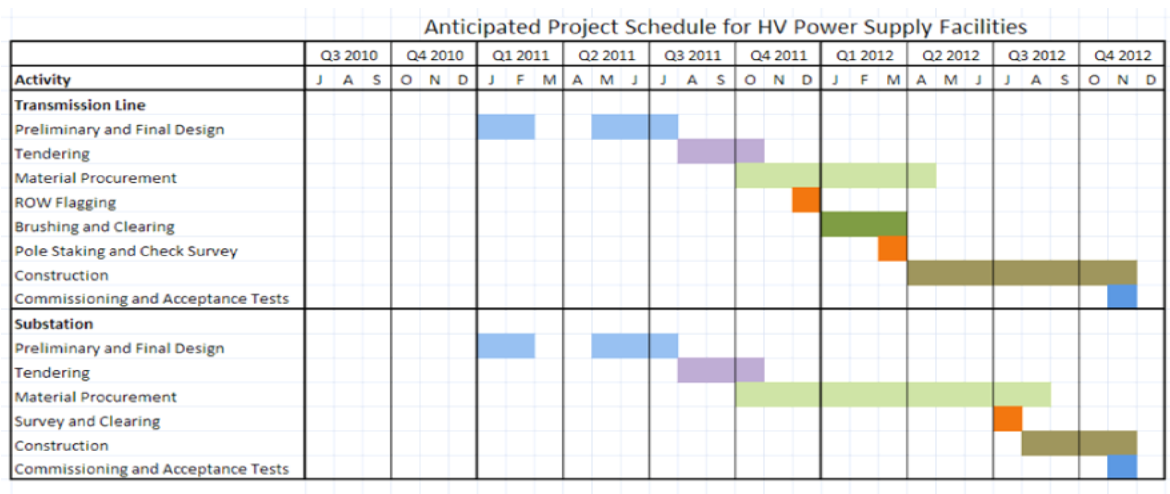
- 1,500 – 1,800 semi-trailer loads (round trip) over the construction phase
- 10 – 20, 1 to 5 tonne trucks per day on the average, or 600 – 800 round trips over the construction phase

- 10 passenger car or pickup trucks per day (trip numbers would depend on the location of the construction camp).

5.4.2.2 Power

Power for the Project during the operations, closure, and post-closure phases is assumed to be available from the Yukon Energy electrical transmission grid. Yukon Energy is currently in the process of upgrading power generation capacity at Mayo (the Mayo Hydro Enhancement Project), and connecting the north and south Yukon transmission grids (the Carmacks-Stewart Transmission Project Stage 2). Funding agreements specify that both projects must be completed by March 31, 2012. Yukon Energy reports that both projects are on schedule to finish in 2011. Power to the Project site will be via a new 45 km transmission line connecting to the Yukon Energy grid, routed along the access road (Figure 5.4-21). The 69 kV transmission line will feed a main substation on site. The conceptual transmission line and substation infrastructure design is provided in Appendix 29 – High Voltage Transmission Facilities for Eagle Gold Project.

The schedule of the 69 kV transmission line and substation will be coordinated with the schedule of the Project. The construction phase Project will commence in the first quarter of 2012 and be completed by August 2013, at which time the operations phase of the Project will begin. Power for the Project for operations, decommissioning, closure and post-closure phases is assumed to be available from the Yukon Energy transmission grid. Therefore, the new 69 kV transmission line and substation will be commissioned before the end of 2012. A detailed preliminary schedule for the transmission line is included in the figure below:



1) In order to reduce the impact on nesting birds, the brushing and clearing of ROW will not be performed in the months of May and June.
2) The brushing and clearing of ROW and main construction activities will not be performed during spring break-up.

VIT will be responsible for all costs associated with the proposed transmission line for the life of the Project. VIT has worked with Yukon Energy Corporation (YEC) to ensure the conceptual design reflected in the Proposal is based on YEC and northern energy infrastructure requirements and a suitable level of detail for the assessment stage. Further technical and design requirements of the transmission line will be made at the detailed design stage. Discussions are currently underway and ongoing with YEC to determine details and arrangements of ownership and operation, permitting requirements, and potential decommissioning post-closure.

The following assumptions and criteria were used during the conceptual overhead line (OHL) route selection process:

- The 69 kV wood pole transmission line will generally be located along the existing and the new road alignment. Parts of the transmission line RoW may overlap with portions of the road's RoW.
- The transmission line route will be designed so that the best combination of safety, environmental protection, site access, and economic cost is achieved.
- The transmission line poles will be placed outside the desirable clear zone (DCZ), as defined by the *Roadside Design Guide*, issued by Alberta Infrastructure and Transportation (as Yukon specific guidelines are not available). For road design speeds below 90 km/h and average annual daily traffic fewer than 750 vehicles, the minimum distances from the edge of the driving lane to the pole will be in the range of 2.5 m to 5.5 m. The DCZ will be increased at outside road curves.
- The minimum vertical clearances between road surface and bottom conductors of the 69 kV transmission line will be 9 m. This clearance is based on the measurement of Mayo – Keno City 69 kV line height above Silver Trail highway. If VIT determines that higher vehicles and loads will be present, the road crossing clearances will be increased by the amount that the vehicles and loads' height exceeds 5.3 m.
- The minimum vertical clearances alongside roads and in areas unlikely to be travelled by road vehicles will be 6.1 m.
- In accordance with Yukon Energy practice, the width of the RoW for the 69 kV transmission line will be 60 m.
- The clearing width within the 69 kV transmission line RoW will normally be 30 m (i.e., 15 m from centerline). Danger trees outside the clearing width will be removed as well.
- The transmission line RoW will not cross cultural or archaeological sites.
- Zones of permafrost, steep slopes, and wetlands will be avoided if possible.
- Terrains of limited stability (e.g., permafrost, steep slopes, or wetlands) will be given special attention. Where possible, longer spans and special foundations will be used.

Yukon Energy's best practices, as outlined in their EMS Manual, will be applied by experienced contractors in the construction of the transmission line. Construction will also follow conditions specified in the Land Use Permit, as well as an Environmental Protection Plan (EPP) specific to the Project and developed after receipt of environmental approvals.

Surveying and Clearing of RoW

The final routing design and final pole spotting design will be done using PLSCADD© software and will be based on a light detection and ranging (LiDAR) survey or high accuracy digitized mapping. The designer will provide a route map and plan and profile drawings with the coordinates for each pole location. A survey crew will flag the edges of the RoW for clearing widths before the commencement of the brushing and tree clearing work. Clearing of trees allows transmission line construction to proceed. In order to ensure safe and reliable operation of the line, the cleared width of the RoW will be maintained during the entire service life of the line. Regular brushing, clearing, and danger tree removal will also minimize the risk of wildfires. Brushing and clearing will be carried out as specified in the Yukon Energy EMS Manual best practices.

Tree clearing and brushing will typically be done by mechanized equipment. A mechanical feller buncher is mounted on a crawler tractor to cut trees up to 20 cm in diameter. If the work is done during the frozen ground period, this method will cause minimal ground disturbance. Chainsaws and skidders will be used to remove salvageable timber in dense forest zones. Further clearing can be done by bulldozers and excavators. Hand clearing with chainsaws will be employed in rugged terrain and near the rivers and streams in riparian areas.

Branches and other residue that remain after the clearing work will normally be piled and burned inside the RoW. Salvage of merchantable timber may be available through the Department of Forestry.

The RoW width has been determined to ensure that there is a safe clearance between vegetation and manmade objects and the transmission line. The clearance between the live parts of the transmission line and other objects will be maintained under still air conditions and when conductors are in position of swing under 230 Pa wind pressure. The typical clearing width and RoW cross section for the 69 kV transmission line is shown in Figure 5.4-25.

Before the installation of the transmission line, a 30 m wide strip inside of the RoW will be cleared of all shrubs and trees. Danger trees within the RoW will also be cut. No tree will hit or come within flashover distance of any part of the transmission line. The RoW will be kept cleared during the service life of the transmission line.

The safe limits of approach distances from the transmission line will be as specified in the Alberta Electrical Utility Code.

In order to minimize tree cutting, it is proposed that the overhead transmission line be located within the right-of-way of the road where possible. Therefore, in some sections, the RoW of the transmission line will overlap with the tree-clearing zone of the road.

Transmission Line Construction

The survey crew will stake the pole locations and guy positions before the start of foundation excavation works. The contractor will transport poles, hardware, fittings, insulators, conductors, and construction materials from the marshalling area to the identified pole locations on the line RoW. Trucks with a loading crane are normally used for transport of line materials to site and tandem axle truck and trailers are used for hauling of poles. The pole structures will be assembled on site.

Typical transportation tools and equipment used between the marshalling area and the pole locations include:

- Tandem axle trucks and trailers for transportation of wood poles
- Fork lifts
- Trucks with loading crane
- Pickup trucks and crew cabs for crew and tools
- Crawler tractor
- Helicopter (if required).

Foundation holes are excavated using small backhoe excavators or diggers with an auger. The pole structure is lifted and set down in the hole using a crane or backhoe. Before backfilling the hole, the pole is checked for proper verticality and alignment. The poles at angles, junctions, and terminal locations will be set and raked against the strain so that the conductors are in line. Pole backfill is thoroughly compacted in full depth. Guy anchors and guys are then installed for the angle and dead-end poles.

Typical tools and equipment used during foundation construction and structure erection includes:

- Backhoe on rubber tires
- Small excavator
- Auger truck
- Hand drills and compressor
- Diggers with auger
- Truck with crane
- Small tools.

Following the erection of the structures, specialized linemen crews perform the conductor stringing. Large diameter pulleys (conductor sheaves) are attached to the pole crossarms or suspension insulators along the entire stringing section. Conductor reels are mounted on reel stands, loaded onto a trailer, and the conductor is pulled from the reels and fed through the sheaves along the stringing section. The sagging operation will begin after all conductors are strung in one section.

Using a sagging winch, the individual conductors are pulled up to the proper design tension. The conductors will be sagged in accordance to a sag chart which considers the conductor type, the length of span, and the prevailing temperature. After the conductor is sagged correctly it is tied to the insulators or fixed into the insulator clamps as per construction drawings.

Typical tools and equipment used in conductor stringing and sagging include:

- Bull wheel puller and bull wheel tensioner
- Sagging winch
- Reel stands
- Reel stand trailer

- Line truck with manlift
- Pulleys and Sheaves
- Conductor cutting tools
- Conductor press and compressor
- Running ground
- Ropes, blocks and tackles, pull-lifts, hand winches
- Pulling socks and come-along clamps
- Small tools.

During the final inspection, the inspectors will ensure that all debris has been removed and that the transmission line has been constructed in accordance with the approved drawings and specifications.

Substation Construction

The 69 kV transmission line will terminate at a distribution substation to provide power to mine site infrastructure and related loads. The substation construction process will include site preparation, and construction and erection of foundations, support structures, and electrical equipment.

Site preparation activities for substation development typically include removing existing vegetation and organic topsoil, excavation, adding fill material, laying a grounding grid of un-insulated copper wire, and placing cover materials for drainage and access. A thin layer of crushed aggregate will be added as the final layer.

Construction and erection of equipment will include pouring concrete equipment foundations for the transformer bases, and installing grounding arrangements and oil containment systems. Major equipment, including the main transformer, main disconnect switch, and dead end structure will be installed and erected, along with miscellaneous protection equipment, cables, connectors, and associated hardware.

The mine substation is estimated to be 25 m by 20 m and will be fenced, gated and locked. It will operate 24 hours a day, year round, and will be visited regularly by Yukon Energy personnel performing inspections and maintenance.

The location of the mine substation and the 13.2kV transmission lines are illustrated in Figure 5.4-26.

5.4.2.3 Mine Site Accommodations Facilities

The following paragraphs and Figures 5.4-31 and 5.4-32 provide information on the facilities associated with the mine site accommodations, including:

- Permanent accommodations
- Temporary construction camp
- Mine administration building
- Camp water source, distribution, and disposal infrastructure

- Potable water treatment plant
- Wastewater treatment plant.

Permanent Accommodations Facility

The mine site accommodations complex will be constructed for use during the construction, commissioning, operations, and closure phases of the mine.

New pre-constructed modular units will be assembled on a compacted gravel pad, typical for accommodation complexes for remote sites. Constructing the modules off site means that all the units are pre-wired and plumbed to the appropriate codes, resulting in efficient complex commissioning. The units can also later be separated into their original modules, which will facilitate demobilization of the structures, decommissioning of the site, and abandonment of the area.

The accommodations complex will be constructed from modular units and will include a kitchen, a dining room, dorms, male and female washrooms with showers, a sewage treatment plant, a potable water treatment facility and distribution system, and a recreation complex (complete with games and gym facilities).

The advanced exploration camp modular units, including sleeping quarters and kitchen/dining facilities, will likely be moved to the site of the permanent accommodation facilities to consolidate personnel accommodations for the Project and the continuing exploration program. The sewage treatment plant used for the advanced exploration camp would be retained either as a back-up system for the permanent accommodations facility or for a new advanced exploration camp site.

Temporary Construction Camp

The initial construction phase for the Project will begin with the preparation of the compacted gravel pad for the site of the permanent accommodation facilities. The workforce required for this phase of construction will be housed in the existing advanced exploration camp on the project site.

Once a sufficient number of new modular units have been assembled, the construction workforce will relocate to the Permanent accommodation facilities.

During construction, additional accommodation modules will be installed in the area of the permanent accommodations facility that is capable of accommodating a peak on site workforce of 415 people. This will be undertaken as required, and these modules will be removed at end of construction. The general arrangement of the camp area during construction is illustrated in Figure 5.4-31 and of the general arrangement of the camp during operation is illustrated in Figure 5.4-32.

Mine Administration Building

The administration building will be situated near the camp facility and will house the mine dry and various administration offices. The administration building will be a pre-engineered building.

Camp Water Source, Distribution, and Disposal Infrastructure

Water will be pumped from a groundwater well to the mine site through an insulated and heat-traced pipeline. The pumps at the intake station will run year-round during the operations phase. Test work for the camp water supply was carried out in 2010 and the aquifer used for the advanced exploration camp facilities will be sufficient[16] for the commissioning and operations stages of the project. The well location for the advanced exploration camp may be changed to accommodate other infrastructure; and new wells will be located in the vicinity of the permanent accommodations facility and will produce from the same lower valley aquifer as the existing camp water supply well. Storage will be provided at the mine site in the fresh water storage tank.

The mine site accommodations complex will have both a potable water treatment facility and a wastewater treatment facility. Potable water will be treated from the freshwater storage tank, and treated waste water will be discharged through a rock drain to Haggart Creek.

Potable Water Treatment Plant

The potable water treatment system will be a packaged system, which will treat the freshwater to Canadian Drinking Water Standards. Potable water will only be used to service the camp and will not be used for mine or process activities.

Wastewater Treatment Plant

The camp wastewater collection system will gravity feed the treatment plant. Insulated HDPE pipes will connect the camp site infrastructure with the wastewater treatment plant (WWTP).

The WWTP will be a Membrane Biological Reactor unit built to produce effluent in accordance with the Yukon Water Board requirements for treated sewage effluent. Treated wastewater effluent will be discharged from the plant through a rock drain into Haggart Creek.

5.4.2.4 Water Usage

Water usage for the construction phase will be for the camp facilities and construction activities. Water for the camp will be sourced from ground wells and pumped to the fresh water storage tanks in the camp. It is expected that the water usage for the camp during construction will be approximately 300 L per person per day for a total of 120,000 L per day at peak capacity.

Water required for construction fill purposes will be sourced first from available surface water structures (sediment control ponds), and then from the fresh water storage tanks. During the construction stage, approximately 1,000,000 L of water will be needed for concrete manufacture, 1,000,000 L will be needed for dust suppression, and 1,000,000 L will be required for other purposes.

[16] Water supply well produced at a rate of 207 m^3/day compared to an estimated maximum demand of 125 m^3/day (415 people x 300 L/ day/person = 124,500 L/day)

5.4.2.5 Mine Water Treatment Plant

A Mine Water Treatment Plant (MWTP) will be constructed to treat contaminated surface water and detoxified process solution to enable solution to be discharged to Haggart Creek. The mine water treatment plant will be located in proximity to the process plant area. The MWTP is designed to treat the maximum anticipated contaminated water volume for removal of various trace metals of concern. Initial treatment capacity will be 310 m^3/hr. To treat additional volumes associated with draindown, the flow train will be duplicated in year 10, bringing treatment capacity up to 610 m^3/hr.

The proposed treatment process will consist of three stages:

6. Chlorination and lime softening for removing most of the metals of concern, such as copper, iron, lead, manganese, nickel, thallium, uranium, and zinc at high pH by precipitating them as their corresponding metal hydroxides as well as removal of non-metals like fluoride as insoluble calcium fluoride. Some sulfate will also be removed as gypsum, and the lime softening process will also remove some arsenic, ^{226}Ra, and mercury.

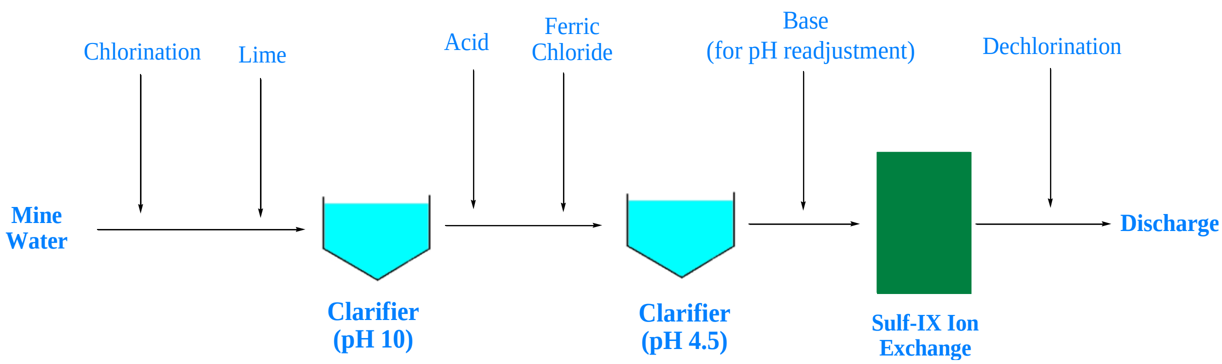
   Chlorination will be required to help oxidize redox-active metals such as iron and manganese to aid in their removal in the lime softening process. It can also help oxidize reduced arsenic and antimony species to optimize their removal in the next treatment process, where these and other contaminants will be removed via coagulation by ferric chloride. Additionally, the chlorination will remove ammonia via breakpoint chlorination, when necessary. Finally, chlorination can also oxidize and destroy free and weak-acid dissociable (WAD) cyanide, should it be present.

   After the high pH lime softening process step, the pH will be adjusted using an acid such as hydrochloric acid until the pH can reach approximately 4.5 from the appropriate amount of ferric chloride addition. Hydrochloric acid and ferric chloride are proposed for use instead of sulfuric acid and ferric sulfate because the water is already elevated in sulfate content. Ferric coagulation at pH 4.5 will remove antimony, arsenic, mercury, molybdenum, phosphate, and selenium. Barium chloride will also be added in this treatment step to remove ^{226}Ra. It is anticipated that barium addition here will also help remove some sulfate as insoluble barium sulfate.

7. Although the two treatment processes described above will be sufficient for removing almost all of the contaminants of concern to sufficiently low levels, they may not remove sulfate or nitrate to adequately low levels to allow for discharge. Therefore, a third treatment process will consist of a Sulf-IX ion exchange system for removing sulfate and nitrate.

8. The treated water will be dechlorinated when necessary with sodium thiosulfate to remove any residual chlorine so that the treated water will not be harmful to aquatic life when discharged and will pass the toxicity tests as required by the Metal Mining Effluent Regulations (MMER).

A simplified treatment process flow diagram is shown in the following diagram:



Two separate freeze consolidation pads, each consisting of two cells will be constructed next to the MWTP: a caustic sludge pad (2 x 1,500 m^3 cells) and a ferric sludge pad (2 x 100 m^3 cells). After consolidation, sludges will be transferred to HPDE lined sludge storage pads constructed nearby. The caustic sludge storage pad will sized for capacity of 9,500 m^3, and the ferric sludge storage pad will be sized for 5,200 m^3. These capacities are sufficient to hold all of the sludge produced in operating Years 1 through 12.

Further details on the MWTP design and waste management plan can be found in Appendix 20 – Mine Water Treatment Plant Technical Memo.

5.4.2.6 Fuel and Explosives Facilities

Fuel Storage Facility

During construction, fuel will be stored in two new double-walled enviro-tanks. The temporary double-walled enviro-tanks will be demobilized from site once one of the mobile equipment bulk fuel storage tanks is constructed and commissioned. If possible, the temporary tanks will be re-used.

Bulk fuel for operations will be stored in two separate tanks, each constructed with a capacity of 400,000 L, for a total storage volume of 800,000 L, equivalent to about four weeks of operating consumption of diesel fuel.

In addition to the two large fuel storage tanks, a 100,000 L diesel fuel storage tank will be installed adjacent to the ADR building to provide fuel for use in the process plant boilers.

All bulk fuel storage tanks will be single walled tanks placed inside lined, bermed containment areas. The containment areas will be sized to hold the larger of 110% of the largest tank or 10% of the total maximum volume of all tanks in the facility, in accordance with the National Fire Code and in conformity with the *Environmental Code of Practice for Aboveground Storage Tank Systems Containing Petroleum Products.*

Waste lubricating oil will be stored in a 10,000 L steel tank located next to the truck shop. It is anticipated that this oil, collected from the mine equipment, will be burned along with diesel fuel in the solution heating boiler in the process plant. Oil filters and a blending system to facilitate in-line mixing of lube and diesel oil are included.

Explosives and Magazine Facilities

The explosives site will be located at the eastern end of Dublin Gulch (Figure 5.4-27). Explosives will be used during construction of the infrastructure site pads, pre-production of the open pit mine, and during life of mine in the open pit. Over life of mine, both Fortan emulsion and Fortan wet hole explosives products will be employed. Approximately 40 tonnes of fixed emulsion will be stored within the facility. The facility will also have capacity to store 130 tonnes of ammonium nitrate (2 x 65 tonne silos). Explosive material will be stored in accordance with the applicable regulations and standards.

The magazine site will be located in the eastern end of Dublin Gulch as well and will be designed to comply with applicable standards and required regulations.

The preparation of each site involves removal of any salvageable soils required for reclamation, followed by any additional overburden material unsuitable for the site base. The designated areas will be graded and surrounded by a perimeter berm with a minimum height of 1.2 m, and a single gated lockable entry point, as per requirements of the explosive's license.

Due to the remote nature of the operation and the volume of product scheduled for consumption, it is expected that a base factory licence will be a preferred option versus a satellite explosives storage licence; however, the final decision will be based on discussion with the potential explosives contractors.

5.4.3 Waste Management

Throughout the Project, from construction, operations, closure and reclamation, and finally post-closure monitoring, responsible waste management initiatives such as waste minimization, recycling, and re-use options will be implemented. Environmentally sound practices that are economically viable in respect of waste transportation and disposal will be implemented.

Waste generated during most phases of the project will fall into the key categories set out below. Waste will be managed in accordance with applicable regulations and requirements. Waste types identified below include:

- Solid waste (from the camp, including food waste, and from ongoing operations)
- Construction/demolition waste
- Lubricants (from equipment/facilities)
- Special waste
- Sewage/treated sewage effluent, hazardous/specified waste, and brush (from clearing).

A detailed Waste Management Plan will be developed to meet all regulatory and permitting requirements.

The construction phase will take place over two summer construction seasons in 2012 and 2013. The number of personnel in camp during this time will peak at 415; however, the average number of personnel on site will be approximately 350 people. There will be several types of waste generated during the construction phase of the Project. The waste types, volumes, and handling and disposal methods are summarized in Table 5.4-3.

For the **construction** phase, the following assumptions were made:

- **Solid Waste:** an average of 350 personnel, with a waste generation rate of 1.3 kg/person/day
- **Construction Waste:** accommodation and administration facilities will be constructed offsite and will generate waste associated with transportation and shipping material and waste construction supplies related to electrical and plumbing connection. All other buildings will be constructed on site and will generate typical waste building materials. The quantity of waste was calculated based on a disturbed infrastructure area of 15.4 hectares and assumed wood waste, concrete, steel/metals and miscellaneous packaging waste. Re-use, good workmanship, and efficient practices would be put into practice to minimize waste generated.
- **Lubricants:** 80 pieces of major equipment, a total of 326,000 operating hours, and a construction period of 20 months. Oil changes consisting of 20 litres every 200 hours, with one change of anti-freeze/glycol (30 litres/equipment) and hydraulic fluids (55 litres/equipment) during the construction period
- **Sewage:** 300 liters/person per day, from which 3.1 m^3/month of sewage sludge would be generated
- **Special/hazardous waste** that includes:
    - Equipment spills/leaks (20 litres/year/equipment)
    - Oil filters (between one and four filters per oil change)
    - Hydraulic filters (between one and four filters every three months)
    - Batteries (between one and eight batteries/equipment, every five years [limited number during construction period])
    - Aerosol cans (one/equipment/week)
    - Tires (one/equipment/year)
    - Miscellaneous spent materials/chemicals (1 kg/equipment/week)
    - Miscellaneous totes/bulk bags/packaging (10 kg/week)
    - Miscellaneous metals (10 kg/equipment/week).
- **Brush:** 433 ha to be cleared, 97% of clearing to be carried out during the construction phase/3% during the operations phase:
    - 342 ha of trees >150 mm DBH which would be salvaged (residue brush/small tree waste = 20,000 kg/ha)
    - 53 ha of “scrubby forest” (waste = 46,000 kg/ha) which would be excluded from the salvage
    - 38 ha of scrub (waste = 17,240 kg/ha).

The Waste Management Plan for subsequent phases of the Project is discussed in subsequent sections of Section 5 – Project Description. Quantities of waste anticipated for the construction phase can be found in Appendix 30, Section 15 – Waste Management Plan, Table 16-1.

Table 5.4-3: Wastes Generated during Construction Phase

Wastes Generated during Construction Phase			
Waste Type	**Description**	**Handling Method**	**Disposal Method**
Solid Waste	General waste produced in camp, including food scraps	Bagged garbage hauled by truck	Shipped to Mayo landfill
Construction Waste	Wood, drywall, metal, etc. from building construction	Sorted in bins as: ▪ Solid ▪ Non-combustible Hazardous.	Solid waste as above,
Lubricants	Oils used in machinery, glycol, etc.	Stored in bulk waste oil containers, specific to waste type	Waste oil that is usable in a waste oil heater will be used to produce heat, all other wastes in this category will be hauled to an approved disposal facility
Sewage	Human waste, grey water		Sewage treatment facility will produce two types of waste: treated sewage effluent and sewage sludge waste. Sewage sludge waste will be 3.1 m^3/ month. VIT will seek arrangements with the Village of Mayo to dispose of sewage sludge cakes at the Village of Mayo Sewage Facility (i.e., lagoon).
Treated Sewage Effluent	Liquid effluent exiting the sewage treatment plant	Effluent will be pumped in an insulated, heat traced HDPE pipeline to a suitable disposal field prior to discharging to natural environment.	Treated effluent will be disposed of in a rock drain
Special/Hazardous Waste	Paint, waste from hydrocarbon spill clean-up, aerosol cans, batteries, cleaning chemicals, etc.	Hazardous waste will be separated and stored in approved containers	Hazardous waste will be hauled off-site and disposed at an approved facility
Brush	Wood or woody debris generated from clearing (<150 mm DBH)	Brush will be handled in accordance with Timber Salvage Plan and regulatory requirements	Brush and wood will be disposed of per the Timber Salvage Plan and regulatory requirements (for example, stockpiled or burned).

5.4.4 Water Management

During the construction phase, the objective of the water management plan will be to safely convey, or store as necessary, all freshet and precipitation runoff captured on the Project site, while maintaining water quality objectives in receiving water. This objective includes minimizing total suspended sediment levels and treating contact water to achieve appropriate water quality standards at the Project site.

Section 6.0 of the Water Management Plan (Appendix 18) describes the sequence of construction and water routing activities during the first two years of the Project (the construction phase). Appendix 21 – Surface Water Balance Model Report and Appendix 22 – Groundwater Model Report provide results which quantify the routing of water at the Project site for the construction phase, where applicable. A discussion of model results is provided in detail for average, wet and dry conditions, with additional discussion as needed to address supplementary scenarios when appropriate. A brief summary of the Water Management Plan during construction is included below. For details and additional information, refer to the Water Management Plan (Appendix 18).

The construction phase of the Project will require approximately 1.7 yrs to complete (i.e., approximately 69 weeks over two summer construction periods). Thus the water management plan has addressed conditions during the two spring freshets, and summer-fall rainfall-runoff periods, including storm events, and low flow periods during the summer and fall periods.

None of the major Project facilities (i.e., HLF, WRSAs and open pit) will be in service during the construction phase. However, various water management structures, including sediment control ponds, feed and product ponds, the Events Ponds, and diversion ditches and channels, will be built prior to any upstream site development and used to control runoff and associated erosion and sediment movement from two freshets and two summer seasons.

5.4.4.1 Dublin Gulch Diversion Channel

The lower Dublin Gulch valley currently drains into Haggart Creek via Dublin Gulch and the smaller Eagle Creek (fed by Eagle Pup). The HLF will extend into the Dublin Gulch valley, and the majority of mine site water management facilities will be located in the lower Dublin Gulch valley. Therefore, both Eagle Creek and Dublin Gulch will require realignment around the proposed mine site infrastructure. This realignment is referred to as the Dublin Gulch diversion channel (DGDC). Figures 5.4-28, 5.4-29, and 5.4-30 provide details on the upper, central, and lower sections of the DGDC.

The relocation of the Dublin Gulch watercourse is designed to convey streamflow safely past the HLF and divert the water to the Eagle Creek drainage, downstream of the Project site facilities. The DGDC will be constructed during the construction phase and will remain in place indefinitely.

The DGDC will be approximately 2.6 km long and will transport flows from upland (non-contact water) of the mine site infrastructure for eventual discharge to Haggart Creek. The upstream end of the DGDC will intercept flow from the existing Dublin Gulch channel midway between the existing confluences of Eagle Pup and Stewart Gulch, then cross the Eagle Pup and Stuttle Gulch basins while passing the HLF and WRSA facilities. The DGDC will end and be directed into the existing Eagle Creek channel downstream of the water management facilities approximately where the channel turns south within the Haggart Creek valley. Although much greater flow rates will be conveyed down Eagle Creek than what exists currently, these increased flows from the DGDC will provide an opportunity to rehabilitate and enhance the lower Eagle Creek channel, which currently has reaches with high rates sedimentation and aggradation. Conceptual enhancement design for Eagle Creek is provided by the Fish Habitat Compensation Plan (FHCP) (Appendix 23).

The DGDC will consist of an upper reach, an energy dissipater (steep middle reach) and a lower reach. The upper reach will be 5 m wide and 3 m deep with a 1% slope over 900 m along the valley contour. The upper reach will be constructed of earth-fill, HDPE liner, and rock-fill erosion protection. The upper reach will be routed down the Stuttle Gulch drainage at an approximately 15% gradient, and stream energy will be decreased through in-channel energy dissipation structures. In-stream erosion control structures for this section of the DGDC will include large size rock-fill, placed on a gravel bed, on a heavy duty geotextile. The energy dissipater will allow fish passage to upper reaches and open habitat previously inaccessible to fish due to a steep 30 m cascade. The energy dissipater will be constructed as a boulder step pool and enhanced to provide naturalized fish habitat. The energy dissipater will discharge to a velocity reduction pond where the lower reach of the DGDC will begin. The lower reach of the DGDC will consist of a channel that will be 5 m wide and 3 m deep with an approximate gradient of 5% over a length of 1,160 m. The channel will follow the southern boundary of the lower Dublin Gulch valley, where it will discharge into the lower Eagle Creek drainage.

The realignment will require two velocity reduction ponds. The Upper Dublin Gulch Velocity Reduction Pond will be located immediately below the diversion from the existing channel into the DGDC. The Lower Dublin Gulch Velocity Reduction Pond will be located below the energy dissipater (along the existing Stuttle Gulch channel) within the DGDC. The purpose of this pond will be to control water velocity entering the lower section of the DGDC. The DGDC and both ponds will be designed to accommodate a 1:100 year flood event. Currently, fish bearing habitat in Dublin Gulch is extensively degraded as a result of placer mining operations over the last several decades. The DGDC will be designed to enhance fish habitat, to increase productivity of the sub-basin. The entire DGDC will be enhanced for fish habitat to the greatest extent possible while maintaining a stable geometry and planform during operations. Enhancement prescriptions will include in-stream complexing (addition of large woody debris (LWD), boulders, and pools), and riparian planting to increase the stability of the banks, decrease erosion and sedimentation, reduce temperature fluctuations, and provide allochthonous food sources—plants and insects from riparian vegetation.

The geotechnical design basis for the Dublin Gulch diversion channel is presented in Appendix 35, which describes the assumed geotechnical material properties, and presents the proposed methods for dealing with identified geological hazards, including permafrost processes. The geotechnical design aspects of the diversion channel will be completed for the feasibility study and required license applications including the following: selection of backfill material; further design of Stuttle Gulch erosion protection measures; further geotechnical data along the proposed diversion; and, design of the lower Dublin Gulch diversion with regard to providing suitable fish habitat.

5.4.5 Workforce Requirements

The construction workforce will be a combination of VIT employees and construction contractor skilled and unskilled labour. The following table lists the expected labour during the construction phase. The expected construction work force schedule will be three weeks on/one week off at 11 hours per day. Seventy percent of the workforce will work day shifts and the remaining 30% will work night shifts.

Table 5.4-4: Peak Construction Phase Workforce

Position	Number of Employees
Heavy Equipment Operators	115
Mechanics	35
Construction Supervisors	35
Management and Technical	45
Non-skilled Labourers	50
Specialty Trades	20
Skilled Trades	80
Catering and Services	35
Total	**415**

5.4.6 Energy Requirements

There will be a demand for approximately 500 kW of power during the construction phase. All power will be generated on site by diesel generators prior to the completion of the power transmission line. The camp and surface facilities will be serviced by one 250 kW diesel generator unit located in the process plant area. Open pit development will be serviced by several portable electrical power centres rated at 250 kW. All other construction sites will be serviced by a maximum of ten 10 kW portable generators.

5.5 Operations Phase

The operations phase of the Project will commence in late in 2013 and will run through the end of 2020, at which time the closure and reclamation phase will begin.

5.5.1 Mine Operations

The majority of this section has been excerpted from the July 2010 PFS. Additional information can be attained through reference to the PFS document (Scott Wilson Mining 2010).

5.5.1.1 Open Pit Mining

Conventional open pit methods are proposed for mining the Project ore. Over the life of the mine, the open pit is to advance in four phases, beginning with a starter pit (Phase 1), and followed by three push backs (Phases 2 – 4). This will maximize the Project's net present value at a mine production rate of 3.3 Mt ore in the first year of production followed by 9.1 Mt ore thereafter. The daily mining rate is 26,000 tonnes per day ore.

The mine production schedule is generated based on the Probable Reserves within the designated open pit phases and final open pit limits. The life-of-mine production schedule by year is shown in the table below.

Table 5.5-1: Life of Mine Production Schedule

Year	Ore kT	Grade g/t Au	Waste kT	Strip Ratio	Contained Au Oz
2012	0	0.00	587	NA	0
2013	3,300	1.02	6,848	2.13	108,100
2014	9,100	0.84	5,647	0.73	244,800
2015	9,100	1.01	13,739	1.56	294,600
2016	9,100	0.83	8,752	1.03	242,700
2017	9,100	0.87	12,885	1.47	253,600
2018	9,100	0.73	9,476	1.04	214,800
2019	9,100	0.73	3,978	0.44	213,700
2020	8,241	0.67	3,704	0.45	178,600
Total	**66,141**	**0.82**	**65,616**	**1.04**	**1,751,000**

The open pit limits are located on a mountainside, with an average slope of three horizontal to one vertical. The long axis of the open pit strikes east-west, roughly parallel to the fall-line of the slope, and the surface footprint of the final open pit is just under 70 ha. The west facing final highwall crests at 1,410 m above sea level (m asl) and has the greatest vertical presence at just over 400 m to the intermediate pit bottom, followed by a 70 m step down to the final pit bottom at 930 m asl. The first bench containing ore is at the 1,260 m asl elevation. Mining development phases are illustrated in isometric views in Figures 5.5-1 through 5.5-4 and are described below.

Mining of the Phase 1 starter pit will start mid Year 2013, and continue where the pre-strip left off, with first ore exposure at a bench elevation of 1,260 m asl. The last bench of the Phase 1 open pit will occur at 1,155 m asl. No haul roads will be developed in the Phase 1 open pit highwalls as semi-permanent haul roads will be developed external to the open pit limits.

Phase 2 mining will begin on the 1,260 m asl bench. The last bench, at 1,042.5 m asl, will be completely in ore. The upper benches of Phase 2 will have been previously cut to the first ore bench during the construction phase as described earlier. An in-pit highwall ramp will be developed to support two-way traffic and connect with the external ramp system. This will maintain road access to the primary crusher area during subsequent phases.

Phase 3 mining will start with a pioneering bench at 1,395 m asl elevation. The Phase 3 highwall will be shared in common with the final open pit highwall up to the 1,350 m asl bench. At this point, to defer waste movement, a split between the final wall and a pushback wall will start. The lowest bench of Phase 3 is at 990 m asl and is approximately 90% in ore. An in-pit ramp system supporting two-way traffic will be developed in the Phase 3 highwall. This will connect with the external ramp system to maintain access to the primary crusher area during mining of the final phase.

Phase 4 mining will start on the 1,335 m asl bench and continue down to the last bench at 940 m asl. The length of the final cut at 940 m asl will be approximately 300 m, and is exclusively in ore. No ramps are left in the final open pit highwalls as reclamation access to open pit safety berms is maintained on external roads and dump faces.

Mining Equipment

The Project is a conventional open pit mining operation with two diesel hydraulic excavators as the primary loading units. These will load off-highway, rigid-frame, mechanical-drive haulage trucks. A fleet of self-propelled, diesel, rotary down-the-hole hammer drills are selected for production rock drilling. The mining fleet will be owned and operated by VIT.

Table 5.5-2: Operations Phase Mine Equipment

Type	Description	Area	Maximum Units Required	Unit Operating Time (hours per year)	Engine Type	Engine Size (hp)
Major Equipment						
Rotary Blasthole Drill	Reichdrill C-700-D	Open Pit	2	5,197	Diesel	700
Rotary Blasthole Drill	Sandvik DX800	Open Pit	1	2,050	Diesel	225
Excavator	Hitachi EX1900-6	Open Pit	2	5,010	Diesel	1,090
Support Equipment						
Wheel Loader	CAT 992G	–	1	4,300	Diesel	800
Track Dozer	CAT D10	–	1	2,900	Diesel	580
Track Dozer	CAT D8	–	1	3,800	Diesel	310
Motor Grader	CAT 16H	–	2	4,800	Diesel	265
Haul Truck (91t, 161 GVM)	CAT 777	–	9	5,100	Diesel	1,020
Water Truck, 14,000 gal	773	–	1	5,060	Diesel	550
Ancillary Equipment						
Backhoe	300P	–	1	1,750	Diesel	270
Front End Loader	CAT 988	–	1	880	Diesel	800
Fuel/Lube Truck, 3,600 Gal	Truck	–	1	3,500	Diesel	500
Service Truck	Truck	–	1	3,500	Diesel	400
Tire Manipulator	Support	–	1	700	Diesel	400
Mobile Lighting Units	Support	–	8	3,600	Diesel	11
Light Vehicles	3/4t		16	2,700	Diesel	300
Mine Rescue Truck	3/4t	–	1	351	Diesel	300

Type	Description	Area	Maximum Units Required	Unit Operating Time (hours per year)	Engine Type	Engine Size (hp)
Other Equipment ADR						
Light Vehicles	3/4t	–	3	1715	Diesel	300
All Terrain Forklift	Manitou Mc	–	1	877	Diesel	50
Warehouse Forklift	Manitou Mc	–	1	3,508	Diesel	50
Plant Forklift	Manitou Mc	–	2	3,508	Diesel	50
Backhoe/Loader: CAT 938G	Cat 93G	–	1	702	Diesel	172
Bobcat Loader	Support	–	1	3,577	Diesel	140
Flatbed Truck (Warehouse)	3/4t	–	1	5,261	Diesel	215
Maintenance Vehicle	3/4t		2	1,052	Diesel	300

Open Pit Slope Design

Bench geometry for open pit design is based on the design criteria supplied by BGC Engineering Inc. (BGC) (*0792-001 – Pre-Feasibility Open Pit Slope Design, Final Report*, BGC Engineering Inc., May 2010). A global bench face angle of 65° is used, along with a 15 m bench height. Safety berm widths will be variable by domain and design sector to achieve the minimum required overall and interramp slope angles. The minimum safety berm width is 9 m, with a maximum of 17 m. The application of controlled blasting to achieve steeper bench face angles and overall steeper slopes was investigated. However, the presence of numerous design sectors with limited to no increase in overall slope angle controlled the overall slope model. Therefore, limited benefit, in the form of reduced strip ratio, was observed for the increased risks and costs attached to achieving steeper overall open pit slopes. The final open pit design was reviewed by BGC for consistency with their recommended slope design criteria, and accepted. Further optimization of the open pit slope design is expected during the feasibility study engineering.

Haul road width was based on 91-tonne payload class haul trucks. For two-way traffic and a single shoulder barrier, a minimum 24 m design width is allowed, based on three times the truck operating width and a shoulder barrier at three quarters height of the truck tire. A shoulder barrier is employed whenever there is a drop-off of greater than 3 m. Similarly, for single-way traffic, a minimum of 18 m design width was used.

For the final open pit, no haul roads will be left in the highwalls. However, during open pit phase construction, haul roads will exist both internal and external of the open pit. Road design gradients are typically between 8 and 10%; however, segments up to 200 m with gradients up to 12% may exist in various open pit phases and on external roads. The bottom of the final open pit will be accessed via a sinking cut ramp with ramp retrieval in the last half bench to maximize mining recovery of ore.

5.5.1.2 Drilling

Production drilling in mineralized material and waste is performed by a fleet of two identical, track-mounted, diesel-powered, rotary down-the-hole hammer drills that can drill a 7.5 m bench height (including subdrill requirement) in a single pass. A smaller drill is selected for use in pioneering new benches at surface and for use in final wall control pre-shear drilling.

Rotary blasthole drills have been selected to drill 200 mm blastholes. Blastholes will be drilled in an 8.5 by 5 m to 8.5 by 7 m grid, in order to provide suitable fragmentation for the proposed loading equipment. A diesel powered hydraulic percussion track will be used for secondary drilling of oversize material.

5.5.1.3 Blasting

The blast holes will be loaded with explosives and the pattern will be tied together with detonating cord. Blasting will occur only in daylight hours and will be scheduled to take place at a shift change or lunch break. The broken rock resulting from the blast will be inspected for misfires before production crews resume work in the area. Efforts will be made to minimize fly rock and noise with the use of appropriate blasting delays and best industry practices.

It has been assumed that 75% of the drill holes will be dry and will use Fortan emulsion, while 25% will be wet and will use Fortis wet hole product. A powder factor of 0.20 kg explosive per tonne for waste, and 0.23 kg explosive per tonne for mineralized material has been suggested. The Fortan15 emulsion was selected over more traditional ammonium nitrate-fuel oil (ANFO) as it presents a better overall cost per tonne for the complete drill and blast cycle.

The supply of explosives will be a contractor-provided service for delivery of explosives to the drill hole. The following table lists estimated annual explosives consumption.

Table 5.5-3: Explosives Consumption

		2013	2014	2015	2016	2017	2018	2019	2020
Explosives	tonnes	2,300	3,600	5,200	4,200	5,000	4,200	3,100	2,800

5.5.1.4 Hauling

The Project mine plan calls for conventional open pit operation and is based on 10 m benches, using front-end loaders, and 91 t rear dump trucks. The operation will be supported by a variety of earthmoving equipment, such as bulldozers, motor graders, and water trucks. After blasting and grade control, ore will be transported to the primary crusher, located on the northern edge of the open pit rim. Waste rock will be taken to either the Platinum Gulch or Eagle Pup WRSA or used in rock or infrastructure construction.

5.5.1.5 Open Pit Dewatering

As the open pit is developed, dewatering of the open pit will be required *(0792-001-06 Pre-Feasibility Open Pit Depressurization Final Report,* BGC Engineering Inc., May 31, 2010). Open pit perimeter wells and horizontal bench wells will be employed to extract groundwater and depressurize open pit walls. Meteorological water and surface runoff will be collected in surface sumps and be handled according to the Water Management Plan (Appendix 18).

Surface water and ground water in and around the open pit will be controlled. Surface water from precipitation and snow melt will be diverted around the open pit to the greatest extent possible. Discharge from mine dewatering operations will be routed to the MWTP feed pond for use as process make-up. In the event that this water is not required as process make-up water, the MWTP will treat this water prior to release to Haggart Creek.

Based on the predicted groundwater flows from the numerical model of the proposed open pit area, it is estimated that approximately 115 horizontal drains will be required over the life of the mine for a total drilling length of approximately 14 km. BGC also recommends that five to ten pumping wells be constructed throughout the life of the mine to aid in local depressurization of the open pit slopes. Pumping wells could prove more effective for depressurizing the rock mass in localized areas with greater hydraulic conductivity or where local instability of the highwall is occurring.

Water collected in both the vertical wells and the horizontal drains have been taken into account in the site water balance.

5.5.1.6 Low Grade Ore Stockpiles

Two permanent stockpile areas are defined in the mine plan for lower-grade mineralized material mined in Phases 1, 2, and 3. Potential additional stockpile capacity is available if warranted for segregation of grade groups and or alteration types.

The first stockpile area to be developed has a design capacity of 0.3 Mt, and will be located at 1,196 m asl. This stockpile will be used for mineralized material located at similar elevations or higher (to minimize the haulage profile) and will reach design capacity by the end of Year 2.

The second permanent stockpile area has a design capacity of 2.6 Mt and will be located just north of the primary crusher. Trucks can end dump to this stockpile between 1,100 and 1,140 m asl elevations. This stockpile will reach capacity at the end of Phase 3 mining (start of 2018).

5.5.1.7 Primary Crushing and Conveying

The primary crusher dump pocket will be located at 1,065 m asl, just over 100 m north of the final open pit rim. During regular operations, run-of-mine ore will be direct-dumped into the dump pocket or a small run-of-mine stockpile if the primary crusher is not available for direct dumping. Run-of-mine ore will be delivered by haul trucks from the open pit to the primary gyratory crusher, located north of the open pit. The ore will be direct-dumped into the dump hopper situated above the 1,372 to 1,651 mm (50 to 65 in.) gyratory crusher, and will be discharged to the crusher with a discharge setting of 150 mm. The primary crushed ore will be collected in the discharge pocket below the primary crusher. A belt feeder will regulate the discharge rate of the primary crushed ore, at nominally, 1,350 dry t/h, onto a 1,524 mm wide primary crushing discharge conveyor.

The conveyor will be fitted with belt cleaners near the point of discharge to minimize the risk of carryback material being released from the underside of the belt into the air or beneath the conveyor.

The conveyor will be fitted with covers along its entire length. Covers aid significantly in controlling the generation of fugitive dust by controlling the action of wind as it passes over the moving belt. Reducing the interaction of wind with bulk material is a proven method to reduce dust emissions from outdoor conveyor belt systems. Water sprays will be used in the primary crusher dump hopper for dust control during the summer months.

5.5.1.8 Secondary Crushing and Conveying

The primary crushing discharge conveyor will deliver the primary crushed ore to two 50 t surge bins. Belt feeders will regulate the ore feed rate from the surge bins at nominally 675 dry t/h each to two 2,438 by 7,315 mm (8 by 24 ft) double deck vibrating screens (secondary screens) with apertures of 89 and 38 mm. Screen oversize material will discharge to two Metso MP1000 standard head cone crushers (secondary crushers) with closed side settings of 19 mm.

The combined secondary crusher discharge product and screen undersize will be transported by a 1,219 mm secondary crushing discharge conveyor at a nominal rate of 1,350 dry t/h to an overland conveyor. The secondary crushed ore will be delivered to a conical stockpile with 10,000 t live capacity.

As described for primary conveying above, the secondary conveyor will be fitted with belt cleaners near the point of discharge to minimize the risk of carryback material being released from the underside of the belt into the air or beneath the conveyor. The conveyor will be fitted with covers along its entire length. Covers aid significantly in controlling the generation of fugitive dust by controlling the action of wind as it passes over the moving belt. Reducing the interaction of wind with bulk material is a proven method to reduce dust emissions from outdoor conveyor belt systems. Water sprays and a telescopic discharge chutes will be used for dust control during the summer months.

5.5.1.9 Reclaim and High Pressure Grinding Rolls

Secondary crushed ore will be withdrawn from the stockpile at a controlled rate (nominally 1,550 dry t/h) by vibrating pan feeders (two operating) onto a 1,372 mm wide reclaim conveyor, which will discharge into a 20 t bin, located above the high pressure grinding roll (HPGR). The feed rate to the bin will be controlled so that the HPGR is choke-fed. Product with a nominal P80 of 5 mm will be discharged onto a 1,219 mm wide HPGR discharge conveyor, and then conveyed to the HLF pad at a nominal rate of 1,550 dry t/h.

The conveyors will be fitted with covers along their entire lengths. It is expected that a fogging dust suppression system will be utilized at the HPGR discharge chute to control dust emissions.

During the first year of ore stacking to the HLF, quicklime (CaO) and cement will be added at a controlled rate onto the HPGR discharge conveyor and will be thoroughly mixed on the heap feed conveyors. Quicklime and cement may be used to improve the stability of the ore in the first several ore lifts.

5.5.1.10 Heap Leach Operation

The proposed HLF will be located approximately 1.2 km north of the open pit. The HLF will be operated during non-winter months (265 days per year) using a 1,219 mm wide conveyor stacking system. Crushed ore will be stockpiled on the heap leach pad during the coldest part of winter (100 days per year). The on-heap crushed ore stockpile will be fed to the conveyor stacking system by a bulldozer (via mobile feeder), when stacking operations resume in warmer weather. Raw water will also be added to the HPGR discharge material to assist with the agglomeration of fines in the ore.

The heap stacking system includes:

- 915 m of overland conveyors
- Tripper conveyor to divert ore to the HLF area (not required until Year 3)
- Up to 20 "Grasshopper" portable transfer conveyors, each approximately 38 m in length
- 43 m long horizontal mobile bridge conveyor mounted on a dozer crawler carriage
- 37 m long radial stacking conveyor, capable of powered luffing, slewing and stacking to a height of 10 m and fitted with a 6.1 m stinger.

The HLF feed conveyors will be installed adjacent to the leach pad, running north and east from the HPGR area. The grasshopper conveyors will transport the ore from the overland conveyors to the bridge conveyor. The ore will be placed in 10 m lifts using the radial stacker. The HLF will be constructed from west to east, retreating up the slope of the pad. As the stacker retreats, grasshopper conveyors will be removed from the transfer train and relocated in an adjacent area, so that the heap will be constructed from the toe upwards in a series of 60 m wide by 500 m long ribbons.

The in-heap pond area will be the first area filled with ore. The maximum depth of ore in this area will be approximately 26 m. In subsequent operations, ore will be stacked on top of this heap base in 10 m lifts. Ramps will be established to allow conveyor access to the top of the heap for construction of further lifts. Figure 5.5-5 illustrates the HLF after two years of operation (2014). Figures 5.5-6 through 5.5-8 present a plan view and multiple cross sections for the HLF at end of mine life.

For areas of the heap that will be under leach in the winter, the ore will be placed initially in 7 m lifts. After installation of the drip emitter system, an additional 3 m of ore for the insulation cover will be placed in stockpiles on the heap and spread by low ground pressure dozers to facilitate rapid placement.

The nominal stacking rate will be 2,170 dry t/h. That will consist of 620 dry t/h reclaimed from the crushed ore stockpiles and 1,550 dry t/h from the crushing circuit. Raw water will also be added to the HPGR discharge material to assist with the agglomeration of fines in the ore.

The ore heaps will be leached using a dilute solution of sodium cyanide applied by a system of drip emitters. Sprinklers may also be utilized in the late spring and summer months when increased evaporation may be required to maintain the system water balance.

The dilute cyanide leach solution will percolate through the ore and collect on the geomembrane liner at the base of the heap. Drainage pipes above the liner will deliver the solution to the in-heap pregnant solution storage area. Vertical turbine pumps located in sumps in the heap will pump pregnant solution directly to the ADR plant. All exposed pipelines will be insulated and heat traced.

To minimize the risk of freezing the drip irrigator lines, and to maintain a "heat sink" within the heap, a low-pressure 600 HP steam boiler and heat exchanger will be used to warm the barren solution when required. A bleed stream from the barren solution tank will be pumped through the heat exchanger and back to the barren solution tank. The boiler is sized for a maximum barren solution temperature rise of approximately 2.8°C (5°F). It is anticipated that waste oil from the mining fleet can be used along with diesel fuel to fire the boiler.

Solution management of the HLF comprises the efficient management of the solution delivered to, permeating through, and reporting from under the stacked heap, and the secure containment of pregnant and barren leachate leading to optimum metal recovery.

Figure 5.5-9 presents a schematic of the mining process. The leaching process components are described as follows:

- Barren and recycled solution are applied to the heap through a series of buried dripper type and (summer only) sprinkler applicators
- Solution permeates through the heap, where it is contained by the lining system and directed via collection pipes to the collection well within the in-heap pond area
- Pregnant solution is pumped to the ADR plant
- A spillway is located at the top of the in-heap pond to discharge excess solution to the events pond via 450 mm diameter HDPE pipes
- Events pond is zero release and all solution is recycled back to the ADR plant
- After removal of gold in the ADR plant, barren solution is pumped to the heap leach.

The above process is repeated until cessation of operations, when the heap will then be rinsed and treated until the quality of the untreated rinse water meets predetermined targets and can be treated through the site mine water treatment plant prior to discharge.

Gold extraction metallurgical test work is summarized in the Section 7 of the PFS.

Waste Rock Management

Waste rock and ore geochemical behaviour has been evaluated (see Appendix 8 – Geochemical Characterization Report). Characterization indicated that carbonates, predominantly calcite, were generally well in excess of sulphides. Calcite content was generally 1 to 4% (from XRD) whereas sulphur was most often less than 0.5% (from Leco S and ICP-S). Static testing showed a strong propensity towards non acid generating conditions with 82% of samples tested having a neutralization potential to acid potential ratio above 4. Acid rock drainage, or ARD, is therefore not anticipated for the Project.

Kinetic testing and contact water quality predictions based on the kinetic testing results indicate that, although pH conditions are expected to be neutral, moderately elevated concentrations of some trace elements are likely to be present in seepage from the waste rock storage areas. The waste rock storage areas may have moderately elevated concentrations of sulphate, dissolved arsenic, cadmium, manganese, antimony, and selenium (based on a comparison with CCME water quality guidelines for the protection of aquatic life and BC drinking water guidelines). Closure water management and reclamation plans have been developed with these waste rock characteristics in mind.

Life-of-mine waste production is 31.5 million loose cubic metres (66 Mt) including overburden. As outlined in Section 5.4.1.2, during the life-of-mine plan, waste rock is scheduled to go to one of five areas:

1. Fill material for haul road development
2. Fill material for the HLF embankment
3. Platinum Gulch waste rock storage area
4. Eagle Pup waste rock storage area
5. Pit backfilling during final stages of open pit mining.

The use of waste rock for road development and infrastructure rockfill has been addressed previously.

The following table presents the split of waste rock to either the Platinum Gulch or Eagle Pup WRSAs. The table also presents the cumulative area of waste rock on each of those WRSAs. The Platinum Gulch WRSA reaches its ultimate footprint of approximately 33 ha at the end of Year 3 (2015). The Eagle Pup WRSA reaches its ultimate footprint of approximately 80 ha at the end of Year 8 (2020), immediately prior to closure. Figures 5.5-1 through 5.5-4 presented isometric views of both Platinum Gulch and Eagle Pup WRSAs through the life of the mine.

Table 5.5-4: Annual Waste Rock Production and Storage Area

	2013		2014		2015		2016		2017		2018		2019		2020	
	Mt	ha	Mt	ha	Mt	ha	Mt	ha	Mt	Ha	Mt	ha	Mt	ha	Mt	ha
Platinum Gulch	1	6	2.8	25	5.8	33	0	33	0	33	0	33	0	33	0	33
Eagle Pup	2	12	2.8	25	7.9	45	8.8	53	12.8	62	9.5	68	4	74	3.4	80
TOTAL	**3**	**18**	**5.6**	**50**	**13.7**	**78**	**8.8**	**86**	**12.8**	**95**	**9.5**	**101**	**4**	**107**	**3.4**	**113**

WRSAs are built by the top-down construction method, or in lifts from the bottom-up.

For top-down construction, dump crests are designed to a maximum vertical lift of 100 m at a 36º face angle (angle of repose[17] minus one degree). Waste rock buttresses keyed in at the design toe along with intermediate buttresses are installed as required for increased stability and to reduce downslope risk.

For bottom-up construction, dump faces are designed at angle of repose minus one degree, which can result in dump crest heights of up to 50 m vertical, as all dump toe foundations are on downhill sloped terrain. Dump toes will be buttressed and keyed in as required for stability. Additional lifts are added as per the mine plan, with individual dump lifts stepped back to achieve the desired closure

[17] The steepest angle of the slope relative to the horizontal plane when material on the slope face is on the verge of sliding.

face angle, or terraces left in place of sufficient width to allow for resloping to the closure face angle of two horizontal to one vertical overall slope.

The civil, hydrological and geotechnical engineering design parameters used for the design of both the Platinum Gulch and Eagle Pup WRSAs are based on the following relevant standards:

- Regulatory Requirements of Yukon and Canada
- Dump Stability Performance Objectives and Evaluation Standards
- British Columbia Mine Waste Rock Pile Research Committee Investigation and Design Manual Interim Guidelines May 1991.

5.5.1.11 Gold Recovery Process

The recovery plant for the Project is a carbon ADR facility that will be located west of the heap and north of the events ponds. Engineering details and design criteria are presented in Section 10 of the PFS document (Scott Wilson Mining 2010). A process flowsheet of the recovery process is provided in Figure 5.5-10.

The following major components will be included in the ADR facility:

- Adsorption
- Desorption and recovery
- Acid wash
- Carbon regeneration
- Refining.

Adsorption

Pregnant solution (PLS) will be pumped from the in-heap pond to the carbon adsorption columns. The activated carbon in the columns adsorbs the gold from the PLS. Pregnant solution will continue to flow through the columns until the carbon contained in the lead column achieves the desired precious metal loading of approximately 4,000 grams of gold per tonne of carbon. The carbon will then be pumped to either of two elution columns or to the acid wash vessel. Carbon will then be sequentially moved up the adsorption train counter-currently to the solution flow from Column 5 to Column 1. Stripped and regenerated carbon will then be pumped into Column 5. The maximum time off-line per column for carbon transfer operations will be 30 minutes to 1 hour per day. Carbon transfer will be achieved using recessed impeller pumps.

Barren solutions from the last carbon columns will be continuously sampled by wire samplers for metallurgical accounting then discharged to the carbon safety screens to recover floating fugitive carbon. The discharge from the screens will flow by gravity to transfer tanks from which it will be pumped to the barren solution tank. Any fugitive carbon will be collected and recovered into tote bins.

Desorption and Recovery

The gold will be stripped (desorbed) from the loaded carbon and deposited onto stainless steel wool cathodes using a modified Zadra pressure strip procedure.

A complete strip (desorption) cycle, including carbon transfers and strip solution preparation, will take 14 to 18 hours. After a batch of loaded carbon is transferred to an elution column from the adsorption circuit, caustic-cyanide strip solution will be pumped through the heat recovery heat exchangers and 350 HP (14.3 MMBtu/hr) Cleaver Brooks solution heater, then introduced to the elution column at a temperature of 135°C and a pressure of approximately 450 kPa. As the strip solution rises through the bed of loaded carbon in the strip vessel, the precious metals will be desorbed from the carbon. The gold-laden strip solution will exit the column, flow through the cooling side of the heat recovery heat exchanger (to pre-heat the incoming solution), then through a cooling heat exchanger where raw water is used to further cool the strip solution. Cooled to approximately 85°C, the solution will flow through an electrowinning cell, where the gold will be deposited onto stainless steel wool cathodes.

The barren strip solution will be pumped from the electrowinning cell discharge tank to the strip solution storage tank. Solution will be continually recycled until stripping of the carbon is completed.

Two or three times a week, the gold precipitates in the electrowinning cells will be washed in-situ using high pressure water sprays, then filtered in a filter press. The filter cake, consisting typically of 80% gold and 20% silver, will be dried and smelted periodically as described under ‘Refining’ below.

After stripping, the carbon will be transferred via recessed impeller pumps to either the acid wash circuit or to the carbon regeneration kiln dewatering screen.

Acid Wash

Stripped carbon will be pumped to the acid wash vessel. Fresh water will be re-circulated through the bed of carbon to remove any entrained cyanide. The rinse water will be drained to the strip solution storage tank. Concentrated hydrochloric acid will then be pumped from 200 L drums or 1 m^3 totes into the acid mix tank to achieve and maintain a pH ranging from 1 to 2. The acid wash solution at nominally 2% HCl by weight will be circulated up-flow through the acid wash vessel. This process will remove scale and other inorganic contaminants that inhibit gold adsorption onto carbon. All gases generated in the acid wash process will be extracted by vent fan, processed through a gas scrubber and then vented out of the building.

After acid washing is complete, the spent acid wash solution will be pumped to one of the barren solution transfer tanks. The carbon will then be washed with process solution to remove any residual chlorides. The total time required for a 3 t batch of carbon to be acid washed is typically 4 to 6 hours. Washed carbon will then be pumped to either of two carbon column trains, or to the carbon regeneration circuit.

Carbon Regeneration

Following acid washing (or carbon stripping, depending on operator preference), the carbon will be transferred via a recessed impeller pump to the dewatering screen, where it will be dewatered and discharged to the kiln feed hopper. If the carbon is not scheduled to be reactivated, it will be pumped to one of the "tail" adsorption columns, Column 5.

The carbon to be regenerated will be fed at a controlled rate by a screw feeder into the kiln and then thermally reactivated at approximately 750°C. The hot carbon will discharge into a "quench" tank which will be partially filled with solution. The quench will increase the reactivity of the carbon, thus additionally enhancing the gold adsorption capabilities. Quenched carbon will be pumped to the dewatering screen to remove any fine carbon (less than 24 mesh) generated in the regeneration process.

On average, approximately one in three carbon batches will be thermally reactivated. The carbon regeneration circuit will have the capability to process between one half and one third of the carbon stripped to satisfy the peak periods of gold production.

Refining

Smelting will take place up to three times per week. The electrowinning cathodes and fluxes will be added to the crucible and the furnace will be brought up to temperature. The fluxes will be a combination of borax, fluorspar, soda ash, and niter. Fluxes are reagents that are used to improve the smelting process, leading to a higher grade gold product.

Slag will be poured off into slag molds. A jaw crusher will be provided to reduce the slag. The slag will be examined for gold prills and recycled to the next smelt if prills are present. Otherwise, slag will be transported to the heap where it will contribute any contained precious metal values to the leach system.

Molten gold doré will be poured into ingot molds of 20 kg size. The doré produced will be sampled, cleaned, weighed and prepared for shipment.

A fume hood will collect the furnace fumes which will pass through a baghouse to remove particulates, then through an induced draft fan. The system will be designed to remove over 99.5% of the particulates present in the exhaust fumes.

Reagent Addition

Sodium cyanide will be delivered to the site in sealed bulk bags (Supersacks, contained within plywood boxes) that each contain approximately 1,000 kg of sodium cyanide in solid briquette form. Supersacks of sodium cyanide will be unloaded into and dissolved in the agitated cyanide mix tank with barren solution to make a 20% cyanide solution. Completed batches of cyanide solution will be transferred to the cyanide storage tank. Controlled quantities of cyanide solution will be added to the barren solution tank via metering pumps to control the cyanide concentration in leach solutions to approximately 180 to 250 ppm.

Cyanide solution will also be metered to the strip solution tank prior to a strip cycle to make-up the 0.1% cyanide strip solution. Sodium cyanide usage is estimated to be up to 8.8 tonnes per day.

Sodium hydroxide (caustic) solution will be pumped into the strip solution tank as needed to maintain appropriate operating conditions. The concentration of sodium hydroxide typically contained in the strip solution will be 1 to 2%. Caustic consumption is estimated at 70 kg/day.

Antiscalant solution will be delivered to site in 200 L plastic barrels or 1 m^3 carboys, from which it will be metered into the barren solution pumps, pregnant solution pumps and strip solution pump via metering pumps.

Cyanide Detoxification Plant

The HLF water balance indicates that there will not be any significant release of treated process water during the production period for average, dry, and wet meteorological conditions. See the operational water management discussion in Section 5.5.4 and the Water Management Plan (Appendix 18) for further information. Details on the functionality of the Cyanide Detoxification Plant can be found in Section 5.4.1.7.

Events Ponds Usage

Under normal operating conditions, solution will flow directly from the in-heap pond to the process plant. When there is a high rainfall or high precipitation event, or when the plant cannot accept solution, the flow can be directed from the heap to the events ponds. The events ponds will have an operating capacity of approximately 175,000 m^3, with a maximum capacity of 229,000 m^3.

At the start of the winter season and until the start of the snowmelt every year, the events ponds will be empty, thereby ensuring that the full solution storage capacity of the system is available during the winter and in advance of the annual snowmelt.

Expected use of the Events Ponds throughout the life of the Project is detailed in the Water Management Plan (Appendix 18).

5.5.2 Mine Site Support Infrastructure

5.5.2.1 Access Road

Details regarding access to the mine site were presented in Section 5.4.2.1.

Traffic Volume

The Project will operate year round and require year round access. Road use data is not available for the SMR or HCR to determine the exact increase of traffic volume. However, there are currently relatively few land users that use the HCR. Traffic data is collected by HPW via an electronic counting device located at Km 0 of the Silver Trail Highway, just east of the Silver Trail – Klondike Highway Junction towards Mayo. There is also a pneumatic counting device located at Km 63.4 of the Silver Trail at the Minto Bridge, north of Mayo towards Keno City. Average daily traffic from 1997 to 2008 at km 0 of the Silver Trail Highway has ranged from 71 vehicles in 1997 to 262 in 2006. Average daily traffic for the same period from Km 63.4 of the Silver Trail Highway ranges from 90 vehicles in 2007 to 147 in 1995. Daily averages compiled only for the summer season (May 1 to

September 30) show that the greatest highway use occurs at this time of year. It is assumed that use of the SMR and HCR is currently considerably less than that of the Silver Trail.

Estimated traffic volume during operations:

- Crew shift changes are expected to occur approximately every two weeks. Personnel will travel from Mayo to the mine site by bus. This will involve approximately 100 – 120 round trips per year.
- Total truck loads are estimated at 1,944 trucks per year (round trips). As with the estimates for the construction phase, these numbers do not account for potential seasonal load limits, which would determine potential truck size and load types.

Note that the above estimates do not include traffic for exploration programs, placer mining operations, or public/tourism uses. However, information available from HPW on current and historical traffic volumes for the Silver Trail, the SMR, and the HCR have been included in the effects assessment in the Project Proposal in terms of road use. In addition, volume of traffic will vary throughout the year, with higher volumes expected during peak construction times and after freshet/prior to freeze up.

Access Road Maintenance

The Project will operate year round and therefore the SMR and HCR will be maintained (snow clearing) to provide access year round. This will result in winter access on the SMR and HCR which is not currently possible via wheeled vehicles.

Road maintenance is essential to ensure user safety, preserve the existing condition of the road, and ensure convenient and efficient travel to the Project site. Maintenance of the SMR up to the South McQuesten Bridge will continue to be conducted by HPW and is not included in the scope of this Project Proposal. Regular maintenance of the HCR will be performed by VIT throughout all phases of the Project and is included in the scope of this Project Proposal. VIT will coordinate with HPW to develop and undertake a maintenance plan for all sections of the road to meet Project needs for year-round operations.

5.5.2.2 Power

Power will be distributed at 13.2 kV via two sets of overhead lines (Figure 5.4-26). The first set of overhead lines will provide power to primary crushing, secondary crushing, conveying, and HPGR. The second set of overhead lines will provide power to the ADR facility and heap leach operation. Each area will require an electrical room housing high voltage and low voltage equipment including indoor 13.2 – 4.16 kV and 13.2 – 575 V step-down unit substations.

The following voltages will be established in the plant:

- **13.2kV**—Plant distribution voltage to feed major groups of loads
- **4,160 V**—Motors 190 kW (250 hp) and higher
- **575 V**—To feed motors rated less than 190 kW (250 hp) and other plant auxiliary loads

- **120/208 V**—Lighting, heating and motor load up to 0.55 kW (0.75 hp).

All plant transformers will be the dry-type, and will be located indoors. Analog instrumentation signals will be 4 – 20 mA DC. Control signals, status signals and interlocks will be 110V AC, 60 Hz.

Emergency Power

In the event of a power failure, three emergency diesel generation sets will be available for use. The emergency generator sets will be fuelled from a 2-week capacity fuel tank located adjacent to the emergency generators, which can be refuelled from the site fuel storage tank as required, resulting in sufficient fuel for long term emergency power supply. Each unit will be rated at 1,500 kW, 575 V with a 575 V/13.2 kV transformer and will supply power to the following items:

- Barren solution pumps
- Pregnant solution pumps
- Carbon stripping circuit
- Camp and buildings
- Fire water and fresh water distribution systems
- Fire and other alarm systems
- Security systems.

5.5.2.3 Truck Shop Operation

Mine equipment maintenance will be conducted in the truck shop facility. The truck shop facility will have bulk storage capacity for fuel, oils, and lubricants that are required for the operation of mobile equipment fleet. Fuel will be stored and handled as per the description outlined in Section 5.4.2.6. Oils and lubricants will be stored in supplier provided bulk storage containers. Spent oil and lubricant will be transferred to a 10,000 L steel tank located adjacent to the ADR plant. It is anticipated that this oil, collected from the mine equipment, will be burned along with diesel fuel in the solution heating boiler in the process plant.

5.5.2.4 Operating Fuel and Explosives Facilities

Storage facility details for fuel and explosives were provided in Section 5.4.2.6. This section provides further details specific to the operations phase.

Fuel Loading and Storage

Diesel fuel is delivered to site by wheeled vehicles along the main access road. Delivery to site will be by 40,000 kg full loads for ten months of the year and 20,000 kg half loads for two months of the year to cover the spring breakup period.

The following table lists the total fuel volume and number of fuel truck trips that are expected in each year of operation.

Table 5.5-5: Fuel Consumption and Delivery Schedule

	2013	2014	2015	2016	2017	2018	2019	2020
Diesel Fuel (‘000 litres)	6,400	8,500	10,100	9,400	10,000	9,100	6,600	6,400
Fuel Delivery (trips)	170	220	260	250	260	240	170	170

Explosives Consumption and Delivery

The following table presents the expected annual requirements for explosives. See Section 5.4.2.6 for further information regarding explosives storage and use.

Table 5.5-6: Explosives Consumption and Delivery Schedule

	2013	2014	2015	2016	2017	2018	2019	2020
Explosives (tonnes)	2,300	3,600	5,200	4,200	5,000	4,200	3,100	2,800
Deliveries (trips)	90	140	200	160	190	160	120	110

5.5.3 Waste Management

The operations phases will extend over 7.3 years during 2013 – 2020. The number of personnel in camp during this time is anticipated to average 200 personnel on site per shift.

For the **operations** phase, the following assumptions were made:

- **Solid Waste:** 200 personnel on site at one time, with a waste generation rate of 1.3 kg person/day
- **Construction and Maintenance Waste:** maintenance activities including replacement of heating/ventilation/air conditioning equipment at a rate of 5%/year (assuming 12 buildings with units and two units/building) and general building maintenance (1kg/person/year)
- **Lubricants:** 62 pieces of equipment, a total of 205,000 operating hours/year for 7.3 years. Oil, anti-freeze/glycol and hydraulic fluids will be changed at the intervals described in section 5.4.3
- **Sewage:** 60 gallons/person per day, from which 3.1 m^3/month of sewage sludge would be generated
- **Special/Hazardous Waste:** wastes as described above
- **Brush:** 433 ha to be cleared, 97% of clearing to be carried out during the construction phase/3% during the operations phase.

Waste generated during the operations phase will be handled and disposed of as per the construction phase (see Table 5.4-3). Quantities of waste anticipated for the operations phase can be found in Appendix 30, Section 15 – Waste Management Plan.

5.5.4 Water Management

The Water Management Plan (Appendix 18) describes the sequence of mine operations and water routing activities during this phase of the Project. Results of the Surface Water Balance Model Report (Appendix 21) for the operational phase quantify the routing of water at the Project site.

5.5.4.1 Mine Water Treatment Plant and Sludge Management

The MWTP will treat the combined net water discharge from the Open Pit and WRSAs. MWTP capacity during the operations phase will be 310 m^3/hr. The MWTP will operate 150 days per year, with projected feed rates of 4 – 104 m^3/hr under average climatic conditions. During this phase, the MWTP will produce 0 – 8 tons of dry solids per year of ferric sludge, and 2 – 188 tons of dry solids per year of caustic sludge.

Sludge produced by the MWTP during operations phase will be placed on freeze consolidation pads adjacent to the MWTP. Caustic and ferric sludges will be managed separately to prevent release of precipitating contaminants. Each pad will be comprised of two cells, with one cell being filled while solids in the second cell are left to freeze consolidate. Sludge discharge will alternate between cells annually, and be moved to the sludge storage pads when consolidation is complete. The storage pads are sized to store all sludge produced during Years 1 – 12.

Further details on the MWTP design and sludge management can be found in Appendix 20 – Mine Water Treatment Plant Technical Memo.

5.5.5 Workforce Requirements

During operations, the majority of Project personnel are scheduled to work 12-hour shifts on a rotation of two weeks on and two weeks off. Four work crews are required for 24-hours per day, year-round coverage. Mine services employees will work a weekly rotation of ten hour days, four days on, three days off, for a 40-hour work week. General and administrative employees will work a weekly rotation of 10 hour days, four days on, three days off, for a 40-hour work week.

Table 5.5-7: Operations Phase Workforce Estimate

Department	2013	2014	2015	2016	2017	2018	2019	2020
Mine	169	186	206	204	207	196	169	176
Process	106	113	113	113	113	113	113	113
General and Administrative	64	64	64	64	64	64	64	64
Total Manpower	**339**	**363**	**383**	**381**	**384**	**373**	**339**	**353**

5.5.6 Energy Requirements

The average seasonal forecast operating loads for the operations are estimated to be 11 MW, supplied by grid power. Estimated power loads and consumption are outlined in the table below.

Table 5.5-8: Estimated Electrical Loading and Power Consumption

Description	Estimated Connected Load (kW)	Estimated Operating Load (kW max)	Estimated Power Consumption (MWh/y)
Crushing, Conveying and Stacking	12,265	7,673	66,293
Leaching	1,805	1,626	14,049
ADR, Refinery and Reagents	640	393	3,395
Laboratory	90	49	420
Support Services	346	176	1,523
Water Distribution	74	45	392
Detoxification	104	73	0
Mine and Infrastructure	1,500	1,000	8,760
Total	**15,324**	**11,035**	**94,832**

In the event of a power failure, three emergency diesel generation sets will supply power as outlined in Section 5.5.2.2.

5.6 Closure and Reclamation Phase

Engaging the local community, First Nation, stakeholders, and relevant regulatory agencies is critical in developing agreed upon closure objectives and responsibilities for the closure planning process. In addition to a review of applicable guidelines and Yukon policy, work to date to develop the Conceptual Closure and Reclamation Plan (CCRP) has included consultation with the First Nation of Na-Cho Nyäk Dun (FNNND) and the community of Mayo on key closure and reclamation objectives, strategies and CCRP elements.

Consultation has occurred concurrently with the development of the Project Proposal and the CCRP. Closure and reclamation information was presented and discussed at Project open houses, and community meetings. A specially focused Conceptual Closure and Reclamation Plan workshop and open house was held with the FNNND and community members of Mayo on November 4, 2010. Feedback from these meetings and open houses has been incorporated into this CCRP.

A detailed and comprehensive CCRP, required for license applications under the QMA and the WA will be developed to reflect YESAB assessment recommendations and government Decision Documents, specific regulatory and license requirements and feedback received through agency and stakeholder consultations.

The following sections summarize the Conceptual Closure and Reclamation Plan. Further details with respect to closure and reclamation may be found in the Conceptual Closure and Reclamation Plan (Appendix 24).

The CCRP as outlined is subject to refinement on the basis of ongoing test work, advances in technology, and reclamation research scheduled to commence with site operations. Reclamation test plots and reclamation trials will likely commence early in the operations phase.

5.6.1 Reclamation Strategy and Objectives

VIT's overall strategy for the CCRP is to provide for an eventual "walk-away" closure condition with mine features decommissioned and reclaimed, and monitoring conducted until it is demonstrated that mitigation measures have achieved the required outcomes. The main focus of the reclamation program is to foster the return of the site to appropriate and functional ecosystems, similar to pre-development, and meet the key end-land use objective of wildlife and vegetation resources.

Closure and reclamation has been considered from the early planning and design stages of the Project. CCRP objectives have been developed to address the following main issues:

- Geochemical stability
- Water quality
- Physical stability (stable land forms)
- Land use, aesthetics and public health and safety.

Key objectives of the CCRP include:

- Prevent, minimize or mitigate adverse environmental impacts during closure and reclamation
- Reflect and address FNNND and stakeholder priorities and concerns
- Protect aquatic resources and prevent invasive plant establishment
- Reclaim land to the point that is can become, over time, comparable both visually and in land use to the undisturbed surrounding land
- Re-establish a productive land use that is of value for wildlife and mitigates the residual effects of mining on wildlife habitat, at-risk plant communities and the habitat of species at risk
- Ensure long term physical stability of the mine facilities (HLF and waste rock storage areas)
- Protect site water quality during and after closure
- Ensure that the site poses minimal risk to the public and native fauna
- Demonstrate that future risks and liabilities associated with the post-closure site have been eliminated or controlled to an acceptable level.

5.6.2 Reclamation Schedule

The reclamation phase of the Project is conservatively assumed to occur over a 10-year period from January of 2021 to December of 2030. The 10-year length of time is more a product of the required time to close the HLF. Most of the other facilities are less constrained and will be closed and reclaimed in a shorter time period.

During this time, the closure of the HLF will have three successive periods:

- The supplemental gold recovery period (first year after operations)
- The rinse period (Years 2 and 3 following operations)
- The drain down period (beginning after the rinse period), followed by post-closure monitoring.

The overall Project design objective is a “walk-away” closure condition, with limited post-closure water quality monitoring until it is demonstrated that remediation measures have achieved the required outcomes.

During the closure and reclamation phase, all facilities will be decommissioned with the exception of some of the drainage ditches and portions of the DGDC. Progressive reclamation will begin during operations to promote slope stabilization and reduce erosion during the life of the mine. Disturbed slopes will be stabilized and revegetated. Equipment and infrastructure will gradually be removed upon closure. Effluent monitoring, bio-monitoring and geotechnical assessment will occur annually for a minimum of 15 years to ensure that revegetation is successful, slopes are stable, and heap chemistry is assured.

Table 5.6-1: Reclamation Schedule

Facility/Structure/Feature	Closure Conditions/Process	Begin Date	End Date
EP WRSA			
WRSA cover	Recontour and cap as per WQ determined criteria	2021	2022
EP Sediment Control Pond	Maintain until meeting WQ criteria can be sustained for five years	2022	2027
PG WRSA			
WRSA cover	Recontour and cap as per WQ determined criteria	2016	2017
PG Sediment Control Pond	Maintain until water is not required for make-up and meeting WQ criteria can be sustained for five years	2021	2027
PG to open pit drainage ditch	Maintain until water is not required for make-up and meeting WQ criteria can be sustained for five years	2021	2027
Open Pit			
Open Pit Sump	Open pit will be backfilled as geochemical conditions allow, small Pit Lake will form (2.5 ha) and drain to Platinum Gulch	2022	2022
Crusher Pad	Will be reclaimed when mining stops	2022	2022
Perimeter Wells	Will be abandoned or destroyed as mine open pit expands	2022	2022
Horizontal Drains	Will remain in place	NA	NA
Groundwater Wells	Will be abandoned when crushing has stopped	2022	2022

Facility/Structure/Feature	Closure Conditions/Process	Begin Date	End Date
HLF			
HLF	Post-mining leaching of ore	2021	2021
	Rinsing/detoxification/recycle/discharge	2022	2024
	Cap heap	2025	2025
	Drain down heap to be treated on an as needed basis	2024	2030
Ann Gulch East Diversion Ditch	Stabilize for long-term – maintain drainage to Dublin Gulch	2022	2022
Ann Gulch East Sediment Control Pond	Maintain SCP until AG EDD stabilized and WQ criteria met	2022	2027
Ann Gulch West Diversion Ditch	Stabilize for long-term, route drainage to Haggart Creek when stabilized and WQ criteria met	2022	2027
Events ponds	Will keep until HLF cover built; afterwards runoff conveyed to the mine water treatment plant (MWTP) Feed Pond or directly to DG SCP – depending on WQ		2030
MWTP Ponds			
MWTF Feed Pond	Will maintain until draindown water meets WQ criteria	2028	2029
MWTF Product Pond	Will maintain until draindown water meets WQ criteria	2028	2029
Dublin Gulch SCP			
DG Sediment Control Pond	Will receive all discharge water until WQ criteria are met		2030
Dublin Gulch Diversion Channel			
Upper Velocity Reduction Pond	Will stabilize for long-term (kept in place)	2022	2022
Upper Channel	Will stabilize for long-term (kept in place)	2022	2022
Energy Dissipator	TBD	2022	2023
Lower Velocity Reduction Pond	Will either stabilize for long-term of be eliminated based on fish enhancement options	2022	2023
Lower Channel	Will be stabilized and enhanced for fish habitat	2022	2023
Camp			
Sewage Treatment Facility	Reclaim at end of post-closure monitoring period		2030
Groundwater Well	Abandon at end of post-closure monitoring period		2035

5.6.3 Reclamation Practices

A number of reclamation practices may be carried out during the life of the Project to promote the return of self-sustaining vegetation communities and specific habitat features to the reclaimed mine site. A summary of the key reclamation activities include:

During Construction:

- The salvage and stockpile of sufficient quantity and quality of soil materials for reclamation.

During Operations:

- Progressive reclamation of the PG WRSA
- Reclamation of disturbed sites to prevent erosion and control sediment from entering watercourses.

At Closure:

- Decommissioning of mine infrastructure and ancillary facilities, removal of structures from site
- Conducting soil, surface water and groundwater assessments to evaluate the potential for contamination, and remediation as required
- Demolition and burial of remaining foundation structures
- Recontouring of surfaces where appropriate to facilitate optimum plant production, appropriate site drainage, and animal access
- Site preparation activities such as scarification and ripping where required to alleviate compaction to allow for better plant root establishment/growth and facilitate water drainage
- Replacing topsoil onto reclamation sites to stimulate plant establishment and long-term sustainable ecosystem function
- The seeding of areas susceptible to surface erosion as soon as possible after placement of soil with a grass-legume erosion control seed mix. In some areas a compromise may be necessary to balance the use of agronomic species required for erosion control and native species required to provide wildlife habitat.
- Seeding and/or planting on exposed soils and disturbed ground as soon as possible to control establishment of invasive plants
- Planting sites (planned as forested areas) to achieve a diversity of native tree and shrub species, focusing replanting programs on a mix of coniferous and broadleaf species, linking species selection to post-closure ecosystem properties
- Planting native coniferous and deciduous plants in dense patches or islands interspersed with open herbaceous cover areas to provide visual breaks for wildlife, and diversity in habitat structure
- Maintaining forested connections to connect habitat patches within the mine footprint with surrounding forest to enable movement and dispersal of animals and plants (where feasible)
- Retaining, when possible, areas of forest, small patches or individual trees in order to provide wildlife populations connections to enable movement.
- Add structural diversity to future stands.
- Providing visual breaks for wildlife along road edges through a combination of topographic features (berms) and dense plantings of conifers and large deciduous shrubs

- Installing rock piles, large logs, stumps and other coarse woody debris in specific reclamation areas to: provide micro-habitats for small mammals and insects, visual breaks for large animals moving across reclaimed sites, wind protection and snow capture to assist in the establishment of vegetation, and potential animal denning sites
- Installing artificial snags to provide wildlife tree habitat for cavity-nesters, and feeding habitat for birds such as woodpeckers and raptor perches.

Revegetation of mine disturbance areas will be based on candidate plant species best suited to re-establish post-closure ecosystems. This will consist of a combination of native grasses, forbs, shrubs, and trees. VIT will utilize *Guidelines for Reclamation/Revegetation in Yukon* (Kennedy 1993) as a guide for selecting appropriate candidate reclamation species to be assessed by seeding/planting trials.

5.6.3.1 Open Pit

At mine closure, the open pit floor area will be allowed to flood with groundwater and runoff; the open pit is expected to flood to the level of the west side of the open pit. The floor area will remain inundated and will be a permanent water feature within the open pit. The remainder of the open pit disturbance area will consist of open pit walls and benches. Total area of disturbance will be 65.4 ha.

After mine closure, the open pit perimeter and upper benches within the overburden layer will be resloped down to the first rock bench and revegetated with suitable candidate vegetation species that will provide erosion and invasive plant control and are appropriate for the predicted post-closure ecosystem. If required, VIT will install fencing and warning signs as a safety precaution to control access to the open pit perimeter and benches.

Prior to initial development of the open pit, the area will be cleared of forest cover and the topsoil will be salvaged and placed in local stockpiles for use in reclamation at other mine disturbance areas.

On closure, the open pit walls will be comprised of exposed metasediment and granodiorite rock. Geochemical characterization of these lithological units to date has indicated that they will be non-potentially acid generating. As such, the pH of the water in contact with the open pit walls (i.e., open pit wall run-off) is anticipated to be near neutral. Neutral pH metal leaching has, however, been identified as a potential issue for these materials. This may include elevated concentrations of elements such as arsenic and antimony in open pit wall run-off. Monitoring and mitigation of metal concentrations in water discharged from the open pit post closure is discussed further in the Water Management Plan (Appendix 18) and Water Quality Model (Appendix 21).

5.6.3.2 Heap Leach Facility

The post-closure HLF would remain as a permanent land feature, resembling a large interfluve (region of higher land between two rivers) with vegetation cover and no restriction of access to the public or local fauna.

To satisfy closure objectives, the facility would be designed to:

- Protect both the surface water and regional groundwater during operations and in the long-term
- Provide a stable facility during extreme precipitation events and design seismic events during operations and after closure.

At closure, the heap leach will be a completed valley HLF constructed by placement of ore on a pad behind a confining embankment. The HLF will comprise approximately 66 Mt of crushed ore over an area of 870,000 m^2. At completion of leaching, the engineered triple composite liner system, the leachate collection and recovery system, and the leak detection and recovery system will remain in an operational state, and be utilized as required during closure and reclamation. The currently proposed closure plan is based on an initial, demonstrated active treatment technology, followed by a passive treatment system to demonstrate the long term chemical stability of the heap prior to full closure of the site.

At this time, the proposed conceptual closure measures for the HLF comprise:

- HLF Detoxification and Rinsing
- HLF Draindown
- HLF Contouring and Soil Cover.

These closure measures are detailed below.

HLF Detoxification and Rinsing

After mining has stopped at the end of 2020, the HLF will continue to operate for supplemental gold recovery during 2021. Solution will be recycled through the HLF to recover any gold resources remaining in the mined ore that was stacked on the leach pad.

The detoxification of the HLF will begin in January of 2022, and continue for a period of approximately two and a half years. This process includes rinsing the HLF with a treated solution and raw water. The objective of rinsing the heap is to reduce cyanide, cyanate, ammonia, nitrate, and dissolved metals that could migrate from the heap after it has been decommissioned. HLF solution is processed through the cyanide detoxification circuit, which removes cyanide by oxidation, cyanate by acid hydrolysis, and ammonia by air stripping. The rinse solution will be recycled through the HLF. Excess solution will be transferred to the MWTP for final treatment. The treated water will be discharged to the MWTP Product pond.

After cyanide, cyanate, and ammonia concentrations have been reduced to sufficiently low levels, the HLF will then be rinsed with raw water, which can either be sourced from ground water or from MWTP product solution. Raw water must be low in cyanide, cyanate, ammonia, and nitrate, and moderately low in dissolved metals. Raw water will rinse serve to rinse out additional cyanide, cyanate, and ammonia, and will also reduce nitrate levels to acceptable levels prior to discharge (see Water Quality Model Technical Data Report [Appendix 25]).

It is anticipated that the HLF can be rinsed such that seepage from the HLF after the rinse stage will contain <0.2 ppm WAD cyanide, <2.0 ppm total cyanide, <1 ppm cyanate, <1 ppm ammonia, and <35 ppm nitrate (as N).

Heap detoxification testwork has been conducted by Kappes, Cassiday and Associates. A summary of this testwork can be found in KCA's *Eagle Gold Project Interim Report of Metallurgical Test Work November 2010* (Appendix 26) and KCA's *Eagle Gold Heap Leach Metallurgy &Neutralization Summary November 2010* (Appendix 27).

HLF Draindown

Following rinsing, the HLF will be re-contoured and capped. The HLF will begin to drain following the raw water additions during the rinsing period. The draindown period will begin in 2024 and is expected to be complete by 2030. About 40 – 50% of the total draindown is expected in the first month. Within the first year, about 88% is expected to drain, while the remaining 10 to 12% is assumed to take another 5 – 6 years to drain. The draindown solution will be processed through the Cyanide Detoxification Plant if required, and then transferred to the MWTP Feed Pond for final treatment.

HLF Contouring and Soil Cover

Following draindown, the top surface of the heap will be capped with a cover system to reduce infiltration of precipitation through the HLF. Recent cover design has favoured a store and release cover system over a traditional compacted cap design due to concerns with freeze/thaw in climate conditions at site. The store and release cover will reduce infiltration into the heap by storing precipitation (similar to a sponge) in the cover material and then releasing the water back to the atmosphere through evapotranspiration of plants. The current design is a cover that limits infiltration to 10% of net precipitation.

The final configuration of the HLF will consist of a large platform area at the top of the facility bounded by slopes to the north and south; total area will be approximately 91 ha. The HLF will continue to operate for several years following completion of mining operations in order to complete the heap detoxification and rinsing process. Final reclamation of the HLF will be conducted once the rinsing process has been completed.

The surface of the HLF will be recontoured to promote the controlled runoff of precipitation, eliminate areas where ponding of water may occur, and to minimize seepage. Approximately three quarters of the surface area will have an average slope gradient of 22° (40%) and the remainder will have an average slope gradient of 4° (7%). The recontoured areas will then be capped with a minimum of 1 m of salvaged soil material. Soil material will be supplied from soil stockpiles. Soil will be hauled by dump trucks to the HLF and spread by dozer. Soils may require scarification before conducting revegetation treatments if the surface becomes compacted due to truck or equipment traffic.

Once the sites have been capped, they will be planted with vegetation that is suitable for the predicted post-closure ecosystems in order to establish a long-term self-sustaining vegetation cover and steward the establishment of productive ecosystems.

On the slope sections of the HLF, it is proposed that candidate tree/shrub species for final reclamation will be planted in distinct patches or islands across the slopes, interspersed between areas of grass/legume/forb cover. The vegetation cover ratio will be approximately 60%

grass/legume/forb cover to 40% tree/shrub cover. This revegetation technique will allow for the establishment of tree/shrub cover on the slopes, which will provide visual breaks and cover for wildlife and diversity in habitat structure, and still provide control of surface erosion by the grass/legume/forb strips. In addition, any benches present on the HLF slopes will be planted to a tree/shrub cover.

If required, slope stabilization measures will be implemented on the sloped sections of the HLF in order to prevent erosion and maintain the soil capping material, and thereby stabilizing the ground material to facilitate vegetation establishment and growth. In conjunction with the candidate reclamation species revegetation, other slope stabilization measures will be undertaken. These will include: installation of erosion control blankets, application of a bonded fibre matrix, installation of bioengineering structures such as wattle fences and modified brush layers, and dense seeding/planting rates.

5.6.3.3 Waste Rock Storage Areas

Progressive reclamation of the PG WRSA will be initiated during the early stages of production, to improve short term stability and reduce surface erosion and sedimentation. The following are preliminary recommendations for progressive reclamation and final closure of the WRSA:

- Maintain sloped grading of bench surfaces to minimize surface water infiltration and erosion of downstream slopes.
- Maintain surface water collection ditches and the sediment control pond to control surface drainage during operations and reclamation.
- The operational slopes, consisting of benches and raises, will be maintained at 2.25H:1V and will not be re-graded at closure. This approach removes the problems associated with the re-grading of long slopes and the corresponding erosion of drainage channels by runoff down long slopes.
- Surface runoff collection ditches and the sediment control pond will remain operational until vegetation on the storage area has reached a self sustaining growth.

WRSAs will be capped with a minimum of 50 cm of salvaged soil material. Soil material will be supplied from soil stockpiles. Soil will be hauled by dump trucks to the WRSA platforms and spread by dozer down the resloped dump face and across the platforms. The resloped 2H:1V WRSA slopes are at a gradient that will allow the dozer to operate effectively to spread overburden. Soil placed on the platform may require scarification before revegetation if the surface becomes compacted due to truck or equipment traffic.

Once the sites have been soil capped they will be revegetated using plants that are suitable for the predicted post-closure ecosystems. As areas of the WRSA become available, progressive final reclamation will be carried out wherever feasible. Interim reclamation treatments such as grass seeding will be carried out during operational mine life in order to provide soil stabilization for erosion control and invasive plant control.

On the WRSA slopes, it is proposed that candidate tree/shrub species for final reclamation be planted on flat benches and slopes less than 51%. Steeper slopes will be seeded with grass. In areas with long and uniform slopes, 20 to 30 m strips of tree/shrub plantings interspersed with grass seeding will control water surface flow velocities.

The Platinum Gulch WRSA reaches its ultimate footprint at the end of Year 3 of mining and becomes available for reclamation. As soon as suitable areas become available at Platinum Gulch, VIT will establish various revegetation trials, testing species suitable for reclamation at the Project footprint.

In some sections of the WRSAs, particularly at the Eagle Pup WRSA, full resloping may not be feasible due to space constraints. For these slopes, stabilization techniques, such as those used during heap contouring and soil cover (Section 5.6.3.2) will be implemented.

5.6.3.4 Mine and Process Plant Facilities

Structures at the Project site will consist of the process offices, lab, shops and warehouse, process plant site and reagent refinery, primary and secondary crusher facilities, laydown area, gatehouse, main sub-station, camp/recreation area, mine water treatment plant and water tanks, and overland conveyors. Approximately 16 ha of disturbance are associated with the plant site and ancillary facilities.

Some of the facilities at the site will be required beyond the duration of the operations phase. A portion of the process plant will be operational for at least several years past mine closure in order to recover residual dissolved metals during the heap detoxification process. However, the plant facilities that are not required for future use will be dismantled, and equipment will be sold for salvage value.

All structures and equipment will be removed in the closure and reclamation phase. The only features that will be permanently retained are key diversion channels and structures required to meet long-term water management objectives. Concrete building/structure foundations will be left in place if the concrete is steel-reinforced, otherwise they will be broken apart. Foundations left in place will be buried. Non-salvageable materials will be buried within the WRSAs and/or disposed of according to the site waste management plan.

Prior to soil replacement, the disturbance sites will be recontoured to original grades and topography and pre-mining drainage patterns will be restored. Salvaged soil material that was windrowed adjacent to the disturbance sites will be spread directly by dozer, pushing from the windrow berms. Soil that was salvaged and stored in designated stockpiles will be hauled by dump trucks and placed at the disturbance sites; the soil will then be spread by dozer. Soil replacement will be to the same depth that was originally salvaged from the disturbance site. One exception will be at the conveyor area; this disturbance site will be capped with a minimum of 1 m of soil material in order to adequately cover soil contaminated by dust deposited from the conveyor system. Placed soil will require scarification prior to revegetation if the surface becomes compacted due to truck or equipment traffic.

Events, Solution, and Sediment Control Ponds

Water management structures will consist of events polishing ponds, sediment ponds and surface water diversion and collection ditches covering approximately 37 ha. These structures will at least remain in place until the reclamation earthwork activities, such as resloping WRSA slopes, have been completed and vegetation has been established to prevent surface erosion.

Once reclamation activities have been completed, ditches will be backfilled to original topography and capped with windrowed topsoil, and original drainages will be re-established. This will allow surface waters to flow along the natural local drainage pathways.

If the SCPs are not required as passive or semi-passive water treatment mitigation areas, the SCP containment berms will be recontoured to pond height so that the pond surface will be free draining and not impound water. The captured sediment will be retained within the containment pond and the berm material will be graded over the surface to assist in dust control and revegetation. Soil replacement of constructed ditches will be to the same depth that was originally salvaged from the disturbance site; the material will be sourced from adjacent windrows or soil stockpiles.

During the operations phase, interim reclamation will be carried out on these disturbance features in order to prevent erosion and invasive plant establishment. If required, slope stabilization techniques will be undertaken during the operations and closure phases to stabilize pond slopes and diversion ditch banks. These would include techniques such as installation of erosion control blankets, application of a bonded fibre matrix, or installation of bioengineering structures such as wattle fences, and modified brush layers.

The DGDC will not be decommissioned and will permanently remain in place. The channel will be revegetated using interim reclamation species mixes (consisting of grasses/legumes) in order stabilize slopes to prevent surface erosion. The structures may be planted with candidate tree/shrub species if the structural integrity is not compromised by root penetration of these deeper rooting species. If required, stabilization techniques such as erosion control blankets, bonded fibre matrix, rip-rap, rock filled gabion baskets, or bioengineering structures will be implemented to stabilize the slopes of this structure.

5.6.4 Mine Support Infrastructure

Infrastructure at the Project site will consist of the access roads, transmission line corridors, fuel storage facilities/tanks and explosives storage sites. Approximately 14 ha of disturbance are associated with these facilities.

5.6.4.1 Roads

Site Roads

Following closure of the HLF and site facilities, the main access road within the Project area, from Haggart Creek (at the confluence with Dublin Gulch) to the process plant site, will be permanently closed and reclaimed. The one exception will be the road that provides access to the Potato Hills as this has been identified as an important area for traditional use. The remaining linear disturbances such as exploration roads, tote roads, trenches and drill sites will be progressively reclaimed during the life of the mine as they become available.

Prior to soil replacement on these road disturbances, the following permanent deactivation activities will be carried out:

- Removal of all culverts, bridges, and approaches
- Scarification of road beds
- Re-establishment of drainages across the former road corridor and stabilization with rock material
- Pullback of road sidecast material and backfilling of cutbanks to re-establish the original ground contours.

Soil replacement for these disturbances will be to the same depth that was originally salvaged from the disturbance site; the material will be sourced from adjacent windrows or soil stockpiles.

Main Access Road

The Haggart Creek Road will be left in place at the end of Project life, as a public unmaintained road.

5.6.4.2 Power and Transmission Line

Ground cover vegetation along the transmission line route will be well established at mine closure and no further seeding will be required. Transmission line removal would not significantly disturb established vegetation. To ensure that the RoW is left in a state that will allow for future land use or natural re-growth of the indigenous vegetation the transmission line decommissioning will be done in accordance with the following procedure:

- The line will be de-energized and grounded in accordance with the safety rules.
- Crossing of transmission lines, roads, and other objects will be secured.
- The conductors will be disconnected from the insulators, winded on conductor reels, and transported to designated storage.
- The structures will be removed from the foundations and disassembled.
- Crossarms, conductor fittings, insulators, pole hardware, and guys will be dismantled, sorted, counted, and packed separately.
- All guy anchors, the structure foundations grounding wires, and grounding rods will be removed from the ground.
- The foundation and anchor holes will be backfilled. In agricultural land, at least 0.3 m of topsoil will be spread on any excavation site.
- All materials will be removed from site. Materials that cannot be salvaged will be transported to an approved landfill site.
- The RoW will be inspected to ensure that the site is cleared of all transmission line materials.

5.6.4.3 HLF Water Treatment

Water treatment facilities will remain intact until the HLF has been detoxified and seepage quality is suitable for direct release to Haggart Creek. The MWTP will receive water from the HLF after the Events Ponds have been closed. The MWTP and ponds will remain intact until the HLF has been detoxified and seepage quality is suitable for release to the lower DG SCP.

The quality of detoxified water from the heap to the MWTP was predicted based on results of a standard humidity cell conducted on a composite ore sample provided by KCA (Appendix 27) and a modified humidity column of spent ore composite sample following cyanidation and detoxification in a metallurgical test column (Appendix 8 – Geochemical Characterization and Water Quality).

During draindown, heap leach solution water quality is expected to have elevated concentrations of arsenic, antimony, aluminum, copper, lead, and selenium, and will need to be treated through the MWTP prior to release to Haggart Creek, in order to maintain water quality objectives within Haggart Creek.

Physical reclamation of the surface of the HLF will include an evaporative transpiration (ET) cover that has been assumed to restrict the amount of rainfall infiltrating the heap to about 10% of net precipitation. Further discussions regarding predicted water quality during the Closure and Reclamation phase are provided in Section 6.5.2.2 of the Project Proposal.

As draindown and rinsing of the HLF progresses, water quality of the heap leach solution will improve and seepage from the HLF may be suitable for treatment through a wetlands system rather than the MWTP. A Technical Memorandum (Appendix 28 – Engineered Wetlands as a Post-closure Water Quality Mitigation Method) was prepared for the Project to describe effectiveness of semi-passive engineered wetland systems for removing metals, metalloids, sulphate and nutrients in many mining situations (e.g., at the Teck Cominco Smelter in Trail, BC, the closed Yankee Girl Mine in BC, the Park City Mine in Utah, Newmont's Golden Giant Mine in Ontario, and many others). These dry surfaced "wetlands" have mainly subsurface flow and are considered proven technology. They involve various series of passive and semi-passive aerobic and anaerobic bioreactor and chemical unit operations in separate basins (cells), depending on the situation, and can operate effectively throughout the coldest of northern winters, regardless of ambient air temperatures. Arsenic and other metals and metalloids can be reduced from the 100s to 1,000s of mg/L range to the 0.001 to 1 mg/L range (100-fold to 1,000 fold decreases), and other metals and metalloids show similar reductions. The semi-passive systems can be modified to become fully passive over time. The need for treatment wetlands and the applicable design features will be assessed based on monitoring of runoff quality during operations, which will enable comparisons of predictions to operating conditions.

Ultimately, the seepage from the decommissioned heap leach facility will be suitable for direct release to Haggart Creek.

5.6.4.4 Fuel and Explosives Facilities

Prior to construction of the fuel and explosives facilities, soils will be salvaged and stockpiled locally in windrows adjacent to the disturbance sites or in designated soil stockpile areas.

All tanks and fuel storage facilities will be emptied of their contents before they are removed from their foundations. Tank residues will be disposed of as outlined in the Waste Management Plan. Contaminated soils will be remediated on site or removed from site for disposal at an approved waste disposal site on an as-required basis. Foundations and confining bunds/walls will be broken down and covered with overburden, pre-mining drainage patterns will be restored and re-enforced as required with rip-rap.

Prior to soil replacement, the disturbance sites will be re-contoured to original grades and topography, and pre-mining drainage patterns will be restored. Salvaged soil material that was windrowed adjacent to the disturbance sites will be spread directly by dozer, pushing from the windrow berms. Soil that was salvaged and stored in designated stockpiles will be hauled by dump trucks and placed at the disturbance sites; the soil will then be spread by dozer. Soil replacement will be to the same depth that was originally salvaged from the disturbance site. Placed soil will require scarification prior to revegetation if the surface becomes compacted due to truck or equipment traffic.

5.6.5 Water Management

The objective of the Water Management Plan for the closure and reclamation phase will be to safely convey and/or store as necessary, all freshet and rainfall runoff through the Project site, while maintaining water quality at background levels or meet Canadian Council of Ministers of the Environment (CCME) standards (if applicable) in receiving water bodies. This objective includes minimizing total suspended sediment levels and treating contact water to achieve water quality standards*.* Furthermore, during the reclamation phase, most of the water-related mine facilities will be gradually decommissioned and reclaimed.

From a water management perspective, the reclamation phase of the Project is assumed to occur over a 10 year period from January of Year 10 to December of Year 19. The 10-year length of time is more a product of the required time to close the HLF, whereas most of the other facilities are less constrained and are scheduled to be closed and reclaimed in a shorter time period. During this time, the closure of the HLF will have three successive periods:

1. Supplemental gold recovery period (Year 1 following operations)
2. Rinse period (Years 2 and 3 and half of Year 4 following operations)
3. Drain down period (beginning after the rinse period), followed by post-closure monitoring.

The overall Project design objective is a “walk-away” closure condition, with post-closure water quality monitoring at specific locations until it is demonstrated remediation measures have achieved the required out-comes.

As reclamation progresses, the routing of water among the various Project facilities will change, and the amount of water to manage will become increasingly less as long-term water routing is implemented.

The Water Management Plan (Appendix 18) describes the sequence of water routing activities during this phase of the Project. Results of the Surface Water Balance Model Report (Appendix 21) for the operational phase quantify the routing of water at the Project site.

5.6.5.1 Mine Water Treatment Plant and Sludge Management

Before closure, the MWTP capacity will be upgraded to 620 m^3/hr. Projected feed rates are 29 – 510 m^3/hr under average climatic conditions. Sludge production will increase significantly during closure. Ferric sludge production during closure is projected to be 8 – 198 tons of dry solids per year, and caustic sludge production 77 – 3,870 tons of dry solids per year. Significant peaks in sludge production will occur during draindown.

Sludge will continue to be managed in the freeze consolidation cells through to Year 12. During draindown in Years 13 – 16, mechanical dewatering of the high volume solids will take place. During Years 13 – 14, after commencement of the heap closure capping, the caustic sludge will be transferred from the storage pad to the heap, for permanent disposal. The actively dewatered caustic sludge produced during draindown will be incorporated directly into the heap. Freeze consolidation will resume in Years 17 – 23, and the consolidated caustic sludge will be transferred to the heap closure cap for final disposal.

During closure, the ferric sludge will be transported from the storage pad to a permanent lined disposal cell excavated into the existing hillside. The sludge will be encapsulated in an 80 mil HDPE liner, and covered with 200 mm of rock fill and 400 mm growth media. The cell will be underlain with 200 mm of drainage material.

Further details on the MWTP design and sludge management can be found in Appendix 20 – Mine Water Treatment Plant Technical Memo.

5.6.6 Workforce Requirements

The reclamation and closure workforce will be a combination of VIT employees and construction contractor skilled and unskilled labour. Exact closure workforce requirements have not been determined, however staff requirements during reclamation are likely to initially be around 200, which will decrease over time as reclamation objectives are met and site moves to a monitoring stage.

5.6.7 Energy Requirements

During the initial Reclamation phase, while there remains considerable active management of water on the site to support gold extraction and recovery, energy requirements are likely to be on the order of 1.0 MW as high flowrate pumps are required during this period. Once gold extraction ceases completely and permanent closure water management plans are implemented, energy requirements will decrease and are not expected to be higher than 250 kW after HLF draindown and rinsing is complete.

5.6.8 Waste Management

The closure and reclamation phase will extend over 10 years during 2021 – 2030. The number of personnel in camp during this phase will drop from a maximum of 200 to an assumed minimum of 50.

For the **closure and reclamation** phase, the following assumptions were made:

- **Solid Waste:** an average of 125 personnel, with a waste generation rate of 1.3 kg/person/day

- **Demolition Waste:** 90% of modular buildings taken offsite, 10% decommissioned due to wear and tear, all fold-away steel structures removed from site for reuse
- **Lubricants:** twice the construction quantity
- **Hazardous/specified waste:** twice the construction quantity
- **Brush:** none.

The post-closure monitoring phase will extend from 2030 – 2035. No facilities will remain on site during this phase and no activities are anticipated other than monitoring. While the number of individuals on site has not been estimated, it will be substantially below the number at the end of reclamation, and their presence intermittent and limited to that required to collecting monitoring data. Any wastes generated by monitoring personnel will be minimal and will be removed off-site for disposal at the landfill. These wastes will consist of food items (lunch waste) and task-related activities (packaging, bags, PPE/equipment wrappers, etc.).

5.7 Post-closure Monitoring and Inspection Programs

Please refer to the Conceptual Closure and Reclamation Plan for a list and summary of post-closure monitoring and inspection programs (Appendix 24).

5.8 Alternatives and Chosen Approach

Alternative methods of completing the Project were considered throughout the planning of the Project for engineering, environmental, regulatory and economic reasons. The Project as described in this Project Proposal was considered to be the best technically and economically feasible means of completing the Project in a way that maximizes environmental protection.

5.8.1 Alternatives to the Project

Without construction of a mine at this site, it would not be possible to access the gold resource available in the Project deposit. This Project as proposed outlines a feasible method for extracting, processing, and marketing the gold while considering the effects of the Project on the surrounding environment, the FNNND, and the economic climate in Yukon.

The only alternative to this Project is not to mine the Project deposit. Not developing the deposit would negate any potential economic gains, sacrifice employment and training opportunities, and reduce infrastructure opportunities for residents of surrounding communities and Yukon.

5.8.2 Alternative Means of Carrying Out the Project

During the course of evaluating the Project, eleven areas were evaluated for alternative means of carrying out the Project. These eleven areas were:

- Production Capacity
- Mining Method

- Processing Method
- HLF Site Selection
- Process Solution Storage
- Cyanide Detoxification Method
- HLF Detoxification Technology
- Waste Rock Storage Area Site Selection
- Mine Accommodation Options
- Mine Site Access Road Route Selection
- Power Source Selection
- Transmission Line Route Selection.

The sections below present a brief overview of the alternative and the reasoning that lead to the selection of one alternative over the other.

5.8.2.1 Production Capacity Alternatives

A key design criteria of this Project is the production capacity of the site, in terms of annual ore mining rate. Several capacity alternatives were investigated, with the final selection of the mine production capacity made on the basis of preliminary Project economics and mine life. Capital and operating costs typical of the industry were utilized to evaluate the most economic mine production capacity. It was decided that a 9.1 Mt per annum heap leach option would offer the most attractive return on investment, with the expected value of the resource. A lower production rate was evaluated, but did not offer sufficient return on investment in comparison to the higher production rate.

The financial analysis of the Project at this production rate is described in Section 16 of the PFS (Scott Wilson Mining 2010).

5.8.2.2 Mining Method Alternatives

There are two main options for mining method: open pit or underground. The Eagle Zone mineralization is not of sufficient value to support underground mining, nor is it of a deposit type that is amenable to underground mining. The Project has been proposed as an open pit mine.

5.8.2.3 Processing Method Alternatives

The alternative to the proposed heap leaching process for the Project is milling (grinding) of the ore followed by cyanidation of the ore slurry for gold recovery. Economic, environmental, and operational factors were evaluated to determine the best option for this Project.

The primary considerations which ultimately lead to the selection of the heap leach process are as follows:

- Capital costs for a milling facility are at least double those of a HLF>

- A tailings impoundment area would be required for the milled product. It was considered that it would be both technically difficult and expensive to construct a suitable tailings dam for 66 Mt of milled material on the property, given the current deposit size and grade.
- Power consumption requirements for grinding processes are significantly higher than for heap leaching. A very preliminary estimate indicated that a milling process would require three times more power per tonne of ore than for heap leaching. The low grade nature of the deposit does not support the increased power consumption costs.

The result is a non-economically viable Project as the operating and capital costs of a milling operation are significantly higher than those of a HLF, and the increase in gold recovery that results are not significant enough to offset the increases in production costs.

5.8.2.4 Heap Leach Facility Site Alternatives

The proposed HLF is located approximately 1.2 km north of the Eagle Zone orebody. The majority of the HLF is located in the Ann Gulch catchment, a tributary to Dublin Gulch. The base of the HLF is in the valley floor of Dublin Gulch at an elevation of 840 m and at full height, the HLF extends up Ann Gulch to an elevation of 1,080 m.

Following initial screening of a variety of potential heap leach sites in the wider Dublin Gulch catchment area, six sites were considered for taking forward. The potential site options for the HLF were:

Option 1—Cross valley type HLF within Dublin Gulch (lower valley)

Option 2—Cross valley type HLF within Dublin Gulch (mid valley)

Option 3—Valley type HLF on Potato Hills within Bawn Boy headwaters

Option 4—Side valley type HLF on slopes below the Eagle Zone ore deposit

Option 5—Valley type HLF on granodiorite ridge within Olive Gulch headwaters

Option 6—Side valley type HLF in Ann Gulch headwaters.

The engineering assessment considered the factors that influence the suitability of the facility at each using a qualitative comparison of each site against a set of significant engineering (cost related) criteria. These criteria are drawn from the experience within the mining engineering firm of URS-Scott Wilson concerning the design, construction, and closure of heap leach facilities. The engineering assessment of alternatives established options 3, 5, and 6 as scoring significantly more suitable than 1, 2, and 4. From an engineering and construction perspective of the heap leach facility, Option 3—Potato Hills is the most favourable of the leading group.

A Project wide consideration of the leading options was undertaken in regard to impacts of the HLF site option on:

- Mining operations—particularly haulage and access
- Other infrastructure layouts
- Mineral resources—condemnation requirements

- Environment—notably on surface and ground water, fauna (fisheries), flora, and visual quality, as well as consideration for archaeology, air quality, and sociology.

The results of the Project-wide review of the leading three sites established a clear site location preference in Option 6—Ann Gulch, with similar neutral scores as compared to other sites, but much lower impacts on (costs to) mining and infrastructure. The Project concluded that Option 6 was to be taken forward for pre-feasibility engineering.

Further details on HLF site selection can be found in Section 9 and Appendix F of the PFS document (Scott Wilson Mining 2010).

5.8.2.5 Process Solution Pond Alternatives

The alternative to the proposed in-heap solution storage system is a set of open air pregnant solution ponds. Employing in-heap solution storage avoids water and wildlife management issues related to open solution storage ponds which can be plagued by heat loss, wind exposure, ice cover, and snow removal, and accentuate potential environmental risks from spills and wildlife interactions.

5.8.2.6 Cyanide Detoxification Technology Alternatives

There are a variety of cyanide detoxification methods, including treatment processes that involve the use of copper-catalyzed hydrogen peroxide, sulfur dioxide-air (INCO SO_2-air), iron sulfate, hydrogen peroxide-sulfuric acid (Caro's acid), alkaline chlorination, ion exchange, reverse osmosis. soil attenuation (land application), biological treatments or a combination of these methods.

The proposed method for cyanide detoxification is that of a copper-catalyzed hydrogen peroxide circuit, which removes cyanide by oxidation, cyanate by acid hydrolysis, and ammonia by air stripping. The use of hydrogen peroxide is favoured over many of the alternatives because the process does not add any new reagents to the solution (hydrogen peroxide decomposes to water), does not involve the need for complicated reagents, is a low cost process, is a proven technology and is a straight-forward process.

The method is considered an industry standard for cyanide destruction and has proven to provide an effluent with consistently low levels of cyanide, cyanate, and ammonia.

5.8.2.7 Heap Leach Facility Detoxification and Rinsing Alternatives

The proposed HLF detoxification and rinsing plan includes recycling detoxified heap leach solution in order to remove cyanide, cyanate, and ammonia, followed by rinsing of the heap with raw water to reduce dissolved metals, nutrients, and other compounds.

Recycle and rinse solutions will be processed through the MWTP in order to produce an effluent that can either by recycled back to the HLF for further rinsing, or discharged to Haggart Creek.

This proposed detoxification and rinsing plan was chosen as it is an industry proven method for heap leach detoxification and rinsing. The plan uses the two available water treatment plants (the cyanide detoxification plant and the MWTP) and does not require any additional technology.

Alternatives exist to the proposed detoxification and rinsing plan; for example, the biological treatment method employed by Brewery Creek which involves the use of indigenous bacteria whose growth is enhanced through nutrient addition. These alternatives have proven to be successful in many applications and will continue to be evaluated as the Project progresses through engineering design.

5.8.2.8 Waste Rock Storage Area Alternatives

Four potential sites for the location of WRSAs were identified, including all the main catchments draining the proposed open pit area (i.e., Platinum Gulch, Stuttle Gulch, Eagle Pup and Stewart Gulch).

Based on a comparison of capacity, location, and geology, the preferred locations for waste rock storage are the Platinum Gulch and Eagle Pup catchments. Although Stuttle Gulch is closer to the open pit than Eagle Pup, it would interfere with crushing and conveying infrastructure.

5.8.2.9 Mine Accommodation Alternatives

The alternative to the proposed onsite accommodation camp is the option of housing all employees in the existing communities of Mayo, Keno City, and Elsa and bussing personnel to site each shift was considered as an alternative. Due to the comparatively high number of employees in relation to the size of the local communities and the travel times required from those communities to site, housing all employees within existing local centres would result in the need for extensive construction of housing and related community infrastructure and would result in unacceptable safety risks as personnel commute after regular 12-hour work days.

By providing a camp, and working on a shift rotation basis, workers will be able to live elsewhere in the Yukon, in addition to the local communities. This spreads the economic benefits of the Project, reduces the impact on local communities to a manageable and beneficial level, reduces road traffic volume, and eliminates the boom and bust phenomenon associated with mining towns in the past.

5.8.2.10 Mine Site Access Road Alternatives

Alternative options for the mine site access road are discussed in the 1996 Road Design Report and are summarized here.

The original design for access to the Project (previously known as the Dublin Gulch Project) was completed in 1996 for New Millennium Mining Ltd., and presented two options:

Option 1: South McQuesten Route—utilizing and upgrading the South McQuesten Road for approximately 23 km to the South McQuesten River Bridge, then utilizing and upgrading the Haggart Creek Road for approximately 22 km.

Option 2: Mount Haldane Route—constructing along the old Mt. Haldane Route for 16.9 km to the South McQuesten River Bridge, then utilizing and upgrading the Haggart Creek Road for approximately 22 km to the mine site.

In 1996, Option 2 (Mount Haldane Route) was selected by New Millennium Mining Ltd. because the total distance to the mine site would be shortened. This route consisted of a road starting near

Halfway Lakes on the Silver Trail, traversing the west side of Mt. Haldane, and rejoining the existing access road near the South McQuesten River Bridge. Since 1996, however, this access route has not been utilized is now overgrown and returned to an almost natural state. The Yukon Government has put considerable effort into upgrading and maintaining the section of the South McQuesten Road and South McQuesten Bridge. In addition, the FNNND and residents of the Village of Mayo provided comments that did not favour Option 2 to New Millennium Mining Ltd. during consultation for the Dublin Gulch Project in the late 1990s. For these reasons, there has been no further consideration of Mt. Haldane Route for the Eagle Gold Project.

5.8.2.11 Power Source Alternatives

Two scenarios were considered as power source alternatives during the PFS document (Scott Wilson Mining 2010) as part of a “power-trade-off study”. The first scenario, Option 1, is based on 100% diesel generated power. The second scenario, Option 2, is a combination of diesel generated power and power supplied by the Yukon grid.

Option 1 included the use of five diesel generators each rated at 3 MW. This option includes the use of three generators to provide power for the Project during normal operating conditions and four generators during peak load periods. The power plant will have five generators to allow for maintenance and emergency back-up. The total annual estimated power consumption on site of 71 MWh will require 18.6 million litres of diesel fuel annually.

Option 2 included both diesel generated power as well as transmission line provided power. This option involves construction and the first two years production run solely on diesel generated power on site. During the third year of production the power will be switched over to the Yukon Electric grid power, and the five diesel generators will be used for emergency or back-up power generation. The lag in switching to grid power is an allowance for upgrades to the grid system, required for supplying the Project, to be carried out by the Yukon government. Option 2 includes installation of a new transmission line from the existing transmission line that follows the Silver Trail Highway. Installation of the new transmission line would follow the existing South McQuesten Road and Haggart Creek Road to the mine site.

The power-trade-off study determined that Option 2—Power provided by the Yukon Energy Corporation grid is the economically favourable option because of significant annual cost savings, offset by only moderately higher capital costs. The payoff for switching to grid power is less than one year—transmission line capital costs plus one year of operating costs are less than one year of diesel operating costs. This conclusion, therefore, is independent of when in the life of the mine the switch to grid power occurs.

Given that the economic conclusions favour grid power generation over diesel power generation, VIT has engaged in discussions with Yukon Energy Corporation to determine provision of grid power to the Project. VIT has requested that Project connection to the Yukon Energy Corporation power transmission grid occur at the onset of the operations phase of the Project. Although discussions between VIT and Yukon Energy Corporation are ongoing at this time, it is assumed that grid power will be available by 2013 to supply power during the operations phase of the Project.

5.8.2.12 Transmission Line Alternatives

Further optimization of power supplied by the Yukon Energy Corporation grid was assessed by VIT and the Yukon Energy Corporation through examining alternative (shorter) transmission line alignments, providing an opportunity for reducing capital expenditure and potential environmental effects. Alternatives were considered to the transmission line alignment of the existing SMR and HCR access road to the proposed Project site. Figure 5.8-1 depicts each of the three alignment options considered. The three options considered include:

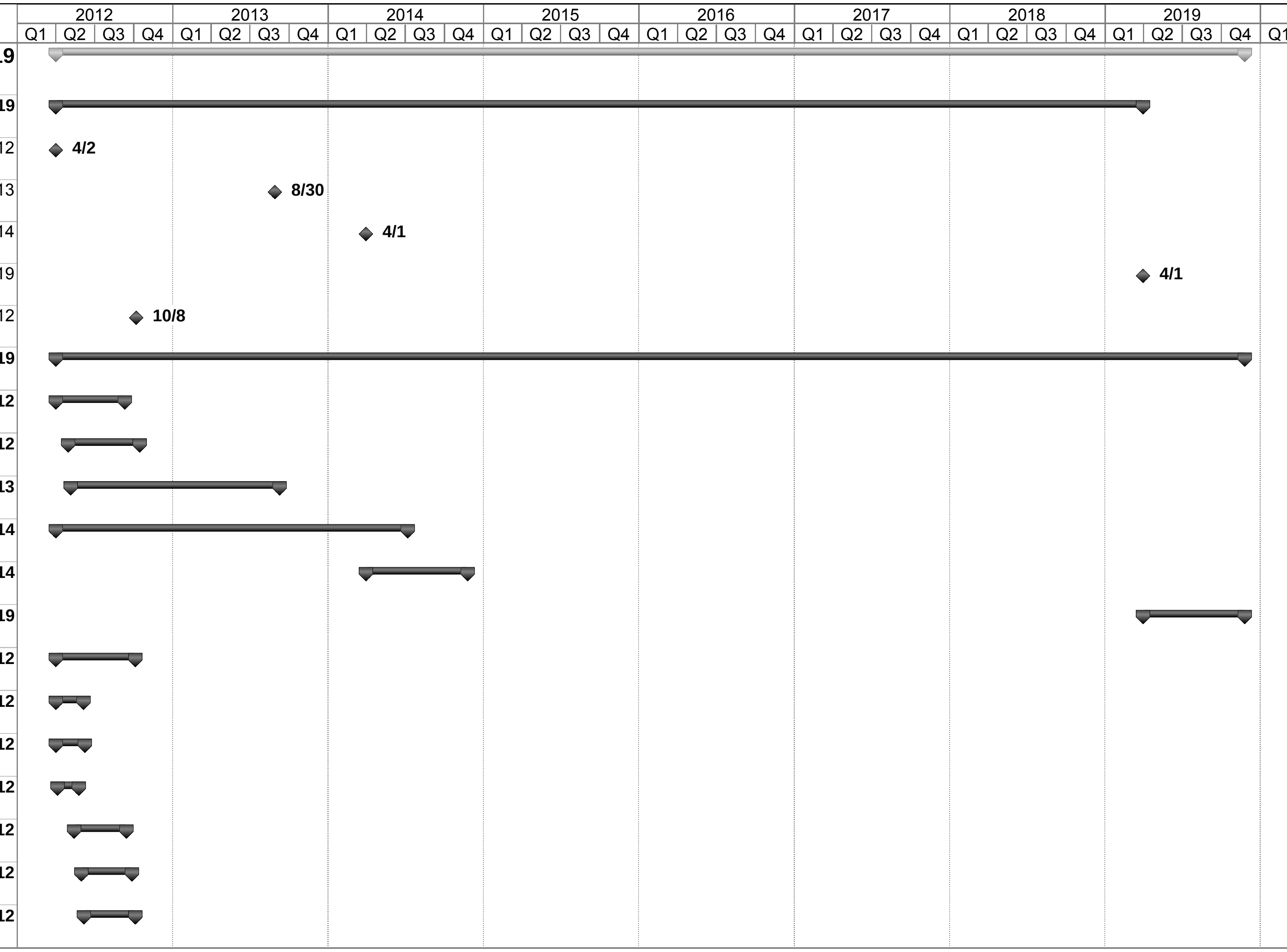
- Existing South McQuesten Road/Haggart Creek Road option—this alignment option follows the existing 45 km South McQuesten Road/Haggart Creek Road to the mine site. Benefits of this alignment option include considerably reduced environmental effects when compared to other options due to the alignment construction along an existing road. However, capital and maintenance costs are marginally higher than other options considered due to the length of the transmission line for this option. This alignment option has been chosen to reduce environmental impacts over the other options. Appendix 19 (Eagle Gold Project Access Road Report) includes conceptual design drawings that depict the proposed alignment for this option.
- Mount Haldane Hiking Trail and South McQuesten Road/Haggart Creek Road option—this alignment option includes use of the existing hiking trail along the southeast flank of Mount Haldane from the Silver Trail to connect to the South McQuesten Road. The route of the transmission line would then follow the existing access road to the mine site. This alignment is approximately 40 km in length, and is approximately 5 km shorter than if the transmission line alignment followed the existing South McQuesten Road from the Silver Trail to the mine site. Although shorter, this route is unfavourable due to increased environmental impacts associated with RoW clearing and maintenance along the Mount Haldane Trail, concerns with effects to trail users, and comments of concern from the FNNND.
- Overland route—this alignment option includes a short section of the South McQuesten Road from the Silver Trail, an overland route across a Class B FNNND settlement land parcel (Lot 1000) Quad 105M/13,and an approximately 10 km section of the Haggart Creek Road to the mine site. This is the shortest of the options. However, this option was not chosen due to environmental effects resulting from disturbance of pristine terrain via construction of the RoW. Additionally, this option presents construction and maintenance access challenges due to terrain and lack of existing access.

5.9 Figures

Please see the following pages.

HEAP LEACH DEVELOPMENT SCHEDULE

ID	Task Name	Duration	Start	Finish
0	**HEAP LEACH DEVELOPMENT SCHEDULE**	**1996 days?**	**April 2, 2012**	**November 25, 2019**
1	**KEY TASKS & MILESTONES**	**1825 days**	**April 2, 2012**	**April 1, 2019**
2	Start Heap Leach Facility Construction	0 days	April 2, 2012	April 2, 2012
3	Deliver Ore to Heap Leach Pad	0 days	August 30, 2013	August 30, 2013
4	Start Stage 2 Construction	0 days	April 1, 2014	April 1, 2014
5	Start Stage 3 Construction	0 days	April 1, 2019	April 1, 2019
6	Connect Upper and Lower Diversion Channel - October 2012	0 days	October 8, 2012	October 8, 2012
7	**HEAP LEACH PAD**	**1996 days?**	**April 2, 2012**	**November 25, 2019**
8	**Rough Earthworks**	**116 days**	**April 2, 2012**	**September 10, 2012**
14	**Cushion Layer Material**	**120 days?**	**May 1, 2012**	**October 15, 2012**
16	**Event Ponds**	**351 days?**	**May 7, 2012**	**September 9, 2013**
25	**Phase 1 - Heap Leach Pad**	**591 days**	**April 2, 2012**	**July 7, 2014**
44	**Phase 2 - Heap Leach Pad**	**171 days**	**April 1, 2014**	**November 25, 2014**
60	**Phase 3 - Heap Leach Pad**	**171 days**	**April 1, 2019**	**November 25, 2019**
76	**Dublin Gulch Water Management Features**	**135 days?**	**April 2, 2012**	**October 5, 2012**
77	**Upper Section Velocity Reduction Pond/Embankment**	**47 days**	**April 2, 2012**	**June 5, 2012**
89	**Upper Dublin Gulch Diversion Channel**	**50 days?**	**April 2, 2012**	**June 8, 2012**
100	**Lower Dublin Gulch Sediment Control Pond**	**36 days**	**April 6, 2012**	**May 25, 2012**
109	**Lower Dublin Gulch Diversion Channel**	**89 days**	**May 15, 2012**	**September 14, 2012**
120	**Lower Velocity Reduction Pond**	**85 days**	**June 1, 2012**	**September 27, 2012**
132	**Energy Dissipation Structure**	**87 days**	**June 7, 2012**	**October 5, 2012**



Project: HEAP LEACH DEVELOPMEN
Date: May 19, 2011

Task | Progress | Summary | External Tasks | Deadline
Split | Milestone | Project Summary | External Milestone

Data Sources; Government of Canada, Victoria Gold Corp.

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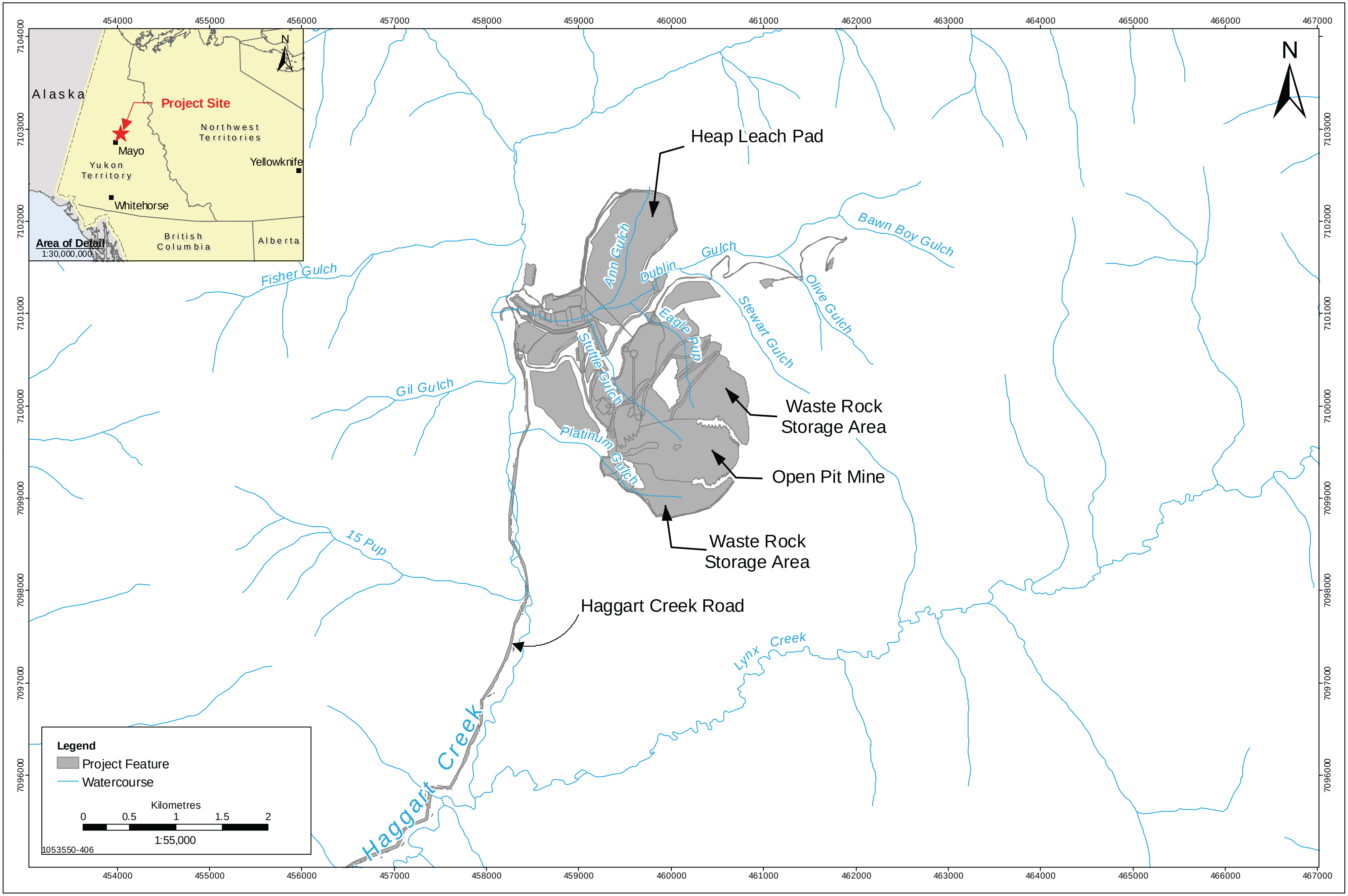
GENERAL LOCATION MAP

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION	DRAWN BY
UTM - ZONE 8	LS
DATUM	CHECKED BY
NAD 83	RS
DATE	FIGURE NO.
8-November-2010	5.1-1



Data Sources: Government of Canada, Victoria Gold Corp.

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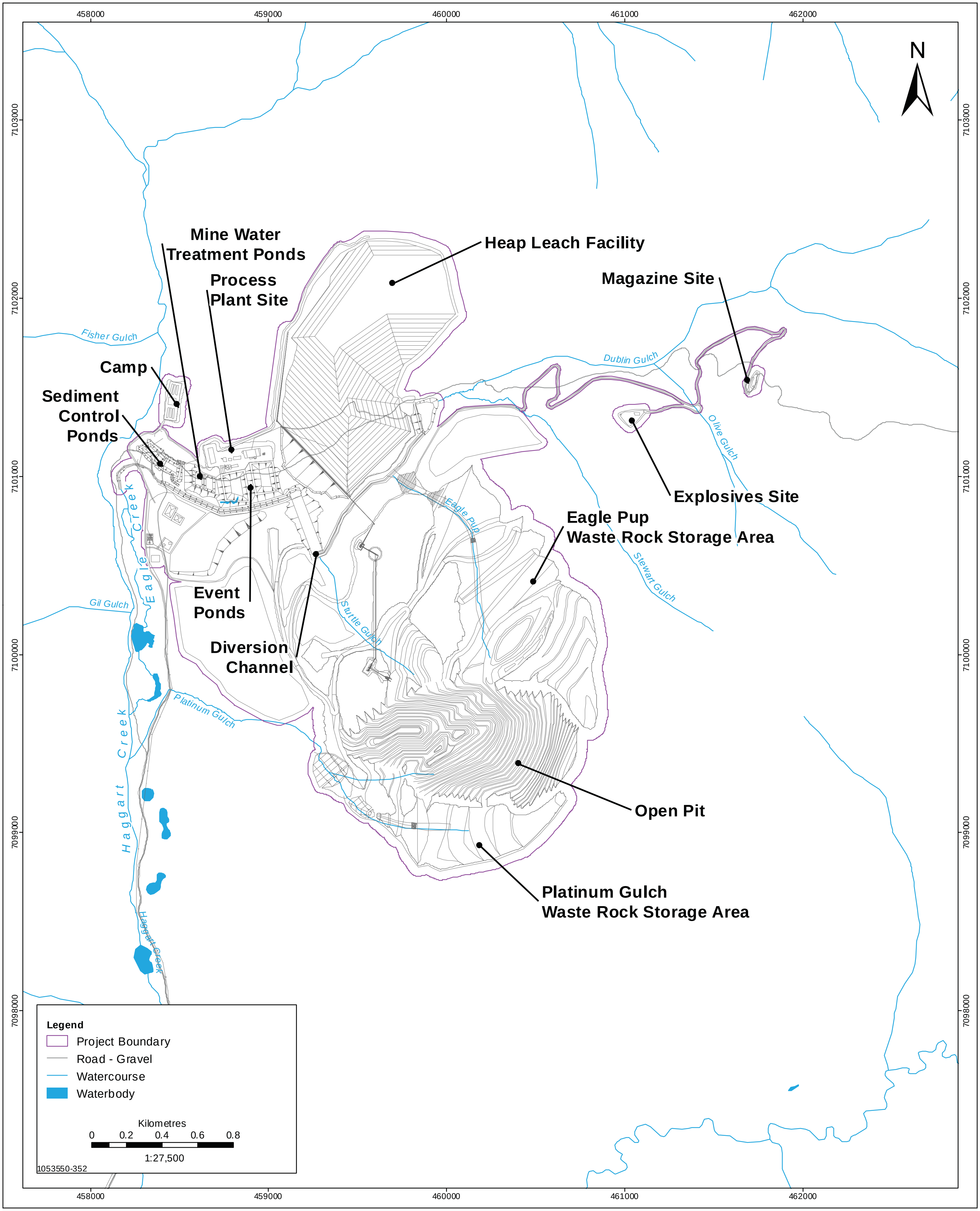
Victoria GOLD CORP

PROJECT AREA OVERVIEW
EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION: UTM - ZONE 8	DRAWN BY: LS
DATUM: NAD 83	CHECKED BY: RS
DATE: 8-November-2010	FIGURE NO. 5.1-2



Data Sources; Government of Canada, Victoria Gold Corp.

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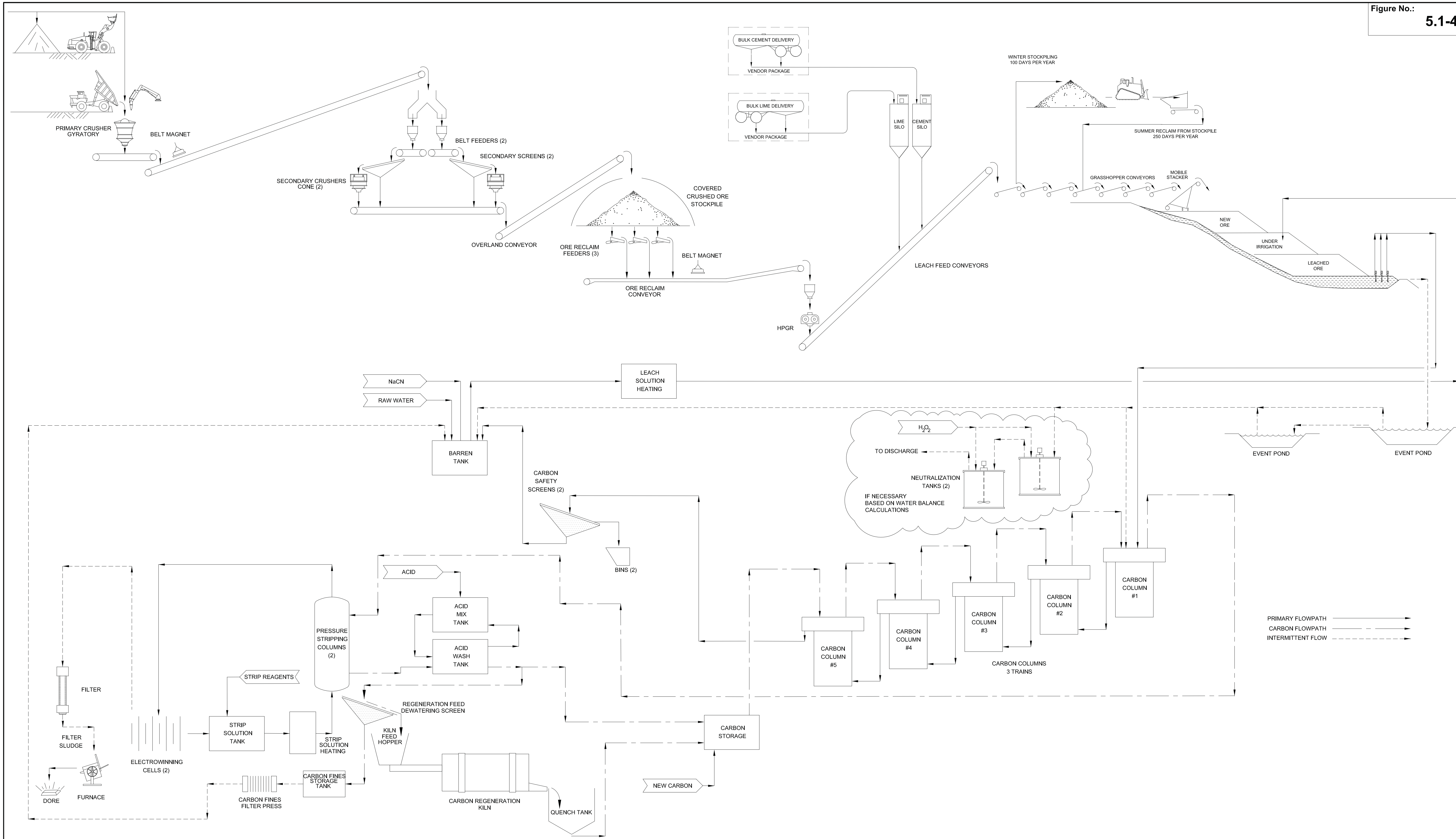
Victoria GOLD CORP

PROJECT FOOTPRINT AND FEATURES

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION: UTM - ZONE 8	DRAWN BY: LS
DATUM: NAD 83	CHECKED BY: RS
DATE: 8-November-2010	FIGURE NO. 5.1-3

Figure No.: **5.1-4**



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REVISIONS

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REVISIONS

NO.	BY	CK'D	APPROVED	DATE	DESCRIPTION
A	TJM	WMR		21 OCT 09	ISSUED FOR REVIEW
B	KCA	WMR		11 JAN 10	ISSUED FOR PRE-FEASIBILITY STUDY
C	KCA	WMR		08 APR 10	UPDATED FOR WINTER STACKING, REISSUED FOR PRE-FEASIBILITY STUDY
D					
E					
F					
G					
H					
I					

Designed by: WMR 18 DEC 09
Drawn by: KCA 08 JAN 10
Checked by: WMR 11 JAN 10
Approved 1: -
Approved 2: -
Client Approval: -

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Project: **EAGLE GOLD PROJECT**

Title: SIMPLIFIED OVERALL FLOWSHEET
3 STAGE

Job No.	Scale	ACAD Filename:	
366G	N.T.S.	0110-11-501-C.DWG	
8166		0110-11-501	REV C

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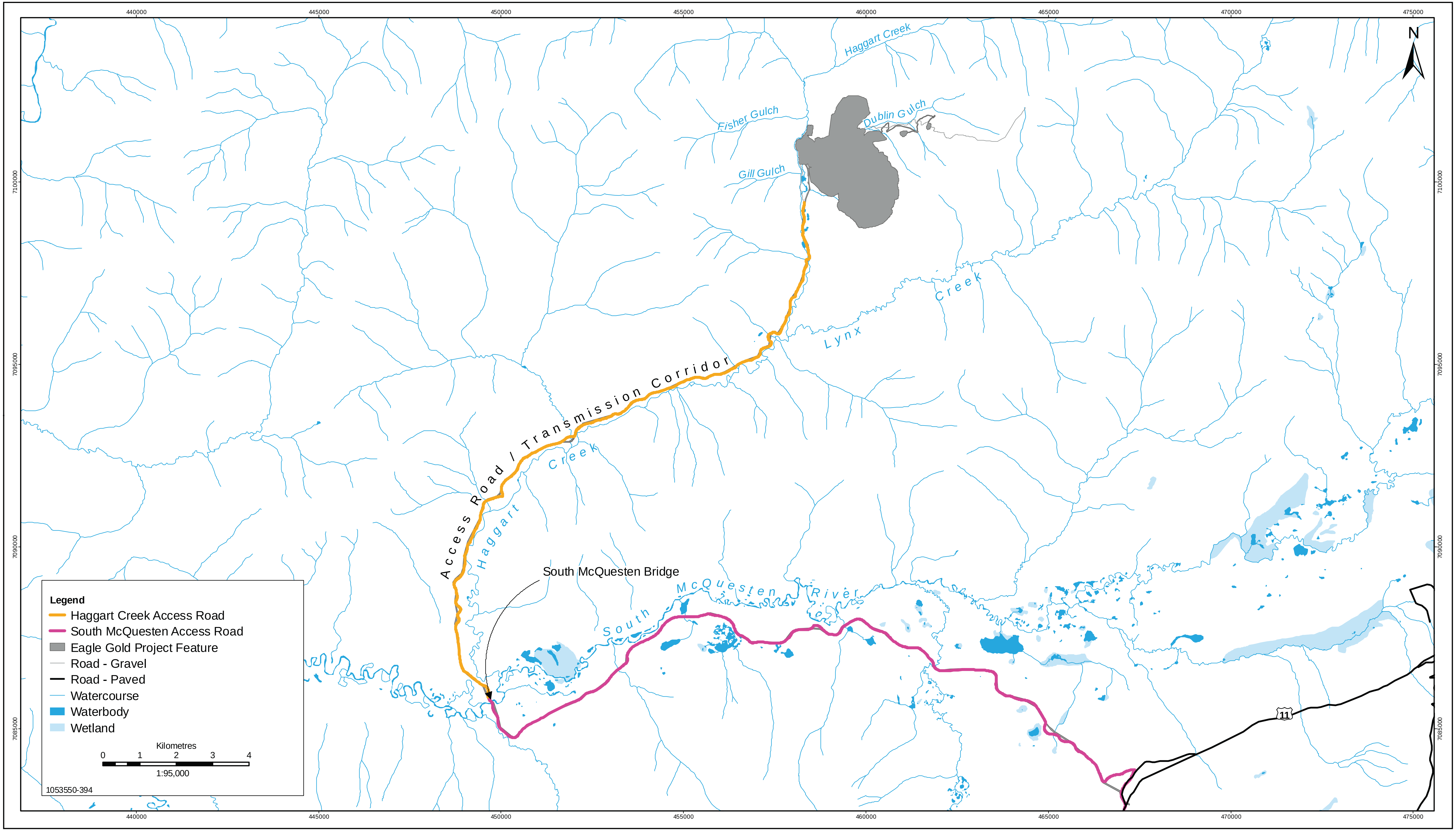

Data Sources; Government of Canada, Victoria Gold Corp.

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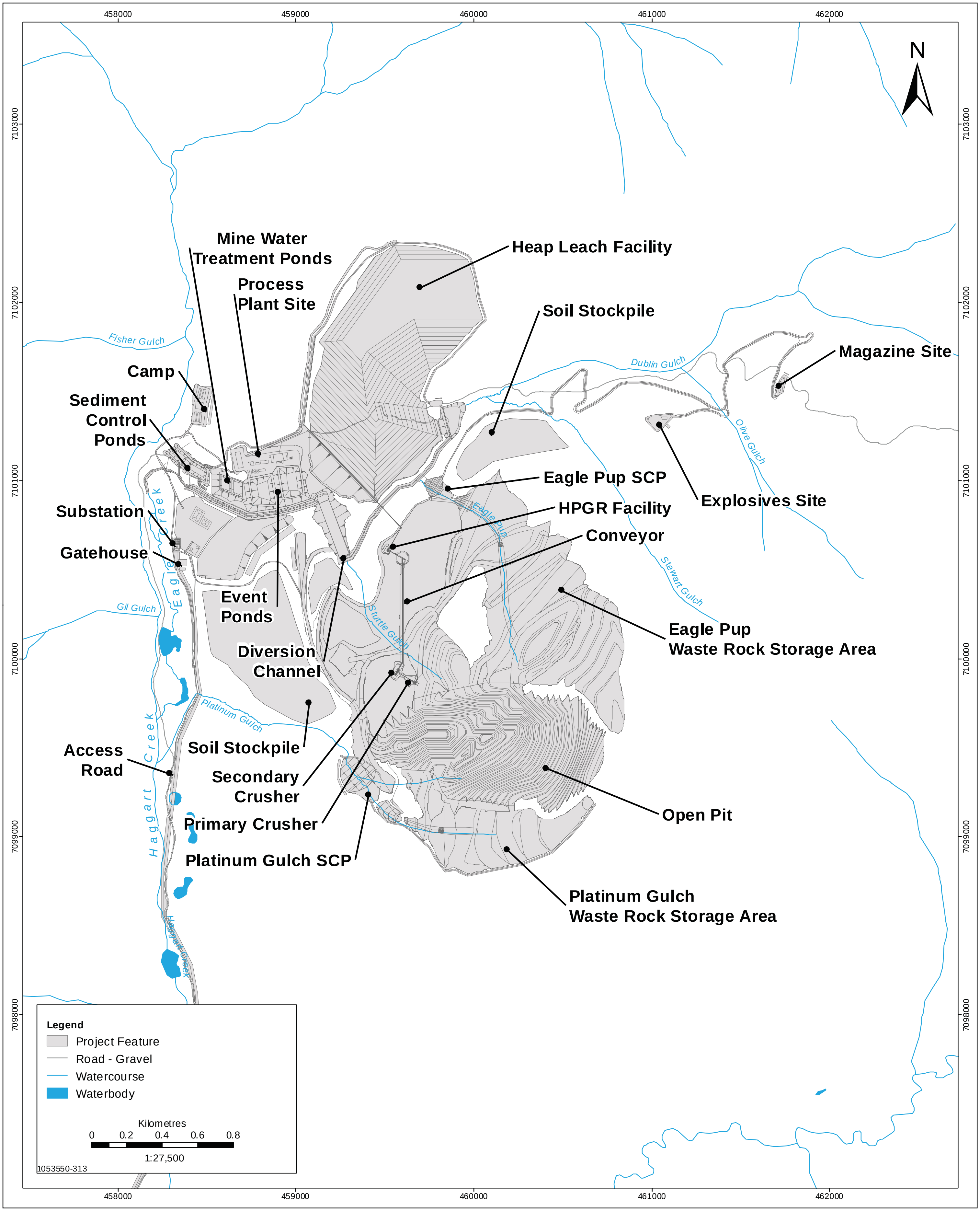
Victoria GOLD CORP

Haggart Creek Access Road and Power Transmission Route

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION	DRAWN BY
UTM - ZONE 8	LS
DATUM	CHECKED BY
NAD 83	RS
DATE	FIGURE NO.
8-November-2010	5.1-5



Data Sources; Government of Canada, Victoria Gold Corp.

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PROJECT SITE GENERAL ARRANGEMENT

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION: UTM - ZONE 8	DRAWN BY: LS
DATUM: NAD 83	CHECKED BY: RS
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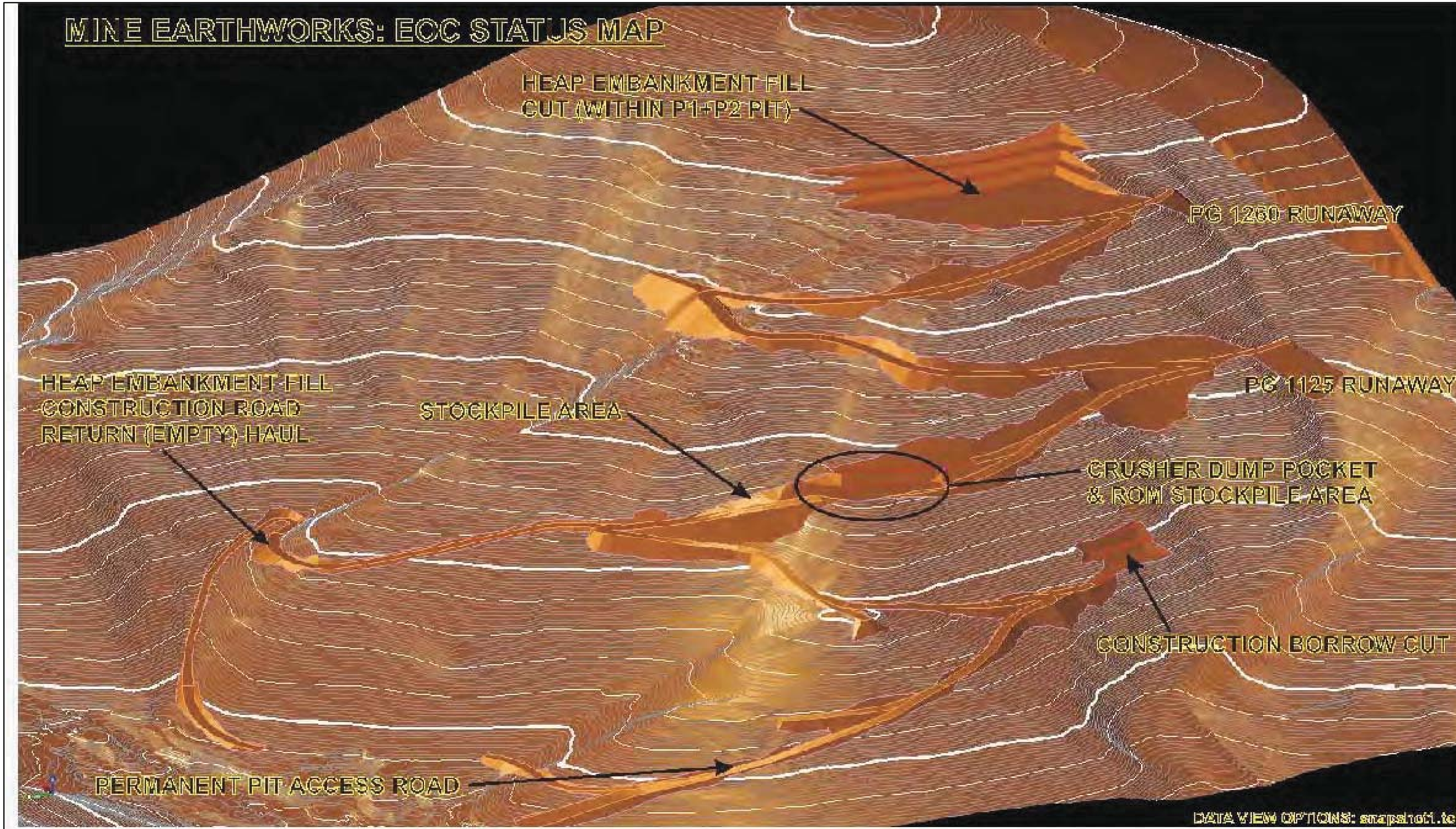

Data Sources; Government of Canada, Victoria Gold Corp.

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Victoria GOLD CORP

OPEN PIT AND WRSA's ISOMETRIC VIEW - END OF CONSTRUCTION PHASE

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION UTM - ZONE 8	DRAWN BY LS
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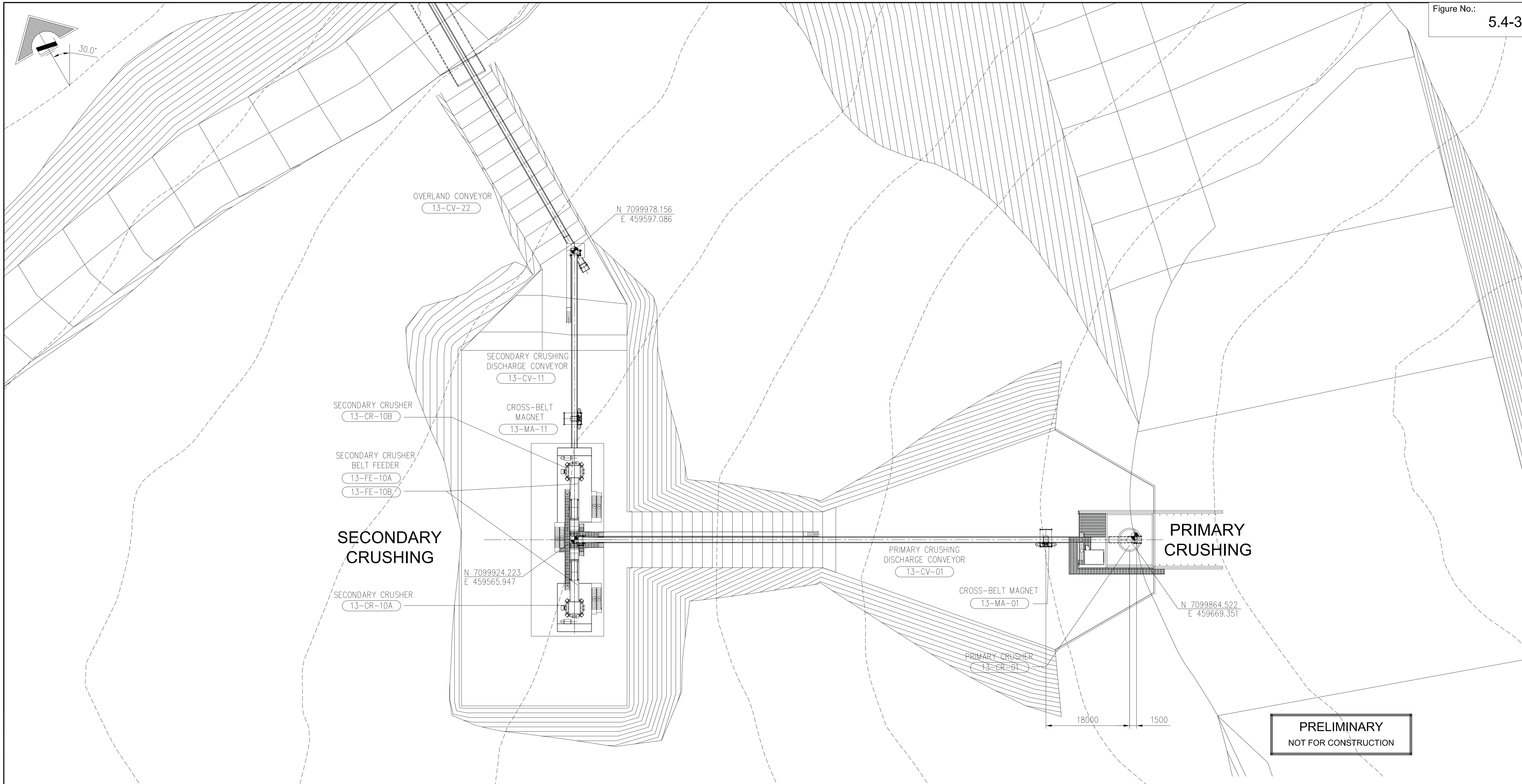
DATE 3-November-2010	FIGURE NO. 5.4-2

Figure No.: 5.4-3



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REVISIONS

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B	KCA	WMR		19 FEB 10	UPDATED AS PER MINE ROAD LAYOUT
C					
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G					
H					
I					

Designed by: WMR 18 DEC 09
Drawn by PRV 08 JAN 10
Checked by WMR 11 JAN 10
Approved 1 –
Approved 2 –
Client Approval –

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Project: **EAGLE GOLD PROJECT**

Title: GENERAL ARRANGEMENT
PRIMARY & SECONDARY CRUSHING
PLAN VIEW

Job No.	Scale	ACAD Filename:	
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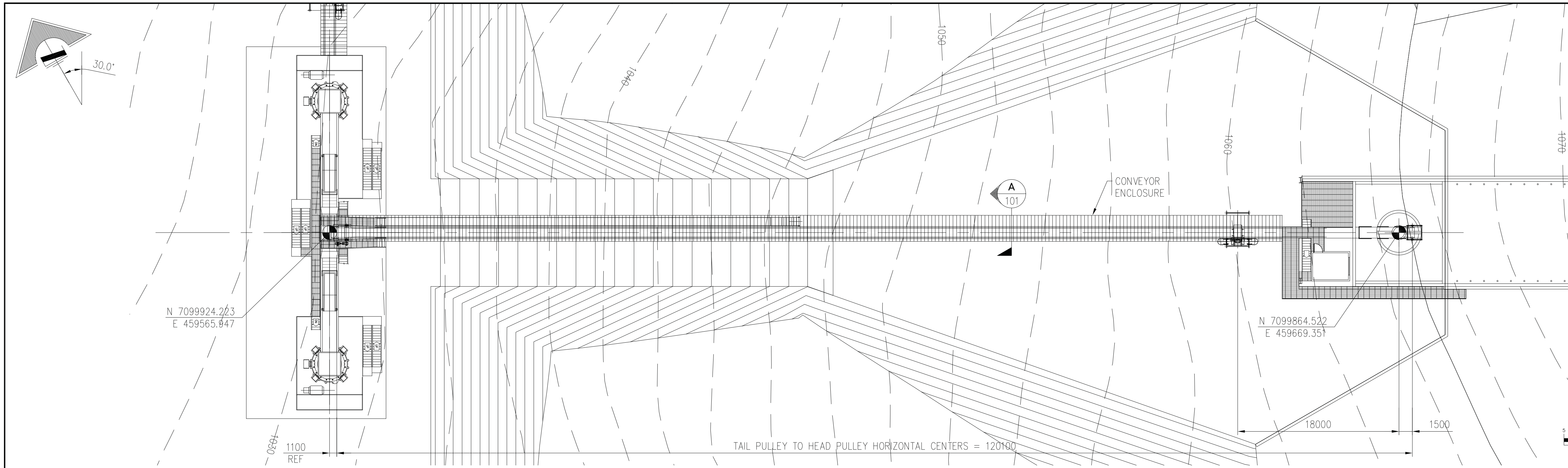

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(IN METERS)

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PRIMARY CRUSHING DISCHARGE CONVEYOR 13-CV-01 - PLAN VIEW

SCALE 1:250

PRELIMINARY

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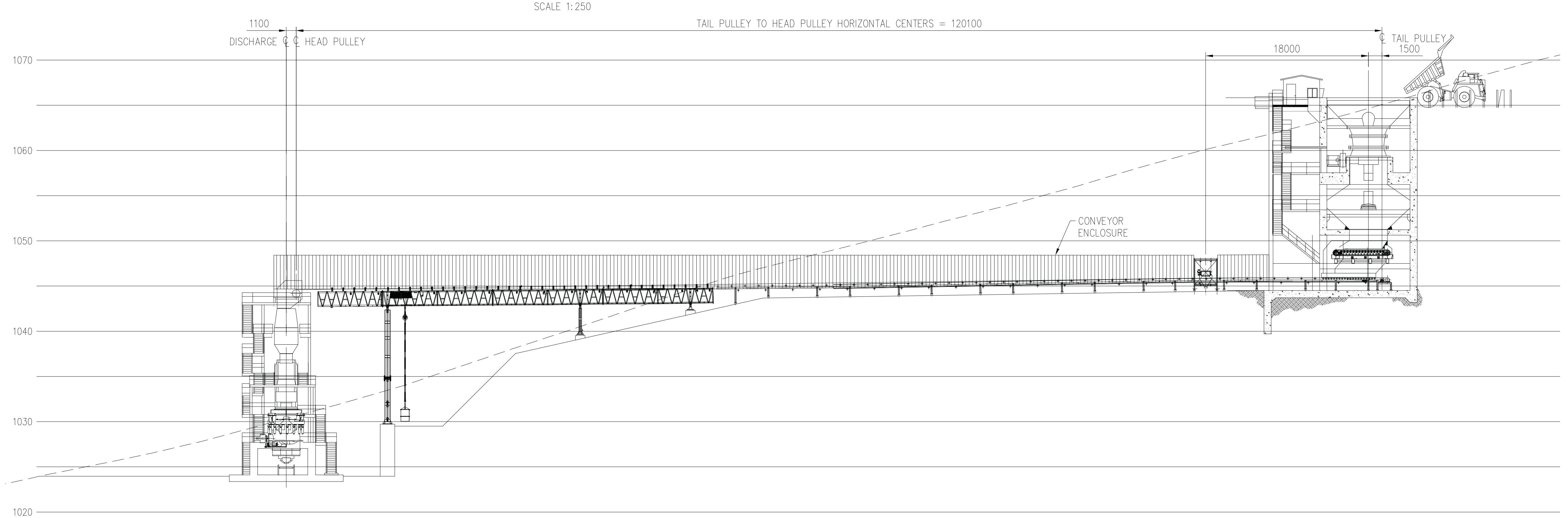

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1.- ELEVATIONS IN METERS
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SCALE 1:250

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DWG. NO.	TITLE
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B	KCA	WMR		19 FEB 10	UPDATED PER MINE ROAD LAYOUT
C	KCA	AFB		10 JUN 10	ADDED CONVEYOR ENCLOSURE

Designed by: WMR 18 DEC 09
Drawn by: PRV 08 JAN 10
Checked by: WMR 11 JAN 10
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Approved 2: -
Client Approval: -

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Project: **EAGLE GOLD PROJECT**

Title: GENERAL ARRANGEMENT
PRIMARY-SECONDARY CRUSHING
PLAN AND PROFILE

Job No.	Scale	ACAD Filename:
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8166 **0113-13-601** REV C

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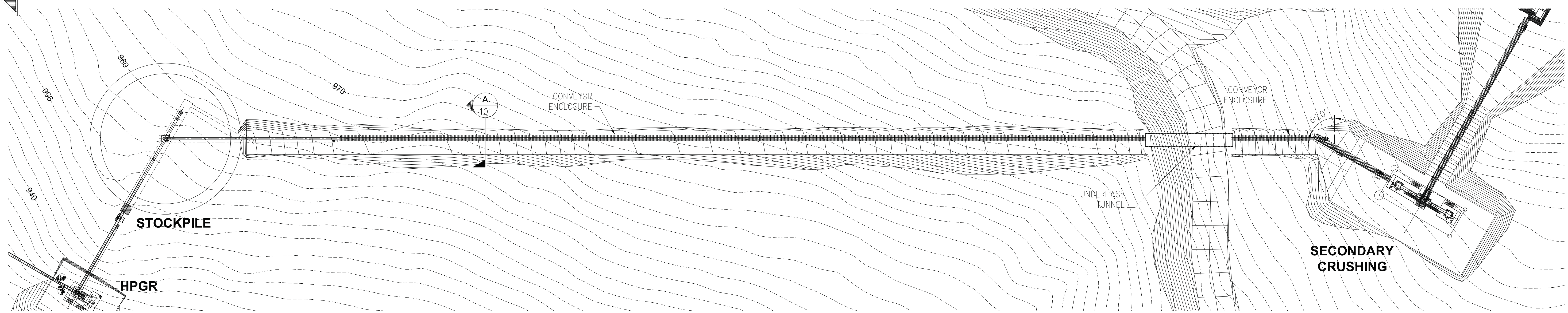

OVERLAND CONVEYOR 13-CV-22 - PLAN VIEW

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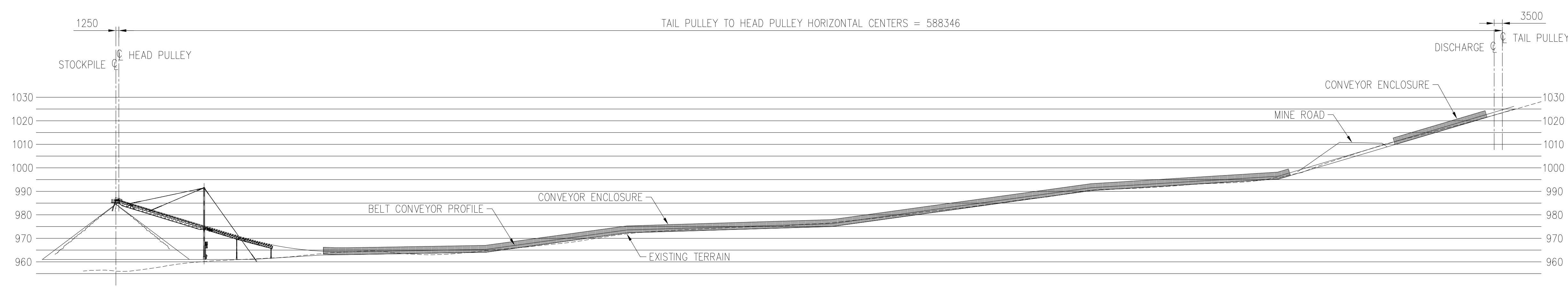

OVERLAND CONVEYOR 13-CV-22 - ELEVATION VIEW

SCALE 1:1000

PRELIMINARY
NOT FOR CONSTRUCTION

NOTE:
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8166-0110-13-003	HPGR, ORE DELIVERY & RECOVERY PLANT

REVISIONS

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REVISIONS

NO.	BY	CK'D	APPROVED	DATE	DESCRIPTION
A	KCA	WMR		11 JAN 10	ISSUED FOR PRE-FEASIBILITY STUDY
B	KCA	WMR		19 FEB 10	MODIFIED PER MINE ROAD LAYOUT
C	KCA	AFB		10 JUN 10	ADDED CONVEYOR ENCLOSURE
D					
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H					
I					

Designed by: WMR 18 DEC 09
Drawn by PRV 08 JAN 10
Checked by WMR 11 JAN 10
Approved 1 -
Approved 2 -
Client Approval -

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Project: **EAGLE GOLD PROJECT**

Title: GENERAL ARRANGEMENT
OVERLAND CONVEYOR 13-CV-22
PLAN AND PROFILE

Job No.	Scale	ACAD Filename:
366G	AS NOTED	8166-0113-13-720-C

8166 **0113-13-720** REV C

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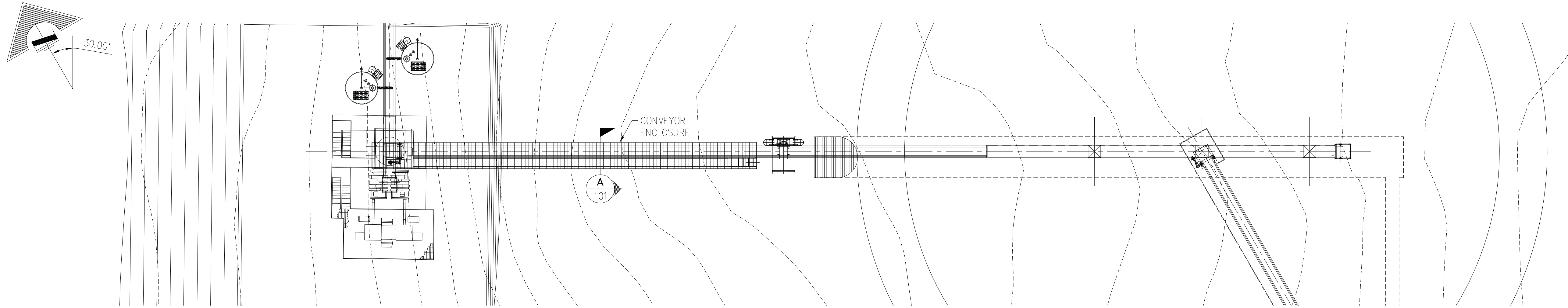
Figure No.: 5.4-6



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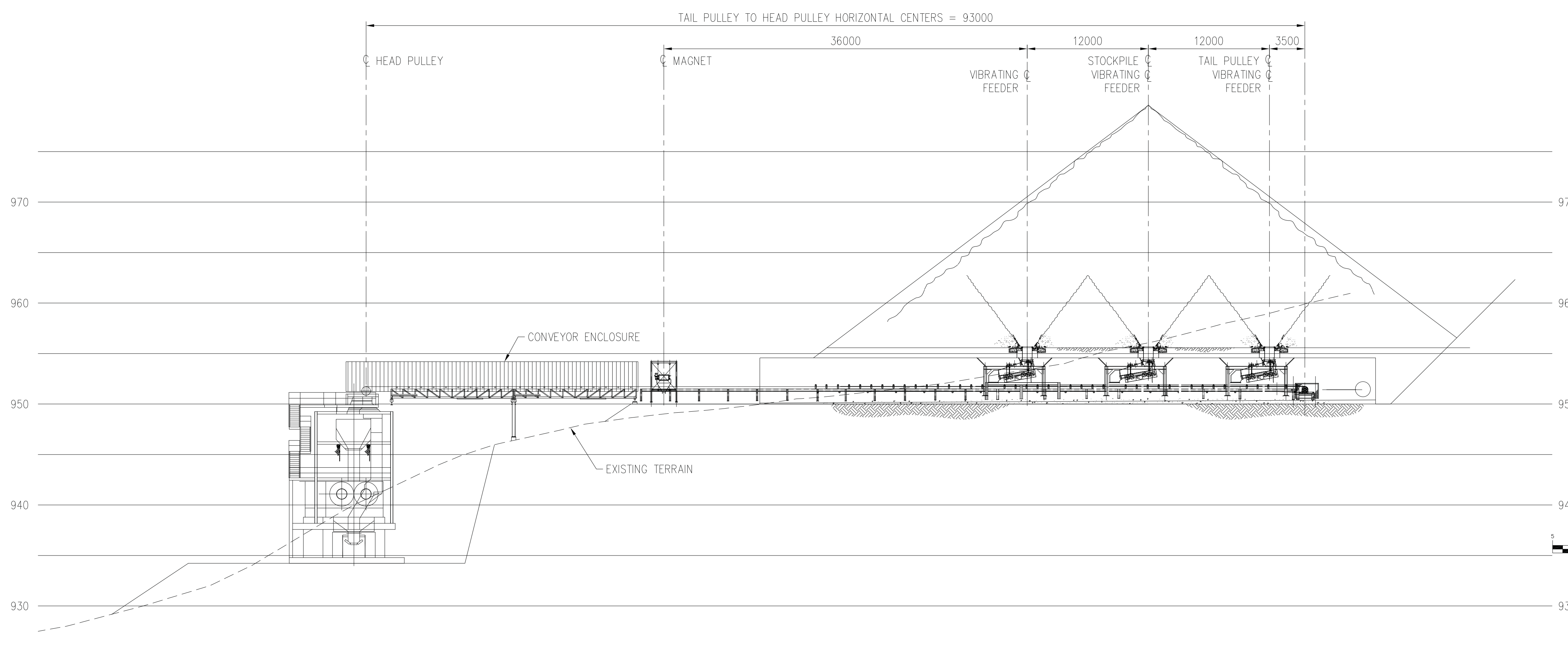

HPGR RECLAIM CONVEYOR 16-CV-30 - ELEVATION

SCALE 1:250

NOTE:
1.- ELEVATIONS IN METERS
2.- DIMENSIONS IN MILLIMETERS

GRAPHIC SCALE
(IN METERS)

1 : 250

CONTOUR INTERVAL = 2 meters

PRELIMINARY
NOT FOR CONSTRUCTION

REFERENCE DRAWINGS

DWG. NO.	TITLE
8166-0110-13-002	PRIMARY-SECONDARY-TERTIARY CRUSHERS PLAN VIEW
8166-0110-13-003	HPGR, ORE DELIVERY & RECOVERY PLANT

REVISIONS

NO.	BY	CK'D	APPROVED			DATE	DESCRIPTION
1							
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REVISIONS

NO.	BY	CK'D	APPROVED			DATE	DESCRIPTION
A	KCA	WMR				16 NOV 09	ISSUED FOR REVIEW & COMMENT
B	KCA	WMR				15 DEC 09	UPDATED LAYOUT, REISSUED FOR REVIEW & COMMENT
C	KCA	WMR				19 FEB 10	ADDED CEMENT AND LIME SILOS
D	KCA	AFB				10 JUN 10	ADDED CONVEYOR ENCLOSURE
E							
F							
G							
H							
I							

Designed by: WMR 06 NOV 09
Drawn by: PRV 11 NOV 09
Checked by: WMR 12 NOV 09
Approved 1: –
Approved 2: –
Client Approval: –

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Project: **EAGLE GOLD PROJECT**

Title: GENERAL ARRANGEMENT
HPGR RECLAIM CONVEYOR 16-CV-30
PLAN AND PROFILE

Job No.	Scale	ACAD Filename:
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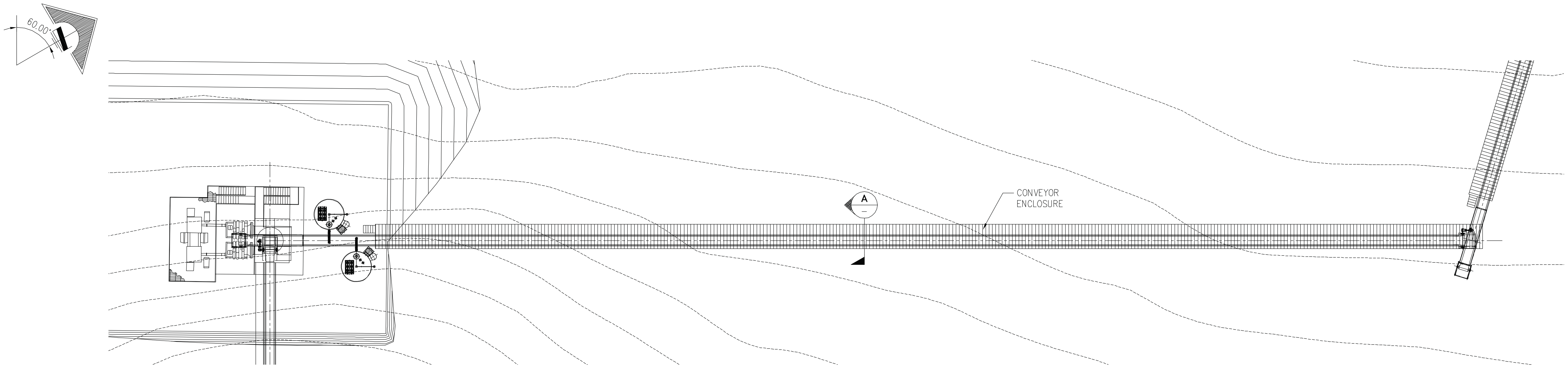
8166 **0116-13-301** REV D

File: J:\DRAWINGS\Active Projects\Eagle Gold\13 General Arrangements\8166-0116-13-301-D.dwg LAST UPDATE: JUN 15, 2010 @ 4:47 PM BY: cad5 LAST REV: PLOT SCALE: 1:25.4

Figure No.: 5.4-7



HPGR DISCHARGE CONVEYOR 16-CV-31 - PLAN VIEW

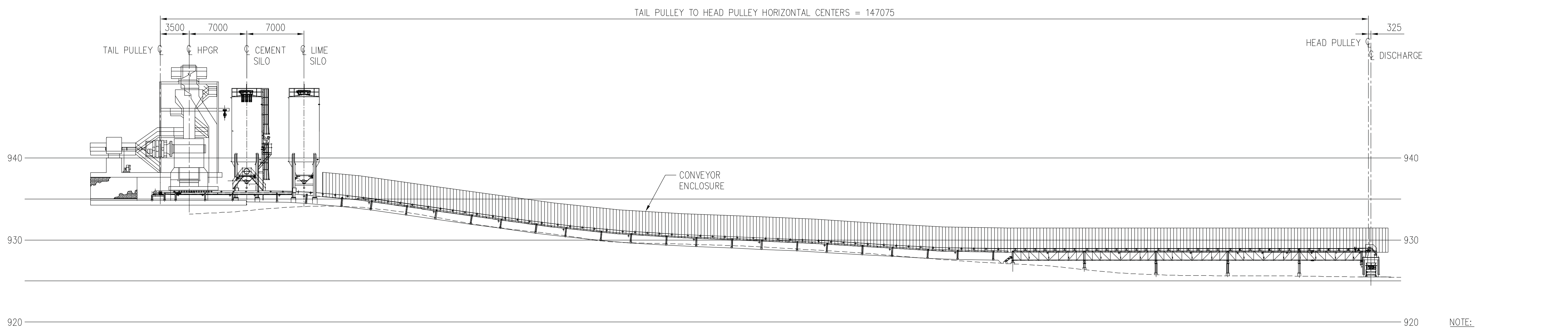
SCALE 1:250

GRAPHIC SCALE

(IN METERS)

1 : 250

CONTOUR INTERVAL = 2 meters



HPGR DISCHARGE CONVEYOR 16-CV-31 - ELEVATION VIEW

SCALE 1:250

NOTE:
1.- ELEVATIONS IN METERS
2.- DIMENSIONS IN MILLIMETERS

PRELIMINARY
NOT FOR CONSTRUCTION

REFERENCE DRAWINGS

DWG. NO.	TITLE
8166-0110-13-002	PRIMARY-SECONDARY-TERTIARY CRUSHERS PLAN VIEW
8166-0110-13-003	HPGR, ORE DELIVERY & RECOVERY PLANT

REVISIONS

NO.	BY	CK'D	APPROVED	DATE	DESCRIPTION
1					
2					
3					
4					
5					
6					
7					
8					
9					

REVISIONS

NO.	BY	CK'D	APPROVED	DATE	DESCRIPTION
A	KCA	WMR		16 NOV 09	ISSUED FOR REVIEW & COMMENT
B	KCA	WMR		15 DEC 09	UPDATED LAYOUT, REISSUED FOR REVIEW & COMMENT
C	KCA	WMR		19 FEB 10	ADDED SILOS
D	KCA	AFB		10 JUN 10	ADDED CONVEYOR ENCLOSURE
E					
F					
G					
H					
I					

Designed by: WMR 06 NOV 09
Drawn by: PRV 11 NOV 09
Checked by: WMR 12 NOV 09
Approved 1: -
Approved 2: -
Client Approval: -

PREPARED FOR
VICTORIA GOLD CORPORATION

PREPARED BY
KCA Kappes, Cassiday & Associates
7950 Security Circle, Reno, Nevada USA 89506
Telephone: (775) 972-7575 FAX: (775) 972-4567

Project: **EAGLE GOLD PROJECT**

Title: GENERAL ARRANGEMENT
HPGR DISCHARGE CONVEYOR 16-CV-31
PLAN AND PROFILE

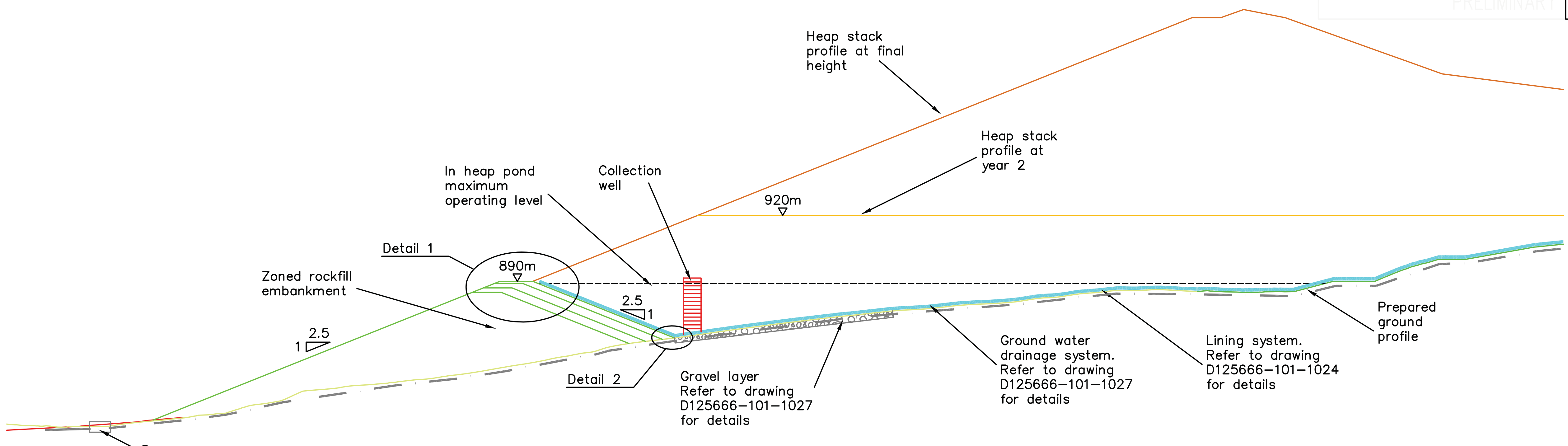
Job No.	Scale	ACAD Filename:
366G	1:100	8166-0116-13-310-D

8166 **0116-13-310** REV D

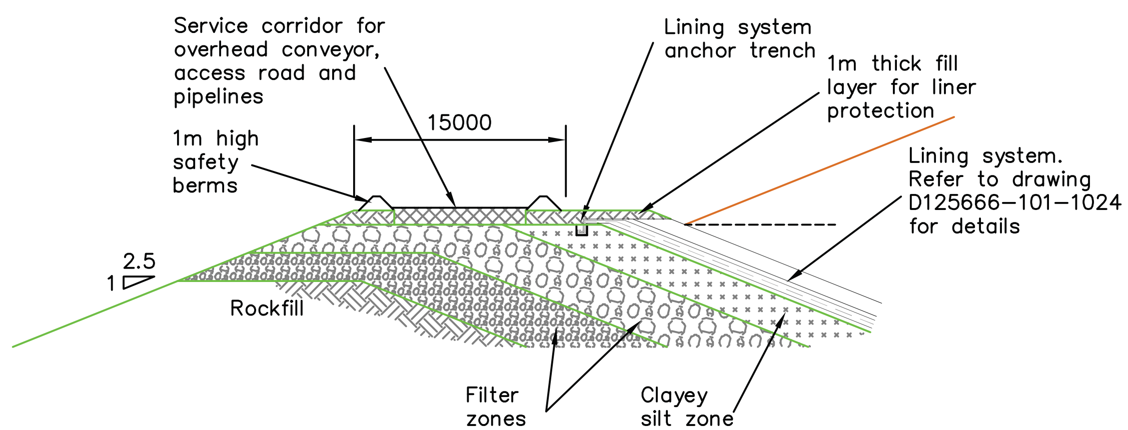
File: J:\DRAWINGS\Active Projects\Eagle Gold\13 General Arrangements\8166-0116-13-310-D.dwg LAST UPDATE: JUN 15, 2010 @ 4:51 PM BY: cad5 LAST REV: PLOT SCALE: 1:25.4

PRELIMINARY

Figure No.: **5.4-8**

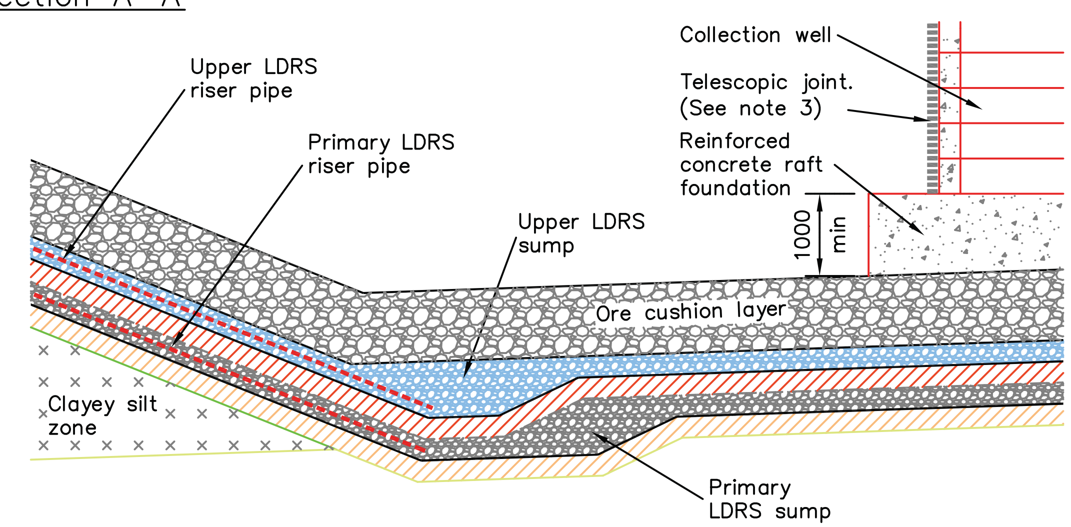


Section A–A



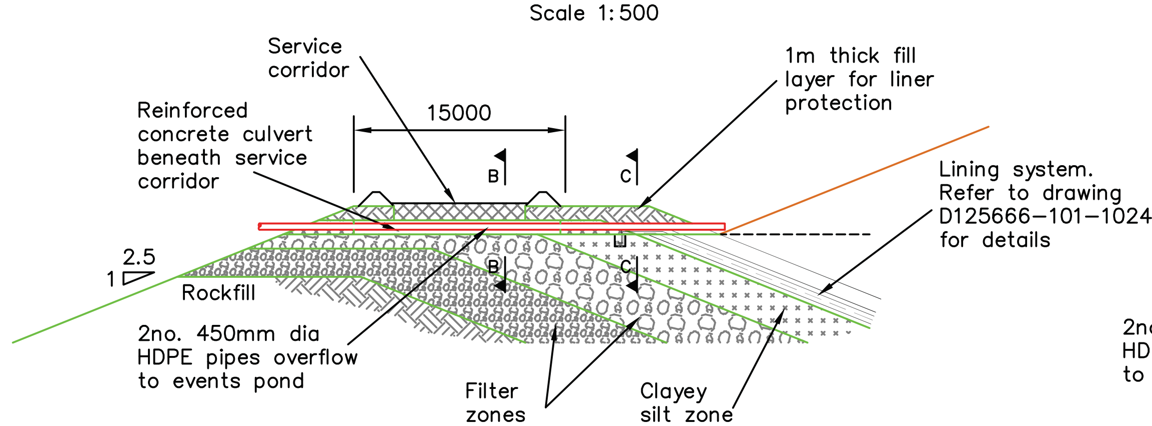
Detail 1

Scale 1:500



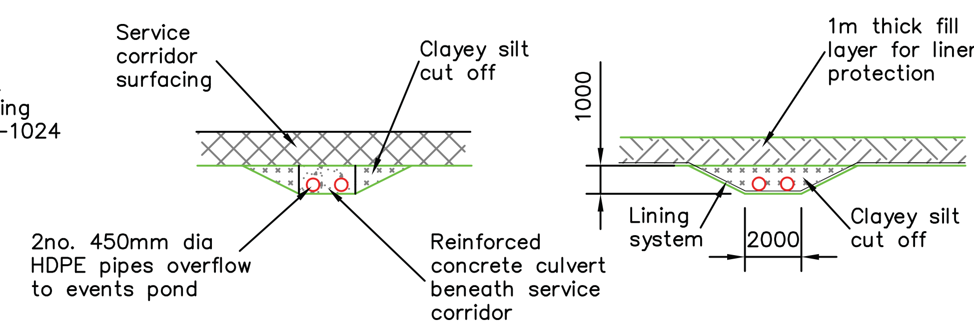
Detail 2

Lining system Sumps
Scale 1:100



Details of Overflow Pipes

Scale 1:500



Typical Sections Through Overflow Pipes

Scale 1:250

Note

1. All dimensions are in millimetres and elevations in metres unless noted otherwise.
2. All sections are provisional, awaiting geological profile data
3. Details of joint and low friction skin to be developed during feasibility study.

VICTORIA GOLD CORPORATION

EAGLE GOLD PRE FEASIBILITY STUDY

ANN GULCH HEAP LEACH FACILITY
HEAP LEACH FACILITY
EMBANKMENT DETAILS

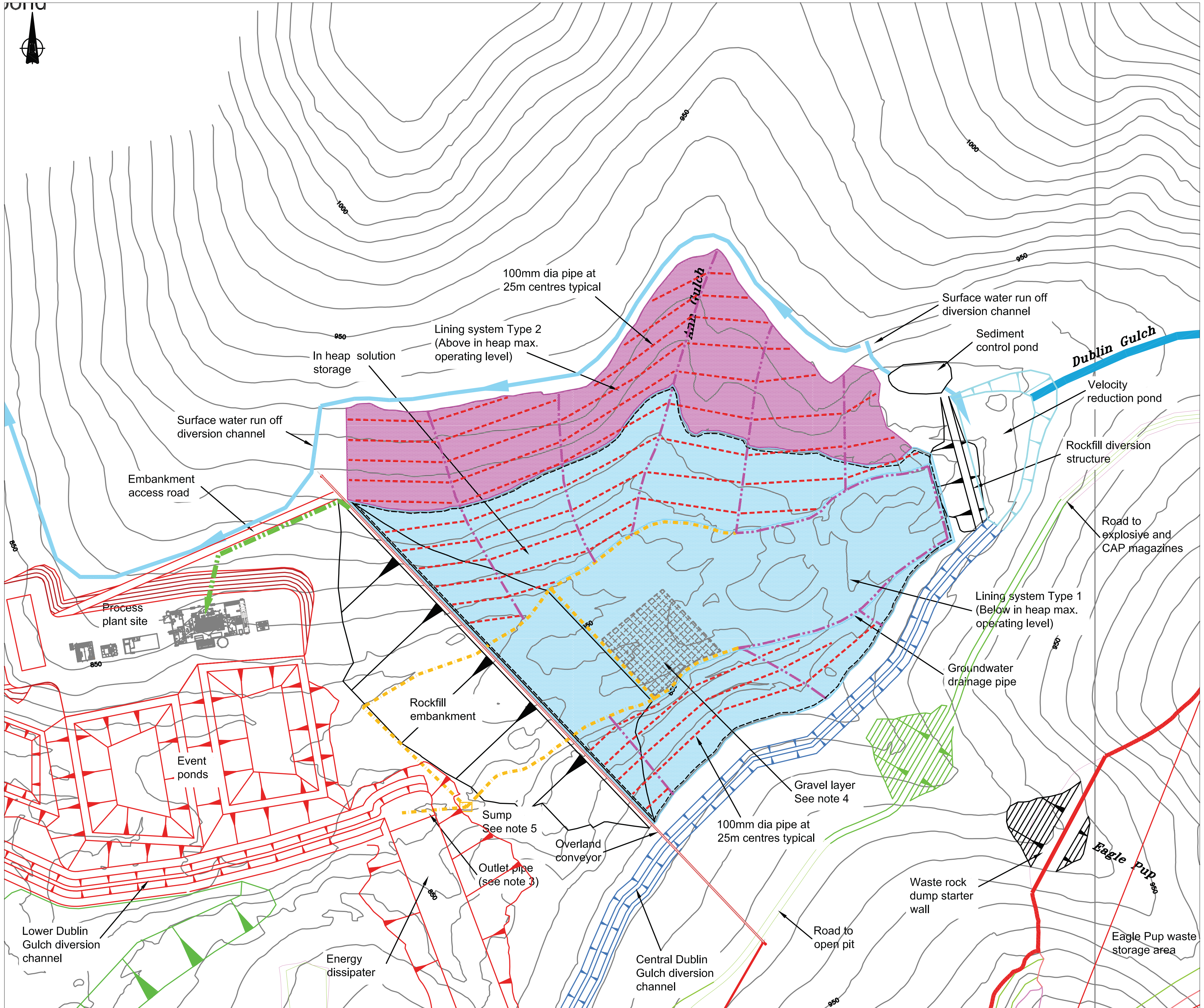
DESIGNED	DJB	MAY 10	
DRAWN	DJT	MAY 10	
DESIGN CHECK			
DRAWING CHECK	DJB	JUN 10	
APPROVED	AMW	23-06-10	

DRG. No.	REFERENCE DRAWINGS	No.	DATE	REVISION	MADE	CHKD.

SCALE UNLESS SHOWN 1:2 000

ORIGINAL SIZE A3

DRG. No. D125666-101-1047 REV. P1



PRELIMINARY

Figure No.: **5.4-9**

Notes

1. Contours are supplied by client with areas added from contours with elevations in feet converted into metres.
2. Any other identified springs or areas with high groundwater will require additional drainage works.
3. Outlet pipe from underdrainage to be directed to suitable temporary storage for testing before release to the environment via the sediment control pond.
4. 1m thick gravel layer for drilling perforations through liner at closure.
5. Sump to consist of valve chamber and space for pump to feed pipeline to the events pond.

Legend

- 300mm dia pipe
- 200mm dia pipe
- 100mm dia pipe

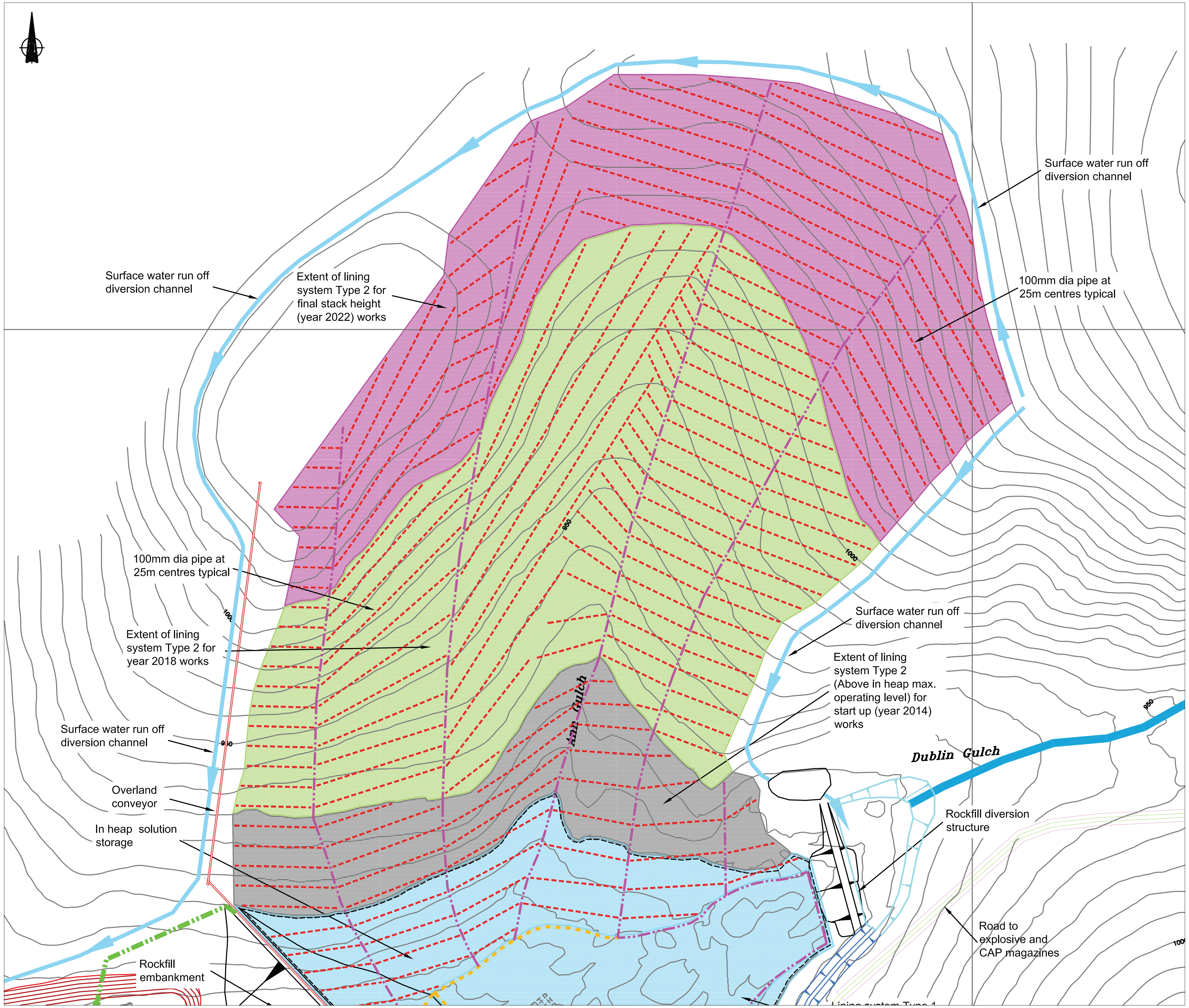
VICTORIA GOLD CORPORATION

EAGLE GOLD PRE FEASIBILITY STUDY

DESIGNED	SD	OCT 09	DRG. No.	REFERENCE DRAWINGS	No.	DATE	REVISION	MADE	CHKD.	SCALE UNLESS SHOWN
DRAWN	APC	OCT 09			P2	18/12/09	Ponds and waste rock dump layouts revised	DJT	DJB	
DESIGN CHECK					P3	27/05/10	Update open pit and waste rock dump footprints. Revise crusher location. Add conveyor and plant site buildings.	DJT	DJB	1:5 000
DRAWING CHECK										
APPROVED	AMW	27/05/10								ORIGINAL SIZE A3

ANN GULCH HEAP LEACH FACILITY
GROUNDWATER DRAINAGE
PIPEWORK LAYOUT
AT 2014 STACK HEIGHT

DRG. No. D125666-101-1027 REV. P3



PRELIMINARY

Figure No.: **5.4-10**

Notes

1. Contours are supplied by client with areas added from contours with elevations in feet converted into metres.
2. Any other identified springs or areas with high groundwater will require additional drainage works.
3. Outlet pipe from underdrainage to be directed to suitable temporary storage for testing before release to the environment.

Legend

- 300mm dia pipe
- 200mm dia pipe
- 100mm dia pipe

VICTORIA GOLD CORPORATION

EAGLE GOLD PRE FEASIBILITY STUDY

ANN GULCH HEAP LEACH FACILITY
GROUNDWATER DRAINAGE
PIPEWORK LAYOUT
AT FINAL STACK HEIGHT (YEAR 2022)

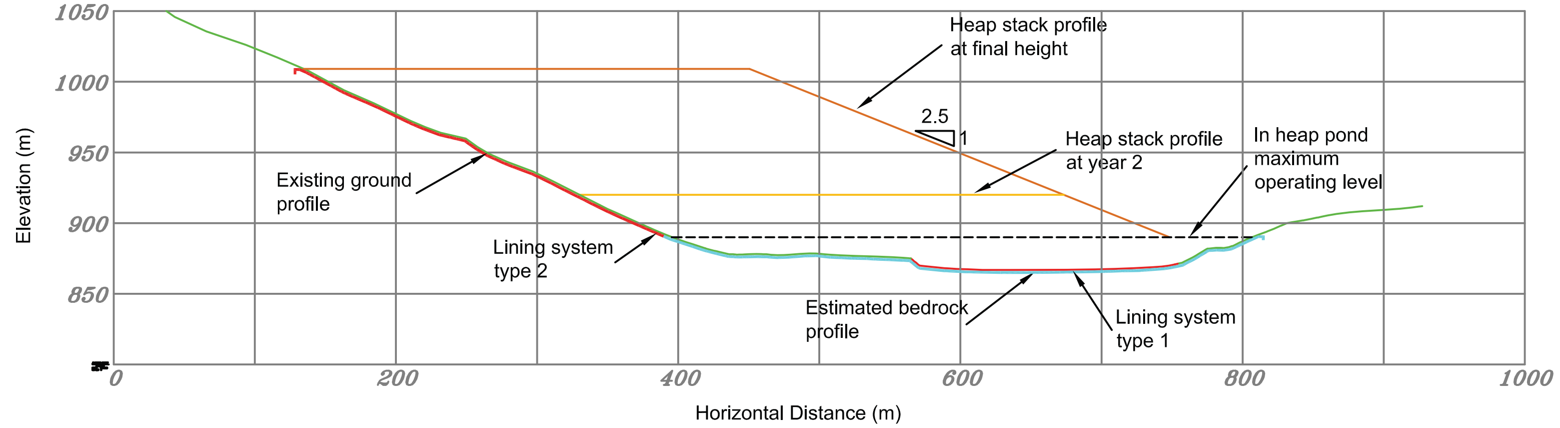
Scott Wilson

DESIGNED	SD	MAY 10	DRG. No.	REFERENCE DRAWINGS	No.	DATE	REVISION	MADE	CHKD.	SCALE UNLESS SHOWN
DRAWN	DJT	MAY 10								
DESIGN CHECK										1:5 000
DRAWING CHECK	DJB	18-06-10								
APPROVED	AMW	18-06-10								ORIGINAL SIZE A3

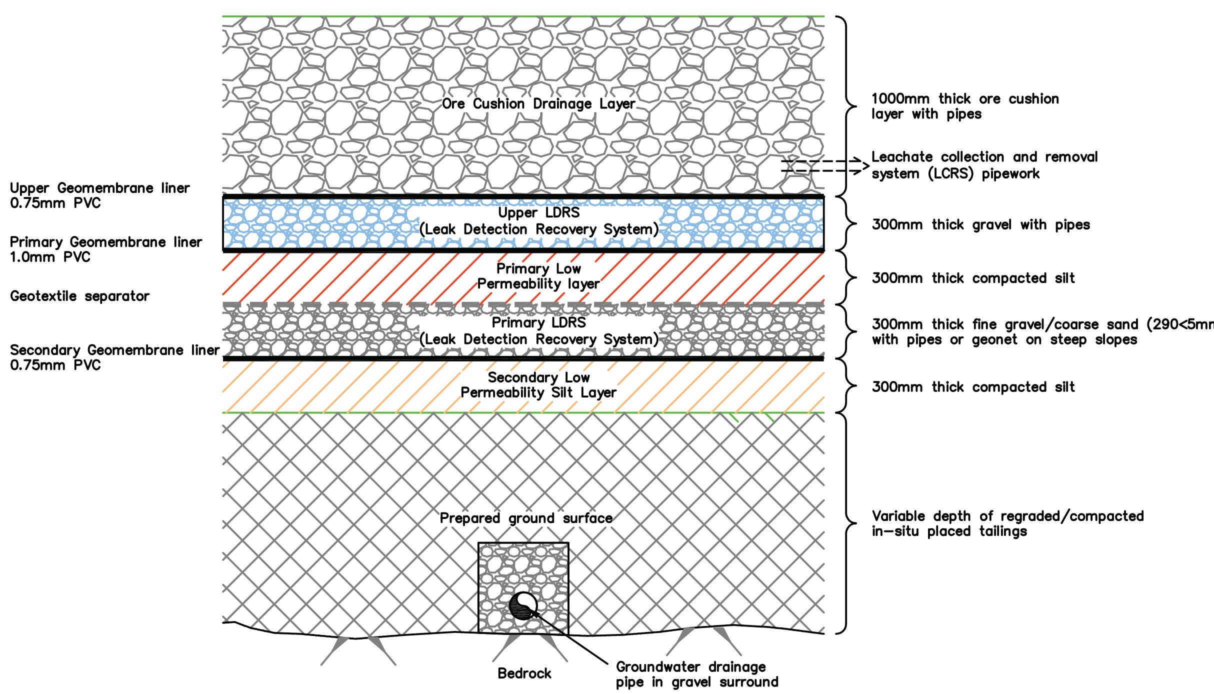
DRG. No. D125666-101-1036 REV. P1

Figure No.: **5.4-11**

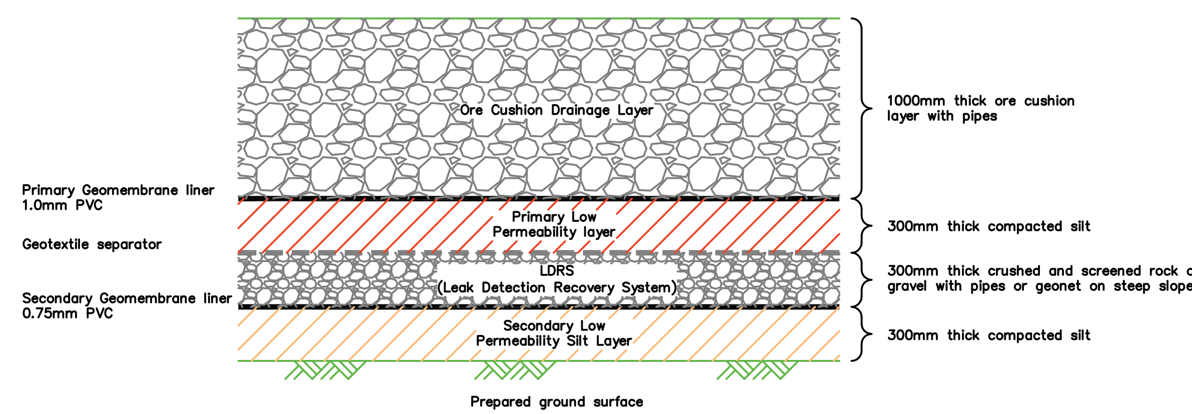
Note
All sections are provisional, awaiting geological profile data



Typical Section Through Heap Leach Facility



Lining System Type 1
In Heap Triple Liner Area
(Below in heap pond maximum operating level)



Lining System Type 2
Heap Pad Double Liner Area
(Above in heap pond maximum operating level)

VICTORIA GOLD CORPORATION
EAGLE GOLD PRE FEASIBILITY STUDY
ANN GULCH HEAP LEACH FACILITY
LINING SYSTEM DETAILS

Scott Wilson

DESIGNED	SD	OCT 09	DRG. No.	REFERENCE DRAWINGS
DRAWN	DJT	OCT 09		
DESIGN CHECK				
DRAWING CHECK				
APPROVED				

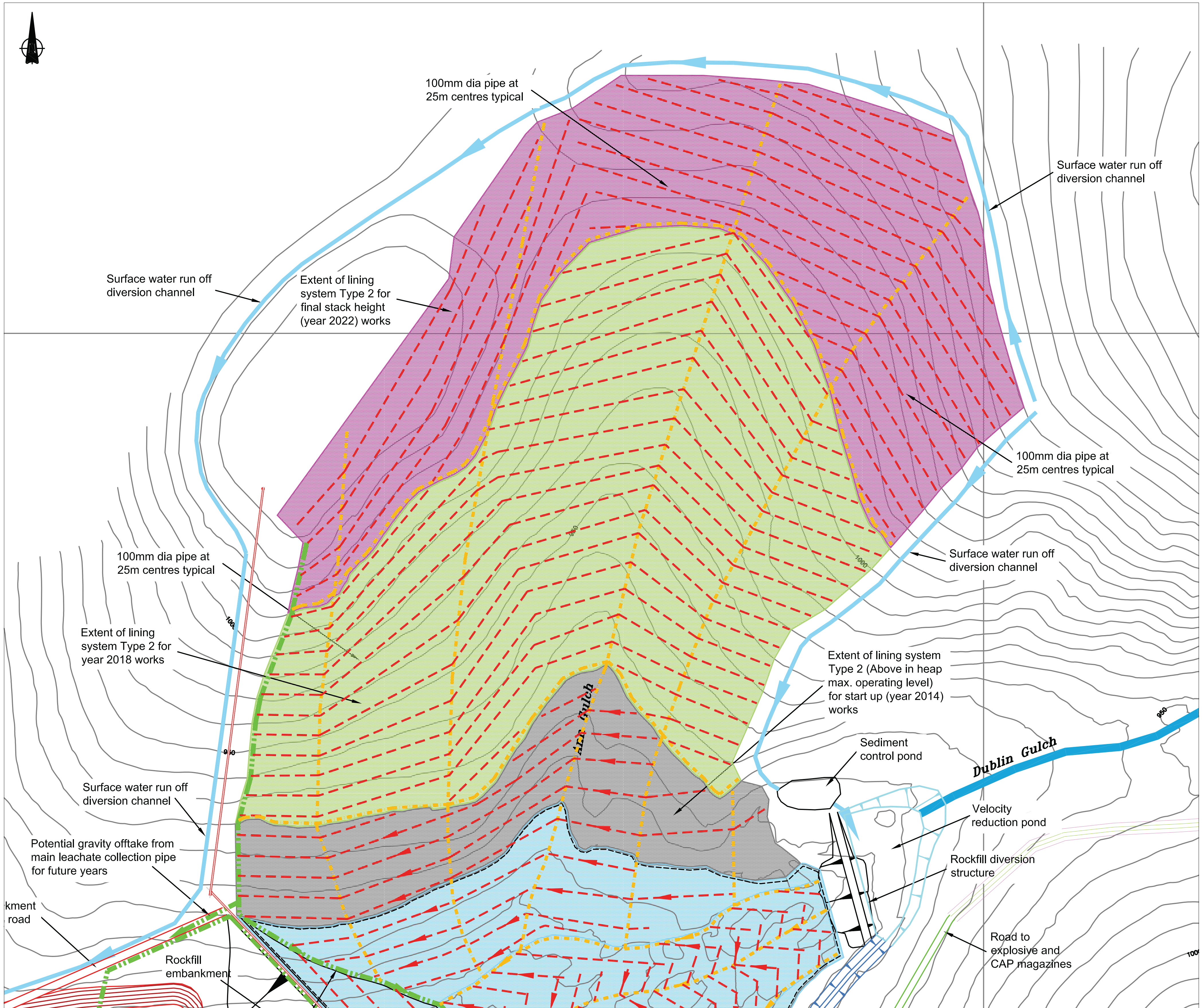
No.	DATE	REVISION	MADE	CHKD.

SCALE UNLESS SHOWN
1:5 000
ORIGINAL SIZE A3

DRG. No. D125666-101-1024 REV. P1

PRELIMINARY

Figure No.: **5.4-12**



Notes
1. Contours are supplied by client with areas added from contours with elevations in feet converted into metres.
2. Any other identified springs or areas with high groundwater will require additional drainage works.

Legend

- 450mm dia pipe
- 300mm dia pipe
- 100mm dia pipe

VICTORIA GOLD CORPORATION

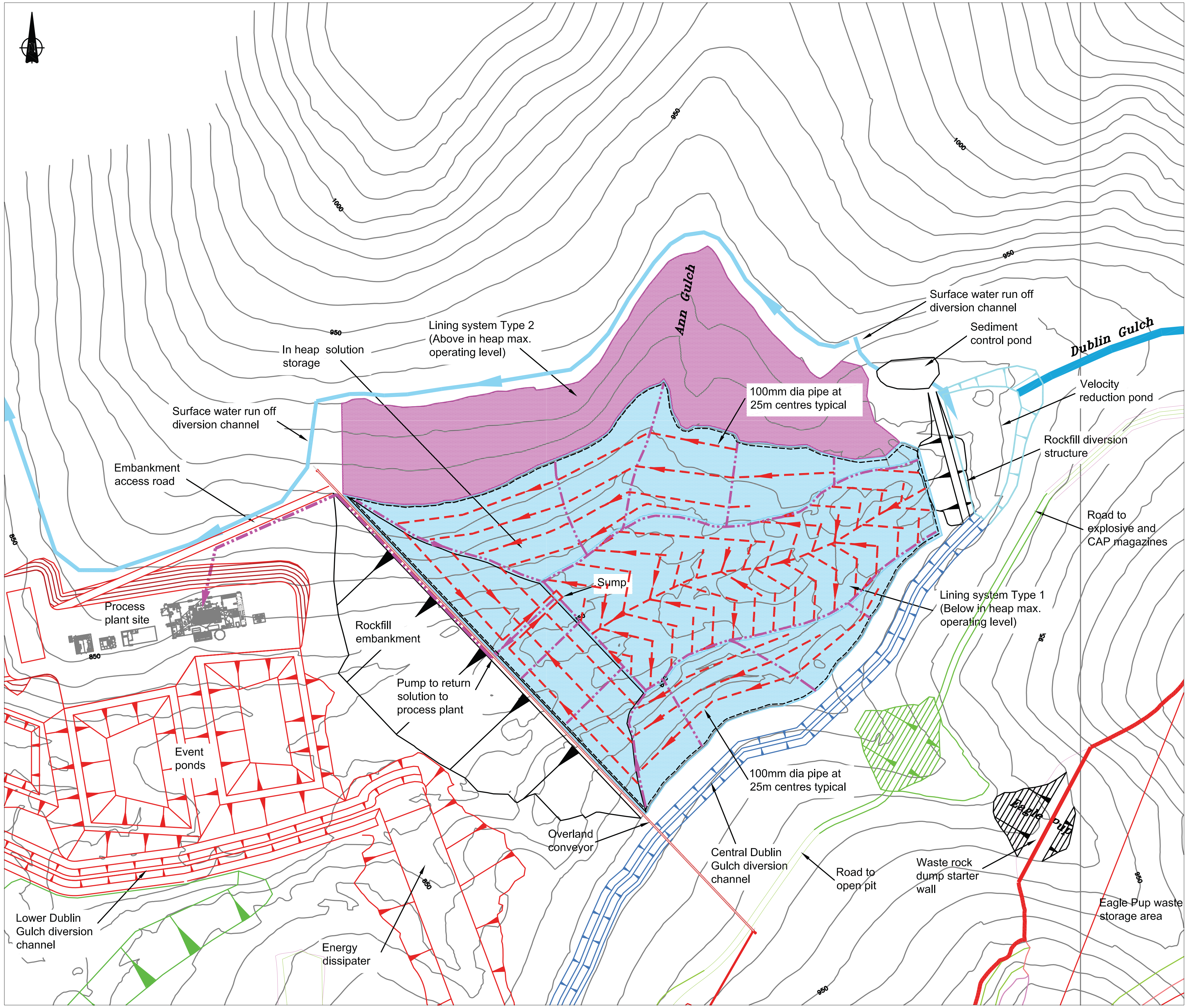
EAGLE GOLD PRE FEASIBILITY STUDY

DESIGNED	DJB	JUN 10	DRG. No.	REFERENCE DRAWINGS	No.	DATE	REVISION	MADE	CHKD.	SCALE UNLESS SHOWN
DRAWN	DJT	JUN 10								
DESIGN CHECK										1:5 000
DRAWING CHECK	DJB	JUN 10								
APPROVED	AMW	23-06-10								ORIGINAL SIZE A3

Scott Wilson

ANN GULCH HEAP LEACH FACILITY
LEACHATE COLLECTION AND
REMOVAL SYSTEM PIPEWORK LAYOUT
AT FINAL STACK HEIGHT (YEAR 2022)

DRG. No. D125666-101-1039 REV. P1



PRELIMINARY

Figure No.: **5.4-13**

Notes
1. Contours are supplied by client with areas added from contours with elevations in feet converted into metres.
2. Any other identified springs or areas with high groundwater will require additional drainage works.

Legend

- 200mm dia pipe
- 100mm dia pipe

VICTORIA GOLD CORPORATION

EAGLE GOLD PRE FEASIBILITY STUDY

ANN GULCH HEAP LEACH FACILITY
UPPER LEAK DETECTION
RECOVERY SYSTEM PIPEWORK LAYOUT
AT 2014 STACK HEIGHT

Scott Wilson

DESIGNED	SD	OCT 09	DRG. No.
DRAWN	DJT	OCT 09	
DESIGN CHECK			
DRAWING CHECK			
APPROVED	AMW	27/05/10	

REFERENCE DRAWINGS

No.	DATE	REVISION	MADE	CHKD.
P2	18/12/09	Ponds and waste rock dump layouts revised	DJT	DJB
P3	27/05/10	Update open pit and waste rock dump footprints. Revise crusher location. Add conveyor and plant site buildings.	DJT	DJB

SCALE UNLESS SHOWN 1:5 000

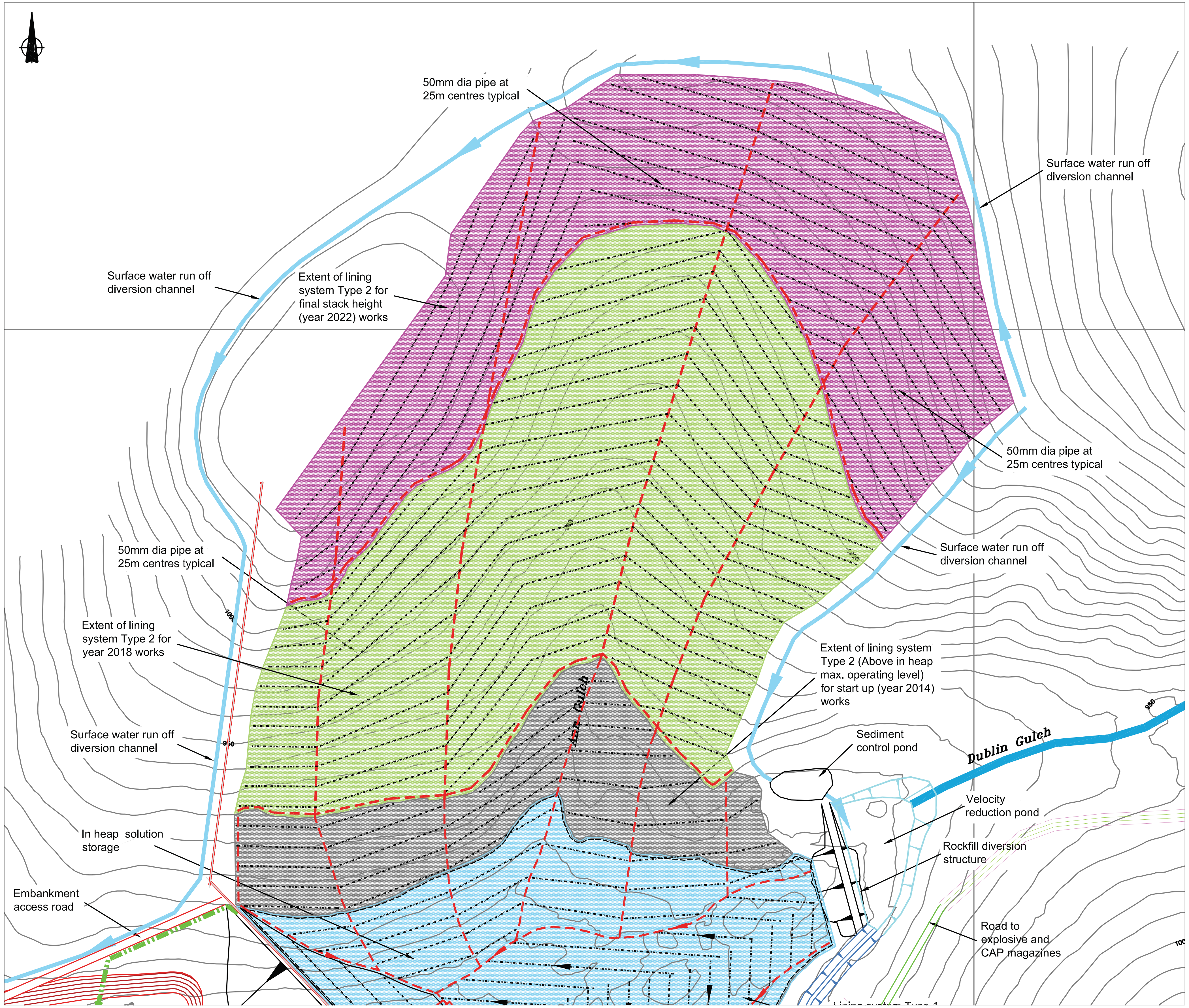
ORIGINAL SIZE A3

DRG. No. D125666-101-1029 REV. P3

PRELIMINARY

Figure No.: **5.4-14**

Notes
1. Contours are supplied by client with areas added from contours with elevations in feet converted into metres.
2. Any other identified springs or areas with high groundwater will require additional drainage works.



Legend

red dashed line	100mm dia pipe
black dotted line	50mm dia pipe

VICTORIA GOLD CORPORATION

EAGLE GOLD PRE FEASIBILITY STUDY

ANN GULCH HEAP LEACH FACILITY
PRIMARY LEAK DETECTION
RECOVERY SYSTEM PIPEWORK LAYOUT
AT FINAL STACK HEIGHT (2022)

DESIGNED	DJB	JUN 10
DRAWN	DJT	JUN 10
DESIGN CHECK		
DRAWING CHECK	DJB	JUN 10
APPROVED	AMW	23-06-10

DRG. No.	REFERENCE DRAWINGS	No.	DATE	REVISION	MADE	CHKD.

SCALE UNLESS SHOWN 1:5 000
ORIGINAL SIZE A3

DRG. No. D125666-101-1037 REV. P1

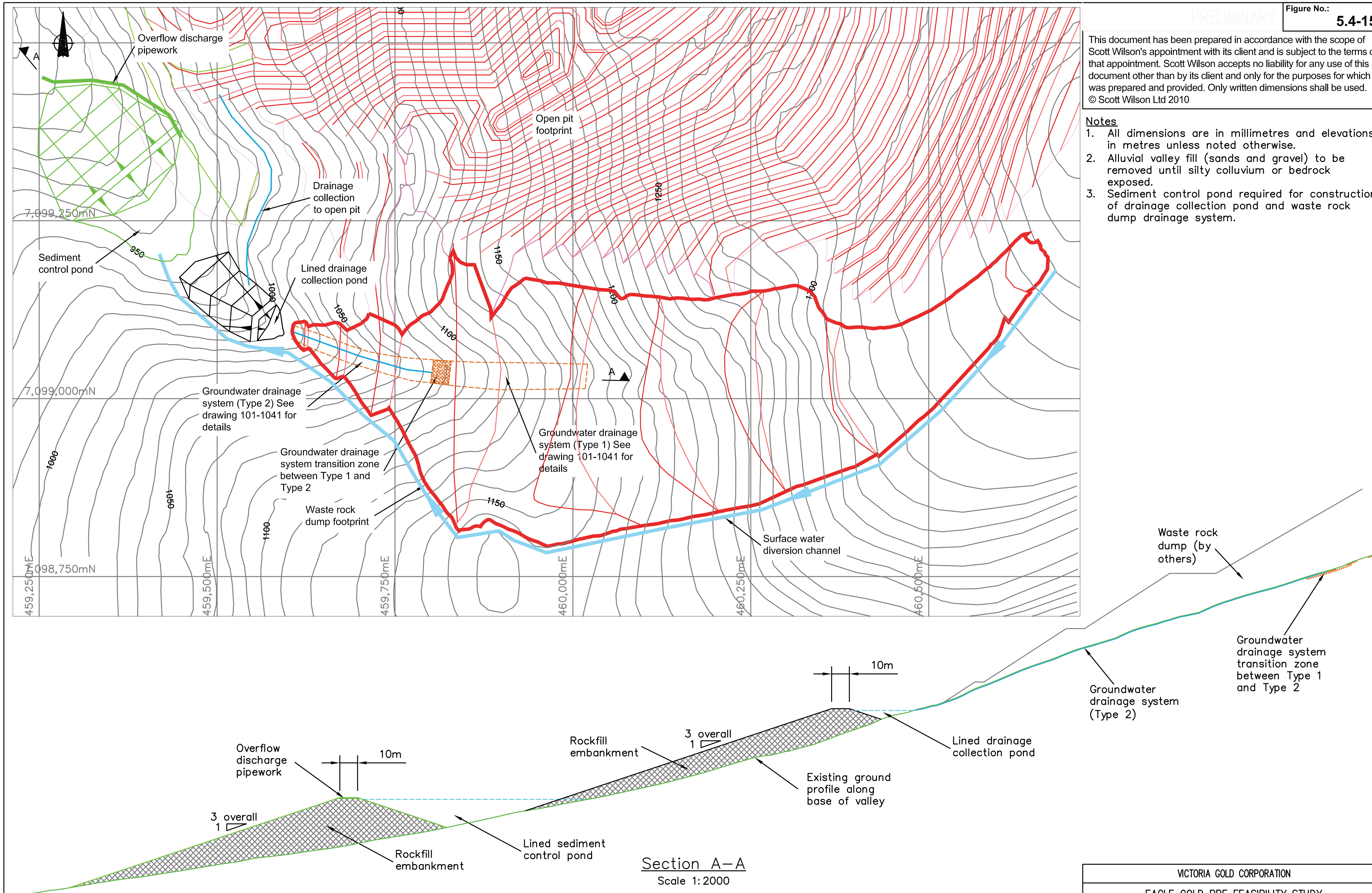


Figure No.: 5.4-15

PRELIMINARY

Notes

1. All dimensions are in millimetres and elevations in metres unless noted otherwise.
2. Alluvial valley fill (sands and gravel) to be removed until silty colluvium or bedrock exposed.
3. Sediment control pond required for construction of drainage collection pond and waste rock dump drainage system.

VICTORIA GOLD CORPORATION

EAGLE GOLD PRE FEASIBILITY STUDY

PLATINUM GULCH WASTE ROCK DUMP START UP WORKS CONTAINMENT TOE EMBANKMENT AND UNDERDRAINAGE TYPICAL DETAILS

			DRG. No.	REFERENCE DRAWINGS	No.	DATE	REVISION	MADE	CHKD.
DESIGNED	DJB	JUN 10							
DRAWN	DJT	JUN 10							
DESIGN CHECK									
DRAWING CHECK	DJB	JUN 10							
APPROVED	AMW	23-06-10							

SCALE UNLESS SHOWN 1:5 000

ORIGINAL SIZE A3

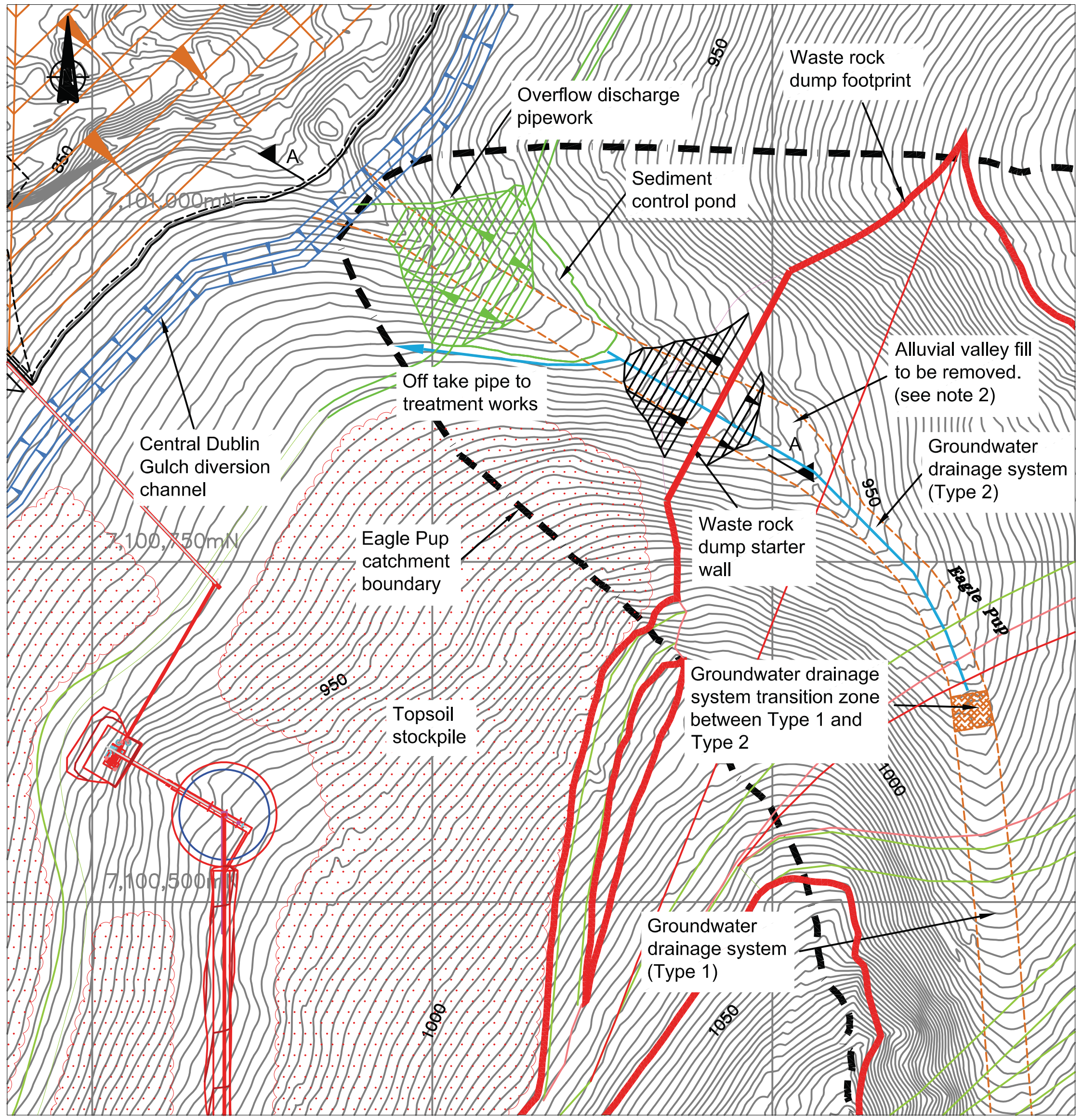
DRG. No. D125666-101-1050 REV. P1

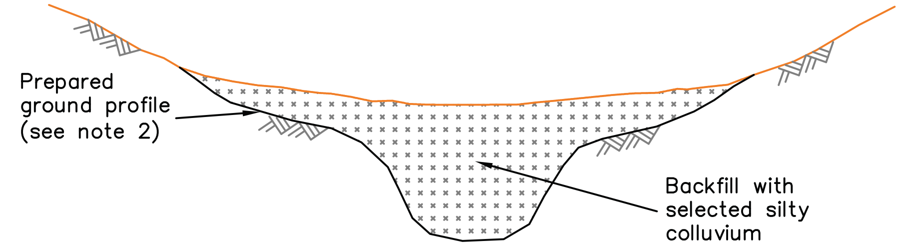
Scott Wilson

PRELIMINARY

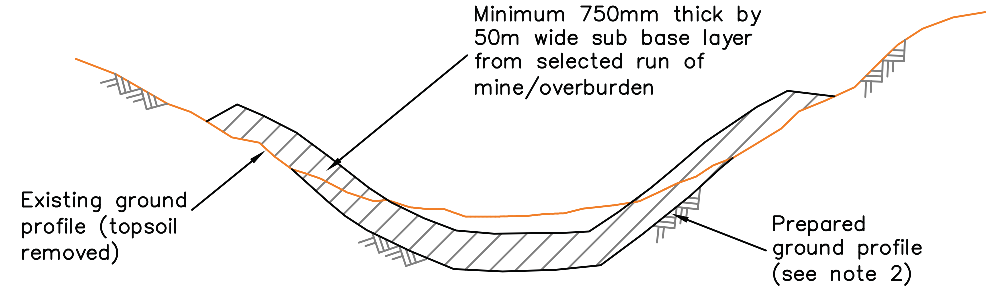
Figure No.: **5.4-16**

Notes
1. All dimensions are in millimetres and elevations in metres unless noted otherwise.
2. Alluvial valley fill (sands and gravel) to be removed until silty colluvium or bedrock exposed.

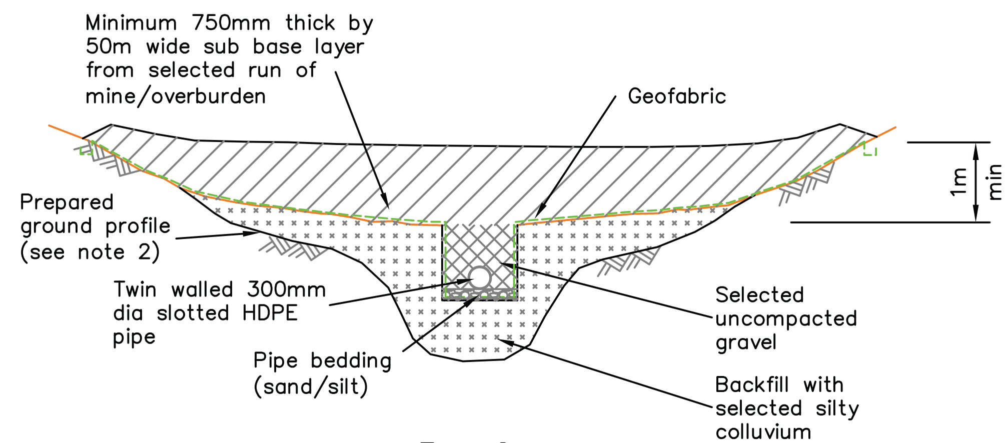




Details of Alluvial Valley Fill Beneath Sediment Pond and Embankment
Not to scale

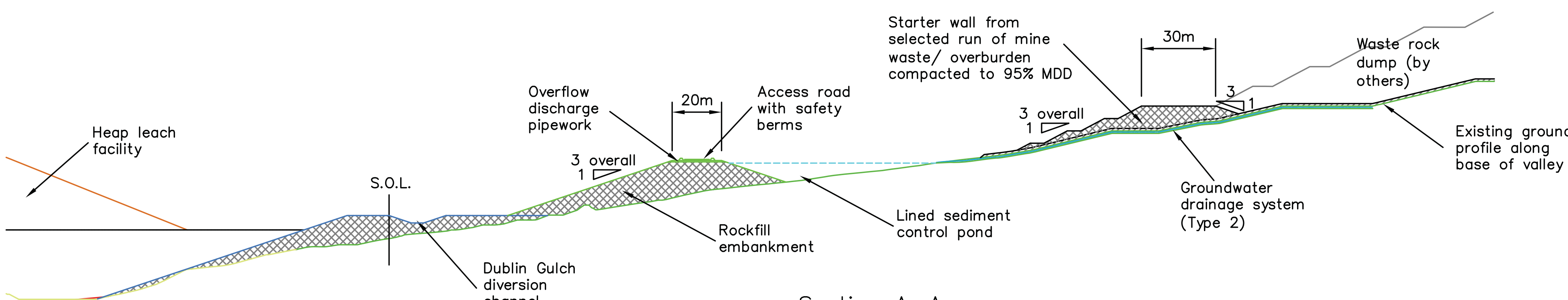


Type 1



Type 2

Typical Details of Groundwater Drainage System
Not to scale



Section A–A
Scale 1:2000

VICTORIA GOLD CORPORATION

EAGLE GOLD PRE FEASIBILITY STUDY

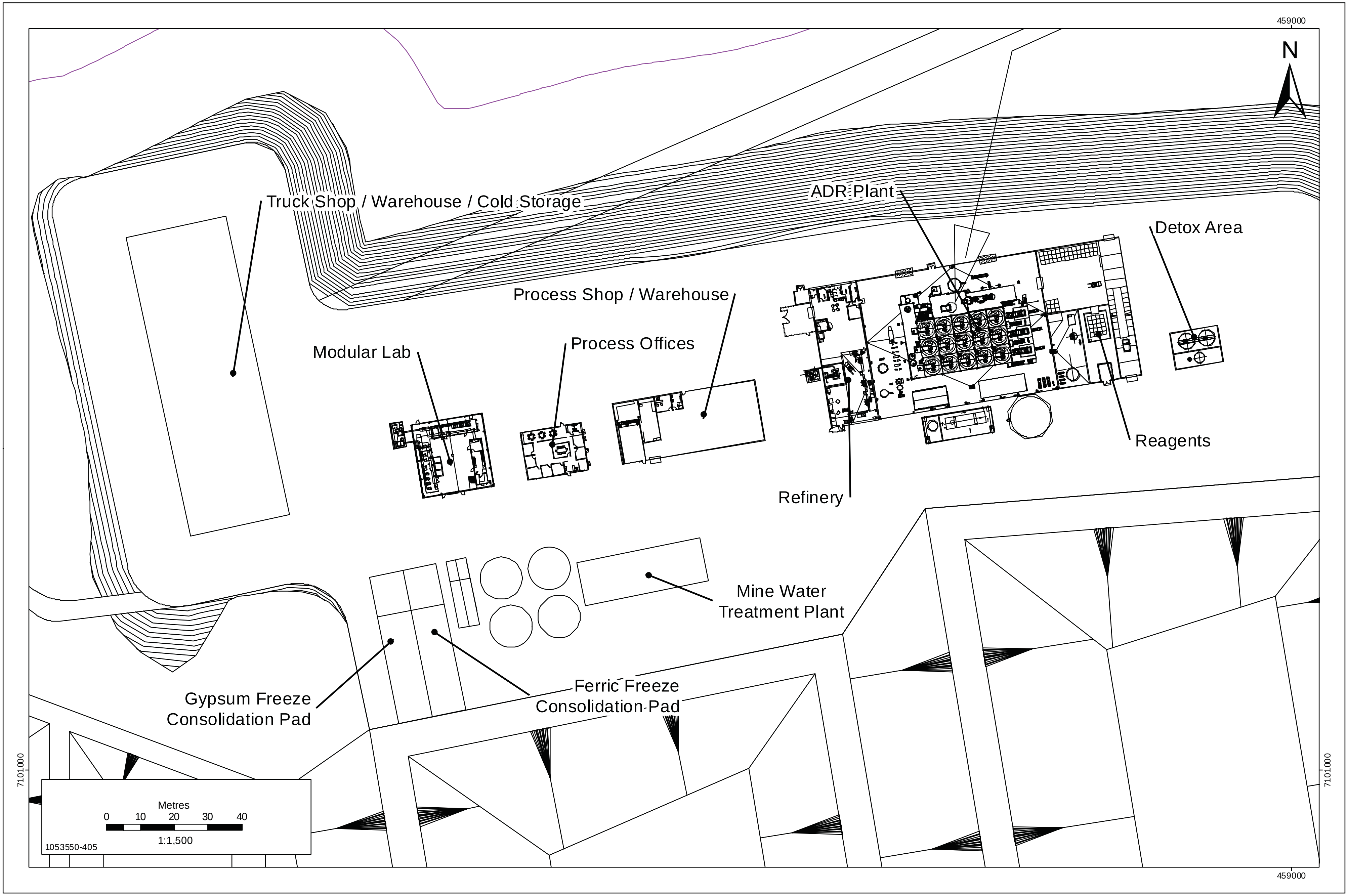
DESIGNED	DJB	NOV 09	DRG. No.	REFERENCE DRAWINGS
DRAWN	DJT	NOV 09		
DESIGN CHECK				
DRAWING CHECK				
APPROVED	AMW	27/05/10		

No.	DATE	REVISION	MADE	CHKD.
P2	13/05/10	Update open pit and waste rock dump footprints. Revise crusher location. Add conveyor and plant site buildings. Remove starter wall.	DJT	DJB
P3	27/05/10	Starter wall and topsoil stockpiles added, road route revised.	DJT	DJB

SCALE UNLESS SHOWN
1:5 000
ORIGINAL SIZE A3

EAGLE PUP WASTE ROCK DUMP
START UP WORKS
CONTAINMENT TOE EMBANKMENT
AND UNDERDRAINAGE TYPICAL DETAILS

DRG. No. D125666-101-1041 REV. P3



Data Sources: Government of Canada, Victoria Gold Corp.

Stantec
4370 Dominion Street
Burnaby, British Columbia
V5G 4L7
Tel. (604) 436 3014
Fax. (604) 436 3752

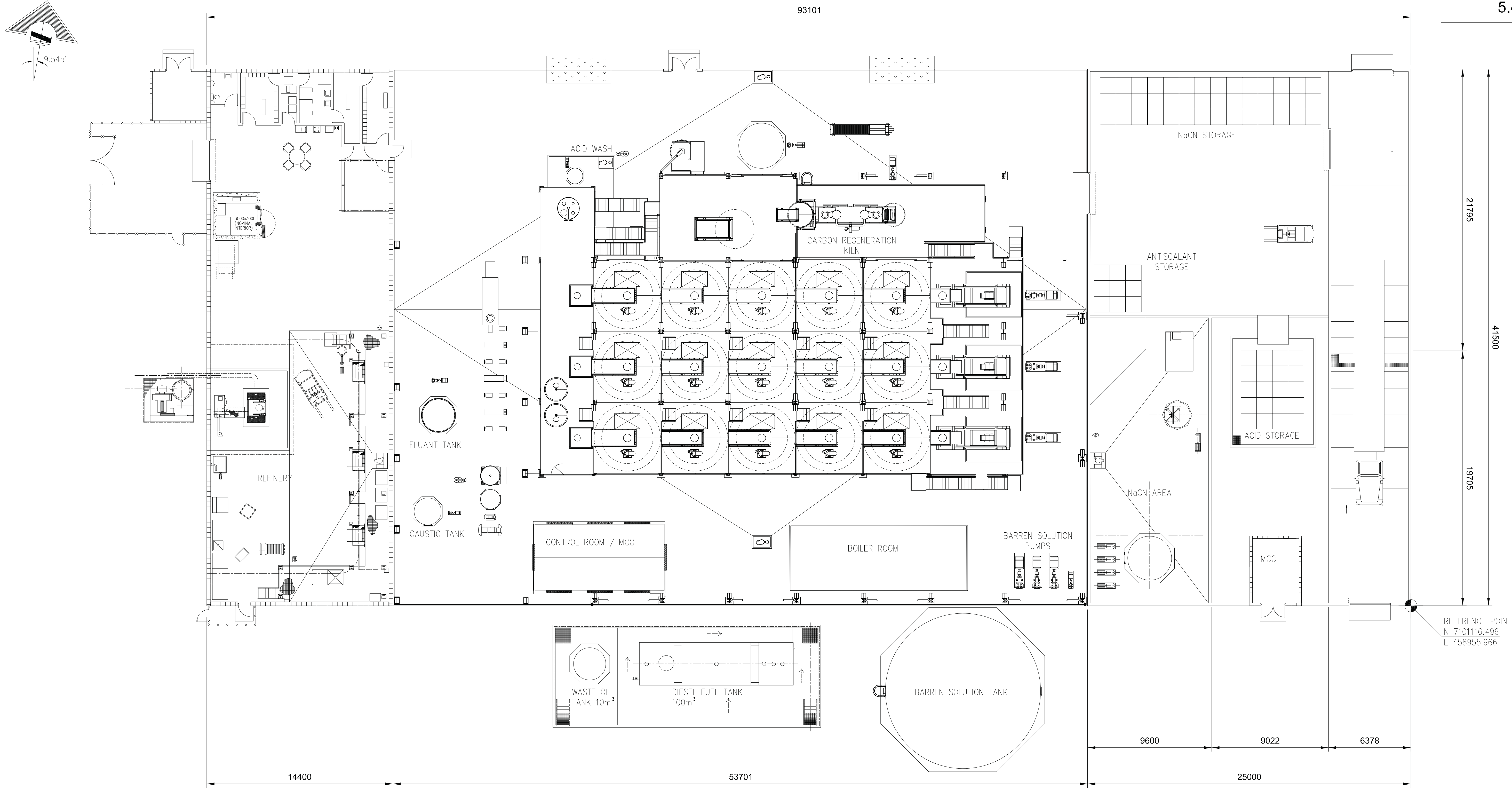
Victoria GOLD CORP

PROCESS PLANT AREA OVERVIEW PLAN

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION UTM - ZONE 8	DRAWN BY KP
DATUM NAD 83	CHECKED BY
DATE 8-November-2010	FIGURE NO. 5.4-17

Figure No.: 5.4-18

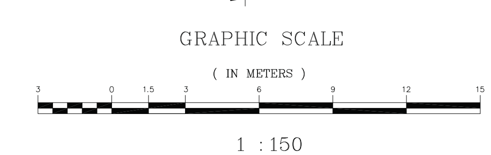


GENERAL ARRANGEMENT

SCALE- 1 : 150

PRELIMINARY

NOT FOR CONSTRUCTION



REFERENCE DRAWINGS

DWG. NO.	TITLE

REVISIONS

NO.	BY	CK'D	APPROVED	DATE	DESCRIPTION

REVISIONS

NO.	BY	CK'D	APPROVED	DATE	DESCRIPTION
A	KCA	WMR		16 NOV 09	ISSUED FOR REVIEW & COMMENT
B	PRV	WMR		17 DEC 09	REISSUED FOR REVIEW & COMMENT
C	PRV	WMR		21 JAN 10	REVISED COORDINATES FOR NEW POND LAYOUT
D	RT	WMR		08 APR 10	ADD 3RD TRAIN OF ADSORPTION COLUMNS
E					
F					
G					
H					
I					

Designed by: TOS 26 OCT 09
Drawn by: TJP 26 OCT 09
Checked by: WMR 12 NOV 09
Approved 1: –
Approved 2: –
Client Approval: –

PREPARED FOR

VICTORIA GOLD CORPORATION

PREPARED BY

KCA Kappes, Cassiday & Associates
7950 Security Circle, Reno, Nevada USA 89506
Telephone: (775) 972-7575 FAX: (775) 972-4567

Project: **EAGLE GOLD PROJECT**

Title: GENERAL ARRANGEMENT
RECOVERY PLANT AREA
PLAN VIEW

Job No.	Scale	ACAD Filename:
366G	1:150	8166-0128-13-001-D.dwg

8166 **0128-13-001** REV D

File: J:\DRAWINGS\Active Projects\Eagle Gold\13 General Arrangements\8166-0128-13-001-D.dwg LAST UPDATE: JUN 15, 2010 @ 5:02 PM BY: cad5 LAST REV: PLOT SCALE: 1:25.4

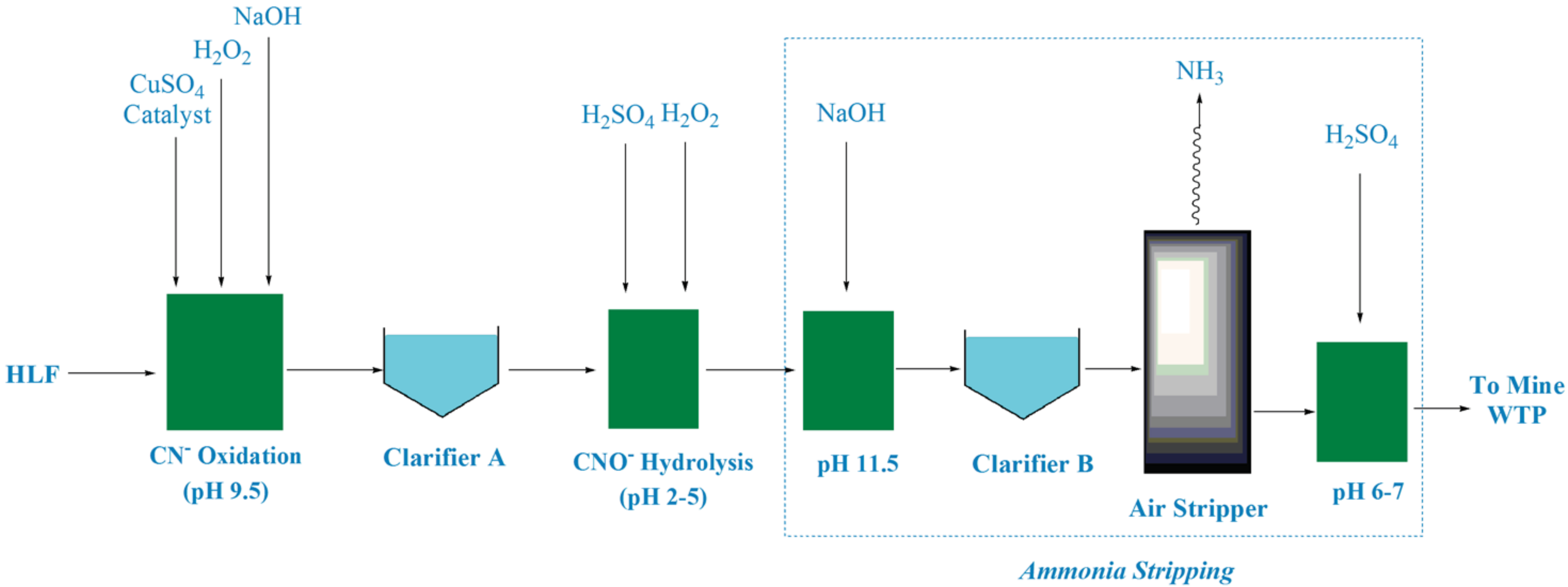
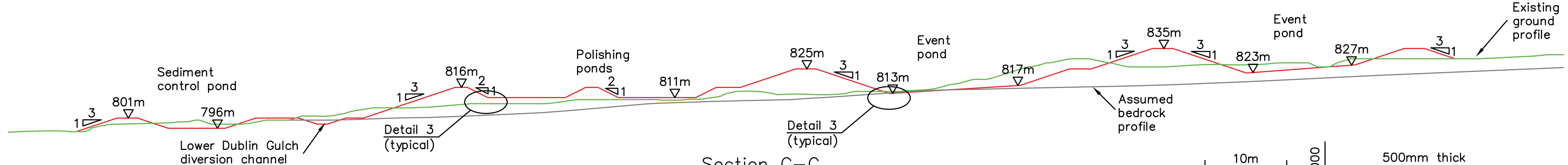


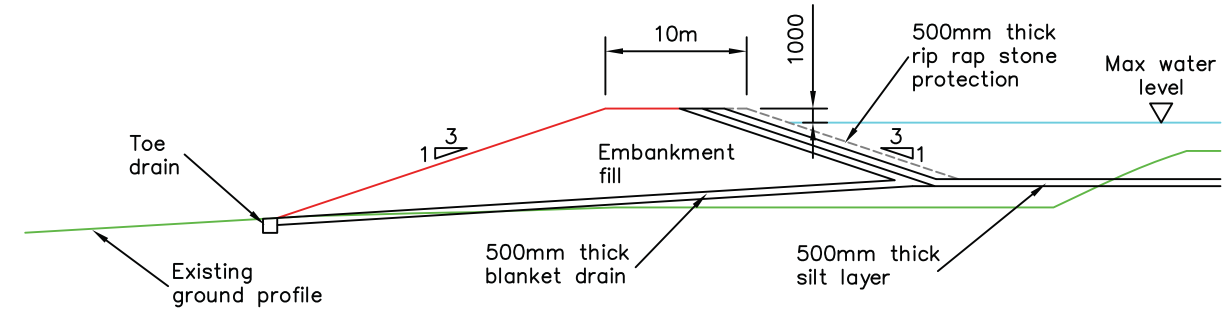
Figure No. 5.4 - 19 Cyanide Detoxification Plant Schematic

PRELIMINARY

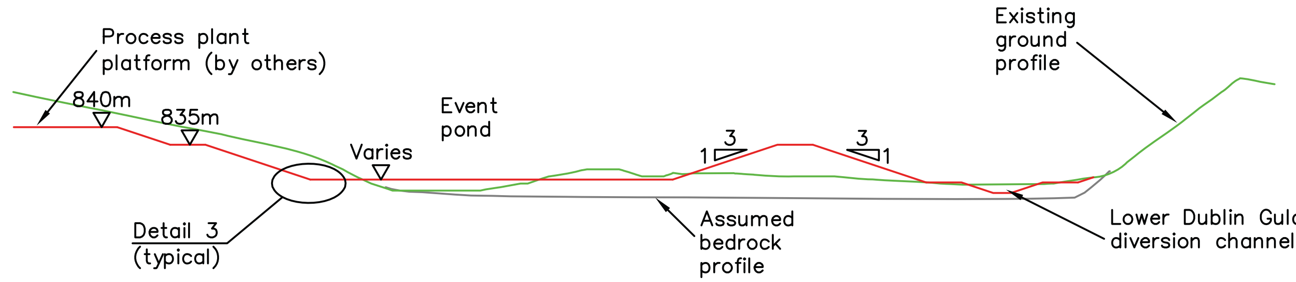
Figure No.: **5.4-20**



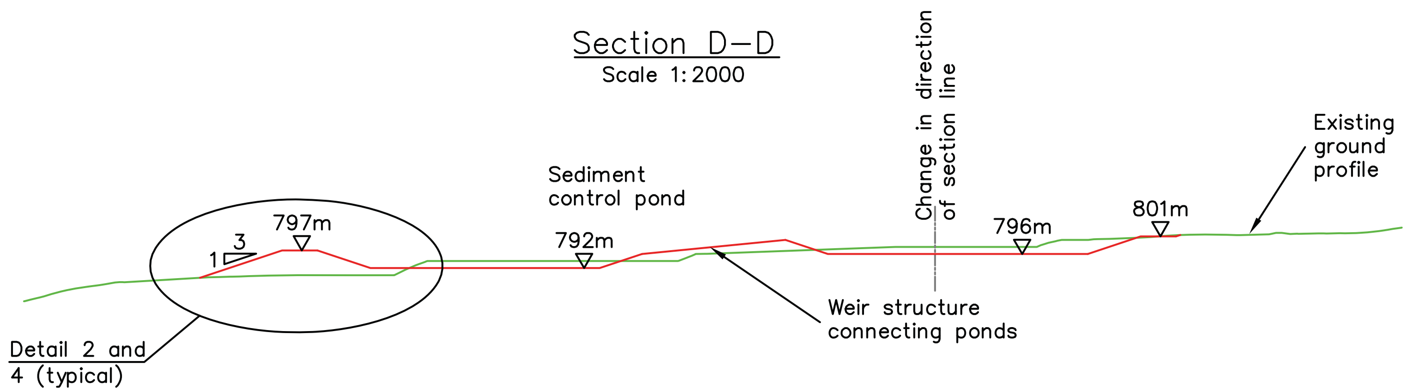
Section C–C
Scale 1:2000



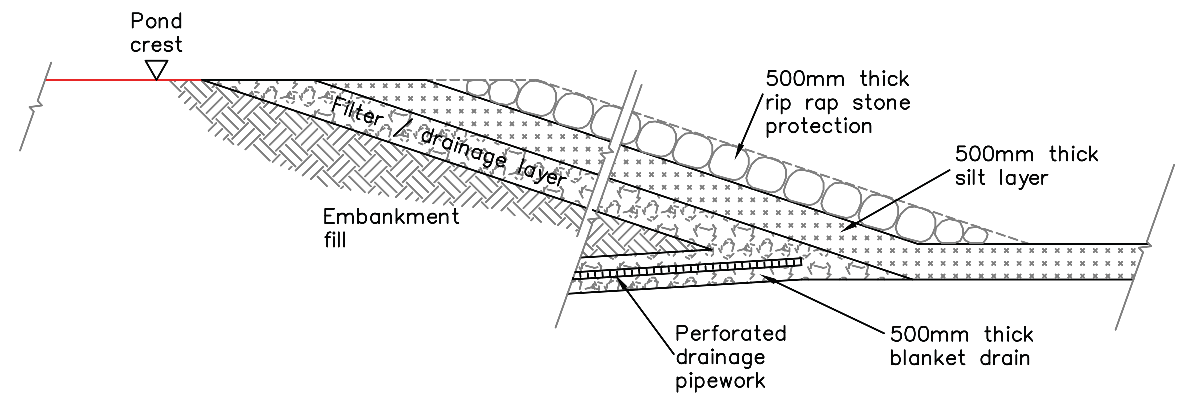
Detail 2
Sediment Control Pond Embankment
Scale 1:500



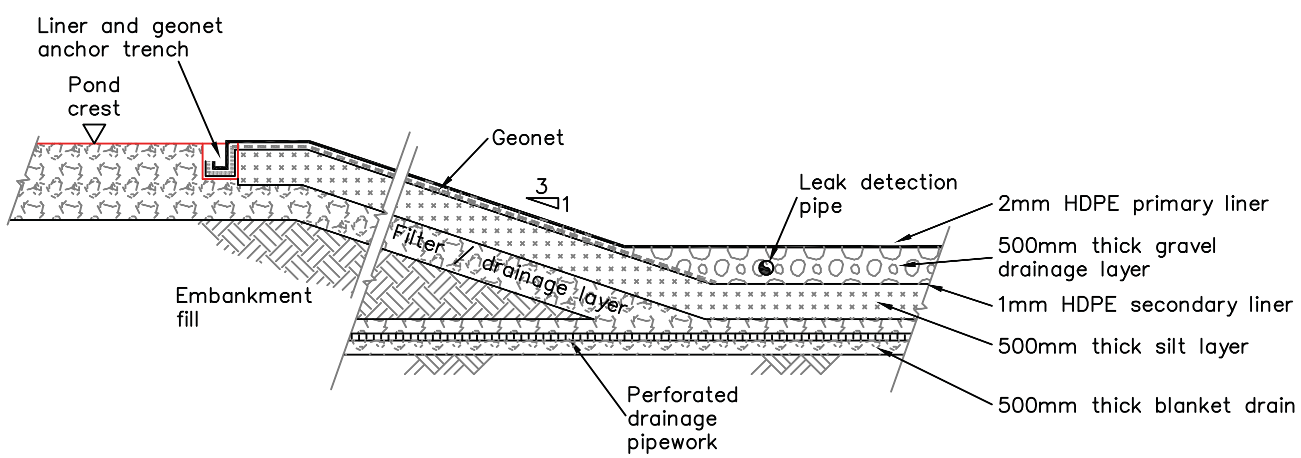
Section D–D
Scale 1:2000



Section E–E
Scale 1:2000



Detail 4
Liner for Sediment Control Pond
Scale 1:100



Detail 3
Liner for Event Ponds and Polishing Ponds
Scale 1:100

Notes

1. All dimensions are in millimetres and elevations in metres unless noted otherwise.
2. Contours are supplied by client with areas added from contours with elevations in feet converted into metres.
3. Refer to drawing D125666–101–1034 for locations of sections C, D and E and also details of the energy dissipater and lower Dublin Gulch diversion channel.

VICTORIA GOLD CORPORATION

EAGLE GOLD PRE FEASIBILITY STUDY

ANN GULCH HEAP LEACH FACILITY
LOWER DUBLIN GULCH
PROCESS PONDS
SECTIONS AND DETAILS

Scott Wilson

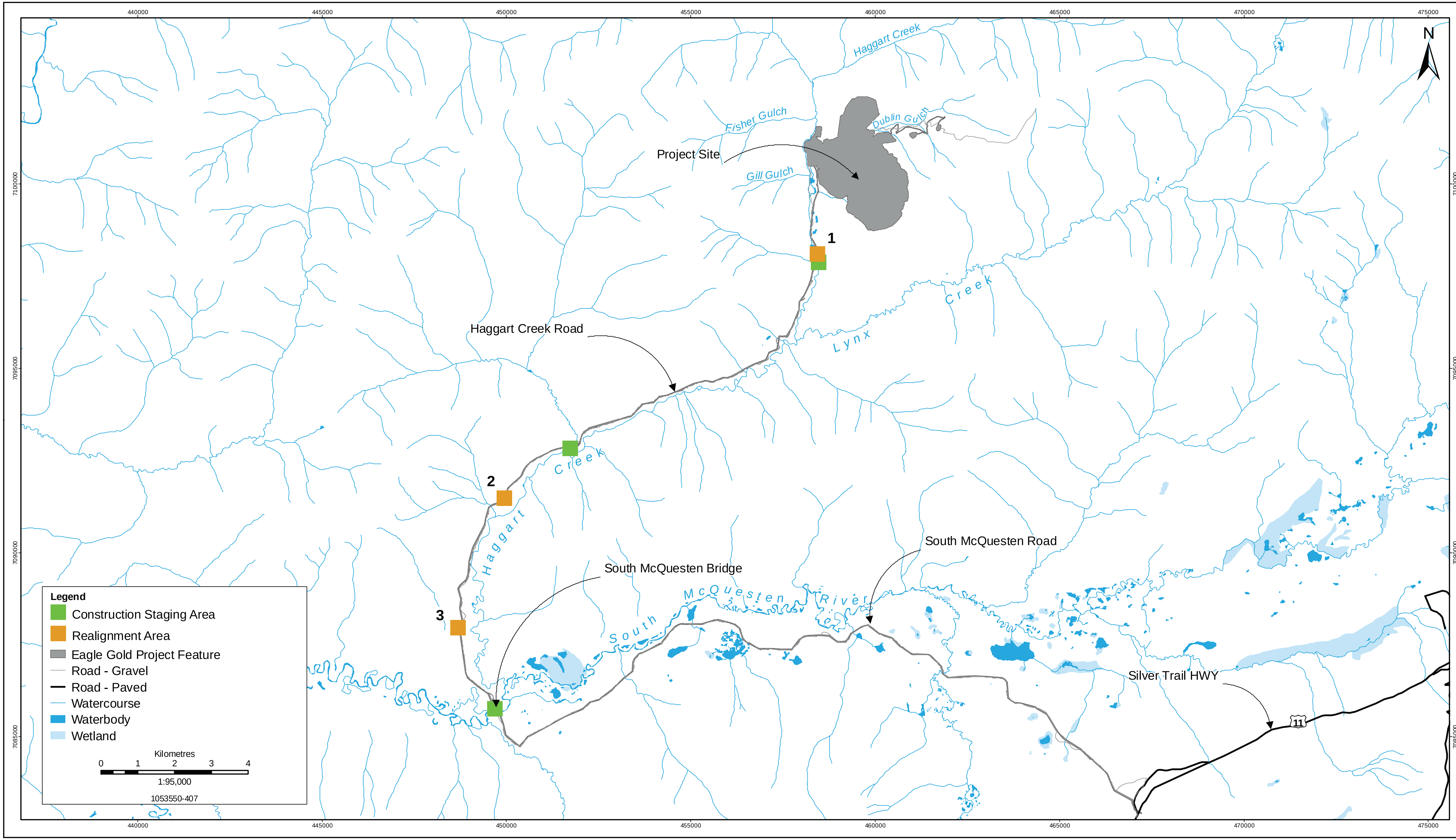
DESIGNED	DJB	JUN 10
DRAWN	DJT	JUN 10
DESIGN CHECK		
DRAWING CHECK	DJB	18–06–10
APPROVED	AMW	18–06–10

DRG. No.	REFERENCE DRAWINGS	No.	DATE	REVISION	MADE	CHKD.

SCALE UNLESS SHOWN 1:2000

ORIGINAL SIZE A3

DRG. No. D125666–101–1048 REV. P1



Data Sources; Government of Canada, Victoria Gold Corp.

Stantec
4370 Dominion Street
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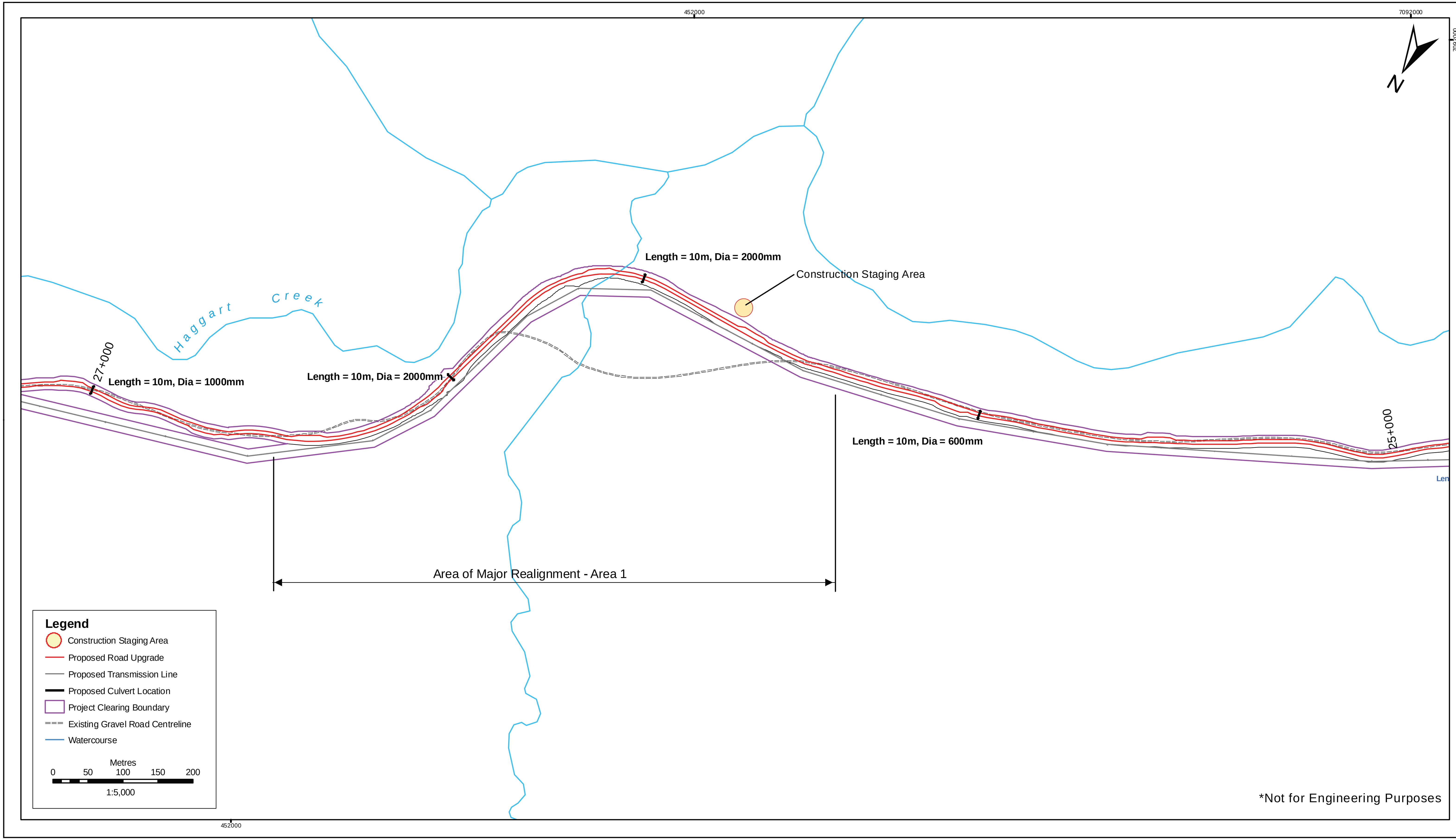
Victoria GOLD CORP

ACCESS ROAD AND TRANSMISSION LINE ROUTE WITH REALIGNMENT AREAS HIGHLIGHTED

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION	DRAWN BY
UTM - ZONE 8	LS
DATUM	CHECKED BY
NAD 83	RS
DATE	FIGURE NO.
8-November-2010	5.4-21



Data Sources; Government of Canada, Victoria Gold Corp.

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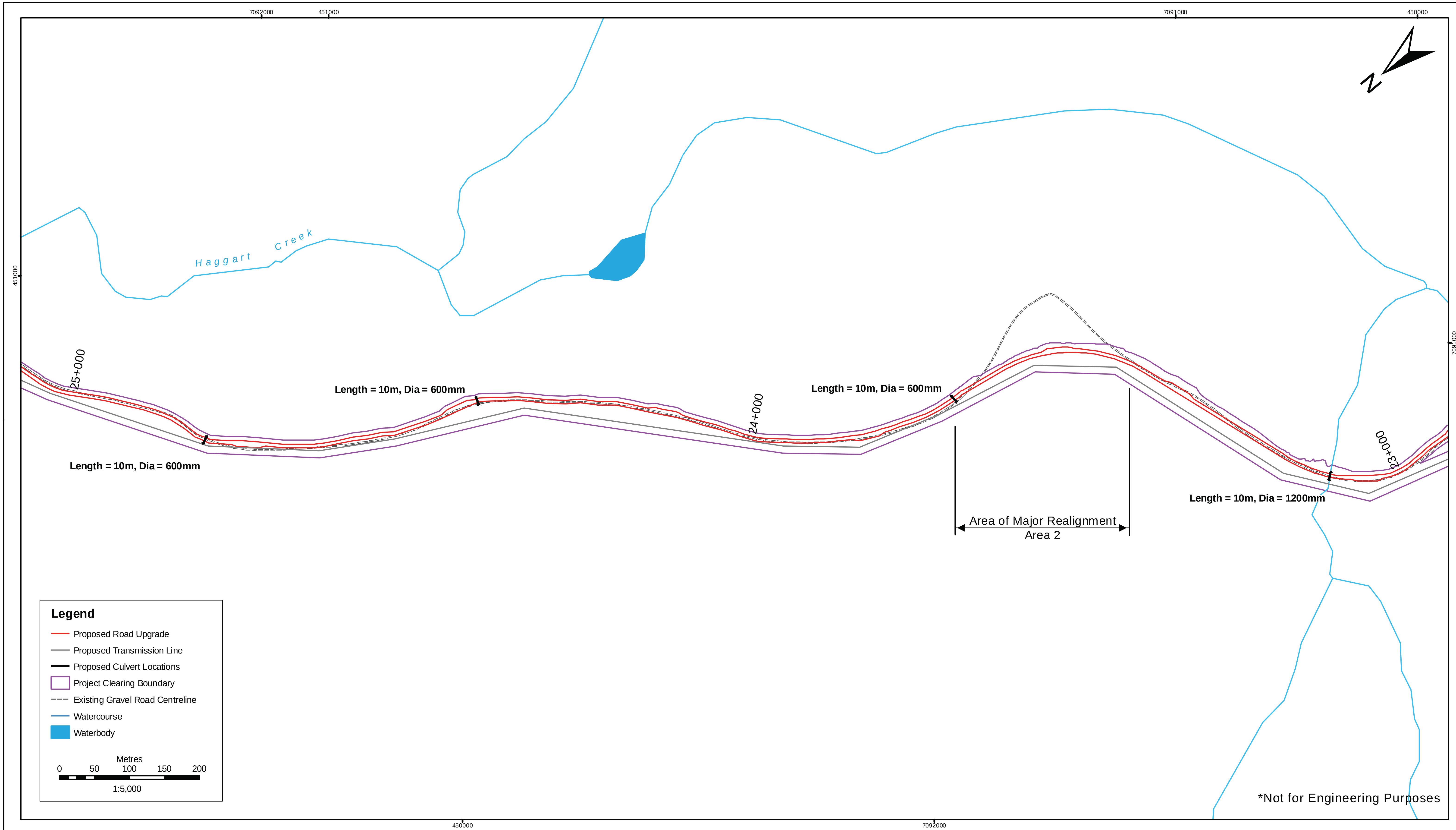
Victoria GOLD CORP

HAGGART CREEK ACCESS ROAD - PROPOSED UPGRADES
Realignment Area 1
EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION	DRAWN BY
UTM - ZONE 10	NP
DATUM	CHECKED BY
NAD 83	LS
DATE	FIGURE NO.
29-October-2010	5.4-22



Data Sources; Government of Canada, Victoria Gold Corp.

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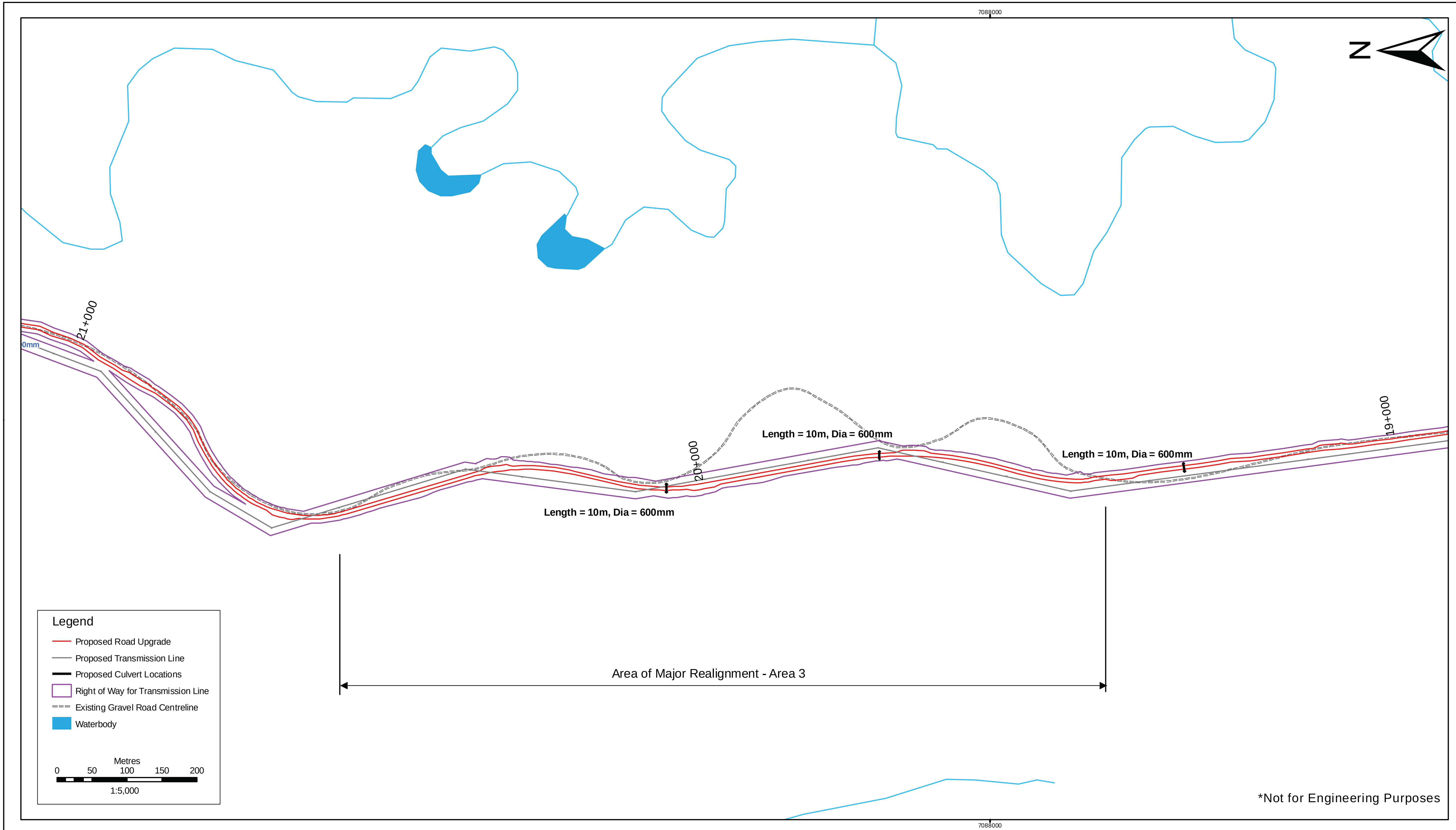
Victoria GOLD CORP

HAGGART CREEK ACCESS ROAD - PROPOSED UPGRADES
Realignment Area 2
EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION: UTM - ZONE 10	DRAWN BY: NP
DATUM: NAD 83	CHECKED BY: LS
DATE: 8-November-2010	FIGURE NO. 5.4-23



Data Sources; Government of Canada, Victoria Gold Corp.

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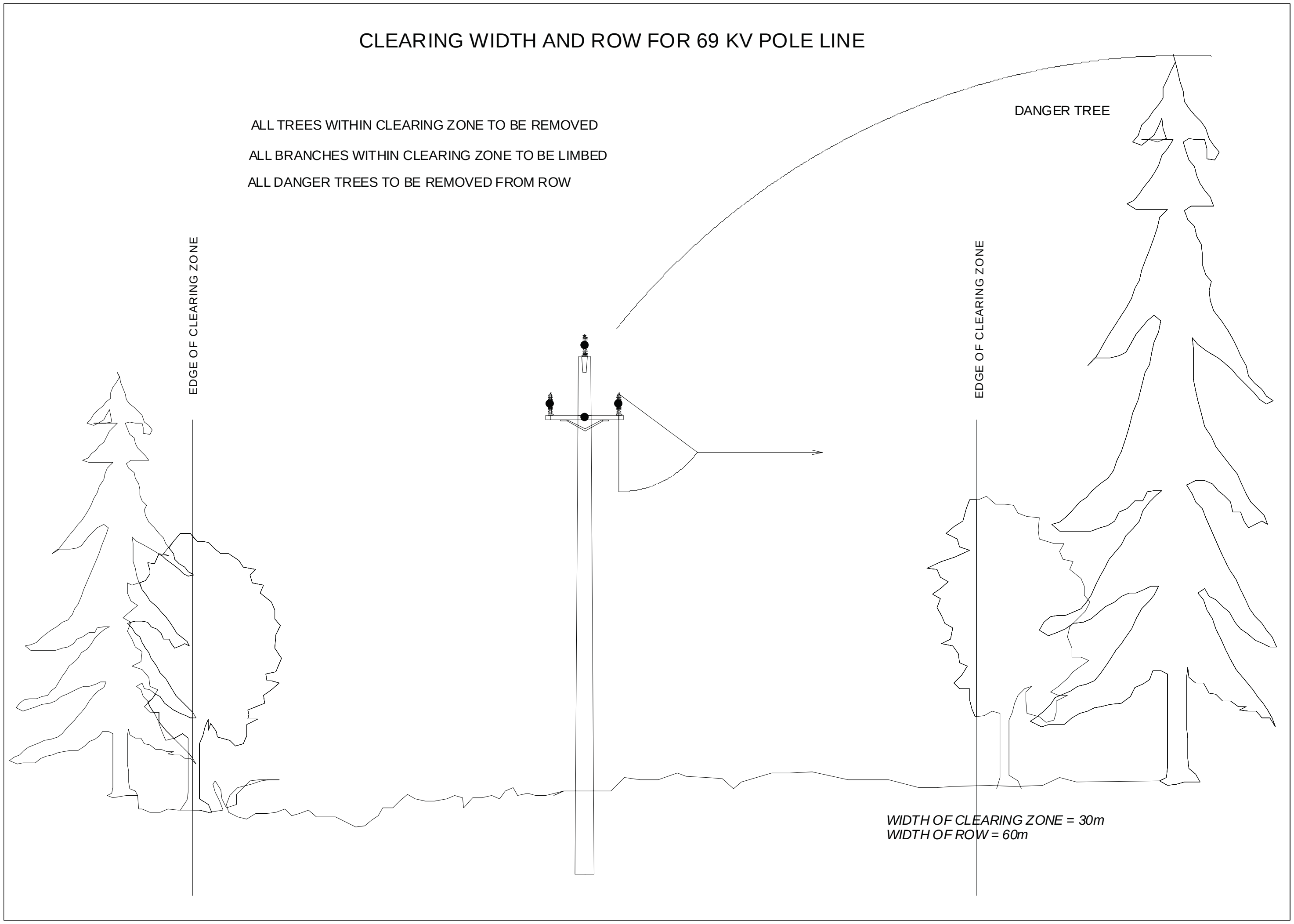
Victoria GOLD CORP

HAGGART CREEK ACCESS ROAD - PROPOSED UPGRADES
Realignment Area 3
EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION UTM - ZONE 10	DRAWN BY NP
DATUM NAD 83	CHECKED BY LS
DATE 8-November-2010	FIGURE NO. **5.4-24**



Data Sources: Government of Canada, Victoria Gold Corp.

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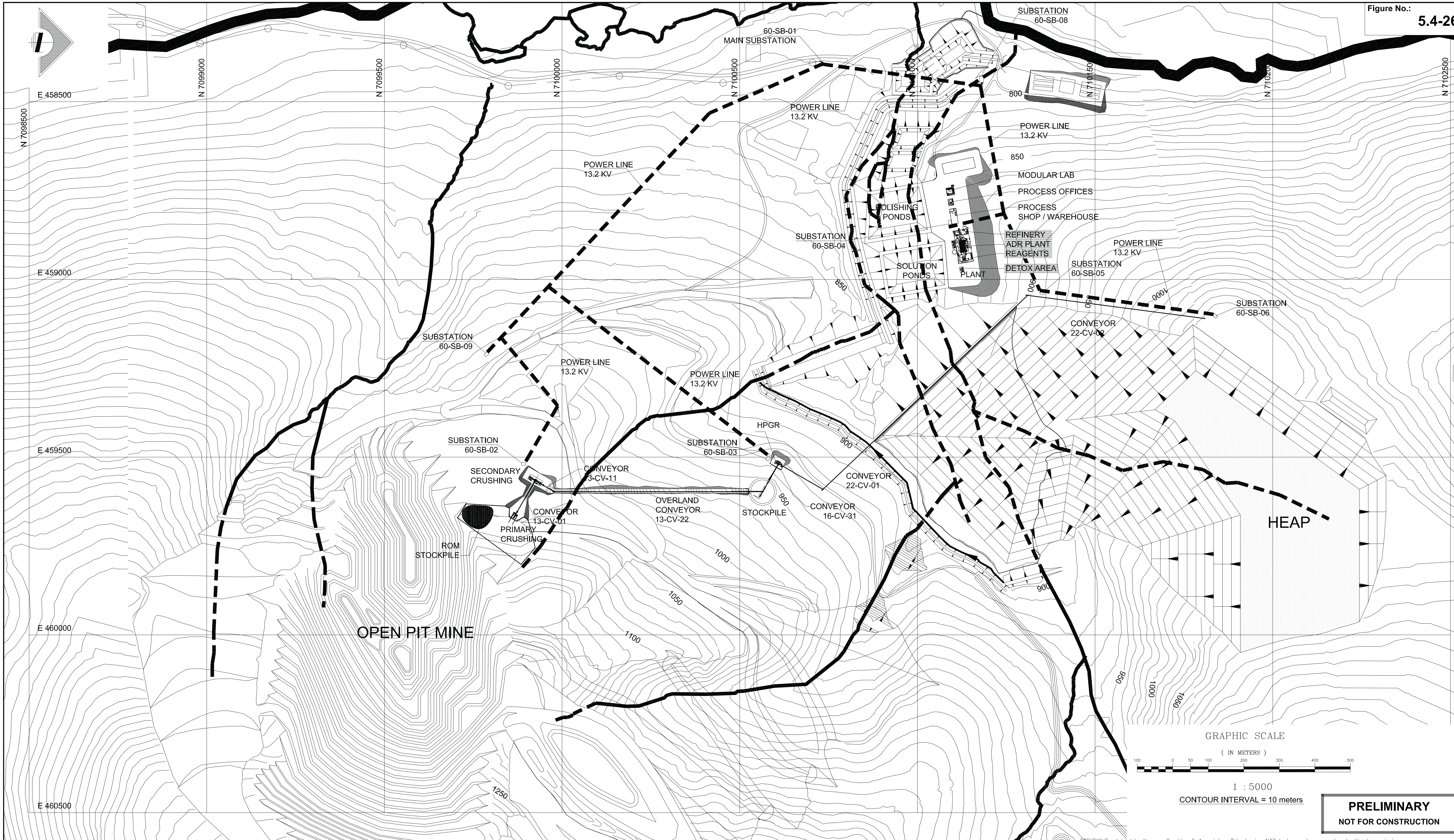
TRANSMISSION LINE RIGHT OF WAY TYPICAL SECTION

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION: UTM - ZONE 8	DRAWN BY: LS
DATUM: NAD 83	CHECKED BY: RS
DATE: 8-November-2010	FIGURE NO. 5.4-25

Figure No.: **5.4-26**



PRELIMINARY
NOT FOR CONSTRUCTION

REFERENCE DRAWINGS

DWG. NO.	TITLE
0360-27-001	POWER SITE DISTRIBUTION SINGLE LINE

REVISIONS

NO.	BY	CK'D	APPROVED	DATE	DESCRIPTION
A	KCA	WMR		18 DEC 09	ISSUED FOR REVIEW & COMMENT
B	KCA	WMR		11 JAN 10	ISSUED FOR PRE-FEASIBILITY STUDY
C	PRV	WMR		21 JAN 10	REVISED FOR POND LAYOUT
D	PRV	WMR		18 FEB 10	REVISED FOR MINE ROAD AND PIT LAYOUT
E	PRV	WMR		25 MAY 10	UPDATED PLANT AREA AND ADDED ROM STOCKPILE
F					
G					
H					
I					

Designed by: SOG 14 DEC 09
Drawn by: PRV 11 JAN 10
Checked by: WMR 11 JAN 10
Approved 1: -
Approved 2: -
Client Approval: -

PREPARED FOR
VICTORIA GOLD CORPORATION

PREPARED BY
Kappes, Cassiday & Associates
KCA
7950 Security Circle, Reno, Nevada USA 89506
Telephone: (775) 972-7575 FAX: (775) 972-4567

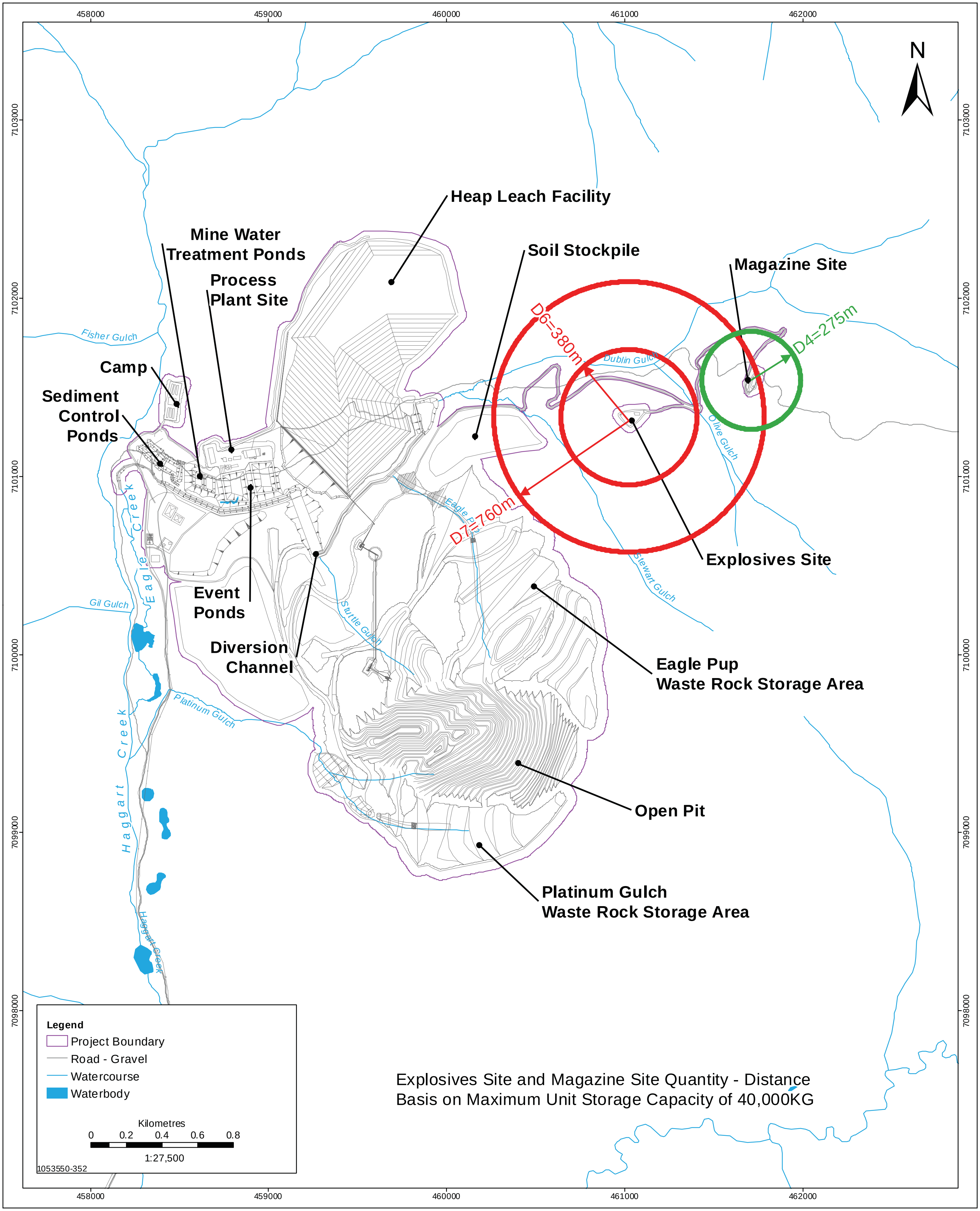
Project: **EAGLE GOLD PROJECT**

Title: POWER SITE DISTRIBUTION
13.2 KV POWERLINE
ELECTRICAL
LAYOUT

Job No.	Scale	ACAD Filename:
366G	PER PLAN	8166-0360-27-600-E.dwg

8166 **0360-27-600** REV E

File: J:\DRAWINGS\Active Projects\Eagle Gold\27 Electrical\8166-0360-27-600-E.dwg LAST UPDATE: JUN 15, 2010 @ 5:20 PM BY: cad5 LAST REV: PLOT SCALE: 1:25.4



Data Sources; Government of Canada, Victoria Gold Corp.

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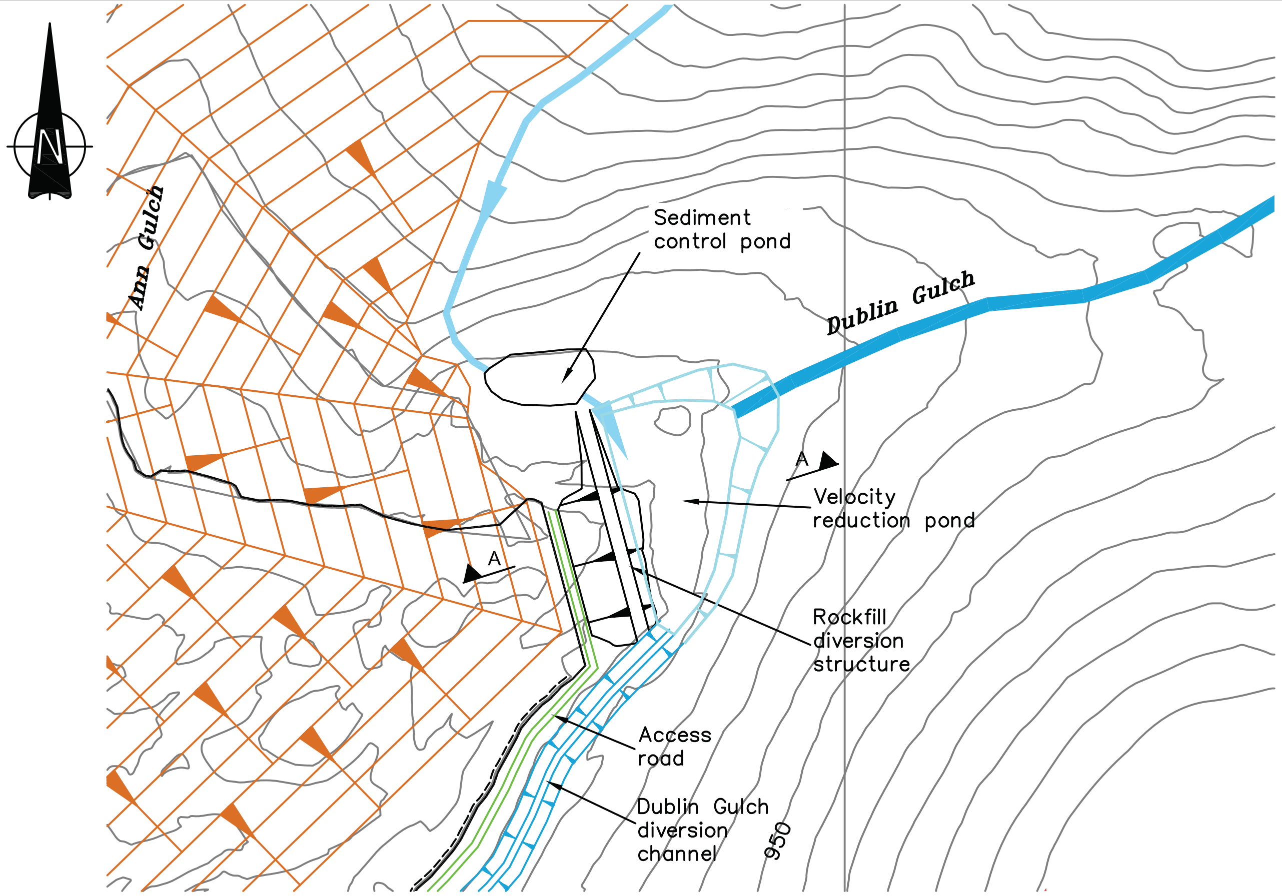
Victoria GOLD CORP

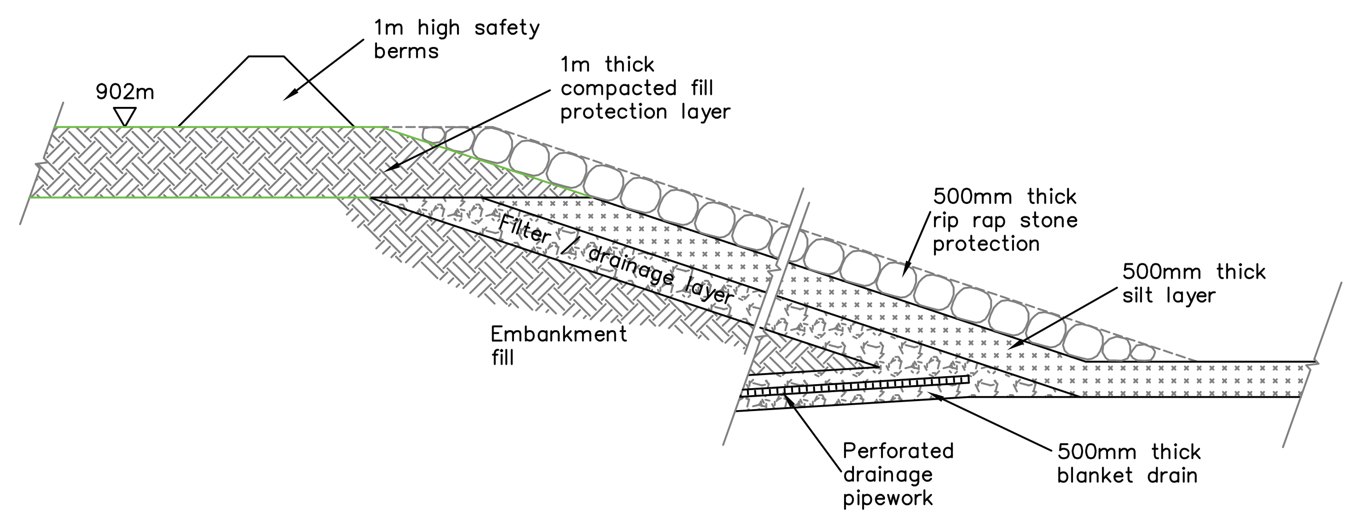
EXPLOSIVES AND MAGAZINE SITE LOCATION AND DISTANCE FROM PROJECT FACILITIES

EAGLE GOLD PROPERTY
YUKON TERRITORY

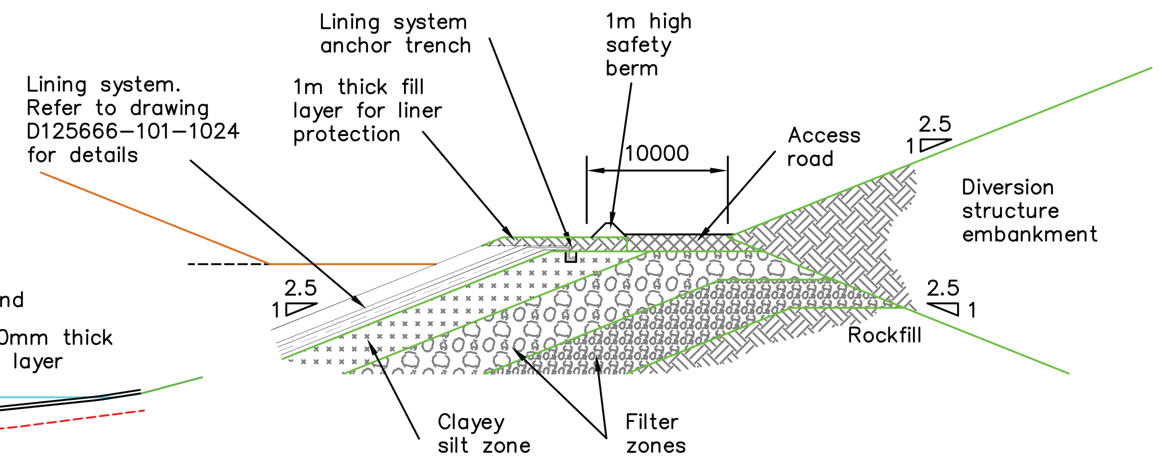
PROJECTION	DRAWN BY
UTM - ZONE 8	LS
DATUM	CHECKED BY
NAD 83	RS
DATE	FIGURE NO.
3-November-2010	5.4-27

Figure No.: **5.4-28**

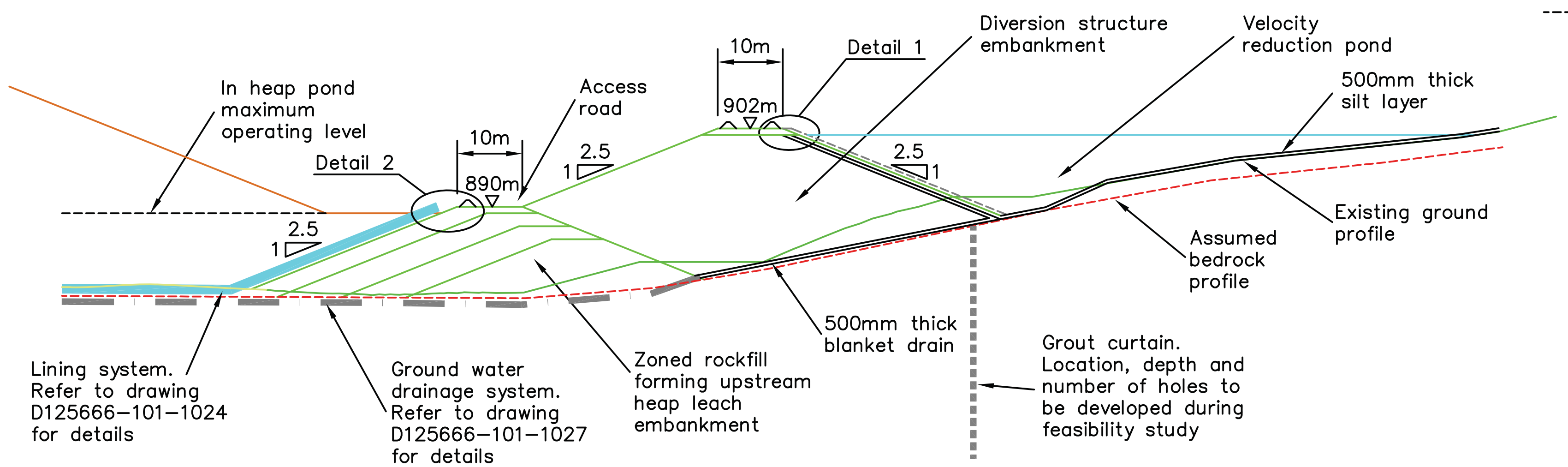




Detail 1
Typical Diversion Structure Lining
Scale 1:100



Detail 2
Typical Heap Leach Facility Lining
Scale 1:500



Section A–A
Scale 1:1000

Notes:
1. All dimensions are in millimetres and elevations in metres unless noted otherwise.

VICTORIA GOLD CORPORATION

EAGLE GOLD PRE FEASIBILITY STUDY

DESIGNED	DJB	JUN 10	DRG. No.
DRAWN	DJT	JUN 10	
DESIGN CHECK			
DRAWING CHECK	DJB	JUN 10	
APPROVED	AMW	24-06-10	

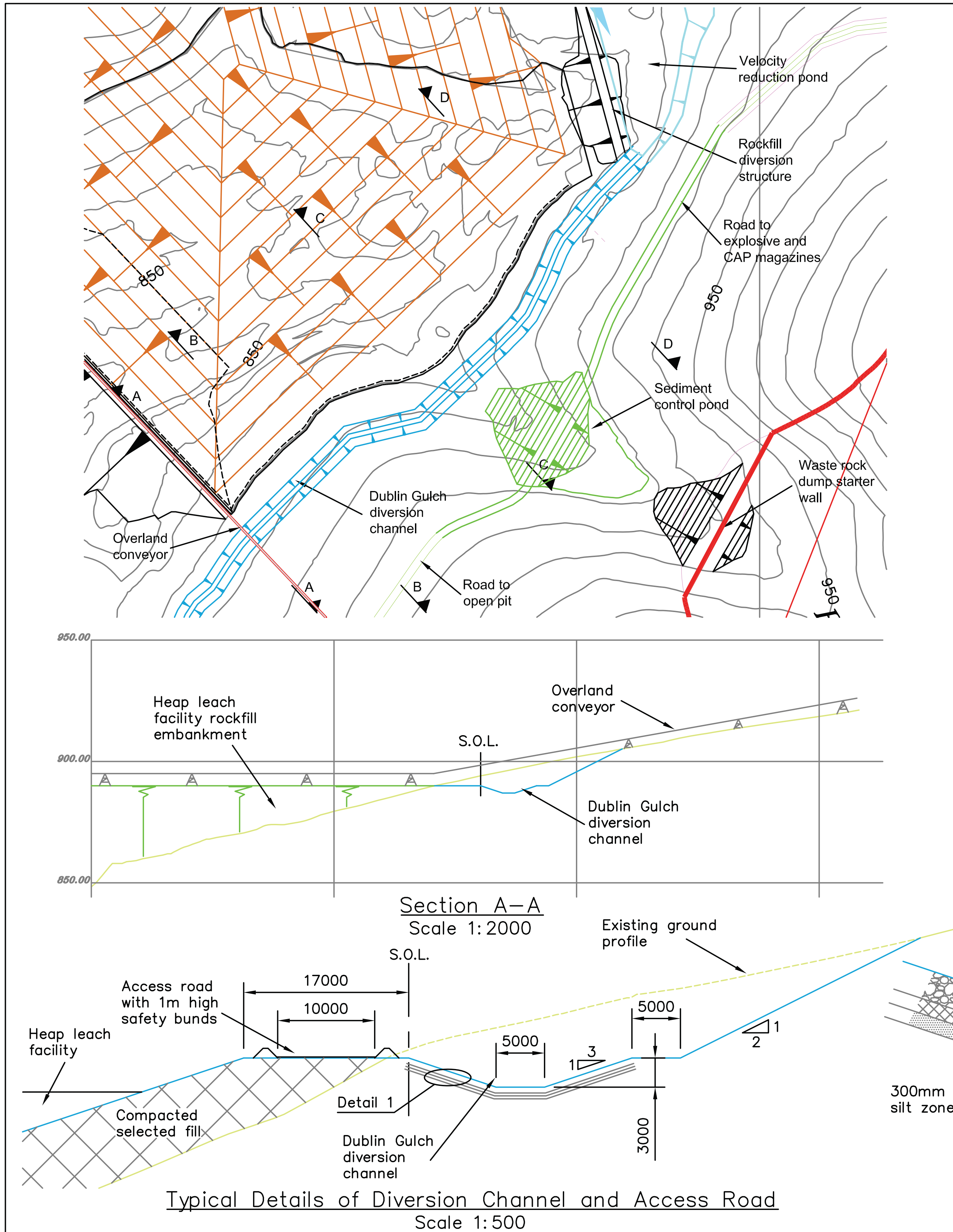
REFERENCE DRAWINGS	No.	DATE	REVISION	MADE	CHKD.

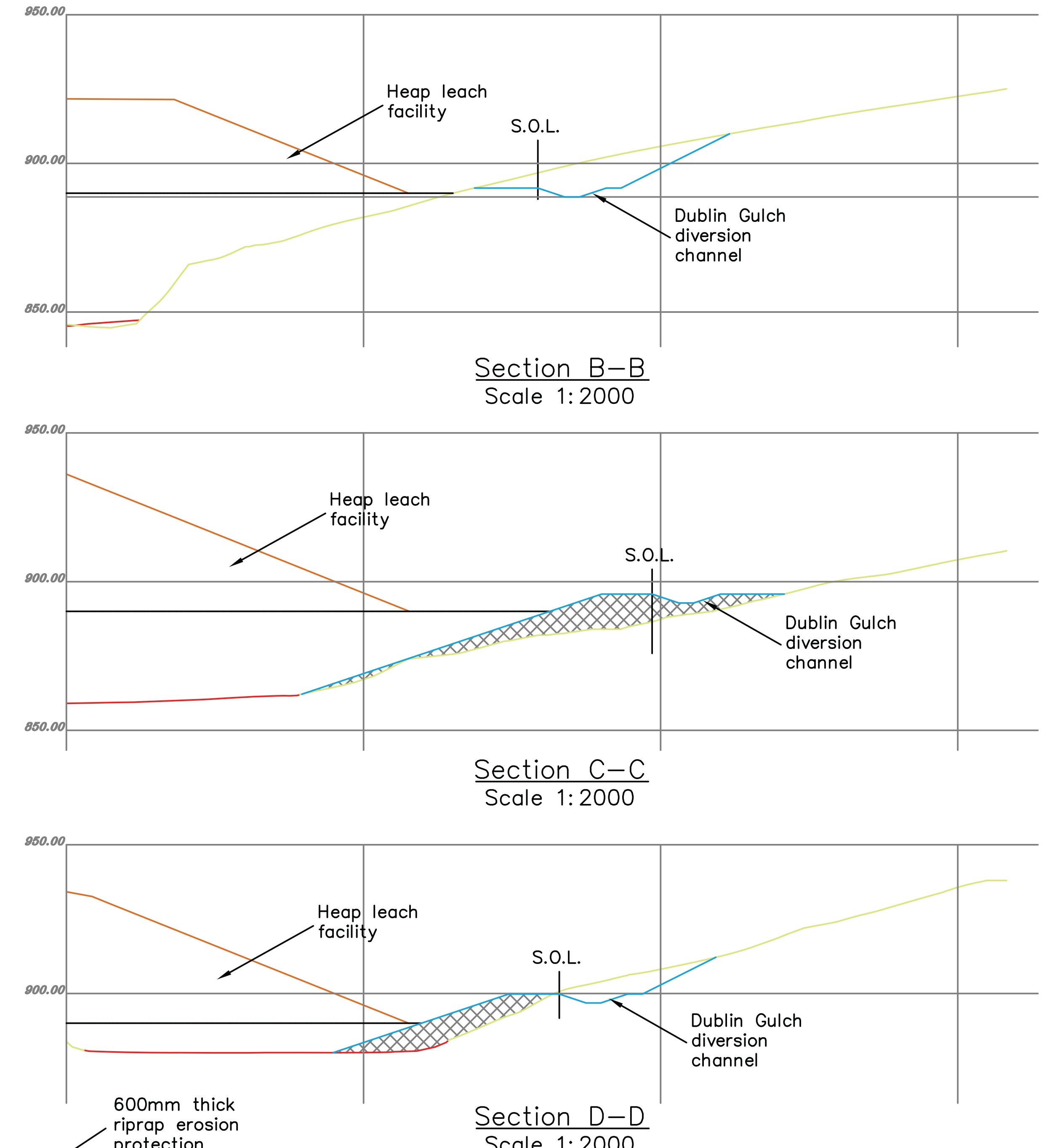
SCALE UNLESS SHOWN
1:5 000
ORIGINAL SIZE A3

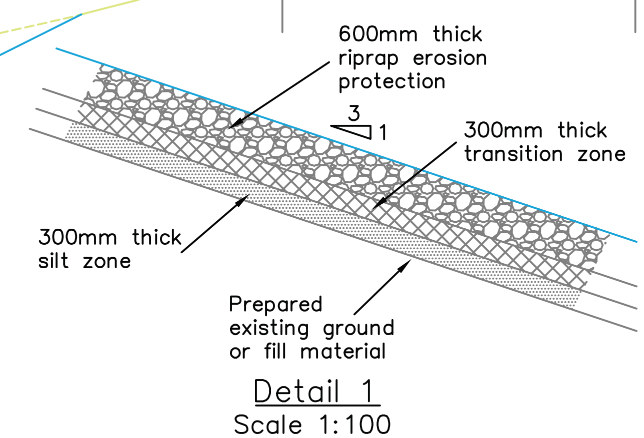
ANN GULCH HEAP LEACH FACILITY
CENTRAL DUBLIN GULCH
RIVER DIVERSION STRUCTURE
SECTIONS AND DETAILS

DRG. No. D125666–101–1049 REV. P1

Figure No.: **5.4-29**







Notes:

1. All dimensions are in millimetres and elevations in metres unless noted otherwise.

VICTORIA GOLD CORPORATION

EAGLE GOLD PRE FEASIBILITY STUDY

ANN GULCH HEAP LEACH FACILITY
CENTRAL DUBLIN GULCH
RIVER DIVERSION CHANNEL DETAILS

DESIGNED	DJB	NOV 09
DRAWN	DJT	NOV 09
DESIGN CHECK		
DRAWING CHECK		
APPROVED	AMW	27/05/10

DRG. No. | REFERENCE DRAWINGS

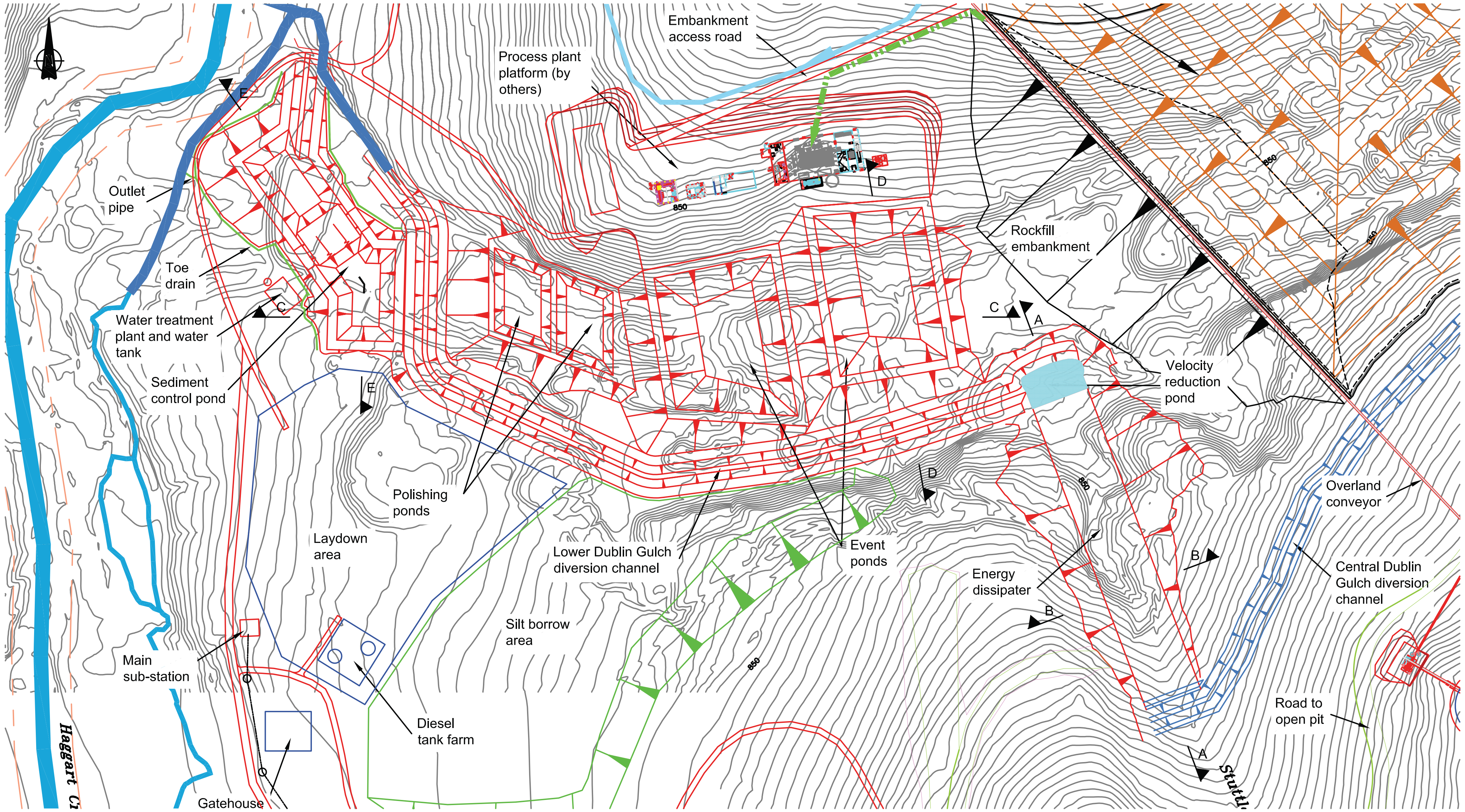
No.	DATE	REVISION	MADE	CHKD.
P2	13/05/10	Update open pit and waste rock dump footprints. Revise crusher location. Add conveyor and plant site buildings.	DJT	DJB
P3	27/05/10	Access road revised, velocity reduction pond added	DJT	DJB

SCALE UNLESS SHOWN 1:5 000
ORIGINAL SIZE A3

DRG. No. D125666-101-1026 REV. P3

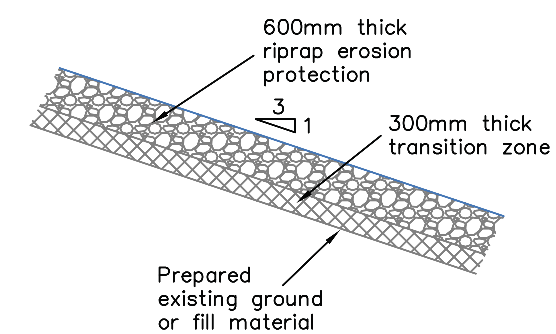
PRELIMINARY

Figure No.: **5.4-30**

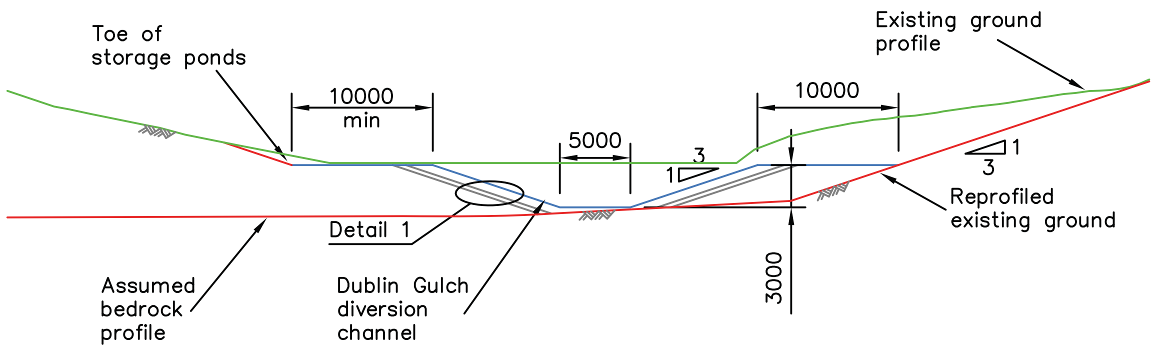


Notes

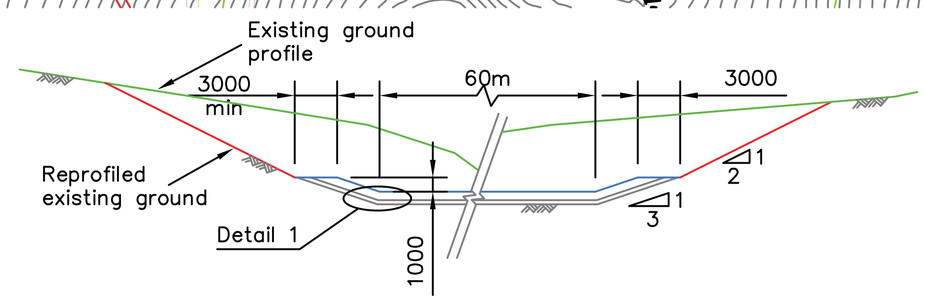
1. All dimensions are in millimetres and elevations in metres unless noted otherwise.
2. Contours are supplied by client with areas added from contours with elevations in feet converted into metres.
3. Refer to drawing D125666-101-1048 for details of sections C, D and E together with liner system and anchor trench details.



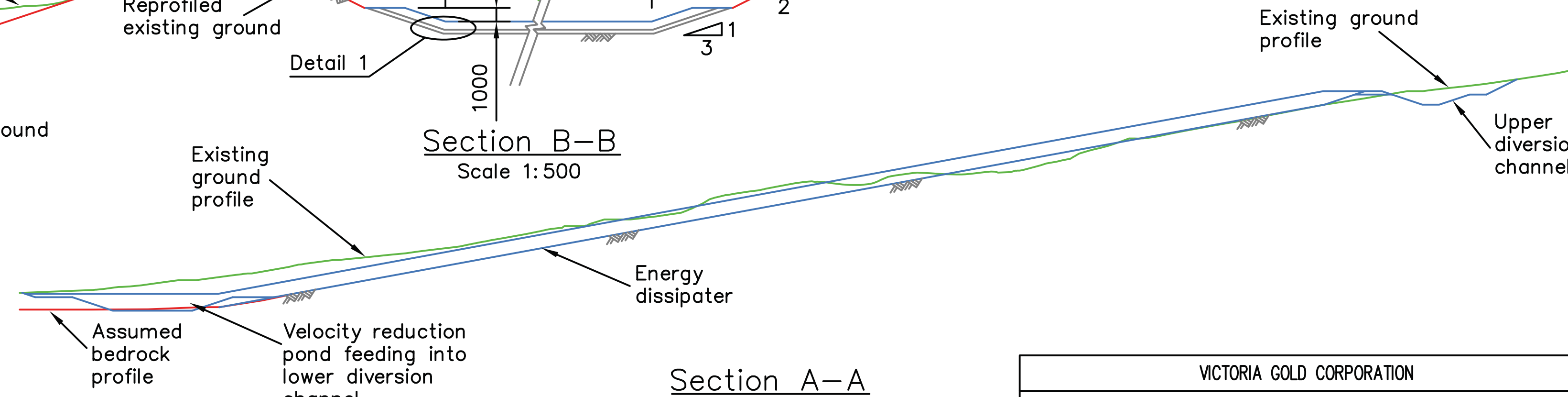
Detail 1
Scale 1:100



Typical Section of Lower Dublin Gulch Diversion Channel
Scale 1:500



Section B–B
Scale 1:500



Section A–A
Scale 1:2000

DESIGNED	SD	DEC 09	DRG. No.	REFERENCE DRAWINGS	No.	DATE	REVISION	MADE	CHKD.
DRAWN	DJT	DEC 09			P2	21/12/09	Mine site area revised, annotations added	DJT	AMW
DESIGN CHECK					P3	13/05/10	Update open pit and waste rock dump footprints. Revise crusher location. Add conveyor and plant site buildings.	DJT	DJB
DRAWING CHECK									
APPROVED	AMW	04/06/10			P4	04/06/10	Laydown area, diesel tank farm and access roads revised, velocity reduction pond and Section B–B added	DJT	AMW

SCALE UNLESS SHOWN 1:5 000
ORIGINAL SIZE A3

VICTORIA GOLD CORPORATION
EAGLE GOLD PRE FEASIBILITY STUDY

ANN GULCH HEAP LEACH FACILITY
LOWER DUBLIN GULCH
RIVER DIVERSION CHANNEL DETAILS
AND ENERGY DISSIPATER

DRG. No. D125666-101-1034 REV. P4

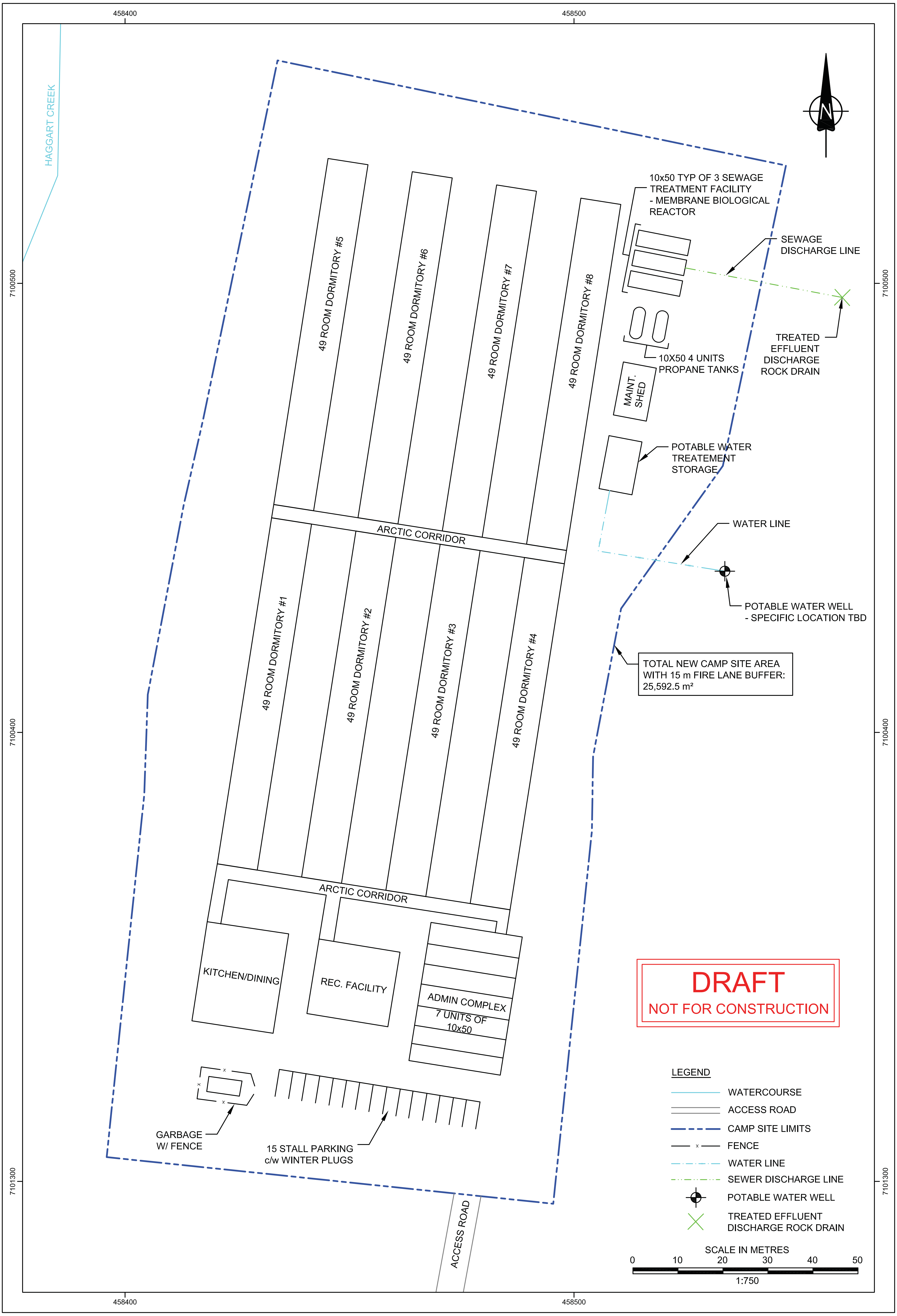


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FIGURE 5.4-31
PRELIMINARY CONSTRUCTION CAMP SITE LAYOUT
EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION	DRAWN BY
UTM - ZONE 8	GH
DATUM	CHECKED BY
NAD 83	MP
DATE	FIGURE NO.
05-May-2011	5.4-31

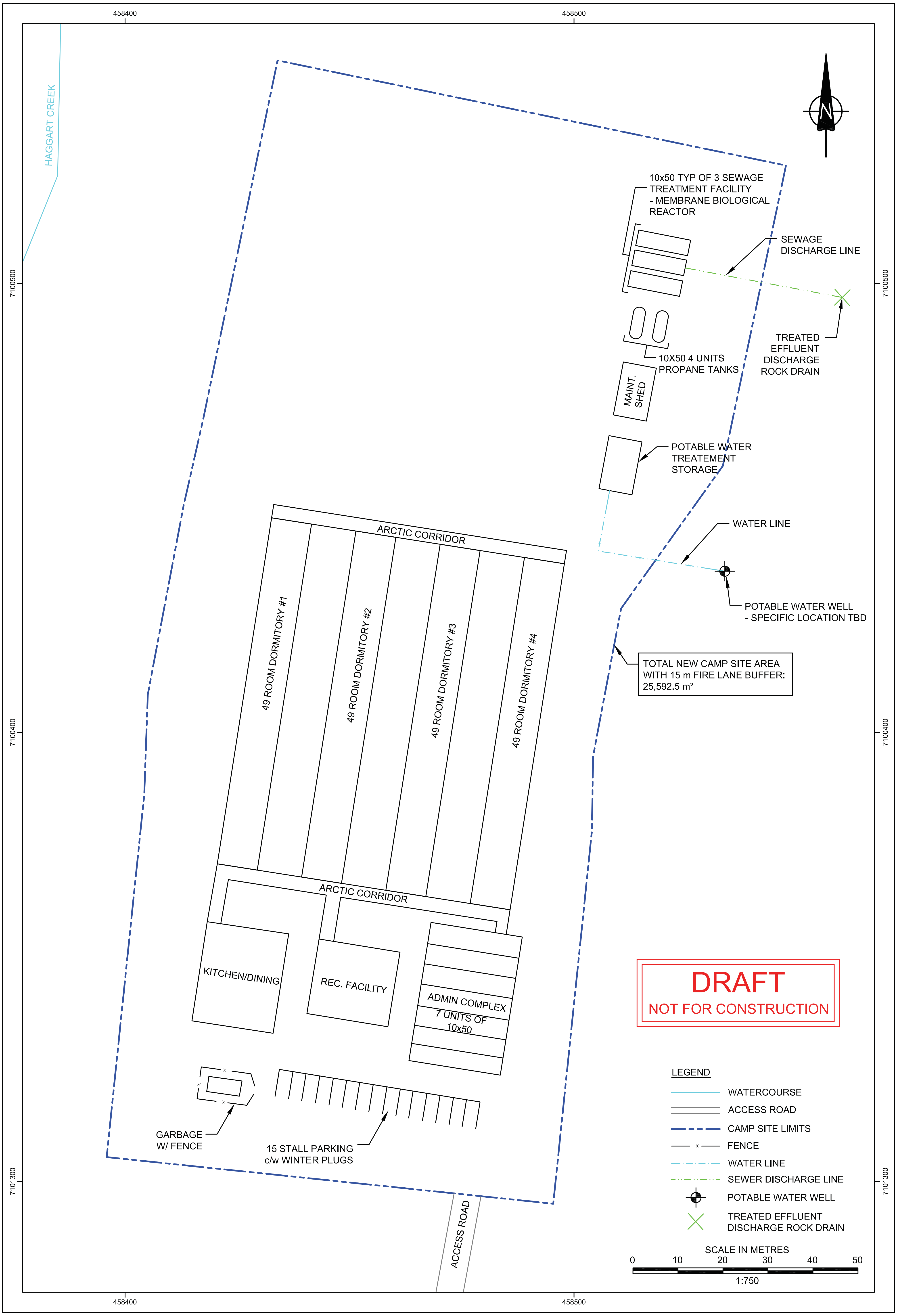

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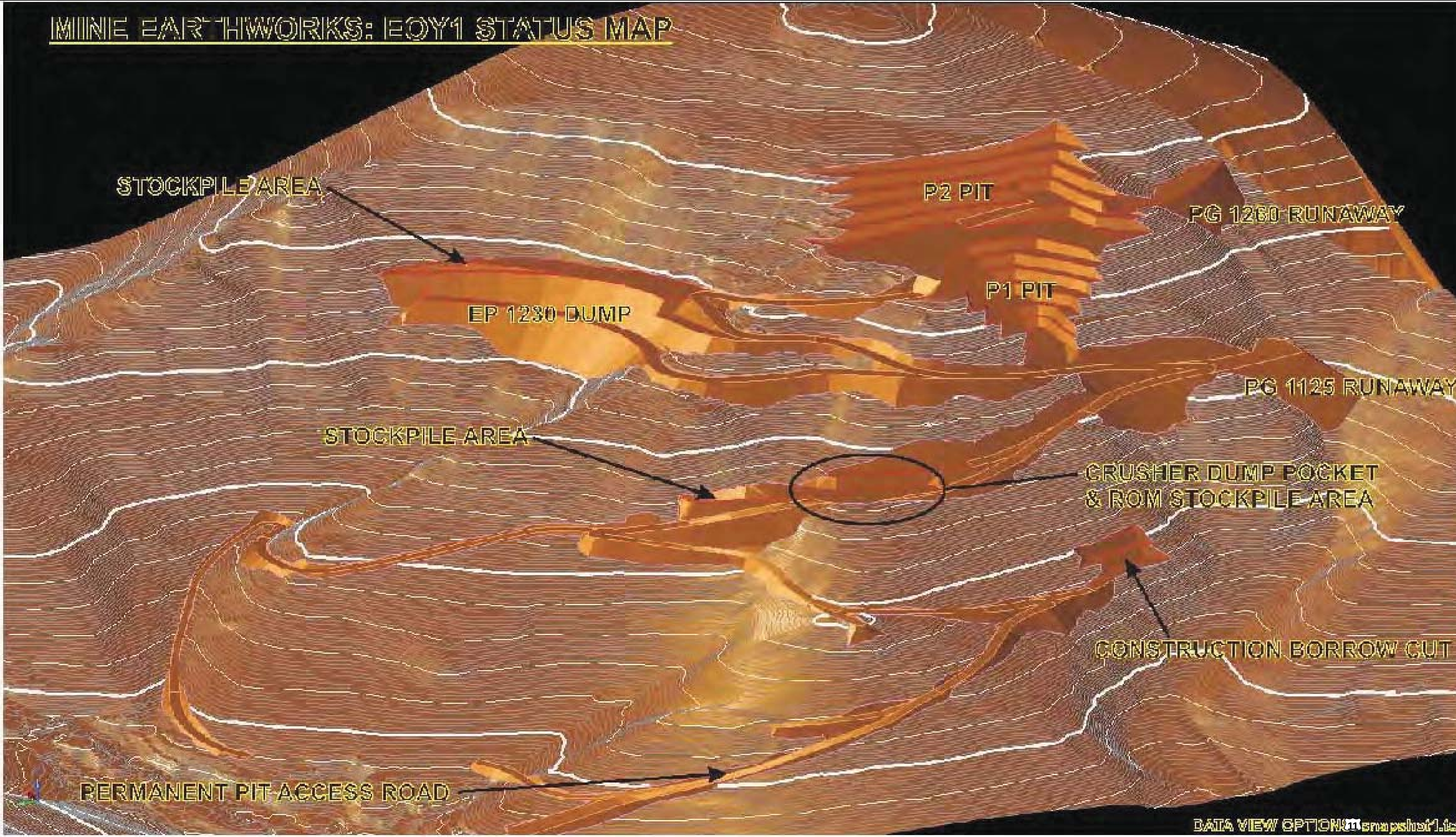
FIGURE 5.4-32
PRELIMINARY OPERATIONS CAMP SITE LAYOUT
EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION: UTM - ZONE 8	DRAWN BY: GH
DATUM: NAD 83	CHECKED BY: MP
DATE: 05-May-2011	FIGURE NO. 5.4-32



Data Sources; Government of Canada, Victoria Gold Corp.

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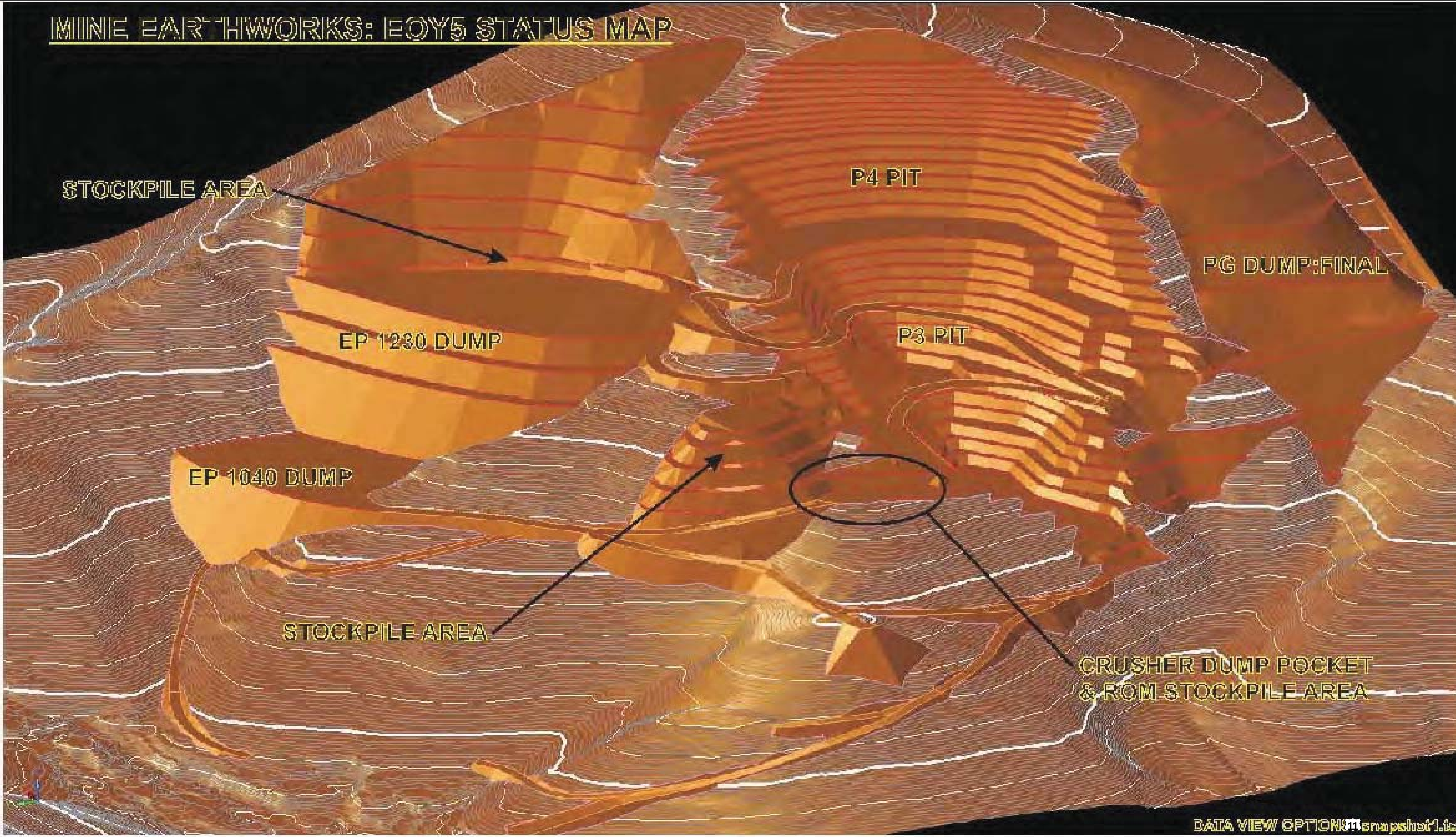
OPEN PIT AND WRSA's ISOMETRIC VIEW - END OF OPERATION YEAR 1

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION	DRAWN BY
UTM - ZONE 8	LS
DATUM	CHECKED BY
N1AD 83	RS
DATE	FIGURE NO.
3-November-2010	**5.5-1**



Data Sources; Government of Canada, Victoria Gold Corp.

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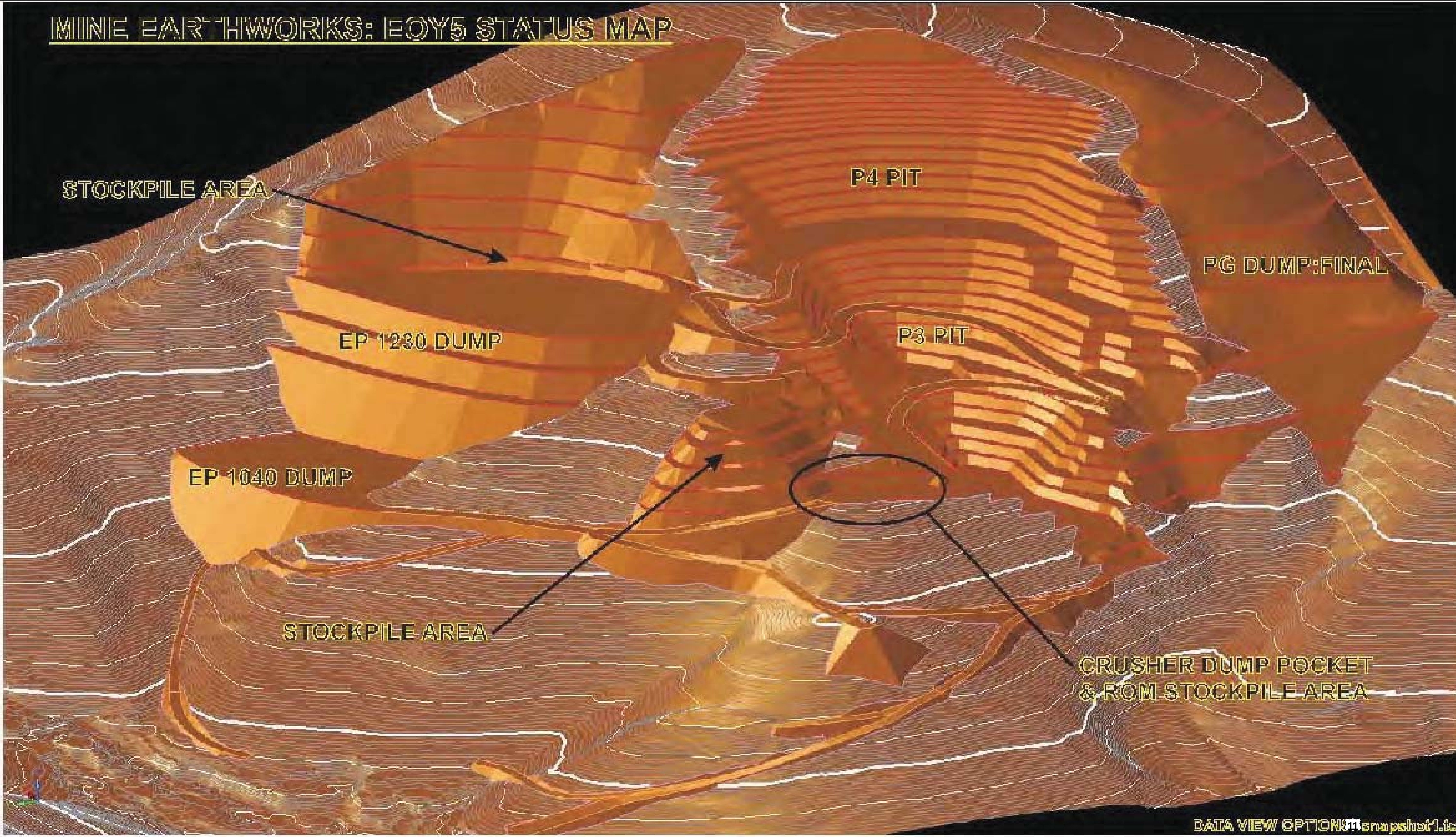
Victoria Gold Corp

OPEN PIT AND WRSA's ISOMETRIC VIEW - END OF OPERATION YEAR 3

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION: UTM - ZONE 8	DRAWN BY: LS
DATUM: NAD 83	CHECKED BY: RS
DATE: 3-November-2010	FIGURE NO. 5.5-2



Data Sources; Government of Canada, Victoria Gold Corp.

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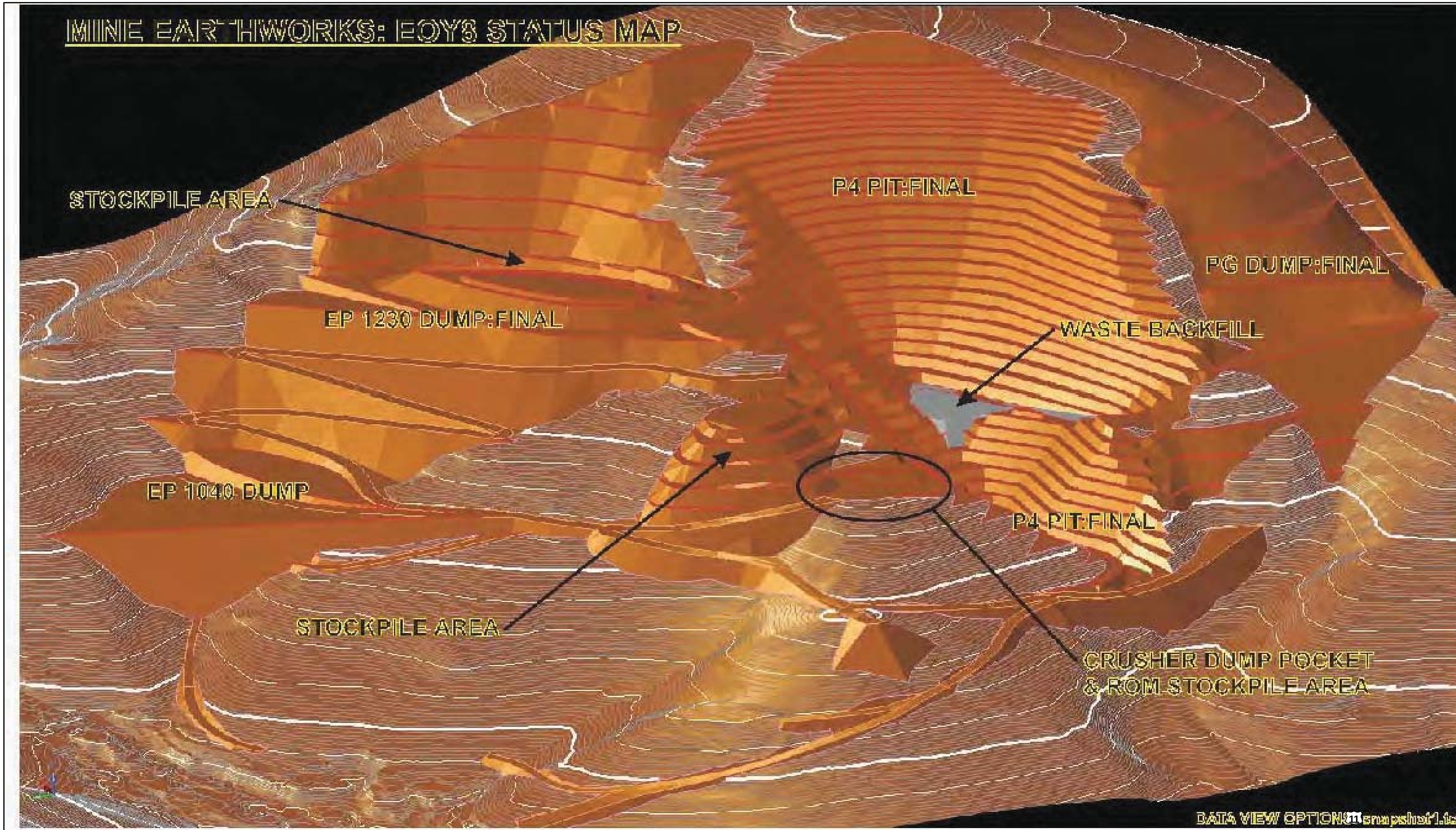
Victoria GOLD CORP

OPEN PIT AND WRSA's ISOMETRIC VIEW - END OF OPERATION YEAR 5

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION UTM - ZONE 8	DRAWN BY LS
DATUM NAD 83	CHECKED BY RS
DATE 3-November-2010	FIGURE NO. 5.5-3



Data Sources; Government of Canada, Victoria Gold Corp.

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Victoria GOLD CORP

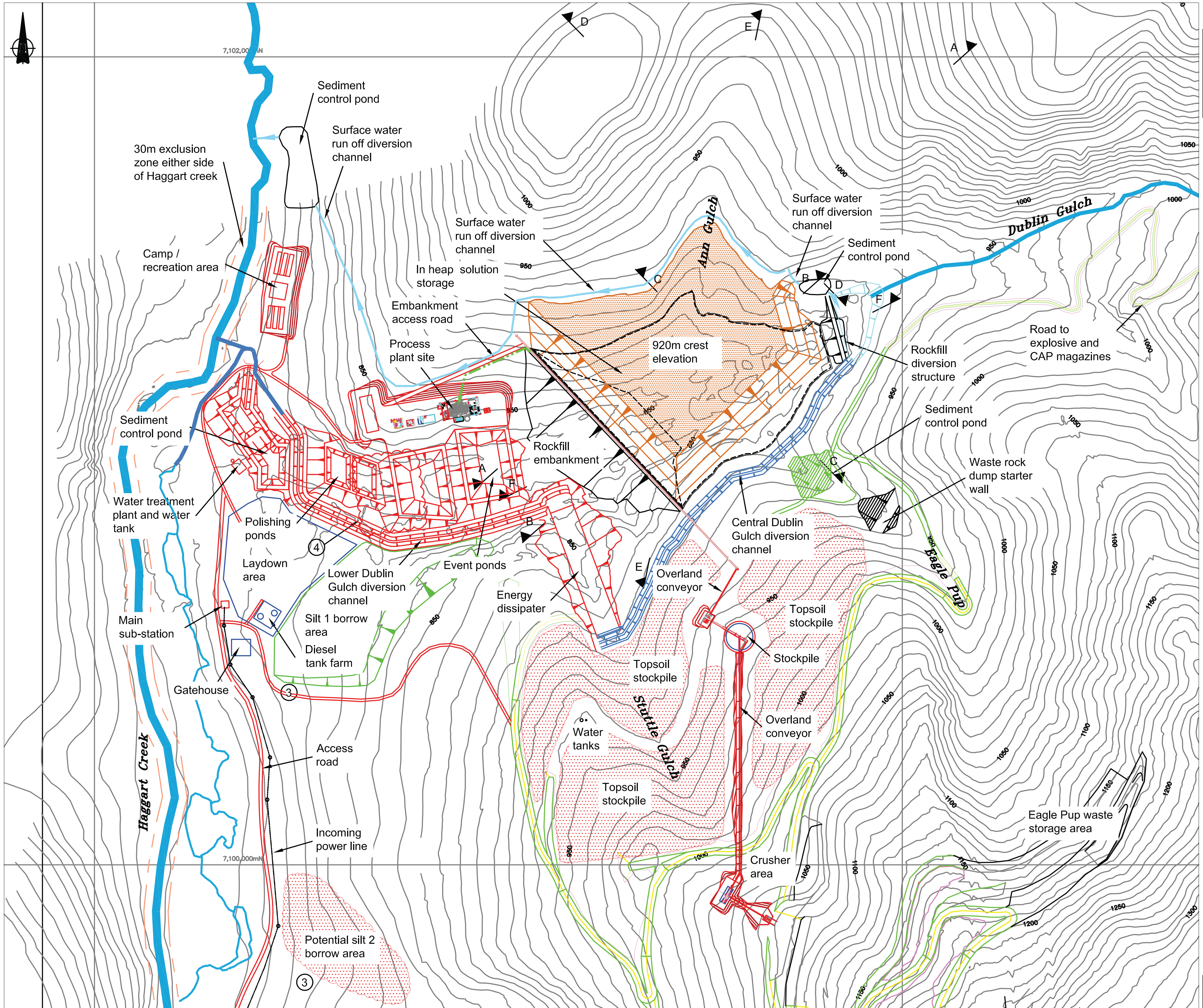
OPEN PIT AND WRSA's ISOMETRIC VIEW - END OF OPERATION YEAR 8

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION UTM - ZONE 8	DRAWN BY LS
DATUM NAD 83	CHECKED BY RS
DATE 3-November-2010	FIGURE NO. 5.5-4

PRELIMINARY

Figure No.: **5.5-5**



Notes

1. Rock for embankment fill to be provided from open pit.
2. Gravel and sands for drainage requirements to be screened from placer tailings deposits in Dublin Gulch & Haggart Creek (not shown).
3. Fine material (silts) for liner construction to be provided from borrow pits.
4. Area required for embankment and liner construction activities.
5. Area requirement for energy dissipation of flow in Dublin Gulch diversion.
6. Contours are supplied by client with areas added from contours with elevations in feet converted into metres.
7. Erosion control measures (surface runoff channels and sediment control ponds) are required for borrow areas and stockpiles. (Not shown on this drawing)

DESIGNED	SD	OCT 09	DRG. No.
DRAWN	DJT	OCT 09	
DESIGN CHECK			
DRAWING CHECK			
APPROVED	AMW	27/05/10	

REFERENCE DRAWINGS

No.	DATE	REVISION	MADE	CHKD.
P3	13/05/10	Update open pit and waste rock dump footprints. Revise crusher location. Add conveyor and plant site buildings.	DJT	DJB
P4	27/05/10	Laydown area, diesel tank farm and access roads revised, Topsoil stockpiles added. Footprint of borrow area 1 and diversion channel updated	DJT	DJB

SCALE UNLESS SHOWN 1:10 000
ORIGINAL SIZE A3

VICTORIA GOLD CORPORATION

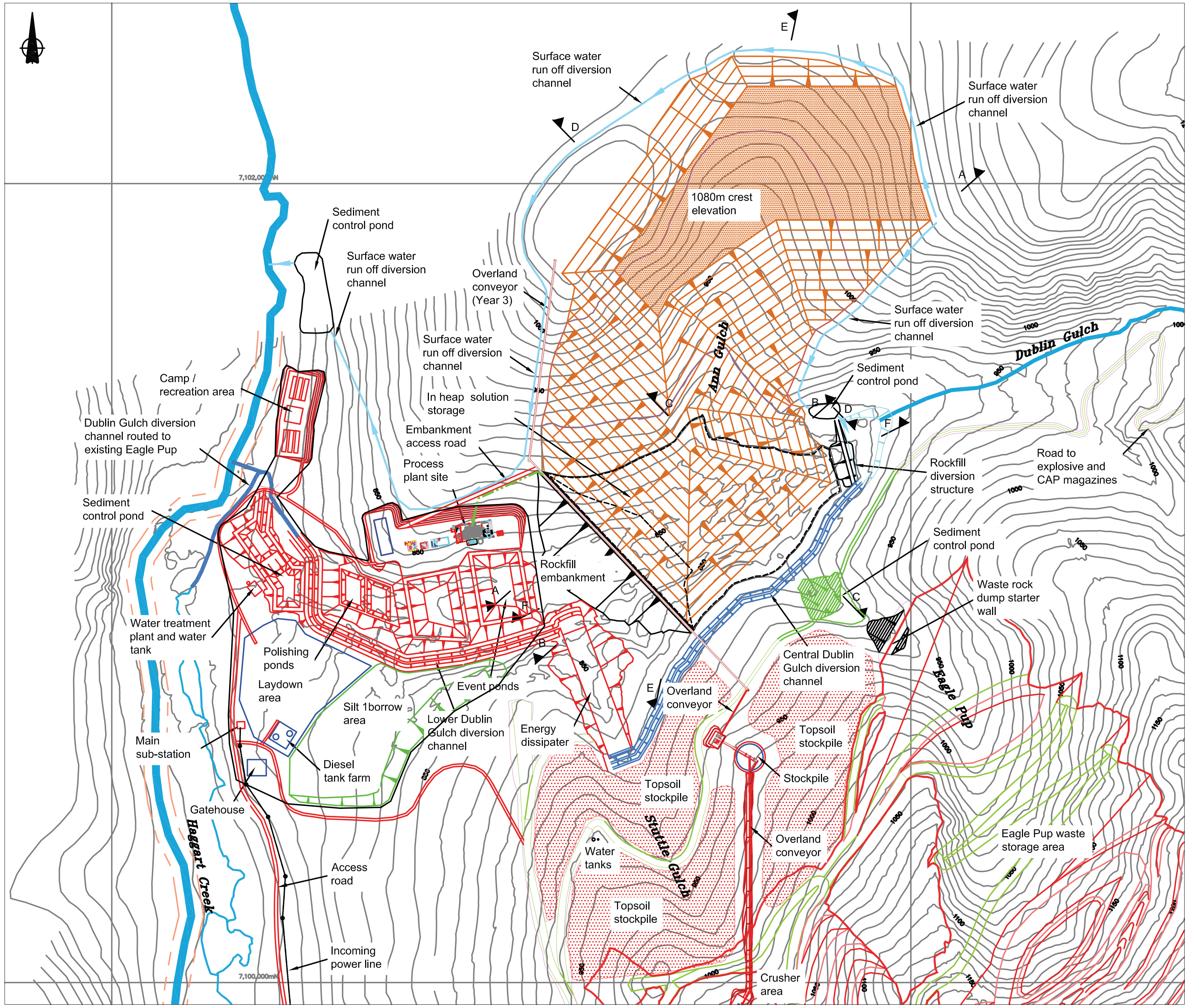
EAGLE GOLD PRE FEASIBILITY STUDY

ANN GULCH HEAP LEACH FACILITY
LAYOUT OF FACILITY
AND INFRASTRUCTURE
AT 2014 STACK HEIGHT

DRG. No. D125666-101-1023 REV. P4

Figure No.: 5.5-6

PRELIMINARY



Notes

1. Contours are supplied by client with areas added from contours with elevations in feet converted into metres.

Scott Wilson

DESIGNED	SD	OCT 09	DRG. No.	REFERENCE DRAWINGS	No.	DATE	REVISION	MADE	CHKD.	SCALE UNLESS SHOWN
DRAWN	DJT	OCT 09			P3	13/05/10	Update open pit and waste rock dump footprints. Revise crusher location. Add conveyor and plant site buildings.	DJT	DJB.	1:10 000
DESIGN CHECK					P4	27/05/10	Laydown area, diesel tank farm and access roads revised, Topsoil stockpiles added. Footprint of borrow area 1 and diversion channel updated	DJT	DJB	ORIGINAL SIZE A3
DRAWING CHECK										
APPROVED	AMW	27/05/10								

VICTORIA GOLD CORPORATION

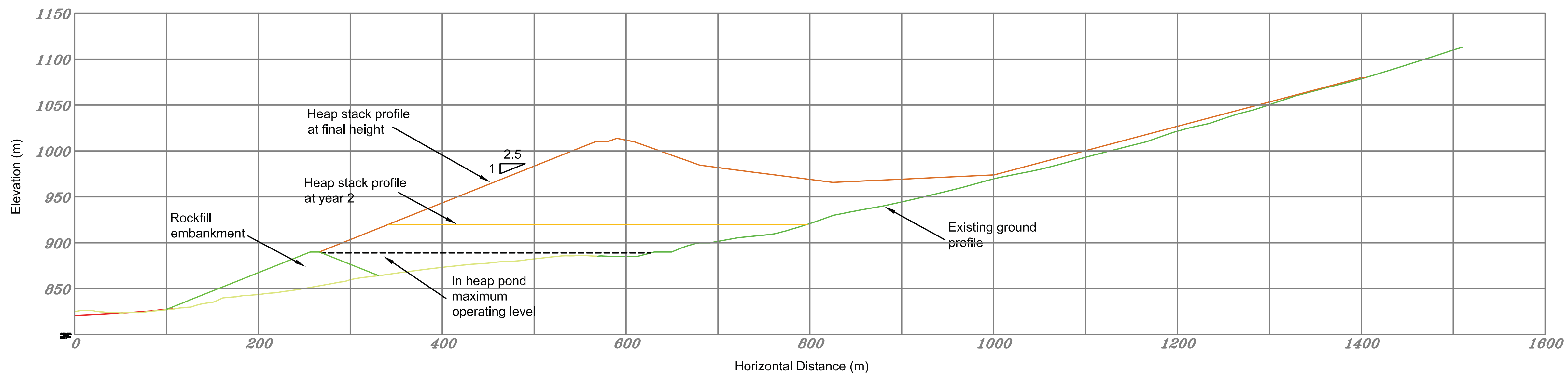
EAGLE GOLD PRE FEASIBILITY STUDY

ANN GULCH HEAP LEACH FACILITY
GENERAL ARRANGEMENT
AT FINAL STACK HEIGHT
(YEAR 2022)

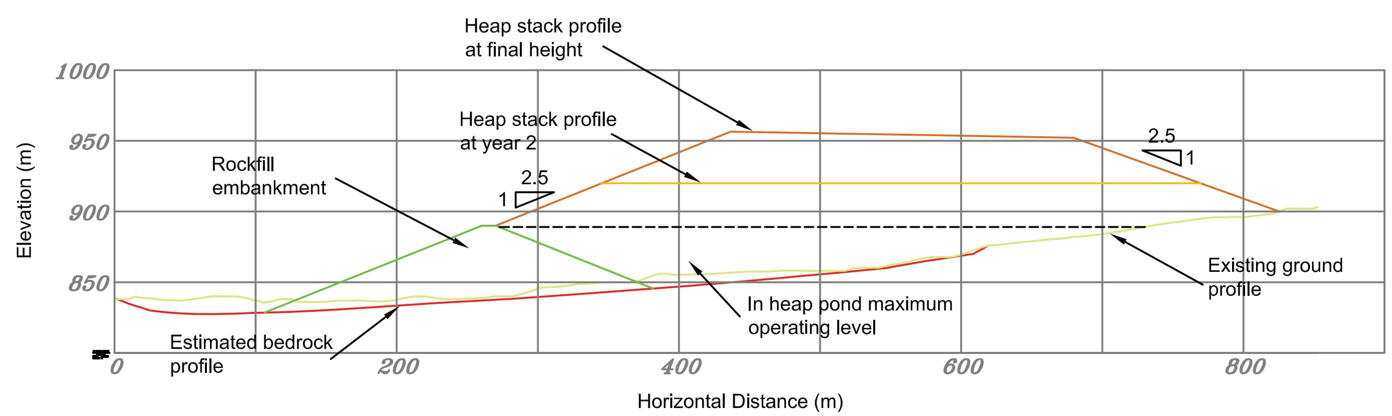
DRG. No. D125666-101-1020 REV. P4

Figure No.: **5.5-7**

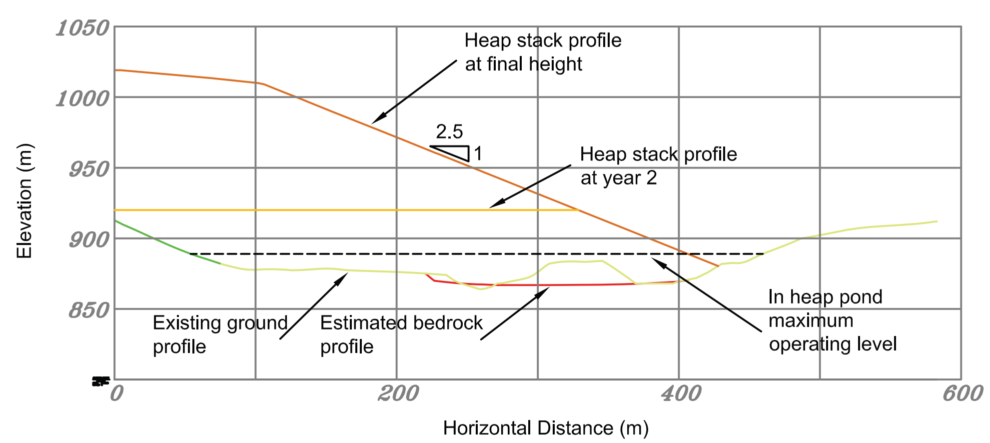
PRELIMINARY



Section A–A



Section B–B



Section C–C

Note
1. All dimensions are in millimetres and elevations in metres unless noted otherwise.
2. All sections are provisional, awaiting geological profile data.
3. Refer to drawing D125666–101–1047 for details of rockfill embankment.

VICTORIA GOLD CORPORATION

EAGLE GOLD PRE FEASIBILITY STUDY

ANN GULCH HEAP LEACH FACILITY
CROSS SECTIONS
SHEET 1

Scott Wilson

DESIGNED	SD	OCT 09	DRG. No.
DRAWN	DJT	OCT 09	
DESIGN CHECK			
DRAWING CHECK			
APPROVED	AMW	27/05/10	

REFERENCE DRAWINGS

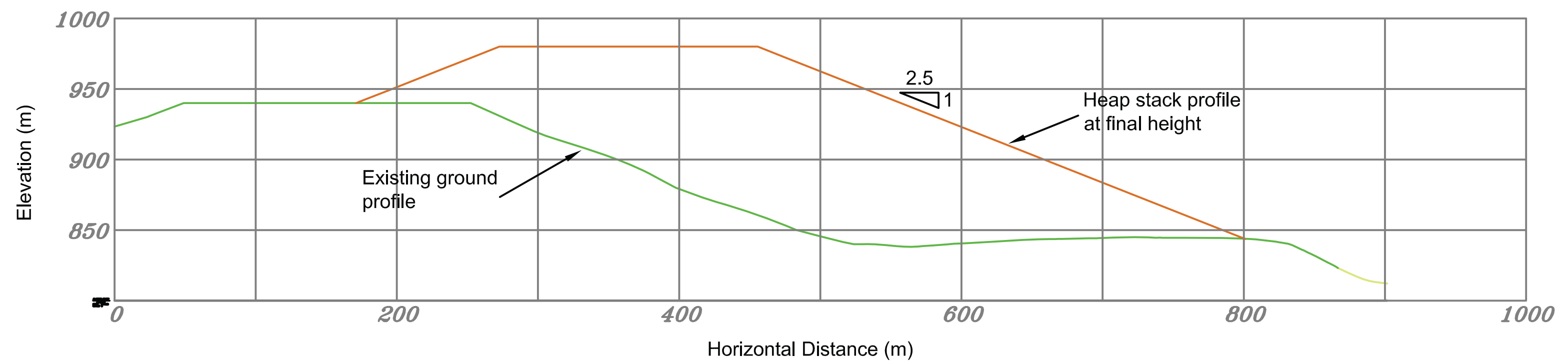
No.	DATE	REVISION	MADE	CHKD.
P2	27/05/10	Drawing reference added to notes.	DJT	DJB

SCALE UNLESS SHOWN
1:5 000
ORIGINAL SIZE A3

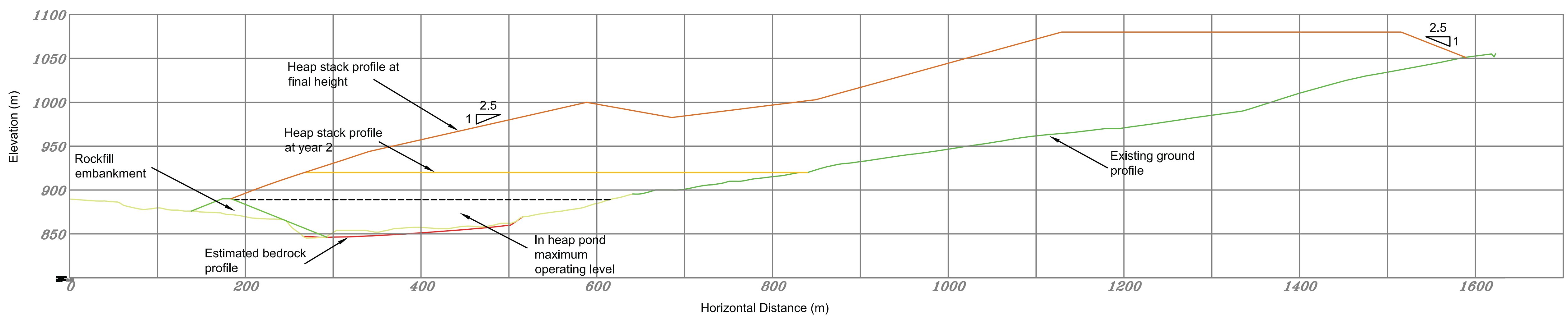
DRG. No. D125666–101–1021 REV. P2

PRELIMINARY

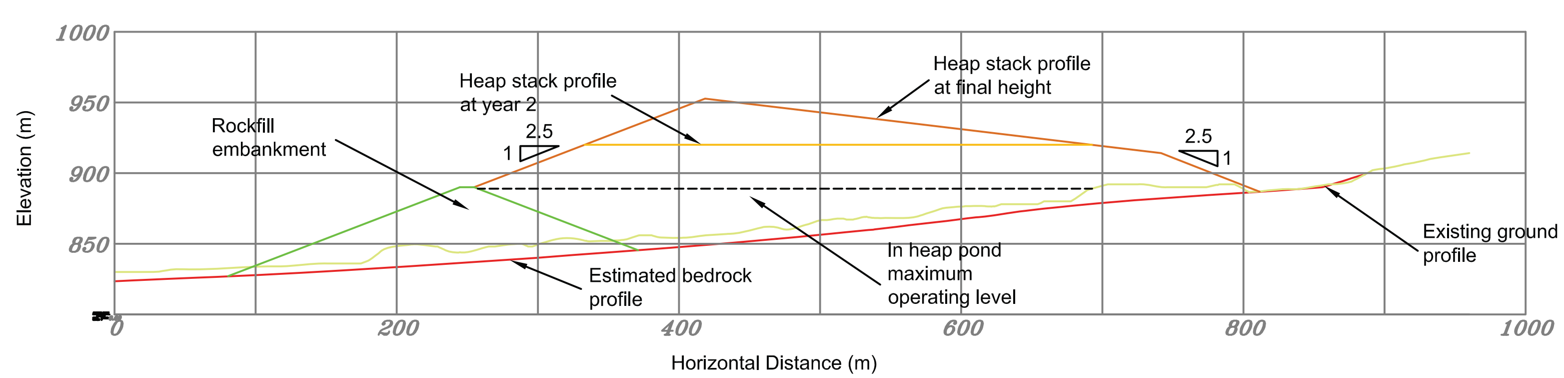
Figure No.: **5.5-8**



Section D–D



Section E–E



Section F–F

Note

1. All dimensions are in millimetres and elevations in metres unless noted otherwise.
2. All sections are provisional, awaiting geological profile data.
3. Refer to drawing D125666–101–1047 for details of rockfill embankment.

VICTORIA GOLD CORPORATION

EAGLE GOLD PRE FEASIBILITY STUDY

ANN GULCH HEAP LEACH FACILITY
CROSS SECTIONS
SHEET 2

Scott Wilson

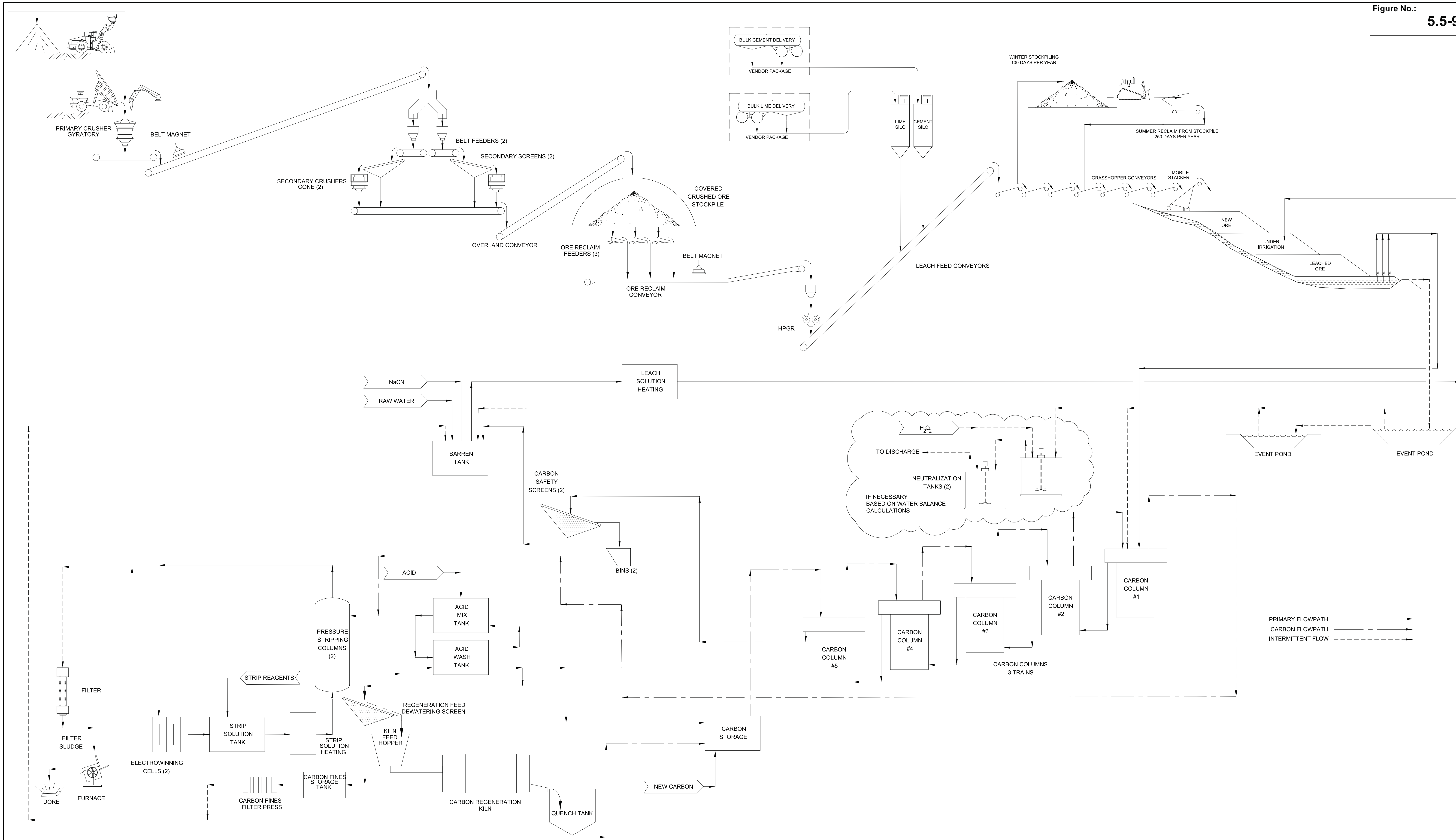
DESIGNED	SD	OCT 09	DRG. No.	REFERENCE DRAWINGS	No.	DATE	REVISION	MADE	CHKD.
DRAWN	DJT	OCT 09			P2	27/05/10	Drawing reference added to notes.	DJT	DJB
DESIGN CHECK									
DRAWING CHECK									
APPROVED	AMW	27/05/10							

SCALE UNLESS SHOWN 1:5 000

ORIGINAL SIZE A3

DRG. No. D125666–101–1022 REV. P2

Figure No.: 5.5-9



REFERENCE DRAWINGS

DWG. NO.	TITLE

REVISIONS

NO.	BY	CK'D	APPROVED	DATE	DESCRIPTION
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REVISIONS

NO.	BY	CK'D	APPROVED	DATE	DESCRIPTION
A	TJM	WMR		21 OCT 09	ISSUED FOR REVIEW
B	KCA	WMR		11 JAN 10	ISSUED FOR PRE-FEASIBILITY STUDY
C	KCA	WMR		08 APR 10	UPDATED FOR WINTER STACKING, REISSUED FOR PRE-FEASIBILITY STUDY
D					
E					
F					
G					
H					
I					

Designed by: WMR 18 DEC 09
Drawn by: KCA 08 JAN 10
Checked by: WMR 11 JAN 10
Approved 1: -
Approved 2: -
Client Approval: -

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KCA

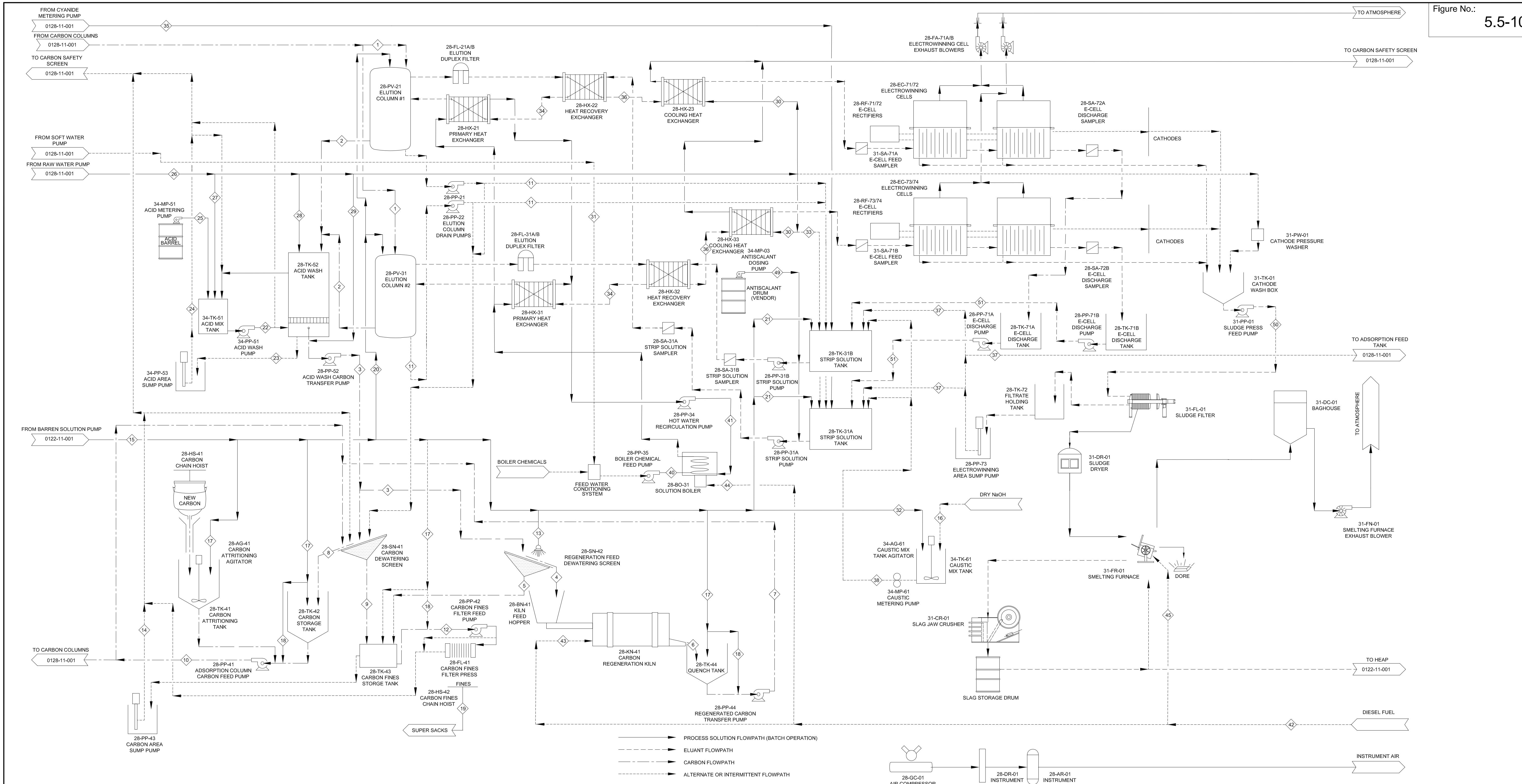
Project: **EAGLE GOLD PROJECT**

Title: SIMPLIFIED OVERALL FLOWSHEET 3 STAGE

Job No.	Scale	ACAD Filename:
366G	N.T.S.	0110-11-501-C.DWG

8166 | 0110-11-501 | REV C

Figure No.:
5.5-10



STREAM NUMBER	UNITS	1 CARBON FROM ADSORPTION	2 CARBON TO ACID WASH TANK	3 CARBON FROM ACID WASH TANK	4 REGEN. SCREEN O'SIZE	5 REGEN. SCREEN U'SIZE	6 CARBON FROM KILN	7 REGEN. CARBON TRANSFER	8 DEWATER. SCREEN O'SIZE	9 DEWATER. SCREEN U'SIZE	10 CARBON TO ADSORPTION	11 ELUTION COLUMN OUTLET	12 C FINES FILTER FEED	13 REGEN. SCREEN WASH	14 CARBON AREA SUMP PUMP	15 BARREN SOLUTION SUPPLY	16 DRY CAUSTIC	17 BARREN SOLUTION	18 BARREN SOLUTION	19 CARBON FINES	20 BARREN TO ELUT. COLUMNS	21 BARREN TO STRIP SOLN. TANK	22 ACID WASH RECIRC.	23 ACID WASH DRAIN	24 ACID AREA SUMP PUMP
NORMAL FLOW	m³/h																								
DESIGN FLOW	m³/h	20	20	20	3.0	21		20	3.0	17	20	15	16.5	4	44	50		30	7		25	30	15	22	18
% SOLIDS	%	20-30	20-30	20-30	70	<2		20-30	70		20-30		<10												
SOLIDS	t/h						0.100													0.005					
																	600 kg / BATCH								

STREAM NUMBER	25 CONC. ACID ADDITION	26 RAW WATER SUPPLY	27 RAW WATER TO ACID MIX	28 RAW WATER TO ACID WASH TANK	29 RAW WATER TO C TRANSFER	30 RAW WATER TO COOLING HEAT EXCH.	31 SOFT WATER TO BOILER	32 BARREN TO CAUSTIC MAKEUP	33 RAW WATER TO STRIP SOLN. TANK	34 STRIP SOLUTION	35 NaCN TO STRIP SOLN. TANK	36 ELUATE	37 EW AREA SUMP PUMP	38 CAUSTIC TO STRIP SOLN. TANK	39	40 BOILER CHEMICAL FEED	41 HOT WATER TO HEAT EXCHANGER	42 TOTAL FUEL	43 FUEL TO KILN	44 FUEL TO BOILER	45 FUEL TO FURNACE	46	47	48	49 ANTI-SCALANT	50 SLUDGE FILTER FEED	51 EW CELL DISCHARGE
NORMAL FLOW																	11.3		0.518	0.451	0.207						
DESIGN FLOW	0.25	39	30	30	7	2.1	0.12		30	15	1.1	15	18	2.0		0.12	23.6	0.152	0.619	0.553	0.276					2.0	15
% SOLIDS																											
SOLIDS																											
								2400 L / BATCH																	0.15 L/h		

REFERENCE DRAWINGS

DWG. NO.	TITLE
8166-0122-11-001	HEAP LEACH FLOWSHEET
8166-0128-11-001	ADSORPTION, RAW WATER, CYANIDE MIX FLOWSHEET

REVISIONS

NO.	BY	CK'D	APPROVED	DATE	DESCRIPTION
1					
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REVISIONS

NO.	BY	CK'D	APPROVED	DATE	DESCRIPTION
A	AFB	WMR		20 OCT 09	ISSUED FOR REVIEW
B	WMR	TOS		12 NOV 09	ISSUED FOR REVIEW & COMMENT
C	KCA	WMR		08 DEC 09	REISSUED FOR REVIEW & COMMENT
D	KCA	WMR		11 JAN 10	ISSUED FOR PRE-FEASIBILITY STUDY
E	KCA	WMR		31 MAR 10	UPDATED FOR 4 EW CELLS, REISSUED FOR PRE-FEASIBILITY STUDY
F					
G					
H					
I					

Designed by: AFB 20 JUL 09
Drawn by: TJP 20 JUL 09
Checked by: WMR 20 OCT 09
Approved 1: -
Approved 2: -
Client Approval: -

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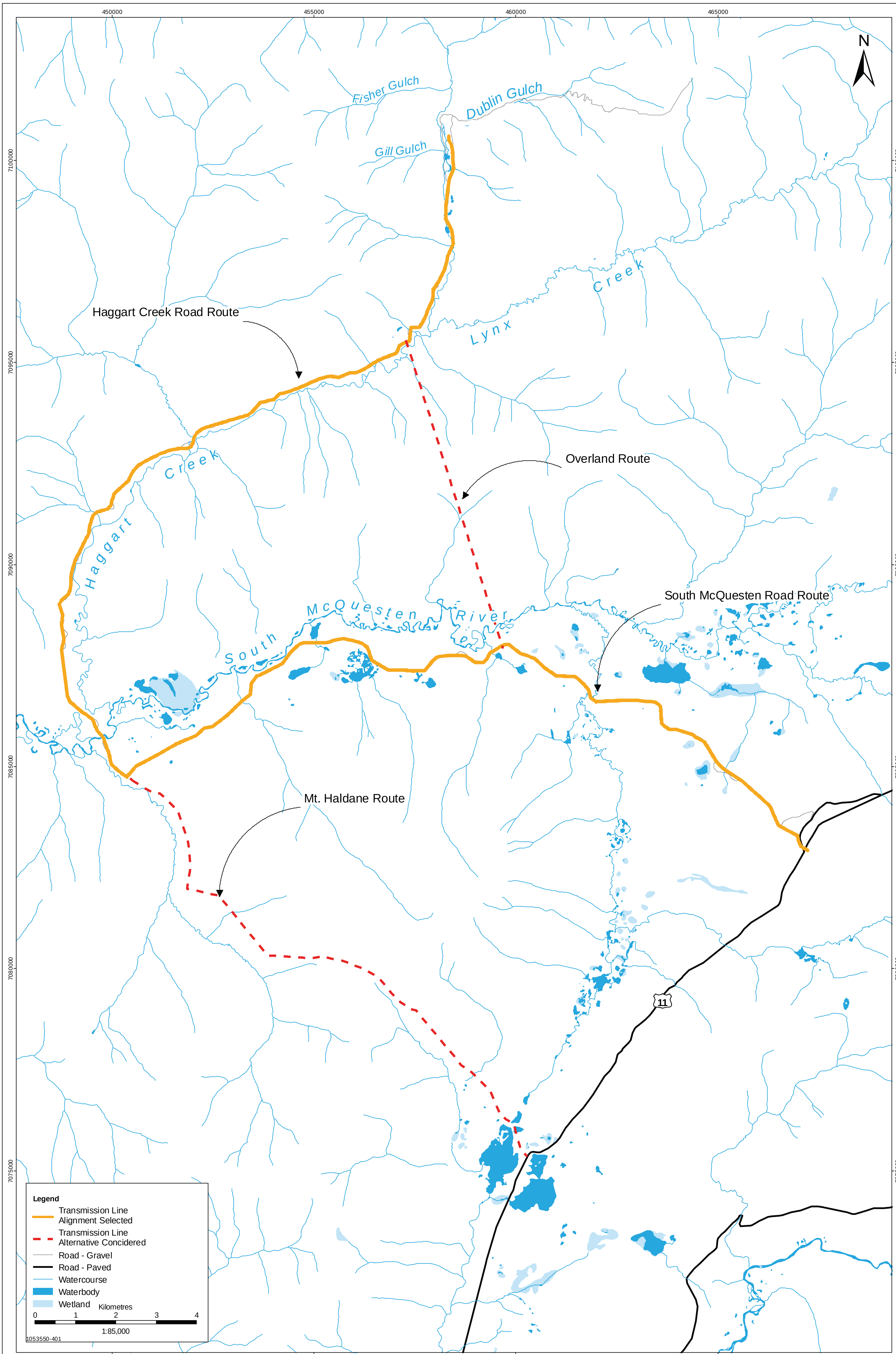
Project: **EAGLE GOLD PROJECT**
Title: GOLD RECOVERY FLOWSHEET

Job No.	Scale	ACAD Filename:
366G	NTS	8166-0128-11-002-Ex.DWG

8166 | 0128-11-002 | REV E



Data Sources; Government of Canada, Victoria Gold Corp.

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Victoria GOLD CORP

TRANSMISSION LINE ALIGNMENT ALTERNATIVES

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION: UTM - ZONE 8	DRAWN BY: LS
DATUM: NAD 83	CHECKED BY: RS
DATE: 8-November-2010	FIGURE NO.: 5.8-1

6 ENVIRONMENTAL AND SOCIO-ECONOMIC EFFECTS ASSESSMENT

6.1 Assessment Approach

This assessment of the Project's potential environmental, economic, social, heritage, and health effects uses a framework that addresses the requirements of environmental assessment legislation across Canada, including YESAA. The methods are based on a structured approach corresponding to YESAB's approach, which first assesses potential Project-specific effects and then potential cumulative effects. Five steps are involved:

1. Identification of Valued Environmental and Socio-economic Components (VCs) relevant to the Project and the assessment. This identification is based on information derived from consultations with First Nations, other governments, regulators, and communities (see Section 2); as well as the professional knowledge of the proponent and the assessment team.
2. Examination of possible interactions between the Project and the VCs with a focus on identifying those to be carried forward in the assessment (see Section 6.3.1). Carried forward are those for which, even with the application of proven codified environmental protection practices, it is reasonably foreseeable that there could be significant effects.
3. Assessment of Project-specific effects carried forward, which involves:
    - Description of effects
    - Mitigation of effects
    - Characterization of residual effects
    - Determination of significance of residual effects and the level of confidence in the characterization.
4. Assessment of Project interactions with other projects (Cumulative Effects), which involves:
    - Identification of other projects that could lead to cumulative effect
    - Screening to identify effects for which there is a reasonable expectation that the Project's potential contribution to cumulative effects could affect the viability or sustainability of a VC[18]
    - Description of the cumulative effects identified for further assessment
    - Identification of mitigation measures that VIT can implement for cumulative effects

[18] The screening process establishes three conditions to warrant further assessment. These conditions are: (1) the Project results in a demonstrable residual effect; (2) these effects are likely to act in a cumulative fashion with those of other past, current, and announced future projects; and (3) there is a reasonable expectation that the Project's contribution to cumulative impacts will have a significant effect on the VC. A cumulative-effects assessment of potential cumulative effects proceeds past screening only when all three of the necessary conditions are met.

- Characterization of residual cumulative effects
- Determination of the significance of residual cumulative effects.

5. Recommendations for monitoring and adaptive management of Project-specific and cumulative effects.

The fundamentals of the above five steps are followed in the assessment of each VC. Some adjustments, however, are made in the assessment of the socio-economic VCs to accommodate the particular issues and methods involved in the assessment of these VCs (see Section 6.11).

The carbon management assessment (Section 7) is an exception to the methods above. It is based on a consideration of policy in an area with limited tools to assess overall effects. Quantitative information is presented regarding proposed CO_2 emissions from the Project; however, methods are not available to assess the Project's actual contribution or effects on climate change in conjunction with carbon outputs from other sources. Therefore, Section 7 uses the following approach:

1. Identification of CO2 emissions from the Project
2. Identification of regulations and policy affecting carbon management
3. Assessment of options available for carbon management in the context of the Project
4. Conclusions regarding the ability to meet both current regulatory and policy direction, as well as commitments to carbon management should these directives change.

6.2 Valued Environmental and Socio-economic Components

Valued Environmental and Socio-economic Components (VCs) are defined as broad components of the biophysical and human environments that, if altered by the Project, would be of concern to First Nation citizens, regulators, resource managers, scientists, and the general public.

VCs for the biophysical environment represent major components or aspects of the physical and biological environment (e.g., air quality, fish and fish habitat, wildlife, and vegetation) that are widely recognized as important for ecological reasons, and that might be altered by the Project.

VCs for the socio-cultural and economic environment are aspects of the human environment that include such components as economy, employment and business, land use, community vitality or community life, and traditional use of land and resources.

6.2.1 Identification and Consideration of Issues

Table 6.2-1 presents environmental and socio-economic components relevant to the Project. The table identifies and provides the rationale for the selection of those components to be VCs. Rationale is also provided for the determinations of the "other" components not being selected as VCs. Not being selected is not necessarily an indication that the component is not of importance. Rather, in the judgment of those consulted, and that of VIT and its consultants, it is not reasonably foreseeable that the Project would have a substantial effect, or an effect of concern, on these "other" components. In many cases, though, there is concern about Project-related changes to "other" components affecting the selected VCs. For example, "Sound Quality" has not been selected as a VC because the standards for assessing significance of project-related noise involve assessment of effects on "permanent" human residents. In the case of Eagle Gold, there are no permanent residents in the vicinity of the Project. There is concern, however, for the potential effect of project-related noise on wildlife. Where there is concern about changes to "other" components affecting VCs, extensive baseline studies and modeling as appropriate of these changes have been completed. The information gathered will be used in VC assessments and appended to the Project Proposal. For example, Project-related noise modeling was completed and a Noise Assessment Report appended (Appendix 10).

Selection of VCs was based on information from a number of sources. These included: discussions with YESAB; open houses and meetings to date with the FNNND and the Village of Mayo; meetings with various government agencies; review of the FNNND and the Village of Mayo Integrated Community Sustainability Plans; and extensive baseline studies that VIT has conducted on socio-economic, land tenure and use, and Traditional Knowledge and use. In addition decisions were based on the professional knowledge and experience of VIT and its consultants.

Table 6.2-1: Selection of Valued Environmental and Socio-economic Components

Environment/Socio-economic Component	Rationale
Components selected as VCs	
Surficial Geology, Terrain, and Soils	▪ Soils will be removed and stockpiled in preparation of the mine site and could be affected by these activities and by Project emissions. ▪ Proper handling of soils is essential to successful closure and reclamation. ▪ Changes in hydrology and hydrogeology, and potential effects on permafrost could affect surficial geology and terrain.
Water Quality and Aquatic Biota	▪ Mine site water use, watercourse diversions, riparian vegetation clearing, soil removal, open pit development, the heap leach facility, and waste rock storage among other Project activities have the potential to affect water quality and aquatic biota.
Air Quality	▪ Air emissions including dust during construction, operations, and closure have the potential to affect air quality.
Fish and Fish Habitat	▪ Fish and fish habitat will be altered in various watercourses on the mine site due to infrastructure construction. A fish habitat compensation plan will be developed as part of the request for authorization under the federal *Fisheries Act.*
Vegetation Resources	▪ Vegetation clearing is required for the proposed mine site and support facilities. ▪ Vegetation could also be affected by Project emissions (dust deposition).
Wildlife Resources	▪ Wildlife habitat will be altered through vegetation clearing, as well as construction, and operations activities that will result in direct and indirect interactions with wildlife.

Environment/Socio-economic Component	Rationale
Heritage Resources (historic and palaeontological)	▪ Construction activities have the potential to affect historic and palaeontological resources.
Employment and Economic Opportunities	▪ There are five Socio-economic VCs assessed to address objectives and concerns of the FNNND and the Village of Mayo. These VCs were determined via consultation with these groups and in their Integrated Community Sustainability Plans. ▪ There is potential for the Project to result in effects on each of the five socio-economic VCs.
Traditional Activities and Culture	
Community Vitality	
Human Health and Well-being	
Infrastructure and Services	
Components not selected as VCs	
Aesthetics	▪ Consultations have not identified aesthetic values of concern that could be affected by the Project. ▪ The Project will not interfere with any viewscapes. ▪ The Project site is not a tourist destination. ▪ An objective of the reclamation plan is returning the site to a visual condition consistent with the surroundings. ▪ Project effects on aesthetics that may affect tourism or traditional use will be evaluated with the assessment of the VCs encompassing these activities.
Carbon Management/Climate Change Considerations	▪ Though not identified as a VC, a separate section in the Project Proposal will address carbon management. CO_2 emissions from the Project will be identified and conclusions will be drawn regarding the Project's ability to meet both current regulatory and policy direction, as well as commitments to carbon management should these directives change.
Human and Ecological Health	▪ A human and ecological health baseline and technical data report has been prepared upon which other VC assessments (Wildlife, Fish and Socio-economic) will draw upon and reference as appropriate. ▪ The permitting process and existing worker safety regulations will ensure that employees and the public are protected. ▪ Potential effects of accidents and malfunctions are assessed in Section 8 of the Project Proposal.

Environment/Socio-economic Component	Rationale
Hydrology and Hydrogeology	A comprehensive Site Water Management Plan has been developed for the Project that discusses management of process water supply, potable water supply, sediment and erosion control, treatment of mine water, and required diversions as a result of mine site infrastructure. The Project Proposal will include technical data reports for hydrology and hydrogeology, and geochemical characterization of all disturbed rock as a result of the Project (including assessment of potential acid rock drainage). However, there are not local end users that would be affected by potential effects on hydrology and hydrogeology resources. It is expected that changes to surface water flow downstream of the Project will not impact local placer mining operations. Rather it is indirect effects on other VCs such as fisheries resources, wildlife, and aquatic biota that require assessment. Consequently, project-related changes on hydrology and hydrogeology will be addressed as follows ▪ Changes in hydrology will be assessed in the fish habitat section, in terms of changes to watercourse flows and habitat availability ▪ Hydrology data was used to develop the site water balance, which will be used in modeling changes to water quality in the receiving environment ▪ Groundwater quality and quantity, geochemical changes, discharges from heap leach facility, open pit, waste rock storage areas and other sources of metals and nutrients will be assessed in the water quality section (i.e., in the model developed to predict water quality) ▪ Changes to total suspended solids in watercourses is assessed in the fish and fish habitat section rather than the water quality section
Land and Resource Use	▪ Addressed as appropriate under the socio-economic VCs in Section 6.11 and Section 9 pertaining to effects on “Capacity of Renewable Resources.”
First Nations’ Land Use and Interests	▪ Consideration to be integrated throughout the assessment of all VCs as appropriate, particularly in the assessment of the socio-economic VCs, Fish and Fish Habitat, Vegetation, and Wildlife.

6.3 Potential Environmental and Socio-economic Effects

6.3.1 Project Interactions with the Bio-physical and Human Environment

An initial step of the effects assessment was to identify interactions between the Project and each of the VCs. For the bio-physical VCs, effects of a specific Project activity can be of concern. Project activities and emissions were identified based on the information provided in the Project Description – Section 5 of this Project Proposal. All interactions between each bio-physical VC and Project activity were then identified and ranked according to reasonably foreseeable effects. The potential interactions and their rank are summarized in Table 6.3-1. Higher-risk interactions, on which the assessments will focus, are scored “2” in the table. Low-risk interactions are: a) those, which based on past experience and professional judgment, would be nominal and not result in significant effects, even without mitigation (scored “0”); or b) those interactions that would not be significant due to the application of codified practices known to effectively mitigate the predicted effects (scored “1”). Lower-risk interactions are not carried forward in the effects assessment. High-risk interactions are those for which it is reasonable foreseeable that there could be an effect of potential concern even with the application of proven codified practices.

The assessment of potential interactions between the Project and socio-economic VCs did not use the same ranking system used for biophysical VCs. Consequently, Table 6.3-1 does not contain these VCs. Unlike bio-physical VCs, specific Project activities do not interact with socio-economic VCs independently, in general. Rather it is the Project as a whole that interacts with socio-economic VCs. Consequently the ranking used for the bio-physical VC in Table 6.3-1 is of little utility in identifying potential interactions of concern for socio-economic VCs. Instead, these determinations were informed largely by the YESAB Guide to Socio-economic Effects Assessment (YESAB 2006), Project specific consultation, and the professional expertise of the assessors. Detailed information on this approach is set out in section 6.11.

Table 6.3-1: Potential Project-Interactions with the Bio-physical Valued Components

Project Activities and Physical Works	Surficial Geology, Terrain, and Soils	Water Quality/Aquatic Biota	Air Quality	Fish and Fish Habitat	Vegetation Resources	Wildlife Resources	Heritage Resources
Construction Phase							
Site clearing and grubbing	2	1	2	2	2	2	1
Disposal of cleared vegetation (burning)	1	0	2	0	0	0	0
Salvaging and stockpiling of top and sub soils	2	1	2	1	1	1	1
Site grading including blasting, overburden removal and overburden disposal	2	1	2	1	1	1	1
Borrow areas development and use	2	1	2	0	1	2	1
Access road upgrades	1	1	1	2	2	2	1
Camp construction (construction and operations camps)	1	1	2	0	1	2	1
Waste handling (liquid and solid)	1	1	0	0	0	1	0
Diesel power generation (1-2 megawatts)	1	0	1	0	0	2	0
Use of large construction vehicles and equipment	2	0	2	0	1	2	0
Construction of mine site infrastructure and haul roads	2	1	2	2	1	2	1
Water supply and usage	1	1	0	1	0	1	0
Site water-management (diversions and runoff)	2	2	0	2	1	1	1
Fish habitat-compensation	1	1	0	1	1	1	0
Vehicular traffic	1	1	1	1	1	2	0
Clearing of transmission line RoW	1	1	1	1	2	2	1
Installation of transmission line	1	0	1	0	1	1	1

Project Activities and Physical Works	Surficial Geology, Terrain, and Soils	Water Quality/Aquatic Biota	Air Quality	Fish and Fish Habitat	Vegetation Resources	Wildlife Resources	Heritage Resources
Operations Phase							
Open-pit mining (blasting, ore/waste hauling, open pit dewatering)	2	1	2	1	2	2	0
Ore Processing (crushing, conveying and hauling)	2	0	2	0	2	2	0
Waste-rock disposal	1	1	1	1	1	1	0
Gold heap leach facility operation	0	1	2	0	1	2	0
Potable and non-potable water use	0	1	0	1	0	1	0
Mine water treatment and discharge	0	2	0	1	1	1	0
Solid-waste management	1	0	0	0	0	2	0
Camp operation	0	0	1	0	0	2	0
Vehicle traffic	1	1	1	0	1	2	0
Access road and transmission line presence and maintenance	1	1	1	1	1	2	1
Quarry/borrow pit operations	2	1	2	1	1	2	1
Diesel power generation	1	0	1	0	0	2	0
Fuel, Hazardous Materials, and Explosives Mgmt.	1	1	0	1	1	2	0
Closure and Reclamation Phase							
Reclamation of waste rock storage areas	1	2	1	2	1	1	0
Heap leach facility reclamation	1	2	1	2	2	2	0
Pit lake filling	2	2	1	2	2	2	0
Plant and associated facility removal and site reclamation	1	0	1	0	1	1	0
On-going water treatment and discharge	0	2	0	2	1	1	0
Haul Roads closure and reclamation	1	1	1	1	1	1	0
Transmission line closure and reclamation	1	1	1	1	1	1	0

NOTE:

Project-Specific – Environment Interactions

0 = No interaction

1 = Interaction occurs; however, based on past experience and professional judgment the interaction would not result in a significant environmental effect, even without mitigation; or interaction would not be significant due to application of codified environmental-protection practices that are known to effectively mitigate the predicted environmental effects

2 = Interaction could result in an environmental effect of concern even with standard mitigation; consequently the potential environmental effects are considered further in the environmental assessment

The justifications for assigning the rankings for each VC are provided in the specific environmental assessment section for the VC. Interactions ranked as “0” or “1” are not discussed in detail in the assessment because significant effects would not result.

Section 6.3.8 and Table 6.3-2 identify and describe other projects, activities, and actions that may act cumulatively with the Project. The screening methods for cumulative effects are applied to both biophysical and socio-economic VCs.

6.3.2 Description of Project Effects Mechanisms

For each VC, the mechanisms whereby specific Project activities and actions are anticipated to result in respective potential effects are described. Where possible, the spatial and temporal extent of these anticipated changes (i.e., where and when an effect might occur) are also described.

6.3.3 Temporal Boundaries

The temporal boundaries for the assessment for each VC is defined based on the timing and duration of Project effects on the VC. The purpose of a temporal boundary is to identify when an effect may occur in relation to specific Project phases and activities. The Project is planned to have a 20-month construction phase, a 7.3-year operations mining phase, and a 10-year closure and reclamation phase, followed by a post-closure monitoring phase. Project phases assessed include:

- Baseline: the biophysical characteristics of the environment, at the time of the assessment, including all existing disturbances form past and present projects
- Construction
- Operations
- Closure and Reclamation.

6.3.4 Spatial Boundaries

Spatial boundaries defining assessment areas are primarily based on the zone of Project influence, beyond which the potential environmental, cultural, and socio-economic effects of the Project are expected to be non-detectable. Spatial boundaries will be established for each VC and vary according to the nature and distribution of the VC and the type of environmental effect. The assessment areas will be of two types—Local Assessment Areas (LAA) and the Regional Assessment Areas (RAA).

Local Assessment Area (LAA)—is used for the assessment of the Project-specific effects. The LAA is defined as the maximum area where project-specific environmental effects can be predicted or measured with a reasonable degree of accuracy and confidence, and also where it is reasonably foreseeable that effects could be significant. Project environmental effects include direct effects such as habitat alteration within the Project footprint (e.g., site-specific environmental effects), as well as indirect Project effects such as deposition of air emissions, sensory disturbances (sound transmission) and wildlife avoidance around the Project footprint.

Regional Assessment Area (RAA)—provides a broader geographical context for understanding Project effects and is the area used for assessment of potential cumulative effects with the effects of other projects and activities. The RAA varies for VCs, depending on physical and biological conditions (e.g., air sheds, watersheds, seasonal wildlife movements, population unit), and the type and location of effects of other past, present or reasonably foreseeable projects or activities. For the human environment, the RAA may be based on planning areas, regions, etc. Note that other projects and activities included in the assessment of cumulative effects are not necessarily located in the RAA, but their effects do occur within the RAA.

6.3.5 Mitigation of Project Effects

Mitigation is defined as changes to reduce or eliminate potential adverse Project effects. These changes may be in the temporal or spatial aspects of the Project and/or the means in which the Project is constructed, operated, or decommissioned. Mitigation can also include such measures as restitution, habitat compensation, replacement, and transplant.

Mitigation measures that reduce or eliminate an adverse effect are described in each VC assessment section, with an emphasis on how these measures will help alter the effect. Where possible, the effectiveness of the proposed mitigation measure(s) are expressed as expected change in measurable parameter(s) for the effect. In some cases, mitigation measures may include monitoring to verify results.

6.3.6 Characterization of Residual Effects

The following criteria are used to characterize residual effects. Where possible, these criteria are described quantitatively for each VC. When quantitative characterization is not possible, defined qualitative terms (such as the examples in parentheses below) are used.

- **Direction:** the ultimate long-term trend of the environmental, economic, social, heritage, or health effect (positive or negative).
- **Magnitude:** the amount of change in a measurable parameter or variable relative to baseline case (low, moderate, high).
- **Geographical Extent:** the geographic area in which an environmental, economic, social, heritage, or health effect of a defined magnitude occurs (site-specific, local, regional, provincial, national, international).
- **Timing and Frequency:** the number of times during a project or a specific project phase that an environmental, economic, social, heritage, or health effect may occur (once, daily, weekly, monthly, continuous etc.).
- **Duration:** the period of time required until the VC returns to its baseline condition, or the effect can no longer be measured or otherwise perceived (short term, medium term, long term, permanent).

- **Reversibility:** the likelihood that a measurable parameter will recover from an effect (reversible, irreversible).
- **Context:** the general characteristics of the area in which the project is located (undisturbed, disturbed, urban setting).
- **Probability of Occurrence:** likelihood of effect occurring (unlikely, likely, certain).

6.3.7 Determination of Significance of Residual Effects

A conclusion on the significance of residual Project effects will be included for each VC. Where they exist management standards will be identified, beyond which a residual effect is considered significant. Standards are recognized government or industry regulations or objectives for physical aspects such as air quality, water quality, or effluent release. These thresholds reflect the limits of an acceptable state for an environmental component based on resource management objectives, community standards, scientific literature, or ecological processes (e.g., desired states for wildlife habitats or populations). Where standards or thresholds do not exist, significance criteria will be developed and defined, and justifications for the criteria provided.

The determination of significance includes a discussion of the "prediction confidence" in the determination. The prediction is based on:

- Scientific certainty relative to quantifying or estimating the effect, including the quality and/or quantity of data and the understanding of the effect mechanisms
- Scientific certainty relative to the effectiveness of the proposed mitigation measures
- Professional judgment from prior experience including tried and true mitigation measures.

Confidence in all three variables produces greater confidence in the effect predictions, assessment of significance, and the mitigation measures selected.

6.3.8 Project Interactions with Other Projects (Cumulative Effects)

The focus of the cumulative effects assessment is to assess incremental effects directly attributable to the Project on each VC. The cumulative effects assessment will consider: 1) the baseline effects that have resulted or are resulting from other past or present physical works and activities; 2) the contribution of the Project's residual effects to cumulative effects; and finally 3) the anticipated effect of known future projects. Cumulative effects will be considered for each VC for which it is shown there are Project-specific residual effects.

The assessment for each potential cumulative effect begins with a description of the effect and the mechanisms whereby the effects from the Project might interact with other projects and activities on the VC. Not all residual effects can contribute to measurable cumulative effects. To determine when a detailed cumulative effects assessment is necessary a screening will be completed for each predicted residual effect on each VC. The screening involves determining whether or not all three of the following conditions are met:

1. The Project results in a demonstrable or measurable residual effect on the VC.

2. The Project-specific residual effect on the VC does or is likely to act in a cumulative fashion with the effects of past, existing, or future projects and activities in the area (i.e., there is a temporal and spatial overlap of effects).
3. There is a reasonable expectation that the Project's contribution to cumulative effects will affect the viability or sustainability of the VC.

The cumulative effects assessment proceeds beyond the screening assessment-level for an effect only when all three conditions are met. For cumulative effects carried forward, the residual cumulative environmental or socio-economic effects will be characterized and evaluated using the same criteria and significance thresholds previously established for the VC for Project-specific effects.

6.3.8.1 Cumulative Effects Assessment Methods

Where possible, the cumulative effect will be quantified in terms of the degree of change in the measurable parameter(s) and the spatial and temporal extent of these changes (i.e., where and when the interactions between the Project residual effects and the residual effects of other projects and activities are expected to occur). Where practical, cumulative effects are described for three temporal cases:

1. Baseline Case: the current status of the measurable parameter(s) for the effect before the start of the Project, including all past and present projects or activities. Present projects and activities include all projects or actions that currently exist. The Baseline Case is normally presented in the existing conditions of the VC with the explicit reference to the fact that the Baseline Case reflects the contributions of past and present physical works and activities.
2. Project Case: the status of the measurable parameter(s) with the effect of the Project combined with the Baseline Case. This is usually the peak effect of the Project or the maximum active footprint for the Project.
3. Future Case: the status of the measurable parameter(s) for the effect as a result of the Project Case in combination with all projects that have been approved under some form of regulatory permitting, plus announced but incomplete projects, activities, and actions. Announced projects were defined as future projects, activities, or actions that will occur with a high degree of certainty, including projects that are in some form of a regulatory approval process or have made a public announcement to seek regulatory approval (i.e., they are likely to occur) and details allowing for the assessing of potential project effects have been publicly announced. The evaluation of the combined Baseline, Project, and Future Cases allows the Project contribution to cumulative effects of all past, present and reasonably foreseeable projects and activities (i.e., Future Case) to be determined.

6.3.8.2 Mitigation of Cumulative Effects

Measures available to VIT to reduce identified potentially adverse Project cumulative effects will be described for each effect, including a discussion of how these measures might modify the characteristics of the effect. Mitigation measures that would require government action or a broader industry approach will be identified but not discussed in detail.

6.3.8.3 Characterization of Residual Cumulative Effects

Residual cumulative effects, after application of the mitigation measures, will be described. Where practical, the residual cumulative effects will be characterized by direction, magnitude, geographic extent, frequency and timing, duration, reversibility, and context using the same definitions as those used for project-specific effects. The focus is on the incremental effect directly attributable to the Project.

6.3.8.4 Determination of Significance of Cumulative Effects

A determination of the significance of the residual cumulative effects will be made using the standards or thresholds established for the Project-specific effects for individual VCs. The determination of significance will also include a discussion of the “prediction confidence” based the same criteria identified in Section 1.3.4 above.

6.3.8.5 Project Inclusion List for Assessment of Cumulative Effects

The Project Inclusion List (PIL) includes all past, present, and reasonably foreseeable (those likely to occur) projects, activities, and actions with residual environmental and socio-economic effects that could overlap spatially and temporally with Project residual environmental and socio-economic effects.

Table 6.3-2 presents the PIL and Figure 6.3-1 shows the location of these projects and activities. In developing the PIL, the following individuals and information sources were consulted:

- YESAB
- FNNND
- Yukon and other Governments
- Stakeholders and the public-at-large.

With respect to future projects for consideration in the cumulative effects assessment, only those projects or activities that have been publicly announced (with a defined project execution period and adequate project details), that are currently undergoing an environmental and socio-economic assessment, or that are in a permitting process are taken into account in determining the potential for cumulative effects. After receiving comments from YESAB, FNNND, and others, the cut-off date for inclusion of new projects in the assessment was set at November 1, 2010.

Table 6.3-2: Project Inclusion List

Activity	Proponent	Status	Location (UTM Zone, UTM Coordinates)	Distance to Project (km)	Description	Website
Placer Mining	Multiple	Past, Present, Future	08 459421 7100498	0	Numerous placer claims exist along Dublin Gulch and Haggart Creek drainages. There are a total of 198 placer claims in the general Project area including 136 active claims, 3 future applications, and 59 expired claims shared amongst 20 owners. 125 of these placer claims are held by VIT.	http://www.emr.gov.yk.ca/mining/placermining.html
Gold Dome	Golden Predator	Present	08 435000 7075000	35	The Gold Dome Project is a gold deposit exploration that involves drilling, camp construction, geological mapping, and soil/rock sampling. Work proposed in 2010 involves further investigation of mineral deposits and improved mapping.	http://www.goldenpredator.com/Gold-Dome.html
Brewery Creek	Golden Predator	Past, Present	08 341386 7107375	118	Brewery Creek is a past producing heap leach gold mining project with 793 claims over 12,656 ha. Operations were halted in 2002; however operation licenses extend to 2021 (some mining leases expire beginning in 2016). In 2009, a 30-hole diamond drilling program was conducted. Programs in 2010 include further exploratory drilling.	http://www.goldenpredator.com/Brewery-Creek.html and http://www.alexcoresource.com/s/AdvancedStage.asp?ReportID=178016
Antimony Mountain	Golden Predator	Present	08 345795 7133564	118	The Antimony Project consists of 478 quartz claims over an area of 9,617 ha. Geophysical surveys, mapping, and geochemical sampling have been completed, along with limited drilling programs. A detailed mapping and an exploratory drilling program were proposed for 2010.	http://www.goldenpredator.com/Antimony-Mtn.html
Clear Creek	Golden Predator	Present	08 365706 7046361	108	The Clear Creek project consists of 132 quartz claims in the Dawson Mining District. The Clear Creek project lies in the active portion of the Clear Creek placer mining area. Previous efforts included exploratory drilling, soil sampling, and geophysical surveys. Programs in 2010 include further exploratory drilling.	http://www.goldenpredator.com/Clear-Creek.html

Activity	Proponent	Status	Location (UTM Zone, UTM Coordinates)	Distance to Project (km)	Description	Website
Bellekeno	Alexco Resource Corporation	Present	08 485265 7086988	60	The Bellekeno Mine Development is an underground narrow vein cut and fill mining operation to extract silver, lead, and zinc. The project land comprises 713 surveyed quartz leases, 794 unsurveyed quartz claims, and 2 crown grants over approximately 23,350 ha. The mine will operate at 250 tonnes per day for years 1 and 2, and increase to 400 tonnes per day for years 3-5. The mine will employ approximately 120 people for the duration of the project. Predevelopment work commenced in 2008, followed by drilling and mine development work. Production is scheduled for 2010.	www.alexcoresource.com/s/Home.asp http://www.emr.gov.yk.ca/mining/bellekeno.html
Casino	Western Copper Corporation	Future	08 319393 6928091	222	Casino copper-gold-molybdenum deposit will be developed as an open pit mine and processed in outside facilities. A drilling program was conducted from 1992 to 1995 along with metallurgical, geotechnical, and environmental work and a scoping study. Road upgrades will be required as part of the project. The pre-feasibility study has been completed and drilling is underway. The schedule forecasts permitting in 2011-2013 and production in 2015-2016.	www.westerncoppercorp.com/index.php/properties/casino/snapshot/
Carmacks Copper Mine	Western Copper Corporation	Present	08 426661 6898373	205	Carmacks Copper Project is a proposed ore and copper open pit mine operation that includes a processing facility and road upgrades. The end product is copper cathode.. The operation is designed to produce 1.73 million tonnes of ore per year. Exploratory programs have been carried out and the project has obtained a quartz mining license allowing construction to commence. Western Copper's stated schedule anticipates water licence issuance in 2011.	www.westerncoppercorp.com/index.php/properties/carmacks/project_details/

Activity	Proponent	Status	Location (UTM Zone, UTM Coordinates)	Distance to Project (km)	Description	Website
Minto Copper Mine	Capstone Mining Corporation	Present	08 385000 6945000	172	The Minto Mine is an open pit mine using crushing, grinding, and flotation to produce copper concentrate. Concentrates are processed at facilities off site. The mine commenced commercial production in 2007. Production in 2009 totalled 51.9 million pounds of payable copper. Exploration has been ongoing and an updated pre-feasibility study is underway. The mine is currently permitted to process 3,600 tonnes per day. Capstone will be seeking permit amendments in 2010 to increase production and expand operations.	www.capstonemining.com/s/Minto.asp?ReportID=343888
MacTung Tungsten Mine	North American Tungsten Corporation	Future	08 742956 7026498	293	The MacTung Project will be an underground mining project extracting ore using long hole cut and fill methods. The project land comprises 151 quartz mining claims within the Mayo Mining District of Yukon. The anticipated life of the mine is 11.2 years with possible extension to 17 years as an open pit mine. . The feasibility study has been completed and screening of the proposal pursuant to *YESAA* has commenced.	www.northamericantungsten.com/s/Mactung.asp
Haldane Silver	Habanero Resources Incorporated	Future	08 458000 708200	19	The Haldane Silver Project is a proposed operation to extract silver from a vein deposit in the Keno Hill Silver District. The Project consists of 143 contiguous quartz claims covering 7,100 acres. In June 2010, Habanero began an exploratory drilling program and had commenced the permitting process to open road access to the property to facilitate the next phase of drilling.	www.habaneroresources.com/s/HaldaneYukonSilver.asp

Activity	Proponent	Status	Location (UTM Zone, UTM Coordinates)	Distance to Project (km)	Description	Website
Howard's Pass	Selwyn Resources Ltd.	Future	08 488295 6927207	176	The Howard's Pass property includes three zinc-silver-lead deposits over a 38 km belt. Investigations undertaken in 1983 indicated a mineral resource of 115.4 million tonnes. Previous work included exploratory drilling, test mining, and a scoping study. Selwyn has developed a tentative permitting and development schedule that would see the completion of permitting in late 2011 and receipt of permits in early 2012 in conjunction with completion of a bankable feasibility study. It is expected that construction will take 18 to 24 months and commissioning of the mill will occur in late 2013. As of November 30, 2010, Selwyn had not entered the YESAA Project Proposal review process.	www.selwynresources.com/en/selwyn_howards_pass.cfm
Rau Gold	Atac Resources Ltd.	Future	08 509703 7131496	72	The Rau gold project is comprised of 1300 km^2 of land, located approximately 55 km northeast of Keno City. Preliminary investigations were conducted in 2010 to determine the extent of the deposit and the best method for extraction. These included mapping, geochemical sampling, and drilling in the Tiger Zone area of the project and a systematic first pass exploration of the rest of the property.	www.atacresources.com/s/Rau.asp
Osiris	Atac Resources Ltd.	Future	08 628097 7112768	169	The Osiris Target is located in the eastern portion of the Rau Gold Project. During early exploration programs, the Osiris Target was identified as a potential source of a new gold district in central Yukon. A systematic first pass of the entire Rau Gold Property is underway for 2010, and further exploratory programs will be conducted in 2011.	www.atacresources.com/s/Home.asp

Activity	Proponent	Status	Location (UTM Zone, UTM Coordinates)	Distance to Project (km)	Description	Website
Wolverine Zinc Silver	Yukon Zinc Corporation	Future	08 758437 6826882	405	The Wolverine Project consists of a zinc-copper-lead-silver-gold deposit that will be accessed through underground extraction. The deposit is estimated at 4.5 million tonnes with a proposed production of 1,700 tonnes per day. The project is anticipated to continue for 9.5 years with a possible extension of 3 years. An exploratory drilling program was conducted in 2005, the quartz mining licence was received for mine construction in 2006, and the water licence came into effect in 2007. Construction began in 2009 and is ongoing.	www.yukonzinc.com/development_wolverine_index.cfm
Mayo B Hydroelectric	Yukon Energy Corporation	Present	08 458129 7062529	38	The Mayo B project involves the construction of a second power facility downstream from a pre-existing one on the Mayo River which will increase power production to 15 megawatts. Land-based construction was started in June 2010, and water-related construction activities will commence in 2011 and be completed no later than March 2012.	www.yukonenergy.ca/about/projects/mayob/
Registered Trapline Concession 39	Tommy Moses	Present	08 447922 7117914	5	Registered trapline concessions are owned and operated by First Nations and non-First Nations. Marten and lynx are important harvest species, but wolverine, wolf, beaver, and muskrat may also be trapped. Concession holders have the exclusive right to trap in their area.	http://www.environmentyukon.gov.yk.ca/huntingtrapping/
Registered Trapline Concession 43	Alvin Peterson, Peter Hurt	Present	08 484627 7119535	14		
Registered Trapline Concession 44	Hepner Family	Present	08 499360 7116577	19		
Registered Trapline Concession 66	Stewart Moses	Present	08 419742 7089598	28		
Registered Trapline Concession 71	Simon Mervyn	Present	08 437054 7074835	23		

Activity	Proponent	Status	Location (UTM Zone, UTM Coordinates)	Distance to Project (km)	Description	Website
Registered Trapline Concession 81	Mary Beattie, Bruce MacGregor	Present	08 458497 7094358	0		
Registered Trapline Concession 82	–	Future	08 482325 7087061	13		
Registered Trapline Concession 84	Bernard Menelon	Present	08 453974 7072351	13		
Registered Trapline Concession 85	Lolita Welchman	Present	08 480034 7072617	19		
Game Management Zone 262	–	Present	08 467991 7096575	0	Yukon hunting regulations divide the territory into game management zones and subzones, of which only one subzone overlaps the Project. Each subzone is subject to license requirements, seasonal restrictions on bag limits. Hunting is considered a recreational and subsistence activity by visitors, local residents, and First Nations.	http://www.environmentyukon.gov.yk.ca/huntingtrapping/
Fishing	–	Present	S. McQuesten River Haggart Creek Haldane Creek McQuesten Lake Hanson Lake	10 0 15 25 25	Fishing occurs throughout the RAA year-round, with Chinook salmon and Arctic grayling being the most important fish species in the area. Five domestic fishing licenses have been issued within the RAA.	www.environmentyukon.gov.yk.ca/fishing/
Registered Outfitting Concession 4	Midnight Sun Outfitting Ltd.	Present	08 447922 7117914	0	Registered Outfitting Concessions allot individual outfitters an area with exclusive rights for guiding activities.	www.midnightsunoutfitting.com
Registered Outfitting Concession 7	Rogue River Outfitters Ltd.	Present	08 580769 7067004	21		www.yukonoutfitters.net/rogue.asp

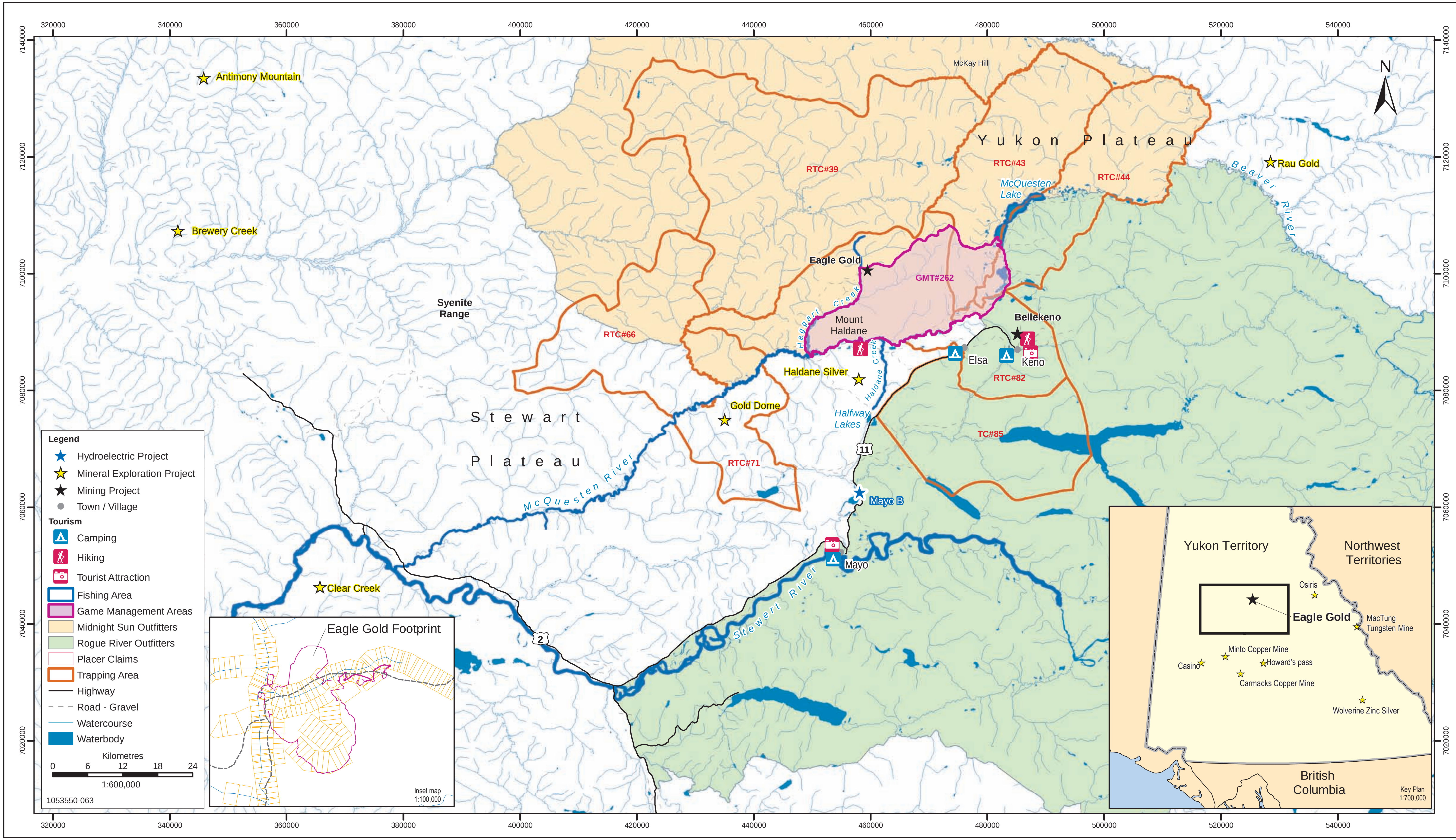
Activity	Proponent	Status	Location (UTM Zone, UTM Coordinates)	Distance to Project (km)	Description	Website
Camping	Keno City Campground	Present	08 483294 7085984	30	Camping	www.environmentyukon.gov.yk.ca/camping/
Camping	McIntyre Campground		08 453638 7051151	50		
Camping	Gordon Park Campground		08 453638 7051151	20		
Canoeing	–	Present	South McQuesten River	10	Canoeing	http://www.yukonwild.com/yukoncanoeing/
Hiking	Silver Trail Tourism Association	Present	Keno Hill	30	Hiking	
	Silver Trail Tourism Association		Mt. Haldane	13		http://www.canadatrails.ca/hiking/yk/mthaldane.html
Keno City Mining Museum	Yukon Government	Present	08 476012 7089119	28	The Keno City Mining Museum provides a history of mining activity for the region dating back to early 1900s.	http://www.yukonmuseums.ca/museum/keno/keno.html
Binet House	Yukon Government	Present	08 456468 7051750	47	The Binet House is a restored heritage building currently acting as an interpretive center in the town of Mayo. Binet House provides a history of the culture for region.	http://www.yukonmuseums.ca/interp/binet/binet.html

The projects and activities included in the cumulative impacts assessment depend on the extent of their measurable environmental effects on each selected VC. Environmental and socio-economic effects of other projects and activities will only be considered if it is reasonably foreseeable that they might affect a particular VC and if there is adequate information about the project or activity to assess its effects.

Assessment of potential cumulative effects is carried forward in the individual VC assessment sections. There which of the other projects, facilities, or activities in Table 6.3-1 for which it is reasonably foreseeable that Project effects could interact to affect the VC, are identified.

6.3.9 Figures

Please see the following pages.



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Victoria GOLD CORP

LOCATIONS OF PROJECTS AND ACTIVITIES INCLUDED IN THE PROJECT INCLUSION LIST

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION UTM - ZONE 8	DRAWN BY LS
DATUM NAD 83	CHECKED BY RS
DATE 23-November-2010	FIGURE NO. 6.3-1

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6.4 Surficial Geology, Terrain, and Soils

Surficial geology, terrain, and soils are closely interrelated and are considered as a single valued component (VC) for the Project. Combined they are the building blocks that shape the landscape and ecosystems that support a broad array of biological, cultural and societal functions and values. The Project has the potential to affect this VC because the mining operations and its supporting activities will involve land clearing, alteration of underlying soil and subsoil resources, and changes to local landscape features. These potential effects are of concern to government, communities, non-governmental organizations, Yukon residents, and First Nations as the effects on this VC have the potential to affect vegetation, wildlife habitat and hydrology. Specific terrain- and soils-related issues identified by the Yukon government and the FNNND for consideration in this environmental assessment were landslides, melting of permafrost, soil contamination, and reclamation (see Section 6.4.5).

The purpose of this assessment is to predict the potential environmental effects of the Project on surficial geology, terrain and soils, and to identify mitigation and environmental management measures that can be applied to avoid or minimize predicted effects.

While surficial geology, terrain, and soils are considered as a single VC they are independently defined as follows:

- **Surficial geology:** surface material or sediment that includes the source of the material whether it is weathered in situ bedrock or material moved by gravity, ice, wind or water. Surficial geology is used to assist in characterizing terrain and provides the basis of soil properties.
- **Terrain:** defined by Allaby and Allaby (1999) as, “an area of the ground with a particular physical character.” For this assessment, terrain includes landforms, surficial materials, material texture, surface expression, slope, and geomorphic processes (as defined by Howes and Kenk 1997).
- **Soils:** the material in the top layer of the surface of the earth in which plants can grow.

Terrain-related issues are also addressed elsewhere in the Project Proposal including: Bedrock Geology (Section 4.1.3), Surface Water (Section 4.1.10.1), Groundwater Hydrology (Section 4.1.10.2), Extreme Weather Events (Section 10.4), Terrain Instability (Section 10.2), and Seismic Activity (Section 10.3).

Soil contamination from spills is not addressed in this section. Large spill events are addressed in Accidents and Malfunctions (Section 8). Prevention and management of small-scale hazardous material spills will be addressed as part of the detailed Environmental Management Plan.

Information on soils is relevant to other VCs. That is, the assessment of soil element loading is the basis for the assessment of dusting effects on vegetation (Section 6.9), wildlife health (Section 6.10), and human health (Appendix 31 – Qualitative Human and Ecological Health Assessment); and the assessment of soil moisture changes informs the assessment of potential Project effects on wetlands and riparian ecosystems (Section 6.9).

6.4.1 Scope of Assessment for Surficial Geology, Terrain, and Soils

6.4.1.1 Regulatory/Policy Setting

The scope of the assessment is based on existing information and new studies completed as part of the Project. This information is summarized in the Surficial Geology, Terrain, and Soils Baseline (Appendix 6). In addition, the scope of the assessment was influenced by comments and input on soils and terrain received from regulatory agencies and the FNNND. As most of the mitigation for terrain and soils is addressed under reclamation, regulatory guidelines related to closure and reclamation also influence the scope of the assessment for this VC.

The assessment for surficial geology, terrain, and soils is based on the detailed table of contents for submissions under the *Yukon Environment and Socio-economic Assessment Act* (YESAA). The required information for Project Proposals submitted to the Executive Committee is found in the Proponent's Guide to Information Requirements for Executive Committee Project Proposal Submissions (YESAB 2005).

6.4.1.2 Surficial Geology, Terrain, and Soils Baseline Information

The following sections provide a brief summary of the baseline conditions for surficial geology, terrain, and soils in the local assessment area (LAA)[19]. This overview sets the general context for the understanding the potential Project effects, mitigation measures, and residual effect predictions for this VC. A detailed baseline description for this VC is provided in the Surficial Geology, Terrain, and Soils Baseline (Appendix 6) and the general physiography of the region is described in Section 4.1.

Surficial Geology and Terrain

The mine site is located in the Dublin Gulch watershed which has not been glaciated for more than 200,000 years. Since that time the landscape has been modified by freeze-thaw action, gravity, and water. The majority of the LAA, which encompasses the Dublin Gulch watershed, is characterized as weathered bedrock and colluvial deposits. Morainal, fluvial, and glaciofluvial materials are confined to the lower sections of the gulches. Anthropogenic materials in the LAA are the result of placer mining in Dublin Gulch and Haggart Creek, mining exploration trails and trenches, and road construction.

Geomorphic processes have modified the landscape through erosion, deposition, and movement of surficial material and rock. The dominant geomorphic condition within the LAA is permafrost (Figure 6.4-1). Permafrost is primarily concentrated in three locations: south of the confluence of Dublin Gulch and Haggart Creek, the plateau to the east, and a small area at the head of Ann Gulch (Figure 6.4-1). Some geomorphic processes, such as seepage and rock fall, pose stability concerns and are termed geohazards. Seepage occurs mostly along Haggart Creek and the lower reaches of gulches, particularly Stuttle and Platinum (Figure 6.4-1). Almost 13% of the observed geomorphic processes within the LAA are rapid mass movements such as rock slides and rock falls

[19] See Section 6.4.1.6 for a description of this assessment area.

(Figure 6.4-1). Gullies in the LAA are at risk for small failures, particularly during periods of intense water flow in ephemeral stream channels.

The majority of the LAA is classified as generally stable terrain, (Figure 6.4-2). Almost a quarter of the LAA is classified as moderately stable terrain (Figure 6.4-2). Nine percent of the LAA is classified as potentially unstable and unstable terrain. This naturally unstable terrain occurs mainly along the upper reaches of Eagle Pup, Stewart Gulch, Olive Gulch, Bawn Boy Gulch, and a lower section of Ann Gulch, with the largest unstable areas occurring within Dublin Gulch (Figure 6.4-2). Much of the original terrain integrity of Dublin Gulch and Haggart Creek has been altered by placer mining and exploration.

Table 6.4-1: Summary of Terrain Stability Classes in the Local Assessment Area

Terrain Stability Class	Terrain Stability Class Description	Area (ha)	Percent (%) of LAA
I	Stable	144.3	9.0
II	Generally Stable	942.4	58.7
III	Moderately Stable	375.1	23.3
IV	Potentially Unstable	95.2	5.9
V	Unstable	49.0	3.1
Total		**1,606.0**	**100.0**

Soils

Although the relatively cold climate has limited soil development, the length of time since the last glaciations has allowed some soil to develop, particularly on weathered bedrock. The most common soils types in the LAA are Cryosols and Brunisols. Soil textures are predominantly sandy-silt to silty-sandy-loam, with coarse fragments ranging from gravel to boulders. Topsoil depths are generally from 10 to 15 cm. The average depth of salvageable soil material (including both topsoil and subsoil) is approximately 50 cm.

The soil and overburden of the LAA are highly enriched with arsenic; most baseline samples collected have arsenic concentrations well above the Canadian Council of Ministers of the Environment (CCME) guidelines (CCME 1999) and the Yukon Contaminated Sites Regulation (CSR) guidelines[20] for agriculture and parkland soils. The baseline conditions for arsenic in soil are described further in the context of the assessment of Project effects on soil reclamation suitability in Section 6.4.3.3.

The majority of the LAA is comprised of soil unsuitable for reclamation because of excessive stoniness. However, the soil that has developed in the fine fraction of these materials could be rendered suitable for reclamation by sorting or screening. Just over 12% of the LAA has soils that

[20] http://www.gov.yk.ca/legislation/regs/oic2002_171.pdf

have fair to good suitability for reclamation. These soils have developed from fluvial and morainal materials located in the lower gulches and valleys.

Table 6.4-2: Summary of Soil Reclamation Suitability in the Local Assessment Area

Soil Reclamation Suitability [a]	Area (ha)	Percent (%) of LAA
Good	94.2	5.9
Good-Fair [b]	102.9	6.4
Fair-Good [c]	12.4	0.8
Poor	245.7	15.3
Unsuitable	902.4	56.2
Not Rated Anthropogenic	247.2	15.4
Not Rated Organic	1.2	0.1
Total	**1,606.0**	**100.0**

NOTE:
[a] Soil reclamation suitability ratings were calculated from field data for the upper soil, excluding overburden.
[b] 60% or more of the soil map unit has good soil reclamation suitability, the rest is fair.
[c] 60% or more of the soil map unit has fair soil reclamation suitability, the rest is good.

6.4.1.3 Key Issues and Identification of Potential Effects

Potential environmental effects on each of the three interrelated components of the VC are discussed below.

Surficial Geology

Consideration of surficial geology with respect to this Project occurs only as it pertains to the overburden[21] to be used as a potential growth medium for reclamation when there is insufficient soil, and in reference to it being the basis for local soil properties. Thus, surficial geology is indirectly addressed as part of the soils assessment (see below) with the assumption that surficial geology will be altered and affected in much the same way as soils.

Terrain

The key environmental effect for terrain for this Project is an adverse change in terrain stability. This potential environmental effect is measured by the increased risk of debris flows, slumps, earth flows, permafrost thaw, and other events collectively known as mass wasting. Mass wasting events are natural geomorphic processes that are common in mountainous areas and in association with dynamic fluvial systems such the Dublin Gulch watershed. The risk of a mass wasting event can be created or exacerbated by forest clearing, road construction, and other disturbances on slopes. Mass wasting events are commonly triggered by intense periods of high rainfall or snowmelt or from areas within permafrost thaw zones. Mass wasting can affect a number of biophysical and socio-economic

[21] Surficial material below 1 m of the soil surface.

receptors including: soil resources, vegetation, water and fisheries, property and infrastructure, cultural and archaeological resources, and human life and safety.

The majority of terrain stability issues, including all those within the mine features area[22], have been addressed through mine design (Appendix 35) and risk management (Section 10). A summary of the preliminary mine design mitigation measures identified for site-specific geohazards within the mine features area is presented in Section 6.4.1.4. Addressing terrain stability issues in advance, at the mine design stage, is important to minimize the potential for a high magnitude effect—that is, a single mass wasting event triggered by Project activities could affect terrestrial ecosystems, aquatic ecosystems and overall mine safety collectively.

The only terrain stability issue not adequately addressed by mine design mitigation measures is associated with permafrost areas and geohazards identified in the clearing area[23]. The Project activities with the potential to result in an adverse change in terrain stability in this case are: site clearing and grubbing and site water management. This effect will be addressed in detail in the assessment (Section 6.4.2).

Unique terrain landforms or landforms of cultural significance were reviewed in the FNNND Traditional Knowledge and Use Study (Stantec 2010). Based on a review of this report, the Project will not directly affect any known unique terrain features, and any areas requiring special access or protection identified in the report have been addressed through Project design.

Table 6.4-3: Potential Project Effects to Surficial Geology, Terrain, and Soils

Project Activities and Physical Works	Potential Environmental Effects	
	Adverse Change in Terrain Stability	Adverse Change in Soil Reclamation Suitability
Construction Phase		
Site clearing and grubbing	✓	✓
Salvaging and stockpiling of top and sub soils		✓
Site grading including blasting, overburden removal and overburden disposal		✓
Borrow areas development and use		✓
Use of large construction vehicles and equipment		✓
Construction of mine site infrastructure and haul roads		✓
Site water management (diversion and runoff)	✓	✓

[22] This is the area of direct mine development within the Project footprint as described in Section 6.4.1.6.

[23] This is the area within the Project footprint that will be cleared but not ground disturbed as described in Section 6.4.1.6.

Project Activities and Physical Works	Potential Environmental Effects	
	Adverse Change in Terrain Stability	Adverse Change in Soil Reclamation Suitability
Operations and Modification Phase		
Open-pit mining (blasting, ore/waste hauling, open pit dewatering)		✓
Ore processing (crushing and hauling)		✓
Quarry/borrow pit operations		✓
Closure and Reclamation Phase		
Pit lake filling		✓

NOTE:
Project Environmental Effects
Only Project-Environment interactions ranked as “2” in Table 6.3-1, the Project-Environment Interaction Table, are carried forward to this Table.
✓ Indicates that an activity is likely to contribute to the environmental effect.

Soils

The key potential environmental effect for soils (and by association, surficial geology) for this Project is adverse change in soil reclamation suitability[24] as measured by changes in soil physical and chemical properties. Eleven Project activities (see Table 6.4-3). are identified as having the potential to result in an adverse change in soil reclamation suitability: site clearing and grubbing; salvaging and stockpiling of top and subsoils; site grading including blasting, overburden removal and overburden disposal; borrow areas development and use; use of large construction vehicles and equipment; construction of mine site infrastructure and haul roads; site water management; open-pit mining; ore processing quarry/borrow pit operations; and pit lake filling. This effect will be addressed in detail in the assessment (Section 6.4.3).

6.4.1.4 Standard Mitigation Measures and Effects Addressed

Surficial Geology

See the mitigation measures for soils described below, as the mitigation measures for soils also apply to potential effects on surficial geology.

Terrain

As indicated in Section 6.4.1.3, the majority of the potential environmental effects on terrain stability will be addressed through risk management and mine design. Table 6.4-4 lists the geohazards identified within the mine features area at baseline and summarizes the preliminary mine design mitigation

[24] No areas with agricultural potential are present in the LAA.

measures identified to address these geohazards (further information can be found in Appendix 35). For example, there are 179.9 ha of permafrost within the Project footprint[25] (Figure 6.4.3), the majority of which (132.7 ha) will be removed as a result of soil and overburden stripping from the mine features area (Table 6.4-4) and will consequently no longer pose a concern. Mine design mitigation measures will be developed further and in greater operational detail during the feasibility stage and provide the opportunity for addressing remaining issues posed by permafrost.

Consideration of permafrost as it relates to the effect of the environment on the Project is addressed in detail in Section 10.2 (Terrain Instability).

Construction phase activities that may interact with terrain stability but are not expected to result in a significant effect (i.e., ranked as ‘1’ in Table 6.3-1) are: access road upgrades and installation of transmission line. For road upgrades, standard Best Management Practices (BMPs) outlined by the Yukon Occupational Health and Safety Regulations (YWCHSB 2006) set out minimum design criteria for safety considerations. Stabilizing rock slopes and faces adjacent to road construction is an example of a safety consideration related to terrain stability. Mine haul road design guidelines developed by the University of Alberta (Tannant and Regensburg 2001) will also be reviewed to determine BMPs. General guidelines for haul road construction as it relates to terrain stability include: constructing and maintaining drainage through culvert installation and maintenance; and periodic grading and resurfacing of road surfaces. For the transmission line, very little access is required as it parallels the existing road. Pole placement will avoid unstable terrain as identified on baseline terrain stability maps (Appendix 6) and confirmed by pre-development site assessment by geotechnical engineers.

[25] See Section 6.4.1.6 for a description of the Project footprint.

Table 6.4-4: Preliminary Mine Design Plan to Address Terrain Stability

Baseline Geohazards	Mine Design Mitigation Measures
Flooding potential in northern part of Dublin Gulch and on Haggart Creek floodplain	The Dublin Creek diversion attends to the flooding hazard
Surface seepage visible in disturbed areas	Under-drainage to collect seepage has been designed
Permafrost	Safety margin has been built in to account for potential reduction in stability due to removal of frozen layers. Zones of permafrost with excess ice will be prestripped to encourage thawing and drainage, or excavation to thaw stable overburden or bedrock before being covered with waste rock, and monitoring and reduced bench heights if required.
Rockfall on southeast facing slope towards Dublin Gulch, northeast of lower end of Ann Gulch	
Rock fall on south-facing slope just north of Dublin Gulch where the proposed Dublin Gulch diversion embankment is proposed	At the rockfall areas, particularly near the base of Ann Gulch where it meets Dublin Gulch, stabilization will be designed
Permafrost in northeast third of Ann Gulch and on west-facing slope of the upper gulch	Design accommodates for removal of frozen stable layer
Active rockslide in northern portion of Eagle Pup and steep west-facing slope	Stabilization of rockfall areas have not been specifically designed, but have been considered in the construction method (i.e., placement of material in an upslope direction will provide a buttressing/stabilizing effect to the steep slopes). Instrumentation to assist in the assessment of slope stability of the WRSA benches
Historic rockfall in southern portion of Eagle Pup along west side on southeast-facing slope	
Rockslide, gullies and piping in southeast corner of Eagle Pup	Stabilization of rockfall areas have not been specifically designed, but have been considered in the construction method (i.e., placement of material in an upslope direction will provide a buttressing/stabilizing effect to the steep slopes). The Eagle Pup WRSA is to be constructed through a hybrid of ascending lifts, waste-rock terraces and some areas of descending platforms and wrap-arounds.
Seepage and gully in centre of Eagle Pup along creek	Under drainage to collect seepage has been designed. Horizontal benches with ditches t to control the concentration of runoff and potential for erosion. All precipitation infiltrating the Eagle Pup WRSA will report to the rock drain and ultimately as seepages from the toe of the waste rock and into the sediment control pond. Seepage and surface runoff water will be partially redirected into the neighbouring catchment of Stewart Gulch and the interception and diversion ditch system will divert seepage and surface flows above the dump catchment.

Baseline Geohazards	Mine Design Mitigation Measures
Permafrost on northernmost portion of Eagle Pup	Design provides an allowance for removal of stable frozen layer
Several gullies are present on the north lower slope of Platinum Gulch There is a landslide at the very upper reaches of both tributaries that enter the gulch Overall terrain is stable in the Gulch, but areas with gullies or steep-walled terrain are potentially unstable	Placement of material in an upslope direction will provide a buttressing/stabilizing effect to the steep slopes. Where WRSAs are built from the bottom to top, with ascending terrace lifts, relative increases in strength characteristics are achieved through improved state of particle packing during construction, and reduced (bench) slope heights. Gullies on the north slope of Platinum Gulch likely require removal of loose materials down to bedrock before waste rock is placed. This removal of colluviums should mitigate any potential erosion of waste rock within the existing gullies
Small area of solifluction at eastern margin of open pit	
Large fault to southeast of open pit	Fault will be considered in mine design using Loading under an Operational and Maximum Design Earthquake (ODE and MDE) and Probable Maximum Precipitation (PMP). Pit walls will be monitored for movement as necessary.
Permafrost in secondary crushing area	Design provides an allowance for removal of stable frozen layer
The till material upslope on the east side of Haggart Creek is potentially unstable in areas of permafrost. The permafrost with a thick thaw zone and seepage, has liquefied soil and soil creep made evident by tilted trees and narrow gaps in vegetation groundcover exposing soil	Given that Stockpile 1 is a contingency storage area, no specific design measures warranted at this time. Site will be reviewed at the feasibility study stage.
Shallow colluvium over bedrock may be potentially unstable	Given that Stockpile 4 is a contingency area, no specific design measures warranted at this time. If the site is required, site preparation will be done to remove colluvium and level site if soil storage area required. The site will be reviewed at the feasibility study stage

NOTE:

Preliminary mine design mitigation measures provided by Scott Wilson Mining January 2010 and outlined in Appendix 35.

Soils

Construction phase activities that may interact with soils but are not expected to result in a significant effect (i.e., ranked as ‘1’ in Table 6.3-1) are: disposal of cleared vegetation; access road upgrades; camp construction; waste handling; diesel power generation; water supply and usage; fish habitat compensation; vehicle traffic; clearing of transmission line right-of-way; and installation of transmission line. The effect of these activities will be limited in extent and covered off with standard mitigations measures, mostly linked to sediment and erosion, control and windrow soil salvage (see Conceptual Closure and Reclamation, Appendix 24). Diesel power generation will not produce sulphur emissions in high enough concentrations to cause soil acidification (see Air Quality Assessment, Section 6.6). Water usage will not affect soil moisture conditions.

Operations phase activities that may interact with soils but are not expected to result in a significant effect (i.e., ranked as ‘1’ in Table 6.3-1) are: waste rock disposal; solid waste management; vehicle traffic; access road and transmission line presence and maintenance; diesel power generation; and fuel, hazardous materials, and explosives management. The effect of these activities will be limited in extent and covered off with standard mitigations measures or specific environmental management plans. Vehicle traffic will be limited to trails and roads already constructed or in areas that will be decompacted before reclamation. Fish habitat compensation is an enhancement and will not result in loss of soils. Road and transmission line maintenance will result in little effect to soils as the transmission line is along the road so undisturbed soil will likely not be driven over and compacted or eroded during maintenance. As indicated above, diesel power generation will not produce sulphur emissions in high enough concentrations to cause soil acidification.

Operations phase activities which are considered to have no potential to interact with soils (i.e., ranked as ‘0’ in Table 6.3-1) are: gold heap leach facility operation; potable and non-potable water use; wastewater treatment and discharge; and camp operation.

Closure and reclamation phase activities that may interact with soils but are not expected to result in a significant effect (i.e., ranked as ‘1’ in Table 6.3-1) are: reclamation of waste rock storage areas (WRSAs); heap leach facility reclamation; plant and associated facility removal and site reclamation; haul roads closure and reclamation; and transmission line closure and reclamation. Most of the potential adverse changes to soils in this phase are mitigated through the Conceptual Closure and Reclamation Plan (Appendix 24). For example, this plan addresses site-specific mitigation measures for the handling of soils and BMPs for transmission line closure. Reclamation is expected to restore soil productivity to the mine features area. Similarly, the removal of the mine water treatment plant and associated facilities (including closure of sediment control ponds) are also considered to have a positive effect on soils once reclamation measures have been implemented.

One closure and reclamation phase activity is considered to have no potential to interact with soils (i.e., ranked as ‘0’ in Table 6.3-1): ongoing water treatment and discharge.

6.4.1.5 Selection of Measurable Parameters

One measurable parameter was selected for the assessment of Project effects on terrain stability and a suite of eight measurable parameters were selected for the assessment of Project effects on soil reclamation suitability (Table 6.4-5).

Table 6.4-5: Measurable Parameters for Surficial Geology, Terrain, and Soils Assessment

Environmental Effect	Rationale for Inclusion of the Environmental Effect in the Assessment	Measurable Parameters for the Environmental Effect	Rationale for Selection of the Measureable Parameters
Adverse change in terrain stability	Terrain stability is an important consideration in mine design. Also, a decrease in terrain stability may trigger a mass wasting event that could have high consequence for other resources (e.g. fish-bearing streams, infrastructure).	Change in terrain stability class due to permafrost thaw and/or the presence of geohazards in the clearing area (within the Project footprint)	Terrain stability classes are indicative of the risk of mass wasting events.
Adverse change in soil reclamation suitability	The availability of suitable soils for reclamation is directly relevant to the development of an effective closure and reclamation plan.	Change in measurable parameters related to soil physical properties: ▪ Admixing[a] ▪ Compaction[b] ▪ Erosion ▪ Topsoil volume loss ▪ Soil cover loss[c] ▪ Soil moisture change Change in measurable parameters related to soil chemical properties: ▪ Soil contamination ▪ Soil fertility change	Soil reclamation suitability can be altered by changes to one or more of these measurable parameters.

NOTE:

[a] Admixing is the reduction of soil quality as a result of the mixing or dilution of topsoil with subsoil, spoil or waste (BC Ministry of Forests 2001; Powter 2002).

[b] Compaction is the packing together of soil particles and aggregates by external forces. During compaction soil particles are packed closer together while aggregates are crushed and porosity decreases (BC Ministry of Forests 2001; Powter 2002).

[c] Soil cover loss occurs if soil replacement is not possible because of permanent disturbance (e.g., flooding).

6.4.1.6 Spatial Boundaries for Surficial Geology, Terrain, and Soils

Two spatial boundaries were defined for the assessment of Project effects on surficial geology, terrain and soils as described below.

Local Assessment Area

The local assessment area (LAA) encompasses the entire Project footprint with a buffer to ensure that all direct physical effects of mine activities on the VC are contained within its boundaries. The

Project footprint encompasses all mine features and clearing areas, exclusive of the road corridor upgrades and the transmission line right-of-way (Figure 6-4.4). The total area of the LAA is 1,606 ha. The Project footprint is 585 ha. The majority of this area (457 ha) is the mine features area where facilities are located and in which ground disturbance (soil removal) is planned. The remaining 128 ha is the clearing area in which vegetation will be cleared but soils will be left in place.

The LAA is generally defined by the extent of Dublin Gulch watershed but with two extensions outside of the watershed to encompass all components of the Project footprint[26] (Figure 6.4-4). The first extension is in the northwest corner of the watershed near Ann Gulch (to include the Heap Leach Facility) and the second is north of the confluence of Dublin Gulch and Haggart Creek (to include proposed camp development).

Regional Assessment Area

The regional assessment area (RAA) encompasses the 1,606 ha LAA plus an additional 5,932 ha surrounding the LAA, for a total of 7,538 ha (Figure 6.4-4). The boundaries of the RAA were defined by the natural terrain breaks in the landscape and extend from Lynx Creek in the south, to Haggart Creek in the north, and to the height of land for the small sub-watersheds located west of Haggart Creek. The RAA provides a broader geographical context for understanding Project effects such as soil element loading from dust deposition and soil moisture changes due to changes in surface groundwater. The RAA also represents the area in which potential cumulative environmental effects are likely to occur.

6.4.1.7 Temporal Boundaries for Surficial Geology, Terrain, and Soils

Four temporal boundaries are used for the assessment of Project effects on surficial geology, terrain, and soils as described below.

- **Baseline:** represents surficial geology, terrain and soils characteristics as measured in the summer of 2009 when field surveys were conducted.
- **Construction:** is defined as the time at which the maximum extent of ground disturbance for mine construction has been achieved.
- **Operations:** is defined as Year 7.3 (Year 2021) of mine operations when the greatest changes to soil moisture and the maximum loading of elements on soils is expected. No active blasting, hauling and crushing are expected after 7.3 years of operations.
- **Post-closure:** represents conditions forecast following complete closure and reclamation of the mine. This scenario is when all mitigation, including soil replacement, has occurred and the new post-closure environmental equilibrium has been achieved. This is estimated to occur in 2030.

Accordingly, the timeframe for the effects assessment spans the period from the establishment of baseline conditions through to Project closure, 2009 through 2030.

[26] The LAA is identical to the local study area (LSA) described in the Surficial Geology, Terrain, and Soils Baseline (Appendix 6).

6.4.1.8 Characterization of Residual Effects Surficial Geology, Terrain, and Soils

Each residual Project and cumulative environmental effect identified in the assessment is characterized using multiple criteria: direction, magnitude, geographic extent, timing and frequency, duration, reversibility, ecological context and probability of occurrence. The definitions for effects characterization under each criterion are presented in Table 6.4-6 for terrain and Table 6.4-7 for soils.

Table 6.4-6: Characterization of Residual Environmental Effects for Terrain

Characterization	Description	Quantitative Measure or Definition of Qualitative Criterion
Direction	The ultimate long-term trend of the environmental effect	**Positive**—Terrain stability improves relative to baseline **Neutral**—Terrain stability does not change relative to baseline **Adverse**—Terrain stability worsens relative to baseline
Magnitude	The amount of change in a measurable parameter or variable relative to baseline case	**Low**—No change in terrain stability class **Moderate**—Terrain stability class changes from stable to potentially unstable **High**—Terrain stability class changes to unstable
Geographical Extent	The geographic area in which an environmental effect of a defined magnitude occurs	**Site-specific**—Effect confined to specific features within Project footprint **Local**—Effect confined to LAA **Regional**—Effect extends beyond LAA
Timing and Frequency	The number of times during a Project or a specific Project phase that an environmental effect may occur	**Once**—Effect occurs once **Sporadic**—Effect occurs more than once but at unpredictable intervals **Frequent**—Effect occurs repeatedly at regular intervals **Continuous**—Effect occurs continuously
Duration	The period of time required until the VC returns to its baseline condition, or the effect can no longer be measured or otherwise perceived	**Short-term**—Effect limited to <1 year (i.e., terrain stabilizes after one year) **Medium-term**—Effect occurs for >1 year but not beyond the life of the Project (i.e., terrain stabilizes before closure) **Long-term**—Effect extends beyond the life of the Project (i.e., terrain stabilizes after closure) **Permanent**—Effect is permanent (terrain does not stabilize)
Reversibility	The likelihood that a measurable parameter will recover from an effect	**Reversible**—Effect will reverse over time **Irreversible**—Effect will not reverse over time
Ecological Context	The general characteristics of the area in which the Project is located	**Disturbed**—Existing unstable or potentially unstable areas within LAA **Undisturbed**—No existing unstable or potentially unstable areas within LAA
Probability of Occurrence	The probability that an effect or event will occur in a given time period	**Low**—Effect unlikely to occur **Moderate**—Effect likely to occur **High**—Effect will occur

Table 6.4-7: Characterization of Residual Environmental Effects for Soils

Characterization	Description	Quantitative Measure or Definition of Qualitative Criterion
Direction	The ultimate long-term trend of the environmental effect	**Positive**—Soil reclamation suitability improves relative to baseline **Neutral**—Soil reclamation suitability does not change relative to baseline **Adverse**—Soil reclamation suitability worsens relative to baseline
Magnitude	The amount of change in a measurable parameter or variable relative to baseline case	**Low**—Effect on one or more of the measurable parameters is detectable, but within range of natural variation or baseline values, no change in soil reclamation suitability class **Moderate**—Effect on one or more of the measurable parameters is detectable and outside the range of natural variation or baseline values, but is unlikely to change soil reclamation suitability class **High**—Effect on one or more of the measurable parameters is detectable, outside the range of natural variation or baseline values, and changes soil reclamation suitability by at least one class
Geographical Extent	The geographic area in which an environmental effect of a defined magnitude occurs	**Site-specific**—Effect confined to specific features within Project footprint **Local**—Effect confined to LAA **Regional**—Effect extends beyond LAA
Timing and Frequency	The number of times during a Project or a specific Project phase that an environmental effect may occur	**Once**—Effect occurs once **Sporadic**—Effect occurs more than once but at unpredictable intervals **Frequent**—Effect occurs repeatedly at regular intervals **Continuous**—Effect occurs continuously
Duration	The period of time required until the VC returns to its baseline condition, or the effect can no longer be measured or otherwise perceived	**Short-term**—Change in soil reclamation suitability is limited to a period ≤2 growing seasons **Medium-term**—Change in soil reclamation suitability spans 2 to 10 growing seasons **Long-term**—Change in soil reclamation suitability lasts longer than 10 growing seasons **Permanent**—Change in soil reclamation suitability lasts longer than the life of the Project
Reversibility	The likelihood that a measurable parameter will recover from an effect	**Reversible**—Effect will reverse over time **Irreversible**—Effect will not reverse over time
Ecological Context	The general characteristics of the area in which the Project is located	**Disturbed**—Existing human-caused ground disturbances within LAA **Undisturbed**—No existing human-caused ground disturbances within LAA
Probability of Occurrence	The probability that an effect or event will occur in a given time period	**Low**—Effect unlikely to occur **Moderate**—Effect likely to occur **High**—Effect will occur

Additionally, a confidence rating is applied to the significance determination for any residual effect identified. The rating considers the accuracy and application of analytical tools, an understanding of the effectiveness of mitigation measures, and an understanding of known responses of the measurable parameters to potential Project effects. The confidence ratings are:

- **Low**—not confident in prediction, could vary considerably
- **Moderate**—confident in prediction, moderate variability
- **High**—confident in prediction, low variability.

6.4.1.9 Standards or Thresholds for Determining Significance for Surficial Geology, Terrain, and Soils

Threshold for Determining Significance of Adverse Change in Terrain Stability

Determining the significance of an adverse change in terrain stability is a semi-quantitative prediction primarily based on the magnitude and probability of occurrence of such a change (see Table 6.4-6) considered in the context of the potential consequence of the event triggered by the adverse change (i.e., mass wasting). Thus, for this assessment, an adverse effect on terrain stability will be considered significant if the following threshold is reached:

- A high magnitude, adverse potential effect of high probability is identified that results in a greater area of unstable terrain within the LAA than was present at baseline or that could potentially trigger an event of high consequence (i.e., a mass wasting event which directly affects a fish-bearing stream, important wildlife habitat, infrastructure or human life).

Threshold for Determining Significance of Adverse Change in Soil Reclamation Suitability

Determining the significance of an adverse change in soil reclamation suitability is a semi-quantitative prediction primarily based on the magnitude, reversibility, and geographic extent of such a change considered in the context of the baseline soil reclamation suitability (see Table 6.4-7). Thus, for this assessment, an adverse effect on soil reclamation suitability will be considered significant if the following threshold is reached:

- Soil reclamation suitability within a soil map unit[27] is irreversibly reduced by one or more class relative to baseline, specifically from good or fair to poor or unsuitable, and where such a change would impede or prevent successful reclamation within the Project footprint.

The characterizations of the changes in the measurable parameters related to soil reclamation suitability are primarily qualitative. However, specific quantitative thresholds have been identified for three of the measurable parameters that influence soil reclamation suitability and these are described below. A change that crosses any one of these quantitative thresholds will be considered collectively with changes in the other measurable parameters when determining the significance of the adverse change in soil reclamation suitability.

[27] A soil map unit is a "defined and named repetitive grouping of soil bodies occurring together in an individual and characteristic pattern over the soil landscape" (Gregorich, et al., 2001) (see Appendix 6, Surficial Geology, Terrain, and Soils Baseline).

- **Topsoil Volume Loss:** Threshold is whether there is sufficient soil volume for successful reclamation on areas requiring soil replacement.
- **Soil Contamination:** Thresholds are based on the CCME guidelines for agricultural land (CCME 1999), the most stringent guidelines available territorially and federally. The CCME guidelines are for general guidance only and site-specific conditions should be considered (CCME 1999). Thus, for this Project, if any elements were naturally in exceedance of the CCME guidelines at baseline (e.g., arsenic) then a 10% increase above baseline at operations was considered to be a notable change. The 10% threshold was chosen to account for inherent variability in laboratory, air modeling and soil interpretation results, while still being indicative of an actual increase in element concentration.
- **Soil Moisture Change:** Thresholds were developed for three soil moisture classes for which prolonged or permanent changes in groundwater levels are likely to be manifested in an eventual change in baseline vegetation community characteristics (through changes to drainage and soil moisture conditions) (Table 6.4-8).

Table 6.4-8: Thresholds for Soil Moisture Change

Soil Moisture Class	Class Description	Baseline Drainage Class	Threshold of Change (m)	Direction of Change in Water Table	New Drainage Class
Wet	Organic or wetland peat-forming soils, saturated throughout growing season, water table within 1 m of surface	Poorly to very poorly drained	Water table drops below 1 m from surface	Decrease	Imperfectly drained if within 2 m, well drained if >2 m
Moist to wet	Gleysols or water-saturated mineral soils, saturated for part or all of growing season, water table fluctuates but often within 2 m of surface	Imperfectly drained	Water table drops to more than 2 m from surface	Decrease	Well drained
Dry	Upland mineral soils , water table is often >2 m below surface	Well drained	Water table rises <2 m from surface	Increase	Imperfectly to Poorly drained

6.4.1.10 Effects Analysis Methods

Key information sources used in the prediction of Project effects on terrain stability and soil reclamation suitability are: 1:10,000 terrain mapping with its associated terrain stability and geohazards interpretations; 1:10,000 soil mapping with its associated soil reclamation suitability and erosion potential interpretations; soil element analysis; air quality modeling, and groundwater modeling. The base terrain and soil maps and their interpretative products were developed using air photo interpretation, field survey data, and geotechnical drill, test pit and trench log data. Details on the methods used to develop these map products are provided in the Surficial Geology, Terrain, and Soils Baseline (Appendix 6) and below (erosion potential). The air quality modeling methods are described in Air Quality Assessment, Section 6.6. The groundwater modeling methods are described in Appendix 22 – Groundwater Model Report. The methods for the soil element analysis are described below.

The effect assessment methods for determining adverse change in terrain stability and adverse change in soil reclamation suitability are described in the following sections.

Adverse Change in Terrain Stability

Adverse change in terrain stability was characterized semi-quantitatively using: 1) a spatial overlay of the Project footprint on the baseline terrain stability map to identify the location of permafrost areas and potential geohazards within the clearing area, in combination with; 2) professional expertise regarding risk and consequence of a mass wasting event, and the effectiveness of relevant mitigation measures.

Permafrost areas were identified based on the presence of frozen conditions (summer and fall measurements) within 2 m of the surface and/or evidence of permafrost was visible during the terrain mapping photo interpretation (e.g., the presence of soil creep/cracks at surface, tilted trees). The 2 m depth and surface evidence of permafrost processes was used as the thaw risk from vegetation removal in the clearing area. Thawing is likely not to occur in permafrost at deeper depths (>2m) where soil and overburden cover should sufficiently insulate the permafrost. The data used to generate permafrost areas for this assessment were measured during the soil and terrain survey data 2009, and drill logs between 1995 and 2009 (Figure 6.4-3). Raw data is provided in Appendix 35 – Geotechnical Design Basis for Mine Site Infrastructure in the Project Proposal, Appendix D – Permafrost Data. Additional drill logs were completed in 2010, and although not used in the permafrost mapping the data was used to address geotechnical stability (Appendix 35).

Adverse Change in Soil Reclamation Suitability

The adverse change in soil reclamation suitability was determined qualitatively based on: (1) consideration of the combined effect of changes in the eight measurable parameters on soil reclamation suitability (see Table 6.4-5) supported by a clear understanding of the methods and rationale used to classify soils according to their reclamation suitability (see Appendix 6), and (2) professional expertise regarding how soil properties affect soil reclamation suitability. Although this is a qualitative assessment some of the measurable parameters are quantitative as described in Section 6.4.1.9. The specific methods used to determine Project effects on the measurable parameters are described below.

Admixing

Admixing is the reduction of soil quality as a result of the mixing or dilution of topsoil with subsoil, spoil or waste (BC Ministry of Forests 2001; Powter 2002). The potential for admixing was determined qualitatively based on professional expertise regarding the level of admixing risk associated with the Project activities and the effectiveness of relevant mitigation measures.

Compaction

Compaction is the packing together of soil particles and aggregates by external forces. During compaction soil particles are packed closer together while aggregates are crushed and porosity decreases (BC Ministry of Forests 2001; Powter 2002). The potential for compaction was determined qualitatively based on professional expertise regarding the level of compaction risk associated with the Project activities and the effectiveness of relevant mitigation measures.

Erosion

An erosion potential map was developed for the LAA based on methods described in BC Ministry of Forests (1999). Erosion potential ratings were based on slope, parent material, drainage, texture, gullying, and other terrain attributes. This information was available from the terrestrial ecosystem mapping (TEM) and soil mapping supplemented with field survey data. Five ratings were used: very high, high, moderate, low, and very low. Organic soils, disturbed land, water and exposed bedrock were not rated. The erosion potential ratings apply to bare soil conditions and reflect the potential risk of sediment loss due to surface erosion as a result of exposure through clearing of vegetative cover and construction activities.

The potential for erosion was determined semi-quantitatively using a spatial overlay of the Project footprint on the erosion potential map to identify areas with moderate or higher erosion potential ratings. The characterization of the effect was informed by professional expertise regarding the effectiveness of relevant mitigation measures and the potential for erosion in association with other mine features (e.g., soil stockpiles).

Topsoil Volume Loss

Average topsoil depths for each soil map unit in the LAA were calculated from field data. Topsoil depth (LFH, A and AB horizons) ranged between 10 and 40 cm. Bedrock, water bodies and disturbed lands are categorized as non-soils and have a corresponding topsoil depth of zero. Topsoil volume is the product of the soil map unit area and the average topsoil depth for that unit.

Topsoil volume loss was determined quantitatively using a spatial overlay of the portion of the Project footprint where soil salvage will not occur on the soil map in order to identify the area and identity of the soil map units affected. That information was then be used to calculate the topsoil volume lost.

Soil Cover Loss

Soil cover loss was determined quantitatively using a spatial overlay of the soil reclamation suitability map on the portion of the Project footprint on which soil replacement will not be possible because of the presence of permanent mine features (e.g., the open pit and pit lake) resulting in permanent soil cover loss.

Soil Moisture Change

Soil moisture change was determined semi-quantitatively using a spatial overlay of groundwater model outputs (Appendix 22 – Groundwater Model Report) on soil map units within the Dublin Gulch watershed to identify where and how soil moisture classes would be affected by changes in groundwater level (see Table 6.4-8).

Soil Contamination

Element loading on soil was calculated based on the predicted dust levels of 18 elements. The analysis area was defined by a spatial overlay of the air modeled particulate matter (dust) isopleths (see Air Quality Assessment, Section 6.6) on the soil map units in the LAA and RAA. The effect of the Project on soil element concentrations was determined with a simple comparison between baseline soil element concentrations[28] and the predicted soil element concentrations at operations. The element loading period for the operations phase was assumed to be for 7.3 years (see Section 6.4.1.7). As described in Section 6.4.1.9, the soil element concentrations were compared to the CCME agricultural guidelines to identify any exceedances or, using a 10% threshold, to identify any notable changes in cases where baseline values are already in exceedance of the guidelines. The following assumptions were made in determining the element loading on soils:

- Element loading calculations were made for each of 656 individual soil map units that fell within the 8 million g/ha/year isopleth. The grid values of dust values were averaged per soil polygon.
- Accumulation of elements would occur in the uppermost mineral soil horizon just beneath the LFH horizon. Thickness of the horizon varies from 2 to 16 cm, so a depth of 10 cm was used.
- Baseline soil element concentrations for each soil map unit were interpreted from baseline element laboratory data. In cases where there were no baseline data for a particular soil map unit an appropriate surrogate was used (e.g., the C2 soil map unit data was applied to cryogenic or frozen soils).
- Bulk density values were based on texture and type of soil horizon. Where surface horizon type was unknown for a particular soil map unit, bulk density values for an appropriate surrogate were used (e.g., the C2 soil map unit values were applied to cryogenic or frozen soils.
- No element loading was calculated for rock, water, and disturbed land.
- The mine features area was excluded from the analysis as those areas will be capped with soil and reclaimed.
- To allow calculation of beryllium, the cumulative deposition baseline value of <0.1 mg/kg was converted to 0.05 mg/kg.
- To allow calculation of cadmium loading, the cumulative deposition baseline value of <0.2 mg/kg was converted into 0.1 mg/kg.
- For air modeling, the median concentration of elements in the ore dust was used for element loading from ore data.

[28]Details on the sampling methods, laboratory analysis and results for baseline soil metal concentrations are provided in the Surficial Geology, Terrain, and Soils Baseline (Appendix 6).

- Wet deposition was not accounted for in the air model and would decrease dust loading distance. Thus, the model has a conservative approach in predicting dust loading (see Air Quality Assessment, Section 6.6).

The CCME guidelines are not to be viewed as standards that can be polluted up to, but as recommended guidelines for understanding soil health relative to element concentrations in the soil. Thus, a precautionary approach was taken in this assessment, and the more stringent guidelines were used (i.e., agricultural land rather than parkland guidelines).

Soil Fertility Change

Soil fertility change was determined qualitatively based on soil chemistry data from field studies within the LAA, taking into account how Project activities such as long-term topsoil storage influence soil fertility.

6.4.2 Assessment of Adverse Change in Terrain Stability

6.4.2.1 Description of Adverse Change in Terrain Stability

As discussed in Section 6.4.1.3, through mine design and risk management, the only remaining potential for an adverse change in terrain stability exists within the clearing area. The clearing area is the 128 ha of the Project footprint cleared of vegetation, but not soil, which will not be covered by Project facilities or infrastructure. Consequently the clearing area does not have applied to it the risk management and mine design mitigations of the mine features area.

Two Project activities were identified as having the potential to result in an adverse change in terrain stability in the clearing area: site clearing and grubbing and site water management. With respect to site water management, if an increase in the water table within 2 m of the surface were to occur in a geohazard area, shear strength could be lowered and the risk of a mass wasting event could increase. Additionally, such a water table change could accelerate permafrost thaw thereby decreasing slope stability and increasing the risk of a mass wasting event. Within respect to site clearing, the removal of vegetation cover in the absence of soil or overburden salvage could also accelerate permafrost thaw. Mitigation measures and monitoring efforts directed at permafrost and geohazard areas within the clearing area are described in the following section and a detailed monitoring plan is outlined in Appendix 30.

Permafrost areas were identified based on a number of criteria.

6.4.2.2 Mitigation Measures for Adverse Change in Terrain Stability

There are 47.2 ha of permafrost area and 20.3 ha of geohazard area within the 128 ha clearing area (Table 6.4-9). Table 6.4-9 summarizes the mitigation and monitoring measures required to minimize the potential for an adverse change in terrain stability in these areas and Figure 6.4-5 indicates the specific sites where these measures are to be applied based on the current mine design.

Table 6.4-9: Mitigation and Monitoring Plan for Terrain Stability within the Clearing Area

Terrain Stability Class	Terrain Stability Class Description	Area with Permafrost (ha)	Geohazard Area (ha)	Geohazard Description	Plan
I	Stable	4.8	0.4	Seepage and flooding	No mitigation required, stable terrain
II	Generally Stable	38.7	9.3	Seepage	No mitigation required, generally stable terrain
III	Moderately Stable	3.7	3.4	Gullying and solifluction. No overlap of permafrost with geohazards	Monitor permafrost thaw, potential stability concern for the 3.7 ha
IV	Potentially Unstable	0.0	5.7	Rockfall, rock slides, gullying	Stabilization of terrain is required if clearing is to occur
V	Unstable	0.0	1.5	Rockfall and rock slides	
Total		**47.2**	**20.3**		

Mitigation measures to manage terrain stability, within the clearing area and the mine features area as appropriate to the areas, include but are not limited to:

- Avoiding areas of known unstable and potentially unstable terrain through Project design where feasible, and locating Project infrastructure and activities on stable slopes (Terrain Stability Class I to III)
- Reducing geohazards using engineered solutions such as stripping or excavating of unstable materials, grading to reducing slope gradients, scaling off overhanging rock, and diverting water from steep slope faces
- Installing of groundwater monitoring equipment to identify and measure subsurface water in and upslope of confirmed unstable terrain
- Installing strain gauges to detect slope movement in confirmed unstable areas and areas of permafrost thaw
- Controlling drainage to direct surface and groundwater away from geohazards
- Stabilizing, restoring, and re-vegetating slopes after construction to increase stability and minimize the rates of surface water runoff or groundwater infiltration
- Reducing loads on slopes, particularly those identified as unstable and potentially unstable
- Implementing a rainfall shutdown guideline for ground crews working within and down slope of unstable or potentially unstable terrain
- Preventing undercuts or overloads on dangerous slopes
- Preventing redirection of surface or groundwater flow that could result in decreased terrain stability

- Rip-rapping and/or diversion of streams that can undercut slopes (e.g. the Dublin Gulch realignment is designed to prevent undercutting of the HLF)
- Removing potential debris from a site using grading or excavating procedures, or diverting water from debris by means of surface drains and/or subsurface galleries or sub-drains so that it cannot mobilize
- Designing structures such as sediment ponds and/or catchment structures to contain debris flows and other mass movements, using protective structures such as walls and embankments, and/or diverting the flow away from the down slope areas using diversion barriers or channels
- Implementing the Permafrost Mitigation and Monitoring Plan (Appendix 30, Section 19).

Adaptive Management Plans

Adaptive management planning will be used to ensure that terrain stability measures are effectively implemented as the Project moves from prefeasibility mine design to feasibility mine design. Geotechnical investigations may be used to more accurately define the extent and location of the areas of permafrost and geohazards within the Project footprint (clearing area and mine features area).

Even with the implementation of mitigation measures, the risk of a mass wasting event cannot be ruled out and an adaptable approach to terrain stability management is necessary. Should mass wasting occur in the vicinity of the Project footprint by natural means or as a result of Project activity, natural processes and prescribed mitigation measures can minimize the effects over time. Following mass wasting, slide paths and run-out zones may naturally stabilize and recover following plant recolonization of the disturbed surface. In this case, mitigation measures such as grass seeding can be implemented to accelerate slope stabilization and decrease the effects of erosion and sedimentation. Alternately, it may take many years for a state of equilibrium to be reached that allows the site to begin to recover (e.g., if a slope remains actively unstable following a landslide). In such cases, engineering solutions may need to be considered.

6.4.2.3 Residual Adverse Change in Terrain Stability

No residual adverse change in terrain stability is predicted. This finding is contingent on the full and effective implementation of mine design mitigation measures (Section 6.4.1.4), risk management (Section 10), site-specific mitigation and monitoring measures and geotechnical investigations described for the clearing area (Section 6.4.2.2), and adaptive management plans (Section 6.4.2.2).

6.4.2.4 Determination of Significance of Adverse Change in Terrain Stability

No residual adverse change in terrain stability is predicted. Consequently no significance determination is warranted. Confidence in this prediction is moderate for the following reasons:

- Spatial data used to identify the location of potential areas of concern (i.e., permafrost and geohazards areas) within the clearing area are good.
- Effectiveness of mitigation measures related to terrain stability is generally well understood.

- Spatial data used to identify the potential consequence of a mass wasting event are good.
- Prediction of rate and extent of permafrost thaw is qualitative.
- Prediction of groundwater changes are based on a conceptual model.

Prediction confidence would be improved through the implementation of site-specific monitoring and geotechnical investigations as described above and in Section 6.4.6.

6.4.3 Assessment of Adverse Change in Soil Reclamation Suitability

6.4.3.1 Description of Adverse Change in Soil Reclamation Suitability

The potential effect mechanisms that may result in an adverse change to soil reclamation suitability are described below as manifested through the eight measurable parameters:

- **Admixing:** Admixing normally occurs during soil salvage activities at construction and to a lesser extent during site reclamation. Admixing can result in adverse changes to soil texture, structure, organic matter content, and friability.
- **Compaction:** Compaction results from the use of heavy equipment during the construction and reclamation activities. Compacted areas will have reduced water infiltration and overland flow will occur. Compaction can also affect rooting success once topsoil is placed for reclamation.
- **Erosion:** Erosion of soils may occur during rainfall and snow melt events, or during high wind conditions and, especially, following vegetation removal. Soil erosion may also occur on mine features following soil replacement as part of reclamation activities, and on soil stockpiles, prior to the establishment of an adequate vegetation cover. The greatest risk of erosion occurs for soils with long slopes where water can accelerate and move a large amount of material, particularly on bare soils. When soil is bare the rates of erosion may be undesirable for soil productivity and may affect other environmental receptors such as water quality and fish habitat.
- **Topsoil Volume Loss:** Project activities resulting in soil loss are linked to surface disturbance and soil handling during all phases of the Project, but particularly at the construction phase. Topsoil loss may occur due to incorrect stripping of topsoil, burial of topsoil by fill material during construction, or the decision to not salvage topsoil that is poor or unsuitable for reclamation. During operations, topsoil loss can occur due to vehicles and machinery activity in areas where soil salvage has not occurred, by mass movement of unstable slopes, through erosion, or by transfer of soil material from one location to another.
- **Soil Cover Loss:** Typical areas of soil cover loss include open pit walls and benches, flooded open pit floors, and permanent diversion ditches or retention ponds.
- **Soil Moisture Change:** Soils may dry out or become wetter through a number of mechanisms including: drawdown from mining operations/open pit construction, changes in contour or slope, changes in subsurface or surface water flow patterns, permafrost thaw or

changes in vegetative cover. Soil moisture changes can affect vegetation communities and soil or land capability.

- **Soil Contamination:** Primary effect mechanism is dust deposition from open pit mining and ore processing (crushing and hauling) and, to a lesser extent, vehicle activity. Soil contamination can result in damage or imp ment to the environment, human health, safety, or property.
- **Soil Fertility Change:** Long-term stockpiling is the primary effect mechanism for change (decrease) in soil fertility. Changes in soil fertility can alter the capability of soils to provide essential chemical elements for the growth of specific plants (Brady and Weil 1999).

6.4.3.2 Mitigation Measures for Adverse Change in Soil Reclamation Suitability

Mitigation measures intended to minimize the Project effect on the measurable parameters directly relevant to soil reclamation suitability are outlined in Table 6.4-10. These mitigation measures are described in greater detail in the Conceptual Closure and Reclamation Plan (Appendix 24). This overall plan includes the Erosion and Sediment Control Plan (Section 2 of Appendix 30 – Environmental Management Plans), and the Soil Material and Handling Plan (Section 2.4 of Appendix 24). In addition, the Fugitive Dust Control Plan (Section 3 of Appendix 30) is directly applicable to concerns related to soil contamination. Conveyor dust covers have been incorporated into the design of the project as a key mitigation measure and will greatly reduce or eliminate dust deposition on soils in the vicinity of the conveyor system. Sections 5.5.1.7 and 5.5.1.8 describe the conveyor dust covers in further detail.

Table 6.4-10: Mitigation Measures for Adverse Change in Soil Reclamation Suitability

Mitigation Measures	Measurable Parameter Addressed								Project Phase
	Admixing	Compaction	Erosion	Topsoil Volume Loss	Soil Cover Loss	Soil Moisture Change	Soil Contamination	Soil Fertility Change	
Control erosion on salvaged stockpiles and reseed areas cleared but not salvaged Erosion and Sediment Control Plan (Section 2 of Appendix 30)			✓	✓					Construction
Salvaging appropriate volumes that will allow reclamation objectives to be met Soil Material and Handling Plan (Section 2.4 of Appendix 24)				✓					Construction
Prevent and respond to all potential spills							✓		Project Life
Avoid salvaging and mixing unsuitable reclamation material with suitable reclamation material Soil Material and Handling Plan (Section 2.4 of Appendix 24)	✓								Construction

Mitigation Measures	Measurable Parameter Addressed								Project Phase
	Admixing	Compaction	Erosion	Topsoil Volume Loss	Soil Cover Loss	Soil Moisture Change	Soil Contamination	Soil Fertility Change	
Environmental supervisor on site during construction and operations	✓	✓	✓	✓					Construction and Operations
The mitigation for soil cover loss is to ensure that reclamation is completed on all remaining mine features and, wherever feasible, carry out soil replacement/reclamation on permanent disturbance features Soil Material and Handling Plan (Section 2.4 of Appendix 24)					✓				Closure and Reclamation
Place soil stockpiles an appropriate distance from operations that may result in contamination, including high levels of dusting							✓		Construction
Supervision of topsoil stripping and stockpiling by qualified personnel				✓					Construction
Detailed tracking of topsoil salvage volumes and storage locations				✓					Construction and Operations
Check areas where hazardous materials were located for ground contamination prior to topsoil replacement at reclamation and remediate as necessary							✓		Closure and Reclamation
Decompact WRSAs, mine infrastructure locations (parking lots, camp sites) prior to topsoil replacement		✓							Closure and Reclamation
Recontour landscape to facilitate proper drainage (e.g. WRSAs, Sediment control pond locations) before and after topsoil placement			✓			✓			Closure and Reclamation
An application of a standard nitrogen-phosphorus-potassium fertilizer may be required after soil replacement to assist in revegetation efforts								✓	Closure and Reclamation
Care must be taken in the timing and amount of fertilizer applied so as to not contaminate nearby aquatic systems and to allow for effective uptake of the added nutrients. The application rates should be based on soil testing recommendations								✓	Closure and Reclamation
Fugitive Dust Control Plan (Section 3 of Appendix 30)							✓		Construction and Operations

Adaptive Management Plans

Adaptive management planning will be used to ensure that soil mitigation measures can be modified to suit changing conditions during construction, operations, and closure and reclamation to limit residual adverse changes to soil reclamation suitability.

The soil volumes provided in this assessment and in the Conceptual Closure and Reclamation Plan (Appendix 24) are estimates and the location of suitable soils is partially based on landscape level interpretations. The natural variability on the ground at the local scale will require some adaptive management in actual practice. For example, more overburden may be required if insufficient topsoil is present. Conversely, if more suitable topsoil can be salvaged then the volume of overburden required for reclamation may be reduced.

With regards to soil fertility, while a standard nitrogen-phosphorus-potassium fertilizer application is recommended, it may be found over time that certain other nutrients may be deficient. This might require a reformulation of the mixture.

Other adaptive management plans applicable to soil reclamation suitability are described in Section 2.8 of the Conceptual Closure and Reclamation Plan (Appendix 24).

6.4.3.3 Residual Adverse Change in Soil Reclamation Suitability

The residual Project effects on the eight measurable parameters that are applicable to soil reclamation suitability are described below. The residual adverse change in soil reclamation suitability is identified and characterized as per Table 6.4-7 based on a collective consideration of the measurable parameter effects (see Section 6.4.1.50). That discussion is presented at the end of this section following the descriptions of the residual effects on each measurable parameter.

Admixing

There are existing areas of admixing within the Project footprint (e.g. exploration trails, pit test drilling sites, placer mining) that are not usable for reclamation and have been identified as disturbed land (Figure 6.4-6). To prevent further admixing, a Soil Material and Handling Plan (Section 2.4, Appendix 24) has been developed and will be further refined during the feasibility stage. The plan will provide guidance for the identification of suitable materials and for the adaptation of soil handling procedures to site-specific conditions. A number of areas have been identified as unsuitable for reclamation (Figure 6.4-6). To prevent adverse admixing these sites are not recommended for soil salvage or for storage of reclamation material (see Table 6.4-10). In conclusion, with mitigation, admixing is not predicted to have an effect on soil reclamation suitability.

Compaction

Compaction is only a risk in areas exposed to vehicle traffic and most of the compaction concern is related to subsoil or waste rock material. Topsoil will likely not be compacted as it will be salvaged and replaced, and will not be subject to heavy traffic. Compaction reduces water infiltration and may affect rooting success on reclaimed areas. Thus, compacted areas will need to be decompacted prior to topsoil replacement (see Table 6.4-10). This also applies to the WRSA, where waste rock will be compacted at the time of reclamation. Compaction will be limited in spatial extent and confined to areas of mine infrastructure, roads and trails, and the WRSAs. In conclusion, with mitigation, compaction is predicted to be short term and reversible and will not affect soil reclamation suitability.

Erosion

The majority of the Project footprint has moderate to high erosion potential (Figure 6.4-7, Table 6.4-11). Soils will be at a higher risk of erosion during the construction phase due to activities such as site clearing, soil handling, and soil stockpiling. The erosion potential ratings identify target areas for development of site-specific erosion control measures (see Table 6.4-10). In general, erosion from Project activities will be confined to the clearing area and the amount of soil loss from erosion is anticipated to be low magnitude. Thus, with mitigation, erosion is predicted to have only a minimal effect on soil reclamation suitability.

Table 6.4-11: Summary of Erosion Potential Ratings in the Project Footprint at Baseline

Erosion Potential Rating	Area (ha)	Percent (%)of Project Footprint
Very High	0.0	0.0
High	174.1	29.8
Moderate	263.6	45.0
Not Rated[a]	147.4	25.2
Totals:	**585.1**	**100.0**

NOTE:
[a] Organic soils, disturbed land, water and exposed bedrock were not rated (see Section 6.4.1.10).

Topsoil Volume Loss

All good and fair topsoil within the Project footprint will be salvaged. However, there will be a topsoil volume loss of 18.4% within the footprint because topsoil rated as poor to unsuitable for reclamation will not be salvaged (Table 6.4-12, Figure 6.4-6). Details on soil salvage are presented in the Soil Material and Handling Plan (Section 2.4 of Appendix 24). Suitable overburden materials[29] will be used to provide sufficient volumes of capping material to meet reclamation objectives for the Project footprint (Appendix 24). The amount of material required for reclamation is 1.76 million m^3 and the predicted topsoil salvage volume is 0.53 million m^3. Therefore, over 1.2 million m^3 of overburden will be salvaged. Further details are provided in the Soil Material and Handling Plan (Section 2.4 of Appendix 24). Thus, soil reclamation suitability will not be affected by the predicted topsoil loss.

[29] Suitability of the overburden material for reclamation capping was based on test pit and drill log data collected in the Project footprint.

Table 6.4-12: Topsoil Volume Loss within the Project Footprint

Soil Map Unit	Soil Reclamation Suitability Rating	Potential Soil Salvage Volume (m^3)	Calculated Soil Salvage Volume (m^3)	Soil Volume Loss (m^3)	Soil Volume Loss in Project Footprint (%)
C3x	Good	151,679.9	151,679.9	0.0	0.0
F1	Good	2,630.3	2,630.3	0.0	0.0
F2	Good	63.5	63.5	0.0	0.0
M5x	Good-Fair	103,342.4	103,342.4	0.0	0.0
Subtotal for Good Soil Reclamation Suitability		**257,716.1**	**257,716.1**	**0.0**	**0.0**
M3	Fair-Good	2,388.5	2,388.5	0.0	0.0
M4	Fair-Good	5,861.5	5,861.5	0.0	0.0
Subtotal for Fair Soil Reclamation Suitability		**8,250**	**8,250**	**0.0**	**0.0**
C2	Poor	218,259.5	196,467.8	21,791.1	3.4
C4	Poor	8,413.5	8,413.5	0.0	0.0
Subtotal for Poor Soil Reclamation Suitability		**226,673.0**	**204,881.3**	**21,791.1**	**3.4**
C1	Unsuitable	64,884.0	18,573.3	46,310.7	7.2
D1	Unsuitable	1,834.4	0.0	1,834.4	0.3
D2	Unsuitable	24,584.6	1,486.0	23,098.6	3.6
D3x	Unsuitable	10,330.1	0.0	10,330.1	1.6
D4x	Unsuitable	15,032.8	322.5	14,710	2.3
Subtotal for Unsuitable Soil Reclamation Suitability		**116,665.9**	**20,381.8**	**96,283.8**	**15.0**
DL	Not Rated Anthropogenic	37,980.1	37,827.8	152.3	<0.1
Totals:		**647,285.1**	**529,057.0**	**118,074.9**	**18.4**

Soil Cover Loss

Within the Project footprint, 71.6 ha (4.5% of the LAA) will not be capped or re-vegetated (Table 6.4-13, Figure 6.4-8). This loss of soil cover is a result of the creation of the Open pit and Pit Lake, the Dublin Gulch diversion channel, and the velocity control pond (Table 6.4-13, Figure 6.4-8). Most of the areas associated with these three features were previously disturbed and do not have topsoil layers so there is no effect of this loss on soil reclamation suitability. Before the Dublin Gulch diversion is constructed any soil, if suitable, will be salvaged and used on other portions of the mine during reclamation. Details on soil salvage are presented in the Soil Material and Handling Plan (Section 2.4 of Appendix 24).

Table 6.4-13: Soil Cover Loss within the Project Footprint

Mine Feature	Area of Soil Cover Loss (ha)	Percent Loss in LAA	Soil Reclamation Suitability Rating at Baseline in Area of Loss	Reason for Permanent Loss
Open Pit (including Pit Lake)	65.4	4.1	Not rated–disturbed by exploration and areas rated as Poor	Steep-sided open pit walls cannot be capped and re-vegetated and Open pit bottom will fill with water
Diversion–Wet 1	4.5	0.3	Not rated–placer mining areas and areas rated as Good to Poor	Realignment of Dublin Gulch. Permanent feature.
Diversion–Wet 2	1.7	0.1	Not rated–placer mining areas	Velocity pond to control flow into Dublin Gulch realignment. Permanent feature.
Total soil cover loss	**71.6**	**4.5**		

Soil Moisture Change

The majority of soils in the LAA are well drained (Figure 6.4-9). This is the dry soil moisture class in Table 6.4-8. A total of 19.6 ha are predicted to be affected by soil moisture changes at operations with no additional changes anticipated at post-closure (Table 6.4-14, Figure 6.4-10). Project-related effects on soil moisture are mostly confined to drainages that may be affected by the drawdown effect on groundwater from mining activities (Figure 6.4-10). Consequently, the soil moisture effect is not only linked to ground disturbance but can occur beyond the extent of the mining activity both upslope and down slope.

All the predicted soil moisture changes are changes from a wet to moist state to a drier state as the result of a lowering in the water table (Table 6.4-14, Figure 6.4-10). The lower water table in poorly or imperfectly drained areas (wet to moist soil moisture) has a positive effect, on soil reclamation suitability. Drier soils that were previously wetlands are easier to salvage and may have a higher soil productivity rating relative to imperfectly drained or poorly drained soils. There are no predicted changes in soil moisture outside the LAA.

Table 6.4-14: Soil Moisture Changes within the LAA

Soil Moisture Class	Baseline (ha)	Operations (ha)	Operations Change (ha)	Type of Change	Post-closure (ha)	Post-closure Change (ha)	Type of Change
Wet to moist	36.8	28.0	-8.8	Drier	28.0	-8.8	Drier
Wet	1.4	0.4	-1.0	Drier	0.4	-1.0	Drier
Dry	1,046.9	1046.9	–	–	1046.9	0.0	–
Other (not rated/ disturbed in placer areas along Haggart Creek)	214.9	224.7	-9.8	Drier	224.7	-9.8	Drier
Total Area (ha)	**1,300.0**	**1,300.0**	**-19.6**		**1,300.0**	**-19.6**	

NOTE:
LAA is based on groundwater model extent of 1,300 ha.

Soil Contamination

At baseline the soil concentrations of three elements were naturally found to be in exceedance of guidelines at the landscape level: chromium, nickel and arsenic (see Appendix 6). In particular, as the ore body is primarily arsenopyrite and scordite, the soils derived from weathered bedrock, particularly where the granodiorite ore body is located, are well above all CCME guidelines for arsenic (Figure 6.4-11). However these forms of arsenic (arsenopyrite and scordite) are largely unavailable for plant uptake due to low dissolution rates. When compared to the receptor-specific guidelines the natural arsenic content of the soils and overburden in the footprint are above the values considered to pose a risk to livestock, soil invertebrates, plants, and even humans (Figure 6.4-11, Table 6.4-15).

Table 6.4-15: Arsenic Guideline Limits for Various Receptors

Guideline Limit (mg of Arsenic/kg of soil)	Receptor
12	Agricultural Soil CCME (1999) Guideline
15	Yukon CSR guidelines
25	Livestock ingesting soil or fodder (YK CSR guidelines)
50	Toxicity to soil invertebrates or plants (YK CSR guidelines)
100	Human ingestion of soil (YK CSR guidelines)

NOTE:
For comparison, baseline soil arsenic concentrations in the LAA are presented in Figure 6.4-11 and Table 6.4-16.

At operations, the only soil element concentration predicted to exceed CCME guidelines or increase by greater than 10% is arsenic (Figure 6.4-12, Table 6.4-16). A total of 90.5 ha, mostly within the LAA, has a predicted 10% increase in arsenic concentrations from dusting occurring beyond the boundaries of the Project footprint (Figure 6.4-12, Table 6.4-16). The 10% increase does not mean that the Project has resulted in a critical threshold being crossed for soil arsenic since baseline levels were also in exceedance. However within the Project footprint, elevated arsenic levels, independent of potential Project-related effects, will require consideration with respect to soil handling (see Table 6.4-10) and post-closure monitoring of reclamation success (Appendix 24 and Section 6.4.6). Additional monitoring will be conducted in the areas with a predicted 10% increase in arsenic outside the Project footprint (Section 6.4.6).

Arsenic concentrations were not considered in the soil reclamation suitability ratings because high arsenic levels are ubiquitous to the LAA at baseline, and do not appear to be reflected in the vegetation (see Section 5.5 of Appendix 24). Thus, suitable soils with a high arsenic content were considered salvageable, as the primary purpose of reclamation is to ensure that the average baseline land capability is not reduced in the post-closure landscape. In conclusion, with mitigation, soil contamination, specifically arsenic, is not considered to have an adverse effect on soil reclamation suitability.

Project effects on soil metal concentrations are also addressed in detail in the Qualitative Human and Ecological Health Assessment (Appendix 31).

Table 6.4-16: Effect of the Project on Soil Arsenic Concentrations in the Local and Regional Assessment Areas

Assessment Area	Soil Map Unit	Soil Reclamation Suitability	Baseline Soil Arsenic Concentration (mg/kg)	Operations (Year 7.3) Soil Arsenic Concentration (mg/kg)	Percent Increase from Baseline to Operations	Area (ha) of Increase
LAA	D3x	Unsuitable	43.7	56.1	28.4	2.0
				48.5	11.1	43.0
				52.9	21.0	9.6
				56.1	28.3	1.5
				52.8	20.8	3.7
	D4x	Unsuitable	88.9	100.6	13.2	0.0
				102.5	15.3	2.1
				102.3	15.0	0.1
				99.2	11.5	6.6
				102.6	15.4	2.8
				98.3	10.6	0.6
Subtotal						**72.0**
RAA	D4x	Unsuitable	88.9	100.6	13.2	9.1
				100.4	13.0	7.1
				98.7	11.0	2.3
				99.2	11.5	0.0
				102.6	15.4	0.0
Subtotal						**18.5**
Total						**90.5**

NOTE:
Excludes the mine features area as this area will be capped with soil and reclaimed.

Soil Fertility Change

Soil fertility change as the result of long-term stockpiling (greater than two years of storage) is confined to the stockpiles and windrows on the Project footprint. At baseline some nutrient deficiencies were noted in the vegetation growing in the soils within the LAA. Specifically, potassium and phosphorus concentrations were found to be in low in foliage (Section 5.5 of Appendix 24). These nutrients and others such as nitrogen will become more limiting after long-term soil storage. General application of fertilizer is the recommended mitigation to remedy anticipated nutrient deficiencies (Section 6.4.3.2) so the effect on soil reclamation suitability is predicted to be minimal.

Residual Adverse Change in Soil Reclamation Suitability

With full and effective implementation of all mitigation measures, admixing, compaction, erosion, topsoil volume loss, soil cover loss, soil contamination, and soil fertility change are predicted to have minimal to no adverse affect on soil reclamation suitability. The predicted changes in soil moisture will have a small positive effect on soil reclamation suitability. Considering these effects collectively and with an understanding of how the measurable parameters affect soil reclamation suitability, the residual change in soil reclamation suitability is characterized as adverse, low magnitude, local, continuous, long term, and reversible with a moderate probability of occurrence. The ecological context for this effect is disturbed.

6.4.3.4 Determination of Significance of Adverse Change in Soil Reclamation Suitability

The residual adverse change in soil reclamation suitability is predicted to be minimal (Section 6.4.3.3) and will not prevent the Project footprint from being successfully reclaimed with the exception of the small area occupied by the Open pit and Pit Lake, Dublin Gulch diversion channel, and the velocity pond. Further, no change in soil reclamation suitability class is predicted for any soil map unit in the LAA. In conclusion, the adverse change in soil reclamation suitability is predicted to be not significant. Confidence in this prediction is moderate for the following reasons:

- Spatial data that form the basis of this assessment are good.
- Effectiveness of mitigation measures related to soil reclamation suitability is well understood and the recommended practices are typical for mining operations.
- Confidence is high with respect to the determination of the Project effect on admixing, compaction, erosion, soil fertility, topsoil volume loss, and soil cover loss.
- Confidence is low for the determination of the Project effect on soil moisture and soil contamination outside the Project footprint where sampling intensity is lower and the findings are more dependent on modeled results.
- Prediction of groundwater changes are based on a conceptual model.

Prediction confidence will be improved through specific monitoring programs particularly in regard to groundwater measurements and soil moisture changes, and soil element (dusting) effects (see Section 6.4.6).

6.4.4 Assessment of Cumulative Effects on Surficial Geology, Terrain, and Soils

6.4.4.1 Screening of Cumulative Environmental Effects

A screening of the Project’s potential contribution to the cumulative effects of past, current, and announced future Projects was done following the procedures described in Section 6.1. The screening process establishes three conditions to warrant further assessment. These conditions are: 1) the Project results in a demonstrable residual effect; 2) these effects are likely to act in a cumulative fashion with those of other Projects; and 3) there is a reasonable expectation that the

Project's contribution to cumulative effects has the potential to measurably change the health or sustainability of the VC.

No residual adverse change in terrain stability was predicted. However, the Project does result in a low magnitude residual adverse change in soil reclamation suitability. Thus, soil reclamation suitability and the parameters that affect it (see Table 6.4-5) will be the focus of this discussion of cumulative effects.

Placer mining is the only identified past, current, and future activity that may interact with Project-related effects to soil reclamation suitability in the RAA (Table 6.3-3). Numerous placer claims are located along the Dublin Gulch and Haggart Creek drainages. The majority of these claims, including some that are active, are located within the Project footprint and on land previously disturbed at baseline. Only three future applications are on record for the RAA. Yukon government regulations now require reclamation by placer mining operations. The *Guidebook of Mitigation Measures for Placer Mining in the Yukon* (Yukon Placer Secretariat 2009) includes detailed mitigation measures and best practices that address issues related to erosion, slope stability, soil handling and stockpiling, and reclamation. As a result future placer mining Projects should not have a long-term cumulative effect on soil reclamation suitability in the RAA.

Cumulative effects on admixing and soil loss have been addressed where placer mining intersected with the Project footprint. The result of topsoil loss from placer mining and exploration activities at baseline partially resulted in the need to use overburden as reclamation material. Under current guidelines (Yukon Placer Secretariat 2009), placer mining must now account for detailed sediment and erosion control so further cumulative effects from erosion are not anticipated. The only other issue is soil moisture, which could be further altered by placer mining activities along Haggart Creek. As the effect of soil moisture changes cannot be predicted from placer activities, monitoring is recommended to determine if changes occur. This is addressed under Water Quality and Aquatic Biota (Section 6.5) and Fish and Fish Habitat (Section 6.8).

In conclusion, there is not a reasonable expectation that the Project's contribution to cumulative effects has the potential to measurably change soil reclamation suitability in the RAA. Consequently, no further assessment of cumulative effects is warranted.

6.4.5 Summary of Consultation Influence on the Assessment

A number of concerns specific to surficial geology, terrain, and soils were identified in the FNNND Traditional Knowledge and Use Study completed in June 2010.

Terrain

Landslides that could occur after closure were identified as a concern. That concern is specifically addressed in the re-slope of the WRSA and heap leach facility to allow for revegetation (Appendix 24). Baseline geohazards have been identified and mitigation measures to reduce the risk of a mass wasting event have been identified (see Section 6.4.1.4). These terrain stability concerns will be addressed further in the detailed mine design. There was also concern expressed over developing the heap leach facility (HLF) on permafrost and how it could affect the integrity of the HLF. The design for the heap leach facility is to remove the permafrost and scrape to bedrock where feasible in areas of Ann Gulch where permafrost has been identified from baseline conditions (see Section 5.4.1.5).

Other concerns were the road conditions of the South McQuesten-Haggart Creek Road which is subject to seasonal flooding and thick ice formation at the South McQuesten Bridge and near Lynx Creek. The South McQuesten-Haggart Creek Road is also very narrow and high. The road upgrades are described in the Section 5.4.2.1. Mitigation will follow BMPs for road development. Bridge upgrades will be a government responsibility.

Soils

Contaminants and how they are handled were identified as a concern by the FNNND. The FNNND does not want contaminants buried and expressed the need to establish an emergency spill response plan that involves the FNNND and the Village of Mayo. Emergency (large) spill response is addressed in Accidents and Malfunctions (Section 8) and prevention and management of small-scale hazardous material spills will be addressed as part of the detailed Environmental Management Plans (Appendix 30).

6.4.6 Effects Monitoring and Adaptive Management for Surficial Geology, Terrain, and Soils

Terrain

Geotechnical investigations will be completed at the permitting stage prior to construction, as a component of the detailed mine planning. Once exact locations for Project infrastructure have been identified, detailed on-site terrain stability assessments will be carried out by qualified professionals in areas identified as having potential terrain stability issues from baseline mapping, seismicity investigations, and drill/trench log information.

Once mine infrastructure is built a program to monitor permafrost conditions in the clearing area within the Project footprint will be in place. Gauges that measure downslope movement and groundwater/moisture changes in the surficial material are recommended. Monitoring should take place in the spring and end of summer. The monitoring interval may need to be more frequent if there is a large storm event or other weather condition that may affect terrain stability.

Soils

A number of follow-up and monitoring programs designed to protect soil resources and achieve reclamation objectives have been identified and are listed below. Further details are provided in the (Appendix 24).

- An environmental supervisor with knowledge of soil will be assigned to the site during Project construction and closure activities. The supervisor will ensure that sufficient volumes, appropriate depth and soil material suitable for reclamation is salvaged and stored.

- The environmental supervisor will re-evaluate topsoil volumes based on stockpile dimensions after soil salvage is complete to ensure there is sufficient material for reclamation. If there is a shortage of topsoil based on the requirements of the reclamation plan, additional areas of overburden salvage will be identified.
- The environmental supervisor will ensure that suitable soil is available for reclamation. If the quality of topsoil does not meet the requirements of the reclamation plan, additional areas of soil salvage will need to be identified. If undesirable overburden material has inadvertently been incorporated into topsoil, physical and chemical analysis may be required to determine soil quality.
- Soil stockpiles will be checked regularly and after storm events or rapid snow melt to ensure vegetation cover is maintained and erosion control measures are effective.
- Prior to revegetation, the effectiveness of soil mitigation should be evaluated with respect to compaction, rutting, drainage and recontouring.
- Once vegetation is established, visual inspections of vegetation vigour and cover density will provide an indication of soil fertility. If soil fertility has been diminished from baseline conditions, foliar analysis will be required to determine the fertilizer amendments that may be required.
- Monitoring for soil moisture changes can coincide with monitoring areas used to refine the groundwater model for the operations and post-closure phases (e.g., see Figure 6.4-10). Soil moisture measurements can be designed as an add-on to the groundwater monitoring wells in these areas. These sites should be established prior to the commencement of construction activities to establish baseline conditions.
- Monitoring at surface groundwater sites can also include measurements on vigour and growth of the vegetation in addition to physical properties of the soil. Data collection would include soil sampling and profile descriptions. The monitoring program would be maintained until post-closure and checked on an annual basis during the growing season.
- Long-term soil and vegetation monitoring sites outside the Project footprint will be established to monitor for element concentrations, in particular arsenic, in soil and foliage. These monitoring sites will be established prior to construction activities to establish baseline conditions and continue until Year 8 of operations (when dusting is complete). Approximately 10 sites should be established throughout the area of predicted arsenic exceedance from metal loading.

6.4.7 Commitments for Surficial Geology, Terrain, and Soils

Terrain Commitments

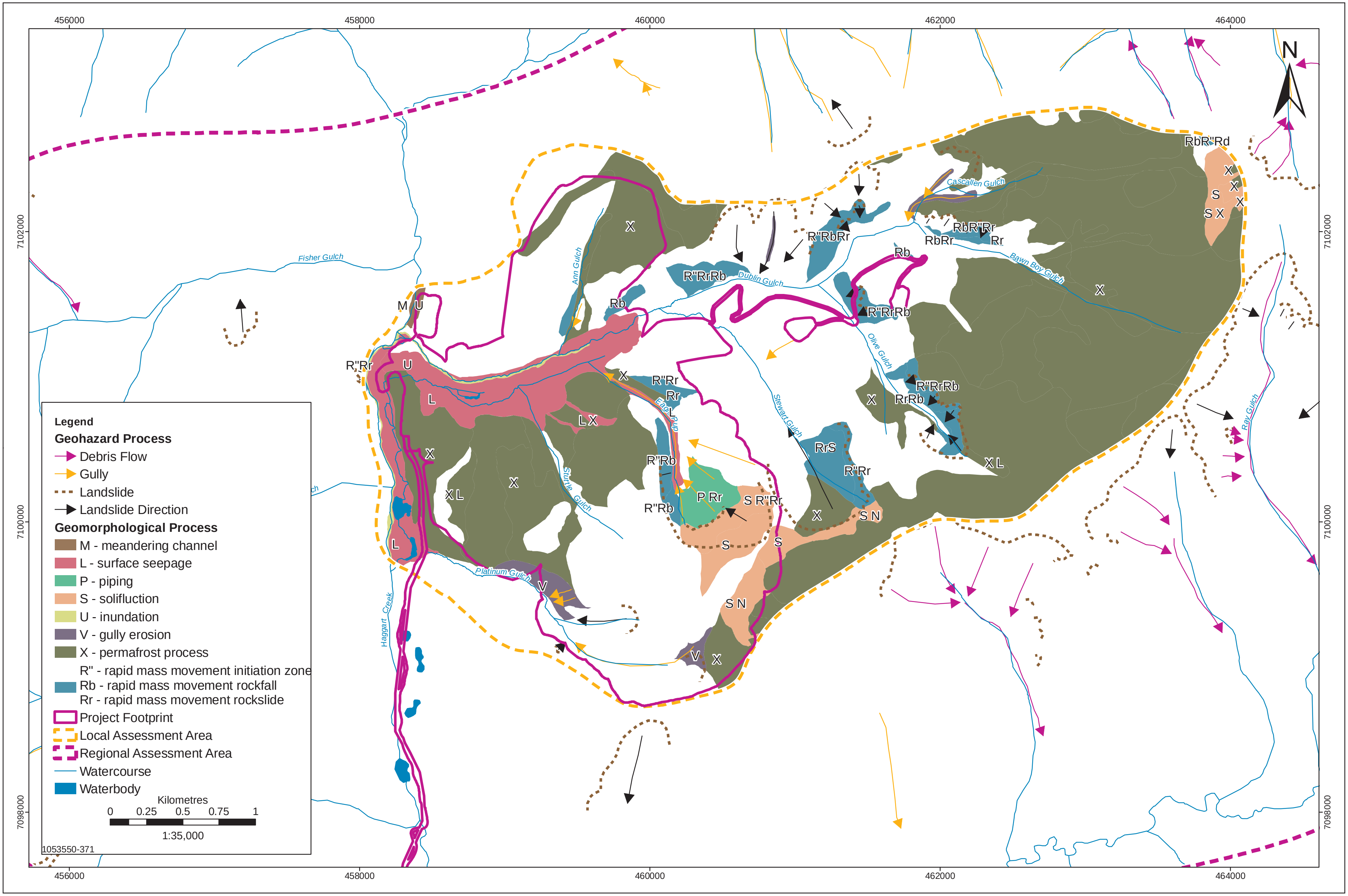
1. Re-evaluate terrain stability conditions during detailed mine design at the mine feasibility stage of the Project
2. Monitor the effects on permafrost in the clearing area
3. Conduct further geotechnical investigations in the clearing area.

Soils Commitments

1. Place a qualified environmental supervisor on site during soil salvage to enforce proper soil conservation practices
2. Implement sediment and erosion control measures in areas of high erosion risk
3. Follow and adapt, as necessary, the soil handling plan and conceptual reclamation plan during construction and progressive reclamation and at final reclamation as that is the primary mitigation for soils
4. Conduct long-term monitoring for groundwater and soil moisture conditions in recommended locations
5. Conduct long-term monitoring of soil element and vegetation foliar and berry levels in areas outside the Project footprint where arsenic effects were noted
6. Test for foliar nutrient status once soil is replaced and amending soil as necessary to successfully revegetate the mine features area.

6.4.8 Figures

Please the following pages.



Data Sources; Government of Canada, Victoria Gold Corp.

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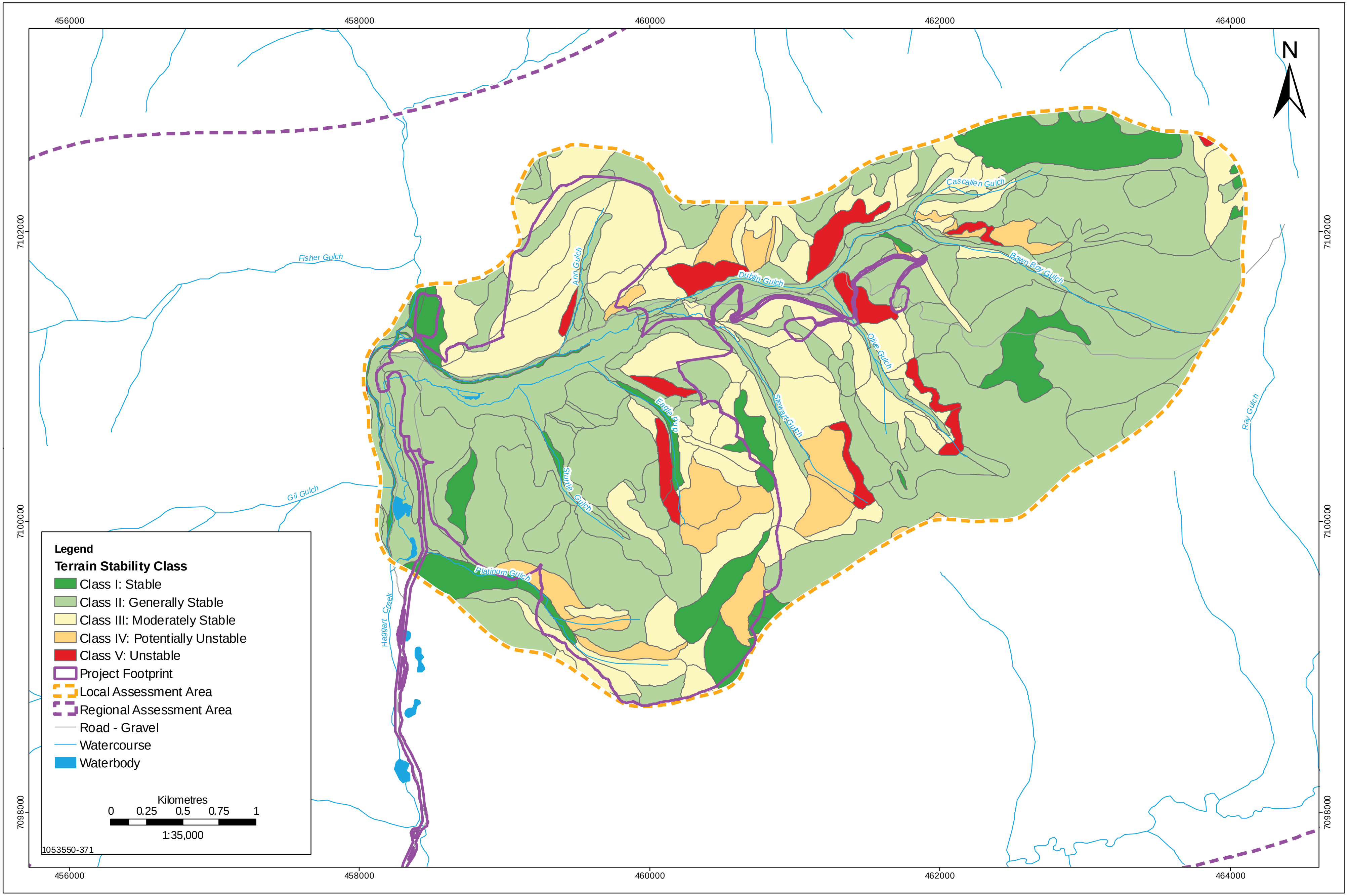
Victoria GOLD CORP

TERRAIN GEOPROCESSES IN THE LOCAL ASSESSMENT AREA

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION	DRAWN BY
UTM - ZONE 8	LS
DATUM	CHECKED BY
NAD 83	RS
DATE	FIGURE NO.
30-November-2010	6.4-1



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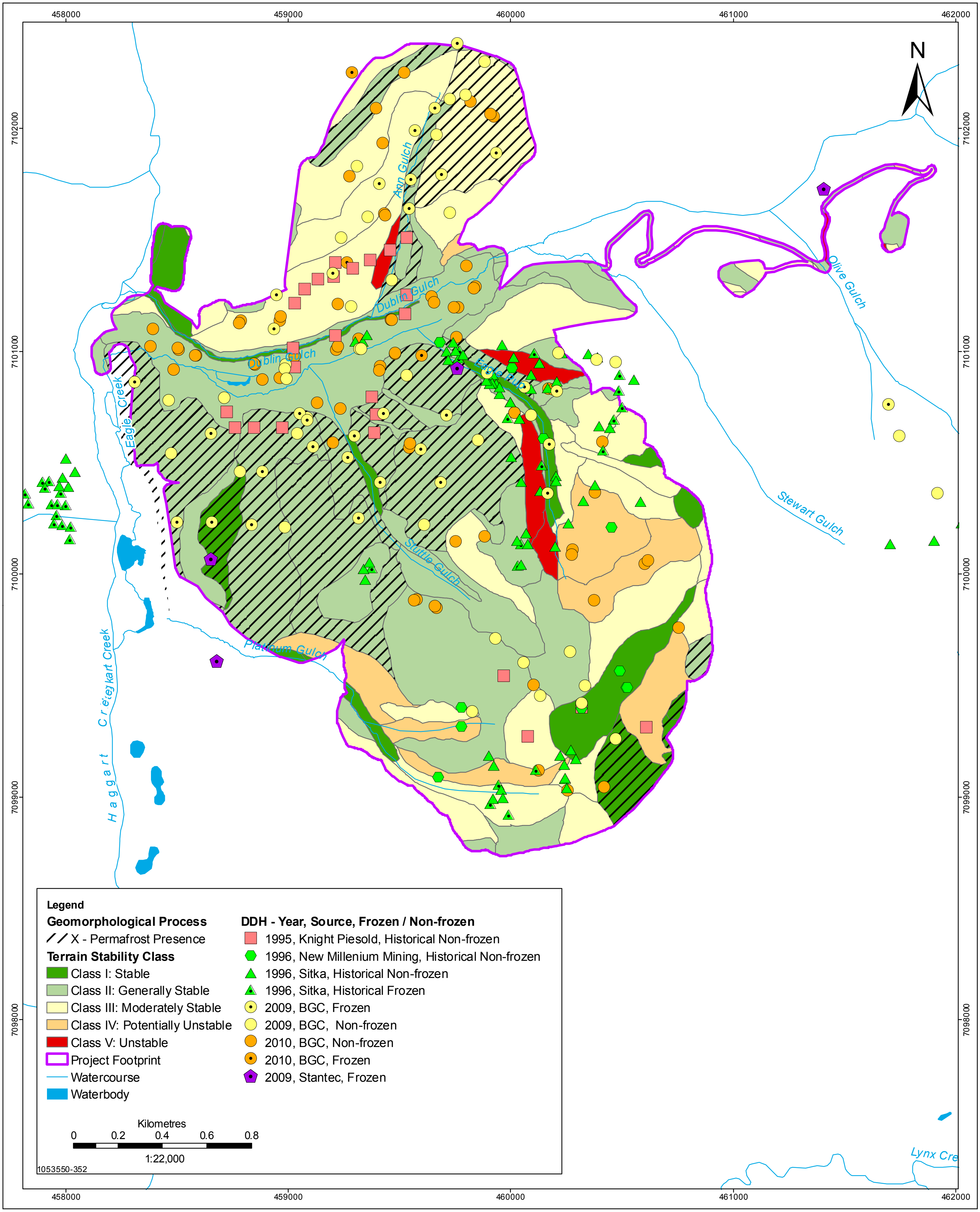
TERRAIN STABILITY IN THE LOCAL ASSESSMENT AREA

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION	DRAWN BY
UTM - ZONE 8	LS
DATUM	CHECKED BY
NAD 83	RS
DATE	FIGURE NO.
30-November-2010	6.4-2



Data Sources; Government of Canada, Victoria Gold Corp.

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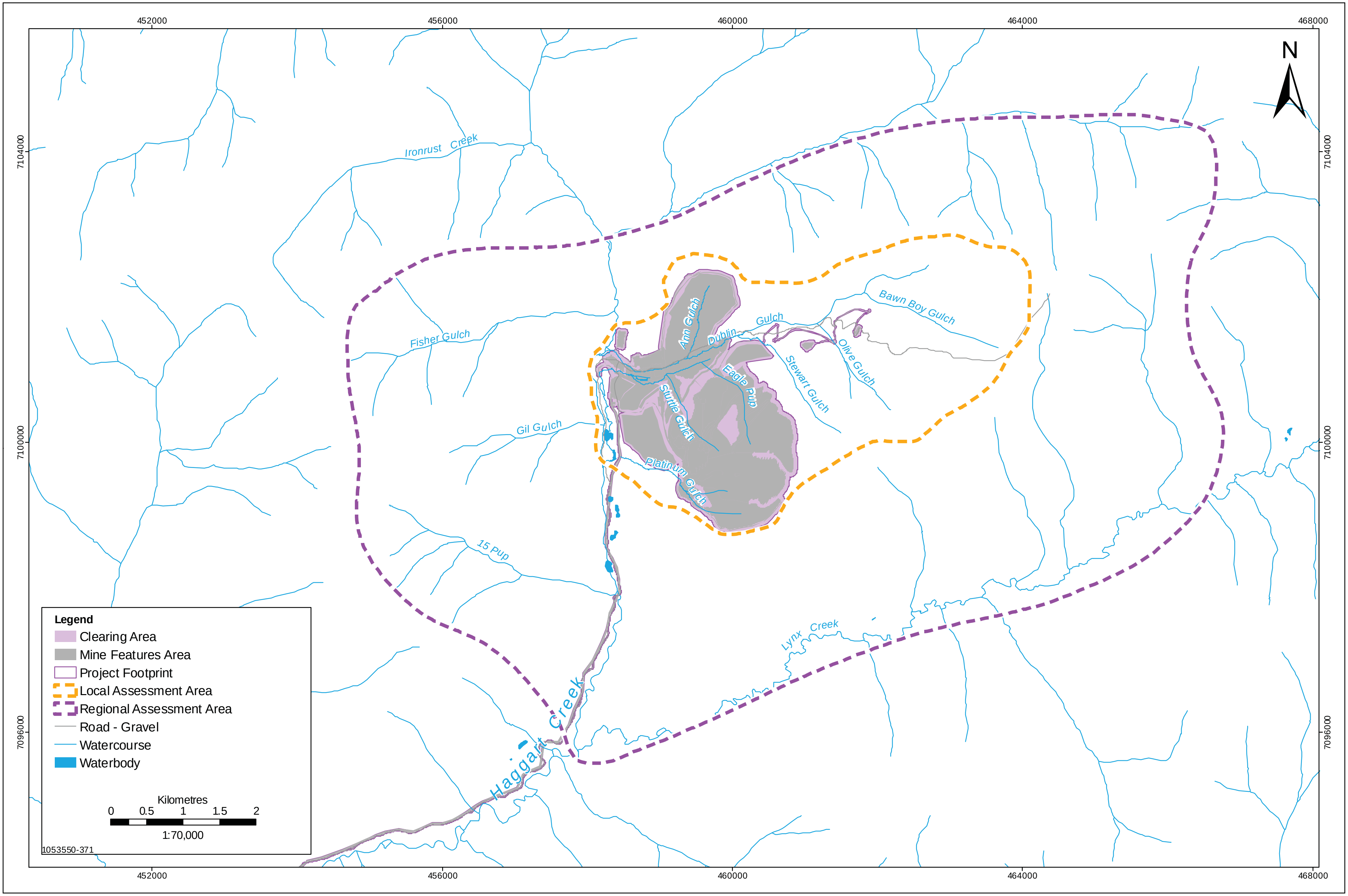
PERMAFROST AREAS AND TERRAIN STABILITY IN THE PROJECT FOOTPRINT AT BASELINE

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION UTM - ZONE 8	DRAWN BY LS
DATUM NAD 83	CHECKED BY RS
DATE 25-April-2011	FIGURE NO. 6.4-3



Data Sources: Government of Canada, Victoria Gold Corp.

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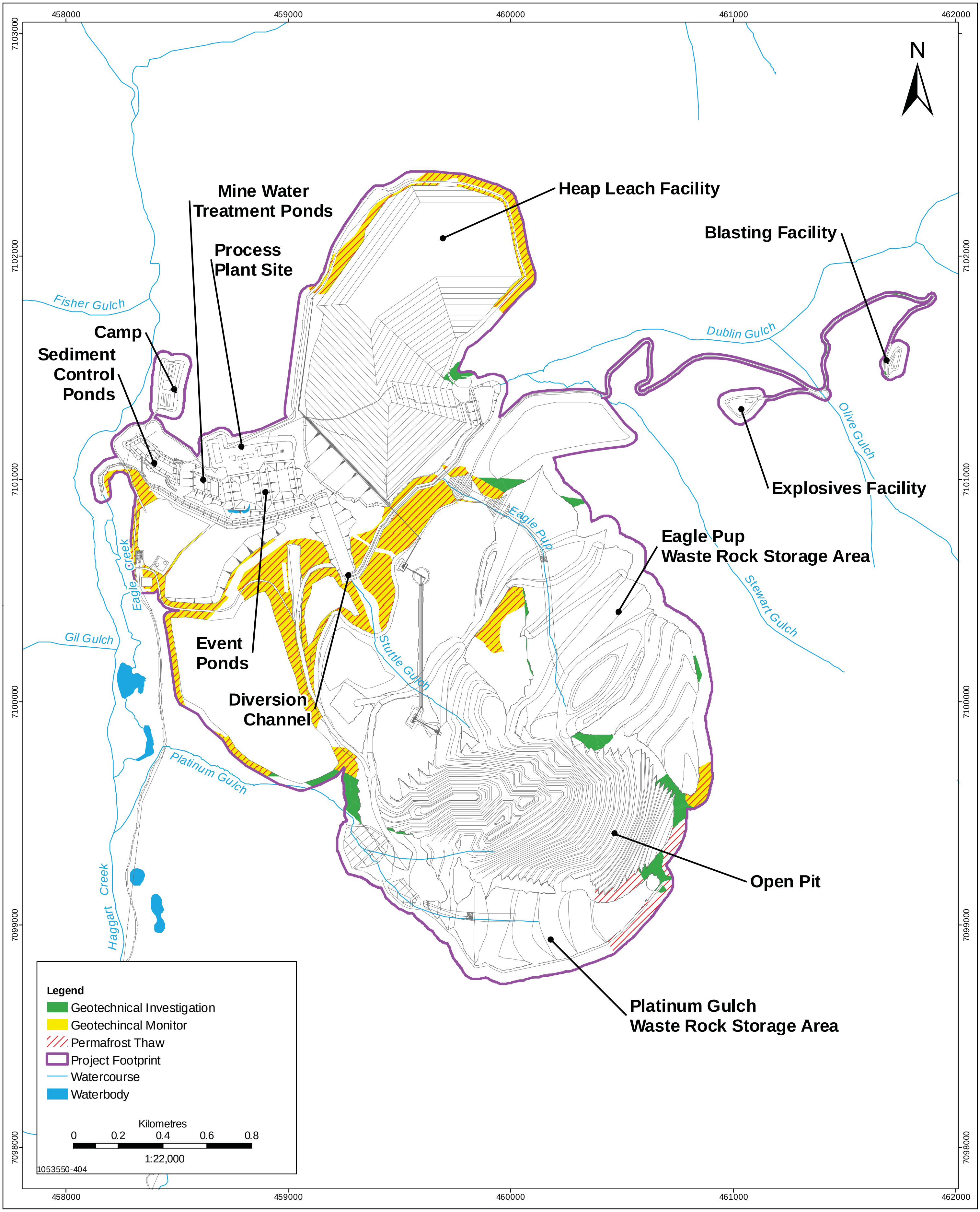
Victoria GOLD CORP

SURFICIAL GEOLOGY, TERRAIN AND SOILS ASSESSMENT AREAS

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION	DRAWN BY
UTM - ZONE 8	LS
DATUM	CHECKED BY
NAD 83	RS
DATE	FIGURE NO.
30-November-2010	6.4-4



Data Sources; Government of Canada, Victoria Gold Corp.

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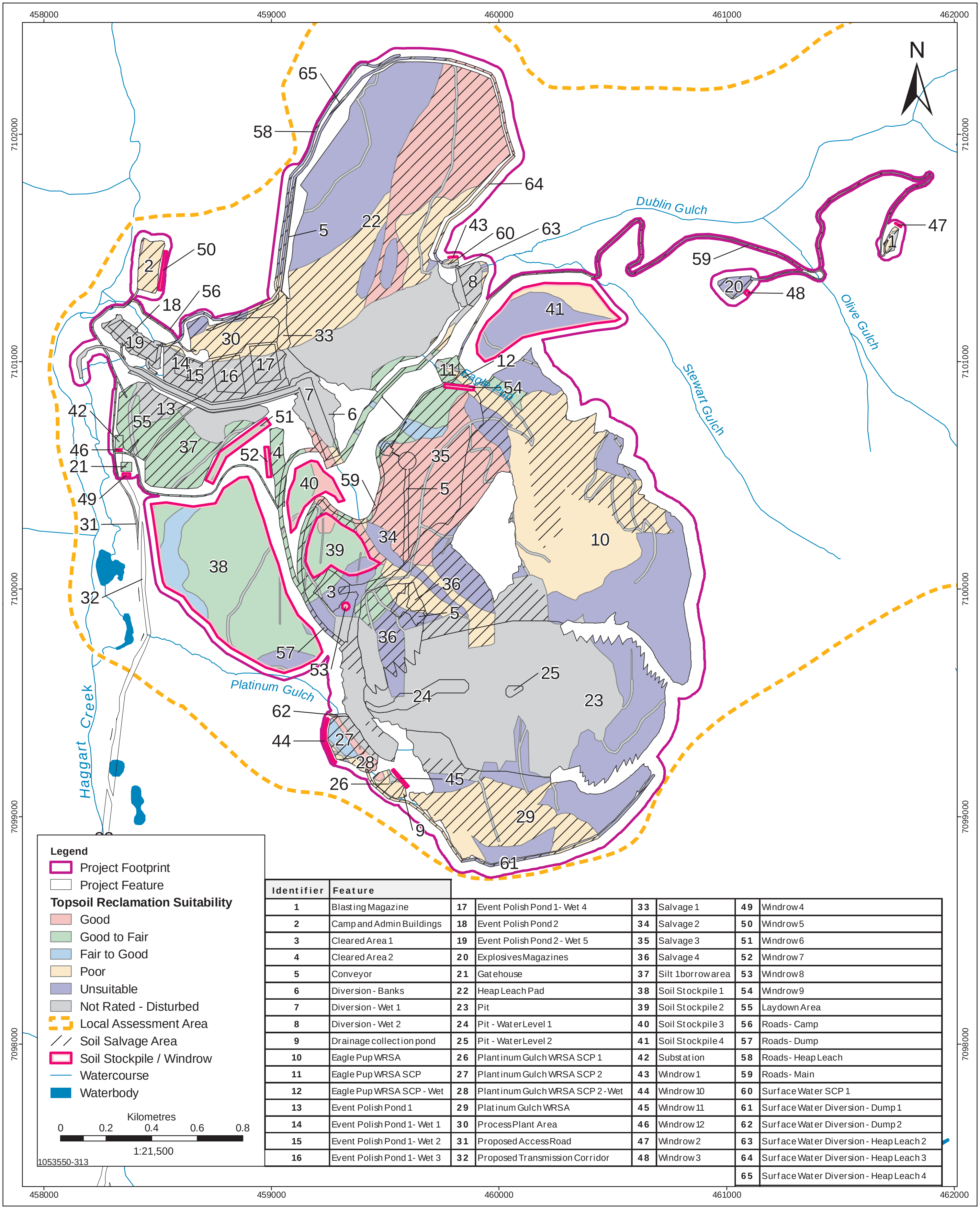
Victoria GOLD CORP

PERMAFROST AREAS AND GEOTECHNICAL INVESTIGATION AREAS IN THE PROJECT FOOTPRINT

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION: UTM - ZONE 8	DRAWN BY: LS
DATUM: NAD 83	CHECKED BY: RS
DATE: 30-November-2010	FIGURE NO. 6.4-5



Identifier	Feature						
1	Blasting Magazine	17	Event Polish Pond 1 - Wet 4	33	Salvage 1	49	Windrow 4
2	Camp and Admin Buildings	18	Event Polish Pond 2	34	Salvage 2	50	Windrow 5
3	Cleared Area 1	19	Event Polish Pond 2 - Wet 5	35	Salvage 3	51	Windrow 6
4	Cleared Area 2	20	Explosives Magazines	36	Salvage 4	52	Windrow 7
5	Conveyor	21	Gatehouse	37	Silt 1 borrow area	53	Windrow 8
6	Diversion - Banks	22	Heap Leach Pad	38	Soil Stockpile 1	54	Windrow 9
7	Diversion - Wet 1	23	Pit	39	Soil Stockpile 2	55	Laydown Area
8	Diversion - Wet 2	24	Pit - Water Level 1	40	Soil Stockpile 3	56	Roads - Camp
9	Drainage collection pond	25	Pit - Water Level 2	41	Soil Stockpile 4	57	Roads - Dump
10	Eagle Pup WRSA	26	Plantinum Gulch WRSA SCP 1	42	Substation	58	Roads - Heap Leach
11	Eagle Pup WRSA SCP	27	Plantinum Gulch WRSA SCP 2	43	Windrow 1	59	Roads - Main
12	Eagle Pup WRSA SCP - Wet	28	Plantinum Gulch WRSA SCP 2 - Wet	44	Windrow 10	60	Surface Water SCP 1
13	Event Polish Pond 1	29	Platinum Gulch WRSA	45	Windrow 11	61	Surface Water Diversion - Dump 1
14	Event Polish Pond 1 - Wet 1	30	Process Plant Area	46	Windrow 12	62	Surface Water Diversion - Dump 2
15	Event Polish Pond 1 - Wet 2	31	Proposed Access Road	47	Windrow 2	63	Surface Water Diversion - Heap Leach 2
16	Event Polish Pond 1 - Wet 3	32	Proposed Transmission Corridor	48	Windrow 3	64	Surface Water Diversion - Heap Leach 3
						65	Surface Water Diversion - Heap Leach 4

Data Sources; Government of Canada, Victoria Gold Corp.

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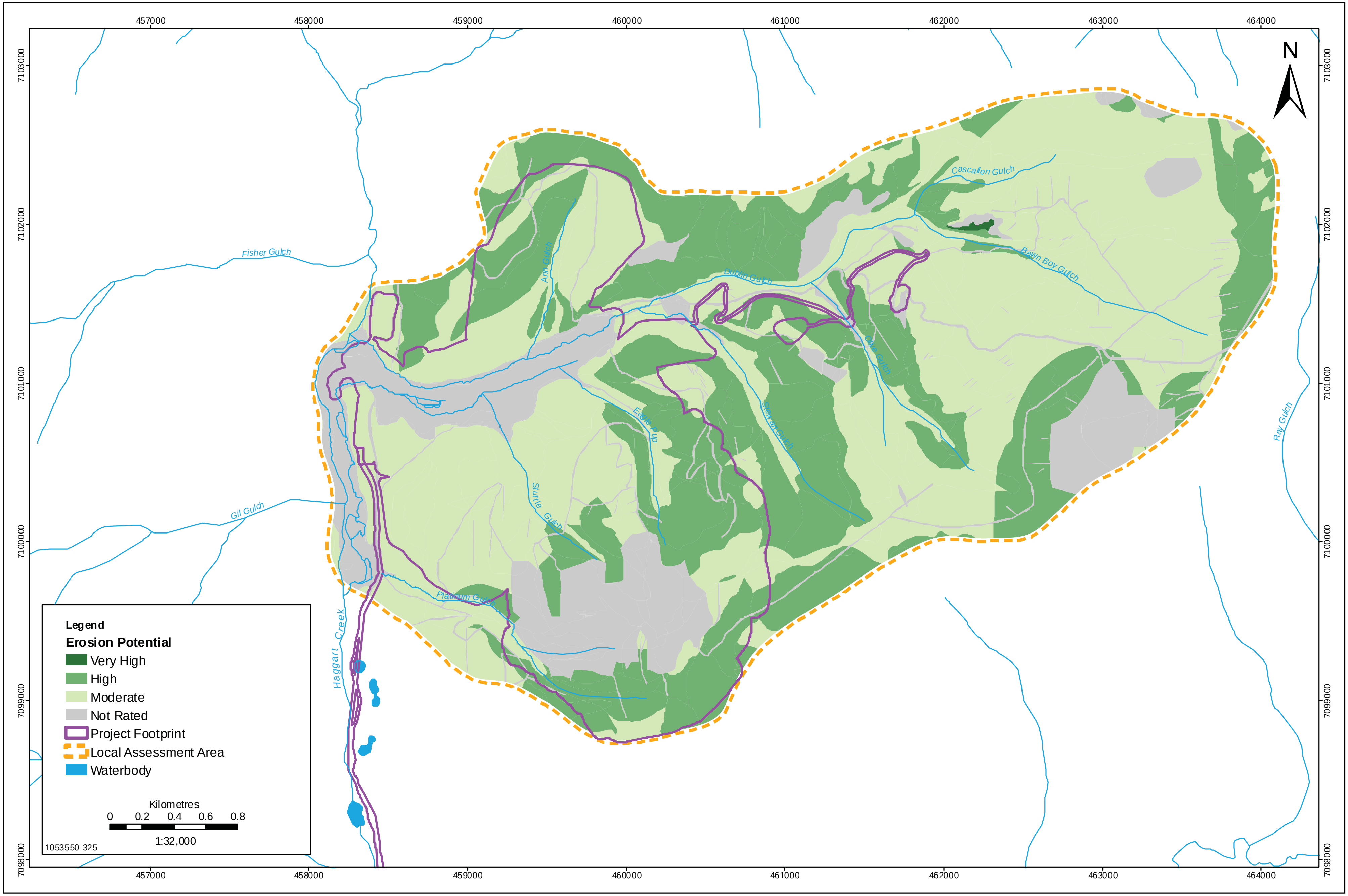
SOIL SALVAGE AREAS IN RECLAMATION SUITABILITY UNITS IN THE PROJECT FOOTPRINT

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION	DRAWN BY
UTM - ZONE 8	LS
DATUM	CHECKED BY
NAD 83	RS
DATE	FIGURE NO.
30-November-2010	6.4-6



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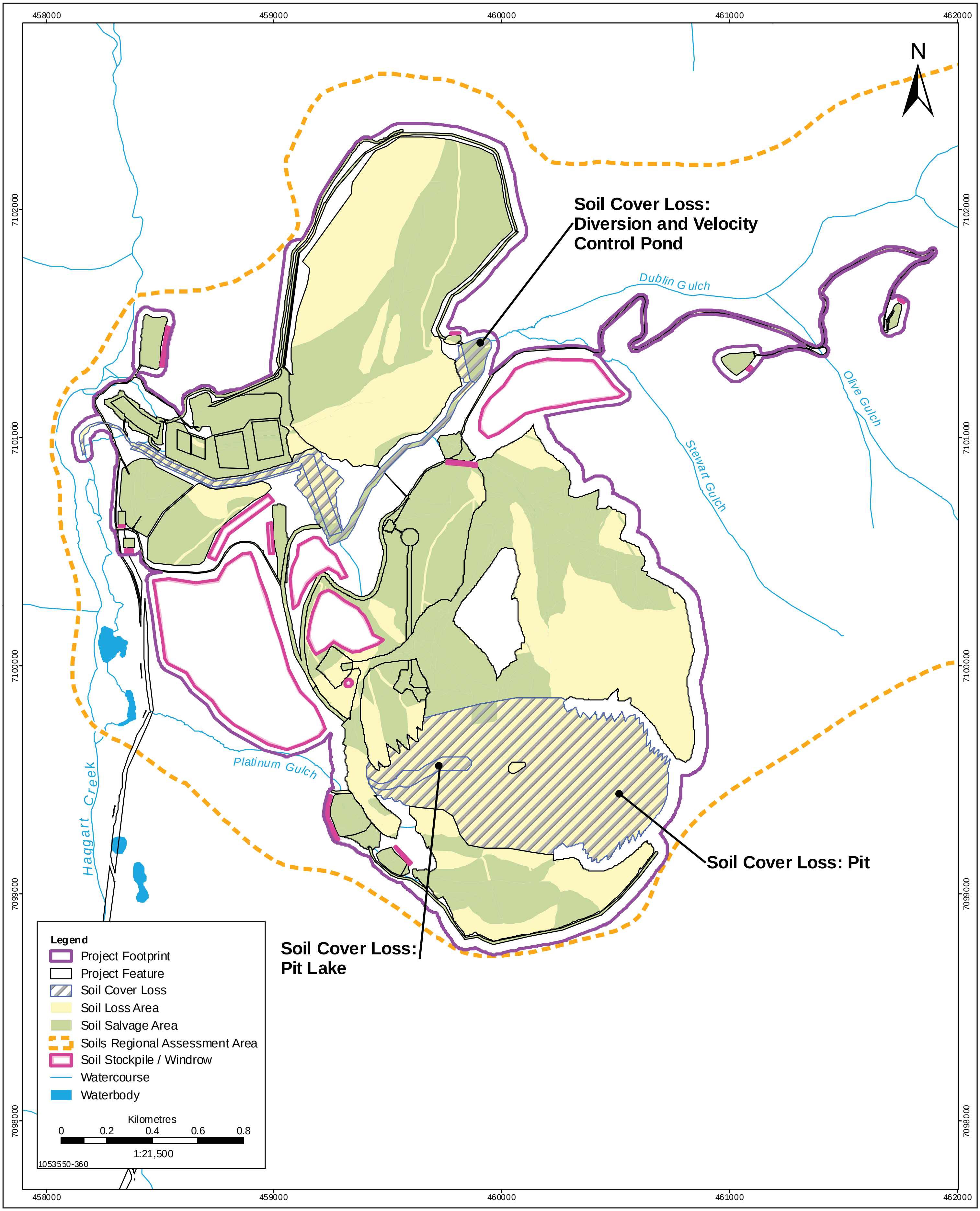
EROSION POTENTIAL IN THE LOCAL ASSESSMENT AREA

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION: UTM - ZONE 8	DRAWN BY: KP
DATUM: NAD 83	CHECKED BY: LS
DATE: 26-November-2010	FIGURE NO. 6.4-7



Data Sources; Government of Canada, Victoria Gold Corp.

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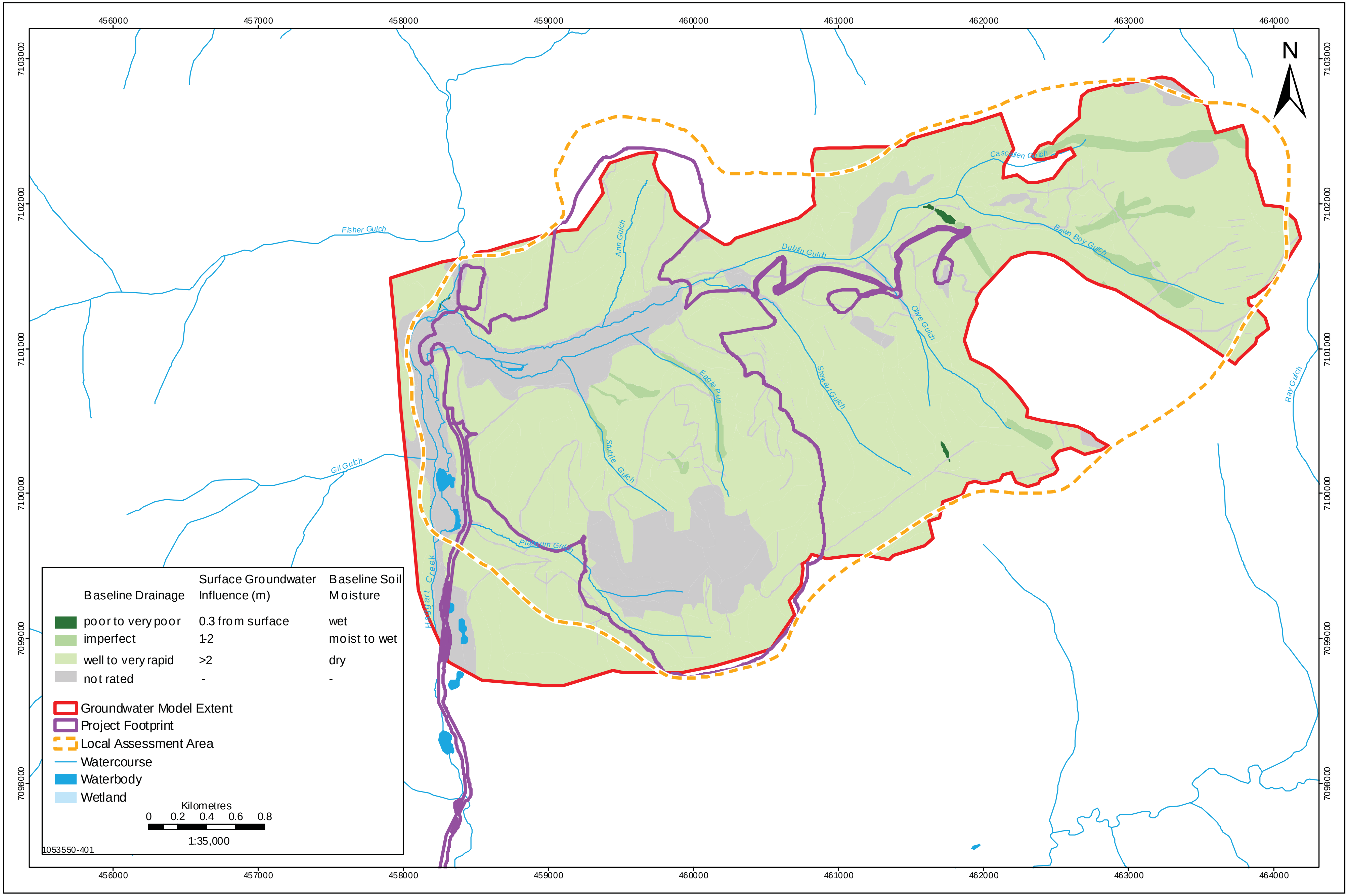
AREAS OF SOIL LOSS AND SOIL COVER LOSS IN THE PROJECT FOOTPRINT

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION	DRAWN BY
UTM - ZONE 8	RS
DATUM	CHECKED BY
NAD 83	LS
DATE	FIGURE NO.
26-November-2010	6.4-8



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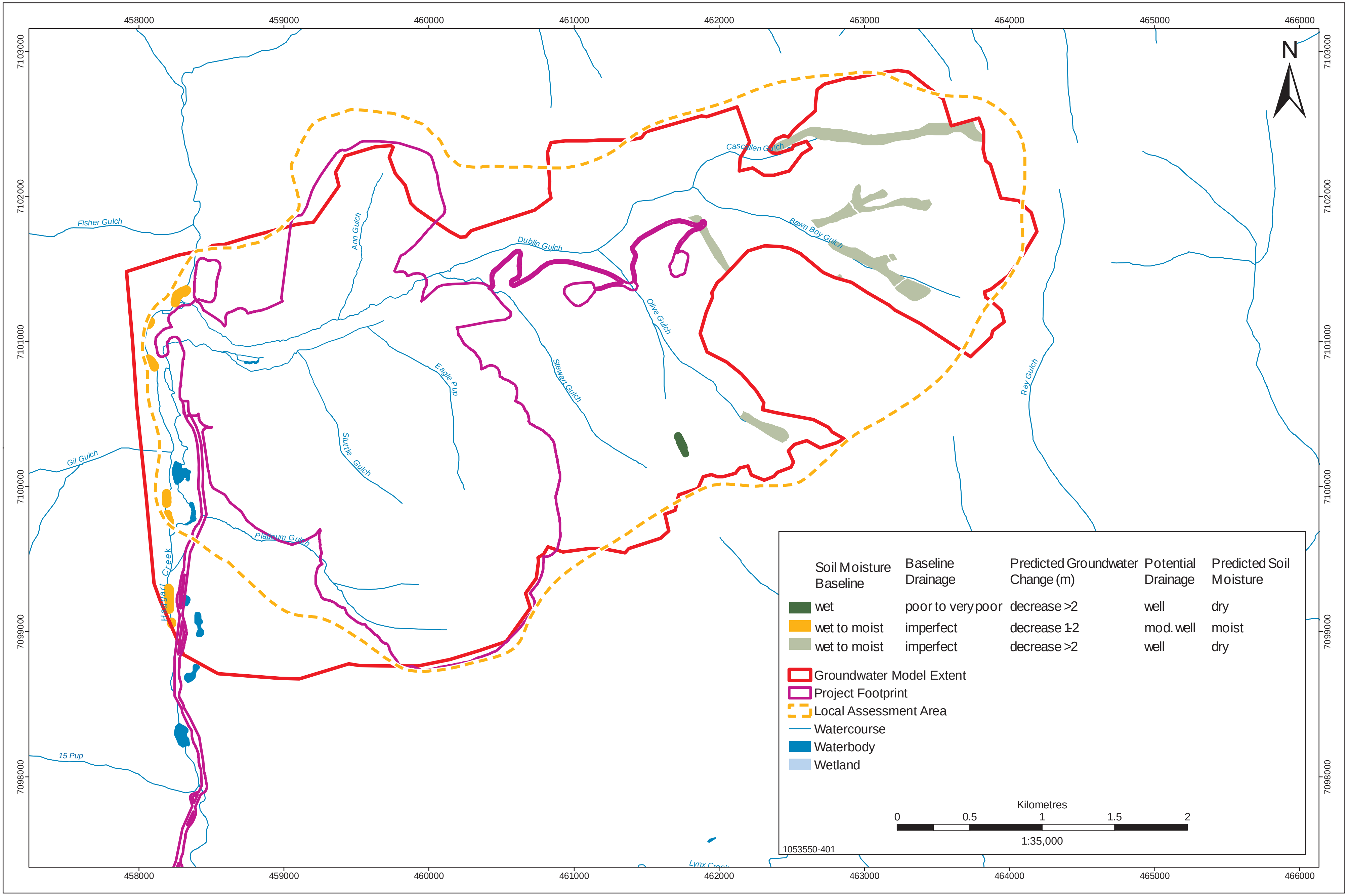
BASELINE SOIL DRAINAGE

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION	DRAWN BY
UTM - ZONE 8	RS
DATUM	CHECKED BY
NAD 83	LS
DATE	FIGURE NO.
26-November-2010	6.4-9



Data Sources; Government of Canada, Victoria Gold Corp.

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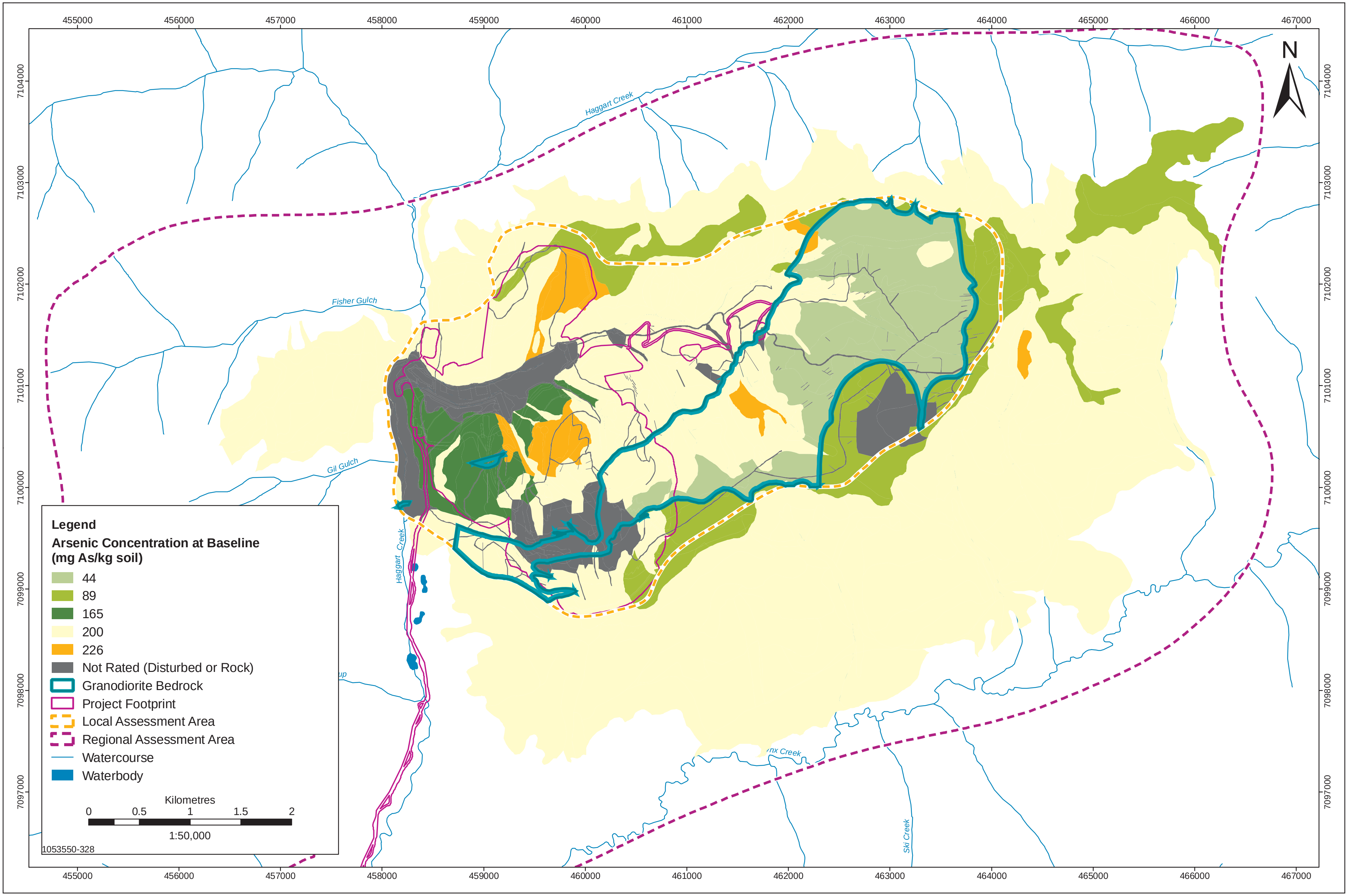
PREDICTED SOIL MOISTURE CHANGES AT 7.3 YEARS OF OPERATION AND POST CLOSURE

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION	DRAWN BY
UTM - ZONE 8	RS
DATUM	CHECKED BY
NAD 83	LS
DATE	FIGURE NO.
17-November-2010	6.4-10



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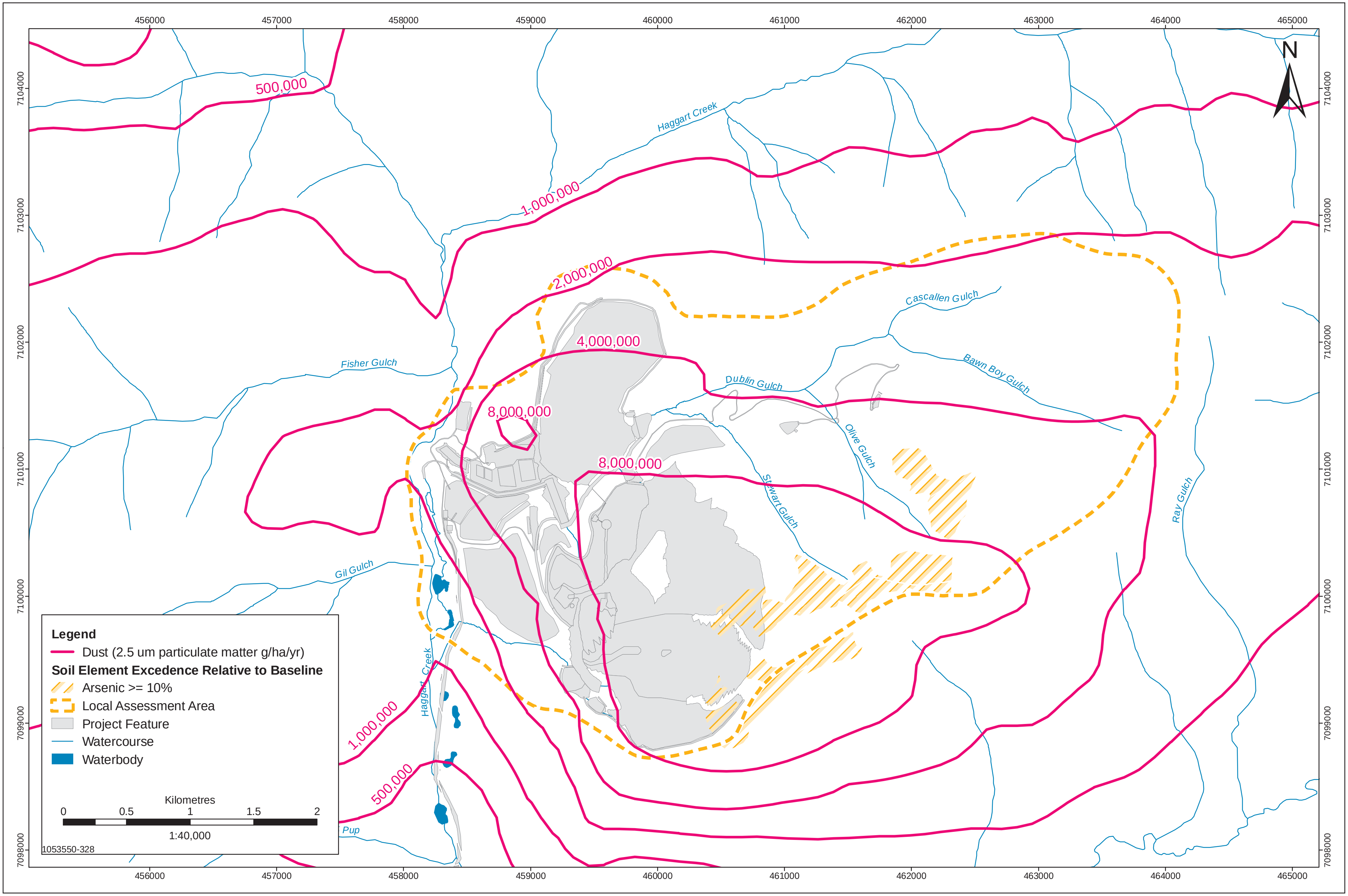
SOIL ARSENIC CONCENTRATIONS AT BASELINE

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION: UTM - ZONE 8	DRAWN BY: LS
DATUM: NAD 83	CHECKED BY: RS
DATE: 17-November-2010	FIGURE NO.: 6.4-11



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PREDICTED SOIL ARSENIC LOADING AT 7.3 YEARS OF OPERATION

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION	DRAWN BY
UTM - ZONE 8	LS
DATUM	CHECKED BY
NAD 83	RS
DATE	FIGURE NO.
17-November-2010	6.4-12

6.5 Water Quality and Aquatic Biota

Water quality and aquatic biota are sensitive to environmental effects of the Project and are identified as VCs because they are vital in sustaining healthy aquatic ecosystems. The assessment of environmental effects on water and aquatic biota provides an indication of potential effects at the population and community levels for periphyton and benthic invertebrates. Many aquatic organisms have known responses to metals, nutrients and suspended sediments typically associated with mining operations. Other potential uses, such as for drinking water, are also considered. Sediment has been considered, and will be an important monitoring component, but is not assessed as a VC because of the limited potential for interaction between the Project and sediment quality in streams with moderate or high flow.

The Project will involve open pit mining to remove ore and waste rock over a 7.3 year period. The waste will be transported to waste rock storage areas. The ore will be crushed and transferred to a heap leach facility, where it will undergo cyanide leaching to recover gold. At closure, the waste rock storage areas will be reclaimed and the heap leach facility will be rinsed, detoxified, and reclaimed. These activities have the potential to release sediment, metals and other constituents to nearby streams if not carefully managed and mitigated. Water in contact with Project infrastructure (contact water) will be collected, settled, and treated prior to discharge to area streams (Haggart Creek and its tributaries, including Dublin Gulch). The purpose of this assessment is to identify where the interactions between the Project and surface water in the receiving environment will occur, define mitigation measures to reduce the extent of adverse effects, and quantify the changes in water quality that will result. Implications for aquatic biota are discussed more qualitatively. Significant adverse environmental effects of the Project are defined as those predicted to result in discharge of a deleterious substance into fish habitat that is not authorized under applicable regulations and an impairment of the ability of the streams to sustain aquatic life (ultimately, the ability to sustain fish populations at levels similar to Project pre-development).

The water quality and aquatic biota assessment focuses on effects related to the mine itself (open pit, heap leach facility, waste rock storage areas, water management), given that treated effluent will be discharged to Haggart Creek, clean water in Dublin Gulch will be diverted through or around the mine into Eagle Creek, and several tributaries will be altered within the mine footprint. Potential effects related to access road upgrades and transmission line construction are not treated in detail in the water quality and aquatic biota assessment as they can be adequately addressed through use of published standards and Best Management Practices (BMPs), and are addressed more appropriately in the assessment of the Fish and Fish Habitat VC (Section 6.7).

Potential environmental effects of the Project under routine construction, operations, closure and reclamation phases are assessed using information in the Project Description (Section 5), the Site Water Management Plan (Appendix 18), and predictions of discharge quality from the heap leach facility, waste rock storage areas, and open pit. Water quality predictions are made using results from laboratory testing for acid rock drainage (ARD) generation and metal leaching (ML) from ore and waste rock (Appendix 8), and from modeling for hydrology (Appendix 21 – Surface Water

Balance Model Report), and groundwater quantity and quality (Appendix 22 – Groundwater Model Report), and are used to assess potential environmental effects on aquatic organisms.

Results of the assessment of environmental effects on water quality and aquatic biota are used, in turn, to support the assessment of potential effects on fish and fish habitat (Section 6.7), wildlife (Section 6.9), and human health and well-being (Section 6.11.5 and Appendix 31 – Qualitative Human and Ecological Health Assessment).

For simplicity, this assessment follows the convention of referring to metals in general, with the understanding that this refers both to metals (e.g., copper, zinc, gold) and metalloids (e.g., arsenic, antimony, selenium).

6.5.1 Scope of Assessment for Water Quality and Aquatic Biota

6.5.1.1 Regulatory/Policy Setting

Water resources in Yukon are regulated at the federal and territorial level under a number of Acts and regulations. Information requirements for the water quality assessment are provided in the YESAB "Draft Proponent Guidance for Water Information Required for Assessments" and Water Board Guidelines for Quartz Mining Undertakings.

Relevant acts, policies and guidelines related to the protection of water quality and aquatic ecosystems include the following:

- *Yukon Environmental and Socio-economic Assessment Act*
- *Yukon Waters Act* and Regulations
- Canadian *Fisheries Act* and Metal Mine Effluent Regulation (MMER) of the *Fisheries Act*
- Water quality guidelines (Canadian Council of Ministers of the Environment [CCME 2009a] and, where not listed in CCME, British Columbia approved and working guidelines [BC MoE 2006, Nagpal, et al. 2006])
- Fish-Stream Crossing Guidebook (BC MoF 2002)
- Riparian Management Area Guidebook (BC MoF 1995)
- Pacific Region Operational Statement Overhead Line Construction Version 2 (DFO 2006b)
- Land Development Guidelines for the Protection of Aquatic Habitat (DFO and MoELP 1992)
- Umbrella Final Agreement between the Government of Canada, the Council for Yukon Indians and the Government of the Yukon – Chapter 14 Water Management.

Discharge of effluent from metal mines to surface waters is regulated under the *Fisheries Act* through the MMER, which came into effect in 2002. Environment Canada administers MMER and associated environmental effects monitoring (EEM) programs that are required to assess effects of effluent discharges on fish and fish habitat. This program, along with any monitoring stipulated in a water license, will be required for any discharges during operations and at closure of the mine.

6.5.1.2 VC Baseline Information

Baseline information about water, sediment and aquatic biota is summarized in Section 4.1.11 and described more fully in Appendix 25 (Water Quality Model TDR). Field studies were conducted during 1993 through 1996 (Hallam Knight Piésold Ltd. 1996a, 1996b) and during 2007 through 2010 (Appendix 25) in the four drainage basins of interest (Haggart, Dublin, Eagle, Lynx). Over the years, 25 sites have been sampled, with up to 14 sites sampled in 2007 through 2010. The programs included monthly water sampling during the open water season, some late winter sampling, and two surveys of short-term variability of water quality (June and September). Sediment and biota samples were collected in late summer of 1995, 2007, 2009, and 2010 at various sites. While not considered a VC, sediment quality is a useful monitoring tool, so baseline data provide a benchmark for monitoring conducted during operations and closure.

Area streams are low in nutrients, have moderate hardness, and periodically exceed CCME water quality guidelines (WQG) for some metals. These conditions are indicative of annual freshet, mineralized soils in the watersheds, and previous placer mining activity. The baseline total phosphate levels of 0.002 to 0.012 mg P/L in Haggart Creek and Dublin Gulch suggest oligotrophic conditions—nutrient poor systems within the oligotrophic trigger range of 0.004 to 0.010 mg/L total P (CCME 2004). Nitrate levels are higher in Haggart Creek (mean of 0.060 to 0.070 mg N/L) than in Dublin Gulch (mean of 0.030 mg/L). Ammonia levels are low and similar (mean of 0.005 to 0.007 mg N/L) in the two systems.

Arsenic levels higher than WQG are reported year-round at sites in Dublin Gulch, Eagle Pup, and Lynx Creek, and occasionally at sites in Haggart Creek below the confluences of these tributaries. Aluminum, cadmium, copper, iron, and lead frequently exceed WQG during freshet, associated with elevated suspended solids levels.

Metals levels in stream sediment are also indicative of mineralized conditions. Small amounts of sediment were collected in riffle (moderate flow) habitat and the fine fraction (<63 µm fraction) analyzed. Levels of arsenic were higher than CCME probable effects levels (PEL) in all samples collected from Haggart Creek, Lynx Creek, and Dublin Gulch and its tributaries. Arsenic levels were higher and more variable for sites within Dublin Gulch than from the other systems.

Water quality monitoring is the basis for defining baseline conditions and assessing effects of a Project on water, from baseline through post-closure. Because water quality is highly transient, and even frequent sampling can miss unusual events, aquatic communities are typically monitored, to augment the water quality programs. The periphyton and benthic invertebrate communities are continually exposed to stream conditions in a stream and reflect overall water, sediment, and physical processes in a watershed.

Periphyton (algae growing attached to substrates) have been used as indicators of water quality since the early 1900s and are used in some biomonitoring programs in Canada (e.g., Aquamin 1996; BC MoE) and the United States (e.g., Barbour, et al. 1999). Periphyton are used as indicators of water quality because of their role at the base of the food web, sensitivity to changes in nutrients, total suspended solids (TSS), metal levels, habitat characteristics, and known responses of some species to effects of mining. Composition and productivity of the periphyton assemblage change in response to changes in sedimentation, stream flow, temperature, and water quality. Periphyton chlorophyll *a* (a measure of biomass) and taxonomic composition and abundance can be used to assess potential changes in the stream ecosystems. Because of their sensitivity to changes in water chemistry and stream habitat, periphyton provides valuable links to benthic and fish communities. Effects of metals on algae were summarized by St-Cyr, et al. (1997) as part of the Aquatic Effects Technology Evaluation leading up to the EEM programs required under MMER (Aquamin 1996; Environment Canada 2002). Effects range from chronic and acute toxicity through physical deformities of diatoms. Nutrient additions (eutrophication) can lead to excessive periphyton growth, with filamentous mats clogging or entangling invertebrates, depleting oxygen as they decompose, decreasing aesthetic values, decreasing the value of fish spawning habitat, and altering composition of the benthic invertebrate community (Horner, et al. 1983).

Benthic invertebrates have been used as indicators of water quality for over a century and are also used in biomonitoring programs in Canada (e.g., Environment Canada 2002) and the United States (e.g., Barbour, et al. 1999). They consume smaller animals and plants, aid in decomposition of organic material, and are an important source of food for fish and other animals. Changes in benthic productivity (food supply) can have a direct effect on fish (abundance, size, accumulation of metals in tissue), which can affect birds and wildlife that consume fish. Benthic invertebrates are assessed as indicators of water quality because of their role as secondary producers and sensitivity to changes in water quality and habitat. Many species have known responses to metals and sediment, making them useful sentinels of changes related to mine operations. Benthic invertebrate abundance, taxonomic composition, and derived indices (richness, diversity, and evenness) were used to assess changes in aquatic ecosystems in streams. The main advantages of using benthic invertebrates for biomonitoring are: 1) they are ubiquitous, so can be affected by perturbations in aquatic habitats; 2) the many species involved offer a wide range of responses to environmental stresses; 3) they are relatively sedentary, which allows for the determination of the spatial changes caused by perturbations; and 4) they have life cycles ranging from months to two years, so the effects of perturbations over time can be observed (Rosenberg and Resh 1993).

Benthic communities of area streams contain a variety of species of periphyton (predominantly diatoms and blue-green algae) and invertebrates (predominantly Ephemeroptera, Plecoptera, Trichoptera [collectively known as the pollution-sensitive EPT], Chironomidae, and Oligochaeta). Ephemeroptera, Plecoptera and Chironomidae provide important fish food.

In general, chlorophyll *a* levels of 0.02 to 1.1 mg/m^2 in streams of the Project assessment area are low compared with results for other systems in western Canada, where chlorophyll *a* levels range from 1 to 100 mg/m^2 (Appendix 25). This suggests that low productivity in the Project area is a result of low nutrient supply or stresses from elevated metals levels (e.g., arsenic), or both. Periphyton communities in Dublin Gulch, Lynx Creek, Eagle Pup, and Stuttle Gulch consist mainly of thin films of blue-green algae tightly associated with the rocks; these streams all have elevated arsenic levels and relatively low nitrogen levels. Diatoms are more abundant in Haggart Creek upstream and downstream of the Dublin Gulch confluence, although the proportion of blue-green algae increases further downstream. Community structure indices (taxon richness, diversity, and evenness) tend to be higher in Haggart Creek than in the other systems. Periphyton abundance is highest in Dublin Gulch, intermediate in Haggart Creek, and lowest in Eagle and Lynx Creeks.

Benthic invertebrate assemblages in Haggart Creek tend to have lower abundance and higher richness, diversity, evenness, and EPT values than do assemblages in the other three systems. The small tributaries (Eagle Pup, Stewart, and Stuttle), Dublin Gulch and Lynx Creek tend to contain mainly lumbriculid Oligochaeta, Ephemeroptera, and Plecoptera, with low proportions of Chironomidae. In Haggart Creek, lumbriculid Oligochaeta tend to be predominant and Ephemeroptera and Plecoptera common upstream of the Dublin Gulch confluence, with increasing proportions of Ephemeroptera, Plecoptera, and Chironomidae downstream. These patterns suggest habitat, food supply or metal stresses in the tributaries that favour predominance of the more tolerant Oligochaeta, while maintaining a diversity of insect taxa.

Overall, community abundance and composition reflect oligotrophic conditions. It is also possible that the low abundance and diversity of benthic organisms in the headwater tributaries is associated with lower opportunity for colonization compared to the mainstem Haggart Creek or with the elevated arsenic levels documented for the tributaries. In all these systems, however, pollution sensitive invertebrates (EPT) are predominant or common, and provide food for fish.

6.5.1.3 Key Issues

Consultation with regulators, First Nations, stakeholders, and community members, in conjunction with professional judgment of VIT and its consultants, has resulted in identification of key issues for the Project. For water quality and aquatic biota, these issues are related to construction activities with the potential to release suspended sediment to area streams and the discharge or seepage of mine water containing metals, cyanide, sulphate and other constituents during any phase of the Project. These discharges have the potential to affect water quality for aquatic life or human uses through toxicity or by altering conditions for growth of aquatic organisms (e.g., through nutrient addition). The *Fisheries Act* prohibits the release of deleterious substances into fish-frequented waters or in a place or under any conditions where it may enter fish-frequented waters, unless it is authorized.

6.5.1.4 Identification of Potential Environmental Effects

Potential interactions between specific Project components and water quality and aquatic biota are identified and ranked in Table 6.3-1. Those interactions ranked as a “2” (interaction could result in an environmental effect of concern even with mitigation) are described below and assessed further in Section 6.5.2. Those ranked as a “1” (interaction occurs; however, based on past experience and professional judgment the interaction would not result in a significant environmental effect, even without mitigation; or interaction would not be significant due to application of codified environmental protection practices known to effectively mitigate the predicted environmental effects) are described below but not assessed further.

Interactions between the Project activities and the aquatic environment ranked as “2” in Table 6.3-1 are listed in Table 6.5-1 with associated potential environmental effects. The main interaction is through discharge of treated mine water to area streams. During operations, several activities within the mine footprint (storage of waste rock, development of the open pit, operation of the heap leach facility) will not result in direct discharges to streams, because any contact water will be sent to the mine water treatment plant before being discharged. The other possible Project interaction with water quality would be through potential uncontrolled releases, i.e., seepage of contact water during operations or closure into groundwater, which could then discharge additional metals to area streams. Also, the potential environmental effects of closure and reclamation activities are assessed regarding possible direct discharge to streams.

Table 6.5-1: Potential Project Interactions with Water Quality and Aquatic Biota

Project Activities and Physical Works	Potential Environmental Effects	
	Change in Water Quality	Change in Aquatic Biota
Site water management (diversions and runoff)	✓	✓
Mine water treatment and discharge during operations	✓	✓
Waste rock storage area reclamation	✓	✓
Heap leach facility reclamation	✓	✓
Open pit filling and discharge after closure	✓	✓
Ongoing water treatment and discharge during closure and post-closure	✓	✓

NOTE:
Project Environmental Effects
Only Project-Environment interactions ranked as 2 in Table 6.3.1, the Project-Environment Interaction Table, are carried forward to this Table.
✓ = Indicates that an activity is likely to contribute to the environmental effect.

The potential environmental effects have been grouped into the following categories:

- Change in surface water quality (TSS, metals, nutrients, sulphate, cyanide)
- Change in aquatic biota (abundance and composition of periphyton and benthic invertebrates).

The potential for effects on sediment quality were also considered; however, the likelihood of interaction with the Project is considered low, given the extensive use of sediment control and erosion protection measures, sediment control ponds and TSS criteria to be met for effluent from the mine water treatment plant. Haggart Creek and Dublin Gulch, the two main receiving streams, are fast flowing, with few areas of depositional habitat, as regular freshets flush fine-grained sediments from the stream bed. No other effects, such as precipitation of gypsum on the stream substrates, related to high sulphate and calcium levels, are predicted, given that levels will be lower than those required to trigger such reactions. Sediment quality will continue as a component of the monitoring program for streams, and results can be compared with baseline data.

Surface water affected by Project activities will be classified as either contact or non-contact:

- **Non-contact water**—clean water that has had no contact with exposed ore or industrial processes. This will be diverted around mine facilities and into adjacent surface waters.
- **Contact water**—water that has been in contact with ore or industrial processes. This includes water from the open pit and waste rock storage areas (to be collected and either recycled for mine operations or treated and released to surface waters) and water from the heap leach facility (to be recycled during operations and then treated prior to release during closure and reclamation).

Implementation of the Water Management Plan (Appendix 18), erosion and sediment control provisions in the Environmental Management Plans and the commitment to treat contact water will ensure that water released to area streams will meet applicable standards.

The Water Management Plan will be implemented starting with the construction phase, and will protect surface water quality by construction of diversion channels to convey non-contact flows through the site (Dublin Gulch diversion channel) and around the heap leach facility (Ann Gulch diversion channels). Diversion will result in changes to hydrology, and may result in changes to water chemistry and aquatic biota in Dublin Gulch, so has been assigned a rank of “2”. Quality of the diversion water is modeled in Section 6.5.2 and effects of diversion are considered in detail in Fish and Fish Habitat assessment (Section 6.7).

Activities during operations that could result in discharge or seepage of mine water to area streams have been ranked as a “2” and are discussed in Section 6.5.2. While essential to an understanding of discharges to the streams, activities such as open pit and heap leach facility development and waste rock storage do not result in direct discharges. These activities are ranked a “1” because the potential contact water that could result from them is sent to the mine water treatment plant (one of the primary mitigations for water quality). Details are provided for “mine water treatment and discharge” in Section 6.5.2. The heap leach facility will require large amounts of water for the first few years, during which there would be little or no discharge to area streams. Also assessed in Section 6.5.2 are planned discharges of contact water. This water will be monitored and released only if the resulting surface water quality will meet applicable WQG, with treatment as necessary. In accordance with MMER, effluent, water quality and EEM programs will be required for any effluent discharges during operations. While discharge quality will be in compliance with MMER criteria for effluent, Project effects on surface water are assessed in terms of the more stringent WQG for protection of aquatic life.

During closure and reclamation, cyanide in the heap leach facility will be rinsed then drained, with the cyanide detoxified. Discharges from the heap leach facility, open pit, and waste rock storage areas have the potential to release contaminants to area streams; these interactions between Project and environment are ranked as “2” and addressed in Section 6.5.2. The closure and reclamation phase includes the time required to treat effluent from the heap leach facility, waste rock storage areas and open pit according to the Conceptual Closure and Reclamation Plan (Appendix 24).

6.5.1.5 Standard Mitigation Measures and Environmental Effects Addressed

Many Project activities described in Table 6.3-1 are assigned a rank of "0" (no direct interaction) or "1" (the interaction would not result in a significant environmental effect, even without mitigation; or interaction would not be significant due to application of codified environmental protection practices that are known to effectively mitigate the predicted environmental effects). Examples of interactions ranked as "0" include burning of cleared vegetation, use of diesel power generators and heavy construction equipment, infrastructure and camp construction and closure, ore processing, solid waste management, and camp operation. Several of the activities ranked as "1" were discussed in the section immediately above. These activities and others ranked as "1," and the types of mitigations used to manage effects are further discussed below for each phase of the Project.

Construction

Construction activities (site clearing, grubbing, site grading, soil and overburden removal, access road upgrades, transmission line construction, vehicle traffic, etc.) have the potential to release large amounts of sediment to area streams. However, effects of sediment and erosion on aquatic organisms are well documented, as are mitigation methods. Codified erosion prevention and sediment control practices and the Water Management Plan (Appendix 18) will be in place to prevent sediment release during construction. All runoff from camp construction, site clearing, and other soil and vegetation disturbance and stockpiling activities will report to sediment ponds for settling. Sediment ponds have been designed for a 1:100 year 24-hour rain event. These practices will ensure there will be no discharge of sediment-laden water above permit levels during construction. With these mitigation measures, little or no change in water quality and aquatic organisms is expected, and these effects have been ranked as "1".

Potable water will be drawn from a well near the camp, held in a storage tank, and treated to meet Canadian Drinking Water Standards before being distributed through the camp. This will not affect water quality of area streams. Non-potable water may be drawn from surface water storage facilities or Haggart Creek, as required and permitted, but it is anticipated that the well will supply the majority of water requirements. No large external water sources are required for the heap leach facility (except potentially at the start of operations) as contact water from the waste rock storage areas, open pit, and sediment control ponds will be used as makeup water.

A sewage treatment plant (membrane biological reactor) will be installed near the camp for use during construction, operations, and closure. It will be sized for the maximum construction workforce (Section 5: Project Description). Low phosphate detergents will be used at the camp, to limit potential phosphate enrichment in the effluent. Quality of treated effluent will meet Yukon Water Board requirements and will be discharged through a rock drain into Haggart Creek. Sewage from facilities distant from the camp will be transferred to the sewage treatment plant. Because contact water will be treated on site and treated effluent will reach Haggart Creek after further attenuation, this interaction has been assigned a rank of "1".

The fish habitat compensation project will be built in Eagle Creek downstream of the Project. Instream and streambank construction could result in disturbance of aquatic habitat and release of sediment. These potential environmental effects will be mitigated by following VIT's surface erosion prevention and erosion control practices (Appendix 18 – Water Management Plan), and by pumping water around any worksites. As a result, this interaction has been assigned a rank of “1”.

Activities associated with construction and maintenance of the 45 km long, 30 m wide, 69 kV transmission line RoW have the potential to alter riparian vegetation at stream crossings and to release sediment to streams. However, DFO's Pacific Region Operational Statement for Overhead Line Construction and VIT's surface erosion prevention and erosion control practices (Appendix 18) will be followed to avoid adverse effects on aquatic habitat. The route will be selected to avoid sensitive habitats such as wetlands or unstable terrain. Following these procedures should limit or avoid any potential release of sediment or other contaminants to watercourses. With these mitigation measures, the interaction was ranked as “1” and is not assessed further. A similar approach is taken for decommissioning of the transmission line, also ranked as “1”.

Upgrades to the mine access road, the Haggart Creek Road, have the potential to affect water quality and aquatic habitat through clearing of riparian vegetation and bank erosion at stream crossings. Construction or replacement of culverts and construction of pullouts on the road also have the potential to result in loss or alteration of instream habitat and reduction in water quality. These potential environmental effects will be minimized or avoided through implementation of surface erosion and sediment control measures (Appendix 18) and other BMPs (BC MoF 1995, 2002; DFO 2006b). Road runoff and dust control related to vehicle traffic use will be managed to avoid discharge of sediment and metals to streams (ditches that allow infiltration of runoff; dust suppression). As a result, these interactions are ranked as “1” and are not considered further in this assessment.

Operations

Interactions between the Project and surface water during operations ranked as “1” include potable and non-potable water use, maintenance of the access road and transmission line, and vehicle traffic. The reasons for their scoring of “1” are covered above in the discussion for construction. Fuel, hazardous materials, and explosives will be managed according to industry standards as described in Section 5. This includes storage in appropriate containers, containment in berms with over 100% capacity, and storage of explosives in separate buildings away from the rest of the mine activities.

Surface drainage in the vicinity of the mining, processing, waste rock storage area and camp facilities will be collected in ditches, directed to surface sumps, and stored for use at the heap leach facility. As there will be no direct release of contact water to surface waters, this interaction was ranked as “1” and is not assessed further. Non-contact water (water diverted around features) will be diverted through ditches, into sediment control ponds and discharged to surface water.

Non-potable water for process use will come from recirculation within the heap leach facility, runoff and seepage from the waste rock storage areas, open pit dewatering, and sediment control ponds, and when these sources are insufficient, from two groundwater wells.

Closure and Reclamation

Potential environmental effects associated with removal of mine facilities have been ranked as "1" or "0." The potential effects of these activities are disturbance of soils and vegetation in riparian areas and alteration of instream habitat. These effects will be addressed and mitigated as discussed in the Conceptual Closure and Reclamation Plan (Appendix 24) and through the use of surface erosion prevention and sediment control practices (Appendix 18). Effects of decommissioning the transmission line and road, and applicable mitigations, will be similar to those described for construction, and are expected to result in little or no effect on water quality or aquatic biota.

6.5.1.6 Selection of Measurable Parameters

Measurable parameters for the assessment are mostly quantifiable, given that water samples can be analyzed for chemical characteristics and compared with guidelines and that changes in biological communities can be assessed using statistical tests. Measurable parameters for environmental effects identified in Table 6.5-1 are summarized in Table 6.5-2.

Table 6.5-2: Measurable Parameters for Water Quality and Aquatic Biota

Environmental Effect	Rationale for Inclusion of Environmental Effect in the Assessment[1]	Measurable Parameter(s) for the Environmental Effect	Rationale for Selection of the Measureable Parameter[1]
Change in Water Quality	Consultation with regulators, First Nations, stakeholders, and the public; YESAB's guidelines; CCME WQG	TSS, turbidity	Construction or operations activities could result in release of suspended sediment to streams.
		Levels of metals and metalloids (e.g., aluminum, antimony, arsenic, copper, iron, lead, selenium, silver)	Water in contact with heap leach facility, waste rock storage areas, processing plant, events ponds, or open pit wall could convey particulate and dissolved metals into streams, resulting in exceedance of WQG and toxic or effects on aquatic organisms due to bioaccumulation.
		Sulphate	Ore processing often generates sulphate, which can lead to effects on aquatic biota.
		Cyanide and its breakdown products	Cyanide used in the heap leach facility would be toxic to aquatic biota if it reached streams.
		Nutrients (nitrate, ammonia, phosphate)	Blast residues in waste rock storage areas or products of cyanide destruction could release nitrogen to surface waters. Waste rock storage area runoff containing phosphorus could be discharged to the streams. This can result in eutrophication of streams.

Environmental Effect	Rationale for Inclusion of Environmental Effect in the Assessment[1]	Measurable Parameter(s) for the Environmental Effect	Rationale for Selection of the Measureable Parameter[1]
Change in Aquatic Biota	Consultation with regulators, First Nations, stakeholders, and the public; YESAB's guidelines	Periphyton chlorophyll *a*, taxon richness, diversity, evenness Benthic invertebrate abundance, taxon richness, diversity, evenness, ecological tolerances	Changes in water quality could lead to changes in aquatic communities through habitat, nutrient enrichment or toxicity effects. Abundance and community structure are well recognized descriptive characteristics of benthic communities, and are used in monitoring programs to recognize change resulting from human activities. These organisms are important indicators of fish habitat quality, and provide fish food.

NOTES:

[1] Includes input from consultation with regulators, First Nations, affected stakeholder, and the public: as well as YESAB's guidelines, other regulatory drivers, policies, and/or programs.

Measurable parameters for water quality were selected based on potential Project activities that would result in release of metals, suspended sediment, nutrients, or sulphate. WQG that protect aquatic life were used where appropriate, as these are typically the most stringent, so also protect uses such as drinking water, irrigation, and recreation.

6.5.1.7 Spatial Boundaries for Water Quality and Aquatic Biota

Local Assessment Area (LAA)

The local assessment area (LAA) is shown in Figure 6.5-1 and is defined by the natural drainage boundary of Haggart Creek, from above Dublin Gulch to above Lynx Creek. Surface waters in the LAA will drain the processing plant, heap leach facility, waste rock storage areas, open pit, camp, transmission line and roads. The LAA boundary was selected based on the maximum area where altered water quality would most likely be detected.

Regional Assessment Area (RAA)

The regional assessment area (RAA) includes the Haggart Creek watershed to the South McQuesten River (Figure 6.5-1). There is considerable dilution of flows from the Dublin Gulch watershed within this area. Dublin Gulch contributes 10 to 15% of the flows into Haggart Creek at its confluence, and Lynx Creek and Haggart Creek have similar flows (1:1 dilution) as noted in Appendix 14 – Environmental Baseline Report: Hydrology. Haggart Creek contributes about 20% to 30% of the flow of the South McQuesten River (0.3:1 dilution or less), calculated using the basin-discharge ratio method. Overall dilution of flows from W29, below mine activities, into the South McQuesten River will be about 0.15:1, or less. This is the area where interactions with other projects, if they were to take place, could potentially result in cumulative effects.

6.5.1.8 Temporal Boundaries for Water Quality and Aquatic Biota

Temporal boundaries for the assessment of water and aquatic biota are the same for all potential environmental effects identified in Table 6.5.1.The temporal boundary includes all mine phases:

- Construction phase of about 1.7 years (Jan. 2012 to Aug. 2013 or Year 1 and Year 2)
- Mining operations phase of about 7.3 years (Sept. 2013 to Dec. 2020, or Year 3 to Year 9)
- Closure and reclamation phase of about 10 years (Jan. 2021 to Dec. 2030 or Year 10 to Year 19)
- Post-closure monitoring beginning midway during reclamation and estimated to continue for another 5 years (to 2035 or to Year 25).

6.5.1.9 Characterization of Residual Environmental Effects for Water Quality and Aquatic Biota

Criteria used to characterize potential residual effects (potential effects remaining after the application of mitigations) on water quality and aquatic biota are described in Table 6.5-3.

Table 6.5-3: Characterization of Residual Environmental Effects for Water Quality and Aquatic Biota

Criterion	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The ultimate long-term trend of the environmental, economic, social, heritage, or health effect	**Positive**—a reduction in levels of metals that exceed WQG at baseline; condition of water quality or biota is improving **Adverse**—an increase in levels of metals and other parameters compared to baseline; a change in aquatic productivity or trophic state compared to baseline; worsening condition for water or biota **Neutral**—condition of water quality or biota is not changing in comparison to baseline conditions and trends
Magnitude	The amount of change in a measurable parameter or variable relative to baseline case	**Negligible**—not measurable, where an environmental effect is nominal or not measurable **Low**—where an environmental effect occurs that is detectable, but within the normal variability of baseline conditions **Moderate**—where an environmental effect occurs that would cause a change outside of normal variability of baseline conditions, but is within regulatory limits and goals **High**—where an environmental effect occurs that would singly, or as a substantial contribution in combination with other sources, exceed limits and goals in the local or regional boundaries
Geographical Extent	The geographic area in which an environmental, economic, social, heritage, or health effect of a defined magnitude occurs	**Site-specific**—within the 100 m initial dilution zone of the effluent discharge in Haggart Creek, or for smaller ditches conveying runoff from reclaimed areas, within the 100 m initial dilution zone of Dublin Gulch or Platinum Gulch **Local**—in Haggart Creek between the effluent dilution zone and Platinum Gulch, in Dublin Gulch or Eagle Creek **Regional**—in Haggart Creek downstream of the confluence with Platinum Gulch, and beyond to South McQuesten River

Criterion	Description	Quantitative Measure or Definition of Qualitative Categories
Timing and Frequency	The number of times during a project or a specific project phase that environmental, economic, social, heritage, or health effect may occur	**Once** **Occasional**—occurs infrequently, e.g., during freshet, snowmelt, storms, or mine upsets **Frequent**—occurs on a regular basis and at regular intervals **Continuous**—occurs throughout the Project e.g., effluent discharge, seepage
Duration	The period of time required until the VC returns to its baseline condition, or the effect can no longer be measured or otherwise perceived	**Short-term**—occurs for hours to days (e.g., storm event) **Medium-term**—occurs for up to one year (e.g., during construction) **Long-term**—occurs for between one and five years (the life cycle of many salmonids and Arctic grayling), so has implications for fish and fish habitat **In perpetuity**—once initiated, change that is predicted to continue forever or for the long term
Reversibility	The likelihood that a measurable parameter will recover from an effect	**Reversible**—will cease after the project activity has stopped **Irreversible**—will persist after the project activity has stopped
Ecological and Socio-economic Context	The general characteristics of the area in which the project is located	**Undisturbed**—the area is relatively unaffected by human activity **Disturbed**—the area is affected by human activity
Probability of Occurrence		**Unknown**—not well understood and, based on potential risk to the aquatic environment or its economic or social/cultural values, effects will be monitored and management measures taken, as appropriate **High**—well understood and there is a high likelihood of effect on water or sediment quality as predicted

The magnitude criteria were developed considering existing WQG for protection of aquatic life or drinking water (whichever is lower), and the range of natural variability in development of regulatory limits and goals, which will be established during permitting. The CCME WQG define levels at which no adverse effects are expected for aquatic life, but they do not define levels at which adverse effects are likely to occur. That is to say, they are conservative in nature and an exceedance does not equate to an environmental effect. Most of the existing WQG were set for the most sensitive species tested in the laboratory, typically selecting a long-term lowest observed effect concentration (LOEC), and then applying a ten-fold safety factor.

More recently, CCME (2007) has published “A Protocol for the Derivation of Water Quality Guidelines for the Protection of Aquatic Life 2007”, which describes an updated approach to setting WQG. A cumulative species sensitivity distribution is developed for a given parameter, and the guideline for long term exposure is set at the intercept of the 5th percentile of species affected. However, most of the effect concentrations at the low end of the species distribution curve are based on no-observed effect concentrations (NOEC), leading to similar challenges in identifying concentrations at which an effect is likely to occur.

Revision of the CCME WQG is an ongoing process, and there are draft WGQGs for a few metals at this time. For example, the existing WQG for cadmium at hardness of 150 mg/L (common in Haggart Creek) is 0.05 µg/L, but the draft WQG is almost six times higher at 0.29 µg/L (Roe, et al. 2010). For zinc, in contrast, the current WQG (30 µg/L, any hardness) and draft WQG (31 µg/L at hardness of 180 mg/L $CaCO_3$) are similar (Roe, et al. 2010).

Further complicating development of effect criteria is the presence of parameters at levels higher than WQG, either periodically or continuously. For example, arsenic levels are ten times higher than WQG in Dublin Gulch and other tributaries of Haggart Creek, whether they were disturbed by placer mining or not. For arsenic, and for other parameters that exceed CCME WQG, a SSWQO will be proposed, following the CCME guidance on setting SSWQO (Background Concentration Procedure) based on two standard deviations of the mean baseline values (based on all data, year-round), to cover natural variability in the baseline (CCME 2003). Like the CCME WQG, SSWQO will be set to be protective of the most sensitive use of the water (typically aquatic life).

6.5.1.10 Standards or Thresholds for Determining Significance

For water quality and aquatic biota, a significant adverse residual environmental effect is defined as a Project-related environmental effect that results in either of the following:

- A discharge of a deleterious substance into fish habitat (Haggart Creek, Dublin Gulch diversion channel, Eagle Creek) that is not authorized under the *Fisheries Act* (using effluent standards defined by MMER) and/or Yukon Water Board permits, including ongoing effluent discharge or an isolated accidental release.
- An impairment of the ability of the watercourses to sustain aquatic life (ultimately, the ability to sustain fish populations at levels similar to Project pre-development).

While the criteria used to characterize the residual environmental effect provide a valuable role in informing the significance determination, they are not used explicitly for that purpose, given that the *Fisheries Act* definition of a deleterious substance does not make reference to the attributes, characterization or significance of an effect.

6.5.1.11 Effects Analysis Methods

Environmental effects of the Project on water quality were assessed using a mass balance model combining baseline water quality and applicable source terms (drainage from waste rock storage areas, open pit, heap leach facility, groundwater quality) for a range of flow conditions (average, wet, and dry flows) during the life of the mine. The model was used in two ways:

- To predict concentrations of metals, nutrients and sulphate: in Haggart Creek downstream of the mine water treatment plant discharge during operations and closure; in Dublin Gulch downstream of the Eagle Pup waste rock storage area during closure; and in Haggart Creek downstream of the Platinum Gulch facilities during closure. Resulting predictions were compared to WQG and SSWQO.

- To predict concentrations of metals, nutrients and sulphate at various points within the mine (open pit, waste rock storage areas, heap leach facility) for the purposes of assisting in development of design criteria for the mine water treatment plant and identify when, and for what facilities, water treatment would be needed.

Environmental effects of the Project on aquatic biota were assessed qualitatively, based on baseline conditions, water quality predictions and WQG for protection of aquatic life. By protecting water quality (through permits and monitoring), it is assumed that aquatic life is protected. While the generic WQG typically include a safety factor of ten (i.e., are set to be ten times higher than the LOEC for the most sensitive species), Environment Canada is revising the approach, and is developing draft WQG for many metals using the species sensitivity distribution method and a combination of NOEC and LOEC values (CCME 2007). There are also provisions for setting site-specific WQO when baseline levels are already higher than WQG (CCME 2003).

Water Quality Guidelines Used for Comparison

The parameters analyzed are listed in Table 6.5-4, along with CCME WQG for protection of aquatic life and alternative guidelines when there is no CCME WQG or where recommendations will be made for a SSWQO. The detection limits used in field surveys were appropriate for comparison with WQG (with the exception of cadmium data from the 1990s). Additional considerations for SSWQO are discussed below and in Section 6.5.5. Although water quality data are compared to CCME WQG, it is recognized that these are levels below which adverse effects on aquatic life are not expected, but that the CCME WQG do not provide guidance about levels that are likely to cause adverse effects. In some cases, more recent research in another jurisdiction (e.g., provincial, US EPA) has resulted in publication of WQG different from CCME, and more applicable to site conditions. In other cases, a SSWQO will need to be developed to address baseline conditions. WQG for protection of aquatic life generally is lower (more protective) than the guidelines for drinking water.

Table 6.5-4: Parameters Analyzed, CCME Water Quality Guidelines for Protection of Aquatic Life, and Alternative Recommendations for Site-specific Objectives

Parameter	CCME WQG (maximum) (mg/L unless stated)	Alternative WQG or Recommendation for SSWQO (mg/L unless stated)
Dissolved oxygen	Minimum 5.5 – 9.5	
pH, units	6.5 – 9	
TSS	Clear flow—max increase of 25 mg/L and 5 mg/L above background for short term and long term exposure, respectively High flow—max increase of 25 mg/L above background when background is 25 to 250 mg/L; ≤ 10% of background when background is >250 mg/L	BC WQG of 25 mg/L when background ≤250
Fluoride	NA	BC WQG of 0.3 for hardness >50 mg/L

Parameter	CCME WQG (maximum) (mg/L unless stated)	Alternative WQG or Recommendation for SSWQO (mg/L unless stated)
Chloride	128 (draft CCME) – document not finalized; final guideline could change	BC WQG of 600
Sulphate	NA	BC WQG 100
Ammonia-N	Total ammonia varies with temperature, pH; un-ionized ammonia <0.019	
Nitrate-N	2.9	
Nitrite-N	0.06	0.06 – 0.6 for chloride 2 to >10 mg/L
Phosphorus-P (total)	NA, only guidance for protection from eutrophication See CCME (2004) and Gartner Lee (2006)[1]	
Cyanide	0.005 (free CN)	0.010 (weak acid dissociable CN)
Aluminum	0.1 (total), pH≥6.5	BC WQG of 0.1 (dissolved), pH ≥6.5
Antimony, total	NA	BC WQG of 0.02, US EPA of 0.03
Arsenic, total	0.005	SSWQO developed for baseline levels would be 0.07 in Dublin Gulch and tributaries and 0.02 in Haggart Creek
Barium, total	NA	BC WQG of 5
Beryllium, total	NA	BC WQG of 0.0053
Boron, total	1.5 (draft CCME 2009b)	BC WQG of 1.2
Cadmium, total	0.00001 to 0.00006 for hardness of 20 – 180 mg/L (see also Draft CCME WQG)	Draft CCME WQG of 0.0001 to 0.0003 for hardness of 20 to 150 mg/L
Chromium, total	0.0089 (Cr III)	BC WQG is the same as CCME
Cobalt, total	NA	BC WQG of 0.11
Copper, total	0.002 (hard <120 mg/L) to 0.004 (hard >180 mg/L)	BC WQG of 0.013 to 0.019 for hardness from 120 to 180 mg/L
Iron	0.3 (based on an International Joint Commission value for the Great Lakes; not necessarily an appropriate value for streams or areas of groundwater discharge)	BC WQG of 1.0 for total iron and 0.35 for dissolved; Linton et al. 2007 proposed 1.74 for effects on benthic community structure[2]
Lead, total	0.001 to 0.007 (for hardness of 60 to 180 mg/L)	BC WQG of 0.034 to 0.197 for hardness of 60 to 180 mg/L
Manganese, total	NA	BC WQG for drinking water of 0.05 World Health Organization (2004) suggests 1 mg/L for aquatic life[3]
Mercury	0.000026	BC WQG of 0.0001
Molybdenum, total	0.073	BC WQG of 2
Nickel, total	0.025 (hard <60 mg/L) to 0.15 (hard >180 mg/L)	BC WQG is the same as CCME

Parameter	CCME WQG (maximum) (mg/L unless stated)	Alternative WQG or Recommendation for SSWQO (mg/L unless stated)
Selenium, total	0.001	BC WQG of 0.002 (mean, but considered max), US EPA of 0.005
Silver, total	0.0001	BC WQG of 0.0001 (hardness ≤100) and 0.003 (hardness >100)
Uranium, total	NA	Draft CCME 0.015
Vanadium, total	NA	BC WQG of 0.006
Zinc, total	0.03	BD WQG of 0.033 to 0.1 for hardness of 20 to 180 mg/L Draft CCME of 0.015 to 0.031 for hardness of 90 to 180 mg/L

NOTES:

Additional parameters analyzed include: temperature (field), turbidity, alkalinity, conductivity (field and lab), total hardness, total dissolved solids (TDS), chloride, phosphate (dissolved, ortho and total), sodium, total or dissolved organic carbon (TOC)

[1] CCME (2004) trigger ranges are most applicable to lakes: ultra-oligotrophic (<4 µg/L), oligotrophic (4 – 10 µg/L), mesotrophic (10-20 µg/L), meso-eutrophic (20-35 µg/L) and eutrophic (35-100 µg/L); for rivers, Garner Lee Limited (2006), under contract to CCME, proposed three trophic state trigger ranges for total phosphorus: oligotrophic (<25 µg/L), mesotrophic (25-75 µg/L) and eutrophic (>75 µg/L)

[2] Linton, et al. (2007) proposed a benchmark value of 1.74 mg Fe/L as protective for “no or minimal changes” in benthic community structure

[3] World Health Organization (2004) report that the most sensitive freshwater toxicity result for manganese was a 48-hour LC50 value for *Daphnia magna* in soft water; however, toxicity was reduced substantially with increasing water hardness. In water with moderate to high hardness, effects at concentrations less than 1 mg/L are not likely.

SOURCES: CCME 2004, CCME 2007, BC MoE 2006, BC MoE 2008, Nagpal, et al. 2006

Development of Site-Specific Water Quality Objectives

As indicated in the baseline data (Appendix 16), several parameters exceeded CCME WQG at some point during a given year in the 1993 through 1996 and 2007 through 2010 datasets. Alternative WQG are presented in Table 6.5-4. Most of these come from other jurisdictions, and are provided as recommendations for use where there are no corresponding CCME WQG. The alternative WQG for cadmium, uranium, and zinc reflect draft CCME WQG, which were recently proposed, but have not been finalized. The alternate WQG for aluminum and iron are British Columbia WQG, for which technical background material on derivation approach are published. It is likely that only arsenic would require following another process for development of a SSWQO. An arsenic SSWQO would be developed to reflect the background levels from naturally high arsenic levels in soil and groundwater and from previous disturbance of streambeds and riparian areas during historic placer mining.

Two SSWQOs for arsenic would be developed to reflect natural variability, one for Haggart Creek and one for the combined Eagle Creek and Dublin Gulch Diversion Channel, as arsenic levels are different in these two water systems. These SSWQOs would protect both aquatic life and drinking water quality. The Background Concentration Procedure was used to derive the SSWQO for Haggart Creek (0.02 mg/L) and the Dublin Gulch Diversion Channel and Eagle Creek (0.07 mg/L). The Background Concentration Procedure is one of four approaches described by CCME (2003) for developing SSWQO. The other approaches are the Recalculation, Water Effects Ratio (WER), and Resident Species Procedures.

The Background Concentration approach was selected as most applicable, as it reflects background conditions and takes advantage of the several years of data available for analysis.

The two datasets used to establish SSWQO were Eagle Creek at site W27 (period of record from 2007 through 2010, as it was not sampled in the 1990s) and Haggart Creek at site W4 (period of record from 1993 through 1996 and 2007 through 2010). The W27 Eagle Creek location was selected because Dublin Gulch would not exist during operations (it would become the Dublin Gulch Diversion Channel and drain into Eagle Creek, which would provide fish habitat. The W4 Haggart Creek site was selected as a compliance point because it is just downstream of the proposed effluent discharge location, and is currently just downstream of Dublin Gulch and reflects the influence of that tributary over time; the SSWQO would apply to Haggart Creek in general.

The SSWQO for arsenic was established by calculating the mean plus two standard deviations of measurements. Other statistical endpoints can be used for the Background Concentration method, and the implications for a SSWQO for arsenic are as follows:

- The 95th percentile (mean plus 2 standard deviations), as defined above, still excludes 5% of the range of reported values (which were previously screened for outliers): Haggart Creek is 0.021 mg/L and Dublin Gulch/Eagle Creek is 0.07 mg/L.
- The 90th percentile excludes 10% of the range of reported values—Haggart Creek is 0.02 mg/L and Dublin Gulch/Eagle Creek is 0.06 mg/L.
- The median excludes even more of the reported data (all values higher than the median)—Haggart Creek median is 0.003 mg/L and Eagle Creek median is 0.04 mg/L. For comparison, mean values are 0.006 and 0.045 mg/L, respectively, for the two systems.

The use of the 90th percentile would result in a slightly lower SSWQO compared to using the 95th percentile and the use of the median value would be notably lower than either the 90th and 95th percentile values. Any of these approaches results in exclusion of some of the reported and verified data, and has a risk of not recognizing natural variability. Of these statistical approaches, the 95th percentile incorporates the greatest amount of verified data (i.e., outliers examined and excluded where appropriate) and was used for that reason.

A further consideration for use of the 95th percentile is the extent to which inclusion of data from the 1990s, during active placer mining, would influence a potential SSWQO. The 95th percentile for Haggart Creek, using only data for the period 2007 through 2010, is 0.014 mg/L, compared to 0.021 for the entire period, indicating an influence of the historic data and suggesting improvements since the cessation of placer mining in that area. Other statistics from W4 also showed a difference for historic vs. current data for maximum (0.0306 vs. 0.0228 mg/L, respectively) and mean values (0.0072 vs. 0.0045 mg/L, respectively); however, there were no statistically significant differences in median values for arsenic (Kruskall-Wallace, $p > 0.05$, as discussed in Appendix 16).

Arsenic sources at W4 include Dublin Gulch and upstream areas on Haggart Creek. Both the historic and recent data for Dublin Gulch (W1) indicate arsenic levels five to eight times higher than at W4 (i.e., Dublin Gulch is a substantial source but generally only contributing about 10% of the flow). For W1, the mean arsenic values are identical (0.036 mg/L) for historic and current data, but have a greater range of values in the historic data (0.0268 to 0.0578 mg/) compared to current (0.0291 to 0.0420 mg/L). The Dublin Gulch results suggest the primary influence of placer mining on arsenic levels was on the variability of the dataset rather than mean values, and corroborate the evidence of naturally as well as anthropogenically elevated arsenic levels in the Dublin Gulch watershed.

Since arsenic levels in Haggart have come down over time but have generally remained the same in Dublin Gulch, other sources of natural variability not fully encompassed in the sampling regime may place a role for arsenic and other watershed influences in Haggart upstream of Dublin Gulch during the historic and current monitoring periods. There is no reason to suggest that other watershed influences could not recur and influence baseline water chemistry in Haggart Creek. Based on these considerations, the dataset used to describe a SSWQO for Haggart Creek included all the data reported for W4 from 1993 through 1996 and 2007 through 2010. As noted, the maximum value for W4 in the current dataset (0.0228 mg/L) would still be higher than the proposed SSWQO of 0.02 mg/L, indicating the appropriateness of the 95th in defining the SSWQO. There is no comparison over time for W27 in Eagle Creek, as the value of 0.07 mg/L is based on the more recent data.

The Recalculation Procedure involves elimination of toxicity data for those sensitive species that are not present at the site, and recalculation of a SSWQO based on the remaining species assemblage. Because the CCME WQG was derived using species commonly used in laboratory toxicity tests, it does not incorporate data for the many fish, invertebrate and algae species present in Dublin Gulch and Haggart Creek, a common situation for many waterbodies. Removal of species from the CCME list would result in few or no species for evaluation. For arsenic, algae are typically the most sensitive species, but the taxa used in the establishment of the generic WQG are planktonic species, and there are no comparable periphyton species in the database used to establish the CCME WQG, making this approach less applicable to the Eagle Gold situation.

The Water Effect Ratio Procedure is most useful when there is an identifiable ameliorating characteristic (e.g., hardness, organic carbon, pH, nutrients) that affects bio-availability of the parameter in question. For arsenic, no ameliorating conditions were identified, and preliminary discussions with a toxicology lab also indicated that such an approach would not be helpful in defining a SSWQO for arsenic. Also, the WER approach has limitations in that water quality can change notably throughout the year, requiring toxicity tests on several samples.

The Resident Species Procedure is costly and seldom used in Canada. Many of the limitations discussed for the recalculation and WER procedures also apply to this procedure. It requires toxicity tests for three fish, two invertebrate, and one algal species that are resident in the water body. This is a difficult criterion to meet, as there are not six species that are common in these watercourses that are used for standard laboratory toxicity tests. Based on a review of species used to derive the generic arsenic WQG, most of these species are not present or common in Haggart Creek or Dublin Gulch. Ultimately, the resident species have adapted to elevated background levels of arsenic (whether ideal or stressed conditions), so establishing a SSWQO that reflects the range of natural variability has been considered the most applicable and protective approach.

The Background Concentration Procedure, using the 95th percentile (mean plus two standard deviations) accurately reflected the range of variability in the recent and historic data, and is proposed as the basis for deriving SSWQOs for arsenic. Use of data from the period of active placer mining in the 1990s introduces some bias for Haggart Creek (but not for Dublin Gulch / Eagle Creek), given that arsenic levels in Haggart (but not Dublin Gulch and Eagle Creek) have come down over time. This apparent decreasing trend in the absence of any noted upstream placer activities suggests that other sources of arsenic in Haggart upstream of Dublin Gulch are only meta-stable and may be sensitive to factors other than anthropogenic stresses. The full range of historic and recent monitoring data are included in the SSWQO for Haggart as there is no reason to suggest that placer mining and other environmental variations upstream in Haggart will not cause an increase in arsenic concentrations in the future.

The compliance points in the receiving environment where both generic WQGs and SSWQOs would be met has been modeled for a fully mixed condition as part of the water quality predictions. These points, shown in Figure 6.5-2, are at the edge of a mixing zone (initial dilution zone or IDZ, expected to be about 100 m in size) where contact water enters a watercourse, with the actual discharge about 100 m upstream of those points. The discharge location for the Mine Water Treatment Plant is preliminary, with the final site arrangement to be determined during detailed planning for permit applications. During operations, the compliance point will be downstream of where treatment plant effluent would enter Haggart Creek (vicinity of site W4). During the closure phase of the Project, this will be at three locations: Haggart Creek downstream of the treatment plant effluent discharge (site W4), the Dublin Gulch Diversion Channel downstream of inputs from the reclaimed Eagle Pup Waste Rock Storage Area (vicinity of W71, before it becomes fish habitat in Eagle Creek), and Haggart Creek downstream of all inputs of contact water (vicinity of site W29). These mixing points are also shown in figures in the Surface Water Balance Model (Appendix 21) and Water Management Plan (Appendix 18).

Additional modeling will be conducted to verify the mixing patterns at the compliance points for the water licence application and provide preliminary engineering for the type of discharge needed to facilitate rapid mixing.

The potential environmental effects in the receiving environment from the point of discharge to the compliance point (i.e., the point where generic WQGs and SSWQOs would be met) would depend on several factors, including the species most sensitive to the metals in question, the project phase, and the time of year. The general situation would be similar for any of the metals present in effluent from the Mine Water Treatment Plant (e.g., arsenic, antimony, selenium, silver and cadmium). The SSWQOs for arsenic, aluminum, manganese and iron are meant to reflect background concentrations, as opposed to discharges from the Mine Water Treatment Plant, so these parameters could be present at levels up to or at the SSWQO at any time. For arsenic and other metals present in effluent, the discharge criteria for the Mine Water Treatment Plant will be designed to handle the periods of greatest loading of metals, as well as smaller loadings. As discussed later in this assessment, the time of greatest loads and lowest dilution in Haggart Creek is considered to be a short period (July and August) during closure, when a large volume of water will be discharged in the first year of draindown of the heap leach facility. This is the time when concentrations of metals in Haggart Creek could be greatest (i.e., approaching or at the WQG or SSWQO) in the absence of specific water management optimization strategies, and the time when potential effects on aquatic life the most likely. However, it is more likely that several mitigation strategies (see Section 7.7, Appendix 18 – Water Management Plan) will be employed, which will significantly lower the predicted maximum metals concentrations. During operation, and during later stages of closure, the increase in metals levels in the IDZ (the region between the discharge point and compliance point) would be notably lower than during this short period of draindown.

Within the IDZ, environmental effects would include:

- No acute toxicity to fish, given that effluent leaving the treatment plant will meet the MMER criterion of no acute lethality to fish (based on regular testing of effluent) and individual parameters will need to meet applicable MMER effluent criteria.
- The potential for some chronic toxicity associated with metals such as arsenic, antimony, selenium and silver, etc. However, as noted in Section 6.5.1.9, the CCME WQG define levels at which no adverse effects are expected for aquatic life, but do not define levels at which adverse effects are likely to occur (they are conservative in nature and an exceedance does not equate to an environmental effect). Most of the WQG were set for the most sensitive species tested in the laboratory, typically selecting a long-term lowest observed effect concentration (LOEC), and then applying a ten-fold safety factor. As a result of use of this safety margin and project design, there is only a low potential for chronic toxicity. In addition, the SSWQO are being proposed only for metals that already exceed WQG in the baseline data, and are designed to reflect natural variability and conditions to which biota are already exposed.

Water Quality Model

A water quality model was developed to predict the concentrations resulting from mixing of the various bodies of water during operations and post-closure. The water quality model, described in detail in Appendix 16, used predicted water flows at the compliance or mixing points over various periods of time modeled by the Surface Water Balance Model (Appendix 21). The results from these models support water management decisions summarized in the Water Management Report (Appendix 18).

The sources of water are shown in Figure 6.5-2 and include:

- Eagle Pup and Platinum Gulch waste rock storage areas (contact water flowing over and through the storage areas and non-contact water diverted around or under them)

- Open pit (contact water flowing over exposed open pit surfaces and non-contact water from dewatering)
- Heap leach facility (contact water flowing through the HLF, surface water flowing over the HLF post-closure, and non-contact water collected from drains under the HLF)
- Dublin Gulch, Eagle Pup, Ann Gulch, Stuttle Gulch, Platinum Gulch, and Haggart Creek
- Mine water treatment plant effluent.

Methods to Determine Source Terms from Geochemical Testing

Source term refers to the estimates of contact water quality of a particular source of contaminants, such as the Eagle Pup waste rock storage area during operations or the heap leach facility at draindown. The source terms are used, in conjunction with the surface water balance, to make predictions of water quality of streams that receive contact water.

Section 4.1-4 summarizes the geochemical setting and ARD ML test work, with details provided in Appendix 8. Acid base accounting, whole rock and metals analyses, mineralogical evaluations, and kinetic tests were conducted on material representative of the main rock units (metasediments and the oxidized, unaltered and altered granodiorite units). Results of the characterization program indicated that low pH seepage, or ARD, is not anticipated to occur at the Project. In the samples tested, the amount of carbonate minerals, predominantly calcite, were generally well in excess of sulphide levels. Kinetic testing indicated the potential for some metal leaching at neutral pH for parameters such as arsenic, antimony, and selenium when exposed to weathering conditions. Data from the kinetic testing program were used to develop water quality predictions for the source areas (waste rock storage areas, open pit walls, and heap leach facility).

The predictions for the waste rock and open pit runoff quality were largely calculated by scaling up the results of tests on small, but representative, samples of material to field situation. These scale-up calculations used average steady state release rates for the main material types, obtained from humidity cells and included a series of conservative assumptions to account for differences between laboratory conditions and anticipated field conditions. Geochemical speciation software was used to assess solubility limits that may influence seepage chemistry. An extensive analog dataset for similar mineral deposits was included in the assessment.

Estimates of contact water quality for the HLF ore material after detoxification were conducted in a similar manner and relied in part on a modified kinetic test on an ore composite that had undergone cyanidation and detoxification (conducted by Kappes Cassidy and Associates) and in part on a standard humidity cell of the same ore sample that had not been subjected to cyanidation.

Methods to Predict Water Quality

A simple mass balance was developed to estimate concentrations of water quality parameters downstream of the Eagle Pup and Platinum Gulch waste rock storage areas, the heap leach facility, and the mine water treatment plant. The mass balance method assumes that incoming flows are thoroughly mixed a short distance downstream of the confluence and that there are no losses of constituents due to chemical reactions such as precipitation.

The mass balance equation is:

$$C_{new} = \frac{[(C_i \times Q_i) + (C_{i+1} \times Q_{i+1}) + (C_n \times Q_n)]}{(Q_i + Q_{i+1} + Q_n)}$$

where:

C_{new} = mixed concentration (mg/L)

C_i = concentration of stream i (mg/L)

Q_i = flow rate of stream i (m^3/month)

C_{i+1} = concentration of stream i+1 (mg/L)

Q_{i+1} = flow rate of stream i+1 (mg/L)

mg/L = g/m^3

n = number of streams.

The data used in the model consisted of:

- Baseline surface water quality (Appendix 25 – Water Quality Model Technical Data Report)
- Predicted surface water and mine process flows (Appendix 21 – Surface Water Balance Model Report)
- Predicted source terms for contact water in Eagle Pup and Platinum Gulch waste rock storage areas and heap leach facility, including nitrogen resulting from the destruction of cyanide (Appendix 8 – Geochemical Characterization and Water Quality Predictions)
- Estimates of nitrogen leaching from blast residues, based on powder factors for ore and waste rock, percent loss and release of nitrogen blast residues in Fortan15 and Fortis Wet Emulsion (Hallam Knight Piesold 1996d).
- Groundwater quality (Appendix 15 – Environmental Baseline Report: Hydrogeology).

Results were modeled for all relevant locations and are stressed for three mixing points, shown in Figure 6.5-2:

- Mixing Point A (a new site in Dublin Gulch downstream of the Eagle Pup waste rock storage area)
- Mixing Point B (in Haggart Creek at W4, downstream of the mine water treatment plant discharge)
- Mixing Point C (in Haggart Creek at W29, downstream of Platinum Gulch and all mine-related activities).

The following methods and assumptions were used to develop the model:

- Water quality data from the period 1993 through 2010 were used to characterize baseline conditions in surface waters for most parameters. Where detection limits improved over time (cadmium, chromium, copper, lead, manganese, molybdenum, nickel, silver), data from 2007 through 2010 were used.

- Mean monthly concentrations were used to characterize baseline conditions in the streams for all parameters analyzed. At most monitoring sites, data were available from March through November with December, January, and February means interpolated from the March and November results. For parameters of concern, maximum baseline levels were also modeled to ensure a conservative estimate of potential environmental effects on water quality.
- The model was not designed to assess short term fluctuations in variability of background or baseline water quality. Two studies of variability over a seven day period were done at sites W1, W4 and W5 in September 1995 and June 1996 while there was active placer mining in the watersheds (Appendix 25).
    - In both periods, the TSS, turbidity, nitrate, total phosphate, aluminum and iron levels showed obvious fluctuations, while most of the other parameters (metals, anions, and other cations) remained within about 10% of the mean.
    - The most informative data were from late June 1996, as samples were taken before, during and after a freshet. There was high variability in TSS, especially at the most downstream site (W5), where TSS ranged from 19 to 114 mg/L. Accompanying that were fluctuations in turbidity (12 to 53 NTU), ammonia (<0.005 to 0.017 mg N/L), total phosphate (0.050 to 0.127 mg P/L), aluminum (0.12 to 0.62 mg/L) and iron (0.028 to 0.600 mg/L) over the seven day period.
    - While smaller variation over the short-term was more typically reported in September 1995 at all three sites and in June 1996 at W1 and W4, the analysis indicates the potential for a strong influence of watershed activities and flow conditions on water quality and the importance of comparisons with background (e.g., upstream) sites.
    - There are times when this background influence will be important in assessing effects of Project activities on water quality, especially where exceedances of WQG or SSWQO are concerned.
- Surrogate water quality values were developed for streams with low, intermittent flows, using data from neighbouring streams draining similar rock types. For example, Stuttle Gulch and Platinum Gulch water quality were assigned values from Eagle Pup (W9) and Ann Gulch water quality was assigned values from Dublin Gulch (W1).
- Source term predictions for contact water are described in Appendix 8. They are considered conservative estimates of the quality of contact water from waste rock storage areas, open pit wall run-off, and the spent ore heap leach facility (i.e., after detoxification). Several assumptions are required for scale-up calculations conducted for the source term predictions, many of which are conservative in nature. Calculations for boron, bismuth, chromium, cadmium, mercury, nickel, silver, and thallium are influenced by detection limits in that, if

measured leachate concentrations were reported as below detection limits, the detection limit was used in the calculations. In these cases, predicted values are likely over-estimated.

- The source terms used were those predicted for:
    - Years 1, 3, 5, 7, and post-closure at Eagle Pup waste rock storage area
    - Years 1, 3, and 7 at Platinum Gulch waste rock storage area
    - Years 1, 3, 5, and post-closure at the Open Pit
    - Operations, Detoxification/Rinsing, and Post-closure (short- and long- term) at the heap leach facility.

  Source terms used for other years were interpolated from these data.

  Surface runoff from the waste rock storage areas is considered to be contact water up to the time of reclamation and has been characterized using the open pit wall source terms to represent runoff quality. After reclamation, the runoff is considered to be non-contact water. Its quality has been characterized using Eagle Pup baseline data (W9) for Eagle Pup and Platinum Gulch waste rock storage areas, and from Dublin Gulch baseline data (W1) for the HLF.

- Hydrology data and predictions for average, wet, and dry scenarios were used (Appendix 21) to ensure the effects of variable annual precipitation were considered in the model. Average, wet and dry scenarios were defined as follows, with the years selected based on time of maximum extent of mine development in operation (Year 9), maximum draindown of the HLF (Year 13), and ongoing release of pore water from the HLF (post-closure Year 21):
    - **Average scenario**—average annual precipitation in all phases, no hydrologic events, no process upsets
    - **Wet scenario**—one wet year in each phase of the Project (operations Year 9, draindown Year 13, post-closure Year 21), no hydrologic events, no process upsets
    - **Dry scenario**—one dry year in each phase of the Project (operations Year 9, draindown Year 13, post-closure Year 21), no hydrologic events, no process upsets

  Average, wet, and dry years were defined as:
    - **Average year**—annual precipitation with a 2-year return period (50% chance of annual precipitation exceeding this level, 50% chance of annual precipitation less than this level)
    - **Wet year**—annual precipitation with a 20-year return period (5% chance of annual precipitation exceeding this level, 95% chance of annual precipitation less than this level).

- **Dry year**—annual precipitation with 1.055-year return period (95% chance of annual precipitation exceeding this level, 5% chance of annual precipitation less than this level). The dry year is also defined as having a 5% chance of not exceeding an annual precipitation amount.

The most conservative results (those yielding highest concentrations of metals) are presented in the assessment of environmental effects. The Water Quality Model TDR (Appendix 25) provides additional data for the modeling runs.

- Hydrogeology data from 1995 through 2010 were used to characterize baseline groundwater quality. Where detection limits improved over time (cadmium, chromium, copper, lead, manganese, molybdenum, nickel, silver), data from 2007 through 2010 were used.
    - Mean concentrations in groundwater from open pit dewatering were estimated using data from monitoring wells near the open pit footprint (MW#95-105, MW#95-106, MW#96-18). Data were collected on six dates (n=10).
    - Mean concentrations in groundwater collected in the HLF sub-surface drains were estimated using data from monitoring wells in Ann Gulch (MW#10-AG3, MW#10-AG5, MW#10-AG6) and Dublin Gulch (MW#09-DG1, MW#10-DG6). Data were collected on five dates (n=11).
    - Mean levels in groundwater entering Eagle Creek were estimated using data from well MW#09-DG2 in Dublin Gulch. Data were collected on three dates (n = 3).
- Nitrate and ammonia concentrations for discharges from the waste rock storage areas and HLF from blasting residues were predicted using powder factors of 0.2 kg/tonne for waste rock and 0.23 kg/tonne for ore (based on the mine plan). Fortan15 and Fortis Wet Emulsion were assumed to be 25% nitrogen by weight (NH_4NO_3 comprising 70% of blasting agents by weight—Material Safety Data Sheet; nitrogen comprising 35% of NH_4NO_3 by weight). It was assumed that 2% of the nitrogen from blasting was unexploded residue, so was transported to the waste rock storage areas and HLF, with losses occurring in the year that the waste rock and ore were stacked (Hallam Knight Piésold 1996d).
- Predicted phosphorous concentrations for discharges from the waste rock storage areas, open pit wall runoff, and heap leach facility were derived from humidity cell leach rates adjusted to anticipated field conditions, as described in Appendix 8. In most of the samples tested in the humidity cell program, phosphate concentrations were often below or near the detection limit (0.002 mg P/L) and predictions based on these values are likely conservative. In these instances, concentrations from analog sites are included in the assessment. Maximum phosphate levels for the analog sites were 0.2 mg P/L for Pogo, 0.5 mg P/L for True North, and 8.5 mg P/L for Brewery Creek. The Brewery Creek value appears to be an outlier. The 95th percentile from the Brewery Creek data is 0.78 mg P/L, similar to the other analog sites, and was selected as the source term concentration for the Project. Subsequent monitoring for the closed Brewery Creek mine has not identified phosphorus as a concern and phosphate monitoring is not a license requirement (Yukon Government 2003b; Alexco Resource Corp. 2010).
- Cyanide will be removed in a detoxification plant prior to discharge and will be treated to two times the CCME WQG for free cyanide (0.01 mg/L).

Concentrations were predicted for each month for all Project phases for all parameters with predicted source terms above WQG. Potential environmental effects on the receiving environment are discussed in terms of worst case predicted values through construction, operations, closure, and post-closure. Worst case predictions are defined as the low probability events of high or low flow and resulting high chemical concentrations.

Dissolved versus Total Metal Concentrations

A blend of total and dissolved metals was used in most cases to develop the predictions of water quality. Results of leaching tests are provided for dissolved metals. The most applicable groundwater data are dissolved levels (particulate matter could reflect contamination during sampling). Effluent from the mine water treatment plant may contain both particulate and dissolved metals; however, particulate content will be regulated through a discharge criterion for TSS. Baseline surface water data are provided as total and dissolved concentrations. Finally, water quality guidelines are set for total metals, although it is recognized that toxicity is associated with the dissolved fraction.

When metals levels were modeled for receiving waters, it was assumed that the mainly dissolved fraction would be discharged into an area with both dissolved and particulate matter. Total metals levels in the stream were used as the base for modeling. Hence, the predicted levels should represent conditions in the streams when the discharge is mixed in, and this provides a realistic basis for application of the WQG. This is supported by review of the baseline data, which show that, for Haggart Creek and the tributaries, dissolved metals are predominant for most parameters for most of the year. The main exception is during freshet and storm events, when TSS and metals (aluminum, iron, others) levels are elevated.

Conservatism Built into Model

Several technical limitations and uncertainties are used to develop water chemistry predictions. Generally, these are related to assumptions inherent in the estimates of contact water quality from the planned facilities (see Appendix 8) and to uncertainty about actual site conditions after mine construction. Also, technical and legislative requirements force adoption of reasonable but conservative inputs at all steps in the modeling process. The result is a water quality model that predicts discharge concentrations of parameters that are likely to be higher than actual concentrations (conservative worst case predictions).

The following points summarize some of the main sources of conservatism inherent to the Project water quality predictions:

- A number of assumptions are required in the calculations to estimate contact water qualities (see Appendix 8 for details).
- Where laboratory testing indicated a range of release rates, the average release rates for each of the material types were typically used in the model, with each represented by a number of samples in the kinetic program, including at least one sample representing the median sulphur content and the 95th percentile for sulphur content.

- Source terms were developed from the maximum levels reported in the humidity cell tests, and by comparison with analogs from operating mines with geologically similar deposits and climate (Fort Knox, True North, Pogo, Brewery Creek, and Zortman/Landusky Mines). The analogs provide an upper bound for concentrations (rationale provided in Appendix 8). For example, the highest arsenic level measured in humidity cell tests of waste rock material was 0.18 mg/L; however, the source term used was 1.4 mg/L. Similarly for the heap leach facility at closure, the highest arsenic level measured in test work was 2.3 mg/L; the source term used was 6.0 mg/L, from Brewery Creek. This conservatism is used to bridge the gap between the relatively small volumes of material used in the test work and the conditions for an operating mine.
- The model does not estimate metal removal that might occur via attenuation of dissolved species (either through adsorption or through secondary precipitation) along flow paths. These processes are generally accepted as providing important controls on metal mobility, but are not realistic to quantify given the various uncertainties.

The role of hardness in moderating metal toxicity is well recognized, particularly in the hardness-dependent WQG for cadmium, copper, lead, nickel and zinc. Instead of using the predicted hardness of heap leach solution (650 to 1,700 mg/L $CaCO_3$, maximum in post-closure), the maximum hardness measured in Haggart Creek during baseline (150 mg/L $CaCO_3$) was used to calculate WQG. This provides additional conservatism to the predictions of environmental effects.

Other considerations for various parameters include:

- Modifying the mass balance approach for parameters such as sulphate to reflect well-understood controls on dissolved concentrations (primarily mineral precipitation and dissolution, with sulphate levels adjusted to account for gypsum saturation). Any gypsum precipitation (which occurs at sulphate levels >2,000 mg/L) would occur within the mine facilities, and not in the streams, where predicted levels are well below 2,000 mg/L.
- Prediction of phosphorous concentrations calculated using analog data from other mines of similar geochemistry, and mine water treatment plant effluent criteria. Phosphorous concentrations were modeled with no consideration of attenuation or biological uptake.
- Prediction of nitrate and ammonia concentrations in waste rock storage area runoff and infiltration using estimated blasting residue values as sources. Blasting residues were estimated based on rapid flushing of nitrogen to the streams to predict worst case conditions. Nitrate and ammonia were conservatively modeled, with no account taken for losses due to biological uptake or denitrification.

As a result of using these conservative approaches, there is high confidence that water quality will be no worse than predicted, but the extent to which it will be better than predicted has not been quantified. Monitoring of water quality during mine operations and during and after decommissioning will assess the accuracy of these predictions.

A sensitivity analysis was also done, using parameters where elevated concentrations were predicted (aluminum, antimony, arsenic, cadmium, iron, manganese, selenium, silver), to determine the sensitivity of the receiving environment to variable hydrologic scenarios and to temporary events that could result in higher than normal baseline concentrations. Average, wet, and dry scenarios were modeled to assess variation in predicted monthly concentrations with the most conservative results (those yielding highest concentrations of metals) presented in the assessment of environmental effects. In addition, the model was rerun using maximum monthly baseline concentrations, rather than monthly mean values, to further refine worst case predictions.

The Water Quality Model TDR (Appendix 25) provides a general discussion of the degree to which the water quality predictions are conservative. Uncertainty in the water quality predictions is addressed by building in conservatism, in the ways described above, to the source term predictions and flow scenarios used to predict water quality. Mitigation measures are then designed to manage these outcomes, which are considered to be worst case rather than most likely outcomes. Quantifying the degree to which the geochemical characterization is conservative is difficult, in that the source term predictions for metals are based on conservation of mass (no losses for commonly expected chemical reactions), and adjusting the assumptions is not common practice. Rather, these are adjusted during pilot testing and operational monitoring.

One area where conservativism of the water quality predictions is demonstrated is in use of alternative flow scenarios. The Water Quality Model TDR (Appendix 25) presents worst-case (low probability) predictions using a range of scenarios to reflect average, wet, and dry years. The highest predicted metal concentrations typically occur under either wet or dry scenarios. For example, during draindown, Haggart Creek is most susceptible during dry conditions due to the influence of large heap leach facility draindown volumes on low receiving environment flows. Predicted values from average (most likely) and dry (less likely) scenarios at W4 (during draindown) are compared in Appendix 25 to quantify the conservatism introduced when using the low probability cases rather than most likely predictions. Maximum predicted concentrations occurred under dry conditions in July, when draindown volumes were greatest and dilution least, for antimony, arsenic, cadmium, selenium, and silver. Worst-case predictions, taken from the low probability dry scenario, were from 14% (arsenic) to 51% (antimony) greater than predictions for average (most likely) flow conditions, which provide an indication of the conservatism that has been built into the modeling results.

The Water Management Plan also discusses conservatism introduced by using low probability flow scenarios.

Cyanide Detoxification

The cyanidation and detoxification processes for extracting gold are discussed in Section 5. During closure, cyanide will be removed in a detoxification plant through copper catalyzed hydrogen peroxide (H_2O_2) destruction prior to discharge, with cyanate removed through pH adjustment. Cyanide can be present as free cyanide (HCN and CN), simple cyanide salts (e.g., KCN, NaCN), metal-cyanide complexes, sulphur-cyanide (thiocyanate), cyanate (CNO) and organic compounds. Free cyanide is the most relevant form for assessing toxicity to aquatic life, as indicated by WQG specified as free cyanide (most metallocyanide complexes have low toxicity). Total cyanide measurements refer to free cyanide plus metal-cyanide complexes. Free cyanide levels in effluent from the detoxification plant will be two times the CCME WQG (0.005 mg/L). The levels in heap seepage were estimated assuming the detoxification plant will continue until levels in seepage are less than 0.2 mg/L WAD and 1.9 mg/L total cyanide (a reduction in cyanide of between 150 and 250 times from that of the operating levels).

Baseline cyanide levels in surface waters were analyzed for total and weak acid dissociable (WAD) cyanide. During operations of the detoxification plant (estimated to operate until the end of draindown, Year 19), the mixing model combines free cyanide from the detoxification plant with WAD cyanide in surface waters to provide a conservative estimate of bioavailable cyanide (free cyanide) in Haggart Creek at Mixing Points B and C, downstream of the HLF. Following closure of the detoxification plant, estimates of WAD cyanide in HLF seepage are combined with WAD cyanide in surface waters.

Ammonia is released during detoxification of cyanide and its breakdown products (cyanate, thiocyanate), and is oxidized to nitrite and nitrate. Detoxification will continue until ammonia reaches 1 mg N/L and nitrate plus nitrite reaches 35 mg N/L in the contact water from the HLF. At this point, the detoxification plant will be removed. Nitrate and ammonia concentrations in heap seepage at closure were predicted assuming that the HLF has been flushed of these sources of nitrogen to these levels.

6.5.2 Assessment of Potential Environmental Effects of Water Diversions during Construction and Operations

Prior to any watershed disturbance, tributaries flowed into Dublin Gulch then Haggart Creek; however, during the years of placer mining, several channels have been re-routed. Figure 6.5-3 shows the current alignment, with two main channels (Dublin Gulch and Eagle Creek). Dublin Gulch, the original main channel, receives water from Bawn Boy, Cascallen, Olive, Stewart and Ann Gulch; it enters Haggart Creek downstream of the proposed camp. Eagle Creek is south of and flows parallel to Dublin Gulch for some distance, receiving flows from Eagle Pup and Stuttle Gulch, before turning south near Haggart Creek and flowing about 1.5 km before joining Haggart Creek upstream of Platinum Gulch.

During construction, several diversion channels will be built to direct non-contact water around the facilities (Figure 6.5-2), resulting in short term and permanent changes to the streams (Appendix 18). For example, the Dublin Gulch diversion channel will discharge to Haggart Creek during Year 1 to allow construction of the Eagle Creek Fish Enhancement Channel, and then it will discharge to Eagle Creek from Year 2 onward.

This section describes the longer-term diversions to be maintained for operations, closure, and post-closure, and the potential of these changes to affect water quality and aquatic biota. The diversions are expected to affect about 2 km of Haggart Creek (between W4 and W39) and to result in relatively small changes in water quality, given the use of sediment and erosion control practices to reduce risks of sediment inputs to the creeks during construction. A clear description of these diversions, and the resulting water quality, is also necessary for an understanding of effluent or seepage release into streams during operations and closure (discussed in Sections 6.5.2.2 and 6.5.2.3), which were predicted using models incorporating the diversion water quality, site water balance and geochemical source terms. Changes in flow resulting from the diversions also have the potential to affect aquatic organisms, although this aspect is addressed in Section 6.7 in terms of Fish and Fish Habitat.

6.5.2.1 Description of Water Diversions during Construction and Operations

The planned diversions for non-contact water (Appendix 18) include:

- **The Dublin Gulch Diversion Channel**—a 2.6 km long channel to convey water past the heap leach facility into Eagle Creek downstream of the mine. Currently, Dublin Gulch discharges into Haggart Creek at site W4. The channel will be completed in Year 2 and will be a permanent structure.
- **Platinum Gulch Waste Rock Storage Area Ditches**—for non-contact water in the Platinum Gulch drainage basin. This water will be diverted away from the south perimeter of the waste rock storage area into a sediment control pond, Platinum Gulch, and, ultimately, Haggart Creek.
- **Ann Gulch Diversion Ditches**—two diversion ditches around the heap leach facility. The east ditch will divert non-contact water along the east portion of the Ann Gulch basin into a sediment control pond then into Dublin Gulch upstream of the heap leach facility; the west ditch will divert non-contact water along the west portion of the Ann Gulch basin into Haggart Creek. The diversion ditches will be periodically located up-basin as the HLF grows, and will carry less and less flow as the runoff capture areas decrease.

Contact water will also be collected in diversion and interceptor ditches around the heap leach facility, ponds, open pit, plant site, and yards to convey natural runoff away from the structures into sediment control ponds. There will be no diversion of non-contact water around the Eagle Pup waste rock storage area, due to steep topography in that area.

The main diversions are listed in Table 6.5-5. Quality of diverted non-contact water was predicted using data from the baseline water quality program, at sites identified in Figure 6.5-3. This includes mean and maximum monthly data collected for Dublin Gulch and tributaries (W1, W26), Eagle Creek and tributaries (W9) and Haggart Creek (W22, W4 and W29, upstream and downstream of Dublin Gulch, and just below Platinum Gulch). W4 on Haggart Creek (Mixing Point B) will be the main mixing point for most of the contact water, as this is where discharge of effluent from the mine water treatment plant will occur. W29 on Haggart Creek (Mixing Point C) will represent water quality below all Project activities. The Dublin Gulch diversion channel will enter Eagle Creek at approximately W27, and Mixing Point A is used to represent mixing from the Eagle Pup waste rock storage area. More detailed flow estimates are provided in Appendix 21 (Surface Water Balance Model Report) and Appendix 18.

Table 6.5-5: Changes in Flow Regimes (mean annual flow) of Diverted Watercourses in Dublin Gulch during Construction, Operations, and Post-decommissioning

Watercourse	Details	Project Phase
Dublin Gulch	Diverted into Eagle Creek	All phases
Eagle Pup	Absorbed in footprint of mine waste rock storage area	All phases
Stuttle Gulch	Upper part absorbed in Eagle Pup waste rock storage area, lower part goes to Lower Dublin Gulch Sediment Control Pond	Construction, operations
Ann Gulch	East Diversion Ditch goes to upper Dublin Gulch diversion channel, West Diversion Ditch goes to Haggart Creek	Construction, operations
Eagle Creek	Not diverted, but has increased flow from Dublin Gulch diversion channel, becomes fish habitat compensation area (with up to seven times higher flows during freshet, and smaller increases at other times of year)	All phases
Platinum Gulch	Receives non-contact water diverted around the waste rock storage area during operations, then surface run-off from reclaimed waste rock storage area after reclamation is complete; this water goes to Haggart Creek	All phases
Haggart Creek	Decreased flow at W4 given the diversion of Dublin Gulch into Eagle Creek. No net change downstream of Eagle Creek confluence	All phases

Source: Appendix 18: Water Management Plan and Appendix 21: Surface Water Balance Model Report

Diversions of non-contact water will have the greatest effect on flows and water quality of the following area streams:

- Haggart Creek at W4 and downstream for about 1.5 km to the confluence of Eagle Creek, given that flows from Dublin Gulch will be diverted to Eagle Creek; water quality in this area will be similar to baseline water quality at W22, upstream of the current Dublin confluence. Dublin Gulch contributes 10 to 15% of the flows in Haggart Creek at the confluence (Appendix 14 – Environmental Baseline Report: Hydrology).
- Eagle Creek downstream of W27 for Year 1 of construction, during construction of the fish compensation habitat.
- Eagle Creek at W27 and downstream in Year 2 onward, given that it will receive water from the Dublin Gulch diversion channel and no longer from Eagle Pup (which will be mostly taken up in the waste rock storage area footprint); predicted Eagle Creek water quality will be a mix of Eagle Creek and predominantly Dublin Gulch baseline data.

6.5.2.2 Mitigation Measures for Water Diversions during Construction and Operations

The diversion channels are a main design feature and mitigation measure to keep non-contact water away from mine activities. Water quality in the streams will also be protected in the following ways:

- Sediment control ponds will be in place to allow fine sediments to settle out, and will be sized for a 1:100 year flood event; TSS and/or turbidity will be monitored prior to release.
- Diversion ditches will be built incorporating erosion protection measures.

- Diversion channels will be sized for the maximum flow velocities expected based on estimated surface runoff volumes.
- At closure, diversion ditches will be stabilized or returned to natural drainages.

6.5.2.3 Residual Environmental Effects of Water Diversions during Construction and Operations

Effects on Water Quality

Baseline conditions indicate that water in Haggart Creek at W22 is generally low in metals, with high hardness (up to 215 mg/L) and sulphate (up to 84 mg/L), as shown in Table 6.5-6. The system is low in nutrients, and is likely phosphorus limited, with total phosphate levels up to 0.007 mg P/L, nitrate levels of up to 0.075 mg N/L and ammonia up to 0.006 mg N/L during the June through September growing season. Levels of several metals (aluminum, iron, copper, zinc) are highest in May, during freshet, associated with elevated TSS levels; of these, total aluminum and iron levels are about two times higher than the CCME WQG in May. During winter, levels of manganese are elevated, reflecting high levels in groundwater (Appendix 22 – Groundwater Model Report). Levels of parameters such as arsenic increase at W4 in Haggart, downstream of the confluence with Dublin Gulch.

Given that Dublin Gulch contributes about 10% to 15% of the flows in Haggart Creek, diversion of Dublin Gulch is expected to result in a negligible change to Haggart Creek water quality between W4 and W29, 1.5 km downstream, where Dublin Gulch and Eagle Creek will rejoin Haggart Creek.

Dublin Gulch (Table 6.5-7) is lower in hardness (up to 76 mg/L) and sulphate (up to 28 mg/L) compared to Haggart Creek. Arsenic levels are, on average, nine times greater than CCME WQG year-round, and tend to be highest during winter low flow. Other metals are at their greatest during freshet, when TSS levels are also high: total aluminum is 12 times higher and total iron is two times higher than the CCME WQG. For nutrients during the growing season, nitrate levels (up to 0.040 mg N/L) are lower than in Haggart, ammonia levels (0.007 mg N/L) are similar, and phosphate levels are slightly higher (up to 0.012 mg P/L). The relative proportions of nitrogen to phosphorus suggest that at baseline, nitrogen, rather than phosphorus may limit growth of periphyton in Dublin Gulch. Eagle Creek water quality will be similar to that shown in Table 6.5-7 when Dublin Gulch is diverted into it.

The diversion of Dublin Gulch water to Eagle Creek (Table 6.5-7) will result in a negligible change compared to baseline, as the two water sources are generally similar in composition (Appendix 25 – Water Quality Model TDR).

Platinum Gulch will be diverted from Eagle Creek to Haggart Creek. Given the intermittent flow during baseline, this diversion will have a negligible effect on flows or water quality of either system.

The residual environmental effects of diversion of non-contact water in the LAA on water quality will be neutral, negligible in magnitude, local in geographic extent, continuous, and occurring in perpetuity. Changes will occur in an area already disturbed by placer mining and stream diversions, and are reversible. The significance of these residual effects is addressed in Section 6.5.2.4.

Table 6.5-6: Mean Monthly Flow Rates and Water Quality in Haggart Creek at W22 above Dublin Gulch

Parameter[1]	Mean Monthly Baseline Concentration (mg/L, unless indicated)												WQG[2] (mg/L)	Max/ WQG
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Flow (m^3/s)	0.179	0.145	0.112	0.116	1.046	0.800	0.637	0.620	0.746	0.685	0.415	0.282	–	–
pH	7.9	7.9	8.1	7.2	7.0	7.9	8.0	8.0	7.9	7.9	7.8	7.9	–	–
Hardness T	193	193	204	215	72	118	138	154	138	162	181	193	–	–
Alkalinity T	110	110	122	83	44	69	80	93	80	92	98	110	–	–
TSS	2	2	2	2	18	3	4	1	2	2	2	2	–	–
TDS	219	219	238	245	108	138	177	200	166	190	200	219	–	–
DOC	1.09	1.09	0.98	0.88	11.4	3.98	2.06	2.33	3.02	1.56	1.19	1.09	–	–
Sulphate S	77	77	84	55	26	45	55	64	51	63	70	77	100	0.8
Fluoride	0.103	0.103	0.117	0.093	0.069	0.060	0.094	0.098	0.079	0.075	0.089	0.103	0.30	0.4
Chloride	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	–	–
Nitrate N	0.126	0.126	0.120	0.120	0.039	0.075	0.051	0.043	0.067	0.107	0.131	0.126	2.9	0.0
Ammonia N	0.005	0.005	0.007	0.003	0.003	0.003	0.003	0.006	0.005	0.010	0.003	0.005	–	–
Phosphate TP	0.006	0.006	0.010	0.002	0.016	0.003	0.007	0.002	0.004	0.001	0.001	0.006	–	–
Cyanide T	0.0025	0.0025	0.0025	0.0062	0.0040	0.0040	0.0018	0.0022	0.0031	0.0025	0.0025	0.0025	–	–
Aluminum T	0.0074	0.0074	0.0077	0.0128	**0.226**	0.0473	0.0274	0.0127	0.0272	0.0089	0.0071	0.0074	0.10	**2.3**
Antimony T	0.0002	0.0002	0.0002	0.0003	0.0002	0.0002	0.0003	0.0003	0.0003	0.0002	0.0002	0.0002	0.02	0.0
Arsenic T	0.0007	0.0007	0.0007	0.0010	0.0011	0.0009	0.0010	0.0008	0.0008	0.0007	0.0007	0.0007	0.005	0.2
Boron T	0.028	0.028	0.005	0.005	0.005	0.028	0.020	0.012	0.020	0.020	0.050	0.028	1.2	0.0
Cadmium T[3]	0.00001	0.00001	0.00002	0.00002	0.00003	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.0003	0.1
Calcium T	46.4	46.4	47.1	50.4	16.8	30.8	33.9	39.0	35.8	40.0	45.7	46.4		
Chromium T	0.0004	0.0004	0.0002	0.0002	0.0004	0.0004	0.0002	0.0002	0.0003	0.0003	0.0005	0.0004	0.0089	0.1
Copper T	0.0004	0.0004	0.0002	0.0002	0.0018	0.0007	0.0004	0.0004	0.0006	0.0004	0.0005	0.0004	0.003	0.6

Parameter[1]	Mean Monthly Baseline Concentration (mg/L, unless indicated)												WQG[2] (mg/L)	Max/ WQG
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Iron T	0.077	0.077	0.089	0.130	0.593	0.144	0.106	0.054	0.091	0.060	0.066	0.078	1.0	0.6
Lead T	0.00003	0.00003	0.00003	0.00003	0.00029	0.00016	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003	0.004	0.1
Magnesium T	18.5	18.5	20.3	22.0	5.9	9.4	12.0	14.0	11.9	13.6	16.7	18.5	–	–
Manganese T	**0.0855**	**0.0855**	0.1280	0.0836	0.0635	0.0367	0.0404	0.0279	0.0322	0.0235	0.0430	**0.0855**	0.05	**2.6**
Mercury T[3]	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	0.00002	<0.00002	0.00003	<0.00002	<0.00002	0.00003	1.0
Molybdenum	0.00030	0.00030	0.00010	0.00003	0.00004	0.00030	0.00008	0.00006	0.00015	0.00023	0.00050	0.00028	0.073	0.0
Nickel T	0.0015	0.0015	0.0017	0.0017	0.0025	0.0007	0.0009	0.0008	0.0009	0.0006	0.0012	0.0015	0.110	0.0
Potassium T	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	–	–
Selenium T	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0004	0.0005	0.0005	0.0005	0.0005	0.0005	0.002	0.2
Silver T	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00002	0.00001	0.00001	0.00001	0.00001	0.00001	0.0001	0.2
Sodium T	1.6	1.6	2.1	2.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.6	–	–
Thallium T	0.00008	0.00008	0.00005	0.00005	0.00005	0.00008	0.00005	0.00005	0.00006	0.00007	0.00010	0.00008	0.0008	0.1
Uranium T	0.0012	0.0012	0.0014	0.0013	0.00035	0.00058	0.00072	0.00082	0.00066	0.00089	0.00106	0.00122	0.015	0.1
Zinc T	0.0065	0.0065	0.0027	0.0052	0.0047	0.0018	0.0018	0.0012	0.0019	0.0015	0.0103	0.0065	0.03	0.3

NOTES:

Derived from Baseline Flows and Water Quality (1993 - 2010) at W22 upstream of Dublin Gulch. Data from 2007 - 2010 were used for cadmium, chromium, copper, lead, manganese, molybdenum, nickel, silver, and thallium due to lower detection limits over that period.

Values at the detection limit were included at one-half the detection limit when calculating mean values.

Bold indicates maximum monthly mean exceeds WQG.

[1] Total metals concentrations (T), elemental values for nitrate (N), ammonia (N), phosphate (P), sulphate (S)

[2] CCME WQGs for protection of aquatic life, with these exceptions: CCME drinking water (Sb, Tl), BC aquatic life (Fe, Se, SO_4, F^-), BC drinking water (Mn), draft CCME (Cd, U)

[3] Most of the cadmium and mercury values were below the detection limit in baseline data.

Table 6.5-7: Mean Monthly Baseline Flow Rates and Water Quality in Dublin Gulch (W70) above Eagle Pup

Parameter[1]	Mean Monthly Baseline Concentration (mg/L, unless indicated)												WQG[2] (mg/L)	Max/ WQG
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Flow (m^3/s)	0.021	0.017	0.013	0.014	0.132	0.101	0.171	0.094	0.112	0.105	0.050	0.033	–	–
pH	7.5	7.5	7.4	6.6	7.0	7.6	7.7	7.8	7.8	7.8	7.6	7.5	–	–
Hardness T	66	65	76	64	39	44	61	67	65	61	58	66	–	–
Alkalinity T	48	48	55	42	29	36	50	55	53	49	45	49	–	–
TSS	9	9	17	2	49	2	2	2	5	2	2	9	–	–
TDS	87	87	99	90	60	61	83	88	84	79	79	88	–	–
DOC	1.12	1.11	0.94	1.45	9.05	4.21	1.96	1.92	1.80	1.52	1.45	1.17	–	–
Sulphate S	22	22	28	16	8	11	14	15	15	15	16	22	100	0.3
Fluoride	0.054	0.054	0.098	0.091	0.088	0.072	0.066	0.084	0.087	0.074	0.015	0.055	0.30	0.3
Chloride	0.25	0.25	0.25	0.34	0.43	0.26	0.32	0.25	0.27	0.31	0.25	0.25	–	–
Nitrate N	0.113	0.113	0.154	0.115	0.030	0.039	0.021	0.015	0.024	0.050	0.074	0.113	2.9	0.0
Ammonia N	0.003	0.003	0.004	0.003	0.009	0.003	0.003	0.007	0.005	0.007	0.003	0.003	–	–
Phosphate TP	0.007	0.007	0.009	0.008	0.075	0.011	0.012	0.006	0.009	0.005	0.004	0.007	–	–
Cyanide T	0.0020	0.0020	0.0015	0.0025	0.0047	0.0016	0.0024	0.0022	0.0022	0.0020	0.0025	0.0020	–	–
Aluminum T	0.0928	0.0930	**0.179**	0.0283	**1.21**	0.0840	0.0787	0.0464	0.0587	0.0230	0.0079	0.0919	0.10	**12**
Antimony T	0.0019	0.0019	0.0027	0.0014	0.0008	0.0010	0.0010	0.0012	0.0011	0.0011	0.0011	0.0019	0.02	0.1
Arsenic T	**0.0414**	**0.0415**	**0.0442**	**0.0363**	**0.0308**	**0.0289**	**0.0331**	**0.0346**	**0.0362**	**0.0344**	**0.0376**	**0.0411**	0.005	**8.9**
Boron T	0.016	0.016	0.027	0.004	0.029	0.040	0.034	0.020	0.021	0.017	0.007	0.017	1.2	0.0
Cadmium T[3]	0.00001	0.00001	0.00001	0.00002	0.00002	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.0003	0.1
Calcium T	17.7	17.6	19.3	17.7	10.0	11.9	16.0	17.7	17.1	16.3	16.7	17.8	–	–
Chromium T	0.0004	0.0004	0.0002	0.0001	0.0007	0.0004	0.0005	0.0002	0.0003	0.0004	0.0005	0.0004	0.0089	0.1
Copper T	0.0004	0.0004	0.0003	0.0005	0.0011	0.0008	0.0005	0.0003	0.0004	0.0004	0.0005	0.0004	0.003	0.4

Parameter[1]	Mean Monthly Baseline Concentration (mg/L, unless indicated)												WQG[2] (mg/L)	Max/ WQG
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Iron T	0.127	0.127	0.239	0.030	0.583	0.083	0.086	0.040	0.060	0.018	0.015	0.125	1.0	0.6
Lead T	0.00003	0.00003	0.00003	0.00007	0.00047	0.00025	0.00022	0.00005	0.00006	0.00003	0.00003	0.00003	0.004	0.1
Magnesium T	5.4	5.4	6.8	5.1	3.4	3.7	5.1	5.5	5.2	4.6	4.5	5.5	–	–
Manganese T	0.0005	0.0005	0.0008	0.0023	0.0105	0.0032	0.0042	0.0013	0.0015	0.0006	0.0002	0.0005	0.05	0.2
Mercury T[3]	<0.00002	<0.00002	<0.00002	<0.00002	0.00002	<0.00002	<0.00002	<0.00002	<0.00002	0.00002	<0.00002	<0.00002	0.00003	0.8
Molybdenum	0.0020	0.0020	0.0022	0.0022	0.0015	0.0019	0.0022	0.0021	0.0020	0.0020	0.0018	0.0020	0.073	0.0
Nickel T	0.0004	0.0004	0.0002	0.0003	0.0012	0.0006	0.0005	0.0002	0.0003	0.0004	0.0005	0.0004	0.110	0.0
Potassium T	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	–	–
Selenium T	0.0004	0.0004	0.0004	0.0005	0.0004	0.0004	0.0003	0.0004	0.0004	0.0004	0.0005	0.0004	0.002	0.3
Silver T	0.00001	0.00001	0.00001	0.00001	0.00002	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.0001	0.2
Sodium T	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	–	–
Thallium T	0.00008	0.00008	0.00005	0.00005	0.00005	0.00008	0.00005	0.00005	0.00006	0.00007	0.00010	0.00008	0.0008	0.1
Uranium T	0.0004	0.0004	0.0005	0.0007	0.0010	0.0005	0.0008	0.0009	0.0009	0.0008	0.0005	0.0004	0.015	0.1
Zinc T	0.0028	0.0028	0.0031	0.004	0.0053	0.0026	0.0022	0.0012	0.0017	0.0015	0.0025	0.0028	0.03	0.2

NOTES:

Derived from Baseline Flows and Water Quality (1993 - 2010) at W22 upstream of Dublin Gulch. Data from 2007 - 2010 were used for cadmium, chromium, copper, lead, manganese, molybdenum, nickel, silver, and thallium due to lower detection limits over that period.

Values at the detection limit were included at one-half the detection limit when calculating mean values.

Bold indicates maximum monthly mean exceeds WQG.

[1] Total metals concentrations (T), elemental values for nitrate (N), ammonia (N), phosphate (P), sulphate (S)

[2] CCME WQGs for protection of aquatic life, with these exceptions: CCME drinking water (Sb, Tl), BC aquatic life (Fe, Se, SO_4, F^-), BC drinking water (Mn), draft CCME (Cd, U)

[3] Most of the cadmium and mercury values were below the detection limit in baseline data.

The modeling described here is for "average" conditions. Because flow regimes in Haggart Creek, Dublin Gulch and the smaller tributaries are governed by similar processes (winter freeze-up, spring freshet driven by snow melt, small freshets driven by rain events), the analysis does not consider high flow and low flow conditions separately. Such weather related changes would affect the systems similarly, given the small geographic area being considered. Nor does the analysis represent short term variability (events with duration of hours to days) in water quality, as this is a model for conditions without additions from mine sources.

In Section 6.5.2.2, the results for Haggart Creek are used to predict water quality resulting from discharge of effluent from the mine water treatment plant during operations.

Effects on Aquatic Biota

Biota in Haggart Creek will experience a reduction in flows (10 to 15%, on average) following diversion of Dublin Gulch into Eagle Creek. On a monthly basis, this change will be within the range of natural variability (Appendix 14 – Environmental Baseline Report: Hydrology). The potential for changes to habitat quantity and quality and effects on overall productivity are further assessed in terms of fish habitat (Section 6.7). The predicted water quality resulting from the diversions will also be within the range of natural variability, as noted above.

The residual environmental effects of diversion of non-contact water in the LAA on aquatic biota are considered to be the same as for water quality: neutral, negligible in magnitude, local in geographic extent, continuous, and occurring in perpetuity. Changes will occur in an area already disturbed by placer mining and stream diversions, and are reversible. The significance of these residual effects is addressed in Section 6.5.2.4.

6.5.2.4 Determination of Significance of Water Diversions during Construction and Operations

The diversion of non-contact water around the LAA will result in environmental effects on water quality and aquatic biota that are considered to be not significant, as there will be negligible changes in water quality. Consequently, there will be no impairment of the ability of watercourses affected by Project activities to sustain aquatic life. There is a high degree of confidence in this determination, as the effect itself (clean water, not mine contact water, diversion, the mitigation measures, and the baseline data are well understood.

6.5.3 Assessment of Project Discharges during Operations

There is potential that metals or nutrients in effluent released from the mine could affect water quality, and ultimately, growth and survival of aquatic organisms in Haggart Creek, resulting in changes in community structure and productivity. This in turn could lead to effects on food supply for fish. Also, cyanide, used to recover gold in the heap leach facility, is toxic to aquatic organisms.

The assessment of Project discharges during operations considers three flow conditions (average, wet and dry year scenarios) and describes variation in water quality through the year on a mean monthly basis. The wet scenario is defined as annual precipitation with a 20 year return period and the dry scenario is for a 1.055 year return period (Appendix 18). Since events such as storms or droughts can occur during any month in any phase of the Project, these scenarios were developed to assess the range of conditions that could occur.

The assessment addresses discharges from the mine water treatment plant and seepage from the waste rock storage areas into groundwater, with eventual discharge to local streams. Inputs into the treatment plant are described first, using source terms developed in the geochemistry assessment (Appendix 8) and flows identified in the Surface Water Balance Model Report (Appendix 21). Then the outputs (effluent) of the treatment plant are estimated and environmental effects of the discharges on water quality are assessed.

Direct and indirect inputs to the mine water treatment plant are described in Table 6.5-8. Since these facilities will not discharge to Dublin Gulch diversion channel or Haggart Creek unless the discharges can meet CCME WQG or SSWQO, the predicted water quality of these sources was modeled and used to design operating criteria for the treatment plant.

Table 6.5-8: Direct and Indirect Inputs to Mine Water Treatment Plant during Operations

Facility	Source	Pathway During Operations
Open pit	Dewatering, precipitation	▪ To events ponds, then used as process water at heap leach facility, or ▪ To treatment plant then Haggart Creek if excess water does not meet discharge criteria
Platinum Gulch waste rock storage area	Runoff, groundwater	▪ To open pit sump, then events ponds, then used as process water at heap leach facility, or ▪ To treatment plant then Haggart Creek if excess water does not meet discharge criteria
Eagle Pup waste rock storage area	Runoff, groundwater	▪ To seepage collection pond, then events ponds, then used as process water at heap leach facility ▪ To treatment plant then Haggart Creek if excess water does not meet discharge criteria
Heap Leach Facility	Runoff	▪ To recirculation in the HLF (no discharge planned until closure, when treated effluent will be discharged)

The effect of effluent discharge from the mine water treatment plant into Haggart Creek is the main effect assessed during operations, and is based on effluent criteria for the mine water treatment plant. The criteria were established to ensure that the effluent meets MMER criteria for metals, TSS, and pH, and that Haggart Creek continues to meet CCME WQG or SSWQO downstream of an initial dilution zone. The monthly predictions are made to cover average, high and low flow conditions in Haggart Creek. This approach encompasses the range of conditions that may occur, while recognizing it is not possible to predict when a high or low flow event might occur. The predictions are made based on flows in Year 9, at the end of operations, as this is when the mine footprint will be greatest. At any time, there could be a wider range of background and downstream concentrations on a daily basis than predicted on a monthly basis. This does not affect the predictions, in that sampling upstream and downstream of the effluent discharge will clearly show if or when elevated background levels have an effect on concentrations.

Although the waste rock storage areas will be designed to collect groundwater as well as surface water, it is possible that not all the groundwater will be collected. Some contact water may seep into groundwater and be discharged to area streams, so this potential effect is also assessed below.

The discharge of treated sewage effluent from the sewage treatment plant at the camp into Haggart Creek is not assessed further, as this interaction was rated as a "1". As discussed in Section 6.5.1.4, the sewage treatment plant will be a rotating biological contact unit built to produce effluent in accordance with the Yukon Water Board requirements for treated sewage effluent. Treated effluent will be discharged through a rock drain and flow into Haggart Creek. If there are noticeable effects of attenuated concentrations of nutrients in Haggart Creek, the treated effluent can be sent to the mine water treatment plant for further reduction in metals levels.

6.5.3.1 Description of Project Discharges during Operations

Water management for the Project is described in Appendix 18 and summarized in the following sections, along with estimates of flows and water chemistry during operations. Mass balance models were used to predict water quality. Figure 6.5-4 shows predicted flows out of the Eagle Pup waste rock storage area, Platinum Gulch waste rock storage area and open pit, and the mine water treatment plant and heap leach facility.

Platinum Gulch Waste Rock Storage Area

The Platinum Gulch waste rock storage area will be built during construction and used for the first three years of operations (Years 3 through 5), then reclaimed. A diversion channel will be built around the south of the facility to divert non-contact water through a sediment control pond and into Platinum Gulch. A seepage collection pond will collect contact water from surface runoff and a system of rock drains below the waste rock storage area; this will drain to the open pit sump through a channel. Quality of contact water from the Platinum Gulch waste rock storage area was estimated based on geochemistry work (Appendix 8) and flows (Appendix 21 – Surface Water Balance Model Report). Quality of the source term is assumed to be constant throughout the year with concentrations of several parameters increasing as the waste rock storage area grows in size between Years 3 and 5. Modeling showed little influence of wet or dry scenarios on the quality of the contact water, given that overall dilution would remain the same.

The modeled chemical characteristics are described in Table 6.5-9 for Year 5, the last year of use. Measurable flows from the waste rock storage area will occur from May to October of each year. Levels of almost all metals, sulphate, fluoride and nutrients are predicted to be elevated in the contact water. Nitrate and ammonia, both very soluble in water, will have elevated levels due to leaching of blast residues from the waste rock during operations, and will decrease to minimal levels in closure, long before seepage from the Platinum Gulch waste rock storage area is likely to be discharged to Dublin Gulch (Year 14).

The following parameters are predicted to be higher than WQG:

- Those at least ten times higher than WQG—antimony, arsenic, cadmium, copper, lead, manganese, selenium, silver, and uranium
- Those less than ten times higher than WQG—sulphate, fluoride, chromium, mercury, molybdenum, nickel, thallium and zinc.

Phosphate, for which there is no WQG, is predicted to range from 0.59 to 0.83 mg P/L. Nitrate and ammonia levels are assumed to be equal, given that the blast compound contains equal molar amounts of nitrate and ammonia. Results for major anions and cations are not shown in Table 6.5-9, but are modeled in Appendix 8. For the waste rock storage area contact water, pH is predicted to be about 7.1, alkalinity 160 to 250 mg/L, chloride 10 to 14 mg/L, calcium 140 to 370 mg/L, magnesium 43 to 75 mg/L, potassium 27 to 43 mg/L, and sodium 7 to 12 mg/L. These parameters will contribute to treatment plant inputs, along with the parameters modeled and shown in Table 6.5-9.

After the area is reclaimed midway through the operations phase, contact water quality will be monitored and sent to the open pit until the rest of the mine site is reclaimed. At that time, flows will be re-established into Platinum Gulch then Haggart Creek.

Open Pit

The open pit will be developed over 7.3 years. Contact water will come from depressurizing and dewatering open pit walls, rainfall and surface runoff, as well as from the Platinum Gulch waste rock storage area, the water from which, as noted above, will be sent to the open pit midway through the operations phase. Open pit water will be sent to the events pond for process use, with water in excess of process needs going to the mine water treatment plant prior to discharge to Haggart Creek.

Quality of the open pit water was estimated based on geochemistry tests (Appendix 8) and flows (Appendix 21 – Surface Water Balance Model Report). Chemical composition is assumed to be relatively constant throughout the year, with the geochemistry predictions showing a gradual increase in concentrations over the 7.3 years of operations. The predicted chemical characteristics are described in Table 6.5-10 for Year 9 (last year of operations) for combined open pit and Platinum Gulch waste rock storage area sources. Water quality under wet, dry and average scenarios was modeled and the results with highest concentrations are shown in Table 6.5-10.

Table 6.5-9: Predicted Flows (average) and Water Quality (max) from Platinum Gulch Waste Rock Storage Area during Operations (Year 5)

Parameter[1]	Mean Monthly Concentration (mg/L, unless indicated)												WQG[2] (mg/L)	Max/ WQG
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Flow (m^3/s)	NF	NF	NF	NF	0.001	< 0.001	0.004	0.004	0.003	0.002	NF	NF		
Sulphate S	NF	NF	NF	NF	**128**	**128**	**910**	**934**	**875**	**856**	NF	NF	100	**9.3**
Fluoride	NF	NF	NF	NF	**1.00**	**1.00**	**1.40**	**1.42**	**1.39**	**1.38**	NF	NF	0.30	**4.7**
Nitrate N	NF	NF	NF	NF	0.000	0.000	**89.2**	**91.9**	**85.2**	**83.0**	NF	NF	2.9	**31**
Ammonia N	NF	NF	NF	NF	0.000	0.000	89.2	91.9	85.2	83.0	NF	NF		
Phosphate TP	NF	NF	NF	NF	0.591	0.591	0.778	0.784	0.770	0.765	NF	NF		
Aluminum D	NF	NF	NF	NF	0.026	0.026	0.029	0.029	0.029	0.029	NF	NF	0.10	0.3
Antimony D	NF	NF	NF	NF	**0.099**	**0.099**	**1.26**	**1.30**	**1.21**	**1.18**	NF	NF	0.02	**65**
Arsenic D	NF	NF	NF	NF	**0.280**	**0.280**	**1.28**	**1.31**	**1.24**	**1.21**	NF	NF	0.005	**262**
Boron D	NF	NF	NF	NF	0.050	0.050	0.050	0.050	0.050	0.050	NF	NF	1.2	<1
Cadmium D	NF	NF	NF	NF	**0.00070**	**0.00070**	**0.00653**	**0.00671**	**0.00627**	**0.00613**	NF	NF	0.0003	**22**
Chromium D	NF	NF	NF	NF	**0.0197**	**0.0197**	**0.0307**	**0.0310**	**0.0302**	**0.0299**	NF	NF	0.0089	**3.5**
Copper D	NF	NF	NF	NF	**0.0200**	**0.0200**	**0.0647**	**0.0661**	**0.0627**	**0.0616**	NF	NF	0.003	**22**
Iron D	NF	NF	NF	NF	0.048	0.048	**1.02**	**1.04**	0.972	0.949	NF	NF	1.0	1.0
Lead D	NF	NF	NF	NF	0.00290	0.00290	**0.0490**	**0.0504**	**0.0469**	**0.0458**	NF	NF	0.004	**13**
Manganese D	NF	NF	NF	NF	**0.0530**	**0.0530**	**0.9696**	**0.9974**	**0.9289**	**0.9065**	NF	NF	0.05	**20**
Mercury D	NF	NF	NF	NF	**0.00010**	**0.00010**	**0.00010**	**0.00010**	**0.00010**	**0.00010**	NF	NF	0.00003	**3.8**
Molybdenum D	NF	NF	NF	NF	**0.0796**	**0.0796**	**0.0889**	**0.0892**	**0.0885**	**0.0883**	NF	NF	0.073	**1.2**
Nickel D	NF	NF	NF	NF	0.0400	0.0400	**0.6887**	**0.7084**	**0.6598**	**0.6440**	NF	NF	0.110	**6.4**
Selenium D	NF	NF	NF	NF	**0.0067**	**0.0067**	**0.0478**	**0.0490**	**0.0459**	**0.0449**	NF	NF	0.002	**25**
Silver D	NF	NF	NF	NF	**0.00200**	**0.00200**	**0.00200**	**0.00200**	**0.00200**	**0.00200**	NF	NF	0.0001	**20**
Thallium D	NF	NF	NF	NF	**0.00160**	**0.00160**	**0.00160**	**0.00160**	**0.00160**	**0.00160**	NF	NF	0.0008	**2.0**
Uranium D	NF	NF	NF	NF	**0.0260**	**0.0260**	**0.363**	**0.373**	**0.348**	**0.340**	NF	NF	0.015	**25**
Zinc D	NF	NF	NF	NF	0.0150	0.0150	**0.254**	**0.261**	**0.243**	**0.238**	NF	NF	0.03	**8.7**

NOTE: predicted values from September Year 4 to August Year 5
NF – no flow
[1] Dissolved metals concentrations (D), elemental values for nitrate (N), ammonia (N), phosphate (P), sulphate (S)
[2] CCME WQGs for protection of aquatic life, with these exceptions: CCME drinking water (Sb, Tl), BC aquatic life (Fe, Se, SO4, F^-), BC drinking water (Mn), draft CCME (Cd, U)

Table 6.5-10: Predicted Flows (average) and Water Quality (max) from the Open Pit at Year 9 (with Platinum Gulch Waste Rock Storage Area)

Parameter[1]	Mean Monthly Concentration (mg/L, unless indicated)												WQG[2] (mg/L)	Max/ WQG
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Flow (m^3/s)	< 0.001	< 0.001	< 0.001	0.005	0.044	0.022	0.016	0.014	0.017	0.009	< 0.001	< 0.001		
Sulphate S	96	96	96	**107**	**111**	**225**	**170**	**174**	**154**	**269**	**659**	96	100	**6.6**
Fluoride	0.099	0.099	0.099	**0.776**	**0.811**	**1.01**	**0.996**	**1.01**	**0.893**	**0.844**	**0.978**	0.099	0.30	**3.4**
Nitrate N	0.015	0.015	0.015	0.077	0.037	0.094	0.054	0.045	0.058	0.116	0.010	0.015	2.9	0.0
Ammonia N	0.007	0.007	0.007	0.003	0.003	0.001	0.001	0.001	0.002	0.002	0.005	0.007		
Phosphate TP	0.085	0.085	0.085	0.475	0.521	0.599	0.596	0.603	0.525	0.492	0.580	0.085		
Aluminum D	0.073	0.073	0.073	**0.241**	**0.484**	0.060	0.042	0.096	0.055	0.048	0.060	0.073	0.10	**4.8**
Antimony D	0.0063	0.0063	0.0063	**0.0746**	**0.0831**	**0.1540**	**0.1180**	**0.1207**	**0.1065**	**0.1739**	**0.4187**	0.0063	0.02	**21**
Arsenic D	**0.194**	**0.194**	**0.194**	**0.162**	**0.167**	**0.300**	**0.230**	**0.236**	**0.209**	**0.358**	**0.865**	**0.194**	0.005	**173**
Boron D	0.005	0.005	0.005	0.041	0.043	0.047	0.046	0.046	0.043	0.041	0.036	0.005	1.2	<1
Cadmium D	0.00002	0.00002	0.00002	**0.00048**	**0.00057**	**0.00152**	**0.00102**	**0.00104**	**0.00086**	**0.00189**	**0.00536**	0.00002	0.0003	**18**
Chromium D	0.0003	0.0003	0.0003	**0.0150**	**0.0161**	**0.0204**	**0.0198**	**0.0200**	**0.0175**	**0.0171**	**0.0222**	0.0003	0.0089	**2.5**
Copper D	0.0001	0.0001	0.0001	**0.0169**	**0.0186**	**0.0263**	**0.0231**	**0.0226**	**0.0207**	**0.0259**	**0.0485**	0.0001	0.003	**16**
Iron D	0.023	0.023	0.023	0.307	0.620	0.116	0.088	0.149	0.112	0.120	0.264	0.023	1.0	0.6
Lead D	0.00005	0.00005	0.00005	0.00233	0.00266	**0.00464**	0.00355	0.00363	0.00321	**0.00522**	**0.01252**	0.00005	0.004	**3.1**
Manganese D	**0.1329**	**0.1329**	**0.1329**	**0.0586**	0.0462	**0.0883**	**0.0677**	**0.0668**	**0.0638**	**0.1144**	**0.2909**	**0.1329**	0.05	**5.8**
Mercury D	0.00003	0.00003	0.00003	**0.00007**	**0.00008**	**0.00009**	**0.00009**	**0.00009**	**0.00008**	**0.00008**	**0.00008**	0.00003	0.00003	**3.5**
Molybdenum D	0.01032	0.01032	0.01032	0.05870	0.06188	**0.07629**	**0.07707**	**0.07822**	0.06803	0.06104	0.06553	0.01032	0.073	**1.1**
Nickel D	0.0020	0.0020	0.0020	0.0297	0.0334	0.0640	0.0481	0.0493	0.0431	0.0733	**0.1811**	0.0020	0.110	**1.6**
Selenium D	0.0003	0.0003	0.0003	**0.0051**	**0.0057**	**0.0115**	**0.0085**	**0.0087**	**0.0075**	**0.0132**	**0.0331**	0.0003	0.002	**17**
Silver D	0.00001	0.00001	0.00001	**0.00135**	**0.00144**	**0.00175**	**0.00177**	**0.00180**	**0.00155**	**0.00140**	**0.00139**	0.00001	0.0001	**18**
Thallium D	0.00005	0.00005	0.00005	**0.00109**	**0.00116**	**0.00141**	**0.00142**	**0.00145**	**0.00125**	**0.00113**	**0.00112**	0.00005	0.0008	**1.8**
Uranium D	0.0145	0.0145	0.0145	**0.0208**	**0.0214**	**0.0388**	**0.0305**	**0.0312**	**0.0281**	**0.0449**	**0.1017**	0.0145	0.015	**6.8**
Zinc D	0.0042	0.0042	0.0042	0.0127	0.0152	0.0232	0.0178	0.0184	0.0160	0.0265	**0.0638**	0.0042	0.03	**2.1**

[1] Dissolved metals concentrations (D), elemental values for nitrate (N), ammonia (N), phosphate (P), sulphate (S)

[2] CCME WQGs for protection of aquatic life, with these exceptions: CCME drinking water (Sb, Tl), BC aquatic life (Fe, Se, SO_4, F^-), BC drinking water (Mn), draft CCME (Cd, U)

Open pit water quality is predicted to be high in most parameters:

- Those more than ten times higher than WQG are antimony, arsenic, cadmium, copper, selenium, and silver.
- Those less than ten times higher than WQG are sulphate, fluoride, chromium, lead, manganese, mercury, thallium, uranium, and zinc.

Results for major anions and cations not shown in Table 6.5-10 are modeled in Appendix 8. For open pit contact water, pH is predicted to be about 7.5, alkalinity 100 to 125 mg/L, chloride 3 to 4 mg/L, calcium 82 to 88 mg/L, magnesium 6 to 7 mg/L, potassium 12 to 15 mg/L, and sodium 2 to 3 mg/L.

Eagle Pup Waste Rock Storage Area

The Eagle Pup waste rock storage area will be built during construction and used in Years 3 through 9. A seepage collection pond will collect runoff from the waste rock storage area and groundwater from the rock drain collection system. This contact water will be sent to the events pond for use as process water. Any excess water will be sent to the treatment plant, then discharged to Haggart Creek.

Quantity and quality of discharges from the Eagle Pup waste rock storage area were estimated based on geochemistry testing (Appendix 8) and flows (Appendix 21 – Surface Water Balance Model Report). Quality of contact water is assumed to be constant throughout a year, with concentrations of many parameters increasing over the years of operations. Water quality under wet, dry and average scenarios was modeled and the results with the highest predicted concentrations (typically for the wet scenario) are shown in Table 6.5-11 for Year 9, the last year of operations, when the waste rock storage area is at its fullest extent. Year 9 is modeled to begin in October and run to September, not January to December.

Flows from the Eagle Pup waste rock storage area will occur in May through November, peaking in June. Although monitoring will be in place to confirm predictions, the modeled results indicate that contact water from the waste rock storage area will need to be treated prior to discharge.

Results for major anions and cations are not shown in Table 6.5-11, but are modeled in Appendix 8. For the waste rock storage area contact water, pH is predicted to be about 7.0 to 7.2, alkalinity about 220 to 320 mg/L, chloride 8 to 13 mg/L, calcium 260 to 460 mg/L, magnesium 27 to 68 mg/L, potassium 27 to 41 mg/L, and sodium 4 to 11 mg/L.

The following parameters are predicted to be higher than WQG:

- Those at least ten times higher than WQG—antimony, arsenic, cadmium, copper, lead, manganese, selenium, silver, uranium, and zinc
- Those less than ten times higher than WQG—sulphate, fluoride, aluminum, chromium, iron, mercury, nickel, and thallium

Phosphate levels are predicted to range from 0.09 to 0.80 mg P/L, nitrate from 0.27 to 25.4 mg N/L and ammonia from 0.007 to 25.3 mg/L during the year.

Table 6.5-11: Predicted Flows (average) and Water Quality (max) from Eagle Pup Waste Rock Storage Area during Operations (Year 9)

Parameter[1]	Mean Monthly Concentration (mg/L, unless indicated)												WQG[2] (mg/L)	Max/ WQG
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Flow (m^3/s)	< 0.001	< 0.001	< 0.001	< 0.001	0.006	0.016	0.010	0.010	0.009	0.007	0.004	< 0.001		
Sulphate S	29	29	29	29	**398**	**708**	**628**	**663**	**615**	78	**744**	29	100	**7.4**
Fluoride	0.106	0.106	0.106	0.106	**0.989**	**1.18**	**1.08**	**1.13**	**1.08**	**0.470**	**1.19**	0.106	0.30	**4.0**
Nitrate N	0.270	0.270	0.270	0.270	**6.63**	**25.4**	**10.7**	**14.5**	**14.0**	0.336	**14.2**	0.270	2.9	**8.8**
Ammonia N	0.007	0.007	0.007	0.007	6.61	25.3	10.7	14.4	13.9	0.004	14.2	0.007		
Phosphate TP	0.092	0.092	0.092	0.092	0.640	0.758	0.689	0.719	0.682	0.239	0.771	0.092		
Aluminum D	**0.781**	**0.781**	**0.781**	**0.781**	**0.364**	0.067	0.076	**0.207**	0.073	0.086	**0.781**	**0.781**	0.10	**7.8**
Antimony D	0.0006	0.0006	0.0006	0.0006	**0.660**	**1.27**	**1.11**	**1.18**	**1.09**	**0.0384**	**1.34**	0.0006	0.02	**67**
Arsenic D	**0.0299**	**0.0299**	**0.0299**	**0.0299**	**0.704**	**1.27**	**1.12**	**1.19**	**1.10**	**0.0839**	**1.34**	**0.0299**	0.005	**269**
Boron D	0.024	0.024	0.024	0.024	0.046	0.049	0.048	0.048	0.046	0.030	0.049	0.024	1.2	<1
Cadmium D	0.00002	0.00002	0.00002	0.00002	**0.00401**	**0.00770**	**0.00675**	**0.00716**	**0.00659**	0.00025	**0.00813**	0.00002	0.0003	**27**
Chromium D	0.0006	0.0006	0.0006	0.0006	**0.0229**	**0.0301**	**0.0271**	**0.0284**	**0.0268**	0.0078	**0.0307**	0.0006	0.0089	**3.5**
Copper D	0.0014	0.0014	0.0014	0.0014	**0.0409**	**0.0645**	**0.0574**	**0.0605**	**0.0563**	**0.0087**	**0.0672**	0.0014	0.003	**22**
Iron D	0.948	0.948	0.948	0.948	**1.10**	**1.50**	**1.33**	**1.43**	**1.31**	0.072	**1.63**	0.948	1.0	**1.6**
Lead D	0.00036	0.00036	0.00036	0.00036	**0.0370**	**0.0732**	**0.0641**	**0.0681**	**0.0626**	0.00120	**0.0776**	0.00036	0.004	**19**
Manganese D	0.0049	0.0049	0.0049	0.0049	**0.735**	**1.46**	**1.28**	**1.36**	**1.25**	0.0198	**1.55**	0.0049	0.05	**31**
Mercury D	0.00002	0.00002	0.00002	0.00002	**0.00009**	**0.00010**	**0.00009**	**0.00009**	**0.00009**	**0.00005**	**0.00010**	0.00002	0.00003	**3.7**
Molybdenum D	0.00112	0.00112	0.00112	0.00112	**0.0736**	**0.0858**	**0.0784**	**0.0816**	**0.0779**	0.0306	**0.0864**	0.00112	0.073	**1.2**
Nickel D	0.0009	0.0009	0.0009	0.0009	**0.507**	**1.01**	**0.881**	**0.935**	**0.860**	0.0152	**1.07**	0.0009	0.110	**9.7**
Selenium D	0.0004	0.0004	0.0004	0.0004	**0.0209**	**0.0371**	**0.0328**	**0.0346**	**0.0321**	**0.0028**	**0.0390**	0.0004	0.002	**20**
Silver D	0.00001	0.00001	0.00001	0.00001	**0.00167**	**0.00191**	**0.00175**	**0.00182**	**0.00174**	**0.00069**	**0.00192**	0.00001	0.0001	**19**
Thallium D	0.00005	0.00005	0.00005	0.00005	**0.00134**	**0.00153**	**0.00140**	**0.00146**	**0.00140**	0.00058	**0.00154**	0.00005	0.0008	**1.9**
Uranium D	0.0059	0.0059	0.0059	0.0059	**0.332**	**0.659**	**0.578**	**0.613**	**0.564**	**0.0157**	**0.698**	0.0059	0.015	**47**
Zinc D	0.0062	0.0062	0.0062	0.0062	**0.186**	**0.366**	**0.321**	**0.341**	**0.313**	0.0063	**0.388**	0.0062	0.03	**13**

NOTE: Predicted values from Jan Year 9 to Dec Year 9 (last year of operations), based on geochemistry predictions and Eagle Pup baseline data

[1] Dissolved metals concentrations (D), elemental values for nitrate (N), ammonia (N), phosphate (P), sulphate (S)

[2] CCME WQGs for protection of aquatic life, with these exceptions: CCME drinking water (Sb, Tl), BC aquatic life (Fe, Se, SO_4, F^-), BC drinking water (Mn), draft CCME (Cd, U)

Heap Leach Facility

The east and west Ann Gulch Diversion Ditches will direct non-contact water around the heap leach facility into the Dublin Gulch diversion channel and Haggart Creek, respectively. The HLF will expand progressively over Years 3 through 9 and will be irrigated with re-circulated leach solution, using contact water from the open pit and waste rock storage areas as make-up water. Leach solution will drain to an in-heap storage area and be sent to the process recovery plant for gold extraction. Processed water will be returned to irrigate the HLF. This recycling of process solution will result in no planned release to the mine water treatment plant.

Non-contact groundwater from below the HLF will be collected, stored temporarily in a facility at the toe of the HLF, and sent to Haggart Creek if water quality is suitable for discharge. Otherwise, it will be circulated within the HLF. Table 6.5-12 describes baseline quality of groundwater in and around Ann Gulch, based on the Water Management Plan (Appendix 18) and baseline studies (Appendix 15 – Environmental Baseline Report: Hydrogeology). Mean values were calculated for data collected in 2009 and 2010 from three monitoring wells in Ann Gulch (AG3, AG5, AG6) and two in Dublin Gulch (DG1, DG6). No change from baseline is predicted, as there is no contact with heap solution, and this groundwater currently discharges into Dublin Gulch. The high TSS levels indicate some samples contained high amounts of sediment, perhaps from disturbance of permafrost or collection of samples from shallow wells subject to surface disturbance. As a result the dissolved, rather than total, metals levels are reported. Groundwater chemistry is dominated by calcium, carbonate or bicarbonate, and sulphate, and also contains arsenic, cadmium, iron, and manganese concentrations higher than WQG. This groundwater already discharges to the streams (Dublin Gulch or possibly Haggart Creek), contributing to elevated baseline levels of metals in the streams, so it should be considered suitable for release to Haggart Creek during operations.

Table 6.5-12: Predicted Groundwater Quality from under the Heap Leach Facility during Operations (mean values from Ann Gulch, 2009 and 2010)

Parameter[1]	Mean[2] (mg/L)	WQG[3] (mg/L)	Mean/WQG
Sulphate	84	100	0.8
Nitrate N	0.048	2.9	0.0
Ammonia N	0.073	NA	NA
Phosphate P, total	0.049	NA	NA
Hardness	177	NA	NA
TSS	132	NA	NA
Aluminum D	0.0130	0.10	0.1
Antimony D	0.0104	0.020	0.5
Arsenic D	0.367	0.005	**73**
Boron D	0.006	1.20	0.0
Cadmium D	0.00032	0.00004	**8.0**

Parameter[1]	Mean[2] (mg/L)	WQG[3] (mg/L)	Mean/WQG
Chromium D	0.0003	0.0089	0.0
Copper D	0.0010	0.003	0.3
Iron D	1.86	0.30	**6.2**
Lead D	0.00005	0.0040	0.0
Manganese D	0.244	0.05	**4.9**
Mercury D	0.00007	0.00003	**2.3**
Molybdenum D	0.00199	0.073	0.0
Nickel D	0.0175	0.110	0.2
Selenium D	0.0006	0.001	0.6
Silver D	0.00002	0.0001	0.2
Thallium D	0.00005	0.0008	0.1
Uranium D	0.0007	0.0200	0.0
Zinc D	0.0328	0.030	**1.1**

NOTES:

[1] Dissolved metals concentrations (D), elemental values for nitrate (N), ammonia (N), phosphate (P), sulphate (S)

[2] Derived from baseline water quality (2009, 2010) on five dates (n = 10) for monitoring wells in Ann Gulch (MW#10-AG3, MW#10-AG5, MW#10-AG6) and Dublin Gulch (MW#09-DG1, MW#10-DG6).

[3] CCME WQGs for protection of aquatic life, other than CCME drinking water (antimony, thallium, uranium), BC aquatic life (sulphate, fluoride), BC drinking water (manganese).

Bold indicates max monthly mean exceeds WQG

NA = not applicable

Excess leach solution during peak flow events and HLF draindown (e.g., during plant shutdown and at closure) will be stored in the events ponds downstream of the HLF. The events ponds will be empty during winter to ensure full capacity during spring. Should the events ponds contain more water than needed for process water make-up, the excess will be treated in the cyanide detoxification plant then the mine water treatment plant prior to discharge.

Mine Water Treatment Plant

The mine water treatment plant will be online at the start of operations. It will consist of a feed pond, treatment plant and product pond. The average design flow rate for the treatment plant will be about 420 m^3/hr (117 L/s), with a maximum of 620 m^3/hr, to meet closure requirements. Inputs to the treatment plant are expected to be low at the start of operations phase, increase as the mine facilities become developed, and reach a maximum during the first two years of heap leach facility draindown during decommissioning (Figure 6.5-4). During operations, the treatment plant will receive flows of any contact water not needed for the heap leach facility or not suitable for direct discharge to the Dublin Gulch diversion channel or Haggart Creek. This includes flows from the open pit (including the Platinum Gulch seepage collection pond) and the Eagle Pup seepage collection pond. If needed, discharges from the sediment control ponds and ditches will also be sent to the treatment plant.

Projected average monthly flows to the treatment plant during operations (Years 3 through 9) are shown in Figure 6.5-4. To provide a worst-case scenario, it was assumed that Year 9 (2020, the last year of operations, beginning in October and running to September) would be the wet year, as that is when flows to the treatment plant from the waste rock storage areas and open pit are expected to be greatest. Under average conditions, during Years 3 through 6, treatment may only be needed during late summer, at monthly flow rates of 17% of the plant capacity (20 L/s or 72 m^3/hr), due to the large demand for water as the heap leach facility is built up. During Years 7 through 9, for average flow conditions, treatment may be required between June and October, with maximum monthly flows to the treatment plant of about 25% of the plant capacity (30 L/s).

The quality and quantity of contact water directed to the treatment plant are described in Tables 6.5-10 and 6.5-11 individually for the waste rock storage areas and open pit, and their combined flows and quality in Table 6.5-13. Results for major anions and cations are not shown in Table 6.5-13, but are modeled from the source terms (Appendix 8). During operations, maximum concentrations in the treatment plant influent will be the highest of those identified for the individual source terms. The ranges are predicted to be pH 7.0 to 7.5, alkalinity 106 to 320 mg/L, chloride 3 to 14 mg/L, calcium 82 to 460 mg/L, magnesium 6 to 73 mg/L, potassium 12 to 43 mg/L, and sodium 2 to 11 mg/L.

Seepage of Contact Water into Groundwater

Although the Project Description and Water Management Plan describe all contact water in the waste rock storage areas being directed to seepage collection ponds, monitored and treated prior to discharge, with rock drains intercepting the groundwater, the potential for this contact water to seep into groundwater was assessed.

As described in the Groundwater Model Report (Appendix 22) for baseline conditions, groundwater has generally been observed deeper (about 6 m – 45 m below grade [mbg]) at higher elevations and shallow (about 6 mbg or less) to artesian in lower elevations and in valley bottoms. At low elevations, an upward gradient has been noted for groundwater movement (constrained by the intact bedrock layers). These characteristics were noted for the Eagle Pup basin, although deeper elevations were noted for Platinum Gulch (60 mbg in the upper basin and 9 to 26 mbg in lower basin). Groundwater levels are expected to have seasonal trends related to the spring freshet and fall rainstorms.

The watersheds contain fractured bedrock (at the surface in some areas, up to 20 mbg in other areas), and thin surficial layers of placer, colluvial, alluvial, fluvial, and till deposits. Hydraulic testing indicates a hydraulic conductivity range of 10^{-3} to 10^{-7} m/s for the variable surficial deposits and 10^{-5} to 10^{-8} m/s for bedrock (typical of fractured crystalline rock, which showed decreasing hydraulic conductivity with depth, and no measureable difference in hydraulic conductivities of granodiorite and metasedimentary rock).

Table 6.5-13: Predicted Flow (average) and Quality (maximum) of Contact Water into the Mine Water Treatment Plant during Operations (from Open Pit and Waste Rock Storage Areas)

Parameter	Mean Monthly Concentration (mg/L, unless indicated)												WQG[2] (mg/L)	Max/ WQG
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Flow (m^3/s)	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.021	0.025	0.021	0.023	0.003	< 0.001	< 0.001		
Sulphate S	29	29	29	**106**	**153**	**474**	**374**	**407**	**342**	**221**	**735**	29	100	**7.4**
Fluoride	0.106	0.106	0.106	**0.766**	**0.837**	**1.06**	**0.978**	**1.01**	**0.960**	**0.759**	**1.17**	0.106	0.30	**3.9**
Nitrate N	0.270	0.270	0.270	0.079	0.867	**8.75**	**4.08**	**4.88**	**6.41**	0.146	**12.5**	0.270	2.9	**4.3**
Ammonia N	0.007	0.007	0.007	0.003	0.839	8.69	4.03	4.84	6.36	0.002	12.5	0.007		
Phosphate T P	0.092	0.092	0.092	0.469	0.539	0.651	0.596	0.622	0.579	0.434	0.752	0.092		
Aluminum D	**0.781**	**0.781**	**0.781**	**0.249**	**0.471**	0.053	0.043	0.087	0.058	0.057	**0.500**	**0.781**	0.10	**7.8**
Antimony D	0.0006	0.0006	0.0006	**0.0735**	**0.168**	**0.734**	**0.563**	**0.6261**	**0.508**	**0.139**	**1.25**	0.0006	0.02	**62**
Arsenic D	**0.0299**	**0.0299**	**0.0299**	**0.158**	**0.246**	**0.804**	**0.628**	**0.6904**	**0.573**	**0.288**	**1.30**	**0.0299**	0.005	**259**
Boron D	0.024	0.024	0.024	0.040	0.044	0.048	0.047	0.046	0.044	0.039	0.048	0.024	1.2	<1
Cadmium D	0.00002	0.00002	0.00002	**0.00047**	**0.00108**	**0.00471**	**0.00358**	**0.00396**	**0.00320**	**0.00148**	**0.00785**	0.00002	0.0003	**26**
Chromium D	0.0006	0.0006	0.0006	**0.0148**	**0.0171**	**0.0245**	**0.0219**	**0.0229**	**0.0211**	**0.0146**	**0.0299**	0.0006	0.0089	**3.4**
Copper D	0.0014	0.0014	0.0014	**0.0167**	**0.0219**	**0.0457**	**0.0378**	**0.0406**	**0.0353**	**0.0211**	**0.0653**	0.0014	0.003	**22**
Iron D	0.948	0.948	0.948	0.316	0.625	0.840	0.640	0.759	0.601	0.108	**1.49**	0.948	1.0	**1.5**
Lead D	0.00036	0.00036	0.00036	0.00230	**0.00774**	**0.0404**	**0.0306**	**0.0343**	**0.0275**	**0.00417**	**0.0710**	0.00036	0.004	**18**
Manganese D	0.0049	0.0049	0.0049	**0.0571**	**0.147**	**0.804**	**0.608**	**0.683**	**0.545**	**0.0905**	**1.42**	0.0049	0.05	**28**
Mercury D	0.00002	0.00002	0.00002	**0.00007**	**0.00008**	**0.00009**	**0.00008**	**0.00009**	**0.00008**	**0.00007**	**0.00009**	0.00002	0.00003	**3.6**
Molybdenum D	0.00112	0.00112	0.00112	0.05789	0.06362	**0.0771**	0.0719	**0.0745**	0.07056	0.05545	**0.084**	0.00112	0.073	**1.2**
Nickel D	0.0009	0.0009	0.0009	0.0293	0.1035	**0.555**	**0.420**	**0.471**	**0.3766**	0.0583	**0.976**	0.0009	0.110	**8.9**
Selenium D	0.0004	0.0004	0.0004	**0.0050**	**0.0079**	**0.0247**	**0.0193**	**0.0210**	**0.0176**	**0.0105**	**0.0384**	0.0004	0.002	**19**
Silver D	0.00001	0.00001	0.00001	**0.00133**	**0.00147**	**0.00174**	**0.00163**	**0.00169**	**0.00160**	**0.00127**	**0.00186**	0.00001	0.0001	**19**
Thallium D	0.00005	0.00005	0.00005	**0.00108**	**0.00119**	**0.00140**	**0.00131**	**0.00136**	**0.00129**	**0.00103**	**0.00149**	0.00005	0.0008	**1.9**
Uranium D	0.0059	0.0059	0.0059	**0.0206**	**0.0673**	**0.362**	**0.275**	**0.308**	**0.2470**	**0.0375**	**0.638**	0.0059	0.015	**43**
Zinc D	0.0062	0.0062	0.0062	0.0126	**0.0405**	**0.202**	**0.153**	**0.172**	**0.1374**	0.0213	**0.355**	0.0062	0.03	**12**
Cyanide WAD	0.0025	0.0025	0.0011	0.0008	0.0004	0.0006	0.0005	0.0007	0.0009	0.0022	0.0025	0.0025	0.010	0.3

[1] Dissolved metals concentrations (D), elemental values for nitrate (N), ammonia (N), phosphate (P), sulphate (S)

[2] CCME WQG for protection of aquatic life, except: CCME drinking water (Sb, Tl), BC aquatic life (Fe, Se, SO_4, F^-), BC drinking water (Mn), draft CCME (Cd, U)

Groundwater flow and contaminant transport were modeled using a three dimensional numerical model (MODFLOW) to simulate conditions. Groundwater flow and contaminant transport were assessed in discrete units within three zones. Layer 1 is surficial geology, Layer 2 is weathered bedrock and Layers 3 through 5 are deeper bedrock. Interactions of groundwater and the streams were incorporated in the model.

The effects on water quality of Haggart Creek should seepage in the waste rock storage areas be released into the subsurface was evaluated using qualitative modeling. Seepage was modeled as being transported into groundwater at appropriate layers of the ground, assuming a constant rate of 8.4×10^{-5} m^3/d (approximately 1% of expected precipitation in the areas of the waste rock storage areas) with an arbitrary concentration value of 100 (i.e., 100%). Transport was assumed to begin at the start of mining activities and continue for 10 years after mining activities ceased. During this time, the rate and concentration of seepage transported into Layer 2 (the weathered bedrock) was considered to be constant. To add further conservatism, no retardation or degradation rates were assigned, although these would be expected to occur and to reduce metals levels in groundwater.

Results of the model indicate the following:

- Groundwater would migrate towards Haggart Creek via Platinum Gulch and lower Dublin Gulch via Eagle Pup, and seepage in the groundwater would discharge to the streams within one year.
- Seepage in the groundwater would enter Layer 1 (surficial geology) but not migrate into deeper layers.
- By the time groundwater beneath the waste rock storage areas migrates to Dublin Gulch or Haggart Creek, attenuation effects would reduce the arbitrary concentration values to less than 1 in most areas and up to 4 in some areas (i.e., the concentration of waste rock storage area seepage in groundwater would be 1 to 4% of the original seepage concentration.

The model was extended for 200 years, and the results indicated no additional change over that time.

Based on model results, the rise in metal concentrations in groundwater that may occur due to seepage from the waste rock storage areas would be lowered to 1 to 4% of the concentration in the seepage due to advection and dispersion transport processes. Furthermore, there are many common geochemical reactions and other mechanisms that would further attenuate transport of mine seepage, such as precipitation, binding to organic matter or iron hydroxide complexes.

6.5.3.2 Mitigation Measures for Site Discharges during Operations

Several design features and mitigations are incorporated to reduce the potential for Project-related adverse effects on stream water quality, the most important of which is the mine water treatment plant. The Water Management Plan indicates there will be minor inputs to and discharges from the treatment plant during operations, given that most of the contact water from the waste rock storage areas will be sent untreated to the heap leach facility for make-up water.

The treatment plant will have a maximum design capacity of 620 m^3/hr (420 m^3/hr average) to meet closure requirements; this is about four times higher than the maximum capacity predicted to be required for operations. Should higher capacity be needed on a temporary basis, contact water can be stored prior to treatment in a number of locations (the HLF, in-heap storage facility, events ponds, pit sump, waste rock storage area seepage collection ponds, treatment plant feed pond and product pond). Expected flows to the treatment plant are described more fully in the Water Management Plan (Appendix 18). Effluent from the treatment plant will be discharged to Haggart Creek through a diffuser pipe on the creek bed. Discharge will occur mainly in May through October (depending on rainfall patterns).

The treatment plant will be designed to reduce levels of metals, nitrogen, and phosphorus. There are two considerations for water treatment: 1) End of pipe effluent criteria are provided in Schedule 4 of MMER for arsenic, copper, lead, nickel, zinc, radium 226, pH and cyanide; and 2) Downstream receiving environment quality is defined in terms of CCME or other WQG or SSWQO in Haggart Creek. For the purpose of modeling effects on water quality, the mine water treatment plant end of pipe effluent criteria have been set at two times the downstream WQG or SSWQO (considerably lower and more protective than MMER criteria) to provide a conservative measure even when dilution in the receiving water is only 3:1. This minimum amount of dilution (worst case scenario) is predicted for one month of closure, during the peak of draindown; however dilution will generally be in the range of 12:1 to 61:1 annually during both operations and draindown of early closure. The actual discharge criteria for the effluent treatment plant will be defined during the water license and permitting stage.

During the feasibility phase, VIT will design the mine water treatment plant, at which time the effluent criteria will be defined based on review of specific criteria (e.g., sulphate, for which there is a BC WQG but no CCME WQG; metals that could receive a lower level of treatment and still meet WQG or SSWQO in Haggart Creek). Also, water management options for closure, such as slowing down the release of draindown water to maintain higher dilution ratios in the creek will be examined. During operation of the treatment plant, testing of effluent for chemistry and for acute toxicity to fish will be required under MMER. Recommendations for SSWQO are discussed in detail in Section 6.5.2.4.

Details of anticipated treatment technology are provided in the Mine Water Treatment Technical Memorandum (Appendix 20) and will likely include pH adjustment, precipitation with iron or alum, flocculation, clarification, filtration, and ion exchange. These processes will be effective in reducing metals, nitrogen, and phosphorus levels. Standard mitigations will remove phosphorus down to about 0.2 mg/L in effluent; if required, specific phosphorus removal technology can be added and nitrate and ammonia levels can be reduced to 0.4 and 1.0 mg/L, respectively, to avoid excessive algae growth (eutrophication). There will be time during operations to adapt the mitigation strategy based on actual quality of contact water.

Table 6.5-14: Assumptions for Effluent Quality for the Mine Water Treatment Plant

Parameter[1]	Concentration (mg/L)		Rationale for Assumptions for Treatment Plant Criteria[2]
	MMER Sched. 4[a]	Treatment Plant	
pH	6.0 to 9.5	6.0 to 9.5	
Sulphate	–	200	Two times higher than BC WQG of 100 mg/L
Fluoride	–	0.6	Two times higher than BC WQG of 0.3 mg/L[2]
Nitrate N	–	5.8 or 0.4	Two times higher than CCME WQG of 2.9 mg/L, based on aquatic toxicity[2] or Set at 0.4 mg/L to protect from eutrophication effects
Ammonia N	–	11.2 or 1.0	Two times higher than CCME WQG maximum of 5.6 mg/L[2], adjusted for temperature and pH, based on aquatic toxicity or Set at 1.0 mg/L to protect from eutrophication effects
Phosphate P		0.2	Best available technology, to protect from eutrophication effects
TSS	15	–	According to Yukon Water Board permit
Aluminum D	–	0.2	Two times higher than BC WQG for dissolved (0.10 mg/L) rather than CCME WQG for total (0.1 mg/L) [2]
Antimony T	–	0.04	Two times higher than BC WQG of 0.02 mg/L[2]
Arsenic T	0.5	0.01	Two times higher than CCME WQG of 0.005 mg/L[2]
Boron T	–	2.4	Two times higher than BC WQG of 1.2 mg/L[2]
Cadmium T	–	0.0006	Two times higher than draft CCME WQG (2010) of 0.0003 mg/L[2]
Chromium T	–	0.0178	Two times higher than CCME WQG of 0.089 mg/L[2]
Copper T	0.3	0.006	Two times higher than CCME WQG of 0.003 mg/L[2]
Iron T	–	2.0	Two times higher than BC WQG (2008) for total iron of 1.0 mg/L[2], also considers BC WQG for dissolved iron of 0.35 mg/L
Lead T	0.2	0.008	Two times higher than CCME WQG of 0.004 mg/L[2]
Manganese T	–	0.1	Two times higher than BC WQG for drinking water, 0.05 mg/L[2]
Mercury T	–	0.00005	Two times higher than CCME WQG of 0.000025 mg/L[2]
Molybdenum T	–	0.146	Two times higher than CCME WQG of 0.073 mg/L[2]
Nickel T	0.5	0.22	Two times higher than CCME WQG of 0.11 mg/L[2]
Selenium T	–	0.004	Two times higher than BC WQG of 0.002 mg/L[2]
Silver T	–	0.0002	Two times higher than CCME WQG of 0.0001 mg/L[2]
Thallium T	–	0.0016	Two times higher than BC WQG of 0.0008 mg/L[2]
Uranium T	–	0.03	Two times higher than draft CCME WQG of 0.015 mg/L[2]

Parameter[1]	Concentration (mg/L)		Rationale for Assumptions for Treatment Plant Criteria[2]
	MMER Sched. 4[a]	Treatment Plant	
Zinc T	0.5	0.06	Two times higher than CCME WQG of 0.03 mg/L[2]
Radium 226	0.37 Bq/L	NA	
Cyanide (free)	1.0	0.01	Two times higher than CCME WQG of 0.005 mg/L[2]
Cyanide (WAD)		0.02	Two times higher than BC WQG of 0.01 mg/L[2]

NOTE:
Assumptions for Effluent Discharge Criteria are two times higher than WQG or a SSWQO
[1] Dissolved (D) or total (T) metals concentrations, elemental values for nitrate (N), ammonia (N), phosphate (P), sulphate (S)
[a] MMER maximum authorized monthly mean concentration, also includes a requirement for 100% non-acutely lethal effluent (survival of at least 50% of rainbow trout subjected to 100% concentration effluent for a period of 96 hours)
[2] CCME WQG used, with BC WQG substituted if there is no corresponding CCME WQG or if BC WQG are based on more recent scientific evaluation. Effluent criteria set considering the potential for at least 3:1 dilution in Haggart Creek (from 12:1 to 61:1 annually during operations and 3:1 to 57:1 annually during early closure, i.e., draindown of the heap leach facility).

Water quality in the receiving streams will also be protected in the following ways:

- Sediment control ponds will be in place to allow fine sediments to settle out, and will be sized for a 1:100 year flood event; TSS and/or turbidity will be monitored prior to release.
- Ponds used for sediment control, seepage collection, and feed and product ponds for the mine water treatment plant will be constructed of rockfill and will be HDPE-lined.
- Diversion ditches to keep non-contact water away from mine facilities will be built incorporating erosion protection measures and will be sized for the maximum flow velocities expected (peak flows from a 1 in 100 year storm event, with storm duration consistent with the time of concentration of the local catchment area).
- Contact water from the open pit and waste rock storage areas will be sent to the heap leach facility; excess water will be tested and sent to the mine water treatment plant, if needed.
- Groundwater in contact with the waste rock storage areas will be intercepted in rock drains and sent with the rest of the contact water to the heap leach facility or the mine water treatment plant.
- Sewage from the camp will be treated to meet Yukon guidelines, and water quality will be monitored at the outlet of the drainage field.
- The HLF is designed with a double liner in the upper area, triple liner in the lower area, leak detection and recovery system, seepage collection, and collection of groundwater from below the HLF.
- The detoxification plant for removal of cyanide from heap leach solution will be built for the operations phase to handle any potential releases of solution containing cyanide.

6.5.3.3 Residual Environmental Effects of Site Discharges during Operations

Discharge of Mine Water Treatment Plant Effluent to Haggart Creek

Effects on Water Quality

The potential environmental effects of discharge of treated effluent from the mine water treatment plant into Haggart Creek were estimated using effluent quality criteria (Table 6.5-14) and predicted water chemistry in Haggart Creek for W22 (Table 6.5-6, to account for diversion of Dublin Gulch into Eagle Creek). The predicted water quality year-round in Haggart Creek for a wet year in Year 9, when inputs to the treatment plant will be at a maximum during operations, is presented in Table 6.5-15 for W4 (downstream of the effluent discharge) and in Table 6.5-16 for W29 (downstream of Platinum Gulch and all Project discharges). Results for Year 9 are modeled beginning in October and running through September. Modeling results indicate that a wet year would yield the highest peak concentrations, as indicated in Figure 6.5-5. Although it might be presumed that a dry year would have higher concentrations, due to the lower dilution potential, the model results indicate the reverse. This result is due to the higher volumes of water treated in a wet year, relative to Haggart Creek.

Results for major anions and cations are not shown in Tables 6.5-15 and 6.5-16. These results, like others in this assessment are conservative. They were estimated from the source terms, by assuming they are less than the maxima calculated for waste rock storage areas and the open pit (Appendix 8). For example, pH is predicted to be 7.0 to 7.5. During operations, the maximum concentrations of major anions and cations in water entering the treatment plant are predicted to be alkalinity about 106 to 320 mg/L, chloride 3 to 14 mg/L, calcium 82 to 460 mg/L, magnesium 6 to 73 mg/L, potassium 12 to 43 mg/L, and sodium 2 to 11 mg/L. Assuming these are diluted in Haggart Creek up to 41:1 in May and October and as little as 12:1 during the summer (Table 6.5-15), the maximum concentrations can be estimated by dividing the maximum source term concentration by the lowest dilution. This suggests additions of alkalinity (26 mg/L), chloride (2 mg/L), calcium (38 mg/L), magnesium (6 mg/L), potassium (4 mg/L) and sodium (2 mg/L) would occur during June through September. These would be added to baseline (Table 6.5-6), and indicate a change of alkalinity (up to 35% higher over summer but within annual range), chloride (up from 0.25 mg/L year round), calcium and magnesium (up to 100% higher over summer, and beyond annual variation), and potassium and sodium (up from 1 mg/L to 4 to 6 mg/L). These parameters do not have CCME WQG, (although there is now a draft WQG for chloride), as they occur naturally in wide ranges of concentrations in Canadian watercourses.

In Haggart Creek, the only parameters predicted to exceed WQG during operations are those that already exceed in baseline: aluminum in freshet and manganese in winter at both W4 and W29, and also arsenic at W29 (due to inputs from Dublin Gulch and Eagle Creek, which are naturally high in arsenic). The range of these values is predicted to be similar to the baseline range. Nitrogen levels will not change markedly due to discharges from the mine water treatment plant, but phosphate levels are predicted to increase.

Table 6.5-15: Predicted Flows (average) and Water Quality (maximum) in Haggart Creek (Site W4) Below the Initial Dilution Zone of the Mine Water Treatment Plant Effluent during Operations, Year 9

Parameter[1]	Mean Monthly Concentration (mg/L, unless indicated)												WQG[2] (mg/L)	Max/ WQG
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Flow (m^3/s)	0.179	0.146	0.113	0.117	1.05	0.823	0.664	0.643	0.769	0.689	0.415	0.282		
Dilution Factor	No flow	No flow	No flow	No flow	41	12	17	18	23	61	No flow	No flow		
Sulphate S	77	77	84	55	29	57	63	71	57	64	70	77	100	0.8
Fluoride	0.103	0.103	0.117	0.094	0.082	0.103	0.122	0.126	0.100	0.084	0.089	0.103	0.30	0.4
Nitrate N	0.126	0.126	0.121	0.120	0.045	0.101	0.071	0.063	0.081	0.108	0.132	0.126	2.9	0.0
Ammonia N	0.005	0.005	0.007	0.003	0.009	0.081	0.058	0.060	0.046	0.010	0.003	0.005		
Phosphate TP	0.006	0.006	0.010	0.003	0.021	0.018	0.018	0.012	0.012	0.005	0.001	0.006		
Aluminum T	0.007	0.007	0.008	0.013	**0.226**	0.047	0.028	0.016	0.028	0.010	0.007	0.007	0.10	**2.3**
Antimony T	0.0002	0.0002	0.0002	0.0003	0.0012	0.0034	0.0025	0.0024	0.0019	0.0009	0.0003	0.0002	0.02	0.2
Arsenic T	0.0007	0.0007	0.0007	0.0037	0.0027	0.0026	0.0023	0.0020	0.0012	0.0013	0.0007	0.0007	0.005	0.7
Boron T	0.028	0.028	0.005	0.005	0.006	0.029	0.021	0.014	0.021	0.020	0.050	0.028	1.2	<1
Cadmium T	0.00001	0.00001	0.00002	0.00002	0.00005	0.00006	0.00004	0.00004	0.00003	0.00002	0.00001	0.00001	0.0003	0.2
Chromium T	0.0004	0.0004	0.0003	0.0003	0.0008	0.0017	0.0012	0.0012	0.0010	0.0006	0.0005	0.0004	0.0089	0.2
Copper T	0.0004	0.0004	0.0002	0.0002	0.0019	0.0011	0.0007	0.0007	0.0008	0.0005	0.0005	0.0004	0.003	0.6
Iron T	0.078	0.078	0.089	0.142	0.598	0.204	0.139	0.095	0.112	0.063	0.066	0.078	1.0	0.6
Lead T	0.00003	0.00003	0.00003	0.00003	0.00046	0.00077	0.00047	0.00045	0.00035	0.00007	0.00003	0.00003	0.004	0.2
Manganese T	**0.0855**	**0.0855**	**0.128**	**0.0847**	**0.0650**	0.0422	0.0441	0.0321	0.0350	0.0242	0.0430	**0.0855**	0.05	**2.6**
Mercury T	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00002	0.00002	0.00003	0.00001	0.00001	0.00003	1.0
Molybdenum	0.00028	0.00028	0.00007	0.00004	0.00156	0.00634	0.00409	0.00407	0.00303	0.00112	0.00050	0.00028	0.073	0.1
Nickel T	0.0015	0.0015	0.0017	0.0018	0.0049	0.0180	0.0131	0.0126	0.0098	0.0012	0.0012	0.0015	0.110	0.2
Selenium T	0.0005	0.0005	0.0005	0.0005	0.0006	0.0008	0.0006	0.0006	0.0006	0.0006	0.0005	0.0005	0.002	0.4
Silver T	0.00001	0.00001	0.00001	0.00001	0.00001	0.00002	0.00003	0.00002	0.00002	0.00001	0.00001	0.00001	0.0001	0.3
Thallium T	0.00008	0.00008	0.00005	0.00005	0.00008	0.00018	0.00012	0.00012	0.00011	0.00008	0.00010	0.00008	0.0008	0.2
Uranium T	0.0012	0.0012	0.0014	0.0013	0.0011	0.0029	0.0023	0.0024	0.0019	0.0013	0.0011	0.0012	0.015	0.2
Zinc T	0.0065	0.0065	0.0027	0.0054	0.0056	0.0065	0.0051	0.0044	0.0043	0.0017	0.0103	0.0065	0.03	0.3
Cyanide WAD	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.005	0.5

[1] Total (T) metals concentrations, elemental values for nitrate (N), ammonia (N), phosphate (P), sulphate (S)

[2] CCME WQGs for protection of aquatic life, with these exceptions: CCME drinking water (Sb, Tl), BC aquatic life (Fe, Se, SO_4, F^-), BC drinking water (Mn), draft CCME (Cd, U)

Table 6.5-16: Predicted Flows (average) and Water Quality (maximum) in Haggart Creek (Site W29) Below the Initial Dilution Zone of the Eagle Creek and Platinum Gulch Waste Rock Storage Area during Operations, Year 9

Parameter[1]	Mean Monthly Concentration (mg/L, unless indicated)												WQG[2] (mg/L)	Max/ WQG
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Flow (m^3/s)	0.208	0.169	0.131	0.136	1.245	0.988	0.928	0.798	0.948	0.848	0.485	0.328		
Sulphate S	72	72	78	51	27	53	52	63	52	58	65	72	100	0.8
Fluoride	0.098	0.098	0.115	0.094	0.084	0.101	0.110	0.120	0.100	0.084	0.082	0.098	0.30	0.4
Nitrate N	0.124	0.124	0.123	0.119	0.044	0.095	0.060	0.055	0.073	0.100	0.125	0.124	2.9	0.0
Ammonia N	0.004	0.004	0.006	0.003	0.009	0.073	0.045	0.051	0.040	0.010	0.003	0.004		
Phosphate TP	0.006	0.006	0.010	0.003	0.026	0.017	0.016	0.011	0.011	0.005	0.001	0.006		
Aluminum T	0.016	0.016	0.025	0.015	**0.342**	0.052	0.039	0.022	0.033	0.012	0.008	0.017	0.10	**3.4**
Antimony T	0.0004	0.0004	0.0005	0.0005	0.0012	0.0032	0.0023	0.0023	0.0019	0.0010	0.0004	0.0004	0.02	0.2
Arsenic T	0.0049	0.0049	**0.0052**	**0.0072**	**0.0061**	**0.0055**	**0.0099**	**0.0075**	**0.0063**	**0.0060**	0.0048	0.0050	0.005	**2.0**
Boron T	0.026	0.026	0.007	0.005	0.008	0.030	0.024	0.015	0.021	0.019	0.045	0.026	1.2	<1
Cadmium T	0.00001	0.00001	0.00002	0.00002	0.00004	0.00005	0.00004	0.00004	0.00003	0.00002	0.00001	0.00001	0.0003	0.2
Chromium T	0.0004	0.0004	0.0003	0.0003	0.0008	0.0016	0.0011	0.0011	0.0009	0.0006	0.0005	0.0004	0.0089	0.2
Copper T	0.0004	0.0004	0.0003	0.0003	0.0018	0.0011	0.0007	0.0007	0.0008	0.0005	0.0005	0.0004	0.003	0.6
Iron T	0.084	0.084	0.105	0.133	0.599	0.196	0.132	0.094	0.111	0.063	0.064	0.084	1.0	0.6
Lead T	0.00003	0.00003	0.00003	0.00003	0.00047	0.00072	0.00042	0.00040	0.00032	0.00008	0.00003	0.00003	0.004	0.2
Manganese T	**0.0774**	**0.0773**	**0.1154**	**0.0764**	**0.0603**	0.0409	0.0411	0.0323	0.0334	0.0240	0.0394	**0.0774**	0.05	**2.3**
Mercury T	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00002	0.00001	0.00002	0.00001	0.00001	0.00003	0.9
Molybdenum	0.00047	0.00047	0.00030	0.00028	0.00157	0.00588	0.00364	0.00375	0.00290	0.00127	0.00065	0.00047	0.073	0.1
Nickel T	0.0014	0.0014	0.0016	0.0017	0.0045	0.0162	0.0101	0.0106	0.0085	0.0012	0.0011	0.0014	0.110	0.1
Selenium T	0.0005	0.0005	0.0005	0.0005	0.0006	0.0007	0.0006	0.0006	0.0006	0.0005	0.0005	0.0005	0.002	0.4
Silver T	0.00001	0.00001	0.00001	0.00001	0.00001	0.00002	0.00002	0.00002	0.00002	0.00001	0.00001	0.00001	0.0001	0.2
Thallium T	0.00007	0.00007	0.00005	0.00005	0.00007	0.00017	0.00010	0.00011	0.00010	0.00008	0.00010	0.00007	0.0008	0.2
Uranium T	0.0011	0.0011	0.0013	0.0013	0.0011	0.0027	0.0020	0.0022	0.0018	0.0013	0.0010	0.0012	0.015	0.2
Zinc T	0.0062	0.0062	0.0029	0.0054	0.0058	0.0066	0.0051	0.0045	0.0045	0.0023	0.0096	0.0063	0.03	0.3
Cyanide WAD	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.005	0.5

[1] Total (T) metals concentrations, elemental values for nitrate (N), ammonia (N), phosphate (P), sulphate (S)
[2] CCME WQGs for protection of aquatic life, with these exceptions: CCME drinking water (Sb, Tl), BC aquatic life (Fe, Se, SO_4, F^-), BC drinking water (Mn), draft CCME (Cd, U)

Phosphate levels in Haggart Creek are predicted to be higher during operations than at baseline, due to passage of contact water from the waste rock storage areas (where it will pick up phosphate) through the mine water treatment plant, which will be able to treat down to 0.2 mg P/L. The predicted range for the June through September growing season is 0.012 to 0.021 mg P/L at W4, slightly more at W29, for a wet scenario (worst case). In average and dry years of operations, predicted levels are 0.015 mg P/L or less (Figure 6.5-5). Mean baseline values are 0.002 to 0.007 during summer (Table 6.5-6). This suggests levels in operation could be up to six times higher than in baseline in some years, although it is noted that the comparison does not take into account the role of phosphate uptake by periphyton for operations as it does for baseline.

Nitrogen levels in Haggart Creek are also predicted to be higher during operations that at baseline, related to inputs of blast residues from the waste rock storage area. Following treatment, the predicted range for June through September at W4 is 0.063 to 0.101 mg N/L for nitrate and 0.046 to 0.081 mg N/L for ammonia. Predicted levels are slightly lower at W29. Overall, the combined nitrogen sources are predicted to be about two times higher than in baseline in some years. As for phosphate, this comparison does not take into account nutrient uptake during operations, although it is taken into account for the baseline conditions.

The residual environmental effects of discharge of effluent from the mine water treatment plant into Haggart Creek are considered neutral in direction, negligible to low in magnitude for metals and nutrients, regional in extent (beyond the confluence of Platinum Gulch), continuous, and long term in duration (throughout operations). The effect has a moderate likelihood of occurring (given the conservative predictions) and would be reversible when discharge ceases. The effluent will also result in some increases in levels of major anions and cations (e.g., hardness, sodium, chloride), increasing the conductivity or ionic strength of the water. These changes are not expected to result in toxicity. Discharges will occur in an area already disturbed by placer mining. Any predicted changes in water quality of Haggart Creek will be assessed through monitoring of both surface water quality and groundwater.

Effects on Aquatic Biota

The predicted increase in major anions and cations will not result in toxicity (no WQG are applicable), but will result in a general change in water chemistry (higher total dissolved solids). Aquatic communities typically adapt to such changes, although there may be some changes as organisms more tolerant of a wide range of conditions become predominant. Organisms in Haggart Creek are already adapted to harder water and higher sulphate compared to other streams in the area, and the effect is likely to be neutral.

Baseline total phosphate levels in Haggart Creek range from 0.002 to 0.007 mg/L during the growing season. With baseline nitrate levels of 0.043 to 0.075 mg/L and ammonia levels of 0.003 to 0.006 mg/L over that period, it is likely that phosphate is the limiting nutrient for periphyton growth. Hence, additional phosphate and nitrogen will introduce the potential for increased productivity, which is likely to be beneficial to aquatic communities, including fish, but is not likely to trigger eutrophication (extensive periphyton mats that could smother the substrates, affecting benthic invertebrates and fish habitat).

The 2004 CCME document "Phosphorus: Canadian Guidance Framework for the Management of Freshwater Systems" provides total phosphorus triggers for Canadian waterbodies (Table 6.5-17), although the framework is considered to be more applicable to lakes than to rivers. Further work to refine triggers for rivers was done for the CCME by Gartner Lee (2006), and these numbers are also included in Table 6.5-17. Although the Gartner Lee work references Ontario rivers, it is applicable across Canada, as it covers a wide range of naturally occurring phosphate levels.

Table 6.5-17: Phosphorus and Nitrogen Trigger Ranges for Canadian Lakes and Rivers

Trophic Status	Trigger Ranges for Total Phosphorus (mg P/L)		Trigger Ranges for Total Nitrogen (mg N/L) (Alexander and Smith 2006)
	For Lakes (CCME 2004)	For Rivers (Gartner Lee 2006)	
Ultra-oligotrophic	< 0.004		
Oligotrophic	0.004 to 0.010	<0.025	<0.70 mg/L
Mesotrophic	0.010 to 0.020	0.025 to 0.075	
Meso-eutrophic	0.020 to 0.035		<1.5 mg/L
Eutrophic	0.035-0.100	>0.075	
Hyper-eutrophic	>0.1100		

A classification system for trophic levels referring to nitrogen was developed by Dodds, et al. (1998) and evaluated for long term data sets of streams and rivers in the United States (Alexander and Smith 2006). This system provides rationale for the boundary between oligotrophic and mesotrophic (0.7 mg N/L) and between mesotrophic and eutrophic (1.5 mg/L). Although not measured and reported on directly for baseline (Table 6.5-6), total nitrogen (nitrate plus ammonia plus organic N) is likely to be at the boundary between oligotrophic and mesotrophic for Haggart Creek.

Based on Gartner Lee (2006), Haggart Creek would remain in the oligotrophic category for phosphate. Also the response of periphyton to the increase in phosphate would be constrained by the availability of nitrogen, for which a smaller increase (two-fold) is predicted during operations. Physical factors such as flows and spate events would periodically wash the accumulated periphyton downstream. For the wet scenario modeled, for example, much of the accumulated periphyton would be washed out periodically in the rain events. During average or dry flow scenarios, the maximum phosphate levels are predicted to be lower (maximum of 0.20 mg P/L) than for the Year 9 wet scenario (Figure 6.5-5).

Because the assessment of biological responses is complicated, and not controlled by just one factor, monitoring of water chemistry and aquatic biota, and comparison to predictions is important. There is time, within the operations phase, to adapt the management approach based on the results, for example by changing the phosphate treatment criteria at the mine water treatment plant. Options available for mitigating effects are described in Section 6.5.3.2.

The residual environmental effects of effluent discharge on benthic algae and invertebrate communities are predicted to be adverse, low to moderate in magnitude through Haggart Creek downstream to Lynx Creek (regional extent), continuous (but expressed seasonally), and will occur through the operations phase (long-term). The effect has a moderate likelihood of occurring (given the conservative predictions) and would be reversible (when discharge ceases). Given that placer mining has occurred in the tributaries of Haggart Creek, the change will occur in an area already disturbed by human activities. The significance of these effects is addressed in Section 6.5.3.4.

Movement of Groundwater Affected by Contact Water

Contact water that seeps from the two waste rock storage areas into groundwater is predicted to move to Dublin Gulch diversion channel or Haggart Creek within one year, with no movement into deeper groundwater predicted. The concentration of seepage in groundwater is expected to be low (less than 1% in most areas and not greater than 4%). That means if the concentration of a particular parameter in the seepage is less than 25 to 100 times WQG, the concentration at the stream would be at or less than WQG. The main parameter of interest in seepage is arsenic, given that Tables 6.5-10 and 6.5-11 predict worst-case arsenic levels at 0.86 and 1.28 mg/L in Platinum Gulch and Eagle Pup waste rock storage area seepage, respectively. Although much higher than the CCME WQG, the elevated arsenic levels should be compared to the SSWQO that would be developed to reflect baseline conditions (0.02 mg/L in Haggart Creek, four times higher than CCME WQG, and 0.07 mg/L for Dublin Gulch, 14 times higher than WQG). Use of the SSWQO would bring the worst case predictions for arsenic in seepage to the range expected for the streams to meet SSWQO (about 43 times higher for Platinum Gulch into Haggart and 18 times higher for Eagle Pup into Dublin Gulch).

Residual environmental effects of movement of deep groundwater affected by contact water are expected to be neutral in direction, negligible in magnitude, local in geographic extent, continuous, and in perpetuity. The effect would be expressed in an area already disturbed by placer mining and, once begun, would be irreversible, in that seepage from waste rock storage areas would continue even when the areas are reclaimed. No increase in arsenic or other concentrations to higher than guidelines would be predicted for the streams as a result this interaction. Given the conservatism built into the modeling approach, and the additional attenuation processes in soil that bind metals, there is a high degree of confidence in this prediction. Quality of groundwater and surface water will be monitored during operations, to assess accuracy of this prediction.

6.5.3.4 Determination of Significance of Site Discharges during Operations

The environmental effect of effluent discharge from the mine water treatment plant on water quality and aquatic biota of Haggart Creek or of seepage of contact water into groundwater then into streams during operations is considered not significant. The effluent discharges will meet regulatory requirements for effluent and for receiving waters of Haggart Creek, Dublin Gulch diversion channel, and Eagle Creek (MMER, Yukon Water Board permits) and the concentrations will not impair the ability of the watercourses to sustain aquatic life.

Contact water will be treated prior to discharge and water quality in Haggart Creek will meet WQG (unless a parameter already exceeds the WQG) or a SSWQO. Many parameters are predicted to remain near baseline levels, and the increase in phosphate levels will not be high enough to trigger a change in trophic status. There is a high probability of the effect occurring, with a moderate degree of confidence in this prediction, given the uncertainties (conservative worst-case predictions) of source terms, which tend to overestimate the modeled concentrations in the streams. There is a high degree of confidence in baseline conditions in the streams and effectiveness of mitigations incorporated in the treatment technologies for the mine water treatment plant (described in Section 6.5.3.2).

6.5.4 Assessment of Site Discharges during Closure and Post-closure

At the end of mine operations, the site will be decommissioned and reclaimed, as described in Appendix 24 from Year 10 through Year 19. Some drainage ditches and portions of the Dublin Gulch diversion channel will be stabilized for long-term use. Water routing during reclamation is described in the Water Management Plan (Appendix 18).

The overall design objective is a closure condition that does not require ongoing maintenance, with monitoring until it is demonstrated the remediation measures have achieved the required outcomes. Potential site discharges are described in Section 6.5.4.1, with mitigations identified in Section 6.5.4.2 and residual environmental effects described in Section 6.5.4.3. The following overview of the Conceptual Closure and Reclamation Plan is relevant to water quality:

- Platinum Gulch waste rock storage area will be capped and reclaimed, with seepage going to the open pit sump and mine water treatment plant until about Year 14, after which seepage and surface runoff will be directed to Platinum Gulch, then Haggart Creek upstream of W29.
- The open pit will be closed in Year 10, and open pit water will go to the mine water treatment plant until about Year 16, after which open pit water will be directed to Platinum Gulch then Haggart Creek upstream of W29.
- The Eagle Pup waste rock storage area will be capped and reclaimed in Year 11, with seepage and surface runoff directed into the Dublin Gulch diversion channel, then into Eagle Creek and Haggart Creek upstream of W29.
- The heap leach facility will be reclaimed after about one year of additional gold recovery and several years of rinse and draindown. During this time, draindown water will be treated at a detoxification plant for cyanide destruction and all contact water will be treated at the mine water treatment plant prior to discharge to Haggart Creek at W4. After the majority of draindown has occurred, the HLF will be covered and revegetated. Seepage will go to Haggart Creek at W4.
- Monitoring of site discharges is anticipated to continue for at least 15 years (to Year 25).

Environmental effects of the Project on water quality and aquatic biota during and after closure are assessed in terms of discharges directly to Haggart Creek and to Dublin Gulch and Eagle Creek, and indirectly through seepage of metals into groundwater and transport to the streams.

6.5.4.1 Description of Site Discharges during Closure and Post-closure

From Platinum Gulch Waste Rock Storage Area and Open Pit to Platinum Gulch

Platinum Gulch waste rock storage area will be the first area reclaimed, and monitoring will provide useful information for adjusting the Closure and Reclamation Plan. In Year 6, the waste rock storage area will be re-contoured and reclaimed with a soil cover (Appendix 24). In Years 6 through 9, contact water (water infiltrating the cover, groundwater) will continue to be collected and sent to the open pit sump, then the HLF for process water (given the low dilution potential in the intermittently flowing Platinum Gulch), or to the mine water treatment plant. Non-contact run-off will be collected in the sediment control pond and flow into Platinum Gulch. Water quality in seepage from the waste rock storage area will be monitored and performance of the soil cover assessed. During closure (about Year 14), a channel will be built from the seepage collection pond to Platinum Gulch and seepage will flow into Platinum Gulch, then to Haggart Creek upstream of W29.

In Year 10, extraction from the open pit will cease, and a small pit lake will form as it fills with precipitation and runoff (Appendix 18). Much of the open pit wall will remain exposed above the pit lake surface. The pit lake will be about 130,000 m^3 in volume after, 25,000 m^2 in surface area (2.5 ha), and 20 m in depth. It will take one season to fill (by the middle of Year 11), given the estimated average annual inflow of 255,000 m^3. Initially, this contact water will be sent to the mine water treatment plant; however, by about Year 16, open pit discharges will flow into the Platinum Gulch seepage collection pond or, if required, a passive engineered treatment system at the seepage collection pond.

Open pit water quality will be influenced primarily by contact of rainwater with the open pit walls (given that 90% of the inflow will come from that runoff) and by groundwater discharged into the open pit. Although geochemical testing (Appendix 8) indicates the open pit walls will not be acid generating, neutral metal leaching is predicted to result in antimony, arsenic, cadmium, selenium, and silver levels two to ten times higher than WQG. Other metals are predicted to be less than two times higher than WQG. Pit lake chemistry is not expected to change through the year, over time, or with changing rainfall scenarios, although the volume discharged will vary through the year. The pit lake will provide some opportunities for settling of suspended sediment and for biogeochemical reactions (e.g., primary production facilitating sedimentation, precipitation of metals) to occur, which will further reduce metals levels beyond those conservative worst case levels predicted.

Retention time of the pit lake can be simplistically assumed to be half a year, given that the estimated average annual inflow is twice the pit lake volume. However, many factors will affect retention time. The high inflow during spring freshet will travel quickly through the pit lake, and may not completely mix vertically. Variations in precipitation would lead to a doubling of overflows during a wet year and a 40% reduction during a dry year, compared to an average year. Amounts of water lost to groundwater have not been quantified, and will affect retention time. Temperature (thermocline) and less likely chemical stratification (chemocline) may prevent full mixing and flushing. Meromictic conditions (where a pit lake has a permanent, unmixed layer) are unlikely, given the shallow (20 m) depth planned. Design of the outlet structure (to be done at the feasibility stage) will control rate of outflow and maximum pit lake depth, so will affect retention time. If the pit lake was designed as aquatic habitat, stratification, retention time, and water quality would be important considerations in the assessment. However, this is not a goal of reclamation, given the predicted ongoing poor water quality and lack of connectivity to fish habitat downstream. The expected poor quality water will be mitigated downstream at Platinum Gulch prior to discharge to Haggart Creek.

Platinum Gulch flows will consist of non-contact water from the diversions and contact water from the waste rock storage area and pit lake. This watercourse is not considered fish habitat, given the intermittent and small baseline flows. Quality of contact water was modeled assuming a soil cover on the waste rock storage area that allows 20% infiltration of net precipitation.

From Eagle Pup Waste Rock Storage Area to Dublin Gulch Diversion Channel

Eagle Pup waste rock storage area will be reclaimed in Years 10 and 11 by re-contouring and capping, with seepage released to Dublin Gulch diversion channel then Eagle Creek. Quality of contact water is expected be similar to or slightly better than that shown in Table 6.5-11 for operations; however, amounts of seepage will be much lower than during operations (Figure 6.5-4).

From Heap Leach Facility to Mine Water Treatment Plant – Draindown

During closure, the heap leach facility will be rinsed and cyanide and metals removed prior to discharge to surface waters. Reclamation of the heap leach facility will include:

- **Year 10**—gold recovery (remaining leach solution recycled through HLF to recover any remaining gold); stabilization of Ann Gulch diversion ditches with existing pathways; maintenance of Ann Gulch sediment control pond until WQG are met (anticipated to be Year 15).
- **Years 11 and 12**—rinsing and detoxification to remove cyanide (Year 11 is recycling of solution within the HLF; Year 12 is adding neutralized solution and raw water). The cyanide detoxification plant will use hydrogen peroxide and copper sulfate to reduce the cyanide concentration below 0.2 mg/L WAD cyanide and 2.0 mg/L total cyanide, as described in Appendix 24. The detoxification plant will also remove ammonia and nitrate. Test work will continue during design and operations to gain a better understanding of HLF effluent quality.
- **Years 13 through 19**—recontouring and capping of the HLF starting in Year 13 and draindown in Years 13 to 16 (longer if required). Drained and detoxified water will be sent to the mine water treatment plant for removal of metals and nitrogen while draindown volumes are high (Years 13 to 16), with treated effluent discharged to Haggart Creek as for operations. After the peak of draindown (and confirmed through testing of seepage quality), the mine water treatment plant will be decommissioned. The leak detection and recovery system will remain in place and will discharge into the general draindown collection system for treatment.

The Surface Water Balance (Appendix 21) indicates that the mine water treatment plant will handle large volumes of draindown water in Years 13 through 15:

- Peak discharge from the mine water treatment plant (380,000 m^3/month) will occur in July of Year 13.

- After that, discharge will range from about 25,000 to 250,000 m^3/year between April and November, decreasing between Year 13 and Year 15.
- During winter, monthly average discharge from the mine water treatment plant will be about 5,000 to 10,000 m^3/month the first winter and less than 5,000 m^3/month in subsequent winters.

Until about Year 16, the mine water treatment plant will be in place to reduce levels of metals, phosphorus and nitrogen in discharge from the heap leach facility. The mine water treatment plant will remain until water quality objectives for cyanide, nitrate and ammonia can be achieved. After that, discharges from the reclaimed HLF will be released to Haggart Creek.

Quality of detoxified HLF contact water (either as influent to the mine water treatment plant or as seepage to a passive engineered treatment system) was predicted based on results of a standard humidity cell conducted on a composite ore sample provided by Kappes Cassidy and Associates and a modified humidity column of spent ore composite sample following cyanidation and detoxification in a metallurgical test column (see Appendix 8). The short-term results of these tests were used to predict inputs to the mine water treatment plant, shown in Table 6.5-18, which reflects mainly inputs from HLF draindown starting in Year 13, with some contributions from the open pit and Eagle Pup waste rock storage area.

The surface water balance model included wet, dry and average scenarios to assess their influence on draindown volumes. The water quality model also assessed the three flow scenarios for Year 13.

Levels of sulphate, antimony, aluminum, copper, lead, selenium and uranium in contact water are predicted to be between 20 and 250 times higher and arsenic is predicted to be 1,000 times higher than WQG during Year 13. Untreated, these levels of metals would likely produce a discharge acutely lethal to rainbow trout and *Daphnia magna* (commonly used for acute toxicity tests), and would be considered a deleterious substance under the federal *Fisheries Act*.

The mine water treatment plant and cyanide detoxification plant will remain in place until contact water is suitable for release. Mine water treatment plant effluent quality criteria listed in Table 6.5-14 for operations will also apply during closure.

Table 6.5-18: Predicted Flow (average) and Water Quality (maximum) of Influent Water to Mine Water Treatment Plant during Closure, Year 13

Parameter[1]	Mean Monthly Concentration (mg/L, unless indicated)												WQG[2] (mg/L)	Max/ WQG
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Flow (m^3/s)	0.003	0.003	0.002	0.012	0.089	0.058	0.142	0.084	0.062	0.032	0.009	0.004		
Sulphate	**2310**	**2230**	**2170**	**1010**	**480**	**569**	**2410**	**2260**	**2090**	**1860**	**2380**	**2360**	100	**24**
Fluoride	**1.98**	**1.92**	**1.86**	**1.12**	**0.725**	**0.956**	**2.15**	**2.05**	**1.91**	**1.74**	**2.10**	**2.03**	0.30	**7**
Nitrate N	**28.6**	**27.7**	**26.8**	**12.0**	**5.29**	**4.43**	**29.5**	**27.7**	**25.6**	**22.3**	**28.6**	**29.3**	2.9	**10**
Ammonia N	0.820	0.793	0.769	0.344	0.155	0.124	0.842	0.792	0.731	0.637	0.818	0.839		
Phosphate P	0.109	0.108	0.108	0.303	0.366	0.396	0.201	0.258	0.278	0.310	0.350	0.110		
Aluminum T	**2.15**	**2.08**	**2.02**	**1.16**	**1.19**	**0.396**	**2.20**	**2.09**	**1.92**	**1.68**	**2.15**	**2.21**	0.10	**22**
Antimony T	**1.39**	**1.35**	**1.31**	**0.614**	**0.311**	**0.465**	**1.50**	**1.39**	**1.30**	**1.17**	**1.50**	**1.42**	0.02	**75**
Arsenic T	**4.94**	**4.78**	**4.64**	**2.13**	**1.01**	**1.06**	**5.13**	**4.81**	**4.45**	**3.92**	**5.04**	**5.06**	0.005	**1030**
Boron T	0.411	0.397	0.385	0.191	0.104	0.099	0.428	0.404	0.374	0.329	0.414	0.420	1.2	0.4
Cadmium T	**0.00309**	**0.00298**	**0.00289**	**0.00146**	**0.00088**	**0.00200**	**0.00355**	**0.00321**	**0.00303**	**0.00285**	**0.00469**	**0.00316**	0.0003	**16**
Chromium T	0.0031	0.0030	0.0029	0.0088	**0.0098**	**0.0139**	0.0067	0.0088	**0.0096**	**0.0110**	**0.0133**	0.0032	0.0089	**1.6**
Copper T	**0.0917**	**0.0886**	**0.0859**	**0.0448**	**0.0263**	**0.0348**	**0.0989**	**0.0927**	**0.0861**	**0.0776**	**0.0982**	**0.0939**	0.003	**33**
Iron T	0.630	0.609	0.589	0.593	**1.13**	0.310	0.674	0.649	0.609	0.539	0.728	0.654	1.0	**1.1**
Lead T	**0.155**	**0.150**	**0.146**	**0.0658**	**0.0303**	**0.0319**	**0.162**	**0.152**	**0.141**	**0.1237**	**0.159**	**0.159**	0.004	**41**
Manganese T	**0.539**	**0.525**	**0.513**	**0.242**	**0.129**	**0.235**	**0.574**	**0.527**	**0.496**	**0.456**	**0.630**	**0.547**	0.05	**13**
Mercury T	**0.00033**	**0.00032**	**0.00031**	**0.00017**	**0.00010**	**0.00010**	**0.00035**	**0.00033**	**0.00031**	**0.00027**	**0.00034**	**0.00034**	0.00003	**13**
Molybdenum	**0.166**	**0.160**	**0.156**	**0.0908**	0.0567	0.0707	**0.177**	**0.169**	**0.156**	**0.142**	**0.173**	**0.169**	0.073	**2.4**
Nickel T	0.0112	0.0109	0.0106	0.0186	0.0265	**0.118**	0.0398	0.0601	0.0578	0.0923	**0.182**	0.0114	0.110	**1.7**
Selenium T	**0.183**	**0.177**	**0.172**	**0.0783**	**0.0365**	**0.0387**	**0.191**	**0.179**	**0.166**	**0.146**	**0.188**	**0.188**	0.002	**96**
Silver T	**0.0246**	**0.0237**	**0.0230**	**0.0107**	**0.00507**	**0.00467**	**0.0254**	**0.0240**	**0.0221**	**0.0194**	**0.0247**	**0.0251**	0.0001	**255**
Thallium T	0.00034	0.00033	0.00032	0.00063	0.00067	**0.00088**	0.00053	0.00063	0.00067	0.00072	0.00079	0.00034	0.0008	**1.1**
Uranium T	**0.3031**	**0.293**	**0.285**	**0.137**	**0.0712**	**0.121**	**0.329**	**0.304**	**0.285**	**0.260**	**0.334**	**0.310**	0.015	**22**
Zinc T	**0.469**	**0.453**	**0.439**	**0.201**	**0.0991**	**0.111**	**0.492**	**0.460**	**0.426**	**0.377**	**0.485**	**0.480**	0.03	**16**

[1] Total (T) metals concentrations, elemental values for nitrate (N), ammonia (N), phosphate (P), sulphate (S)

[2] CCME WQGs for protection of aquatic life, with these exceptions: CCME drinking water (Sb, Tl), BC aquatic life (Fe, Se, SO_4, F^-), BC drinking water (Mn), draft CCME (Cd, U)

From Heap Leach Facility to Haggart Creek—Short- and Long-term

During the first few years of draindown, contact water from the HLF will require detoxification of cyanide and cyanate and removal of metals and nitrogen, given the quantity and quality of contact water. The cyanide detoxification plant is described in the Project Description (Section 5). The timing for removal of the mine water treatment plant and detoxification plant will be established based on monitoring of seepage quality and quantity. For effluent or seepage to be discharged to fish-bearing waters, it must not be acutely toxic to fish (*Fisheries Act*), and this may require additional treatment.

Once the draindown volume has decreased and there has been sufficient rinsing of the HLF, the mine water treatment plant will be removed. The Surface Water Balance (Appendix 21) indicates flows from the reclaimed HLF will remain low during closure (Figure 6.5-4), in the range of 2,500 to 21,500 m^3/month between April and October for an average year (more or less for a wet or dry year). This range was predicted based on a reclamation cover that allows 10% infiltration of net precipitation (Appendix 24). Dilution potential in Haggart Creek is estimated to be about 16:1 or greater during April through October.

There are three questions relevant to fate of heap seepage during closure and to an evaluation of any need for further treatment: 1) Does it meet MMER Schedule 4 discharge criteria?; 2) Is it acutely toxic to fish?; and 3) If not toxic, does dilution of seepage in Haggart Creek maintain water quality WQG or SSWQO?

The geochemical testing of heap materials (Appendix 8) provides information useful in assessing potential acute toxicity to fish, given that no recent toxicity tests have been done on leachate from the tests. Toxicity tests were done on detoxification plant effluent in the 1990s (Hallam Knight Piésold 1996d).

Geochemical predictions for seepage from the reclaimed HLF are provided in Table 6.5-19. These values were estimated for two time frames of post-closure:

- Short-term (considered to be roughly 10 to 30 years, given an estimate of 10 to 15 years for flushing one pore volume through the HLF, and to allow two volumes to be flushed).
- Long-term (several decades after detoxification of the HLF) reflecting ongoing chemical reactions in sulphide-bearing minerals).

Table 6.5-19: Predicted Seepage Quality from Reclaimed Heap Leach Facility Post-closure, with a Cap that Allows 10% Infiltration

Parameter	Concentration (mg/L unless noted)			
	Short-term	Long-term	WQG or SSWQO	MMER Schedule 4
pH (standard units)	7.5	7.5	6.5 to 9.5	6.0 to 9.5
Sulphate	294	239	100	–
Alkalinity as HCO_3	72	72	–	–
Chloride	4	4	–	–
Fluoride	0.32	0.30	0.3	–

Parameter	Concentration (mg/L unless noted)			
	Short-term	Long-term	WQG or SSWQO	MMER Schedule 4
Nitrate N	3.6[a]	Not measured[1]	2.9	–
Ammonia N	0.108[a]	Not measured[1]	Varies with temperature and pH	–
Phosphorus[2]	0.090	0.122	–	–
Total cyanide	0.20[a]	Not measured[1]	–	–
Weak acid dissociable cyanide	0.02[a]	Not measured[1]	0.010	–
Cyanate	0.1[a]	Not measured[1]	–	–
Aluminum D	1.53	1.28	0.1 (Total, CCME), pH ≥6.5	–
Antimony D	0.17	0.17	0.02	–
Arsenic D	0.634	0.467	0.005 (CCME) 0.020 (SSWQO, Haggart)	0.5
Boron D[2]	0.1	0.1	1.2	–
Calcium D	65	39	–	–
Cadmium D[2]	0.0004	0.0002	0.0003	–
Chromium D[2]	0.001	0.003	0.0089	–
Copper D	0.012	0.013	0.003	0.3
Iron D	0.69	0.67	1.0	–
Lead D	0.019	0.001	0.004	0.2
Magnesium D	8	28	–	–
Manganese D	0.07	0.08	0.05	–
Mercury D [2,3]	0.00006	0.00023	0.00003	–
Molybdenum D	0.02	0.02	0.073	–
Nickel D[3]	0.00	0.01	0.110	0.5
Selenium D	0.02	0.03	0.002	–
Silver D[2]	0.0030	0.0001	0.0001	–
Sodium	73	17	–	–
Thallium D[2]	0.0001	0.0004	0.0008	–
Uranium D	0.04	0.04	0.015	–
Zinc D	0.06	0.02	0.030	0.5

NOTES:

Source: Heap water balance, porewater source terms (Appendix 8), performance criteria for the cyanide detoxification plant (for nitrogen and cyanide compounds).

[a] Higher levels measured in humidity cell tests, but will be reduced in cyanide detoxification plant.(values presented are performance criteria for the detoxification plant)

[1] Not measured—and presumed to be reduced to low levels (leached out in short term closure).

[2] Parameters suffer from detection limit influences, i.e., humidity cell leachate values consistently or often less than detection; scaling of detection limits results in excessively conservative numbers (possibly by an order of magnitude or more).

[3] Analytical issues identified with mercury values are being investigated.

While the values in Table 6.5-19 are conservative worst-case predictions, the levels of arsenic over the short-term (20% higher than the MMER Schedule 4 effluent criterion) are high enough to suggest seepage may not meet regulatory requirements for discharge (i.e., it will be a deleterious substance). Copper, lead, nickel and zinc levels will be less than the MMER effluent criteria. Sulphate levels are predicted to be three times higher than the BC WQG.

During the multi-step rinse phase, cyanide, cyanate, and ammonia will initially be rinsed out of the HLF using recycled detoxification solution that has had these compounds removed in the detoxification plant. Once levels of these compounds have been reduced to an acceptably low level, the second stage of rinsing will use a clean water source (either local ground or surface water or recycled detoxification solution that has been further treated to remove nitrate to a low level). Rinsing of these compounds from the HLF is a physical process, achievable in a short time frame with high efficiency. Table 6.5-19 presents the values for nitrogen species (nitrate, nitrite, ammonia) and cyanide compounds based on performance criteria for the detoxification plant.

Over time, the geochemical testing indicated three trends:

- A decrease over decades (i.e., short-term) in nitrate, ammonia, Al, Ag, Ba, Bi, Ca, Na, Pb, and Zn levels—these constituents are present in pore water, and are released during rinsing of one to two porewater volumes.
- A decrease over several decades, or no decrease (i.e., long-term) in sulphate, alkalinity, chloride, fluoride, As, Cd, Cu, Fe, Mn, Mo, Ni, Se, Sb, and U levels—these are released in chemical reactions from sulphide-bearing minerals over long periods.
- An increase between short-term and long-term for phosphate, Cr, Mg, Hg, Mn, and Tl—due to ongoing chemical reactions from sulphide bearing minerals.

Based on the predictions for arsenic in Table 6.5-19, the need for further treatment of heap seepage post-closure is suggested. Further testing will be required to assess acute toxicity and chemistry of the seepage. This information will be used to further refine the design of post-closure treatment. The acute toxicity of final effluent from a detoxification plant was assessed in 1996 as part of the original work done for the Project (Hallam Knight Piésold 1996d). Three tests were run with rainbow trout (96 hour LC50), using effluent from intermediate stages as well as final effluent at that time. While the intermediate stages of detoxification were toxic to fish, the final effluent was not (LC50 >100% effluent). No further toxicity tests were done.

From Heap Leach Facility to Haggart Creek at W4–Short-term

Water chemistry in Haggart Creek (W4) with discharge of untreated heap seepage was modeled using flows (described in Figure 6.5-4), baseline water quality for Haggart Creek (Table 6.5-5), and seepage quality (Table 6.5-19) for average, wet and dry scenarios (Figure 6.5-5). The highest concentrations predicted are shown in Table 6.5-20 for the short-term (the first several decades).

Table 6.5-20: Predicted Flow (average) and Water Quality (maximum) in Haggart Creek (W4) during the Short-term of Post-closure, 10% Infiltration of the Cover, before or without Passive Engineered Treatment System

Parameter[1]	Mean Monthly Concentration (mg/L, unless indicated)												WQG[2] (mg/L)	Max/ WQG
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Flow (m^3/s)	0.179	0.145	0.112	0.121	1.09	0.821	0.656	0.634	0.760	0.692	0.415	0.282		
Dilution Factor	No flow	No flow	No flow	16	24	29	32	38	47	78	No flow	No flow		
Sulphate S	77	77	84	69	36	53	62	70	56	66	70	77	100	0.8
Fluoride	0.103	0.103	0.117	0.107	0.079	0.068	0.100	0.104	0.084	0.078	0.089	0.103	0.30	0.4
Nitrate/Nitrate	0.126	0.126	0.121	0.330	0.177	0.191	0.156	0.132	0.140	0.151	0.132	0.126	2.9	0.0
Ammonia N	0.005	0.005	0.007	0.008	0.007	0.006	0.006	0.009	0.007	0.011	0.003	0.005		
Phosphate TP	0.006	0.006	0.010	0.003	0.019	0.003	0.007	0.002	0.004	0.002	0.001	0.006		
Aluminum T	0.007	0.007	0.008	0.029	**0.278**	0.057	0.036	0.020	0.033	0.012	0.007	0.007	0.10	**2.8**
Antimony T	0.0002	0.0002	0.0002	0.0105	0.0069	0.0059	0.0054	0.0046	0.0038	0.0024	0.0003	0.0002	0.02	0.5
Arsenic T	0.0007	0.0007	0.0007	**0.0390**	**0.0260**	**0.0218**	**0.0200**	**0.0171**	**0.0141**	**0.0087**	0.0007	0.0007	0.005	**7.8**
Boron T	0.028	0.028	0.005	0.008	0.008	0.029	0.022	0.014	0.021	0.021	0.050	0.028	1.2	<0.1
Cadmium T	0.00001	0.00001	0.00002	0.00004	0.00005	0.00002	0.00002	0.00002	0.00002	0.00002	0.00001	0.00001	0.0003	0.2
Chromium T	0.0004	0.0004	0.0003	0.0003	0.0004	0.0004	0.0003	0.0003	0.0003	0.0003	0.0005	0.0004	0.0089	0.1
Copper T	0.0004	0.0004	0.0002	0.0009	0.0022	0.0010	0.0008	0.0007	0.0008	0.0005	0.0005	0.0004	0.003	0.7
Iron T	0.078	0.078	0.089	0.130	0.597	0.145	0.107	0.056	0.092	0.060	0.066	0.078	1.0	0.6
Lead T	0.00003	0.00003	0.00003	0.00117	0.00105	0.00079	0.00060	0.00051	0.00042	0.00027	0.00003	0.00003	0.004	0.3
Manganese T	**0.0855**	**0.0855**	**0.128**	**0.0833**	**0.0639**	0.0376	0.0412	0.0288	0.0329	0.0240	0.0430	**0.0855**	0.05	**2.6**
Mercury T	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00002	0.00001	0.00003	0.00001	0.00001	0.00003	1.0
Molybdenum	0.00028	0.00028	0.00007	0.00134	0.00087	0.00101	0.00073	0.00062	0.00060	0.00050	0.00050	0.00028	0.073	<0.1
Nickel T	0.0015	0.0015	0.0017	0.0017	0.0025	0.0008	0.0009	0.0008	0.0009	0.0006	0.0012	0.0015	0.110	<0.1
Selenium T	0.0005	0.0005	0.0005	0.0018	0.0014	0.0012	0.0011	0.0010	0.0009	0.0008	0.0005	0.0005	0.002	0.9
Silver T	0.00001	0.00001	0.00001	**0.00019**	**0.00013**	**0.00011**	**0.00011**	0.00009	0.00008	0.00004	0.00001	0.00001	0.0001	**1.9**
Thallium T	0.00008	0.00008	0.00005	0.00005	0.00005	0.00008	0.00005	0.00005	0.00006	0.00007	0.00010	0.00008	0.0008	0.1
Uranium T	0.0012	0.0012	0.0014	0.0035	0.0018	0.0018	0.0018	0.0018	0.0014	0.0013	0.0011	0.0012	0.015	0.2
Zinc T	0.0065	0.0065	0.0027	0.0085	0.0069	0.0037	0.0035	0.0027	0.0031	0.0022	0.0103	0.0065	0.03	0.3
Cyanide WAD	0.0025	0.0025	0.0025	0.0037	0.0033	0.0032	0.0031	0.0030	0.0029	0.0028	0.0025	0.0025	0.005	0.7

[1] Total (T) metals concentrations, elemental values for nitrate (N), ammonia (N), phosphate (P), sulphate (S)
[2] CCME WQGs for protection of aquatic life, with these exceptions: CCME drinking water (Sb, Tl), BC aquatic life (Fe, Se, SO_4, F^-), BC drinking water (Mn), draft CCME (Cd, U)

Elevated levels of the following are predicted for W4:

- Aluminum and manganese, to the same extent and timing noted for baseline
- Arsenic, above WQG April through October; up to 0.039 mg/L (8 times higher than the CCME WQG and 2 times higher than a SSWQO of 0.02 mg/L that will be proposed for Haggart Creek based on baseline conditions)
- Silver, up to 0.00019 mg/L in April (2 times CCME WQG) and just above WQG in May through July.

Nitrate and ammonia levels are predicted to be higher than baseline in Haggart Creek, due to ongoing release of nitrogen from cyanide detoxification. For the June through September growing season, nitrate levels of 0.13 to 0.19 mg N/L (two to three times higher than baseline) and ammonia levels of 0.006 to 0.0009 mg N/L (up to two times higher than baseline) are predicted at W4. This is an increase of two to three times over baseline for total inorganic nitrogen, but these levels are still within the range of oligotrophic conditions (<0.70 mg N/L) discussed in Table 6.5-17. No increase in phosphate levels is predicted compared to baseline (0.002 to 0.007 mg P/L), as seepage is not predicted to contain elevated phosphorus levels.

The levels of nitrate and ammonia would meet CCME WQG, which are based on toxic effects, not eutrophication. Any potential for eutrophication would need to be evaluated in terms of phosphorus as well as nitrogen. Since phosphate levels in Haggart Creek are not predicted to change post-closure, the low phosphate levels will provide protection against eutrophication due to increased nitrogen levels, so no change in trophic status of the creek would be predicted for the reach between W4 and W29.

From Heap Leach Facility to Haggart Creek at W4–Long-term

A similar prediction for long term of closure was made for Haggart Creek at W4 using long-term seepage concentrations (Table 6.5-19), baseline water quality for Haggart (Table 6.5-5), and flows (Figure 6.5-4) for average, wet and dry scenarios. The highest concentrations predicted are shown in Table 6.5-21 and in Figure 6.5-5 for the long-term (for several decades).

During that time, the majority of nitrogen will have been released from the HLF, and seepage water will be dominated by ongoing chemical reactions of sulphide-bearing minerals in the HLF. While levels of many parameters are expected to decrease over the long-term, magnesium levels are predicted to increase. A small decrease in the maximum arsenic level is predicted (0.029 mg/L compared to 0.039 mg/L in short-term), but this is still about 1.5 times higher than a SSWQO for Haggart. Nitrate, ammonia and phosphate levels are predicted to be close to baseline levels. Selenium is predicted to be just above WQG (up to 0.0023 mg/L during April). Other than aluminum and manganese, which exceed WQG at baseline, and arsenic, water quality is predicted to meet WQG or SSWQO in Haggart Creek.

Table 6.5-21: Predicted Flow (average) and Water Quality (maximum) in Haggart Creek (W4) over the Long-term Post-Closure, 10% Infiltration of the Cover, before or without Passive Engineered Treatment System

Parameter[1]	Mean Monthly Concentration (mg/L, unless indicated)												WQG[2] (mg/L)	Max/ WQG
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Flow (m^3/s)	0.179	0.145	0.112	0.121	1.086	0.821	0.656	0.634	0.760	0.692	0.415	0.282		
Dilution Factor	No flow	No flow	No flow	16	24	29	32	38	47	78	No flow	No flow		
Sulphate S	77	77	84	66	34	51	60	68	54	65	70	77	100	0.8
Fluoride	0.103	0.103	0.117	0.106	0.078	0.067	0.099	0.103	0.083	0.078	0.089	0.103	0.30	0.4
Nitrate/Nitrite	0.126	0.126	0.121	0.120	0.038	0.075	0.051	0.043	0.067	0.107	0.132	0.126	2.9	0.0
Ammonia N	0.005	0.005	0.007	0.002	0.003	0.003	0.002	0.006	0.005	0.010	0.003	0.005		
Phosphate TP	0.006	0.006	0.010	0.005	0.021	0.004	0.008	0.003	0.005	0.002	0.001	0.006		
Aluminum T	0.007	0.007	0.008	0.014	**0.268**	0.049	0.029	0.014	0.028	0.009	0.007	0.007	0.10	**2.7**
Antimony T	0.0002	0.0002	0.0002	0.0105	0.0069	0.0059	0.0054	0.0046	0.0038	0.0024	0.0003	0.0002	0.02	0.5
Arsenic T	0.0007	0.0007	0.0007	**0.0290**	**0.0194**	**0.0162**	**0.0150**	**0.0128**	**0.0106**	**0.0066**	0.0007	0.0007	0.005	**5.8**
Boron T	0.028	0.028	0.005	0.008	0.008	0.029	0.022	0.014	0.021	0.021	0.050	0.028	1.2	<0.1
Cadmium T	0.00001	0.00001	0.00002	0.00003	0.00004	0.00001	0.00001	0.00002	0.00001	0.00002	0.00001	0.00001	0.0003	0.1
Chromium T	0.0004	0.0004	0.0003	0.0004	0.0005	0.0004	0.0003	0.0003	0.0003	0.0004	0.0005	0.0004	0.0089	0.1
Copper T	0.0004	0.0004	0.0002	0.0010	0.0023	0.0011	0.0008	0.0007	0.0008	0.0005	0.0005	0.0004	0.003	0.8
Iron T	0.078	0.078	0.089	0.129	0.596	0.145	0.106	0.055	0.091	0.060	0.066	0.078	1.0	0.6
Lead T	0.00003	0.00003	0.00003	0.00009	0.00033	0.00019	0.00006	0.00005	0.00005	0.00004	0.00003	0.00003	0.004	0.1
Manganese T	**0.0855**	**0.0855**	**0.128**	**0.0834**	**0.0643**	0.0379	0.0414	0.0290	0.0330	0.0241	0.0430	**0.0855**	0.05	**2.6**
Mercury T	0.00001	0.00001	0.00001	0.00002	0.00001	0.00001	0.00002	0.00002	0.00002	**0.00003**	0.00001	0.00001	0.00003	**1.1**
Molybdenum	0.00028	0.00028	0.00007	0.00134	0.00087	0.00101	0.00073	0.00062	0.00060	0.00050	0.00050	0.00028	0.073	<0.1
Nickel T	0.0015	0.0015	0.0017	0.0019	0.0026	0.0009	0.0010	0.0009	0.0010	0.0007	0.0012	0.0015	0.110	<0.1
Selenium T	0.0005	0.0005	0.0005	**0.0023**	0.0017	0.0015	0.0013	0.0012	0.0011	0.0009	0.0005	0.0005	0.002	**1.1**
Silver T	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00002	0.00001	0.00001	0.00001	0.00001	0.00001	0.0001	0.2
Thallium T	0.00008	0.00008	0.00005	0.00007	0.00006	0.00009	0.00006	0.00006	0.00007	0.00007	0.00010	0.00008	0.0008	0.1
Uranium T	0.0012	0.0012	0.0014	0.0035	0.0018	0.0018	0.0018	0.0018	0.0014	0.0013	0.0011	0.0012	0.015	0.2
Zinc T	0.0065	0.0065	0.0027	0.0060	0.0052	0.0023	0.0022	0.0016	0.0022	0.0016	0.0103	0.0065	0.03	0.3
Cyanide WAD	0.0025	0.0025	0.0025	0.0037	0.0033	0.0032	0.0031	0.0030	0.0029	0.0028	0.0025	0.0025	0.005	0.7

[1] Total (T) metals concentrations, elemental values for nitrate (N), ammonia (N), phosphate (P), sulphate (S)

[2] CCME WQGs for protection of aquatic life, with these exceptions: CCME drinking water (Sb, Tl), BC aquatic life (Fe, Se, SO_4, F^-), BC drinking water (Mn), draft CCME (Cd, U)

Seepage of Contact Water into Groundwater

Similar to during operations (Section 6.5.3), rock drains will intercept almost all the groundwater that could be in contact with water infiltrating the reclaimed waste rock storage areas. Flows will be directed to seepage collection ponds, monitored and treated prior to discharge. The potential for some contact water to seep into deeper groundwater and travel, over time, into Haggart Creek or Dublin Gulch was also considered, and results are as described for operations. The three dimensional numerical model predicts groundwater would migrate toward Haggart Creek via Platinum Gulch and lower Dublin Gulch via Eagle Pup, and seepage in the groundwater would discharge to the streams. This would occur within one year of operations and continue into the future (200 years modeled, although at reduced rates with lower infiltration after the waste rock storage areas are reclaimed). Contact water would seep into the first layer (surficial layers) and not into deeper layers. The concentrations eventually reaching the streams would be less than 1% of the original concentration (source term) in most areas, and would not exceed 4%. This is a worst case prediction, and many common geochemical reactions and other mechanisms, such as precipitation, binding to organic matter or iron hydroxide complexes, would further reduce concentrations.

6.5.4.2 Mitigation Measures for Site Discharges during Closure and Post-closure

Water quality has been modeled using a conservative worst-case approach, and it is unlikely that contact water quality will be as poor as predicted. For this reason, the mitigation measures include a variety of economically and technically feasible options, with options for further treatment if indicated based on results of monitoring programs during operations and closure. This process is described further in the adaptive management program for the Project (Section 6.5.9). The Conceptual Closure and Reclamation Plan (Appendix 24) and Water Management Plan (Appendix 18) also provide details of the mitigation measures.

The Project incorporates several design features and mitigations to maintain surface water quality at levels suitable for aquatic life, including the mine water treatment plant, cyanide detoxification plant, and soil and vegetation covers on reclaimed HLF and waste rock storage areas. Groundwater wells around the waste rock storage areas will be monitored to assess whether seepage is affecting groundwater quality and to assess accuracy of predictions made in the environmental assessment.

The mine water treatment plant will remain in operation during the early years of closure to remove metals and nitrogen in the large volumes of contact water coming from HLF draindown. Effluent treatment criteria are described in Table 6.5-14. Inputs to the mine water treatment plant will be greatest during the first two to three years of HLF draindown, following rinsing and cyanide detoxification.

The cyanide detoxification plant described in Section 5 will use hydrogen peroxide and copper sulfate to reduce the cyanide concentration below 0.2 mg/L WAD cyanide and 2.0 mg/L total cyanide. The detoxification plant will also remove ammonia and nitrate.

The reclamation cover on the HLF will be designed to allow 10% infiltration of net precipitation, calculated as rainfall plus snowmelt, minus evapotranspiration (Appendix 14 – Environmental

Baseline Report: Hydrology). This design criterion was established based on preliminary water quality modeling that predicted elevated levels of arsenic, other metals and nitrogen in seepage from these facilities should the more commonly used performance target of 20% infiltration be used. The reclamation covers for the two waste rock storage areas are assumed to allow 20% infiltration, and this number is used in the modeling, although results for a cover that allows 10% infiltration for the Eagle Pup waste rock storage area are also discussed.

The covers will be designed to optimize reclamation and re-vegetation objectives. The extent to which precipitation evaporates, is transpired by plants, runs off as surface water, or infiltrates the underlying facilities is determined by soil characteristics such as hydraulic conductivity, and by vegetative cover. Water that infiltrates the reclaimed waste rock storage areas and HLF has the potential to result in seepage containing elevated metals and nutrients. A review of cover performance at various closed mines indicates a typical infiltration rate of about 20% of net precipitation (Rykaart, et al. 2006). Closure of the Platinum Gulch waste rock storage area in Year 6 will provide an opportunity to assess performance and to refine the cover requirements, if needed.

Conservative water quality modeling for the closure stage of the Project indicates a potential need to continue treatment of seepage and run-off from the heap leach facility and waste rock storage areas after closure of the mine water treatment plant due to elevated concentrations of several metals. Several options are available and will be further developed based on treatability studies, acute toxicity tests, and ongoing monitoring during operations. These include the following, alone or in combination:

- Keeping the mine water treatment plant or the cyanide detoxification plant, or both, in use beyond Year 15 to provide active treatment. Treatment could continue until the most problematic parameter (arsenic) meets MMER effluent criteria. This could take 10 to 30 years (the time required for one or two complete exchanges of porewater within the HLF, based on an estimated 10 to 15 years for one complete exchange; Appendix 8).
- Prolonging the period of active rinsing and draindown, to speed up release of porewater while the detoxification and mine water treatment plants are in operation. This would require additional re-circulation of leach solution or the addition of fresh water to the HLF (a water source), and a delay for installation of the HLF cover.
- Providing treatment of seepage in a passive engineered treatment system. Low maintenance requirements would be necessary for such systems. The practical experience and literature on design of passive engineered treatment system indicates they are effective in removing metals and other contaminants from a variety of sources, treatment volumes and environmental conditions, including northern Canada (Appendix 28: Passive Techniques for the Treatment of Mine Effluent).

Engineered treatment systems (active or passive) can be built at the base of the waste rock storage areas and heap leach facility to retain contaminants in seepage and to even out peak flows, if required. Appendix 28 describes use and effectiveness of various types of passive or active engineered treatment systems for removing metals, metalloids, sulphate and nutrients. These systems are used in many mining situations, including at the Teck Cominco Smelter in BC, the closed Yankee Girl Mine in BC, the Park City Mine in Utah, Newmont's Golden Giant Mine in Ontario, and many others. Engineered systems have a dry surface, with mainly subsurface flow and various series of passive and semi-passive aerobic and anaerobic bioreactor and chemical unit operations in separate basins (cells). Engineered systems can operate effectively is northern winters, regardless of ambient air temperatures, and have high removal rates for contaminants. Arsenic and other metals and metalloids can be reduced from the 100s to 1,000s of mg/L range to the 0.001 to 1 mg/L range (100-fold to 1,000 fold decreases). Phosphorus can be reduced to 0.05 mg P/L and nitrogen to 90% of nitrate and 99% of ammonia. Engineered systems require periodic maintenance; however, they can be modified to become fully passive over time. Passive constructed systems can have a wet or dry surface. Removal rates are lower in passive wetlands (e.g., 50% removal of arsenic, phosphorus, and nitrogen), but have lower maintenance requirements than for engineered wetlands. The need for passive engineered treatment systems and the applicable design features will be assessed based on monitoring of runoff quality during operations, which will enable comparisons of predictions to operating conditions and identify treatment objectives.

Closure of the Platinum Gulch waste rock storage area at the end of Year 5 will provide an ideal situation for refining the cover requirements and assessing performance. If monitoring indicates that water quality will be similar to the conservative worst case prediction, additional mitigation measures discussed above will be developed to manage water quality.

Other mitigation measures can be incorporated as part of the adaptive management strategy, based on monitoring during operations. For example, it may make environmental and economic sense for mine water treatment plant effluent (detoxified and treated draindown water) to be applied to the reclaimed land in Years 13 through 15 (high draindown volumes) in May through September, where the nitrogen from cyanide breakdown would fertilize the soils. This is because the mine water treatment plant will have reduced metals levels to acceptable levels for land application. In addition, reclamation methods used for closure of the Brewery Creek heap leach facility will be further reviewed (organic carbon source added to the HLF to facilitate removal of cyanide, ammonia and metals). This is further discussed in terms of adaptive management options (Section 6.5.9).

6.5.4.3 Residual Environmental Effects of Site Discharges during Closure and Post-closure

Discharge of Runoff from Platinum Gulch Waste Rock Storage Area and Open Pit to Platinum Gulch

Effects on Water Quality

The reclamation cover on the Platinum Gulch waste rock storage area will be designed to allow 20% infiltration of net precipitation. Platinum Gulch will receive runoff from the waste rock storage area in Year 14 and open pit starting in approximately Year 17. Pit lake runoff will comprise the majority (approximately 65%) of the flows and Platinum Gulch waste rock storage area flows include both contact and non-contact water. Predicted water quality in Platinum Gulch without further treatment is shown in Table 6.5-22 and predictions for all Project phases are shown in Figure 6.5-6 for several parameters. At baseline and during operations, Platinum Gulch flows intermittently. With no baseline data for this stream, Eagle Pup was used as a surrogate, as the two creeks drain similar topography and substrates. During closure, chemistry of the pit lake and waste rock storage area runoff is predicted to be relatively constant through the year, although the volume discharged will vary.

Modeling predicts elevated levels of several parameters, particularly the following:

- Arsenic (peak up to 0.75 mg/L), about 150 times higher than CCME WQG, and 11 times greater than a SSWQO of 0.070 mg/L proposed for Dublin and other tributaries
- Antimony, cadmium, copper, selenium, and silver peaks 15 to 20 times higher than WQG or SSWQO
- Phosphate (worst case of 0.52 to 0.63 mg P/L during the growing season).

Acute toxicity of the seepage and measured (as opposed to predicted) water quality would need to be assessed prior to obtaining a discharge permit. The predicted arsenic level of 0.75 mg/L is higher than the MMER Schedule 4 effluent criterion of 0.5 mg/L (Table 6.5-14); levels of copper, lead, nickel and zinc are predicted to be well below the MMER criteria.

Major cations and anions not presented in Table 6.5-22 are listed in Appendix 8 for the Platinum Gulch waste rock storage area at closure. These include pH (7.1), alkalinity (230 mg/L), chloride (13 mg/L), calcium (400 mg/L), magnesium (87 mg/L), potassium (41 mg/L), and sodium (11 mg/L) as conservative worst-case predictions.

Table 6.5-22: Predicted Flows (average) and Water Quality (maximum) from the Platinum Gulch Waste Rock Storage Area Seepage Collection Pond, with Open Pit Water, in the Predicted Worst Year of Closure (Year 21), 20% Infiltration of Cover, before or without Passive Engineered Treatment System

Parameter[1]	Mean Monthly Concentration (mg/L, unless indicated)												WQG[2] (mg/L)	Max/ WQG
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Flow (m^3/s)	< 0.001	0.001	< 0.001	0.006	0.045	0.024	0.019	0.015	0.018	0.010	0.001	0.001		
Dilution Factor	260	248	245	16	28	28	40	40	46	73	332	483		
Sulphate S	**140**	**140**	**139**	**114**	**110**	**219**	**158**	**168**	**151**	**252**	**574**	**140**	100	**5.7**
Fluoride	**1.03**	**1.03**	**1.02**	**0.807**	**0.772**	**0.928**	**0.969**	**0.991**	**0.845**	**0.860**	**1.09**	**1.034**	0.30	**3.6**
Nitrate N	0.001	0.001	0.001	0.075	0.040	0.102	0.076	0.054	0.065	0.131	0.041	0.057	2.9	0.0
Ammonia N	0.001	0.001	0.001	0.002	0.004	0.001	0.001	0.001	0.002	0.002	0.001	0.002		
Phosphate TP	0.663	0.660	0.657	0.523	0.529	0.577	0.615	0.632	0.524	0.519	0.658	0.663		
Aluminum T	0.030	0.030	0.030	**0.238**	**0.518**	0.064	0.048	**0.110**	0.059	0.051	**0.144**	**0.187**	0.10	**5.2**
Antimony T	**0.131**	**0.130**	**0.130**	**0.0993**	**0.0989**	**0.164**	**0.136**	**0.133**	**0.122**	**0.181**	**0.388**	**0.131**	0.02	**19**
Arsenic T	**0.237**	**0.237**	**0.237**	**0.189**	**0.188**	**0.309**	**0.251**	**0.247**	**0.224**	**0.345**	**0.749**	**0.237**	0.005	**150**
Boron T	0.047	0.047	0.047	0.041	0.042	0.045	0.046	0.046	0.042	0.041	0.045	0.047	1.2	<1
Cadmium T	**0.00065**	**0.00065**	**0.00065**	**0.00050**	**0.00054**	**0.00145**	**0.00090**	**0.00097**	**0.00082**	**0.00175**	**0.00471**	**0.00066**	0.0003	**16**
Chromium T	**0.0219**	**0.0218**	**0.0217**	**0.0167**	**0.0162**	**0.0195**	**0.0204**	**0.0209**	**0.0173**	**0.0181**	**0.0246**	**0.0219**	0.0089	**2.8**
Copper T	**0.0243**	**0.0242**	**0.0240**	**0.0187**	**0.0187**	**0.0254**	**0.0238**	**0.0235**	**0.0208**	**0.0262**	**0.0477**	**0.0243**	0.003	**16**
Iron T	0.058	0.058	0.057	0.304	0.663	0.118	0.091	0.163	0.117	0.119	0.378	0.245	1.0	0.7
Lead T	0.00336	0.00335	0.00333	0.00262	0.00274	**0.00459**	0.00356	0.00360	0.00326	**0.00513**	**0.0115**	0.00336	0.004	**2.9**
Manganese T	**0.0652**	**0.0656**	**0.0659**	**0.0521**	**0.0509**	**0.0893**	**0.0707**	**0.067**	**0.0598**	**0.100**	**0.229**	**0.0649**	0.05	**4.6**
Mercury T	**0.00009**	**0.00009**	**0.00009**	**0.00008**	**0.00007**	**0.00008**	**0.00009**	**0.00009**	**0.00008**	**0.00008**	**0.00009**	**0.00010**	0.00003	**3.7**
Molybdenum	**0.0847**	**0.0843**	**0.0839**	0.06439	0.06152	0.07220	**0.0780**	**0.0805**	0.06673	0.06390	**0.0761**	**0.0847**	0.073	**1.2**
Nickel T	0.0440	0.0438	0.0436	0.0335	0.0341	0.0629	0.0474	0.0486	0.0434	0.0713	**0.165**	0.0440	0.110	**1.5**
Selenium T	**0.0070**	**0.0070**	**0.0070**	**0.0054**	**0.0055**	**0.0110**	**0.0078**	**0.0083**	**0.0073**	**0.0126**	**0.0299**	**0.0070**	0.002	**15**
Silver T	**0.00187**	**0.00186**	**0.00185**	**0.00141**	**0.00136**	**0.00159**	**0.00172**	**0.00177**	**0.00146**	**0.00141**	**0.00168**	**0.00187**	0.0001	**19**
Thallium T	**0.00150**	**0.00149**	**0.00148**	**0.00114**	**0.00110**	**0.00128**	**0.00138**	**0.00142**	**0.00118**	**0.00114**	**0.00135**	**0.00150**	0.0008	**1.9**
Uranium T	**0.0336**	**0.0335**	**0.0334**	**0.0270**	**0.0257**	**0.0419**	**0.0350**	**0.0348**	**0.0322**	**0.0464**	**0.0921**	**0.0336**	0.015	**6.1**
Zinc T	0.0162	0.0161	0.0160	0.0137	0.0155	0.0228	0.0174	0.0181	0.0160	0.0255	**0.0581**	0.0162	0.03	**1.9**

[1] Total (T) metals concentrations, elemental values for nitrate (N), ammonia (N), phosphate (P), sulphate (S)

[2] CCME WQGs for protection of aquatic life, with these exceptions: CCME drinking water (Sb, Tl), BC aquatic life (Se, SO_4, F^-), BC drinking water (Mn), draft CCME (Cd, U)

There is uncertainty in the predictions for all parameters, and concentrations of metals and phosphate are likely to be lower than predicted. However, the levels predicted, particularly for arsenic, are high enough to warrant inclusion of further treatment mitigations, such as within a passive engineered treatment system or with a cover that allows less infiltration. However, since the majority of flow is from the pit lake, rather than the waste rock storage area seepage, only a small improvement in water quality would be predicted should a tighter cover be built. While Platinum Gulch is not considered fish habitat, it would probably provide drinking water for wildlife in the area, additional rationale for further treatment. Given the time scale required, a passive engineered treatment system design will be appropriate, as it would have lower requirements for maintenance compared with an active system. There would be lower performance in a passive system (e.g., 50% reduction in metals and phosphate) compared to an active system (arsenic reduction of 100 to 1000 fold and phosphate reduction to 0.05 mg/L [Appendix 28 – Passive Techniques for the Treatment of Mine Effluent]).

To be conservative, the residual water quality was assessed assuming a passive engineered treatment system will be used to further reduce metals and phosphate by 50%. For Platinum Gulch a 50% reduction would still result in predicted levels of arsenic, antimony, cadmium, copper, selenium, and silver above WQG or SSWQO for this nonfish-bearing watercourse, but effluent would meet the MMER effluent criteria. For phosphate, a 50% reduction in levels in Platinum Gulch (down to 0.25 to 0.31 mg P/L during the June to September growing season) is achievable and would help manage eutrophication potential in Haggart Creek (as discussed for Haggart Creek). The use of a passive engineered treatment system at the base of the waste rock storage area would lead to improved water quality downstream in Haggart Creek compared to conditions modeled later in this assessment.

Residual environmental effects of runoff from the Platinum Gulch waste rock storage area and open pit (with passage through a passive engineered treatment system and/or with a tighter reclamation cap, if indicated through monitoring during operations), on water quality of Platinum Gulch during closure are expected to be adverse, moderate to high magnitude, site-specific in geographic extent (restricted to the ephemeral and intermittent Platinum Gulch), continuous, and perpetual (at least several decades). Once begun, the effect will be irreversible, as seepage will continue over time. The measureable change in water quality of Platinum Gulch will be confirmed through monitoring of both surface water quality and groundwater. Significance of the effect is described in Section 6.5.4.4.

Effects on Aquatic Biota

Platinum Gulch is an ephemeral, intermittent watercourse at baseline. It is not considered fish habitat and the flow regime is not conducive to maintaining periphyton and benthic invertebrate communities. Nitrate and ammonia levels are predicted to be well below WQG and similar to baseline, as blast residues will be flushed out each year of operations (Hallam Knight Piésold 1996d). The phosphate levels predicted for Platinum Gulch (0.52 to 0.63 mg/L, or lower with further mitigation measures) predicted for June through September could result in eutrophication; however, with the lack of aquatic biota in Platinum Gulch it is more appropriate to discuss potential effects of phosphorus additions and eutrophication on Haggart Creek downstream of all mine influences (W29, downstream of Platinum Gulch), as presented later in this discussion. Hence, the residual effects on aquatic biota were not assessed.

Discharge of Runoff from Eagle Pup Waste Rock Storage Area to Dublin Gulch and Eagle Creek

Effects on Water Quality

Runoff and infiltrated precipitation through the reclaimed Eagle Pup waste rock storage area will drain to the Dublin Gulch diversion channel rather than to the mine water treatment plant, starting in about Year 15. Acute toxicity and chemical composition of the seepage will need to be assessed prior to obtaining a discharge permit. The predicted arsenic level of 1.4 mg/L (source term, Appendix 8) is higher than the MMER Schedule 4 effluent criterion of 0.5 mg/L (Table 6.5-14); however, levels of copper, lead, nickel and zinc are predicted to be below the MMER criteria. Hence, if arsenic levels are as high as predicted, additional mitigation measures will be required to allow effluent to meet MMER discharge criteria. This would be passive engineered treatment, with about 50% reduction.

Modeled water quality in the diversion channel is shown in Table 6.5-23 for closure and in Figure 6.5-7 for all Project phases, assuming a cover on the reclaimed waste rock storage area that allows 20% infiltration of net precipitation. The predictions are based on modeled flows (Figure 6.5-4), Dublin Gulch baseline water quality (Table 6.5-7) and runoff quality (Appendix 8). Runoff chemistry is predicted to be relatively constant through the year, and over time, although the volume discharged will vary, resulting in varying concentrations in Dublin Gulch. Wet, dry and average scenarios were modeled and the highest concentrations are shown in Table 6.5-23.

Predictions were also made for water quality assuming a reclamation cover that allows 10% infiltration of net precipitation, given that additional mitigation may be required to protect water quality in Dublin Gulch and Eagle Creek. Results are presented in Table 6.5-24.

Table 6.5-23: Predicted Flows (average) and Water Quality (maximum) in Dublin Gulch Diversion Channel (W71) after Closure, with Untreated Runoff from Eagle Pup Waste Rock Storage Area, with 20% Infiltration of Cover, before or without a Passive Engineered Treatment System

Parameter[1]	Mean Monthly Concentration (mg/L, unless indicated)												WQG[2] (mg/L)	Max/ WQG
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Flow (m^3/s)	0.021	0.017	0.013	0.018	0.167	0.130	0.195	0.113	0.129	0.114	0.051	0.033		
Dilution	284	309	333	2	4	2	5	3	6	10	22	253		
Sulphate S	22	22	28	20	14	**101**	47	66	42	56	53	22	100	**1.0**
Fluoride	0.054	0.054	0.098	0.096	0.092	0.209	0.119	0.160	0.129	0.133	0.069	0.055	0.30	0.7
Nitrate N	0.114	0.114	0.154	0.160	0.047	0.118	0.051	0.051	0.048	0.076	0.073	0.114	2.9	0.0
Ammonia N	0.003	0.003	0.004	0.004	0.009	0.003	0.003	0.006	0.005	0.007	0.003	0.003		
Phosphate TP	0.007	0.007	0.010	0.032	0.102	0.084	0.038	0.049	0.030	0.040	0.036	0.007		
Aluminum T	0.095	0.095	**0.181**	**0.248**	**1.33**	0.098	0.080	**0.103**	0.068	0.029	0.012	0.096	0.10	**13**
Antimony T	0.0019	0.0019	0.0027	0.0013	0.0085	**0.128**	**0.0459**	**0.0701**	**0.0372**	**0.0615**	**0.0560**	0.0019	0.02	**6.4**
Arsenic T	**0.0415**	**0.0415**	**0.0442**	**0.0358**	**0.0411**	**0.150**	**0.0750**	**0.100**	**0.0703**	**0.0932**	**0.0914**	**0.0415**	**0.005**	**30**
Boron T	0.016	0.016	0.027	0.011	0.029	0.040	0.035	0.023	0.022	0.018	0.008	0.017	1.2	<1
Cadmium T	0.00001	0.00001	0.00001	0.00002	0.00006	**0.00065**	0.00024	**0.00036**	0.00019	**0.00032**	0.00028	0.00001	0.0003	**2.2**
Chromium T	0.0004	0.0004	0.0003	0.0003	0.0009	0.0032	0.0015	0.0018	0.0011	0.0017	0.0017	0.0004	0.0089	0.4
Copper T	0.0004	0.0004	0.0003	0.0008	0.0018	**0.0070**	0.0027	**0.0038**	0.0022	**0.0034**	**0.0033**	0.0004	0.003	**2.3**
Iron T	0.130	0.130	0.242	0.298	0.872	0.168	0.116	0.151	0.102	0.061	0.056	0.130	1.0	0.9
Lead T	0.00003	0.00003	0.00003	0.00016	0.00079	**0.00447**	0.00181	0.00253	0.00137	0.00220	0.00191	0.00003	0.004	**1.1**
Manganese T	0.0005	0.0005	0.0008	0.0031	0.0157	**0.0793**	0.0327	0.0458	0.0249	0.0397	0.0341	0.0005	0.05	**1.6**
Mercury T	0.00001	0.00001	0.00001	0.00001	0.00002	0.00001	0.00001	0.00002	0.00002	0.00002	0.00001	0.00001	0.00003	0.9
Molybdenum	0.00197	0.00197	0.00225	0.00206	0.00182	0.00936	0.00495	0.00627	0.00425	0.00576	0.00505	0.00199	0.073	0.1
Nickel T	0.0004	0.0004	0.0003	0.0005	0.0047	0.0551	0.0198	0.0300	0.0159	0.0265	0.0242	0.0004	0.110	0.5
Selenium T	0.0004	0.0004	0.0004	0.0005	0.0007	**0.0049**	0.0019	**0.0029**	0.0017	**0.0026**	**0.0024**	0.0004	0.002	**2.5**
Silver T	0.00001	0.00001	0.00001	0.00001	0.00003	**0.00019**	0.00007	**0.00011**	0.00006	0.00009	0.00009	0.00001	0.0001	**1.9**
Thallium T	0.00007	0.00007	0.00005	0.00005	0.00006	0.00021	0.00010	0.00013	0.00010	0.00013	0.00016	0.00008	0.0008	0.3
Uranium T	0.0004	0.0004	0.0005	0.0022	0.0035	**0.0402**	**0.0152**	**0.0228**	0.0126	**0.0192**	**0.0170**	0.0005	0.015	**2.7**
Zinc T	0.0028	0.0028	0.0031	0.0046	0.0079	0.0232	0.0095	0.0129	0.0077	0.0114	0.0115	0.0028	0.03	0.8

[1] Total (T) metals concentrations, elemental values for nitrate (N), ammonia (N), phosphate (P), sulphate (S)

[1] CCME WQGs for protection of aquatic life, with these exceptions: CCME drinking water (Sb, Tl), BC aquatic life (Fe, Se, SO_4, F^-), BC drinking water (Mn), draft CCME (Cd, U)

Table 6.5-24: Predicted Flows (average) and Water Quality (maximum) in Dublin Gulch Diversion Channel (W71) after Closure, with Runoff and Seepage from Eagle Pup Waste Rock Storage Area, with 10% Infiltration of Cover, before or without a Passive Engineeered Treatment System

Parameter[1]	Mean Monthly Concentration (mg/L, unless indicated)												WQG[2] (mg/L)	Max/ WQG
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Flow (m^3/s)	0.021	0.017	0.013	0.018	0.167	0.130	0.195	0.113	0.129	0.114	0.051	0.033		
Dilution Factor	284	309	333	2	3	3	5	4	6	10	40	253		
Sulphate S	22	22	28	20	12	60	33	44	31	36	35	22	100	0.6
Fluoride	0.054	0.054	0.098	0.096	0.088	0.152	0.098	0.129	0.113	0.105	0.042	0.055	0.30	0.5
Nitrate N	0.114	0.114	0.154	0.164	0.049	0.131	0.055	0.055	0.051	0.080	0.074	0.114	2.9	0.0
Ammonia N	0.003	0.003	0.004	0.004	0.009	0.003	0.003	0.007	0.005	0.007	0.003	0.003		
Phosphate TP	0.007	0.007	0.010	0.034	0.102	0.050	0.026	0.030	0.020	0.023	0.020	0.007		
Aluminum T	0.095	0.095	**0.181**	**0.266**	**1.333**	**0.103**	0.081	**0.110**	0.069	0.029	0.012	0.096	0.10	**13**
Antimony T	0.0019	0.0019	0.0027	0.0013	0.0045	**0.0656**	**0.0235**	**0.0359**	0.0192	**0.0319**	**0.0291**	0.0019	0.02	**3.3**
Arsenic T	**0.0415**	**0.0415**	**0.0442**	**0.0357**	**0.0373**	**0.0890**	**0.0529**	**0.0668**	**0.0526**	**0.0642**	**0.0652**	**0.0415**	0.005	**18**
Boron T	0.016	0.016	0.027	0.011	0.028	0.040	0.035	0.022	0.022	0.017	0.007	0.017	1.2	<0.1
Cadmium T	0.00001	0.00001	0.00001	0.00002	0.00004	**0.00034**	0.00013	0.00019	0.00010	0.00017	0.00015	0.00001	0.0003	**1.1**
Chromium T	0.0004	0.0004	0.0003	0.0004	0.0008	0.0018	0.0010	0.0010	0.0007	0.0010	0.0011	0.0004	0.0089	0.2
Copper T	0.0004	0.0004	0.0003	0.0008	0.0016	**0.0040**	0.0016	0.0021	0.0013	0.0020	0.0019	0.0004	0.003	**1.3**
Iron T	0.130	0.130	0.242	0.321	0.895	0.133	0.102	0.136	0.092	0.042	0.038	0.130	1.0	0.9
Lead T	0.00003	0.00003	0.00003	0.00016	0.00066	0.00237	0.00100	0.00130	0.00072	0.00114	0.00096	0.00003	0.004	0.6
Manganese T	0.0005	0.0005	0.0008	0.0031	0.0131	0.0414	0.0182	0.0236	0.0132	0.0205	0.0169	0.0005	0.05	0.8
Mercury T	0.00001	0.00001	0.00001	0.00001	0.00002	0.00001	0.00001	0.00001	0.00001	0.00002	0.00001	0.00001	0.00003	0.8
Molybdenum	0.00197	0.00197	0.00225	0.00205	0.00157	0.00566	0.00354	0.00410	0.00311	0.00389	0.00337	0.00199	0.073	0.1
Nickel T	0.0004	0.0004	0.0003	0.0005	0.0030	0.0284	0.0101	0.0152	0.0081	0.0137	0.0126	0.0004	0.110	0.3
Selenium T	0.0004	0.0004	0.0004	0.0005	0.0005	**0.0028**	0.0011	0.0016	0.0011	0.0015	0.0015	0.0004	0.002	**1.4**
Silver T	0.00001	0.00001	0.00001	0.00001	0.00002	0.00010	0.00004	0.00006	0.00003	0.00005	0.00005	0.00001	0.0001	1.0
Thallium T	0.00007	0.00007	0.00005	0.00005	0.00006	0.00014	0.00007	0.00009	0.00008	0.00010	0.00013	0.00008	0.0008	0.2
Uranium T	0.0004	0.0004	0.0005	0.0023	0.0024	**0.0217**	0.0086	0.0126	0.0072	0.0103	0.0089	0.0005	0.015	**1.4**
Zinc T	0.0028	0.0028	0.0031	0.0047	0.0074	0.0130	0.0058	0.0073	0.0047	0.0066	0.0071	0.0028	0.03	0.4

[1] Total (T) metals concentrations, elemental values for nitrate (N), ammonia (N), phosphate (P), sulphate (S)

[2] CCME WQGs for protection of aquatic life, with these exceptions: CCME drinking water (Sb, Tl), BC aquatic life (Fe, Se, SO_4, F^-), BC drinking water (Mn), draft CCME (Cd, U)

With a cover on the waste rock storage area that allows 20% infiltration of net precipitation, the following parameters are predicted to exceed WQG in Dublin Gulch and Eagle Creek:

- Arsenic, peaking in June at 0.15 mg/L, and 0.04 to 0.10 mg/L the rest of the year. While baseline levels are up to nine times higher than CCME year round, the peak of 0.15 mg/L is 30 times higher than CCME; it is also two times higher than a SSWQO of 0.07 mg/L that could be established for Dublin Gulch based on baseline concentrations.
- Antimony, peaking in June at 0.128 mg/L, which is six times higher than the BC WQG; exceedances would occur for six months of the year, compared to levels near the detection limit during baseline.
- Aluminum (particulate and dissolved), peaking in May at 1.33 mg/L (13 times higher than CCME); the baseline maximum in Dublin Gulch is lower at 0.223 mg/L, but the predicted peak is influenced by high baseline freshet values for the Eagle Pup data used to model water quality.
- Many metals are predicted to meet WQG or SSWQO in Dublin Gulch most of the year, although several (cadmium, copper, selenium, silver and uranium) show a peak in June at up to 2.5 times their guidelines.

Results for major cations and anions are not shown in Table 6.5-23, and are modeled in Appendix 8 for the source term. For the waste rock storage area contact water, pH is predicted to be about 7.1, alkalinity 245 mg/L, chloride 8 mg/L, calcium 365 mg/L, magnesium 29 mg/L, potassium 27 mg/L, and sodium 5 mg/L. Assuming these flows are diluted in Dublin Gulch by 2 to 6 times during April through November (Table 6.5-23), the maximum concentrations can be conservatively estimated by dividing the source term concentration by the lowest dilution. This approach suggests a substantial change in general water chemistry from April through November compared to baseline (Table 6.5-7):

- Additional alkalinity (120 mg/L) on top of a baseline of 29 to 50 mg/L
- Additional chloride (4 mg/L) on top of a baseline of 0.25 to 0.43 mg/L
- Additional calcium (18 mg/L) on top of a baseline of 10 to 18 mg/L
- Additional of magnesium (15 mg/L) on top of a baseline of 3.4 to 5.5 mg/L
- Additional of potassium (18 mg/L) on top of a baseline of 1.0 mg/L
- Additional of sodium (5 mg/L) on top of a baseline of 1.0 mg/L.

Phosphate levels in Dublin Gulch are predicted to range from 0.03 to 0.08 mg P/L during June through September, three to eight times higher than baseline (maximum of 0.01 mg/L), as a result of phosphorus release from the waste rock. Nitrate and ammonia levels are predicted to remain at baseline levels, given that blast residues will have leached out of the waste rock during operations.

For most metals, a conservative worst-case prediction of up to 2.5 times over the guideline for a one-month period can be dealt with by moderating flows (with a pond or a wetland), and also by considering the conservative aspects built into the prediction. However, this would likely not be sufficient for arsenic or antimony, given the peaks are greater and occur over several months of a year. Although a decision to include additional mitigation, i.e., a passive engineered treatment system or a tighter cover allowing 10% infiltration of precipitation, will be made closer to mine closure based on results of monitoring during operations, the modeling of Dublin Gulch water quality suggests that additional treatment will be required. The values in Table 6.5-24 indicate lower metals and phosphate levels using a reclamation cover that allows 10% infiltration compared to 20%:

- Arsenic, peaking in June at 0.089 mg/L, and 0.036 to 0.067 mg/L the rest of the year, with the peak just above a proposed SSWQO of 0.07 mg/L based on baseline concentrations
- Antimony, peaking in June at 0.066 mg/L, which is three times higher than the BC WQG
- Aluminum, no change as the prediction is based on background water quality
- Cadmium, copper, selenium, and uranium, peaking in June just above WQG
- Phosphate, 0.02 to 0.05 mg P/L during the June through September growing season.

Further improvements would be obtained through conversion of the seepage collection pond at the base of the waste rock storage area into a passive engineered treatment system. As discussed for Platinum Gulch, passive systems commonly produce a 50% reduction in metals and phosphate levels. The 50% reduction in levels of metals and other parameters with passage through a treatment system would be enough to meet the MMER effluent criterion for arsenic (compare with Table 6.5-11) and WQG for Dublin Gulch for all parameters except antimony (peak of 0.03 mg/L, close to the WQG of 0.02 mg/L). For phosphate, a reduction of at least 50% would contribute to an improvement in predicted levels downstream in Haggart Creek.

Residual environmental effects on water quality of discharge of runoff and seepage from the Eagle Pup waste rock storage area, after passage through a passive engineered treatment system, to the Dublin Gulch diversion channel during closure, are considered adverse, moderate in magnitude, local in geographic extent, continuous, and perpetual (at least several decades). Once begun, the effect would be irreversible, and would occur in an area disturbed by previous placer mining. Monitoring of surface water quality during operations and closure will provide an evaluation of these predictions and identify whether a treatment system is required. Significance of the effect is described in Section 6.5.4.4.

Effects on Aquatic Biota

Elevated phosphate levels from waste rock storage area seepage could lead to a change in trophic status in Dublin Gulch, Eagle Creek or further downstream in Haggart Creek, depending on the balance between nitrogen and phosphorus in the system. At baseline, the low nutrient levels indicate oligotrophic conditions and the relative levels of nitrate, ammonia, and phosphate suggest that nitrogen is the limiting nutrient for periphyton growth in Dublin Gulch and Eagle Creek. Blue-green algae are predominant, mainly as a thin film on the rocks. While some blue-green algae species are known to fix atmospheric nitrogen, the more abundant species (*Homeothrix varians, Oscillatoria* sp.) in Dublin Gulch do not, although it is possible that nitrogen-fixing species could become established and respond to the change in water quality with increased growth.

The 0.03 to 0.08 mg P/L predicted for Dublin Gulch at closure (no passive treatment system, 20% infiltration through the cover) would be considered a trigger for mesotrophic to eutrophic conditions (Gartner Lee 2006 and Table 6.5-17). While it is likely that heavy periphyton growth would not occur in Dublin Gulch or Eagle Creek, given the low predicted nitrogen levels, uncertainty over that prediction contributes to the rationale for further mitigation to help reduce phosphorus levels in discharges from the Eagle Pup waste rock storage area and in Dublin Gulch. With both the passive treatment system and the tighter cover, described above, phosphate levels of 0.01 to 0.025 mg/L would be achieved, which would keep Dublin Gulch in the range for oligotrophic to slightly mesotrophic (Table 6.5-17).

Residual environmental effects on aquatic biota of discharge of runoff and seepage from the Eagle Pup waste rock storage area, after passage through a passive engineered treatment system and with a tighter cover, to the Dublin Gulch diversion channel during closure, are considered adverse, moderate in magnitude, local in geographic extent, continuous, and perpetual. Once begun, the effect would be irreversible. Monitoring during operations and closure will provide an evaluation of these predictions and identify whether a treatment system is required.

Discharge from Heap Leach Facility to Mine Water Treatment Plant to Haggart Creek during Draindown

Effects on Water Quality

While the mine water treatment plant is in place, treated effluent will enter Haggart Creek at W4. The source of contact water will be mainly the HLF draindown in Years 13 through 15, with smaller inputs from seepage and runoff from the two waste rock storage areas. Water quality was modeled at W4 using baseline data for W22 (Table 6.5-5), effluent quality (Table 6.5-14) and predicted flows (Figure 6.5-4). Predicted water quality in Haggart Creek at W4 during draindown (Years 13 to 16) is shown in Table 6.5-25 for the maximum concentrations and Figure 6.5-5 for average, wet and dry scenarios.

The following are predicted for Haggart Creek at W4 during draindown (Years 13 through 15) while the mine water treatment plant is in operation:

- Metals are predicted to meet WQG or SSWQO in Haggart Creek, although aluminum and manganese will continue to exceed WQG to the extent noted for baseline.
- Nitrate and ammonia levels are predicted to be higher than baseline in Haggart Creek, related to release of the products of cyanide detoxification. Values for the June through September growing season are predicted to be 0.09 to 0.15 mg N/L nitrate and 0.01 to 0.23 mg N/L ammonia (total inorganic nitrogen of 0.11 to 0.38 mg/L). Combined, these inorganic nitrogen levels are 1.5 to 7 times higher than at baseline (Table 6.5-6).
- Phosphate levels are predicted to be higher than in operations during the growing season, and to range from 0.020 to 0.051 mg P/L (reflecting inputs from the HLF and the waste rock storage areas). These levels are 5 to 18 times higher than the baseline values (Table 6.5-6).

Table 6.5-25: Predicted Flow (average) and Water Quality (maximum) in Haggart Creek (W4) during Draindown of the Heap Leach Facility in Years 13 through 15 (Mine Water Treatment Plant and Cyanide Detoxification Plant Operating)

Parameter[1]	Mean Monthly Concentration (mg/L, unless indicated)												WQG[2] (mg/L)	Max/ WQG
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Flow (m^3/s)	0.182	0.148	0.114	0.132	1.167	0.875	0.794	0.715	0.820	0.722	0.424	0.285		
Dilution	37	43	46	7	12	11	3	4	12	20	40	57		
Sulphate S	80	80	87	72	38	57	94	90	61	69	73	79	100	0.9
Fluoride	0.116	0.114	0.127	0.157	0.110	0.106	0.231	0.196	0.118	0.099	0.101	0.112	0.30	0.8
Nitrate/Nitrite N	0.133	0.132	0.126	0.156	0.066	0.102	0.146	0.113	0.092	0.120	0.138	0.131	2.9	0.0
Ammonia N	0.026	0.023	0.023	0.023	0.014	0.010	0.231	0.160	0.052	0.038	0.022	0.019		
Phosphate TP	0.008	0.008	0.012	0.028	0.032	0.020	0.051	0.036	0.019	0.011	0.005	0.007		
Aluminum T	0.012	0.012	0.012	0.037	**0.259**	0.061	0.075	0.050	0.041	0.018	0.012	0.011	0.10	**2.6**
Antimony T	0.0013	0.0011	0.0010	0.0054	0.0032	0.0036	0.0111	0.0080	0.0033	0.0021	0.0012	0.0009	0.02	0.6
Arsenic T	0.0009	0.0009	0.0009	0.0037	0.0028	0.0024	0.0038	0.0030	0.0020	0.0015	0.0009	0.0008	0.005	0.8
Boron T	0.038	0.036	0.013	0.018	0.013	0.032	0.131	0.089	0.043	0.034	0.059	0.034	1.2	0.1
Cadmium T	0.00003	0.00003	0.00003	0.00009	0.00008	0.00006	0.00017	0.00013	0.00005	0.00004	0.00002	0.00002	0.0003	0.6
Chromium T	0.0004	0.0004	0.0003	0.0013	0.0011	0.0015	0.0018	0.0013	0.0009	0.0008	0.0008	0.0004	0.0089	0.2
Copper T	0.0005	0.0005	0.0004	0.0010	0.0021	0.0011	0.0019	0.0015	0.0010	0.0007	0.0006	0.0005	0.003	0.7
Iron T	0.092	0.090	0.100	0.185	0.636	0.157	0.260	0.170	0.124	0.081	0.082	0.087	1.0	0.6
Lead T	0.00023	0.00021	0.00020	0.00104	0.00088	0.00083	0.00220	0.00158	0.00063	0.00040	0.00022	0.00016	0.004	0.5
Manganese T	**0.0859**	**0.0858**	**0.128**	**0.0834**	**0.0649**	0.0412	**0.0562**	0.0417	0.0369	0.0268	0.0444	**0.0858**	0.05	**2.5**
Mercury T	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00002	0.00002	0.00002	**0.00003**	0.00001	0.00001	0.00003	1.0
Molybdenum	0.00410	0.00362	0.00318	0.00815	0.00431	0.00555	0.03978	0.02859	0.00952	0.00663	0.00404	0.00282	0.073	0.5
Nickel T	0.0017	0.0017	0.0019	0.0038	0.0042	0.0107	0.0115	0.0070	0.0047	0.0049	0.0048	0.0016	0.110	0.1
Selenium T	0.0006	0.0006	0.0006	0.0009	0.0008	0.0008	0.0014	0.0011	0.0007	0.0007	0.0006	0.0006	0.002	0.7
Silver T	0.00001	0.00001	0.00001	0.00003	0.00002	0.00002	0.00007	0.00005	0.00003	0.00002	0.00001	0.00001	0.0001	0.7
Thallium T	0.00008	0.00008	0.00006	0.00012	0.00010	0.00014	0.00017	0.00014	0.00010	0.00010	0.00011	0.00008	0.0008	0.2
Uranium T	0.0020	0.0019	0.0020	0.0049	0.0026	0.0031	0.0087	0.0065	0.0029	0.0022	0.0018	0.0017	0.015	0.6
Zinc T	0.0079	0.0077	0.0039	0.0121	0.0089	0.0068	0.0176	0.0127	0.0063	0.0042	0.0115	0.0074	0.03	0.6
Cyanide WAD	0.0027	0.0027	0.0027	0.0035	0.0031	0.0031	0.0045	0.0040	0.0031	0.0028	0.0027	0.0026	0.005	0.9

[1] Total (T) metals concentrations, elemental values for nitrate (N), ammonia (N), phosphate (P), sulphate (S)

[2] CCME WQGs for protection of aquatic life, with these exceptions: CCME drinking water (Sb, Tl), BC aquatic life (Fe, Se, SO_4, F^-), BC drinking water (Mn), draft CCME (Cd, U)

Residual environmental effects on water quality of Haggart Creek from the discharge of treated effluent from the mine water treatment plant during HLF draindown are predicted to be adverse, moderate in magnitude, local in geographic extent, continuous, and long term (ending after the three year peak of draindown volumes). Once begun, the effect would be reversible (ceasing once the major draindown volumes have been released). The measureable change in water quality of Haggart Creek is predicted to be within WQG or SSWQO for metals (unless they reflect existing exceedances for baseline), with increases in levels of major anions and cations (as discussed for operations), and a change in nutrient levels from oligotrophic to mesotrophic. Conditions will be confirmed through monitoring of surface water quality and groundwater. Significance of the effect is described in Section 6.5.4.4.

Effects on Aquatic Biota

The predicted increase in nitrogen and phosphorus levels in Haggart Creek at W4 during draindown could lead to an increase in trophic status and productivity of the creek. The measured baseline summer levels reflect uptake of nutrients by periphyton (not accounted for in the closure predictions). The predicted phosphate levels for closure (Table 6.5-24) of 0.020 to 0.051 mg P/L are 5 to 18 times higher than in baseline (Table 6.5-6). This suggests the trophic status of Haggart Creek could increase from oligotrophic to mesotrophic (Table 6.5-17 and Gartner Lee 2006). The response of aquatic biota, however, is also influenced by availability of nitrogen, which is also predicted to be 1.5 to 7 times higher than in baseline and operations, but still within an oligotrophic range (Alexander and Smith 2006), and by physical factors such as flows and incidents of freshet.

There is uncertainty in these predictions of nutrient levels and community response, based on the conservative worst-case approach used to predict water quality and the uncertainty in the source term prediction for phosphate (Table 6.5-19 indicates that the many values at and near the detection limit were not used to develop the source term, so phosphate levels could be ten times lower). The increase in cation and anion levels will not result in toxicity, but may result in some changes to aquatic communities, which are able to adapt to such changes. No exceedances of WQG for metals have been identified (other than those that already exceed in baseline).

Residual environmental effects on aquatic biota of the discharge of treated effluent from the mine water treatment plant to Haggart Creek during HLF draindown are predicted to be adverse, moderate in magnitude (potential change in one trophic level), local in geographic extent, continuous, and long term (reversible, ending after the three year peak of draindown volumes). There is a high probability of the effect occurring, given the predicted characteristics of the mine water treatment plant effluent. Conditions will be confirmed through monitoring of surface water quality and groundwater.

Discharge from HLF to Haggart Creek during Closure (Short-term)

Effects on Water Quality

Modeling of Haggart Creek water quality based on discharge of heap seepage (quality shown in Table 6.5-19) is shown in Table 6.5-20 for short-term (one to three decades needed for replacement of one to two volumes of HLF porewater). The preliminary prediction shows the June through

September growing season with nitrate levels of 0.13 to 0.19 mg N/L (up to three times higher than baseline) and ammonia levels of 0.006 to 0.009 mg N/L (up to two times higher than baseline).The elevated levels of arsenic and silver predicted (about eight and two times higher than WQG, respectively) indicates there will likely be a need for further treatment of seepage after closure of the mine water treatment plant. This would need to be confirmed through assessment of actual monitoring data.

The treatment option selected needs to effectively deal with elevated arsenic levels, given that levels predicted for the seepage (1.23 mg/L) are about 2.5 times higher than the MMER effluent criterion of 0.5 mg/L. With a minimum dilution in Haggart Creek of at least 16:1, this is predicted to result in levels up to 0.039 mg/L arsenic in Haggart Creek during April, almost two times higher than a proposed SSWQO of 0.20 mg/L that could be developed based on background concentrations in Haggart Creek. Hence, a 50% reduction in arsenic levels would be needed if the conservative, worst-case predictions occur. This can be achieved by providing treatment in a passive engineered treatment system downstream of the HLF; these low maintenance systems have been shown to reduce levels of arsenic, other metals and nitrogen by at least 50%. The need for this mitigation measure would be confirmed through monitoring during operations and draindown. Aluminum and manganese would continue to exceed WQO in Haggart Creek, to the same extent and timing noted for baseline, as these reflect background levels and would not be affected by treatment.

The change in concentrations of major anions and cations resulting from release of seepage was not modeled, and it is likely that concentrations would also change with passage through a passive engineered treatment system. Assuming no change with passage through the system, levels can be estimated considering the smallest dilution typical of May through October and concentrations of anions and cations predicted for the HLF source terms (Appendix 8). For seepage itself, pH is predicted to be 7.5, alkalinity about 70 mg/L, chloride 4 mg/L, calcium 65 mg/L, magnesium 8 mg/L, and sodium 73 mg/L (potassium value not provided), These values are for short-term, and are predicted to decrease or stay constant in the long term, except for magnesium, which is predicted to increase four fold over time. Assuming these are diluted at least 16:1 (Table 6.5-20), the maximum concentrations can be estimated by dividing the source term concentration by that dilution. This suggests additions of alkalinity (4 mg/L), chloride (0.3 mg/L), calcium (4 mg/L), magnesium (<0.1 mg/L), and sodium (4 mg/L) would occur. These small amounts would be added to baseline, and would be within the range of annual variation. These parameters do not have CCME WQG, as they occur naturally in wide range in Canadian watercourses (although there is now a draft WQG for chloride), and, like the other predictions, are conservative.

The residual environmental effects on water quality of discharge of heap leach facility runoff and seepage during closure are expected to be adverse, low to moderate in magnitude, local in geographic extent, continuous, and in perpetuity. Once begun, the effect will be irreversible. The effect will occur in an area already disturbed by historic placer mining. Surface water and groundwater quality monitoring will be done during all phases of the mine life to evaluate the predictions. With the mitigation measures outlined (passive system, tighter cover for reclaimed HLF), levels of metals should be low enough for the seepage to meet MMER effluent criteria. Further, dilution of the seepage in Haggart Creek (at least 16:1 depending on the month) will result in parameters meeting WQG or SSWQO in the stream. Significance of the effect is described in Section 6.5.4.4.

Effects on Aquatic Biota

The preliminary predicted concentrations of nitrate and ammonia in Haggart Creek at W4 (up to 0.19 mg N/L nitrate and up to 0.009 mg N/L ammonia) for mixing of untreated seepage (Table 6.5-20) suggest the potential for nutrient enrichment. Within the reach from W4 to W29, the predicted low phosphate levels (0.002 to 0.007 mg P/L, same as baseline) would continue to limit periphyton growth, so a stimulation of the aquatic community would be unlikely in that area. Downstream, at W29, however, the mixing of the more phosphorus-rich waters from Dublin Gulch, Eagle Creek, and Platinum Gulch would result in elevated levels of both nitrogen and phosphorus, and could lead to greater growth of periphyton, and other signs of eutrophication. Nitrate plus ammonia levels will be up to three times higher than baseline, and will remain within the oligotrophic category. Table 6.5-17 and Alexander and Smith (2006) indicate that 0.70 mg/L total nitrogen is the trigger for a mesotrophic status. Combined with the low phosphate levels, there is no indication that the up to three-fold increase in nitrogen will stimulate a eutrophic response.

The residual environmental effects on aquatic biota of discharge of heap leach facility runoff and seepage during closure are expected to be adverse, low to moderate in magnitude, local in geographic extent, continuous, and in perpetuity. Once begun, the effect would be irreversible. The effect will occur in an area already disturbed by historic placer mining. Aquatic biota will be monitored during all phases of the mine life to evaluate the predictions.

Discharge from Heap Leach Facility to Haggart Creek during Closure (Long-term Closure)

Effects on Water Quality

Over the long-term (after several decades), levels of nitrate, ammonia and some other constituents in heap seepage are predicted to be reduced by being rinsed out (Table 6.5-19). However, ongoing treatment in a passive engineered treatment system will likely be required to reduce metals levels over the long term. Levels of many metals will decrease slowly over time, while levels of others will stay the same or increase slightly. Phosphate, too, is predicted to increase in concentration, related to ongoing dissolution from the HLF materials. Over the long-term, the seepage water will be dominated by ongoing chemical reactions of sulphide-bearing minerals in the HLF.

The modeling of heap seepage mixed into Haggart Creek over the long term of closure (Table 6.5-21) predicts some improvement in water quality of Haggart Creek compared to the short-term (Table 6.5-20), but also indicates that seepage would likely require ongoing treatment. The reductions associated with use of a passive engineered treatment system will lead to concentrations of metals at or below WQG and SSWQO in Haggart Creek, as there will be about a two-fold decrease over the concentrations shown in Table 6.5-21. Nitrate, ammonia and phosphate levels are predicted to be close to baseline.

The residual effects on water quality of post-closure discharges to Haggart Creek between W4 and W29 over the long term, with mitigation, are considered adverse, low to moderate in magnitude, local in geographic extent, continuous and perpetual. Once begun, the effect will be irreversible and occur in an area already disturbed by placer mining. Effects will be confirmed through monitoring of both surface water quality and groundwater. Significance of the effect is described in Section 6.5.4.4.

Effects on Aquatic Biota

With nutrient levels at or close to baseline, no change in trophic status of aquatic biota is predicted for the long-term of closure. The residual effects on aquatic biota of post-closure discharges to Haggart Creek between W4 and W29 over the long-term, with mitigation, are considered adverse, negligible or low magnitude, local in geographic extent, continuous and perpetual. The effect would be irreversible, and expressed in an area already disturbed by placer mining.

Overall Release of Mine Contact Water to Haggart Creek during and after Closure

Effects on Water Quality

The overall environmental effects of the various discharges to Haggart Creek were considered by predicting concentrations at W29, downstream of Platinum Gulch and all mine activities, to account for inputs from:

- Mine water treatment plant (early draindown period) and reclaimed heap leach facility via W4
- Reclaimed Eagle Pup waste rock storage area via Dublin Gulch and Eagle Creek
- Reclaimed Platinum Gulch waste rock storage area and open pit via Platinum Gulch.

The results of modeling the combined sources of Project-affected water are presented here for information only, recognizing that concentrations are for the worst-case approach described earlier in the assessment and to be consistent with the approach taken for modeling residual water quality at W4. The predicted concentrations do not incorporate the 50% reduction in metal and nutrient levels achievable through construction of passive engineered treatment systems at the base of the three facilities. However, this reduction is factored in following presentation of the data in the tables. Concentrations in Haggart Creek at W29 were modeled using flow data (Figure 6.5-4) and post-closure predictions for mine facilities (Tables 6.5-20 to 6.5-24). Tables 6.5-26 and 6.5-27 provide the preliminary, unmitigated results for the short term and long term post-closure, respectively. Figure 6.5-8 shows predicted concentrations for average, wet and dry scenarios for all Project phases.

Table 6.5-26: Predicted Flow (average) and Water Quality (maximum) in Haggart Creek (W29) during the Short-term of Closure, 10% Infiltration for HLF and 20% Infiltration for Eagle Pup and Platinum Gulch Waste Rock Storage Areas, before or without Passive Treatment

Parameter[1]	Mean Monthly Concentration (mg/L, unless indicated)												WQG[2] (mg/L)	Max/ WQG
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Flow (m^3/s)	0.208	0.169	0.130	0.150	1.358	1.004	0.958	0.821	0.973	0.868	0.487	0.328		
Sulphate	72	72	79	65	35	64	59	69	56	65	70	72	100	0.8
Fluoride	0.102	0.102	0.119	0.143	0.103	0.113	0.117	0.128	0.107	0.092	0.090	0.100	0.30	0.5
Nitrate/Nitrite	0.124	0.124	0.123	0.292	0.154	0.176	0.123	0.112	0.123	0.138	0.125	0.124	2.9	0.0
Ammonia N	0.004	0.004	0.006	0.008	0.007	0.005	0.005	0.008	0.007	0.010	0.003	0.004		
Phosphate T P	0.008	0.008	0.013	0.035	0.046	0.031	0.023	0.020	0.018	0.011	0.007	0.007		
Aluminum T	0.017	0.017	0.025	0.069	**0.416**	0.062	0.046	0.033	0.039	0.016	0.009	0.017	0.10	**4.2**
Antimony T	0.0009	0.0009	0.0010	0.0141	0.0097	**0.0255**	0.0137	0.0152	0.0108	0.0111	0.0074	0.0007	0.02	**1.3**
Arsenic T	**0.0058**	**0.0059**	**0.0062**	**0.0464**	**0.0323**	**0.0465**	**0.0345**	**0.0334**	**0.0266**	**0.0201**	**0.0128**	**0.0055**	0.005	**9.3**
Boron T	0.026	0.026	0.007	0.010	0.011	0.031	0.025	0.016	0.021	0.020	0.045	0.026	1.2	<0.1
Cadmium T	0.00001	0.00002	0.00002	0.00007	0.00006	0.00014	0.00007	0.00008	0.00006	0.00007	0.00005	0.00001	0.0003	0.5
Chromium T	0.0005	0.0005	0.0003	0.0012	0.0010	0.0014	0.0009	0.0009	0.0008	0.0007	0.0007	0.0004	0.0089	0.2
Copper T	0.0005	0.0005	0.0004	0.0019	0.0027	0.0026	0.0015	0.0016	0.0014	0.0011	0.0010	0.0004	0.003	0.9
Iron T	0.084	0.084	0.105	0.161	0.631	0.150	0.116	0.079	0.099	0.066	0.068	0.085	1.0	0.6
Lead T	0.00004	0.00004	0.00004	0.00111	0.00105	0.00135	0.00081	0.00080	0.00062	0.00048	0.00027	0.00004	0.004	0.3
Manganese T	**0.0773**	**0.0772**	**0.1151**	**0.0743**	**0.0584**	0.0464	0.0446	0.0367	0.0349	0.0291	0.0434	**0.0773**	0.05	**2.3**
Mercury T	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00002	0.00002	0.00003	0.00001	0.00001	0.00003	1.0
Molybdenum	0.00079	0.00080	0.00064	0.00482	0.00297	0.00423	0.00296	0.00296	0.00249	0.00188	0.00123	0.00064	0.073	0.1
Nickel T	0.0015	0.0015	0.0018	0.0033	0.0038	0.0093	0.0048	0.0054	0.0039	0.0048	0.0042	0.0015	0.110	0.1
Selenium T	0.0005	0.0005	0.0005	0.0018	0.0014	0.0020	0.0013	0.0014	0.0011	0.0010	0.0008	0.0005	0.002	1.0
Silver T	0.00001	0.00001	0.00001	**0.00023**	**0.00015**	**0.00016**	**0.00012**	**0.00012**	**0.00010**	0.00006	0.00002	0.00001	0.0001	**2.3**
Thallium T	0.00008	0.00008	0.00006	0.00011	0.00009	0.00013	0.00008	0.00009	0.00009	0.00008	0.00011	0.00008	0.0008	0.2
Uranium T	0.0013	0.0013	0.0014	0.0046	0.0027	0.0077	0.0044	0.0050	0.0036	0.0040	0.0031	0.0012	0.015	0.5
Zinc T	0.0063	0.0063	0.0029	0.0084	0.0075	0.0071	0.0052	0.0047	0.0045	0.0039	0.0107	0.0063	0.03	0.4
Cyanide WAD	0.0025	0.0025	0.0025	0.0034	0.0031	0.0030	0.0029	0.0028	0.0028	0.0027	0.0025	0.0025	0.005	0.7

[1] Total (T) metals concentrations, elemental values for nitrate (N), ammonia (N), phosphate (P), sulphate (S)

[2] CCME WQGs for protection of aquatic life, with these exceptions: CCME drinking water (Sb, Tl), BC aquatic life (Fe, Se, SO_4, F^-), BC drinking water (Mn), draft CCME (Cd, U)

Table 6.5-27: Predicted Flow (average) and Water Quality (maximum) in Haggart Creek (W29) over the Long-term of Closure, 10% Infiltration for HLF and 20% Infiltration for Eagle Pup and Platinum Gulch Waste Rock Storage Areas, before or without Passive Treatment

Parameter[1]	Mean Monthly Concentration (mg/L, unless indicated)												WQG[2] (mg/L)	Max/ WQG
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Flow (m^3/s)	0.208	0.169	0.130	0.150	1.358	1.004	0.958	0.821	0.973	0.868	0.487	0.328		
Sulphate	72	72	79	62	34	63	59	69	55	65	70	72	100	0.8
Fluoride	0.102	0.102	0.119	0.142	0.103	0.113	0.117	0.128	0.107	0.092	0.090	0.100	0.30	0.5
Nitrate/Nitrite	0.124	0.124	0.123	0.122	0.039	0.080	0.050	0.043	0.063	0.101	0.125	0.124	2.9	0.0
Ammonia N	0.004	0.004	0.006	0.003	0.004	0.003	0.003	0.006	0.005	0.009	0.003	0.004		
Phosphate T P	0.008	0.008	0.013	0.037	0.047	0.032	0.024	0.021	0.019	0.011	0.007	0.007		
Aluminum T	0.017	0.017	0.025	0.057	**0.407**	0.055	0.041	0.028	0.035	0.013	0.009	0.017	0.10	**4.1**
Antimony T	0.0009	0.0009	0.0010	0.0141	0.0097	**0.0255**	0.0137	0.0152	0.0108	0.0111	0.0074	0.0007	0.02	**1.3**
Arsenic T	**0.0058**	**0.0059**	**0.0062**	**0.0383**	**0.0268**	**0.0419**	**0.0309**	**0.0301**	**0.0237**	**0.0193**	**0.0128**	**0.0055**	0.005	**8.4**
Boron T	0.026	0.026	0.007	0.010	0.011	0.031	0.025	0.016	0.021	0.020	0.045	0.026	1.2	<0.1
Cadmium T	0.00001	0.00002	0.00002	0.00006	0.00006	0.00014	0.00007	0.00008	0.00006	0.00007	0.00005	0.00001	0.0003	0.5
Chromium T	0.0005	0.0005	0.0003	0.0013	0.0010	0.0014	0.0009	0.0009	0.0008	0.0007	0.0007	0.0004	0.0089	0.2
Copper T	0.0005	0.0005	0.0004	0.0019	0.0027	0.0026	0.0016	0.0016	0.0015	0.0011	0.0010	0.0004	0.003	0.9
Iron T	0.084	0.084	0.105	0.161	0.631	0.150	0.116	0.078	0.099	0.066	0.068	0.085	1.0	0.6
Lead T	0.00004	0.00004	0.00004	0.00024	0.00047	0.00085	0.00042	0.00043	0.00031	0.00038	0.00027	0.00004	0.004	0.2
Manganese T	**0.0773**	**0.0772**	**0.1151**	**0.0744**	**0.0587**	0.0466	0.0447	0.0369	0.0350	0.0292	0.0434	**0.0773**	0.05	**2.3**
Mercury T	0.00001	0.00001	0.00001	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	**0.00003**	0.00001	0.00001	0.00003	1.0
Molybdenum	0.00079	0.00080	0.00064	0.00482	0.00297	0.00423	0.00296	0.00296	0.00249	0.00188	0.00123	0.00064	0.073	0.1
Nickel T	0.0015	0.0015	0.0018	0.0035	0.0039	0.0094	0.0048	0.0055	0.0039	0.0048	0.0042	0.0015	0.110	0.1
Selenium T	0.0005	0.0005	0.0005	**0.0022**	0.0016	**0.0022**	0.0014	0.0015	0.0013	0.0010	0.0008	0.0005	0.002	**1.1**
Silver T	0.00001	0.00001	0.00001	0.00008	0.00006	0.00008	0.00006	0.00006	0.00005	0.00003	0.00002	0.00001	0.0001	0.8
Thallium T	0.00008	0.00008	0.00006	0.00013	0.00010	0.00014	0.00009	0.00009	0.00009	0.00009	0.00011	0.00008	0.0008	0.2
Uranium T	0.0013	0.0013	0.0014	0.0046	0.0027	0.0077	0.0044	0.0050	0.0036	0.0040	0.0031	0.0012	0.015	0.5
Zinc T	0.0063	0.0063	0.0029	0.0063	0.0061	0.0060	0.0043	0.0041	0.0038	0.0037	0.0107	0.0063	0.03	0.4
Cyanide WAD	0.0025	0.0025	0.0025	0.0034	0.0031	0.0030	0.0029	0.0028	0.0028	0.0027	0.0025	0.0025	0.005	0.7

[1] Total (T) metals concentrations, elemental values for nitrate (N), ammonia (N), phosphate (P), sulphate (S)

[2] CCME WQGs for protection of aquatic life, with these exceptions: CCME drinking water (Sb, Tl), BC aquatic life (Se, SO_4,F^-), BC drinking water (Mn), draft CCME (Cd, U)

With no further treatment of discharges from the reclaimed HLF and waste rock storage areas (i.e., passive engineered treatment systems), modeled results for W29 are generally similar to those for W4 (Table 6.5-20 and 6.5-21) and predict:

- Aluminum and manganese above WQG, to the same extent noted for baseline.
- Arsenic higher than the CCME WQG and a SSWQO several months of the year (maximum of 0.046 mg/L during short term and 0.042 mg/L during long-term, up to two times higher than a proposed SSWQO).
- Silver up to two times the WQG during short term, decreasing to less than WQG in the long-term.
- Nitrogen in the short-term with a maximum of 0.176 mg N/L nitrate and 0.008 mg N/L ammonia in the June to September growing season, from the heap seepage further upstream into Haggart Creek (up to 2.5 times higher than baseline). In the long term, nitrogen levels are similar to baseline.
- Phosphorus in the short- and long-term with a maximum of 0.032 mg P/L over the growing season (3 to 10 times higher than baseline), from seepage of waste rock storage areas that drain into Dublin Gulch and Platinum Gulch.

This analysis of water quality in Haggart Creek over the longer distance emphasizes the importance of mitigation to reduce levels of arsenic and nutrients. There are two options: tighter reclamation covers on the waste rock storage areas and use of passive systems should monitoring indicate the actual levels are similar to those predicted.

The use of a tighter cover on the Eagle Pup waste rock storage area was discussed earlier and results for Dublin Gulch were presented for a cover that allows 20% infiltration (base case) and another that allows 10% infiltration of net precipitation (Tables 6.5-23 and 6.5-24). Because predictions for Dublin Gulch strongly suggest the need for a 10% infiltration rate, this was integrated into the prediction for W29. Results for this modeling exercise are shown in Table 6.5-28, for the short term. Similar trends would be obtained over the long term. Compared to the results predicted in Table 6.5-20 (with a 10% cap on the HLF and 20% caps on the two waste rock storage areas), the modification of the Eagle Pup waste rock storage area to a 10% cap would result in:

- Aluminum and manganese above WQG, to the same extent noted for baseline.
- No change in arsenic (0.046 mg/L), silver, nitrate or ammonia levels over those predicted in Table 6.5-20, given the higher baseline levels and SSWQO for arsenic in Dublin Gulch and the small contribution of Dublin Gulch flows to Haggart Creek (about 10%).
- A 10% decrease in phosphate, with a maximum of 0.027 mg P/L over the growing season (three to nine times higher than baseline).

While the use of a tighter cover on the Eagle Pup waste rock storage area does not result in predictions of substantial improvement for water quality in Haggart Creek, it will be important for protection of water quality in Dublin Gulch and Eagle Creek, especially in the area developed as fish habitat compensation.

Table 6.5-28: Predicted Flow (avg) and Water Quality (max) in Haggart Creek (W29) over the Short-term of Closure, 10% Infiltration for HLF and Eagle Pup Waste Rock Storage Area, 20% Infiltration for Platinum Gulch Waste Rock Storage Area, before or without a Passive Engineered Treatment System

Parameter[1]	Mean Monthly Concentration (mg/L, unless indicated)												WQG[2] (mg/L)	Max/ WQG
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Flow (m^3/s)	0.208	0.169	0.130	0.150	1.358	1.004	0.958	0.821	0.973	0.868	0.487	0.328		
Sulphate	72	72	79	65	35	60	58	67	54	63	68	72	100	0.8
Fluoride	0.102	0.102	0.119	0.143	0.103	0.106	0.114	0.125	0.105	0.091	0.087	0.100	0.30	0.5
Nitrate/Nitrite	0.124	0.124	0.123	0.292	0.154	0.178	0.124	0.113	0.123	0.139	0.125	0.124	2.9	0.0
Ammonia N	0.004	0.004	0.006	0.008	0.007	0.005	0.005	0.008	0.007	0.010	0.003	0.004		
Phosphate T P	0.008	0.008	0.013	0.036	0.046	0.027	0.022	0.018	0.017	0.010	0.005	0.007		
Aluminum T	0.017	0.017	0.025	0.073	**0.419**	0.063	0.046	0.034	0.039	0.016	0.009	0.017	0.10	**4.2**
Antimony T	0.0009	0.0009	0.0010	0.0140	0.0092	0.0181	0.0104	0.0111	0.0084	0.0070	0.0045	0.0007	0.02	0.9
Arsenic T	**0.0058**	**0.0059**	**0.0062**	**0.0463**	**0.0319**	**0.0391**	**0.0313**	**0.0295**	**0.0242**	**0.0168**	**0.0099**	**0.0055**	0.005	**9.3**
Boron T	0.026	0.026	0.007	0.010	0.011	0.031	0.025	0.016	0.021	0.020	0.045	0.026	1.2	<0.1
Cadmium T	0.00001	0.00002	0.00002	0.00007	0.00006	0.00010	0.00006	0.00006	0.00005	0.00005	0.00004	0.00001	0.0003	0.3
Chromium T	0.0005	0.0005	0.0003	0.0012	0.0010	0.0012	0.0008	0.0008	0.0008	0.0006	0.0006	0.0004	0.0089	0.1
Copper T	0.0005	0.0005	0.0004	0.0019	0.0027	0.0022	0.0014	0.0014	0.0013	0.0009	0.0008	0.0004	0.003	0.9
Iron T	0.084	0.084	0.105	0.165	0.635	0.146	0.114	0.077	0.098	0.064	0.066	0.085	1.0	0.6
Lead T	0.00004	0.00004	0.00004	0.00111	0.00103	0.00110	0.00069	0.00065	0.00053	0.00039	0.00016	0.00004	0.004	0.3
Manganese T	**0.0773**	**0.0772**	**0.1151**	**0.0742**	**0.0580**	0.0419	0.0429	0.0348	0.0333	0.0266	0.0416	**0.0773**	0.05	**2.3**
Mercury T	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00002	0.00002	0.00003	0.00001	0.00001	0.00003	1.0
Molybdenum	0.00079	0.00080	0.00064	0.00481	0.00294	0.00379	0.00275	0.00271	0.00234	0.00173	0.00104	0.00064	0.073	0.1
Nickel T	0.0015	0.0015	0.0018	0.0033	0.0036	0.0061	0.0033	0.0037	0.0028	0.0031	0.0029	0.0015	0.110	0.1
Selenium T	0.0005	0.0005	0.0005	0.0018	0.0014	0.0017	0.0012	0.0012	0.0011	0.0009	0.0007	0.0005	0.002	0.9
Silver T	0.00001	0.00001	0.00001	**0.00023**	**0.00015**	**0.00015**	**0.00012**	**0.00011**	0.00010	0.00006	0.00002	0.00001	0.0001	**2.3**
Thallium T	0.00008	0.00008	0.00006	0.00011	0.00009	0.00012	0.00008	0.00008	0.00009	0.00008	0.00011	0.00008	0.0008	0.2
Uranium T	0.0013	0.0013	0.0014	0.0046	0.0026	0.0055	0.0035	0.0038	0.0029	0.0028	0.0022	0.0012	0.015	0.4
Zinc T	0.0063	0.0063	0.0029	0.0084	0.0075	0.0059	0.0047	0.0042	0.0041	0.0032	0.0102	0.0063	0.03	0.3
Cyanide WAD	0.0025	0.0025	0.0025	0.0034	0.0031	0.0030	0.0029	0.0028	0.0028	0.0027	0.0025	0.0025	0.005	0.7

[1] Total (T) metals concentrations, elemental values for nitrate (N), ammonia (N), phosphate (P), sulphate (S)
[2] CCME WQGs for protection of aquatic life, with these exceptions: CCME drinking water (Sb, Tl), BC aquatic life (Se, SO_4, F^-), BC drinking water (Mn), draft CCME (Cd, U)

The use of passive engineered treatment systems at the HLF and waste rock storage areas has been discussed, and would be needed primarily to ensure that effluent (i.e., seepage) quality would meet MMER criteria, and also to contribute to water quality in Haggart Creek being able to meet WQG or SSWQO. Each system would provide about 50% reduction in levels of arsenic, other metals, phosphorus and nitrogen prior to discharge to the creeks. This approach will reduce the potential eutrophic effects from the combined addition of nitrogen and phosphorus, and reduce arsenic levels to the SSWQO or less. As noted above, these passive systems have low requirements for maintenance over the long-term. Given that results shown in Tables 6.5-26, 6.5-27 and 6.5-28 are conservative, worst-case predictions, for low probability flow conditions likely to have the greatest adverse effect on water quality, it is likely that they overestimate concentrations of most parameters. The need for passive engineered treatment systems will be assessed further during operations, based on monitoring results and comparisons with predictions made in the environmental assessment.

The residual effect of post-closure discharges to Haggart Creek downstream of Platinum Gulch over the short term and long term, with use of passive engineered treatment system below the reclaimed facilities, is considered adverse, low to moderate in magnitude, local in geographic extent, continuous and perpetual. The effect will be irreversible, once begun, and occur in an area already disturbed by placer mining. Significance of the effect is described in Section 6.5.4.4.

Effects on Aquatic Biota

Nitrogen additions from the heap seepage and phosphorus additions from the waste rock storage areas have the potential for eutrophication effects in Haggart Creek at W29 and downstream over the short term of closure. While no change in trophic status is predicted for Haggart Creek upstream (likely controlled by the low phosphate levels) or for Dublin Gulch and Eagle Creek (likely controlled by the low nitrogen levels), the mixing of these waters above W29 brings together both essential nutrients for periphyton growth and makes a shift in trophic status more likely. Over the long term, nitrogen levels will return to baseline, but phosphate levels are predicted to remain elevated.

The passive engineered treatment system likely to be needed at the base of the heap leach facility and waste rock storage areas will remove some of the nitrogen and phosphorus from the seepages. Targets for returning nutrients to baseline or to no change in trophic status were developed considering the framework for phosphorus and nitrogen management (Table 6.5-17; Gartner Lee 2006; Alexander and Smith 2006):

- Phosphate in the predicted 0.018 to 0.032 mg P/L range for Haggart Creek during the growing season, while still in the mesotrophic range, would be 3 to 9 times higher than baseline, over the post-closure phase. A 50% reduction in stream concentrations (0.009 to 0.015 mg P/L) would maintain conditions in the oligotrophic category (<0.025 mg P/L).
- Inorganic nitrogen (combined nitrate plus ammonia) in the predicted range of 0.12 – 0.18 mg N/L for Haggart Creek during the growing season would be two to three times higher than baseline over the short term of post-closure. A 50% reduction would result in inorganic nitrogen levels of 0.06 to 0.09 mg N/L, up to 1.5 times higher than baseline, and more in balance with the phosphorus and less sensitive to other inputs that might occur.

The targets of 50% reduction in phosphate and inorganic nitrogen in passive engineered treatment systems are well within the performance documented in such systems (Appendix 28 – Passive Techniques for the Treatment of Mine Effluent). The small residual increases in nitrogen and phosphorus concentrations predicted for closure end (still within the oligotrophic category) could be seen as a benefit in an oligotrophic system such as Haggart and its tributaries, as it would translate to greater availability of food supplies for some of the benthic invertebrates (the herbivores) and then for fish.

Given that results shown in Tables 6.5-24 and 6.5-25 are conservative, worst-case predictions, for flow conditions likely to produce the highest concentrations of nutrients, it is likely that they overestimate concentrations of most parameters. The need for further mitigation measures (passive engineered treatment systems) will be assessed over the life of the mine, based on monitoring results and comparisons with predictions made in the environmental assessment.

The residual effect on aquatic life of post-closure discharges to Haggart Creek downstream of Platinum Gulch over the short term and long term, with mitigations, is considered adverse, low to moderate in magnitude, local in geographic extent, continuous and perpetual. The effect will be irreversible once begun and will be expressed in an area already disturbed by placer mining.

Seepage of Contact Water into Groundwater

The assessment for potential for seepage from the waste rock areas to move into groundwater, then to Haggart Creek or Dublin Gulch is similar both post-closure and operations (Section 6.5.3). Seepage in the groundwater is predicted to move to Dublin Gulch diversion channel or Haggart Creek within one year. No movement of seepage into deeper groundwater is predicted. The concentration of seepage in groundwater is expected to be low (less than 1% in most areas and not greater than 4%). That means if the concentration of a particular parameter in the seepage is less than 25 to 100 times a guideline, the concentration at the stream would be at or less than WQG. The main parameter of interest is arsenic, given the worst case predictions for source terms (Appendix 8), and a similar relationship would be predicted for the other metals, which are not as highly elevated above guidelines as is arsenic. As very little seepage into groundwater is predicted (1% to 4%), this would translate into little change in the streams where the groundwater discharges. For Platinum Gulch waste rock storage area, the source term of 1.2 mg/L of arsenic in seepage is 60 times higher than a proposed SSWQO (0.020 mg/L) for Haggart Creek, so groundwater that enters Haggart Creek will not result in arsenic concentrations above SSWQO (i.e., it is in the range of 25 to 100 times the guideline). A similar situation would occur for Eagle Pup waste rock storage area, where the 1.4 mg/L predicted source term for seepage is 20 times higher than a proposed SSWQO of 0.07 mg/L for Dublin Gulch (also within the range of 25 to 100 times the guideline).

Residual environmental effects of movement of groundwater affected by contact water are expected to be adverse, negligible to low in magnitude, local in geographic extent, continuous, and perpetual. The effect will be irreversible, once begun. No increase in arsenic or other parameters to higher than guidelines would be predicted for the streams as a result this interaction. Given the conservatism built into the modeling approach, and the additional attenuation processes in soil that bind metals, it is likely that results will be better than predicted. Quality of groundwater and surface water will be monitored during operations, to assess accuracy of this prediction. Significance of the effect is described in Section 6.5.4.4.

6.5.4.4 Determination of Significance of Site Discharges during and After Closure

The main sources of discharge (HLF to Haggart Creek; waste rock storage areas to Platinum Gulch then Haggart Creek or Dublin Gulch then Eagle Creek then Haggart Creek) during closure were considered at individual points and combined at W29 in Haggart Creek. The residual environmental effects of these discharges on water quality and aquatic biota are considered not significant, given that, with mitigation measures (passive engineered treatment systems), the effluent discharges and resulting water quality in the streams will meet regulatory requirements (MMER effluent criteria, Yukon Water Board permits, WQG or SSWQO). There will be no unauthorized release of a deleterious substance (as defined under the *Fisheries Act*) into waters frequented by fish and no impairment of the streams to sustain aquatic life.

Levels of arsenic and other metals are predicted to be at or below WQG or SSWQO. Levels of phosphorus and nitrogen, while higher than baseline, are predicted to remain within an oligotrophic or mesotrophic category and will not stimulate a eutrophic response of aquatic communities. For Platinum Gulch, an ephemeral, intermittent watercourse, the prediction is for high magnitude changes in a site-specific geographic extent; this watercourse is not fish-bearing and is not expected to support aquatic communities. Early in closure, when there is a high volume of draindown from the heap leach facility, the mine water treatment plant will be in operation and will remove large amounts of metals and nitrogen from the discharge. After reclamation, runoff and seepage from the reclaimed HLF and waste rock storage areas will be directed to passive engineered treatment systems for further treatment, which will reduce metal and nutrient levels. The post-closure discharges are not predicted to result in exceedances of WQG or SSWQO in Haggart Creek, Dublin Gulch or Eagle Creek. Metals levels are predicted to meet WQG or SSWQO that could reasonably be established. A change in trophic status (from oligotrophic to the upper end of the oligotrophic to lower end of the mesotrophic range) is predicted, but this is considered a small enough change to not present management challenges for the watershed. Changes in water chemistry related to seepage into groundwater then streams are predicted to be low or not measureable.

While the well-defined baseline dataset provides a reliable basis for making predictions of water quality, overall, there is a moderate confidence in the prediction of effects being not significant related to:

- The amount of conservatism built into the worst case predictions for the geochemical source terms and hydrology regimes (concentrations are likely to be lower than predicted).
- The effectiveness of and range in mitigation measures available to manage effluent quality (mine water treatment plant, cyanide detoxification plant, passive engineered treatment systems, use of caps that allow 10% rather than 20% infiltration of net precipitation). The tighter cap has been shown to be technically and economically feasible (high confidence).

Passive systems are well known to be effective; while maintenance requirements are considered low, further research is needed to confirm these requirements.

6.5.5 Considerations for Site Specific Water Quality Guidelines for Metals of Concern

The CCME WQG are useful in defining levels at which no adverse effect would be expected; however, they do not define concentrations at which adverse effects would occur. For many parameters, the WQG were developed by applying a ten-fold safety factor to the lowest chronic value in the toxicological literature for the most sensitive plant, invertebrate or fish species. Recently, draft WQG for some parameters have been circulated based on guidance provided in CCME 2007. Some, like cadmium, are higher than the existing CCME WQG, some, like zinc, are similar, and some, like uranium, provide a WQG where none was previously published. The new approach depends on a combination of no effect and low effect concentrations (NOEC, LOEC), and again defines a level that is considered safe, but not a level where adverse effects can be predicted.

CCME (2003) provides guidance in developing SSWQO. The approach described here is to consider the baseline concentration approach and WQG set by other jurisdictions.

Water chemistry in Haggart Creek and the Dublin Gulch diversion channel, which will be affected by mine discharges, was modeled using the conservative approach described in Section 6.5.1.11. Baseline arsenic concentrations are up to ten times higher than WQG year round in Dublin Gulch and occasionally in Haggart Creek. These baseline levels indicate the need for SSWQO. Discharge of treated mine effluent and seepage from reclaimed facilities is predicted to result in concentrations of several metals to above CCME WQG or other guidelines in these creeks, although it is noted that these predictions are likely to overestimate the concentrations.

The main metals of concern are antimony, arsenic, cadmium, selenium, and silver. Aluminum, manganese and iron would have SSWQO related to baseline concentrations (aluminum and iron levels are high in spring freshet, manganese levels are elevated in winter), rather than to Project discharges, so are not discussed further. General considerations for development of SSWQO are summarized in Table 6.5-29, along with recommended levels for this Project.

While it is anticipated that a SSWQO will be requested only for arsenic (elevated baseline levels) and cadmium (draft CCME WQG), the discussion below provides background information and rationale for the metals identified as a potential concern. It is also noted that use of treatment systems or a cover that allows less infiltration of precipitation will reduce these metals to levels lower than the worst-case predictions, although to be conservative, these were not modeled quantitatively.

6.5.5.1 Antimony

Antimony in surface waters typically comes from weathering and erosion of soils and bedrock. It occurs as Sb III and Sb V in oxygenated environments (Beak 2002). The trivalent form is considered more toxic than the pentavalent form, although this is based on a relatively small database (Nam, et al. 2009). Little is known of the toxicity mechanism for antimony, but it has been suggested that it is similar to that of arsenic, given their similar chemistry.

Antimony is not considered particularly toxic to fish (Beak 2002). For acute toxicity, the 96-h LC50 was 21.9 mg/L for fathead minnow and 35.5 mg/L for tilapia; for chronic toxicity, the 28 day median lethal concentration was as low as 0.6 mg/L for rainbow trout and higher for fathead minnows. Acute toxicity for the invertebrate *Daphnia magna* was 9 to 20 mg/L; for chronic toxicity (28-day life cycle exposure), measurable toxic effects occurred at 5.4 mg/L. Results for plants were based on limited testing, with a green alga showing an EC50 of 0.61 mg/L and no effect on duckweed within the solubility range of antimony. Environment Canada considerations for the now closed Eskay Creek mine in northern British Columbia included a discussion of elevated antimony levels (0.40 to 0.75 mg/L) in a lake used for tailings deposition, toxicity information and relevant guidelines for antimony (Sheehan 2000).

There is no CCME WQG for protection of aquatic life for antimony; however, the BC working WQG for protection of aquatic life is 0.020 mg/L, based on a draft Ontario guideline (Nagpal, et al. 2006). While the US EPA does not currently provide a chronic or acute criterion, it did publish a draft document (US EPA 1988) recommending a chronic freshwater WQG of 0.03 mg/L, similar to BC and Ontario. This WQG is set to be protective of algae, the most sensitive organisms.

Given that discharge of water from the reclaimed HLF after the mine water treatment plant is decommissioned is predicted to result in up to 0.128 mg/L antimony in Dublin Gulch, there is a low potential toxicity issue, especially for periphyton. However, this concentration is six times the BC WQG, within the 10-fold safety factor used in developing the WQG. This could be reduced up to 50% through use of a passive engineered treatment system and a further 50% by use of a tighter reclamation cover, resulting in a prediction of 0.03 mg/L in Dublin Gulch.

Table 6.5-29: Elevated Metals and Considerations for Site Specific Water Quality Objectives

Parameter	Guideline	Concentrations	Other Factors to Consider	Recommended SSWQO
Aluminum	▪ 0.10 mg/L total (CCME) ▪ 0.10 mg/L dissolved (BC)	▪ Total Al elevated during freshet to 0.226 in baseline (no change for operations or closure)	▪ BC WQG for dissolved Al recognizes that particulate Al (especially in freshet) is due to silt content, and is not toxic	▪ 0.10 mg/L dissolved Al, BC WQG (BC BC MoE 2006)
Antimony	▪ No CCME WQG for aquatic life ▪ BC WQG for aquatic life is 0.02 mg/L ▪ No USEPA WQG for aquatic life ▪ Little toxicological literature	▪ Baseline in Haggart is near detection limit (0.0002 mg/L) ▪ Predicted to increase in Dublin to 0.128 mg/L post-closure (before passive treatment and tighter reclamation cap) ▪ High levels predicted for source terms (1.7 mg/L in reclaimed HLF, 0.6 to 0.14 mg/L in runoff from reclaimed waste rock storage areas, 1.4 mg/L in runoff from reclaimed open pit)	▪ Sb levels are controlled by adsorption onto iron oxyhydroxide surfaces (which was not modeled) ▪ Baseline Sb levels are near or below detection limits in Haggart Creek and Dublin Gulch	▪ 0.04 mg/L Sb, based on 2 times the BC WQG (Nagpal et al. 2006), which assumes a 10-fold safety margin)
Arsenic	▪ CCME WQG is 0.005 mg/L ▪ USEPA Criterion Continuous Concentration (chronic) is 0.15 mg/L	▪ Baseline max in Haggart is 0.016 mg/L ▪ Baseline maximum is 0.058 in Dublin and 0.078 mg/L in Eagle ▪ Baseline maximum in Lynx is 0.008 mg/L ▪ Predicted maximum in Haggart is 0.075 mg/L in closure (before passive treatment) ▪ Predicted to come from all sources (greatest is reclaimed HLF, 67 mg/L)	▪ Adsorbs to iron or clay particles, occasionally precipitates or co-precipitates (which was not modeled) ▪ No evidence in freshwater food chains of biomagnification ▪ Already elevated in several streams in the area, which support healthy benthic and fish communities ▪ Algae are the most sensitive organisms	▪ 0.02 mg/L in Haggart Creek ▪ 0.07 mg/L in Dublin Gulch, Eagle Creek ▪ Developed using CCME baseline concentration method (Mean + 2 SD of background)
Cadmium	▪ CCME WQG is 0.05 µg/L at 150 mg/L hardness ▪ Draft CCME WQG is 0.3 µg/L for 150 mg/L hardness ▪ US EPA Criterion Continuous Concentration is 0.25 µg/L dissolved	▪ Baseline in Haggart, Dublin and tributaries is low (0.01 to 0.2 µg/L) ▪ Predicted to increase in Dublin to up to 0.65 µg/L in closure, mainly from reclaimed waste rock storage areas (before passive treatment or tighter reclamation cover)	▪ Toxicity reduced in presence of increasing hardness and dissolved organic carbon ▪ Adsorbs onto iron oxyhydroxide (which was not modeled)	▪ 0.3 µg/L at 150 mg/L hardness; draft CCME WQG (Roe, et al. 2010)

Parameter	Guideline	Concentrations	Other Factors to Consider	Recommended SSWQO
Iron	▪ 0.30 mg/L total (CCME) ▪ 1.0 mg/L total and 0.35 mg/L dissolved (BC)	▪ Total Fe elevated during freshet in most of the creeks in baseline	▪ The more recently set BC WQG recognizes the role of particulate Fe in silt during freshet, provides a WQG for dissolved and total Fe	▪ 1.0 mg/L total Fe ▪ 0.35 mg/L dissolved Fe ▪ BC WQG (BC MoE 2008)
Selenium	▪ CCME WQG is 0.001 mg/L ▪ BC WQG is 0.002 mg/L (a mean value over longer term ▪ USEPA Criterion Continuous Concentration (chronic) is 0.005 mg/L	▪ Baseline in Haggart, Dublin and tributaries is near detection limit (0.0001/L) ▪ Predicted maximum in Haggart is 0.005 mg/L post-closure (before passive treatment or tighter reclamation cap) ▪ From all sources (waste rock storage area, open pit, HLF).	▪ Adsorbs onto iron oxyhydroxide (which was not modeled) ▪ An essential element ▪ Can bioaccumulate; levels in fish tissue are ecologically more relevant than levels in water ▪ More of a concern in depositional than faster flowing habitat	▪ 0.002 mg/L Se; BC WQG (Nagpal 2001)
Silver	▪ CCME and BC WQG is 0.0001 mg/L at hardness >100 mg/L	▪ Baseline in Haggart, Dublin and tributaries is near detection limit (0.00002 mg/L) ▪ Predicted maximum in Haggart is 0.0004 mg/L post-closure (before passive treatment), decreases over long term to below WQG	▪ Associates with iron oxides and humic substances.	▪ 0.0003 mg/L ▪ Based on three times CCME WQG

Based on these considerations, it is recommended that a SSWQO of 0.04 mg/L antimony, two times the BC WQG, be used, recognizing the amount of protection provided in the WQG. It is also noted that the use of passive engineered treatment systems would reduce levels of antimony to below the WQG, and that a SSWQO might not be needed.

6.5.5.2 Arsenic

Arsenic in surface waters typically comes from weathering and erosion of soils and bedrock. It occurs as As III and As V in oxygenated environments (CCME 1999c). Arsenic can absorb onto colloidal humic material when there is high organic content and low pH, phosphorus and mineral content. Levels are affected by biotic uptake, sorption to iron or clay particles, and sometimes precipitation or co-precipitation.

Arsenic is toxic to a range of aquatic organisms, with algae and some invertebrates more sensitive than fish (CCME 1999c). It is structurally similar to phosphate, easily taken up, interferes with aerobic metabolism in many organisms, and can result in morphological and physiological changes (Lage, et al. 2006). Toxicity may be through formation of stable bonds with sulphur and carbon, interfering with enzyme activity (US EPA 1984a).

The CCME and BC WQG for protection of aquatic life was set at 0.005 mg/L (CCME 1999c, BC MoE 2010). This was based on toxicity tests using the most sensitive alga tested, the green alga *Scenedesmus obliquus*, which showed growth inhibition at 0.05 mg/L arsenic in a 14 day test (14 day EC50). This finding was supported by toxicity tests on other algae (diatom, chrysophyte). The WQG was set applying a ten-fold safety factor. The planktonic invertebrate *Daphnia magna* was more sensitive, with a Lowest Observed Effect Concentration (LOEC) for growth of 0.02 mg/L in a 21-d flow-through chronic bioassay and a No Observed Effect Concentration (NOEC) of 0.01 mg/L in US EPA tests; the safety factor is only four times the WQG, and is considered to be sufficiently protective (BC MoE 2010). The lowest chronic EC50 for fish reported in the literature was 0.55 mg /L for rainbow trout after 28-d exposure.

For Haggart Creek, Dublin Gulch, and Eagle Creek, the SSWQO could be set to reflect baseline conditions, which are:

- **Haggart Creek baseline** (sites W4, W22, W29) ranges from 0.0007 to 0.031 mg/L, increasing downstream of Dublin Gulch (W4) and again downstream of Eagle Creek (W29); at W4, the mean is 0.006 mg/L and mean plus two SD is 0.021 mg/L; at W29, the mean is 0.008 mg/L and mean plus two SD is 0.017 mg/L
- **Dublin Gulch baseline** (sites W1 and W21) ranges from 0.025 to 0.058 mg/L; for W1, the mean is 0.036 mg/L and mean plus two SD is 0.047 mg/L
- **Eagle Creek baseline** (site W27) ranges from 0.029 to 0.083 mg/L; the mean is 0.026 mg/L and mean plus two SD is 0.071 mg/L.

Based on historic data, a reasonable SSWQO for Dublin Gulch and Eagle Creek would be 0.070 mg/L and for Haggart Creek would be 0.020 mg/L. These cover the range of natural variability (95% confidence intervals). Elevated baseline levels of arsenic in Dublin Gulch, Eagle Creek and tributaries year round reflect naturally high arsenic levels in soil and groundwater. Levels are also elevated in nearby Lynx Creek, which has not been disturbed by placer mining. Haggart Creek is the only local creek that does not show routinely elevated arsenic levels. Fish travel within these connected streams, all of which contain diverse assemblages of invertebrate and periphyton species, including pollution sensitive insect larvae (Appendix 15 – Environmental Baseline Report: Water Quality and Aquatic Biota).

6.5.5.3 Cadmium

Cadmium is toxic to a range of organisms, including salmonids, at levels well below 1 µg/L. It competes with calcium in cellular uptake and interferes with calcium metabolism. Species Mean Chronic Values for cadmium toxicity in rainbow trout and the zooplankter *Daphnia magna* are 0.0013 and <0.0004 mg/L respectively (US EPA 2001). Potential effects include bioconcentration and responses at the cellular, organism and population levels (World Health Organization 1992, Beak 2002, Burger 2008). Toxic effects of cadmium decrease with increasing hardness (as recognized in the WQG) and with increasing levels of dissolved organic matter (US EPA 2001). Hardness is high (150 mg/L) in Haggart Creek, which will help reduce potential toxicity.

The proposed SSWQO is the CCME draft WQG of 0.0003 mg/L at 150 mg/L hardness (Roe, et al. 2010), which is similar to the US EPA criterion chronic concentration for dissolved cadmium of 0.00015 to 0.00039 mg/L for hardness of 50 to 180 mg/L (US EPA 2001). The draft WQG is about eight times higher than the existing CCME WQG of 0.00004 mg/L at hardness of 150 mg/L. The draft CCME WQG was developed using the species sensitivity distribution approach, and is undergoing review. The US EPA criterion was based on a rigorous evaluation of chronic and acute toxicity data for freshwater biota, with peer and public reviews, and was developed for the more biologically relevant dissolved concentration.

6.5.5.4 Selenium

Biogeochemical processes control selenium cycling, and organic forms of selenium are common in surface waters (Beak 2002). Its chemistry resembles that of sulphur, and toxicity occurs mainly when selenium replaces sulphur in cellular reactions. Selenium is also an essential micro-nutrient, with only a ten-fold difference between beneficial and detrimental levels for biota (Nagpal 2001; Himeno and Imura 2002). Bioavailability and toxicity depend on the form present, with selenate and the more toxic selenite readily taken up by aquatic organisms. Depending on duration and magnitude of exposure and type of uptake, effects can include mortality, deformities and impaired reproduction that can affect fish communities and local populations of birds.

Although WQG are set for water, there is general agreement that levels in depositional sediment and in fish tissue are more informative measurements of selenium and its effects (Nagpal 2001). The CCME WQG is a maximum of 0.001 mg/L; the BC WQG is a 30 day mean of 0.002 mg/L (no maximum published); and the USEPA criterion chronic concentration is 0.005 mg/L (US EPA 2004b). The BC WQG mean of 0.002 mg/L is designed to protect aquatic life both from direct toxic effects and from accumulating undesirable levels of selenium via the food chain. It is based on the lowest observed effect level of 0.01 mg/L and a safety factor of five (lower than the ten recommended in the

CCME protocol because selenium is an essential element and because food, not water, is the major source of selenium in the food chain [Nagpal 2001]). Measurement of selenium levels in depositional sediment and fish tissue have been found to provide more accurate assessments of the fate and effect of selenium in aquatic systems than does measurement in water, given that the potential for toxicity increases in standing water (anaerobic, organically rich areas), where selenium tends to accumulate (Chapman 2000).

The proposed SSWQO is 0.002 mg/L selenium (the BC WQG). Both the British Columbia and US EPA guidelines also include guidelines for tissue concentrations in fish, given the importance of assessing bioaccumulation of selenium (BC MoE 2006, US EPA 2004b). Baseline levels in Haggart Creek, Dublin Gulch and Eagle Creek are low, and close to analytical detection limits. It is also noted that the use of passive systems would reduce levels of selenium in the streams to this level.

6.5.5.5 Silver

Silver is considered toxic to a range of organisms, and the CCME and BC WQG are set at 0.0001 mg/L for hardness greater than 100 mg/L (CCME 2009a, BC MoE 2006). Toxicity is affected by water hardness, length of exposure, and size and life stage of the organism. Silver is notably more toxic to microorganisms, including bacteria, than it is to vertebrates, which have mechanisms to excrete silver (Warrington 1996). The effects appear to be due to formation of reversible bonds with enzymes and other active molecules on the cell surface, via binding with sulphydryl groups. Biologically available silver disrupts membranes, disables proteins and inhibits enzymes.

The WQG is set to protect the most sensitive life-stage of the most sensitive species (phytoplankton and embryonic and larval stages of invertebrates). Juvenile and adult stages of fish are less sensitive than the embryo stage.

A proposed SSWQO of 0.0003 mg/L, three times to WQO, is recommended. This should maintain protection of the more sensitive organisms, while recognizing the ten-fold safety margin incorporated in the CCME and BC WQG. It is also noted that the use of passive engineered treatment systems would reduce levels of silver to below the WQG, and that a SSWQO might not be needed.

6.5.6 Follow-up and Monitoring

A water quality, sediment, and aquatic biota monitoring program will be developed for all phases of the mine life to meet permit and license requirements and assess accuracy of the predictions. Details will be finalized in consultation with regulatory agencies. In all phases, the mine will be subject to permitting requirements of the Yukon Water Board. During operations and the start of closure, the mine will be subject to monitoring under MMER, and EEM programs will be developed as required. After closure, discharges from mine facilities will be directed to the mine water treatment plant until monitoring indicates there is no further need for treatment, i.e., that untreated seepage from the HLF and waste rock storage areas does not comprise a deleterious substance as defined in the *Fisheries Act*, and that their discharge will result in acceptable water quality in the receiving streams. The monitoring program implemented during construction and operations will be adapted to site conditions for closure and will include all necessary QAQC components to assess accuracy and reproducibility of the program.

Based on the Project Description (Section 5), the elements of the water quality monitoring program for receiving waters (streams) applicable to all Project phases are as follows:

- Measurement of metal, cyanide, nutrient and general physical and chemical parameters, with detection limits and methods consistent with recent baseline studies
- Monitoring of benthic communities (sediment, benthic invertebrates, and periphyton)
- Monitoring frequency to be determined through permitting (likely to be daily for effluent, monthly for receiving environment water quality during operations; likely to be on a one to three year cycle, during late summer, for aquatic biota)
- Monitoring until it is determined that closure measures are resulting in acceptable effluent and receiving water quality under the appropriate range of flows
- Sampling sites as follows (see Figure 6.5-3, which indicate general areas):
    - For the Platinum Gulch waste rock storage area and open pit, which will discharge to Platinum Gulch and then Haggart Creek at closure, monitoring sites will be located in the open pit, lower Platinum Gulch (site W34) and Haggart Creek downstream of the confluence (W29). Aquatic biota will not be sampled in this area (intermittent flow).
    - For the Eagle Pup waste rock storage area, which will discharge to the Dublin Gulch diversion channel at closure, monitoring sites will include lower Eagle Pup (W9) and two new sites upstream and downstream of the discharge, to be established after channel construction.
    - For the heap leach facility, which will discharge to Haggart Creek in the area of the mine water treatment plant discharge once water quality is acceptable, the monitoring sites will include the HLF discharge, and locations in Haggart Creek upstream (W22) and downstream (W4) of the discharge.
    - For additional sites as defined during permitting, e.g., to assess potential for seepage from waste rock storage areas and the heap leach facility into groundwater then discharge into area streams.
    - For additional sites in Haggart Creek to monitor conditions relevant to the discharges (e.g., W5, upstream of the Lynx Creek confluence).

The mine will be subject to the federal MMER, and will require an effluent and receiving environment program designed to determine if: a) effluent quality meets MMER requirements; and b) there is an effect of the discharge on receiving water quality (to assess physical, chemical and biological conditions in an exposure area that receives effluent and in a reference area).

A groundwater quality monitoring program will be developed using the established network of monitoring wells to assess whether predictions made about potential changes to groundwater related to seepage of contact water are correct and to develop alternative management strategies if needed. Parameters, detection limits, and monitoring frequency will be determined during permitting, and will be consistent with recent baseline data. In addition, surface water sites will be monitored for changes in groundwater influences.

6.5.7 Assessment of Cumulative Effects on Water Quality and Aquatic Biota

A screening of the Project's potential contribution to the cumulative effects of past, current, and announced future projects was done per the procedures described in Section 6.1. The screening process establishes three conditions to warrant further assessment. These conditions are: 1) the Project results in a demonstrable residual environmental effect; 2) these environmental effects are likely to act in a cumulative fashion with those of other projects; and 3) there is a reasonable expectation that the Project's contribution to cumulative effects has the potential to measurably change the health or sustainability of water quality and aquatic biota.

Based on these screening criteria, the assessment of environmental effects on water quality indicates there will be a demonstrable residual environmental effect on water quality of Haggart Creek, Dublin Gulch, and Eagle Creek, due to discharge of treated effluent from the mine water treatment plant during operation and from reclaimed waste rock storage areas and the HLF during and after closure. These discharges are predicted to release metals, nutrients, suspended solids and other constituents to Haggart Creek, and this change in water quality could interact with discharges from other activities.

The past, current and announced future projects with which the Project could interact are identified in Table 6.3-2. Of these, placer mining could have an interaction with Project environmental effects on water quality or aquatic biota. The other listed activities and Projects are located outside the watersheds that could be affected by the Project, and therefore the Project's potential effects could not interact with effects of these projects. Since water quality associated with the Project would not adversely affect downstream First Nation or recreational fishing and fishing would not affect water quality, the screening criteria for a cumulative effects assessment are not met.

Interactions of Project effects with the effects of placer mining could arise from historic, current or future, activities. Numerous placer claims exist along Dublin Gulch and Haggart Creek drainages. There are 198 placer claims in the general Project area including 136 active claims, three future applications, and 59 expired claims shared amongst 20 owners. Of these, 125 placer claims are held by VIT. The potential for interactions with the Project is addressed as follows:

- Historic interactions were addressed within the water quality environmental assessment. Placer mining on streams in the Dublin Gulch watershed occurred most recently in the 1990s, although there is still active placer mining in Fisher Gulch (a tributary that enters Haggart Creek upstream of Dublin Gulch), Gil Gulch and 15 Pup (downstream of W29) and Haggart Creek downstream of Lynx Creek in some years. Effects on water quality from historic and current placer mining are reflected in the baseline conditions, which includes data from the 1990s and from 2007 to 2010. Appendix 16 – Environmental Baseline Report: Water Quality and Aquatic Biota provides a comparison of historic and recent data.

- The lasting effects of historic placer mining have been related to habitat change (alteration of Dublin Gulch channel and creation of Eagle Creek). The levels of arsenic higher than WQG noted for Dublin Gulch, its tributaries, and Haggart Creek may be related to previous disturbance. However, arsenic levels in Lynx Creek (a downstream watershed not affected by placer mining) are also above WQG, particularly in the upper watershed. Levels in soils and groundwater are also high Appendix 6 – Environmental Baseline Report: Surficial Geology, Terrain, and Soils; Appendix 15 – Environmental Baseline Report: Hydrogeology), so the documented arsenic levels in water are likely related to general watershed conditions rather than or as well as disturbance from historic placer mining.
- Ongoing or future placer mining may contribute TSS and particulate metals from time to time, similar to the variability in water quality already recorded in the baseline dataset for Haggart Creek. Class 1 placer mining operations can include diversion or use of water to a certain extent, or direct or indirect deposition of waste in surface waters (where no chemicals have been added to the mineral recovery process). These activities do not require application for an active water licence and can affect downstream water quality. Any potential for cumulative effects from interactions of discharges from placer mining and the Project in the future would be recognizable during monitoring on Haggart Creek at sites upstream and downstream of the Project.
- Placer and quartz mining claims on the Project footprint are currently recorded in the name of StrataGold Corporation (StrataGold), a wholly owned subsidiary of VIT, with the exception of one claim on Stewart Gulch in the upper Dublin Gulch watershed. No further placer mining, which could lead to a cumulative effect with the Project, is anticipated for the Dublin Gulch watershed, so there will be no current or future interactions in that area. No placer mining is expected for Haggart Creek itself above the confluence with Lynx Creek.
- The likelihood of future placer mining in the Haggart Creek watershed is difficult to define because, although claims may be registered, many of these will not have status that meets the criterion of a project for the purpose of a cumulative effects assessment (i.e., announced or in the approval process).

There is no reasonable expectation that the Project's contribution to cumulative effects has the potential to measurably change the health or sustainability of water quality and aquatic biota. For the Project, the predicted residual effects on water quality will be to meet WQG or SS WQG in Haggart Creek, and no further interactions with other projects are anticipated for Haggart Creek. Arsenic will meet a SSWQO that would be developed recognizing baseline levels. The small increase in nitrogen and phosphorus levels may contribute to a small increase in productivity, but no change in the overall trophic status from oligotrophic to mesotrophic. The mitigation measures incorporated in the Project are in place to protect the health and sustainability of water quality and aquatic biota, and environmental effects of the Project on water quality and aquatic biota are predicted to be not significant.

No potential contributions of the Project to the cumulative effects of past, current, and announced projects have been identified, with one exception: future placer mining activities in the Haggart Creek watershed. For these activities, there is typically no information about timing, extent of activities or even whether they would occur. As a result, there is insufficient information to allow further evaluation of cumulative effects.

6.5.8 Summary of Consultation Influence on the Assessment

Consultation with the local community, the FNNND, and regulatory agencies has occurred throughout the assessment process. During initial discussions, the FNNND stressed the importance of protecting water quality in Haggart Creek. A traditional knowledge study was carried out with the help of the FNNND, which helped refine the fish and fish habitat VC and indirectly support an understanding of water uses in the Haggart Creek watershed. Territorial (Yukon Government and YESAB) and federal (EC) regulatory agencies were consulted during development of this assessment.

6.5.9 Effects Monitoring and Adaptive Management for Water Quality and Aquatic Biota

VIT will provide qualified environmental managers to monitor and report on activities during construction, operations and closure. Managers will be familiar with all relevant territorial and federal acts and regulations pertaining to mine activities and protection of water quality and fish habitat.

During operations and closure, VIT will comply with Yukon and federal requirements. This includes MMER requirements for effluent characterization (chemistry, acute and chronic toxicity tests) and receiving environment conditions (EEM programs) on a regular schedule. The EEM programs monitor conditions for fish populations, benthic invertebrate conditions, water and sediment to identify whether the effluent is having an effect on the receiving environment. Results of these studies, in combination with other monitoring required by the Yukon Water Board, will be used to verify predictions made about effects of the Project on water quality and aquatic biota. Annual reports for the water license will be submitted to the Yukon Water Board. Follow-up and monitoring programs are described in Section 6.5.6.

The water quality modeling is based on many conservative assumptions for stream flow regimes (wet dry and average scenarios), source terms (geochemical testing for waste rock, HLF and open pit) and baseline water quality to yield worst-case predictions of water quality in Haggart Creek and Dublin Gulch. This approach builds a high confidence that contact water from the mine and water quality in the streams receiving discharges will be no worse than predicted, and will most likely be better. However, this conservative approach poses challenges in providing prescriptive approaches to mitigation measures. Generally, the modeled water quality in Haggart Creek and Dublin Gulch predicts that arsenic will be several times higher than a proposed SSWQO based on background levels, other metals will be closer to WQG and nitrogen or phosphorus will be above background (but not enough to stimulate eutrophic conditions) at some locations. Monitoring during operations will provide the information necessary to make decisions about the need for further mitigation measures.

A range of mitigation measures is presented in the effects assessment, in addition to the standard erosion and sediment control measures, mine water treatment plant for metals and nutrients, and detoxification plant for cyanide destruction and ammonia removal. These include:

- Running the cyanide detoxification and mine water treatment plant for a few more years in closure, which would allow WQG or SS WQG to be met, and provide a short-term solution while the HLF continues to drain and other mitigation measures are developed.
- Using a passive engineered treatment system (including a semi-passive anaerobic system) at the base of the HLF and waste rock storage areas; these are known to be effective in substantially reducing arsenic, nitrogen and phosphorus levels but require periodic maintenance, and are most suited to a short term situation (decades).
- Using passive engineered treatment systems at the base of the HLF and waste rock storage areas; these are known to be effective reducing arsenic, nitrogen and phosphorus levels by about 50% (lower performance than active engineered systems) but require less maintenance over time, making them more suitable for the long term (several decades).
- Developing a tighter cover for reclamation of the waste rock storage areas; a cap that allows 10% infiltration of net precipitation, rather than the 20% used in modeling the post-closure water quality, would provide about a 50% reduction in seepage volumes and loads of arsenic, other metals and nutrients.

With this range of mitigation measures available for use in a workable time frame for closure, there is moderate confidence that effects of the Project on water quality at and after closure can be managed and will be not significant. While the approach will be refined during operations, the current understanding is that tighter reclamation covers, with a passive engineered treatment system downstream of the reclaimed facilities, will provide a four-fold reduction in levels of metals and nutrients, sufficient to meet WQG or SSWQO, and to manage potential for eutrophication in the streams. These two mitigation measures would have the lowest long term maintenance requirements of those proposed. They are both technically and economically feasible and further research into passive engineered treatment system design and maintenance requirements will increase confidence in the prediction of the effects after closure.

It will also be important to further consider the approach used at Brewery Creek for closure, where nutrients were added to the HLF to detoxify cyanide and reduce levels of metals and ammonia, all of which are relevant at the Project. Further work will be needed to assess feasibility of this approach for the Project site.

The adaptive management plan for the mine will integrate results of the monitoring programs with triggers for decision points identified. This will allow refinement of the Closure and Reclamation Plan based on actual, as opposed to predicted, conditions.

6.5.10 Commitments for Water Quality and Aquatic Biota

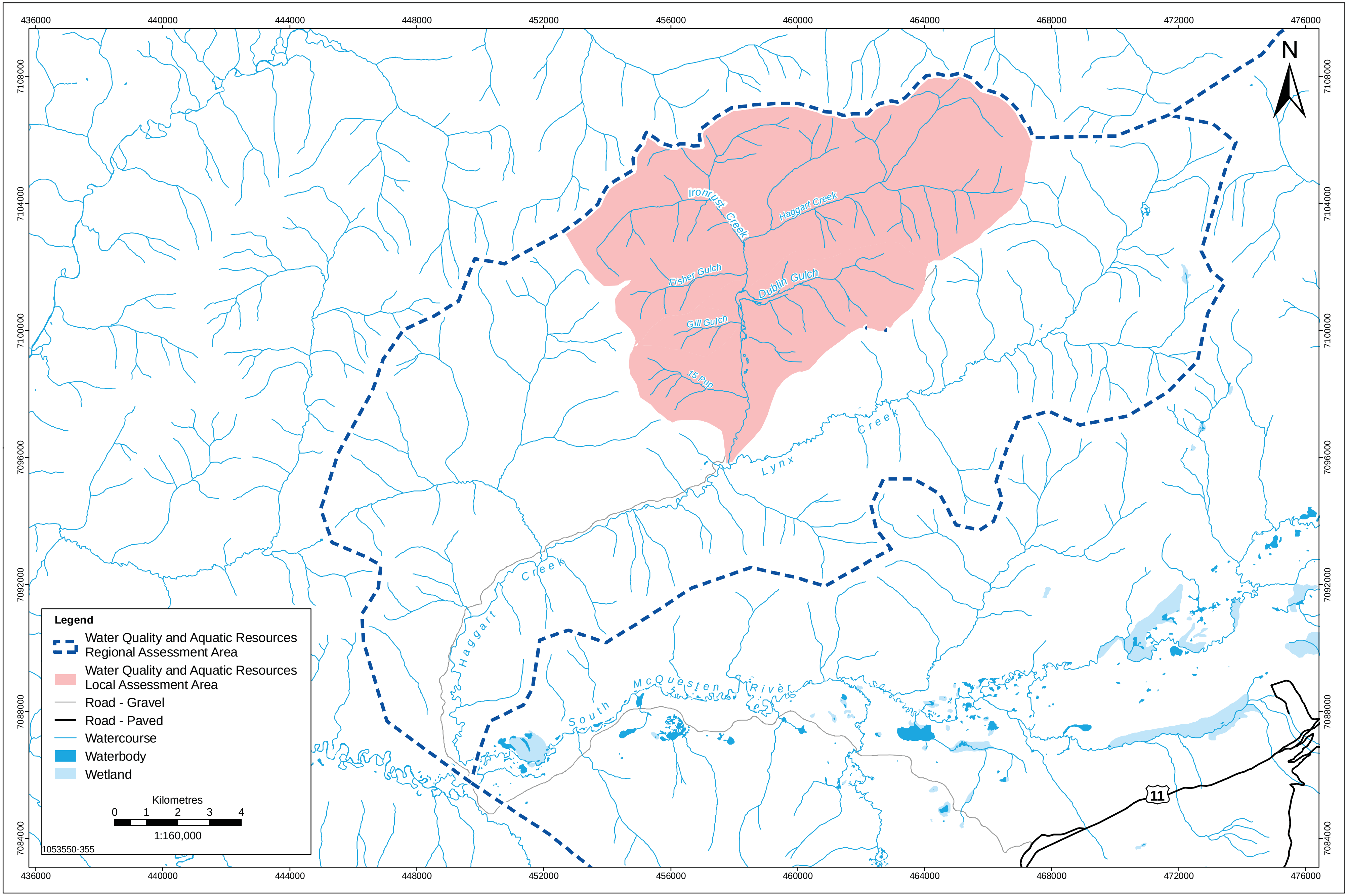
Mitigations incorporated in Project design include:

- Codified erosion prevention and sediment control practices and the Water Management Plan (Appendix 18) to prevent sediment release during construction (sediment control ponds).
- Sewage treatment plant (packaged membrane biological reactor) sized for the maximum construction workforce, with effluent quality meeting requirements of the Yukon Water Board.
- Diversion channels to keep non-contact water away from mine activities.
- Sediment control ponds to allow fine sediments to settle out, sized for a 1:100 year flood event; monitoring of TSS and/or turbidity prior to release, constructed of rockfill and HDPE-lined.
- Diversion ditches to keep non-contact water away from the sites, built with erosion protection measures included, and sized for the maximum flow velocities expected based on estimated surface runoff volumes.
- The mine water treatment plant for use in operation and early in closure. This will have a maximum design capacity of 620 m^3/hr (420 m^3/hr average), and treatment for metals, nutrients and pH. The effluent will meet MMER criteria (not acutely toxic to fish, well below MMER criteria concentrations). The effluent quality is designed to allow metals and other parameters to meet WQG or SSWQO in Haggart Creek or Dublin Gulch diversion channel (generally to be two times the CCME or other applicable guideline in effluent). The criteria for nitrogen and phosphorus are set to prevent eutrophication in the streams.
- Extending the use of the mine water treatment plant beyond Year 15 if indicated by monitoring of heap seepage quality and quantity.
- Treatment of contact water from the open pit and waste rock storage areas during operations and early in closure at the mine water treatment plant.
- Interception of groundwater in contact with waste rock storage areas in rock drains; will be sent with the rest of the contact water to the heap leach facility or the mine water treatment plant.
- Monitoring of groundwater wells around the waste rock storage areas to assess accuracy of predictions of effects on groundwater quality.
- HLF design with a double liner in the upper area and triple liner in the lower area, leak detection and recovery system, seepage collection, and separate collection of groundwater below the HLF (to prevent upward pressure on the lines).
- Cyanide detoxification plant for removal of cyanide and its breakdown products from the HLF solution, for use in operations (emergency use) and closure (to treat draindown water from heap leach facility.
- Reclamation of heap leach facility and waste rock storage areas, using covers that reduce infiltration to about 10% and 20% of net precipitation, respectively for the HLF and waste rock storage areas, with the alternative of developing waste rock storage area covers that reduce infiltration to 10%.

- Passive engineered treatment systems for treatment of metals and nutrients post-closure. The system at the base of the heap leach facility will treat seepage to reduce levels of arsenic, other metals, and nitrogen. The need for passive systems at the base of the two waste rock storage areas (replacing the sediment control ponds) will be determined based on monitoring during operations and at closure of the Platinum Gulch waste rock storage area (in Year 6) and, if required will provide treatment of metals and phosphate.

6.5.11 Figures

Please see the following pages.



Data Sources; Government of Canada, Victoria Gold Corp.

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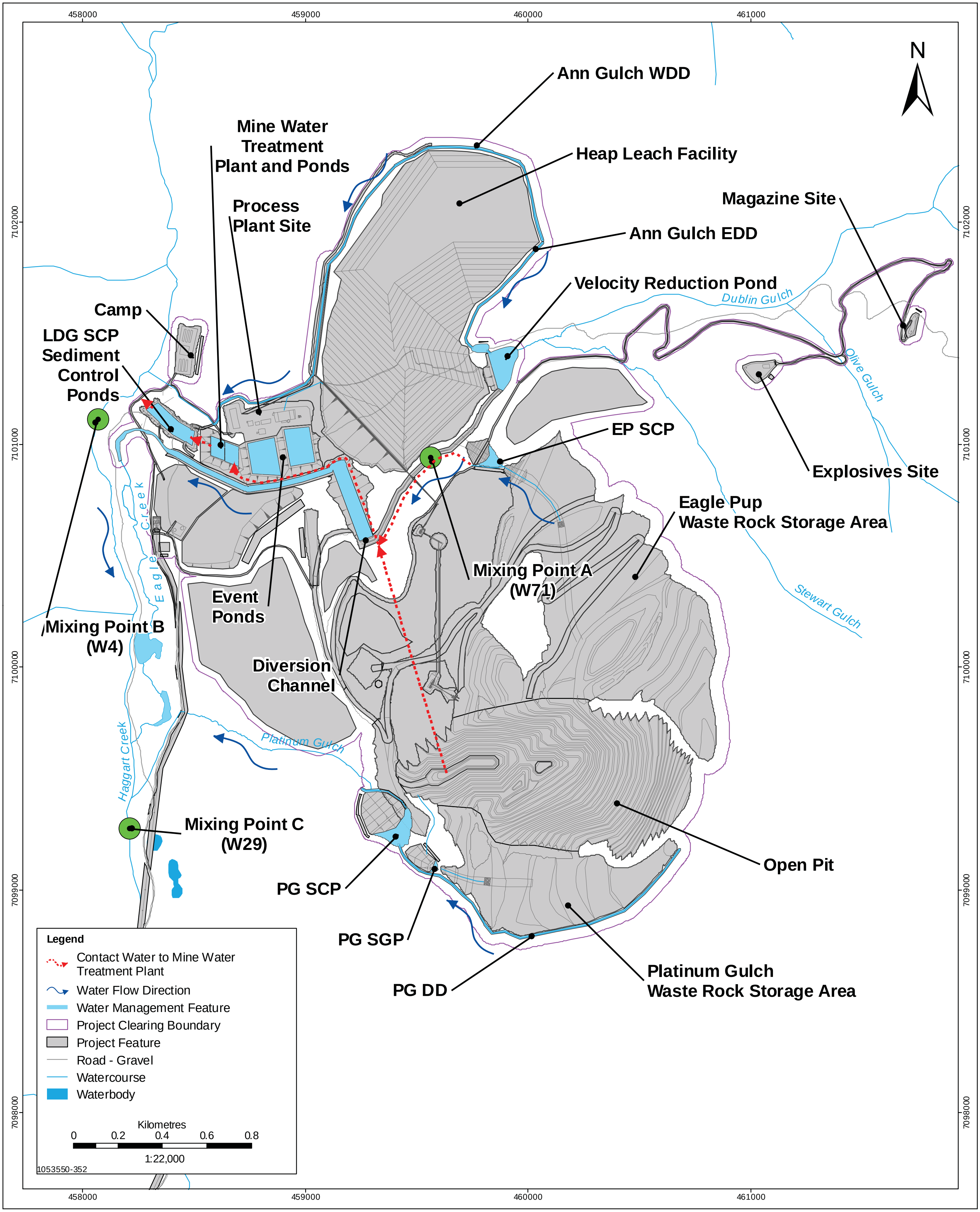
WATER QUALITY AND AQUATIC RESOURCES LOCAL ASSESSMENT AREA AND REGIONAL ASSESSMENT AREA

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION	DRAWN BY
UTM - ZONE 8	LS
DATUM	CHECKED BY
NAD 83	RS
DATE	FIGURE NO.
15-November-2010	6.5-1



Data Sources; Government of Canada, Victoria Gold Corp.

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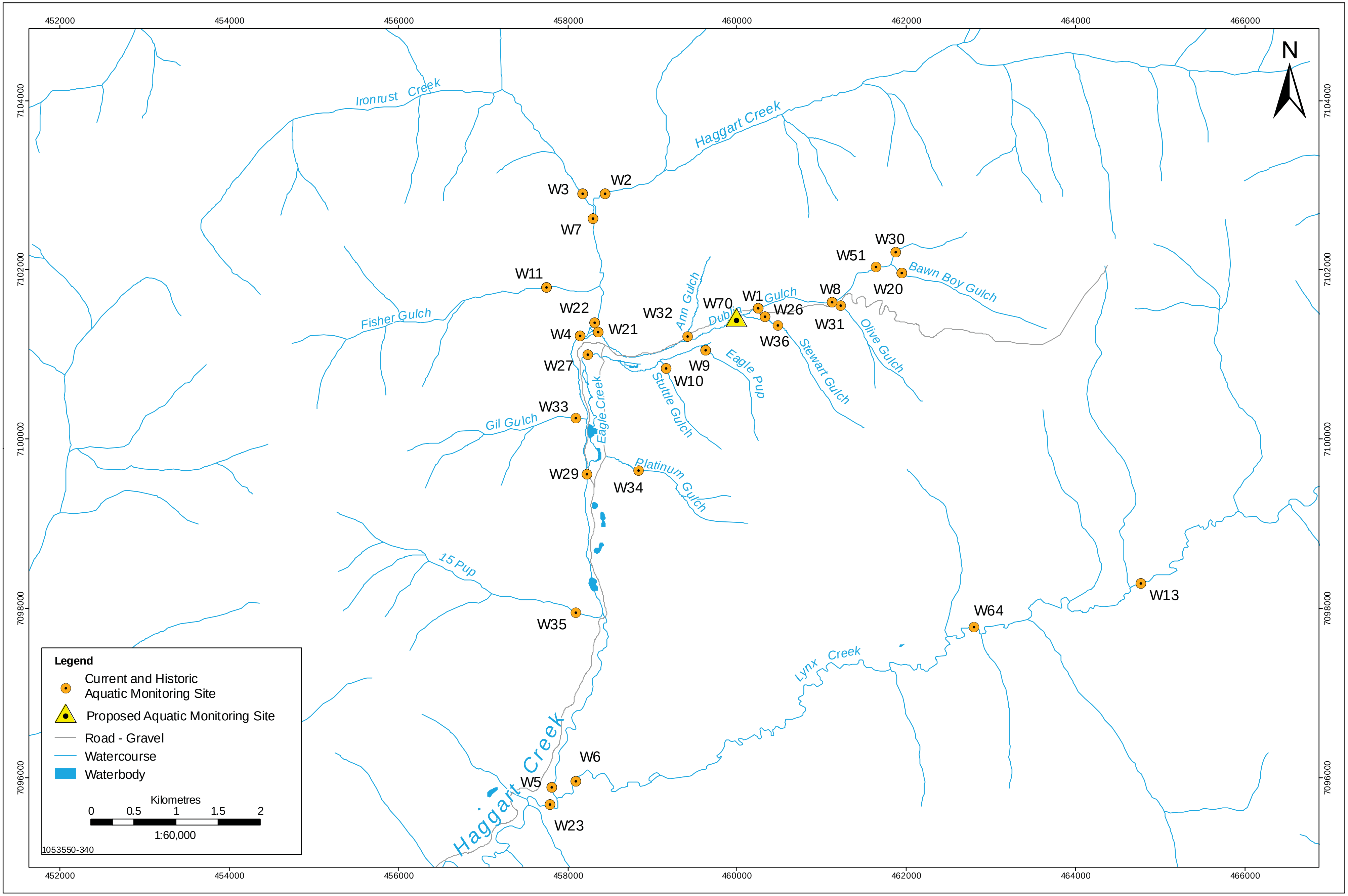
Victoria Gold Corp

WATER MANAGEMENT AT THE PROJECT

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION	DRAWN BY
UTM - ZONE 8	LS
DATUM	CHECKED BY
NAD 83	RS
DATE	FIGURE NO.
8-December-2010	6.5-2



Data Sources: Government of Canada, Victoria Gold Corp.

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Victoria GOLD CORP

CURRENT, HISTORIC, AND PROPOSED AQUATIC MONITORING SITES
EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION: UTM - ZONE 8	DRAWN BY: LS
DATUM: NAD 83	CHECKED BY: RS
DATE: 7-November-2010	FIGURE NO.: 6.5-3

Figure 6.5-4: Predicted Flows from the Eagle Pup Waste Rock Storage Area, Platinum Gulch Waste Rock Storage Area and Open pit, and the Mine Water Treatment Plant and Heap Leach Facility (*C= construction, O = operations, Rinse and Drain = Closure, PC = Post-closure*)

NOTE: Graphs show modeling to Year 24, but data indicate the trend continues well into the future

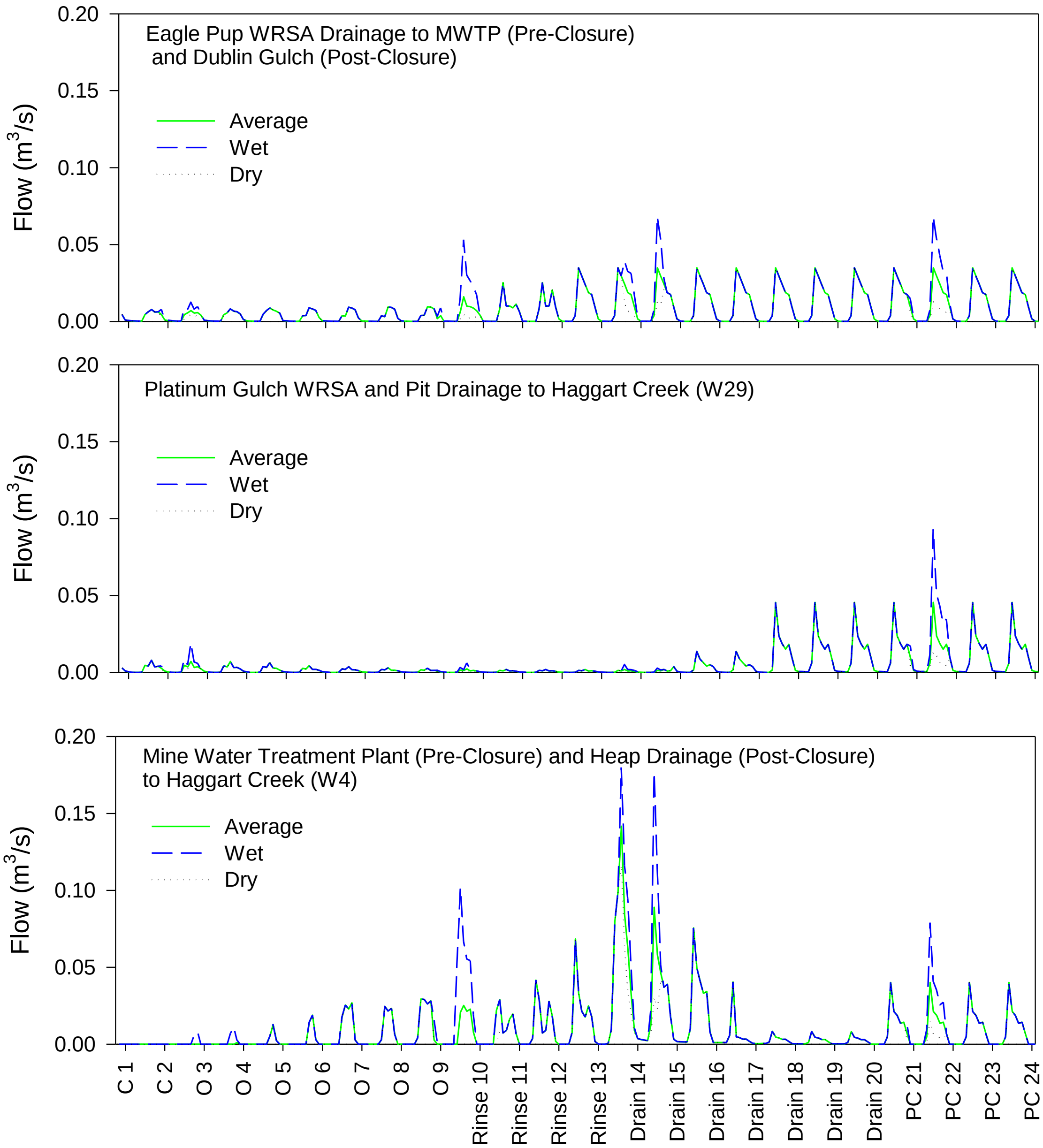


Figure 6.5-5: Predicted Concentrations of Metals and Nutrients in Haggart Creek at W4 during all Project Phases (*C=Construction, O=Operations, Rinse and Drain=Closure, PC= Post-Closure*)

NOTE: Graphs show modeling to Year 24, but data indicate the trend continues well into the future (BC = BC WQG; CCME = CCME WQG; SSWQO = site specific water quality objective)

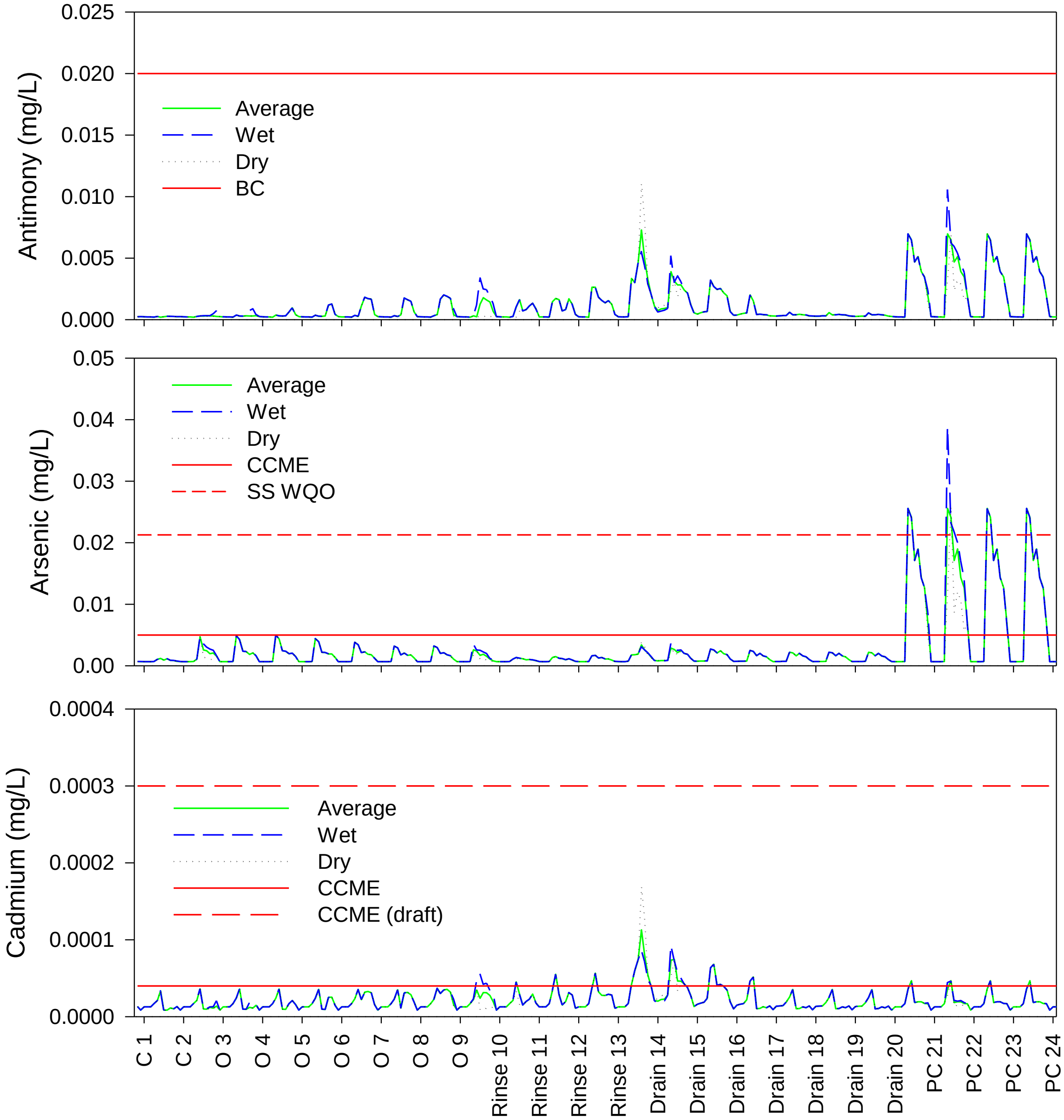


Figure 6.5-5: ***Continued.*** **Predicted Concentrations of Metals and Nutrients in Haggart Creek at W4 during all Project Phases**

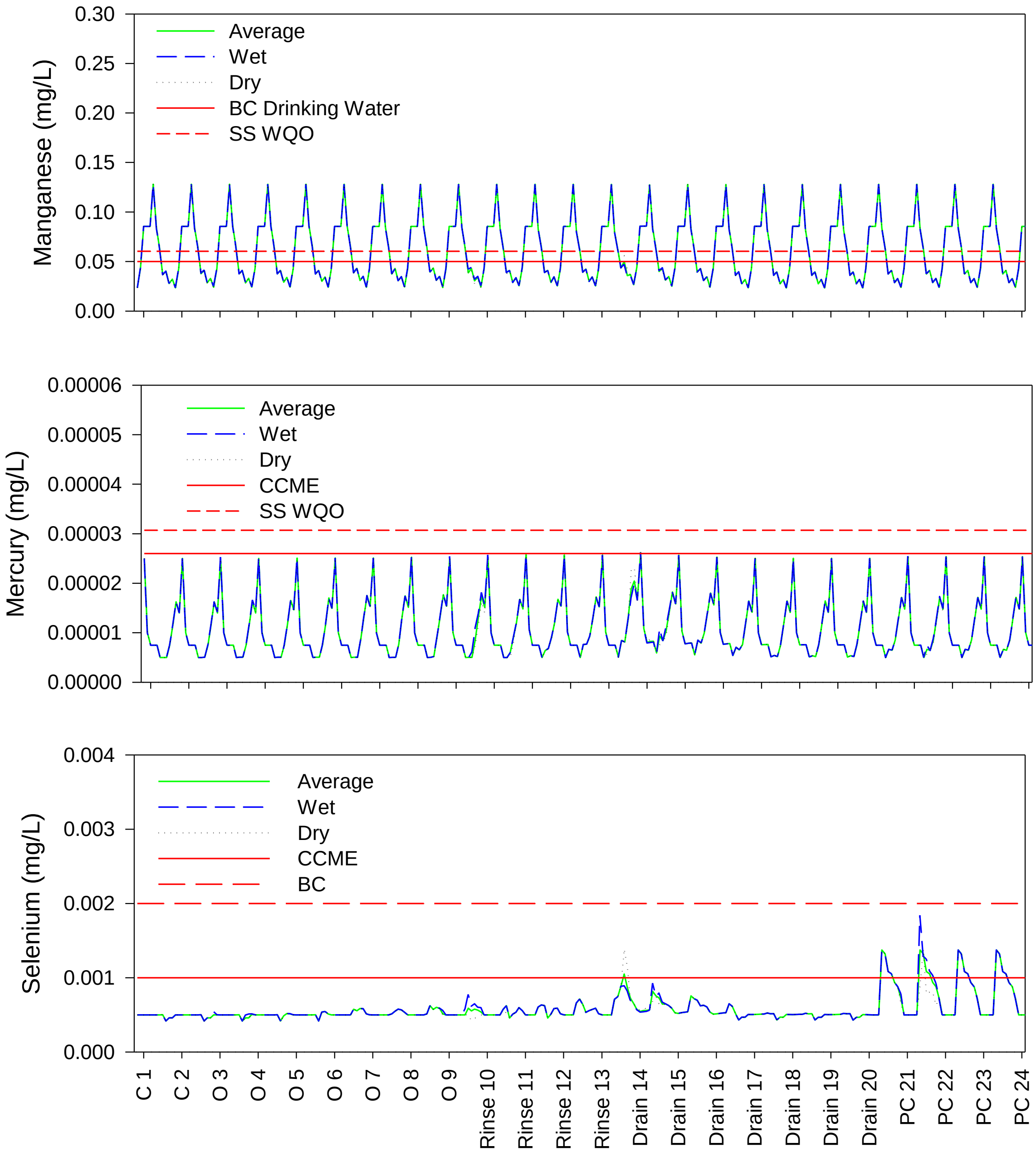


Figure 6.5-5: ***Continued.*** **Predicted Concentrations of Metals and Nutrients in Haggart Creek at W4 during all Project Phases**

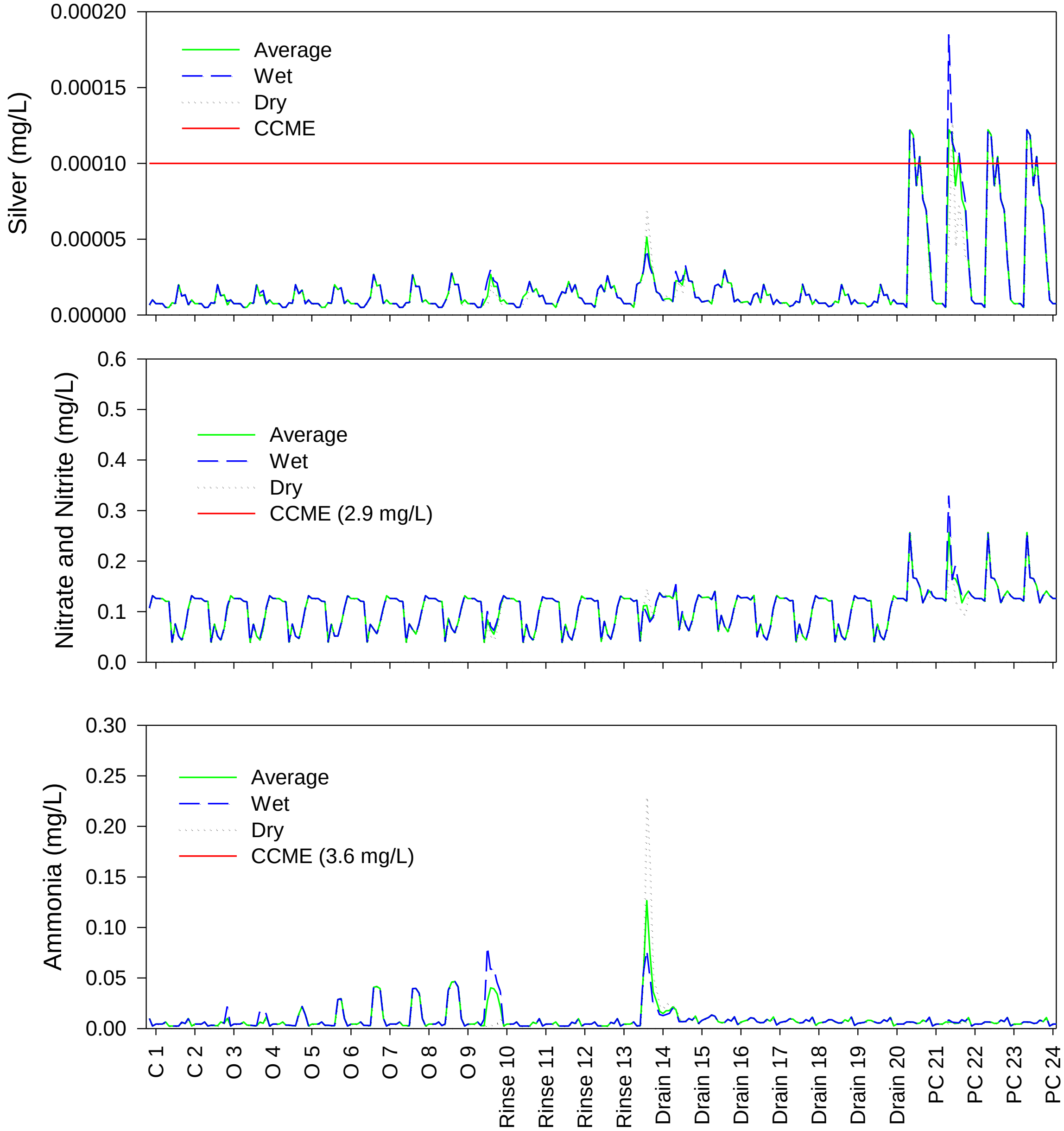


Figure 6.5-5: *Continued.* Predicted Concentrations of Metals and Nutrients in Haggart Creek at W4 during all Project Phases

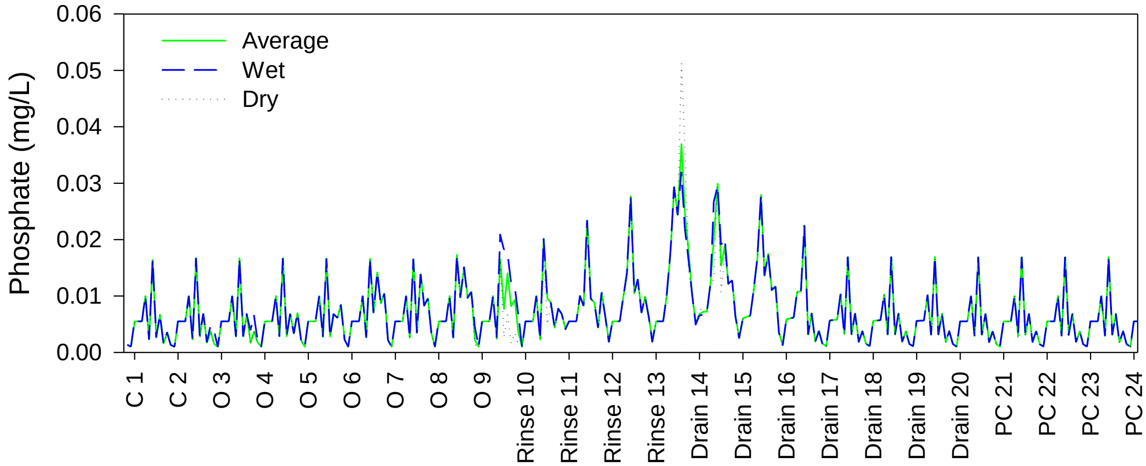


Figure 6.5-6: Predicted Concentrations of Metals and Nutrients in Platinum Gulch Sediment Control Pond during all Project Phases, before Passive Engineered Treatment System (*C=Construction, O=Operations, Rinse and Drain=Closure, PC= Post-Closure*)

NOTE: Graphs show modeling to Year 24, but data indicate the trend continues well into the future (BC = BC WQG; CCME = CCME WQG; SSWQO = site specific water quality objective)

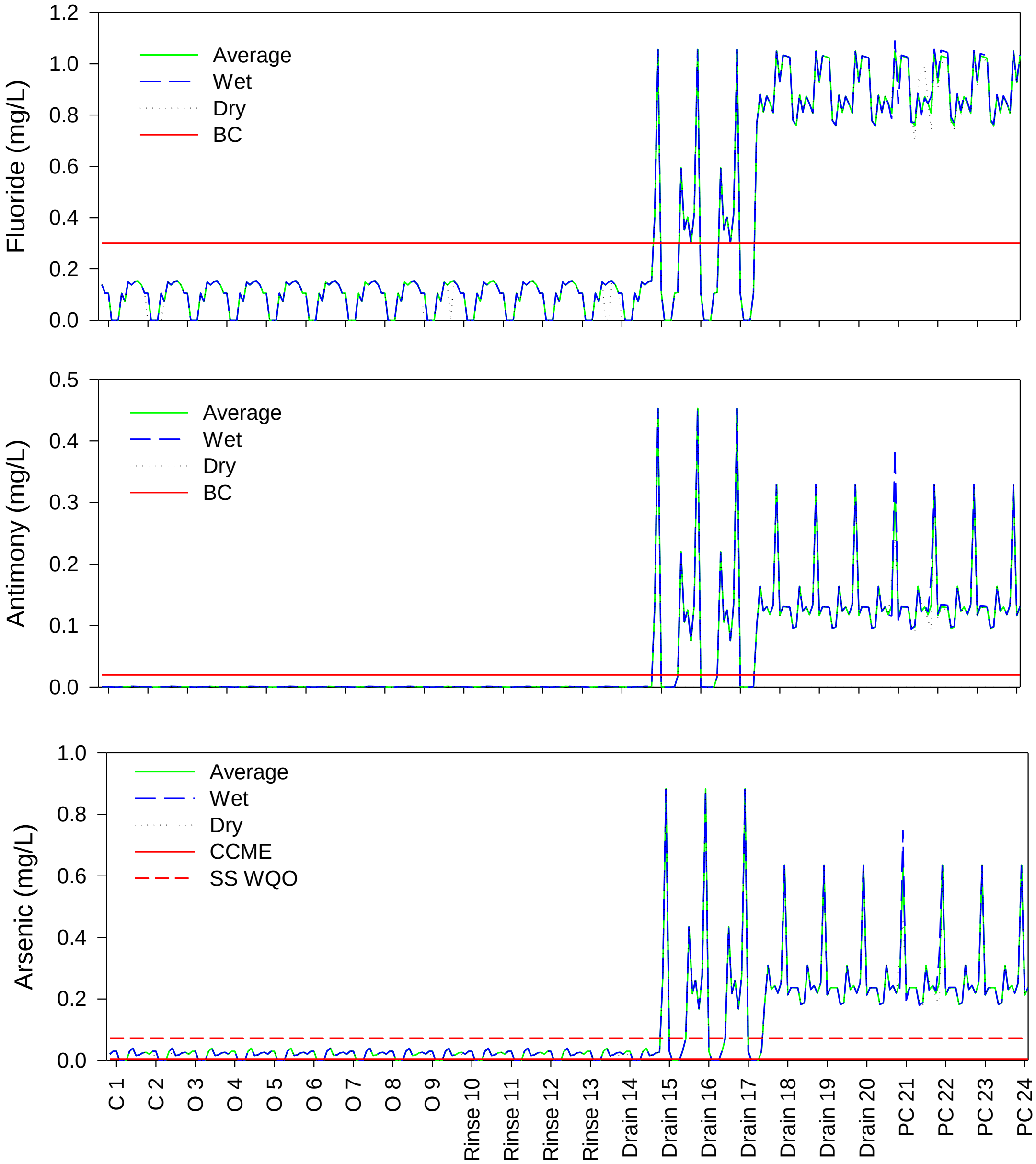


Figure 6.5-6: ***Continued.*** **Predicted Concentrations of Metals and Nutrients in Platinum Gulch Sediment Control Pond during all Project Phases, before Passive Engineered Treatment System**

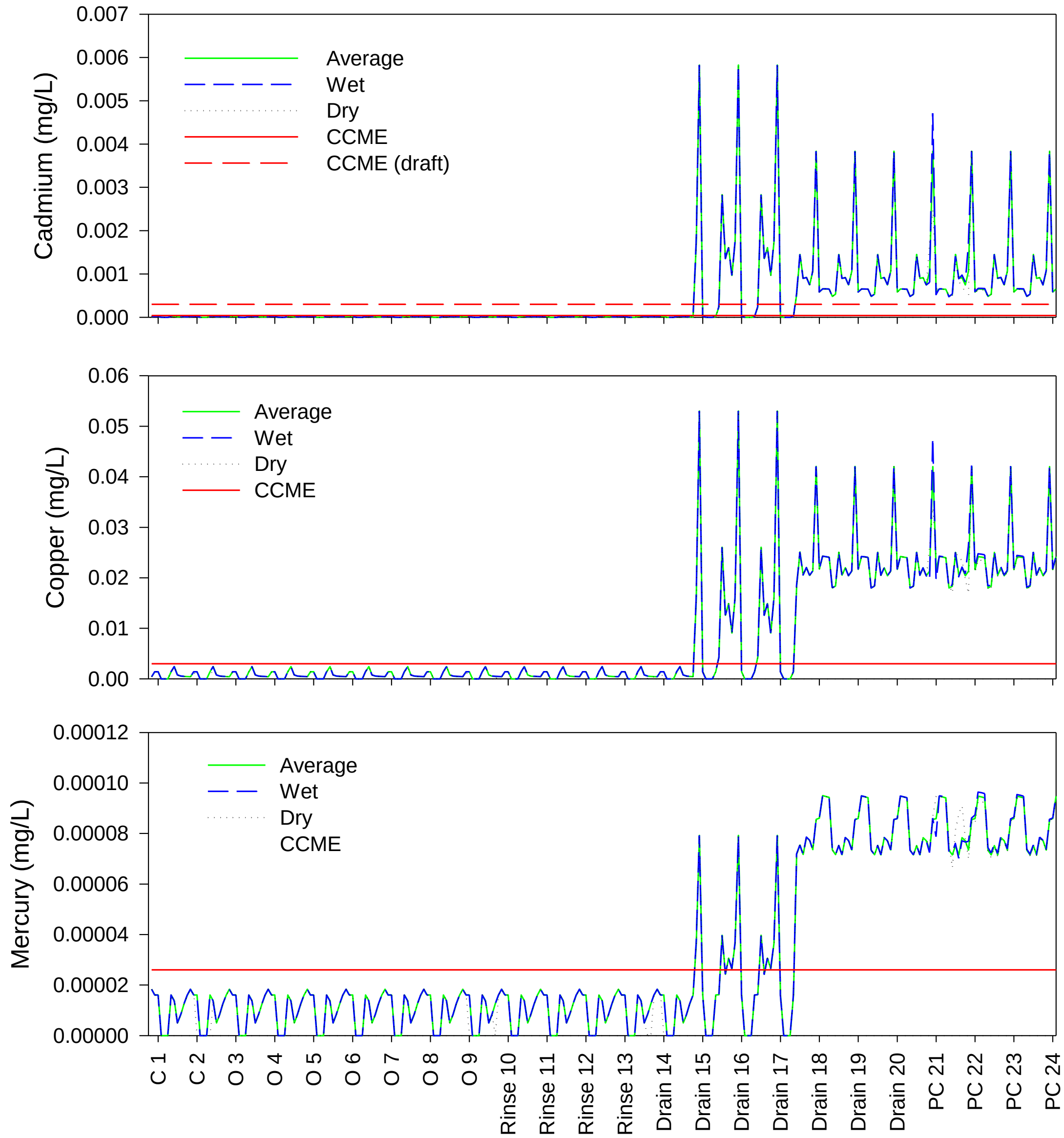


Figure 6.5-6: ***Continued.*** **Predicted Concentrations of Metals and Nutrients in Platinum Gulch Sediment Control Pond during all Project Phases, before Passive Engineered Treatment System**

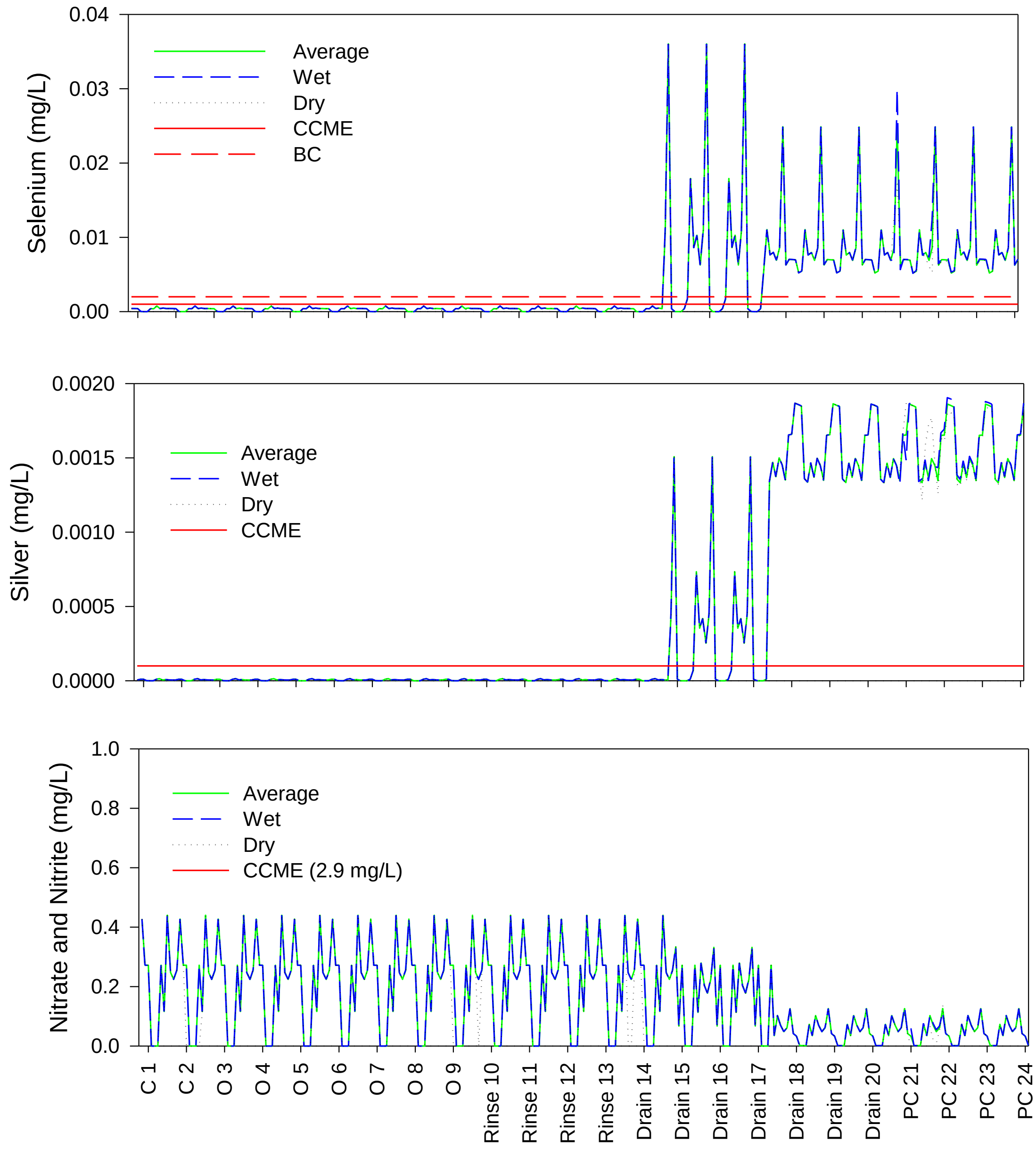


Figure 6.5-6: ***Continued.*** **Predicted Concentrations of Metals and Nutrients in Platinum Gulch Sediment Control Pond during all Project Phases, before Passive Engineered Treatment System**

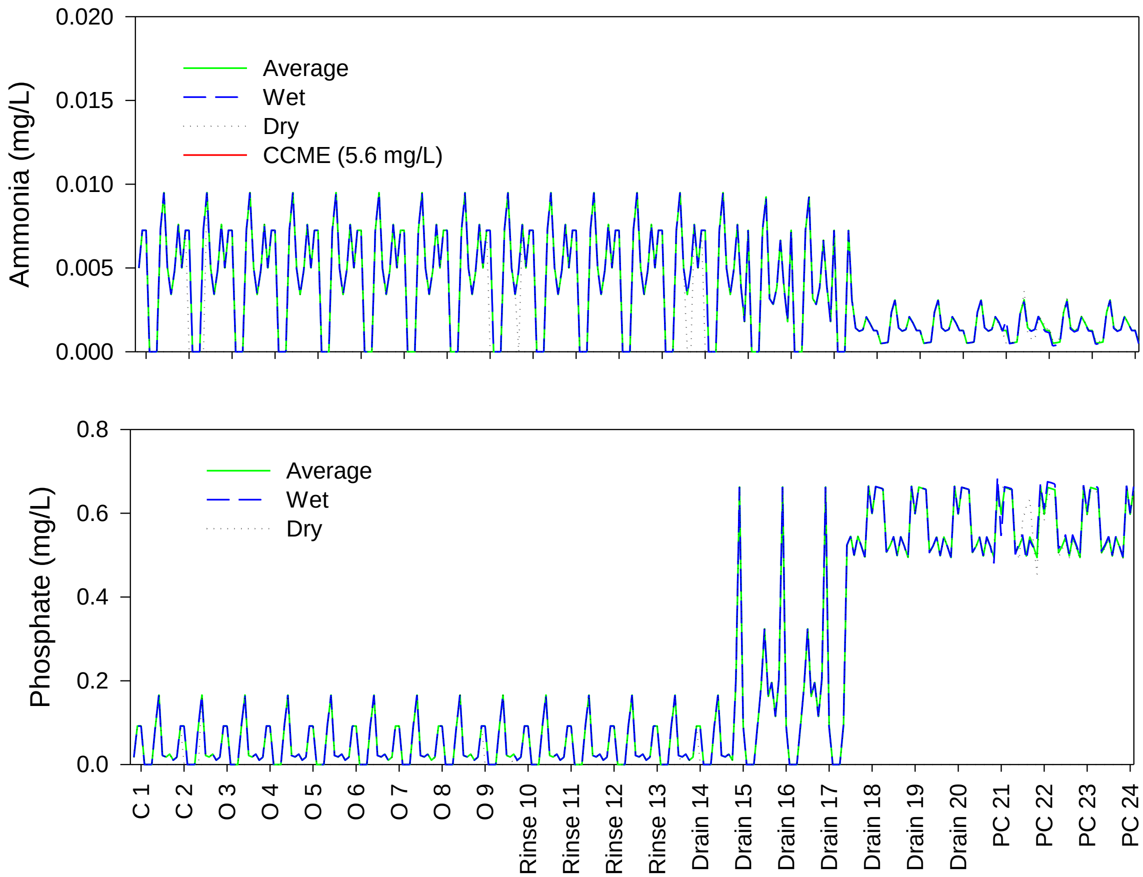


Figure 6.5-7: Predicted Concentrations of Metals and Nutrients in Dublin Gulch (W71) during all Project Phases, before Passive Engineered Treatment System (*C=Construction, O=Operations, Rinse and Drain=Closure, PC= Post-Closure*)
NOTE: Graphs show modeling to Year 24, but data indicate the trend continues well into the future (BC = BC WQG; CCME = CCME WQG; SSWQO = site specific water quality objective)

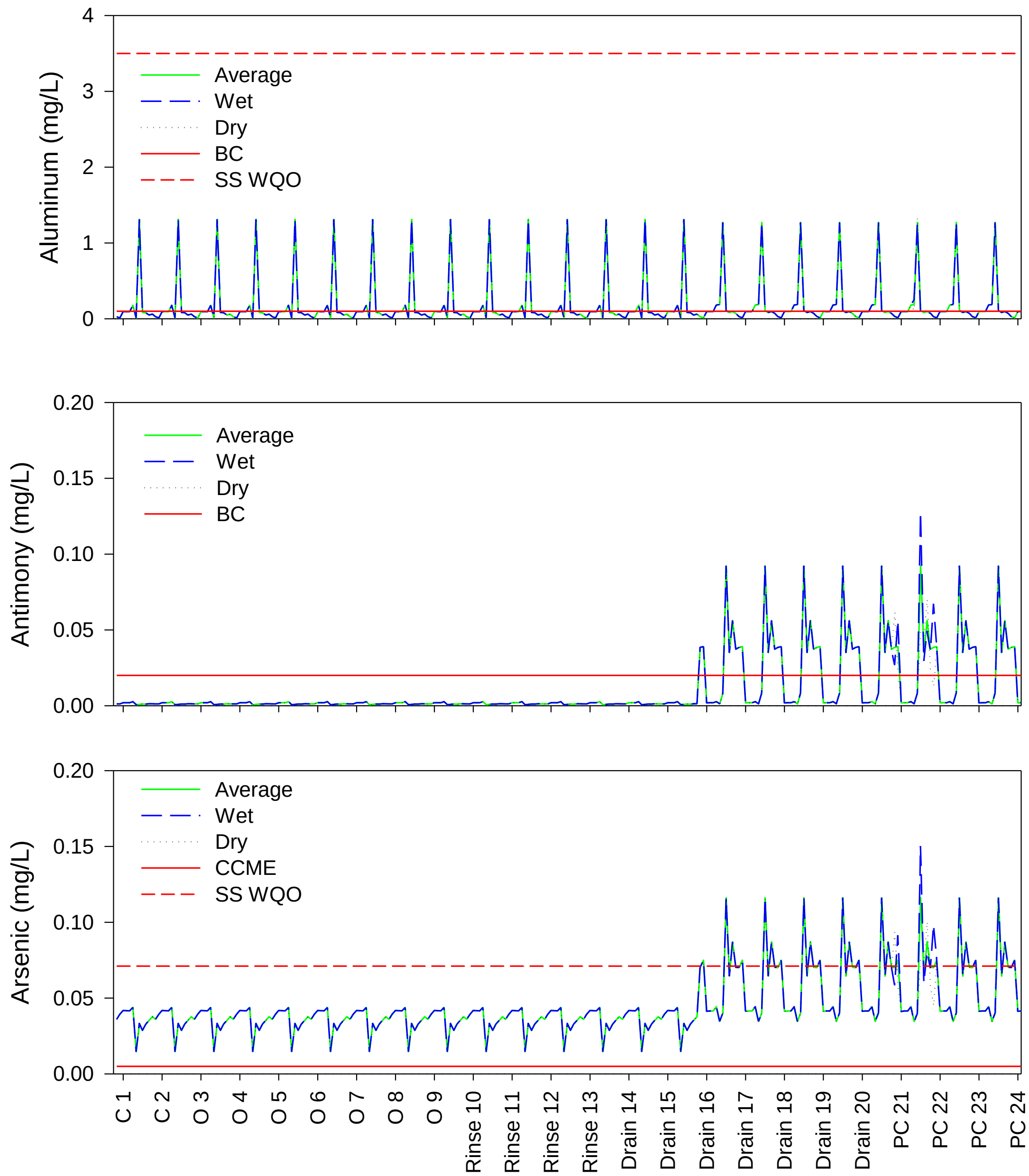


Figure 6.5-7: ***Continued.*** **Predicted Concentrations of Metals and Nutrients in Dublin Gulch (W71) during all Project Phases, before Passive Engineered Treatment System**

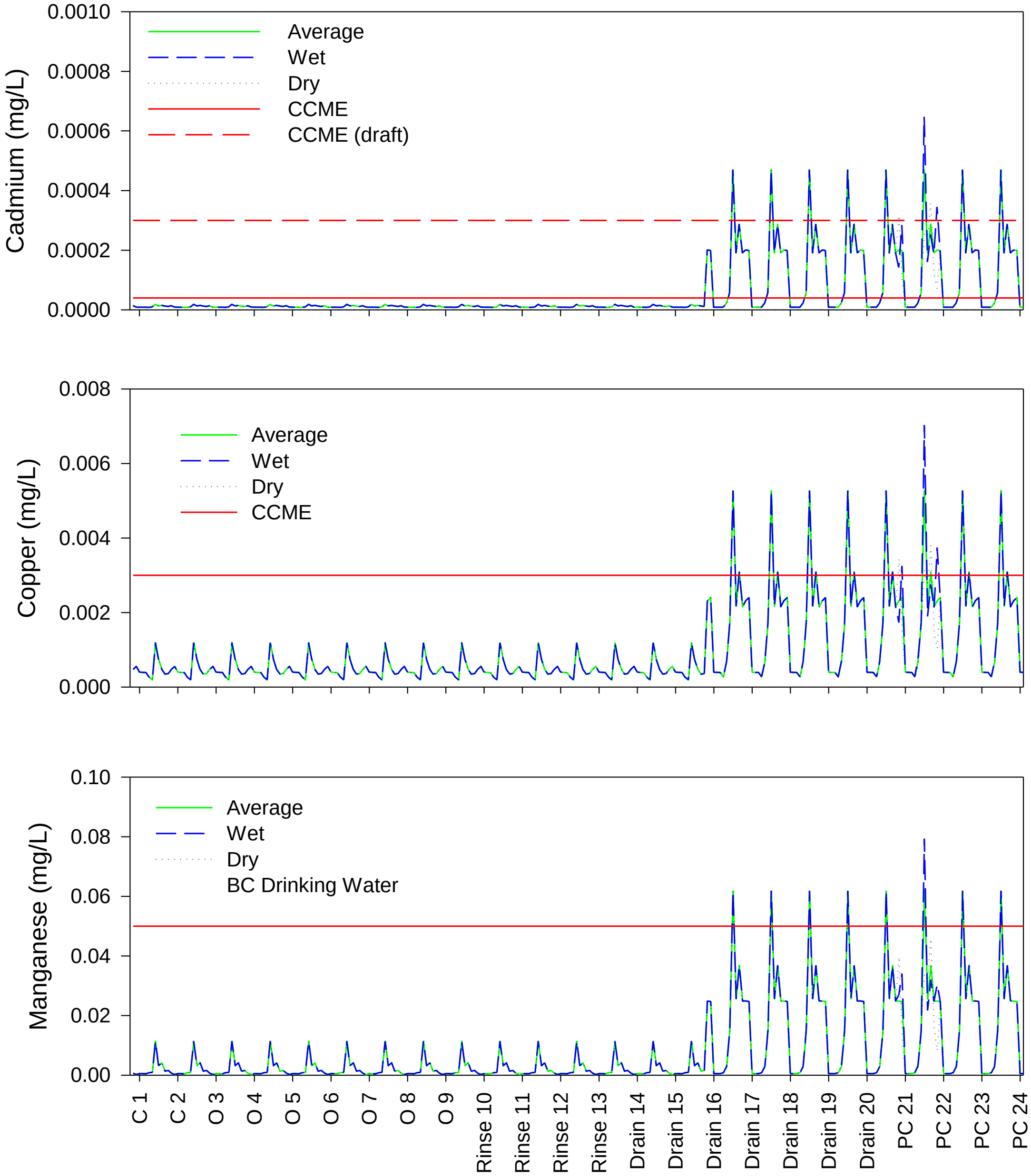


Figure 6.5-7: ***Continued.*** **Predicted Concentrations of Metals and Nutrients in Dublin Gulch (W71) during all Project Phases, before Passive Engineered Treatment System**

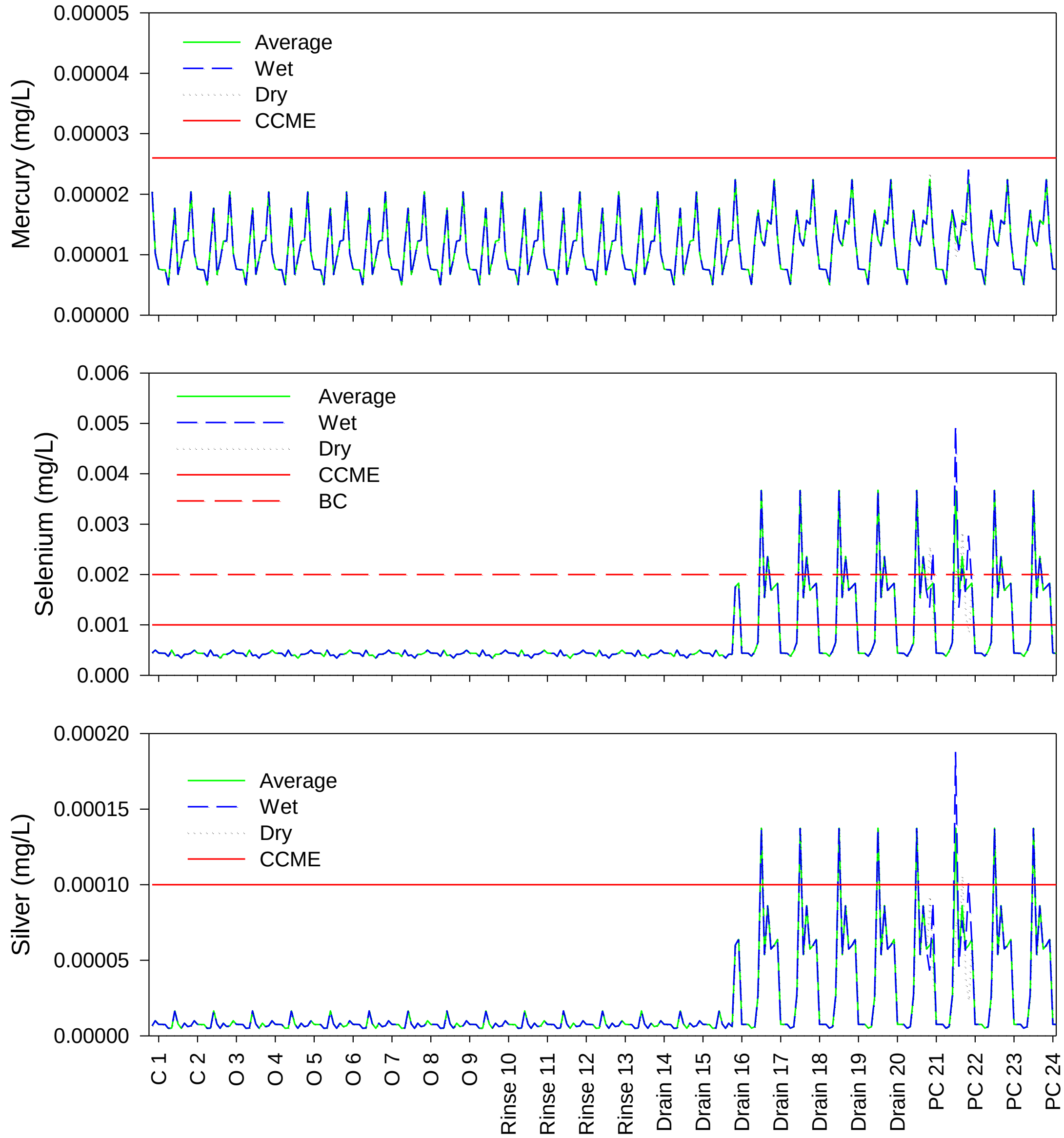


Figure 6.5-7: ***Continued.*** **Predicted Concentrations of Metals and Nutrients in Dublin Gulch (W71) during all Project Phases, before Passive Engineered Treatment System**

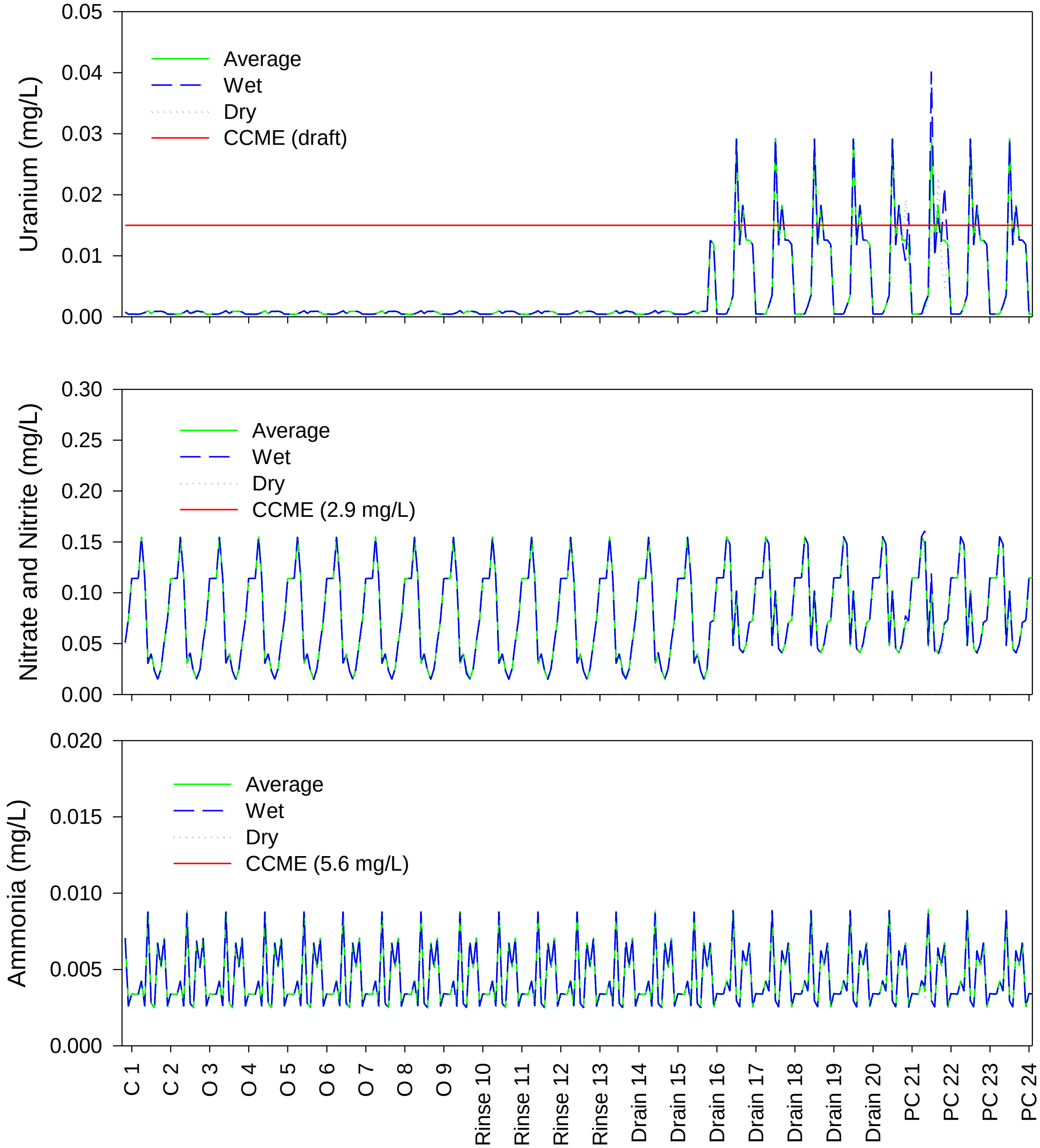


Figure 6.5-7: *Continued.* Predicted Concentrations of Metals and Nutrients in Dublin Gulch (W71) during all Project Phases, before Passive Engineered Treatment System

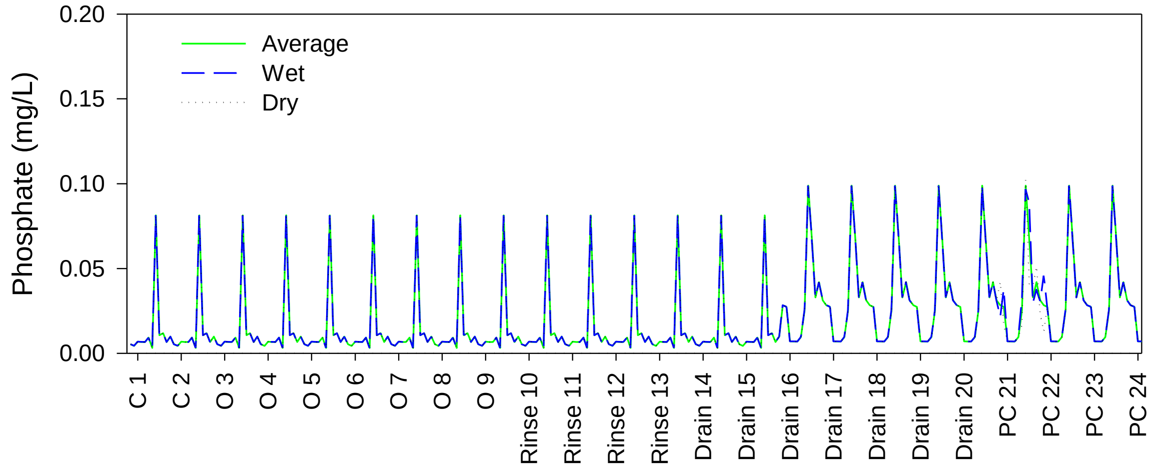


Figure 6.5-8: Predicted Concentrations of Metals and Nutrients in Haggart Creek (W29) during all Project Phases, before Passive Engineered Treatment System (*C=Construction, O=Operations, Rinse and Drain=Closure, PC= Post-Closure*)
NOTE: Graphs show modeling to Year 24, but data indicate the trend continues well into the future (BC = BC WQG; CCME = CCME WQG; SSWQO = site specific water quality objective)

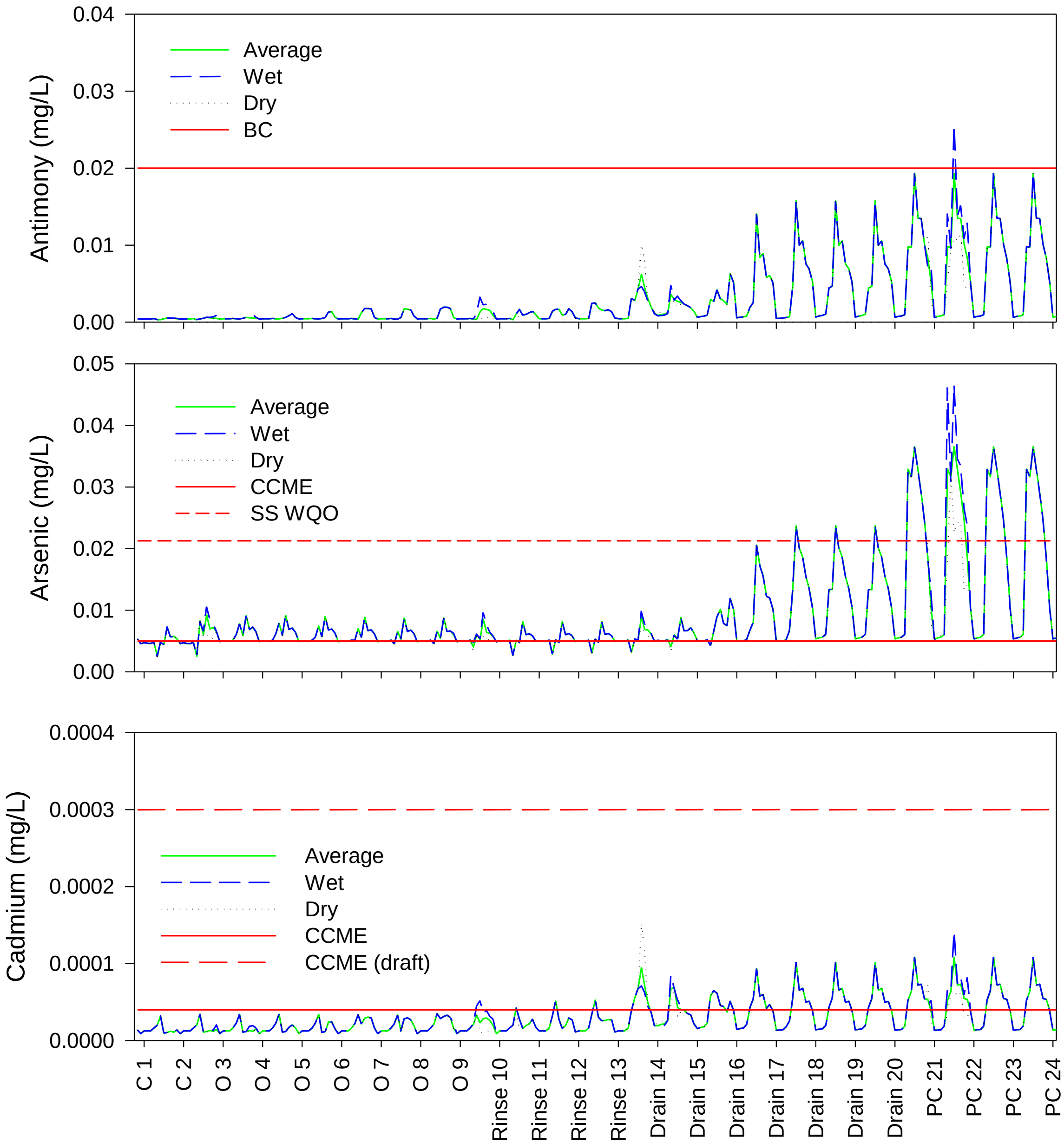


Figure 6.5-8: ***Continued.*** **Predicted Concentrations of Metals and Nutrients in Haggart Creek (W29) during all Project Phases, before Passive Engineered Treatment System**

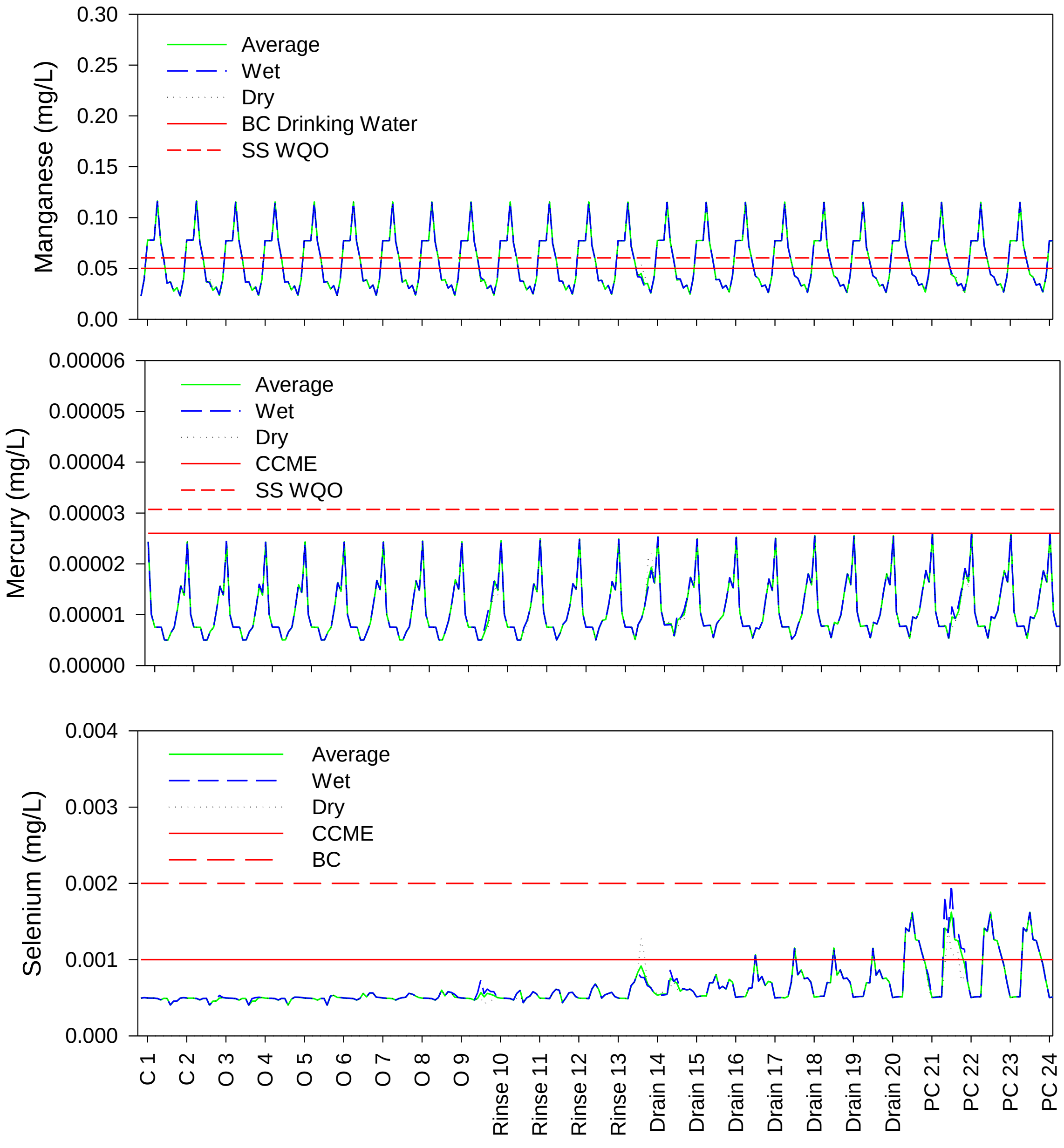


Figure 6.5-8: ***Continued.*** **Predicted Concentrations of Metals and Nutrients in Haggart Creek (W29) during all Project Phases, before Passive Engineered Treatment System**

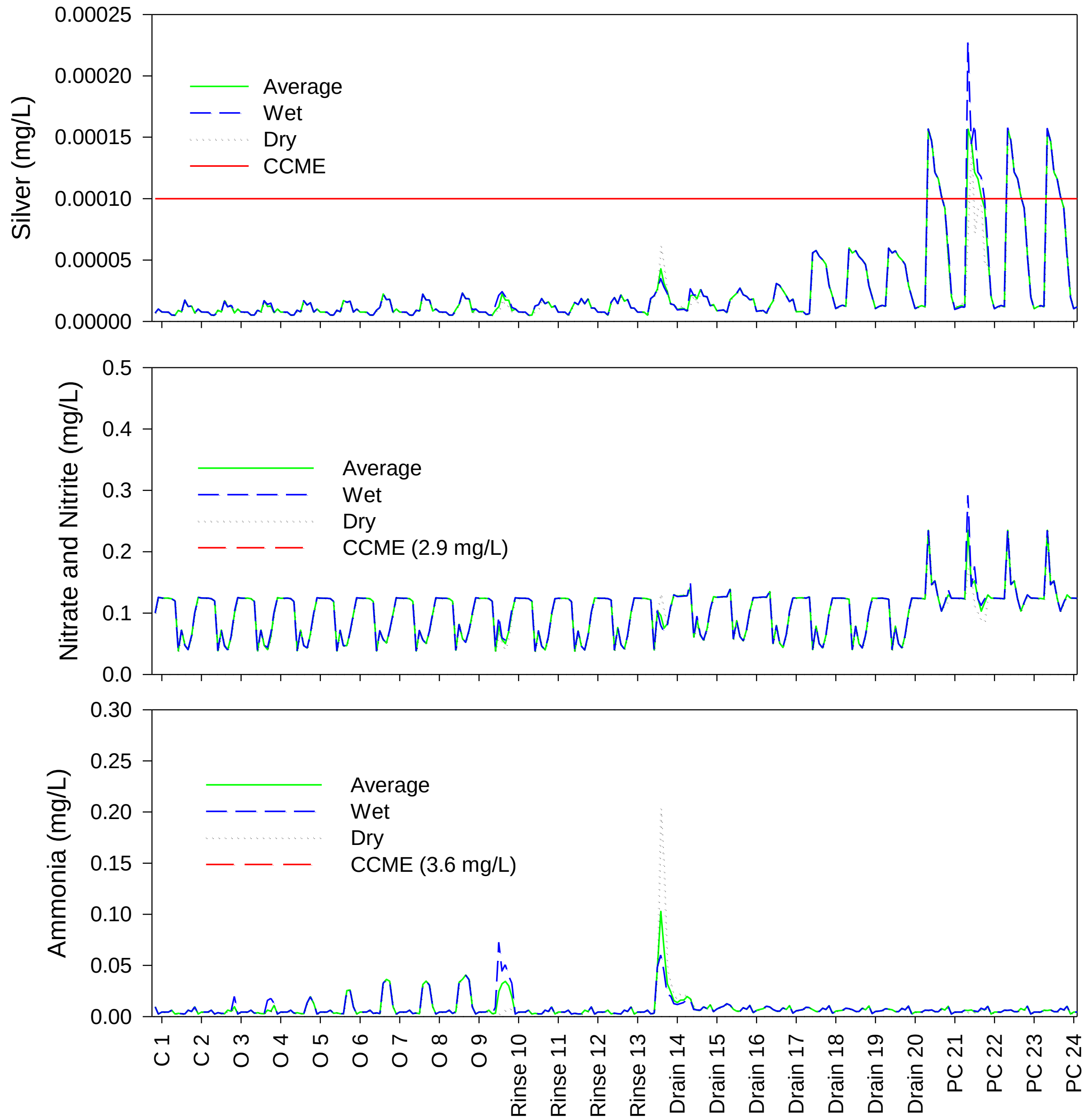
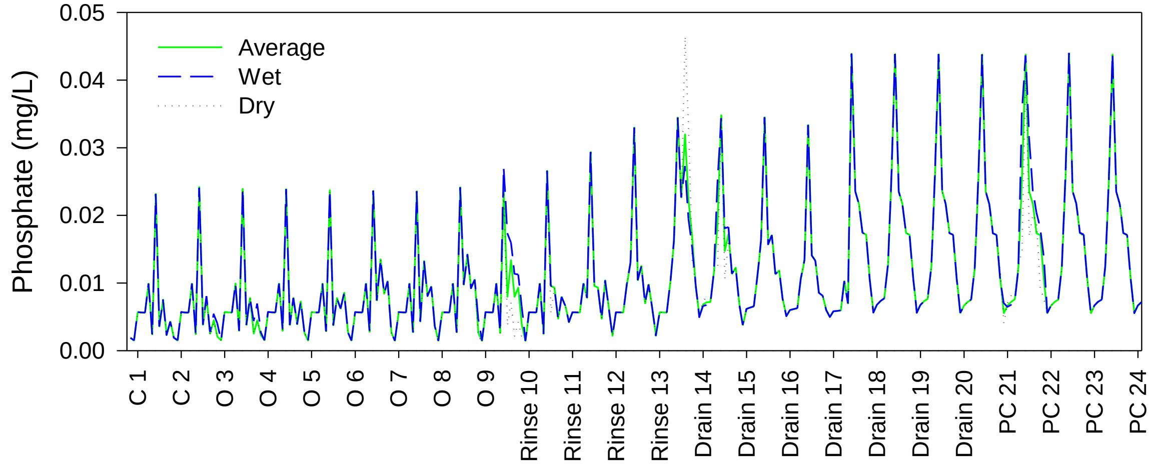


Figure 6.5-8: *Continued.* Predicted Concentrations of Metals and Nutrients in Haggart Creek (W29) during all Project Phases, before Passive Engineered Treatment System



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6.6 Air Quality

Air Quality has been selected as a Valued Component (VC) because of its intrinsic importance to the health and well being of humans, wildlife, vegetation and other biota. The atmosphere is an important pathway for the transport of contaminants to the freshwater, terrestrial, and human environments. This Air Quality assessment was completed based on data presented in the Air Quality Technical Data Report (Appendix 9).

Project activities will result in the release of substances that, owing to their physical and chemical properties, are classed as air contaminants. These emissions are activity-dependant. Total Suspended Particulates (TSP), respirable particulate matter ($PM_{2.5}$), nitrogen dioxide (NO_2), carbon monoxide (CO), and sulphur dioxide (SO_2) are regulated by Environment Yukon, Environment Canada and Health Canada and at the national level are often referred to as Criteria Air Contaminants (CACs). Environment Canada and Health Canada CAC criteria (Government of Canada 2004) are referred to as National Ambient Air Quality Objectives (NAAQO). $PM_{2.5}$ (and O_3) concentration standards have been set by the Canadian Council of Ministers of the Environment (CCME 2000) and are known as the Canada Wide Standard. Environment Yukon has established standards which are consistent with the national and Canada Wide Standards for "*the maximum concentrations of pollutants acceptable in ambient air throughout the Yukon Territory…to determine the acceptability of emissions from proposed and existing developments*" (Environment Yukon 2010).

For ease of reference when required, the NAAQO, Canada Wide Standard and applicable Yukon standards are collectively referred to as the "regulatory objectives" and relevant air emissions (contaminants or pollutants) are referred to as CACs. Section 6.6-1 discusses the CACs and the regulatory objectives in detail.

Particulate Matter (PM) is characterized based on the diameter of the particle and includes both $PM_{2.5}$ and TSP. The size of a particle determines the velocity with which gravitational settling occurs. $PM_{2.5}$ is defined to be equal or less than 2.5 µm. TSP range in size from 0.001 to 500 µm (a human hair is about 70 µm in diameter). Depending on their size and other properties, particles may remain suspended in the air for a few seconds or indefinitely. Generally, large particles settle out very close to the source.

The air quality and epidemiological communities have shifted their research interests in recent years from TSP to $PM_{2.5}$ as a result of concerns related to human health effects. Very fine particles can be transported over large distances and can penetrate deep into the respiratory tract. Short-term exposure to elevated concentrations of $PM_{2.5}$ can irritate the lungs and cause lung constriction, producing shortness of breath and coughing. Long-term exposure can lead to asthma, lung disease, decreased lung function, and cardiovascular problems (US EPA 2006a). Consequently, the quantification of PM emissions generated by the Project is important to accurately assess the potential effects on health and quality of life.

During the Construction phase, dust related PM emissions will be caused by site clearing and grubbing, soil salvaging and stockpiling, site grading, borrow area development, camp and haul road construction, and surface disruption from vehicle movement. Combustion $PM_{2.5}$ emissions are from large construction vehicles and equipment exhausts. The Operations phase will also have dust related TSP and $PM_{2.5}$ emissions as a result of open pit mining, ore processing activities, and surface disruption from vehicle movement. Combustion $PM_{2.5}$ emission sources include the exhaust from large vehicles and the operation of boilers and regenerator kiln.

Dust related particulate matter (PM) is not a homogenous substance and can be composed of many compounds including metallic compounds. Metal deposition may affect soils, vegetation, and water quality, all of which may in turn affect habitat quality for wildlife and aquatic communities. These resources are of critical importance to local First Nations that rely on them for food and livelihood. The metal deposition effects are considered in the Qualitative Human and Ecological Health Assessment included as Appendix 31.

Nitrogen Dioxide (NO_2) is produced in most combustion processes including in the operation of internal combustion engines. NO_2 is an orange to brown gas that is corrosive, and irritating at high concentrations. Most NO_2 in the atmosphere is formed by the oxidation of nitric oxide (NO), which is emitted directly by diesel fuel combustion processes in internal combustion engines. The levels of NO and NO_2, and the ratio of the two gases, together with the presence of hydrocarbons and sunlight, are the most important factors in the formation of ground-level ozone and other oxidants. Oxidation in combination with atmospheric water forms nitric acid, a constituent of acid rain.

Project-related NO_x emissions will result from the operation of vehicles, generators, boilers, and regenerator kiln.

Carbon Monoxide (CO) is a colourless, odourless gas and is a product of incomplete combustion from internal combustion engines. Project-related CO emissions will result from the operation of vehicles, generators, boilers, and regenerator kiln.

Sulphur Dioxide (SO_2) is a colourless gas with a distinctive pungent sulphur odour. It is produced in combustion processes by the oxidation of diesel fuel containing sulphur. At high enough concentrations, SO_2 can have negative effects on plant and animal health, particularly with respect to their respiratory systems. In addition, SO_2 can be further oxidized and may combine with water to form sulphuric acid, another constituent of acid rain.

6.6.1 Scope of Assessment for Air Quality

6.6.1.1 Regulatory/Policy Setting

Air emissions are regulated by Environment Yukon under the *Environment Act*, Air Emissions Regulations and nationally by Environment Canada and Health Canada as noted above. Only regulated CACs are considered in this Project Proposal. It should be noted that Yukon regulatory air quality standards reflect the most stringent Canada Wide Standard and national standards, and these are what have been used in the Air Quality effects assessment.

The Project effect on the Air Quality VC is determined by comparing predicted CAC concentrations against the regulatory objectives (Canada Wide Standard and NAAQO). These regulatory objectives are shown in Table 6.6-1. PM_{10} (PM of 10 µm or less) are not included in the assessment because no national objectives exist. NAAQO are rated as Desirable, Acceptable and Tolerable, and are historically defined as follows:

- **Maximum Desirable** level is the long-term goal for Air Quality and provides a basis for anti-degradation policy for unpolluted parts of the country, and for the continuing development of control technology.
- **Maximum Acceptable** level is intended to provide adequate protection against effects on soil, water, vegetation, materials, animals, visibility, personal comfort and well-being.
- **Maximum Tolerable** level denotes time-based concentrations of air contaminants, beyond which, due to a diminishing margin of safety, appropriate action is required to protect the health of the general population.

Table 6.6-1: National Ambient Air Quality Objectives

Substance (Units)	Averaging Period	Canada Wide Standard[a]	NAAQO[b]		
			Maximum Desirable	Maximum Acceptable	Maximum Tolerable
TSP (µg/m^3)	24-hour	–	–	120	400
	Annual	–	60	70	–
$PM_{2.5}$ (µg/m^3)	24-hour	30	–	–	–
NO_2 (µg/m^3)	One-hour	–	–	400	1,000
	24-hour	–	–	200	300
	Annual	–	60	100	–
CO (µg/m^3)	One-hour	–	15,000	35,000	–
	Eight-hour	–	6,000	15,000	20,000
SO_2 (µg/m^3)	One-hour	–	450	900	–
	24-hour	–	150	300	800
	Annual	–	30	60	–

NOTES:

[a] Canadian Council of Ministers of the Environment (CCME 2000) Canada-wide Standard for Respirable Particulate Matter ($PM_{2.5}$). This objective is referenced to the 98th percentile 24-h concentration, averaged over three consecutive years.

[b] National Ambient Air Quality Objectives, or NAAQO (Government of Canada 2004)

6.6.1.2 VC Baseline Information

As noted in Section 4, little is known of the existing air quality regime in the area of the Project. Since there are no existing industrial activities near the Project site, existing air quality is influenced by surrounding natural sources and contributions from long-distance transport of air contaminants. Gaseous CAC ambient concentrations are assumed to be minimal and both TSP and $PM_{2.5}$ are assumed to have a (conservative) ambient concentration in the range of 2 to 3 µg/m^3.

6.6.1.3 Key Issues and Identification of Potential Effects

Project activities which scored "2" in Table 6.3-1 were identified as the most likely activities to contribute to a change in the Air Quality VC; these are summarized in Table 6.6-2. While virtually all activities have the potential to emit CACs, those that result in the emission of insubstantial quantities are omitted from this table and are not carried forward in this assessment. Activities in Table 6.6-2 are divided according to the construction and operations phases. Potential air quality effects resulting from closure activities were assumed to be minimal due to the lack of blasting, crushing and earth moving and certainly less than during the Construction and Operations phases. Consequently, they are not included.

Table 6.6-2: Potential Project Effects to Air Quality

Project Activities and Physical Works	Potential Environmental Effects
	Criteria Air Contaminants
Construction	
Site clearing and grubbing	✓
Disposal of cleared vegetation	✓
Salvaging and stockpiling of top and sub soils	✓
Site grading including blasting, overburden removal and overburden disposal	✓
Borrow areas development and use	✓
Camp construction (construction and operations camps)	✓
Use of large construction vehicles and equipment	✓
Construction of mine site infrastructure and haul road	✓
Operations	
Open-pit mining (blasting, ore/waste hauling, open pit dewatering)	✓
Ore Processing (crushing and hauling)	✓
Quarry/borrow pit operations	✓

NOTE:

Project Environmental Effects

Only Project environment interactions ranked as 2 in Table 6.3.1, the Project-Environment Interaction Table, are carried forward to this Table.

✓ = Indicates that an activity is likely to contribute to residual environmental effects.

Construction Phase

- Site clearing and grubbing will be done with large construction vehicles. Soil disruption during site preparation will generate significant PM emissions.

- Disposal of cleared vegetation will cause CAC emissions, especially PM emissions.
- Salvaging and stockpiling of top and sub soils will cause PM emissions.
- Blasting, site grading, and overburden removal and disposal will cause soil disruption at the Project site, discharging PM from the surface.
- Development of quarry and borrow areas and the salvaging and stockpiling of top and sub soils will cause soil disruption and PM emissions.
- Development of the construction and operations camps will require site preparation and installation of camp infrastructure, generating CACs.
- Use of large vehicles and mining equipment will cause combustion CAC emissions.
- Construction of mine site infrastructure will cause soil disruption and PM emissions.

Operations and Modifications Phase

- Open-pit mining including blasting, and ore and waste hauling will cause soil disruption and PM emissions.
- Ore processing, including crushing, hauling, and the use of conveyor systems will cause PM emissions at transfer points. Gold heap leach facility operations will require finely-ground ore transferred to the heap leach facility, causing PM emissions.
- Quarry and borrow area activities during normal open pit operations will cause soil disruption and generate PM emissions.

6.6.1.4 Standard Mitigation Measures and Effects Addressed

Project activities which scored "1" in Table 6.3-1 will result in minor sources of CACs. Access road and transmission line upgrades, and subsequent maintenance will result in minor CAC emissions from surface disturbance and motor vehicle exhaust. Relatively small amounts of CACs will be produced from the equipment fleet used to construct the Project site access road and other onsite road systems. During construction of the transmission line, air emissions from 12 small diesel generators are expected to be transient, short-term, and local in nature. The generators are small and the CAC emissions are not expected to be significant.

During operations, the transmission line and associated facilities will not result in substantial emissions and were not investigated further. Waste rock disposal and reclamation activities will not result in PM emissions except in extraordinary wind conditions when the wind entrains smaller particles. Diesel power generators originally used during construction will be used only during operational emergencies. Consequently, CAC emissions from sporadic use of diesel generators are not expected to be significant. During camp operations, best dust management practices will be carried out, including the heavy use of water suppressants. The efficiency of all dust suppression activities is expected to approximate 85% (US EPA 2006b, Kucewicz 2010a, pers. comm.).

During closure, most reclamation will be carried out with waste rock material. The waste rock particles should contain a relatively small amount of PM, resulting in a low level of emissions.

Project activities which scored "0" in Table 6.3-1 will not result in CAC discharges. These activities include water supply and usage, site water-management, fish habitat compensation, and potable and non-potable water use. Solid-waste management and wastewater treatment and discharge will have little to no exposure to the atmosphere, and will result in minimal CAC discharges. Fuel, Hazardous Materials, and Explosives Management are all self contained activities with no exposure to the atmosphere.

6.6.1.5 Selection of Measurable Parameters

In the case of air quality, effects are framed with reference to measurable parameters. Measurable parameters facilitate quantitative or qualitative measurement of potential Project and cumulative effects, and provide a means to determine the level or amount of change to a VC. The selected measurable parameters for the Air Quality VC are outlined in Table 6.6-3 as a function of the potential effect. The following sections provide a brief overview of the selected measurable parameters.

Table 6.6-3: Measurable Parameters for Air Quality

Environmental Effect	Rationale for Inclusion of the Environmental Effect in the Assessment[a]	Measurable Parameter(s) for the Environmental Effect	Rationale for Selection of the Measureable Parameter[a]
Criteria Air Contaminants (CACs)	▪ CACs are associated with human health effects and other effects in the receiving environment. They may affect the intrinsic quality of life nearby ▪ Some CACs ($PM_{2.5}$) can penetrate deep into the respiratory tract and are associated with respiratory effects ▪ PM deposition may affect vegetation, soil, and aquatic ecosystems ▪ Some CACs (NO_x, SO_2) are associated with acid rain, which can affect vegetation, soil, and aquatic ecosystems ▪ Some CACs (NO_x) may assist in the formation of ozone, which can affect human health, materials, and vegetation, important locally and regionally	▪ Respirable Particulate Matter ($PM_{2.5}$) ▪ Total Suspended Particulates (TSP) ▪ PM deposition ▪ Nitrogen Dioxide (NO_2) ▪ Carbon Monoxide (CO) ▪ Sulphur Dioxide (SO_2)	▪ NAAQO (Government of Canada 2004) ▪ CCME Canada-wide Standard for $PM_{2.5}$ (CCME 2000) ▪ Project Proposal Terms of Reference

NOTES:
[a] Includes input from consultation with regulators, First Nations, affected stakeholder, and the public: as well as YESAB's guidelines, other regulatory drivers, policies, and/or programs.

6.6.1.6 Spatial Boundaries for Air Quality

Regional Assessment Area (RAA)

The air quality local assessment area is 30 km by 30 km, centred on the mine site. Due to its size, this area is referred to as the RAA and a separate LAA is not considered.

The modelling domain (Figure 6.6-1) defines the RAA, where the majority of air quality effects from the Project are expected to occur. Within this area, Project effects can be predicted with a reasonable degree of accuracy and confidence, generally accepted to extend to distances at which predicted concentrations have decreased by approximately 10% of the regulatory objective.

The RAA is comprised of a 30 km by 30 km area (the receptor grid; Figure 6.6-1), which is laid out as follows:

- 250-m spacing within 4.5 km from the sources of interest (9 km by 9 km)
- 500-m spacing within 7.5 km from the sources of interest (15 km by 15 km)
- 1,000-m spacing beyond 7.5 km
- 100-m spacing along the mine facility perimeter
- No receptors within the mine site area.

6.6.1.7 Temporal Boundaries for Air Quality

Temporal boundaries have been established by determining the period of time over which the Project-specific effects on air quality are to be considered. To study the CAC emission effects, the temporal boundaries for the assessment include a variety of time averaging intervals. CAC concentrations are estimated and presented for the 1-hour, 8-hour, 24-hour, and annual averaging periods. These averaging periods correspond to the applicable regulatory objective (Table 6.6-1) averaging periods.

Project CAC emission effects will occur primarily during the construction and operations phases. During the Project closure phase, emissions will be minimal and will cease entirely after facility closure.

6.6.1.8 Characterization of Residual Effects for Air Quality

Effects on the atmospheric environment were characterized in relation to the following criteria:

- **Direction**—describes the ultimate long-term trend of the effect
- **Magnitude**—describes the amount of change in a measurable parameter or variable relative to the baseline case
- **Geographic Extent**—describes the area within which an effect of a defined magnitude occurs
- **Timing and Frequency**—the number of times during the Project or a specific Project phase that an effect may occur
- **Duration**—the period of time required until the VC returns to its baseline condition or the effect can no longer be measured or otherwise perceived

- **Reversibility**—the likelihood that a measurable parameter will recover from an effect
- **Ecological and Social Economic Context**—general characteristics of the area in which the Project is located
- **Probability of Occurrence**—probability that the effect will result from Project activities.

Definitions for each of these evaluation criteria are provided in Table 6.6-4.

Table 6.6-4: Characterization of Residual Environmental Effects for Air Quality

Effect Attribute	Effect Rating Criteria	Definition
Direction	Positive	Condition of air quality is improving in comparison to baseline conditions and trends
	Adverse	Condition of air quality is worsening in comparison to baseline conditions and trends
Magnitude	Low	Effect occurs that is detectable but is within normal variability of baseline conditions
	Moderate	Effect occurs that would cause an increase with regard to baseline but is within regulatory limits and objectives
	High	Effect occurs that would singly or as a substantial contribution in combination with other sources cause exceedances or impingement upon limits and objectives beyond the Project boundaries
Geographic Extent	Site-Specific	Environmental effect restricted to the right-of-way
	Local	Environmental effect restricted to the local study area
	Regional	Environmental effect extends beyond the regional study area
Frequency	Once	Effect occurs once
	Sporadic	Effect occurs at sporadic intervals throughout the Project
	Regular	Effect occurs on a regular basis and at regular intervals throughout Project
	Continuous	Effect occurs continuously throughout the Project
Duration	Short-term	Environmental effect is measurable for less than one month
	Medium-term	Environmental effect is measurable for greater than one month but less than two years
	Long-term	Environmental effect is measurable for greater than two years but less than 10 years
	Permanent	Environmental effect is permanent (measurable for greater than 10 years)
Reversibility	Reversible	Effect on environmental component will cease during or after the Project is complete
	Irreversible	Effect on environmental component will persist during and/or after the Project is complete
Ecological or Social Context	Affected	Effect substantially affected by human activity
	Unaffected	Effect not substantially affected by human activity

Effect Attribute	Effect Rating Criteria	Definition
Probability of Occurrence	Little to no chance	The likelihood of the effect occurring is 10% or less
	Unlikely	The likelihood of the effect occurring is less than 50% but more than 10%
	Likely	The likelihood of the effect is more than 50% but less than 100%
	Certain	The effect will occur (100%)

6.6.1.9 Standards or Thresholds for Determining Significance for Air Quality

Relevant regulatory criteria for ambient air quality (Table 6.6-1) will be used to determine if a change in air contaminants of interest will be significant or not. Significance will be determined as follows:

- **Not Significant**—ambient concentrations of air contaminants are likely to be below relevant regulatory criteria for ambient air quality.
- **Significant**—ambient concentrations of air contaminants are likely to exceed relevant regulatory criteria for ambient air quality and are of concern relative to the geographical extent of predicted exceedance or their frequency of occurrence.

6.6.1.10 CACs Effects Analysis Methods

A CAC emissions inventory was developed to characterize the Project emissions likely to result in an air quality effect. The activities generating the emissions are listed in Table 6.6-2. Dispersion modeling was used to assess the potential effects on the receiving environment. Finally, maximum predicted ground-level concentrations (GLCs) were compared to applicable regulatory objectives (Table 6.6-1).

Project Emissions

Project equipment lists were developed based on information provided by the 2010 Prefeasibility (PFS) document (Scott Wilson Mining 2010) and by information provided by Kappes, Cassiday & Associates (Kucewicz 2010b, pers.comm). Project CAC combustion emissions from generators, boilers, and regenerator kiln are characterized as “point sources" since they originate from a stack. Vehicle exhaust and dust emissions are characterized as “fugitive emissions” as they do not originate from a specific point. Rather, vehicle emissions are treated as area sources since the vehicles will move around within a defined area. Almost all Project-related emissions are fugitive emissions, and are treated as area sources. The following sections present an overview of the calculation methodology. Details pertaining to the emissions inventory are provided in the Eagle Gold Air Quality Technical Data Report (Appendix 9).

Point Sources

During the construction phase, all diesel generators used to supply power to the site are assumed to operate continuously at an operational load factor of 75% (Caterpillar 2006). Emission rates are power prorated based on manufacturer’s specifications (Caterpillar 2006).

At the gold recovery plant, three major pieces of equipment will emit CACs:

- Heating Solution Boiler—Heap Leach Facility (600 hp unit)
- Solution Heater—Carbon Desorption (350 hp unit)
- Carbon Regeneration Kiln (100 kg/hr carbon capacity).

Fugitive Sources

Project-related CAC emissions from combustion sources are quantified based on source type, quantity, and maximum operating time. Emission rates were obtained from literature for various types of equipment, vehicles, and ore mining processes. During the operations phase, CAC emissions were estimated based on the expected peak mine operation and production levels.

All of the major mining equipment is assumed to be diesel fired. For diesel-fired combustion equipment, emission factors defined by the United States Environmental Protection Agency (US EPA) and the *Canadian Environmental Protection Act,* 1999 (CEPA, Tier 4 Emission Limits for Off-road Heavy Duty Diesel Engines [Environment Canada 2006a]) are applied. To comply with sulphur regulations for off-road diesel, a fuel sulphur content of 15 ppm in diesel was assumed (Kucewicz 2010b, pers. comm.).

Procedures for estimating dust-related PM emissions from the mine site processes are described below. Emission rates are calculated by assuming the dust control program will achieve 85% reduction efficiency at 4% moisture (US EPA 2006b; Kucewicz 2010a, pers. comm.).

Blasting emission estimates are based on emission factors defined in US EPA AP-42 for Western Surface Coal Mining (US EPA 1998). It is assumed that one blast period will occur each day, and each blast will impact an area of about 2500 m^2. The impact area was determined by referencing another open-pit mine with similar blasting parameters (JWA 2006b).

Drilling, truck loading and unloading emission estimates are based on emission factors defined in US EPA AP-42 for Crushed Stone Processing (US EPA 2004a). A handling rate of about 52,000 tonnes/day (26,000 tonnes/day of ore and 26,000 tonnes/day of waste rock), were used in the calculation (based on information provided in the PFS document [Scott Wilson Mining 2010]).

Primary crushing and materials handling and transfer emission estimates are based on emission factors defined in US EPA AP-42 for Metallic Minerals Processing (US EPA 1982). A processing rate of 26,000 tonnes/day at a 4.0% (by weight) ore moisture content is applied based on information provided in the PFS document (Scott Wilson Mining 2010). The moisture content was verified with VIT (Kucewicz 2010a, pers. comm.). This classifies the US EPA emission factor as that applicable to unpaved surface moisture material.

Secondary crushing and re-grinding operations will be housed. Activities will use water to mitigate dust emissions, resulting in insignificant emissions.

Heap leach facility loading emission estimates are based on emission factors defined in US EPA AP-42 for Metallic Minerals Processing (US EPA 1982). Emissions were calculated by assuming a processing rate of 26,000 tonnes/day based on information provided in the PFS document (Scott Wilson Mining 2010).

Haul road emission estimates are based on emissions defined by US EPA AP-42 for Unpaved Roads (US EPA 2006b). A silt loading of 5.0% was applied (based upon quarry and stone mining haul roads), as recommended by the US EPA (2006b).

Dispersion Modelling Methods

A dispersion modelling assessment was conducted to determine potential Project effects on ambient air quality. Considered effects were associated with Project emissions during peak construction and operations phases. Dispersion model predictions provide a link between the emissions and the meteorology for any given hour, and determine how concentrations vary across the assessment area in response to terrain and other surface factors. The location and magnitude of the maximum CAC GLCs within the RAA are of particular importance.The quantified effects provide the basic information required to study compliance with the regulatory objectives (Table 6.6-1).

Dispersion modelling was completed using the US EPA CALPUFF v6.262 model. The CALPUFF model is suitable for estimating air quality concentrations on both local and regional scales, from tens of metres to hundreds of kilometres. CALPUFF also incorporates PM deposition and complex terrain algorithms.

Year 2008 site specific meteorological data was applied the for dispersion modelling. Both hourly surface and 12-hourly upper-air meteorological data were required for the CALPUFF simulations. The upper air data were taken from the Whitehorse (Environment Canada) upper air station. Most of the surface conditions were taken from the observations at the Project Camp meteorological station. Meteorological parameters (cloud ceiling, opacity) not observed at the Camp Station were obtained from Yukon Mayo airport observations.

6.6.2 Assessment of Criteria Air Contaminants Emission Effects

6.6.2.1 Potential Effects

The following sub-sections provide a summary of potential effects resulting from Project-related construction and operations phase CAC emissions. Detailed equipment lists, emission estimates and modeling results are found in the Eagle Gold Air Quality TDR (Appendix 9).

Construction Phase

Construction Emissions: Construction sources can be grouped into two categories of diesel engine exhaust (from fuel combustion) and dust emissions (from surface soil disruption). Estimates are made for short- and long-term periods. Short-term rates (i.e., hourly and daily) are determined for sources that are assumed to operate continuously for short periods of time. Long-term rates (i.e., annually) include down periods during which some sources of emissions are inactive. Emission rates for both are summarized in Table 6.6-5.

Table 6.6-5: CAC Emission Rates during Construction

Source Category	Emission Rate (g/s)				
	TSP	$PM_{2.5}$	NO_x	CO	SO_2
Short-term					
Fugitive Dust	29.16	0.75			
Construction Vehicles and Equipment Exhaust[a]	0.15	0.15	5.17	13.61	0.008
Total Short-term Construction Emissions	**29.31**	**0.90**	**5.17**	**13.61**	**0.008**
Long-term					
Fugitive Dust	7.22	0.19			
Construction Vehicles and Equipment Exhaust [a]	0.02	0.02	1.42	1.99	0.004
Total Long-term Construction Emissions	**7.24**	**0.21**	**1.42**	**1.99**	**0.004**

NOTE:
[a] PM emissions ($PM_{2.5}$,and TSP) values for heavy equipment consist of $PM_{2.5}$ emissions produced from fuel combustion.

Construction Effects: Predicted maximum CAC concentrations on and outside the mine site are presented in Table 6.6-6 with reference to applicable regulatory objectives. All predicted maximums are below the regulatory objectives except for TSP and $PM_{2.5}$. The maximum TSP and $PM_{2.5}$ 24-hour concentrations of 1,251 and 35.1 µg/m^3, respectively, are predicted at the south perimeter of the mine site in an area where the terrain rises rapidly. Plumes impinge upon steep terrain in this area, and this phenomenon commonly leads to overestimates in dispersion modelling exercises. The area in which these exceedances are predicted to occur lies outside of the mine disturbance boundary and is small relative to the total LAA.

Table 6.6-6: Construction: Maximum Predicted CAC Concentrations

Substance	Averaging Period	Maximum Predicted Concentration (µg/m^3)	Regulatory Objective (µg/m^3)
TSP	24-hour	**1,251**	120a
	Annual	59.0	70a
$PM_{2.5}$	24-hour	**35.1**	30b
NO_2	One-hour	137	400a
	24-hour	99.7	200a
	Annual	12.2	100a
CO	One-hour	1,195	35,000a
	Eight-hour	988	15,000a
SO_2	One-hour	0.52	900a
	24-hour	0.31	300a
	Annual	0.03	60a

NOTES:
Values in **bold** identify exceedance to applicable regulatory objectives.
[a] National Ambient Air Quality Objectives, NAAQO. Maximum Allowable Objective Level. (Government of Canada 2004).
[b] Canadian Council of Ministers of the Environment (CCME 2000) Canada-wide Standard for Respirable Particulate Matter ($PM_{2.5}$). This objective is referenced to the 98th percentile 24-h concentration, averaged over three consecutive years.

Operations Phase

Operations Emissions: Operations emissions consist of:

- Fugitive dust, operations vehicles and equipment emissions
- Point source emissions from the adsorption, desorption, recovery (ADR) facility.

Both short-term and long-term emission rates are summarized in Table 6.6-7. Detailed equipment lists and emission estimates are found in the Air Quality Technical Data Report (Appendix 9).

Table 6.6-7: CAC Emission Rates during Operations

Source Category	Emission Rate (g/s)				
	TSP	$PM_{2.5}$	NO_x	CO	SO_2
Short-term					
Fugitive dust	19.52	0.54			
ADR facility	0.26	0.12	1.21	0.34	0.001
Construction vehicles and equipment	0.32	0.32	10.36	18.25	0.005
Total Short-term Operations Emissions	**20.10**	**0.98**	**11.57**	**18.59**	**0.007**
Long-term					
Fugitive dust	10.23	0.30			
ADR facility	0.26	0.12	1.21	0.34	0.001
Construction vehicles and equipment	0.03	0.03	0.52	4.53	0.001
Total Long-term Operations Emissions	**10.51**	**0.45**	**1.73**	**4.87**	**0.002**

NOTE:
[a] PM emissions ($PM_{2.5}$,and TSP) values for heavy equipment consist of $PM_{2.5}$ emissions produced from fuel combustion.

Operations Effects: Predicted maximum CAC concentrations, on and outside the mine site, are summarized in Table 6.6-8, with reference to applicable regulatory objectives. All predicted maximums are below the regulatory objectives except for TSP. The maximum 24-hour TSP concentration of 397 µg/m^3 is predicted at the south perimeter of the mine site in an area where the terrain rises rapidly. The area where TSP values are predicted to exceed the regulatory objectives is very small.

Table 6.6-8: Operations: Maximum Predicted CAC Concentrations

Substance	Averaging Period	Maximum Predicted Concentration (µg/m^3)	Regulatory Objective (µg/m^3)
TSP	24-hour	**397**	120[a]
	Annual	38.4	70[a]
$PM_{2.5}$	24-hour	19.3	30[b]
NO_2	One-hour	145	400[a]
	24-hour	89.7	200[a]
	Annual	15.8	100[a]

Substance	Averaging Period	Maximum Predicted Concentration ($\mu g/m^3$)	Regulatory Objective ($\mu g/m^3$)
CO	One-hour	1,311	35,000[a]
	Eight-hour	1,085	15,000[a]
SO_2	One-hour	0.40	900[a]
	24-hour	0.21	300[a]
	Annual	0.02	60[a]

NOTES:
Values in **bold** identify exceedance to applicable regulatory objectives.
[a] National Ambient Air Quality Objectives, NAAQO. Maximum Allowable Objective Level. (Government of Canada 2004).
[b] Canadian Council of Ministers of the Environment (CCME 2000) Canada-wide Standard for Respirable Particulate Matter ($PM_{2.5}$). This objective is referenced to the 98th percentile 24-h concentration, averaged over three consecutive years.

Dustfall Effects

The air quality dispersion model was used to predict $PM_{2.5}$ dustfall in the RAA. The CALPUFF dispersion model was used to determine dustfall resulting from Project activities. Deposition simulations are affected by the PM characterization (particle size means and spreads), the characteristics of the surface (roughness and terrain height) and atmospheric variables (stability and turbulence). In this simulation:

- The geometric mass mean diameter was set at 0.48 microns, at 2.0 microns standard deviation.
- The receptor heights follow the terrain determined by the Canadian Digital Elevation Data values.
- Atmospheric stability and turbulence are determined by the model for each hourly time step.

These characteristics determine dustfall at discrete receptor locations. The approach applied to this Project did not include wet deposition. Between 2008 and 2010, precipitation (>0.2 mm) was observed an average of 67 days per year in this region. Assuming the annual precipitation trend continues during the life of the Project, this precipitation is expected to decrease Project dustfall emissions by 18%.

In air quality, total dustfall is measured in milligrams per decameter squared per day ($mg/dm^2/d$). Dustfall effects result from the deposition of $PM_{2.5}$ emitted by fugitive sources. $PM_{2.5}$ generated by combustion sources is much smaller and remains airborne for much longer periods of time. Whereas TSP are removed from the atmosphere through gravitational settling, $PM_{2.5}$ is susceptible to long range transport. Since the construction phase is relatively short in duration (less than two years), dustfall was considered only during the operations phase of the Project. Predicted dustfall concentrations are speciated to determine the corresponding metals deposition. The composition of dustfall is diverse and contains a large percentage of metals, most often in compound form.

The 2009 drill hole assay data was used to determine metal speciation for the Project. The metal portion of the dustfall speciation profile is presented in Table 6.6-9. Potassium is the most abundant metal at 2.8%, followed by Iron at 2.6%.

Figure 6.6-2 shows the $PM_{2.5}$ dustfall predictions in the RAA. The maximum dustfall of 77.9 mg/dm^2/d occurs at the southeastern mine area perimeter along the rising terrain.

Predicted metal dustfall results are carried forward to the effects assessment of the Surficial Geology, Terrain and Soils Assessment (Section 6.4) and the Qualitative Human and Health and Ecological Risk Assessment (Appendix 31).

Table 6.6-9: Victoria Gold Assays Metals Speciation Profile

Metal	Symbol	Total Metal Composition	
Silver	Ag	0.38	ppm
Aluminum	Al	5.98	%
Arsenic	As	89.0[a]	ppm
Boron	B	212.41	ppm
Beryllium	Be	2.82	ppm
Barium	Ba	1099.77	ppm
Calcium	Ca	1.90	%
Cadmium	Cd	0.57	ppm
Cobalt	Co	8.55	ppm
Chromium	Cr	53.59	ppm
Copper	Cu	26.79	ppm
Iron	Fe	2.60	%
Mercury	Hg	0.40	ppm
Potassium	K	2.81	%
Magnesium	Mg	0.78	%

Metal	Symbol	Total Metal Composition	
Manganese	Mn	292.36	ppm
Molybdenum	Mo	2.20	ppm
Sodium	Na	1.08	%
Nickel	Ni	21.17	ppm
Phosphorus	P	461.03	ppm
Lead	Pb	33.91	ppm
Antimony	Sb	12.95	ppm
Selenium	Se	1.00	ppm
Strontium	Sr	317.77	ppm
Titanium	Ti	0.26	%
Thallium	Tl	4.35	ppm
Vanadium	V	40.14	ppm
Tungsten	W	30.00	ppm
Zinc	Zn	97.22	ppm

Notes:
[a] 50th percentile median value.

6.6.2.2 Mitigation Measures

Of all CACs considered in this assessment, only the 24-hour predicted maximum TSP and $PM_{2.5}$ concentrations exceeded applicable regulatory objectives. The CALPUFF dispersion modelling approach predicted ambient CAC concentrations (including TSP) that are indicative of screening or most-conservative Project conditions. The maximum is predicted at the southeast perimeter of the mine site in an area where the terrain rises rapidly. Plumes impinge on the steep terrain in this area, and this phenomenon commonly leads to overestimates in dispersion modelling exercises.

Wet scavenging refers to natural dust suppression by rain and snow. Wet scavenging is an important naturally-occurring means to remove airborne TSP through deposition. The dispersion model did not account for wet scavenging effects. Inclusion of wet scavenging would have resulted in lower predicted ambient CAC concentrations (including TSP) and higher dustfall deposition within the RAA.

Mitigations to control Project dust and combustion emissions are identified below.

Fugitive dust emissions can be minimized through the following mitigation measures:

- Minimize disturbances and manage all land clearings
- Construct haul roads with very low silt content material
- Enforce low speed limits for all mobile mine equipment
- Apply water to open surfaces and heavily used roads (in the summer months)
- Control active open pit haul roads and active customer haul roads by periodically wetting surfaces using a water truck
- Water inactive roads to suppress dust if there is visible evidence of fugitive dust emissions (e.g., dust clouds resulting from wind)
- Water active roads, in hot, dry conditions, at least once every three hours unless meteorological conditions (e.g., rain, frozen surfaces, etc.) are adequate to suppress dust to a degree that is equivalent to 3-hour periodic watering
- Record fugitive dust suppression activities daily using the fugitive dust suppression log attached to this plan (Appendix 30 – Environmental Management Plans)
- Make available the fugitive dust suppression log to authorized Yukon's representatives upon request.

The Combustion Source Control Plan (Appendix 30) will promote the following mitigation measures to minimize combustion emissions:

- Use Best Available Technology Economically Achievable (BATEA) measures and best practices to meet or exceed relevant regulatory emission standards for all mine equipment and practices
- Use diesel fuel with low sulphur content following Canadian Tier 4 regulation
- Enforce low speed limits for all mobile mine equipment
- Ensure all mine equipment is properly tuned and maintained
- Reduce vehicle idling times.

6.6.2.3 Residual Effects

Construction Effects

During the construction phase, the majority of emissions will consist of TSP and $PM_{2.5}$. Predicted ambient 24-hour TSP and $PM_{2.5}$ concentrations exceed the applicable NAAQO at or very near the mine site. The area outside of the mine site with TSP concentrations exceeding regulatory objectives is very small (Air Quality Technical Data Report, Appendix 9).

The residual effects during the construction phase are minimal and will be significantly reduced with natural dust suppression and the Fugitive Dust Control Plan (Appendix 30 – Environmental Management Plans). While the direction is adverse and the magnitude is high, the effect will be local in extent and reversible. If the effect of wet scavenging is considered, actual exceedances of ambient regulatory objectives are unlikely.

Operations Effects

During the operations phase, the majority of material hauling, processing, and material transfer will consist of TSP and $PM_{2.5}$. Heavy equipment CAC combustion emissions are considered to be insignificant and are not a concern. Predicted ambient 24-hour TSP concentrations exceed the NAAQO at or very near the mine site. The area outside of the mine site with TSP concentrations exceeding regulatory objectives is very small.

The residual effects during the operations phase are minimal. Project effects will be significantly reduced with natural dust suppression, the Fugitive Dust Control Plan, and the Combustion Source Control Plan (Appendix 30 – Environmental Management Plans). While the direction is adverse and the magnitude is high, the effect will be local in extent and reversible. If the effect of wet scavenging is considered actual exceedances of ambient regulatory objectives are unlikely.

6.6.2.4 Determination of Significance

Project emission rates are estimated based on a combination of emission factors, engineering estimates, and manufacturer's specifications. Consequently, emission rates are typically representative of maximum possible values. In reality, actual emissions vary from hour to hour and day to day. Removal of Project CACs through wet scavenging was not included as part of this assessment. The precipitation is expected to decrease yearly impact of dustfall emissions by 18%. Because of the nature of this approach, there is a high degree of confidence that emissions are being over-estimated.

Given the conservative nature inherent in CALPUFF modeling, and the location and limited areas over which predicted TSP concentrations are in exceedance, it is concluded that the residual Project effects for all phases of the Project are not significant. While the direction is adverse, the magnitude is small, local in extent, and reversible. The duration and frequency for most activities is regular and medium term, however concentrations above the regulatory objectives are expected to be very rare, local, short in duration and reversible. Based on these results, the effects of Project activities on air quality are not significant.

6.6.3 Assessment of Cumulative Effects on Air Quality

6.6.3.1 Screening of Cumulative Environmental Effects

With the use of the proposed mitigation measures, Project residual effects on air quality are considered to be not significant. Applying the screening process for cumulative effects, it is also concluded that cumulative effects will not be significant. This assessment determined that there are no other industrial activities in the RAA. Predicted CAC concentrations (except for small local areas with TSP exceedance) are below the regulatory objectives. The baseline concentrations are expected to be minimal, so no change in sustaining current air quality is expected. Therefore, no further cumulative effects assessment is warranted.

6.6.4 Summary of Consultation Influence on the Assessment

The assessment relied on information provided by YESAB, FNNND, Yukon Government (Environment Yukon) to determine whether other projects are located within the air quality RAA. Based on this information, it was determined that no other projects exist within the RAA that have an impact on air quality.

6.6.5 Effects Monitoring and Adaptive Management for Air Quality

During the early part of the construction phase and continuing through with the operations phase, the following actions are recommended:

- Establishment of a PM monitoring system with one monitor located in both the northwest and southeast perimeter of the mine site
- Maintenance of the CAC emission inventories
- Development and implementation of a Fugitive Dust Control Plan
- Development and implementation of a Combustion Source Control Plan.

The information available from these activities will determine the effectiveness of the measures taken to mitigate any adverse Project air quality effects. Detailed Fugitive Dust Control and Combustion Source Control Plan s will be completed as part of the permitting process for the Project and are outlined in Appendix 30 – Environmental Management Plans.

6.6.6 Commitments for Air Quality

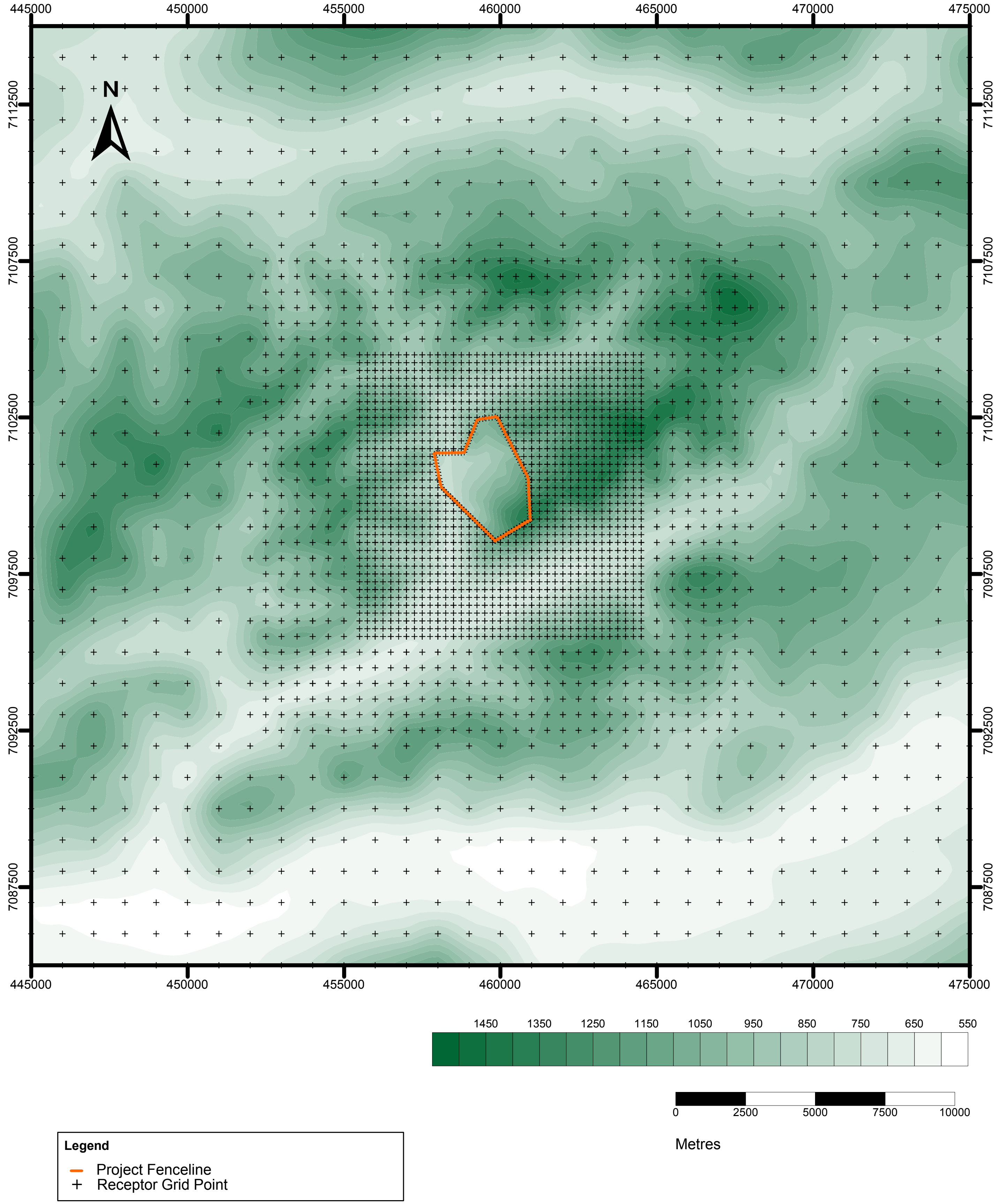
VIT is committed to reducing residual effects to air quality by implementing the actions recommended above (Section 6.6.5).

6.6.7 Summary of Air Quality Assessment

Air Quality has an intrinsic importance to the health and well being of humans, wildlife, vegetation and other biota. The atmosphere is an important pathway for the transport of contaminants to the freshwater, terrestrial, and human environments. Since there are no existing industrial activities near the Project site, existing air quality is influenced by surrounding natural sources and contributions from long-distance transport of air contaminants. Project activities will result in the release of Criteria Air Contaminants (CACs), substances that are regulated by Environment Canada and Health Canada. The potential Project effect on air quality was determined by comparing predicted CAC concentrations against the national regulatory objectives (National Ambient Air Quality Objectives and the Canada Wide Standards). A CAC emissions inventory was developed to characterize the Project emissions likely to result in an air quality effect, dispersion modeling was used to assess the potential effects on the receiving environment, and maximum predicted ground-level concentrations (GLCs) were compared to the applicable regulatory objectives. The primary Project sources of CACs include diesel engine exhaust (from vehicles and equipment), fugitive dust emissions (from surface soil disruption), and point source emissions from the adsorption, desorption, and recovery (ADR) facility. During both construction and operations, the majority of the Project emissions will consist of total suspended particulates (TSP) and 2.5 µm particulate matter ($PM_{2.5}$). Of all CACs considered in this assessment, only the 24-hour predicted maximum TSP and $PM_{2.5}$ concentrations exceeded applicable regulatory objectives, and this occurs at or very near the mine site. This area outside of the mine site with predicted TSP concentrations exceeding regulatory objectives is very small. Emission rates are estimated based on a combination of emission factors, engineering estimates, and manufacturer's specifications and are typically representative of maximum possible values. The effect of wet scavenging (natural dust suppression by rain and snow) was not included in this assessment, and there is a high degree of confidence that emissions are being over-estimated. If wet scavenging is considered, actual exceedances of ambient regulatory objectives are unlikely. Residual effects are minimal and will be significantly reduced with natural dust suppression, the Fugitive Dust Control Plan, and the Combustion Source Control Plan (Section 4 of Appendix 30). Concentrations of CACs above the regulatory objectives are expected to be very rare, local, short in duration and reversible and it is concluded the effects of Project activities on air quality are not significant.

6.6.8 Figures

Please see the following pages.



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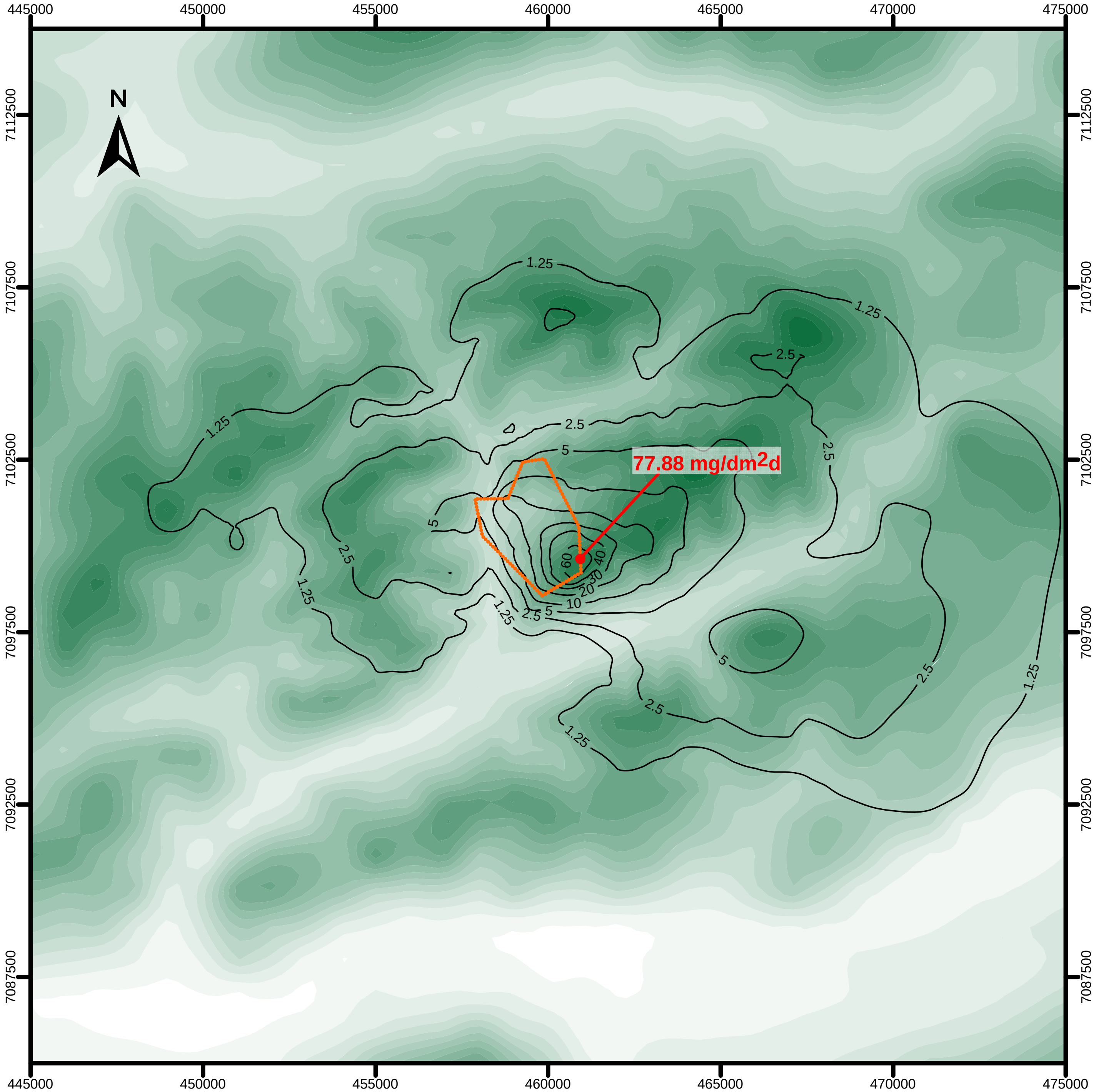
Victoria Gold Corp

Eagle Gold Project Air Quality Modelling Domain and Receptor Grid

PROJECTION	UTM	DRAWN BY	MK
DATUM	NAD 83	CHECKED BY	BK
DATE	2010-Sept-15	FIGURE NO.	6.6-1

Job No: 1490-10002



1450 1350 1250 1150 1050 950 850 750 650 550

0 2500 5000 7500 10000
Metres

Legend

- Project Fenceline
- $PM_{2.5}$ Deposition Concentrations: mg/dm^2d
- Maximum Concentration

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Stantec

Victoria GOLD CORP

Predicted Maximum Predicted Average Daily Dust Fall Deposition (mg/dm^2 d) Associated with 85% dust control efficiency of Project Case emissions

PROJECTION	UTM	DRAWN BY	MK
DATUM	NAD 83	CHECKED BY	BK
DATE	2010-Sept-2	FIGURE NO.	6.6-2

Job No: 1490-10002

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6.7 Fish and Fish Habitat

This section examines potential effects of the proposed Project on fish and fish habitat in water bodies of Dublin Gulch, Eagle Pup, Haggart Creek, and the potentially affected portions of the South McQuesten River. The Project would be located in the Haggart Creek watershed which discharges into the South McQuesten River. Haggart Creek supports Arctic grayling and slimy sculpin. The South McQuesten in addition supports Chinook salmon. Construction of the Project will require modifications to Dublin Gulch, a tributary to Haggart Creek, and upgrades of the access road to the mine site include widening, re-grading, and resurfacing along the Haggart Creek portion of the road. Construction and operations of the Project also have the potential to cause discharges of sediment and mine waste into these waters.

Due to their position as a top predator in the aquatic food chain, fish are important as an indicator of overall aquatic health. They are also important for their recreational and food value to both First Nation and other users. The *Fisheries Act* establishes regulatory requirements for the protection of fish and fish habitat. By including fish and fish habitat as a VC, the environmental effects assessment ensures issues arising from the Project can be addressed within the requirements of the legislation. By identifying important fish habitats potentially affected by the Project and developing mitigation measures to protect these resources, the overall ecological function of the affected aquatic ecosystems can be assessed as part of the Project Proposal.

6.7.1 Scope of Assessment for Fish and Fish Habitat

6.7.1.1 Regulatory/Policy Setting

In Yukon, management of fisheries is shared by Fisheries and Oceans Canada (DFO) and the Yukon Government (Environment Yukon) under a combination of federal legislation and regulations, delegation of management authority, territorial administration, and policy. The primary legislation governing fisheries and fish habitat management in Yukon is the federal *Fisheries Act* and its supporting regulations.

DFO is the federal agency responsible for administration of the *Fisheries Act* and the policies and programs addressing national interests in marine and fresh waters. In Yukon, DFO has primary responsibility for administration of the Act, including the management of all fish habitat, and the management of anadromous fish (species such as salmon that spend time in salt water and return to fresh water streams and rivers to spawn). Under *Fisheries Act* Regulations, the *Canada-Yukon Freshwater Fisheries Agreement* (1989) and *the Canada/Yukon Memorandum of Understanding on Aquaculture Development* (1991), Environment Yukon has been delegated authority for the management of freshwater fisheries in the territory and under this authority, administers, establishes policy, and sets out license conditions for freshwater fisheries, including aquaculture activities in the territory.

In addition, a number of Boards and Councils have been established under the Umbrella Final Agreement (UFA) and Yukon First Nation Final Agreements which have advisory and management responsibilities related to fish and fish habitat Yukon-wide, and within specific First Nation Traditional Territories. These include the Yukon Fish and Wildlife Management Board which make recommendations to the Yukon and First Nation governments on issues related to fisheries management, legislation, research, policies and programs; and the Mayo District Renewable Resource Council (MDRRC), which is responsible for making recommendations on fish and wildlife management; policies and proposed development activities in the Na-cho Nyäk Dun Traditional Territory. The Salmon Sub-Committee, also established under the UFA, is mandated with providing advice and recommendations to governments specific to the management of salmon and salmon habitat in the territory.

Under the authority of DFO, the following sections of the *Fisheries Act* restrict development activities in and adjacent to fish habitats and are applicable to the proposed Project:

- Sections 20 through 22 – Obstructions and Fish Passage
- Section 30 – Water Intake Screening
- Section 32 – Illegal Fish Kills
- Section 35 – Destruction of Fish Habitat
- Section 36 – Pollution of Fish Habitat.

Section 35 is the primary driver in the design, construction, and incorporation of mitigation measures for the Project. Section 35 prohibits the harmful alteration, disruption or destruction (HADD) of fish habitat unless authorized by the Minister of Fisheries and Oceans through DFO. Fish habitat is defined by the Act as “spawning grounds and nursery, rearing, food supply, and migration areas on which fish depend directly or indirectly to carry out their life processes” (GoC 1985b).

Interpretation of section 35 is provided by the federal Policy for the Management of Fish Habitat, which was presented to Parliament on October 7, 1986 (DFO 1986). This policy established: 1) the long-term objective for an overall net gain of productive capacity of fish habitats; and 2) the guiding principle of no net loss (NNL) in the productive capacity of fish habitat. The policy is supported by the Habitat Conservation and Protection Guidelines (DFO 1998a), by the Decision Framework for the Determination of a Harmful Alteration, Disruption or Destruction of Fish Habitat (DFO 1998b), and by the Practitioners Guide to the Risk Management Framework for DFO Habitat Management Staff (DFO 2007a).

An authorization under the *Fisheries Act* Section 35(2) will be required prior to construction of the Project. A Fish Habitat Compensation Plan has been developed to support the authorization and DFO review of the Project Proposal.

The *Species at Risk Act* (SARA) is also applicable in Yukon. However, no freshwater fish species on Schedules 1 or 2 of SARA are present in the South McQuesten River watershed or the entire Yukon Territory (GoC 2010).

6.7.1.2 VC Baseline Information

Baseline information on fish and fish habitat in the local study area is summarized in Section 4.2 and described more fully in the Environmental Baseline Report: Fish and Fish Habitat (Appendix 5). Field studies within the local Project area were completed over four sampling periods (August 2007, October 2007, April 2008, and July 2009) and included 59 sample sites, located on 28 watercourses. Field studies focused on collecting biophysical habitat data, determining fish presence and abundance, and characterizing fish populations (i.e., size, age, and tissue metal concentrations).

Dublin Gulch is the only fish-bearing watercourse that lies within the footprint of the mine. The remaining watercourses inside the perimeter of the mine footprint are non-fish-bearing and include non-fish-bearing sections of Dublin Gulch, Eagle Creek, Eagle Pup, Stuttle Gulch, Platinum Gulch, and Ann Gulch (Figure 4.1-21).

Arctic grayling and slimy sculpin are the only two fish species captured during field sampling programs. There has been one recorded observation of Chinook salmon in Haggart Creek downstream from the Project location; however none were observed or captured in Haggart Creek during field sampling programs conducted between 2007 and 2010. Chinook spawners were observed in August 2009 at the Haggart Creek Road (HCR) Bridge crossing of the South McQuesten River. Other fish known to inhabit lower Haggart Creek include burbot, longnose sucker and round whitefish.

Arctic grayling, a member of the Salmonidae family (salmonids), are known to rear in upper Haggart Creek and its sub-basins. Past studies have determined that grayling migrate to the South McQuesten River to overwinter (Pendray 1983); however, 2008 field studies demonstrated that some overwinter in a large placer pool located in the upper Haggart Creek mainstem. Pendray (1983) observed that spawning by Arctic grayling in the Project area occurred predominantly in the South McQuesten River during the last two weeks of May. He also identified a small area at the mouth of Haggart Creek as a probable spawning site.

6.7.1.3 Key Issues and Identification of Potential Effects

Consultation with regulators, First Nations, stakeholders, and community members, in conjunction with professional judgment of VIT and its consultants, has identified a number of issues for consideration while planning the Project. Key issues for fish and fish habitat are related to construction and operations activities that alter or remove key components of fish habitat, change base flows, introduce substances into watercourses that are deleterious to fish, or cause the direct mortality of fish. Activities during the construction and operations phases of the Project that have the potential to interact with fish and fish habitat include:

- Removal and alteration of riparian vegetation for construction of the mine site, access road upgrades, and transmission line right-of-way
- Access road upgrades including road crossings over watercourses
- Construction of mine infrastructure within instream and riparian areas:
    - Water intake and discharge structures

  - Watercourse infilling for waste rock storage, pit development, and construction of the heap leach facility
  - Haul road construction.
- Water usage and disposal during construction and operations
- Site water management including the diversion of watercourses and site runoff.

The significance of potential interactions between specific Project components and water quality and aquatic ecology are identified and ranked in Table 6.3-1 (Section 6.3.1). Those interactions ranked as a “2” (those that can cause environmental effects of concern) are described below and assessed further in the following sections. Those ranked as a “1” are described in Section 6.7.1.4 but are not carried further in the assessment, while those interactions ranked as “0” are identified but are not assessed.

Fish habitat attributes such as water quality, habitat type, substrate materials, cover, and complexity are needed to support fish populations. These attributes also provide the conditions and ecological niches needed to support the full spectrum of aquatic life. As a result, Project activities that might interact with fish populations or fish habitat productive capacity also have the potential to interact with other components of the aquatic ecosystem, such as aquatic plants and benthic macroinvertebrates. Therefore, establishing environmental protection measures to prevent or reduce environmental effects on fish mortality and fish habitat is also likely to mitigate potential environmental effects on other aspects of the aquatic ecosystem. Therefore, changes in fish habitat availability, and changes to fish mortality risk have been selected as two broad potential effects that will be used to assess overall environmental effects on fish and fish habitat (Table 6.7-1).

Table 6.7-1: Potential Project Effects to Fish and Fish Habitat

Project Activities and Physical Works	Potential Environmental Effects	
	Changes in Fish Habitat Availability	Change in Fish Mortality Risk
Construction		
Site clearing and grubbing	✓	✓
Access road upgrades	✓	
Construction of mine site infrastructure	✓	✓
Site water-management (diversions and runoff)	✓	✓
Operations		
No Project-environment interactions ranked as 2 in Table 6.3-1 for fish and fish habitat		

Project Activities and Physical Works	Potential Environmental Effects	
	Changes in Fish Habitat Availability	Change in Fish Mortality Risk
Closure and Reclamation		
Reclamation		✓
Heap leach facility		✓
Pit lake		✓
On-going water treatment and discharge		✓

NOTE:
Project Environmental Effects
Only Project-Environment interactions ranked as 2 in Table 6.3-1, the Project-Environment Interaction Table, are carried forward to this Table. A ✓ indicates that an activity is likely to contribute to the environmental effect.

6.7.1.4 Standard Mitigation Measures and Effects Addressed

Project interactions ranked as “0” in Table 6.3-1 (Section 6.3.1) are those for which no direct interaction between activities and fish and fish habitat exist. These activities include burning of cleared vegetation, handling of liquid and solid waste, generation of diesel power, installation of power transmission lines, processing of ore, operation of camp facilities, vehicle traffic, management of hazardous materials and explosives, reclamation of stockpiles and the HLF, infilling of the pit lake, and removal of the plant and mine infrastructure.

The types of mitigations used to manage effects of interactions ranked as “1”, those for which an interaction occurs but for which no significant environmental effect would result are discussed below for each phase of the Project.

Construction

Those construction activities (site grading, soil and overburden removal, stockpiling of soils, camp construction, etc.) ranked as “1” in the Project-interactions table (Section 6.3.1; Table 6.3-1) occur greater than 30 m from area streams. Although there is still potential for these activities to release sediment to streams, standard erosion prevention and sediment control practices and the implementation of the Water Management Plan (Appendix 18) will be sufficient to minimize the effects of these activities. All runoff from camp construction, site clearing, and other soil and vegetation disturbance and stockpiling activities will be diverted to the sediment control ponds for settling. Discharged water will meet criteria for total suspended solids and turbidity that will be established in permits required for the Project. With these mitigation measures all potential effects to fish and fish habitat from the construction activities ranked as “1” are predicted to be nominal.

The fish habitat compensation project will be constructed in Eagle Creek downstream of the Project. Instream and stream bank construction could result in disturbance of aquatic habitat and release of sediment to fish-bearing waters downstream. These potential effects will be mitigated by ensuring all areas of habitat construction are completely isolated and by following VIT's surface erosion prevention and erosion control practices (Appendix 30 – Environmental Management Plans).

Potable water will be drawn from a groundwater well near the camp, held in a storage tank, treated to meet Canadian Drinking Water Standards, and distributed through the camp. This use will not affect water quality or temperature of area streams. Non-potable water (grey water) may be drawn from surface water storage facilities or Haggart Creek, as required, but it is anticipated that the well will supply the majority of water requirements.

Activities associated with construction and maintenance of the 45 km long, 30 m wide, 69 kV transmission line RoW have the potential to alter riparian vegetation at stream crossings, reduce shade, cover, and allochthonous inputs, cause erosion and sedimentation, and disrupt sensitive fish life stages. However, DFO's Pacific Region Operational Statement (DFO 2007b) for Overhead Line Construction and VIT's surface erosion prevention and erosion control practices (Appendix 30) will be followed and other mitigations used to avoid adverse effects on fish and fish habitat. The route will be selected to avoid sensitive habitats such as those required for key life stages of resident fish species, as well as wetlands and unstable terrain. Where pole placement in wet or unstable areas is unavoidable, mitigation measures such as placing the poles during late summer when soils are driest, or in winter when the ground is frozen and snow-covered will be utilized. Construction of the transmission line will not involve the complete removal of riparian vegetation within 30 m of top of bank; the construction or placement of temporary or permanent structures below the high water mark; nor physical disturbance, infilling, or disturbance of stream channels. By following these processes, any potential effects to fish and fish habitat will be negligible.

The large number of people present during construction, operations, and closure of the mine has the potential to increase fishing pressure on local grayling populations. All mine staff and contractors will adhere to a no-fishing policy, implemented by VIT, during Project construction, operations, and closure and reclamation activities.

Operations

Project interaction with fish and fish habitat during mine operations ranked as "1" include open-pit mining (blasting, hauling, open pit dewatering), waste rock disposal, access road and transmission line use and maintenance, quarry pit operations, and hazardous materials and explosives management. Types of mitigation and the nature of rationale for ranking these potential interactions as "1" are as follows:

- Open pit mining, waste rock disposal and quarry pit operations will generally take place a minimum of 30 m from area watercourses, yet there is still the potential for these activities to introduce sediment into fish-bearing streams. A discussion of standard measures employed to mitigate sedimentation from these types of activities is discussed in Construction and Commissioning.
- Road runoff and dust control related to vehicle traffic use and RoW maintenance will be minimized through the design of road and RoW of way stream crossings. All stream crossings will follow DFO operational statements or will comply with the requirements of

DFO and relevant territorial standards for protection of fish and fish habitat. On approaches to vehicle crossing structures, road ditches designed for drainage control will incorporate the necessary sedimentation control measures (e.g., silt fence, check dams) to prevent sediment from entering the watercourse.

- Fuel, hazardous materials and explosives will be managed according to industry standards as described in Section 5 (Project Description), including storage in appropriate containers, containment in bermed areas with over 100% capacity, and storage of explosives in separate buildings away from the rest of the mine activities.

Closure and Reclamation

Potential effects associated with the removal of mine facilities have been ranked as “1” or “0” because disturbance of soils and vegetation in riparian areas and alteration of instream habitat will be addressed and mitigated through the Conceptual Closure and Reclamation Plan (Appendix 24) and the use of surface erosion prevention and sediment control practices described in the Water Management Plan (Appendix 18). Use of these mitigations is expected to result in little or no effect on fish and fish habitat.

6.7.1.5 Selection of Measurable Parameters

DFO has developed a series of pathways of effects (PoEs) flow charts within its Integrated Risk Management Framework (DFO 2007a) that identify potential effects associated with land-based and in-water activities. Each of these PoE identified effects are used to define a measurable parameter for assessment of the effects on change or loss of fish habitat and change in fish/egg mortality.

Measurable parameters are features that alone, or in combination with other measurable parameters, can provide management or scientific evidence of ecosystem quality, or reliable evidence of the trends or changes in quality. Measurable parameters were selected to facilitate the quantitative measurement of potential Project and cumulative effects and compare baseline conditions with conditions that are predicted to exist during construction and operations. The measurable parameters selected to meet these objectives are outlined in Table 6.7-2.

Table 6.7-2: Measurable Parameters for Fish and Fish Habitat

Environmental Effect	Rationale for Inclusion of the Environmental Effect in the Assessment	Measurable Parameter(s) for the Environmental Effect	Rationale for Selection of the Measureable Parameter
Changes in fish habitat availability	Consultation with regulators, First Nations, affected stakeholder, and the public; to ensure the Project has no effect on fish productive capacity and meets the requirement of Section 35 of the federal *Fisheries Act*	**Changes in habitat structure:** Changes to areal extent (m^2). of habitat (rearing, overwintering, spawning and staging/holding) due to physical disturbance or modification of flows	Area of physical disturbance is a means of quantifying disturbance to the productive capacity of fish habitat. Extent of HADDs can be totalled and amount of required compensation can be stated in area of habitat to be created or enhanced.

Environmental Effect	Rationale for Inclusion of the Environmental Effect in the Assessment	Measurable Parameter(s) for the Environmental Effect	Rationale for Selection of the Measureable Parameter
	Consultation with regulators, First Nations, affected stakeholder, and the public; YESAB's guidelines; CCME WQG; regulatory requirements of Section 32 of the federal *Fisheries Act*.	**Change in sediment concentrations:** Changes in total suspended solids (TSS). Discussion of TSS levels is provided in Surface Water Quality and Aquatic Biota, Section 6.5.	Measurement of TSS provides an indicator of sediment loads relative to baseline conditions.
	Consultation with regulators, First Nations, affected stakeholder, and the public; requirements of Section 32 of the federal *Fisheries Act*.	**Change in Water Temperature:** Water temperature (^{o}C) should remain within optimum temperature ranges for various life history stages of Arctic grayling.	Change in water temperature can be determined through direct measurement.
	Consultation with regulators, First Nations, affected stakeholder, and the public; to ensure the Project has no effect on fish productive capacity and meets the requirement of Section 35 of the federal *Fisheries Act*	**Change in food and nutrient concentrations:** Is related to the areal (m^2).extent of riparian habitat due to physical disturbance	Area of physical disturbance is a means of quantifying disturbance to the productive capacity of riparian habitat. Extent of HADDs can be totalled and amount of required compensation can be stated in area of habitat to be created or enhanced.
	Consultation with regulators, First Nations, affected stakeholder, and the public; YESAB's guidelines; CCME WQG; regulatory requirements of Section 32 of the federal *Fisheries Act*.	**Change in contaminant concentrations:** Changes various water quality parameters outlined in CCME guidelines (CCME 1999c, 2003). Discussion of contaminant levels is provided in Surface Water Quality and Aquatic Biota, Section 6.5.	Measurement of various water quality parameters provides an indicator of water quality as it pertains to fish health.
	Consultation with regulators, First Nations, affected stakeholder, and the public; to ensure the Project has no effect on fish productive capacity and meets the requirement of Section 35 of the federal *Fisheries Act*	**Change in access to habitats:** Changes to areal extent (m^2) of available habitat (rearing, overwintering, spawning and staging/holding) due to physical disturbance or modification of flows	Area of change in available habitat is a means of quantifying disturbance to the productive capacity of fish habitat. Extent of habitat made inaccessible bam be totalled and included in HADD calculations.

Environmental Effect	Rationale for Inclusion of the Environmental Effect in the Assessment	Measurable Parameter(s) for the Environmental Effect	Rationale for Selection of the Measureable Parameter
Changes in fish mortality risk	Consultation with regulators, First Nations, affected stakeholder, and the public; YESAB's guidelines; CCME WQG; regulatory requirements of Section 32 of the federal *Fisheries Act*.	**Change in fish/egg mortality:** Risk of fish mortalities (all life stages) due to instream work, reduced water quality, or modification of flows	The number of fish mortalities can be directly measured and the risk to local stocks or populations evaluated based on this number.
	Consultation with regulators, First Nations, affected stakeholder, and the public; YESAB's guidelines; CCME WQG; regulatory requirements of Section 32 of the federal *Fisheries Act*.	**Change in contaminant concentrations:** Changes various water quality parameters outlined in CCME guidelines (CCME 1999c, 2003). Discussion of contaminant levels is provided in Surface Water Quality and Aquatic Biota, Section 6.5.	Measurement of various water quality parameters provides an indicator of water quality as it pertains to fish health.

6.7.1.6 Spatial Boundaries for Fish and Fish Habitat

Local Assessment Area (LAA)

The LAA is shown in Figure 6.7-1 and consists of freshwater fish habitats within the Project site perimeter, Haggart Creek between Dublin Gulch and the Haggart/Eagle Creek confluence, instream and flood plain areas of Eagle Creek, and watercourses potentially affected by road upgrades to the HCR. For watercourses crossed by the HCR, the LAA extends from immediately upstream of the road to 300 to 1,000 m downstream. These boundaries encompass those instream areas that are likely influenced by Project-related habitat disturbance and sedimentation. The LAA defines the area used to assess Project-specific effects.

Regional Assessment Area (RAA)

The RAA includes the Haggart Creek watershed from Dublin Gulch (including the Dublin Gulch drainage) to the South McQuesten River (Figure 6.7-2). This is the area in which the potential for interaction with other projects exists that may result in a cumulative effect.

6.7.1.7 Temporal Boundaries for Fish and Fish Habitat

The temporal boundary for surface water and aquatic biota includes all mine development phases from baseline to construction through post-reclamation:

- The baseline period represents the conditions for freshwater fish and fish habitat prior to development activities associated with the Project.
- The construction phase will be 20 months in duration (Q1 2012 to Q3 2013 or Year 1 – Year 2).
- The operations phase will be 7.3 years in duration (Q4 2013 to Q4 2020, or Year 3 – Year 9).

- The closure and reclamation phase will be 10 years in duration (Q1 2021 to Q4 2030 or Year 10 – Year 19).

During closure the mine water treatment plant will remain in operation during the initial years as required to meet water quality criteria (see Section 6.5 – Water Quality and Aquatic Biota). Post-reclamation monitoring of fish, water quality, and the effectiveness of habitat compensation works will begin midway during reclamation as progressive reclamation and continue for another five years (2025 to 2035 or Year 15 – Year 25).

6.7.1.8 Characterization of Residual Effects for Fish and Fish Habitat

Criteria and definitions used to characterize residual environmental effects on fish and fish habitat are described in Table 6.7-3.

Table 6.7-3: Characterization of Residual Environmental Effects for Fish and Fish Habitat

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The ultimate long-term trend of the environmental effect	**Positive**—an increase in fish habitat productive capacity; a reduction in the risk of fish mortality **Adverse**—a reduction in fish habitat productive capacity; an increase in the risk of fish mortality **Neutral—**productive capacity of fish habitat and the risk of fish mortality remain unchanged from baseline conditions
Magnitude	The amount of change in a measurable parameter or variable relative to baseline case	**Negligible**—no measurable adverse environmental effect on the function or use of the habitat; no measurable reduction in the number of fish **Low**—a measurable environmental effect on habitat function is anticipated but on low sensitivity habitat only; anticipated mortality risk to non-sport fish species **Moderate**—measurable environmental effect on habitat function is anticipated on moderate sensitivity habitat; anticipated mortality risk to sport fish species **High**—measurable environmental effect on habitat function and is anticipated on high sensitivity habitat or critical habitat for SARA-listed species; anticipated mortality risk to SARA-listed species or Chinook salmon
Geographical Extent	The geographic area in which an environmental, economic, social, heritage, or health effect of a defined magnitude occurs	**Site-specific**—effects are restricted to the stream within the specific construction activity area (i.e., Project site or temporary workspaces) **Local**—effects extend beyond the construction activity area but remain within the assessment area **Regional**—effects extend to watershed/sub-regional level
Timing and Frequency	The number of times during a project or a specific project phase that an environmental, economic, social, heritage, or health effect may occur	**Once**—effect occurs once **Sporadically**—effect occurs sporadically at irregular intervals throughout construction or operations of Project **Regularly**—effect occurs on a regular basis and at regular intervals throughout the Project **Continuously**—effect occurs continuously

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Duration	The period of time required until the VC returns to its baseline condition, or the effect can no longer be measured or otherwise perceived	**Short-term**—no measurable effect beyond construction **Medium-term**—effect is measurable beyond construction but not beyond 5 years **Long-term**—measurable effect beyond five years, but not permanent **Permanent**—effects are permanent
Reversibility	The likelihood that a measurable parameter will recover from an effect	**Reversible**—habitat productive capacity will recover after disruption through natural process or restoration; loss of an individual or small number of fish that are part of a secure population **Irreversible**—loss of habitat productive capacity is permanent; destruction of developing eggs or population is at risk
Ecological and Socio-economic Context	The general characteristics of the area in which the project is located	Undisturbed—LAA is relatively unaffected by human activity **Disturbed**—LAA is affected by human activity
Probability of Occurrence		**Unknown**—not well understood and, based on potential risk to fish and fish habitat or its economic or social/cultural values, effects will be monitored and management measures taken, as appropriate **Low**—well understood and there is a low likelihood of effect on fish or fish habitat as predicted **High**—well understood and there is a high likelihood of effect on fish or fish habitat as predicted

6.7.1.9 Standards or Thresholds for Determining Significance for Fish and Fish Habitat

An environmental effect is considered significant if the environmental effects of the Project result in:

- A residual reduction in the productive capacity of fish habitat that would remain after mitigation and compensation measures are implemented and therefore is likely to result in an uncompensated HADD of fish habitat.
- The likelihood of fish mortality, after mitigation measures are implemented, at a level that would require regulatory bodies to implement specific management plans for the recovery of the affected populations.

An effect on fish habitat productivity is considered not significant if after mitigation and compensation measures are implemented an alteration or disruption of habitat does not result in an anticipated loss of productive capacity.

A fish mortality risk is not significant if it would not require adjustments to management plans for any given species. The determination of significance might be influenced by the implementation of mitigation and habitat compensation measures.

6.7.1.10 Effects Analysis Methods

The primary Project interactions with fish and fish habitat will result from construction of mine components which require infilling of watercourses within the mine site and creation of diversion channels to direct surface drainage around mine infrastructure.

Both qualitative and quantitative analyses supported by baseline data and the literature, were used to assess the potential effects of the Project on changes in habitat availability and changes in fish mortality risk. Primary Project effects relate to the aerial extent of Project impacts on habitat and fish distribution characterized during baseline studies.

Average channel widths and the length of the watercourse sections directly affected within the mine footprint were used to calculate the aerial extent of lost or altered fish habitat (HADD). Potential losses in wetted area of Haggart Creek (between Dublin Gulch and Eagle Creek), due to the diversion of Dublin Gulch flows, were calculated using cross-sectional survey data and monthly surface water balance flow rates during the summer low-flow fish rearing period. Wetted perimeters were modeled for both baseline and operational conditions using HEC-RAS hydraulic modeling software. Results of the two scenarios were compared and used to calculate the predicted loss of instream habitat (HADD) due to reduced flows in this section of Haggart Creek.

The assessment of Project effects on the quality of fish habitat (e.g., water temperature, sediment concentrations, fish access) was carried out more qualitatively. Baseline conditions for these fish habitat components were characterized and Project construction, operations, and closure activities identified that may have a potential effect on these components. In the following sections, the effectiveness of measures to mitigate these effects is evaluated and the potential for residual effects on each habitat component is considered.

6.7.2 Assessment of Effects on Changes in Fish Habitat Availability

6.7.2.1 Fish Habitat Components

Project activities have the potential to alter and reduce the availability of fish habitat within the mine footprint, in areas downstream of the mine, and in watercourses near proposed access road upgrades. Reduction in available habitat can impair the ability of the system to maintain current levels of fish production. This section assesses effects on fish habitat availability that may result from Project-environment interactions ranked in Table 6.3-1 as a “2”—those that can cause environmental effects of concern.

Project activities and their potential effects are identified in Table 6.7-1 above. The measurable parameters used to quantify or show trends in the availability of fish habitat are listed in Table 6.7-2 and include:

- Change in habitat structure
- Change in sediment concentrations
- Change in water temperature

- Change in food and nutrient concentrations
- Change in access to habitats.

The interactions and potential effects of the Project on each of these habitat components are discussed in the following sections.

6.7.2.2 Habitat Structure

The productive capacity of fish habitat is affected by the area, complexity, stability, and types of habitats present. Instream physical structures (e.g., rock, woody debris, and vegetation) provide fish with shelter from swift currents, cover from predators and critical habitat for specific life stages or activities (e.g., foraging sites, spawning sites). The critical habitat types contributing to the productive capacity of freshwater fish habitat are outlined below:

- Overwintering habitat consists of pools, deep runs and off-channel habitats that maintain high dissolved oxygen concentrations and do not freeze to bottom during the winter months. These habitats are critically important to fish. They allow fish to survive the cold winter water temperatures with lower energy expenditure, and are commonly limiting habitat types within streams.
- Spawning and rearing habitat requirements differ for each fish species that occupies a watercourse or water body. Elements of spawning habitats common to most fish species include substrate composition, water quality, depth, water velocity, and cover. Important features of rearing habitats include water velocity, cover, depth, food supply, predator presence, and competition for habitat (i.e., space limitations, particularly important for territorial salmonids). Both spawning and rearing habitat are commonly the limiting factor for fish populations and, therefore, loss or degradation of these habitat types are often directly linked to the productive capacity of fish habitat.
- Cover habitat serves to protect fish from predators, high flow conditions and other competitive fish. Functioning cover habitat is provided mainly by complex substrates such as boulders and cobbles, overhanging vegetation, large woody debris (LWD), deep pools, and undercut banks. Although these attributes contribute mainly to rearing habitat, they are equally as important in providing sensitive habitat essential for spawning, foraging, and overwintering for some fish species.
- Riparian habitat. The inputs of large woody debris (LWD) from riparian habitats into streams directly affect the structure and cover provided by fish habitat. LWD contributes to natural channel processes that maintain regular stream sinuosity and help to create pools, undercut banks, and riffles. LWD also provides fish with instream cover from predators, regulates stream energy during high flow conditions, and prevents downstream bed load movement. In addition, small and large woody debris provide sources of organic carbon to aquatic invertebrates and improve substrate habitat for aquatic invertebrates, an important source of food for salmonids (Keeley and Slaney 1996). If riparian vegetation is removed, large woody debris replacement ceases which affects stream ecosystem function.

Project activities such as clearing and grubbing in riparian areas, instream and riparian works associated with road upgrades and watercourse crossings, infilling of watercourses to accommodate mine components, and the diversion of watercourses and site runoff have the potential to physically alter or eliminate fish habitat.

Effects of Access Road Upgrades and Riparian Clearing on Habitat Structure

Clearing and grubbing, and access road upgrade activities have the potential to cause changes or loss in fish habitat structure where they occur near or across watercourses. Direct instream works, such as the installation or replacement of road crossings have the potential to physically alter the structure of important habitat features, such as overwintering pools and high-value spawning areas. In addition, instream work may require the removal of cover structures such as LWD, boulders, undercut banks or instream vegetation. At the reach level of a stream (homogenous linear sections of a stream channel), habitat condition increases with number of LWD pieces and percent wood cover in pools (Johnston and Slaney 1996). Good quality habitat for salmonids is considered to be pools with greater than 20% wood cover and channels with more than two pieces of LWD per bankfull channel width (the width of the wetted channel at the 1 in 2 year high water event). Removal of LWD, boulders or undercut banks can reduce the productive capacity of habitat near Project development areas.

Clearing of riparian vegetation next to watercourses can adversely affect the quality of habitat by reducing available cover from predators, eliminating temperature-regulating shade from streamside vegetation, and decreasing allochthonous nutrient inputs to the stream that come from insect and leaf litter drop. Destabilized stream banks can result in increased erosion and the potential introduction of suspended sediments into the watercourse. In addition, erosion in cleared upland areas can also lead to increased instream sediment deposition. This may affect the benthic community and/or developing fish embryos, and reduce the habitat available for juvenile, overwintering fish, and other aquatic organisms.

Effects of Mine Component Construction and Dublin Gulch Diversion Channel on Habitat Structure

The primary changes in fish habitat structure will be from the diversion of Dublin Gulch into the proposed Dublin Gulch diversion channel (DGDC), and the infilling of existing watercourses to accommodate mine components (i.e., open pit, waste rock storage areas, heap leach facility) (Figure 6.7-3).

Historically, all flows from the Dublin Gulch watershed entered Haggart Creek near the existing Dublin Gulch/Haggart Creek confluence. However, recent placer mining activities have disturbed the watershed and re-routed flows from Stuttle Gulch and Eagle Pup into a new channel known as Eagle Creek. Eagle Creek parallels Dublin Gulch, to the south, and Haggart Creek, to the east, before directly entering Haggart Creek approximately 2.0 km downstream from the existing Dublin Gulch/Haggart Creek confluence (Figure 6.7-3). The DGDC will be a 2.6 km long channel that conveys water from the upper Dublin Gulch watershed past the Heap Leach Facility (HLF) and into Eagle Creek downstream of the Project area (Figure 6.7-4) consequently avoiding contact with the

Project. Currently, Dublin Gulch discharges directly into Haggart Creek. The DGDC will be completed in Year 2 of construction and will be in place through operations and remain after closure.

The construction of the DGDC will divert flows from and eliminate fish habitat in 2,090 linear metres, of lower Dublin Gulch. Construction of the DGDC, the HLF, and the Eagle Pup waste rock storage area (WRSA) will also infill Ann Gulch, sections of Stuttle Gulch, and the majority of Eagle Pup. In addition, the open pit and Platinum Gulch WRSA will eliminate upper portions of Platinum Gulch. The reduction in Haggart Creek flows, between its existing confluence with Dublin Gulch and its confluence with Eagle Creek approximately 1.8 km downstream, will result in a loss of wetted usable area by fish within this section.

Table 6.7-4 and Figure 6.7-5 provide an overview of habitat loss due to the construction of mine components and the DGDC. For reasons given below, Ann Gulch and Platinum Gulch have been excluded from habitat loss calculation as well as the upper intermittent, ephemeral sections of Eagle Pup and Stuttle Gulch. Ann Gulch is an ephemeral, non-fish-bearing watercourse that accounts for less than 2% of the total volume of flow in Dublin Gulch (Appendix 14 – Environmental Baseline Report: Hydrology). Platinum Gulch is similarly intermittent and ephemeral and accounts for less than 0.5% of Haggart Creek flows (Appendix 14). The Project will affect the upper areas of Platinum Gulch in which the channel is poorly defined and flows during high precipitation events only. Downstream effects to fish habitat, due the loss of food, water, and nutrient inputs from these systems are predicted to be negligible.

Mine site construction and the diversion of Dublin Gulch will result in disruption or loss of 17,812 m^2 of fish habitat, of which 9,680 m^2 is fish-bearing (9,300 m^2 in Dublin Gulch and 380 m^2 in Haggart Creek) and 8,131 m^2 is non-fish-bearing habitat.

Table 6.7-4: Estimated Fish Habitat Loss and Alteration (HADDs)

Estimated Habitat Loss			
Watercourse	**Linear Distance (m)**	**Avg. Channel Width (m)**	**Area (m^2)**
Dublin Gulch	2,090	6.04	12,624
Eagle Pup	776	1.27	986
Eagle Creek	1,425	2.41	3,434
Stuttle Gulch	554	0.70	388
Haggart Creek[1]	1,800	Variable	497
Total	**6,645**		**17,929**

NOTE:
[1] Habitat loss in Haggart Creek is due to a loss of wetted area between the existing Dublin Gulch confluence and Eagle Creek confluence.

Haggart Creek

Baseline flows in Haggart Creek will be altered by the diversion of Dublin Gulch into Eagle Creek via the DGDC, and by the re-direction of flows from Eagle Pup and Stuttle Gulch (both of which currently drain into Eagle Creek) through the mine's process plant and into Haggart Creek. These changes in flow have been modelled in the Surface Water Balance Model (Appendix 21 of the Project Proposal – Eagle Gold Project Surface Water Balance Model Report) and have been used to evaluate the potential effects on stream morphology and on fish and fish habitat in both Haggart and Eagle Creek.

Changes to the channel morphology of Haggart Creek downstream of Dublin Gulch were addressed through analysis of the Surface Water Balance Model (Appendix 21). The expected stream flow regime of Haggart Creek was compared to the baseline stream flow regime to assess the seasonality and magnitude of Project-related effects on the flow regime. Reults of this comparison are used to assess potential changes in the channel morphology in Haggart Creek.

Annually, throughout the life of the Project, the relative distribution of monthly stream flows is not expected to change on Haggart Creek. Therefore, changes to channel morphology resulting from changes to the seasonal distribution of stream flow are also not expected to occur.

In average and dry hydro-climatic conditions during the Project, the largest change in stream flow (both relative (%) and absolute values) will occur annually in July, when stream flow in Haggart Creek will periodically be as low as 79% of baseline conditions. In wet hydro-climate conditions, this percentage will drop to as low as 75% in July. All other reductions result in stream flow conditions of 85% or greater during the life of the Project compared to baseline conditions (Figure 6.7-6). Peak stream flows in May are expected to be approximately 90% of baseline conditions.

The total monthly stream flow for July is approximately 69% of the peak monthly flow in May (Figure 6.7-7). Thus, July represents a transitional period within the annual hydrograph when stream flows are decreasing following spring freshet, leading into summer low flow conditions in August.

With respect to channel morphology, in existing average conditions, stream flow in July is typically not expected to scour major portions of the channel. These geomorphic processes occur at peak flows in the spring. Consequently, potential changes in July flows are not expected to affect natural channel scour processes. The overall maintenance of stream flows above 85%, and peak flows of 90% of those occurring in baseline conditions, indicates there will not be significant changes to channel scour processes as a result of the Project. In the few instances where stream flows exceed baseline conditions (e.g., during drain-down, May stream flow is as much as 108% of baseline), the proportionate increases are generally low and will not cause excessive scour of Haggart Creek downstream of the Eagle Creek confluence.

In addition, because the July stream flow magnitude is relatively high on an annual basis (i.e., the fourth largest monthly stream flow), aggradation via bedload deposition, is also not expected to change substantially because stream flow velocities will remain sufficiently high to maintain transport of fine-grained material.

Consequently, the predicted changes in stream flows during the Project are not likely to have an effect on channel morphology, specifically, in the maintenance of scour pools or removal of fine-grained material.

Haggart Creek, between its confluence with Dublin Gulch and its confluence approximately 1.8 km downstream with Eagle Creek, consists of a relatively straight, homogenous channel, with low habitat complexity. Lateral movement of the channel is restricted by the HCR and past placer mining disturbances to the east, and by the valley wall to the west. This section of Haggart Creek is primarily used by Arctic grayling for rearing. Moderate spawning habitat which could potentially be used by grayling is present in the upstream areas of this section, near the mouth of Dublin Gulch; however, there is no historical record of Arctic grayling spawning in these upper sections of Haggart Creek. The lower areas of this section are characterized by straight, run morphology with limited slow-flowing edgewater areas, and trace amounts of fish cover, providing poor rearing habitat for grayling. Spawning habitat is very limited due to an absence of suitable substrates, and there are no pools deep enough for overwintering grayling throughout.

Changes in the quality of rearing Arctic grayling habitat due to reduced flows in Haggart Creek between Dublin Gulch and Eagle Creek are not expected to be significant. There is a predicted loss of wetted usable area for grayling associated with lower water levels (Table 6.7-5); however, reduced flows may provide higher quality rearing habitat with lower water velocities and increased edgewater habitat.

Loss of wetted usable area for fish in Haggart Creek was estimated using survey and hydrology data to model the change of wetted perimeter at 82 transects. Transects were grouped into five homogenous reaches and estimates of change in wetted area were calculated for baseline and operations flow conditions. Three scenarios were used in the model: average, wet, and dry years (Table 6.7-5). For the purpose of calculating the potential HADD represented by reduced flows in Haggart Creek, the scenario in which the largest estimated loss of wetted usable area was used to provide the most conservative approach to HADD calculation.

Table 6.7-5: Modelled Change in Haggart Creek Wetted Area due to Dublin Gulch Flow Diversion

Change in Wetted Area for Three Model Scenarios			
Reach	Average Year m^2 (%)	Wet Year m^2 (%)	Dry Year m^2 (%)
1	-63 (-2%)	-171 (-5.5%)	-28 (-0.9%)
2	-44 (-1.7%)	-50 (-1.9%)	-35 (-1.4%)
3	-50 (-3.2%)	-44 (-2.7%)	-19 (-1.2%)
4	-66 (-3.8%)	-53 (-3%)	-19 (-1.1%)
5	-156 (-2.3%)	-180 (-2.7%)	-67 (-1%)
Total	**-380 (-2.4%)**	**-497 (-3.2%)**	**-169 (-1.1%)**

Eagle Creek

Eagle Creek upstream of the Haggart Creek flood plain will be replaced by the DGDC, which will be designed to convey flows diverted from Dublin Gulch during construction and operation, and flows from the mine site after closure. Expected loss of instream habitat in Eagle Creek due to the construction of the DGDC is 3,434 m^2 of non fish-bearing habitat (Table 6.7-4). The DGDC design will facilitate fish passage above the existing barrier on Eagle Creek and will include riffle-pool sequences, habitat complexing, riparian planting, and fish-passable gradients that will provide instream fish habitat for Arctic grayling where none previously existed. Details of the DGDC fish habitat are provided in the Fish Habitat Compensation Plan (FHCP) (Appendix 23).

Lower Eagle Creek, downstream of the proposed DGDC, contains rearing habitat for Arctic grayling and slimy sculpin. The channel was formed as a result of placer mining activities in the Dublin Gulch watershed. Habitat quality throughout the channel is poor due to limited flows and a predominance of very fine substrates. This section of Eagle Creek is an important component of the proposed FHCP (Appendix 23). The channel will be designed to convey the increased flows from the diversion of Dublin Gulch, and will be enhanced to provide more, high quality rearing, overwintering, and spawning habitat for Arctic grayling. Details of the compensation habitat design are included in the FHCP (Appendix 23).

6.7.2.3 Sediment Concentrations

Sediments can enter a watercourse from point sources during instream works associated with road upgrades, mine site infrastructure construction, or when infilling watercourses for the locating of mine components and the DGDC. Additionally, sediments can enter watercourses adjacent to or downstream from exposed soils at road crossings during the post-construction phase while vegetation is re-establishing. Uncontrolled or chronic sedimentation can degrade downstream habitats resulting in a reduction in complex substrates, egg survival and invertebrate productive capacity.

High levels of fine sediment can simplify bed features, decrease populations of macroinvertebrates, cover incubating eggs; and fill in pools used for cover, overwintering, and staging or holding areas. Riparian habitats are important natural biofilters, protecting aquatic environments from excessive sedimentation, polluted surface runoff, and erosion. Many streamside areas of Dublin Gulch and its tributaries have had riparian vegetation removed and banks exposed due to past placer mining activities. This has resulted in higher baseline levels of suspended sediments in these systems; especially during precipitation events.

In watercourses where sediment loads are elevated, many aquatic organisms have adapted to short-term exposure to low and moderate concentrations of sediments (Waters 1995). As a result, the environmental effects of sediment deposition on habitat productive capacity is directly proportional to the volume of sediment introduced to the receiving waters, the depth of deposition, the type of habitat affected by deposition, the importance of affected habitat to fish, and the sensitivity of the fish species present.

6.7.2.4 Water Temperature

In addition to providing LWD to streams and rivers, riparian vegetation provides shade and helps regulate water temperatures. Land use activities and development projects can remove or alter riparian vegetation, thereby affecting thermal regulation of streams, primarily due to an increase in warming from solar radiation. To moderate water temperature, stream surfaces should have 60 to

80% shade throughout the day (Castelle, et al. 1994); this level of shading can be achieved through the preservation of appropriate riparian buffer widths.

Water withdrawal and diversion, and wastewater discharge associated with mine construction and operation activities can alter base flows that may result in changes to stream temperature. Water temperature can have direct effects on the physical and biological composition of a watercourse. Salmonids can experience changes in reproductive activity, growth, and mortality rates due to increased water temperatures. Optimum temperature ranges for Arctic grayling are 4.0 – 9.0°C for spawning and 10 – 12°C for rearing fish (BC MoE 2001). High temperatures also encourage the microbial breakdown of organic matter which in turn can lead to depleted levels of dissolved oxygen in the water column (Dissmeyer 1994).

Potential changes in water temperature are a direct effect of riparian vegetation clearing associated with access road upgrades near watercourse crossings and riparian areas located within the footprint of the mine site. The clearing of vegetation next to watercourses can reduce or eliminate this temperature regulating effect of riparian vegetation. Currently, watercourses within the Project area have been heavily impacted by past placer mining, and riparian vegetation is limited or non-existent in many parts of the Dublin Gulch and Eagle Creek watersheds. Water temperature may also potentially be affected through the introduction of warmer discharges of wastewater.

6.7.2.5 Food and Nutrient Concentrations

As with changes in water temperature, the primary activity that will potentially effect food and nutrient contributions is riparian vegetation clearing. A mixture of deciduous and coniferous riparian vegetation provides inputs of food and nutrients to the aquatic food web. Insects that fall from streamside vegetation become food for many aquatic organisms and leaf litter provides year-round inputs of nutrients (particularly carbon) for fish and aquatic invertebrates. Woody debris provides a source of organic carbon and improves substrate habitat for aquatic invertebrates, an important source of food for salmonids (Keeley and Slaney 1996). Disturbances that result in the removal of the riparian vegetation can change the type and amount of insects and litter that enter the stream. Once the riparian vegetation is modified food and nutrient inputs can be altered (Murphy and Meehan 1991).

6.7.2.6 Water Quality

Construction activities may release sediment to area streams and mine water containing metals, cyanide, sulphates and other constituents may discharge or seep into fish-bearing watercourses during any phase of the Project. These discharges have the potential to affect water quality for aquatic life through toxic effects or by altering conditions for growth of aquatic organisms (e.g., through nutrient addition).

All potential effects associated with activities ranked as “2” during closure and reclamation are associated with the introduction of contaminants or a reduction in water quality. As indicated in Table 6.7-3, the primary discussion around Project effects to water quality is included in the Water Quality and Aquatic Biota assessment (Section 6.5). To avoid redundancy, this discussion has not been repeated here. As they relate to fish, water quality issues are considered in relation to established targets for aquatic species. All water flowing into fish-bearing streams during construction, operations, and reclamation, whether flowing from the mine treatment facility or from direct mine runoff, will either:

- Adhere to water quality parameter limits as set out in the Canadian Water Quality Guidelines for the Protection of Aquatic Life (CCME 1999c), **OR**
- Meet site-specific water quality objectives that reflect background levels of specific metal concentrations.

6.7.2.7 Access to Habitats

The maintenance of migration corridors and access to specific habitats is critical to many types of freshwater fish. Unimpeded access to spawning, overwintering, and rearing habitats is critical to salmonids during inter-river migrations (Prince 1991; cited in McPhail 2007; Scott and Crossman 1998), as well as when moving between rivers and lakes, often when water levels are low and over distances from a few kilometres to several hundred kilometres (McPhail 2007). Arctic grayling migrate in spring from their overwintering grounds into tributaries, immediately after the decline of spring freshet flows (Pendray 1983).

Project activities that inhibit the natural movements of fish can limit access to key habitats and reduce the overall productive capacity of fish habitat. The infilling of streams to accommodate mine components and the diversion of watercourses are the two primary Project activities that have the potential to inhibit fish movement.

6.7.2.8 Mitigation for Change in Habitat Availability

A suite of mitigation measures will be implemented to minimize or avoid effects on the availability of fish habitat. Principle among these mitigation measures are those incorporated directly into the Project design which include minimizing the riparian clearing where practicable, incorporating fish habitat complexing and features into Dublin Gulch diversion channel design, conducting instream works during least risk periods, and incorporating a mine water treatment plant (MWTP) capable of meeting water quality guidelines for aquatic life into the design of the mine. In addition, best management practices (BMPs) will be implemented to manage effects and avoid adverse effects on fish habitat. Mitigations and BMPs to minimize potential Project effects on change of fish habitat availability are provided in Table 6.7-6. As a final mitigation measure, fish habitat compensation will off-set any loss of habitat that occurs as a result of mine infrastructure construction and water diversions.

Mitigation measures to protect water quality are provided in the Water Quality and Aquatic Biota assessment (Section 6.5), and are not repeated here.

Table 6.7-6: Mitigation for Change in Fish Habitat Availability

Effects on Fish Habitat Availability	Mitigation	Effectiveness of Mitigation
Change in habitat structure	▪ Design of Project to include fish habitat creation (complexing, features, critical habitat types) ▪ Minimize extent of clearing, grubbing and grading adjacent to watercourses to that required for safe vehicle access and construction activities ▪ Existing road use where possible and appropriate temporary crossing methods where needed (e.g., temporary bridges) ▪ Flag environmentally sensitive areas before clearing and construction begins near watercourses ▪ Re-vegetate where soil stabilization and erosion control is required ▪ Locate temporary work spaces and stockpiles at least 30 m from top-of-bank of fish-bearing watercourses ▪ Protect stockpiles from erosion with tarps, sumps, or berms ▪ Compensate for lost fish habitat where a HADD is unavoidable	▪ High ▪ A temporal reduction of riparian cover and food and nutrients will occur ▪ Small residual sediment loads are expected ▪ A temporal reduction in fish habitat productivity is expected while compensation habitat is being constructed

Effects on Fish Habitat Availability	Mitigation	Effectiveness of Mitigation
Change in sediment concentrations	▪ Design of channel diversions to include streamside vegetation and functioning riparian areas ▪ Minimize extent of clearing, grubbing and grading adjacent to watercourses to that required for safe vehicle access and construction activities ▪ Isolate all instream works within fish-bearing watercourses or non-fish-bearing watercourses where instream works have the potential to affect fish-bearing waters downstream ▪ Stage construction within 16 m of all watercourses and retain buffer zones until construction activities begin to limit time of bank and soil exposure ▪ Maintain 30 m riparian buffer between mine components and fish-bearing watercourses ▪ Implement a rigorous erosion and sediment control program including sediment and erosion control ponds sized to the 1:100 year flood event ▪ Monitor TSS and turbidity levels prior to release from sediment control ponds ▪ Time instream and riparian construction activities to avoid high risk weather and flow conditions ▪ Re-vegetate where soil stabilization and erosion control is required	▪ High ▪ Introduction of minor levels of sediment are expected to occur
Change in water temperature	▪ Design of channel diversions to include streamside vegetation and functioning riparian areas ▪ Minimize extent of clearing, grubbing and grading adjacent to watercourses to that required for safe vehicle access and construction activities ▪ Maintain 30 m riparian buffer between mine components and fish-bearing watercourses ▪ Re-vegetate where soil stabilization and erosion control is required	▪ High ▪ Modest reductions in riparian cover could occur in areas with intact streamside vegetation

Effects on Fish Habitat Availability	Mitigation	Effectiveness of Mitigation
Change in food and nutrient concentrations	▪ Design of channel diversions to include streamside vegetation and functioning riparian areas ▪ Minimize extent of clearing, grubbing and grading adjacent to watercourses to that required for safe vehicle access and construction activities ▪ Maintain 30 m riparian buffer between mine components and fish-bearing watercourses ▪ Re-vegetate where soil stabilization and erosion control is required	▪ High ▪ Modest reductions in riparian cover could occur in areas with intact streamside vegetation
Change in contaminant concentrations	▪ Mitigations for water quality issues are provided in the Water Quality and Aquatic Biota Assessment (Section 6.5)	▪ High ▪ Water quality objectives will be met
Change in access to habitats	▪ Time construction activities to avoid key migration periods ▪ Design new habitat to facilitate fish passage ▪ Manage flow diversions and water extraction to ensure adequate flows are maintained for fish passage ▪ Place material and instream structures in a manner that does not inhibit fish passage ▪ Prevent the formation of fish barriers when conducting instream works ▪ Minimize the time that instream works occur	▪ High ▪ Stream flows will be maintained so that no restriction of fish movement occurs ▪ Obstructions will not be formed

The original design of the DGDC was altered to include fish habitat enhancements and increase fish habitat productivity. Enhancement features include stream complexing (addition of LWD, boulders, pools) and riparian planting. Riparian planting will stabilize banks, limit erosion and sedimentation, reduce temperature fluctuations, and provide allochthonous inputs. Diversion channels have been successfully developed as fish habitat in northern mining projects, as was the 3.5 km long Panda diversion channel at the Ekati diamond mind in the Northwest Territories (Packman et al. 2006). Details of all proposed compensation works are provided in the FHCP (Appendix 23).

The aerial extent of instream and riparian habitat will be minimized wherever possible as will encroachments in to fish habitat by heavy machinery and mine equipment. Natural revegetation of sensitive habitat will be encouraged. Where planting is required, seed mixes that are free of noxious or restricted weed species will be used.

6.7.2.9 Residual Effects from Changes in Fish Habitat Availability

Potential residual effect from changes in habitat structure may include slightly modified stream bed substrate and re-contoured banks related to road upgrades near watercourse crossings; a reduction of LWD within cleared areas; and residual riparian habitat alteration over a period of up to five years as streamside vegetation becomes re-established. Residual effects are predicted to be adverse, occur once, be negligible to low in magnitude, site-specific, or local in geographic extent and short or medium term in duration. All potential effects are predicted to be reversible.

Where permanent loss of habitat productive capacity is anticipated (i.e., infilling of watercourses, watercourse diversions) residual effects of construction activities are predicted to be adverse, occur once, be low in magnitude, local in geographic extent, and permanent in duration. Reductions in fish habitat productive capacity associated with the permanent loss of habitat structure will be offset by compensation measures as per the FHCP (Appendix 23) and are therefore considered reversible.

The highest risk for sedimentation effects is associated with instream works (infilling of watercourses for locating mine components and construction of the DGDC). All watercourses in which instream works will occur will be isolated from fish-bearing reaches prior to the commencement of work to minimize or eliminate the risk of sedimentation. Total suspended solids (TSS) will not exceed 25 mg/L above background levels for short and long term exposure to fish when background levels are <250 mg/L, and will not exceed 110% of background levels when background TSS is >250 mg/L. With the implementation of the mitigation strategies described in Table 6.7-6, the effects on changes to sediment concentrations are expected to be nominal. Residual effects of sedimentation are anticipated to be adverse in direction, occur once, be negligible to low in magnitude, local in geographic extent, and short term in duration. All residual effects of changes in sediment concentrations are predicted to be reversible.

Potential changes to water temperature and food and nutrient concentrations are directly related to riparian function. The existing riparian vegetation communities within the Project area watershed have been heavily impacted by past placer mining activities. Riparian rehabilitation associated with reclamation and habitat compensation should restore riparian function in these areas beyond current levels. During and immediately following construction, clearing of vegetation may cause a temporary reduction in food and nutrient inputs to fish habitat. However, the goal of the mitigation measures described above is to bring the productive capacity of the streamside habitats to pre-construction levels, or higher, through natural succession and replanting where required.

It is expected that the riparian community adjacent to all affected watercourses will develop and mature through natural succession. As many riparian areas are currently impacted by placer mining activities, the productive capacity of the adjacent fish habitats is expected to return to pre-construction or better levels within five years. Effects on riparian vegetation are expected to be adverse or neutral, occur once, be negligible to low in magnitude, local in geographic extent, and medium term in duration. All residual effects to riparian areas are predicted to be reversible.

The majority of construction activities (mine components) occur in watercourses that are non-fish-bearing upstream of known fish-bearing waters and therefore do not have the potential to limit fish access to habitat. If mitigation measures described in Table 6.7-6 are implemented for the construction of the DGDC, no residual effects from changes in access to fish habitat are anticipated.

The effects of changes in access to habitats are expected to be neutral, occur once, be negligible in magnitude, site-specific in geographic extent, and medium term in duration. All residual effects of changes in access to habitats are predicted to be reversible.

6.7.2.10 Determination of Significance of Changes in Fish Habitat Availability

Based on effects characterization on changes in fish habitat availability due to riparian clearing and grubbing, road upgrade activities, mine component construction, and the construction of the DGDC; the residual effects are predicted to be not significant, provided that mitigation and compensation measures are implemented as planned (Table 6.7-6).

The level of confidence for the significance evaluation of potential changes in fish habitat availability is high due to a thorough understanding of Project activities, associated risks, the use of proven approaches to mitigation of effects, and implementation of adequate fish habitat compensation (Appendix 23) where habitat loss cannot be avoided. Baseline data is sufficient to assess and characterize existing habitat and the potential effects and risks associated with the Project.

6.7.3 Assessment of Effects on Changes in Fish Mortality Risk

6.7.3.1 Mortality Risk Factors

Section 32 of the *Fisheries Act* prohibits the destruction of fish by any means other than fishing unless authorized by DFO. Project activities have the potential to increase the risk of fish mortality in fish-bearing watercourses within the mine footprint, in areas downstream of the mine, and in watercourses near proposed access road upgrades. Table 6.7-2 lists the measurable parameters that have been selected as indicators of changes in fish mortality risk are:

- Change in fish/egg mortality
- Change in contaminant concentrations.

A description of Project activities that can increase the risk of fish mortality due to the physical harming of fish or the introduction of deleterious substances in to fish-bearing watercourses is provided below:

- **Stranding of fish**—fish can become stranded during isolation of watercourses during diversion of streams, construction of road crossings, and the construction of mine infrastructure. Isolation activities can dewater downstream sections of streams and strand fish or developing embryos. Stress and mortality might also occur if isolated pools are created during Project activities, which can trap fish and expose them to decreased water quality, temperature and predation.
- **Water extraction (impingement of fish in pumps or against pump screens)**—pumps will be used to divert flows around work areas during isolation of watercourses and to withdraw water from streams for camp and mine activities. Many pumps draw water at velocities

greater than the burst speed of most fish, and thus can suck fish into the pump screen or into the impeller. The impingement of fish against the intake screen or entrainment of fish in the pump generally results in mortality.

- **Use of industrial equipment**—instream activities might require construction equipment to be present within the channel during mine site construction, diversion channel installation, or road crossing installation. As such, there is a risk to fish species present within the work area from direct mortality from construction equipment. This includes direct crushing of fish, destruction of eggs and ova in substrates, and disturbance of channel substrates that may contain alevin.
- **Use of explosives**—the use of explosives in or near watercourses can cause lethal and sub- lethal effects on fish. Shock waves from underwater explosions can kill fish or damage swim bladders and other internal organs (CAPP, et al. 2005). Although most mortality occurs from underwater blasts, blasting activities near fish habitats can induce pressure waves with enough energy to cause mortality. In addition, the introduction of by-products from the blasting materials, such as ammonia, can lead to fish mortalities if blast residues are released in sufficient quantities (reviewed in Wright and Hopky 1998).
- **Suspension of sediments and increased turbidity**—high levels of turbidity and suspended sediments can have both lethal and sub-lethal effects on fish. It can affect the ability to feed, increase susceptibility to predation, suppress immune function and reproduction, and in extreme levels cause the direct mortality of fish. The severity of these effects is dependent on both the concentration and duration of exposure to elevated levels of suspended sediments (Waters 1995, Birtwell 1995).
- **Degradation of water quality**—construction activities may release toxic substances to area streams. Mine water containing metals, cyanide, sulphates and other constituents may discharge or seep into fish-bearing watercourses during any phase of the Project. These discharges have the potential to affect water quality for aquatic life through toxic effects or by altering conditions for growth of aquatic organisms (e.g., through nutrient addition). Detailed discussion of Project effects on water quality is provided in the Surface Water Quality and Aquatics (Section 6.5).

6.7.3.2 Mitigation Measures for Changes in Fish/Egg Mortality

Mitigation of potential environmental effects on change in fish mortality from Project activities can be achieved by implementing the following industry standards and best practices.

Table 6.7-7: Mitigation for Change in Fish Mortality

Effects on Fish Habitat Availability	Mitigation	Effectiveness of Mitigation
Change in fish/egg mortality	▪ Conduct instream work on fish-bearing watercourses during established LRPs where practicable to avoid conflicts with critical life-history stages ▪ Ensure fish migration is not impeded ▪ Ensure instream work does not occur in spawning areas if conducted outside of established LRPs ▪ Ensure industrial equipment operating near fish-bearing watercourses is in good working order and free of leaks ▪ Conduct instream work in fish-bearing watercourses in isolation of flows ▪ Conduct fish salvages before isolating channels for instream work or diversion ▪ Follow DFO's Freshwater Intake End-of-Pipe Fish Screen Guideline (DFO 1995) when placing intakes for pumps in fish-bearing watercourses ▪ Re-introduce flows to isolated watercourses immediately downstream of isolated areas to avoid fish stranding ▪ Dissipate discharge water energy where flows are re-introduced to fish-bearing watercourses ▪ Incorporate recommendations from DFO's Guidelines for the Use of Explosives in or near Canadian Fisheries Waters (Wright and Hopky 1998) to the greatest extent possible where blasting in or near fish-bearing watercourses ▪ Conduct blasting in dewatered works areas and within established LRPs to minimize fish mortalities ▪ Conduct fish salvages prior to infilling watercourses for mine development	▪ High ▪ Direct mortality of eggs or fish can be avoided ▪ Direct mortality of eggs or fish can be avoided ▪ Introduction of sediment and hazardous substances such as hydrocarbons, can be reduced to very low levels
Change in contaminant concentrations	▪ Mitigations for water quality issues are provided in the Surface Water Quality and Aquatics (Section 6.5)	▪ High ▪ Water quality objectives will be met

6.7.3.3 Residual Effects from Changes in Fish Mortality Risk

All potential effects on changes in fish mortality risk are predicted to be adverse or neutral, negligible in magnitude, site-specific or local in geographic extent, short- or medium-term in duration, and occur only once.

Effects of all construction activities are predicted to be reversible. Although loss of an individual fish is a permanent loss for that individual, the reduced fitness or loss of a small number of fish that are part of a secure population will be a reversible effect with respect to the local population. In all fish-bearing watercourses located in the LAA, reduced fitness or loss of a small number of individuals will have a negligible magnitude effect on a population and replacement of the individuals will occur within one or two generations (i.e., short- to medium-term duration).

With the exception of water withdrawal, the geographic extent of all Project-related effects on fish mortality risk is anticipated to be local and these effects are primarily due to the potential for minor inputs of sediments to streams. Effects of water withdrawals for mine processes on fish health and mortality are predicted to be site-specific, as potential stranding or intake screen impingement are restricted to the stream within the immediate water withdrawal area.

Residual Effects on Water Quality

Assessment of the Project effects on water quality is provided in the Water Quality and Aquatic Biota Assessment (Section 6.5). Residual effects characterization is provided for discharges to watercourses during construction, operations, reclamation, and post-closure of the Project. Characterizations of these residual effects in Section 6.5 are used below to determine significance for water quality effects on fish mortality risk.

6.7.3.4 Determination of Significance of Change in Fish/Egg Mortality

Significance of Change in Fish/Egg Morality due to Direct Fish/Egg Mortality

With the application of mitigations described in Table 6.7-7, the effects of Project-related construction and reclamation activities on fish/egg mortality risk due to direct mortality are predicted to be not significant.

The level of confidence for this significance evaluation of potential effects on fish and egg mortality is high due to a strong understanding of:

- Project activities and their effects
- Mechanisms for potential fish mortalities
- Sufficient baseline data on existing fish populations.

Significance of Change in Fish/Egg Morality due to Water Quality Issues

Confidence in water quality predictions for the Project is high as:

- The Project will be designed to adhere to standards set out in the CCME Canadian Water Quality Guidelines for the Protection of Aquatic Life (CCME 1999c) or to meet site-specific water quality objectives that reflect background levels of specific metal concentrations.
- Conditions for the quality of effluent that may be discharged to Project area watercourses will be specified within a Water License issued by the Yukon Water Board.

The effect of effluent discharges on stream sediment quality in Haggart Creek is predicted to be not significant during construction, operations, and reclamation, given the low magnitude change predicted. There is a high degree of confidence in this prediction, given the types of mitigations incorporated, and their proven effectiveness.

The effect of effluent discharges on aquatic biota in Haggart Creek during operations is predicted to be not significant, given the low to moderate magnitude change predicted (mild eutrophication). There is a moderate degree of confidence in this prediction, given the types of mitigations incorporated, and their effectiveness, which will be addressed through monitoring during the life of the mine. The uncertainty in source term predictions for waste rock has resulted in development of conservative worst case prediction. There is high confidence in the quality of baseline data and proven effectiveness of the proposed mitigation measures.

The effect of site discharges on aquatic biota in Haggart Creek during and after closure is predicted to be not significant, given the low to moderate magnitude, local changes predicted for water quality in the individual creeks and for Haggart Creek downstream of all mine activities. Levels of metals will meet water quality guidelines and site-specific water quality objectives avoiding the potential for any toxic effects. The addition of nitrogen and phosphorus is predicted to result in some nutrient additions and a subsequent small increase in benthic productivity, but no change in the overall trophic status of Haggart Creek from oligotrophic to mesotrophic. There is a high degree of confidence in the prediction of low magnitude effects for metals toxicity effects, and moderate confidence in the prediction for nutrients, given the conservative assumptions used in the models. There is a high confidence in the types of mitigations incorporated and their effectiveness, and in the quality of baseline data.

The three main sources of discharges (HLF to Haggart Creek; WRSAs to Platinum Gulch, Dublin Gulch and Eagle Creek then Haggart Creek) during closure were considered at individual points and combined in Haggart Creek. The residual effects of these discharges on water quality in fish-bearing watercourses are considered not significant, as predicted levels of metals and nutrients in the creeks will be moderate in magnitude. The MWTP will treat the majority of draindown solution from the HLF and will remove large amounts of metals and nitrogen from the discharge. Runoff from the reclaimed HLF and WRSAs, after passage through treatment wetlands, will not result in high magnitude changes in water quality in Haggart Creek, Dublin Gulch or Eagle Creek post-closure. Metals levels will meet water quality guidelines and site-specific water quality objectives that could reasonably be established. Nutrient enrichment is not predicted to be an issue as implemented wetland technology will also reduce nitrogen and phosphorus levels.

6.7.4 Assessment of Cumulative Effects on Fish and Fish Habitat

6.7.4.1 Screening of Cumulative Environmental Effects

A screening of the Project’s potential contribution to the cumulative effects of past, current, and known future projects was done per the procedures described in Section 6.1. Three conditions must be in place to warrant a cumulative effects assessment. These conditions are: 1) the Project is predicted to result in a demonstrable residual effect; 2) these effects are likely to act in a cumulative fashion with those of other projects; and 3) there is a reasonable expectation that the Project’s contribution to cumulative effects has the potential to measurably change the health or sustainability of fish and fish habitat.

Other activities in the area having the potential to interact cumulatively with potential Project effects are placer mining activities in Haggart Creek and in the sub-basins of the Haggart Creek watershed. However, the proposed Fish Habitat Compensation Plan (Appendix 23) to be implemented as part of the Project will eliminate Project contributions to cumulative effects adversely affecting the viability of fish and fish habitat resources.

Table 6.7-8 indicates which Project effects have the potential to overlap spatially and temporally with effect from placer mining activities.

Table 6.7-8: Potential Cumulative Environmental Effects to Fish and Fish Habitat

Project Activities and Physical Works	Potential Environmental Effects	
	Changes in Fish Habitat Availability	Change in Fish Mortality Risk
Placer Mining Operations in Haggart Creek Watershed	✓	✓

NOTE:

Only those projects and activities identified in Table 6.3-3 as having the potential for acting cumulatively with the Project on the VC are included in the table above.

✓ = Reasonable expectation that Project contribution to cumulative effects has the potential to measurably change the health or sustainability of the VC.

0 = No reasonable expectation of Project contribution to cumulative effects.

No significant effects on fish and fish habitat are predicted to occur due to mine infrastructure construction, construction of the DGDC, road upgrades, water withdrawals, and mine operations. However, localized alterations of fish habitat will occur within the mine footprint. DFO's Policy for the Management of Fish Habitat (the Policy) establishes a long term objective for an overall net gain of the productive capacity of fish habitat and a guiding principle of no net loss of fish habitat productivity. To satisfy the objectives of the Policy habitat compensation for any losses of fish habitat is required. A preliminary FHCP (Appendix 23) has been developed for watercourses negatively affected by the Project. In developing the FHCP, the scope and scale of the compensatory works were dictated by the estimated aerial extent of HADDs. Ultimately, it is DFO that determines if no-net-loss can and has been achieved.

Meetings regarding the FHCP were held with the Environmental Assessment and Major Projects (EAMP) division of DFO in August and November of 2010. Initial review of the proposed FHCP indicate that no-net-loss of fish habitat productive capacity is achievable, adverse residual environmental effects on the productive capacity of fish habitat can effectively be offset by the proposed compensation, and no residual effect to fish habitat productive capacity will occur. Consequently, construction and operations activities associated with the Project will not contribute to cumulative losses or change to fish habitat in the assessment areas and no further assessment of cumulative effects on fish habitat is included.

No significant changes to fish mortality risk are predicted to result from Project activities with the implementation of mitigation measures discussed above. Therefore no residual risk of change in fish mortality is anticipated during the construction, operations, or closure phases of the Project. As such, no cumulative effects on fish mortality are predicted and further assessment is not warranted.

6.7.5 Summary of Consultation Influence on the Assessment

Consultation with the local community, the FNNND, and regulatory agencies has occurred throughout the assessment process. A Traditional Knowledge and Use study (Stantec 2010) was carried out with the FNNND which was instrumental in defining the fish and fish habitat VC and contributed baseline information that has been incorporated into the assessment.

Territorial (Yukon Government and YESAB) and federal (DFO) regulatory agencies were consulted throughout the assessment to review baseline information, comment on proposed engineered diversion, determine the appropriate scope of the assessment, and review potential compensation options for Project HADDs. These discussions have helped direct the assessment and have contributed to the development of Project commitments described below.

6.7.6 Effects Monitoring and Adaptive Management for Fish and Fish Habitat

Monitoring programs will include both compliance monitoring—to verify appropriate implementation of all mitigation measures—and follow-up monitoring—to determine the accuracy of conclusions made within the assessment and the efficacy of prescribed mitigation strategies.

VIT will provide qualified environmental managers to monitor and report on activities during construction. Managers will be familiar with all relevant territorial and federal acts and regulations pertaining to instream construction activities related to fish and fish habitat protection. Managers will also be provided with emergency contact numbers for appropriate territorial and federal regulatory agencies.

During construction, inspection and monitoring of suspended sediments will be required within Project area watercourses to ensure sediment and erosion control measures have been implemented effectively and are functioning in accordance with regulatory requirements and commitments in the Environmental Management Plans (EMP) (Appendix 30). During operations and closure, monitoring will be conducted periodically to confirm that reclamation efforts and environmental protection measures, such as sediment and erosion control provisions, are properly maintained and functioning until no longer required. Once mitigation measures are no longer required, the VIT environmental manager will ensure that all non-biodegradable materials are removed and disposed of in an appropriate manner. An overview of the follow-up and monitoring programs for fish and fish habitat conducted through all phases of the Project is provided in the EMP (Appendix 30).

During operations and closure, monitoring of water quality will comply with MMER requirements for effluent characterization and receiving environment conditions. Monitoring requirements for water quality and aquatic biota are provided in more detail in Section 6.5.9.

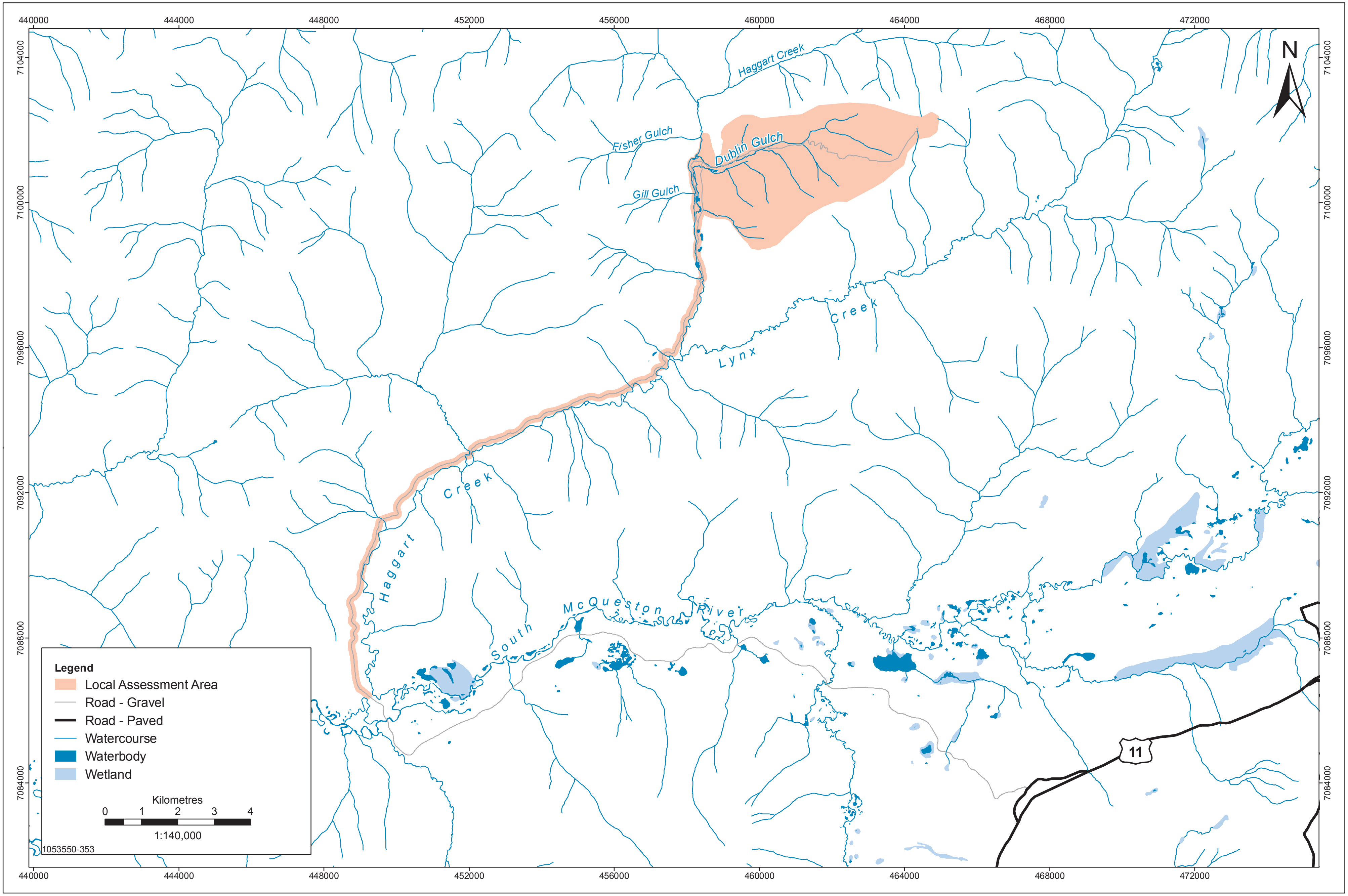
Post-construction follow-up studies on fish and fish habitat will be undertaken to assess the effectiveness of compensation works, and are provided in more detail in the FHCP (Appendix 23). The scope and extent of follow-up studies will be incorporated into *Fisheries Act* authorizations DFO issues in relation to the Project.

6.7.7 Commitments for Fish and Fish Habitat

Commitments for addressing effects on fish and fish habitat include measures proposed to mitigate potential negative effects to fish and fish habitat, including compensation works; and a commitment to ongoing construction and habitat development effectiveness monitoring. A summary of commitments to mitigation for each Project activity ranked as “2” in the potential interactions table (Table 6.7-1) are provided in Tables 6.7-6 and 6.7-7. Commitments to construction and effects monitoring are summarized in the previous section (Section 6.7.6).

6.7.8 Figures

Please see the following pages.



Data Sources; Government of Canada, Victoria Gold Corp.

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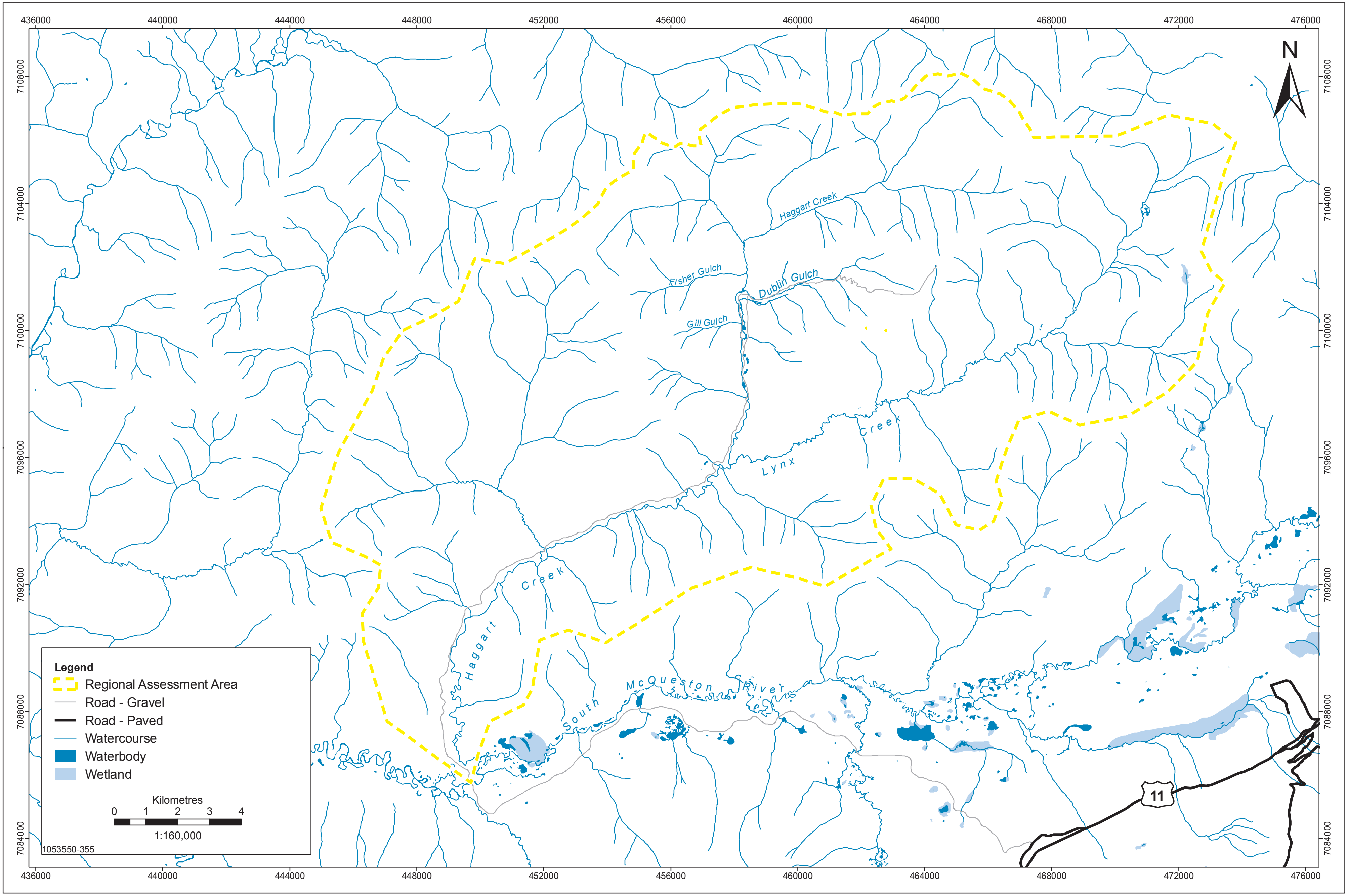
Eagle Gold Project

Figure 6.7-1

Fish and Fish Habitat Local Assessment Area

PROJECTION	DRAWN BY
UTM - ZONE 8	LS
DATUM	CHECKED BY
NAD 83	RS
DATE	FIGURE NO.
18-October-2010	6.7-1



Data Sources; Government of Canada, Victoria Gold Corp.

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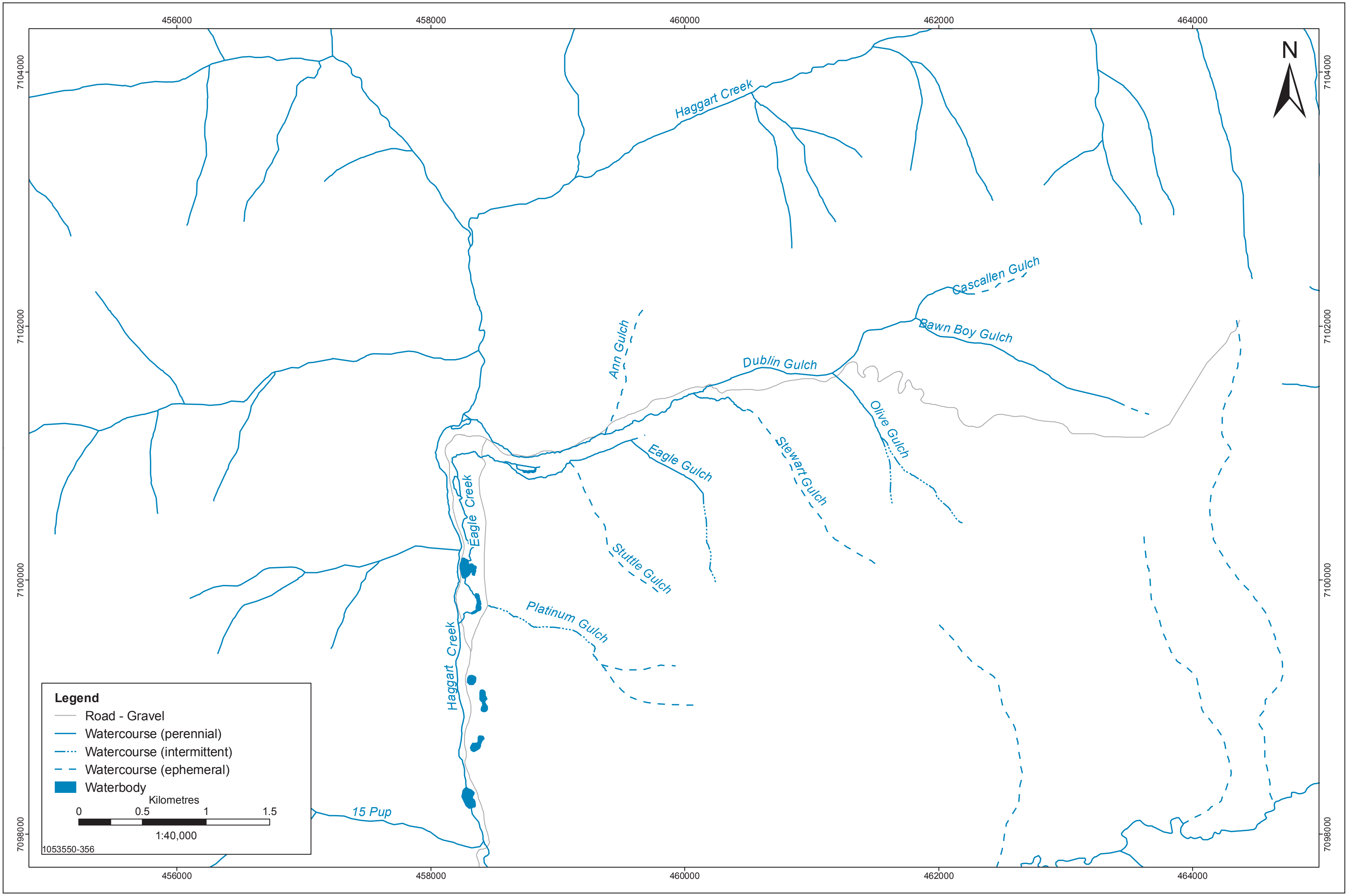
Figure 6.7-2
Fish and Fish Habitat Regional Assessment Area

PROJECTION	DRAWN BY
UTM - ZONE 8	LS
DATUM	CHECKED BY
NAD 83	RS
DATE	FIGURE NO.
18-October-2010	6.7-2



Data Sources; Government of Canada, Victoria Gold Corp.

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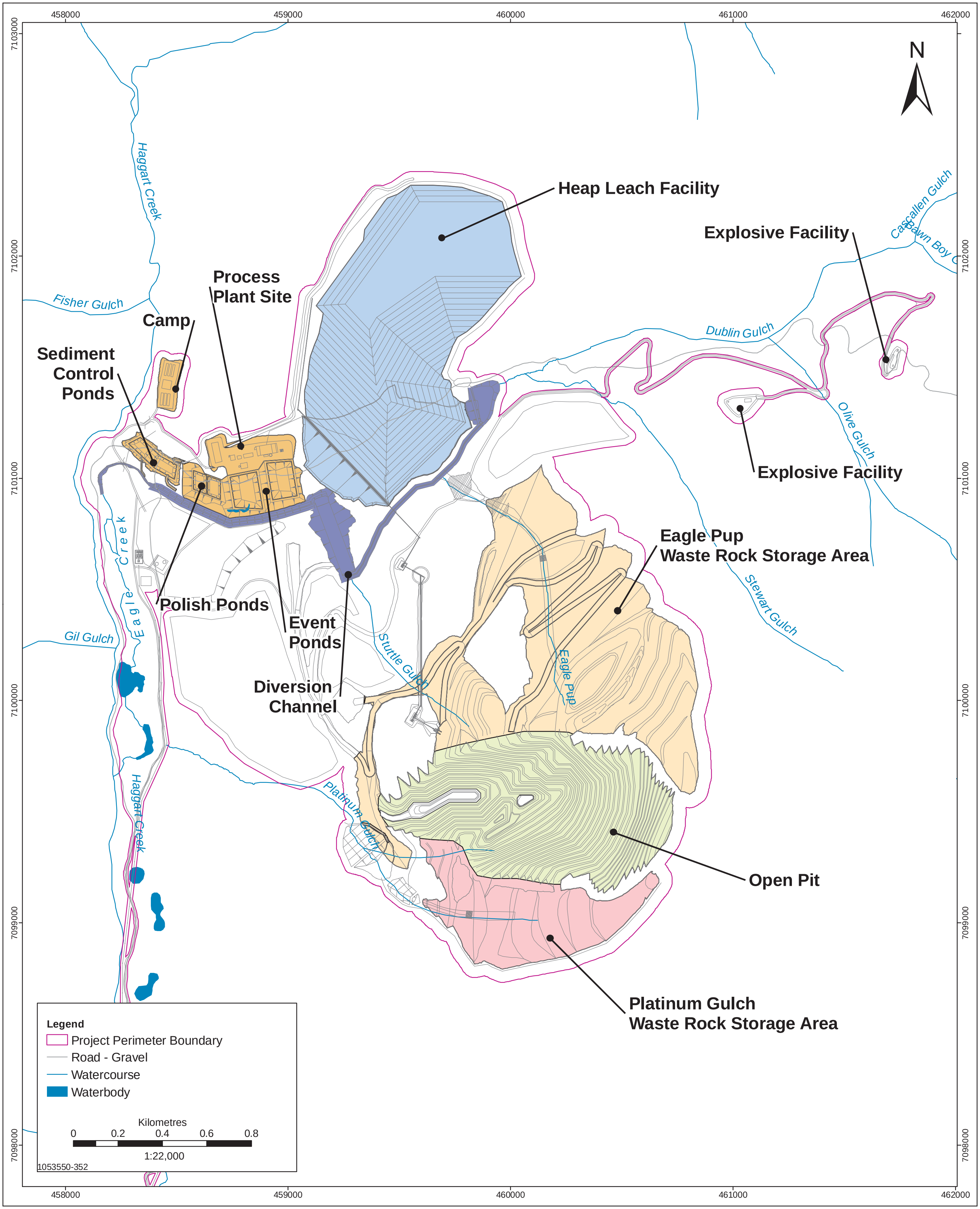
Figure 6.7-3
Project Area Stream Network

PROJECTION	DRAWN BY
UTM - ZONE 8	LS
DATUM	CHECKED BY
NAD 83	RS
DATE	FIGURE NO.
15-October-2010	6.7-3



Data Sources; Government of Canada, Victoria Gold Corp.

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Victoria Gold Corp

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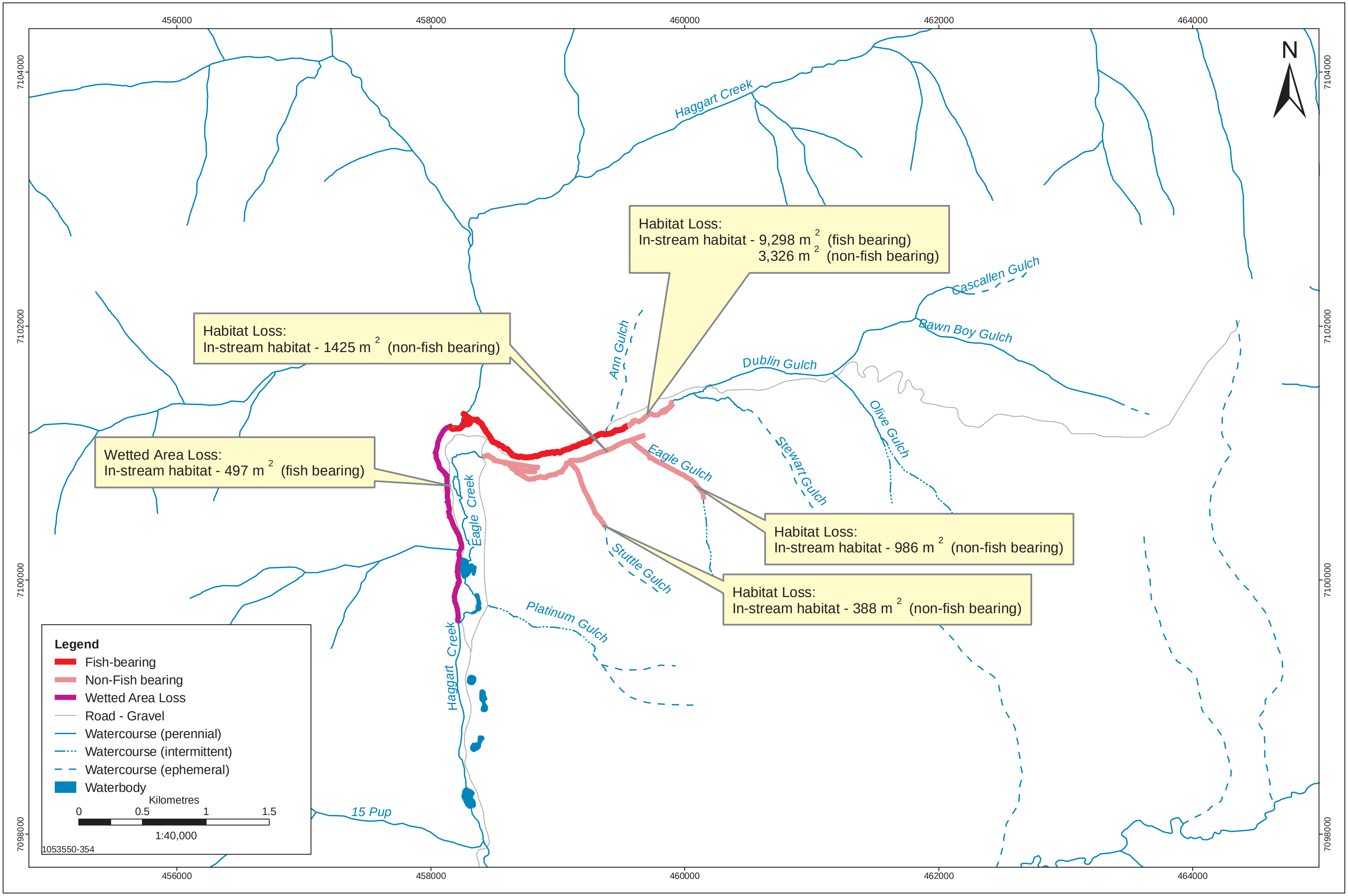
Figure 6.7-4
Mine Site Overview

PROJECTION: UTM - ZONE 8	DRAWN BY: LS
DATUM: NAD 83	CHECKED BY: RS
DATE: 18-October-2010	FIGURE NO.: 6.7-4



Data Sources: Government of Canada, Victoria Gold Corp.

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Figure 6.7-5
Project Fish Habitat Alteration Disruption or Destruction (HADD)

PROJECTION: UTM - ZONE 8	DRAWN BY: LS
DATUM: NAD 83	CHECKED BY: RS
DATE: 15-October-2010	FIGURE NO.: 6.7-5

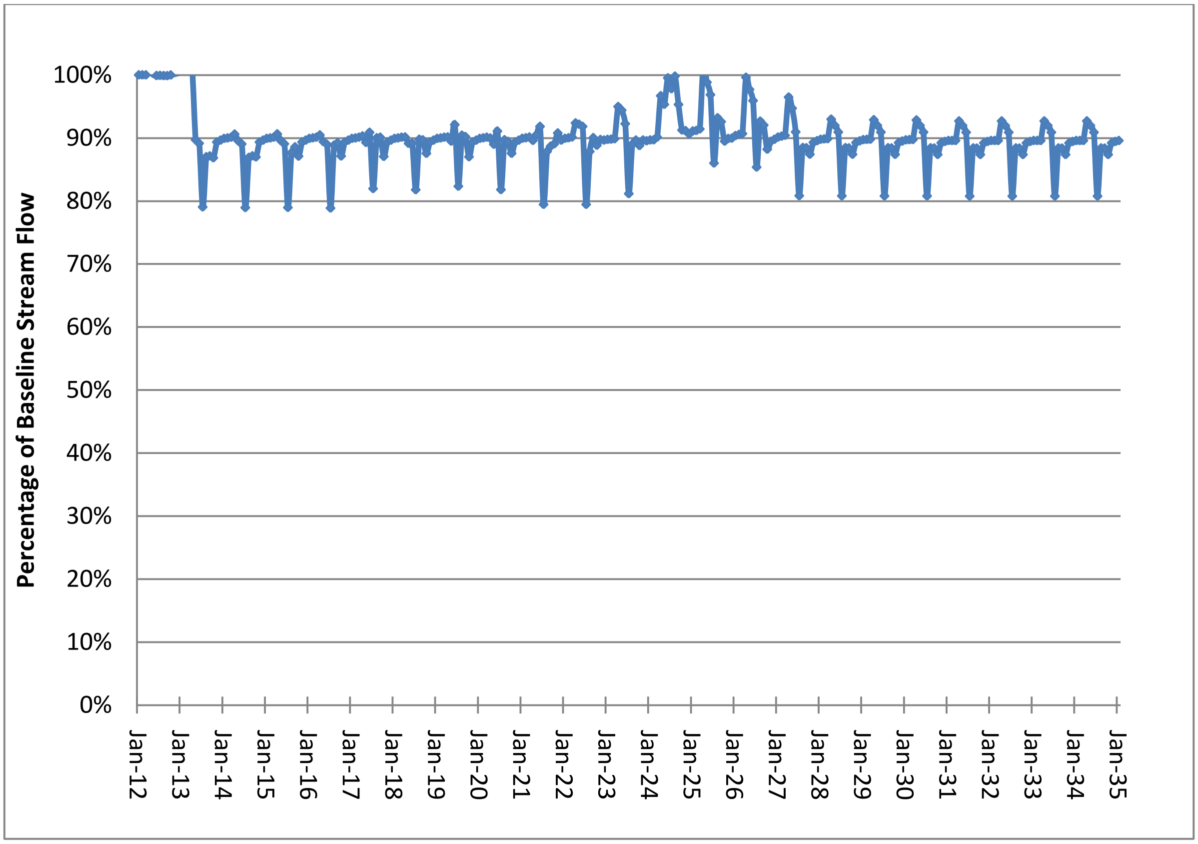

Figure 6.7-6: Percentage of Baseline Stream Flow Conditions on Haggart Creek during Operational Phases

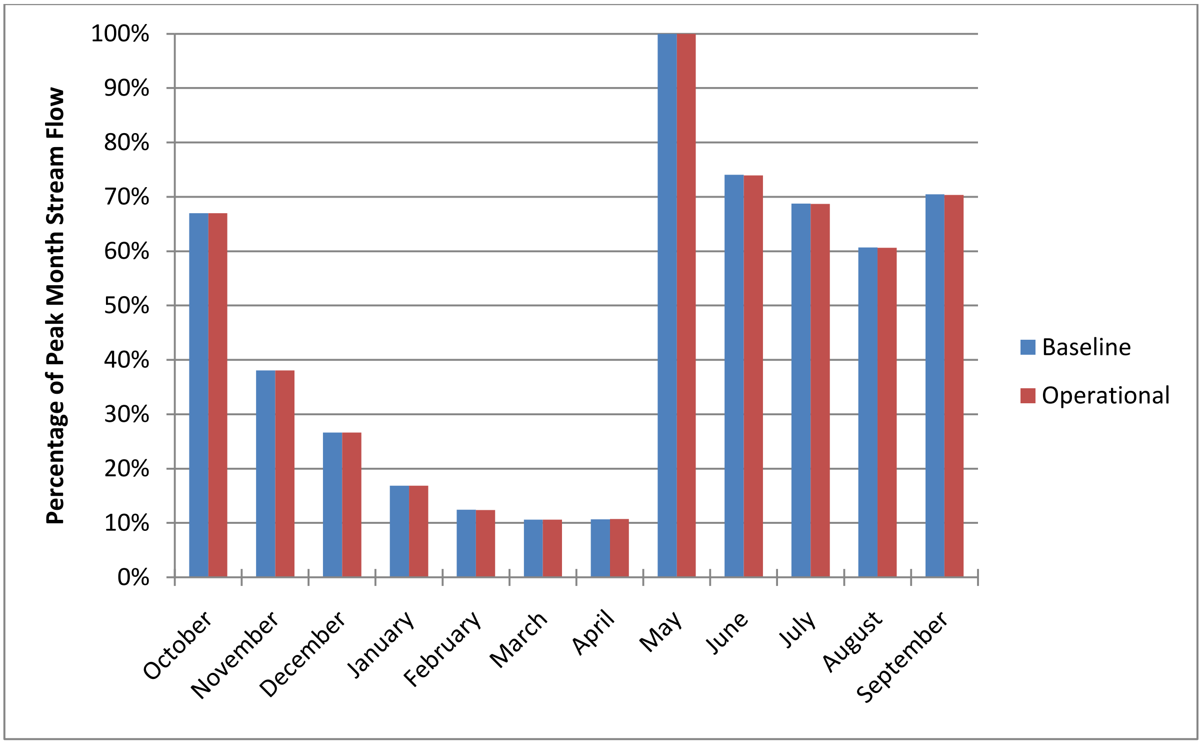

Figure 6.7-7: Monthly Percentage of Peak Month Stream Flow for Hydrologic Year – Baseline and Operational Phases

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6.8 Vegetation Resources

Vegetation is considered a valued component (VC) for the Project because vegetation contributes to a broad array of biological, cultural and societal functions and values—it contributes to landscape, ecosystem and species-level diversity and is an indicator of overall ecosystem health; it is an important component of wildlife habitat, and the hydrological system; and it is valued by members of society and is strongly linked to First Nations cultural values as a component of “the land”.

The proposed Project has the potential to affect local and regional vegetation resources as mining operations and supporting activities will involve the clearing of land and the alteration of underlying soil resources. These potential effects are a concern to government, communities, non-governmental organizations, Yukon residents, and First Nations. Vegetation was identified as a VC for consideration during environmental assessment of the Project by Yukon Government and the FNNND.

The purpose of this assessment is to predict the potential environmental effects of the Project on vegetation and to identify mitigation and environmental management measures that can be applied to avoid or reduce predicted effects.

The assessment of vegetation is linked to the assessment of several VCs including:

- Wildlife (provides wildlife habitat) in Section 6.9
- Soils (contributes to soils processes, stabilizes soils and prevents erosion) in Section 6.4
- Water quality (contributes to hydrological processes; wetlands) in Section 6.5
- Fish and fish habitat (riparian areas) in Section 6.7.

6.8.1 Scope of Assessment for Vegetation Resources

6.8.1.1 Regulatory/Policy Setting

The vegetation assessment for the Project has been completed in accordance with the requirements of the *Yukon Environmental and Socio-Economic Assessment Act* (YESAA). YESAA is not specific with respect to which aspects of vegetation are to be assessed. However, the Yukon Environmental and Socio-economic Assessment Board (YESAB) does provide guidance in the Proponent’s Guide to Information Requirements for Executive Committee Project Proposal Submissions (YESAB 2005). Under the Guide, Project proponents are advised to consider the potential effects of a project on vegetation age, composition, and structure. Other factors related to vegetation that may be considered in a Project Proposal include vegetation type (i.e., ecosystems or plant communities), rare plants, forest age, fire and harvest history, and wildlife habitat.

6.8.1.2 VC Baseline Information

Background

The following sections provide a summary of the baseline information detailed in Section 4 of this document, and in the Environmental Baseline Report: Vegetation (Appendix 11).

Ecosystem Mapping

Terrestrial ecosystem mapping (TEM) is a biophysical mapping process that allows for stratification of the landscape into map units based on ecological features, physiography, surficial material, soils and vegetation (RISC 1998). During the mapping process the landscape is divided into polygons (bounded by a line) representing discrete area; each polygon may contain up to three separate terrain and ecosystem map units. The final mapping product serves several functions in the assessment process. It provides: a process for integrating abiotic and biotic ecosystem components in one integrated data set; a tool for displaying the distribution of ecosystems or abiotic conditions; and a basis for rating values (i.e., wildlife capability) or indicating sensitivities. TEM at 1; 20,000 scale, was prepared for 11,527.23 ha RAA surrounding the proposed mine and for a one km wide corridor centred along the full length of the access road and transmission line corridor (Figure 6.8-1). The Local Assessment Area (LAA) (2,153.36 ha) includes the Dublin Gulch watershed and a 100 m buffer, centered on the access road and transmission line. More detailed 1:10,000 scale mapping was completed for the Dublin Gulch portion (1,606 ha) of the LAA (i.e., the LSA in the Baseline report). The LAA mapping covers the area where Project disturbances are expected to occur. The Regional Assessment Area (RAA) mapping is used to provide regional context to the vegetation assessment. A description of the LAA and RAA is set out in Section 6.8.1.6.

A Project specific ecosystem classification system was developed based on field data collected in 2009 and on review of relevant literature including:

- *Ecoregions of the Yukon Territory* (Yukon Ecoregions Working Group 2004)
- *Ecosystem Classification for the Southeast Yukon* (Geomatics International 1995)
- *Ecosystems of the Peel Watershed: A Predictive Approach to Regional Ecosystem Mapping* (Meikle and Waterreus 2008)
- *Wolverine Project Environmental Assessment Report* (Yukon Zinc Corporation 2005)
- *Dublin Gulch Initial Environmental Evaluation – Volume II Environmental Setting* (Hallam, Knight Piésold 1996).

A complete description of the mapping methodology is provided in the Vegetation Baseline Report (Appendix 11). Terrestrial ecosystem mapping results, along with locations of field survey points, are presented in the baseline report. The area occupied by each of the vegetated and non-vegetated ecosystem units, summarized by ecological zone (i.e., Forested and Subalpine) for the LAA and RAA, is provided in Table 6.8-1. A total of 21 vegetated ecosystem units and nine non-vegetated units have been mapped in the assessment areas. A description of the site characteristics and dominant species for these ecosystems is provided in the Vegetation Baseline Report (Appendix 11).

Two ecological zones were delineated within the baseline mapping: the Subalpine zone and the Forested (Boreal) zone. The majority of Project activities occur within the Forested zone.

The Subalpine zone, which covers 1,136.84 ha within the RAA, occurs on the ridge tops and high plateaus above about 1,225 m asl. Tree cover is discontinuous or absent at this elevation, and the vegetation is dominated by dwarf birch, willows, ericaceous shrubs, herbs, mosses, and lichens. The highest points within the three study areas is 1,520 m asl. These upper elevations are dominated by dwarf-shrub, heath and lichen communities.

The Forested zone (10,390.40 ha), which is part of the northern boreal forest (Boreal Cordillera Ecoregion), includes the valley bottoms, and the slopes of the mountains at elevations ranging from 600 m asl up to approximately 1,225 m asl. Vegetation in the Forested zone includes a range of forested patches with both open and closed canopy coniferous forest, as well as deciduous, and mixedwood stands.

Table 6.8-1: Summary of Mapped Ecosystem Units within the LAA and RAA at Baseline

Ecological Zone	Map Code	Eagle Gold Ecosystem Name	LAA		RAA	
			ha	%	Ha	%
Forested	AK	Aspen-Kinnikinnick	19.51	0.91	124.88	1.08
Forested	AW	Alaska birch-White spruce-Willow	74.51	3.46	653.65	5.67
Forested	BL	Dwarf birch-Lichen	10.42	0.48	41.99	0.36
Forested	BS	Black spruce-Sphagnum	14.70	0.68	478.48	4.15
Forested	CF	Sedge fen	1.07	0.05	15.10	0.13
Forested	CL	Cliff			0.28	0.00
Forested	ES	Exposed Soil	2.72	0.13	3.00	0.03
Forested	FC	Subalpine fir-Cladina	354.57	16.47	1,727.15	14.98
Forested	FF	Subalpine fir-Feathermoss	97.10	4.51	838.19	7.27
Forested	FM	Subalpine Fir-Labrador tea	100.14	4.65	1,148.26	9.96
Forested	FP	Subalpine fir-Dwarf birch-Crowberry	61.57	2.86	190.25	1.65
Forested	GB	Gravel Bar	1.67	0.08	16.15	0.14
Forested	MA	Marsh	0.21	0.01	19.53	0.17
Forested	MM	Mountain heather meadow			0.51	0.00
Forested	OW	Open Water	1.06	0.05	66.21	0.57
Forested	PD	Pond	0	0	1.88	0.02
Forested	PH	Balsam poplar-Horsetail	1.54	0.07	15.97	0.14
Forested	PM	Placer Mine	10.88	0.51	30.64	0.27
Forested	RI	River	12.21	0.57	101.53	0.88
Forested	RO	Rock Outcrop	3.12	0.14	26.27	0.23
Forested	SA	Dwarf birch-Northern rough fescue	35.33	1.64	128.74	1.12
Forested	SC	Black spruce-Cladina	62.79	2.92	419.54	3.64
Forested	SF	White spruce-Feathermoss	55.83	2.59	379.53	3.29
Forested	SH	White spruce-Horsetail	73.68	3.42	571.10	4.95
Forested	SL	Black spruce-Labrador Tea-Feathermoss	362.74	16.85	2,753.75	23.89
Forested	TA	Talus	4.38	0.20	10.01	0.09

Ecological Zone	Map Code	Eagle Gold Ecosystem Name	LAA		RAA	
			ha	%	Ha	%
Forested	WG	Willow-Groundsel	30.54	1.42	101.57	0.88
Forested	WH	Willow-Horsetail	3.34	0.16	35.82	0.31
Forested	WM	Willow-Mountain sagewort	10.47	0.49	67.30	0.58
Forested	WS	Willow-Sedge	5.13	0.24	47.07	0.41
Subalpine	BL	Dwarf birch-Lichen	60.82	2.82	211.98	1.84
Subalpine	ES	Exposed Soil	0.13	0.01	0.53	0.00
Subalpine	FP	Subalpine fir-Dwarf birch-Crowberry	56.45	2.62	288.76	2.51
Subalpine	MM	Mountain heather meadow	4.01	0.19	37.84	0.33
Subalpine	MW	Mountain avens – Dwarf willow	7.31	0.34	39.88	0.35
Subalpine	RO	Rock Outcrop	0.82	0.04	11.07	0.10
Subalpine	SA	Dwarf birch-Northern rough fescue	248.41	11.54	425.90	3.69
Subalpine	TA	Talus	3.48	0.16	29.63	0.26
Subalpine	WG	Willow-Groundsel	11.79	0.55	11.82	0.10
Subalpine	WM	Willow-Mountain sagewort	25.93	1.20	26.16	0.23
Subtotals			**1,830.37**	**85.00**	**11,097.90**	**96.28**
Disturbances			322.99	15	429.34	3.72
Totals			**2,153.36**	**100**	**11,527.23**	**100**

Forest Productivity

Forest productivity, as measured by site index, has been estimated for the forested portions of the LAA and RAA (excluding the portion along the access road). Site index is based on the height and age of dominant trees making up the forest stand or site unit (i.e., ecosystem unit). A site index estimate was prepared for each of the forested site units mapped for the Project. Site index estimations were summarized into classes for interpretation. The site index classes are as follows:

- Nil – 0 (generally the non-forested ecosystems)
- Very Low (VL): <5
- Low (L): 5-10
- Medium (M): 11 – 14
- High (H): 15+.

The site index number reflects the anticipated (or potential) tree height for the leading species at 50 years of age.

Moderate and low productivity forested sites are most common, with moderate productivity sites occupying approximately 35% and 34% of the RAA and LAA, respectively, while low productivity sites cover 33% and 28% of the RAA and LAA, respectively. High productivity sites occupied only a small portion (approximately 2%) of both assessment areas. Non-forested ecosystems (i.e., nil productivity for commercial tree species) occupy about 36% and 30% of the LAA and RAA, respectively.

Plant Communities or Assemblages

The areal extent of ecosystem units was summarized by land cover type for the assessment areas (Table 6.8-2). Coniferous dominated forest is the most common land cover type found in the LAA (52.1%), and the RAA (68.0%). Dwarf birch dominated ecosystems are the second most common land cover type in the LAA and RAA; they occupy about 22.0% and 11.2% of these areas, respectively. These ecosystems dominate the ridge top and plateau sites in the Subalpine zone. Disturbances, associated with exploration and previous mining activities cover about 15% of the LAA compared to about 3.7% of the RAA. Riparian areas (4.7%) and deciduous forest (4.4%) are the next most common land cover types in the LAA. Riparian areas are associated with Haggart Creek both the local and regional assessment areas. Non-vegetated units such as rock, talus and exposed soil, and dwarf shrub land-cover types each occupy less than one percent of the LAA. Dwarf shrub ecosystem types are found in the Subalpine zone.

Table 6.8-2: Ecosystem Category Summaries at Baseline

Ecosystem Category	Map Codes	LAA		RAA	
		(ha)	(%)	(ha)	(%)
Coniferous forest	FC, FF, FM, SC, SF, SH, SL	1,121.5	52.1	7,837.5	68.0
Dwarf birch dominated	BL, FP, SA	473.0	22.0	1,287.6	11.2
Riparian areas: non-vegetated*	GB, RI	13.9	0.6	117.7	1.0
Riparian areas: vegetated*	PH, SH, WG, WH	100.6	4.7	625.5	5.4
Deciduous forest	AK, AW, PH	95.6	4.4	794.5	6.9
Wetlands	BS, MA, OW, CF, WS	22.2	1.0	626.4	5.4
Water (Pond and River)	PD, RI	12.2	0.6	103.4	0.9
Rock/talus/exposed soil	CL, ES, RO, TA	14.7	0.7	80.8	0.7
Dwarf shrub	MM, MW	11.3	0.5	78.2	0.7
Mining areas	PM	10.9	0.5	30.6	0.3
Disturbances	(roads; seismic; exploration)	323.0	15.0	429.3	3.7
Total area		**2,153.4**		**11,527.2**	

NOTE:

The values under ha and % do not sum to the totals or 100% as some ecosystems are used in multiple categories.

* Only riparian ecosystems are listed in the table, although other ecosystems and non-vegetated units are present within the riparian corridors.

Old Forest

Old forest patches occupy about 269.3 ha (12.5%) and 1,237.8 ha (10.7%) of the LAA and RAA, respectively. These stands are typically dominated by white or black spruce at lower elevations while subalpine fir is the dominant overstorey species at higher elevations.

Rare Plants

Rare plant surveys were conducted in early August 2009 and early July 2010 within the local study area and along specific sections of the access road in 2010. One rare plant species, island purslane (*Koenigia islandica* L), was identified at a single location in the LSA. A relatively small patch of this plant, covering about 2 m x 2 m was found in Bawn Boy Gulch. The location of the island purslane occurrence is shown in Figure 6.8-2.

Wetlands

Wetlands are uncommon in the Dublin Gulch portion of the LAA. Most of the wetlands present in the LAA are associated with the access road and transmission line corridor. In total, wetlands cover about 22.2 ha (1.0%) of the LAA. Wetlands are more common in the RAA (626.4.1 ha; 5.4%) than in the LAA. The wetlands are generally associated with the Lynx and Haggart Creek valley bottoms. Bogs (the black spruce – sphagnum wetland) are most common in the LAA and RAA followed by shrub dominated willow-sedge wetlands. Herbaceous dominated marsh (MA) and sedge fen (CF) wetlands are uncommon in the assessment areas.

Riparian

Riparian ecosystems are defined as occurring immediately adjacent to flowing water. For the purposes of this assessment, riparian areas have been defined based on a two step approach using TEM and National Topographic System (NTS) watercourse data. Specific riparian ecosystems that are identified from the TEM data include: river (RI), gravel bars (GB), Spruce-Horsetail (SH), Poplar-Horsetail (PH), Willow-Groundsel (WG) and Willow-Horsetail (WH). The non-vegetated units (RI and GB) occupy about 117.7 ha at baseline in the RAA while the vegetated riparian specific ecosystems occupy 625.5 ha. In addition to these specific TEM ecosystems, riparian areas were delineated by buffering all watercourses, ponds, and lakes present in the base NTS data (1:50,000 scale). A buffer of 30 m was applied to Haggart Creek, Lynx Creek and South McQuesten River to identify these lands. This buffer has been increased from the 20 m used in the vegetation baseline. A buffer of 10 m was applied to smaller streams.

A total of 2,060.2 ha of riparian area is mapped in the RAA at baseline. This includes 901.0 ha of land within TEM polygons dominated by the TEM riparian ecosystems as well as 1,159.2 ha of additional land as defined by the NTS riparian buffers. The land within the riparian buffers excludes the area occupied by polygons dominated by riparian specific codes discussed above.

Traditional Use Plants

A study of traditional use plants was not included in the Vegetation Baseline Report (Appendix 11) because at that time the Traditional Knowledge study for the Project had not been completed.

However, the baseline survey field data includes descriptions of the physical characteristics and percent cover of plant species within the ecosystems encountered. This information has been used for the assessment of affects to traditional use plants in conjunction with *First Nation of Na-Cho Nyäk Dun Traditional Knowledge and Use* (Stantec 2010) completed in June 2010.

To quantitatively assess potential Project effects on traditional use plant species the relationship between FNNND traditional use berry producing species and ecosystems was analyzed. The berry species used in this analysis were selected from the list of traditional use plant species harvested by the FNNND (Stantec 2010). Berry producing plant species were selected to represent traditional use plant potential because, collectively, they represent the majority of plant species identified for harvest in the traditional use study (i.e., 9 of 11 species). The other two species harvested by FNNND citizens (as identified in the traditional use study) include Labrador tea (*Ledum groenlandicum*) and wild onion (*Allium* sp.). Labrador tea was not selected for analysis as it is common to abundant in most of the forested ecosystems found in the RAA. Wild onion was not used in the assessment of effects because it was not found during the Project field surveys.

The berry species selected for the analysis include: blueberry/bog bilberry (*Vaccinium uliginosum*), mountain cranberry/lingberry (*Vaccinium vitis-idaea*), high-bush cranberry (*Viburnum edule*), bog cranberry (*Oxycoccus microcarpus*), cloudberry (*Rubus chamaemorus*), currants and gooseberries (*Ribes* spp.), and soapberry (*Shepherdia canadensis*). Each mapped ecosystem was rated for potential occurrence of berry producing species used by the FNNND. Field data was analyzed to generate the rating by summing the percent cover of all berry producing species and then multiplying by the frequency of berry occurrence. The frequency of berry occurrence is defined as the number of plots that contained berries divided by the total number of plots sampled for the ecosystem. Five berry potential classes were created:

- High potential (>10)
- Moderate potential (5 – 10)
- Low potential (1 – 5)
- Very low potential (<1)
- Nil potential (non-vegetated units).

The ecosystems assigned to the berry potential classes are summarized in Table 6.8-3.

Table 6.8-3: Distribution of Traditional Use Berry Producing Sites at Baseline

Traditional Use Berry Potential Class	Ecosystem Unit (Map Code)	Baseline			
		RAA		LAA	
		(ha)	%	(ha)	%
High Potential	Spruce-Cladina (SC); Spruce-Horsetail (SH)	990.64	8.59	136.47	6.34
Moderate Potential	Aspen –Kinnikinnick (AK); Alaska birch-White spruce-Willow (AW); Black spruce-Sphagnum (BS); Subalpine fir-Cladina (FC); Subalpine Fir-Labrador tea (FM); White spruce-Feathermoss (SF); Black spruce-Labrador Tea-Feathermoss (SL)	7,265.70	63.03	981.99	45.60

Traditional Use Berry Potential Class	Ecosystem Unit (Map Code)	Baseline			
		RAA		LAA	
		(ha)	%	(ha)	%
Low Potential	Dwarf birch-Lichen (BL); Subalpine fir-Feathermoss (FF); Subalpine fir–Dwarf birch-Crowberry (FP); Mountain heather meadow (MM); Placer Mine (PM); Dwarf birch-Northern rough fescue (SA)	2194.79	19.04	584.99	27.17
Very Low Potential	Sedge fen (CF); Graminoid-Herb (GH); Mountain avens – Dwarf willow (MW); Balsam poplar-Horsetail (PH); Marsh (MA); Willow-Groundsel (WG); Willow-Horsetail (WH); Willow-Mountain sagewort (WM); Willow-Sedge (WS)	38.21	0.33	106.80	4.96
Nil Potential (Non-vegetated)	Armoured Channel (AC); Cliff (CL); diversion channel (DC); Gravel Bar (GB);Lake (LA); Open water (OW); Pond (PD); River (RI); Rock outcrop (RO); Talus (TA)	266.55	2.31	29.59	1.37
Disturbances		429.3	3.7	323.0	15.00
Totals		**11,527.23**		**1,830.37**	**100**

NOTE:

Ecosystems GH, AC, DC, and LA were not present at baseline but are included in this table as they are used in the assessment of the Post-closure scenario. Disturbances at baseline (except PM) were not rated.

6.8.1.3 Key Issues and Identification of Potential Effects

The key issue for vegetation is the sustainability of ecosystems and plants in the Project footprint and vicinity. One of the primary concerns is the potential for direct losses of vegetated ecosystems that support traditional use activities, provide wildlife habitat, and support intrinsic ecological values such as plant species and ecosystem diversity. The interactions of the Project with vegetation may result in the following potential environmental effects:

- Loss of vegetation due to the direct effects of clearing and grubbing of land associated with Project activities
- Changes in abiotic conditions necessary for the sustainability of existing communities or vegetation development due to effects such as ground disturbance (i.e., changes in soil compaction, alteration of texture), changes in drainage patterns, and dust deposition
- Changes in the structure and/or composition of vegetation communities due to the direct effects of clearing or alteration of the underlying soil resources or due to a variety of indirect effects in areas adjacent to Project disturbance (i.e., invasive species).

Those Project activities and physical works that may result in a significant environmental effect to vegetation resources (those ranked “2” in Table 6.3-1, Section 6.3-1) are listed in Table 6.8-4. In addition, the potential environmental effects associated with each of these activities or works on vegetation resources are also presented. Three construction activities have been ranked as “2”. These include: site clearing and grubbing, access road upgrades, and clearing of the transmission line right-of-way (RoW). Construction will result in the removal of all vegetation and active soil layers for the majority of the mine site and for specific locations along the access road. Some areas at the margins of the mine facilities will be cleared of trees while shrubs, forbs, and the active soil layer will be left intact. However, for the purposes of the vegetation assessment it is assumed that all areas within the clearing boundary of the mine site will be cleared and grubbed. This conservative approach is used to demonstrate the worst case scenario that may occur within the development of the mine site. It is assumed that once clearing and grubbing is complete, subsequent construction activities will not greatly add to the loss of vegetation. However, mine site clearing may also cause other indirect effects such as changes in stand structure or composition. Mining activities, such as overburden removal and disposal in the waste rock storage areas (WRSAs), development of borrow areas, and the construction of the heap leach facility have the potential to result in changes to the abiotic environment, especially soil conditions, that support plant growth and ecosystems.

Table 6.8-4: Potential Project Effects to Vegetation Resources

Project Activities and Physical Works	Potential Environmental Effects		
	Vegetation Loss	Changes to Abiotic Conditions	Changes to Vegetation Community Structure and Composition
Construction			
Mine site clearing and grubbing	✓	✓	✓
Access road upgrades	✓	✓	✓
Clearing of transmission line RoW		✓	✓
Operations			
Open pit mining (blasting, ore/waste hauling, pit dewatering)		✓	
Ore Processing (crushing and hauling)		✓	

NOTE:
Project Environmental Effects
Only Project-Environment interactions ranked as 2 in Table 6.3-1, the Project-Environment Interaction Table, are carried forward to this Table. A
✓ = Indicates that an activity is likely to contribute to the environmental effect.

Clearing of the transmission line RoW will result in the removal of trees and some tall shrubs but its assumed that lesser vegetation (shrubs, forbs, and mosses etc.) and the active soil layer will remain intact except at very localized sites (i.e., pole placement). This clearing will result in a change in stand structure and composition over the operational life of the RoW. Clearing for the transmission line may also result in changes to abiotic conditions in areas adjacent to the RoW.

Two activities associated with mine operations are ranked as “2”: open pit mining (blasting, ore/waste hauling, open pit dewatering) and ore processing (crushing and hauling). These activities have the potential to cause changes in abiotic conditions in areas outside of the Project footprint as a result of metals loading from dust deposition.

To assess the potential effects of the Project (vegetation loss; changes in abiotic conditions; and changes to vegetation community structure and composition) on vegetation, a set of more specific key indicators were developed for analysis. These key indicators represent communities, species groups, or ecosystem attributes that have ecological, social or cultural value and are sensitive to Project activities. Together, the condition of these indicators may be representative of overall vegetation conditions and health, and the functions they provide within the Project assessment areas. Criteria considered in the selection of the key indicators include:

- Known or likely presence in the Project assessment area
- Abundance and distribution in the Project assessment area
- Conservation status
- Sensitivity to Project activities
- Socio-economic and cultural value
- Potential role as indicators for other vegetation components or ecological conditions (e.g., biodiversity).

Five specific indicators were selected for the vegetation assessment following the evaluation of the above criteria. These include: rare plants, wetland ecosystems, riparian ecosystems, old forest, and traditional use species.

- **Rare plants**—for the purposes of this assessment, rare plants are plant species, subspecies or varieties included on a list of 64 rare species that may occur within FNNND Territory and Yukon as prepared by Bruce Bennett (see Appendix 11). Mr. Bennett, is a biologist and vascular plant specialist with Environment Yukon, who studies and tracks rare plant species in Yukon. No SARA or COSEWIC listed species were identified within the LAA. Rare plants are included as a key indicator because of the contribution they make to species and genetic diversity, and their intrinsic value to society.
- **Wetland ecosystems**—include forested and non-forested ecosystems that occur on sites with soils that are saturated or flooded for a substantial period of the year and that support an assemblage of hydrophytic plant species. Wetlands, identified from the terrestrial ecosystem mapping, include the black spruce-sphagnum (BS), marsh (MA), open water (OW), sedge fen/meadow (CF), and willow-sedge (WS) ecosystem units. Wetlands are included as a key indicator for vegetation resources because of the contribution they make to biological diversity (community- and landscape-level), their influence on water flow and quality, and as habitat for wildlife, rare plants and traditional use plant species. Wetlands are also included because of their sensitivity to disturbance.
- **Riparian areas**—areas adjacent to streams and wetlands that are wet enough or inundated frequently enough to develop and support vegetation cover distinct from that in neighboring upland sites (Stevens, et al. 1995). For the purposes of this assessment, riparian areas are considered to be the ecosystem units that are defined specifically as riparian (PH, SH, WH or WG). The designation is not based solely on proximity to a watercourse. In addition to these specific riparian ecosystems, riparian areas where further defined for the assessment

by buffering the NTS watercourses, lakes, and ponds. Buffers of 30 m where applied to the larger systems including South McQuesten River, Haggart Creek, and Lynx Creek. A 10 m buffer was applied to the smaller watercourses. Riparian ecosystems are included as a key indicator for Vegetation Resources because of the contribution they make to biological and structural diversity (e.g., large trees, shrub fringe) on the community and landscape scales, their importance to hydrology and water quality, and the habitat these ecosystems provide for wildlife and rare plants. Riparian areas as they pertain to fish habitat are discussed in Section 6.7, Fish and Fish Habitat.

- **Old forest**—for the purposes of this assessment, old forest is defined as structurally diverse stands older than 140 years. This definition is consistent with that used for boreal forest in other jurisdictions in western Canada. These forests are typically comprised of shade-tolerant and regenerating tree species as well as dead or decaying tree snags and coarse woody debris on the forest floor; and often have large openings in the tree canopy with a patchy understory providing opportunities for a diverse array of flora and fauna. Old forest is identified as structural Stage 7 in the ecosystem mapping. Old forest is includes as key indicators because of their contribution to the conservation of species- and ecosystem-level biodiversity and wildlife habitat values.
- **Traditional use plants**—traditional use plants are defined in *First Nation of Na-Cho Nyäk Dun Traditional Knowledge and Use* (Stantec 2010). Plants are considered an integral part of "the land" by the FNNND. They may be gathered for food, medicinal or cultural use. The potential effects to traditional use must consider the FNNND right to harvest trees and plants throughout FNNND traditional territory. Traditional use berry species were selected for analysis of traditional plant use because berry harvesting is a key component of FNNND culture and because they were the most commonly identified as harvested species in the traditional use study. The potential of TEM ecosystems to contain traditional use berry species was selected to assess and represent the effect of the Project on traditional plant use.

These indicators directed the collection of baseline data and are the primary focus of the assessment of Project effects.

6.8.1.4 Standard Mitigation Measures and Effects Addressed

Interactions identified as "1" and "0" in Table 6.3-1 indicate Project activities or physical works that are not expected to result in any significant environmental effects to vegetation. In the case of activities identified as a "1" the application of standard mitigation measures and/or environmental management practices are expected to prevent the occurrence of significant effects. As a result, these interactions are not addressed specifically in the vegetation effects assessment. Those activities that are not expected to interact with vegetation resources during the various Project stages are identified as "0".

Construction

Several construction activities may interact with vegetation resources but are not expected to result in significant effects (ranked as "1"). These include: salvaging and stockpiling of soils, camp construction, construction of site mine site infrastructure and haul roads, site water management, vehicular traffic, and installation of the transmission line. The effect of these activities on vegetation can be mitigated by following standard practices for construction (sediment control measures) and site waste management (Section 5.4, Project Description) and use of dust control measures (Section 6.6, Air Quality).

Construction phase activities which are thought to have no potential to interact with vegetation resources (ranked as “0”) include disposal of cleared vegetation (burning), waste handling, diesel power generation, use of construction vehicles and equipment, and water supply and usage. Since all of these activities are restricted to areas previously disturbed by site clearing and grubbing, further effects to vegetation are not anticipated.

Operations

Operations activities ranked as “1” include: wastewater treatment and discharge, vehicle traffic, fish habitat compensation, access road and transmission line maintenance, quarry/borrow pit operations, and fuel, hazardous material and explosive management. All of these activities, with the exception of fish habitat compensation, will occur in areas previously cleared of vegetation during the construction phase. The potential effect of these activities on vegetation can be mitigated (and monitored) by following standard practices for construction and site waste management and the use of dust control measures. For example, dust deposition on vegetation from the quarry/borrow pit operations haul road traffic can be effectively mitigated through the use of dust control measures outlined in the Air Quality assessment (Section 6.6). Potential effects to vegetation due to sedimentation can be mitigated through erosion and sediment control practices described in the Surficial Geology, Terrain and Soils assessment (Section 6.4). Thus, these interactions will not be considered further in the assessment.

Operations phase activities which are considered to have no potential to interact with vegetation resources include potable and non-potable water use, solid-waste management, camp operation and diesel power generation. These activities will occur within, and be part of, the existing facility infrastructure and consequently will not affect vegetation following the construction phase.

Closure and Reclamation

All activities associated with closure and reclamation are ranked as “1”. These include:

- Reclamation of waste rock storage areas (WRSAs)
- Heap leach facility (HLF) reclamation
- Plant and associated facility removal and site reclamation
- Pit lake filling
- On-going water treatment and discharge
- Haul Roads closure and reclamation
- Transmission line closure and reclamation.

Reclamation is expected to have a positive effect on vegetation, restoring soil productivity and vegetation cover to the mine site. The removal of the mine water treatment plant (MWTP) and associated facilities (including decommissioning of sediment control ponds) are also considered to have a positive effect on vegetation once rehabilitation measures have been implemented. Closure of the transmission line is also expected to have a positive effect on vegetation along the corridor as cleared communities will be allowed to regenerate. Any adverse effects associated with these activities can be addressed through standard mitigations; best management practices; the restoration of productive growing surfaces; and the establishment of ecologically appropriate plant species. Therefore, the net effect of these activities for vegetation resources should be positive.

Post-closure Monitoring

The post-closure phase is not expected to result in any adverse effects to vegetation resources. Activities undertaken at this stage should be limited to environmental monitoring required to document successful closure and reclamation, and compliance with applicable regulations and agreements.

6.8.1.5 Selection of Measurable Parameters

The measurable parameters used for assessing the three Project potential effects—vegetation loss, change to abiotic conditions, and changes to community structure and composition—on vegetation resources are presented in Table 6.8-5. One of two approaches is used to measure (quantify) the direct effect associated with vegetation loss. In the case of rare plants, the number of plants or populations affected is measured against the total number known at baseline. For indicators such as wetlands, riparian, and old forest, effects are characterized in terms of the spatial extent (in hectares) of the change due to the Project. These changes are determined from the Project-specific ecosystem mapping. The condition of each of the key indicators at baseline is compared spatially with their condition in the Maximum Disturbance and Post-closure scenarios.

With the exception of the clearing of vegetation along the transmission line RoW, there are no measureable parameters for assessing the changes to abiotic conditions, or to the structure and composition of plant communities. These effects will be assessed qualitatively based on the Project description, best management practices, and professional judgment.

Table 6.8-5: Measurable Parameters for Vegetation Resources

Environmental Effect	Rationale for Inclusion of the Environmental Effect in the Assessment[a]	Measurable Parameter(s) for the Environmental Effect	Rationale for Selection of the Measureable Parameter[a]
Vegetation Loss	▪ Sensitivity to Project disturbance ▪ Conservation status of species at the territorial and national levels ▪ Potential to affect genetic, species-level, community	▪ Rare plants – number of rare plant populations or point locations affected (determined from Project studies)	▪ Can be measured in a temporal context ▪ Important to regulators, First Nations, and stakeholders ▪ Limited distribution and extent of these species ▪ Conservation status of plant species at the territorial and national levels ▪ Contribute to genetic and species-level biodiversity

Environmental Effect	Rationale for Inclusion of the Environmental Effect in the Assessment[a]	Measurable Parameter(s) for the Environmental Effect	Rationale for Selection of the Measureable Parameter[a]
	and landscape biodiversity ▪ Ecosystems provide other valuable ecological functions ▪ Importance to regulators, First Nations and stakeholders	▪ Wetlands – changes in spatial extent based on mapped occurrences (ha) using Project-specific mapping	▪ Changes can be quantified with mapping (and placed in temporal context) ▪ Federal and territorial wetland policy ▪ Important to First Nations, and Yukon residents ▪ Important for ground water recharge ▪ Important for wildlife ▪ May have high potential for rare species ▪ Contribute to community- and landscape-level biodiversity ▪ These ecosystems provide other valuable ecological functions – influence stream flow, water quality and temperature and provide habitat to other species
		▪ Riparian area – changes in spatial extent (ha) using Project-specific mapping	▪ Changes can be quantified with mapping ▪ Important to Regulators ▪ Important to First Nations, and Yukon residents ▪ Potential for rare species ▪ Contribute to community- and landscape-level biodiversity ▪ Wildlife habitat values ▪ Provide inputs to aquatic food web, shade streams, stabilize soil, influence stream flow and nutrient input
		▪ Old forest – Changes in spatial extent (ha) using Project-specific mapping	▪ Changes can be quantified with mapping with temporal context ▪ Important to regulators ▪ Important to First Nations, and Yukon residents ▪ Contributions to biodiversity (species- and ecosystem-level) ▪ Wildlife habitat values; ▪ Long time periods (100-140 yrs+) required to develop old forest attributes
		▪ Traditional use plants – changes in spatial extent of ecosystems that provide traditional use plants (ha)	▪ Importance to First Nations ▪ Changes may be interpreted from mapping

Environmental Effect	Rationale for Inclusion of the Environmental Effect in the Assessment[a]	Measurable Parameter(s) for the Environmental Effect	Rationale for Selection of the Measureable Parameter[a]
Changes to Abiotic Conditions	▪ Sensitive to Project disturbance ▪ May influence the viability of species or ecosystems at the site level	▪ Change in physical properties or characteristics ▪ Indirect changes in moisture or hydrologic conditions	▪ Substrate influences composition and distribution of plants and ecosystems at the site level ▪ Changes may affect other ecological/cultural values associated with vegetation loss
Changes to Community Structure and Composition	▪ Sensitive to Project disturbance ▪ Changes may affect ecological function ▪ Changes may affect cultural or social values	▪ Change in ecosystem structure – measure spatial extent of clearing using Project-specific mapping ▪ Change in species composition within ecosystems	▪ Clearing of vegetation will influence structure on a temporal scale ▪ Structure and composition may be influenced by Project activities ▪ Potential to affect ecosystem function and values ▪ Can be measured during post-closure reclamation and environmental monitoring

NOTES:
[a] Includes input from consultation with regulators, First Nations, affected stakeholder, and the public: as well as YESAB's guidelines, other regulatory drivers, policies, and/or programs.

6.8.1.6 Spatial Boundaries for Vegetation Resources

Local Assessment Area (LAA)

The vegetation LAA is the area in which Project effects could potentially occur and includes the Dublin Gulch watershed and several smaller sub-watersheds, as well as a buffered transmission line/access road corridor extending to 50 m to either side of the transmission line and road footprint) (Figure 6.8-1). The 50 m buffer was established to capture potential direct and indirect effects associated with the transmission line and road upgrade. It was also designed to balance the area retained with the RAA for the effects assessment. The vegetation LAA is approximately 2,153 ha in size. The vegetation field work conducted to support the Project assessment focused on the LAA. The Project footprint refers to the area that will be directly affected by Project activities; it is contained within the LAA.

Regional Assessment Area (RAA)

The vegetation RAA is designed to include good representation of the broad subalpine ridges, forested mountain slopes and valley bottoms typical of the Project area and provide regional context for Project effects. This area provides adequate representation of the vegetation and ecosystems present in the LAA that may be affected by the Project. It will also serves as the recruitment area for the natural ingress of native species following closure and reclamation. The vegetation RAA includes the LAA and extends to the boundary of Lynx Creek to the south, to Haggart Creek to the north, and to the height of land of the small sub-watersheds located to west of Haggart Creek and a 1km-wide corridor centered on the existing South McQuesten Road (SMR) and the Haggart Creek Road (HCR) (Figure 6.8-1). The total area of the RAA (including the LAA) is 11,527 ha. The RAA boundaries are identical to the regional study area and road corridor study areas established for the vegetation baseline study.

6.8.1.7 Temporal Boundaries for Vegetation Resources

Three temporal boundaries (or scenarios) are used for the assessment of potential environmental effects on Vegetation Resources: Baseline, Maximum Disturbance, and Post-closure. Accordingly, the timeframe for the vegetation effects assessment spans the period from the establishment of baseline conditions through to beyond Project closure.

- **Baseline Scenario**—The baseline scenario represents biophysical conditions of the environment in summer 2009 as characterized by the TEM. Considerable exploration and placer mining disturbance has occurred in the area over the century prior to the baseline study and baseline conditions incorporate the environmental effects of past human-caused disturbances (e.g., mining exploration, placer mining, industrial facilities, roads) and the early seral vegetation communities that follow such disturbance. Baseline for rare plants was established in the summers of 2009 and 2010.
- **Maximum Disturbance Scenario**—This scenario represents the maximum state (i.e., worst case) of disturbance to vegetation resources during the construction, and operations phases of the Project, as these phases do not vary greatly in terms of their effects on vegetation. The maximum disturbance (footprint) scenario is used to provide a conservative assessment of the effects on vegetation.
- **Post-closure**—The post-closure phase represents conditions forecast following complete decommissioning and reclamation of the mine and transmission line. For vegetation, post-closure is estimated to extend 20 years past the end of the reclamation phase. This period is intended to provide time for reclamation treatments to take effect (i.e., appropriate species, cover/biomass, growth and sustainability with respect to vegetation). Reclamation activities will focus on restoring productive vegetation communities on the plant-site structures and equipment, waste rock storage areas (WRSAs), heap leach facility (HLF), soil stockpiles, silt borrow area and on-site road reclamation. It is assumed that the access road, outside the mine gate, will not be decommissioned at closure).

6.8.1.8 Characterization of Residual Effects for Vegetation Resources

Each residual Project and cumulative environmental effect identified in the assessment is characterized using multiple environmental effects rating criteria: direction, magnitude, geographic extent, timing and frequency, duration, reversibility, ecological context, and probability of occurrence. The definitions for these environmental effects rating criteria are presented in Table 6.8-6.

These criteria are used to characterize the effects to the VC or indicator but they do not solely determine if an effect is significant.

Table 6.8-6: Characterization of Residual Environmental Effects for Vegetation Resources

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The ultimate long-term trend of the environmental, economic, social, heritage, or health effect (positive or negative)	▪ Negative ▪ Positive ▪ Neutral (no change in extent)
Magnitude	The amount of change in a measurable parameter or variable relative to baseline case	▪ Where quantifiable assessment is not possible, magnitude is described as follows: ▪ **Negligible**—no effect occurs ▪ **Low**—effect occurs but might or might not be detectable, and does not comprise ecological, economic, or social/cultural values ▪ **Moderate**—effect occurs but is unlikely to pose a serious risk to the indicator or represent management challenge from an ecological, economic or social/cultural standpoint ▪ **High**—effect is likely to pose a serious risk to the indicator and represents a management challenge from an ecological, economic or social/cultural standpoint
Geographical Extent	The geographic area in which an environmental, economic, social, heritage, or health effect of a defined magnitude occurs	▪ Site specific ▪ Local (Vegetation LAA) ▪ Regional (Vegetation RAA) ▪ Territorial (used for rare plants) ▪ National (used for rare plants)
Timing and Frequency	The number of times during a project or a specific project phase that an environmental, economic, social, heritage, or health effect may occur	▪ Once (applied to all clearing and grubbing activities) ▪ Frequent and continuous
Duration	The period of time required until the VC or indicator returns to its baseline condition, or the effect can no longer be measured or otherwise perceived	▪ **Short-term**—effect limited to <1 year ▪ **Medium-term**—effect occurs >l yr and <10yrs ▪ **Long-term**—effect extends 10 to 25 years ▪ **Permanent** (far future)—effect extends >25 years beyond the life of the Project
Reversibility	The likelihood that a measurable parameter Will recover from an effect	▪ **Reversible**—effect is reversible over time with application of mitigation measures (e.g., reclamation) ▪ **Irreversible**—effect is not reversible over time
Ecological and Socio-economic Context	The general characteristics of the area in which the project is located	▪ **LAA**—remote, disturbed ▪ **RAA**—remote, partially disturbed
Probability of Occurrence	The probability that an effect or event will occur in a given time period	▪ Low ▪ Moderate ▪ High

6.8.1.9 Standards or Thresholds for Determining Significance for Vegetation Resources

The significance of an environmental effect was determined by considering the residual environmental effect in the context of the sustainability of the key indicator within an appropriate ecological context (e.g., the Yukon range of a rare plant species). This determination of significance was generally qualitative—considerations include conservation status; range of the species or community; and level of existing disturbance. However, measurable parameters such as magnitude and duration, which determine the intensity of the effect, as well as reversibility, also played a key role in the assessment of potential effects on individual key indicators. Ideally, the weighting or measurement of effects attributes would be objective and based on comparison of the vegetation indicator condition to ecological thresholds and policy objectives. However, numerical thresholds that reflect the limits of acceptable change for vegetation resources or associated key indicators were not available. In the absence of well-defined criteria or thresholds, a qualitative approach has been adopted based on characterization of effects as described above and professional judgment. If the sustainability of the existence or ecological function of the key vegetation indicators is not threatened by the Project in the RAA then the residual effect is determined to be not significant.

6.8.1.10 Effects Analysis Methods

The Project residual and cumulative effects for the vegetation key indicators are characterized and their significance is then determined based on defined criteria. In general, Project effects on vegetation were assessed using quantitative analysis of the change in the available area of each key indicator from baseline to maximum disturbance. The 1:10,000 and 1:20,000 TEM developed for the LAA and RAA provide the primary basis for quantifying and analyzing direct losses of vegetation resources as a result of the Project. The TEM is also integral to the assessment of Project-related effects on wildlife habitat (Section 6.9). Details on the methods used to develop the TEM are presented in Section 6.8.1.2 and in the vegetation baseline report (Appendix 11). Predictions of post-closure conditions are based on the post-mine ecosystems identified as part of the development of the closure and reclamation phase (Section 5.6). Area summaries for maximum disturbance and post-closure scenarios were calculated using ArcGIS mapping software, and were based on data from the Project TEM and Conceptual Closure and Reclamation Plan.

Effects assessment methods specific to each key indicator, including the use of the TEM, are described below. Any indicator-specific analysis methods are described as part of the detailed assessment.

Rare Plants

The environmental effect of the Project on rare plants was assessed with a simple spatial analysis through an overlay of any known rare plant locations within the Project footprint and LAA boundary. Rare plant locations were based on rare plant surveys conducted in 2009 and 2010. Where the Project footprint overlaps with mapped rare plant locations, it is assumed that the effect will be a direct loss. Indirect effects on the site conditions that may support rare plants are expected to occur along edges of the Project footprint throughout the operations phase.

Wetland Ecosystems

The environmental effect of the Project on wetland ecosystems was assessed with a simple spatial analysis, that is, an overlay of the Project footprint and LAA boundary on the TEM. An area summary of the wetland ecosystems intersected by Project footprint was generated and summarized for both the Baseline and Maximum Disturbance scenarios. Wetland ecosystems include: black spruce-sphagnum (BS), sedge fen (CF), marsh (MA), open water (OW), and willow-sedge (WS). Where clearing and grubbing associated with the Project footprint overlaps directly with wetland ecosystems, direct loss of wetlands is predicted to occur during the maximum disturbance scenario. Indirect effects on wetland ecosystems may occur at the edge of the Project footprint. A change in vegetation community structure will occur within the transmission line footprint where trees and tall shrubs are removed, while the low shrub layer, herbaceous layer, and surface soil remain intact.

Regional context for Project effects on wetland ecosystems is based on the availability of wetland features identified in the TEM prepared for the RAA.

Riparian Ecosystems

The environmental effect of the Project on riparian areas was assessed by overlaying the Project footprint and LAA boundary on the TEM riparian areas. An area summary of the riparian areas intersected by this overlay was then generated and summarized for the baseline and maximum disturbance scenarios. Where the Project footprint overlaps directly with riparian areas, it is assumed that direct loss will occur. A change in structural stage is expected to occur within the transmission line footprint where trees and tall shrubs within riparian areas are removed but the low shrub, herbaceous layer and surface soil remain undisturbed.

Indirect effects on riparian areas may occur along the edge of the Project footprint.

The assessment of the Project effect on riparian areas in a regional context is based on the availability of riparian features identified from the TEM map for the RAA.

Old Forest

The environmental effect of the Project on old forest was assessed using a simple spatial analysis. As with the wetland and riparian indicators, an area summary of the old forest intersected by the Project footprint and LAA boundaries was generated for the baseline and maximum disturbance scenarios. Where the Project footprint overlaps old forest, it is assumed that direct loss will occur. Indirect effects to old forest may occur along the edge of the Project footprint.

Regional context for the assessment of Project effects on old forest is provided by the TEM for the RAA, and by field observations, and general information about forest harvesting history in the RAA.

Traditional Use Plants

The assessment of the Project effect on ecosystems with the potential to support traditional use plants (berries) is based on an analysis of the TEM, field data and information contained in the Na-Cho Nyäk Dun Traditional Knowledge and Use report (Stantec 2010).

To quantitatively assess the potential effects of the Project on traditional use plant species, the relationship between traditional use berry producing species and ecosystems was analyzed. As with other vegetation key indicators, direct losses were determined by identifying the spatial overlap between the five berry potential classes and the Project footprint.

Regional context for the assessment of Project effects on ecosystems rated for traditional use berry potential is provided by the TEM for the RAA, field observations and the traditional use study.

6.8.2 Assessment of Vegetation Loss

6.8.2.1 Description of Vegetation Loss

Site clearing, grubbing and soil handling (removal) are the primary mechanisms for the loss of vegetation within the maximum disturbance footprint. Clearing generally refers to the removal of trees and lesser vegetation but not the disturbance of soil. Grubbing refers to removal of roots and organic layers (and associated ground and soil disturbance) during site preparation. Although some areas within the mine site footprint may only be subject to clearing, it has been assumed that vegetation in these areas will be lost, providing a conservative assessment of potential disturbance within the mine site clearing boundary.

Clearing and grubbing will occur during site preparation for a number of mine components including: the camp and related infrastructure; open pit; waste rock storage areas (WRSAs); heap leach facility (HLF); mine water treatment plant (MWTP); silt borrows and soil stockpiles; roads; and the Dublin Gulch diversion channel. Removal of vegetation will occur during preparation of the transmission line RoW. Larger trees (>8 in diameter) will be removed using a feller buncher or a chainsaw and skidders. Related soil disturbance will be minimized by completing this clearing when ground is frozen. Localized ground disturbance will occur during preparation of site access and pole installation. A description of the transmission line preparation and construction method is provided in Section 5.4.2.2 of the Project Description. Removal of trees and some shrubs within the transmission line footprint has been considered as a change in structure only and is assessed in Section 6.8.4 (Changes in Structure and Composition).

Clearing and grubbing of vegetated sites will also occur during site preparation for the upgrade of the access road.

Loss of vegetation as a result of clearing and grubbing is a key issue for wetland and riparian ecosystems, old forest, and traditional plant use indicators. Loss of vegetation, as it applies to the key vegetation indicators, is described in the following sections.

6.8.2.2 Mitigation Measures for Vegetation Loss

Site clearing, grubbing and soil handling (removal) are the primary mechanisms expected to result in the loss of vegetation within the mine footprint.

The following mitigation measures have been prescribed to protect known rare plant locations during all phases of the Project:

- Flag and stake the known rare plant location near the maximum disturbance boundary and instruct equipment operators to avoid these areas. Conduct regular monitoring of these sites during construction and operations.

The following general mitigation and management measures have been identified to minimize effects to vegetation resources:

- Reduce vegetation loss in areas around the footprint perimeter by adhering closely to construction plans, and avoiding off-site machine use.
- Clear tree and necessary tall shrubs within the transmission line RoW during periods when the ground is frozen and snow covered to minimize the disturbance to low shrubs, the moss layer and topsoil.
- Minimize the extent of grubbing, stripping and the removal of shrubs and herbaceous species where possible.
- When clearing is required, retain the humus layer and vegetation root mat, when possible.
- Minimize disturbance in sensitive areas by implementing best management practices including the creation of buffer zones around riparian and wetland habitats.
- Follow guidelines for prevention of invasive plants introduction and spread as per the Invasive Plants Management Plan during all Project phases (Section 2.6 of Appendix 24 – Eagle Gold Conceptual Closure and Reclamation Plan).

Site clearing, grubbing and soil handling (removal) are the primary mechanisms contributing to the direct loss of vegetation. Reclamation is the primary mitigation for the effects to vegetation and ecosystems.

As the area of wetland disturbed is very small, no wetland reclamation will be undertaken as part of the Closure and Reclamation Phase (Section 5.6). Therefore, the very small Project-related losses to wetlands in the mine site footprint are considered to be permanent.

Reclamation will however be the primary mitigation measure used to address changes in riparian ecosystems as well as ecosystems likely to support traditional use plants. Reclamation is expected to be successful in the restoration of riparian ecosystems along post-closure watercourse. It is also expected to be successful in reestablishing ecosystem conditions that will support traditional use plants; however, it may take several decades to establish abundance similar to off-site ecosystems.

Reclamation is also expected to restore forested ecosystems on suitable sites. However, long time periods are required for re-establishment of old forest conditions.

6.8.2.3 Residual Effects of Vegetation Loss

Residual Effects to Rare Plant Loss

A single population of island purslane was found in the LAA. This population is located outside of the Project footprint and will therefore not be subject to disturbance as a result of clearing activities. As a result, no direct effects on rare plants are anticipated.

There are no residual effects to known occurrences of rare plants.

Residual Effects to Wetlands Loss

A total of 626.4 ha of wetlands are present in the RAA at Baseline. The majority of these wetlands are located in valley bottoms along Haggart and Lynx Creek and along lower slope positions east of the South McQuesten River (Figures 6.8-2 and 6.8-3). At maximum disturbance, a total of 0.01 ha of wetland ecosystems will be disturbed by the Project (Table 6.8-7). Minor loss of wetlands will occur along the road re-alignment (<0.01ha of sedge fen, mapcode CF) and <0.01 ha of willow-sedge wetland (map code WS) and within the mine footprint (<0.01 ha of WS). These losses are so small that they may not be measurable (i.e., within the margin of error of the mapping) or meaningful to the indicator. With mitigation (i.e., buffering and avoidance of wetlands wherever possible) no wetland loss is anticipated.

Table 6.8-7: Project-related Change in Wetland Ecosystems in the RAA

Ecosystem Unit (Map Code)	Baseline		Maximum Disturbance Scenario						Post-closure Change Compared to RAA Baseline	
			Loss by Project Feature				Total Loss (%)			
	RAA (ha)	LAA (ha)	Mine (ha)	Trans Line (ha)	Road (ha)	Total (ha)	% RAA	% LAA	Change (ha)	% Change
BS	478.48	14.70	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00
CF	15.10	1.07	0.0	0.0	0.01	0.01	0.06	0.79	<-0.01	-0.06
MA	19.53	0.21	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00
WS	47.07	5.13	<0.01	0.0	<0.01	0.01	0.1	0.05	<-0.01	-0.01
Subtotal: vegetated ecosystems	560.17	21.11	<0.01	0.0	0.01	0.01	<0.01	0.05	-0.01	<-0.01
OW	66.23	1.06	0.0	0.0		0.0	0.0	0.0	0.00	0.00
Total Wetlands	**626.40**	**22.16**	**<0.01**	**0.0**	**0.01**	**0.01**	**<0.01**	**0.05**	**-0.01**	**-<0.01**

At post-closure a very small area of wetlands will be irreversibly lost as a result of the construction of the permanent access road upgrades. With the implementation of the prescribed mitigation measures, including reclamation, the effect of wetland loss is expected to be negative in direction, negligible in magnitude, local in extent, permanent, and irreversible. While not numerical, there is a federal policy that can be applied to the assessment of the wetland indicator for lands. The federal government has a broad objective to "*promote the conservation of Canada's wetlands to sustain their ecological and socio-economic functions, now and in the future*" (Government of Canada 1991). This very small magnitude loss will not affect the sustainability of wetlands in the RAA in the future.

Residual Effects to Riparian Areas

There are a total of 2,060 ha of riparian ecosystems in the RAA at baseline (Table 6.8-8; Figures 6.8-4 and 6.8-5). These riparian areas consist of about 901 ha of TEM specific riparian and 1,159 ha of NTS riparian areas.

At maximum disturbance, the Project will affect 20.2 ha of total riparian area representing <1% of the total riparian area in the RAA. Construction of the mine site and road upgrade will result in the disturbance of 19.6 ha and 0.5 ha of total riparian area, respectively. Overall, 14.2 ha of this cleared riparian area is vegetated and is comprised of 7.9 ha of white spruce-horsetail (SH), 4.7 ha of willow-groundsel (WG), 0.1ha of willow-horsetail (WH), <0.1 ha of poplar-horsetail (PH), and 1.7 ha of other miscellaneous ecosystems. The mine site footprint will result in the greatest proportion of this loss (13.4 ha) with about 0.5 ha of vegetated riparian ecosystems loss expected to be caused by the road upgrade.

Table 6.8-8: Project-related Change in Riparian Ecosystems in the RAA

Ecosystem Unit (Map Code)	Baseline		Maximum Disturbance Scenario						Post-closure Change Compared to RAA Baseline	
			Loss by Major Project Feature			Loss By Riparian Type				
	RAA (ha)	LAA (ha)	Mine (ha)	Trans Line (ha)	Road (ha)	Total (ha)	% RAA	% LAA	Change (ha)	% Change
TEM Riparian										
PH	15.97	1.54	0.03	0.0	0.0	0.03	0.19	1.95	-0.03	-0.19
SH	494.32	65.07	7.02	0.0	0.27	7.29	1.47	11.20	-6.27	-1.27
WG	79.42	30.68	4.72	0.0	0.00	4.72	5.94	15.38	16.75	21.1
WH	35.82	3.34	0.06	0.0	0.02	0.08	0.22	2.40	-0.08	-0.21
Other Codes	157.82	25.87	1.58	0.0	0.13	1.71	1.08	6.61	-1.23	-0.19
Subtotal: TEM vegetated	783.34	126.50	13.40	0.0	0.50	13.9	1.77	10.99	9.15	1.17
GB	16.15	1.67	0.04	0.0	0.0	0.04	0.25	2.40	-0.04	-0.24
RI	101.53	12.21	0.29	0.0	0.08	0.37	0.36	3.03	-0.37	-0.36
Subtotal: TEM non-vegetated	117.68	13.88	0.33	0.0	0.08	0.41	0.35	2.95	-0.41	-0.35
Total TEM	**901.02**	**140.38**	**13.74**	**0.0**	**0.50**	**14.24**	**1.58**	**10.146**	**8.74**	**0.97**
NTS Riparian										
NTS	1,159.18	22.43	5.88	0.0	0.04	5.92	0.51	26.39	0.65	0.06
Total Riparian	**2,060.20**	**162.81**	**19.62**	**0.0**	**0.54**	**20.16**	**0.98**	**12.38**	**9.39**	**0.46**

Following de-commissioning, reclamation efforts will result in an overall increase of about 9 ha (<1%) in the amount of riparian ecosystems within the RAA. This is largely due to an increase in willow-groundsel ecosystem that will be established during reclamation (an increase in 16.8 ha in this unit relative to baseline). A residual loss of 6.3 ha (1.3%) of the spruce-horsetail and minor losses (<0.1 ha) of the willow-horsetail and poplar-horsetail ecosystems will occur following reclamation.

With the implementation of the prescribed mitigation measures, including reclamation, the change in riparian areas is positive in direction, negligible in magnitude, local in extent and reversible.

Residual Effects to Old Forest

Old forest occupies 1,237.8 ha (10.7%) of the RAA landscape at Baseline. At maximum disturbance, 90.8 ha of old forest will be lost; this represents about 7.3% of the old growth present in the RAA at baseline (Table 6.8-9; Figures 6.8-6 and 6.8-7). The majority (84.4 ha; 93.0%) of this loss is associated with clearing of vegetation for the mine site. An additional 6.2 ha and 0.2 ha will be lost due to construction of the transmission line and upgrades to the access road, respectively.

Table 6.8-9: Project Related Change in Old Forest in the RAA

Ecosystem Unit (Map Code)	Baseline		Maximum Disturbance Scenario						Post-closure Change Compared to RAA Baseline	
			Loss by Major Project Feature			Total Loss				
	RAA (ha)	LAA (ha)	Mine (ha)	Trans Line (ha)	Road (ha)	Total (ha)	% RAA	% LAA	Change (ha)	% Change
FC	423.19	133.13	52.89	0.09	<0.01	52.99	12.52	39.80	-52.99	-12.52
FF	205.50	46.64	14.15	0.00	0.00	14.15	6.89	30.34	-14.15	-6.89
FM	119.63	1.45	0.00	0.00	0.00	0.00	0.00	0.00	-0.00	-0.00
FP	107.13	19.37	1.78	0.00	0.00	1.78	1.66	9.19	-1.78	-1.66
SF	4.58	4.58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SH	357.08	52.35	3.76	6.06	0.21	10.03	2.81	19.16	-10.03	-2.81
SL	20.68	11.82	11.82	0.00	0.00	11.82	57.15	100.03	-11.82	-57.15
Totals	**1,237.79**	**269.33**	**84.41**	**6.15**	**0.21**	**90.77**	**7.33**	**33.70**	**-90.77**	**-7.33**

This old forest loss can be placed in context by considering the distribution of other forested structural stages present in the RAA. About 3,301 ha of mature forest will be present in the RAA following development of the Project (Table 6.8-9). This represents about 28% of the total RAA area. Mature forest range between 80 and 140 years in age. If the patches are randomly distributed over six, ten year intervals, about 330 ha of forest would be recruited into the old class every decade assuming no further reduction due to natural disturbances (e.g., fire). If the majority of mature forest in the RAA is currently in the 80 – 100 year old age, it may take several decades to replace with natural recruitment.

There will be a residual loss of 90.8 ha of old forest as a result of the Project. This represents a 7.3% reduction in the old forest area in the RAA relative to baseline. Although forested ecosystems will be reclaimed at closure, the change in old forest is considered permanent since the effect extends into the far future. The change is negative in direction, occurs once, is local in extent, permanent in duration and is only reversible in the far-future (>140 years). The loss is low in magnitude and within the range of natural variability in boreal forest ecosystems due to the high frequency of stand-replacing natural disturbance events (i.e., wildfire) in this region of Yukon (Yukon Ecoregions Working Group. 2004; Wildland Fire Review Panel 2004).

Residual Effects to Ecosystems with High Potential for Traditional Plant Use

The high and moderate berry potential class occupy 990.6 ha (8.6%) and 7,265.70 ha (63.0%, respectively of the RAA at baseline. (Table 6.8-10; Figures 6.8-8 and 6.8-9). The greatest loss of ecosystems likely to support traditional use berry species occurs in the moderate berry potential class (400.8 ha; 5.5% of the RAA). A total of 29.7 ha (3.0%) of the high potential class will be effected at maximum disturbance. The majority of the losses (440.0 ha) are associated with clearing and grubbing to facilitate construction of the mine site. No specific berry harvesting areas were identified within the mine site area during the FNNND traditional knowledge and use study. Many FNNND participants in the study indicated that mine site “is already so disturbed by past mining activities that they cannot use it for berry picking” (Stantec 2010).

Table 6.8-10: Project Related Change in Traditional Use Berry Potential in the RAA

Traditional Use Berry Potential Class	Baseline		Maximum Disturbance Scenario						Post-closure Change Compared to Baseline	
			Total Loss	Loss by Major Project Feature			Change at Maximum Disturbance			
	RAA (ha)	LAA (ha)	(ha	Mine (ha)	Trans Line (ha)	Road (ha)	RAA (%)	LAA (%)	(ha)	%
High Potential	990.64	136.47	29.74	8.59	20.79	0.36	3.00	21.79	-7.61	-0.77
Moderate Potential	7,265.70	981.99	400.77	330.54	68.83	1.40	5.52	40.81	-30.77	-0.42
Low Potential	2194.79	584.99	92.60	91.14	1.28	0.18	4.22	15.83	1.98	0.09
Very Low Potential	38.21	106.80	12.81	8.96	2.77	0.03	3.37	13.16	98.54	25.92
Nil Potential (Non-vegetated)	266.55	29.59	6.54	4.83	1.63	0.08	2.45	22.11	77.4	29.05
Disturbances	429.34	322.98	–	–	–	–	–	–	–	–
Totals	**11,527.23**	**1830.37**	**542.45**	**444.06**	**95.31**	**2.04**	**–**	**–**	**–**	**–**

A residual loss of approximately 7.6 ha and 30.8 ha of the high and moderate traditional use berry sites, respectively, will occur at post-closure. However, both of these changes represent a loss of <1% of the classes in the RAA compared to baseline.

Following the implementation of the prescribed mitigation measures, including reclamation, the effect of the Project on traditional use berry sites that had been ranked as having a high and moderate potential, is expected to be negative in direction, negligible in magnitude, local in extent, permanent, and reversible.

6.8.2.4 Determination of Significance of Vegetation Loss

Assuming application of prescribed mitigation and environmental protection measures, the residual loss of wetland ecosystems is very small in area and is considered to be negligible in magnitude in the context of the RAA. Therefore, this residual loss is considered to be not significant with respect to the sustainability of wetland ecosystems in the RAA.

The TEM wetland ecosystem area calculation is considered to have a high degree of accuracy. This is because the wetland ecosystem units were delineated by an experienced photo interpreter in a well surveyed mine site. The Project effect mechanism is clear—direct loss as result of the Project footprint with no wetland reclamation undertaken in the closure and post-closure phases. Therefore, the overall confidence in the residual effect prediction and significance determinations is high for wetland ecosystems.

With the implementation of the prescribed mitigation measures, including reclamation, a small increase in riparian ecosystem area is expected at post-closure. Therefore the residual effect of Project activities on riparian ecosystems is considered to be not significant.

The TEM riparian accuracy is expected to have a moderately high degree of accuracy as the delineation within the Project footprint and LAA is based on mapping completed by an experienced photo interpreter with field survey data. Confidence in the NTS riparian area is moderate since the interpretation is based on buffering watercourse data with a coarser spatial resolution. The effect mechanism is clear—direct loss of the indicator through site clearing at construction. Overall, the confidence in the residual effect prediction and significance determination for the riparian ecosystem indicator is moderately high.

Assuming application of prescribed mitigation and environmental protection measures, the residual loss of old forest is local in extent and moderate in magnitude in context of the RAA. The loss is permanent and irreversible in the context of the Project (i.e., the effect extents for greater than 25 years). However, a large area of mature forest is present in the RAA that will provide recruitment of old forest outside the footprint following closure. Therefore, this residual loss is considered to be not significant with respect to the sustainability of old forest in the RAA.

The extent of the old forests in the TEM is based on mapping completed by an experienced photo interpreter and on field data. However, the accuracy of the data is moderate since age may be more difficult to interpret than other ecosystem attributes. The effect mechanism is clear—clearing of old forest once during construction. Therefore, this residual loss is considered to be not significant with respect to the sustainability of old forest in the RAA.

Following reclamation, the residual effect of the Project on traditional use berry sites ranked with high and moderate potential is considered to be negative in direction, negligible in magnitude, local in extent, permanent, and reversible. Given that the changes to the high and moderate classes are negligible in the regional context and are confined to a local geographic area (within Dublin Gulch) the overall effect to traditional use berry sites is not significant.

The traditional use berry potential ratings are based on TEM ecosystems delineated by an experience photo interpreter with good coverage of field data for the Project footprint and LAA. The calculation of the berry index is also based on species-cover data from the field surveys. The effect mechanism is clear - direct loss through site clearing at construction. Confidence of the ratings is moderate due to the variation in cover and abundance that may be present within ecosystems. Therefore, the overall confidence in residual effects and significance determination to for traditional use berry potential is moderate.

In summary, the residual effect of vegetation loss is not considered a threat to the sustainability of the resource or indicators in the region. The potential effect of vegetation loss for all of the indicators selected to assess this effect was determined to be not significant, leading to the conclusion that the effect of vegetation loss, as a result of the Project, is not significant on vegetation resources. Based on the assessment done for each indicator, the confidence in this prediction is moderately high.

Follow up or monitoring programs are proposed for vegetation. Post-closure monitoring of vegetation and ecosystems will be undertaken as a component of the Closure and Reclamation Phase (Section 5.6).

6.8.3 Assessment of Changes to Abiotic Conditions

6.8.3.1 Description of Abiotic Changes

Project construction and operations activities have the potential to alter abiotic conditions (non-living components of the environment such as soil or hydrology that affect living organisms) and affect vegetation outside of the maximum disturbance footprint. These indirect effects may result from changes in hydrologic conditions (i.e., near-surface groundwater flow/seepage, or surface water movement) or as a result of dust deposition (i.e., potential increases in soil metal levels as a result of dust generated during operations). Potential changes to hydrologic or soil moisture conditions may potentially affect rare plants, wetlands and riparian ecosystems and dust deposition may affect areas supporting traditional use plant species. Increased levels of metals in soils near the mine site are predicted as a result of dust deposition generated during the operations phase (Section 6.4). Dust may be generated during open pit mining activities (i.e., blasting, ore/waste hauling) and ore processing (i.e., crushing and conveyance). Potential effects on plants include: 1) accumulation of dust on the surface of plants that may alter biological processes (i.e., exchange of gases); and 2) increased metal concentration in plant tissue as a result of uptake of elevated metal levels in soils.

6.8.3.2 Mitigation Measures for Changes to Abiotic Conditions

The following general mitigation and management measures have been identified to minimize effects to vegetation resources including the key indicators:

- Adherence to the Combustion Source Control Plan and Fugitive Dust Control Plan (Section 6.6)
- Sampling of vegetation (plant tissue) within the area of predicted metals loading to the east of the mine site. Additional dust mitigation measures will be applied if soil monitoring confirms the predicted loading increase (>10% increase above the baseline).
- Maintain existing drainage patterns to and from wetlands in areas outside of the maximum disturbance footprint.
- Establish and maintain buffers between Project activities and wetlands adjacent to but outside of the maximum disturbance footprint.
- Revegetation of disturbed soils and vegetation where appropriate to encourage slope stability and minimize soil degradation and erosion (see Appendix 24).
- Hand cutting of vegetation will be employed near access road stream crossings to reduce disturbance to riparian areas during construction of the transmission line.
- When clearing is required, retain the humus layer and vegetation root mat to the extent practical, to reduce the potential for soil erosion and deposition in riparian and wetland ecosystems.

In general, mitigation measures that minimize the loss of vegetation are also applicable to the mitigation of changes to abiotic conditions (see Section 6.8.2.2).

6.8.3.3 Residual Effects of Changes to Abiotic Conditions

Rare Plants

One occurrence of a rare species was recorded in the LAA. The population of island purslane (*Koenigia islandica)* (Figure 6.8-2) is separated from the closest Project activity (road construction) by three factors: it is across Bawn Boy Gulch; 170 m higher in of elevation; and 600 m of linear distance away. Because this population is “upstream” of the Project activities, changes in abiotic conditions arising from the Project are not expected and will not be considered further.

Wetland Ecosystems

The greatest potential for changes to the abiotic conditions necessary to support wetland ecosystems occurs during construction and the operations phases. Potential Project effects are primarily related to activities that interrupt the connection between upland shedding sites and downslope receiving areas, potentially leading to flooding, drying or increased siltation of wetlands.

Wetland ecosystems require very specific soil moisture and nutrient regime conditions for development, function, persistence, and recovery. Therefore, wetlands are not expected to recover or be restored to their original condition if these fundamental abiotic conditions are substantially altered by Project activities.

Construction of the waste rock storage areas and heap leap facility will change abiotic conditions in the mine site during the operations phase. The expected changes to soil moisture are described in the assessment of soils (Section 6.4). However, there are few wetlands in the LAA in the vicinity of the mine site and measurable effects to wetlands located outside the footprint as a result of the mine construction and operations are not expected.

The black spruce-sphagnum (BS) and marsh (MA) ecosystems constitute the majority of the wetlands downslope of Project activities (i.e., the road upgrade) and are primarily located along the road to the east and north of the corridor (Figure 6.8-3). However, since road construction is limited to a few alterations to an existing road, the potential for adverse effects to abiotic conditions for wetlands is very limited. Where required, standard mitigation measures and best management practices, such as culvert installation or erosion and sediment control measures will be applied (see Sections 5.4.2.1; 6.4.2; and Appendix 24) to minimize the potential for abiotic changes to wetlands. Therefore, no changes are predicted that might adversely affect wetland ecosystems outside of the Project footprint. Consequently, the potential effects to wetlands as a result of changes in hydrologic conditions or soil moisture is not considered further in the assessment.

There are no predicted residual effects to wetland ecosystems as a result of changes to abiotic conditions.

Riparian Ecosystems

As with wetlands, the greatest potential for changes in abiotic conditions for riparian ecosystems is expected to occur during the construction and operations phases. Project activities that interrupt the connection between upland, water-shedding sites and downslope receiving areas could lead to alteration of natural drainage regimes and events outside of the Project footprint. To a substantial extent, though, riparian ecosystems are subject to variable water levels during different seasons and have a natural resilience to changes in hydrologic conditions.

Change in soil moisture conditions are predicted for riparian areas in the upper portions of Olive, Bawn Boy and Cascallen Gulches (See Section 6.4; Figure 6.8-4). The affected sites are located in the upper portions of the gulches in areas were riparian ecosystems are narrow and defined by the landscape (i.e., slope and site position). Reduction in soil moisture may result in minor change to species composition and stand structure but is not expected to eliminate the riparian area because the sites are located in the moisture receiving portion of the landscape. Given the considerations above, meaningful changes to riparian area vegetation in the LAA in the vicinity of the footprint are not expected.

Road construction has the potential to affect downslope riparian communities along the length of Haggart Creek (Figure 6.8-5). However, these activities are minor in nature and limited in extent and the potential for substantive effects to downstream riparian areas is very limited. Standard mitigation measures and best management practices for riparian area management are expected to address potential effects. Mitigation measures designed to maintain natural drainages, control erosion and dust deposition will reduce the potential for other changes to abiotic conditions that could adversely affect riparian areas outside of the Project footprint (Sections 5.4.2.1; 6.4.2; and Appendix 24). The residual effects to riparian ecosystems as a result of changes to abiotic conditions, specifically decreasing of soil moisture conditions in the upper reaches of Dublin Gulch tributaries, is predicted to be negligible to low in magnitude, local in extent, and reversible.

Ecosystems with High Potential for Traditional Plant Use

Ecosystems in the Project TEM mapping prepared for the LAA and RAA were rated for traditional use berry potential using a five class system from high potential to nil potential. Indirect effects to potential traditional use berry sites that are outside of the Project footprint are predicted as a result of metal loadings to soil from dust deposition and potential uptake by vegetation. The CCME (1999) soil quality guideline for agricultural land was used for the assessment of metals loading to soils (see Soils, Section 6.4.1.9). In the soils assessment, a threshold is exceeded if the elemental concentration was below the CCME level at baseline and is predicted to increase to a level above the guideline at operations. Or, in the case of arsenic, if the baseline concentration is naturally above the guideline then a predicted increase of 10% in the concentration during operations is considered as a notable change. Based on this approach, arsenic concentrations are predicted to increase by 10% or greater outside the Project footprint during operations. As a result, these areas are considered unsuitable for traditional plant use. The potential for affects associated with increased metals concentrations are discussed further in the Qualitative Human and Ecological Health Assessment (Appendix 31).

Arsenic concentrations in soil resources are predicted to increase by 10% or greater over a total area of 103.82 ha (Table 6.8-11); this includes 72.01 ha of land outside of the Project footprint (Figure 6.8-10). A total of 2.88 ha of land classed as having moderate traditional use berry potential is predicted to be affected by the arsenic deposition in the LAA. The predicted arsenic loading will affect much less than one percent of the moderate potential class found within the RAA at baseline. No land ranked with high potential is affected in the LAA. Arsenic loading is predicted to affect about 18.44 ha (0.16%) of land in the RAA (beyond the LAA boundary). No lands in the high or moderate ranked traditional use berry potential class are affected by this loading. It is important to remember that the existing baseline arsenic concentrations in soils in the Dublin Gulch are well above the CCME (1999) agricultural guideline. Vegetation in the vicinity of Dublin Gulch appears to be adapted to these high concentrations. Despite the high baseline levels of arsenic in the soil, results of vegetation sampling conducted at nine sites in the LAA indicate that trace metal concentrations in plant tissue were below toxic levels for dietary intake by cattle for all sites and vegetation species (based on dietary guidelines outlined in Puls [1994]). Consequently, although the Project Proposal predicted an increase in arsenic concentrations in soil, it does not necessarily follow that there will be a proportional increase of arsenic in plant tissue or that this increase will exceed toxic levels for dietary intake by cattle.

Table 6.8-11: Effects to Traditional Use Berry Potential due to Arsenic Loading in the RAA

Traditional Use Berry Potential Class	Baseline		Maximum Extent of Arsenic Loading						
			Total Extent	LAA				RAA	
	RAA (ha)	LAA (ha)	(ha)	Total (ha)	Mine Footprint (ha)	Outside Footprint (ha)	% Outside Footprint	(ha)	%
High Potential	990.64	136.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Medium Potential	7,265.70	981.99	6.99	6.99	4.11	2.88	0.04	0.00	0.00
Low Potential	2,194.79	584.99	92.46	74.73	6.52	68.21	3.11	17.73	0.81
Very Low Potential	38.21	106.80	0.99	0.28	0.00	0.28	0.74	0.71	1.85
Nil Potential (Non-vegetated)	266.55	29.59	3.38	3.38	2.74	0.64	0.24	0.00	0.00
Totals	**11,527.23**	**1830.37**	**103.82**	**85.38**	**13.37**	**72.01**	**0.62**	**18.44**	**0.16**

A discussion of the limitations of the dust deposition model and resultant soils loading are included in the Air Quality and Soils assessments (Sections 6.6 and 6.4, respectively). The Combustion Source Control Plan and Fugitive Dust Control Plan (Section 6.6) will minimize the potential for abiotic changes to vegetation resources beyond the area disturbed by the Project footprint. The Qualitative Human Health and Ecological Risk Assessment concludes that it is unlikely that there would be a significant increase in arsenic exposure for either humans or wildlife in the LAA or RAA given the limited areas of potential arsenic deposition and the conservatism built into the modeling exercise (Appendix 31, Section 6.2.2) However, because of the predicted increase above baseline conditions outside the mine footprint, soil and vegetation monitoring for metals loading will be undertaken during all phases of the Project. Berries will be included in this monitoring program. The land area covered by monitoring will be posted with appropriate information concerning monitoring results during all phases. If loading does increase 10% above baseline conditions additional dust suppression mitigation will be applied (see Section 6.4) and potential risk to humans, vegetation and wildlife will be further assessed.

The residual effects to the sites ranked with moderate traditional berry use potential as a result of arsenic loading are considered to be negative, local in extent, negligible in magnitude, frequent in occurrence, far future in extent and irreversible. The probability of occurrence is judged to be moderate. There is no residual regional effect to high and moderate ranked lands based on metals loading in the RAA. Again, the probability of occurrence of this effect is judged to be moderate.

6.8.3.4 Determination of Significance of Changes to Abiotic Conditions

The residual change in soil moisture conditions in the upper reaches of Dublin Gulch may result in a low magnitude and local residual effect to riparian ecosystems. Therefore, the effect of changes in abiotic conditions to riparian landscapes (i.e., decreased soil moisture) is considered not significant. The extent of riparian ecosystems in the gulches is based on the TEM and the proximity to the watercourses. However, the effect mechanism is not fully understood as the prediction of the change to riparian ecosystems is based on the predicted effects of the Project on soil moisture via groundwater modeling. Changes to near surface moisture levels may not occur with the groundwater drawdown. Confidence in the prediction is low to moderate given the distance from the Project footprint and the location of these sites in the landscape. Therefore, the overall confidence in residual effects and significance determination to riparian ecosystems as a result of a decrease in soil moisture is low to moderate.

Assuming the application of prescribed mitigation and environmental protection measures, the permanent residual loss of areas of moderate ranked traditional use berry potential is considered to be local in extent and negligible in magnitude. Therefore, the effect of the dust deposition on high and moderate ranked traditional use berry sites is considered to be not significant.

The mitigation measures that are appropriate to dust suppression and metals loading have been applied to the modeling process. Mitigation post dispersion is generally not feasible; the affected land lies beyond the mine site footprint. As discussed in the assessment of the direct loss of traditional use berry sites in Section 6.8.2, the area in the vicinity of the Project does not have any known traditional used berry picking sites. Many FNNND citizens also consider the area in vicinity of the Project to have low value for traditional plant use because of the existing level of disturbance (Stantec 2010); it is not clear however, if this perception of value extends into the upper part of Dublin Gulch. The area is also somewhat inaccessible (without the exploration roads) as the affected lands are located in the middle to upper elevations of Dublin Gulch and the adjacent plateau.

The extent of the ecosystems with high and moderate potential for berry production in the LAA and RAA is based on mapping and field surveys. The effect mechanism is not certain as it is based on the assumption that the predicted metals loading in soils will result in bioaccumulation in plants. There is a moderate level of uncertainty with respect to the predicted metals loading associated with the dust model (see Air Quality and Soils assessments, Sections 6.6 and 6.4, respectively). Therefore, confidence in the prediction of Project effects and significance determination is considered to be moderate.

In summary, the residual effect of vegetation loss is not considered a threat to the sustainability of the resource or indicators in the region. The potential effect of changes to abiotic conditions for the indicators selected to assess this effect were determined to be not significant, leading to the conclusion that indirect changes to abiotic conditions beyond the Project footprint, is not significant on vegetation resources. Based on the assessment completed for each indicator and the conservation assumptions built into the modeling, the confidence in this prediction is moderate.

Follow up or monitoring programs are proposed for vegetation in the affected area. Monitoring will be undertaken from the construction through post-closure phases.

6.8.4 Assessment of Change in Ecosystem Structure or Composition

6.8.4.1 Description of Changes to Structure or Composition

Clearing of the transmission line RoW during the construction phase will remove trees and tall shrubs while lesser vegetation and the surface soil layer will be left intact. The resultant change in stand structure will persist through the operations phase as vegetation in the RoW is maintained to allow access and avoid interference with transmission lines. Changes in stand composition may also occur in ecosystems within and adjacent to the RoW because of potential establishment and/or dispersal of invasive or non-native plants. For wetland ecosystems and riparian areas change in stand structure and composition is a key concern within the transmission line RoW.

6.8.4.2 Mitigation Measures for Changes to Structure or Composition

The following general mitigation and management measures have been identified to minimize affects of changes to community structure or composition:

- Implement the Invasive Plant Management Plan (Section 2.6 of Appendix 24).
- Adhere to the construction practices established for transmission line (Section 5.4.2.2) including the removal of trees and tall shrubs to periods of frozen ground with snow cover.
- Maintain vegetative buffers around both wetland and riparian ecosystems.
- Minimize the extent of grubbing, soil stripping and the removal of shrubs and herbaceous species, where possible, to reduce the area of bare ground potentially subject to invasive plant establishment.
- Mitigate against the establishment of invasive species and reduce erosion potential by re-establishing native vegetation on disturbed areas as soon as possible.
- Ensure that construction equipment is clean and free of soil and seeds before mobilizing to the Project site.
- Hand cutting of vegetation will be employed near access road and transmission line stream crossings to reduce disturbance to riparian areas.
- Use of native species, to the greatest extent possible, during all Project phases, but most specifically during closure and reclamation phases (Section 5.6; Appendix 24) to revegetate disturbed sites.

Prescribed mitigation measures for wetland and riparian ecosystems largely reflect those already described for the direct vegetation loss. Incremental mitigations prescribed for the transmission line include the following measures to minimize disturbance:

- Minimize the removal of shrubby vegetation (brushing) in wetland and riparian areas

- Schedule construction activities so that activities in or adjacent to wetlands and riparian areas occurs when ground is frozen to minimize soil compaction and damage to shrubby and herbaceous vegetation
- Deliver transmission line poles to wetland areas using the existing access road
- Minimize the footprint pole foundations and associated side cast material.

6.8.4.3 Residual Effects of Changes to Structure or Composition

Rare Plants

As mentioned in Section 6.8.3.1, Bawn Boy gulch, the elevation gain (170 m), and the linear distance (600 m) from Project activities all serve to create a barrier between the proposed Projects and the single rare plant population identified in the LAA. This barrier minimizes the likelihood of invasive plants (i.e., changes in species composition) affecting the rare plant location as a result of the proposed Project activities. Therefore, this issue is not considered further in this section.

Wetlands

There is some potential for changes in the structure and composition of wetland ecosystems to occur during the construction and operations phases. The spread of invasive plants along cleared edges is the primary effect mechanism for change in community composition. During the construction and operations phases, invasive plants may become established in wetlands via equipment and by movement of species along new edges created along the road and transmission line corridor. These species can compete with native species and potentially change the suitability of habitat for wildlife.

Best management practices for construction and operation of the transmission line in concert with environmental management measures (e.g., Invasive Plant Management Plan, Section 2.6, Appendix 24) are expected to effectively limit the potential changes to the structure and composition of wetlands, except for the small area discussed below.

During construction and operations, the structure of the forested wetland ecosystems will be altered by the removal of trees (and some shrubs) along the transmission line corridor. A total of 4.3 ha of wetlands occur within the proposed transmission line corridor. Four wetland ecosystems may be affected by this change in habitat structure or species composition: black spruce-sphagnum bog (mapcode BS, 2.8 ha), sedge fen (mapcode CF, 0.2 ha), willow sedge wetland (mapcode WS, 1.1 ha), and willow-horsetail wetland (mapcode WH, 0.8 ha) (Table 6.8-12; Figure 6.8-3). No effects are anticipated to the open water wetland (mapcode OW, 0.2 ha) because these wetlands lack terrestrial vegetation and will be avoided during construction. Alteration of community structure will occur within the black spruce-sphagnum wetland (2.8 ha) as a result of tree removal during the construction and operations phases. It is anticipated that where wetlands cannot be avoided, installation of the poles will only result in a very minor loss of wetland area.

Table 6.8-12: Project-related Clearing Effects on Wetland Ecosystems Structure and Composition in the RAA

Ecosystem Unit (Map Code)	Baseline		Maximum Disturbance Scenario						Post-closure Change Compared to RAA Baseline	
			Cleared Area by Project Feature				Total Loss (%)			
	RAA (ha)	LAA (ha)	Mine (ha)	Trans Line (ha)	Road (ha)	Total (ha)	% RAA	% LAA	Change (ha)	% Change
BS	478.48	14.70	0.0	2.83	0.0	2.83	0.59	19.25	0.0	0.0
CF	15.10	1.07	0.0	0.22	0.0	0.22	1.46	20.56	0.0	0.0
MA	19.53	0.21	0.0	<0.01	0.0	<0.01	0.01	0.54	0.0	0.0
WS	47.07	5.13	<0.01	1.09	0.0	1.10	2.34	21.44	0.0	0.0
Subtotal: vegetated ecosystems	560.17	21.11	<0.01	4.15	0.0	4.15	0.74	19.61	0.0	0.0
OW	66.23	1.06	0.0	0.17	0.0	0.17	0.26	16.04	0.0	0.0
Total Wetlands	**626.40**	**22.16**	**<0.01**	**4.32**	**0.0**	**4.32**	**0.69**	**19.45**	**0.0**	**0.0**

At post-closure, the structure of black spruce-sphagnum wetland is expected to return to pre-construction condition as trees re-establish and grow.

In total, the transmission line will overlap with less than one percent of the wetland area present in the RAA at baseline. Following closure of the transmission line, tree cover is expected to reestablish in previously forested wetlands. As minimal grubbing or site leveling is planned during construction or operation of the transmission line, no substantial changes to wetland soils are expected. Therefore, at post-closure, it is anticipated that the decommissioning and reclamation process will allow wetland ecosystems along the transmission line to return to their pre-disturbance state.

Assuming application of the prescribed mitigation measures, any change in wetland community and structure within the transmission line is expected to be very small in the context of the RAA. As a result, the residual effect to wetland ecosystems is expected to be neutral, negligible in magnitude, local in extent, and reversible over time.

Riparian Ecosystems

Potential for changes in the structure and composition of riparian ecosystems are related to clearing of trees and tall shrubs in the transmission line corridor. Alteration of stand structure because of removal of trees will primarily affect the forested SH ecosystem (7.4 ha) (Table 6.8-13).

Table 6.8-13: Project-related Clearing Effects to Riparian Ecosystem Structure and Composition in the RAA

Ecosystem Unit (Map Code)	Baseline		Maximum Disturbance Scenario						Post-closure Change Compared to RAA Baseline	
			Area by Major Project Feature			Area				
	RAA (ha)	LAA (ha)	Mine (ha)	Trans Line (ha)	Road (ha)	Total (ha)	% RAA	% LAA	Change (ha)	% Change
TEM Riparian										
PH	15.97	1.54	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SH	494.32	65.07	0.0	7.39	0.0	7.39	1.49	11.36	0.0	0.0
WG	79.42	30.68	0.0	0.59	0.0	0.59	0.74	1.92	0.0	0.0
WH	35.82	3.34	0.0	0.79	0.0	0.79	221	23.65	0.0	0.0
Other Codes	157.82	25.87	0.0	3.29	0.0	3.29	2.08	12.72	0.0	0.0
Subtotal: TEM vegetated	783.34	126.50	0.0	12.05	0.0	12.06	1.54	9.53	0.0	0.0
GB	16.15	1.67	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RI	101.53	12.21	0.0	1.46	0.0	1.46	1.44	11.96	0.0	0.0
Subtotal: TEM non-vegetated	117.68	13.88	0.0	1.46	0.0	1.46	1.24	10.52	0.0	0.0
Total TEM	**901.02**	**140.38**	**0.0**	**13.51**	**0.0**	**13.51**	**1.50**	**9.63**	**0.0**	**0.0**
NTS Riparian										
NTS	1,159.18	22.43	0.0	0.63	0.0	6.53	0.05	2.81	0.0	0.0
Total Riparian	**2,060.20**	**162.81**	**0.0**	**14.14**	**0.0**	**14.14**	**0.69**	**8.69**	**0.0**	**0.0**

In addition, indirect effects may occur as a result of potential establishment of invasive plants that could be introduced to riparian areas via equipment and dispersal from existing populations in adjacent disturbances (i.e., the access road). Changes to structure or composition may affect the following riparian ecosystems: white spruce-horsetail forest (mapcode SH, 7.4 ha), willow-groundsel shrubland (mapcode WG, 0.6 ha), and willow-horsetail wetland (mapcode WH, 0.8 ha). In addition, 3.3 ha of other ecosystems associated TEM riparian polygons and 0.6 ha of NTS riparian areas may be affected by changes in community structure. Overall, construction of the transmission line will overlap with about 14.1 ha of riparian area. This represents less than 1% of the riparian area present in the RAA at baseline.

Mitigation measures, such as retention of vegetated buffers between disturbances and riparian areas, will minimize changes to structure and composition of riparian ecosystems. Implementation of the Invasive Plant Management Plan (Section 2.6 of Appendix 24) is intended to eliminate any

Project-related incursion of invasive species into the riparian ecosystems near the footprint beyond existing areas of disturbance.

At post-closure, the structure of the riparian areas affected by construction and operations phases is expected to return to pre-disturbance conditions. Assuming application of prescribed mitigation and environmental protection measures, the residual effect of the Project on riparian ecosystems due to change in stand structure or composition is expected to be neutral, negligible in magnitude, local in extent and reversible.

Ecosystems with Potential for Traditional Use Plants

Potential for change to the structure and composition of ecosystems ranked with high and moderate traditional use berry potential will occur during the construction and operations phases. Removal of tree cover during the construction phase will change the structure of existing forested ecosystems (i.e., young, mature and old forest) to a shrub-herb stage. In addition, potential changes to community composition may occur whereby invasive plants become introduced into the ecosystems. Invasive plants may be transferred to the transmission line via equipment and by dispersal from adjacent existing disturbances (i.e., the access road).

Approximately 95.3 ha of land with potential for traditional use berry production will be affected by construction of the transmission line. All of the lands rated with high and moderate potential consist of forested ecosystems. In total, 20.8 and 68.8 ha of high and moderate potential sites, respectively, will be affected by clearing of trees (Table 6.8-14). This represents about 2.1 and 1% of the area occupied by these two classes in the RAA at baseline. However, berry production is dependent on several factors ranging from physical site characteristics, annual weather conditions to light availability. Clearing of trees during the construction phase will alter the structure of forested ecosystems (i.e., young, mature and old forest) resulting in conversion to early seral shrub-herb communities. Some early seral berry-producing shrub species may have a positive response (i.e., greater cover and berry production) with increased light due to tree removal (Hauessler, et al. 1990).

Table 6.8-14: Project Related Clearing Effects to Traditional Use Berry Potential in the RAA

Traditional Use Berry Potential Class	Baseline		Maximum Disturbance Scenario						Post-closure Change Compared to Baseline	
			Total Loss	Loss by Major Project Feature			Change at Maximum Disturbance			
	RAA (ha)	LAA (ha)	(ha	Mine (ha)	Trans Line (ha)	Road (ha)	RAA (%)	LAA (%)	(ha)	%
High Potential	990.64	136.47	20.79	0.0	20.79	0.0	2.10	15.23	0.0	0.0
Moderate Potential	7,265.70	981.99	68.83	0.0	68.83	0.0	0.95	7.01	0.0	0.0
Low Potential	2194.79	584.99	1.28	0.0	1.28	0.0	0.06	0.22	0.0	0.0
Very Low Potential	38.21	106.80	2.77	0.0	2.77	0.0	7.25	2.59	0.0	0.0

Traditional Use Berry Potential Class	Baseline		Maximum Disturbance Scenario						Post-closure Change Compared to Baseline	
			Total Loss	Loss by Major Project Feature			Change at Maximum Disturbance			
	RAA (ha)	LAA (ha)	(ha	Mine (ha)	Trans Line (ha)	Road (ha)	RAA (%)	LAA (%)	(ha)	%
Nil Potential (Non-vegetated)	266.55	29.59	1.63	0.0	1.63	0.0	0.61	5.51	0.0	0.0
Totals	**1,1527.23**	**1830.37**	**95.31**	**0.0**	**95.31**	**0.0**	**–**	**–**	**–**	**–**

The application of best management practices, such as clearing of vegetation during the winter on frozen ground is expected to limit the potential for creation of bare ground that would allow for the establishment of invasive plants. The Invasive Plant Management Plan (Section 2.6 of Appendix 24) is intended to eliminate any Project-related spread of invasive species into the local plant communities beyond existing areas of disturbance. Trees are expected to reestablish on all ecosystems with potential to develop forest structure in the post-closure phase following the closure phase. It will take about 30 to 40 years to re-establish young forest and a minimum of 140 years for old forest to develop in the post-closure phase.

The majority of clearing will occur once during construction but some additional vegetation removal may be required during operations to maintain required clearance between transmission lines and vegetation. Removal of trees may result in improved berry production because of an increase in sunlight penetration to the low shrub layer. Assuming application of the prescribed mitigation measures, the area change in high and moderate berry potential classes is expected to be neutral in direction and negligible in magnitude, local in extent and reversible following closure.

6.8.4.4 Determination of Significance of Changes to Structure or Composition

With the implementation of the prescribed mitigation measures, the residual change in structure and composition of wetland ecosystems in considered negligible in magnitude. Therefore, the residual effect to wetland ecosystems resulting from changes in structure or composition is considered to be not significant.

As with the assessment of direct loss, the TEM wetland ecosystem area calculation is considered to have a high degree of accuracy. The effect mechanism is clear as relates to the clearing of trees or shrubs from the transmission line RoW, or in an increase in the presence and abundance of invasive species. There is less certainty with respect to the potential for increased presence of invasive plant because of the number of transport mechanisms for the plants. Therefore, the overall confidence in the residual effect prediction and significance determinations is high for clearing of wetlands and moderate for invasive plants.

With the implementation of the prescribed mitigation measures, the residual change in riparian ecosystems should be neutral or negligible flowing closure. Therefore the residual effect of clearing of the transmission line on riparian ecosystems is considered to be not significant.

As discussed in the assessment of direct loss, the TEM riparian accuracy is expected to have a moderately high degree of accuracy because of the air photo interpretation process. Confidence in the NTS riparian area is moderate since the calculation is based on buffering watercourse data that consists of a coarser spatial resolution. The effect mechanism is clear as it is caused by the direct loss of the indicator through site clearing during the construction phase. There is less certainty with respect to the potential for an increase in the number or cover of invasive plant species because of the number of transport mechanisms available to plants. Overall, the confidence in the residual effect prediction and significance determination for the riparian ecosystem indicator is moderate to moderately high.

Following decommissioning, the residual effect of clearing the transmission line RoW on traditional use berry sites ranked with high and moderate potential is considered to be negative in direction, negligible in magnitude, local in extent, permanent, and reversible. Therefore, the residual effect to traditional use plants is considered to be not significant.

Prediction confidence is strengthened by the accuracy of the mapping and clear effect mechanism for changes in structure, but is tempered by uncertainty regarding the potential for changes in composition associated with establishment of invasive plant species and is considered to be moderate overall.

In summary, the residual effect of vegetation loss is not considered a threat to the sustainability of the resource or indicators in the region. The potential effect of changes to structure and composition for the indicators selected to assess this effect were determined to be not significant leading to the conclusion that Project-related affects to ecosystem structure and composition is not significant on vegetation resources. Based on the assessment completed for each indicator and the Project mitigations the confidence in this prediction is high.

6.8.5 Assessment of Cumulative Effects on Vegetation Resources

6.8.5.1 Screening of Cumulative Environmental Effects

A screening of the Project's potential contribution to the cumulative effects of past, current, and announced future projects was done per the procedures described in Section 6.1. The screening process establishes three conditions to warrant further assessment. These conditions are: 1) the Project results in a demonstrable residual effect; 2) these effects are likely to act in a cumulative fashion with those of other projects; and 3) there is a reasonable expectation that the Project's contribution to cumulative effects has the potential to measurably change the health or sustainability of the vegetation VC.

There are no Project-related effects to rare plants within the RAA. There is some limited potential for Project-related losses of wetlands and riparian areas, ecosystems rated as high and moderate traditional use berry potential, and old forest to overlap with similar environmental effects from placer mining. However, the Project's incremental contribution to cumulative effects is considered negligible for the following reasons:

- The permanent residual loss to wetlands at maximum footprint in the mine site footprint is very small in area (0.01 ha) and is minimal in context of the RAA (i.e., is less than 0.1% of all wetlands present in the RAA at baseline).
- The loss of riparian areas at maximum footprint is relatively small in area (about 20 ha) and in context of the RAA (about 1%). However, there is a very small residual increase (9.4 ha) to riparian areas as a result of the Project. This change is small in the context of the RAA (i.e., is less than 1% of the total riparian area in the RAA at baseline).
- The residual loss to old forest at maximum footprint is moderate in area (90.77 ha) but small in context of the RAA (i.e., represents about 7.3% of the total old forest area in the RAA at baseline). In addition, a relatively large portion (31%) of the RAA consists of mature forest that will provide opportunities for recruitment of undisturbed stands to the old forest class in the RAA during the life of the Project and following closure.
- The residual loss to the ecosystems ranked with high (7.61 ha) and moderate (30.77 ha) traditional use berry potential are small in area in context to the amount present in the RAA at baseline. The losses represent less than one percent for each class when compared to the area present in the RAA at baseline. In addition, these losses are restricted to an area that is currently viewed as low value for traditional plant harvesting by the many FNNND citizens because of disturbance by past mining activities (Stantec 2010).
- The residual loss of high (4.3 ha) and moderate (173.55 ha) of traditional use berry sites due to metals loading are small in area in context of the amount of land ranked with high and moderate potential in the RAA at baseline. The losses represent less than 1% of the high potential class and 1.7% of the moderate potential class compared to baseline conditions.
- Placer mining is the one future activity that may interact with Project-related effects to vegetation resources in the RAA. Numerous placer claims are located along Dublin Gulch and Haggart Creek drainages. Yukon government regulations regarding placer mining will minimize the residual effect of the activity on vegetation as revegetation of placer mine sites is required. Placer mining may result in direct loss of vegetation but should not create metals loading in adjacent undisturbed sites as placer mining does not involve the crushing and hauling of ore.

As the Project's effects on vegetation are not expected to measurably change the health or sustainability of any of the vegetation key indicators and there are no residual effects on vegetation that are expected to interact with placer mining, further assessment of cumulative effects is not considered to be warranted.

6.8.6 Summary of Consultation Influence on the Assessment

VIT began to consult with the FNNND in 2007. Information on traditional use plant species contained in *First Nation of Na-Cho Nyäk Dun Traditional Knowledge and Use* (Stantec 2010) has been incorporated into the assessment of vegetation resources. One of the main concerns raised during the traditional knowledge study was the potential for the Project to affect vegetation. The traditional used study identified a number of species used by citizens of the FNNND. These included many berry producing species that are harvested for food. As a result, one of the key indicators chosen to assess the effects of the Project on vegetation resources is the potential of ecosystems to support berry production.

This assessment was also influenced by previous studies undertaken on the Proposed mine site by previous proponents, by subsequent discussions with Yukon regulators, and by other mining projects involved in the regulatory process. The indicators used for assessment of the effect of the Project on the vegetated value component include rare plants, wetlands, riparian ecosystems, old forest and traditional use plants. These indicators are typical of assessments completed for other projects in the Yukon and represent a range of functions and values of concern to Yukon government and the public.

6.8.7 Effects Monitoring and Adaptive Management for Vegetation Resources

No compliance monitoring programs specific to vegetation are proposed. However, a number of monitoring programs identified for other VCs or a part of other management plans have implications for vegetation. These include: metal concentrations monitoring in soils and vegetation, reclamation monitoring, and invasive species monitoring (Sections 6.4; 6.6 and Appendix 24).

Revegetation of the mine site will largely be undertaken in the closure and reclamation, and post-closure phases. The exceptions to this practice will include temporary seeding of disturbed sites that require interim erosion control (soil stockpiles), and the progressive reclamation that will occur on the Platinum Gulch waste rock storage area (PG WRSA) during the operations phase (Section 5.5). The goals and objectives, candidate reclamation species, and monitoring programs of the reclamation program are described in the Conceptual Closure and Reclamation Plan (Appendix 24).

Monitoring of reclaimed sites will be undertaken following establishment of operation revegetation trials (PG WRSA) and operational reclamation. Monitoring will be undertaken to assess revegetation success, sustainability, and compliance with permits requirements. Reclaimed sites will be monitored at an appropriate schedule and duration throughout the mine life to ensure that reclamation techniques being utilized are appropriate for the end land-use objectives. Parameters that may be assessed on reclaimed mine site areas include:

- Species composition and diversity
- Vegetation cover
- Productivity (biomass)
- Tree/shrub seedling survival, growth and stocking density
- Evidence of natural establishment of native plant species
- Nutrient and metals uptake in reclamation vegetation.

Results of the revegetation monitoring will be included in Annual Reclamation Reports submitted to Yukon Energy, Mines, and Resources.

VIT will work with the FNNND to incorporate traditional environmental knowledge in reclamation programs and investigate opportunities to involve community members in monitoring programs.

Sampling of vegetation will also be conducted in conjunction with soils sampling to monitor the extent and effects of metals loading as a result of dust deposition. Because soils metals are predicted to increase above baseline conditions during operations, soil and vegetation monitoring for metals loading will be undertaken during all phases of the Project. A monitoring plan will be developed during the permitting process.

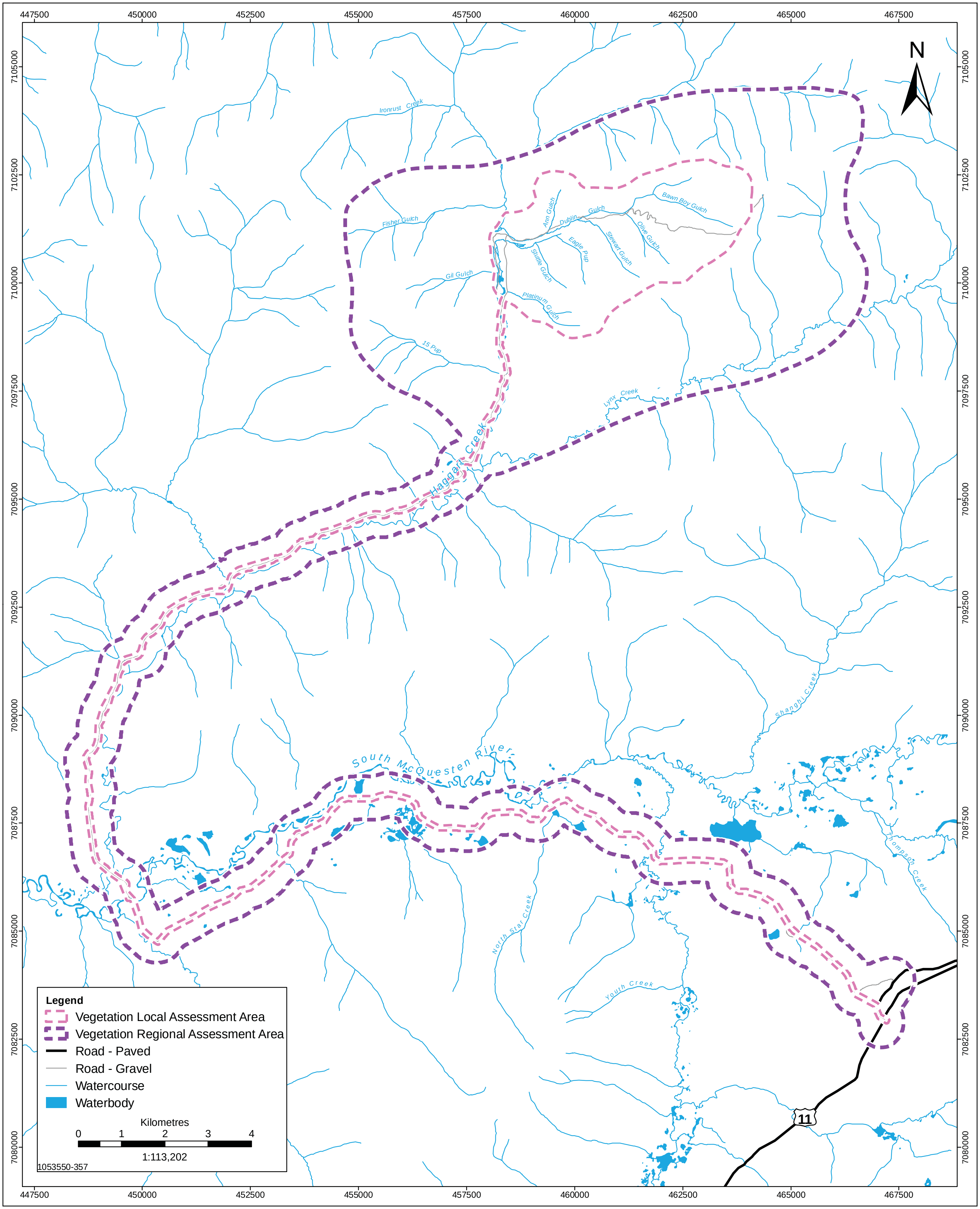
6.8.8 Commitments for Vegetation Resources

VIT is committed to the development and implementation of the following:

- **Invasive species monitoring**—Vegetation communities adjacent to Project disturbance will be monitored throughout the construction, operations and closure phases of the Project. This will ensure that populations of invasive plant species are promptly identified as they become established and that appropriate control measures are applied in a timely manner to ensure the best possible chances of successful eradication. This approach will ensure that vegetation indicators and associated values are protected from the effects of invasive species establishment and dispersal and will mitigate against the mine site acting as a source area for dispersal of invasive species to other areas of the Yukon. It is assumed that invasive plant monitoring will be included as a component of the reclamation monitoring.
- **Monitoring trace elements in vegetation**—Plant tissue will be monitored to further define the baseline trace element concentration in species used by First Nations and wildlife. This monitoring will continue throughout the operations phase to validate the predictions for soils metals loading made by the dust dispersion model. If loading does increase 10% above baseline conditions additional dust suppression mitigation will be applied to operations and a quantitative Human Health and Ecological Risk Assessment will be undertaken to assess potential risk to humans, vegetation and wildlife.
- **Reclamation research and monitoring**—A reclamation research program will be established during the operations phase with the purpose of establishing trials on the Platinum Gulch waste rock storage area (PG WRSA). This program will investigate various planting and seeding practices appropriate to site-specific closure issues and end land-use objectives, including the use of native and traditional use species. Reclamation monitoring will be continued in the closure and post-closure phases with the purpose of assessing reclamation success.
- **Mitigation Measures**—Mitigation measure discussed in Sections 6.8.3.2 and 6.8.4.2 will be applied as appropriate throughout all Project phases.

6.8.9 Figures

Please see the following pages.



Data Sources; Government of Canada, Victoria Gold Corp.

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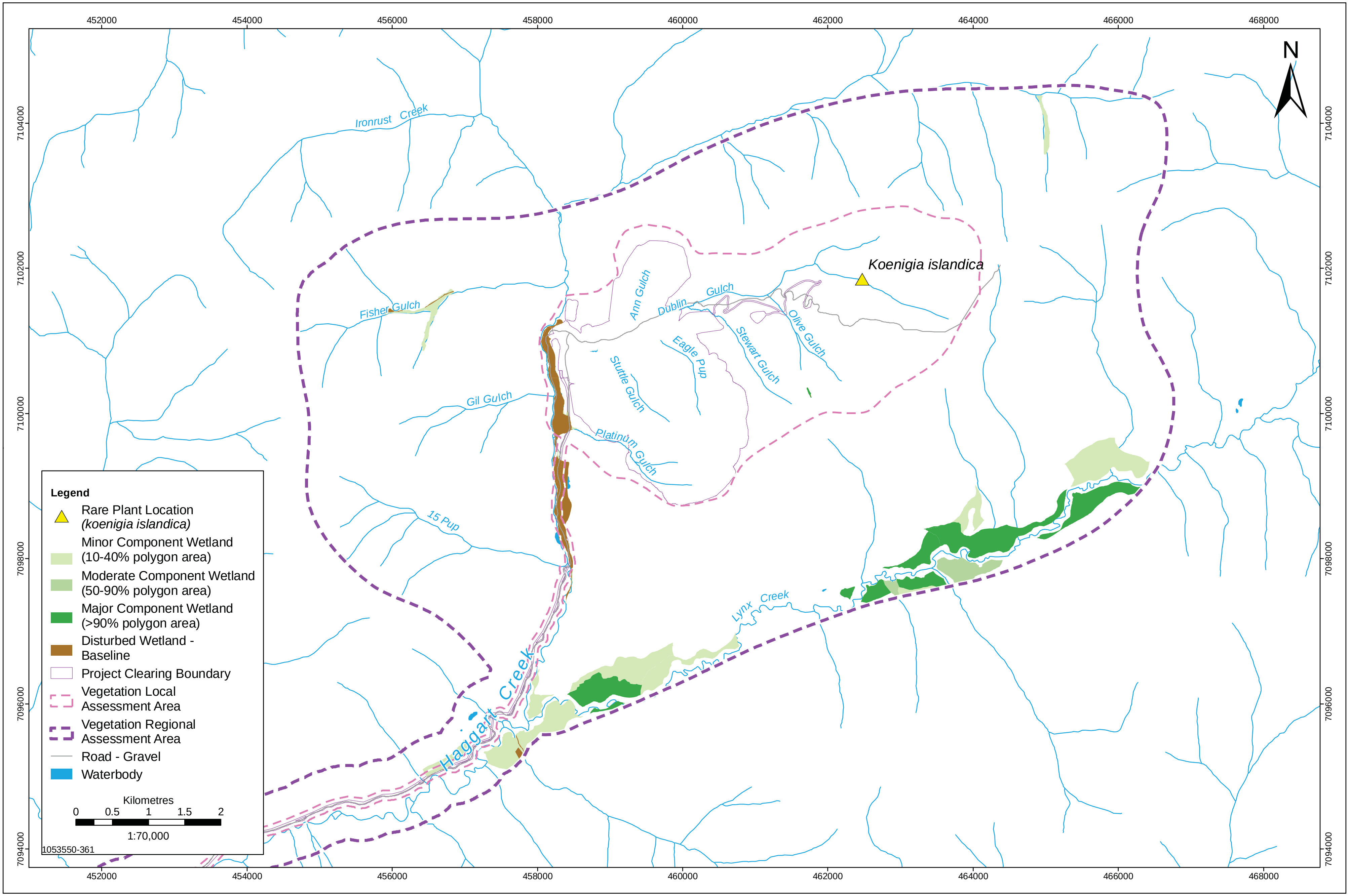
Victoria GOLD CORP

VEGETATION ASSESSMENT AREA BOUNDARIES

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION	DRAWN BY
UTM - ZONE 8	RS
DATUM	CHECKED BY
NAD 83	LS
DATE	FIGURE NO.
3-November-2010	6.8-1



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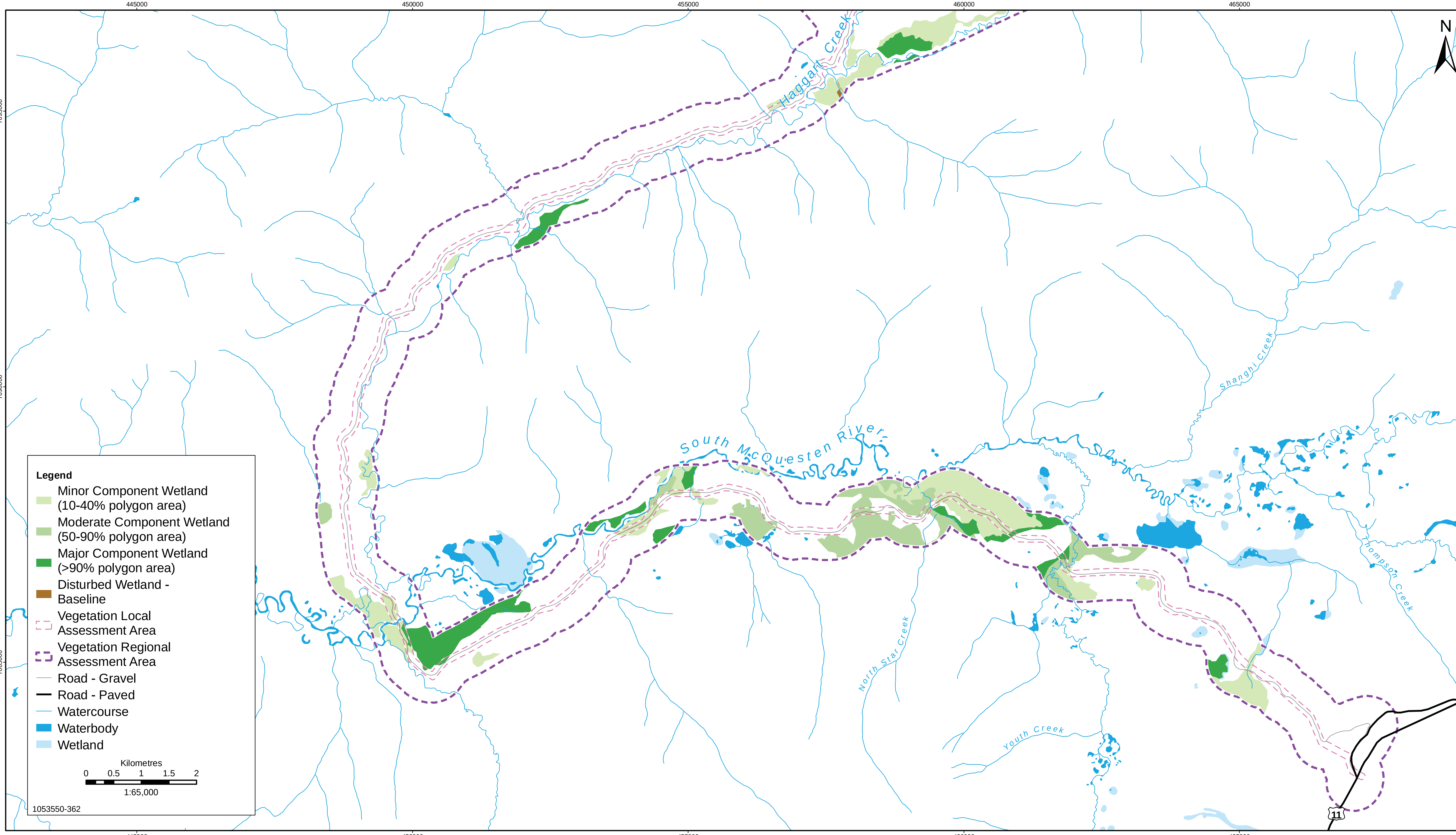
RARE PLANTS AND WETLANDS DISTRIBUTION: MINE SITE

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION	DRAWN BY
UTM - ZONE 8	LS
DATUM	CHECKED BY
NAD 83	RS
DATE	FIGURE NO.
3-November-2010	6.8-2



Data Sources; Government of Canada, Victoria Gold Corp.

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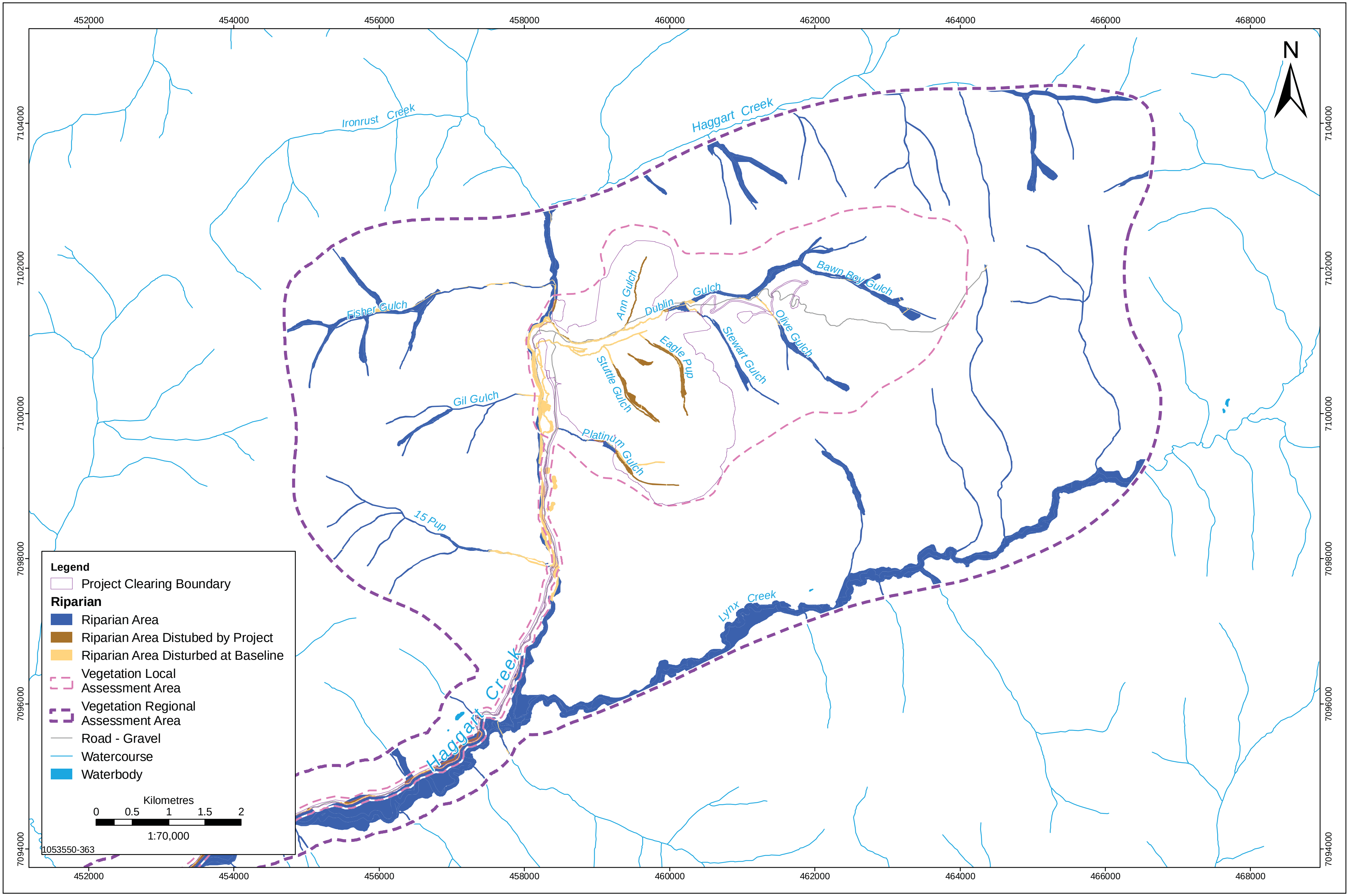
RARE PLANT AND WETLAND DISTRIBUTION: ROAD

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION UTM - ZONE 8	DRAWN BY LS
DATUM NAD 83	CHECKED BY RS
DATE 3-November-2010	FIGURE NO. 6.8-3



Data Sources; Government of Canada, Victoria Gold Corp.

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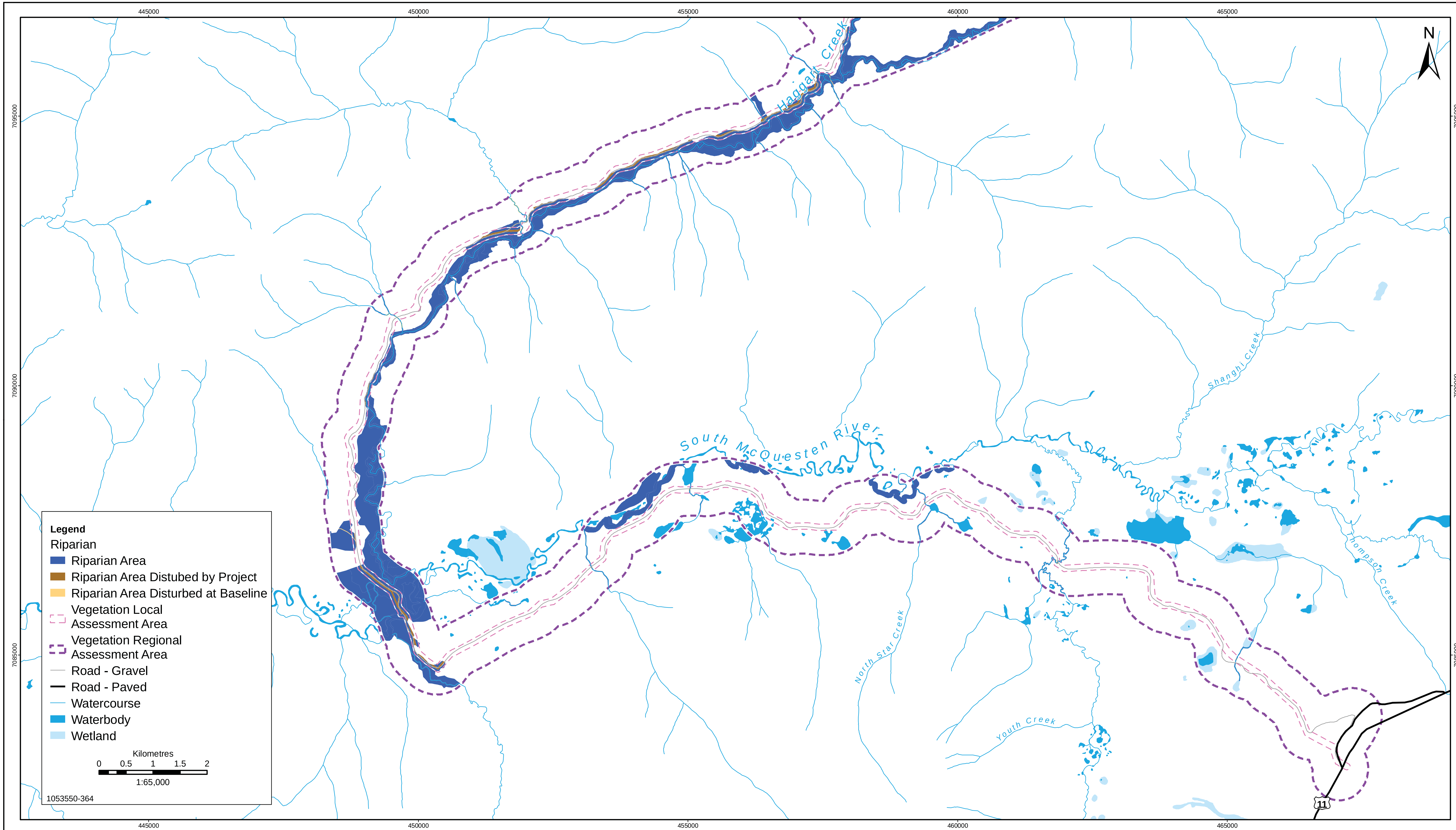
Victoria GOLD CORP

RIPARIAN AREA DISTRIBUTION: MINE SITE

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION	DRAWN BY
UTM - ZONE 8	LS
DATUM	CHECKED BY
NAD 83	RS
DATE	FIGURE NO.
3-November-2010	6.8-4



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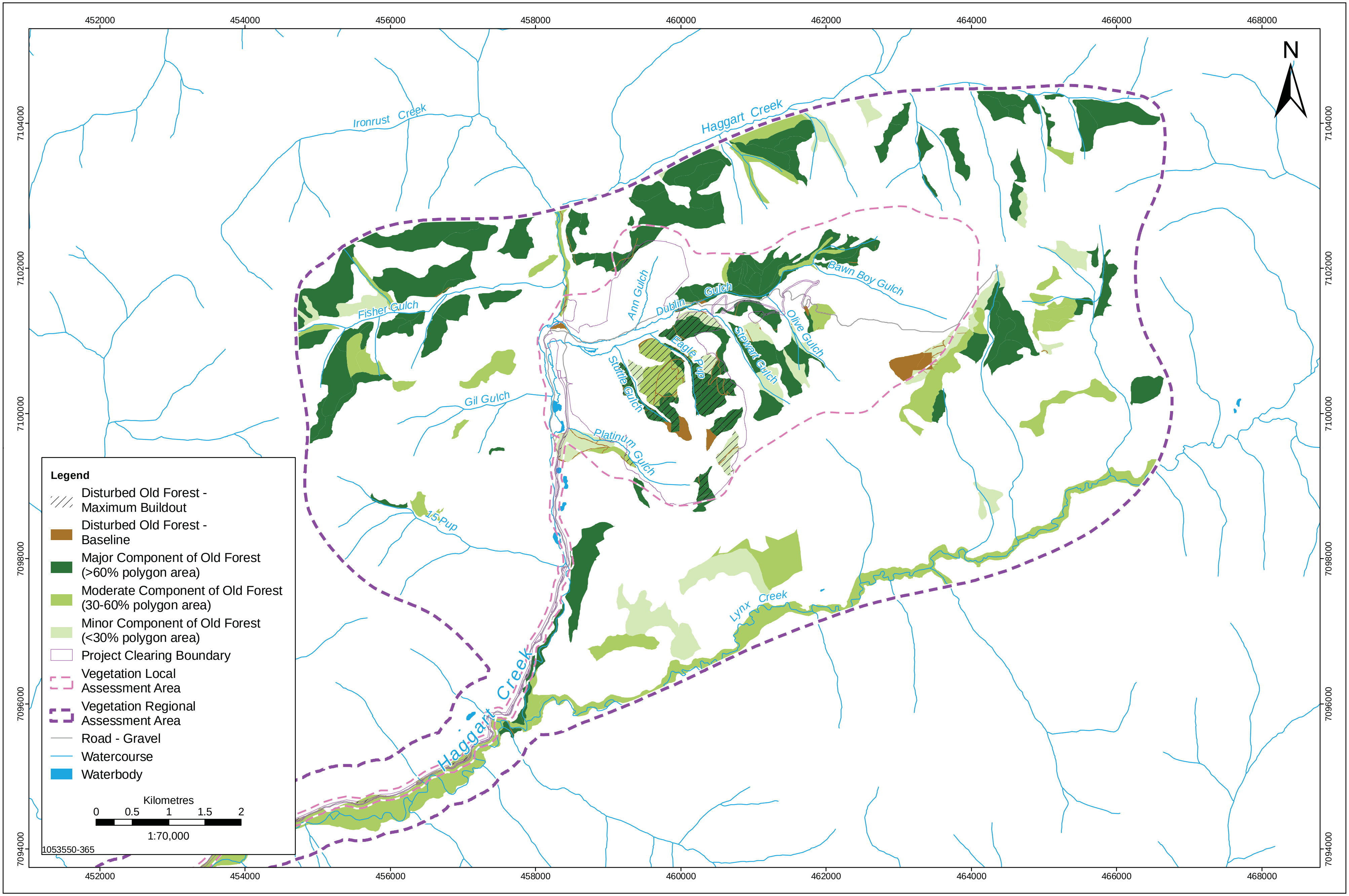
Victoria GOLD CORP

RIPARIAN AREA DISTRIBUTION: ROAD

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION UTM - ZONE 8	DRAWN BY LS
DATUM NAD 83	CHECKED BY RS
DATE 28-October-2010	FIGURE NO. 6.8-5



Data Sources; Government of Canada, Victoria Gold Corp.

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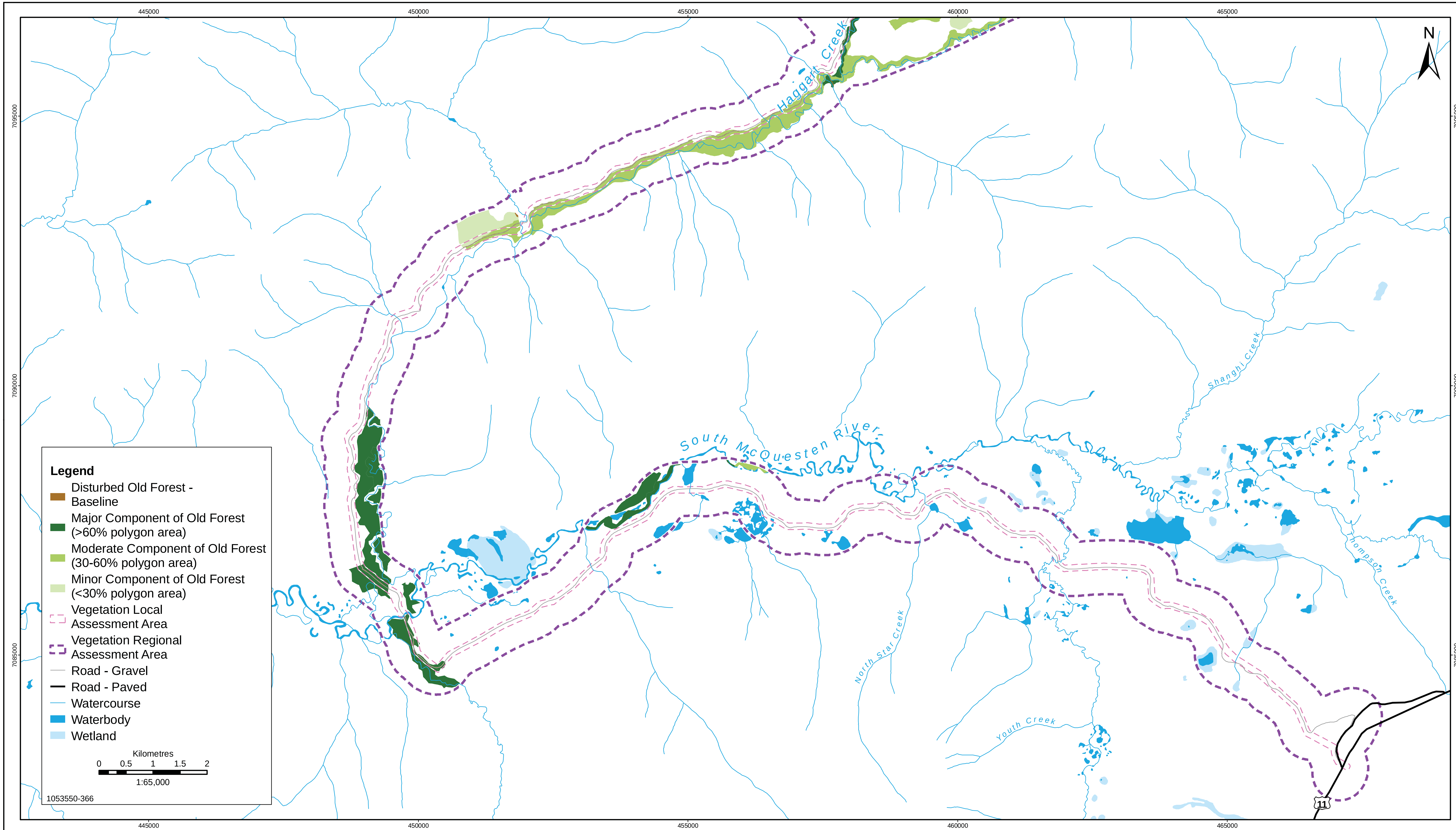
Victoria GOLD CORP

OLD FOREST DISTRIBUTION: MINE SITE

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION: UTM - ZONE 8	DRAWN BY: LS
DATUM: NAD 83	CHECKED BY: RS
DATE: 3-November-2010	FIGURE NO. 6.8-6



Data Sources; Government of Canada, Victoria Gold Corp.

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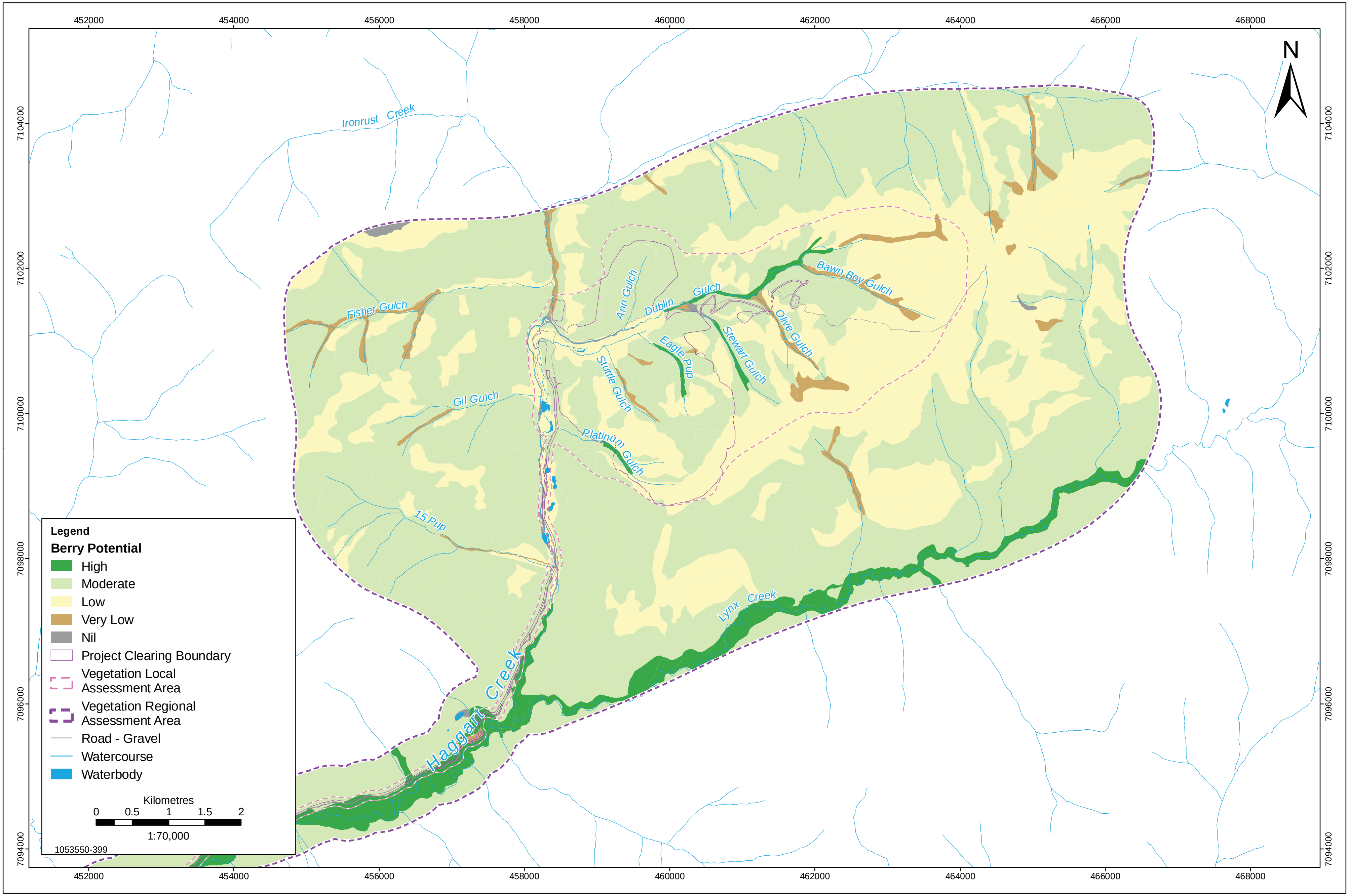
Victoria Gold Corp

OLD FOREST DISTRIBUTION: ROAD

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION	DRAWN BY
UTM - ZONE 8	LS
DATUM	CHECKED BY
NAD 83	RS
DATE	FIGURE NO.
3-November-2010	6.8-7



Data Sources; Government of Canada, Victoria Gold Corp.

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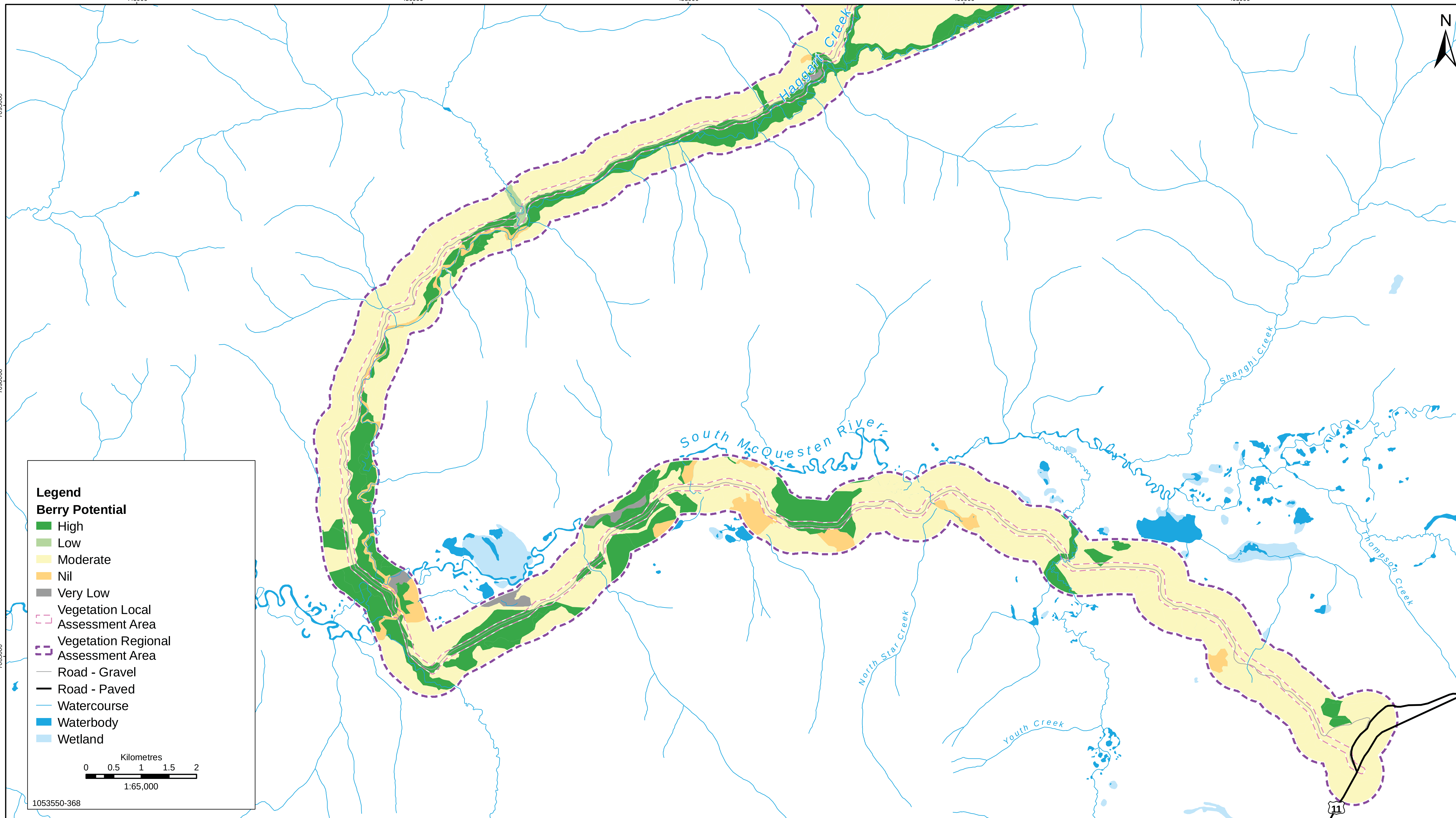
TRADITIONAL USE POTENTIAL BERRY AREAS: MINE SITE

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION: UTM - ZONE 8	DRAWN BY: LS
DATUM: NAD 83	CHECKED BY: RS
DATE: 3-November-2010	FIGURE NO. 6.8-8



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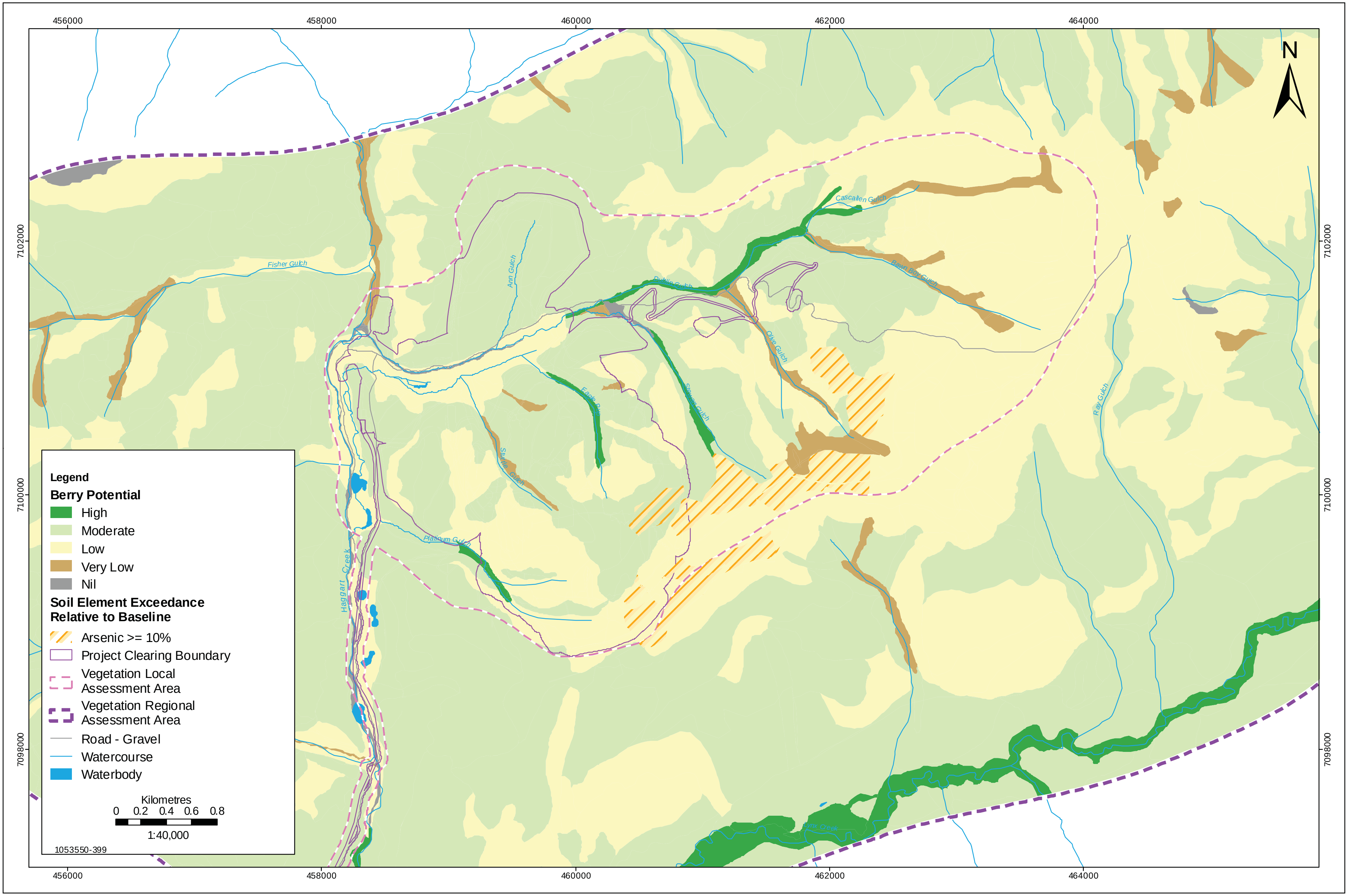
TRADITIONAL USE POTENTIAL: ROAD

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION UTM - ZONE 8	DRAWN BY LS
DATUM NAD 83	CHECKED BY RS
DATE 3-November-2010	FIGURE NO. 6.8-9



Data Sources: Government of Canada, Victoria Gold Corp.

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ECOSYSTEMS WITH TRADITIONAL USE POTENTIAL WITH MAXIMUM EXTENT OF METALS LOADING AT OPERATIONS

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION UTM - ZONE 8	DRAWN BY LS
DATUM NAD 83	CHECKED BY RS
DATE 5-November-2010	FIGURE NO. 6.8-10

6.9 Wildlife Resources

The Project is located in the Mayo Lake-Ross River Ecoregion and spans two ecological zones: the Forested zone and the Subalpine zone. The Forested zone ranges from 600 m asl to 1,225 m asl elevation and covers mid to lower mountain slopes and valley bottoms and is dominated by black and white spruce, subalpine fir, trembling aspen, and Alaska birch. The Subalpine zone occurs above 1,225 m asl along high plateaus and is characterized by discontinuous tree cover, scrub birch, willows, herbs, mosses, and lichens. The combined wildlife habitats within the Forested and Subalpine zones support at least 31 species (see Appendix 12 – Environmental Baseline Report: Terrestrial Wildlife). The objective of this section of the Project Proposal is to determine how the Project will affect these animals, recommend mitigation to manage these effects, and to identify any significant residual effects after mitigation.

6.9.1 Scope of Assessment for Wildlife

6.9.1.1 Regulatory/Policy Setting

Management of wildlife in Yukon occurs through the Yukon *Wildlife Act*, the *Species at Risk Act*, and the *Migratory Birds Convention Act* (MBCA). Under this legislation, territorial and federal agencies, in coordination with Boards, Committees and Councils established under the Umbrella Final Agreement, manage wildlife populations by:

- Protecting species at risk and their habitats
- Protecting nesting birds
- Regulating and restricting the harvest of individuals.

The key regulatory bodies are Yukon Government and the Canadian Wildlife Service of Environment Canada. The Umbrella Final Agreement establishes the Yukon Fish and Wildlife Management Board and, in the FNNND Traditional Territory, the Mayo District Renewable Resource Council (MDRRC) to provide input into wildlife management issues.

The key federal and territorial acts, administered by Environment Canada and Yukon Government that govern wildlife management are described in Table 6.9-1.

Table 6.9-1: Federal and Territorial Legislation Applicable to Wildlife

Agency	Act or Regulation	Summary
Federal		
Environment Canada	*Species at Risk Act*	▪ Requires Canada to provide for the recovery of species at risk due to human activity and to manage species of special concern so they do not become endangered or threatened. The *Species at Risk Act* not only prohibits killing, harming, harassing, capturing or taking species at risk, but also makes it illegal to destroy their critical habitats. Sections 32, 33 and 58 identify prohibitions. It is an offence to: • Kill, harm, harass, capture or take an individual of a listed species that is extirpated, endangered or threatened

Agency	Act or Regulation	Summary
		• Damage or destroy the residence of one or more individuals of a listed endangered or threatened species, or of a listed extirpated species, if a recovery strategy has recommended its re-introduction • Possess, collect, buy, sell or trade an individual of a listed species that is extirpated, endangered or threatened or its part or derivative • Destroy any part of the critical habitat of any listed endangered species or of any listed threatened species, if the critical habitat is on federal land, in the exclusive economic zone of Canada or on the continental shelf of Canada; if the listed species is an aquatic species; or the listed species is a species of migratory bird protected by the *Migratory Birds Convention Act.* ▪ Identifies measures to protect listed wildlife species as well as enforcement measures.
	Migratory Birds Convention Act	The Migratory Birds Regulations (C.R.C., c. 1035) state that no person shall, except under authority of a permit: ▪ Disturb, destroy or take a nest, egg, nest shelter, eider duck shelter or duck box of a migratory bird, or ▪ Have in his possession a live migratory bird, or a carcass, skin, nest or egg of a migratory bird.
Yukon		
Yukon Government	*Yukon Wildlife Act*	The act governs hunting and trapping of wildlife. Unless permitted, the Act states that: ▪ 17(1): A person shall not destroy, take or possess any egg or nest of a bird that belongs to a species that is wild by nature. ▪ 20: A person shall not use a vehicle to chase, drive, flush, exhaust or fatigue wildlife for the purpose of hunting or to assist another person hunting. ▪ 92(1): A person shall not harass any wildlife. Harassment includes attempts to interfere with the movement of any wildlife across any road or watercourse. ▪ 93(2): No person shall encourage any wildlife to become a public nuisance. A person shall be deemed to have encouraged dangerous wildlife to become a public nuisance if the person feeds it or leaves food or garbage in a place where dangerous wildlife may have access to it and he or she does not take reasonable precautions to prevent dangerous wildlife from having access to it or being attracted to the area by it.

6.9.1.2 Key Issues and Identification of Potential Effects

Three key wildlife management issues have been identified through consultation with the FNNND, Yukon Government, Environment Canada, other citizens of Mayo, and through the professional judgment of the assessment team. The key issues are:

- Compliance with the MBCA and *Yukon Wildlife Act* with respect to the destruction of nests and nesting birds
- Management of species at risk, consistent with the requirements of SARA
- Management of species important to the FNNND.

Based on these key wildlife management issues, this assessment focused on potential high risk interactions between the Project and wildlife that could result in significant effects (these potential interactions are scored as a "2" in Table 6.3-1).

Broadly, three potential effects of the Project are assessed: on wildlife habitat (through conversion of habitat and sensory disturbance), on the risk of wildlife mortality (through collisions, destruction of residences, hunting, or the control of problem wildlife), and on wildlife movement. These interactions are highlighted in Table 6.9-2 and described below. The residual effect of the Project is then assessed and compared with thresholds established for the Project to determine whether it is significant.

Change in Wildlife Habitat

Project-related clearing will primarily be required within the Project footprint, and along the transmission line RoW which parallels the existing access road. Clearing of natural vegetation during site preparation can result in habitat loss and fragmentation into smaller, less suitable habitat patches. Project activities that will directly remove habitat include mine site clearing and grubbing, and clearing of the transmission line RoW. Once natural vegetation has been removed from the mine site, additional disturbance within the site will not lead to additional direct losses.

Project activities during construction and operations may result in sensory disturbance, causing wildlife to avoid otherwise suitable habitat. These potentially sensory-disruptive activities include: site grading, blasting, and overburden removal and disposal; camp construction and operations; diesel power generation; the use of large construction vehicles and equipment; the construction of mine site roads and infrastructure; vehicular traffic; ore processing (crushing and hauling); waste rock disposal; access road upgrades, transmission line construction, and the presence and maintenance of both; and quarry/borrow pit operations.

Change in Wildlife Mortality

No new access potential for hunters will result from the Project. However, wildlife mortality may result from clearing of natural vegetation (e.g., for breeding birds), vehicle collisions associated with increased traffic volumes and speed (e.g., upgrades to the existing access road), increased hunting (from mine employees or suppliers), lethal control of problem wildlife (if wildlife are attracted to the mine and pose a health and safety risk to personnel), or potential wildlife contact with toxins.

Change in Wildlife Movement Patterns

Wildlife movement patterns may change as traffic increases along the access road, which runs from the Silver Trail Highway to the mine site. While the access road already exists and little additional vegetation will be cleared, increased traffic may deter wildlife crossings of the road during high traffic volumes. In addition, during construction and operations the access road will be maintained (plowed) during the winter. These changes may affect movement patterns of species such as moose that tend to move over large areas. Sensory disturbance from vehicle traffic, blasting, and camp operations may also influence how wildlife species move within and between habitat types.

Table 6.9-2: Potential Project Effects to Wildlife Resources

Project Activities and Physical Works	Potential Environmental Effects		
	Habitat	Mortality	Movement
Construction Phase			
Site clearing and grubbing	✓	✓	✓
Site grading including blasting, overburden removal and overburden disposal	✓	✓	✓
Borrow areas development and use	✓		
Access road upgrades	✓	✓	
Camp construction (construction and operations camps)	✓	✓	
Diesel power generation (1 – 2 megawatts)	✓		✓
Use of large construction vehicles and equipment		✓	✓
Construction of mine site infrastructure and access roads	✓	✓	
Vehicular traffic	✓	✓	✓
Clearing of transmission line RoW	✓	✓	✓
Operations			
Open-pit mining (blasting, ore/waste hauling, open pit dewatering)	✓		✓
Ore processing (crushing and hauling)	✓		
Gold heap leach facility operation	✓	✓	
Solid waste management		✓	
Camp operation	✓		
Vehicle traffic		✓	✓
Access road and transmission line presence and maintenance			✓
Quarry/borrow pit operations	✓		
Diesel power generation	✓		✓
Fuel, hazardous materials, and explosives management		✓	

NOTE:
Project Environmental Effects
Only Project-Environment interactions ranked as 2 in Table 6.3-1, the Project-Environment Interaction Table, are carried forward to this Table.
✓ = Indicates that an activity is likely to contribute to an environmental effect.

To focus the assessment on key issues, low risk interactions which have little possibility of causing a significant effect are not carried forward. These include activities within the mine site after vegetation has been stripped (salvaging and stockpiling of top and sub soils, waste rock disposal), those that have little interaction with wildlife habitat above and beyond other activities (installation of the transmission line, water supply and usage, access road and transmission line presence and maintenance), and those expected to provide a benefit to most wildlife, which includes all activities during the closure and reclamation phase.

6.9.1.3 Spatial Boundaries for Wildlife

Two areas are used to assess Project effects on wildlife. Each is described below.

Local Assessment Area (LAA)

The LAA is defined as the maximum area where Project-specific environmental effects can be predicted or measured with a reasonable degree of accuracy and confidence. The Wildlife LAA consists of an approximately 115 km^2 area encompassing the proposed Project site, the access road and a surrounding buffer (Figure 6.9-1). The buffer beyond the Project development area is 800 m for the mine site footprint and 500 m on either side of the access road.

Regional Assessment Area (RAA)

The RAA provides a broader geographical context for understanding Project and cumulative effects. The RAA[30] for wildlife is a 30 km by 30 km (900 km^2) area that is essentially centered on the LAA (Figure 6.9-1). The RAA encompasses the major habitat types present in the region, and includes the Lynx Creek watershed to the south (which is relatively undisturbed when compared to the majority of the placer-mined drainages in the area) and the McQuesten River watershed to the north (see Figure 6.9-7). The RAA is at a scale relative to species that use landscapes over large areas, such as grizzly bears (*Ursus arctos*); its size is the equivalent of the home range of two females, at 491 km^2 per bear (YFWCM 2010). It is also the scale used for the cumulative effects assessment, which analyzes the interaction of Project effects with those of other known or reasonably foreseeable projects.

6.9.1.4 Temporal Boundaries for Wildlife

Three assessment scenarios are used:

- **Baseline** represents conditions for wildlife species prior to any development activities associated with the proposed Project. Seasonal habitat use for baseline conditions was characterized based on habitat conditions in 2009/2010.
- **Construction and Operations** represent the maximum disturbance caused by the mine. This reflects conditions during construction (Q1 2012 through Q3 2013), operations (Q3 2013 through 2020), and closure and reclamation (2021 through 2030). This assessment scenario assumes the worst-case land disturbances expected for this period. In other words, the Project footprint is fully developed and no reclamation is assumed to have occurred. Actual

[30] The Regional Assessment Area (RAA) is chosen to represent a scale that approximates habitat requirements for wide ranging species (e.g., grizzly bears) and wildlife management. It is slightly larger than the 23 km by 21 km Regional Study Area (RSA) used in the baseline studies.

disturbance may be less, given that reclamation will be ongoing through the operations phase of the Project.

- **Closure and Reclamation** represent conditions following complete closure and reclamation of the mine site. This scenario assumes implementation of all mitigation recommendations to reduce effects on wildlife habitat. Closure will occur over a ten year period to allow for retention and operation of part of the process plant and the sewage treatment facility as required. Reclamation activities will begin during operations, overlap with closure events and be complete ten years following mine closure. All disturbed surfaces will be re-contoured and re-vegetated. The heap leach facility (HLF) will be capped, re-contoured and vegetated. The open pit will become a permanent pond as it fills with precipitation, runoff and groundwater. Reclamation on the perimeter will establish some riparian habitat. The main access road to the process plant along Haggart Creek from the confluence at Dublin Gulch will be permanently closed and reclaimed, although one road will be left to re-establish access to Potato Hills. Exploration roads, including trench and drill sites will be reclaimed. The transmission line RoW is expected to remain in place and seeding will not be required as vegetation will already be well established at mine closure. Reclamation goals are a stabilized surface and a native plant community to provide wildlife habitat. It is assumed that successional processes will move post-mine vegetation communities towards the original vegetation type within a 20 to 80 year period following closure and final reclamation. When modeling post closure habitat for wildlife, the following post closure time frames were used: moose winter feeding – 20 years, moose winter shelter – 100 years, grizzly bear spring feeding – 10 years, grizzly bear fall feeding 20 – years.

6.9.1.5 Focus of the Wildlife Assessment

The Project interacts with a variety of ecosystems, each with faunal associations. As a result, it is not feasible to assess all wildlife indigenous to the LAA. Instead, the assessment focuses on several focal species selected because they are of special interest and/or whose requirements overlap with a broad spectrum of other wildlife species and specific high value habitats. This allows for an efficient and practicable assessment of potential Project effects on wildlife as a whole.

Focal Species

Five ”focal species” were selected for detailed consideration in this assessment. These were chosen because they are at risk, hunted or trapped, of interest to the FNNND, share life requisites with a broad spectrum of other species, and/or are of management concern to Yukon Government. Justification for selection of these five species is summarized in Table 6.9-3. This list of focal species was developed in collaboration with YESAB and Yukon Environment (Parry 2009). Moose and grizzly bear received the most attention in the assessment as the FNNND, YESAB, and Yukon Environment indicated that they were of particular concern. Species at risk were included when their range overlapped with the Project, potential habitat is available, and there is a reasonable potential for an adverse effect. None of the SARA-listed focal species has a recovery strategy in place.

Table 6.9-3: Focal Wildlife Species Considered in the Assessment

Species	Reason for Inclusion
Moose (*Alces alces*)	Moose is important both recreationally and commercially, particularly to the FNNND (Stantec 2010). Moose were the most commonly detected species during 2009 baseline surveys and were found across a variety of habitat types. Moose was selected as a species for assessment because of its abundance in the RAA, it is harvested by both NNDFD and non-Aboriginal hunters, and it is of management concern for Yukon Government.
Grizzly bear (*Ursus arctos*)	Grizzly bear is a focal species because of its conservation status and importance to the FNNND. Schedule 3 of the *Species at Risk Act* (SARA) identifies grizzly bear as a species of Special Concern. Grizzly bears are also a good indicator species because they are a wide ranging species that utilize a variety of habitat types seasonally. They represents other wide ranging species that have used the RAA historically (e.g., black bear, and wolverine, are sensitive to disturbance, and may be affected by development activities. While few grizzly bears were detected during baseline surveys (four observations), the LAA includes forested riparian areas, marshland, and subalpine areas that represent suitable habitat.
American marten (*Martes americana*)	American marten was selected because it is important both economically and culturally to local citizens, including the FNNND. The FNNND identify marten as present in, or in the vicinity of the RAA. FNNND citizens report recent declines in the local marten population but suggest it might be part of a naturally fluctuating cycle for marten in the region (Stantec 2010).
Olive-sided Flycatcher (*Contopus cooperi*)	Olive-sided Flycatcher is included in the analysis because it is listed as Threatened on Schedule 1 of SARA. This species, including nests and eggs, is also protected from disturbance, destruction, or possession under the federal *Migratory Birds Convention Act*. The breeding range of this bird includes forested regions of northern Canada that overlap the LAA. Although there are no records of this species in the LAA, potential breeding habitat may occur.
Rusty Blackbird (*Euphagus carolinus*)	Rusty Blackbird is included in the analysis as it is listed as a species of Special Concern on Schedule 1 of SARA and protected under MBCA. Breeding range of this bird includes forested regions of northern Canada that overlap the LAA. Although there are no records of this species in the LAA, breeding habitat may occur.

The *Species at Risk Act* makes it illegal to destroy critical habitat; kill, harm, harass or capture listed species; or damage or destroy their residences. No critical habitat has been defined under SARA for any species which occurs in the LAA. In addition, neither the Project, the LAA, nor the larger RAA overlap with any Wildlife Key Areas (WKA). Therefore, the Project is not expected to represent threats to existing or future recovery plans for species of management concern.

Species listed in Table 6.9-4 are SARA-listed species that potentially occur in Yukon. While SARA requirements apply to species included in the List of Wildlife Species at Risk (Schedule 1 of SARA), as a best practice, those recognized as "at risk" by COSEWIC are also considered (Environment Canada 2010). Each species was assessed on the basis of potential range overlap with the RAA, presence of suitable habitat, and the interaction that could lead to an adverse effect as a result of the Project. The final list of focal species for the assessment, listed in Table 6.9-3, was developed in consultation with the Yukon Government, YESAB, Environment Canada and an assessment on the potential for SARA listed species within the RAA to interact with the Project (listed in Table 6.9-4). For example, woodland caribou are wide ranging but use the RAA at very low, almost undetectable densities and there are no caribou WKA within the RAA. In discussions with Yukon Government (Parry 2009) it was agreed that the RAA is peripheral to the range of the Clear Creek Herd (the caribou herd closest to the mine site) and the Project is not expected to have an adverse effect on this species.

Table 6.9-4: Species at Risk Assessed and Determined Not to Interact Adversely with the Project

Species	Summary of Habitat Use and Distribution	Potential for an Adverse Effect
SARA (Schedule 1)		
Canada Warbler *Wilsonia canadensis*	Threatened. Canada Warblers are only present in the extreme southeast Yukon (COSEWIC 2008a).	None. Range does not overlap with RAA. (COSEWIC 2008a)
Common Nighthawk *Chordeiles minor*	Threatened. Breeding range covers south to central Yukon with preferred nesting in open habitats (e.g., beaches, rocky outcrops, burned and logged areas) (COSEWIC 2007a). Breeding is thought to occur as far north as the Dawson region (Sinclair, et al. 2003), however is not confirmed.	Negligible. This species is rare in the RAA and require very open pine forests. Nighthawk has not been recorded at the site and the potential for interaction is relatively low, given its nesting and feeding requirements the Project would have a neutral (for feeding requirements) to positive (at closure as areas are reclaimed in pine forests with opening) interaction should the species occur. It was therefore not considered further
COSEWIC		
Woodland caribou *Rangifer tarandus*	Northern Mountain Population is COSEWIC Special Concern. The Clear Cleek herd is the closest to the Project.	Negligible. Range of the Clear Creek herd does not materially over-lap with the RAA and it was determined that the Project had a negligible potential for an adverse effect on this species, which was therefore not considered further in this assessment (Yukon Government 2009c).
Wolverine *Gulo gulo*	Special Concern. Wolverines inhabit a variety of habitat types (forest, alpine, tundra) but are most abundant in areas with a variety of prey types (Yukon Government 2009c). Wolverines are found at low densities, with the greatest abundance in the southern Yukon, where highly suitable habitat is located.	Negligible. Wolverines are likely to occur at very low densities and are unlikely to experience an adverse effect beyond that experienced at baseline. Moreover, as the effects of land-use activities on wolverines are likely similar to those on grizzly bears (Banci 1994), the tools used to measure mortality risk for grizzly bears (linear feature density) are relevant for wolverine. Mitigation measures for bear will benefit wolverine, while modelling wolverine habitat is not accurate as this species is prey driven.

Species	Summary of Habitat Use and Distribution	Potential for an Adverse Effect
Horned Grebe *Podiceps auritus*	Special Concern. Horned Grebe is present in ecoregions to the south, but is not listed as present in the Yukon Plateau-North ecoregion (Yukon Government 2007). Horned Grebe requires wetlands greater than 0.1 ha for nesting and prefers freshwater ponds or marshes in open or forested habitat.	Negligible. Lack of suitable marsh breeding habitat with open water identified within RAA (Appendix 11 – Environmental Baseline Report: Vegetation).
Peregrine Falcon *Falco peregrinus*	Special Concern. Peregrine Falcon breeding range extends through central Yukon; they require cliff ledges/outcrops for nesting (COSEWIC 2007c).	Negligible. Insufficient suitable nesting cliffs and rocky outcrop habitat within the RAA (Appendix 11).
Red Knot *Calidris canutus*	Threatened. Red knots are extremely rare migrants to the Yukon. The *roseri* subspecies typically breeds in Alaska with occasional vagrants appearing in the extreme north of the Yukon. Migration occurs over the Pacific between Alaska and Central and South America (COSEWIC 2007d).	Negligible. This species is a rare vagrant to the Yukon and identified migration corridors do not pass through the RAA (COSEWIC 2007d).
Short-eared Owl *Asio flammeus*	Special Concern. Uncommon migrant primarily inhabiting tundra areas of Central Yukon and scattered sites in southern Yukon (COSEWIC 2008b). Nests typically built near small willows on the tundra. Confirmed breeding along the Dempster Highway in 1998 (Sinclair, et al. 2003).	Negligible. Lack of suitable tundra/open grass breeding habitat identified within the RAA (Appendix 11).

Habitats of Special Interest

Some habitat types are particularly important to wildlife. The WKA Inventory Program has been developed by Yukon Government "*to inventory locations important to populations of legally harvested and protected wildlife species*". There are no WKAs within the RAA (Yukon Government 2009b) with the closest WKA, designated because of its importance as moose winter habitat, approximately 55 km northeast of the proposed mine.

Other important wildlife habitat types can be identified by their productivity, prevalence, and/or contribution to key requirements of certain wildlife species. For the Project LAA, three such habitats have been identified in consultation with the FNNND, local land users, and Project biologists (see Section 4, Figure 4.1-2). These include:

- **Wetlands**—Wetlands are relatively uncommon, covering 627 ha of the LAA at baseline. The wetlands are generally associated with the Lynx and Haggart Creek valley bottoms. Bogs (the black spruce – sphagnum wetland) are most common in the LAA and RAA followed by shrub dominated willow-sedge wetlands. Herbaceous dominated marsh and sedge fen wetlands are uncommon in the assessment areas. These ecosystems provide important habitats, such as preferred feeding habitat for moose and grizzly bear as well as other wildlife species such as Rusty Blackbird.

- **Riparian areas**—Riparian areas are the vegetation assemblages occurring immediately adjacent to flowing water. For the purposes of this assessment, they include river, gravel bars, Spruce-Horsetail, Poplar-Horsetail, Willow-Groundsel and Willow-Horsetail. Riparian areas, which cover 2,060 ha of the LAA at baseline, provide productive habitat and are often used as travel corridors by a variety of wildlife (including moose and grizzly bear). Riparian corridors are often attractive to wildlife as they provide food, cover, and relatively homogeneous topography, facilitating energy efficient movement. This is particularly true of riparian corridors found in the lower valley bottoms including Lynx Creek, Haggart Creek, and the South McQuesten River.
- **Old forest**—For the purposes of this assessment, old forest is defined as structurally diverse stands older than 140 years. Approximately 1,238 ha of the LAA are comprised of old coniferous forest at baseline. These forests consist of ecosystems dominated by white or black spruce at lower elevations and ecosystems dominated by subalpine fir at higher elevations. Old forest habitat is important for wildlife species such as American marten, which is important both economically and culturally to local citizens, including the FNNND. Bears may also use these areas for hibernation, with dens dug beneath the root wads of large trees, and moose may seek out mature coniferous forest primarily to satisfy winter thermal requirements.

6.9.1.6 Mitigation Measures and Effects Addressed

Interactions identified as “1” and “0” in Table 6.3-1 indicate Project activities or physical works that are not expected to result in any significant environmental effects to wildlife. In the case of activities identified as a “1”, the application of standard mitigation measures and/or environmental management practices is expected to prevent the occurrence of significant effects. As a result, these interactions are not addressed specifically in the wildlife effects assessment. Those activities that are not expected to interact with wildlife resources during the various Project stages are identified as “0”.

In addition to mitigation measures mentioned below, a full list of those that will benefit wildlife are described in each effects section below and summarized in Table 6.9-15.

Construction

Several construction activities may interact with wildlife resources but are not expected to result in significant effects (ranked as “1”). These include:

- Salvaging and stockpiling of soils
- Waste handling (liquid and solid)
- Water supply and usage

- Site water management
- Fish habitat compensation
- Installation of the transmission line.

The effects on wildlife from the activities listed above can be mitigated by following standard practices for construction (i.e., water diversion and management) and site waste management (Section 5.4 – Project Description) and are not significant. The only construction phase activity deemed to have no potential to interact with wildlife resources (ranked as “0”) is the disposal of cleared vegetation (burning). This activity will be restricted to areas previously disturbed by site clearing and grubbing and further effects to wildlife are not anticipated.

Operations

Operations activities ranked as “1” include:

- Waste rock disposal
- Potable and non-potable water use
- Wastewater treatment and discharge.

All of these activities are expected to occur in areas cleared of vegetation within the mine footprint during the construction phase. The effects on wildlife from the activities listed above can be mitigated by following standard practices for construction (i.e., water diversion and management) and site waste management (Section 5.4 – Project Description) and are not significant.

Mitigation measures identified to specifically minimize potential effects on wildlife resources will further reduce the potential for these activities to affect wildlife. During the operations phase, no activities are expected to not have some form of interaction with wildlife and therefore no operations activities are ranked as “0”.

Closure and Reclamation

All activities associated with closure and reclamation are ranked as “1”. These include:

- Reclamation of waste rock storage areas
- Heap leach facility reclamation
- Plant and associated facility removal and site reclamation
- Pit-lake filling
- On-going mine water treatment and discharge
- Haul Roads closure and reclamation
- Transmission line closure and reclamation.

Reclamation is expected to have a positive effect on wildlife habitat relative to operations, restoring soil productivity and vegetation cover to the mine site. The removal of the mine water treatment plant and associated facilities (including decommissioning of sediment control ponds) are also considered to have a positive effect on wildlife once rehabilitation measures have been implemented. Closure of the transmission line is expected to have a positive effect on wildlife along the corridor as cleared communities will be allowed to regenerate and form natural habitat. Any adverse effects associated with these activities can be addressed through standard mitigations; best management practices; the restoration of productive growing surfaces; and the establishment of ecologically appropriate plant species. Therefore, the net effect of these activities for wildlife resources should be positive.

Post-closure Monitoring

The post-closure phase is not expected to result in any adverse effects to wildlife resources. Activities undertaken at this stage should be limited to environmental monitoring required to document successful closure and reclamation, and compliance with applicable regulations and agreements.

6.9.1.7 Selection of Measurable Parameters

Where possible, measurable parameters were selected to quantitatively assess the magnitude of effects on wildlife (see Table 6.9-5). Changes in wildlife habitat focused on habitats of special interest and limiting life requisites for moose and grizzly bears. The assessment of mortality is based on both quantitative and qualitative analyses, whereas the assessment of Project effects on wildlife movement is qualitative.

Table 6.9-5: Measurable Parameters for Wildlife

Environmental Effect	Rationale for Inclusion of the Environmental Effect in the Assessment	Measurable Parameter(s) for the Environmental Effect	Rationale for Selection of the Measureable Parameter[a]
Change in Wildlife Habitat	Habitat alteration/loss can occur either directly through removal or indirectly through the influence of sensory disturbance.	Area (ha) of: ▪ Wetlands ▪ Riparian areas ▪ Old forests ▪ Moose winter feeding/winter shelter ▪ Spring/Fall feeding (grizzly bear) ▪ Natural habitats[b]	Losses of habitat can reduce the viability of regional wildlife populations.
Change in Wildlife Mortality	Project activities may result in wildlife mortality	▪ Number of animals harvested through hunting or trapping ▪ Linear feature density ▪ Potential for mortality (analysis qualitative)	Hunting and trapping is a direct source of wildlife mortality. The density of linear features (roads, rights of ways, seismic lines, etc.) is correlated to potential mortality for grizzly bear (Guyg, et al. 2004, AGBRT 2008).

Environmental Effect	Rationale for Inclusion of the Environmental Effect in the Assessment	Measurable Parameter(s) for the Environmental Effect	Rationale for Selection of the Measureable Parameter[a]
Change in Wildlife Movement Patterns	Wildlife movement patterns may change as traffic increases and sensory disturbance from vehicle traffic, blasting and camp operations.	▪ Potential for blockage of movement (analysis qualitative)	

NOTES:

[a] Includes input from consultation with regulators, First Nations, affected stakeholder, and the public: as well as YESAB's guidelines, other regulatory drivers, policies, and/or programs

[b] Natural habitats are defined as land and water areas where biological communities are formed largely by native plant and animal species, and where human activity has not essentially modified the area's primary ecological functions (IFC 2006).

6.9.1.8 Characterization of Residual Effects on Wildlife

Residual effects are characterized using the parameters provided in Table 6.9-6.

Table 6.9-6: Characterization of Residual Environmental Effects for Wildlife Resources

Criterion	Description
Direction	**Positive**—condition is improving compared to baseline habitat or population status **Neutral**—no change compared to baseline habitat or population status **Adverse**—negative change compared to baseline habitat or population status
Magnitude	Where possible, the magnitude of an effect is expressed quantitatively. Where that is not possible, the effect is characterized qualitatively as follows: **Low**—effect is detectable but has no measurable effect on the resource within the RAA. **Moderate**—effect unlikely to pose a risk to the sustainability of a wildlife resource within RAA. **High**—effect will likely affect the sustainability of a wildlife resource in the RAA
Geographical Extent	**Site-specific**—environmental effect(s) confined to mine site and access road **Local**—environmental effect(s) occurs within the LAA, which is approximately 115km^2 **Regional**—environmental effect(s) on wildlife are measurable within the RAA
Frequency	**Once**—effect occurs once **Rare**—effect occurs monthly **Frequent**—effect occurs daily
Duration	**Short-term**—measurable for less than one month **Medium-term**—measurable for more than one month but less than two years **Long-term**—measurable for the life of the Project (completion of reclamation activities)
Reversibility	**Reversible**—environmental effect(s) reversible with reclamation and/or natural succession and/or decommissioning **Irreversible**—environmental effect(s) permanent and cannot be reversed with reclamation and/or natural succession and/or decommissioning

Criterion	Description
Ecological Context	**Disturbed**—there are existing disturbances within the LAA **Undisturbed**—there are no existing disturbances within the LAA
Probability of Occurrence	**Probable**—the effect is likely to occur **Improbable**—the effect is unlikely to occur

The LAA does have existing disturbances and the ecological context is therefore considered disturbed. Existing levels of disturbance have been captured in the assessment of baseline conditions.

6.9.1.9 Thresholds for Determining Significance for Wildlife

An effect is considered significant when it exceeds either a legal or ecological threshold. From a legal perspective, an effect is considered significant if the activity inducing the effect or the effect itself is not consistent with the SARA, MBCA, or the Yukon *Wildlife Act*. From an ecological perspective, an effect is considered significant when it has a moderate to high probability of reducing the long-term viability of the wildlife population in the RAA. Since there are no codified ecological thresholds, several are developed for the purposes of this assessment.

Ecological significance was evaluated at the scale of the RAA, rather than the LAA, for several reasons. The 30 km by 30 km RAA reflects the landscape scale of habitat requirements for species such as grizzly bear. The RAA is approximately equivalent to the area used by two female grizzly bears. In the Yukon, female grizzly bears maintain large multi annual home ranges approximately 491 km² in size (YFWCM 2010). These ranges may partially overlap with those of other bears. It also provides a regional context appropriate for assessing the sustainability of wildlife with smaller home ranges such as moose. For example the RAA can support approximately 180 moose, using densities of 200 animals for every 1,000 km² (Yukon Government 2003).

Wildlife Habitat Threshold

For this assessment, a habitat related effect is considered significant when >40% of the natural habitat in a landscape (defined here as the RAA) are removed by cumulative land use pressures. Natural habitats are defined as land and water areas where biological communities are formed largely by native plant and animal species, and where human activity has not essentially modified the area's primary ecological functions (IFC 2006).

Most empirical studies suggest that populations may decline more rapidly at a particular threshold of habitat loss and fragmentation, potentially leading to their regional extirpation. Depending on the taxa and landscape, the percentage of residual habitat required to maintain a viable population of a species may vary. However two major reviews conclude that most evidence supports a 10 to 30% residual habitat threshold (Andrén 1994; Swift and Hannon 2010).

The threshold of 60% residual habitat is twice the 30% supported by most literature as the minimum needed to maintain a population. This threshold was chosen to be precautionary, for several reasons. First, thresholds vary with the species, landscape, and spatial scale (Swift and Hannon

2010; Andrén 1999). Thus, in the absence of more detailed local information, caution is warranted when using general guidelines to make management decisions. Second, sensitive or at risk species may decline before habitat loss reaches a critical threshold. To maintain viable populations of all species, it may be necessary for habitat cover to be maintained above these minimum thresholds (Andrén 1999, Radford, et al. 2005, Mönkkönen and Reunanen 1999).

Mortality Thresholds

The primary threshold for wildlife mortality is based on meeting the applicable legal requirements. An effect is considered significant if it is not compliant with the federal *Migratory Birds Convention Act* (which makes it illegal to disturb, or destroy an egg or nest of a migratory bird without a permit) or the *Yukon Wildlife Act* (which also makes it illegal to destroy the egg or nest of a wild bird or encourage wildlife to become a public nuisance). The *Species at Risk Act* also makes it illegal to kill an individual of a SARA listed species that is extirpated, endangered or threatened.

The assessment also employs ecological thresholds for mortality risk where possible. Mortality risk for several species, particularly grizzly bear, is associated with motorized access into their habitat. This can be measured by the density of linear features (roads, right-of-ways, etc.). Mortality risk is considered significant when the density of linear features exceeds 0.6 km/km^2 in high quality grizzly bear habitat and 1.2 km/km^2 in all remaining grizzly bear range (Alberta Grizzly Bear Recovery Plan (AGBRT 2008) and British Columbia's Identified Wildlife Management Strategy [Guyg, et al. 2004]), and these values have been adopted for the purposes of evaluating significance for this assessment.

Movement Thresholds

Project-related effects on wildlife movement are assessed qualitatively in terms of whether there are any reasonable mechanisms by which the Project could alter movement patterns of wildlife in the RAA and undermine the viability of wildlife populations in the RAA as a result.

6.9.1.10 Effects Analysis Methods

Change in Wildlife Habitat

The effects of the Project on wildlife habitat have been assessed two ways. First, changes in the aerial extent of wetland, riparian and old forest habitats are quantitatively assessed based on Predictive Ecosystem Modeling (see Section 6.8 – Vegetation Resources). These habitat types are important for a number of species, including American marten, Rusty Blackbird and Olive-sided Flycatcher.

Second, wildlife habitat suitability models are used to measure the change in habitat for two focal wildlife species (moose and grizzly bear). These analyses are based on the most limiting life requisite(s) for each species. Winter is the most challenging season for moose survival due to low food availability, exposure to predators, and the need to thermoregulate. Fall and spring are critical seasons for grizzly bear as sufficient food resources are needed before entering dens to hibernate and following emergence in the spring. As a result, habitat suitability modeling was focused on these requirements.

Wildlife habitat assessments were completed following standard methods for ecological land classification and wildlife habitat suitability (RIC 1999). To determine the suitability of habitat for a given species, several pieces of information were required. The first was a suitability rating for each type of habitat present on the landscape. These ratings of habitat quality were done in the field as part of the 2009 ecological land classification (ELC) baseline surveys. ELC plots documented a variety of factors (e.g., site series, soil, structural stage, moisture) that can affect the value of a site for wildlife. Information collected on the plot was put into context with the adjacent wildlife habitats and features to establish the wildlife habitat rating. These surveys were used to verify the habitat models (species accounts), and then used to determine habitat suitability for the species modeled.

Habitat suitability was established using a six-class rating system (RIC 1999): nil, very low, low, moderate, moderately high and high. Preferred habitat includes areas identified as moderate, moderately high, or highly suitable. Species accounts (see Appendix 13 – Wildlife Habitat Suitability Modeling Data Report) describe the habitat life requisites that were assessed for each species.

Anthropogenic disturbances can increase or decrease the suitability of habitat for wildlife. To determine habitat suitability, therefore, ratings for habitat must be paired with information on disturbances that occur on the landscape (e.g., roads and buildings). For example, grizzly bears are sensitive to access roads. Habitat located within 400 m of an access road is considered to be less suitable than similar habitat further away. Additional details on how these zones of influence are applied can be found in Appendix 13.

A digital disturbance layer was created that identifies the locations of human developments in the RAA based on a combination of existing mapping layers, satellite imagery interpretations, and or field reconnaissance. This provides an accurate assessment of anthropogenic disturbances up to 2009. Disturbance types included transportation networks (roads, limited-use roads, bridges, and trails), clearings (camps), cutlines, industrial disturbances (placer mining operations) and structural disturbances (buildings). This analysis was used to assess baseline conditions (including wildlife habitat availability), the effects of landscape fragmentation, and the potential contribution of the Project to regional access issues. These layers were also used to infer changes in mortality risk to key species such as moose and grizzly bear due to increases in road access and density. The modeling exercise allowed for comparisons of wildlife habitat at baseline (i.e., before the Project), during construction, operations, closure and reclamation.

Change in Wildlife Mortality

For grizzly bears, mortality risk is assessed quantitatively, using road density as a measurable parameter. For most birds and other mammals, direct risks of mortality resulting from the Project are assessed qualitatively. Possible sources of wildlife mortality include collisions with vehicles and other equipment, destruction of bird nests as vegetation is cleared, the control of problem wildlife, and acute exposure to toxins. Indirectly, clearing of snow from the access road in winter may increase hunting or increase predation via increased winter access.

Change in Wildlife Movement Patterns

The potential environmental effects of the Project on wildlife movement are identified through professional judgment, and information provided by FNNND, stakeholders, and regulators. Because the Project is not expected to disrupt the regional movements of highly mobile species such as SARA-listed birds, these species are only assessed in terms of changes in habitats of special interest (i.e., wetlands, riparian areas, old growth) and mortality.

6.9.2 Assessment of the Change in Wildlife Habitat

6.9.2.1 Description of the Change in Wildlife Habitat

The Project may affect wildlife habitat in several ways. Site clearing and vegetation removal will result in direct loss of habitat as well as the isolation and fragmentation of larger areas into smaller, less suitable habitat patches. Construction and operations are the phases that cause the largest direct and indirect loss of habitat. Wildlife habitat is physically removed during the construction process. In addition, sensory disturbance will continue during construction and operations. Project activities, such as blasting and power generation, and influences from vehicle traffic may also cause sensory disturbance, leading wildlife to avoid otherwise suitable habitat.

Noise during construction and operations could decrease habitat suitability for some species such as moose or grizzly bear. Wildlife typically avoid areas with substantial noise, but the response will vary by individual species. For example, songbirds communicate primarily by song and may avoid noisy areas because they interfere with communication. These factors are considered when applying “zones of influence” and when modeling habitat quality. Sound levels will be greatest during mine operations, particularly during blasting events. Some wildlife may acclimate to lower levels of persistent sound over the life of the Project.

Project effects on habitat are greatly reduced at closure. Relative to baseline conditions, the greatest loss is moose winter shelter habitat, as mature trees will require additional time to develop in the reclaimed landscape. The greatest gain relative to baseline is for grizzly bear spring feeding habitat. The disturbance created by the Project results in the expansion of this habitat during reclamation.

6.9.2.2 Mitigation Measures for Wildlife Habitat

Measures which avoid or reduce effects of the Project on wildlife habitat are described in Table 6.9-7.

Table 6.9-7: Mitigation Measures for Wildlife Habitat

No.	Mitigation
Change in Wildlife Habitat	
1	**Minimize Project footprint.** Site clearing will be minimized to only the area needed to safely construct and operate the Project. Before clearing, wildlife habitat features (e.g., mineral licks, dens, nest trees, snags, rocky outcrops, small ponds/seepages) will be identified and evaluated to determine if they can be maintained. Even if small, these patches will benefit wildlife and contribute to reclamation.

No.	Mitigation
2	**Minimize aircraft overflight disturbance.** Project-related aircraft activity will follow flight restrictions agreed to with Yukon Government. This may include minimum flight altitudes and flight paths to avoid sensitive habitats during specific times of year.
3	**Implement a progressive reclamation plan.** VIT will: a) revegetate reclaimed areas with native species consistent with surrounding vegetation, except where regulatory agencies indicate that natural succession is preferable; and b) maximize use of direct placement techniques (minimizing stockpiling) to minimize the loss of biological activity in reclamation capping materials.

6.9.2.3 Residual Effects on Wildlife Habitat

The Project's effects on habitat are summarized in Table 6.9-8. These habitat changes are expected to be adverse, probable, local, long term, and on a trajectory to be reversible over time. A more detailed discussion follows below.

Table 6.9-8: Area of Wildlife Habitat in the LAA

	Baseline	Construction and Operations		Closure	
	Area (ha)	Area (ha)	Change (ha)	Area (ha)	Change (ha)
Habitats of Special Interest					
Wetlands	627	627	0	627	0
Riparian Areas	2,060	2,040	-20	2,039	-9
Old Forest	1,238	1,147	-91	1,147	-91
Preferred Habitat of Focal Species					
Moose Winter Feeding	3,232	2,625	-607	2,988	-244
Moose Winter Shelter	7,769	6,553	-1,216	6,904	-865
Grizzly Bear Spring Feeding	1,820	1,715	-105	2,205	+385
Grizzly Bear Fall Feeding	2,439	1,055	-1,384	1,526	-913

NOTES:
All calculations of change are relative to baseline conditions
See the Vegetation Resource section for additional discussion of changes to wetlands, riparian areas, and old forest
Preferred habitat is the sum of habitat assessed at moderate or higher quality (in the 6 class rating scheme)

Habitats of Special Interest

Wetlands

Relative to baseline conditions, the Project will result in no net loss of wetlands through construction. The access road, particularly along the first approximately 20 km leading from the Silver Trail Highway, parallels the South McQuesten River and associated wetlands. This area is considered an important calving and rutting area for moose (O'Donoghue 2010a, pers. comm.). The Project will not result in any meaningful loss of wetlands (as less than 0.01 ha will be lost). Human activity associated with the road will cause sensory disturbance which is expected to affect wetland use for some species, such as moose. The Project's effects on wetlands are considered to be adverse, local, long-term, reversible and probable.

Riparian Areas

Relative to baseline, riparian areas will decrease by 20 ha during Project construction and operations. The net loss is reduced to 9 ha during closure and reclamation. Helicopter-based wildlife surveys completed for the Project identified wildlife trails connecting forest habitat and distinct riparian and wetland habitats. Many of these appeared to have long term use, particularly by moose, and appeared to form connections between alpine or sub alpine habitats and lower elevation valley bottoms. The Project's effects on riparian areas are considered to be adverse, local, long-term, reversible and probable. There will be a permanent reduction of 9 ha of riparian area, but the loss of this small area will have little effect on wildlife.

Old Forest

Of the 1,238 ha of old coniferous forest that occurs in the LAA at baseline, 91 ha will be lost due to the Project. The old forests consist of ecosystems dominated by white or black spruce at lower elevations and ecosystems dominated by subalpine fir at higher elevations. Project effects on old forest are considered to be adverse, local, probable, and reversible, although only in the far future (>140 years following reclamation).

Effects on Focal Species

Moose

Moose habitat can be affected by two mechanisms: conversion to another use (e.g., habitat lost to the mine site) or through sensory disturbance (e.g., vehicles passing on the access road). Habitat will be physically converted only during construction. Project effects on moose habitat will be continuous during constructions and operations, while becoming smaller during closure when land is reclaimed and traffic reduced.

The location of moose winter feeding and thermal habitat during construction and operations is illustrated in Figures 6-9.2 and 6-9.3. At baseline 28% (3,232 ha) of the LAA is preferred winter feeding habitat and 67% (7,769 ha) is preferred winter shelter habitat. The majority of preferred habitat for moose is found outside of the direct mine site footprint development area. Winter shelter habitat is concentrated south of the mine above and adjacent to Lynx Creek and is found throughout most of the Access Road corridor. Relatively minor amounts of moose winter feeding habitat were identified within the future mine site footprint, or the entire LAA, when compared to thermal habitat presence.

During construction and operations total winter moose habitat declines by 1,823 ha (17%) in the LAA. This reflects a 607 ha (19%) reduction in preferred winter feeding habitat and a 1,216 ha (16%) reduction in preferred winter shelter habitat in the LAA (Table 6.9-8). This result is considered conservative (precautionary) because a 200 m zone of influence was applied for the construction and operations phases around the mine site footprint and along each side of the access road, which may overestimate of the effects of sensory disturbance and habitat loss on moose.

At closure, moose winter feeding and winter shelter habitat recovers relative to operations, gaining 363 and 351 ha. Relative to baseline, the net loss of habitat narrows to 244 ha (8%) of winter feeding habitat and 865 ha (11%) of winter shelter habitat. This reflects the fact that it may take 10 to 15 years to attain early structural stage suitable winter feeding habitat, and 60 to 80 years to achieve mature structural stages supporting preferred winter shelter habitat. The Project disturbance effects along the access road will essentially end at closure. Effects on moose habitat are adverse, probable, local, frequent, long-term, reversible, and probable[31].

Grizzly Bear

The location of grizzly bear spring and fall feeding habitat during construction and operations is illustrated in Figures 6.9-4 and 6.9-5. Preferred grizzly bear feeding habitat within the LAA represents 37% (4,259 ha) of the total habitat available in the LAA at baseline. This includes 1,820 ha of spring feeding habitat and 2,439 ha of fall feeding habitat (Table 6.9-8). These spring and fall habitats may overlap, particularly during summer months. Spring feeding habitats are associated primarily with riparian corridors such as Haggart Creek, Lynx Creek, and the South McQuesten River outside of the mine footprint. Impacts to habitat adjacent to Lynx Creek are not expected. In addition, only a few relatively small patches of preferred habitat are found along the access road. Fall feeding habitat was more abundant and widespread throughout the LAA, concentrated in patches on forested slopes surrounding the mine site footprint. Smaller, isolated patches were noted along the access road, particularly adjacent to and south of the South McQuesten River.

During construction and operations preferred spring and fall feeding habitat is reduced by 105 (6%) and 1,384 ha (57%) of the LAA respectively. At closure, the area of preferred fall habitat recovers, primarily in the form of berry producing species (e.g., blueberry. bog bilberry, mountain cranberry) with a net loss of 913 ha relative to baseline (Table 6.9-8). This result is considered conservative (precautionary) as an 800 m zone of influence was applied for the construction and operations scenario around the mine footprint, and a 500 m zone on both sides of the access road, which may overestimate the effects of sensory disturbance and consequent habitat loss on grizzly bear.

At closure, grizzly bear spring and fall feeding habitat recovers relative to operations, gaining 490 and 471 ha. Relative to baseline, the loss of fall feeding habitat is 913 ha (37%) of the LAA. The area of spring feeding habitat at closure exceeds the baseline amount by 385 ha (21%, see Table 6.9-8) as grass and other early successional plants will become common during this stage of reclamation.

Project effects on grizzly bear habitat availability during construction and operations are expected to be adverse, probable, local, frequent, long-term, reversible, and probable[32]. Mine site related disturbance and traffic will cease at closure, reversing the effects on habitat availability in much of

[31] Magnitude of effect is only provided when a quantitative determination is not possible. In this case a quantitative measurement of magnitude is provided in preceding text.

[32] Magnitude of effect is only provided when a quantitative determination is not possible. In this case a quantitative measurement of magnitude is provided in preceding text.

the LAA. This may take 5 to 15 years to attain early structural stages and plant communities supporting preferred feeding habitat. Therefore effects at closure are expected to be long-term in duration. Traffic on the access road at closure is expected to be greatly reduced, reducing sensory disturbance levels.

American Marten

American marten depend on course woody debris, which is often associated with old forest. While ecological land classification field studies revealed an almost complete lack of course woody debris, for the purposes of this assessment we assume that American marten utilize course woody debris for shelter in old forests and feed in riparian areas. Typical marten densities in the Yukon are estimated at 0.0006 animals per hectare (Kyle, et al. 2000) indicating the old forest and riparian areas lost is less than the area required to support a single marten. The effects of the Project on American marten is therefore expected to be adverse, low in magnitude, local, frequent, long-term, reversible, and probable.

Rusty Blackbird

Rusty Blackbird is a species that would be particularly sensitive to loss of wetlands and riparian areas. The species prefers wetlands and riparian areas adjacent to mature or old forests (Structural Stages 3 to 7). While density estimates for Rusty Blackbird in the Yukon are generally lacking, Avery (1995) suggest the species may occur at densities of 0.0003 birds per hectare within suitable habitats. Using this figure, the loss of 20 ha of riparian areas presents less than 1% of the area required by one nesting bird. The loss of 20 ha of wetlands is therefore expected to be so small as to be functionally neutral in their effect, site-specific, frequent, long-term, reversible, and improbable (given the small area affected).

Olive-sided Flycatcher

Olive-sided Flycatchers prefer old conifer forests but will use younger forests (structural stage 4 – 6) that are open, in association with edge habitat (proximity to open areas such as wetlands, ponds, lakes, marshes and meadows is preferred). While no Olive-sided Flycatchers have been observed or noted in the literature in the Project area, the LAA does contain some potential habitat. Altman and Sallabanks (2000) estimated that where habitat occurs, Olive-sided Flycatchers defend 40 to 45 ha territories (equivalent to a density at 0.05 birds per hectare). Using this density estimate, it is possible to estimate a range of flycatchers that could be affected.

If the entire area of old forest, riparian, and wetland habitat lost was occupied by Olive-sided Flycatchers, this would equate to the displacement of approximately three pairs (six individuals) within the LAA. An even more conservative assumption would be to assume that all forest, independent of type or structural stage, is fully occupied by Olive-sided Flycatchers. Approximately 5% (575 ha) of all combined forest types will be lost within the LAA during construction and operations, which would be equivalent to a displacement of approximately 15 Olive-sided Flycatcher pairs. This is almost certainly an overestimate given it is reasonable to assume that the actual number of birds affected is within the range of 0 to 29 individuals during construction and operations and that this number would gradually decline during closure and reclamation. The effects of the

Project on this species are therefore expected to be adverse, low in magnitude, site-specific, frequent, long-term, reversible, and improbable.

VIT recognizes the increasing focus on species at risk and has reviewed the new guidance which has come out since baseline studies were conducted for the Project (Environment Canada 2010). In discussions with Yukon Environment and Environment Canada, VIT will consider if there is a need for bird surveys focused on species at risk (Olive-sided Flycatcher and Rusty Blackbird). Neither has been recorded in the LAA but either could potentially occur. If surveys are warranted, they could be carried out prior to construction. If any species at risk are detected, information collected on their habitat requirements could be used to guide reclamation planning.

6.9.2.4 Determination of Significance of Change in Wildlife Habitat

As described above, the RAA provides the appropriate regional context area for determining the significance of loss of wildlife habitat. Both the natural habitats and anthropogenic disturbances within the RAA are identified in Figure 6.9-9. At baseline the vast majority (>99%) of the RAA is covered with natural habitat, with only 750 ha covered by anthropogenic disturbances (Table 6.9-9). When comparing baseline and operations it is important to note that some anthropogenic features, such as cleared land, change categories from baseline to construction and operations. For example, some cleared land is converted to mining. During operations the disturbed area will increase to 1,385 ha. Nonetheless, greater than 98% of the RAA remains as natural habitat.

Table 6.9-9: Total Area Disturbed in the Wildlife Regional Assessment Area

Feature	Area (ha)	
	Baseline	Operations
Cleared Land	25	24
Disturbed Land	13	13
South McQuesten and Haggart Creek Roads	75	72
Exploration Road	60	46
Exploration Trail	100	96
Exploration Trench	9	8
Highway	40	40
Mining	9	704
Mining/Drilling	143	70
Mining/Trenching	4	4
Placer Mining	175	112
Cutlines	61	60
Trail	17	17
Transmission Corridor	19	177
Total Human Disturbance	**750**	**1,385**

Feature	Area (ha)	
	Baseline	Operations
Total Area RAA	**90,000**	**90,000**
Percent RAA disturbed	0.83%	1.54%

NOTES:

Figures above generated from Earth observation for sustainable development of forest (EOSD) coverage. This is mapped based on Landsat-7 Enhanced Thematic Mapper (ETM+). See Figure 6.9-7 for an illustration of these features.

Some anthropogenic features, such as cleared land, change categories from baseline to construction and operations. For example, some cleared land is converted to mining.

The mining category includes the proposed Project.

As described in Section 6.9.1.9, reductions in wildlife habitat are considered significant when >40% of the natural habitat is removed by disturbance. As Table 6.9-9 demonstrates, the habitat loss associated with this Project will be well below this threshold. The abundance of habitat in the RAA means the effects of habitat fragmentation, loss, and isolation are small and the consequent risk that wildlife populations will become non-viable because of habitat loss is also small. In terms of the threshold established for this Project, the effect on wildlife habitat is considered not significant. The confidence level for this determination is high.

6.9.3 Assessment of the Change in Wildlife Mortality

6.9.3.1 Description of the Change in Wildlife Mortality

Wildlife mortality may result from clearing of vegetation (particularly for nesting birds, if done during the breeding season), bird interactions with transmission lines, vehicle collisions, hunting or poaching, lethal control of problem wildlife, or poisoning if wildlife come into contact with cyanide used in the mining process. Cyanide is the only potential toxin that might come into contact with wildlife given its use in the heap leach facility whereas other toxins are contained inside a building or other contained structure. This is further discussed in the accidents and malfunctions of Section 8. Residual effects are described further below.

The Project may affect the mortality of focal species, particularly moose and grizzly bear. Moose may experience increased mortality as access to moose populations improves. Several mechanisms may be responsible (O'Donoghue 2009a, pers. comm.):

- Higher rates of harvest (legal and illegal) due to increased access for hunters or poachers
- Collisions and other interactions with vehicles, which include increased winter energy expenditures if moose run along roads to flee vehicles
- Higher predation rates if the plowed access road provides wolves easier access to winter moose habitat.

Each mechanism is introduced below in greater detail. In terms of hunting, the Project lies within Game Management Zone (GMZ) 2, Subzone 62. Moose is the main species harvested. The South McQuesten River Valley is recognized as an important hunting area. Harvest statistics indicate that over the ten year period 1999 to 2008 an average of 2.1 moose was harvested from GMZ 2-62 (Appendix 3 – Land Use and Land Tenure) per year. The harvest rate has experienced a decline, averaging 3.2 moose per year over the first five years and falling to 1.0 moose per year over the last five years. There has been a voluntary hunting closure in the McQuesten Lake area, east of the Project in previous years (2008/2009) (Appendix 3).

Moose may interact with vehicles as they take opportunistic advantage of the relatively easy access route provided by the plowed access road during winter. Consequently, winter is considered the highest risk season due to the potential for the snow banks on the plowed road making it difficult for moose to leave the road to avoid traffic. In addition, moose may run significant distances on the road, expending valuable winter energy reserves, in attempts to find escape options from the access road. Both collisions and the expenditure of energy may increase their risk of mortality during winter months.

Wolves (*Canis lupus)*, which are present in the LAA and known moose predators, may utilize the access road as a winter movement corridor, facilitating lower energy expenditures and rapid movement amongst habitat types while seeking out prey. Evidence of wolf usage (tracks, sightings of individuals) on the access road was noted during 2009 baseline field studies. Increased wolf activity due to the access road may also increase moose mortality.

Grizzly bear is the second focal species for which mortality may be a concern. Grizzly bear populations are particularly affected by increases in mortality because of the bear's large home ranges, low reproductive rate, and the extensive areas typically required for sustaining stable populations. In this context, even a small number of grizzly bear deaths can have an important effect on the local population (Gibeau, et al. 1996).

Conflicts with humans are a leading cause of grizzly bear mortality. Neilsen, et al. (2004) found that the highest risk of mortalities for grizzly bears in the Central Rockies Ecosystem was related to proximity to humans. Human proximity is known to increase problem human-bear interactions revolving around food/waste management and increased hunter and poacher access.

Wildlife exposure to potential toxins will be limited on the mine site. The main possible pathway of exposure occurs during summer operations when the cyanide leach solution is irrigated on the HLF. There will be some exposure of the solution when irrigation is happening and some of this may crystallize. Crystalline salts do not contain much cyanide, but it is possible that wildlife could ingest them. The HLF will be an active area of the mine and the combination of equipment activity and noise will keep most wildlife away. During the winter, cyanide solution will be applied using buried irrigation lines, reducing the risk of contact with wildlife.

Project effects on mortality are greatly reduced at closure, when road traffic volumes return to baseline and plowing ceases.

6.9.3.2 Mitigation Measures for Wildlife Mortality

The Project will implement 13 measures to avoid or reduce the risk of wildlife mortality. These are described in Table 6.9-10.

Table 6.9-10: Mitigation Measures for Wildlife Mortality

No.	Mitigation
Change in Wildlife Mortality	
4	**Share information to minimize the risk of vehicular collisions with wildlife**. VIT will: a) promote proactive radio communication among users of the access road to convey safety information, including sightings of large wildlife species along the road; b) provide and maintain signage where problems are most likely to occur, reminding drivers to be vigilant for wildlife and give them the right of way; and c) verbally report collisions and/or carcasses of ungulates and other large animals observed on and in the vicinity of the Project site and along the access road to the Environmental manager, Mine Manager or designate(s) as soon as possible to ensure prompt removal. Near misses and collisions that result in the death or injury of an ungulate or other large animal must be reported as soon as possible. Measures will be developed in coordination with overall road planning with Yukon Government Highways and Public Works.
5	**Implement speed limits to minimize dust and reduce wildlife collisions**. The proposed maximum speed limit will be 60 km/h on the access road where speed limits are not designated by Highways and Public Works or a road design engineer.
6	**Provide and encourage the use of personnel transportation (bussing) to the mine site,** minimizing opportunities for wildlife vehicular collisions.
7	**VIT will ensure that the presence and use of firearms are restricted on the Project site.** The restrictions will extend to employees, management and contractors. In addition VIT will develop a policy restricting Project-related employees and contractors from hunting and fishing while on the job at any time throughout the life of the Project.
8	**Implement food and waste storage protocols to avoid attracting wildlife** (primarily bears) that could become a nuisance. Protocols will be designed with guidance from Yukon Government and the Yukon Government's "Guidelines for Industrial Activity in Bear Country."
9	**Implement a Bear Aware Program** as a standard part of the health and safety orientation and make supporting materials (e.g., pamphlets, videos) readily available on site. This part of the orientation program will be designed with guidance from Yukon Government and "Guidelines for Industrial Activity in Bear Country."
10	**Develop a problem wildlife prevention and response plan** as part of the Wildlife Protection and Management Plan. This program will be designed with guidance from the Yukon Government and incorporate direction from "Guidelines for Industrial Activity in Bear Country" as appropriate. When a problem wildlife issue arises, the Environmental manager will take appropriate action based on the plan and consultation with Yukon Government.
11	**Clear vegetation outside of the migratory bird nesting window (May 1 – July 31).** Where this is not possible, VIT will consult with the appropriate regulators (Yukon Government, CWS) and develop management strategies. These strategies are likely to include surveying the area to be cleared for nests a maximum of one week prior to clearing. Bird nests will be identified and protected until nesting has completed.
12	**Reduce bird mortality risk along the transmission line RoW** based on existing design guidelines such as: Avian Protection Plan (APP) Guidelines (APLIC and USFWS 2005) and Suggested Practices for Avian Protection on Transmission lines (APLIC 2006)

No.	Mitigation
13	**Reduce wildlife mortality in the Heap Leach Facility area, events ponds and ditches**. VIT will: (a) fence off and will control (minimize) the growth of vegetative cover at any mine site location with compromised water quality (e.g., events ponds); (b) not reclaim events pond shorelines; (c) use Bird Balls™ or a reasonable alternative to deter waterfowl or other birds from landing on ponds that would pose a health risk to them (e.g., containing the heap leach pregnant solution); and (d) design ditches and sediment ponds to reduce potential for entrapment of wildlife
14	**Follow company procedures and regulatory requirements for the safe and prompt clean up of any chemical spills**.
15	**Manage vegetation to reduce effects on wildlife.** VIT will: (a) minimize or eliminate the use of vegetation attractive to bears and ungulates (e.g., legumes) in seeding mixtures used along roadsides;(b) cut brush early in the growing season, before it becomes an attractant to large wildlife species; and (c) use manual clearing rather than herbicides in vegetation management activities. Manual clearing will follow mitigation measure 11.
16	**Facilitate wildlife movement** by: (a) providing wildlife crossing and escape points in the plowed snow banks along access road (i.e., low areas 0.5 m or less in snow banks at regular intervals); (b) providing wildlife crossing points along extensive open ditches; and)c) provide direction to Project staff and contractors on methods to avoid interference with the movement of wildlife across roads.
General	
17	**Monitor the implementation of all mitigation measures and make adjustments where necessary**.

VIT will implement measures to reduce wildlife mortality in the Heap Leach Facility area, events ponds, and ditches. These measures include fencing around the Heap Leach Facility Area (to deter terrestrial wildlife from entering the area), controlling the growth of vegetation, leaving the banks of event ponds unvegetated (reducing the likelihood that wildlife would be attracted to these areas), and designing ditches and sediment ponds to reduce potential for the entrapment of wildlife. This is particularly important for birds, particularly waterfowl, which utilize but would not be deterred by fencing around event ponds and heap leach ponds. VIT has evaluated a variety of measures to deter birds from landing on the event ponds, including Bird Balls™, exclusion netting, propane cannons, and models of humans or predators. Each is briefly summarized below.

For several reasons, Bird Balls have been selected as the best mitigation option to reduce wildlife mortality in the events ponds. Bird Balls are hollow, floating plastic balls that create a dense cover over the entire surface of a pond. When deployed, flying waterfowl do not recognize the area as open water and therefore do not land on it. This reduces the risk of contact with untreated water and bird mortality. Bird Balls are simple to install, deter a variety of wildlife (e.g., by making the surface of the event pond unrecognizable as water), are effective as water levels change (rising and falling as needed), are not damaged by snow or ice, and minimize free cyanide loss due to volatilization. Bird Balls are effective for the size of the event ponds.

Alternative deterent methods to Bird Balls have a variety of disadvantages. Exclusion netting can collapse in winter under ice and snow and there is risk of bird entanglement in netting. Hazing with propane cannons loses effectiveness over time because of habituation, in the response to the cannons becomes weaker over time as birds become accoustomed to the sound. This is more likely to occur with resident than migratory bird species (March, et al. 1992; Ronconi and St. Clair 2006). In addition, propane cannons are not effective at deterring shorebirds (Simons, et al. 2009), and would disturb other wildlife (and humans) in the area. Human models ('scarecrows') and predator models are simple and easy to install, but birds readily habituate to their presence and they are not effective for shorebirds (Ronconi and St. Clair 2006; Simons, et al. 2009).

An analysis of the pros and cons of alternative wildlife deterents is provided below.

Table 6.9-11: Pros and Cons of Bird Deterrent Options

Option	Pros	Cons
Bird Balls	▪ Simple to install ▪ Deter a variety of wildlife, as they form a continuous barrier that is not associated with water by wildlife ▪ Are effective as water levels change (rising and falling as needed) ▪ Relatively unaffected by snow and ice ▪ Minimize the volatilization and thus loss of free cyanide	▪ Not practical for large areas
Exclusion netting	▪ Keep out all large wildlife ▪ Easy to install	▪ Can collapse in winter under ice and snow ▪ Risk of bird entanglement ▪ not effective for large impoundments
Propane cannons	▪ Habituation unlikely for migratory birds (Simons, et al. 2009)	▪ Disturb other wildlife in area ▪ Lose effectiveness for resident birds over time ▪ Not effective for shorebirds
Models of humans or predators	▪ Simple and easy to install	▪ Habituation ▪ Not effective for shorebirds

Based on this assessment, for this Project, Bird Balls are the preferred deterrent method for preventing bird use of the event ponds.

6.9.3.3 Residual Effects on Wildlife Mortality

Clearing of Natural Vegetation

The Project will minimize clearing of natural vegetation within the migratory breeding bird window for the area. Clearing will be done in a way consistent with the *Yukon Wildlife Act* and the *Migratory Bird Convention Act*, greatly reducing or eliminating the risk of wildlife mortality (mitigation measure 11). The effects of vegetation clearing on mortality are therefore considered adverse, low magnitude, site specific, rare, short-term, reversible and improbable.

Traffic and Wildlife

Increased traffic volumes associated with the Project are summarized in Table 6.9-12.

Table 6.9-12: Estimated Increases in Traffic Associated with the Project

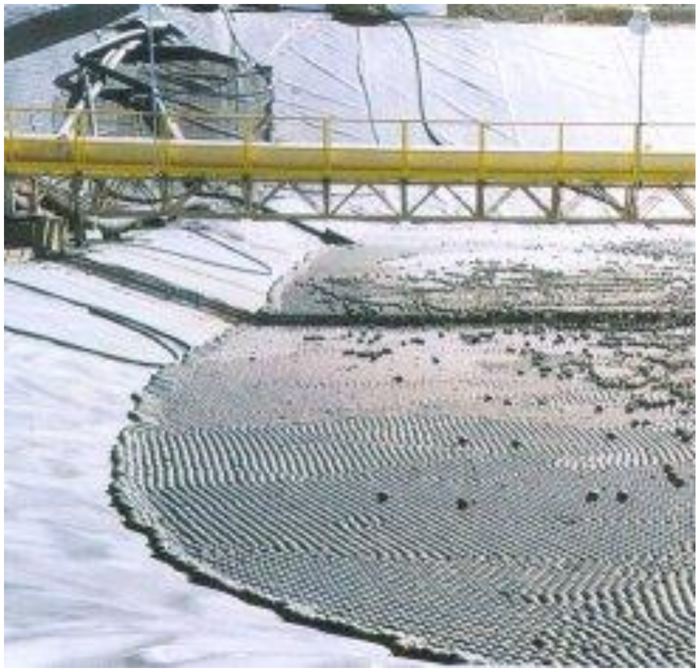
Phase and Vehicle	Round Trips per Day
Construction (1.5 years)	
Semi trailer	3.33
One to five tonne trucks	1.50
Passenger vehicle or pickup truck	10.00
Operations (7.3 years)	
Bus (carrying personnel)	0.33
Truck loads	5.40

NOTES:
Based on maximum estimated traffic volumes associated with the mine and 30 work days per month

The rates of wildlife mortality associated with current or projected traffic volumes are not known. However, the risk of mortality from Project-related traffic is expected to be minimized by sharing information to minimize the risk of vehicular collisions with wildlife (mitigation measure 4); implementing speed limits of 60 km/h on the access road and 50 km/h on mine site roads (measure 5); providing and encouraging the use of Project transportation to the mine site (measure 6); and managing vegetation to reduce wildlife mortality, including discouraging bears and ungulates from using the roadside (measure15; see Table 6.9-10). Traffic volumes will be low; therefore, increased traffic volume as a result of the Project is not expected to prohibit wildlife from crossing roads. The effect of traffic-related mortality arising from the Project is therefore considered adverse, low, site-specific, rare, long-term, reversible and improbable.

Cyanide—Interactions with Wildlife

There is no potential interaction with wildlife and the HLF pond as the process solution is contained within the HLF itself. The risk to birds is from cyanide-contaminated water (Eisler, et al. 1999). Most years during freshet or heavy rainfall, more water will enter the HLF than is needed for operations. The excess solution will be temporarily stored in the events ponds and then recovered into the HLF circuit as required. Mitigation measure 12 will reduce the risk of wildlife mortality in the HLF area, events ponds and ditches. Events ponds will be fenced, vegetation will be controlled, and Bird Balls, netting or reasonable alternatives will be used to deter waterfowl or other birds from landing on the ponds. As illustrated in Photo 6.9-1, Bird Balls are hollow, floating plastic balls used to cover the surface of an industrial pond, deterring waterfowl from coming into contact with untreated water by creating an unstable surface for roosting and lack of access to open liquid. Ditches and sediment ponds will be designed to reduce entrapment of wildlife. With the mitigation measures proposed, the potential interaction between wildlife and cyanide is considered to be adverse, low in magnitude, site specific, short-term, irreversible, rare and improbable.



Source: Euro-Matic (http://www.euro-matic.com/birdb.html)

Photo 6.9-1: Bird Balls floating on the surface of a heap leach pregnant solution pond to prevent waterfowl fatalities

Hunting

The risk of additional hunting mortality will be minimized by bussing Project employees and contractors to the site and restricting the presence and use of firearms on the Project site (measures 6 and 7, see Table 6.9-10).

Effects on Focal Species

Moose

The Project will not construct new access into the proposed mine site, although the access road will be plowed during the winter months. The Project's effect on moose hunting is most likely to occur during those months when access to the LAA is currently limited by snow (winter and the tail end of the fall hunting season). Winter plowing is likely to have a limited effect on the non-Aboriginal moose harvest, most of which occurs when snow does not constrain access. A security gate will be located at the mine site entrance that will limit access beyond the Project site during construction, operations and active reclamation.

The effect of the Project on FNNND hunting, which occurs throughout the year, is less clear. FNNND citizens report that currently they hunt primarily by skidoo up the Stuart River from Mayo. When the access road is maintained year round it may provide an easier travel corridor. Whether it affects hunting patterns depends on general moose abundance and hunting preferences of the

FNNND. In general, hunting is an issue managed by the Yukon Government and the FNNND, and it should be possible to make adjustments, if needed, in response to changing hunting patterns and moose populations.

Traffic on the access road may increase the number of people who become familiar with the LAA. Hunting and firearms will be restricted in camp, so hunting would only be possible if people return (when not working) to the area.

The Project will implement a series of appropriate mitigation measures, including sharing information to reduce the risk of vehicular collisions (mitigation measure 4); implementing speed limits to reduce wildlife collisions (mitigation measure 5); and encourage the use of public transportation (mitigation measure 6); and managing vegetation will all minimize moose mortality (measure 15). Taken together, the effect of the Project on moose mortality is considered adverse, moderate, local, long-term, probable, rare, and reversible. The confidence in this prediction of this effect is moderate, which is one reason that additional moose monitoring is proposed below in Section 6.9.7.

Grizzly Bear

The Project will not increase the linear feature density in the region, a major predictor of bear mortality rates. During operations the total length of linear features in the RAA is 513 km. This represents a linear feature density of 0.006 km/km^2, well below the threshold of 0.6 km/km^2 used in British Columbia and Alberta (see Section 6.9.1.9 for a discussion of thresholds).

The Project will bring increased human activity to the area. However, an extensive list of mitigation measures (found in Table 6.9-10) related to waste management, firearms, education, and bear-human conflict management will mitigate risks.

Traffic volumes of the access road will be relatively low. In addition, the Project will require drivers to cede the right of way to wildlife, report carcasses to reduce the risk of attracting scavengers which themselves may be hit by vehicles (mitigation measure 4) and to maintain low speeds (mitigation measure 5). With the implementation of these measures, the likelihood of traffic collisions that will result in grizzly bear mortality is low. At closure, Project related traffic will drop, reducing this risk even further.

A greater risk is that a bear may be killed with a firearm. No grizzly bears have been harvested while hunting in GMZ2-62 (1999-2008), while three individuals have been harvested from adjacent GMZs from 1999 to 2008 (Appendix 3 – Eagle Gold Project Land Tenure and Land Use). Nonetheless, bear-human conflicts can lead to control actions. To avoid this, VIT will implement a series of mitigation measures to minimize bear-human conflicts and to manage conflicts appropriately should they occur. Key measures include implementation of proper food and waste storage protocols to avoid attractants that would cause animals to become a nuisance (mitigation measure 8), a prohibition against littering at the mine site, the implementation of a Bear Aware Program as a standard part of the health and safety orientation (mitigation measure 9), and the development and implementation of a Wildlife Protection and Management Plan (mitigation measure 10). Should a problem wildlife issue arise, the Environmental manager, Mine Manager or designate(s) will initiate an appropriate response as described in the Wildlife Protection and Management Plan. With these measures in place, and given that the mine will not create new access into bear habitat, the effects of the Project on bear mortality are considered adverse, moderate, local, long-term, improbable, rare, and reversible.

American Marten

Mortalities associated with vehicle collisions and operating machinery are expected to be minimal because the traffic volume on the access road will be low enough to allow marten to cross during longer gaps between vehicles. Since marten tend to change their use behaviors to avoid areas of high human use, it is expected that they will avoid the mine site, reducing mortality risk.

Registered Trapline Concessions (RTCs) are present within the RAA. One registered trapline concession overlaps the LAA, with an additional eight RTCs overlapping to varying degree with the RAA (Figure 3.1-5). On average, 14 marten are harvested in each RTC each year. Improved access via winter access road maintenance will enable easier travel, further into the LAA during winter. This may attract additional interest in the LAA in terms of establishing further RTCs. Additionally, the FNNND will realize improved winter access and may also seek to increase trapping activity within the LAA. VIT understands that any change in trapline concessions would be managed by Yukon Government. Project effects on marten mortality are considered adverse, low, local, long-term, reversible, and improbable.

Olive-sided Flycatcher and Rusty Blackbird

The Project will implement a suite of measures to ensure that it is compliant with the Yukon *Wildlife Act*, *the Migratory Bird Convention Act, Species at Risk Act* and reduces to a minimum the potential effects on bird mortality. Removal of natural vegetation will not be completed during the migratory bird nesting window (May 1 – July 31) (mitigation measure 11), steps will be taken to reduce bird mortality risk along the RoW (mitigation measure 12), and measures will be taken to deter birds from coming into contact with the events ponds, including the use of netting, Bird Balls[33] or a reasonable alternative (mitigation measure 13). The Project's effects on bird mortality are therefore expected to be neutral to adverse, low in magnitude, site-specific, rare, short-term, improbable, and reversible.

6.9.3.4 Determination of Significance of Change in Mortality

Overall, Project effects on the risk of wildlife mortality are considered to be adverse, of moderate magnitude, local, and long term. The Project will implement measures to ensure compliance with the Yukon *Wildlife Act* and the *Migratory Bird Convention Ac*t, and *Species at Risk Act*. Thus, in terms of the legal threshold for significance established for this Project, Project effects on wildlife mortality rate are not considered significant.

The Project will not increase the density of linear features in the RAA because the access road is already in place and the transmission line will parallel the existing access road. The density of linear features will therefore remain below the 0.6 km/km^2 threshold used for Grizzly Bear mortality. Hunting pressure on moose may increase. As described above, however, there is not sufficient data

[33] Bird Balls are hollow, floating plastic balls used to cover the surface of an industrial pond. When deployed, flying waterfowl do not recognize the area as a pond and therefore do not land on it. This reduces the risk of contact with untreated water and bird mortality.

on all sources of moose mortality to quantitatively assess this effect. Given the Project design, and the suite of mitigation measures described in Table 6.9-10, the Project is not expected to pose a substantial mortality risk for wildlife and effects on mortality are considered not significant. Given the quality of data available, and judged effectiveness of the proposed mitigation measures, the confidence in this prediction is moderate. Since the prediction confidence is moderate, monitoring is proposed both as a mitigation measure (e.g., monitoring of collisions with wildlife) and an adaptive management measure (e.g., specific measures are proposed to monitor moose populations (see Section 6.9.7).

6.9.4 Assessment of the Change in Wildlife Movement Patterns

6.9.4.1 Description of the Change in Wildlife Movement Patterns

While the Project will not develop access roads into previously undisturbed areas, it is possible that the increase in activity associated with the construction and operations of the mine may have some effect on wildlife movements. Compared with baseline, on average an addition 15 vehicles will travel the access road each day during construction and an additional six vehicles during operations (Table 6.9-12). This could be particularly important in winter should wildlife be travelling on plowed roads. Since moose and grizzly bear are wide ranging terrestrial species, their movements could be affected by the access road and the mine site. It is not expected that the Project will have an effect on the movement patterns of highly mobile species such as birds. Consequently, assessment of this potential effect on Rusty Blackbird and Olive-sided Flycatcher were not carried forward. As American marten maintain home ranges are in the order of 2 to 16 km², their daily and seasonal movements occur on a smaller scale than larger mammals such as grizzly bears. Their movements may be altered by vegetation clearing and vehicle traffic, which could fragment their habitat patches into smaller blocks.

6.9.4.2 Mitigation Measures for Wildlife Movement Patterns

The Project will implement two mitigation measures to avoid or reduce effects on wildlife movement (Table 6.9-13).

Table 6.9-13: Mitigation Measures for Wildlife Movement

No.	Mitigation
Change in Wildlife Movement Patterns	
16	**Facilitate wildlife movement** by: (a) providing wildlife crossing and escape points in the plowed snow banks along the access road (i.e., low areas 0.5 m or less in snow banks at regular intervals); (b) providing wildlife crossing points along extensive open ditches; and (c) provide direction to Project staff and contractors on methods to avoid interference with the movement of wildlife across roads.
General	
17	**Monitor the implementation of all mitigation measures and make adjustments where necessary**.

6.9.4.3 Residual Effects on Wildlife Movement Patterns

The residual effect of the Project on wildlife movement must be taken into the context of the RAA. The operational phase is the period when wildlife movement is most likely to be affected. Wildlife species may respond to increased traffic levels, but no new roads will be developed and over 98% of the RAA will remain covered by natural habitat (Table 6.9-9), providing a diversity of alternative movement corridors for wildlife. Residual effects on several focal species are described below.

Moose

The increased traffic on the access road and development of the mine site may serve as impediments to moose movement amongst various habitat types used seasonally. Typically, moose in the area will spend summer and fall on middle to upper slopes including higher elevation alpine and sub-alpine habitats during rutting season. If mine site and road access activity interferes with moose moving to and from important rutting and calving areas, this could result in adverse impacts on moose reproduction and over-winter adult survival. Moose movement patterns may also be affected if Project-related activity on the access road fragments suitable habitats along its 45 km length and creates potential movement barriers. The same is true of the mine site footprint.

Moose typically do not display a strong aversion to crossing a roadway or to human use areas. Moose currently use the access road, which can facilitate moose movement, and the road does not appear to be a barrier. While increased traffic may result in less frequent crossings by moose, moose are likely to continue to cross the road given that the increase traffic averages just 15 vehicles during construction and drops to six during operations. In winter they may prefer using the plowed road as a travel corridor, reducing the energy they expend travelling. By Project-related vehicles yielding to wildlife that are crossing roads (mitigation measure 16) and by providing crossing and escape points for wildlife (mitigation measure 16), adverse Project effects on moose movement are considered to be adverse, low in magnitude, probable, local, rare, long-term and reversible.

Grizzly Bear

For the most part grizzly bears will be in their dens during winter, so winter plowing and road interactions will be less of a concern than for moose. Grizzly bears are expected to avoid areas around the access road and mine site during construction and operations (this effect is discussed in Section 6.9.2). Should bears be encountered, yielding to them should they cross roads (mitigation measure 16) will facilitate their movement. Project effects on bear movement are considered to be adverse, low in magnitude, probable, local, long-term and reversible.

American Marten

Marten prefer to stay in areas with tree cover and have been observed to cross high-use roads less frequently than low use roads (Alexander and Waters 2000; Clavenger, et al. 2002). The access road will have substantially less traffic volume than the levels cited in these publications, the width of the access road and adjacent transmission line RoW is expected to be relatively narrow (approximately 30 m), and the transmission line RoW will parallel the existing road. All of these factors limit the effects of the Project on marten movements. As the density of disturbance is low in the RAA (only one primary access road), impacts resulting in habitat fragmentation and isolation are unlikely.

Project effects on disruption to marten movement patterns are expected to be adverse, low magnitude, local, rare long term and probable. Effects will be reversible at closure. The access road will remain, however at closure traffic volumes will be substantially reduced and assumed to return to near baseline traffic volume.

6.9.4.4 Determination of Significance of Changes in Movement Patterns

Project effects on wildlife movement patterns are expected to be adverse, low magnitude, local, frequent and long-term. Mine site related disturbance and traffic will decline at closure, making the low magnitude effects on movement reversible. Consequently, the effect of alteration of wildlife movement patterns is anticipated to be not significant. Riparian corridors that may have been used by wildlife in the upper reaches of Haggart Creek will no longer be available to wildlife. The substantial area undisturbed habitat (>98% in natural vegetation in the RAA) offers a wide range of potential movement corridors within the RAA, wildlife are expected to avoid disturbance features associated with the mine site footprint with relative ease. The access road, although a potential movement barrier, represents a small area in terms of width and is not expected to completely prevent any species from moving over it. Based on professional opinion and the scientific literature, the confidence in this prediction is moderate to high.

6.9.5 Assessment of Cumulative Effects on Wildlife

6.9.5.1 Screening of Cumulative Environmental Effects

A cumulative effects screening is presented below, following the procedures described in Section 6.1 which suggests a screening is warranted when three conditions are met: (1) the Project results in a demonstrable residual effect; (2) the effect is likely to act cumulatively with those of other projects; and (3) there is a reasonable expectation that, with the Project’s contribution, cumulative effects may be significant.

Table 6.9-14 identifies the potential interactions between the residual effects on wildlife and other projects in the RAA. The activities listed in Table 6.9-14 occur in the wildlife RAA and are the only activities that could potentially act in a cumulative manner with the Project on wildlife. It is important to note that this is a subset of the activities listed in Table 6.3-3.

Table 6.9-14: Potential Cumulative Environmental Effects on Wildlife

Other Projects and Activities	Potential Environmental Effects		
	Change in Wildlife Habitat	Change in Wildlife Mortality	Change in Wildlife Movement Patterns
Placer Mining	✓		
Haldane Silver	✓		
Trapping, Hunting, and Fishing			
Registered Trapline Concession 81		✓	
Registered Trapline Concession 82		✓	
Registered Trapline Concession 84		✓	
Game Management Zone 2		✓	
Registered Outfitting Concession 4		✓	

NOTE:
Only those projects and activities with the wildlife RAA are included in this table.
✓ = Reasonable expectation that Project contribution to cumulative effects has the potential to measurably change the health or sustainability of the VC.
0 = No reasonable expectation of Project contribution to cumulative effects

The Project is expected to have residual effects on wildlife habitat, mortality, and movement, meeting the first criterion of the cumulative effects screening. In addition, within the RAA the effects of changes in habitat, mortality, and movement are anticipated to be additive. However, there is not a reasonable expectation that, with the Project's contribution to cumulative environmental effects, they will affect the viability of wildlife populations in the RAA, the criterion for a significant effect. This is analyzed in greater detail below.

Both the natural habitats and anthropogenic disturbances within the RAA are identified in Figure 6.9-7. At baseline the vast majority (>99%) of the RAA is covered with natural habitat, as only 750 ha is disturbed (Table 6.9-15). The disturbed area will increase to 1,385 ha during Project Operations and to 1,437 ha when all known and reasonably foreseeable projects are included in the wildlife RAA. It is important to note that while the area of some features may go down (e.g., the access road declines from 75 ha at baseline to 72 ha), this is because the road overlaps with the mine site during operations and a portion of its area is counted as "mining." The more important result of this analysis is the overall area disturbed and the corresponding area of natural habitat.

Table 6.9-15: Total Area Disturbed in the Wildlife Regional Assessment Area

Feature	Area (ha)		
	Baseline	Operations	All Projects[a]
Cleared Land	25	24	24
Disturbed Land	13	13	13
South McQuesten-Haggart Creek access roads	75	72	72
Exploration Road	60	46	46
Exploration Trail	100	96	96
Exploration Trench	9	8	8
Highway	40	40	40
Mining	9	704	704
Mining/Drilling	143	70	124[b]
Mining/Trenching	4	4	4
Placer Mining	175	112	112
Cutlines	61	60	60
Trail	17	17	17
Transmission Corridor	19	177	177
Total Human Disturbance	**750**	**1,385**	**1,437**
Total Area RAA	**90,000**	**90,000**	**90,000**
Percent RAA disturbed	0.83%	1.54%	1.60%
Percent RAA with natural habitat cover	99.2%	98.5%	98.4%
Linear Features (km)	513	513	514
Linear Feature Density (km/km^2)	0.006	0.006	0.006

NOTES:

Figures above generated from Earth observation for sustainable development of forest (EOSD) coverage. This is mapped based on Landsat-7 Enhanced Thematic Mapper (ETM+). See Figure 6.9-7 for an illustration of these features.

Some anthropogenic features, such as cleared land, change categories from baseline to construction and operations. For example, some cleared land is converted to mining. The mining category includes the proposed Project.

[a] Encompasses the effects of the Project and all other existing and reasonably foreseeable Projects that fall within the Regional Assessment Area. Mining category includes the proposed Project.

[b] Includes Haldane Silver, will clear an area of less than 2 ha and create 1.3 km of new trails. Because the footprint is not available for this Project, for this assessment we assumed maximum affect on wildlife habitat. This includes both the area cleared and a 400 m radius in all directions to accommodate sensory disturbance for our most sensitive species, grizzly bear. This implies that the 1.3 km footprint buffered by a 400 m zone of influence, which totals 154 ha. This amount is included in the Milling/Drilling row as part of the Project Inclusion List.

In terms of habitat loss, the Project will act cumulatively with all other known projects. But since 98% of natural habitat will remain in the RAA, there is not a reasonable likelihood that habitat loss will affect the viability of wildlife populations in the RAA.

For changes in wildlife mortality, as described above, the density of linear features in the RAA will be 0.006 km/km^2, which is well below the threshold of 0.6 km/km^2 considered significant for grizzly bears (Guyg, et al. 2004, AGBRP 2008). Based on this threshold, there is not a reasonable likelihood for significant cumulative effects on grizzly bear mortality in the RAA. The other “projects” that could affect wildlife mortality in the RAA are three trapline concessions and an outfitting concession, all of which are within Game Management Zone 2. The mortality effects of these activities are already occurring at baseline and can be, as needed, adjusted through hunting management. As described above, the Project may influence hunting patterns and road collisions. VIT has committed to measures both to reduce these effects and to monitor them over time. Given the nature of wildlife mortality in the RAA, the risk to the population viability of the species assessed is considered low. Given the abundance of natural vegetation (which covers 98% of the RAA) and the lack of new linear features (since the access road exists and the transmission line will parallel it), the risk that changes in wildlife movement patterns may be significantly affected is also low. As there is not a reasonable expectation that the Project’s contribution to cumulative effects will affect the viability of wildlife populations, no further assessment of cumulative effects is warranted.

6.9.6 Summary of Consultation Influence on the Assessment

Consultation took several forms. A Traditional Knowledge and Use Study (Stantec 2010) was carried out with the FNNND between November 2009 and June 2010. Results of this study were used to refine the focus of key effects and focal species, and contributed information to the assessment.

Both Yukon Government and the Yukon Environmental and Socio-economic Assessment Board (YESAB) were consulted in development of this assessment. Key meetings were held in November 2009, March 2010, May 2010, and August 2010. These discussions informed the scope, methods, and information sources used in this wildlife assessment. They also contributed to the development of Project commitments described below.

6.9.7 Effects Monitoring and Adaptive Management for Wildlife

Effects monitoring is particularly useful when there is uncertainty regarding the efficacy of mitigation measures and/or the resulting Project effects. Mitigation measures described here are generally well known industry practice. Confidence in their effectiveness, as well as in the conclusions of the assessment, is high. However, VIT will monitor their effectiveness as needed and make adjustments where necessary. For example, VIT will track and report all wildlife incidents to the authorities as appropriate (e.g., wildlife vehicle collisions, nuisance wildlife occurrences, bear encounters or problems). In addition, observations of species at risk and the five focal species used in this assessment on the access road and immediately around the mine site will be documented by the Environmental Manager during construction and operations of the mine. At a minimum, species, number, location, date and time of day will be recorded. At the end of the year, if requested by Yukon Government, a report will be prepared to summarize any trends that are observed and any changes to the Wildlife Protection and Management Plan that have been implemented as a result of these observations over the course of that year.

It is unlikely that effects of winter plowing and increased access road traffic on moose mortality will be significant. Confidence regarding this determination is considered moderate, therefore VIT will implement the following effects monitoring program:

- Annual aerial mapping of distribution of moose in winter within 5 km of the access road and mine site. The distribution of moose is influenced by snow depths and conditions in addition to other factors such as predation, human harvest and disturbance. Annual mapping of distribution before construction (in 2011 and 2012), during construction, and during mine operations will allow assessment of displacement and population reduction resulting from mine activities. It will also aid the use of adaptive management measures if negative effects occur. If no effects are observed, the frequency of this monitoring could be reduced. Recommended Methods: Fixed-wing aircraft surveys of moose in February or March each year, with transects spaced approximately every 1 km, roughly perpendicular to and extending at least 5 km in either direction from the access road; waypoints recorded for all observations and fresh tracks of moose.
- Monitoring of volume and type of vehicle traffic along the access road.
- Monthly monitoring of snow depths along the access route to the mine and at the mine site.
- Close collaboration with both the FNNND and Yukon Government to understand harvest rates of moose in Game Management Subzones adjacent to the mine site and proposed access route.

VIT recognizes the increasing focus on species at risk and has reviewed the new guidance which has come out since baseline studies were conducted (Environment Canada 2010). In discussions with Yukon Environment and Environment Canada, the Project will consider if there is a need for bird surveys focused on species at risk (Olive-sided Flycatcher and Rusty Blackbird). Neither has been recorded in the LAA but could potentially occur. If surveys are warranted, they could be carried out prior to construction. If any species at risk are detected, information collected on their habitat requirements would be used to guide reclamation planning.

6.9.8 Commitments for Wildlife

There are two types of commitments: mitigation measures and effects monitoring. The Project will implement 17 mitigation measures to avoid or reduce effects on wildlife. The mitigations are described below in Table 6.9-16 and are listed in accordance to the effect they intend to address. Effects monitoring is summarized above in Section 6.9.7.

Table 6.9-16: Mitigation Measures for Wildlife

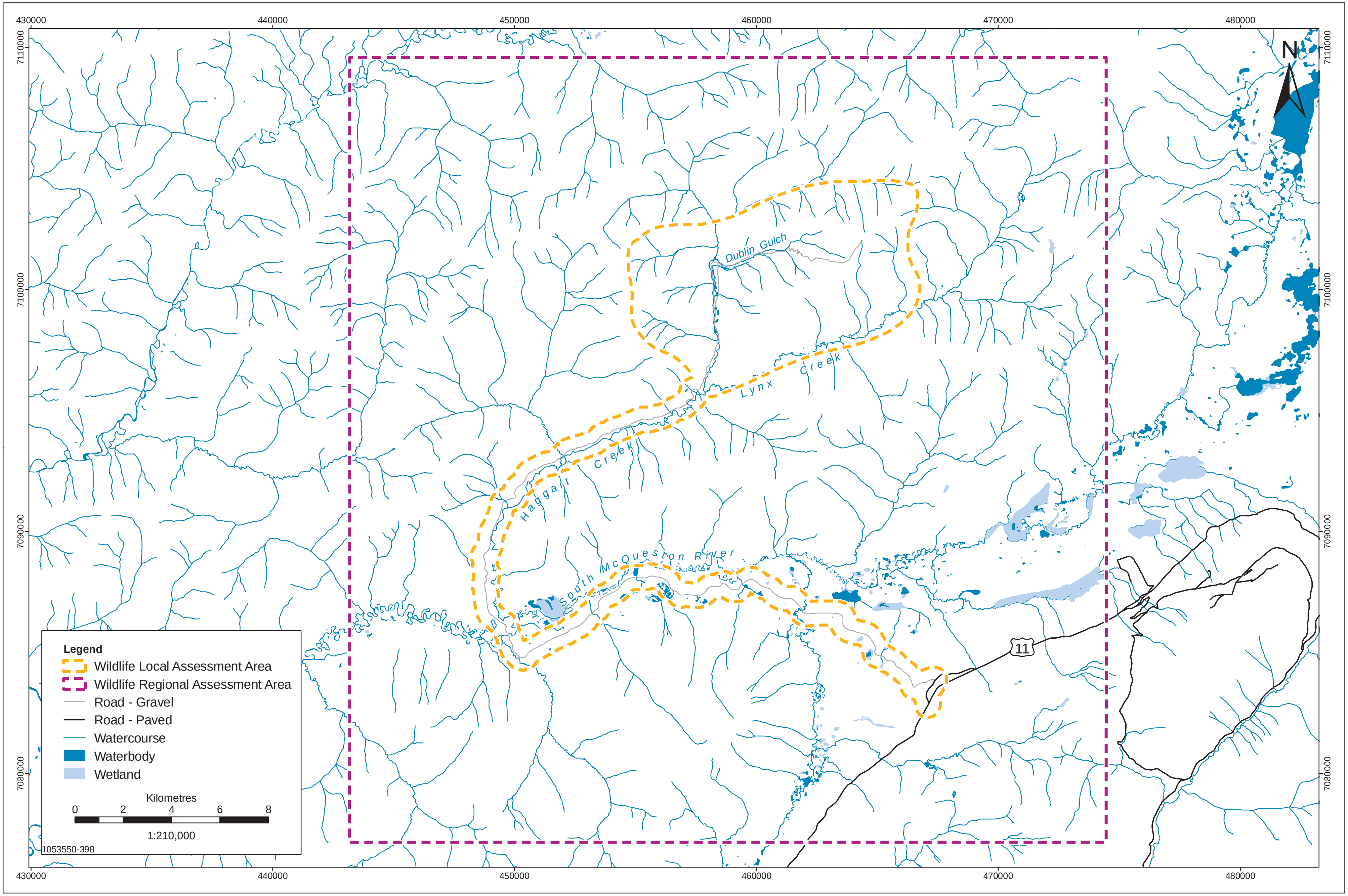
No.	Mitigation
Change in Wildlife Habitat	
1	**Minimize Project footprint.** Site clearing will be limited to the area needed to safely construct and operate the Project. Before clearing, wildlife habitat features (e.g., mineral licks, dens, nest trees, snags, rocky outcrops, small ponds/seepages) will be identified and evaluated to determine if they can be maintained. Even if small, these patches will benefit wildlife and contribute to reclamation.
2	**Minimize aircraft overflight disturbance.** Project-related aircraft activity will follow flight restrictions agreed to with Yukon Government. This may include minimum flight altitudes and flight paths to avoid sensitive habitats during specific times of year.

No.	Mitigation
3	**Implement a progressive reclamation plan.** VIT will: (a) revegetate reclamation areas with native species consistent with surrounding vegetation, except where regulatory agencies indicate that natural succession is preferable; and (b) maximize use of direct placement techniques (minimizing stockpiling) to minimize the loss of biological activity in reclamation capping materials.
Change in Wildlife Mortality	
4	**Share information to minimize the risk of vehicular collisions with wildlife**. VIT will: (a) promote proactive radio communication among users of the access road to convey safety information, including sightings of large wildlife species along the road; (b) provide and maintain signage where problems are most likely to occur, reminding drivers to be vigilant for wildlife and give them the right of way; and (c) verbally report collisions and/or carcasses of ungulates and other large animals observed on and in the vicinity of the Project site and along the access road to the Environmental manager, Mine Manager or designate(s) as soon as possible to ensure prompt removal. Near misses and collisions that result in the death or injury of an ungulate or other large animal must be reported as soon as possible. Measures will be developed in coordination with overall road planning with Yukon Government Highways and Public Works.
5	**Implement speed limits to minimize dust and reduce wildlife collisions**. The proposed maximum speed limit will be 60 km/h on the access road where speed limits are not designated by Highways and Public Works or a road design engineer.
6	**Provide and encourage the use of personnel transportation (busing) to the mine site,** minimizing opportunities for wildlife vehicular collisions.
7	**VIT will ensure that the presence and use of firearms are restricted on the Project site.** The restrictions will extend to employees, management and contractors. In addition VIT will develop a policy restricting Project-related employees and contractors from hunting and fishing while on the job at any time throughout the life of the Project.
8	**Implement food and waste storage protocols to avoid attracting wildlife** (primarily bears) that could become a nuisance. Protocols will be designed with guidance from Yukon Government and the Yukon Government's "Guidelines for Industrial Activity in Bear Country."
9	**Implement a Bear Aware Program** as a standard part of the health and safety orientation and make supporting materials (e.g., pamphlets, videos) readily available on site. This part of the orientation program will be designed with guidance from Yukon Government and "Guidelines for Industrial Activity in Bear Country."
10	**Develop a problem wildlife prevention and response plan** as part of the Wildlife Protection and Management Plan. This program will be designed with guidance from Yukon Government and incorporate direction from "Guidelines for Industrial Activity in Bear Country" as appropriate. When a problem wildlife issue arises, the Environmental manager will take appropriate action based on the plan and consultation with Yukon Government.
11	**Clear vegetation outside of the migratory bird nesting window (May 1 – July 31)**. Where this is not possible, VIT will consult with the appropriate regulators (Yukon Government, CWS) and develop management strategies. These strategies are likely to include surveying the area to be cleared for nests a maximum of one week prior to clearing. Bird nests will be identified and protected until nesting has completed.
12	**Reduce bird mortality risk along the transmission line RoW** based on existing design guidelines such as: Avian Protection Plan (APP) Guidelines (APLIC and USFWS 2005) and Suggested Practices for Avian Protection on Transmission lines (APLIC 2006)

No.	Mitigation
13	**Reduce wildlife mortality in the Heap Leach Facility area, events ponds and ditches**. VIT will: (a) fence off and will control (minimize) the growth of vegetative cover at any mine site location with compromised water quality (e.g., events ponds); (b) not reclaim events pond shorelines; and (c) use BirdBalls or a reasonable alternative to deter waterfowl or other birds from landing on ponds that would pose a health risk to them (e.g., containing the heap leach pregnant solution); and (d) design ditches and sediment ponds to reduce potential for entrapment of wildlife.
14	**Follow company procedures and regulatory requirements for the safe and prompt clean up of any chemical spills**.
15	**Manage vegetation to reduce effects on wildlife.** VIT will: a) minimize or eliminate the use of vegetation attractive to bears and ungulates (e.g., legumes) in seeding mixtures used along roadsides; b) cut brush early in the growing season, before it becomes an attractant to large wildlife species; and c) use manual clearing rather than herbicides in vegetation management activities. Manual clearing will follow mitigation measure 11.
Change in Wildlife Movement Patterns	
16	**Facilitate wildlife movement** by: (a) providing wildlife crossing and escape points in the plowed snow banks along the access road (i.e., low areas 0.5 m or less in snow banks at regular intervals); (b) providing wildlife crossing points along extensive open ditches; and (c) provide direction to Project staff and contractors on methods to avoid interference with the movement of wildlife across roads.
General	
17	**Monitor the implementation of all mitigation measures and make adjustments where necessary**. While mitigation measures described here are generally well known industry practice, VIT will monitor their effectiveness as needed and make adjustments where necessary.

6.9.9 Figures

Please see the following pages.



Data Sources; Government of Canada, Victoria Gold Corp.

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Victoria GOLD CORP

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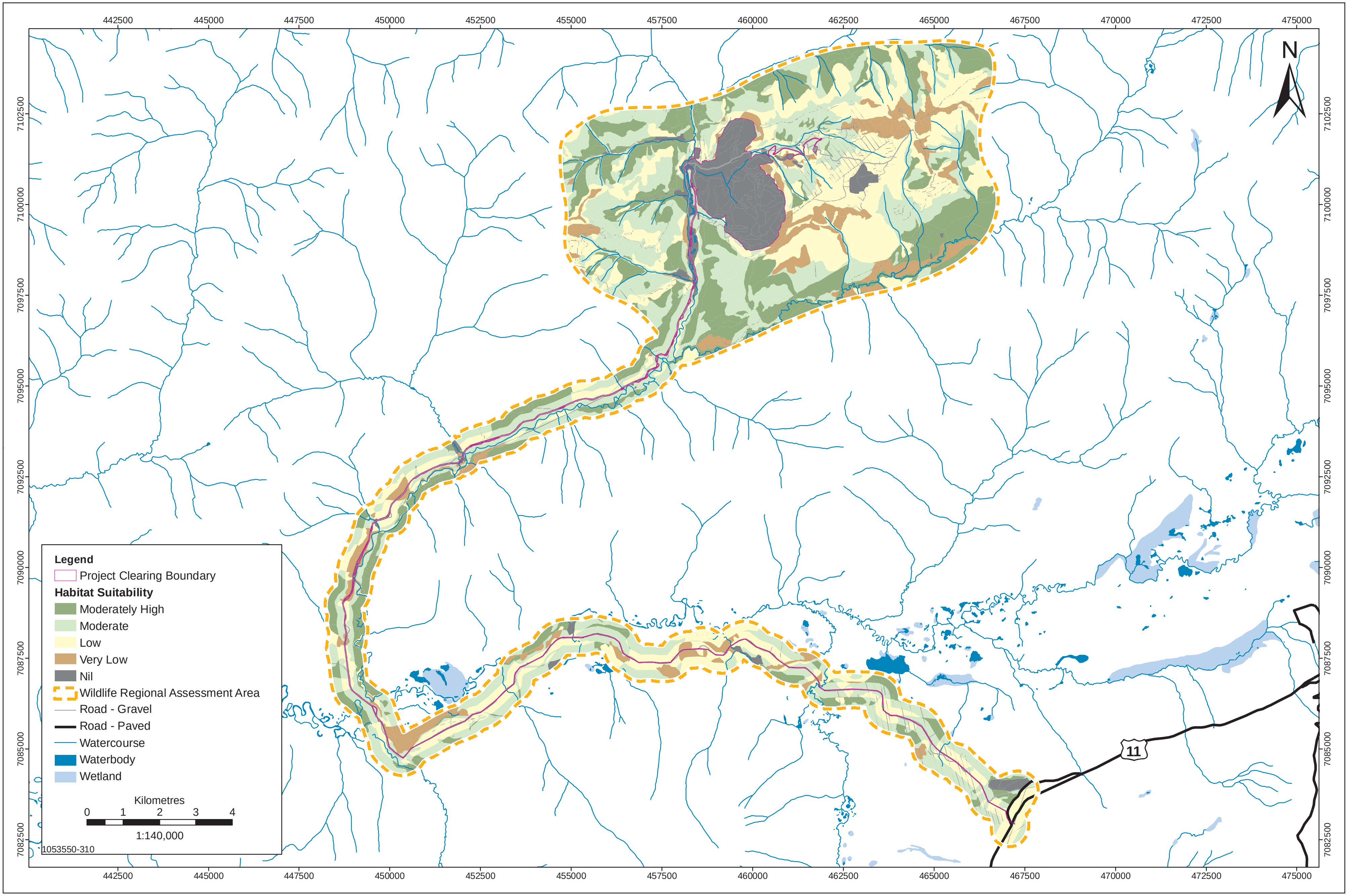
Figure 6.9-1
Local and Regional Study Areas

PROJECTION UTM - ZONE 8	DRAWN BY LS
DATUM NAD 83	CHECKED BY RS
DATE 26-October-2010	FIGURE NO. 6.9-1



Data Sources; Government of Canada, Victoria Gold Corp.

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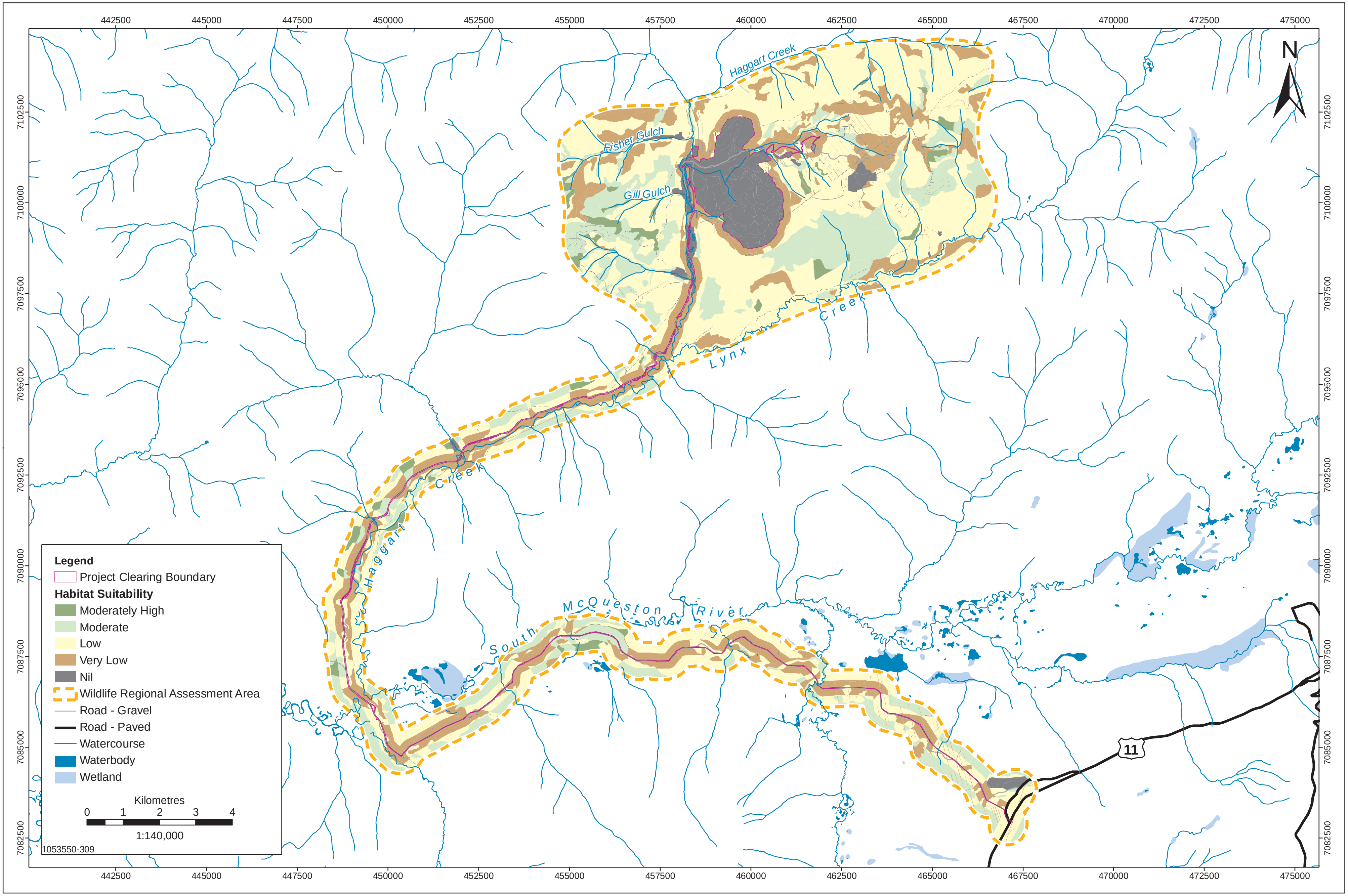
Figure 6.9-2
Moose Winter Shelter Habitat in the LAA During Operations

PROJECTION	DRAWN BY
UTM - ZONE 8	RS
DATUM	CHECKED BY
NAD 83	LS
DATE	FIGURE NO.
26-October-2010	6.9-2



Data Sources; Government of Canada, Victoria Gold Corp.

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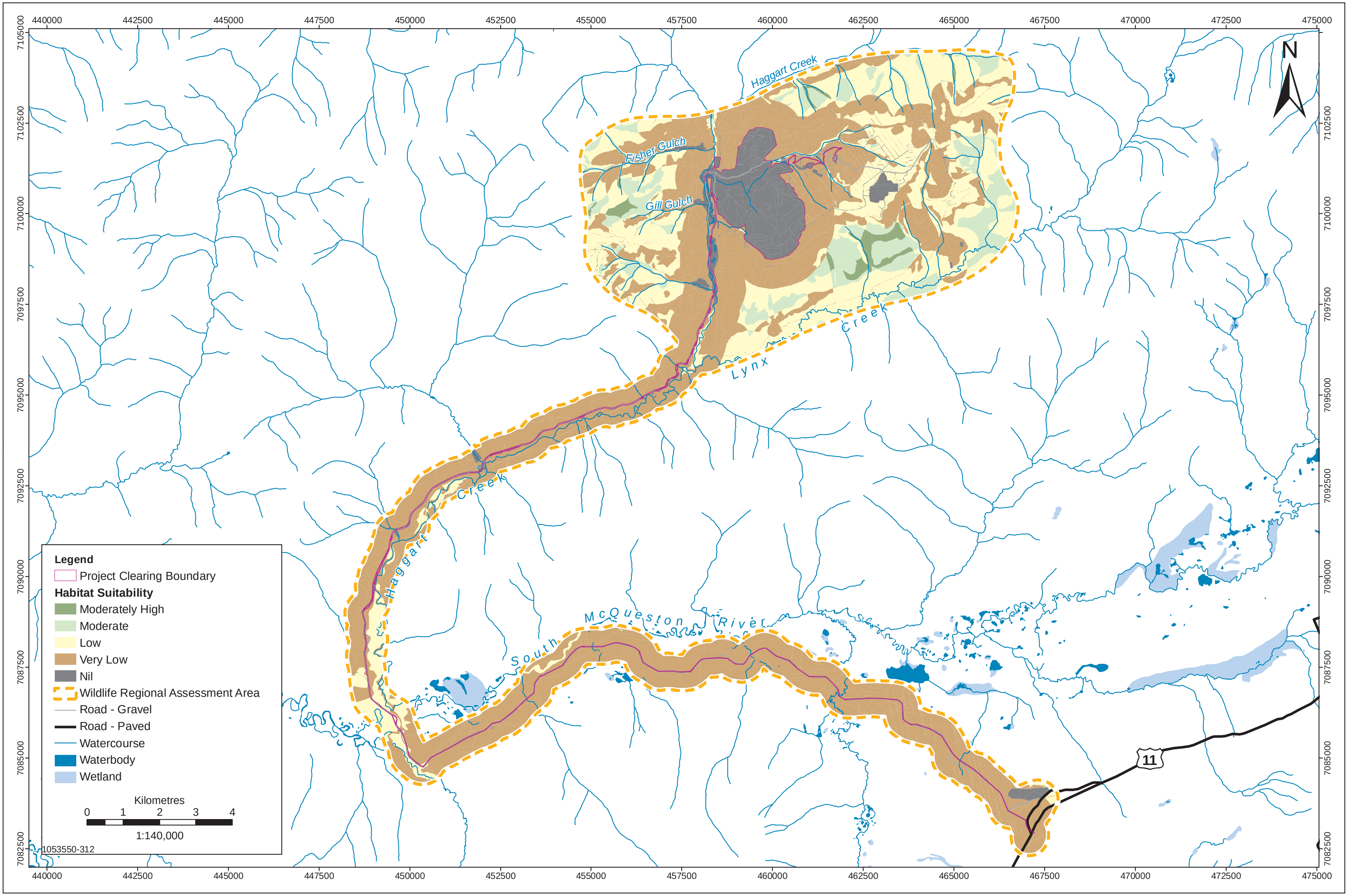
Figure 6.9-3
Moose Winter Feeding Habitat in the LAA During Operations

PROJECTION	DRAWN BY
UTM - ZONE 8	RS
DATUM	CHECKED BY
NAD 83	LS
DATE	FIGURE NO.
30-October-2010	6.9-3



Data Sources; Government of Canada, Victoria Gold Corp.

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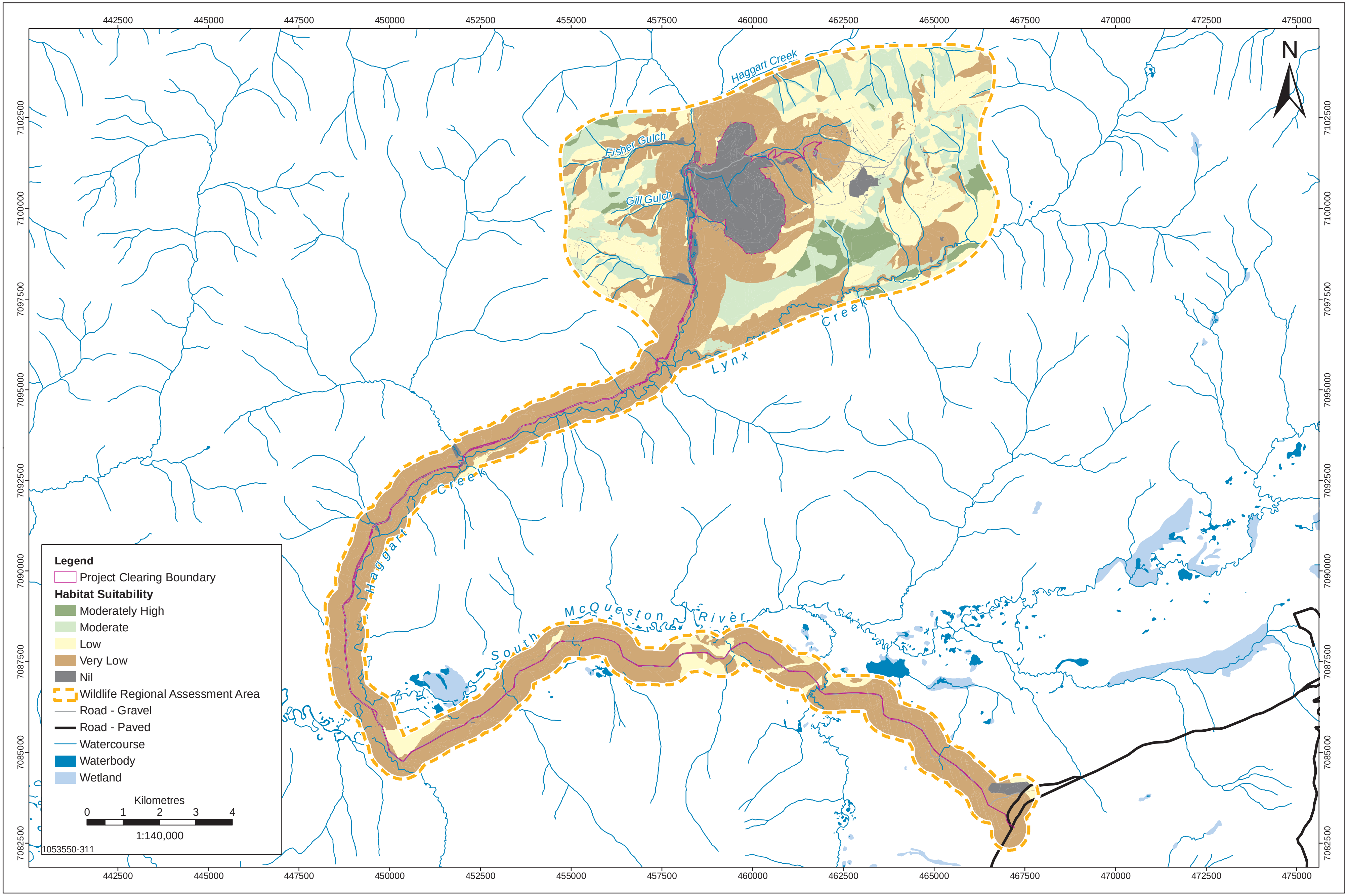
Figure 6.9-4
Grizzly Bear Spring Feeding Habitat in the LAA During Operations

PROJECTION	DRAWN BY
UTM - ZONE 8	RS
DATUM	CHECKED BY
NAD 83	LS
DATE	FIGURE NO.
26-October-2010	6.9-4



Data Sources; Government of Canada, Victoria Gold Corp.

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Figure 6.9-5
Grizzly Bear Fall Feeding Habitat Available in the LAA During Operations

PROJECTION	DRAWN BY
UTM - ZONE 8	RS
DATUM	CHECKED BY
NAD 83	LS
DATE	FIGURE NO.
26-October-2010	6.9-5

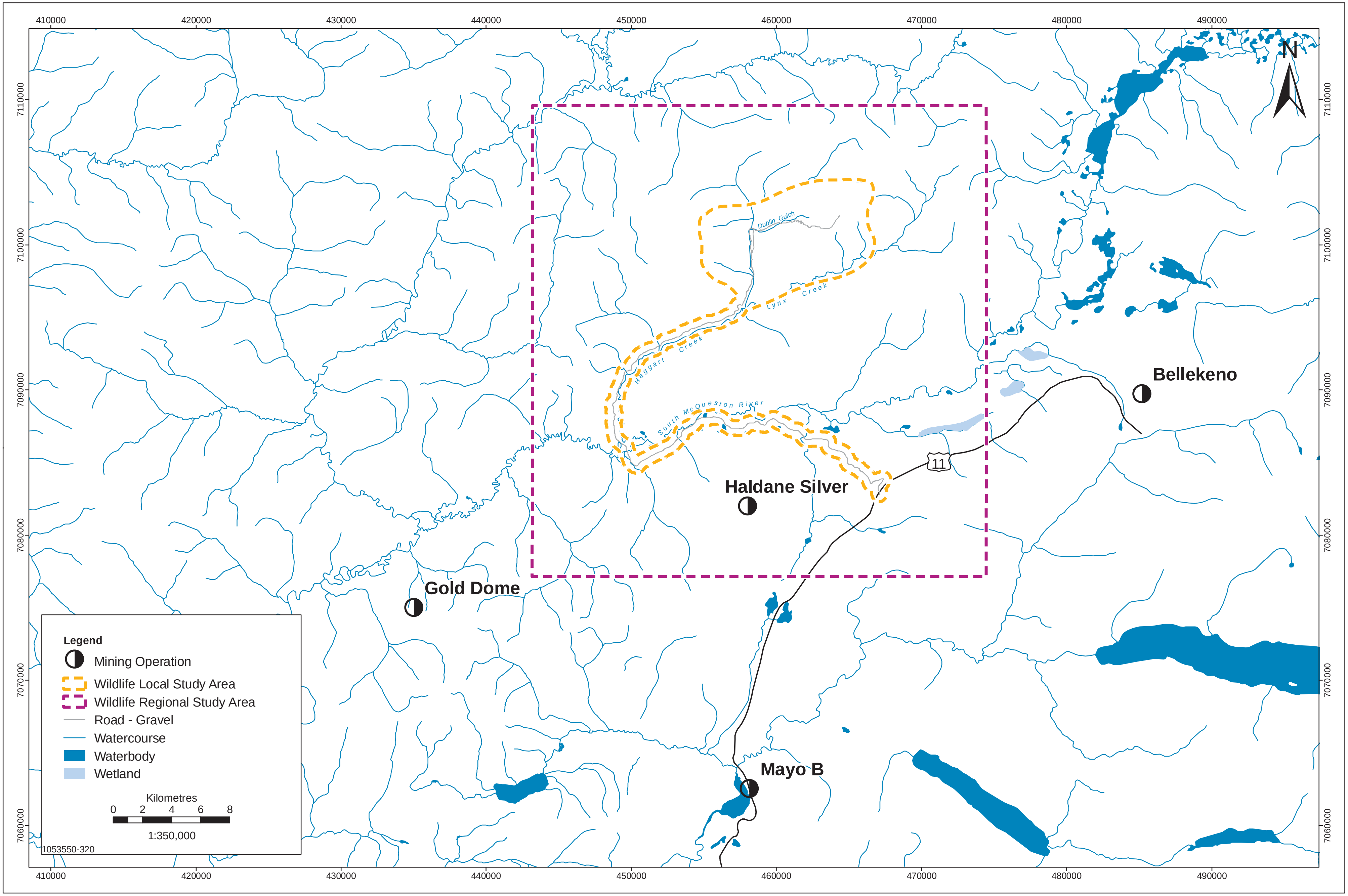

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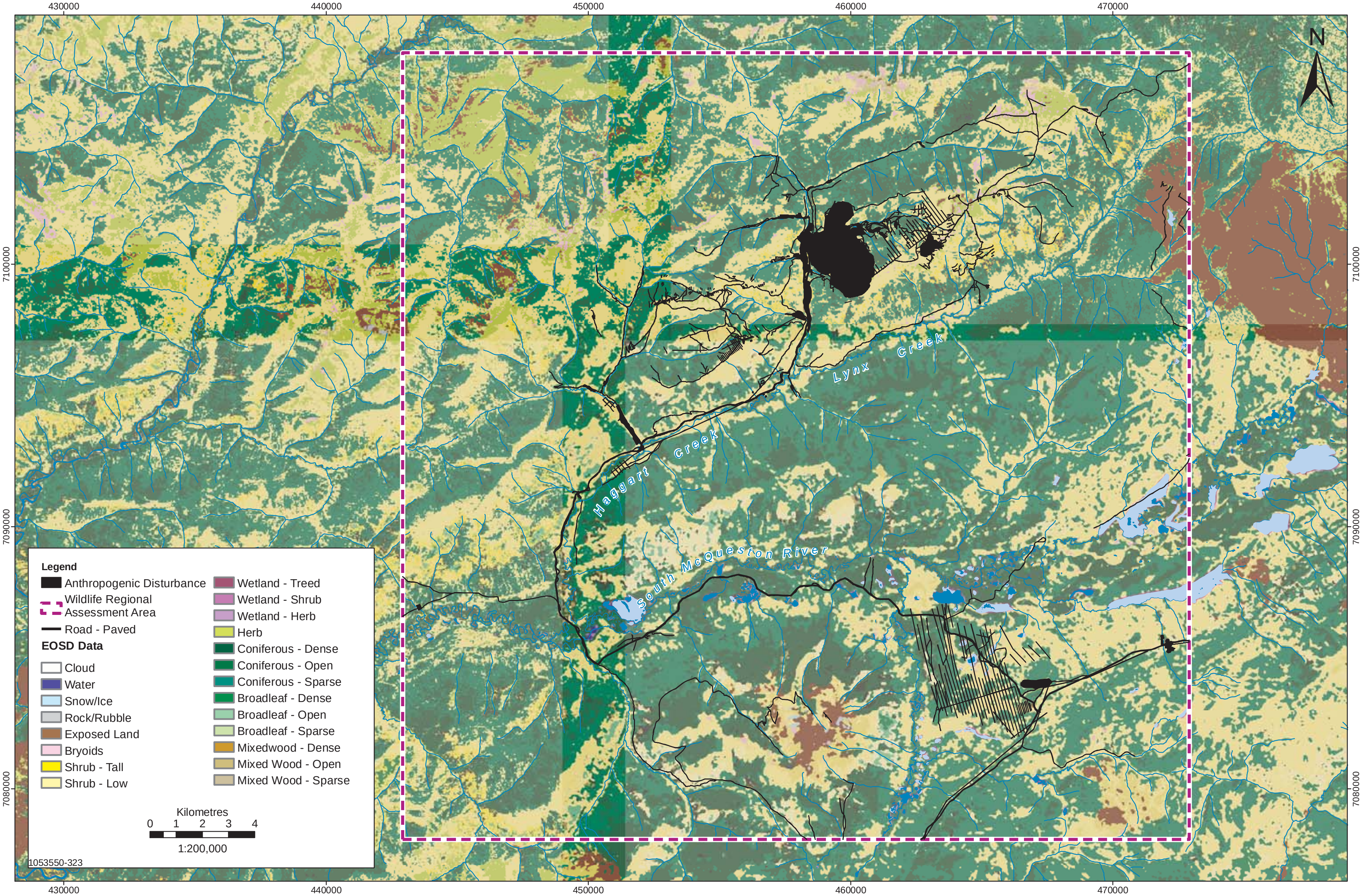
Figure 6.9-6
Projects with Cumulative Effects on Wildlife in the RAA

PROJECTION: UTM - ZONE 8	DRAWN BY: LS
DATUM: NAD 83	CHECKED BY: RS
DATE: 26-October-2010	FIGURE NO. 6.9-6



Data Sources; Government of Canada, Victoria Gold Corp.

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Figure 6.9-7
Wildlife Habitat Available in the RAA During Operations

PROJECTION: UTM - ZONE 8	DRAWN BY: LS
DATUM: NAD 83	CHECKED BY: RS
DATE: 26-October-2010	FIGURE NO. 6.9-7

6.10 Heritage Resources

Heritage Resources are records of scientific or cultural value due to their archaeological, palaeontological, ethnological, prehistoric, historic, or aesthetic features.

There are three main components of Historic Resources:

1. Pre-contact archaeological sites
2. Historic archaeological sites (post-European contact but greater than 45 years old)
3. Palaeontological sites.

Pre-contact archaeological sites include remains (e.g., stone tools, butchered bones, and fire-cracked rock) resulting from the traditional occupation of the Yukon by Aboriginal people before contact with European traders. Pre-contact archaeological sites in the Yukon contain some of the earliest evidence of occupation in North America.

Historic archaeological sites can be Aboriginal or non-Aboriginal, and date from the time of European contact until 45 years ago. Historic period sites can include structures (e.g., homesteads, cabins, and forts), artifacts (e.g., industrial and folk-manufactured items made of metal, glass, ceramic, stone, and other materials), or features (e.g., trails, foundations, and campsites).

Palaeontological resources, or fossils, are remains that indicate the existence of extinct or prehistoric plants or animals discovered on or beneath land in the Yukon. They include body fossils (e.g., bones, shells, and plant stems), impressions (e.g., leaf imprints), and trace fossils (e.g., dinosaur trackways). Fossils are thousands to hundreds of millions of years old and are often the remains of extinct species. Fossil sites provide information on ancient forms of animals and plants, past ecosystems, evolution, natural climate change, and extinction.

6.10.1 Scope of Assessment for Heritage Resources

6.10.1.1 Regulatory/Policy Setting

Heritage resources are protected under the Yukon *Historic Resources Act* (Yukon Government 2002i) and include any work or assembly of works of nature or of human endeavor that is of value for its archaeological, palaeontological, pre-historic, historic, scientific, or aesthetic features. Under the Act, no effect can occur to any historical resources site without approval of the Minister of Tourism and Culture.

A review of background information gathered for the previous Dublin Gulch Project revealed that the proposed Project area had been assessed for heritage resources during 1995 – 1996 (Greer 1995, 1996). Ruth Gotthardt of the Department of Tourism and Culture confirmed that the studies undertaken were adequate, and confirmed that no further field study would be required for the currently proposed Project unless the Project footprint was added to or altered. However, at the request of VIT a field visit by the Project archaeologist was undertaken to confirm the nature of the terrain, existing disturbance and archaeological/historic potential of the area.

6.10.1.2 Valued Component Baseline Information

A detailed description of baseline conditions for pre-contact and historic archaeological sites and palaeontological sites is provided in Section 4.1.13 and Appendix 4 (Historic Resources). Further information is available in the Eagle Gold Project Palaeontological Assessment (FMA Heritage Inc 2010).

The upland areas that will be affected by the Project are rugged, mountainous, unfossiliferous, and are of low archaeological potential. Along Dublin Gulch and Haggart Creek, placer gold mining has extensively re-worked the valley deposits. These activities produced the only substantial collection of Pleistocene vertebrate fossils from the Mayo District (Harington 1996). Field surveys determined that the source-site for these fossils in Dublin Gulch has been completed removed, along with most other high potential palaeontological deposits. Exceptions are a few un-mined pockets along Dublin Gulch and Ann Gulch. Placer mining activities have also disturbed all high potential for pre-contact archaeological sites. Regarding historic structures, there are more than a dozen in the vicinity of Dublin Gulch. These buildings are more than 45 years old and qualify as historic sites in the Yukon. Along the access road, the South McQuesten portion of the road has three pre-contact and historic archaeological sites.

6.10.1.3 Key Issues and Identification of Effects

Information loss through disturbance of heritage resources might affect current understanding of past use and culture at the local and regional levels of knowledge. Disruption of the contents and contexts of heritage resources can be either a primary or secondary effect.

Primary effects result from planned disturbance factors and include surface preparation (including vegetation clearing and grading for roads and the heap leach facility) and construction of the facilities. Particularly at risk are buried archaeological and fossil sites.

Secondary effects are unplanned disturbance factors that could occur as a result of improved access into sensitive areas. Improved access combined with public knowledge of the heritage resource potential of an area could lead to unauthorized collection, excavation, disturbance, or vandalism of sites.

No Project activities are ranked “2” in Table 6.3-1—that is, with codified protection practices, no activity will cause effects of concern to heritage resources. Project activities ranked as 0 in Table 6.3-1 will not have any interaction with heritage resources. All remaining Project activities are ranked 1—although interaction might occur between the activity and heritage resources, the interaction is viewed as not scientifically significant, after completion of standard practices for mitigating the predicted environmental effects.

There are no formal established thresholds for heritage resources and contextual loss at the VC level. Under the *Historic Resources Act* regulatory approval for proposed projects is issued at the discretion of the Minister, with the provision that mitigation studies at specific sites are completed as required and to satisfaction.

6.10.1.4 Standard Mitigation Measures and Effects Addressed

The preferred mitigation measure to address effects is to avoid heritage resource sites. All pre-contact archaeological and historic sites along the access road will be avoided.

However, the historic structures at Dublin Gulch will be impacted by the HLF (Historic Site 1), the Process Plant Site (Historic Site 2), and the Camp (Historic Site 3).The Yukon Heritage Branch has provided a preliminary set of requirements for further study at each of these sites. These requirements are:

- Additional photography, typically eight photos per building, except for smaller buildings for which one photograph per side will be required
- Description of building construction and materials
- Description of building condition
- UTM locations (taken with GPS technology) of each building/feature
- Site plan drawn to scale showing site layout, building orientation and dimensions
- Photos and description of all equipment/machinery and features associated with structures or site
- Other relevant information based on archival sources or interviews.

The Yukon Heritage Branch expressed appreciation that these historic sites were recorded despite the fact that new comprehensive historical resource studies were not required as part of this Project.

VIT will work closely with the Department of Tourism and Culture to determine specific mitigation measures required for each of the structures and sites that will be impacted as a result of the heap leach facility. Mitigation measures will be implemented prior to impact from the Project.

For palaeontological resources, no intact sites were found in the Dublin Gulch area. Most strata with high palaeontological potential have been removed during placer gold mining, except in the Ann Gulch area. It is recommended that the construction plan for the heap leach facility at Ann Gulch be carefully reviewed to identify any opportunity for the collection of detailed stratigraphic and palaeontological information in any exposed sections before the area is covered by the HLF liner.

VIT will implement a discovery protocol to recover and quickly report the chance discovery of heritage resources during Project activities per a discovery protocol (Appendix 32 – Fossil and Artifact Discovery Record).

6.10.2 Influence of Consultation on the Assessment of Heritage Resources

Four members of the FNNND joined the palaeontology field program, and also visited many of the standing historic structures. They expressed a strong interest in palaeontological resources, and in the disposition of the fossils previously recovered from Dublin Gulch. Participants also expressed interest in the historic structures, and were knowledgeable regarding the mining history of the area. No concerns were expressed by the FNNND participants regarding any specific pre-contact archaeological concerns related to the Project, with the understanding that any archaeological sites would either be avoided or would be subject to further study.

6.10.3 Commitments for Heritage Resources

VIT is committed to the protection of heritage resources and will implement a discovery protocol (Appendix 32) to recover and quickly report the chance discovery of heritage resources during Project activities.

For those heritage resource sites that cannot be avoided during construction, VIT will follow mitigation measures as required by the Department of Tourism and Culture.

6.10.4 Summary of Heritage Resources Assessment

Heritage resources are moveable works or records that are of scientific or cultural value due to their archaeological, palaeontological, ethnological, prehistoric, historic, or aesthetic features. The upland areas that will be affected by the Project are rugged, mountainous, unfossiliferous, and are of low archaeological potential. Placer gold mining activities along Dublin Gulch and Haggart Creek have completely removed the source-site for fossils and have disturbed most other high potential palaeontological deposits and pre-contact archaeological sites. The exception is a few un-mined pockets along Dublin Gulch and Ann Gulch. There are also more than a dozen historic structures in the vicinity of Dublin Gulch, and three pre-contact and historic archaeological sites along South McQuesten Road. Information loss through disturbance of heritage resources might affect current understanding of past use and culture at the local and regional levels of knowledge; however, with the implementation of codified protection practices, no Project activity will cause effects of concern to heritage resources. All pre-contact archaeological and historic sites along the access road will be avoided, and for any historic structures at Dublin Gulch that cannot be avoided, all mitigation requirements from the Yukon Government – Palaeontology Program will be followed. VIT will also implement a discovery protocol to recover and quickly report the chance discovery of heritage resources during Project activities. It is concluded that all potential Project-specific effects and contributions to cumulative effects will not be significant. There is a high degree of confidence in this prediction, given the application of mitigation measures as described above.

6.11 Socio-economic Environment

This section documents the potential socio-economic effects of the Project. The discussion is organized as follows:

- Scope of Assessment for the Socio-economic Environment
- Effects Assessments for five VCs:
    - Employment and Economic Opportunities
    - Traditional Activities and Culture
    - Community Vitality
    - Human Health and Well-Being
    - Infrastructure and Services.
- Socio-economic Sustainability of the Project.

Socio-economic conditions are provided in Section 4.2; additional detail may be found in Appendix 17, the Socio-economic Baseline Report.

6.11.1 Scope of Assessment for the Socio-economic Environment

6.11.1.1 Methodology

The *Guide to Socio-economic Effects Assessments* (YESAB 2006) defines SEEA as "the systematic analysis of the likely effects a proposed project will have on the day-to-day life of individuals, families, communities, businesses, and/or governments whose reality may be affected by a proposed project" (p. 4).

Socio-economic Effects Assessment is carried out to identify the changes that will likely result from a proposed project and to determine the significance of the changes and their effects on individuals, their quality of life and day-to-day activities, as well as on the operation of community facilities and the community as a whole. Socio-economic effects assessment complements the study of biophysical effects with information on the socio-economic environment likely to be affected by the proposed Project.

The planning, construction, operations, closure and reclamation, and post-closure phases of a gold mine project can cause various socio-economic impacts, especially on the local (and primarily Aboriginal) communities. Changes to the land, water, and forest resources, and nuisances such as noise, odour, dust, and traffic can disrupt the use and enjoyment of the land, result in a decline in satisfaction with the community, or interfere with the operation of community facilities or services in the area. Changes to the physical environment caused by mine-related activities can affect the populations, health, and distribution of plants, animals, and fish species that are important to traditional culture and are an integral part of both the traditional and cash economies. Increased employment of local residents, as well as an influx of labour from elsewhere in Yukon or Canada, can have potential socio-economic effects on the local communities.

The extent and magnitude of socio-economic effects depends to a large degree on the residents' attitudes, willingness, and ability to adapt to and accommodate change, as well as the responsiveness of the proponent. However, based on the wide range of case study experience with developments in Canada's North over the past 20 years, it is possible to provide an indication of what will most likely happen. The SEEA can therefore evaluate the potential effects and develop mitigation measures or commitments to avoid or reduce the significance of adverse socio-economic effects, or enhance positive socio-economic effects.

The complexity of potential socio-economic effects of a project such as the Project on individuals, families, and the community, and on traditional activities and culture, are shown in Figure 6.11-1.

Six Steps of Socio-economic Effects Assessment

There are six steps involved which were used to carry out this SEEA, as summarized below. These steps were based on YESAB (2006) guidance and professional best practice.

Step 1—Scoping

Scoping set the boundaries for the SEAA of the Project. This involved the identification of concerns and issues that were to be addressed in the SEEA process, as well as the spatial and temporal scope of the assessment. The SEEA identifies aspects of the socio-economic environment that are considered important—Valued Components (VCs).

There were a number of methods used for scoping, including community and regulatory meetings, literature reviews, and documentation of other comparable cases (particularly in Yukon) and any studies pertaining to the local communities. In addition, the initial design and operation information for the Project were considered during scoping in order to better understand how the Project might affect the socio-economic environment.

Step 2—Profiling Baseline Conditions

To determine the potential effects, the current socio-economic conditions in the spatial assessment areas were considered. This involved profiling the existing circumstances for individuals, families, and communities. The baseline conditions (set out in detail in Appendix 17: Eagle Gold Project Socio-Economic Baseline Report) describe the existing environment, as well as past conditions and future trends in the absence of the proposed Project. This information has served as a benchmark against which the predicted effects of the Project were evaluated.

Step 3—Identification and Prediction of Effects

The baseline information and Project characteristics were systematically analyzed to identify and predict the potential socio-economic effects (positive and negative) that may result from the Project. Based on an understanding of the trends, factors, and processes (those related to the Project and those that are not) affecting residents and communities, a determination has been made of how the proposed Project is likely to affect changes in the socio-economic environment. The effects were identified by comparing the predicted future conditions without the Project (baseline projection) to the predicted conditions with the Project.

Effects have been characterized as direct, indirect, induced, cumulative, and residual. These types of effects are explained in Table 6.11-1.

Table 6.11-1: Types of Socio-economic Effects

Effect Type	Definition or Explanation
Direct Effects	Direct effects are the immediate consequences of a project's construction, operations, or decommissioning. They can be characterized as typical or inevitable, and are relatively easy to predict with some degree of accuracy. The timing of direct effects coincides with construction, operations, or closure and reclamation, and is usually limited to the Project 'footprint' or immediately adjacent or nearby areas. Examples include increases in local employment levels, the value of contracts to regional businesses, the noise from construction, and increases in traffic.
Indirect Effects	Indirect effects are changes that result from one or more direct effects of a project (e.g., influx of workers puts additional pressure on existing facilities or services such as medical or recreation services). The increased number of employees may lead to increased demand for housing. Indirect effects cannot be determined or measured with the same certainty as direct effects. In terms of timing, indirect effects follow the direct effect(s) however, may still be associated with construction or operations, and may extend some distance from the Project footprint.
Induced Effects	These are changes that occur more broadly subsequent to the Project (e.g., stimulation of new business or services, changes in community's image). Induced effects may have broader implications than direct or indirect effects, and may result in changes to the overall living conditions experienced by those affected by the Project. Induced effects are difficult to predict because they depend closely on the context from which they arise and a range of somewhat uncertain indirect effects.
Cumulative Effects	These are the changes that may occur when a proposed project is considered in combination with other major projects existing or planned facilities or activities that have been or will be carried out. Existing and proposed projects in an area can have a cumulative effect on individuals, households, and communities (e.g., available services and facilities, and housing resulting in potential service shortfalls or increased housing costs). Likewise, several projects may provide a broader range of job and business opportunities that may benefit a community economically.
Residual Effects	Residual effects—both positive and negative—are those that remain after mitigation. Selected residual effects may addressed through monitoring, impact management initiatives, and compensatory mechanisms or other commitments.

Figure 6.11-2 shows examples of the linkages between direct, indirect, and induced effects, as well as cumulative and residual effects.

Step 4—Identification of Mitigation and Enhancement Measures

Mitigation measures control, reduce, or eliminate adverse effects and enhance potential beneficial effects of a project. Mitigation can include avoiding the effect by not taking or modifying an action; minimizing, rectifying, or reducing the effects through the design or operations of the Project; or compensating for the effect by providing substitute facilities, resources, or opportunities

Step 5—Determination of Significance

The significance of residual effects remaining following the application of mitigation measures was then determined. These residual effects have been identified and carefully considered in the SEAAl.

The significance of potential socio-economic effects has been determined in consultation with the potentially affected parties. The evaluation of significance has also been informed through consideration of standards, guidelines, policy statements, research studies, comparable case studies, and quantitative risk assessment (where applicable).

Step 6—Development of Impact Management Strategies and Commitments

Even after mitigation, there may be some remaining (residual or net) effects. In dealing with residual effects, it is important to establish management strategies or commitments to reduce or eliminate potential adverse residual effects and enhance potential positive effects and benefits. Project commitments include monitoring and follow-up or ongoing reporting, consultation and liaison. 'Follow-up' involves monitoring for effects that were not anticipated (positive or negative), are worse than predicted, or to identify benefits that have exceeded those predicted. Communities or organizations predicted to be affected by a project should be fully involved in the identification, development, and refinement of impact management strategies.

Methodology Limitations

The complexity associated with predicting and analyzing socio-economic effects depends on the nature of information upon which the assessment must be based. In carrying out the SEEA for the Project, the following range of factors was considered:

- The local and regional changes (social, cultural, economic, political, environmental) that are occurring in the absence of the Project
- The capacity of the FNNND, VoM, and the community of Mayo to adapt to the changes in socio-economic conditions associated with the Project
- The reasonably expected residual effects that result from the Project.

Demographic data (e.g., age, gender, unemployment levels), interviews, the consultation findings, and literature reviews have been used to develop a broad understanding of these factors. However, obtaining specific information to predict how individuals and communities will respond to particular changes in their socio-economic conditions, or what decisions will be made by government agencies or service providers regarding the provision of services can be problematic. As noted in the First Nations Caucus' submission to the recent *Yukon Environmental and Socio-economic Assessment Act* (YESAA) Five-Year Review (SENES 2009), there are a variety of shortcomings and gaps in existing socio-economic baseline data in Yukon:

- "Data sources are extremely varied and little data is consolidated across data sources.
- Trend data, which is encouraged by the YESAB's Socio-economic Effects Assessment Guide, are not readily available on most of the cited indicators, especially for Yukon communities and regional data.

- Existing data from custom surveys for select communities, indicators or relevant subject areas are not readily available or publicized.
- Indicators and supporting data to document the form, function and trends of Yukon First Nations' traditional economies are woefully inadequate." (p. 59).

There are several reasons for this:

- The most recent demographic data available for FNNND and Mayo from Statistics Canada and Yukon Bureau of Statistics through the census is now four years old; for some indicators, data are even older. Census data specifically for FNNND is limited to the 1996 and in some cases 2001 census years. The FNNND census data include FNNND citizens resident in Mayo and elsewhere in Yukon and Canada. In addition, in some cases data are limited by the level of detail available (i.e., not all indicators are reported at the FNNND or Village of Mayo level; data may be rounded or suppressed by Statistics Canada due to small sample sizes), or the type of data collected in a given year. In some cases, supplementary information is available from other sources, including the socio-economic interviews conducted for the Project.
- There are few or no socio-economic "thresholds" against which effects can be measured. Socio-economic changes are not static, but dynamic in nature. Because conditions are always evolving, the relative contribution of different factors, and the effects of changes cannot be compared to a baseline or "natural state" of socio-economic conditions.
- Individuals' responses to change will be determined by their values, abilities to engage in Project-related wage employment, to cope with changes, or to benefit from mitigation programs. Individual values and abilities will change over time. They will depend on such factors as the strength of family and community relations, effectiveness of substance abuse or employment training programs, or future provision of social support services.
- The ability of communities to adapt to change will vary, depending on the factors such as the availability of services, organizational capacity, and the skills of community leaders in taking advantage of opportunities and managing any potentially adverse effects.

Assumptions

In order to carry out the socio-economic assessment, a number of assumptions were made. A set of general assumptions have been defined for the Project SEEA:

- Potential socio-economic effects (positive or negative) can be influenced by a number of factors external to VIT's control.
- Effects may be direct, indirect, induced or cumulative; the level of certainty decreases with each intervening link in the causal chain.
- The ability of individuals, families, and communities to cope with and respond to socio-economic change differs, and is influenced by a range of considerations (as shown in Figure 6.11-3).

6.11.1.2 Data Sources

Data Sources

The data sources for the SEEA include:

- Socio-economic Assessment Interviews (conducted primarily June 7 through 11, 2010; see Appendix 17)
- Other discipline studies prepared for the Project (e.g., Traditional Knowledge and Use Study [Stantec 2010], Historical Resources [Appendix 4], Land Use and Tenure [Appendix 3], Training and Capacity, Socio-economic Baseline Report [Appendix 17])
- Project-specific information (e.g., Project Description [Section 5], *Pre-Feasibility Study on the Eagle Gold Project* [Scott Wilson Mining 2010]); effects assessments from other disciplines (e.g., Fish and Fish Habitat [Section 6.7]; Vegetation Resources [Section 6.8]; Wildlife Resources [Section 6.9])
- Secondary source material, such as:
  - Statistical data (Statistics Canada—census and other data; Yukon Bureau of Statistics)
  - Various documents (e.g., reports and plans from the FNNND and the Village of Mayo [VoM]), books such as “Heart of the Yukon” [Bleiler, et al. 2006], “Gold and Galena” [Mayo Historical Society 1999]).
- Other information collected during interviews—e.g., a list of Mayo businesses from the VoM
- Discussions from Project consultation activities (e.g., community open houses and workshops; meetings with FNNND, the VoM, and local organization and service providers, etc.; additional detail is provided in Section 2 and Appendix 2)
- Additional information gathered during the review of the draft Socio-economic Baseline Report by FNNND, VoM, and others (September 21 through 22, 2010)
- YESAB documents and guidance.

Additional detail is provided in Section 13 – References.

Socio-economic Interviews

Interviews were conducted with individuals representing a number of organizations with an interest in the socio-economic aspects of the Project. The face-to-face interviews were conducted the week of June 7 through 11, 2010, using a semi-structured interview instrument. In some cases, interviews were conducted by telephone at a later date. The organizations interviewed included:

- FNNND:
  - Governance and Administration
  - Lands and Resources Department
  - Heritage Department

    - Governance Department
    - Social, Health Department: Drop-in Centre and Counseling Service (Many Rivers Consulting)
    - Operations.
- Village of Mayo
- Yukon College
- J.V. Clark School
- Mayo Health Centre
- Royal Canadian Mounted Police (RCMP) – Mayo Detachment
- Ambulance Service
- Dunena Ko'Honete Ko Day Care
- Mayo Airport
- Yukon Environmental and Socio-economic Assessment Board (YESAB) and Mayo Designated Office
- Silver Trail Chamber of Commerce – Tourism Association
- Yukon Mine Training Association.

In addition, on other occasions VIT and its consultants met with many of these organizations, as well as with the Chief and Council of the FNNND as part of the overall consultation program for the Project. A number of community open houses and other meetings have been held since 2009, as documented in Section 2 and Appendix 2. These activities have informed the development of the Socio-economic Baseline Report and the effects assessment for the Project.

6.11.1.3 Regulatory and Policy Setting

The overarching guidance for SEEA for projects in Yukon is provided under the YESAA and by YESAB. In addition, the FNNND's Final Agreement and Self-Government Agreements and their policies and practices related to development of mineral interests and economic activities in the Traditional Territory are of relevance.

For some specific potential effects associated with various VCs, there may be policy, regulation, or other guidance that will inform the assessment and mitigation of effects (e.g., *Quartz Mining Act Royalty Regulation;* the *Wildlife Act* with respect to hunting and trapping). In these instances, a discussion of the applicable instrument is provided within the effects assessment, or reference is made to discussions provided in other sections of the Project Proposal.

Yukon Environmental and Socio-economic Assessment Act **(YESAA) and Yukon Environmental and Socio-economic Assessment Board (YESAB)**

Both YESAA and YESAB provide guidance that has informed the SEEA, as summarized below. Requirements for socio-economic assessment in Yukon have been summarized in the recent YESAA *Five-Year Review* (SENES 2009):

> "Under the s. 42(1) of YESAA, when assessing a project or existing project, Designated Offices, the Executive Committee or a Board panel are directed to consider *"the significance of any environmental or socio-economic effects of the project or existing project that have occurred or might occur in or outside Yukon*." They are also required to consider "*the significance of any adverse cumulative environmental or socio-economic effects that have occurred or might occur in connection with the project or existing project*. . . "They must also implement mitigative and compensatory measures for any such adverse effects. These "matters to be considered" are supported by a number of relevant YESAA purposes including not only fostering of beneficial socio-economic change (s. 5(2)(e)), but more specifically, recognizing and to the extent possible enhancing the traditional economy of First Nations (s. 5(2)(f)), and more broadly, protecting and promoting the well-being of First Nations and Yukon residents and the interests of Canadians (s. 5(2(d))."

The Yukon Environmental and Socio-economic Assessment Board has also prepared a *Guide to Socio-economic Effects Assessments* (2006). The Guide (no longer available on the YESAB web site; it is understood that the Guide and other YESAB guidance is under review and revision) defines socio-economic effects assessment, the Yukon regulatory framework, participants in the process, and a description of six steps in the assessment process. Potential VCs and types of potential socio-economic effects are described. Appendices define terms, identify relevant literature, identify information requirements, and suggest themes, criteria, and indicators.

The YESAA (section 50(3)) states the following with respect to First Nation and community consultation:

> *"Before submitting a proposal to the Executive Committee, the proponent of a project shall consult any first nation in whose territory, or the residents of any community in which, the project will be located or might have significant environmental or social economic effects."*

Consultation activities with respect to requirements under section 50(3) of the YESAA also informed the SEEA, through the identification of issues and concerns related to potential effects of the Project, the goals and desires of the local community, and potential mitigation measures or other commitments that can reduce or eliminate adverse effects, and enhance or optimize benefits. Consultation and the information gathered through that process has been a fundamental aspect of the SEAA.

First Nation of Na-Cho Nyäk Dun

The Nacho Nyäk Dun have lived and trapped throughout the northeast Yukon and Mayo area for generations. The FNNND is affiliated with the Northern Tutchone Council. Indian and Northern Affairs Canada estimated the registered population of the NND at 460 in 2004. Although a significant number of the First Nation's members live in the Mayo area, some live in other Yukon communities and outside the Territory. The name "Nacho Nyäk Dun" means "big river people."

The FNNND Final Agreement and Self-Government Agreements were signed in 1993. As a self-governing First Nation, the FNNND has the ability to make laws on behalf of their citizens and their lands. The FNNND assumed self-government responsibility for program service delivery in several areas (e.g., housing, infrastructure). In anticipation of involvement in development activity in the area, FNNND has developed several policies and practices, including:

- *Guiding Principles Towards Best Practices Codes for Mineral Interests within the First Nation of Na-Cho Nyäk Dun Traditional Territory* (FNNND 2008c)
- *Cooperative Engagement Process for Economic Activities Proposed in the Traditional Territory of the First Nation of Na Cho Nyäk Dun* (FNNND 2008a)

In relation to the Dublin Gulch properties, the FNNND entered into an Exploration Cooperation Agreement in 2008 with the predecessor to VIT, StrataGold Corporation Ltd. VIT has honoured and implemented that agreement and, in the spring of 2010, concluded a Memorandum of Understanding with the FNNND for the negotiation of a comprehensive Cooperation and Benefits Agreement (CBA) to address the company's mining operations and production in that area. The Project lies within the Northern Tutchone Land Use Planning Region, one of eight planning regions in Yukon. The region includes the Traditional Territories of the FNNND, the Little Salmon Carmacks First Nation, and the Selkirk First Nation. Land use planning has not been initiated for the Northern Tutchone Planning Region.

The northern portion of the FNNND's Traditional Territory is located in the Peel River Watershed Planning Region. A draft land use plan for that region (December 2009) is currently undergoing review and consultation. FNNND has noted that the protection of the Peel River watershed is a priority and that it is not open for mineral exploration or development (NOTE: the Project is located outside the Peel Watershed). The lands in the southern portion of Traditional Territory have already experienced mining development and other disturbances, and are more suited to additional resource development activity.

Village of Mayo

The Village of Mayo is a century old community situated near the confluence of the Stewart and Mayo Rivers. Formerly known as Mayo Landing, the town was established in the early 1900s as a river settlement and port for silver-lead shipments from the Keno mining district. It is located 407 km north of Whitehorse along the North Klondike Highway then east along the Silver Trail that connects the communities of Stewart Crossing, Mayo, Keno City, and the mining town of Elsa. The Village of Mayo was incorporated as a municipality in 1984.

Mayo is also home to the FNNND and is a regional hub that is centered around tourism, outfitting and adventure tours and mining operations. Mayo is the staging point for backcountry wilderness trips into the Peel River Watershed and its approximately 450 residents enjoy the services that include restaurants, accommodations, air charter services, and historical and visitor information. post office, liquor store, propane and gas, grocery store, swimming pool, nursing station, RCMP, airport, and float plane services.

6.11.1.4 Spatial Boundaries for the Socio-economic Effects Assessment

Spatial boundaries defining the socio-economic assessment areas were primarily based on the zone of the Project influence, beyond which the potential biophysical and socio-economic effects of the Project are expected to be non-detectable. The assessment areas are of two types—Local Assessment Areas (LAA) and the Regional Assessment Areas (RAA).

The LAA is used for the assessment of the Project-specific socio-economic effects. The LAA has been defined as the maximum area where Project-specific socio-economic effects can be predicted with a reasonable degree of accuracy and confidence.

The RAA provides a broader geographic context for understanding Project socio-economic effects and is the area in which potential cumulative effects are likely to occur. Thus, the RAA is the assessment area for potential cumulative socio-economic effects.

Local Assessment Areas

- FNNND Traditional Territory
- Village of Mayo (VoM).

The direct socio-economic effects of the Project will be experienced by the FNNND and by residents (FNNND citizens, other Aboriginal and non-Aboriginal people) of the Village of Mayo. To a lesser extent, Keno City may experience socio-economic effects from the Project.

Regional Assessment Areas

- Whitehorse
- Yukon.

Potential effects related to some VCs (e.g., employment and economic opportunities, power supply) may be experienced in Whitehorse or at a territorial level. A large number of FNNND citizens live in Whitehorse (as well as other communities in Yukon, and elsewhere in Canada). Some of the employment and economic opportunities associated with the Project will be experienced in Whitehorse, and at the Yukon territorial level.

6.11.1.5 Temporal Boundaries for the Socio-economic Effects Assessment

The temporal boundaries for the assessment for each VC have been defined based on the timing and duration of Project effects on the VC. The purpose of a temporal boundary is to identify when an effect may occur in relation to specific Project phases and activities. Project phases used to define temporal boundaries include:

- **Construction**—The construction phase includes all construction and site preparation work that occurs prior to the start up of mining and heap leach activities. The duration of the construction phase is ~1.7 yrs (January 2012 to August 2013).

- **Operations**—The operations phase is the period of time from the start of mining operations to the end of mining and ore processing. The operations phase is 7.3 years (88 months) from September 2013 to December 2020.
- **Closure and Reclamation**—The closure and reclamation phase is the period of time where mining operations have ended and closure and reclamation activities are taking place. The closure and reclamation phase is 10 years (120 months) from January 2021 to December 2030.
- **Post-closure Monitoring**—Although environmental monitoring will occur throughout all phases of the Project, post-closure monitoring will be dependent on when reclamation activities are completed for each facility. At this time, it is assumed the post-closure phase will begin in January 2031.

In summary, the Project is planned to have a 20-month construction phase, a 7.3-year operations mining phase, and a 10-year closure and reclamation phase, followed by a post-closure monitoring phase. These are described in detail above in Section 5 – Project Description.

6.11.1.6 Characteristics of Residual Socio-economic Effects

The characteristics of each residual socio-economic effect identified in the assessment is described using the attributes described below in Table 6.11-2. It should be noted that if the assessment determines that there will be no residual socio-economic effect, it will not be carried forward for characterization. Some of the attributes may not be applicable for individual socio-economic effects. For example, 'reversibility' is a concept that may be more readily applied to the biophysical environment (for example if water quality is adversely affected by a project, conditions may return to the baseline once the Project is completed). A return to original socio-economic baseline conditions may not be possible, as the environment is continually evolving in response to a variety of factors.

Table 6.11-2: Characterization/Attributes of Residual Effects for Socio-economic Effects (all VCs)

Characterization/ Attribute	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The ultimate long-term trend of the socio-economic effect (positive or negative) relative to the baseline conditions	▪ **Negative** (or Adverse)—VC would change for the worse ▪ **Positive** (or Beneficial)—change in VC would be an improvement ▪ **Positive and Negative**—change in VC in both directions ▪ **Neutral**—no change in VC
Magnitude	The amount or degree of change relative to baseline conditions	Where quantifiable assessment is not possible, magnitude is described as follows for both positive and adverse effects: ▪ **Low**—effect occurs but may or may not be detectable ▪ **Moderate**—effect occurs and is detectable ▪ **High/Substantial**—effect is substantial change from baseline conditions

Characterization/ Attribute	Description	Quantitative Measure or Definition of Qualitative Categories
Geographical Extent	The geographic area within which a socio-economic effect occurs	▪ **Local**—FNNND, VoM ▪ **Regional**—Whitehorse ▪ **Territorial** ▪ **National**
Timing and Frequency	When during the Project or a specific Project phase a socio-economic effect may occur, and how often (once, daily, weekly, monthly, continuous etc.).	▪ **Timing**—Project phase (construction, operations, closure and reclamation) ▪ **Frequency**—Low: seldom or never; moderate – occasionally; high – continuously
Duration	The period of time required until the VC or indicator returns to its baseline condition, or the effect can no longer be measured or otherwise perceived	▪ **Short-term**—effect limited to <1 year ▪ **Medium-term**—effect occurs >I yr and <10yrs (e.g., construction and operations phases) ▪ **Long-term**—effect extends 10 to 25 years (i.e., post-operations phase) ▪ **Permanent** (far future)—effect extends >25 years beyond the life of the Project
Reversibility	If the effect were to cease, will the affected VC return to pre-disturbance conditions	▪ **Reversible**—effect is reversible over time ▪ **Irreversible**—effect is not reversible over time
Socio-economic Context	Experience with previous projects, or socio-economic resiliency and ability to cope/adapt	▪ **Low**—community(s) has little or no experience with development, or are less resilient and have little capacity to adapt with change ▪ **Moderate**—community(s) has some experience with development, or are somewhat resilient and have some capacity to adapt with change ▪ **High**—community(s) has considerable experience with development, or are resilient and able to adapt with change
Probability of Occurrence	Professional judgement regarding the probability that an effect will occur	▪ **Low** ▪ **Moderate** ▪ **High**
Degree of Confidence in Effect Prediction	Professional judgement regarding overall degree of confidence in the predicted effect, based on the quality and quantity of data, understanding of the effect mechanism(s), and the effectiveness of the proposed mitigation measures,	▪ **Low** ▪ **Moderate** ▪ **High**

6.11.1.7 Standards and Thresholds for Determining Significance

There are few if any quantitative standards or thresholds for evaluating the significance of social or economic effects of development. Significance is context-specific. An effect that may be considered significant in one community may not be in another, depending on factors such as experience with change, current socio-economic conditions, and future goal and aspirations. As YESAB (2006) notes in its *Guide to Socio-economic Effects Assessments*:

> *"In the case of socio-economic effects, the standards, guidelines, objectives and thresholds are not as well defined, understood or necessarily agreed-to. …In the absence of specific targets, standards, thresholds, to define the criteria, the exercise of significance assessment becomes an increasingly more subjective, value dependent judgment of importance." (p. 70).*

The assessment of an effect's significance will also take into account the characterization using the attributes described in Section 6.11.1.7 above. This is helpful at the regional level.

The level of uncertainty in characterizing the significance of an effect is particularly challenging at the regional and national level where the activities that could influence outcome are more numerous and diverse than at the local level.

This socio-economic assessment focused on the communities of the FNNND and Village of Mayo where effects had the likelihood of being adverse. In response to concerns identified during the consultation program, this assessment looked for guidance to the instruments of governance developed by each of those communities. Both the FNND and the VoM have undergone planning exercises that set out visions of what they want their community to look like. The FNNND developed its Five Year Plan and Implementation Plan in 2004 to guide the management of heritage and cultural resources in their traditional territory. It includes a heritage vision statement, goals, objectives and an implementation strategy (http://nndfn.com/departments/detail/heritage). In 2008 the FNNND issued a further plan entitled Na-Cho Nyäk DunTan Sothan—A Good Path Integrated Community Sustainability Plan (http://nndfn.com/images/uploads/pdfs/NND_SUSTAINABILITY_PLAN.pdf) (FNNND 2008d). It was developed with funds received from Federal Gas Tax revenues that were given to municipalities and settled First Nations throughout Canada to support environmentally sustainable infrastructure and related capacity development to help ensure cleaner air, cleaner water and reduce greenhouse gas emissions. The VoM developed and issued a similar plan entitled Integrated Community Sustainability Plan 2006. Both plans included the vision statement of the First Nation or Village respectively, its goals, its process for planning and measuring success and setting priorities, and a list of existing community assets.

In respect for these plans, and in recognition that such plans are dynamic and may change over time, VIT, for the purpose of this assessment, gave considerable weight to the visions, objectives and goals set out in these plans. These goals were reflected in the concerns raised during community consultations and helped inform the choice of indicators examined in this assessment. Together with consideration of the characteristics of effects set out in Section 6.11.1.7 as well as professional experience and opinion, they assisted VIT's determination of significance of adverse effects on the five socio-economic VCs occurring in the LAA.

6.11.2 Employment and Economic Opportunities

6.11.2.1 Baseline Information – Employment and Economic Opportunities

This section provides a brief overview of baseline information with respect to Employment and Economic Opportunities, including a local and regional economic overview and a summary of the Yukon economic outlook. Additional detail on baseline information with respect to Employment and Economic Opportunities is provided above in Section 4.2.4, and in Appendix 17, the Socio-economic Baseline Report. In addition, Section 3.3 above provides information on land tenure in the area, including trapping (Section 3.3.6), outfitting (Section 3.3.7), and placer and quartz mining (Section 3.3.2).

6.11.2.2 Employment and Economic Indicators

Baseline information for each of the key indicators chosen to assess the Project's potential effect on employment and economic opportunities are summarized below:

- Unemployment and employment rates
- Labour force participation
- Median income
- Educational attainment
- Yukon economic outlook.

Unemployment and Employment Rates

The most recent census data for FNNND are for 2001. Data is available for 2001 and 2006 for most indicators for Mayo.

Unemployment rates for FNNND, Mayo, the City of Whitehorse, and Yukon as a whole are presented in Figure 6.11-4. Mayo and FNNND had consistently higher unemployment rates than Whitehorse or Yukon as a whole in 2001 and 2006 (the most recent years for which rates for Mayo and FNNND are available). This same trend is reflected in the employment rates for FNNND, Mayo, the City of Whitehorse, and Yukon for the same period (Figure 6.11-5).

In June 2010, the unemployment rate in Yukon was 7.8% (Yukon Bureau of Statistics 2010b), similar to the rate of 7.9% for Canada as a whole.

Labour Force Participation

Labour force participation rates in Mayo and FNNND have historically been moderately lower than in Whitehorse and Yukon as a whole, as shown in Figure 6.11-6.

Income

Historically, the average income of FNNND citizens and Mayo residents has been significantly lower than that of Whitehorse residents, and somewhat lower than the average income of Yukon residents, as shown in Figure 6.11-7.

Educational Attainment

The educational attainment (percentage of individuals without diploma, certificate, or degree) of FNNND citizens and Mayo residents has historically been significantly less than those living in Whitehorse or for Yukon as a whole, as shown in Figure 6.11-8.

Yukon Economic Outlook

The Yukon Government released its annual "Economic Outlook" in May 2010 (ECDEV 2010). The 2010 report's optimistic outlook is consistent with the view of the Conference Board of Canada, which recently noted that the growing demand for metals, and the opening of two Yukon mines, will be part of a "robust economic expansion" in the territory in 2010. Capstone Mining Corporation's Minto copper mine and Alexco Resource Corporation's Bellekeno silver mine are operational, and Yukon Zinc Corporation's Wolverine mine is anticipated to open later this year. Mineral exploration spending has been increasing in Yukon in recent years, and it is one of North America's 2009 economic "bright spots". The Conference Board forecasted the territory's gross domestic product (GDP) to rise by 4.9% in 2010.

Local and Regional Economic Overview

Mining

The Community of Mayo, including the FNNND and the VoM, has a long-term history of resource development activity, including several "boom and bust" cycles associated with mining (Mayo Historical Society 1999; Aho 2006; Bleiler, et al. 2006). Indeed, Yukon as a whole has experienced several similar mining cycles as a result of fluctuating commodity prices that can result in temporary mine closures, or the permanent closure of major mines such as Faro and Mount Nansen. Today, the Mayo area is experiencing a surge in quartz mining exploration and development. There are a number of active quartz claims in the area (described in more detail in Section 3.3.2 above).

Placer mining continues to be a major contributor to the economy of the area, with the majority of Mayo area placer mines being family-run, some for three or more generations. Extensive placer workings are found in the area surrounding the Project on the Dublin Gulch and Haggart Creek drainages (described in more detail in Section 3.3.2 above, in Appendix 3 – Land Use and Tenure, and Appendix 17 – Socio-economic Baseline), including a number of active and inactive claims.

Outfitters and Tourism

Tourism in the Silver Trail Tourism Region is a component of the local economy, but to a lesser extent than mining or government services. The area's natural beauty, mining history, and outdoor activities attract visitors from elsewhere in Yukon, Canada, and beyond. The number of tourists coming to Mayo varies between 1,000 and 2,000 people annually (VoM 2010). Substantially more visitors may come to the Silver Trail Region, visiting Keno City and the Stewart Crossing area.

In the Project area, Midnight Sun Outfitting Ltd. occupies Concession #4, which covers approximately 31,000 km^2 and includes the watersheds of the McQuesten, Wind, Hart, and Little Wind rivers. The Project is within the southern portion of Concession #4. Rogue River Outfitters (Concession #7) covers approximately 31,000 km^2 and is located to the south and east of the Project area (Appendix 3 – Land Tenure and Land Use, Figure 1). Section 3.3.7 above provides additional information on outfitting.

Commercial Trapping

The Project lies within Registered Trapline Concession (RTC) 81; the Haggart Creek Road bisects the RTC. RTC 84 and RTC 85 are located so the south of the Project and portions of these two RTCs are traversed by the South McQuesten Road (Appendix 3, Figure 1). Access to these three RTCs is by the South McQuesten Road, Section 3.3.6 above provides additional information on the RTCs; trapping is also discussed in terms of Traditional Activities and Culture in Section 6.11.3.

Commercial Fishing

There is no commercial fishing in the Mayo area or in the site vicinity.

Forestry and Agriculture

The Project area was historically used for fuel wood havesting for the early Keno Hill mine operations (Appendix 17). Personal use permits are provided by Energy, Mines and Resources (Yukon Government). There are no permits issued for the area at this time.

Minimal agricultural activity occurs in the area of the Project, although Minto Bridge Farms is located north of Mayo on the Silver Trail.

Oil and Gas

There are several sedimentary basins in Yukon with potential for oil and gas deposits; however, none are within or adjacent to the Project area.

Local Services and Businesses

Mayo's economy is beginning to be more focused on the provisions of various services, including government services, to its residents and individuals living in the surrounding area. There are approximately 42 businesses in Mayo and the surrounding area in 2010. The services offered include contracting, accommodations, and food services.

The Village of Mayo currently has a number of government services and facilities (see Appendix 17).

6.11.2.3 Assessment of Potential Effects—Employment and Economic Opportunities

The following potential effects on employment and economic opportunities have been identified:

4. Potential Effects on Opportunities for Employment
5. Potential Effects on Contracting Opportunities
6. Increased Royalties and Taxes
7. Potential Effects from Expenditures
8. Effects on Other Local or Regional Economic Activities:
    - Placer and Quartz Mining
    - Outfitters and Tourism

- Commercial Trapping
- Commercial Fishing
- Forestry and Agriculture
- Oil and Gas
- Local Services and Businesses.

Development of the Project is predicted to require spending of about $281 million dollars during construction as well as more than $90 million dollars annually during operations. These expenditures have the potential to provide benefits to the FNNND, VOM local community, the Yukon Government and the Government of Canada. The benefits to the governments of Canada and Yukon are predicted on current tax and royalty regimes.

The extent of benefits locally and regionally will depend on a number of factors such as available labour, degree of skills and training; availability of businesses and services that can support the mining activities. These factors will be influenced by the extent to which training opportunities are provided and accessed; the effectiveness of social support programs as well as competition for employees from other mines and businesses.

This effects assessment concentrates on the direct effects from the Project, specifically in terms of employment. However, employees will spend their incomes on a range of goods and services locally, in Yukon, and elsewhere.

These expenditures will have some indirect effects through increased spending, e.g., purchases of equipment such as boats/snowmobiles. There will also be the potential for some induced effects such as increased services and new businesses, such as opening of a new coffee shop because of increasing disposable incomes. The relationships between direct, indirect and induced effects are shown in Figure 6.11-8.

6.11.2.4 Description of Potential Effects on Opportunities for Employment

VIT is committed to providing employment opportunities throughout all phases of the Project, as described below.

Construction Phase Employment

The construction phase of the Project will be about 20 months, commencing in Q1 2012 and be completed by Q3 2013. The anticipated duration of construction is approximately 69 weeks, over two summer construction phases. This assumes that major construction activities cannot be undertaken during the winter period from approximately October 29, 2012 through March 15, 2013.

The construction workforce will be a combination of VIT employees and construction contractor skilled and unskilled labour. The expected construction work force schedule will be three weeks on, one week off at 11 hours per day. Seventy percent of the workforce will work day shifts and the remaining 30% will work night shifts. Peak construction workforce will be 415 people. Table 6.11-3 provides a breakdown of the number and types of jobs.

Table 6.11-3: Estimated Jobs during Construction Phase

Position	Number of Employees
Heavy Equipment Operators	115
Mechanics	35
Construction Supervision	35
Management and Technical	45
Semi-skilled Labourers	50
Specialty Trades	20
Skilled Trades	80
Catering and Services	35
Total	**415**

It is difficult to predict the exact number of FNNND citizens, residents of Mayo or other Yukon communities who will take up employment with the Project during the construction phase. There are a number of other development activities competing for the available labour pool. There are also many variables that would determine whether individuals would seek Project-related work and whether the available pool of employees will have the skills to match Project-related positions.

Operations Phase Employment

The operations phase is estimated to be approximately 7.3 years in duration (Q4 2013 to Q4 2020). As shown in Table 6.11-4, the workforce during operations will range from 339 to 384, depending on the year. During operations, the majority of Project personnel are scheduled to work 12-hour shifts on a rotation of two weeks on and two weeks off. Four work crews are required for 24-hours per day, year-round coverage. Mine services employees will work a weekly rotation of ten hour days, four days on, three days off, for a 40-hour work week. General and administrative employees will work a weekly rotation of 10 hour days, four days on, three days off, for a 40-hour work week.

Approximately 190 workers will be in camp at any given time. Details on the camp, including accommodations facilities, are provided in Section 5.4.2.3.

Table 6.11-4: Operations Phase Workforce Estimate

Department	2013	2014	2015	2016	2017	2018	2019	2020
Mine	169	186	206	204	207	196	169	176
Process	106	113	113	113	113	113	113	113
General and Administrative	64	64	64	64	64	64	64	64
Total Workforce	**339**	**363**	**383**	**381**	**384**	**373**	**339**	**353**

A wide range of positions will need to be filled during the mine operations from labourers, truck drivers, and camp services to more specialized and technical skills, such as lab technicians and the process operators. As with the construction phase, it is not known precisely how many local and Yukon individuals will be employed at the mine.

Types of jobs during the operations phase will include:

- Loader Operations
- Truck Drivers
- Blasters
- Blasters Helpers
- Labourers
- Mechanics
- Electricians
- Welders
- Lube Operators
- Crusher Operators
- Metallurgist
- Foremen
- Heap Leach Facility Operators
- Recovery Plant Operators
- Lab Technicians
- Plumbers
- Janitors
- Custodians
- Cooks
- Dishwashers
- Management
- Administration
- Safety Managers
- Environmental Monitors

Based on the 2006 local employment statistics (the most recent available), there were about 20 unemployed FNNND citizens, and about 25 unemployed individuals in the VoM. If these figures are assumed to be relevant in 2010, and all of these individuals were willing to work in gold mining, and were qualified, they would constitute 10% of the required construction work force. During the socio-economic assessment interviews conducted in 2010, many participants noted that individuals (FNNND citizens or other residents of Mayo) who are willing and able to work by and large are already employed, given the level of development activity in the community. Therefore it is difficult to predict how many local people will seek employment at theProject.

When looking at Yukon as a whole, in October 2010, there were a total of 1,000 people unemployed in the Territory (Yukon Bureau of Statistics 2010b). Assuming these individuals are willing to work in the mining industry and are qualified,, a consideration of the numbers alone would imply that most of Project-related jobs could be filled by Yukon residents. However, experience shows that:

- Some jobs require highly skilled or experienced individuals who are often not locally available.
- Skilled local or Yukon workers may choose to work elsewhere in the local area or in Yukon.
- Some individuals do not want to work in mining.
- Some will not take the necessary upgrading and training that is needed or available.
- Some cannot meet the zero tolerance policy requirement.

This suggests that VIT may require workers to come from outside of Yukon to meet the operational needs of the mine—particularly some of the more specialized positions.

Closure and Reclamation Phase Employment

During the closure and reclamation phase (Q1 2021 to Q4 2030), there will be fewer jobs available at the Project: those jobs will be primarily for rehabilitation and ongoing monitoring. The reclamation and closure workforce will be a combination of VIT employees and construction contractor skilled and unskilled labour. Exact closure workforce requirements will be determined in planning for Closure and Reclamation. However staff requirements during reclamation are likely to initially be around 200, which will decrease over time as reclamation objectives are met and site activities move to a monitoring stage. Again, as many local individuals as possible would be employed; however, it is anticipated that many of those who were involved in the construction and operations activities will likely move on to similar work with other projects in the region or elsewhere in Yukon. The post-closure monitoring phase will be approximately five years (2030 to 2035).

Table 6.11-5 summarizes the peak workforce during the various Project phases.

Table 6.11-5: Peak Workforce during Construction, Operations, Closure and Reclamation

Project Phase	Peak Workforce
2012 – 2013: Construction	415
2013 – 2020: Operations	384
2020 – 2035: Closure	Approximately 200

6.11.2.5 Mitigation and Enhancement Measures for Potential Effects on Opportunities for Employment

VIT will strive to hire as many FNNND citizens and other local and Yukon residents as practical to fill employment positions.

VIT will work with Yukon College, the FNNND, the Yukon Mine Training Association, and potentially other organizations to develop programs and training relevant to mining. These programs will aim to provide individuals in the local area who are currently unemployed or under-employed to get the necessary upgrading and skills that will permit employment with the Project. Contributions of advice, expertise, mentorship and program development assistance for programs will be considered on a case-by-case basis.

VIT will also provide opportunities for students to be employed at the Project during the summer.

6.11.2.6 Residual Effects – Opportunities for Employment

Employment—especially for those who have learned new skills or gained significant work experience while employed by VIT—can result in opportunities for employment with other mines, or similar industries, in Yukon after the operations phase of the Project is over, or during any temporary closure of the Project (e.g., related to downturns in commodity prices).

The following tables provide the characterization of the residual effects on employment for the construction and operations phases by assessment area.

Table 6.11-6: Summary of Residual Effect Characterization – Construction Employment (Peak Workforce 415)

Direction	Positive	Positive	Positive
Magnitude	Slight	Moderate	High
Geographic Extent	National (305 jobs)	Yukon (est. 100 jobs)	Local (NNND/VoM (est. 10 jobs)
Timing/Frequency	N/A	N/A	N/A
Duration	2 years	2 years	2 years
Reversibility	N/A	N/A	N.A
Socio-economic Context	N/A	N/A	N/A
Probability of Occurrence	High	Moderate	Moderate
Degree of Confidence	High	High	High

Table 6.11-7: Summary of Residual Effect Characterization - Operations Employment (Peak Workforce 384)

Characterization/Attribute	National	Yukon	Local
Direction	Positive	Positive	Positive
Magnitude	Low	Moderate	High
Geographic Extent	National (274 jobs)	Yukon (est. 100 jobs)	Local (NNND/VoM (est. 10 jobs)
Timing/Frequency	N/A	N/A	N/A
Duration	8 years	8 years	8 years
Reversibility	N/A	N/A	N.A
Socio-economic Context	N/A	N/A	N/A
Probability of Occurrence	High	Moderate	Moderate
Degree of Confidence	High	High	High

6.11.2.7 Determination of Significance of Potential Effects on Opportunities for Employment

Employment of local or Yukon residents by the Project has the potential to provide economic benefits related to employment at the local, regional, and territorial levels. The following is a probable base case scenario using the hourly rate for a semi-skilled labourer for the construction phase.

It is important to note that this is the lowest hourly wage for the Project. Therefore this scenario provides for a conservative prediction.

Based on the current hourly wage of $22.50 per hour, this would provide the worker with

- A daily wage of $270 per 12 hour shift

- A gross salary for two weeks of$3,780
- A gross annual income of $49,140
- Annual gross compensation of $56,511 (inclusive of an additional 15% estimate for benefits, vacation pay etc. for a total of $7,371)
- Annual net compensation of $36,855 (after deductions for income tax of $12,285.00 at a conservative income tax rate of 25%.

Based on this scenario, if there were 10 local residents employed in new jobs there could be up to $368,855 annually available for expenditures on local goods and services both locally and territorially.

On a Yukon geographic level, if one assumes 100 workers employed in VIT jobs—at this basic labourer rate—there would be up to $3,688,550, disposable income for expenditures on goods and services.

Given that there are many higher paying jobs that will be available at the Project, to the extent that Yukon residents are employed in Project-related jobs, it is likely that the disposable income at the Yukon level would be somewhat higher.

The direction of the effect of the Project on employment opportunity is positive at the local, Yukon and national level.

Operations

During the 7.3-year operations phase, the economic benefits resulting from the disposable income available to purchase goods and services in the local community and Yukon will again reflect the number of individuals who are employed. If the various training and upgrading initiatives are successful, one could anticipate that there would increase in the disposable income. The direction of the effect of the Project on employment opportunity is positive at the local, Yukon and national level.

6.11.2.8 Description of Potential Effects on Contracting Opportunities

During the construction phase of the Project, numerous major contracts will be utilized. The major contracts will likely have several smaller associated sub-contracts. Construction of the Project will cost approximately $281 million; The VIT team's experience with other mining projects in the North suggests that up to 70% of this amount ($196 million) could be spent with Yukon companies.

During the operations phase of the Project, there will be several major contract opportunities for the provision of goods and services to the mine.

VIT will have an approach to contracting procedures during all phases of the Project to support the objective of using local businesses to the extent possible to supply goods and services. This approach will include the following:

- VIT will use both public tenders and sole-sourcing
- Decisions will be made in a business-like and business-focused manner

- VIT intends to work with a main engineering firm for design and contracting (a Procurement Contractor) that will:
  - Prepare bidder lists for VIT to review and finalize
  - Request proposals or quotations from all companies on the bidders lists
  - Do a technical and financial comparison
  - Recommend suppliers for review by VIT.
- VIT will review the recommendations and make all final approvals
- The EP Contractor will issue contract or purchase order
- VIT will make efforts to 'right-scale' contracts in order to make it possible for local companies to be competitive, and will employ a strategy to provide sub-contracting opportunities.

6.11.2.9 Mitigation and Enhancement Measures for Potential Effects on Contracting Opportunities

VIT will develop a Business Opportunities pamphlet as a tool to clearly communicate to local businesses the Project-related opportunities to enable them to plan for and participate in pursuing contracts/business opportunities with the Project. The Business Opportunities pamphlet will be distributed to Yukon businesses in 2011.

VIT will develop a database of local and Yukon businesses in which those businesses can identify the goods and services they could offer to the Project.

VIT will seek to 'right-size' contracts where practical to enable local businesses to take advantage of the opportunities available with the Project.

VIT will assist, as appropriate, in facilitating the exchange of information between parties who are interested in possible joint ventures. The company will not, however, enter into any joint ventures itself.

6.11.2.10 Residual Effects – Contracting Opportunities

The Project will involve a variety of major and lesser contracting and sub-contracting opportunities during the construction and operations phase. These may be awarded to either existing or new companies that can competitively supply goods and services. To the extent that local or Yukon businesses gain experience with successful Project-related contracts their position to compete for work to provide similar services to other mining to projects would be enhanced.

Although VIT will promote the employment of women through all categories of positions with the Project, the potential for camp services contracts to be awarded locally increases the likelihood of employment for women as well as men who may not be able to obtain jobs that have specific skills/training requirements. VIT is committed to working with local businesses to clarify the needs of the Project as far in advance as possible so they can prepare themselves to take advantage of contract opportunities that have the potential to employ a larger number of local residents and thereby enhancing the overall social benefits for individuals, families and the local community.

6.11.2.11 Determination of Significance of Potential Effects on Contracting Opportunities

Contracting opportunities during the construction, operations, closure and reclamation phases of the Project are expected to have a positive economic effect on the FNNND (in terms of businesses operated by citizens or by the Na-Cho Nyäk Dun Development Corporation), Mayo and the regional and territorial economy as a result of direct contracting opportunities, as well as the indirect and induced business activity that may be generated. Given the difficulty of predicting with any accuracy the magnitude or significance of this effect, VIT has committed to monitor these and other effects and to work together with the businesses of the FNNND, Mayo and Yukon to optimize the positive benefits to Yukon. These commitments are further described in Section 6.11.7.

Table 6.11-8 provides the characterization of residual effects on contracting.

Table 6.11-8: Summary of Residual Effect Characterization – Contracting

Characterization/Attribute	Contracting
Direction	Positive
Magnitude	Moderate
Geographic Extent	Local/Yukon/National
Timing/Frequency	Continuously
Duration	10 years plus
Reversibility	N/A
Socio-economic Context	N/A
Probability of Occurrence	High
Degree of Confidence	High

6.11.2.12 Description of Potential Effects on Royalties and Taxes

A major economic benefit to Canada, Yukon, and by extension to the local community, are the royalties and taxes that a successful mine will pay during the operations phase to the various levels of government.

Royalties

Under the new 2010 *Quartz Mining Act Royalty Regulation*, the annual royalty payment is made on a sliding scale based on the mine profit. The rate ranges from 3% on annual profit greater than $10,000 to a rate of 12% on profits greater than $35 million. The amount retained by the Yukon Government will vary annually based on the *Quartz Mining Act Royalty Regulation*. The amount of royalties retained by Yukon Government will be in a accordance with overall royalty provisions agreed to with the Government of Canada as set out in the 2001 *Yukon Northern Affairs Program Devolution Transfer Agreement*.

Under their Final Agreement, FNNND owns the minerals under all Category A Lands, and receives royalties from any mining on this land. For mining activity elsewhere in the NND Traditional Territory, including on Category B Lands, the NND Government shares in a portion of any mineral royalties collected. The Project is located in the FNNND Traditional Territory, but is not on Category A or B lands. As per the Final Agreement, a portion of royalties collected by the Yukon Government will be shared with FNNND.

Taxes

According to the PFS document (Scott Wilson Mining 2010), the total federal income tax generated by the Project, until 2021, will be about US$32 million; territorial income tax will also be about US$32 million for the same period; and territorial mining tax will be about US$17 million. The total tax generated by the Project during its operations phase is estimated to be about US$82 million between the years 2017 and 2021 (according to estimates, the Project will generate no corporate income taxes between 2012 and 2016). Details are provided in Table 6.11-9 below.

Table 6.11-9: Project Taxes (US$ '000)

Form of Tax	2017	2018	2019	2020	2021	Total
Federal Income Tax	$5,999	$9,341	$9,387	$7,237	$418	**$32,382**
Territorial Income Tax	$5,999	$9,341	$9,387	$7,237	$418	**$32,382**
Territorial Mining Tax	$4,230	$3,444	$5,130	$3,391	$1,191	**$17,386**
Total Tax	**$16,227**	**$22,126**	**$23,905**	**$17,864**	**$2,027**	**$82,150**

Source: PFS document (Scott Wilson Mining 2010)

In addition, there will be other taxes and payments to other levels of government, such as GST on goods and services, and the income taxes paid federally and territorially by employees and contractors.

6.11.2.13 Mitigation and Enhancement Measures for Royalties and Taxes

No mitigation or enhancement measures are required for this effect.

6.11.2.14 Residual Effects – Royalties and Taxes

Royalties will not be paid following the closure of the Project, although some taxes may still apply in relation to income tax and taxed on goods and services during the closure phase. Should the Project be closed temporarily, payment of royalties and taxes would cease or be reduced during that period. Table 6.11-10 summarizes the characterization of residual effects for royalties and taxes.

Table 6.11-10: Summary of Residual Effect Characterization – Taxes/Royalties

Characterization/Attribute	Corporate Income Taxes	Royalties
Direction	Positive	Positive
Magnitude	Substantial	Substantial
Geographic Extent	National/ Yukon	Yukon/FNNND
Timing/Frequency	Operations/Annual	Operations/Annual
Duration	5 years	7- 8 years

Characterization/Attribute	Corporate Income Taxes	Royalties
Reversibility	N/A	N/A
Socio-economic Context	N/A	N/A
Probability of Occurrence	High	High
Degree of Confidence	High	High

6.11.2.15 Determination of Significance of Potential Effects Royalties and Taxes

Royalties and taxes from the Project will be a positive effect and will provide a significant benefit to the Yukon Government, the FNNND and the federal government.

6.11.2.16 Assessment of Potential Effects from Expenditures

Description of Potential Effects from Expenditures

VIT will be making major financial investments during the construction (20 months), operations (7.3 years), and closure and reclamation (10 years) phases.

Details of the main capital (construction) and operations phase expenditures are discussed below.

Capital Costs (Construction Phase)

The major capital cost expenditures will be during the 20-month construction phase in 2012 and 2013. The estimated capital costs for that period are approximately $281 million, as shown in Table 6.11-11. It is not known what percentage of the capital costs will be local or Yukon-based, but based on their experience with similar mine projects, VIT estimates that up to 70% of capital cost expenditures will be made at the local or regional level.

On this basis, about $195 million would be spent locally or regionally. Most of this expenditure will be through contracts with engineering, construction and service provision companies.

Table 6.11-11: Project – Capital Costs ([1]000)

2012	2013
$175,130	$106,347

Operations Costs

The estimated operating costs for the 7.3 years of mine operations range from $85 million to $96 million. The year 2013 will be only a partial production year. It is not known what proportion of the operations cost will be expended locally or territorially, and what proportion will be spent outside Yukon. Neither is it currently known how many local or Yukon residents will be employed at the Project. However, VIT intends to optimize local and Yukon hiring. To realize this goal, VIT will work with the FNNND, Yukon Mine Training Association and Yukon College to provide a range of upgrading and training programs to optimize local and Yukon employment.

In addition, there will be some limited capital expenditures during the years of operation.

Table 6.11-12: Project – Operating Costs (estimated) ('000)

2013	2014	2015	2016	2017	2018	2019	2020
$41,316	$90,184	$96,940	$93,836	$95,922	$92,340	$85,041	$82,012

6.11.2.17 Mitigation and Enhancement Measures for Potential Effects from Expenditures

VIT acknowledges that the magnitude of benefit to Yukon from Project expenditures will be highest in circumstances where local and Yukon business participation can be optimized. VIT will seek to 'right-size' contracts where practical to facilitate greater access to contracting opportunities by local and regional businesses. Those measures are set out above in 6.11.2.4 in relation to contracting opportunities, respectively.

6.11.2.18 Residual Effects from Expenditures

The residual effects from Project-related expenditures in both the LAA and the RAA will be positive. Although the exact value of those expenditures can not be calculated with any accuracy at this time, it is predicted that they will be substantial

For the life of the Project, expenditures can provide stability and continuity of employment to individuals and a stable base for many local/Yukon businesses. To the extent that employees and businesses are successful in their engagement with the Project, they will be in a position to transfer their skills, knowledge and capital to other sectors of the economy including the provision of services to various levels of government or to other mining ventures in Yukon. FNNND and other local and regional businesses have the potential to grow and expand their services.The residual effects from Project expenditures are characterized in Table 6.11-13.

Table 6.11-13: Summary of Residual Effect Characterization – Expenditures

Characterization/Attribute	Construction Phase	Operations Phase	Closure Phase
Direction	Positive	Positive	Positive
Magnitude	Substantial	Substantial	Moderate
Geographic Extent	Yukon, Local and National	Yukon, Local and National	Yukon and Local
Timing/Frequency	Continuously	Continuously	Continuously
Duration	20 months	7.3 years	10+ years
Reversibility	To a degree with decommissioning	To a degree with decommissioning	N/A
Socio-economic Context	N/A	N/A	N/A
Probability of Occurrence	High	High	High
Degree of Confidence	High	High	High

Determination of Significance of Potential Effects of Expenditures

The direct, indirect and induced effects associated with these expenditures will be positive and are predicted to be significant to the local, regional and Yukon economies. These effects will be direct wage employment plus increased expenditures on goods and services in relation to the Project.

6.11.2.19 Description of Potential Effects on Other Local or Regional Economic Activities

Placer and Quartz Mining

The Project could potentially disrupt activities of those local placer mining operations who use the HCR or SMR during the upgrading of the road. These operators may also be disrupted by modifications introduced by VIT to control use of the road through radio-controlled access. This disruption will be negative in the context of construction upgrades but once completed, positive with respect to safe use of the roads.

Given that VIT controls all of the quartz mining claims and leases within 500 m of the South McQuesten and Haggart Creek Roads and on the Dublin Gulch Property, quartz mining activities will not be directly affected by the Project. As such, the effect of the Project on quartz mining was not carried forward for assessment.

Outfitters and Tourism

Tourism in the Silver Trail Tourism Region is not predicted to be adversely affected by the Project. A small or moderate increase in tourism may be experienced if Project employees or contractors decide to spend time in the area for vacation or recreational activities.

There is very little potential for the Project to adversely affect the outfitting operation of Midnight Sun Outfitting Ltd. (Concession #4), which covers approximately 31,000 km^2 (including the Project footprint) or Rogue River Outfitters (Concession #7, which covers a similar area to the south and east of the Project area). Given the historical and current mineral development activity in the LAA and the RAA, as well as the relatively large geographic area of each concession, outfitting activities likely focus on more remote areas. These outfitters may experience indirect benefits, if Project employees or contractors decide to utilize their services for vacation or recreational activities.

Commercial Trapping

The RTCs provide both economic benefits as well as preservation of traditional activities for their operators. The Na-Cho Nyäk Dun Fish and Wildlife Planning Team (2008) note that fewer citizens are participating in trapping for a number of reasons, including higher fuel prices, lack of desire, and difficulty obtaining trap lines.

There are three Registered Trapline Concessions (RTCs) that overlap with the Project. The Project lies within Registered Trapline Concession (RTC) 81. RTC 84 and RTC 85 are located to the south of the Project, and portions of these two RTCs are traversed by the South McQuesten Road (Appendix 3, Figure 1). Within those RTCs there may be individual traplines that may be affected by Project activities such as disturbance to habitat. If wildlife habitat is lost or disturbed, or if wildlife mortality increases or their movement patterns are adversely changed by the Project, wildlife may decrease in numbers or relocate. Trapping may be affected by:

- Having to travel new and different routes to set traps
- Having to establish new traplines to harvest furbearing animals that have an economic value
- Effects of new and existing trails on wildlife movements.

Access to these RTCs is by the South McQuesten Road and Haggart Creek Road and usually in winter. Trappers may benefit from improved access, particularly with the roads being maintained year-round during construction and operations of the Project.

Commercial Fishing

As there is no commercial fishing activity in the Mayo area or in the vicinity of the Project, no effects on commercial fishing will occur as a result of the Project. As such, the effect of the Project on commercial fishing was not carried forward for assessment.

Forestry and Agriculture

As there are no personal use permits for fuelwood harvesting issued for the area at this time (Appendix 3), no effects on wood harvesting are likely to occur as a result of the Project.

Although Minto Bridge Farms is located north of Mayo on the Silver Trail, it is sufficient distance from the Project that effects on the Farm are not anticipated. As such, the effect of the Project on forestry and agriculture was not carried forward for assessment.

Oil and Gas

There are no sedimentary basins with potential for oil and gas deposits within or adjacent to the Project area so no Project effects on potential oil and gas development are predicted. As such, the effect of the Project on oil and gas activity was not carried forward for assessment.

Local Services and Businesses

Local services and businesses may experience direct, indirect or induced benefits from the Project. Even with a fully self-contained camp operation, there will be occasion for VIT management staff or consultants to travel to or stay in Mayo on occasion. Similarly, local residents who do obtain employment at the mine will have discretionary income that will be spent in part locally. There will, for example, be additional customers for services such as the restaurant, local accommodations, fuel providers, taxi service, and the store. While these effects may be focused on Mayo, they would also be experienced to a lesser extent in Keno City and elsewhere along the Silver Trail.

Contracting opportunities are assessed separately in Section 6.11.2.4.

Induced Effects

The Project may induce other activities and businesses. For example, services such as bussing workers from Mayo to the mine site or trucking of materials to the site could be developed. The potential for joint ventures between existing companies and FNNND for skilled or specialized activities, such as blasting or trucking materials to the site, exists. An additional benefit of any induced activities during the period of the VIT operations is that the new businesses may be able to develop contracts with other mines and therefore be in a position to provide services and sustainable employment for the local area.

Among the range of possible other induced effects are:

- Improved quality of life resulting from steady wage employment, which leads to greater disposable income for individuals and families
- Increased skills capacity from training and employment, which can enhance the potential for future work at other similar projects
- New businesses and services created to serve the Project and community.

If a small number of families of Project employees move to Mayo, the moderate increase in local population will mean increased support for various community services and facilities, such as the daycare centre and the school (See ‘Community Vitality’, Section 6.11.4).

6.11.2.20 Mitigation of Potential Effects on Other Local or Regional Economic Activities

To reduce land use conflicts and any potential negative effects on others in relation to proposed activities on-site or along the access route, VIT has and will continue to communicate its plans and the timing of its proposed activities to other resource users (e.g., trappers, outfitters, placer miners, and known subsistence harvesters) who may be affected by the Project, as soon as practicable and prior to commencement of the activity.

VIT has contacted potentially affected operators of placer mines, RTCs, and outfitters, both to advise them of the Project activities and to discuss any questions or potential concerns they may have with the proposed Project so that VIT can better understand the effects the Project might have on these operations. To the extent the Project will adversely interact with these operations, VIT will try to avoid or accommodate those effects by way of Project design and where that is not possible will provide appropriate compensation.

With respect to commercial trapping, a compensation process is set out under the *Wildlife Act*. There are provisions under the VFA and FNNND Final Agreement to develop and implement a compensation policy for trappers affected by development pressure. However, it is not yet in place (Na-Cho Nyäk Dun Fish and Wildlife Planning Team 2008).

6.11.2.21 Residual Effects on Other Local or Regional Economic Activities

Placer Mining

VIT is in discussions with placer mining operations in the Project area. To the extent that the Project will have an adverse effect on the operations of a placer miner, VIT will try to accommodate those effects by way of Project design and where that is not possible will provide appropriate compensation. With these mitigation measures, residual adverse effects are not anticipated to result from the Project. Because placer mining is seasonal in nature, it is anticipated that these operations will benefit from the improved access road.

Outfitting

VIT is in discussions with the two outfitters operating in the Project area. With implementation of planned mitigation measures, residual adverse effects are not anticipated to result from the Project. A small or moderate beneficial effect may occur if employees or contractors utilize the outfitters for vacation or recreational purposes.

Table 6.11-14 summarizes the characterization of the Project's residual effects on outfitting and tourism.

Table 6.11-14: Summary of Residual Effect Characterization – Outfitting and Tourism

Characterization/Attribute	Outfitting
Direction	Positive
Magnitude	Low
Geographic Extent	Project Vicinity
Timing/Frequency	Construction, Operations/High
Duration	Medium-term
Reversibility	reversible
Socio-economic Context	N/A
Probability of Occurrence	Low to Moderate
Degree of Confidence in Prediction	Moderate

Commercial Trapping

Project effects to commercial trapping could be either adverse or positive in direction depending on the specific location of a trapline. Any adverse effect is predicted to be low in magnitude and reversible. The effect would last from Construction through to the point in time during Closure that the disturbed habitat of trapped species is reclaimed and re-populated.

With implementation of planned mitigative measures, residual adverse effects on commercial trapping are not anticipated to result from the Project. A small or moderate beneficial effect may occur if a RTC operator chooses to use the road, which will now be plowed in winter, to access their RTC.

The residual effects of the Project on commercial trapping in the Project area are characterized in Table 6.11-15.

Table 6.11-15: Summary of Residual Effect Characterization – Commercial Trapping

Characterization/Attribute	Commercial Trapping
Direction	Negative/Positive
Magnitude	Low
Geographic Extent	Specific to RTC/Project overlap
Timing/Frequency	N/A
Duration	~10 years T
Reversibility	Reversible
Socio-economic Context	N/A
Probability of Occurrence	Moderate
Degree of Confidence in Prediction	Moderate

Local Businesses and Services

The Project is predicted to have residual direct, indirect and induced benefits on local businesses and services in Mayo, and to a lesser extent to those located in Keno City and elsewhere on the Silver Trail.

Table 6.11-16 summarizes the characterization of the Project's residual effects on local businesses and services.

Table 6.11-16: Summary of Residual Effect Characterization – Local Businesses and Services

Characterization/Attribute	Local Businesses and Services
Direction	Positive
Magnitude	Low to Substantial (depending on nature of business/service)
Geographic Extent	Local
Timing/Frequency	Construction, Operations/Moderate to High
Duration	Medium- to Long-term
Reversibility	N/A
Socio-economic Context	N/A
Probability of Occurrence	High
Degree of Confidence in Prediction	High

6.11.2.22 Determination of Significance of Effects on Other Local or Regional Economic Activities

No significant adverse effects are predicted on: the placer mining operations located along the South McQuesten and Haggart Creek roads; on outfitter operations; or on commercial trapping.

Moderate beneficial effects are predicted on local tourism.

6.11.2.23 Cumulative Socio-economic Effects—Employment and Economic Opportunities

Screening of Cumulative Environmental Effects

The YESAA requires consideration of the significance of *adverse* cumulative socio-economic effects that might occur in connection with the Project in combination with the effects of other proposals submitted to YESAB or other existing activities in Yukon (s. 42 (1)). However, the employment and economic opportunities associated with the Project may have positive or beneficial socio-economic cumulative effects.

A screening of the Project's potential contribution to the cumulative effects of past, current, and announced future projects was done per the procedures described in Section 6.3.8. The screening process establishes three conditions to warrant further assessment. These conditions are:

1. The Project results in a demonstrable residual effect
2. These effects are likely to act in a cumulative fashion with those of other projects
3. There is a reasonable expectation that the Project's contribution to cumulative effects has the potential to change the health or sustainability of the Employment and Economic Opportunities VC.

In the absence of completed discussions or agreements between VIT and the operators of the potentially affected RTCs, it is not possible to provide conclusions with respect to residual effects of the Project on commercial trapping. As such, potential effects on commercial trapping have not been carried forward for cumulative effects assessment.

As a result of the screening process, four potential effects are carried forward for an assessment of cumulative effects:

- Opportunities for Employment
- Contracting Opportunities
- Royalties and Taxes
- Effects from Expenditures.

Description of Cumulative Effects

Opportunities for Employment

There are a number of projects competing for construction and operations labour in the region (e.g., the Bellekeno and Minto mines, and the Mayo B hydro-electric project [slated for completion in 2011, but by March 2012 at the latest, and therefore unlikely to overlap with Project construction]). Table 6.11-17 shows peak workforce estimates for other operating development projects that may be competing for labour. The estimated combined labour force is large relative to the available pools of local or Yukon workers. Many of the FNNND citizens, other residents of Mayo or other Yukon communities who are willing to work in the mining industry may already be employed and may choose not to work for VIT. Several other projects are in exploration stages or in environmental assessment and permitting processes (see Table 6.3-1: Project Inclusion List); if they proceed to operations, the demand for labour will increase significantly, while the pool of skilled labour may remain relatively static.

Cumulatively, the employment opportunities provided by the Project and other projects will provide benefits to FNNND citizens, other residents of Mayo, and workers from elsewhere in Yukon and Canada.

A negative cumulative effect may be that the cost for labour may increase because of the excess available jobs competing for the limited pool of skilled employees in the local area.

Table 6.11-17: Peak Workforce Estimates – Other Operating Projects

Project	Construction Period (Workforce)	Operations Period (Workforce)	Closure and Reclamation Period (Workforce)	Post-closure Period (Workforce)	Source
Bellekeno (Alexco)	NA/ (unknown)	2010 – 2015 (120)	unknown (unknown)	unknown (unknown)	October 29, 2010 News Release, Yukon Government
Wolverine (Yukon Zinc)	2008 – 2010 (unknown)	2010 – 2020 (unknown)	unknown (unknown)	unknown (unknown)	http://www.yukonzinc.com/documents/YukonZincWolverineNewsletterJuly13-10.pdf
Carmacks Copper (Western Copper)	Unknown 300	Unknown 150 (avg)	unknown (unknown)	unknown (unknown)	Note: water licence has been denied; therefore construction/subsequent phases uncertain
Minto (Capstone)	2006 – 2007 NA	2007 (unknown)	unknown (unknown)	unknown (unknown)	Minto Exploration Ltd., Project Proposal
Mayo B	2010 – 2011 120	2013 (unknown)	unknown (unknown)	unknown (unknown)	Mayo B Screening Report and Recommendation
Eagle Gold Project	2012 – 2013 415	2013-2020 384	2021 – 2030 (unknown)	2030 – 2035 (unknown)	Section 6.11.2.3 of Project Proposal
Total Workforce in Period Overlapping with Project Phases	**715+**	**654+**	**unknown**	**unknown**	

NOTES:

Criteria for inclusion: operating and/or pending operational mines in Yukon

Does not include 'future' projects currently in exploration phase or pre-submission of Project Proposal to YESAB; or those in closure/reclamation.

In addition, there is a potential for existing or future projects to attract individuals who are currently employed in local businesses, organizations, or in various seasonal activities. This could strain capacity of local businesses or provision of services in the community. For example, if a truck driver for a local company switches to employment at the Project, this will open up a position that will have to be filled from a very limited pool of available workers.

Those workers who obtain training and years of experience working at VIT will have transferrable skill sets that will make it easier for them to move to employment with other similar projects in the area or elsewhere.

Contracting Opportunities

The positive cumulative effect will be determined by the extent to which FNNND and individual businesses are able to capitalize on the opportunities provided.

As noted above, there are a number of other projects (existing and future) in the Project area and elsewhere in Yukon. These will cumulatively result in contracting opportunities for the provision of goods and services by local and Yukon contractors. Existing and new local businesses that service VIT may be in a position to supply other projects. Their capacity and desire to do so are unknown.

Royalties and Taxes

VIT and other current and future mines will pay royalties and taxes directly to the Yukon and federal governments, cumulatively increasing revenues. In addition, there will be other taxes, such as GST on goods and services, and the income taxes paid federally and territorially by employees and contractors.

The FNNND will experience financial benefit as a result of royalty sharing with the Yukon Government for other development projects in their Traditional Territory.

Mitigation of Cumulative Effects

No mitigation measures are proposed with respect to cumulative effects on employment, contracting, or royalties and taxes.

Determination of Significance of Cumulative Effects

The Project, in combination with other Projects in the local area and Yukon, will result in significant positive or beneficial cumulative effects on employment, contracting, and taxation and royalties.

The competition for the eligible labour pool may result in capacity challenges for local organizations or businesses that lose employees to mining operations. Increased demand for labour may also result in wage increases.

Indirectly, improved capacity and skills development of both individual workers and contractors will result from the Project and other mining projects in the region.

The cumulative effects from expenditures by multiple projects will be greatest for local and Yukon contractors and suppliers that may expand their businesses and offer existing or new services to a range of clients. The projects may stimulate business diversity and stability.

6.11.2.24 Summary of Influence of Consultation on the Assessment of Employment and Economic Opportunities

Training and mentoring the local population for employment with VIT, and employment of the local population in and of itself, were issues very frequently identified by the government, FNNND citizens, and residents of Mayo. The local population and its leadership want to take advantage of VIT's employment and contracting opportunities. This demonstrates that VIT's desire to employ members of the local population will be at least partially met by the local population itself.

Another economic opportunity raised by the community during the consultation process was stimulation of the local economy and businesses. There is a desire among the local residents that VIT make use of the goods and services that can be provided through local businesses as much as possible.

Potential effects on other local economic activities, particularly commercial trapping, were identified as a concern during consultation activities.

6.11.2.25 Effects Monitoring and Adaptive Management for Employment and Economic Opportunities

Given the approximate 20-year life of the Project (construction, operations, closure and reclamation) and the potential for other future development activity in the area, it is a challenge to predict with certainty the full range of socio-economic effects that will occur.

Socio-economic change is not solely within the control of VIT. However, the company will work with FNNND, VoM, the Yukon Government and others to review and respond to the Project's emerging socio-economic effects—both positive and negative. VIT will develop a process for confirming the indicators, reporting and responding to monitoring results will be cooperatively established. This process would identify:

- Project-related socio-economic effects and indicators to be monitored by VIT and others
- The process for adaptive management
- The measures (in addition to those already committed to) that VIT and others could put in place for prevention, mitigation or enhancement of the Project's socio-economic effects.

Key socio-economic indicators for the Project will be monitored by VIT (e.g., number of local, Yukon, other employees; value of local, Yukon goods and services; royalties and taxes). These will need to be considered in terms of the broader socio-economic context and other sources of change. This will provide for an understanding of the Project's socio-economic effects, identification of any emerging or unanticipated effects, and the opportunity for VIT or other parties to respond as appropriate.

The effects monitoring and adaptive management related to Wildlife (Section 6.9), Vegetation Resources (Section 6.8), and Fish and Fish Habitat (Section 6.7) are also relevant in terms of potential effects on 'Other Local or Regional Economic Activities' such as outfitting, tourism, and trapping. More information on proposed mitigation and adaptive management measures can be found in the sections referenced.

6.11.2.26 Summary of Commitments for Employment and Economic Opportunities

To optimize the positive effects and eliminate or minimize any adverse effects of the Project, VIT has made a number of commitments. Some of the mitigations or measures to enhance positive effects are the sole responsibility of and within the control of VIT; some mitigations will require commitments from others including a commitment to coordinate the efforts of all involved (e.g., the Yukon

Government, FNNND, VoM). This is particularly the case in relation to education and training initiatives to provide local and regional workers with the required skills to work on the Project. VIT has suggested a mechanism to coordinate those efforts that are more fully set out in Section 6.11.7.

VIT and the FNNND are in regular communication and are currently engaged in negotiation of a comprehensive Cooperation and Benefits Agreement[34] to address matters specific to the NND in relation to construction and operations of the Project.

VIT is committed to providing Project-related employment and business opportunities to qualified LAA residents and businesses and to residents and businesses in Yukon throughout all phases of the Project.

VIT will develop a Business Opportunities pamphlet as a tool to enable businesses to understand what is on offer and how to gainfully participate in contracting/business with the Project. The Business Opportunities pamphlet will be distributed to Yukon businesses in 2011.

Key socio-economic indicators (including those relevant to Employment and Economic Opportunities) will be monitored by VIT during all phases of the Project. A process for confirming the indicators, reporting and responding to monitoring results will be cooperatively established with FNNND, VoM, the Yukon Government and others.

VIT will provide advice, expertise, mentorship and program development assistance as it relates to educational programs, to be developed by Yukon College, the FNNND, the Yukon Mine Training Association, and potentially other organizations. These programs will aim to encourage and support students to get the necessary education and skills that will permit employment with VIT. Financial contributions for programs will be considered on a case- by-case basis.

VIT will work with FNNND, Yukon College, Yukon Mine Training Association (MTA), and the Yukon Government to promote mining-related training programs.

VIT has committed to a range of safety and health measures to ensure the well-being of workers at the Project.

VIT commitments related to Wildlife (Section 6.9), Vegetation Resources (Section 6.8), and Fish and Fish Habitat (Section 6.7) are also relevant in terms of potential effects on 'Other Local or Regional Economic Activities' such as outfitting, tourism, trapping and maintenance of traditional subsistence lifestyles. Please refer to these sections for additional proposed mitigation and adaptive management measures.

6.11.3 Traditional Activities and Culture

6.11.3.1 Baseline Information – Traditional Activities and Culture

The Project is located within the Traditional Territory of the FNNND and is located approximately 85 km by existing road from the Village of Mayo. FNNND citizens reside in Mayo and in a new housing

[34] An Exploration Cooperation Agreement was signed by FNNND and StrataGold Corp. (VIT's predecessor) in early 2009.

area just outside Mayo. Approximately two-thirds of FNNND citizens reside in Whitehorse or elsewhere. It is the traditional activities of the FNNND in the LAA that are the focus of this section. In anticipation of the proposed Project, a Traditional Knowledge and Use Study (Stantec 2010) was conducted. While the contents of that report are proprietary and confidential to the FNNND, the results of that work have been shared with VIT for the purpose of conducting the assessments required for and reported in this Project Proposal.

Additional detail on baseline information with respect to Traditional Activities and Culture is provided above in Section 4.2.5, and in Appendix 17 – Socio-economic Baseline Report.

Subsistence Harvesting

At community meetings and in the Traditional Knowledge and Use Study (Stantec 2010) completed for the Project, FNNND citizens noted the importance of several areas in the vicinity of the Project for traditional activities including hunting, fishing, trapping, and gathering. FNNND Elders and staff indicated that citizens still rely on traditional foods—berries, fish, moose, deer, small game, and birds—as a significant portion of their diet. Moose, grouse, and fish, as well as many types of plants and berries, are harvested for food and medicinal purposes.

Hunting

Elders have reported that the moose population in the Dublin Gulch area has been declining, likely due to the noise and activity in the area resulting from placer and quartz mining activity. The Project lease area, NND lands south of the lease area, and the Potato Hills have been identified as important moose habitat by Elders. Local waterways, including the Mayo River and the South McQuesten River, are used for travelling and hunting. Deer populations are increasing in the area. As a result, so are lynx (Stantec 2010). Both grizzly and black bears are known in the Project area, as are wolves. Grouse and ptarmigan are also hunted in the Project area.

Fishing

The McQuesten and South McQuesten Rivers are used for fishing by FNNND citizens, as are many lakes in the area. The Haggart Creek watershed is reported to be an important habitat for grayling; pike populations are reported to have increased in the South McQuesten River. Additional information on fishing is provided in Section 3.3.8; existing conditions with respect to fish and fish habitat are described in Section 4.1.11.1, above.

Trapping

Commercial trapping is assessed above in Section 6.11.2. The Project lies within Registered Trapline Concession (RTC) 81. RTC 84 and RTC 85 are located to the south of the Project, and portions of these two RTCs are traversed by the South McQuesten Road (Appendix 3, Figure 1). The RTCs provide both economic benefits as well as preservation of traditional activities for their operators. The Na-Cho Nyäk Dun Fish and Wildlife Planning Team (2008) note that fewer citizens are participating in trapping for a number of reasons, including higher fuel prices, lack of desire, and difficulty obtaining trap lines.

Plants and Medicines

Vegetation harvesting areas are located south of the Project lease area along South McQuesten – Haggart Creek Road, near Haggart Creek Bridge and in the South McQuesten River Valley (Stantec 2010).

Language Preservation and Revitalization

The FNNND represents the most northerly community of the Northern Tutchone language and culture group in Yukon. There are currently several initiatives in the community to teach and promote use of the Northern Tutchone language. In 2001 (the most recent year for which Statistics Canada data is available for FNNND) FNNND citizens were less likely than the overall Yukon Aboriginal Identity population to understand or have knowledge of an Aboriginal language, as shown in Figure 6.11-9. In their 2004 *Five Year Strategic Plan and Implementation Plan* the FNNND identified preservation and management of heritage, cultural and language resources as important objectives.

Other Cultural Activities

FNNND offers a number of "on the land" programs, including day-trips for medicine gathering, fishing and hunting camps for youth, and an archaeological camp, as well as some longer trips. Programs for jigging, beading and other craft work are also offered. Other ongoing activities organized by the FNNND include:

- Traditional food lunches at the school
- Teacher cultural orientation
- Traditional pursuits funding to assist people to get out on the land
- Old Village Day, Aboriginal Day, Self-Government Day
- Elders in the school and daycare
- Recent initiatives include workshops on hide tanning and knife making, and a Wind River canoe trip.

Heritage Sites and Special Places

Although the entire FNNND Traditional Territory is important, there are several places which the Elders and community have identified through their strategic planning process and in the Traditional Knowledge and Use study for the Project. There are trails in the Potato Hills and in the South McQuesten River Valley that have been used by FNNND citizens for generations (Stantec 2010). These include a network of trails leading from the cabins at Big Dave's Lookout (located along a trail north of the South McQuesten Road) to nearby lakes, where NND citizens hunt for moose.

6.11.3.2 Identification of Potential Effects – Traditional Activities and Culture

The following potential effects on Traditional Activities and Culture have been identified:

- Subsistence Harvesting (changes in overall levels of participation in subsistence harvesting; hunting (loss of road access to the Potato Hills; increased hunting pressure from Project employees/contractors; effects on hunting success), fishing (effects on fisheries resources; increased fishing pressure), trapping, plants and medicines)
- Language Preservation and Revitalization
- Other Cultural Activities
- Heritage Sites and Special Places.

6.11.3.3 Description of Potential Effects on Subsistence Harvesting

The Traditional Knowledge and Use Study prepared for the Project (Stantec 2010) identified a number of areas of importance to FNNND (e.g., for fishing, berry picking, plant collection, hunting).

Hunting

FNNND citizens have expressed concern that the current access through the Project area to the Potato Hills for hunting purposes (primarily moose but also other species) will no longer be available due to disturbance and access road restrictions. Several trails and cabins are also accessed via the South McQuesten Road.

Hunting and harvesting activities will not be permitted in the Project footprint and that area will no longer be available for accessing other locations to hunt or to harvest wildlife.

Fishing

Important Arctic grayling fishing areas near the Project include the South McQuesten Bridge, and the Haggart Creek watershed south of the Lynx Creek confluence. The assessment of potential effects for Fish and Fish Habitat (Section 6.7) has concluded that the Project area provides marginal rearing habitat far upstream of the nearest point where ice fishing for grayling takes place (South McQuesten River). The Project will not have effects on downstream fishery resources.

Trapping

Potential Project effects on commercial trapping are assessed in Section 6.11.2.7.

Plants and Medicines

The assessment of potential effects on vegetation (see Section 6.8, above) describes potential effects of the Project on berry sites in terms of vegetation loss and changes to abiotic conditions.

A residual loss of approximately 7.6 ha and 30.8 ha of the high and moderate traditional use berry sites, respectively, will occur at post-closure. However, both of these changes represent a loss of <1% of the classes in the RAA compared to baseline. Following the implementation of the prescribed mitigation measures, including reclamation, the effect of the Project on traditional use berry sites within the vegetation RAA ranked as high and moderate potential is expected to be negative in direction, negligible in magnitude, local in extent, permanent, and reversible (see Section 6.8.3.3 Residual Effects of Vegetation Loss).

The assessment of potential effects on vegetation found a local, negligible in magnitude, irreversible residual effect to lands ranked with moderate berry producing potential as a result of the arsenic loading associated with dust outside of the Project footprint. This effect was judged to be not significant. Dusting is not expected to affect lands rated with high berry potential (see Section 6.8.4.3 Residual Effects of Changes to Abiotic Conditions).

6.11.3.4 Mitigation Measures for Potential Effects on Subsistence Harvesting

See additional mitigation measures for protection of Wildlife (Section 6.9), Fish and Fish Habitat (Section 6.7), and Vegetation Resources (Section 6.8, above).

VIT has proposed improvements as well as radio-controlled access for a portion of the South McQuesten Road. This will be done in a fashion that minimizes the loss or disruption of access to subsistence harvesting areas.

A pull-off or parking area is proposed to accommodate parking needs of FNNND citizens and others at South McQuesten Bridge fishing area.

Potential effects on fish and wildlife populations as a result of employees and contractors at the Project site will be minimized by develop a policy restricting Project-related employees and contractors from hunting and fishing while on the job at any time throughout the life of the Project.

A revegetation program using indigenous flora will be implemented for disturbed sites where native vegetation has been removed. This will promote revegetation success and sustainability. The revegetation program will also follow guidelines for prevention of invasive plants introduction and spread as per the Invasive Plants Management Plan during the reclamation and closure phases (see Section 6.8 – Vegetation Resources and Appendix24 – Conceptual Closure and Reclamation Plan for further details).

VIT will communicate plans and timing of activities to other resource users (e.g., trappers, placer miners, and known subsistence harvesters) who may be affected by the Project as soon as practicable and when possible prior to the actual commencement of activities. Access to lands that were used for harvesting of berries and wildlife will be unavailable to traditional harvesters during Project Construction and Operations through to Closure when disturbed land is revegetated and the road to the Potato Hills is re-opened to the public, VIT will accommodate that loss of access through the comprehensive Cooperation and Benefits Agreement that is currently under negotiation.

6.11.3.5 Residual Effects – Subsistence Harvesting

Loss of road access to the Potato Hills—Access through the Project area to the Potato Hills area for hunting purposes (primarily moose but also other species) will not be available during Construction, Operations and active Closure of the Project (medium-term duration of approximately 10 years). Following closure, the main access road within the Project area, from Haggart Creek (at the confluence with Dublin Gulch) to the process plant site, will be permanently closed and reclaimed. The road that provides access to the Potato Hills will be left in place because it has been identified as an important access route for access to an area in which traditional hunting and gathering take place. With implementation of proposed mitigation measures, there will be no adverse effect from the Project on the loss of access to the Potato Hills.

Increased Hunting Pressure from Project Employees/Contractors—With implementation of a policy restricting Project-related employees and contractors from hunting and fishing while on the job at any time throughout the life of the Project, the presence of mine employees and contractors on and near the Project site (during Construction and Operations) will not result in increased hunting pressure on local wildlife resources.

Effects on Hunting as a Result of the Project

Neither the area covered by the Project footprint nor the road through the Project site will be available for hunting or for accessing other hunting areas during Construction, Operations and active Closure. The amount of land that will be removed from the total amount of land within the RAA is small and is not expected to have a significant effect on wildlife mortality or movement. For example, the LAA for vegetation (the maximum area that would be disturbed by the Project is 21.533 km^2 whereas the RAA for wildlife is 900 km^2 See Figure 6.9-7) Hunters will not be prevented from accessing harvesting areas outside of the Project footprint but will have to use alternative access routes or modes of access.

Effects on fisheries resources or increased fishing pressure: The Project will not have effects on downstream fishery resources, or on off-site fishing activities. The presence of mine employees and contractors on and near the Project site (during Construction and Operations) will not result in increased pressure on local fisheries resources.

Residual effects on off-site berry picking are not anticipated.

Effects on commercial trapping are described in Section 6.11.2.7.

Changes in overall levels of participation in subsistence harvesting: Increased employment at the local level may result in reduced participation in traditional activities (i.e., hunting, fishing, and trapping). Employees at the mine site on a two week rotation will not be able to hunt, fish or trap while at site or while on the job. However, they will be able to harvest wildlife during the two weeks they are not on the job, subject to wildlife laws and regulation. In addition, employment income may provide Project employees with the ability to purchase equipment and needed to pursue traditional activities. Thus the overall residual effect on participation in traditional activities may be positive or negative.

Table 6.11-18 summarizes the characterization of residual effects of the Project on subsistence harvesting.

Table 6.11-18: Summary of Residual Effect Characterization – Subsistence Harvesting – Hunting

Characterization/Attribute	Change in Overall Participation – Subsistence Harvesting	Loss of Road Access to Potato Hills
Direction	Positive and Negative	Positive and Negative
Magnitude	Low	Moderate
Geographic Extent	Local	Local
Timing/Frequency	N/A	Construction and Operations
Duration	N/A	10 – 15 years
Reversibility	N/A	Reversible
Socio-economic Context	N/A	N/A
Probability of Occurrence	N/A	High
Degree of Confidence in Prediction	Low	High

6.11.3.6 Determination of Significance of Potential Effects on Subsistence Harvesting

With implementation of mitigation measures, including restoration of access after Project closure, the residual effects associated with loss of road access through the site to the Potato Hills for hunting purposes are not considered to be significant.

With implementation of mitigation measures, significant adverse effects due to increased hunting pressure from Project employees or contractors are not predicted to occur.

With implementation of mitigation measures, effects on fisheries resources off-site and effects on berry picking activities are not anticipated to be significant.

6.11.3.7 Description of Potential Effects on Language Preservation and Revitalization

FNNND citizens have identified the protection of their culture, language, and traditional practices as a general concern, although not specifically in the context of potential effects from the Project. For reasons of safety and security at the mine and the culture of commercial life in western Canada, particularly Yukon, English will be the language of business and communication for all Project activities. All employees, irrespective of linguistic or cultural background will be expected to understand and speak basic English.

To the extent that FNNND citizens who are conversant in their traditional language or other employees for whom English is not their first language, apply for a job at the Project, they will not be able to perform their job in their traditional language. That may cause some diminishment in their ability to speak their language over the longer term. However, they will be free to speak in their language of choice during off hours.

While VIT acknowledges the concerns of the FNNND in relation to the general loss of their traditional language, VIT would observer that this is a global phenomenon with cultures generally. In Yukon, concern about loss of traditional language skills has been noted for some time and would not be the sole result of the Project, if it were to proceed.

6.11.3.8 Mitigation Measures for Potential Effects on Language Preservation and Revitalization

VIT is not proposing any mitigation measures for potential effects on language preservation and revitalization.

6.11.3.9 Residual Effects – Language Preservation and Revitalization

It is not anticipated that the Project will have residual adverse effects on Aboriginal language use by FNNND citizens.

6.11.3.10 Determination of Significance of Potential Effects on Language Preservation and Revitalization

It is not anticipated that the Project will have significant adverse effects on the use of the preservation of traditional language.

6.11.3.11 Description Potential Effects on Other Cultural Activities

FNNND citizens have identified the need to maintain and enhance other cultural activities (distinct from subsistence harvesting and language preservation and revitalization) as a general concern, although not specifically in the context of potential effects from the Project.

While VIT acknowledges the concerns of the FNNND in relation to the general loss of their traditional culture, VIT would observer that this is a global phenomenon with cultures generally. In Yukon, concern about loss of traditional language and culture has been noted for some time and would not be the sole result of the Project, if it were to proceed.

6.11.3.12 Mitigation or Enhancement Measures for Potential Effects on Other Cultural Activities

VIT will provide Cultural Awareness Training for all employees working on the Project and will provide support for FNNND and VoM community events, via corporate sponsorships, on a case-by-case basis.

6.11.3.13 Residual Effects – Other Cultural Activities

It is not anticipated that the Project will have any direct adverse effects on other cultural activities by FNNND citizens.

6.11.3.14 Determination of Significance of Potential Effects on Other Cultural Activities

The Project will not result in significant adverse effects on other cultural activities.

6.11.3.15 Description Potential Effects on Heritage Sites and Special Places

FNNND's 5-year strategic heritage development plan (FNNND 2007a) identifies priorities relating to a number of heritage sites and special places in their Traditional Territory. None of those are located in the Project vicinity, and as such no potential effects are anticipated. (The potential effects on on-site heritage resources are addressed in Section 6.10 of this Project Proposal.)

As no potential effects from the Project are predicted, the assessment was not carried forward.

VIT notes that through its predecessor, StrataGold Corporation, it entered an Exploration Cooperation Agreement with the FNNND that is still in force. That agreement sets out a process and procedure to be followed in the event any heritage resource is discovered. VIT anticipates a similar provision will be incorporated into the comprehensive CBA it is currently negotiating with the FNNND. In the event VIT discovered any heritage resources in the course of carrying out Project activities it will follow the procedures set out in the Exploration Cooperation Agreement.

6.11.3.16 Cumulative Socio-economic Effects – Traditional Activities and Culture

Screening of Cumulative Environmental Effects

A screening of the Project's potential contribution to the cumulative effects of past, current, and announced future projects was done per the procedures described in Section 6.3.8. The screening process establishes three conditions to warrant further assessment. These conditions are:

- The Project results in a demonstrable residual effect
- These effects are likely to act in a cumulative fashion with those of other projects
- There is a reasonable expectation that the Project's contribution to cumulative effects has the potential to change the health or sustainability of the Employment and Economic Opportunities VC.

There are no predicted residual effects from the Project on subsistence harvesting (fishing, plants and medicines), language preservation, other cultural activities, or heritage sites and special places that are anticipated to interact cumulatively with other projects to adversely affect Traditional Activities and Culture. The potential effects on commercial trapping have been assessed separately above in Section 6.11.2.7. As a result of the screening process, no potential effects are carried forward for an assessment of cumulative effects on Traditional Activities and Culture.

6.11.3.17 Summary of Influence of Consultation on the Assessment of Traditional Activities and Culture

During consultation and through the Traditional Knowledge and Use Study (Stantec 2010), the most prominent recommendation regarding the preservation of FNNND culture and heritage related to the protection of FNNND traditional use areas and avoiding effects to FNNND traditional use sites and harvesting areas (Stantec 2010). VIT considered these concerns during Project design and in the development of various mitigation measures. VIT notes that the FNNND's 5-year strategic heritage development plan (FNNND 2007a) confirmed that no heritage sites or special places in FNNND Traditional Territory are located in the vicinity of the Project. Although no potential effects are anticipated, VIT has committed to follow a process and procedure that is set out in an Exploration Cooperation Agreement between itself and the FNNND In the event a heritage site is identified during the course of Project activities.

VIT will also use best practices and will develop management plans for all phases of the Project to minimize or eliminate its adverse effects.

Additional detail on First Nations, other Government, and Community Consultations is provided in Section 2 of the Project Proposal.

6.11.3.18 Effects Monitoring and Adaptive Management for Traditional Activities and Culture

Socio-economic change would not occur solely as a result of the Project, nor would the influences bringing about that change be solely within the control of VIT. However, the company will work with FNNND, VoM, the Yukon Government and others to review and respond to the Project's emerging socio-economic effects—both positive and negative. VIT will develop a process for confirming the indicators, reporting and responding to monitoring results will be cooperatively established. This process would identify:

- Project-related socio-economic effects and indicators to be monitored by VIT and others
- The process for adaptive management
- The measures (in addition to those already committed to) that VIT and others could put in place for prevention, mitigation or enhancement of the Project's socio-economic effects.

Key socio-economic indicators for the Project will be monitored by VIT in accordance with the committee VIT is proposing to establish in Section 6.11.7. These will need to be considered in the terms of the broader socio-economic context and other sources of change. This will provide for an understanding of the Project's socio-economic effects, identification of any emerging or unanticipated effects, and the opportunity for VIT or other parties to respond as appropriate. Further detail on VIT's proposed monitoring and management approach to long term effects is set out in Section 6.11.7.

6.11.3.19 Commitments for Traditional Activities and Culture

VIT proposed to do the following in support of traditional activities and culture:

- Continue liaison with the FNNND, VoM and the Mayo District Renewable Resource Council (MDRRC) throughout all phases of the Project
- Negotiate a comprehensive CBA with the FNNND that addresses key areas of concern and opportunity regarding VIT's mining interests in the Dublin Gulch area
- Provide support for FNNND and VoM community events, via corporate sponsorships, on a case-by-case basis
- Continue to provide opportunities for FNNND citizens to participate in ongoing environmental monitoring activities during construction, operations, and closure and reclamation
- VIT will hire a Community Liaison person
- The Project labour force will be comprised of Aboriginal and non-Aboriginal employees. VIT is committed to ensuring a harmonious and culturally sensitive work environment. VIT will provide Cultural Awareness training to all staff.
- VIT will use indigenous vegetation during reclamation and closure to increase the likelihood that valued wildlife will be attracted to and will remain in the reclaimed area. A revegetation

program using indigenous flora will be implemented for disturbed sites where native vegetation has been removed. This will promote revegetation success and sustainability. The revegetation program will also follow guidelines for prevention of invasive plants introduction and spread as per the Invasive Plants Management Plan during the reclamation and closure phases.

6.11.4 Community Vitality

6.11.4.1 Baseline Information – Community Vitality

The assessment of community vitality is based on four factors: population and demographic trends, education and capacity development, crime, and community involvement (events, organizations, recreation, and leisure). An overview of baseline information is summarized below. Additional detail on baseline information with respect to Community Vitality is provided above in Section 4.2.6 and in Appendix 17 – Socio-economic Baseline Report.

Population and Demographic Trends—FNNND and Mayo

Recent Population Trends – FNNND and Mayo

In 2009, Mayo's population was 453; approximately half of those residents are FNNND citizens. Figure 6.11-10 shows the % of population with Aboriginal identity in Mayo, Whitehorse and Yukon as a whole. In 2006, Aboriginal people accounted for 19% of the population of Whitehorse, and 25% of Yukon's total population. Over a 10-year period (1999 to 2009), the population of Mayo has remained relatively stable (while populations for Whitehorse and Yukon as a whole continue to grow). Approximately 400 other FNNND citizens live in other parts of Yukon and elsewhere. The total FNNND membership is currently 602 citizens.

Age Structure of the Population

Figure 6.11-11 shows the proportions of the population 0 – 19 years of age and 70 plus for FNNND, Mayo, Whitehorse, and Yukon. While the proportion of the population age 0 – 19 years is similar for all four, the proportion aged 70 or more is greater for FNNND and Mayo.

Mobility Status – FNNND and Mayo

As shown in Figure 6.11-12, FNNND citizens and residents of Mayo were much less likely to move (in the last year or last five years, in both 2001 and 2006) than residents of Whitehorse or Yukon as a whole. This indicates a more stable population in Mayo and for FNNND citizens. However, a greater proportion of the population in Mayo had moved in 2006 than in 2001, indicating a trend toward increased out-migration from the community.

First Nation of Na-Cho Nyäk Dun Community Well-being Index

The Community Well Being Index (CWB) is used as a way to measure the general well-being of Aboriginal communities. Based on four primary indicators (education, labour force activity, income, and housing conditions) the CWB score for Mayo (First Nation collectivity) in 2006 was 79—above the Canadian and territorial averages (57 and 66, respectively) (INAC 2010a).

Spatial Price Index

The spatial price index in Mayo (122.2 in 2010, with Whitehorse being 100) is the second highest for communities in Yukon (Old Crow is higher at 218.2 in 2010).

Education and Capacity Development (First Nation of Na-Cho Nyäk Dun and Mayo)

Community contacts have indicated that there is a relatively small pool of skilled labour resources within FNNND. Education and training are needed in a range of areas that will not only meet the needs of development projects, but provide legacy value in the long-term.

Primary and Secondary Education

The J.V. Clark School in Mayo offers education up to grade 12. Approximately 70% of students are Aboriginal (mostly FNNND citizens, but also other First Nations). Enrolment has been declining; in the period 2004 through 2009 it declined by 23 students (from 88 to 65 students).

Post-Secondary Education

One of 13 Yukon College campuses is located in Mayo. Co-located with the J.V. Clark School, the campus concentrates on distance education as well as the provision of local courses and career counselling. Students are typically from Mayo, but also Pelly Crossing and Dawson, as well as other communities.

Educational Attainment – First Nation of Na-Cho Nyäk Dun and Mayo

As shown in Figure 6.11-8, the level of educational attainment (as indicated by the percentage of the population over age 15 having no certificate, diploma, or degree in 2006) for both FNNND (33.3% in 2001[35]) and Mayo (35.9%) is low relative to Whitehorse (20.4%) and Yukon as a whole (18%).

Crime

The level of crime in Mayo is less than elsewhere in Yukon. In the past year, there appeared to be a slight increase in offences. Mayo RCMP noted that alcohol is linked to many of the calls they respond to, including public intoxication, domestic and other assaults, break and enters, impaired driving, and bootlegging. From 2003 to 2008 the total number of criminal code offences (excluding traffic violations) reached a peak in 2006, and then decreased. The percentage of violent crimes within the Village of Mayo has declined over the years (from almost 20% in 2004 to 8% in 2008). Property crimes have been slightly fluctuating over the same period. Youth crime has been identified as one of the key issues to be addressed in Mayo.

[35] 2006 data not available for FNNND.

Community Involvement

Community Organizations and Events

There are several community events held throughout the year that attract residents and surrounding communities. The FNNND prepares monthly calendars of events to inform residents. The community benefits from a wide range of volunteer organizations. For a small community, the number of community events and organizations is relatively high.

Recreation and Leisure

The Village of Mayo has two gymnasiums, an outdoor swimming pool, a tennis court, skateboard park, arena, curling rink, and a fitness facility (located at J.V. Clark School). Volleyball and horseshoe pits, a gazebo, and playground are all within walking distance. There is also a Youth Centre. In addition, the Village of Mayo is redeveloping the baseball field and adding a sports court and sliding hill in 2010.

Sport hunting is popular with local residents. Moose is the most commonly harvested big game species in the area, followed by black and grizzly bears. Some caribou harvesting also occurs. FNNND citizens, Mayo residents, and non-residents enjoy fishing as a popular year-round activity, for reasons ranging from subsistence to sport. Arctic grayling is the most popularly fished species in the area.

There is an extensive network of rough roads and trails around Mayo, Keno City, and Elsa that provide back country access in all seasons to both residents and tourists. Residents also utilize the local waterways for kayaking, canoeing, and boating. Seasonal berry-picking and mushroom picking is enjoyed by some residents.

6.11.4.2 Description of Potential Effects on Population

Potential effects on the following aspects of Community Vitality have been identified:

- Population
- Local Educational Facilities and Services Education and capacity development
- Crime
- Community involvement (events, organizations, recreation, and leisure).

The Project has been designed as a self-contained camp operation to accommodate a work force that will work on a two week in/two week out rotation. Project-related employees will be transported from Mayo to the Project site by bus from Mayo.

Although the self-contained camp has been designed to discourage in-migration into Mayo by people who are directly employed by the Project, it is possible that there will be in-migration of new residents to Mayo during the construction, operations, or closure and reclamation phases of the Project. This could have potentially negative effects (e.g., additional pressure on an already strained housing market; cultural disruption; potential for increased access to non-prescription drugs, exacerbated alcohol abuse).

Alternatively, the introduction of a small number of 'employee families' could boost enrollment at J.V. Clark School, supplement membership in local organizations, and enhance community activities and events.

6.11.4.3 Mitigation Measures for Potential Effects on Population

The Project will be a fully self-contained camp operation—that is, all employees will be housed on-site, and employees or contractors will generally be transported to and from Whitehorse to restrict unwanted access to Mayo between on-site rotations.

As a 'fully self-contained mine operation', there would be no effect on the population levels in the Mayo area as a result of the Project. Mayo's population will likely continue to be quite stable, or perhaps decline slightly.

Project employees or contractors may choose to relocate to the community of Mayo. If this were to occur, community consulation has suggested this would be positively received. The magnitude of this effect would be moderate in that it would be tempered by the availability of suitable housing.

Project workers who are not already resident in Mayo or elsewhere in Yukon may choose to permanently relocate to Whitehorse (or perhaps other Yukon communities). Alternatively, they may commute to Whitehorse for their work rotations. The potential growth in population in Whitehorse or other communities due to in-migrant Project workers cannot be predicted with confidence.

Table 6.11-19 characterizes the residual effects of the Project on Mayo's population.

Table 6.11-19: Summary of Residual Effect Characterization – Mayo Population

Characterization/Attribute	In-migration to Mayo as a Result of the Project
Direction	Positive
Magnitude	Moderate
Geographic Extent	Local
Timing/Frequency	Construction and Operations; High
Duration	Medium- to Long-term
Reversibility	N/A
Socio-economic Context	Moderate
Probability of Occurrence	Uncertain
Degree of Confidence in Prediction	Low

6.11.4.4 Determination of Significance of Potential Effects on Population

As a 'fully self-contained mine operation', there will be no significant effect—adverse or beneficial—on the population levels in the Mayo area as a result of the Project.

If a small number of Project-related families move to the community, even a moderate increase in population levels would represent a low to moderate effect—albeit a positive one. To address the uncertainty of the occurrence, magnitude and significance of the effect of increased population on Mayo, VIT will work with the FNNND and VoM to establish a monitoring and consultation process that is further described in Section 6.11.7.

6.11.4.5 Description of Potential Effects on Education and Capacity Development

The Project is not expected to directly result in an in-migration of new residents to Mayo during the construction, operations or closure and reclamation phases of the Project, and as a result will not affect enrollment at J.V. Clark School.

Local or regional residents may use the Mayo campus of Yukon College to obtain necessary training or skills required to obtain or advance employment at the Project.

Local capacity will be enhanced by the experience and skills that individuals employed at the mine can bring to the community both during their employment (e.g., during off-shift rotations) and following closure of the mine.

6.11.4.6 Mitigation Measures for Potential Effects on Local Educational Facilities and Services

'Case-by-case' support from VIT for programs and initiatives at both J.V. Clark School and the Mayo campus of Yukon College for mine-related programs will be considered.

6.11.4.7 Residual Effects on Local Educational Facilities and Services

There will be no effect—adverse or beneficial—on the enrollment at J.V. Clark School as a result of the Project, as the Project as proposed will not result in in-migration of new residents to Mayo.

There will be a moderate increase in the demand at the Mayo campus of Yukon College as a result of the Project, as local residents seek additional training and education in order to qualify for employment at the Project.

If a small number of Project-related employee families were to move to Mayo:

- The addition of a moderate number of students would enhance enrollment at J.V. Clark School, with a number of associated benefits.
- As the additional families would have one or more members employed at the mine, it is not clear that there would be any additional associated increase in demand on Yukon College as a direct result of these new families.

Table 6.11-20 characterizes the residual effects of the Project on local educational facilities and services.

Table 6.11-20: Summary of Residual Effect Characterization – Local Educational Facilities and Services

Characterization/Attribute	Enrolment Yukon College Mayo Campus
Direction	Positive
Magnitude	Low/Moderate
Geographic Extent	Local/Regional

Characterization/Attribute	Enrolment Yukon College Mayo Campus
Timing/Frequency	Construction and Operations; High
Duration	Short- to Medium-term
Reversibility	N/A
Socio-economic Context	N/A
Probability of Occurrence	High
Degree of Confidence in Prediction	High

6.11.4.8 Determination of Significance of Potential Effects on Local Educational Facilities and Services

There will be no significant effect—adverse or beneficial—on the enrollment at J.V. Clark School as a result of the Project. If a small number of employee families move to Mayo, the addition of a moderate number of students would result in a beneficial effect on the school.

A moderate—albeit positive—increase in demand for training and education at the Mayo campus of Yukon College could be expected due to the Project.

6.11.4.9 Description of Potential Effects on Crime

The presence of transient Project employees or contractors could potentially contribute to an increase in the level of crime in the community if not managed effectively. Increased levels of disposable income may lead to increased consumption of alcohol and drugs which in turn may lead to increased levels of theft and violence.

6.11.4.10 Mitigation Measures for Potential Effects on Crime

VIT has introduced a number of measures into the Project design that will have the effect of reducing or eliminating the potential for contribution to crime levels in the local community:

- The Project will be a camp operation. All employees will be housed on-site. Employees and contractors will generally be transported to and from Whitehorse to restrict unwanted access to Mayo between on-site rotations.
- There will be a ‘zero tolerance’ policy with respect to drugs and alcohol on the Project site.
- Policies and procedures will be established with respect to the use of local roads and highways (e.g., speed limits, courteous driving practices) under the Project’s control.
- Cultural awareness training for all Project employees will reduce the potential for conflict with local residents.
- Support for life skills programs including money mangment and alcohol and drug abuse.

6.11.4.11 Residual Effects on Crime

With implementation of mitigation measures, it is predicted that the Project will have a minimal contribution to local crime.

The Project may have a potential positive indirect effect on crime, if community members who had been unemployed and in trouble with the law are able to secure employment either directly or indirectly as a result of the Project, and as a result have an increase in self-esteem and stability leading to more positive behavior. However, this cannot be predicted with certainty.

6.11.4.12 Determination of Significance of Potential Effects on Crime

The Project is not predicted to have a significant adverse effect on local crime. However, VIT acknowledges that the Project may be one of many factors that lead to an increase in crime in modern society. It has committed to participate in a monitoring and communication process that is set out in more detail in Section 6.11.7.

6.11.4.13 Description of Potential Effects on Community Involvement

Potential effects on the level of community involvement may range from ‘nil’ to ‘moderate’ as a result of the Project. For example, if there are no new residents, and existing residents who become employees at the Project maintain their levels of involvement, the change would be nil. However, if existing residents who become employees at the Project reduce their level of involvement in the community (e.g., due to shift rotations on-site), there could be an adverse effect.

The addition of a moderate number of new adults and children to the community could enhance participation levels in events, organizations and leisure activities such as sports leagues.

6.11.4.14 Mitigation Measures for Potential Effects on Community Involvement

VIT will encourage its employees, who are residents of Mayo, to continue or initiate involvement in community activities or organizations.

VIT will also support an annual community appreciation day to encourage an understanding of the people and activities taking place in and around Mayo and to enhance community involvement. VIT will provide support for FNNND and VoM community events, via corporate sponsorships, on a case-by-case basis.

6.11.4.15 Residual Effects on Community Involvement

Potential effects on the level of community involvement may range from ‘nil’ to ‘moderate’ as a result of the Project. For example, if there are no new residents, and existing residents who become employees at the Project maintain their levels of involvement, the change would be nil. However, if local resident employees reduce their level of involvement in the community as a result of employment (e.g., they are in camp during shift rotations), there could be an adverse effect. This cannot be predicted with certainty.

To the extent that contractors to the Project choose to relocate to Mayo, the addition of a moderate number of new adults and children to the community could enhance participation levels in events, organizations and leisure activities such as sports leagues. However, as noted above, the movement of a small number of employee families to Mayo is largely beyond the control of VIT, and the probability of this happening cannot be predicted with any certainty. Also, the decision to become involved in the community and the way in which that involvement will occur, is a personal choice that is not within the control of VIT.

To address the uncertainty of the occurrence, magnitude and significance of the effect of increased population on Mayo, VIT will work with the FNNND and VoM to establish a monitoring and consultation process that is further described in Section 6.11.7.

The characterization of residual effects of the Project on community involvement is summarized in Table 6.11-21.

Table 6.11-21: Summary of Residual Effect Characterization – Community Involvement

Characterization/Attribute	Community Involvement
Direction	Positive/Negative
Magnitude	Low
Geographic Extent	Local
Timing/Frequency	N/A
Duration	N/A
Reversibility	N/A
Socio-economic Context	N/A
Probability of Occurrence	N/A
Degree of Confidence in Prediction	Low

6.11.4.16 Determination of Significance of Potential Effects on Community Involvement

The Project is anticipated to have minimal or no adverse effect on community involvement.

6.11.4.17 Cumulative Socio-economic Effects – Community Vitality

Screening of Cumulative Environmental Effects

No residual effects are predicted to occur from the Project (as proposed – a fully self-contained camp operation) on population or demographics, education and capacity development, crime, or levels of community involvement that are anticipated to interact cumulatively with other projects to adversely affect Community Vitality. As a result of the screening process, no potential effects are carried forward for an assessment of cumulative effects on Community Vitality.

6.11.4.18 Summary of Influence of Consultation on the Assessment of Community Vitality

VIT carried out extensive consultations in Mayo with representatives of the FNNND, the VoM and various agencies and service providers. The most significant concern expressed was related to the potential negative effects on community vitality that could flow from a large influx of people into Mayo. In response, VIT made the decision to construct a self-contained camp to house all employees at the Project site and to transport employees to site on a two week rotation. By removing the possibility of a large in-migration of transient mine workers into Mayo, the likelihood of adverse effects to community services and other indicators of community vitality are significantly reduced.

Additional detail on First Nations, other Government, and Community Consultations is provided in Section 2 of the Project Proposal.

6.11.4.19 Effects Monitoring and Adaptive Management for Community Vitality

Socio-economic change is not solely within the control of VIT and will not be brought about solely as a result of the Project. However, the company will work with FNNND, VoM, the Yukon Government and others to review and respond to the Project's emerging socio-economic effects—both positive and negative. VIT's commitments to develop a process for confirming the indicators, reporting and responding to monitoring results will be cooperatively established is set out in detail in Section 6.11.7. This process would identify:

- Project-related socio-economic effects and indicators to be monitored by VIT and others
- The process for adaptive management
- The measures (in addition to those already committed to) that VIT and others could put in place for prevention, mitigation or enhancement of the Project's socio-economic effects.

Key socio-economic indicators for the Project will be monitored by VIT (e.g., corporate sponsorships and donations). These will need to be considered in the broader socio-economic context and other sources of change. This will provide for an understanding of the Project's socio-economic effects, identification of any emerging or unanticipated effects, and the opportunity for VIT and other parties to respond as appropriate.

6.11.4.20 Summary of Commitments for Community Vitality

VIT will provide support for FNNND and VoM community events, via corporate sponsorships, on a case-by-case basis.

VIT will encourage its employees, who are residents of Mayo, to continue or initiate involvement in community activities or organizations.

6.11.5 Human Health and Well-being

6.11.5.1 Baseline Information – Human Health and Well-being

A high level overview of baseline information with respect to Human Health and Well-being can be found in Section 4.2.7, and additional information can be found in Appendix 17 – Socio-economic Baseline Report. Effects on local educational facilities and services are assessed in Section 6.11.4 (Community Vitality). Emergency services (police, fire, ambulance) and child care are assessed in Section 6.11.6 (Infrastructure and Services).

Local Health and Social Facilities

Mayo Health Centre

Mayo has one health clinic that currently has two nurses and one doctor. A third nurse on staff is seen as a priority need. The clinic has an outpatient focus providing family health care, paediatric and prenatal care, chronic care, small surgeries which can be performed under local anaesthetic, and initial acute care prior to patients' transfer to other locations.

Regional Hospitals

The Yukon Government is moving forward with plans to construct a regional hospital in Dawson City, which will serve the Village of Mayo and surrounding area communities. Until it opens, patients requiring hospital care must travel to Whitehorse (by road or aircraft).

First Nation of Na-Cho Nyäk Dun Drop-In Centre

The Drop-In Centre, located in the former FNNND government building in Mayo, is a community resource providing counselling and training services. Until recently, the Centre employed one full-time counsellor. A counsellor from Dawson City who services the area continues to come to Mayo. The Centre has identified a need for life skills training in the community, as well as counselling to help individuals deal with various abuse issues. These needs are linked by practitioners to the legacy from residential schools and historical mining activities in the region. Due to a lack of funding, the Centre is now open only on an "as needed" or activity basis.

Local Health and Social Services

Health and social services in Mayo are delivered by four levels of government: the FNNND, the VoM, the Yukon Government (YG), and the federal government. In 2002 the Mayo Interagency Group, comprised of staff from each level of government, was established to share information between the various service delivery providers.

A number of permanent on-going health and social services are available in or to Mayo residents. Several other health and social services are available in and to Mayo either on demand or through recent contracts. A wide array of health and social services are located outside Mayo but are available to Mayo residents.

Mental Health and Addictions

Mayo, like many First Nation communities, has been affected by residential school experiences and further traumatized by the fall-out from a residential school having been located within the local community. The extent of various mental health issues in the community could well be attributed to this experience. The 2008 feasibility study (Nota Bene Consulting Group 2008) noted that substance abuse is one of the key challenges in Mayo. Interviews with the RCMP and staff at the Mayo Health Centre both indicated that this is the case. Marijuana has been present for some time, but crack cocaine and ecstasy are now a concern. Combined with alcohol, these substances set the stage for violence and addiction in the community.Both agencies expressed their concern that they would not have sufficient staff to respond to increased levels of service requirements that might be introduced by the Project.

6.11.5.2 Assessment of Effect on Local Health and Social Facilities

Potential effects on Human Health and Well-being are considered in terms of:

- Local health and social facilities
- Local health and social services
- Mental health and addictions.

A Qualitative Human Health and Ecological Risk Assessment was prepared for the Project (Appendix 31). The assessment concluded that the proposed mine is not anticipated to adversely affect human or ecological health.

6.11.5.3 Description of Potential Effects on Local Health and Social Facilities

Mayo Health Centre

VIT will have on-site first-aid and trained emergency personnel to provide primary care, and will establish an Emergency Response Plan for the Project. However, it is anticipated that treatment or assessment at the Mayo Health Centre may be needed on occasion for employee injuries or medical events. Based on an assumed average of 2.65 injuries per 200,000 hours worked (from US statistics on injuries in gold mining), it is anticipated that there may be approximately 15 visits per year by Project employees to the Mayo Health Centre (this does not include ‘regular’ visits by FNNND citizens or other VoM residents that might be employed by the Project). Experience to date with the 30-person camp on-site has been approximately three visits per year. Given that the Centre currently experiences approximately 2,000 clinic visits each year (based on interviews with the Mayo Health Centre), the increase in visits related to the Project (a larger camp, year-round) would be under 1%.

Regional Hospitals

The anticipated demand on the regional hospitals in Whitehorse and Dawson as a result of the Project is negligible, given that only a small proportion of any medical situations arising at the mine would require hospital visits.

6.11.5.4 Mitigation Measures for Potential Effects on Local Health and Social Facilities

VIT will have on-site first-aid and trained emergency personnel to provide primary care, and will establish an Emergency Response Plan for the Project. This will be done in consultation with service providers in Mayo (i.e., the Health Centre), and the hospitals in Dawson and Whitehorse.

VIT will work with Mayo Health Centre (Yukon Health and Social Services) to discuss all necessary staffing and equipment trequired to meet Project-related medical needs.

6.11.5.5 Residual Effects on Local Health and Social Facilities

It is not anticipated that the Project will have any direct adverse effects on the operation of the Mayo Health Centre or the regional hospitals (Dawson and Whitehorse). The change in level of service at the Mayo Health Centre can be accommodated with the full staff complement that was to be in place effective September 201).

6.11.5.6 Determination of Significance of Potential Effects on Local Health and Social Facilities

The Project will not result in significant adverse effects on the operation of the Mayo Health Centre, or the regional hospitals. However, it is acknowledged that if there are increases in the population of Mayo indirectly as a result of the Project, there may be increased demands on local health and social facilities. If this were to occur, there could be adverse effects. To address this uncertainty, VIT has committed to establishing a committee to monitor for effects on socio-economic valued components, to understand the changes that are occurring and, if they are adverse, to work together with others towards their solution. Further detail on this commitment is contained in Section 6.11.7.

6.11.5.7 Description of Potential Effects on Local Health and Social Services

There is a potential that the needs of Project employees resident in Mayo could result in increased demands on the various health and social services that are offered by a range of providers in Mayo.

6.11.5.8 Mitigation Measures for Potential Effects on Local Health and Social Services

Project employees and their families will have a benefits package that will complement or supplement those offered locally or regionally by various service providers.

6.11.5.9 Residual Effects on Local Health and Social Services

As the majority of employees (other than FNNND citizens or other residents of Mayo who gain employment with the mine) will not reside in Mayo, it is not anticipated that the Project will have direct adverse effects on the level or quality of local or regional health and social services.

6.11.5.10 Determination of Significance of Potential Effects on Local Health and Social Services

As the Project is not predicted to have adverse effects on Local health and social services, it will not result in significant adverse effects on local or regional health and social services.

However, it is acknowledged that if there are increases in the population of Mayo indirectly in response to the Project proceeding, there may be increased demands on local health and social services. If that were to occur, there could be adverse effects. To address this uncertainty, VIT has committed to establishing a committee to monitor for effects on socio-economic valued components, to understand the changes that are occurring and, if they are adverse, to work together with others towards their solution. Further detail on this commitment is contained in Section 6.11.7.

6.11.5.11 Description of Potential Effects on Mental Health and Addictions

There are pre-existing levels of mental health, substance abuse, and addiction conditions in the local community. The provision of direct employment, or contracting and sub-contracting opportunities, should improve the quality of life for FNNND citizens and other residents of Mayo; this in turn should be a factor that would contribute to reduced levels of mental health issues and substance abuse and addiction.

6.11.5.12 Mitigation Measures for Potential Effects on Mental Health and Addictions

VIT will work with Mayo Health Centre (Yukon Health and Social Services) to discuss all necessary staffing and equipment to be available to meet Project-related medical needs.

VIT will have a ‘zero tolerance’ policy for Project employees and contractors with respect to alcohol and drug use on or at the mine site. VIT will work with the Mayo Health Centre to provide drug and alcohol testing services.

VIT will have an employment policy that will achieve the health and safety requirements of the company. VIT will provide life and employment skills (e.g., budgeting and finances; dealing with rotational shifts and family challenges) opportunities for Project employees.

6.11.5.13 Residual Effects on Mental Health and Addictions

As the Project will be a camp operation whereby most or all employees will be located on-site, and employees and contractors will be restricted from accessing Mayo during their on-site rotations, there should be minimal or no issues with transient employees or contactors disrupting the local community as a result of alcohol or other substance use.

It is not anticipated that the Project will have direct adverse effects on mental health or addiction levels of FNNND citizens or other residents of Mayo. The Project may contribute to an improvement in the quality of life for those able to take advantage of employment or other economic opportunities as a result of the Project.

6.11.5.14 Determination of Significance of Potential Effects on Mental Health and Addictions

The Project is not predicted to result in significant adverse effects on mental health or addictions for FNNND citizens or other residents of Mayo. However, it is acknowledged that if there are increases to the population of Mayo indirectly in response to the Project proceeding, there may be increased levels of mental health and additions in Mayo. If that were to occur, there could be adverse effects. To address this uncertainty, VIT has committed to establishing a committee to monitor for effects on socio-economic valued components, to understand the changes that are occurring and, if they are adverse, to work together with others towards their solution. Further detail on this commitment is contained in Section 6.11.7.

6.11.5.15 Cumulative Socio-economic Effects – Human Health and Well-being

Screening of Cumulative Environmental Effects

A screening of the Project's potential contribution to the cumulative effects of past, current, and announced future projects was done per the procedures described in Section 6.3.8. The screening process establishes three conditions to warrant further assessment. These conditions are:

1. The Project results in a demonstrable residual effect
2. These effects are likely to act in a cumulative fashion with those of other projects
3. There is a reasonable expectation that the Project's contribution to cumulative effects has the potential to change the health or sustainability of the Employment and Economic Opportunities VC.

There are no residual effects from the Project on local health and social facilities, local health and social services, or mental health and addictions that are anticipated to interact cumulatively with other projects to adversely affect health and well-being. As a result of the screening process, no potential effects are carried forward for an assessment of cumulative effects on Health and Well-being.

There may be potential positive cumulative effects on health and well-being resulting from VIT's Project and interaction with other activities and the FNNND and the VOM. This would include improved quality of life for individuals and their families resulting from rehabilitation and recovery prior to seeking employment in the mining industry.

6.11.5.16 Summary of Influence of Consultation on the Assessment of Human Health and Well-being

Consultation with Mayo residents, FNNND citizens, and local service providers, the socio-economic interviews with various local service providers, and the Traditional Knowledge and Use study for the Project identified the following comments and suggestions related to Human Health and Well-being:

- The Project CBA (under negotiation) should include provisions supportive of Health and Well-being, such as healing and addiction initiatives within the community; on-the-land programs and cultural activities. Alternatively VIT should consider potential contributions to local Health and Well-being initiatives that support mutually beneficial goals and objectives.
- The community needs a full-time, resident addictions worker.
- There is a need to ensure that the Mayo Health Centre maintains a full complement of staff (doctor and nurses; possibly other health care providers) in order to provide effective and efficient services.
- The effects of the mine on usage and capacity of local facilities and services such as the Mayo Health Centre will need to be monitored.
- The community would benefit if there were arrangements for local drug-testing.

Additional detail on First Nations, other Government, and Community Consultations is provided in Section 2 of the Project Proposal.

6.11.5.17 Effects Monitoring and Adaptive Management for Human Health and Well-being

Socio-economic change is not solely within the control of VIT and changes will not be brought about solely as a result of the Project. However, the company will work with FNNND, VoM, the Yukon Government and others to review and respond to the Project's emerging socio-economic effects—both positive and negative. VIT will develop a process for confirming the indicators, reporting and responding to monitoring results will be cooperatively established. This process would identify:

- Project-related socio-economic effects and indicators to be monitored by VIT and others
- The process for adaptive management
- The measures (in addition to those already committed to) that VIT and others could put in place for prevention, mitigation or enhancement of the Project's socio-economic effects.

Key socio-economic indicators for the Project will be monitored by VIT (e.g., use of facilities and services such as the medical centre). These will need to be considered in the broader socio-economic context and other sources of change. This will provide for an understanding of the Project's socio-economic effects, identification of any emerging or unanticipated effects, and the opportunity for VIT or other parties to respond as appropriate.

VIT will work cooperatively with FNNND, the VoM, the Mayo Health Centre, and other local service providers, as well as the Yukon Government to assess and monitor the additional pressure on local health and social services and facilities. Further details of this commitment can be found in Section 6.11.7.

6.11.5.18 Summary of Commitments for Human Health and Well-being

VIT will have an employment policy that will achieve the health and safety requirements of the company. VIT will provide life and employment skills (e.g., budgeting and finances; dealing with rotational shifts and family challenges) opportunities for Project employees.

VIT will work with Mayo Health Centre (Yukon Health and Social Services) to discuss all necessary staffing and equipment is available to meet Project-related medical needs.

6.11.6 Infrastructure and Services

6.11.6.1 Baseline Information – Infrastructure and Services

A high level overview of baseline information with respect to Infrastructure and Services can be found in Section 4.2.8, and additional information is provided in Appendix 17 – Socio-economic Baseline Report. Baseline information for Health and Well-being facilities and services is provided in Section 6.11.5.

Housing

The VoM and the FNNND are both faced with a shortage of available housing (e.g., ICSP [FNNND 2008d]). Land suitable for new housing is limited within the confines of the Village itself, although a new subdivision has been built near the FNNND Government House just outside Mayo. There is potential for six to eight new lots near the arena, and discussion of developing a country residential area in the future near 5 Mile Lake. Figure 6.11-13 presents information on the proportion of owned, rented and First Nations housing for Yukon, Mayo and Whitehorse. While the level of home ownership in Mayo is relatively low by comparison, it is offset by the relatively high proportion of First Nation housing.

Emergency Services

The VoM has an emergency plan and has welcomed the FNNND to participate in mock emergency exercises.

RCMP

The Mayo RCMP detachment has a normal staff level of three officers. The area that the Mayo RCMP patrol is very large and includes Elsa, Keno City, to Stewart Crossing, as well as the north towards the Northwest Territories border, much of which is not accessible by vehicle.

Fire Department

The Village of Mayo has two fire trucks and one rescue truck, and is staffed by approximately 10 to 15 volunteers. The Fire Department services the village and the FNNND within a 5 km radius of Mayo.

Ambulance Service

Ambulance emergency services are provided through funding from the Yukon Government. Ten volunteers (drivers and trained attendants) staff the Ambulance Services in Mayo, with two staff being on-call at all times. Services are not provided directly to mine sites; however, there is an understanding with the mines that anyone injured can be brought from the mine in their first aid vehicle and be met by the ambulance at a set location for transport to the medical clinic or to the airport for evacuation.

Landfill and Recycling

A landfill located to the northwest of Mayo on the Silver Trail is operated by the VoM, servicing the community and FNNND, as well as placer miners in the area. Approximately 500 to 600 people use the facility, generating 365 tonnes of garbage per year. A lifespan of approximately 15 years was projected for the landfill in 2006. The VoM is currently considering development of a Regional Landfill as a business opportunity.

A recycling depot offers limited services for the area. The community is building a new recycling depot, which is expected to be finished in June 2011.

Community Services and Public Works

Most village residences are serviced by piped water, sourced from a shallow, cold-water well. Most village residences are serviced by a gravity sewage collection system owned and operated by the VoM. The sewage lagoons, located to the northwest of Mayo, were built in 1990 and last modified in 1999. Some homes in the village and the new subdivision have in-ground septic systems.

Child Care

The Dunena Ko'Honete Ko Day Care in Mayo is funded by the FNNND, the Yukon Government, and the parents of attending children. The day care is licenced for 27 children; currently 16 children attend.

Transportation

Currently there is one local transportation service, and specific shuttle services (primarily used to take people to Whitehorse or Dawson City).

Road Transportation

In 1950, an all-weather road was completed from Whitehorse to Mayo. The principal road in the area is the Silver Trail (Highway 11) which begins at Stewart Crossing on the Klondike Highway, travels through Mayo, and leads to the former mining camp at Elsa and the community of Keno City.

From Mayo, access to the Project site is along approximately 85 km of existing paved and gravel roads. The Project Property is located off the Silver Trail (Highway 11), north east of Mayo, Yukon. Access to the Project site from the Silver Trail will be via the existing South McQuesten Road (SMR, km 0 to 22.9) and the Haggart Creek Road (HCR km 23 to 45). Together, the SMR and HCR comprise a 45 km road, which is divided by the South McQuesten River.

Both roads are public roads, regulated under the Yukon *Highways Act*; however, the SMR is maintained during summer only by the Yukon Government Department of Highways and Public Works (HPW), whereas the HCR is considered a "public unmaintained" road. Currently, snow is not cleared from the SMR or HCR in winter. Figure 5.4-21 (above) depicts the existing alignment of the SMR and HCR. Section 5.4.2.1 provides additional detail on the mine access road.

Yukon Highways and Public Works (HPW) recently upgraded the SMR, and additional upgrades of the South McQuesten Bridge abutments and decking were completed in August 2010. The HCR requires minor alignment and drainage upgrades, and will be maintained by VIT. The HCR will be upgraded to a two-way single-lane road with additional safety mechanisms (e.g., pull-outs and radio-control) from the SMR to the mine site. The HCR improvements are will begin in 2011.

Many vehicles travelling to the site will also travel Highway 11 (the Silver Trail) from Whitehorse to Mayo.

Airport

The Mayo Airport and Weather Centre operates 24 hours a day, seven days a week. In addition to the landing strip, there is a weather station and a small terminal building. Airport traffic reached a high of more than 8,800 aircraft movements in 1981. This dropped to 2,500 by 1988 due to several mine closures. From March 2009 to March 2010, almost 2,700 aircraft movements were recorded for Mayo (Yukon Bureau of Statistics 2010a).

At the moment there are no scheduled flights to Mayo. Most of the current air traffic is related to mining and outfitting. Medi-vacs to Whitehorse also leave from the airport, which have averaged 24 trips per month (between August 2009 and July 2010).

Electrical Power Supply

The Project area, including Mayo, is within the Mayo-Dawson electrical grid, powered by the Mayo hydroelectric plant. Yukon Energy Corporation (YEC) is currently constructing the Mayo Hydro Enhancement Project (Mayo B) and the second stage of the Carmacks-Stewart Transmission Project. The VoM also has back-up diesel generators.

6.11.6.2 Assessment of Potential Effects – Infrastructure and Services

Potential effects on the following infrastructure and services have been identified:

- Housing
- Emergency Services:
    - RCMP
    - Fire Department
    - Ambulance service.
- Landfill Community Services and Public Works – Village of Mayo Lagoons
- Child Care
- Transportation:
    - Roads
    - Airport.
- Electrical Power Supply.

6.11.6.3 Description of Potential Effects on Housing

As the Project will be a camp operation whereby most or all employees will be located on-site, there will be no additional demand for housing in Mayo. However, individuals and families may choose to move to Mayo to take advantage of opportunities arising from the Project. Personal choices such as these are beyond VIT's control.

Although housing stock is currently in short supply, the FNNND, the VoM, and others have noted that the addition of a small number of families to the Mayo community, who would require additional housing stock, would be a benefit in terms of community vitality (e.g., additional students at the school; individuals to participate in community organizations and recreational activities) (see Section 6.11.4 Community Vitality).

Mine workers involved in shift change might require temporary accommodation in Mayo in the event of inclement weather or other emergency.

Project workers who are not already resident in Mayo or elsewhere in Yukon may choose to move to Whitehorse (or perhaps other Yukon communities). A shortfall of available building lots and the growing population in Yukon have resulted in rising housing costs and strong property sales in the territory. The potential contribution to demand for Yukon housing from Project workers cannot be predicted with confidence.

6.11.6.4 Mitigation Measures for Potential Effects on Housing

VIT designed the Project so that it would not require housing in Mayo. In recognition that there may be individuals who are either employed directly or indirectly with the Project who choose to move to Mayo to reside, VIT will work with FNNND and VoM to develop contingency plans to address accommodation needs in Mayo that respond to an increase in population or a need for emergency accommodation because of the Project.

VIT will continue an open line of consultation through the mechanism committed to in Section 6.11.7.

6.11.6.5 Residual Effects on Housing

With a fully self-contained camp operation for the Project, no direct Project effect on the housing stock in Mayo is anticipated.

Contingency plans developed in consultation with FNNND and the VoM will address provision of accommodation and meals in the event they are required in Mayo by Project employees due to inclement weather or other emergencies.

Determination of Significance of Potential Effects on Housing

No significant adverse effects on housing in Mayo are predicted from the Project. The demand for housing elsewhere in Yukon from Project workers, and thus its significance, cannot be predicted with confidence. However, VIT will maintain a continued open line of consultation and exchange of information through the mechanism committed to in Section 6.11.7.

6.11.6.6 Description of Potential Effects on Emergency Services – RCMP

The presence of a 200-person camp for the Project may result in additional dispatches from the RCMP detachment in Mayo to respond to specific circumstances (e.g., missing persons, major accidents with injuries, assaults). Based on experience to date with the current base camp (one call) and experience at other local exploration and development projects, it is predicted that an additional five to ten calls per year may be expected when the camp is at full capacity during construction and operations.

6.11.6.7 Mitigation Measures for Potential Effects on Emergency Services – RCMP

VIT will work with emergency service providers (RCMP, fire department, ambulance service) to identify training and equipment required to respond to potential incidents related to the Project. Similarly, a cooperative approach to the development of emergency response plans is needed.

VIT will implement a policy of zero tolerance for drug and alcohol use on the mine site.

VIT will implement best practices and policies with respect to health and safety and for transportation (e.g., speed, safe driving practices) in relation to the Project.

Provision of on-site security will alleviate potential demand for RCMP services.

6.11.6.8 Residual Effects on Emergency Services – RCMP

Only a minor residual effect related to an increase in calls to the Mayo RCMP for provision of emergency services is anticipated as a result of the Project with respect to calls to the Project site. This increase will not be significant; there is a high degree of confidence in this prediction.

There may be minor residual effects on the Mayo RCMP detachment (or other RCMP detachments having jurisdiction between Whitehorse and Mayo) as a result of planning for and responding to possible access road incidents related to the Project. However, this is beyond VIT's control. To assist in this planning process, VIT will maintain a continued open line of consultation and exchange of information through the mechanism committed to in Section 6.11.7.

Table 6.11-22 summarizes the characterization of residual effects of the Project on the RCMP.

Table 6.11-22: Summary of Residual Effect Characterization – RCMP

Characterization/Attribute	RCMP
Direction	Adverse
Magnitude	Low
Geographic Extent	Local/Regional
Timing/Frequency	Primarily Construction and Operations; to some extent Closure and Reclamation/Low
Duration	Medium- to Long-term
Reversibility	N/A
Socio-economic Context	N/A
Probability of Occurrence	Low
Degree of Confidence in Prediction	High

6.11.6.9 Determination of Significance of Potential Effects on Emergency Services – RCMP

The Project will not result in significant adverse effects on the RCMP's provision of emergency services.

6.11.6.10 Description of Potential Effects on Emergency Services – Fire Department

While the Mayo Fire Department services the VoM and does not go beyond the municipal boundaries with the exception of the FNNND, there may be potential effects as a result of call outs from possible transportation incidents on the access route. These may involve vehicles transporting employees or materials (including potentially hazardous materials).

6.11.6.11 Mitigation Measures for Potential Effects on Emergency Services – Fire Department

VIT will work with emergency service providers (RCMP, fire department, ambulance service) to identify training and equipment required to respond to potential incidents related to the Project. Similarly, a cooperative approach to the development of emergency response plans is needed.

6.11.6.12 Residual Effects on Emergency Services – Fire Department

Because of the geographical limits on the Mayo fire department's service, no residual effect on the fire department's provision of emergency services is anticipated as a result of the Project with respect to calls to the Project site.

There may be minor residual effects on the Mayo fire department (or other fire departments having jurisdiction between Whitehorse and Mayo) as a result of planning for and responding to possible access road incidents (from Whitehorse to the mine site) related to the Project. This is a matter that is beyond VIT's control. However, to assist in this planning process, VIT will maintain a continued open line of consultation and exchange of information through the mechanism committed to in Section 6.11.7.

The residual effects of the Project's effects on the fire department are characterized in Table 6.11-23.

Table 6.11-23: Summary of Residual Effect Characterization – Fire Department

Characterization/Attribute	Fire Department
Direction	Adverse
Magnitude	Low
Geographic Extent	Local/Regional
Timing/Frequency	Primarily Construction and Operations; to some extent Closure and Reclamation/Low
Duration	Medium- to Long-term
Reversibility	N/A
Socio-economic Context	N/A
Probability of Occurrence	Low
Degree of Confidence in Prediction	High

6.11.6.13 Determination of Significance of Potential Effects on Emergency Services – Fire Department

The Project is not predicted to result in significant adverse effects on the provision of emergency services by the Mayo fire department or other fire departments servicing portions of the access route.

6.11.6.14 Description of Potential Effects on Emergency Services – Ambulance Service

The volunteer ambulance service based in Mayo does not provide direct services to the mine sites in the region, however there may be effects on the ambulance service due to:

- Call outs for any transportation incidents on the access route
- Call outs for patient transfer from mining company first aid vehicles.

While not providing direct services to the mine sites in the region, the Mayo ambulance meets mine personnel transporting patients from the site along the access road, for turnover to ambulance service for subsequent transport to the Mayo Health Centre or the Whitehorse hospital (or possibly Dawson in the future). Helicopter medi-vac to Whitehorse is also available. In 2009 the ambulance service responded to a total of 79 calls; in 2008 the figure was 105.

6.11.6.15 Mitigation Measures for Potential Effects on Emergency Services – Ambulance Service

VIT will work with emergency service providers (RCMP, fire department, ambulance service) to identify training and equipment required to respond to potential incidents related to the Project. Similarly, a cooperative approach to the development of emergency response plans is needed.

VIT will have on-site personnel with the appropriate first aid training and will establish an Emergency Response Plan for the Project (see Appendix 33).

6.11.6.16 Residual Effects on Emergency Services – Ambulance Service

The Project will have a minor residual effect on the Mayo ambulance service's provision of emergency services, as a result of planning for and responding to possible access route incidents or patient transfers. Other ambulance services with jurisdiction along portions of the access route (from Whitehorse to Mayo) may also need to plan for or respond to incidents involving Project vehicles.

Table 6.11-24 describes the characterization of residual effects on ambulance services by the Project.

Table 6.11-24: Summary of Residual Effect Characterization – Ambulance Service

Characterization/Attribute	Ambulance
Direction	Adverse
Magnitude	Low
Geographic Extent	Local/Regional
Timing/Frequency	Primarily Construction and Operations; to some extent Closure and Reclamation/Low
Duration	Medium- to Long-term
Reversibility	N/A
Socio-economic Context	N/A
Probability of Occurrence	Low
Degree of Confidence in Prediction	High

6.11.6.17 Determination of Significance of Potential Effects on Emergency Services – Ambulance Service

The Project will not result in significant adverse effects on provision of services along the access route by the Mayo or other ambulance services.

6.11.6.18 Description of Potential Effects on Landfill

Potential effects on landfill or recycling include use of the VoM landfill for selected streams (solid waste, construction waste) of Project waste material and subsequent effects on landfill capacity.

VIT will recycle waste materials where feasible; cardboard and wood components of construction waste may be burned on-site (if acceptable from a regulatory perspective). At the time of writing, the decision to incinerate or deposit all or part of the solid waste in a landfill (construction and operations phases) or construction waste streams has not been made. This will be determined during the engineering design phase.

A Construction Waste Management Plan has been developed for the Project and is set out in Section 5.4.3. Currently the Project design is to transport all waste off-site for disposal.

The Project could produce an average of 1.3 kilograms per person per day of solid waste (general waste produced in camp, including food scraps) for both the construction and operations phases. Assuming the presence of approximately 200 people in camp at any time, with year-round operations, a total of 94,900 kg or approximately 95 tonnes of solid waste would be produced each year.

If the Project's estimated 95 tonnes of solid waste per year are shipped to the Mayo landfill, this would represent a 25% increase in the current landfill demand of 365 tonnes per year, This would reduce the landfill's projected lifespan (approximately 15 years in 2006).

The VoM in their 2006 *Village of Mayo Integrated Community Sustainability Plan* identified as an objective the decrease of waste entering the landfill. At the same time, the VoM is also indicating that it is contemplating as a business opportunity the development of an enlarged or regional landfill and possibly a recycling facility, both of which would require a steady source of waste to be sustainable.

The Project is currently designed to transport all waste off-site for disposal, and there have been early discussions with the VoM about the capacity of the community landfill to accept waste from the Project. In addition, VIT understands that VoM is working with Yukon Government to identify plans and options for the community landfill. VIT will continue discussions with the VoM and the Yukon Government to identify options and a waste management approach consistent with community objectives for the landfill and economic development opportunities.

6.11.6.19 Mitigation Measures for Potential Effects on Landfill

The overall relative contribution of solid waste from the Project would be reduced if the Project was allowed to dispose of its solid waste at a new or expanded facility in the region.

VIT is also pursuing the possibility of incinerating solid waste at the site. The volume of solid waste from the Project would be reduced significantly if the Project were to obtain permission to incinerate solid waste at site.

To assist in this planning process, VIT will maintain a continued dialogue with the VoM and Yukon Government in addition to maintaining an exchange of information through the mechanism committed to in Section 6.11.7.

6.11.6.20 Residual Effects on Landfill

In the absence of either of these mitigations, the effect on the capacity of the Mayo landfill as it currently exists could be moderate to substantial. However, VIT is of the view that a solution can be found to accommodate the current and planned industrial activities in the region. Through ongoing discussions with the VoM and Yukon Government a balance can be established between the community desire to reduce the generation of waste on a per capital basis and the desire to accommodate growth and industrial development.

With implementation of successful mitigation measures as proposed, (i.e., if some of the Project's solid waste is incinerated and some or all is deposited in a regional land fill) the effect of the Project on the capacity of the current Mayo landfill would be reduced to Low.

Table 6.11-25 characterizes the residual effects of the Project on the VoM landfill.

Table 6.11-25: Summary of Residual Effect Characterization – Landfill

Characterization/Attribute	Current Mayo Landfill
Direction	Adverse
Magnitude	Moderate to Substantial
Geographic Extent	Local
Timing/Frequency	Primarily Construction and Operations/High
Duration	Medium-term
Reversibility	Reversible
Socio-economic Context	N/A
Probability of Occurrence	High
Degree of Confidence in Prediction	High

6.11.6.21 Determination of Significance of Potential Effects on Landfill

With implementation of successful mitigation measures as proposed, (i.e., if some or all of the Project's solid waste is incinerated or deposited in a regional land fill) the effect of the Project on the capacity of the Mayo landfill would be reduced to Low.

6.11.6.22 Description of Potential Effects on Community Services and Public Works

Community public works such as VoM sewage lagoons could be affected by the Project.

The membrane biological reactor system at the Project Camp will produce high-quality treated sewage effluent (handled on-site at the Project), and sewage sludge waste. The sewage sludge waste will be trucked to the VoM sewage lagoons for final disposal and treatment. During construction and operations, approximately 3.1 m^3 of sludge will be produced each month; the amount will be lower during the closure and reclamation phase.

6.11.6.23 Mitigation Measures for Potential Effects on Community Services and Public Works

No mitigation measures are planned in relation to predicted Project effects on community services or public works, in particular disposal of sewage sludge at the VoM lagoons.

6.11.6.24 Residual Effects on Community Services or Public Works

Given the relatively small quantities that will be produced, the VoM lagoons should be able to accommodate disposal of Project sewage sludge.

Table 6.11-26 characterizes the Project's effects on the VoM lagoons.

Table 6.11-26: Summary of Residual Effect Characterization – VoM Lagoons

Characterization/Attribute	VoM Lagoon
Direction	Adverse
Magnitude	Low
Geographic Extent	Local
Timing/Frequency	Primarily Construction and Operations
Duration	Medium-term
Reversibility	Reversible
Socio-economic Context	N/A
Probability of Occurrence	High
Degree of Confidence in Prediction	High

6.11.6.25 Determination of Significance of Potential Effects on Community Services and Public Works

No significant adverse effects are anticipated on the VoM sewage lagoons.

6.11.6.26 Description of Potential Effects on Child Care

Increased levels of employment at the Project for FNNND citizens or other Mayo residents may result in increased demand on the Dunena Ko'Honete Ko Day Care. In 2010, 16 of the 27 licensed spots (60%) were filled. With available space at the Day Care, there is additional capacity available that should absorb any potential increase that may result from employment of local residents at the Project. In addition, private home care options may be utilized by Project employees residing in Mayo. The future demand for, and supply of, child care will depend on a number of factors, including demand independent of the Project.

6.11.6.27 Mitigation Measures for Potential Effects on Child Care

No mitigation measures are proposed for potential Project effects on child care.

6.11.6.28 Residual Effects on Child Care

Residual effects from the Project are anticipated on child care services on Mayo, although their probability and magnitude cannot be predicted with certainty.

The Project's residual effects on child care are characterized in Table 6.11-27.

Table 6.11-27: Summary of Residual Effect Characterization – Child Care

Characterization/Attribute	Child Care
Direction	Positive
Magnitude	N/A
Geographic Extent	Local
Timing/Frequency	Primarily Construction and Operations
Duration	Medium-term
Reversibility	N/A
Socio-economic Context	N/A
Probability of Occurrence	N/A
Degree of Confidence in Prediction	Moderate

6.11.6.29 Determination of Significance of Potential Effects on Child Care

The contribution of the Project to the demand for child care services is not predicted to be significant, given the current available capacity at the Dunena Ko'Honete Ko Day Care and the alternative of private home care. However, to assist in ensuring the appropriate agencies can plan for changes in demand, VIT will maintain a continued open line of consultation and exchange of information through the mechanism committed to in Section 6.11.7.

6.11.6.30 Description of Potential Effects on Roads

Employees from Mayo and the surrounding communities will be transported to the Project site by a transfer van service utilizing upgraded existing roads. Employees from outside the local area will be flown in from Whitehorse to Mayo. All employees will be bussed the remaining distance to the mine site. Access to Mayo for freight and other deliveries is by government maintained public roads (Figure 5.1-5).

The additional volumes of traffic associated with the Project may result in additional wear and tear, or exceed the capacity of these roads in terms of volume or speed limits.

Traffic Volume – Construction

As described in Section 5.4.2.1, during construction, increased vehicle and truck traffic will be required for the Project on the SMR and HCR. The largest vehicles will be B-Train vehicles, trucks with long loads (steel members, crane components), and trucks with wide loads (truck boxes, tanks, pre-fabricated camp modules). Loads would be adjusted for seasonal load restrictions, and volumes would coincide with construction and operational needs.

Estimated Traffic Volume during construction (20 months):

- 1,500 – 1,800 semi-trailer loads (round trip) over the construction phase
- 10 – 20, 1 to 5 tonne trucks per day on the average, or 600 – 800 round trips over the construction phase
- 10 passenger car or pickup trucks per day (trip numbers would depend on the location of the construction camp).

Traffic Volume – Operations

The Project will operate year round and require year round access. Road use data is not available for the SMR or HCR to determine the exact increase of traffic volume. However, there are currently relatively few land users that use the HCR. Average daily traffic from 1997 to 2008 at km 0 of the Silver Trail Highway has ranged from 71 vehicles in 1997 to 262 in 2006. Average daily traffic for the same period from Km 63.4 of the Silver Trail Highway ranges from 90 vehicles in 2007 to 147 in 1995. Daily averages compiled only for the summer season (May 1 to September 30) show that the greatest highway use occurs at this time of year. It is assumed that use of the SMR and HCR is currently considerably less than that of the Silver Trail.

As described in Section 5.5.2.1, the traffic volume during operations is estimated as follows:

- Crew shift changes are expected to occur approximately every two weeks. Personnel will travel from Mayo to the mine site by bus. This will involve approximately 100 – 120 round trips per year.
- Total truck loads are estimated at 1,944 trucks per year (round trips). As with the estimates for the construction phase, these numbers do not account for potential seasonal load limits, which would determine potential truck size and load types.

Note that the above estimates do not include traffic for exploration programs, placer mining operations, or public/tourism uses. However, information available from HPW on current and historical traffic volumes for the Silver Trail, the SMR, and the HCR have been included in the effects assessment in the Project Proposal in terms of road use. In addition, volume of traffic will vary throughout the year, with higher volumes expected during peak construction times and after freshet/prior to freeze up.

Access Road Maintenance

The Project will operate year round and therefore the SMR and HCR will be maintained (snow clearing) to provide access year round. This will result in winter access on the SMR and HCR which is not currently possible via wheeled vehicles.

Road maintenance is essential to ensure user safety, preserve the existing condition of the road, and ensure convenient and efficient travel to the Project site. Maintenance of the SMR up to the South McQuesten Bridge will continue to be conducted by HPW. Regular maintenance of the HCR will be performed by VIT throughout all phases of the Project. VIT will coordinate with HPW to develop and undertake a maintenance plan for all sections of the road to meet Project needs for year round operations.

Following closure, the main access road within the Project area, from Haggart Creek (at the confluence with Dublin Gulch) to the process plant site, will be permanently closed and reclaimed. The one exception will be the road that provides access to the Potato Hills, as this has been identified as an important area for traditional use. The Haggart Creek Road will be left in place at the end of Project life, as a public unmaintained road.

6.11.6.31 Mitigation Measures for Potential Effects on Roads

No public vehicle access will be allowed at the mine site—Emergency response organizations (RCMP, fire departments, ambulance services) that service the access road will be trained in terms of the types of materials (e.g., fuel, limes, reagents, cyanide briquets, other chemicals, explosives) being transported and the appropriate response in the event of a spill.

VIT will develop an Emergency Response Plan.

VIT will control vehicle speeds of employees and contractors along the access route through a variety of means (contractual obligations, use of Global Positioning Systems [GPS], encouraging reporting of poor driving practices).

Prior to commencement of radio control use on the HCR, a Radio Use Policy will be established.

A pull-off or parking area is proposed to accommodate parking needs of FNNND citizens and others at South McQuesten bridge fishing area.

VIT will perform regular maintenance on the HCR to ensure safety, maintain road condition, and ensure efficient and convenient travel to the Project.

6.11.6.32 Residual Effects on Roads

The Yukon Department of Highways and Public Works has indicated to VIT that the predicted level of traffic from the Project is insignificant in terms of affecting the publicly maintained roadways along the access route (Silver Trail and SMR), and can be accommodated. VIT will maintain the HCR during construction and operations.

Adverse effects related to speeding vehicles will be minimized or eliminated through a variety of measures described above.

Current and planned upgrades to the bridge at the South McQuesten River will bring the bridge up to highway standard and accommodate the needs of local users fishing in the area.

Table 6.11-28 provides a summary of the characterization of the residual effects on roads and the bridge.

Table 6.11-28: Summary of Residual Effect Characterization – Roads and Bridge

Characterization/Attribute	Transportation	
	Roads	Bridge (at South McQuesten River)
Direction	Negative/Positive	Positive
Magnitude	Low	Substantial
Geographic Extent	Local	Local
Timing/Frequency	Primarily Construction and Operations/High	Construction; Operations; Closure and Reclamation/High
Duration	Long-term	Permanent
Reversibility	N/A	N/A
Socio-economic Context	N/A	N/A
Probability of Occurrence	High	High
Degree of Confidence in Prediction	High	High

6.11.6.33 Determination of Significance of Potential Effects on Roads

There will be increased traffic, mostly trucks and shuttle busses on the access road, but the Project is not expected to result in significant adverse effects on the traffic levels on these roads or to increased levels of speeding. Positive or beneficial effects for other users will result from the physical and maintenance improvements to the SMR and HCR as a result of the Project.

6.11.6.34 Description of Potential Effects on Mayo Airport

Project employees from Mayo and the surrounding communities (e.g., within Dawson – Carmacks radius) will be transported to Mayo by van or bus service utilizing existing roads. VIT workers and contractors from more distant locations will fly from Whitehorse to Mayo. All employees will be bussed the remaining distance from Mayo to the mine site.

In 2009 to 2010, the Mayo airport reported almost 2700 aircraft movements. This is significantly less than the 8,800 movements that were experienced in 1981. There is capacity for additional flights with existing staff levels and current facilities.

Air North has indicated that they are working to schedule a regular flight on the Whitehorse—Mayo route. Local residents have expressed concern that if scheduled flights are reinstated, there will be competing demand for limited seats by the public and VIT or other development activities in the area.

6.11.6.35 Mitigation Measures for Potential Effects on Mayo Airport

VIT plans to transport employees travelling from Whitehorse to Mayo using chartered aircraft and bus services.

VIT will investigate opportunities for 'flight sharing' that would allow local residents, on a user pay basis, to use empty seats on charter aircraft or busses coming to and from Mayo to Whitehorse or other communities.

6.11.6.36 Residual Effects on Mayo Airport

No residual adverse effects are predicted on the Mayo airport as a result of the Project. The residual effects on the Mayo Airport are characterized in Table 6.11-29.

Table 6.11-29: Summary of Residual Effect Characterization – Mayo Airport

Characterization/Attribute	Mayo Airport
Direction	Positive
Magnitude	Moderate
Geographic Extent	Local
Timing/Frequency	Primarily Construction and Operations
Duration	Medium-term
Reversibility	Reversible
Socio-economic Context	N/A
Probability of Occurrence	High
Degree of Confidence in Prediction	High

6.11.6.37 Determination of Significance of Potential Effects on Mayo Airport

No adverse effects are predicted to occur on the Mayo airport as a result of the Project.

6.11.6.38 Description of Potential Effects on Electrical Power Supply

Potential effects related to electrical power supply can be categorized as follows:

1. Relative demand on electrical power supply as a result of the Project, and availability of supply to meet the needs of the Project and other customers (industrial, small business, residential and government)
2. Effects on electricity pricing as a result of the Project
3. Possible disruption in electrical service for various customer classes (industrial, small business, residential and government) if the supply or transmission systems cannot meet future needs.

Each of these categories of potential effect is described below.

Demand On and Availability of Electrical Power Supply

Currently Yukon's power needs are being met using hydroelectric and diesel generation. Yukon's total, hydroelectric, and diesel generation for the period 1994 to 2009 is shown in Figure 6.11-14.

YEC has existing installed capacity (hydroelectric and diesel) to supply 750 GWh of electricity annually on average. The current electrical load is about 375 GWh annually (Campbell 2010, pers. comm.). YEC is currently in the process of upgrading power generation capacity with the Mayo Hydro Enhancement Project. The north and south Yukon transmission grids are being connected (the Carmacks-Stewart Transmission Project Stage 2). Funding agreements specify that both projects must be completed by March 31 2012; both projects are on schedule to finish in 2011. YEC is currently updating its 2006 20-year Resource Plan to reflect increasing use of renewable energy in meeting new future loads. Baseline environmental and social-economic studies are underway on several hydro supply options, and feasibility work is being conducted on geothermal, wind, and waste gasification and demand-side management. Targets for renewable energy will be discussed in the Resource Plan update, anticipated in 2011 (Campbell 2010, pers. comm.).

Additional detail on the Project's power requirements are found in Section 5.4.2.2, above. Power to the Project site will be provided via a new 45 km transmission line connecting to the grid, routed along the SMR/HCR access road. The 69 kV transmission line will feed a main substation on site.

There will be demand for approximately 1.5 MW of power during the *construction phase* (January 2012 to August 2013). All power will be generated on-site by diesel generators prior to the completion of the power transmission line. The camp and surface facilities will be serviced by one 1.0 MW diesel generator unit located in the process plant area. Open pit development will be serviced by portable electrical power centres rated at 250 kW. All other construction sites will be serviced by a maximum of ten 10 kW portable generators.

The average seasonal forecast operating loads for the *operations phase* are estimated to be 11 MW, supplied by grid power. In the event of a power failure, three emergency diesel generation sets will be provided. Estimated power loads and consumption are outlined in Table 6.11-30 below.

Table 6.11-30: Estimated Electrical Loading and Power Consumption

Description	Estimated Connected Load (kW)	Estimated Operating Load (kW max)	Estimated Power Consumption (MWh/y)
Crushing, Conveying and Stacking	12,265	7,673	66,293
Leaching	1,805	1,626	14,049
ADR, Refinery and Reagents	640	393	3,395
Laboratory	90	49	420
Support Services	346	176	1,523
Water Distribution	74	45	392
Detoxification	104	73	0
Mine and Infrastructure	1,500	1,000	8,760
Total	**15,324**	**11,035**	**94,832**

Source: Project Description (Section 5.5.6)

Power demand for the *closure and reclamation phase* has not been determined.

Effects on Electricity Pricing

VIT has had preliminary meetings with YEC to discuss a power-purchase agreement. Industrial customers in Yukon are required to pay not less than the cost to supply them with power (Campbell 2010, pers. comm.). As a customer class, if there are increased costs to service one or more industrial customers, then all customers in that class will pay more.

A number of factors can contribute to the pricing of electricity for various customer classes. Hearings before the Yukon Utilities Board in October 2010 addressed possible changes to the electricity price structure; the timing of a decision is unknown. Currently, residential users only pay 70% of the cost of electricity; the remaining 30% is subsidized by government.

Each industrial customer is required to pay for all of the costs to connect them to the utility grid; thus there are no costs for other customers in this regard. As there were no Project effects identified, electricity pricing was not carried forward for further assessment.

Possible Disruption in Electrical Power Supply

Mayo residents have expressed concern about increased industrial power usage causing potential outages, power surges, and fluctuations that might damage equipment and disrupt residential, commercial, and institutional users. YEC has stated that it does not anticipate changes in power supply to existing customers as a result of power needs of the Project (Campbell 2010, pers. comm.).

6.11.6.39 Mitigation Measures for Potential Effects on Electrical Power Supply

VIT will meet the design criteria of Yukon Energy Corp. in design of the transmission line to supply the Project.

6.11.6.40 Residual Effects on Electrical Power Supply

Demand On and Availability of Electrical Power Supply

The demand for electrical power from the Project can be accommodated within existing generation capacity in Yukon; however, forecast industrial use may require that existing diesel generation capacity be utilized. New renewable energy sources and demand management (e.g., energy efficiency and conservation measures) may offset the need for diesel generation.

Effects on Electricity Pricing

Industrial customers in Yukon are required to pay not less than the cost to supply them with power. As a customer class, if there are increased costs to service one or more industrial customers, then all customers in that class will pay more.

Each industrial customer is required to pay for all of the costs to connect them to the utility grid; thus there are no costs for other customers in this regard.

Hearings before the Yukon Utilities Board in October 2010 addressed possible changes to the electricity price structure; the timing of a decision is unknown.

Possible Disruption in Electrical Power Supply

YEC has stated that it does not anticipate changes in the reliability of power supply to existing customers as a result of power needs of the Project (Campbell 2010, pers. comm.).

The Project's residual effects on electrical power supply are characterized in Table 6.11-31.

Table 6.11-31: Summary of Residual Effect Characterization – Electrical Power Supply

Characterization/Attribute	Electrical Power Supply	Effects on Electricity Pricing	Possible Disruption in Electrical Power Supply
Direction	N/A	N/A	N/A
Magnitude	Substantial	N/A	N/A
Geographic Extent	Territorial	N/A	N/A
Timing/Frequency	Operations; Closure and Reclamation/High	N/A	N/A
Duration	Medium-term	N/A	N/A
Reversibility	Reversible	N/A	N/A
Socio-economic Context	N/A	N/A	N/A
Probability of Occurrence	High	N/A	N/A
Degree of Confidence in Prediction	High	N/A	N/A

6.11.6.41 Determination of Significance of Potential Effects on Electrical Power Supply

The electrical power demands associated with the operations phase of the Project (approximately 95 GWh/year) represent approximately 13% of the existing installed generation capacity (hydroelectric and diesel, 750 GWh annually) or a 25% increase in the current electrical load (approximately 375 GWh annually) in Yukon. While this represents a relatively significant demand, it lies well within existing installed capacity.

6.11.6.42 Cumulative Socio-economic Effects – Infrastructure and Services

Screening of Cumulative Environmental Effects

A screening of the Project's potential contribution to the cumulative effects of past, current, and announced future projects was done per the procedures described in Section 6.3.8. The screening process establishes three conditions to warrant further assessment. These conditions are:

1. The Project results in a demonstrable residual effect
2. These effects are likely to act in a cumulative fashion with those of other projects

3. There is a reasonable expectation that the Project's contribution to cumulative effects has the potential to change the health or sustainability of the Employment and Economic Opportunities VC.

As a result of the screening process, two potential effects are carried forward for an assessment of cumulative effects on Infrastructure and Services:

- Effects on the Mayo landfill
- Demand on and Availability of Electrical Power Supply.

Description of Cumulative Effects

Village of Mayo Landfill

If the Project's estimated 95 tonnes of solid waste per year are shipped to the Mayo landfill, this would represent a 25% increase in the current landfill demand of 365 tonnes per year. In addition to local residential, commercial and institutional waste, the landfill is also receiving unknown quantities of waste from the recently operational Keno Hill mine, local placer mining, the Mayo B project (to be completed in 2011), as well as the exploration projects underway in the area (e.g., Rau Gold, Haldane Silver, Gold Dome). Waste quantities would likely increase if any of these exploration projects move into development.

The VoM is currently considering development of a Regional Landfill as a business opportunity, and the availability of a new or expanded facility would mitigate the overall cumulative effect of solid waste disposal from existing users and from the Project and other mines. The cumulative effect on the capacity of the VoM landfill could be significant, if the landfill is not expanded. However, VIT is of the view that a solution can be found to accommodate the current and planned industrial activities in the region. Through ongoing discussions with the VoM and Yukon Government a balance can be found between the community desire to reduce the generation of waste on a per capital basis and the desire to accommodate growth and industrial development.

With implementation of successful mitigation measures as proposed, (i.e., if some of the Project's solid waste is incinerated and some or all is deposited in a regional landfill) the effect of the Project on the capacity of the current Mayo landfill would be reduced to Low, as would the Project's contribution to cumulative effects on the Mayo landfill.

If some or all of the solid waste at the Project or other mines is incinerated, there would be reduced effect on the Mayo landfill capacity.

Electrical Power Supply

The Minto mine became operational in 2008, and is accounted for in the YEC's 2009 load figure of 375 GWh. Alexco Resource Corp.'s Bellekeno mine became operational in late 2010; its annual power usage is estimated at 14GWh a year (Hopper 2010). Future mining projects (e.g., Western Copper Corp.'s Carmacks Copper mine, Yukon Zinc's Wolverine project) will place additional demands on Yukon's power supply. The Carmacks Copper Project (which has no known operational date as licencing issues are outstanding) is expected to contribute an additional 50GWh of demand annually. YEC has indicated that it has existing installed capacity to supply approximately 750 GWh annually; studies are underway on additional supply options (including renewable energy) and demand-side management. YEC's Resource Plan is being updated in 2011.

While the electrical power demands associated with the operations phase of the Project in combination with existing and possible future mines represent a relatively significant demand on the Yukon electricity supply, known future demand lies within existing installed capacity. The contribution of additional new supply options currently being studied, and demand management, will offset a portion of the cumulative demand from mining projects.

No adverse cumulative effect on electrical power supply is predicted.

6.11.6.43 Summary of Influence of Consultation on the Assessment of Infrastructure and Services

Additional detail on First Nations, other Government, and Community Consultations is provided in Section 2 of the Project Proposal.

6.11.6.44 Effects Monitoring and Adaptive Management for Infrastructure and Services

Socio-economic change is not solely within the control of VIT. However, the company will work with FNNND, VoM, the Yukon Government and others to review and respond to the Project's emerging socio-economic effects —both positive and negative. VIT will develop a process for confirming the indicators, reporting and responding to monitoring results will be cooperatively established. This process would identify:

- Project-related socio-economic effects and indicators to be monitored by VIT and others
- The process for adaptive management
- The measures (in addition to those already committed to) that VIT and others could put in place for prevention, mitigation or enhancement of the Project's socio-economic effects.

Key socio-economic indicators for the Project will be monitored by VIT (e.g., emergency services, the landfill, air and road transportation, and power supply). These will need to be considered in the broader socio-economic context and other sources of change. This will provide an understanding of the Project's socio-economic effects, identification of any emerging or unanticipated effects, and the opportunity for VIT or other parties to respond as appropriate. VIT will pursue this monitoring in the context of the proposed continued communication and exchange of information committed to in Section 6.11.7.

6.11.6.45 Summary of Commitments for Infrastructure and Services

VIT will discuss any specific needs that may result from the Project with program and service delivery agencies, the FNNND, and VoM. Collectively VIT, FNNND, and VoM may engage in discussions with the Yukon Government as appropriate on matters of shared interest.

VIT will utilize the International Cyanide Management Code to guide the use and management of cyanide at the Project.

A Spill Contingency Plan (Appendix 30) and Emergency Response Plan (Appendix 33) will be developed for the Project.

VIT will engage with the VoM to discuss anticipated waste volumes and determine the availability of appropriate waste management facilities and programs that could be used for the Project.

VIT will engage with FNNND, VoM, YG and others to determine if upgrades to the Mayo airport facilities or services are needed as a result of additional aircraft movements related to the Project.

VIT will support in principle the FNNND, VoM and YG in their efforts to encourage resumption of scheduled air service between Whitehorse and Mayo.

VIT will meet the design criteria of Yukon Energy Corp. in design of the transmission line to supply the Project—to minimize potential for disruption in electrical power supply for other users.

6.11.7 Summary of Socio-economic Effects, Mitigations, Monitoring and Adaptive Management, and Commitments

The socio-economic effects of the Project and corresponding mitigation, monitoring and adaptive management, and VIT commitments summarized below in Table 6.11-32 are intended to provide an overview. The full details for each are noted above in the relevant sections of the socio-economic effects assessment. Mitigation measures are generally effect-specific, while monitoring and adaptive management and commitments are more broadly focused on VCs, and may be common to two or more VCs. While some commitments are the sole responsibility of VIT; others will require coordination with others (e.g., the Yukon Government, FNNND, VoM).

Human well-being is influenced by many factors that range from the internal rationale of a single individual making a choice, to external factors that are beyond the control of a project or an entire government. VIT also recognizes that achieving solutions to adverse effects that may occur at an individual or group level is best resolved by open lines of ongoing communication, cooperation and coordination among those who are experiencing the effect, those whose actions are contributing to the effect and those who are in a position to assist in avoiding or minimizing an adverse effect or enhancing an effect if it is positive.

To that end, VIT proposes establishing and convening a committee of representatives of parties that are directly affected by the Project (the Committee). The Committee would be composed of representatives of the FNNND (2), VoM (1) and VIT (2). The Committee would be chaired by VIT. Where the topic is pertinent, representatives of the RCMP, Yukon College, government departments and agencies responsible for delivery of health and social services in Mayo would be invited to attend and contribute their input in the form of any monitoring statistics or observations they may have in relation to the socio-economic indicators as well as any recommendations they might wish to make. The Committee would meet twice a year with the flexibility to meet on a specific issue if necessary. VIT would provide the administrative support needed for the Committee to carry out its business.

The purposes of the Committee would be to:

- Discuss the indicators to be monitored at the community of Mayo level and determine who would be responsible for collecting the data
- Review performance of the commitments made by VIT under this Project Proposal
- Comment on socioeconomic effects arising from the Project and provide recommendations to VIT for follow up with the appropriate parties at a Project, municipal, First Nation or government level
- Provide an ongoing forum for meaningful participation and involvement by Project affected parties.

VIT would commit to:

- Compile information within its control that is appropriate to monitoring the indicators determined appropriate through discussion with the Committee
- Provide an annual report to the Committee that contains the information identified in a) above. This report would be shared with the Yukon Major Mines Coordinating Committee (MMCC) and regulatory agencies as appropriate
- Participate actively and meaningfully in the work of the Committee.

In addition, VIT would liaise with regulatory agencies through the MMCC for the Project to ensure a coordinated approach. The MMCC consists of a core group of Yukon Government agencies, and can include other agencies for discussion and consideration of any Project related issues. Bringing updates, information and any recommendations to the MMCC, including the annual report provided to the Committee and any recommendations from the Committee, would allow for a coordinated process to share information and ensure socio-economic information is well linked and monitored with the appropriate agencies.

Table 6.11-32: Summary of Socio-economic Effects and Commitments, Mitigations, Monitoring and Adaptive Management

VCs	Mitigation, Monitoring and Adaptive Management, Commitments
Cross-Cutting Socio-economic Monitoring/Adaptive Management and Commitments VIT has identified monitoring and adaptive management and other commitments that are common to two or more VCs: ▪ Socio-economic change is not solely within the control of VIT. However, the company will cooperatively develop a process with FNNND, VoM, the Yukon Government and others for confirming socio-economic indicators, reporting and responding to monitoring results. Key socio-economic indicators for the Project will be monitored by VIT ▪ Ongoing negotiation of a comprehensive CBA with the FNNND ▪ Continued liaison and dialogue with FNNND, the VoM, Yukon Government and others throughout all Project phases	
1. Employment and Economic Opportunities	
Employment Opportunities ▪ Direct positive effect on employment opportunities during construction, operations and closure and reclamation for local , Yukon and Canadian residents.	▪ VIT will strive to hire as many FNNND citizens, other local and Yukon residents as practical. ▪ VIT will provide advice, expertise, mentorship and program development assistance to employment training programs, to be developed by Yukon College, the FNNND, the Yukon Mine Training Association. ▪ VIT will offer summer employment aimed at students who are returning to school.
Contracting Opportunities ▪ Direct positive effect on contracting opportunities during construction, operations and closure phase for local , regional and Yukon businesses.	▪ VIT will develop a Business Opportunities pamphlet. ▪ VIT will establish a database of local and Yukon businesses. ▪ VIT will seek to 'right-size' contracts where practical to facilitate greater access for local contracting opportunities. ▪ VIT will assist in facilitating the exchange of information between parties who are interested in possible joint ventures.
Royalties and Taxes ▪ Direct positive effect from royalties and taxes will be significant benefit to the Yukon and Federal governments.	▪ N/A
Effects from Expenditures ▪ Direct, indirect and induced positive effect from expenditures on the local, regional and Yukon economies.	▪ N/A

VCs	Mitigation, Monitoring and Adaptive Management, Commitments
Effects on Other Local and Regional Economic Activities	▪ VIT will continue to communicate its plans and timing of proposed activities to other resource users (e.g., trappers, outfitters, quartz and placer miners, and known subsistence harvesters).
▪ Placer and Quartz Mining operations may benefit from improved access along the SMR and HCR.	▪ VIT has contacted placer mine operators in the area to advise them of the Project and to discuss any questions or potential concerns they may have.
▪ Outfitters and Tourism operators may experience moderate increases in activity as a result of the Project.	▪ VIT has contacted the two outfitters operating in the area to arrange meetings to advise them of the Project, and to discuss any questions or potential concerns they may have with the proposed Project. These discussions are ongoing.
▪ Commercial Trapping – pending the completion of discussions with the RTC owners, the potential effects of the Project on trapping cannot be conclusively stated.	▪ VIT has contacted the owners of Registered Trapline Concessions that overlap the Project to address their interests and concerns. If required, there is a compensation process available under the *Wildlife Act.*
▪ No effects on Commercial Fishing, Forestry and Agriculture, Oil and Gas.	▪ N/A
▪ There will be residual direct, indirect and induced benefits from the Project on local businesses and services in Mayo, and to a lesser extent to those located in Keno City and elsewhere on the Silver Trail.	▪ N/A
Potential Cumulative Effects on Employment and Economic Opportunities ▪ The Project, in combination with other Projects in the local area and Yukon, will result in significant positive cumulative effects on employment, contracting, and taxation and royalties. ▪ The competition for the eligible labour pool may result in capacity challenges for local organizations or businesses. ▪ Indirectly, improved capacity and skills development of both individual workers and contractors will result from the Project and other mining projects in the region.	▪ N/A

VCs	Mitigation, Monitoring and Adaptive Management, Commitments
	Other Commitments for Employment and Economic Opportunities: ▪ VIT will commit to provide employment and business opportunities to qualified FNNND citizens, the Na-Cho Nyäk Dun Development Corporation, other local or Yukon businesses. ▪ VIT will provide advice, expertise, mentorship and program development assistance as it relates to educational programs, to be developed by Yukon College, the FNNND, the Yukon Mine Training Association, and potentially other organizations. ▪ VIT will engage with FNNND, Yukon College, MTA, and the Yukon Government to promote mining-related training programs. ▪ VIT has committed to a range of safety and health measures to ensure the well-being of workers at the Project. ▪ Commitments related to Wildlife, Vegetation Resources, and Fish and Fish Habitat are relevant in terms of potential effects on 'Other Local or Regional Economic Activities' (e.g., outfitting, tourism, trapping and maintenance of traditional subsistence lifestyles).
2. Traditional Activities and Culture	
Subsistence Harvesting ▪ Positive/negative effects on participation in subsistence harvesting ▪ Adverse, but reversible loss of road access to Potato Hills ▪ No effects on fishing ▪ No effects on berry picking ▪ Unknown effect on registered trapline concessions	▪ Improvements and radio-controlled access for a portion of the South McQuesten Road in a fashion that minimizes the loss or disruption of access to subsistence harvesting areas. ▪ A pull-off or parking area proposed at key fishing areas. ▪ VIT will develop a policy restricting Project-related employees and contractors from hunting and fishing while on the job at any time throughout the life of the Project. ▪ A revegetation program using indigenous flora will be implemented. ▪ VIT will communicate plans and timing of activities to other resource users who may be affected by the Project.
Language Preservation and Revitalization ▪ No effects on language preservation and revitalization	▪ N/A
Other Cultural Activities ▪ No effects on other cultural activities	▪ VIT will provide Cultural Awareness Training for all employees.
Heritage Sites and Special Places ▪ No effects on heritage sites or special places	▪ N/A
Potential Cumulative Effects on Traditional Activities and Culture ▪ No cumulative effects on traditional activities and culture	▪ N/A

VCs	Mitigation, Monitoring and Adaptive Management, Commitments
	Other Commitments for Traditional Activities and Culture: ▪ The effects monitoring activities identified in for Fish and Fish Habitat, Vegetation Resources, Wildlife will serve to identify potential Project-related effects on Traditional Activities and Culture. ▪ Continued liaison with the FNNND, VoM and the MDRRC ▪ Provide support for FNNND and VoM community events ▪ Provide opportunities for FNNND citizens to participate in ongoing environmental monitoring activities ▪ Hire a Community Liaison person ▪ Use indigenous species during reclamation and closure
3. Community Vitality	
Population and Demographics ▪ No effect on the population levels in Mayo area ▪ Positive effect if small number of families move to community	▪ The Project will be a fully self-contained camp operation, employees will be transported to and from Whitehorse.
Local Educational Facilities and Services ▪ No effect on the enrolment at J.V. Clark School ▪ Moderate increase in demand at the Mayo campus of Yukon College	▪ Support for programs and initiatives at both J.V. Clark School and the Mayo campus of Yukon College
Crime ▪ No direct effect on local crime levels	▪ All employees will be transported directly to the Project and housed on-site to restrict unwanted access to Mayo. ▪ There will be a 'zero tolerance' policy with respect to drugs and alcohol on the mine site for employees and contractors. ▪ Policies and procedures will be established with respect to the use of local roads and highways. ▪ Cultural awareness training for all Project employees will reduce the potential for conflict.
Community Involvement ▪ No effect on community involvement if there are no new residents in Mayo	▪ VIT will provide support for FNNND and VoM community events. ▪ VIT will encourage its employees, who are residents of Mayo, to continue or initiate involvement in community activities or organizations.
Potential Cumulative Effects on Community Vitality ▪ No cumulative effects on community vitality	▪ N/A

VCs	Mitigation, Monitoring and Adaptive Management, Commitments
4. Human Health and Well-being	
Local Health and Social Facilities and Services ▪ No direct adverse effects on the operation of the Mayo Health Centre or regional hospitals ▪ No adverse effects on the level or quality of local or regional health and social services	▪ VIT will have on-site first-aid and trained emergency personnel to provide primary care. ▪ Will establish an Emergency Response Plan for the Project
Mental Health and Addictions ▪ No effects with transient employees or contractors disrupting local community as a result of substance use ▪ No direct adverse effects on mental health or addiction levels of FNNND citizens or residents of Mayo	▪ Employees and their families will have access to benefits programs. ▪ VIT will make known the government and community agencies that are taking the lead on prevention, awareness, and treatment programs for mental health and addictions ▪ VIT will have a ‘zero tolerance’ policy for Project employees and contractors with respect to drug and alcohol use at the site. ▪ VIT will work with the Mayo Health Centre to provide drug and alcohol testing services.
Potential Cumulative Effects on Human Health and Well-being ▪ No effects on local health and social facilities ▪ Potential positive cumulative effects on improved quality of life for individuals and families	▪ N/A
	Other Commitments for Human Health and Well-being: ▪ VIT has committed to a range of safety and health measures to ensure the well-being of workers at the Project. ▪ VIT will work with Mayo Health Centre to discuss all necessary staffing and equipment to meet Project needs. ▪ VIT will have an employment policy that will ensure the health and safety requirements of the company. ▪ VIT will provide life and employment skills (e.g., budgeting and finances; dealing with rotational shifts and family challenges) opportunities for Project employees.

VCs	Mitigation, Monitoring and Adaptive Management, Commitments
5. Infrastructure and Services	
Housing ▪ No effect on housing stock in Mayo (self-contained camp operation)	▪ VIT will work with FNNND and VoM to develop contingency plans to address accommodation needs of Project employees due to weather or other emergencies.
Emergency Services ▪ Minor effect of increased calls to Mayo RCMP. ▪ Minor effect on Mayo and other RCMP detachments between Whitehorse and Mayo in relation to possible road incidents. ▪ No effect on the Mayo fire department's service in terms of calls to Project site. ▪ Minor effect on Mayo fire department's service or other fire departments between Whitehorse and Mayo in relation to possible road incidents. ▪ Minor effect on Mayo ambulance service. ▪ Other ambulance services with jurisdiction along portions of the access route (from Whitehorse to Mayo) may be affected.	▪ VIT will work with emergency service providers (RCMP, fire department, ambulance service) to identify training and equipment required. ▪ VIT will implement a policy of zero tolerance for drug and alcohol use on the mine site. ▪ VIT will implement best practices and policies with respect to health and safety and for transportation (e.g., speed, safe driving practices). ▪ A Spill Contingency Plan and Emergency Response Plan will be cooperatively developed. ▪ Provision of on-site security will alleviate potential demand for RCMP services. ▪ VIT will have on-site personnel with the appropriate first aid training.
Landfill ▪ Effect on capacity of VoM landfill could be significant, if the landfill is not expanded. ▪ Minimal or no effect if the Project's solid waste is incinerated.	▪ A Waste Management Plan has been developed for the Project. ▪ VIT will engage with the VoM to discuss anticipated waste volumes and determine the availability of appropriate waste management facilities and programs.
Lagoons ▪ No significant adverse effects on lagoon capacity are anticipated from the disposal of sewage sludge waste produced by the Project.	▪ N/A

VCs	Mitigation, Monitoring and Adaptive Management, Commitments
Child Care ▪ Project demand is not significant, given the current available capacity at the Dunena Ko'Honete Ko Day Care and in private home care.	▪ N/A
Roads ▪ Project is insignificant in terms of affecting the roadways (capacity, safety) ▪ Positive or beneficial effects for other users will result from the physical and maintenance improvements to the SMR and HCR	▪ No public vehicle access will be allowed at the mine site—Emergency response organizations that service the access road will be trained in terms of the types of materials transported and appropriate response. ▪ VIT will develop an Emergency Response Plan. ▪ VIT will control vehicle speeds of employees and contractors along the access route. ▪ Prior to commencement of radio control use on the HCR, a Radio Use Policy will be established. ▪ A pull-off or parking area is proposed at South McQuesten Bridge fishing area. ▪ VIT will perform regular maintenance on the HCR to ensure safety, maintain road condition. ▪ VIT will utilize the International Cyanide Management Code to guide the use and management of cyanide at the Project.
Mayo Airport ▪ In 2009 – 2010, there were almost 2700 aircraft movements; this is significantly less than the 8,800 movements that were experienced in 1981. Project charter flights will not significantly increase flight volume. ▪ Possible benefit resulting from 'seat sharing' would allow local residents to use empty seats on charter aircraft or buses coming to and from Mayo to Whitehorse or other communities.	▪ VIT plans to transport employees travelling from Whitehorse to Mayo using chartered aircraft and bus services. ▪ VIT will investigate opportunities for 'flight sharing' that would allow local residents, on a user pay basis. ▪ VIT will engage with FNNND, VoM, YG and others to determine if upgrades to the Mayo airport facilities or services are needed. ▪ VIT will support in principle the FNNND, VoM and YG in their efforts to encourage resumption of scheduled air service between Whitehorse and Mayo.

VCs	Mitigation, Monitoring and Adaptive Management, Commitments
Electrical Power Supply ▪ The electrical power demands associated with the operations phase of the Project represent 13% of the existing installed generation capacity or a 25% increase in the current electric load in Yukon – but is within existing installed capacity. ▪ Each industrial customer is required to pay for costs to connect to the utility grid; there are no costs for other customers. ▪ YEC has stated that it does not anticipate changes in the reliability of power supply to existing customers as a result of power needs of Project.	▪ VIT will meet the design criteria of Yukon Energy Corp. in design of the transmission line to supply the Project.
Potential Cumulative Effects Infrastructure and Services ▪ The cumulative effect on the capacity of the VoM landfill could be significant, if the landfill is not expanded.	▪ N/A
	Other Commitments for Infrastructure and Services: ▪ VIT will discuss any specific needs that may result from the Project with program and service delivery agencies, both the FNNND, and VoM. Collectively VIT, FNNND, and VoM may engage in discussions with the Yukon Government as appropriate on matters of shared interest

6.11.8 Socio-economic Sustainability of the Project

The concept of sustainability includes the notion that a community or area will benefit and be no worse off in the longer term because of a project. To determine whether or not a project will contribute to sustainability requires understanding of the Project, the current socio-economic conditions, and the values and goals of the community(s). The extent to which the Project contributes to sustainability depends, in part, on the community and its vision, goals and objectives. Sustainability is contextual—there is no absolute measure—and so it will be judged by the community in light of their goals and aspirations and the assessment of potential socio-economic effects, both positive and negative.

In the absence of the Project (or other mineral development in the region), the socio-economic trends of the not-so-recent past would likely continue. There would be minor local population fluctuations with a general, slow downward trend as older people leave for centres with senior's facilities, and younger people leave to pursue higher education and careers or employment. School enrolment numbers would likely be stable or continue to decrease.

The Project would create employment and business opportunities, and revenues to governments through tax and royalty payments. The Project would contribute positively to the overall performance and sustainability of local, regional, and Yukon economies.

Through employment, training, and capacity development, the Project would provide sustained ability of individuals to take advantage of current and future opportunities in mineral exploration and development activity in the area. Additionally, business development and contracts at a community and regional level would contribute to more sustainable and robust local and regional economies. If local and regional individuals and businesses take advantage of these opportunities, they have the potential to contribute to overall economic prosperity locally and regionally.

6.11.8.1 Fully Self-Contained Mine Operation

Approximately 190 workers will be in camp at any given time. Details on the camp, including accommodations facilities, are provided in Section 5.4.2.3. The option of housing all employees in the existing communities of Mayo and Keno City, and bussing personnel to site each shift was considered as an alternative means of carrying out the Project. Due to the comparatively high number of employees in relation to the size of the local communities, and community (FNNND and VoM) objectives and specific concerns raised during the consultation program, this alternative was rejected. Housing all employees within existing local centres (Mayo or Keno City) would result in the need for extensive construction of housing and related community infrastructure. There would also be potential adverse effects on community facilities and services, and community well-being.

By providing a camp, and working on a shift rotation basis, workers will be able to live elsewhere in Yukon, if not already resident in local communities. This spreads the economic benefits of the Project, reduces the effect on local communities to a manageable and beneficial level, and moderates the 'boom and bust' phenomenon associated with mining towns in the past.

The Project as proposed (a fully self-contained mine operation) would contribute to the socio-economic sustainability of the FNNND and the community of Mayo in a number of ways. These include:

- Provision of stable, long-term (ten or more years) employment that would provide continuity and probable improvement in quality of life for those individuals and their families.
- Individual capacity building through various training provided by or with Yukon College, the Yukon Mining Training Association and VIT that would lead to employment and provide individuals with transferable skills that can be of benefit post-closure.
- Contracts to existing local and Yukon businesses that would provide continuity of work and may encourage some business growth and expansion.
- Stimulation of new businesses and potential joint ventures that could have potential beyond the Project.
- Road improvements that would contribute to improved safety and ease of access.
- Training of emergency response personnel and provision of the necessary equipment that would improve the protection of health and safety for workers and residents.
- Ensuring that the medical centre is properly supported by the Yukon Government to provide for VIT employee needs that would benefit all local residents.
- VIT, in cooperation with the FNNND and others (e.g., MTA, Yukon College, INAC, YG), would assist with the necessary career counseling services to ensure individuals could take advantage of the training opportunities—the benefit being that more people would be effectively contributing to the community.
- Royalty (under the *Quartz Mining Act* and *Royalty Regulation*) and tax revenues to the Yukon Government that contribute to a wide range of services provided by the Territorial government such as medical care and education.
- Provision of stable employment to qualified residents of Yukon that would contribute to the maintenance and likely enhancement of quality of life for the individuals and families.
- Contracts to Yukon businesses that would provide both stability and employment and may lead to business expansion.
- Stimulation of new businesses and joint ventures that may help diversify the type and range of services available in Yukon.

The Project has been designed so that there would be virtually no direct interaction between workers at the Project mine site and local residents of the FNNND and Mayo (other than those employed or contracted by the Project). This would minimize or eliminate the potential for social disruption in the community.

The population in Mayo would likely remain stable at current levels with limited in-migration that may balance out-migration related to education, employment or movement of elders or seniors to centers with appropriate facilities and services.

6.11.8.2 In-Migration of Project Families

During the socio-economic effects interviews, and during consultation for the Project, the FNNND, the VoM and local residents noted the potential benefits of having a small number of employees of VIT relocating to Mayo with their families. If a small number of families were to move to Mayo, there could be significant and positive effects on the community. For example, families would help bolster school enrolment and day care usage, and contribute additional people with interest and expertise for the range of volunteer activities that occur in the community.

Despite the design of the camp to be self-contained, VIT acknowledges that it is realistic to anticipate that there may be some individuals and families that would choose to move to Mayo. For them to do so, a number of initiatives by several parties would have to be coordinated and moved forward. First, the VoM with the Yukon Government, or possibly FNNND, would need to ensure the availability of serviced lots for new housing (already in shortage). Secondly, the VoM, FNNND or private entrepreneurs would need to ensure that suitable family housing is built. Thirdly, VIT would need to provide information and incentives to employees to encourage relocation to Mayo.

The combined community benefits of added family populations at the FNNND and VoM may also encourage some additional retail services. A moderate level of population growth in Mayo—with prerequisite availability of suitable housing—could have overall socio-economic benefits to the local community—whether due to the direct jobs at the mine or the jobs that are result directly or indirectly from contracts and joint venture opportunities.

If a moderate number of Project families were to move to Mayo, the socio-economic dimensions of sustainability would be even further enhanced as follows:

- The development of additional new housing by FNNND could encourage NND citizens to move back to Mayo from other centres if there is a prospect of stable employment with VIT.
- Additional families would bring with them a number of children. This would help with increasing school, and possibly daycare, enrolment as well, contributing to their viability and vitality.
- The additional families would spend money in the community, thus contributing to improved stability of local businesses.
- The additional residents may become part of the pool of potential volunteers for community events, activities, and organizations.
- The additional families moving in would help to rejuvenate the general mood of a community whose growth and development has been stable or declining on a number of fronts in recent years.

6.11.8.3 'Boom and Bust' Cycles of Mining

As noted previously, the community, including the FNNND and other residents of Mayo, has a long-term history of resource development activity, including several "boom and bust" cycles associated with mining (Mayo Historical Society 1999; Aho 2006; Bleiler, et al. 2006). Indeed, Yukon as a whole has experienced several similar mining cycles as a result of fluctuating commodity prices that has resulted in temporary mine closures, or the permanent closure of major mines such as Faro and Mount Nansen.

Today, the Mayo area is experiencing a surge in mineral exploration and development. Both FNNND and the VOM, while recognizing that there are local and regional benefits associated with resource development, would like to avoid the adverse socio-economic effects associated with earlier mining activities in the region, while enhancing the local benefits. Wider forces of social change—both beneficial and otherwise—also have affected Mayo, the FNNND and its citizens, and the non-Aboriginal residents of the area. Historically these include the Federal Indian Act of 1868; contact with non-First Nations people (including missionaries, beginning in 1839); residential schools; mass media (including the Internet and television); introduction of the wage economy (both mine- and non-mine-related) and a shift from traditional ways.

As a result of the contribution to local sustainability from the Project described above, the community would be better able to adapt to the changes that result from temporary or permanent mine closures, while in the interim experiencing a range of socio-economic benefits.

6.11.8.4 Concluding Observations—Sustainability

As a result of the Project—either as a fully self-contained mine operation, or with a few new families moving to Mayo—socio-economic sustainability of the community would be enhanced to a significant degree. The Project would make an important and positive impact on socio-economic sustainability for the FNNND and its citizens, the VoM, the residents of Mayo, and more broadly in Yukon.

6.11.9 Conclusions

The Project would have direct, indirect and induced positive effects in the local and regional study areas. Positive effects would be experienced locally by the citizens of FNNND and VoM, and regionally by the citizens in Whitehorse and elsewhere in Yukon, and also at a national level. These positive effects would be in the form of employment, contract (with associated income) and training opportunities and, tax and royalty payments.

The socio-economic effects of the Project would be positive and substantial. The success and effectiveness of VIT's commitments, mitigations, monitoring and adaptive management would have a direct relationship to the optimization of benefits and prevention or minimization of negative effects. The commitments would assist individuals, organizations and governments in the local and regional assessment areas to take advantage of the many benefits of the proposed Project.

With more than a decade of substantial employment at the mine, individual FNNND citizens and VoM residents would have the opportunity achieve consistent wage employment, benefitting themselves and their families. Many of these individuals may also enhance their skills and capabilities so that continued employment at mining and other projects in the local and regional assessment areas would be likely.

The development of businesses and joint ventures by FNNND and individuals has considerable potential to create economic and employment opportunities, and for the expansion of services to be offered to other projects in Yukon and potentially elsewhere.

The success of the Project would also contribute significantly at the Yukon and national level in terms of royalties and taxes. FNNND also receives a share of the Yukon royalties. These payments would help sustain and enhance a wide range of services offered by government, including education and health care.

The positive effects of the proposed Project and VIT's commitments, mitigation, monitoring and adaptive management measures would also contribute to the socio-economic sustainability of the FNNND, VoM and Yukon. The range of VIT commitments noted throughout the socio-economic effects assessment would contribute in many ways to augment community services, community vitality and overall social, cultural and economic sustainability in the local and regional assessment areas.

VIT has acknowledged its continuing obligations to work with the Project stakeholders. From the outset, VIT has worked to ensure open, cooperative dialogue with the FNNND, VoM, the Yukon Government and other stakeholders. This partnership approach would continue as VIT moves forward in subsequent steps of the process to further develop stated commitments and work toward the implementation of a mutually beneficial Project. Details of how VIT plans to continue this on-going communication are set out in Section 6.11.7.

6.11.10 Figures

Please see the following pages.

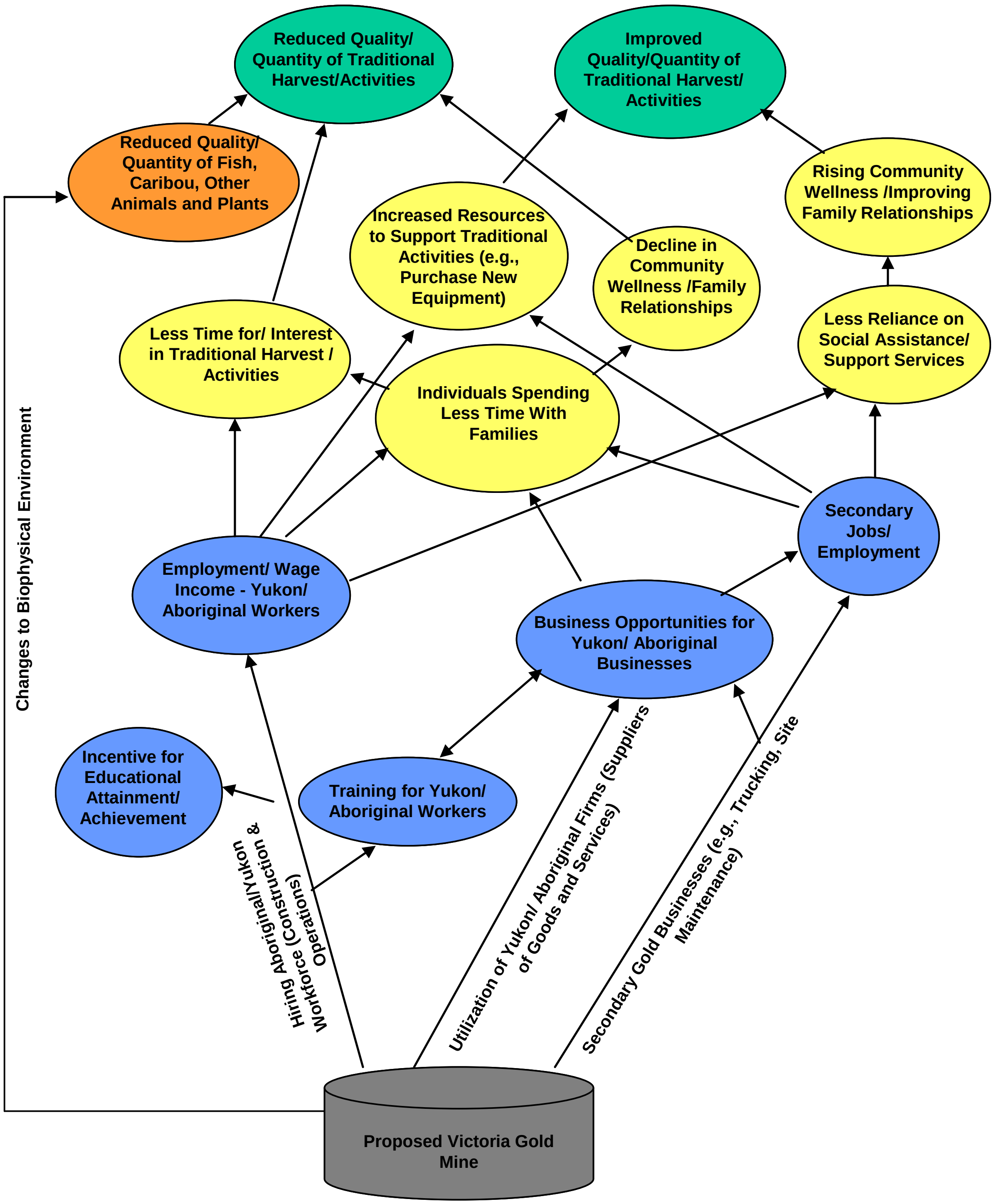


Figure 6.11-1: Linkages Between Proposed Mine and Traditional Activities

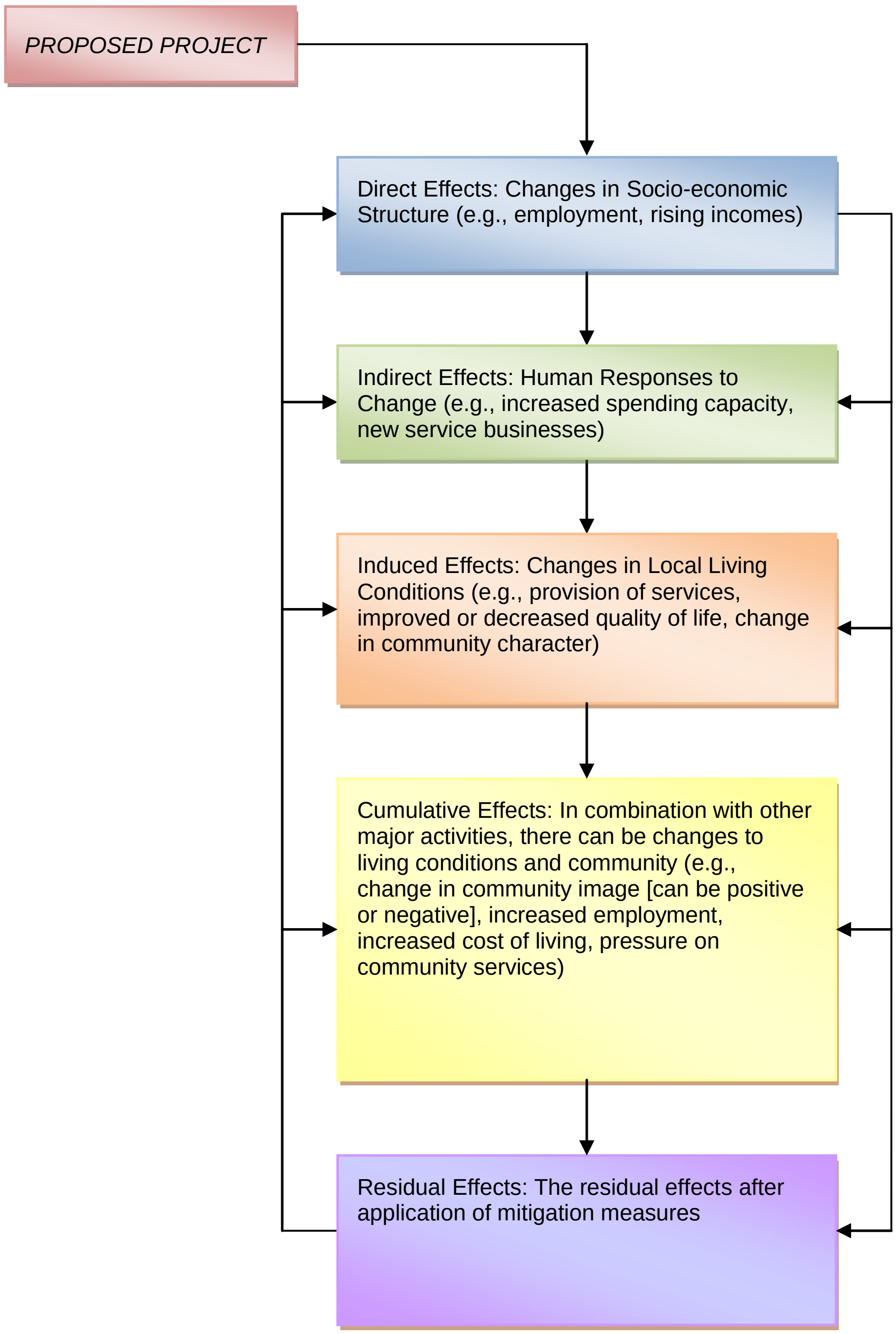


Figure 6.11-2: Types of Effects

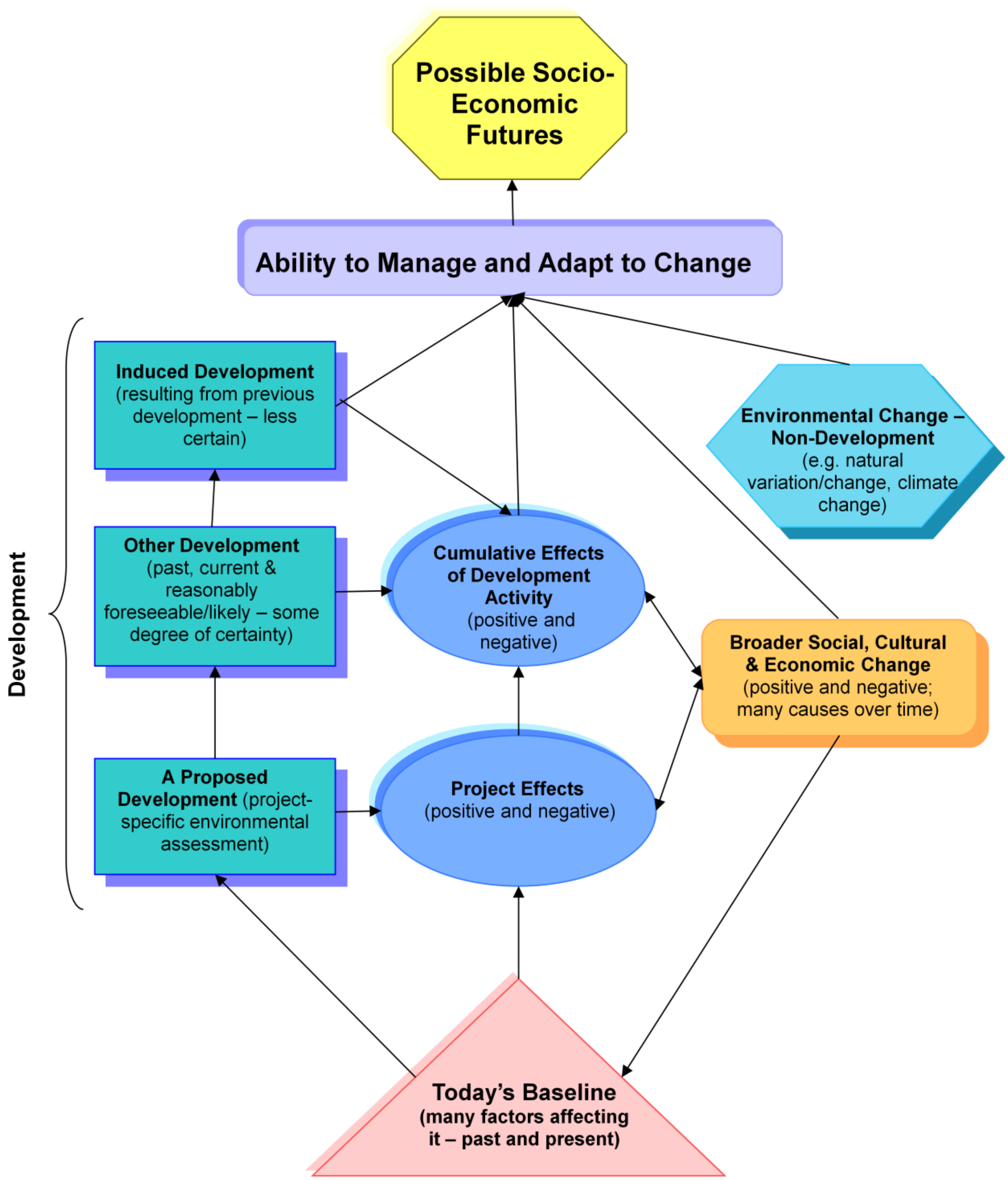
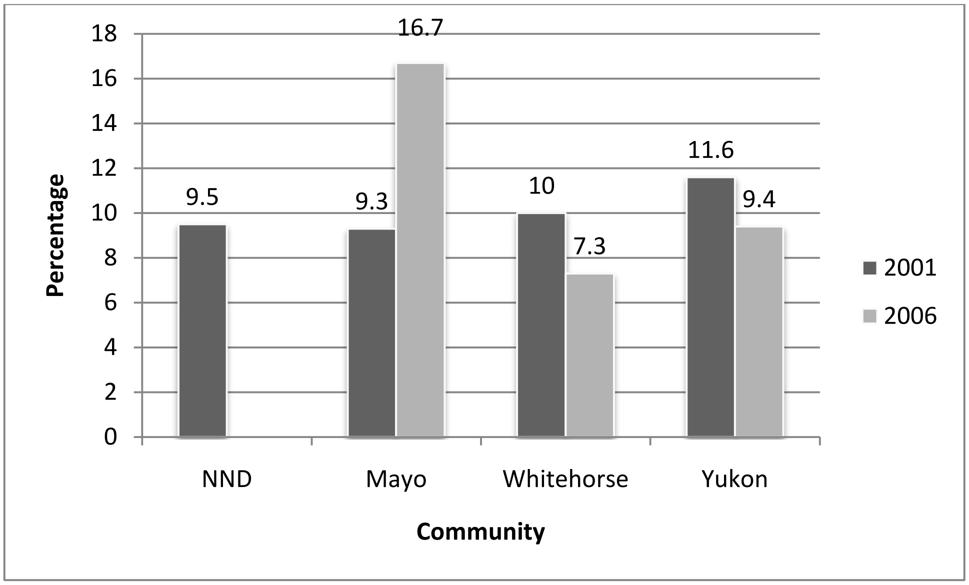
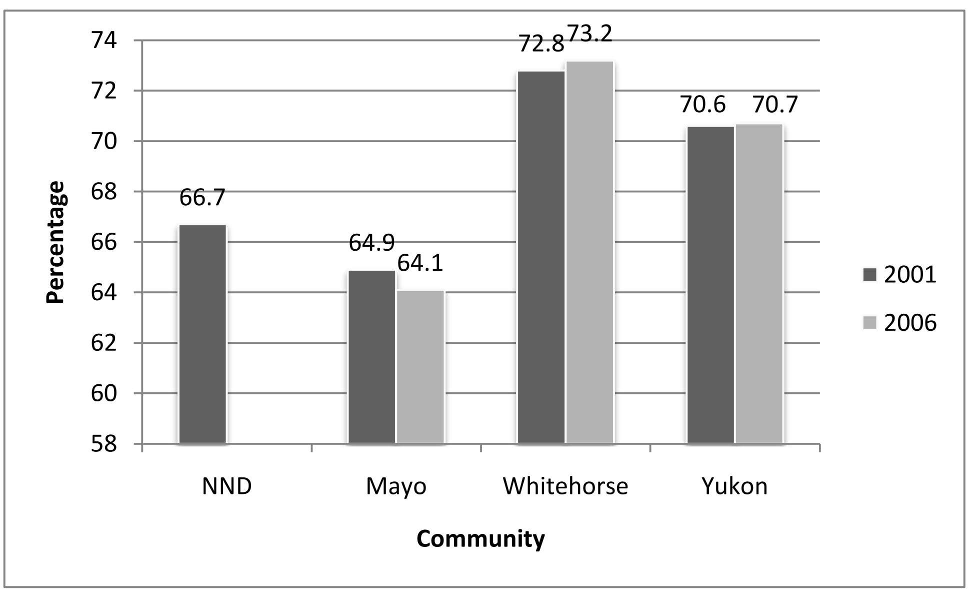


Figure 6.11-3: Socio-economic Change is Influenced by a Range of Factors



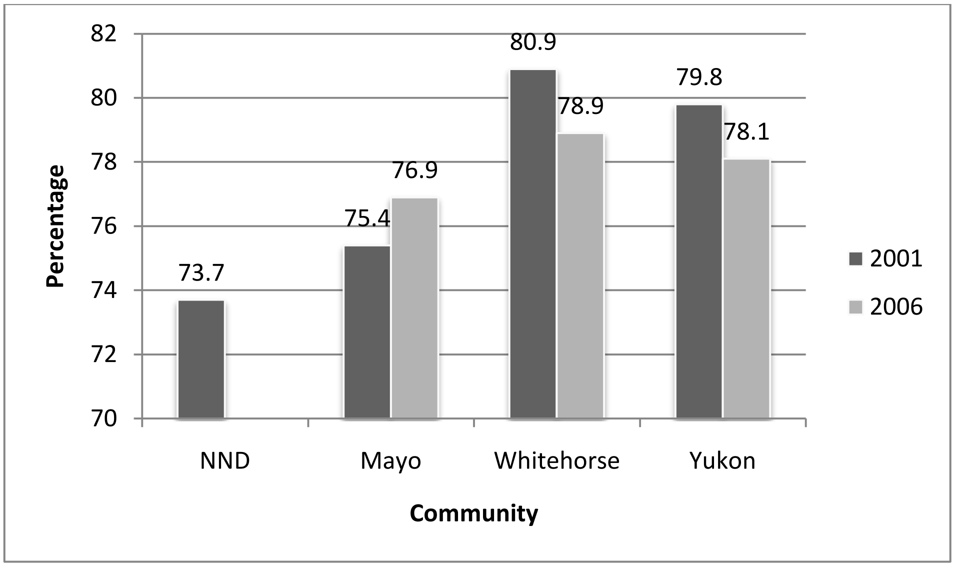
NOTES:
Statistics Canada did not release NND's labour force participation, employment and unemployment rates in 2006.
Source: Statistics Canada, 2010. Community profiles 2001 and 2006

Figure 6.11-4: Unemployment Rates (2001 and 2006)



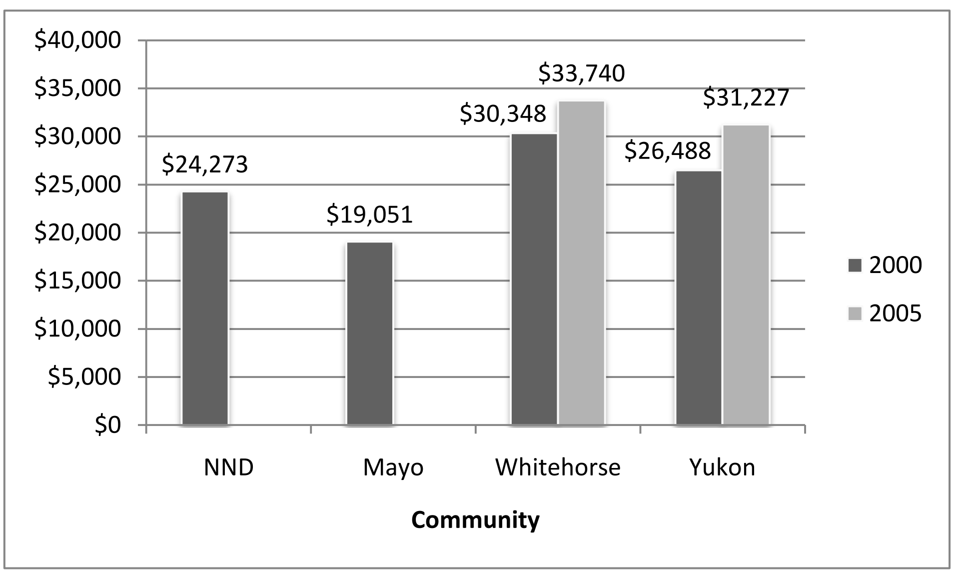
NOTES:
Statistics Canada did not release NND's labour force participation, employment and unemployment rates in 2006.
Source: Statistics Canada, 2010. Community profiles 2001 and 2006

Figure 6.11-5: Employment Rates (2001 and 2006)



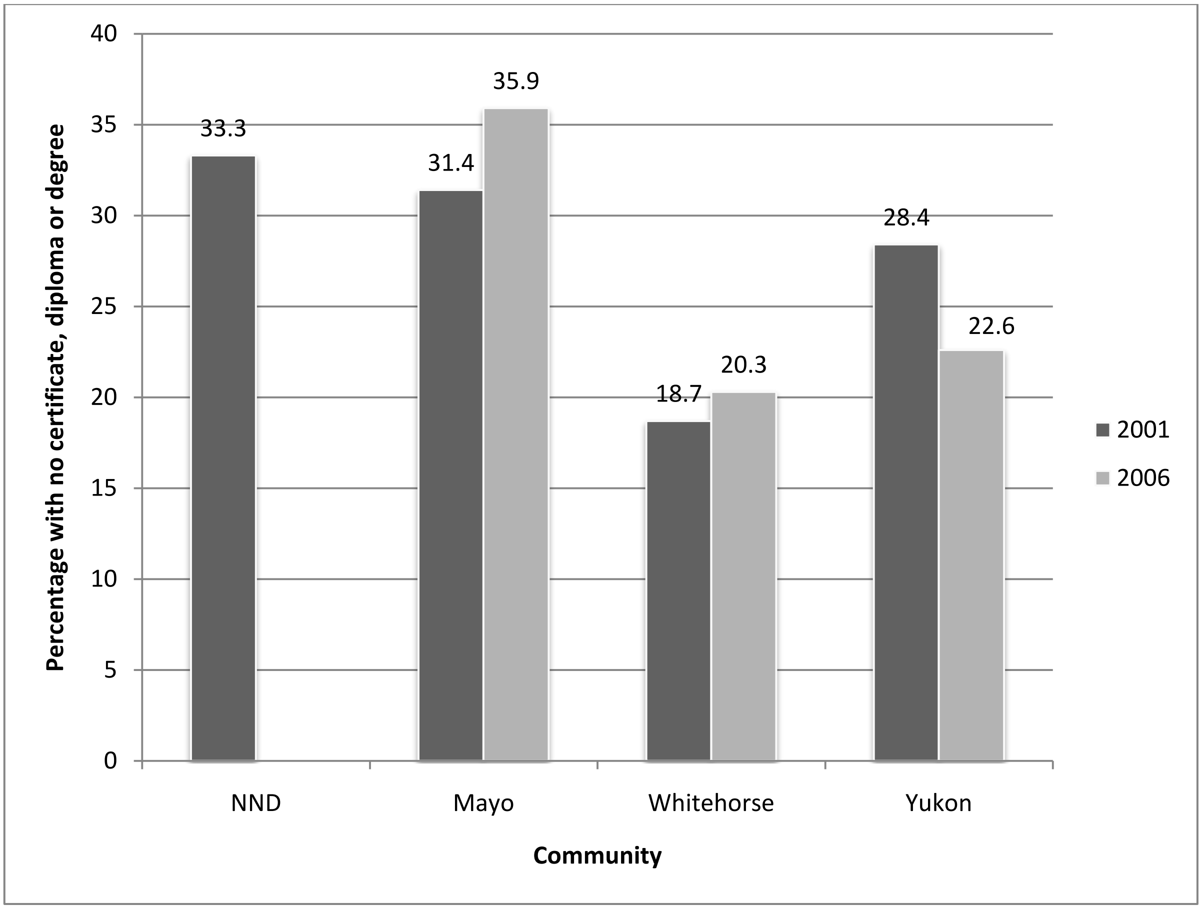
NOTES:
Statistics Canada did not release NND's labour force participation, employment and unemployment rates in 2006
Source: Statistics Canada, 2010. Community profiles 2001 and 2006

Figure 6.11-6: Labour Force Participation Rates (2001 and 2006)



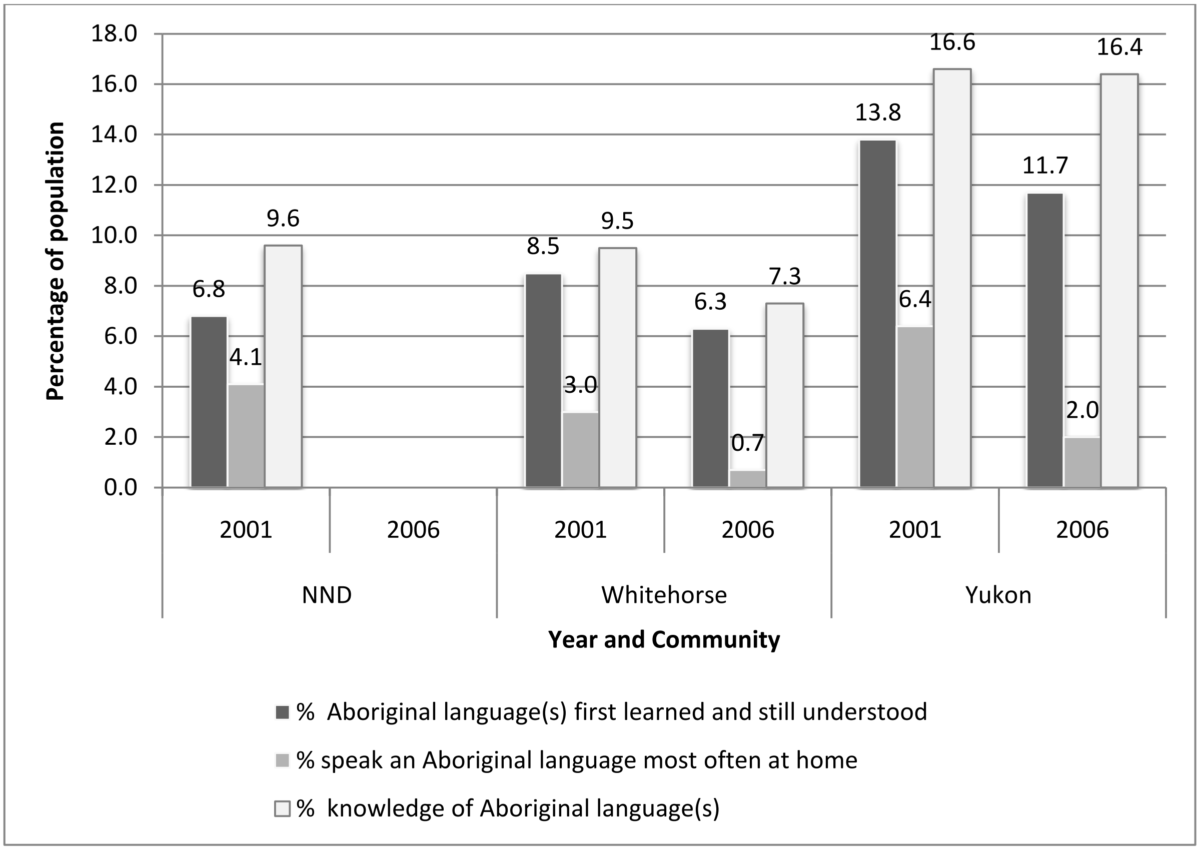
NOTES:
Statistics Canada did not release NND's income figures for 2005.
Statistics Canada suppressed Mayo's income figures in 2006 census.
Source: Statistics Canada, 2010. Community profiles 2001 and 2006

Figure 6.11-7: Average Income (2000 and 2005)



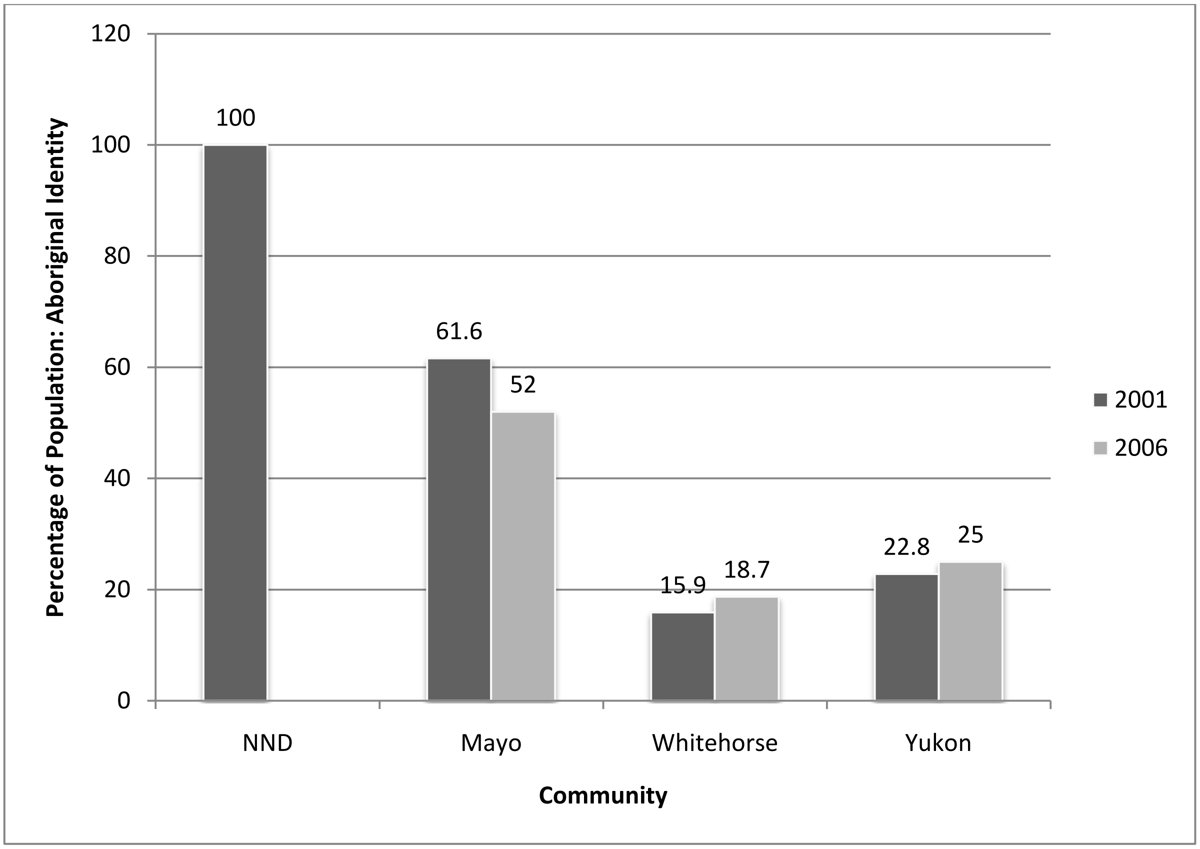
Source: Statistics Canada, 2010. Community profiles 2001 and 2006

Figure 6.11-8: Educational Attainment: No Certificate, Degree or Diploma (2001 and 2006)



NOTES:
Figures on Aboriginal language use were not available for Mayo
Source: Statistics Canada Community profiles 2001 and 2006

Figure 6.11-9: Language Preservation and Revitalization (2001 and 2006)

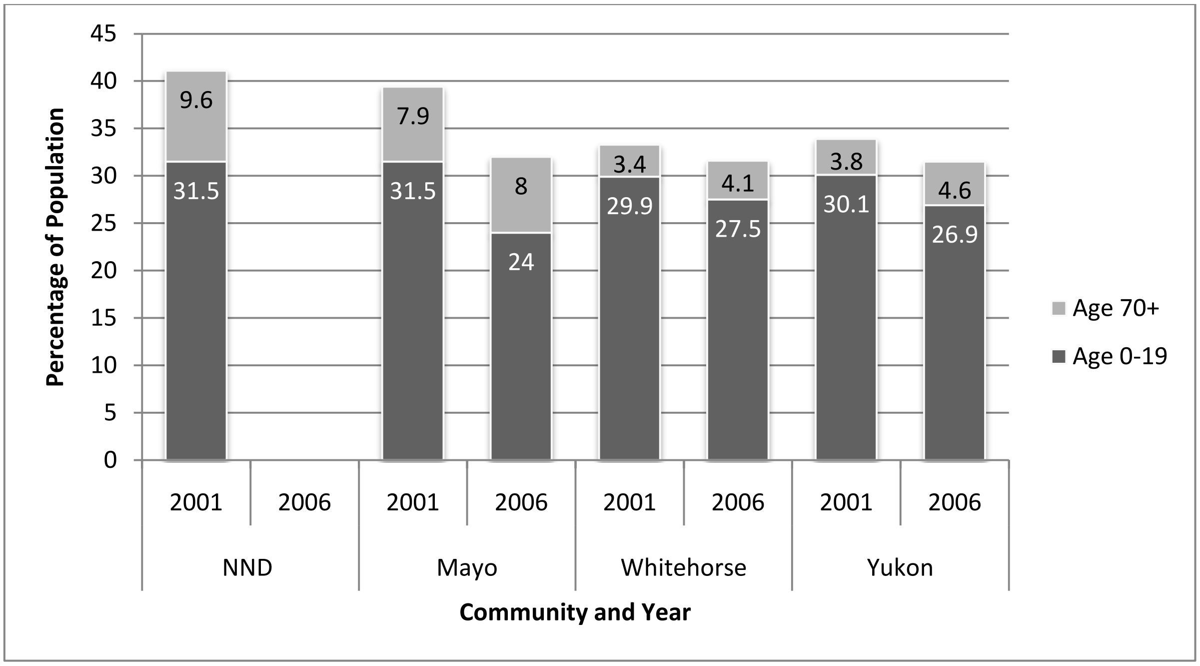


NOTES:

NND statistics are drawn from INAC's 2001 community profile of NND, which is based on Statistics Canada data. INAC's profile indicates that in 2001, there were 365 NND citizens, 205 of whom were "Registered Indian" and 160 of which were "non-registered Indian"

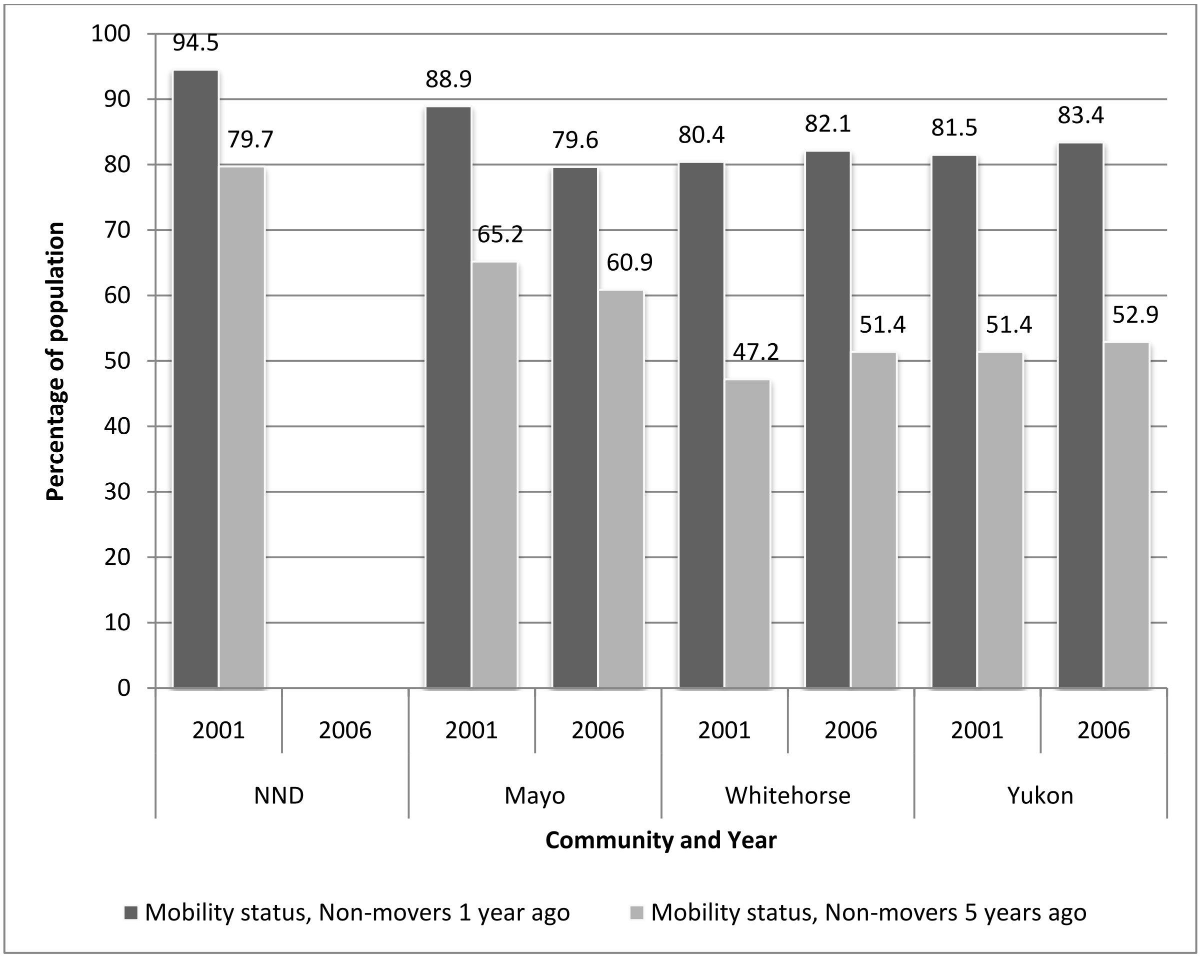
Source: Statistics Canada Community profiles 2001 and 2006

Figure 6.11-10: Recent Population Trends: Aboriginal Identity (2001 and 2006)



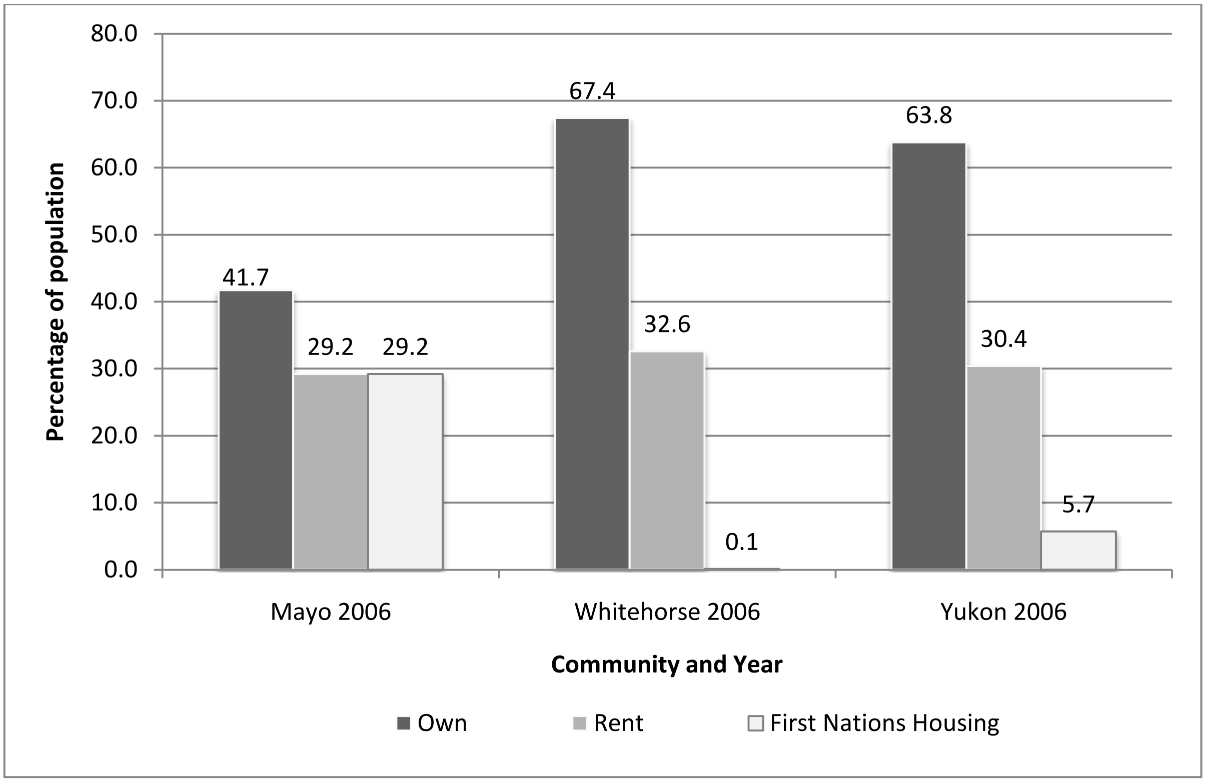
NOTES:
Figures for NND represent the population 65+ years of age and older, due to census reporting methodology.
Source: Statistics Canada Community profiles 2001 and 2006

Figure 6.11-11: Selected Population Age Structures (2001 and 2006)



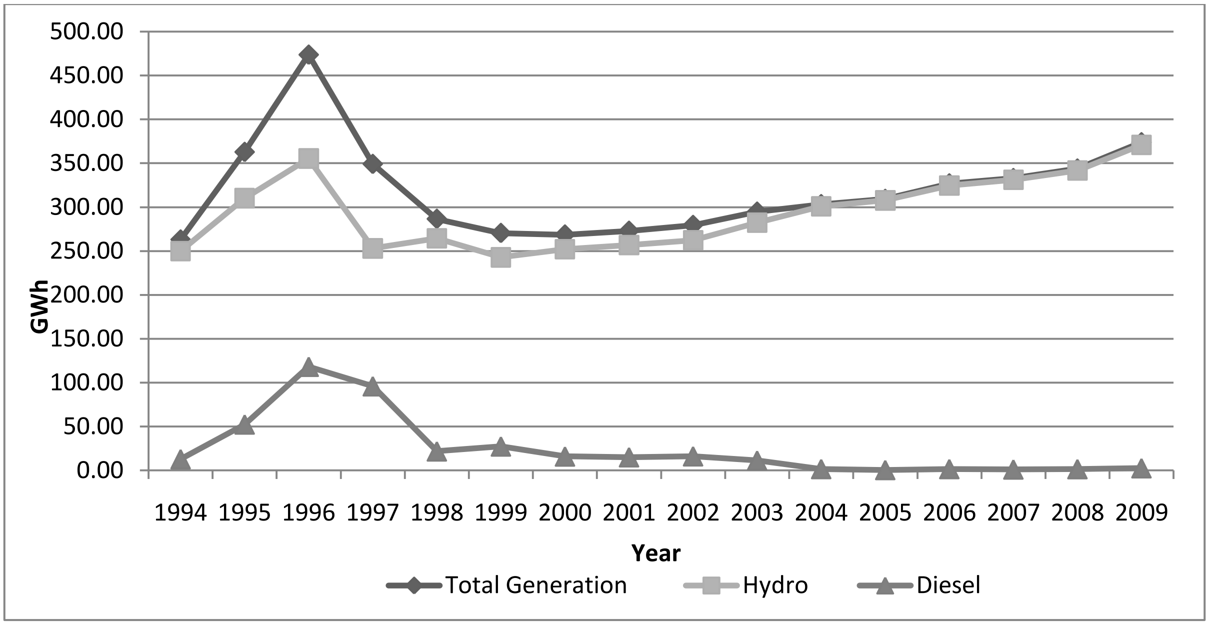
NOTES:
Statistics Canada did not release mobility statistics for NND in 2006
Source: Statistics Canada Community profiles 2001 and 2006

Figure 6.11-12: Mobility Status (2001 and 2006)



NOTES:
Housing information for NND was not available in 2006. NND has been excluded from this chart
Source: Statistics Canada Community profiles 2001 and 2006

Figure 6.11-13: Housing by Tenure (2006)



Source: Personal communication, Yukon Power Corporation, June 2010

Figure 6.11-14: Total, Hydroelectric, and Diesel Generation (1994 to 2009 Yukon)

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7 CARBON MANAGEMENT ASSESSMENT

VIT is committed to working with the federal and territorial governments to meet the greenhouse gas (GHG) targets contained within their respective plans. Although specific policies (e.g., market based solutions such as cap and trade) have not yet been established, an assessment of greenhouse gas emissions will be required to address federal and provincial/territorial concerns and policy, as well as to address existing and emerging legislation to manage carbon.

The carbon management assessment for the Project is based on a consideration of policy in an area with limited tools to assess overall effects. Quantitative information is presented regarding CO_2 emissions from the proposed Project; however, methods are not available to assess the Project's actual potential contribution or effects on climate change in conjunction with carbon outputs from other sources.

Therefore, the following approach is used:

1. Identification of regulations and policy regarding carbon management
2. Quantification of carbon dioxide emissions during the Construction and Operations phase of the Project (from Section 6.6 – Air Quality)
3. Assessment of the options available for carbon management in the context of the Project.

7.1 Background

The term "greenhouses gases" refers to the most abundant gas, carbon dioxide (CO_2), and to methane (CH_4), nitrous oxide (N_2O), sulphur hexafluoride, hydrofluorocarbons, and perfluorocarbons. Total GHG emissions are normally reported as carbon dioxide equivalents (CO_{2e}). This is accomplished by multiplying the emission rate of each substance by its global warming potential (GWP) relative to CO_2. The GWP of the three main greenhouse gases are as follows: CO_2 = 1.0, CH_4 = 21, and N_2O = 310. Details pertaining to the calculation of Project GHG emissions are provided in Appendix 9 (Air Quality Technical Data Report).

Climate change is the long-term shift in local, regional, and global climate patterns. Over the past several decades, a shift in climate has been observed in many regions which may be due to the emission of GHGs. This shift is predicted to translate into, amongst other things, more frequent and intense storm events, droughts, extreme wind-events, and rising sea levels. The northern and arctic regions are particularly vulnerable. For instance, warmer winters could result in the melting of permafrost, which in turn could cause building foundation failures, slope failures, erosion of bridges and dykes, and other infrastructure built on permafrost.

7.2 Regulatory and Policy Setting

7.2.1 Yukon

Concern about the potential impacts of GHG related climate change resulted in policy and regulatory initiatives. At the Canadian federal level, legislation and GHG emissions targets are still being developed based on the approach set out in Canada's 2007 action plan, the *Turning the Corner Plan*, which was further elaborated upon and strengthened by a regulatory framework in 2008 (Environment Canada 2008). With the uncertainty surrounding federal climate change legislation, a number of provinces have been developing their own climate legislation to reduce GHGs. The Yukon Government Climate Change Strategy (YGCCS) was published in 2006 (Yukon Government 2006a). The strategy's four goals call for:

1. Enhancing public awareness
2. Reducing greenhouse gas emissions
3. Building environmental, social, and economic systems to adapt to changes and take advantage of climate change opportunities
4. Establishing Yukon as a northern leader in climate change research and innovation.

Environment Yukon has focused on meeting these goals through the development of the Yukon Climate Change Action Plan, which was finalized in 2009 (Yukon Government 2009a). The Action Plan identifies 33 specific actions that advance the goals set out in the 2006 YGCCS. Amongst them, the Yukon government is committed to demonstrating leadership by reducing GHG emissions from its operations. The Yukon government carbon footprint will be reduced over three stages: capping GHG emissions in 2010, reducing GHG emissions by 20% by 2015, and becoming carbon neutral by 2020. The Action Plan also identifies reduction of GHG emissions as a priority for the transportation sector, which has been found to contribute approximately 60% of Yukon's total GHG emissions. Finally, the Action Plan aims to establish GHG emission reduction targets within two years (by 2011). Currently, though, there are no regulations related to release of GHG emissions within Yukon.

7.2.2 National and Territorial GHG Emissions

The Yukon and Canadian total GHG emissions for the years 1990 to 2008 are presented in Table 7.2-1. The total GHG emissions were obtained from the National Inventory Report (Environment Canada 2010b). Environment Canada's National GHG Inventory reports that 734,000 kt of CO_{2e} was emitted across Canada in 2008 (Table 7.2-1). This represents a decrease of 2.1% from 2007 levels. In comparison, the 2008 Yukon emissions were 350 kt of CO_{2e}, a decrease of 14% from 2007 Yukon levels.

Table 7.2-1: National and Territorial GHG Emissions

Year	GHG Emissions (kt of CO_{2e} per year)	
	Yukon Total	Canada Total
1990	531	592,000
2004	411	741,000
2005	394	731,000
2006	408	718,000
2007	407	750,000
2008	350	734,000

Source: Environment Canada. National Inventory Report. 1990 – 2008. Greenhouse Gas Sources and Sinks in Canada.

Globally, Yukon generates very low GHG emissions but possibly could experience one of the largest temperature changes in the country (Yukon Government 2006a). It has been recognized that the anticipated territorial climate change effects are a result of global anthropocentric activities. As such, if Yukon GHGs were eliminated completely, the global impact would go unnoticed (Yukon Government 2006a). Between 1990 and 2008, Yukon's population increased by about 19%, while per capita emissions decreased from 19.0 to 10.5 tonnes GHG per person, a 44% reduction (Environment Canada 2010b). Yukon's 2008 per capita emissions are well below the national average of 22.0 tonnes, making Yukon the second lowest per capita GHG emitter, behind only Quebec (Environment Canada 2010b).

7.3 Project-related Greenhouse Gas Emissions

Project activities will result in the emission of CO_2 and other GHGs. The primary Project-related sources of GHGs include diesel generators, and exhaust of equipment and vehicles. Emission estimates are provided in Table 7.3-1.

The CO_{2e} emissions amount to 13,473 tonnes during construction. This is calculated using the assumption of 15 months of active construction taking into account cessation during winter months (see Section 5.4 of the Project Proposal – major construction activities will not be undertaken during the winter from approximately October 29, 2012 through March 15, 2013). Construction GHG emissions are small compared to the Yukon and Canada totals (Table 7.2-1).

During the operations phase, CO_{2e} emissions amount to 7,765 tonnes per year—representing a 2.2% per year increase for Yukon measured against its 2008 emissions levels of 350 kt of CO_{2e}. Project operational GHG emissions represent a 0.001% increase per year measured against Canada's 2008 emissions of 734,000 kt of CO_2e.

Construction and operations sources of GHG emissions are discussed in detail in Appendix 9. While the Project's CO_2 emissions can be accurately estimated, their actual contribution to or impact on climate change cannot be measured or determined.

Table 7.3-1: Project GHG Emission Rates

Project Phase	GHG Source	Emission Rates (tonnes of CO_{2e})
Construction Phase[1]	Generators (permanent locations)/year	7,833.6
	Generators (rotating locations)/year	1,044.8
	Heavy and support equipment/year	1,900
	Construction Phase Total/year	**10,778**
	Construction Phase Total (15 months)	**13,473**
Operations Phase	Plant gold recovery equipment/year	4,267
	Heavy mine and support equipment/year	3,498
	Operations Phase Total/year	**7,765**
	Operations Phase Total/year (7.3 years)	**56,684**

NOTES:
[1] Emission rates were estimated for construction equipment operating between Jan. 1, 2012 and Aug. 13, 2013. Equipment is assumed to be inactive during the winter months (Oct. 29, 2012 – Mar. 15, 2013).

The proposed design and operation of the Project is consistent with existing mines in Yukon and Canada, and complies with all existing federal and territorial regulatory requirements. VIT has also incorporated climate change considerations into its Project planning. An example of this is VIT's consideration of two scenarios for power sources. The first scenario, Option 1, was based on 100% diesel generated power. The second scenario, Option 2, was a combination of diesel generated power and power supplied by the Yukon Energy Corporation electrical transmission grid. Option 2 includes installation of a new transmission line from the existing transmission line that follows the Silver Trail Highway, along the existing South McQuesten Road and Haggart Creek Road to the mine site. Option 2—Power provided by the Yukon Energy Corporation electrical transmission grid was determined to be the most economically and environmentally favourable option. Grid power is favourable over diesel power generation from an environmental perspective, as increased diesel emissions from diesel generators will result in increased GHG emissions.

VIT has engaged in discussions with Yukon Energy Corporation to determine provision of grid power to the Project. VIT has requested that Project connection to the Yukon Energy Corporation power transmission grid occur at the onset of the operations phase of the Project. Although discussions between VIT and Yukon Energy Corporation are ongoing at this time, it is assumed that grid power will be available by 2013 to supply power during the operations phase of the Project.

By working with Yukon Energy Corporation to develop a transmission line to the Project site, VIT has reduced the Project's reliance on diesel generators, and in doing so, decreased potential GHG emissions by a substantial margin.

VIT is further committed to minimizing the Project's contribution to emissions by:

- Using Best Available Technology Economically Achievable (BATEA) measures and best practices

- Using BATEA to meet or exceed relevant regulatory emission standards for all mine equipment
- Enforcing low speed limits for all mobile mine equipment
- Ensuring all mine equipment is properly tuned and maintained
- Reducing vehicle idling times.

In addition, the Yukon government is considering reporting territorial GHG emissions through the "Climate Registry" in an effort to reduce its operational emissions (Yukon Government 2009a). The registry is a third party verification organization which provides tools and support in tracking GHG emissions. The reporting mechanism will allow Yukon to measure and track progress towards achieving the goals identified in the Yukon Climate Change Action Plan (2009). If the registry does become active, VIT will support territorial initiatives to minimize GHG emissions during the Construction and Operations phase of the Project.

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8 ASSESSMENT OF EFFECTS OF ACCIDENTS AND MALFUNCTIONS

The following sections present the assessment of effects to environmental and socio-economic VCs that could occur in the event of an accident or malfunction associated with the Project. The assessment identifies:

- Areas or components representative of where an accident or malfunction could occur, either due to a natural event (e.g., ground instability), a failure of a system component (e.g., mechanical or power failure), or human error
- Controls and procedures VIT will put in place to minimize or avoid the potential for these events
- The potential environmental effects from an accident or malfunction, including their characteristics and significance
- The range of measures to be implemented by VIT to initially contain and respond to different types of accidents and malfunctions, as well as further contain and clean-up any accidental releases.

The assessment has taken into consideration the range of legislation applicable to the Project, as well as industry best practices which have been applied to the Project to further strengthen accident and malfunction prevention and planning. As Project design advances and during the permitting and licensing phases, the review of potential accidents and malfunctions and the means for prevention and response will be conducted in detail. The purpose of this assessment at this preliminary stage of Project design is to establish an understanding of the types of events that might occur and to assess whether or not it is reasonable to expect that design and management practices can reduce potential effects to a level that is not significant.

8.1 Scope of the Assessment

Accidents and malfunctions identified for consideration in the assessment were determined through discussions with the FNNND, Yukon and other government representatives, and the public; as well as the professional experience of VIT, its mining engineers, and environmental consultants. Section 2.7.3 provides additional discussion of issues raised during the consultation process. The categories of potential accidents and malfunctions assessed included the following potential events, which are described in detail in Section 8.2:

- Transportation accident
- Hazardous materials spill
- Heap leach facility (HLF) breach
- Slope failure (open pit and WRSAs)
- Water conveyance and storage infrastructure failure
- Power failure

- Fire and/or explosion.

These events are described in detail in Section 8.2.

8.1.1 Regulatory/Policy Setting

Section 42(1)(c) of the *Yukon Environmental and Socio-economic Assessment Act* (YESAA) states that in conducting an assessment, the Yukon Environmental and Socio-economic Assessment Board (YESAB) shall take into consideration:

> *the significance of any environmental or socio-economic effects of the project or existing project that have occurred or might occur in or outside Yukon, including the effects of malfunctions or accidents.*

The YESAB "Proponent's Guide to Information Requirements for Executive Committee Project Proposal Submissions" provides additional guidance and was consulted with respect to information contained in this Section. In addition transportation and use of materials such as fuels and explosives are governed by a number of federal and territorial regulations and guidelines administered by various agencies (at the territorial and federal level). A list of potential permits required for the Project is provided in Section 1.5. VIT will work with Energy Mines and Resources (EMR) and other regulators to seek guidance regarding information requirements for all future permit applications. Permit applications will require additional details regarding accident and malfunction prevention and response measures, and be developed during the feasibility stage of the Project.

Federal and territorial legislation and guidelines, and industry best practices establish requirements for pre-emptive planning for, responding to, and reporting of, accidents and malfunctions. These include:

- For worker health and safety:
  - Yukon Occupational Health and Safety Act
  - Yukon Worker's Compensation Act and Regulations
  - Yukon Public Health and Safety Act.
- For spills or hazardous releases:
  - Yukon *Environment Act*, Spills, Special Waste and Storage Tank Regulations
  - Yukon Quartz Mining Land Use Regulation
  - Federal Transportation of Dangerous Goods Act and Regulations
  - Pollution prevention provisions under the *Fisheries Act* (section 36)
  - Canadian *Environmental Protection Act* and Environmental Emergency Regulations.
- For fire and/or explosion:
  - Yukon Forest Protection Act.
- For mine facility emergencies:
  - Yukon Quartz Mining Land Use Regulation.

An overview of the requirements associated with this legislation is provided in the following sections, as well as other guidelines and industry best practices which have been applied to the Project.

8.1.1.1 Worker Health and Safety

VIT is committed to worker and public health and safety. Through compliance with the *Worker's Compensation Act* and *Regulations*, the *Occupational Health and Safety Act*, and the *Public Health and Safety Act* VIT will ensure its operations are conducted to minimize risk through training, awareness, and continuous improvement. VIT works to instill a culture of safety throughout all levels of the organization and will make safety the top priority at the Eagle Gold mine site. Worker health and safety will form a component of the detailed Environmental Management Plan developed as part of the Quartz Mining License application (see overview in Appendix 30).

8.1.1.2 Spills or Hazardous Releases

The Yukon Department of Environment develops and implements tools to prevent, prepare for, and respond to hazardous materials spills. Treatment of spills is legislated through Part 11 of the *Environment Act* and the Spills and Special Waste Regulations. These Regulations list quantities of substances defined as a spill under the *Environment Act* which must be reported to the Yukon Spills Report Centre (YSRC). Fuel storage requirements are provided for under the Storage Tank Regulations. Additional guidance is provided by the Yukon Water Board's "Fuel Spill Contingency Plan Guidelines".

The federal *Transportation of Dangerous Goods Act* and Regulations and Yukon *Dangerous Goods Transportation Act* ensure safety standards are in place to promote public safety in the transportation of dangerous goods in Canada.

Table 8.1-1 lists hazardous materials that could be subject to accidental spill or release by the Project and externally reportable quantities according to the Spills Regulations and the Special Waste Regulations. These regulations classify substances in accordance with the federal Transportation of Dangerous Goods Regulations. All spills of reportable quantity will be reported to the YSRC (867-667-7244). Spills resulting in deposit of deleterious substances in any water that supports fish or flows into fish-bearing waters will be reported to DFO (1-800-465-4336). Internal reporting will be required regardless of the quantity spilled. The person who had possession, charge, or control of the released substance is responsible for reporting.

Table 8.1-1: List of Externally Reportable Quantities for Project Substances

Substance	Classification	Reportable Quantity
Fortran Advantage (explosives emulsion)	Explosives Class 1	Any amount
Gas, diesel	Flammable liquids, Class 3	200 L
Hydrogen peroxide, smelting flux component 5% (sodium nitrate)	Products or substances that are oxidizing substances, Class 5.1	50 kg or 50 L
Sodium cyanide	Poisonous substances, Class 6.1	5 kg or 5L

Substance	Classification	Reportable Quantity
Sodium hydroxide, hydrochloric acid	Corrosives, Class 8	5 kg or 5 L
Copper sulfate pentahydrate	Miscellaneous products or substances in Class 9.2	1 kg or 1 L
Dangerous goods that are no longer used for their original purpose	Special waste, as defined by the Special Waste Regulations	500 g or 500 mL within 24 hours 5 kg or 5 L within a 30 day period

NOTE:
If there is any doubt regarding the size of a spill, material involved, and whether it is reportable, VIT will err on the side of caution and report the spill.

Spill reporting is also a component of the *Canadian Environmental Protection Act* and *Environmental Emergency Regulations*. These Regulations contain a list of substances which, when stored in specified quantities at a site, require development of an environmental emergency plan (EEP), to be filed with Environment Canada. The emergency plan will have to address the types of emergencies that might reasonably occur, including both on-site and off-site consequences, and the associated prevention, preparedness, response and recovery issues. Table 8.1-2 lists substances used for the Project which are also listed in the *Environmental Emergency Regulations*. If quantities stored onsite exceed the EER minimum quantity, VIT will be required to file an EEP with Environment Canada. Onsite storage quantities will be finalised during the feasibility phase of the Project.

Table 8.1-2: List of Project Substances which May Require Environmental Emergency Plans

Substance	EER Minimum Quantity
Hydrogen peroxide	3.4 tonnes @ [52%]
Hydrochloric acid	6.8 tonnes @ [30%]

Section 36(3) of the *Fisheries Act* prohibits the deposit of “deleterious substances” into water that supports fish for flows into fish-bearing waters. The Fisheries Act defines a deleterious substance as any substance that makes the water deleterious to fish or fish habitat or any water containing a substance in such quantity or concentration or has been changed by heat or other means, that if added to water makes that water deleterious to fish or fish habitat. There is no provision to permit or approve the deposit of deleterious substances except by Regulation or Order in Council. As a result, it is necessary to ensure there are appropriate environmental protection and response plans in place to protect streams, rivers, wetlands, and lakes from spills or other accidental events.

8.1.1.3 Fire and/or Explosion

The Yukon *Forest Protection Act* is enforced through the Fire Management Program, whose mandate is to prevent personal injury and loss of life, and to minimize social and economic disruption resulting from wildfires. The *Forest Protection Act* specifies legal obligations when using fire for various purposes including industrial burning, and puts the onus on those persons using open fire to ensure their activities do not lead to wildfires.

8.1.1.4 Mine Facility Failures

Issuance of a Quartz Mining License for the Project under the *Quartz Mining Act* will require a comprehensive Environmental Management Plan, including an Emergency Response Plan, which contains information for dealing with site-specific emergencies and system failures. The Emergency Response Plan will delineate steps for response and clean up of any spills of fuel or other hazardous materials, including addressing human health and safety. An outline of the Environmental Management Plan and Emergency Response Plans for the Project are provided in Appendices 30 and 33, respectively. The assessment of potential accidents and malfunctions will be used to inform the development of these detailed plans during the feasibility phase of the Project to ensure all potential emergency events are considered, and detailed contingency plans identified.

8.1.2 Approach

The assessment of effects of potential accidents and malfunctions overall follows the same approach described in Section 6.1 for the individual VC assessments. For each potential accident and malfunction:

4. Potential interactions with each VC were identified (Table 8.1-3).
5. Mechanisms of interaction between each accident or malfunction each VC was described.
6. Project design measures that minimize the potential for an accident or malfunction, and the emergency response, mitigations, and follow-up monitoring to minimize the environmental effect were described.
7. The subsequent likelihood of occurrence (Table 8.1-4) and environmental consequence (Table 8.1-5) was described to provide context to the assessment.
8. The potential residual environmental or socio-economic effects to each VC were described or using the measurable parameter(s) and other effect characterization terms identified in the individual VC assessment sections (Section 6.4 to 6.11).
9. The significance of the predicted effect or change was then evaluated within the context of the potential consequence of the effect and the likelihood of the event occurring. (Section 6.3.7).

8.1.2.1 Event Interactions with the Biophysical and Human Environment

The assessment of potential effects to VCs is based on an initial screening and ranking of the interactions between potential accident and malfunction events and each VC to identify areas of higher risk. The ranking of interactions was completed as described in Section 6.3.1.

Higher risk interactions were ranked as ‘2’ and carried forward for more detailed assessment, similar to those carried out for individual VCs (Section 6.3). Lower-risk interactions (ranked as ‘1’) are defined as: a) those, which based on past experience and professional judgment, would be nominal and not result in significant effects, even without mitigation; or b) those interactions that would not be significant due to the application of codified practices known to effectively mitigate the predicted effects. These interactions are described, but not carried forward for detailed assessment. Where no interaction is anticipated a ranking of ‘0’ is assigned. Table 8.1-3 provides the rankings assigned to each event-VC interaction. These interactions are further described in Section 8.2.

Table 8.1-3: Interaction of Project Related Accidents and Malfunctions with Environment

Accident and Malfunction Event Scenarios	Surficial Geology, Terrain, and Soils	Water Quality and Aquatic Biota	Air Quality	Fish and Fish Habitat	Vegetation Resources	Wildlife Resources	Heritage Resources	Employment and Economic Opportunities	Traditional Activities and Culture	Community Vitality	Human Health and Well-being	Infrastructure and Services
Transportation accident	0	0	0	0	0	1	0	0	0	0	0	1
Hazardous materials spill	2	2	1	2	1	1	0	0	1	0	1	1
Heap leach facility breach	2	2	0	2	1	1	0	1	1	0	1	1
Slope failure (open pit and WRSAs)	2	2	1	2	1	0	0	0	0	0	0	0
Water conveyance and storage infrastructure failure	1	2	0	2	0	0	0	0	0	0	0	0
Power failure	0	0	0	0	0	0	0	0	0	0	0	0
Fire and/or explosion	0	1	2	1	2	1	0	0	1	0	1	1

PROJECT-ENVIRONMENT INTERACTIONS

0 = No interaction

1 = Interaction occurs; however, based on past experience and professional judgment the interaction would not result in a significant environmental or socio-economic effect, even without mitigation; or interaction would not be significant due to application of codified environmental protection practices that are known to effectively mitigate the predicted environmental or socio-economic effects

2 = Interaction could result in an environmental or socio-economic effect of concern even with mitigation; the potential environmental and socio-economic effects are considered further in environmental assessment

8.1.2.2 Event Likelihood and Consequence

Based on information from previous mining projects and the professional judgment of the Project team, a classification of likelihood and of consequence were assigned to each event. The purpose of assigning a likelihood category is to ensure consistency in how likelihood is estimated for different events, and to provide context for assessing potential effects. A consequence rating provides a broad view of how severe a potential event could be if it occurred.

Table 8.1-4 list the likelihood and Table 8.1-5 consequence classification definitions used for the assessment.

Table 8.1-4: Event Likelihood Classification

Likelihood	Description
Very unlikely	Not expected to occur during life of the Project
Unlikely	Low probability of occurrence during life of the Project
Likely	Could happen during life of the Project
Highly likely	Expected to happen during life of the Project

Table 8.1-5: Event Consequence Classification

Consequence	Description
Very low	Effects are localized and reversible through mitigation
Low	Effects extend beyond event site and persist over the short-term, but are reversible through mitigation
Moderate	Effects extend to the larger Project site, and persist over the life of the Project, but are reversible through mitigation
High	Effects extend beyond the Project site and persist beyond the life of the Project

8.2 Effects Assessment

8.2.1 Transportation Accident

The vast majority of materials required for Project construction, operations, closure and reclamation will be transported to the site by truck from Whitehorse to Stewart Crossing on Highway 2 (Klondike Highway), northeast toward Mayo on Highway 11 (Silver Trail), and then west and northwest along the South McQuesten Road (SMR) and Haggart Creek Road (HCR) (Section 3.3.1). A small quantity of materials or personnel may come to the site from Dawson City or from Keno City. The SMR and HCR will be upgraded for the Project to accommodate the payloads and traffic volumes required for the Project (Section 5.4.2.1). This section evaluates the potential effects of the “accident” per se, not the effects that might result from the spilling of cargo. Potential effects of hazardous materials spills are considered in Section 8.2.2.

The major risks associated with materials transportation include equipment failure, poor road conditions, multiple vehicle accidents, wildlife crossings, and human error. Assuming a single incident, the magnitude of the largest loss would be restricted to the capacity of the largest load. Without appropriate emergency response, a transportation accident could result in a release of hazardous materials into the environment. Depending on the accident location and the type of material involved, effects could spread significant distances from the accident site if hazardous materials were to reach moving water.

Estimated Project-related traffic volumes include:

- Construction (20 months):
  - 1,500 to 1,800 semi-trailer loads (round trip)
  - 10 to 20, 1 to 5 tonne trucks per day on average (600 to 800 round trips)
  - 10 passenger car or pickup trucks per day.
- Operations (7.3 years):
  - 1,944 trucks per year (round trip) (including 156 cyanide shipments)
  - 100 to 200 buses per year (round trip).

While VIT recognizes that potential for accidents increases with increasing number of trips, the goal for the Project will be zero accidents. Traffic safety will be aggressively implemented and enforced by VIT to ensure human and environmental health and safety. The following section outlines proposed measures to ensure Project vehicle safety.

8.2.1.1 Project Design Measures to Minimize Risk of Transportation Accidents

The following design measures and proposed mitigation have been or will be implemented to minimize the potential for transportation accidents for the Project:

- VIT will work with the Department of Highways and Public Works to ensure both public and private portions of the access road are properly maintained and upgraded as required (Section 5.5.2.1).
- Speed limits will be enforced for all Project vehicles.
- VIT will ensure trucking/hauling contractors have appropriate driver training, radio contact capabilities, vehicle maintenance requirements, and spill response capabilities.
- VIT will ensure all hazardous materials are transported and handled in accordance with the *Transportation of Dangerous Goods Act* and Regulations.
- Bulk carriers will be required to carry two-way radios to communicate with the mine site.
- The HCR will be a two-way, one-lane radio controlled access road with regular vehicle pull-outs to allow passing; signage will be posted to ensure non-Project traffic is aware of radio protocols.
- Wildlife migration corridors and crossings along the road will be identified and signage provided in high risk areas.
- Wildlife crossing and escape points will be plowed in the access road snow banks
- VIT will have on-site personnel with emergency first-aid training to provide primary care in the event of an accident, and will establish an Emergency Response Plan (Appendix 33) for the Project.

Section 5.4.2.1 provides additional details on design safety standards for the SMR and HCR access roads.

8.2.1.2 Transportation Accident Likelihood and Consequence

Transportation of materials by road using bulk carriers is common practice throughout Yukon and North America. The number of accidents due to equipment malfunction (e.g., braking systems, tires, axles) is expected to be proportionately similar. Based on the number of shipments required for Project operations, the potential for an accident due to equipment failure over the life of the Project is considered likely.

The likelihood of accidents involving bulk carriers due to poor road conditions, particularly in the winter are expected to be much higher than accidents due to equipment malfunction. The use of bulk carriers throughout Yukon in all seasons in all road conditions is common practices, and the risks are proportionately similar. A transportation accident due to poor road conditions is considered likely.

Because the area is mainly used by prospectors, trappers, and placer miners, the amount of non-Project traffic between the Silver Trail and the Project site is expected to remain low. A multiple vehicle collision along the SMR and HCR is considered unlikely due to the proposed mitigation measures, including radio-controlled access and development of vehicle pull-outs.

The occurrence of an accidents involving wildlife, particularly in spring, fall, and winter, is considered likely during the life of the Project. Risks of wildlife collisions are common throughout Yukon and are a hazard to both bulk carriers and regular vehicle traffic.

The consequence of an accident due to any of the above causes is considered very low, as effects would be limited to the accident site and could be dealt with by a small number of first-responders, likely from the mine site. Potential consequences of spills due to accidents are discussed in Section 8.2.2.

8.2.1.3 Potential Effects of Transportation Accidents

Based on the screening of potential interactions in Table 8.1-4, transportation accidents are not expected to result in an environmental or socio-economic effect of concern with the following of codified mitigation and industry best management practices. The potential effects of spills resulting from transportation accidents are discussed in Section 8.3.2. The potential interactions ranked as ‘1’ are discussed below.

Wildlife Resources—Effects to wildlife associated with increased traffic are discussed in Section 6.9.3. While the rates of wildlife mortality due to current or projected traffic volumes are not known, it is expected mortality risk will be minimized through implementation of proven mitigation measures described above. The Project is not expected to pose a substantial mortality risk for wildlife and effects on mortality are considered not significant.

Infrastructure and Services—Effects to emergency services associated with transportation accidents are discussed in Sections 6.11.6.4 to 6.11.6.6. Based on the types of Project-related accidents that could occur and the mitigation measures proposed, potential transportation accidents are not expected to have a significant adverse effect on infrastructure and services.

8.2.2 Hazardous Materials Spills

Hazardous materials required for Project construction, operations, and closure and reclamation can be grouped into four major categories:

- Petroleum products (diesel fuel, gasoline)
- Reagents (sodium cyanide, lime, sodium hydroxide, hydrochloric acid, hydrogen peroxide, smelting fluxes)
- Lubricants (oils, degreasers, solvents)
- Blasting compounds.

Hazardous materials could be accidentally released during product transportation, storage, and use, and have the potential to contaminate soil, air or water, damage vegetation, and be toxic to humans and wildlife, either within the facility boundaries or along roads used to transport materials. The magnitude and extent of spills to the terrestrial or aquatic environment will depend on the severity of the spill (e.g., type of product, quantity, location, duration), environmental conditions at the time (e.g., season, weather), and the timing and effectiveness of spill response activities.

Hazardous materials are identified by the TDGR, and their effects are categorized in Material Safety Data Sheets (MSDSs) as, for example, combustible, carcinogenic, or toxic. Table 8.2-1 lists hazardous materials that will be used for the Project, and presents an overview of the potential effects of each substance on human and ecological health.

Table 8.2-1: Hazardous Materials at the Eagle Gold Mine

Substance	Purpose	Potential Effect According to Typical Material Safety Data Sheets[a]	Handling Risk	TDGA Class
Gasoline and Diesel	Fuel; used for machinery, boiler and smelter	Human Health: Contact may cause eye, skin and mucous membrane irritation; harmful if absorbed through the skin. Inhalation may cause irritation, anesthetic effects (dizziness, nausea, headache, intoxication), and respiratory system effects. Long-term exposure may cause effects to specific organs, such as to the liver, kidneys, blood, nervous system, and skin. Ecological Health: Potential to burn in the presence of oxygen and heat. Harmful to wildlife, vegetation, aquatic habitats, soil and groundwater by accidental release or fire/explosion.	Low – commonly handled by the public	Class 3

Substance	Purpose	Potential Effect According to Typical Material Safety Data Sheets[a]	Handling Risk	TDGA Class
Lubricating and Hydraulic oils	Mechanical lubrication and as a force transmitter in hydraulically driven machines	Human Health: Minor irritant; toxic fumes may be released upon burning or exposure to heat. Ecological Health: Potential to burn in the presence of oxygen and heat. Harmful to wildlife, vegetation, aquatic habitats, soil and groundwater by accidental release or fire/explosion.	Low – commonly handled by the public	Not regulated
Sodium cyanide (briquettes)	Used to dissolve gold from ore during leaching process	Human Health: Very toxic by inhalation, in contact with skin, or if swallowed. Contact with acids liberates very toxic gas. Ecological Health: Very toxic to aquatic organisms. May cause long-term adverse effects in the aquatic environment.	Very high – impervious butyl rubber gloves, goggles/face shield, and a protective suit or apron and boots should be used	Class 6.1
Sodium hydroxide (anhydrous)	Used in the Zadra Stripping desorption of gold from activated carbon	Human Health: Corrosive. Causes severe skin and eye burns, and may be fatal if swallowed. Inhalation can cause severe burns to the respiratory tract. Ecological Health: Can cause harmful ecological effects by alkalinisation of aquatic environments.	High – safety glasses, goggles, or face-shield, lab coat or apron, and appropriate protective gloves should be used; breathing apparatus should be used in a dusty environment.	Class 8
Hydrochloric acid (32%/10M)	Used for acid wash of regenerated carbon, to facilitate reuse in the adsorption process	Human Health: Very corrosive and poisonous. Causes severe burns. May be fatal if swallowed. Gives off harmful vapours, causing coughing, choking and inflammation of the respiratory tract. Ecological Health: Can cause harmful ecological effects by acidification of aquatic environments.	High – safety glasses, goggles, or face-shield, lab coat or apron, and appropriate protective gloves should be used. Use only in a well ventilated area.	Class 8
Lime (CaO)	Used to improve the stability of the ore on the heap leach facility	Human Health: Causes irritation in contact with skin and eyes. Can cause severe irritation/burn in contact with wet skin. Inhalation can cause coughing, sneezing or breathing problems. Harmful if swallowed. Can react with water and/or acids to produce large amounts of heat. Ecological Health: In large quantities, can cause harmful ecological effects by alkalinisation of aquatic environments.	Moderate – protect skin and eyes from contact and avoid inhalation of dust. Keep away from moisture.	Class 8 (aircraft only)

Substance	Purpose	Potential Effect According to Typical Material Safety Data Sheets[a]	Handling Risk	TDGA Class
Hydrogen peroxide (50%)	Used to detoxify cyanide solution	Human Health: Strong oxidizer. Causes eye and skin burns, and may cause blindness. May cause respiratory tract irritation. Harmful if swallowed. Contact with combustible materials or reducing agents may cause fire or explosive decomposition. Ecological Health: Slightly toxic to fish, moderately toxic to aquatic invertebrates and microorganisms, and highly toxic to algae.	Moderate – avoid contact with skin, eyes or clothing. Wear chemically resistant gloves and clothing (butyl rubber, SBR rubber, PVC, Gore-Tex).	Class 5.1
Copper sulfate pentahydrate ($CuSO_4.5H_2O$)	Used as a catalyst for cyanide detoxification	Human Health: Toxic if ingested. Can cause irritation in contact with the skin or if inhaled. Can cause severe irritation, conjunctivitis, ulceration or corneal clouding in contact with the eyes. Ecological Health: Mutagenic effects on mammals. Very toxic to aquatic organisms, and may cause long-term adverse effects in the aquatic environment. Designated as a "marine pollutant".	Moderate – safety glasses, goggles, or face-shield, lab coat or apron, and appropriate protective gloves should be used. Use in a well ventilated area.	Class 9.2
Fortan Advantage/Fortis Advantage ANE (Ammonium nitrate/Mineral oil/ Diesel fuel)	Explosives; used to remove overburden and break up ore	Human Health: Explosive. May cause irritation in contact with skin or eyes. Harmful is swallowed. Ecological Health: Harmful to aquatic life at low concentrations. Diesel fuel is an animal carcinogen.	Moderate – use tight fitting safety goggles, impervious butyl rubber gloves and impervious clothing. Avoid inhalation.	Class 1.5D
Portland cement	Used to improve the stability of the ore on the heap leach facility	Human Health: Can cause irritation or inflammation in contact with skin or eyes. Extended contact or contact with large amounts can cause alkali burns. Inhalation can cause irritation to the respiratory tract. Ecological Health: No recognised unusual toxicity to plants or animals.	Low – commonly handled by the public. Impervious clothing and eye protection should be worn to avoid contact.	Not regulated
Smelting flux component 10% (borax)	Mixed with gold (and other metal impurities) for smelting and creation of gold ingots	Human Health: Slightly toxic by ingestion and body tissue irritant Ecological Health: None identified	Low – Avoid contact with eyes or skin	Not regulated

Substance	Purpose	Potential Effect According to Typical Material Safety Data Sheets[a]	Handling Risk	TDGA Class
Smelting flux component 80% (fluorspar – CaF_2)	Mixed with gold (and other metal impurities) for smelting and creation of gold ingots	Human Health: Minimally hazardous. May cause irritation to eyes or if inhaled Ecological Health: Turbidly hazard in water only.	Low – Air borne dust only risk	Not regulated
Smelting flux component 5% (sodium carbonate)	Mixed with gold (and other metal impurities) for smelting and creation of gold ingots.	Human Health: May cause irritation in contact with eyes or skin. If ingested, may induce corrosion of GI tract, vomiting, diarrhoea, circulatory collapse and death. Ecological Health: None identified	Low – Avoid contact with eyes or skin. Impervious clothing and eye protection should be worn to avoid contact. Avoid contact with acids.	Not regulated
Smelting flux component 5% (sodium nitrate)	Mixed with gold (and other metal impurities) for smelting and creation of gold ingots.	Human Health: May cause skin or eye irritation. Harmful if inhaled, absorbed through skin, or swallowed. Ecological Health: Harmful to aquatic life.	Low – Avoid contact with eyes or skin. Impervious clothing and eye protection should be worn to avoid contact. Avoid contact with acids or strong reducing agents.	Class 5.1
Antiscalant – Leach circuit (Millsperse 802)	Combined with cyanide leaching solution to prevent build-up of scale in delivery system	Human Health: Can cause permanent eye injury, including corneal damage and blindness; permanent skin damage; and can be harmful or fatal if swallowed or inhaled. Ecological Health: May cause acidification of aquatic environments.	Low – avoid contact with skin, eyes or clothing. Wear chemically resistant gloves and clothing. Treat with lime or sodium carbonate to neutralise.	Not regulated
Antiscalant – Stripping circuit (Nalco 7814) (Tetrasodium EDTA, Sodium hydroxide)	Combined with hydroxide stripping solution to prevent build-up of scale in delivery system	Human Health: May cause severe irritation or tissue damage in contact with eyes or skin. EDTA may cause blood calcium deficiency. Ecological Health: Minimal risk. May cause minor alkalisation of aquatic environments.	Low – avoid contact with skin, eyes or clothing. Wear chemically resistant gloves and clothing. Avoid contact with acids or reactive metals.	Class 8 (marine and aircraft only)

8.2.2.1 Project Design Measures to Minimize Risk of Hazardous Materials Spills

To minimize the potential for hazardous materials spills, the following measures will be implemented.

Transportation

- VIT will ensure trucking/hauling contractors have appropriate driver training, radio contact capabilities, vehicle maintenance requirements, and spill response capabilities.
- VIT will ensure all hazardous materials are transported and handled in accordance with the *Transportation of Dangerous Goods Act* and Regulations.
- Caches of spill response materials will be placed along the SMR and HCR as required by the Spill Response Plan (see Appendix 30 – Emergency Response Plans), including at the Haggart Creek crossing.
- Project staff will have appropriate emergency response and spill contingency training and knowledge; and equipment, materials and procedures will be maintained to limit consequences of releases to the terrestrial environment through prompt containment and clean-up.

Mitigation measures specifically applicable to cyanide transportation include:

- Cyanide briquettes will be transported in bulk super sacs designed to protect the product from moisture and as defined by the *Transportation of Dangerous Goods Act*.
- A pilot vehicle will lead cyanide shipments from Mayo to the mine site if conditions require.
- A qualified cyanide transporter will be used; and appropriate driver training, radio contact capabilities, vehicle maintenance, emergency clean-up kits will be ensured.
- A cyanide transport management plan will be developed as part of the EMPs (Appendix 30) outlining contractor responsibilities, emergency response procedures and training requirements.

Storage

- Fuels, hydrogen peroxide, and other hazardous liquids will be transferred from tanker trucks to storage tanks by enclosed lines, hoses, and pumps equipped with pressure transducers and volume counters to ensure tanks cannot be overfilled.
- Where stationary equipment cannot be relocated more than 30 m from a watercourse, it will be situated in a designated area that has been bermed and lined with an impermeable barrier with a holding capacity equal to 110% of the largest tank within the berm.
- Explosives will be stored in accordance with the magazine license issued by Natural Resources Canada; explosives and blast caps will be stored in separate facilities, away from operational areas.

Use

- VIT will ensure equipment operators are appropriately trained in spill response procedures and carry spill kits capable of handling spills on land and water.
- All employees will be WHMIS (Workplace Hazardous Materials Information System) trained.

- No lubrication, refueling or maintenance of equipment will occur within 30 m of wetlands or watercourses.
- All fuelling and lubrication of construction equipment will be carried out in a manner that minimizes the possibility of spills. All containers, hoses, and nozzles will be free of leaks and all fuel nozzles equipped with functional automatic shut-offs.
- Sodium cyanide will be mixed with water in a well-ventilated area and maintained at a high pH to prevent the evolution of hydrogen cyanide gas.
- Cyanide solution will be applied to the HLF using buried drip emitters, minimizing the potential for solution to escape to the environment.

8.2.2.2 Hazardous Materials Spill Likelihood

The likelihood of a hazardous materials spill during transportation is expected to be lower than the likelihood of a transportation accident (Section 8.2.1.2) due to the containment methods used for transport. While based on transportation accidents statistics, accidents due to equipment failure, road conditions, and wildlife are considered likely during the life of the Project, it is considered unlikely that these types of accidents would result in a hazardous materials spill. The consequence of a spill during transportation could range from very low to moderate, depending on the quantity, location, and product type. In the unlikely event that a transportation accident was to result in a spill, and if the spill was near a watercourse, and the spill were to enter the watercourse, effects could extend for several kilometres downstream, affecting aquatic species and habitats.

Based on the standards used for design of storage and containment facilities, a spill escaping to the external environment during product storage is considered unlikely. The consequence of a spill in the vicinity of storage areas is considered low to very low, as these areas will generally be designed for containment (lined or concreted areas) and free of vegetation, and designed with drains and oil/water separators to manage potential spills. In addition, all surface water from the mine site will be treated as required before it is discharged to the environment.

The potential for a spill during product use will vary depending on the frequency and quantities used level of handling risk, and handling methods. However, based on the overall frequency of hazardous materials use at the site, a hazardous materials spill during handling is considered likely, but the consequence of a spill during handling is considered low to very low, for the reasons described above related to spills during storage.

8.2.2.3 Potential Effects of Hazardous Materials Spills

Based on the screening of potential interactions between a hazardous materials spill and VCs receiving a “2” in Table 8.3-2, the VCs that are most likely to be adversely affected include:

- Surficial Geology, Terrain, and Soils
- Water Quality and Aquatic Biota
- Fish and Fish Habitat.

Interactions with VCs ranked as “1” in Table 8.3-2 are described below.

Air Quality—the effects of a spill on air quality would depend on the type of material spilled, for example a fuel or lime spill could result in release of criteria air contaminants (CACs), and a sodium cyanide spill could result in the release of hydrogen cyanide gas. For any spill, it is anticipated that under calm conditions, the area in which the gas or particulate would disperse would be limited (<1 km^2) and short-term (4 to 8 hours). Under windy conditions the dispersion area could be larger (<5 km^2), but time for dissipation would be reduced. Potential spills would not result significant effects to air quality (as defined in Section 6.6.1.9), and therefore air quality concerns associated with spills are low.

Vegetation Resources—the potential for spills is higher within the mine site boundaries, which will be cleared of vegetation. Spills during transport could affect vegetation in the immediate vicinity of the roadway, however effects would be localized, mitigated through clean-up and restoration of the area, and not expected to persist over the long-term.

Wildlife Resources—spills during transport of hazardous materials would indirectly affect wildlife through damaged terrestrial habitat. Effects would be short-term and localized, and are not expected to have a significant effect on wildlife species. Spills will be contained and remediated within a short period of time; therefore the risk of wildlife exposure to hazardous materials is very low. As discussed above, spills within the mine site boundaries would not affect vegetated areas and would be contained and treated onsite, therefore no effects to wildlife are anticipated.

Traditional Activities and Culture—Effects to traditional activities due to a spill would be associated with effects to fish, wildlife, or vegetation. As discussed above, effects to these VCs would vary depending on the nature of the spill event. Spills within mine site boundaries are not expected to pose a risk to these VCs, and spills within the road right of way are expected to be localized and reversible through clean-up and restoration efforts. Spills which enter a watercourse could have more severe and/or longer term effects to fish and fish habitat, which have been described below. Should a spill result in areas of contamination, a fish and fish habitat monitoring plan will be developed, which will take into consideration potential effects to fish species used for traditional purposes and follow-up monitoring and reporting will be required.

Human Health and Well-being—The magnitude of potential effects on human health will depend on the severity of the spill (e.g., substance, location, quantity, timing), as well as whether it remains localized. Table 8.2-1 lists potential effects on human health of an accidental release or misuse of hazardous materials that will be used at the mine. With the implementation of standard mitigation measures and use of prescribed personal protective equipment for use of hazardous materials and first-response efforts, no effects to human health are anticipated.

Infrastructure and Services—Hazardous materials spills have the potential to place additional pressure on public emergency response resources. Initial spill response activity will be managed internally and VIT will ensure first responders with training specific to hazardous materials used for the Project (e.g., cyanide) are on hand at the mine site at all times. Based on the quantities of materials transported and stored for the Project, it is anticipated VIT and their contractors would be able to manage spill response internally without placing additional burden on public resources, therefore adverse effects to infrastructure and services are not anticipated.

Evaluation of those VC for which there could be an interaction of concern with hazardous materials spills (those interactions scored "2") are discussed below.

Potential Effects to Surficial Geology, Terrain, and Soils

A hazardous materials spill has the potential to affect soil quality due to contamination. The level of contamination and the mitigation measures required will depend on the physical state of the soil, the type and quantity of product spilled, and the emergency response time. Physical soil properties including texture, bulk density, cation exchange capacity, organic matter content, and permeability influences the amount and depth that a substance can be absorbed into the environment. For example, the depth of absorption would be greater in sandy soils compared to soils that have a higher clay or organic matter content.

The Emergency Response Plan (Appendix 33) will include spill response procedures for the hazardous materials used on site. With regards to soil, the first priority is to control the leak at the source and recover as much of the spill as possible to minimize the potential for migration. Contaminated soils will be tested and remediated as necessary.

Based on the mitigation and emergency response measures, residual effects of a spill on soil quality is expected to be short term, reversible, and site-specific. The magnitude is considered low, as the contaminated area will be remediated and equivalent land capability returned. Potential residual effects could be significant if important habitat, infrastructure, or human safety are affected (as defined in Section 6.4.1.9); however, these effects can be reduced and managed with the application of a well-defined Emergency Response Plan, complemented by additional measures identified in a follow-up and monitoring plan as required. It is anticipated the effects would be temporary and prior land uses could be re-established within a one year timeframe.

Potential Effects to Water Quality and Aquatic Biota

The risk of a hazardous materials spill into a water body exists only during transport (previously discussed in Section 8.2.1), as the mine site is designed to capture and treat potential spills and mine contact water before it is discharged to the environment (potential failures of this system are discussed in Section 8.2.5). With the proposed Project design, mitigation, and emergency response measures in place, a spill entering a water body is considered unlikely. However, should such an event occur, it could have a significant short-term effect on water quality and could lead to sub-lethal or lethal effects on sensitive aquatic species.

Potential effects of a hazardous material spill on water quality and aquatic biota (i.e., periphyton and benthic invertebrates and planktons) depend on the type of spill and can range from acute toxic effects on aquatic organisms to eutrophication of the receiving environment. Table 8.2-1 provides a list of hazardous materials at the Eagle Gold Mine. Below the general approach to such a spill is presented.

The effects of a hazardous materials spill on water quality and aquatic biota will depend on a number of factors:

- Chemical characteristics of the spill material
- Spill volume
- Weather or other environmental/meteorological factors at time of spill
- Physical characteristics (e.g., width, depth, and flow) of the receiving watercourse.

In smaller, slower flowing watercourses, potential effects could include direct mortality of periphyton, macrophytes, benthic invertebrates, and fish, and contamination of stream sediments. In larger, faster flowing watercourses such as Haggart Creek, spilled material may be substantially diluted and travel several kilometres downstream from the point of spill. Potential effects may be evident both locally and regionally to the spill.

Heavy rainfall immediately after a spill may cause dilution of spilled material, reduce concentrations of the spilled material, or, cause the material to be transported farther downstream.

Potential effects of any hazardous material spill on water and sediment quality will be characterized immediately, during the clean up phase. During this phase the following actions will be taken:

- The downstream limit of contaminant migration will be determined
- Aquatic and riparian habitat in areas affected by the spill will be characterized
- Water and sediment samples will be analyzed to determine concentrations of the spilled material and adherence to water quality and sediment quality guidelines.

Mitigation and clean up measures to protect water quality and aquatic biota will include:

- Containment of the spill at the source and at accessible downstream locations
- Potential removal of sediments at the spill site and accessible downstream areas.

Water quality monitoring will be continued until hazardous material concentrations meet water quality guidelines (CCME and BC). Residual effects of hazardous material spills into watercourses may include temporary deterioration of water quality parameters, loss of aquatic invertebrates (including periphyton, macrophytes, and benthic invertebrates), fish mortality and localized areas with contaminated sediments. Sediments contaminated with petroleum products, such as polyaromatic hydrocarbons may adversely affect invertebrates that are in direct contact with sediments and interstitial water. Adverse effects of a hazardous material spill on sediments may persist until the sediments are covered and/or redistributed by channel processes, or until concentrations of contaminants of concern are attenuated through natural processes.

Sediment quality monitoring will be conducted in cleaned areas on an ongoing basis until the combination of field observations and sampling data demonstrate the contaminated sediments are successfully removed, or remaining sediments are consistent with the BC working sediment quality guidelines. Sediment monitoring will continue in other areas affected by the spill, such as machine inaccessible locations where sediment removal impractical, to confirm natural attenuation of all contaminants.

Magnitude and geographical extent of the spill may be significant depending on the spill volume and characteristics of the receiving watercourse (e.g., flow, depth, velocity). However, a well-designed emergency response plan can limit the spatial and temporal effects of such a spill. Emergency response planning may be complemented by additional mitigation measures as determined by follow-up monitoring. Potential residual effects of a hazardous material spill are considered temporary (zero to four years) and reversible.

Given the mitigations that will be in place and that the spill of a hazardous material into a watercourse during the life of the Project is unlikely, the potential for such a spill is not considered to pose a significant threat to water quality and aquatic biota.

Potential Effects to Fish and Fish Habitat

A hazardous material spill event will impact water quality and aquatic environment that fish depend on as their habitat. A discussion of effects of such spill on water quality and aquatic environment is provided in the previous section. Fish dependent on invertebrates as a food source may be adversely affected by contaminated organisms as such a spill may cause mass mortality of invertebrates and planktons. Levels of fish contamination will be a function of contaminant levels in sediments and invertebrates. A sediment monitoring program will assess and evaluate the potential and type of adverse effects on fish species that are directly dependent on sediments and benthic invertebrates.

In such an event, in order to characterize the effects:

- The downstream limit of contaminant migration will be determined
- Mortalities (e.g., fish and amphibians) will be collected
- Aquatic and riparian habitat in areas affected by the spill will be characterized.

Mitigation and clean up measures to protect fish and fish habitat will include:

- Containment of the spill at the source and at accessible downstream locations
- Potential removal of sediments at the spill site and accessible downstream areas.

A fish and fish habitat monitoring program would be designed to help determine the temporal aspects of effects in the spill-impacted areas and to study potential effects of the spill on fish species density, abundance, and diversity. A control site (either upstream of the spill site or in a nearby drainage with similar characteristics) may be required to compare the environmental and water quality parameters.

Residual effects of hazardous material spills into watercourses may include temporary loss of fish and invertebrates, and localized areas with contaminated sediments. Sediments contaminated with petroleum products may adversely affect invertebrates that are in direct contact with sediments and interstitial water. Fish dependent on these invertebrates as a food source may be adversely affected by the contaminated organisms. Levels of fish contamination will be a function of contaminant type and level in sediments and invertebrates. A sediment monitoring program will assess and evaluate the potential and type of adverse effects on fish that are directly dependent on sediments and benthic invertebrates.

Adverse effects of a hazardous material spill on sediments may persist until the sediments are covered and/or redistributed by channel processes, or until concentrations of contaminants of concern are attenuated through natural processes.

Magnitude and geographical extent of the spill may be significant depending on the type and volume of spill and physical characteristics of the receiving environment. A well-designed emergency response plan can limit the spatial and temporal effects of such a spill. Emergency response planning may be complemented by additional mitigation and compensation measures as determined by follow-up monitoring. Potential residual effects of a hazardous material spill are considered temporary (zero to four years) and reversible.

Given the mitigations that will be in place, and that the spill of a hazardous material into a watercourse during the life of the Project is unlikely, the potential for such a spill is not considered to pose a significant threat to fish and fish habitat.

8.2.3 Heap Leach Facility Breach

A review of HLF failures resulting in the release of leach solution, found that effects were limited to temporary contamination of surface and ground water (van Zyl 1992). These releases occurred due to extreme climatic conditions and in a few cases from leaks. The consequence of failures is most critical during operations, when pregnant solution is being circulated through the HLF; therefore the following assessment focuses on the operations phase of the Project.

Potential areas of risk associated with the HLF include:

- Seismic and slope stability of the HLF and confining embankment
- Hydrological water balance
- Infiltration and leaching process
- Liner leaks.

Site selection for the HLF was based on a two stage assessment of the suitability of potential locations (Section 5.8.2.4). Stage 1 considered significant engineering criteria for each potential site, and Stage 2 considered a Project-wide assessment of impacts for each option. The results of this assessment established a clear site location preference for the current location (within the Dublin Gulch valley and up the Ann Gulch side-valley).

Quantitative modelling analyses have been used in the design of all critical components of the HLF, such as the in-heap pond, events ponds, and for assessing potential effects to the environment under worst case conditions (Appendix 21 – Eagle Gold Project Surface Water Balance Model Report). Details of HLF design and construction are provided in Section 5.4.1.5.

Failure of the HLF embankment could lead to:

- Release of untreated leach solution to Dublin Gulch diversion channel (DGDC). Leach solution will have high concentrations of cyanide, ammonia, nitrate, and metals
- High concentrations of suspended solids in DGDC
- Blockage or damage to DGDC
- Impairment of the sub-surface drainage system
- Damage to heap liner and leak detection and recovery system (LDRS)
- Damage to heap cap (post-closure)
- Destruction of wetland (post-closure).

8.2.3.1 Project Design Measures to Minimize Risk of Heap Leach Facility Breach

The following design measures and proposed mitigation have been, or will be, implemented to minimize potential for a HLF breach resulting in release of cyanide solution to the environment.

Stability of HLF and Confining Embankment

- HLF and confining embankment will be designed to withstand seismic ground motions from the maximum design earthquake as defined during feasibility-level design.
- Areas of permafrost have largely been avoided; during site preparation drainage systems will be installed and unstable soils removed to minimize potential instability due to permafrost.
- The HLF will be inspected by an independent third party engineer prior to operations.
- Site selection for the HLF was based on engineering assessments that considered geotechnical conditions.
- Pre-feasibility stability analysis of HLF location was completed to inform preliminary design.
- Further stability analyses and geotechnical testing of the HLF site will be completed during the feasibility stage of the Project.

HLF Liner Leak

- The HLF pad will consist of a double liner system in the upper reaches of the facility, and a triple liner in the lower reaches of the facility (Figure 5.4-11).
- As Yukon does not have regulations specifically developed for heap leach facilities, the HLF will be designed in accordance with Nevada State Guidelines for such facilities.
- The HLF will contain leak detection and recovery system layers (two within in-heap pond and one in upslope area) (Figures 5.4-13 and 5.4-14).
- The liner system will be installed by a contractor with appropriate experience and QA/QC procedures.
- QA/QC testing will be done according to recognized standards and verified by a third party testing agency

- All patches and fused joints of the liner will be vacuum tested before the leak detection and recovery system is installed.
- Construction of the HLF will be monitored by a geotechnical engineer, employing standard quality control and quality assurance requirements. Following construction, the HLF will be inspected by a third-party engineer.

Water Balance Issues

- The in-heap pond is designed to accommodate maximum operational volume combined with a storm event and draindown for Phase 1 of development (Years 1 and 2). In Phases 2 and 3, the events ponds will provide additional storage.
- Should the capacity of the in-heap pond be exceeded, excess solution would flow into two lined events ponds (with leak detection and recovery systems underneath the main liner).
- Events ponds will be maintained empty to allow 100% of the total potential draindown volume to be stored (in combination with the in-heap pond) throughout the life of the Project in all precipitation conditions.
- The HLF will be operated with minimum operating volumes, to allow for adequate storage in the event of an emergency or extreme precipitation event.
- Measures to prevent ice formation, which can reduce storage capacity in the HLF due to reduced pore space in the ore will include:
    - Utilizing boiler heat to warm leachate solution during winter
    - Burying the solution irrigation system within the HLF to retain heat
    - Installation of thermisters and water level sensors to monitor parameters within HLF
    - Limiting placement of ore on the HLF to the freeze-free summer season (250 days per year) to avoid formation of permanent ice lenses within the HLF.

Adaptive Management for Liner Leaks

HLF liners, when properly installed, are essentially leak free. Nevertheless, there are always minute flaws, even under optimal installation, which could allow for solution leakage through one or more layers of the liner. The Nevada State Guidelines for HLF development recognize this potential for leakage, and has developed permitted flow rates from leak detection systems, which will be adhered to for this Project (Bureau of Mining Regulation and Reclamation 1991). According to the Nevada Guidelines, if flow rates from the Leak detection and recovery system (LDRS) exceed permit limitation, a site- specific evaluation must be conducted by the permittee to assess the need for any additional process component or site monitoring. VIT has developed an adaptive management approach to dealing with potential liner leaks (Scott Wilson Mining 2010). This approach will be further developed and integrated into the Environmental Management Plan.

Adaptive management is an accepted decision-making approach to managing risks in the face of uncertainty. The key feature of adaptive management is a plan to modify operational and management actions over time in response to new information gleaned through monitoring during Project operations. The following steps have been applied in developing an adaptive management approach for potential liner leaks in the HLF:

- Identification and description of event(s) that would trigger implementation of adaptive management strategies.
- Identification of parameters to be monitored, including methods and frequency, to ensure identification of events that would trigger adaptive management.
- Description of specific indicators and thresholds that define when management actions will be taken. There may be a series of indicators and thresholds for an individual event.
- Description of management actions to be taken in the case of specific events.

The approach follows an ongoing feedback loop of monitoring→implementation of management measures→monitoring to ensure VCs are protected from effects of HLF liner leaks.

Identification of Events

Two potential events have been identified which would trigger implementation of adaptive management strategies:

9. Change in LDRS quantity from the side slopes above the permanent in-heap pond area, **or**
10. Change in LDRS quantity from the in-heap pond,

which result in exceedance of permit limitations for flow rate into the LDRS.

Monitoring Parameters

To identify occurrence of these events, flow within the LDRSs will be monitored on a daily basis at two locations:

1. The LDRS pipe inlet to splitter box at embankment crest, **and**
11. The LDRS pumps in the in-heap pond.

Monitoring Thresholds

If the quantity of leachate recovered in the LDRS (or anticipated trend) exceeds either:

- 300 litres per day on average in a quarter, **or**
- 100 litres per day on average per year,

then mitigation will be required to bring the HLF into compliance.

Management Actions – Leak in Side Slope Portions of HLF

As a first step, further investigation into the location of the leak will be undertaken. A number of options are available to help determine the location of a leak, such as monitoring and measurement of the individual LDRS pipe outlet flows or closed-circuit television (CCTV) inspection of those LDRS pipes showing excessive flow. The areas where there are potential leaks in the liner will be defined on a plan and daily monitoring of individual LDRS pipe outlets will continue for these areas.

Monitoring of the water quality downstream of the HLF will be assessed for compliance with water quality standards and to determine if there are any indications of leakage through the secondary liner. The Nevada State Guidelines allow for a site-specific evaluation to determine if exceedance of permitted LDRS flow rates is resulting in water quality effects. If it can be demonstrated no adverse effects to water quality are occurring, permitted LDRS flow rates may be adjusted for a specified period of time. Specific LDRS flow rate permit requirements for the Project are not known at this time.

Following the identification of potential leak locations, the leachate application pipe work will be re-arranged to avoid these areas. This will require determining a suitable “exclusion zone” and will be defined by an analysis of leachate flow through the HLF. Monitoring will continue until outflow from the HLF matches inflow, which can take 24 hours per meter depth of the HLF, subject to confirmation from operations.

If the above measures do not bring the HLF into compliance, the next step will be to temporarily stop the application of solution. The HLF will take time to drawdown and monitoring of the individual LDRS pipes will continue during this period, together with observations of the water pressure in the HLF.

Following drawdown, the leachate pipe work will be rearranged to bring the HLF back “on-line” in sections. These sections will be planned based on observations of the leaks and suitable areas to leach. The purpose of this trial is an alternative method to locate the leak in the liner, and to maintain compliance and maintain production.

If the leak can be located, mitigation options can be developed and implemented. These include:

- **Repair of liner**—will require that the material in the HLF is excavated to carefully expose the liner and determine the exact location of the leak. Damaged liner will be removed and replaced or patched. Issues that will need to be considered include the volume of material to be removed, safety, stability of the HLF and avoiding damage to the liner.
- **Grouting**—can be undertaken by drilling into the HLF and pumping in cement grout under pressure to create an impermeable zone above the location of the leak. Grouting will not repair the liner and will only divert leachate around the leak. The design of the zone to be grouted will consider flow through the HLF and the potential for flow beneath the grouted zone.
- **Inter-lift liner**—is a geomembrane, of a similar type to the main liner, placed on the surface of the HLF between lifts. As with grouting, it does not repair the leak, but will be designed to collect or divert leachate around the leaking section. There are fewer risks with this option, but it can sterilise a greater proportion of the HLF.

In a worst case scenario, an inter-lift liner with a separate leachate collection system could be used to completely isolate the HLF beneath the level of the inter-lift liner.

Management Actions – Leak in In-heap Pond Portion of HLF

The management approach applicable to the side slope portions of the HLF cannot be followed for the in-heap pond areas. The LDRS is not easily accessible and the liner is permanently subject to leachate under pressure. For these reasons the design includes for a tertiary liner with its own leachate recovery system. This will reduce the pressure on the primary liner to a level that is designed to be compliant with the Nevada State Guidelines.

In the event that leachate recovered from the in-heap pond LDRS exceeds the permitted threshold, the first step would be to draw down the in-heap pond level to a level at which compliance is achieved (subject to operational constraints for solution treatment and storage). Two options exist for drawing down the in-heap pond, either diverting to the events ponds or treatment and release. If the pond level has to be reduced to a level below that acceptable for operations, then design of an enlargement to the events ponds would be undertaken.

As with the procedure for side slope areas of the HLF, monitoring of the water quality downstream of the HLF will be conducted to assess compliance with water quality standards and determine if there are any indications of leakage through the secondary and tertiary liners.

If further mitigation is required, this is unlikely to be achieved by the methods described above for side slope portions of the HLF. The depth of the liner would likely make excavation impracticable and an inter-lift liner would not solve the problem. Grouting is not viable as it would have to puncture the tertiary liner to access the primary liner, thus creating an even greater risk.

If none of the above mitigation measures are successful at reducing flow rates to the LDRS to permitted levels, then the in-heap pond will need to be completely drained and all flow collected from the HLF and diverted directly to the water treatment plant or to the events ponds. The water balance would be re-assessed for this scenario to ensure that there is sufficient operational storage capacity in the events ponds or capacity in the treatment plant. This may require construction of additional storage or release capacity before full operations can be resumed.

8.2.3.2 Heap Leach Facility Breach Likelihood and Consequence

Based on the design criteria, inspection, testing, and monitoring proposed for the HLF, it is considered very unlikely that cyanide solution will be released into the environment during the life of the Project. In the event of HLF breach due to embankment failure, the consequence would be high if cyanide solution and high volumes of sediment reached the Dublin Gulch Diversion Channel. Consequence of a liner leak would depend on the magnitude of the leak. In a worst case scenario involving catastrophic failure of the liner, the consequence would be considered high, as high volumes of solution would be leaking at a high rate, and would be likely to reach groundwater and potentially Haggart Creek.

8.2.3.3 Potential Effects of Heap Leach Facility Breach

Based on the screening of potential interactions between a hazardous materials spill and VCs (Table 8.1-5), the VCs that are most likely to be adversely affected include:

- Surficial Geology, Terrain, and Soils
- Water Quality and Aquatic Biota
- Fish and Fish Habitat.

Interactions with VCs ranked as 1 are described below.

Vegetation Resources—Effects to vegetation resources due to slope instability in the HLF would only be expected during reclamation and closure, when revegetation activities are underway on the HLF. In this case, damaged areas would be revegetated as described in the Conceptual Closure and Reclamation Plan (Appendix 24) once instability issues are addressed. Effects to vegetation due to liner leakage leading to groundwater contamination are not anticipated, as vascular plants have an enzymatic system to metabolize cyanide (which is a natural by-product of ethylene synthesis in plants). Based on the Groundwater Model Report (Section 5.2.5 and Figure 5.2-7 of Appendix 22), an example worst-case liner leak (25 m length of drain and containment pad breached in three areas) left unmitigated for two years would result in groundwater concentrations <1 mg/L near the lower portion of Dublin Gulch Creek and Haggart Creek. Studies indicate that at low concentrations (generally <10 mg/L), plants are able to metabolize free cyanide from groundwater and soil with no phytotoxic effects (Larsen, Trapp, and Pirandello 2004; Larsen, Ucisik, and Trapp 2005), and woody vegetation has been suggested as a feasible option for phytoremediation of cyanide contaminated soils and water (Yu, Trapp, and Zhou 2005). In the unlikely event of a liner leak that migrates through groundwater into soils outside of the mine site boundaries, no adverse effects to vegetation are anticipated.

Wildlife Resources—Potential effects to wildlife of a HLF failure would be associated with cyanide exposure. Liner leaks would not result in any cyanide being released above-ground, and, as discussed above, vegetation is not expected to lead to accumulate in plant tissues which could be ingested by wildlife. In the event of an embankment failure, the in-heap pond could release cyanide to the environment where wildlife could be exposed. In the event of this unlikely occurrence, the area would be immediately isolated in accordance with the Emergency Response Plan (Appendix 33). Emergency response efforts will include measures to ensure any areas of ponded cyanide solution are covered or isolated to avoid exposure to birds and wildlife, and no adverse effects to wildlife are anticipated.

Employment and Economic Opportunities—In a worst case scenario, a HLF breach could require the mine to shut down for an extended period of time, which could affect employment opportunities at the mine. In such a case, it is expected much of the man-power at the mine would be needed to help with reclamation and clean-up efforts, and therefore a sudden and significant decrease in the number of jobs at the mine is not anticipated.

Traditional Activities and Culture—Potential effects of a HLF failure on traditional activities and culture would be associated with effects to vegetation (traditional use plants), fish and wildlife used for traditional purposes. Potential effects to fish are described below. As described above, no effects to vegetation or wildlife are anticipated.

Human Health and Well-being—Potential effects of a HLF failure on human health would be associated with cyanide exposure through inhalation, ingestion, or skin contact. In the highly unlikely event of a HLF breach, the area would be immediately isolated and appropriate evacuation distances identified in accordance with the Emergency Response Plan (Appendix 33). First responders would be equipped with appropriate PPE to prevent exposure. Cyanide released into the environment through embankment failure or liner leakage is not expected to persist in the environment and become available for human uptake through ingestion of country foods. In the event of a non-lethal exposure, most of the cyanide and its products leave the body within the first 24 hours (World Health Organization 1996, cited in Boadi, Twumasi, and Ephraim 2009). Due to its rapid breakdown in the environment, cyanide does not biomagnify in food webs or cycle extensively in ecosystems (Eisler and Wiemeyer 2004); therefore no adverse effects to human health are anticipated.

Infrastructure and Services—A HLF failure has the potential to place additional pressure on public emergency response resources. Initial emergency response activity will be managed internally and VIT will ensure first responders with training specific cyanide hazards are on hand at the mine site at all times. It is anticipated VIT and their contractors would be able to manage emergency response efforts internally without placing additional burden on public resources, therefore adverse effects to infrastructure and services are not anticipated.

Evaluation of those VC for which there could be an interaction of concern with a potential break of the HLF (those interactions scored “2”) are discussed below.

Potential Effects to Surficial Geology, Terrain, and Soils

In the highly unlikely event of an HLF breach, there is the potential for cyanide solution to reach soils below the HLF. Generally, cyanide seldom remains biologically available in soils because it is either complexed by trace metals, microbially metabolized, or lost through volatilization (Marrs and Ballantyne 1987, cited in Eisler and Wiemeyer 2004). Cyanide ions are not strongly adsorbed or retained on soils, and leaching into the surrounding groundwater is expected to occur (Eisler and Wiemeyer 2004). Due to its rapid breakdown in the environment, cyanide is not expected to persist within soils beneath the HLF. Monitoring and remediation efforts associated with mitigating a leak would include provisions for soil testing to identify and delineate contamination. Should cyanide contamination be identified, soils will be excavated and disposed of in accordance with the Emergency Response Plan (Appendix 33). Potential residual effects are not anticipated to change soil reclamation suitability (as described in Section 6.4.1.9); therefore no significant effects to soils are anticipated.

Potential Effects to Water Quality and Aquatic Biota

Contact water from the HLF will have elevated levels of nutrients (nitrate, ammonia), cyanide, metals, and suspended solids, which could cause eutrophication of streams, toxic effects to aquatic organisms, and sedimentation in fish habitat if released directly into surface watercourses without treatment.

Cyanide compounds, upon entry into the freshwater environment, may be broken down or converted to various derivatives and compounds with free cyanide (HCN) and the cyanide anion (CN^-) most toxic to aquatic organisms including fish, invertebrates and periphyton. In the aquatic environment, cyanide will breakdown into ammonia, also toxic to aquatic biota at elevated concentrations, and nitrate. High nitrate levels may lead to eutrophication and in extreme cases, a sharp decrease in dissolved oxygen and mortality of aquatic organisms.

Potential breach of HLF may also introduce metals (e.g., aluminum, antimony, arsenic, copper, iron, lead, mercury, selenium, silver) to the receiving waters. Metals can cause acute as well as chronic toxic effects in the aquatic environment. Acute effects may cause direct mass mortality of fish and aquatic invertebrates. Chronic effects may impact multiple physiological processes, such as reproductive capacity, in fish and other aquatic organisms.

In the event of a HLF failure, an emergency response plan will be in place to contain the leachate and prevent its entry into the aquatic environment. A water quality monitoring program will also be implemented to monitor the concentration of cyanide compounds (free cyanide, weak acid dissociable (WAD) cyanide, and total cyanide).

Residual effects of an HLF failure may include direct mortality of fish (discussed below) and other aquatic organisms, and eutrophication due to the increase in nitrates resulting from the breakdown of cyanide compounds. The effects could extend for several km down a watercourse. However, all potential residual effects of a HLF failure are considered temporary and reversible, and given the very unlikely possibility of such an even occurring during the life of the Project, the threat that an HLF failure poses to water quality and aquatic biota is not considered significant.

Potential Effects to Fish and Fish Habitat

A HLF facility breach may result in contamination of surface water by toxic cyanide compounds and other metals. The effects of a HLF failure on fish and aquatic environment are a result of the toxicity of cyanide compounds and toxic metals on fish and aquatic habitat. The degree of the effect would depend on a number of factors, including the volume of leachate released and the physical characteristics of the receiving environment.

Upon entry into the freshwater environment, cyanide compounds are broken down or converted into various derivatives and compounds possessing varying levels of toxicity, and aquatic organisms show varying degrees of sensitivity to these compounds.

In the event of a HLF failure, an emergency response plan will be in place as described previously. As part of the emergency response plan, any potential fish that have died will be removed from the aquatic environment and clean up processes will be initiated immediately.

Residual effects of an HLF failure may include loss (mortality) of fish and invertebrates in the vicinity of spill area. The geographical extent for acute toxicity would be considered local, as the breakdown of cyanide compounds occurs rapidly and renders them less toxic to aquatic organisms. However, eutrophication of the aquatic environment may occur further downstream which may cause some regional effects as discussed above.

Several factors contribute to the rates of degradation and oxidization of cyanide in aquatic systems: the presence of bacteria and protozoans which convert cyanide to carbon dioxide and ammonia, pH levels, and the presence of other elements or compounds (e.g., chlorine) (US EPA 1984).

As with rates of degradation, the toxicity of free cyanide is also dependent on a number of biological and abiotic factors: water pH, temperature, oxygen content; life stage and condition, and pre-exposure to cyanide compounds (Eisler 1991). Cyanide does not bio-accumulate in fish tissues and does not pose a risk to human health through the consumption of fish exposed to or poisoned by cyanide (Eisler 1991; Eisler and Weimeyer 2004).

On a regional scale, residual effects of an HLF failure may include eutrophication of downstream habitats due to the increase in nitrates resulting from the breakdown of free cyanide. All potential residual effects of an HLF failure are considered temporary and reversible. Given this, that affected fish populations could be naturally repopulated from unaffected watercourses, and that the likelihood of a HLF breach is highly unlikely, the threat to fish and fish habitat is considered not significant.

8.2.4 Slope Failure (Open Pit and Waste Rock Storage Areas)

The open pit will be developed using standard drill and blast technology. The final open pit footprint will be just under 70 ha between 1,410 m asl and 960 m asl (with pit bottom elevation of 930 m asl). Over the life of the mine, the open pit will advance in four phases, beginning with a starter pit followed by three push backs.

The design of the open pit will ensure that any slope failures result only in the movement of material into the pit itself, and no effects to environmental resources are anticipated due to potential slope failure. The major risk associated with a catastrophic failure of the pit high wall is worker safety.

Waste rock from the open pit will be trucked to one of two waste rock storage areas (WRSAs) at Platinum Gulch and Eagle Pup (Figure 5.1-3). Platinum Gulch will be used for the first two years of production, and have an ultimate footprint of 33 ha containing 4.9 million loose cubic metres of waste rock. Progressive reclamation of the Platinum Gulch WRSA will begin in 2015. Waste rock generated for the remainder of the Project will be placed in Eagle Pup, which will have an ultimate footprint of 80 ha and hold 24.5 million loose cubic metres of waste rock.

Waste rock will be deposited year round at a rate of 9 million tonnes per year (11,800 m^3/day). The WRSAs will be constructed in lifts with a maximum height of 100 m, with benches between successive lifts.

The magnitude of potential effects of slope failure or slumping of the WRSAs would depend on the timing and extent of the failure. Slope failure within either of the WRSAs could lead to mixing of contact and non-contact surface water through disturbance of subsurface drainage, seepage ponds, and drainage channels, allowing surface contact water to bypass treatment and flow directly into Eagle Creek or the Dublin Gulch diversion channel. Following capping of the WRSAs (Platinum Gulch in Year 4 and Eagle Pup at year 10), slope failures could damage vegetation in reclaimed areas and treatment wetlands at the base of the WRSAs and alter the infiltration rates through the caps. Post-closure slope failures could lead to increased contact water entering treatment wetlands and changes to routing of contact water, for example, from the pit lake.

Contact water from WRSAs and the open pit will have elevated levels of nutrients (primarily phosphate), metals, and suspended solids, which could cause eutrophication of streams, toxic effects to aquatic organisms, and sedimentation in fish habitat if released directly into surface watercourses without treatment.

8.2.4.1 Project Design Measures to Minimize Risk of Slope Failure

The following design measures and proposed mitigation have been or will be implemented to minimize the potential for slope failure in the open pit and WRSAs:

- Pit slopes and benches will be designed using ongoing geotechnical investigations and mining best practices.
- During dewatering of the open pit, pit perimeter well and horizontal bench wells will be used to extract groundwater and depressurize pit walls. Pumping wells will also be used to aid in depressurization of pit slopes as required. This will increase pit wall stability.
- Regular inspections will identify areas of potential instability and result in mitigative measures to decrease the likelihood of failure.
- WRSA design has considered the operational and post-closure extreme events of seismic loading under an operational and maximum design earthquake, and probable maximum precipitation.
- Permafrost zones within the proposed WRSAs will be stripped or excavated to encourage thawing and drainage and ensure stability before placement of waste rock.
- An interception and diversion ditch system of the upper-catchment springs and specific construction constraints on the WRSA benches will be used to increase stability by reducing inflows and minimizing erosion.
- Further stability analyses and geotechnical testing for the open pit and WRSAs will be completed during the feasibility stage of the Project.

8.2.4.2 Slope Failure Likelihood and Consequence

Minor slope failures are considered likely during development of the open pit due to the ongoing nature of the drill and blast activities and the potential to encounter areas of instability. These minor failures are anticipated as part of the development process, and the consequence is considered very low, as material will be contained within the open pit and worker safety would not be affected. Major slope failures within the open pit are considered very unlikely based on the geotechnical design considerations and ongoing monitoring proposed. The environmental consequence of a major slope failure within the open pit would be low, as all material would be contained within the open pit area.

Slope failure within the WRSAs areas is considered very unlikely, based on the geotechnical studies and engineering criteria used in their design and construction. In the unlikely event of a slope failure in these areas, which may affect water conveyance and storage infrastructure and cause contact water to flow directly into Eagle Creek or the Dublin Gulch diversion channel, the consequences would be high.

8.2.4.3 Potential Effects of Slope Failure

Based on the screening of potential interactions between slope failure and environmental and socio-economic VCs, potential effects of concern which have been considered in detail (i.e., ranked as ‘2’) include:

- Surficial geology, terrain, and soils
- Water quality/aquatic biota
- Fish and fish habitat.

The following interactions were ranked as ‘1’ for reasons described below:

Air Quality—In the event of a major slope failure in the open pit, air quality could be affected by excess dust generation. The amount of dust generated and the distance it travels would depend on the nature of the failure, type and quantity of material, and weather. Should a slope failure occur, dust suppression measures would be implemented as soon as possible. Effects would be short-term, localized, and reversible, and would not be significant to air quality (as defined in Section 6.6.1.9)

Vegetation Resources—Effects to vegetation resources due to slope failure would only be expected in the case of slope failure affecting already reclaimed portions of the WRSAs. In this case, damaged areas would be revegetated as described in the Conceptual Closure and Reclamation Plan (Appendix 24), and no long term effects to vegetation resources are anticipated.

Surficial Geology, Terrain, and Soils

Terrain instability and slope failure or slumping within the open pit and WRSAs could be triggered by a number of causes including heavy precipitation, rapid snowmelt, high pore pressures, permafrost heave and differential settlement, and seismic events. Terrain instability due to natural causes such as permafrost and seismic events have been addressed in Section 10. Effects of changes in terrain stability have been assessed in Section 6.4.2.1. With regards to stability in the WRSAs and open pit, engineering design and ongoing monitoring will be the key factors to ensure stability. In the event of a major slope failure in these areas, re-establishing terrain stability is one of the first requirements to protect human safety, water quality, and fish and fish habitat.

Following a slope failure event, slide paths and run-out zones may naturally stabilize and recover following plant recolonization of the disturbed surface. In this case, mitigation measures such as grass seeding can be implemented to accelerate slope stabilization and decrease the effects of erosion and sedimentation. Alternately, it may take many years for a state of equilibrium to be reached that allows the site to begin to recover (e.g., if a slope remains actively unstable following a landslide). In such cases, engineering solutions may need to be considered.

With implementation of mitigation measures following a slope failure event, and with ongoing monitoring and adaptive management as required to ensure slope stability, residual effects to terrain stability would be low in magnitude, site-specific, short-term, and reversible. Potential residual effects could be significant if important habitat, infrastructure, or human safety are affected (as defined in Section 6.4.1.9); however, these effects can be reduced and managed with the application of a well-defined Emergency Response Plan, complemented by additional measures identified in a follow-up and monitoring plan as required. It is anticipated the effects would be temporary and prior land uses could be re-established within a one year timeframe.

Evaluation of those VC for which there could be an interaction of concern with slope failure (those interactions scored “2”) are discussed below.

Potential Effects to Water Quality and Aquatic Biota

A slope failure in the open pit or WRSAs may cause contamination of surface waters and lead to significant effects on water quality and aquatic organisms (i.e., periphyton, macrophytes, benthic invertebrates) in neighbouring watercourses.

A slope failure could damage engineered channels used to direct non-contact water around Project facilities, and contact water to the mine water treatment plant during operation and to wetlands during post-closure. As a result, contact water with high concentrations of metals and suspended solids could enter the receiving environment directly (untreated).

Post-closure, slope failures could also result in loss of wetland habitat, impairing the wetlands ability to attenuate flows and precipitate metals, and damage the caps constructed on the WRSAs. Compromised caps could result in increased infiltration of precipitation through the WRSAs (contact water), through the wetlands, and eventually into Dublin Gulch and Eagle Creek.

Local and regional effects of slope failure in the open pit or WRSAs can be classified as:

- Toxicity effects
- Eutrophication effects
- Sedimentation effects.

In the event of a slope failure, an emergency response plan will be in effect to contain the contamination and restore the failed structure. A water quality monitoring program will also be implemented to monitor the concentration of toxic metals (and cyanide compounds in case of HLF failure after the mine closure) in affected surface waters.

Residual effects of a slope failure of WRSAs and HLF (after closure) may include deterioration of water quality, mortality of periphyton and aquatic invertebrates, and eutrophication. All potential residual effects of a slope failure are considered temporary and reversible. Geographic extent of effects may be considered as regional (as a result of potential eutrophication downstream) and magnitude of effects may be considered significant.

The above identified potential effects need to be evaluated within the context of the likelihood of the event occurring. For both the open pit and the WRSAs, slope failure is considered to be very unlikely—not expected to occur during the life of the Project. Given this and the mitigations and response plans that will be in place, slope failure is not considered to pose a significant threat to water quality and aquatic biota.

Fish and Fish Habitat

A major slope failure in WRSAs or the open pit may impact fish and fish habitat in Haggart Creek and Dublin Gulch. Potential effects of a slope failure on fish and fish habitat, regardless of the size of the failure and impacted watercourse, include:

- Constriction/blockage of stream channel and potential dewatering of downstream habitat
- Release of sediments into watercourses
- Release of toxic chemicals and nutrients into watercourses
- Loss of habitat in the impacted area
- Increased turbidity and deterioration of water quality downstream
- Mortality of fish and incubating eggs.

The effects of a slope failure on fish and fish habitat are a function of the extent and location of the failure. While a minor failure in the open pit could happen during the life of the Project, slope failures in WRSAs are considered very unlikely. The effect of such a failure would be limited to the release of nutrients and toxic chemicals (i.e., toxic metals) and sediment plumes. Sediment plumes can be harmful to fish, and degrade fish habitat and spawning areas (through sedimentation of spawning gravel and suffocation of incubating eggs). A major slope failure in the WRSAs may affect watercourses through total blockage and release of relatively high volumes of sediments to the aquatic environment. The blockage may cause disconnection of a section of the watercourse and dewatering of downstream fish habitat that may result in fish and invertebrate mortality.

In the event of a slope failure near fish habitat, immediate mitigation will involve the removal of debris from the watercourse to prevent channel restriction and potential dewatering of downstream habitat; and to restore fish passage and re-establish connectivity of the aquatic habitat.

Water quality will be monitored downstream of the impact (i.e., failure) to identify the downstream extent of effects on turbidity and critical habitat (e.g., spawning habitat). Critical habitats downstream of the failure will be surveyed to determine potential effects of increased sedimentation as a result of the failure.

Residual effects of a slope failure will depend on the magnitude of the failure and the size of watercourse (e.g., total versus partial blockage), and may range from temporary restriction of flow to total obstruction. Release of large amounts of sediment to the aquatic habitat is likely and may cause temporary deterioration of water quality, increased turbidity, and degradation of downstream spawning habitat. Other residual effects of a slope failure may include direct mortality of fish and invertebrates buried by debris. Depending on the magnitude, a mitigation and compensation plan may be required to offset the adverse effects of a slope failure on fish and fish habitat.

Magnitude and geographic extent of residual effects may vary considerably depending on the size of the watercourse and the scale if the slope failure. However, potential residual effects are considered temporary and reversible and given that it is highly unlikely that a major slope failure would occur the threat to fish and fish habitat is considered is considered to be not significant.

8.2.5 Water Conveyance and Storage Infrastructure Failure

The water management infrastructure at the mine site consists of a number of components including:

- **Events ponds:** used to store excess cyanide solution during storm events and for HLF drain down during long-term plan shutdown and final closure phases.
- **Sediment control ponds:** placed at the base of each WRSA to capture surface and ground water, and at the western end of Dublin Gulch to capture non-contact surface water and treated contact water from the site water treatment plant.
- **Polishing ponds:** one pond to receive effluent from the cyanide detoxification plant, open pit sump, and the Eagle Pup SCP and to feed the site water treatment plant; and one pond to receive product solution from the site water treatment plant and act as a product storage pond.
- **Dublin Gulch diversion channel:** designed to convey streamflow safely past the HLF and divert the water to the Eagle Creek drainage downstream of the Project site facilities.
- **Surface water diversions and interceptor ditches**: placed around the perimeter of the HLF, ponds, open pit, plant site and yards to convey natural runoff water away from the structures and into SCPs.

The Water Management Plan (Appendix 18) establishes the protocol for the control and management of non-contact (i.e., from undisturbed basins or areas) and contact (i.e., from areas or facilities developed for the Project) water during all Project phases.

During the life of the Project, it is possible one or more components of the water conveyance and storage infrastructure could fail, potentially resulting in release of contact surface water (nutrients, metals, cyanide, suspended solids) to adjacent watercourses, depending on the systems affected. Potential failure mechanisms include:

- Inadequate engineering
- Unexpected precipitation events (>1:100 year 24 hour event)
- Seismic events
- Terrain instability
- Debris compromising water conveyance.

8.2.5.1 Project Design and Operational Measures to Minimize Risk of Water Conveyance and Storage Infrastructure Failure

The following measures will be implemented to minimize the potential for water conveyance and storage infrastructure failure:

- The HLF and WRSAs will be designed using the following surface water peak flow design assumptions:
    - Surface diversion ditches around HLF/WRSA: 1 in 200 year return for a 24-hour event with a peak flow of 0.5 to 1.2 m^3/s

  - Operational surface collection ditches on the HLF/ WRSA benches: 1 in 10 year return for a 24-hour event with a peak flow of 0.6 m^3/s
  - Foundation drainage: 1 in 200 year return for a 24-hour event with a peak flow of 1.5 m^3/s.
- All water conveyance and storage infrastructure will be designed to accommodate the 1:100 year flood event.
- Diversion ditches will be built incorporating erosion protection measures to minimize potential for instability.
- Diversion channels will be sized for the maximum flow velocities expected based on estimated surface runoff volumes.
- Regular inspection of diversion channel and diversion ditches for debris and snow/ice blockage.

8.2.5.2 Water Conveyance and Storage Infrastructure Failure Likelihood and Consequence

Based on the design criteria, water balance modelling, monitoring, and contingency measures proposed for the water conveyance and storage infrastructure at the mine site, a failure resulting in the release of untreated contact water, sediment, or cyanide solution to the environment is considered very unlikely. The consequence of a failure which resulted in the release of untreated contact water or cyanide solution to the environment would be moderate to high, depending on the volume of water released and the location of the release.

8.2.5.3 Potential Effects of Water Conveyance and Storage Infrastructure Failure

Based on the screening of potential interactions between water conveyance and storage infrastructure failure and environmental and socio-economic VCs, potential effects of concern which have been considered in detail (i.e., ranked as ‘2’) include:

- Water quality and aquatic biota
- Fish and fish habitat.

The following interactions were ranked as ‘1’ for reasons described below:

Surfical Geology, Terrain, and Soils—A failure of one or more components of the water conveyance and storage infrastructure for the Project could result in terrain instability and soil erosion due to a sudden release of water outside of defined channels and storage areas. The magnitude of potential effects would depend on the location an extent of the failure. Following a failure event, efforts to immediately contain the release and re-route any water away from the failure area would be implemented. Following containment of the release, restoration activities would be undertaken to identify failure mechanisms and repair damaged infrastructure. Restoration activities would include monitoring for erosion and instability issues and implementation of mitigation measures as required to address stability issues. No significant effects to soil or terrain stability are anticipated as a result of such an event.

Potential Effects to Water Quality and Aquatic Biota

The failure of a water conveyance or storage system may lead to contamination of surface waters with contact water collected in events ponds, sedimentation control ponds, and polishing ponds. As a result of such a failure, cyanide, metals, and nutrients may enter surface waters in the mine area. A detailed discussion of potential effects of these chemicals is presented in Section 8.2.3.3 (HLF failure) and Section 8.2.4.3 (slope failure).

In the event of a failure in water conveyance and storage systems, an emergency response plan will be in effect to contain the contamination and restore the failed structure. A water quality monitoring program will also be implemented to monitor the concentration of toxic chemicals in affected surface waters.

Residual effects of such a failure may include deterioration of water quality, mortality of periphyton and benthic invertebrates, and eutrophication. All potential residual effects of a failure of water conveyance and storage system are considered temporary and reversible. Geographically the effects could extend the length of local watercourses. The effects being temporary and reversible and their occurrence being very unlikely, the threat to water quality and aquatic biota is considered to not pose a significant threat.

Potential Effects to Fish and Fish Habitat

Effects of failure of water conveyance and storage infrastructure on fish and fish habitat will be a function of the type of failure (i.e., water storage facility failure only, failure of cyanide containing storage facilities, or both) and the impacted watercourse. These effects may consist of:

- Direct mortality of fish and invertebrates as a result of cyanide and other toxic chemicals
- Effects on fish water quality degradation as a result of increased sedimentation.

Effects of cyanide release into the water body are assessed in Section 8.2.2.3 (hazardous material spill) and Section 8.2.3.3 (HLF failure) and effects of sediment release to watercourses are addressed in Section 8.2.4.3 (Slope failure).

Mitigation and clean-up in the case of a water conveyance or storage infrastructure failure include immediate containment of the breached storage facility to contain the release of toxic chemicals and sediment into adjacent watercourses. Follow-up monitoring may be required according to the type of failure.

Magnitude and geographical extent of potential residual effects may be substantial in the event of a failure of cyanide containing storage facilities, and will be dependent on the physical characteristics of the receiving environment. A well defined emergency response plan will limit the potential effects of such an incident on fish and fish habitat. Potential residual effects are considered temporary and reversible, and because of very unlikely probability of an event occurring, the threat to fish and fish habitat is considered not significant.

8.2.6 Power Failure

The Project area, including Mayo, is within the Mayo-Dawson electrical grid, powered by the Mayo hydroelectric plant. Yukon Energy is currently constructing the second stage of the Carmacks-Stewart Transmission Project and the Mayo Hydro Enhancement Project (Mayo B), which will more than double the electrical capacity of the current Mayo plant, and the Carmacks-Stewart Transmission Project will connect the Mayo – Dawson grid with the Whitehorse – Aishihik – Faro grid.

During construction, power will be generated onsite by diesel generators until the transmission line connecting to the grid is established. During construction (after connection to the grid), operations, and reclamation and closure, power will be supplied via a new 45 km, 69 kV transmission line connected to the Yukon energy grid. Power will be distributed at 13.2 kV via two sets of overhead lines (Section 5.1.2). The Project will require 11 MW of power annually on average for Project operations (Section 5.5.6). Diesel generators will be housed on-site to provide a back-up power source during Project operations, and reclamation and closure.

8.2.6.1 Project Design Measures to Minimize Risk of Power Failure

The following measures will be implemented to minimize the potential for power failure:

- Transmission and distribution lines will be inspected regularly and after severe storm events.
- In siting the transmission line, zones of permafrost, steep slopes, and wetlands will be avoided if possible or mitigation measures will be implemented such as longer spans and special foundations.
- Areas of terrain instability along the transmission line route will be identified and monitored on a regular basis, and slope stabilization measures implemented as required.
- Danger trees will be assessed and removed within and adjacent to the transmission line RoW.
- The transmission line poles will be placed outside the desirable clear zone (DCZ), as defined by the *Roadside Design Guide*, issued by Alberta Infrastructure and Transportation to minimize the risk of damage from vehicle collisions.
- The transmission line will be designed and constructed in accordance with Yukon Energy best practices.
- In the event of a power failure, three emergency diesel generation sets will provide back-up power. Each unit will be rated at 1,500 kW, 575 V with a 575 V/13.2 kV transformer and will supply power to pregnant and barren solution pumps, carbon stripping circuit, camp and buildings, fire and freshwater distribution systems, and fire, alarm and security systems. Determination of any additional services requiring back up power will be done during the feasibility study.
- Should back-up power fail, the in-heap pond combined with the events ponds will have the capacity to contain a drain-down of the entire volume of cyanide solution in the HLF at any given time throughout the life of the Project (~189,000 m^3; see Appendix 21 – Eagle Gold Project Surface Water Balance Model Report).

8.2.6.2 Power Failure Likelihood and Consequence

Power outages are common in the Village of Mayo, and it is highly likely over the life of the mine that a storm event could result in loss of power to the mine site. In this situation, the back-up generators would provide power to ensure the HLF pumps remain operational. In the event of a prolonged power outage and loss of road access to site, the mine site will have sufficient diesel stored to run emergency back-up generators for approximately two weeks. As the back-up power onsite is sufficient to continue running the pumps for extended periods, the consequence is considered very low.

In the highly unlikely event that the back-up power source failed, the consequence would remain very low, as the in-heap pond and events ponds have the capacity to ensure cyanide solution is not released to the environment.

8.2.6.3 Potential Environmental Effects of Power Failure

Based on the Project design measures proposed to ensure back-up power to the site, and the capacity of Project infrastructure to contain potential releases should back-up power fail, no effects to environmental or socio-economic VCs have been identified due to power failure.

8.2.7 Fire and/or Explosion

A fire and/or explosion at the mine site could endanger worker health and safety, as well as damage infrastructure. Should a fire escape Project controls within the mine site, a forest fire could be ignited, which could affect a number of VCs in the surrounding area. Fire and explosion hazards are those situations or conditions created by a combination of a fuel source, an oxygen source, and a source of ignition.

A number of potential fuel sources will be stored and used on the Project site including explosives emulsions, engine fuels and hydraulic oils. Combustion of fuel sources can lead to release of harmful gases which can travel various distances, depending on atmospheric conditions. In addition, if a forest fire is ignited, combustion of vegetation would emit carbon dioxide, particulate matter, and other gases.

Explosives will be stored in two separate structures within the eastern reaches of Dublin Gulch—one for explosives and the other for blasting caps (Figure 5.1-3). The explosives areas will be well-separated from other infrastructure and operational areas, and isolated from casual access. The magazines will be separated from each other, and from other buildings, roads, and watercourses as required by Blasting Explosives and Initiation Systems: Storage, Possession, Transportation, Destruction and Sale (NRCan 2008).

8.2.7.1 Project Design Measures to Minimize Risk of Fire and/or Explosion

Fire and explosion hazards will be managed through a systematic approach including identification of risks, determination of how to manage these risks, identifying specific control measures to prevent fires or explosions, and implementing the control measures. To minimize the potential for fire and/or explosion, the following measures will be implemented:

- Fire sensors will be located at critical points throughout the mine site facilities.
- Firefighting equipment will be located throughout the mine site. The process offices, laboratory and shop/warehouse will be fitted with sprinkler systems.
- Portable fire extinguishers will be provided in all buildings.
- Vegetation that could provide fuel for fire will be removed from around mine infrastructure.
- Brushing and clearing along the transmission line and road RoWs will be conducted during low fire danger periods.
- Explosives will be housed in two separate structures located in the eastern reaches of Dublin Gulch. One building will house explosives, while the other will house blasting caps. These buildings will be designed and operated in accordance with the magazine licence issued by Natural Resources Canada.
- A Fire Response Plan will be developed as part of the Emergency Response Plan (Appendix 33), which will include details of standard fire prevention measures and procedures to be implemented, as well as standard equipment, training and emergency response measures to be used for the Project.
- Regular inspections specifically looking at fire risk will be carried out in all areas of the Project site.
- A fully equipped Fire Truck and trained Emergency Response Team will be maintained at all times

8.2.7.2 Fire and/or Explosion Likelihood and Consequence

Based on the Project design and prevention measures in place, it is considered very unlikely that a fire would escape Project controls and ignite a wildfire. Should a wildfire ignite due to Project activities, the consequence could be high, depending on the aerial extent of the damage.

8.2.7.3 Potential Environmental Effects of Fire and/or Explosion

Based on the screening of potential interactions between fire and/or explosion and environmental and socio-economic VCs, potential effects of concern which have been considered in detail (i.e., ranked as ‘2’) include:

- Air quality
- Vegetation resources.

The following interactions were ranked as ‘1’ for reasons described below.

Water Quality and Aquatic Biota—In the event a fire escapes Project controls and ignites a wildfire, there is the potential for effects to water quality associated with damage to riparian vegetation. Post-closure, damage to wetlands could affect their ability to attenuate flows and precipitate metals. Reduced vegetation on HLF and WRSA caps could alter evapotranspiration, surface run-off, and infiltration rates, which could in turn alter volumes of contact water reaching surface waters. Potential effects include elevated concentrations of nutrients, metals, and suspended solids in the receiving environment. In the event of an explosion at the magazine facility, debris could reach Olive Gulch, contributing sediment and blast residue to surface watercourses. Based on the proposed mitigation measures and the low likelihood of a fire escaping Project controls, no significant effects to water quality are anticipated.

Fish and Fish Habitat—Potential effects of a wildfire to fish and fish habitat would be associated with damage to riparian vegetation and changes in water quality as discussed above. Following implementation of mitigation measures, no significant effects to fish and fish habitat (as defined in Section 6.7.2.9) are anticipated due to fire or explosion.

Wildlife Resources—Effects to wildlife resources could include direct mortality for animals that could not escape the fire, as well as loss of habitat. Effects from fire to wildlife are not expected to be significant, as focal species identified in the wildlife assessment (moose, grizzly bear, American marten, Olive-sided Flycatcher, and Rusty Blackbird) are mobile and could escape approaching wildfires. Loss of habitat due to wildfire is not expected to amount to >40% (36,000 ha) of the RAA for wildlife (see Section 6.9.1.9), based on the history of wildfires in the area (Wildland Fire Review Panel 2004).

Traditional Activities and Culture—Effects to traditional activities due to a Project-caused forest fire would be associated with effects to wildlife and vegetation. As discussed above and below, effects to these VCs would vary depending on the aerial extent of a fire, but are expected to be reversible following regeneration. Based on the proposed mitigation measures to prevent a fire from escaping Project controls, and fire response measures should it escape Project controls, potential effects to traditional activities and culture are considered not significant.

Human Health and Well-being—The magnitude of potential effects to human health will depend on the severity of a fire or explosion. A large explosion could directly endanger worker safety, while fire could lead to release of harmful gases that could affect human health. Table 8.2-1 lists potential effects on human health of an accidental release or misuse of hazardous materials that will be used at the mine. With the implementation of standard mitigation measures and use of prescribed personal protective equipment for use of hazardous materials and first-response efforts, no effects to human health are anticipated.

Infrastructure and Services—A fire or explosion has the potential to disrupt public infrastructure due to additional stress placed on the mine access road and emergency fire response resources. Initial fire response will be handled internally by VIT in accordance with their Fire Response Plan. The Yukon Fire Management Program will be contacted for assistance if the fire reaches a threshold size, and according to the protocols outlined in the Fire Response Plan. Based on the internal resources available, and the low likelihood of a fire escaping Project controls, the Project is not expected to have a significant adverse effect on infrastructure and services.

Evaluation of those VC for which there could be an interaction of concern with fire and or explosion (those interactions scored “2”) are discussed below.

Potential Effects to Air Quality

There is potential for adverse effects to air quality associated with fires and/or explosion due to the release of contaminants into the atmospheric environment. The nature of contaminants released would depend on the size and location of the fire. Combustion of sodium cyanide could result in a release of hydrogen cyanide gas to the atmosphere. In this case, the area would be immediately isolated and appropriate evacuation distances identified in accordance with the Emergency Response Plan (Appendix 33). Combustion of other fuel sources at the site could lead to release of harmful gases which can travel various distances, depending on atmospheric conditions. If a fire escaped Project controls, a wildfire could result causing the combustion of vegetation that would emit carbon dioxide, particulate matter, and other gases.

Potential residual effects to air quality could exceed relevant regulatory criteria in the local area over the short-term; however they these potential effects are not expected to be significant due to the low likelihood and frequency of occurrence.

Potential Effects to Vegetation Resources

In the event of a fire on the Project site, there is the potential for ignition of a forest fire if fire fighting measures are not successful at containing the fire within the mine site. Forest fires are a natural and beneficial process in the Yukon landscape, however they can pose serious risk to life and property in development areas surrounded by forest (Wildland Fire Review Panel 2004). Extreme fire seasons are intermittent in the Yukon and over the period of 1950 to 2004, annual area burned exceeded 200,000 ha only 11 times. On average 120,000 ha are burned per year, of which about 55% are caused by lightning strikes. Human caused fires, accounting for 45% of fires annually, are generally smaller and closer to settled areas than lightning-caused events.

The Project is located in an area which has been subject to a number of wildfire events and, as in other forested regions of Yukon, the risk of human- or lightning-caused wildfire increases in the summer during prolonged periods of hot, dry weather. Depending on the size of the fire, residual effects to vegetation resources could range in magnitude from low to moderate, would be local to regional in extent, occur once, and have medium-term effects. Effects would be reversible following regeneration of forest and occur within a partially disturbed context (see Section 6.8.1.8 for definitions). Based on this characterization of residual effects, a fire that escaped Project controls and ignited a wildfire would not be expected to have a significant effect on vegetation resources, as it would not affect the sustainability of key indicators for vegetation (Section 6.8.1.9), and would be reversible following regeneration of forest resources.

8.3 Summary of assessment of Effects of Accidents and Malfunctions

The potential for accidents and malfunctions exists with every project. They can be due to design and construction errors, human error, and natural events such as storms and earthquakes. While the potential for accidents and malfunctions can never be eliminated, their likelihood can be reduced to a minimum with careful planning, precautionary design work that anticipates and addresses potential causes, and protocols that assure proper implementation. Potential effects can also be minimized with anticipatory planning and with pre-placement of procedures, personnel, and equipment for immediate response and subsequent remediation work.

The assessment of effects arising from potential accidents and malfunctions related to the Project focused on seven possible events:

- Transportation accident
- Hazardous materials spill
- HLF breach
- Slope failure (open pit and WRSAs)
- Water conveyance and storage infrastructure failure
- Power failure
- Fire and/or explosion.

The selection of these events was based on input from consultations, regulators, and the public and also on the professions judgment of VIT and its contractors of what events were most like to create effects of concern. In most cases Project design and Project-specific mitigations took into account the potential for these events and either eliminated or reduced the potential effect to a level that would not be of concern. Other identified potential effects were judged to be adequately addressed through the application of codified practices and industry accepted best management practices.

In those cases where the potential for effects of concern could not be eliminated, it was found that the likelihood of the event occurring could be reduced to a level where they were unlikely to very unlikely to occur during the life of the Project. In tandem with this, VIT's commitment to the development of a Project-specific emergency response plan (Appendix 33) for all reasonably foreseeable potential accidents and malfunction is a key mitigation to limiting the scope of potential effects in the case that an event did occur. With mitigations in place and the likelihood of occurrence reduced to unlikely to very unlikely, it was found that accidents and malfunctions do not pose a significant threat to the VC assessed in the Project Proposal.

9 CAPACITY OF RENEWABLE RESOURCES

The Project Proposal includes an assessment of potential Project effects on the capacity of renewable resources to meet the needs of the present and future generations, in consideration of both Project-specific and cumulative effects. YESAA Part 2 Section 42(2) (*b*) states that one of the matters to be considered in assessing a project is: "…the capacity of any renewable resources that is likely to be significantly affected by the project or existing project to meet present and future needs." YESAA does not specifically define the term "renewable resources." This assessment applies the commonly understood meaning of resources that, though used or consumed, can maintain or reestablish themselves. The issue of potential effects on renewable resources is a principal consideration throughout various assessment sections of the PP.

Potential Project effects on renewable resources were assessed in detail in Section 6 – Environmental and Socio-economic Effects Assessment. The physical and biological renewable resources assessed were Surficial Geology, Terrain, and Soils (Section 6.4), Water Quality and Aquatic Biota (Section 6.5), Air Quality (Section 6.6), Fish and Fish Habitat (Section 6.7), Vegetation Resources (Section 6.8), and Wildlife Resources (Section 6.9). In addition, Section 6.11 assessed the socio-economic implications of potential Project effects on activities such as fishing, hunting, trapping, gathering, public recreation, and tourism that rely on renewable resources. Assessments were based on a range of ecological considerations, and included consideration of cumulative environmental effects with other projects.

After consideration of the Project's design, use of best management practices, and the implementation of Project-specific mitigations, VIT, in consultation with its advisors, has determined that the Project will not have significant residual or cumulative effects on any renewable resource. While the means of determining significance is specific to each resource considered, generically, significance thresholds are based on community values or management objectives. None of the Project's residual or cumulative effects exceed either thresholds or standards established by regulation, or thresholds established for this Project's specific circumstances. Therefore, the Project's effects on the capacity of renewable resources are determined to be not significant. The aforementioned sections contain assessment details that support this conclusion.

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10 EFFECTS OF THE ENVIRONMENT ON THE PROJECT

The *Yukon Environmental and Socio-economic Assessment Act* (YESAA) requires that potential effects of the environment on the Project be characterized, including the predicted effects of climate change. In addition, the Act requires that critical site conditions (e.g., ground stability) that would affect the timing of operations for the Project, as well as the manner in which they would affect it, be described.

10.1 Approach

The assessment of potential effects of the environment on the Project included identification of environmental factors deemed to have possible consequences for the Project, and the mitigation measures planned to minimize potential effects. Effects of the environment on the Project that were assessed were characterized as ranging from minor (e.g., inconveniences) to major (e.g., causing the operations to cease for some period). Consideration was also given as to whether they could affect one or more components of the Project.

10.1.1 Influence of Consultation on the Assessment

Environmental conditions with the potential to adversely affect the Project have been identified through the professional experience of VIT, its mining engineers and environmental consultants. In addition, questions raised by the FNNND, the public, and government agencies during meetings and open houses were used to assist with the scope of this assessment.

10.1.2 Potential Effects on the Project

The Project is planned to have a 20-month construction phase, a 7.3-year operations mining phase, and a 10-year closure and reclamation phase, followed by a post-closure monitoring phase. Sections 5.4 to 5.6 provide details of each Project phase. Environmental conditions with the potential to adversely affect the Project during construction, operations, closure and reclamation, and post-closure monitoring phases of the Project include:

- Terrain instability (landslides, avalanches, and permafrost disturbance)
- Seismic activity
- Extreme weather events (extreme wind, rain, snow, ice, or drought)
- Forest fire
- Climate change.

All Project phases will be undertaken in a manner that considers site-specific environmental attributes and risks, including those associated with the extreme environmental conditions listed above. Specific measures that have been considered during Project planning and incorporated into

Project design to address the potential effects of the environment on the Project are detailed in Section 5, and have been summarized in the following sections.

10.2 Terrain Instability

Terrain instability can arise from both human-induced and natural factors and typically relates to the potential for landslides and snow avalanches. The term “landslide” generally refers to the downslope movement of soil, rock, and organic materials, whereas, snow avalanches refer to the mass downslope movements of snow. In northern climates, terrain stability can also be influenced by thawing permafrost and the freeze and thaw cycle causing mass wasting. Unstable terrain has the potential to damage Project infrastructure, cause adverse environmental effects, and pose a threat to health and safety.

In general, the Project area is relatively stable, with shallow surficial deposits and bedrock exposed at the surface near the tops of the hills. A terrain stability assessment that included stability mapping in the Project area was conducted as part of this Project Proposal. The terrain stability assessment classified 70% of the local and regional study areas as stable or generally stable, and identified small portions of these areas (6 to 9%) as having potentially unstable terrain. Unstable terrain is very limited (3%) in the Project area and occurs mainly along the upper reaches of Dublin Gulch, Eagle Pup, Stewart Gulch, Olive Gulch, Bawn Boy Gulch, and a lower section of Ann Gulch (Figure 10-1). Section 4.1.2.3 and Appendix 6 provide additional details on terrain stability.

Historic and active terrain hazards were assessed and provided to Project engineers to aid in Project design, to minimize risk to Project facilities, and to ensure Project development does not accelerate or exacerbate natural geoprocesses (Section 4.1.5). The dominant terrain hazards in the Project area are a consequence of permafrost, which is primarily concentrated in three areas (Figure 10-2):

- South of the Dublin Gulch/Haggart Creek confluence (north of the open pit)
- A plateau to the east of the Project area, outside of the main development areas
- A small area at the head of Ann Gulch where the proposed heap leach facility will be located.

Rapid mass movements are most common in Eagle Pup, and a number of other gullies in the Project area are at risk for small failures on the steeper slopes (see Section 4.1.5 for details). Snow avalanches in the Project area are generally associated with the steeper entrenched gullies.

10.2.1 Mitigation Measures

Mitigation measures to avoid potential effects of terrain instability on Project infrastructure have been incorporated into Project prefeasibility designs (PFS document) and are outlined below (Scott Wilson Mining 2010). Further terrain assessment will be completed to confirm preliminary findings and modify design criteria as required during the feasibility phase of Project engineering design.

Open Pit

- Open pit slopes and benches will be designed using ongoing geotechnical investigations and mining best practices.
- During dewatering of the open pit, pit perimeter well and horizontal bench wells will be used to extract groundwater and depressurize open pit walls. Pumping wells will also be used to aid in depressurization of open pit slopes as required. This will increase open pit wall stability.
- Regular inspections will identify areas of potential instability and result in mitigative measures to decrease the likelihood of failure.

Heap Leach Facility

- Site selection for the HLF was based on engineering assessments that considered geotechnical conditions.
- Prefeasibility stability analysis of the HLF location has been completed to inform preliminary design.
- Further stability analyses and geotechnical testing will be completed during the feasibility stage of the Project.
- The in-heap pond within the HLF is currently designed with a maximum capacity of leach solution storage of 435,000 m^3. Under normal operating conditions, leach solution storage in the in-heap pond will be maintained at a volume of approximately 60,000m^3.

Waste Rock Storage Areas

- Permafrost zones within the proposed WRSAs will be stripped or excavated to encourage thawing and drainage and ensure stability before placement of waste rock.
- Further stability analyses and geotechnical testing will be completed during the feasibility stage of the Project.

Other Infrastructure

Final selection of the transmission line route will include an assessment of potential areas of instability (e.g., permafrost, wetlands, and steep slopes). This assessment will allow for the transmission line infrastructure to avoid potential areas of instability, where possible, through the use of longer spans. Where avoidance is not possible, instability will be mitigated through the use of special foundations. Transmission line watercourse crossings will be located as far back from the water's edge as possible to minimize potential instability issues.

EBA Engineering Consultants Ltd. completed a geotechnical investigation of the HCR as part of the 1996 design process. As there has been little to no development along the HCR since the results of the geotechnical assessment, it is considered valid. The 1996 investigation encountered no permafrost in the constructed grade. Test pits within the SMR valley did however encounter permafrost and visible ice. It is assumed that no further upgrades of the SMR for this section of the access road will be necessary; therefore, access road instability resulting from permafrost is not anticipated. However, a geotechnical investigation for the entire length of the access road (SMR and HCR) has been designed and will be completed by December 2010 to further classify areas of terrain instability.

10.3 Seismic Activity

The Project is located within an area of moderate seismic hazard (Natural Resources Canada 2005). The distribution of recorded seismic events in the vicinity of the Project site is shown in Figure 10-3. Seismic events have the potential to cause terrain instability and damage to Project facilities. Site-specific seismic hazard information was obtained from Natural Resources Canada (www.EarthquakesCanada.ca). The National Building Code of Canada (NBCC) recommends design ground motions corresponding to a 2% probability of exceedance in 50 years (0.000404 per annum; 1 in 2,475 year earthquake). Table 10.1 indicates these recommended design ground motions for the Project site.

Table 10.1: National Building Code of Canada Recommended Design Motions

Spectral Acceleration				Peak Ground Acceleration (g)
0.2 seconds	0.5 seconds	1.0 seconds	2.0 seconds	
0.513	0.312	0.155	0.086	0.245

Depending on the magnitude of a seismic event, damage to Project infrastructure may range from no major damage/minor interruption in operations to, in the case of a large earthquake (i.e., maximum credible), loss of equipment or major structural damage to Project facilities.

The NBCC generally applies to buildings and not geotechnical structures (e.g., embankments). The most appropriate standard to be applied to design of non-building Project facilities will be determined during feasibility-level design studies in consultation with YESAB as required.

Design and construction of the HLF embankment has considered the Canadian Dam Association's Dam Safety Guidelines (2007). The HLF will be designed to withstand seismic ground motions from the maximum design earthquake as defined during feasibility-level design.

10.4 Extreme Weather Events

Extreme weather conditions and weather-related events with the potential to adversely affect the Project include wind storms, heavy rain or snowfall, and snow or ice accumulations. Globally and locally, there has been an increase in the incidence of extreme weather conditions, a trend that most climate models predict will continue in association with ongoing climate change (e.g., Meehl, et al., 2000).

10.4.1 Severe Rainstorms and Flooding

Historical regional climate data recorded from Environment Canada weather stations at Mayo and Dawson (Environment Canada 2010) provide information on the nature of extreme precipitation events that have been reported in the region of the Project (Table 10.2).

Table 10.2: Precipitation Extremes from Canadian Climate Normals

Extremes Data*	Environment Canada Weather Station	
	Mayo A	Dawson A
Extreme daily rainfall	31.8 mm (Aug 27, 1932)	28.8 mm (Aug 14, 1980)
Extreme daily snowfall	35.6 cm (Jan 9, 1949)	23.8 cm (Nov 25, 1986)
Extreme snow depth	117 cm (Mar 4, 1967)	131 cm (Mar 20, 1979)

NOTE:
* Extremes were determined by Environment Canada based on at least 20 years of data collected between 1971 and 2000

Rainfall recorded at the Project site is within 10% of the estimated median rainfall for the region. Between 2007 and 2009, no rain events at the site exceeded the 1:100-year 24-hour event intensities or accumulations in the Mayo records. The maximum 24-hour accumulation at the Potato Hills data station was 35.4 mm on Sept 16, 2007, which represented a 5-year event for Potato Hills based on regression analysis. The extreme 24-hour rainfall recorded for Mayo is 31.8 mm (August 27, 1932) and the predicted 24-hour 100-year accumulation on record for Mayo is 35 mm.

Extreme rainfall events could cause accumulation of several centimetres of precipitation in a 24-hour period, resulting in several million cubic metres of water being rapidly added to water storage and conveyance infrastructure on the Project site. Surface runoff during extreme precipitation events could also lead to slope instability.

Mitigation measures proposed to minimize potential effects to the Project during extreme precipitation events include:

- The HLF and WRSAs will be designed using the following surface water peak flow design assumptions:
  - Surface diversion ditches around HLF/WRSA: 1 in 200 year return for a 24-hour event with a peak flow of 0.5 to 1.2 m^3/s
  - Operational surface collection ditches on the HLF/ WRSA benches: 1 in 10 year return for a 24-hour event with a peak flow of 0.6 m^3/s
  - Foundation drainage: 1 in 200 year return for a 24-hour event with a peak flow of 1.5 m^3/s.
- All water conveyance and storage infrastructure will be designed to accommodate the 1:100 year flood event.
- Monthly access road maintenance will include ensuring proper drainage off the road surface, and checking for erosion of abutments, approaches, and drainage ditches adjacent to the

South McQuesten River Bridge following heavy rainstorms. In addition, culverts along the access road will be inspected and cleared to ensure they operate and drain effectively.

- Under normal operating conditions, water will be pumped from the HLF to the mine water treatment plant to the events ponds. The events ponds will be empty during winter to ensure full storage capacity for an expected large volume of water generated during freshet. During extreme precipitation events, the events ponds will provide capacity for excess process solution storage to eliminate the potential for a breach of Project infrastructure. One hundred percent of the total potential draindown volume of process solution may be stored in the events ponds at all times throughout the life of the mine during all precipitation conditions. The events ponds will remain in-place until the HLF is capped in Year 13. When the events ponds are no longer needed (i.e., HLF is capped, water quality standards are achieved), the events pond area will be reclaimed into a passive treatment wetland system.
- The in-heap pond within the HLF is currently designed with a maximum capacity of leach solution storage of 435,000 m^3. Under normal operating conditions, leach solution storage in the in-heap pond will be maintained at a volume of approximately 60,000m^3. This provides additional capacity for large precipitation events.

The Water Management Plan (Appendix 18) provides a detailed description of design criteria for the Project's water management facilities with respect to extreme precipitation events.

10.4.2 Extreme Snow and Ice Accumulations

Based on regression analysis of regional snowfall data, the estimated mean annual snowfall accumulation is 269 cm at Potato Hills and 190 cm at the Camp station. The maximum extreme daily snowfall in Mayo is 35.6 cm (Table 10.2). High levels of snowfall could affect vehicle and equipment movement along the access road and within the Project site. Buildings and transmission lines could also be damaged by large snow accumulations. In addition, operation of the HLF and the capacity of water conveyance and storage infrastructure could be affected by snow and ice accumulations.

Mitigation measures proposed to minimize potential effects to the Project during extreme snowfall or ice accumulation include:

- Rooflines will be kept as straight and unobstructed as possible to prevent snow build-up. Portal structures at each entry point to buildings will be installed to prevent injury from falling icicles and snow. All building perimeters will have clear access for snow removal.
- Buildings will be constructed to withstand maximum snow loads for the Project area in accordance with the National Building Code of Canada (2005).
- The HLF has been designed with an in-heap pond and in-heap drip emitter system to allow for operation and prevent freezing during winter months.
- In winter, all water conveyance and storage infrastructure will be inspected regularly to ensure storage capacity is maintained, and drainage structures are clear of ice and snow. Culverts will be steamed as required to maintain adequate drainage.

- VIT will coordinate with HPW to develop and undertake a maintenance plan for all sections of the road to meet Project needs for year-round operations including snow removal and sanding/scarifying of access roads (SMR and HCR). The mine production fleet will include equipment to clear snow such as graders, snow plows, sand trucks, loaders, and scrapers.

10.4.3 Wind

Historical regional climate data recorded from Environment Canada weather stations at Mayo and Dawson (Environment Canada 2010) provide information on the nature of extreme wind speed events that have been reported in the regional Project area (Table 10.3).

Table 10.3: Wind Extremes from Canadian Climate Normals

Extremes Data*	Environment Canada Weather Station	
	Mayo A	Dawson A
Maximum hourly wind speed and direction	72 km/hr (Oct 27, 1962); southeast	46 km/hr (Sept 25, 1985); west
Maximum gust speed and direction	126 km/hr (April 20, 2002); southwest	70 km/hr (Dec 19, 1984); west

* Extremes were determined by Environment Canada based on at least 20 years of data collected between 1971 and 2000

High winds may blow down trees and result in direct or indirect damage to buildings and transmission lines. Wind erosion risk in the area is limited due to the high coarse fragment content in Project area soils.

Mitigation measures proposed to minimize potential effects to the Project during extreme wind conditions include:

- All Project components will be designed to withstand maximum wind loads for the Project area as described in the National Building Code of Canada (2005).
- Transmission lines will be inspected regularly and after extreme storm events.
- Danger trees will be assessed and removed within and adjacent to the transmission line RoW.

10.5 Forest Fire

Forest fire risk in the Project area is greatest in the summer, especially from late June to early August, during prolonged periods of higher temperatures. Fires can be initiated by lightning strikes as well as human activities. Between 1950 and 2006, 6,294 wildfires were recorded in the Yukon. Of these, 49% were lightning induced and 51% were human caused. Over this period, an estimated 8.15 million hectares burned (Government of Yukon 2010). The Project is located in the Mayo sub-district of the Northern Tutchone fire management district. The closest fire department is located in the Village of Mayo, and is staffed by 15 to 20 volunteers.

Land in the vicinity of the Project is characterized by a combination of northern boreal forest and subalpine ridges and plateaus. Forested areas are characterized by a mix of coniferous and deciduous patches at various successional stages due to forest fire. A recent fire (<10 years) occurred immediately to the south of Dublin Gulch on the south facing slope above Lynx Creek.

The Project site will be mainly cleared of vegetation, reducing the risk of a forest fire damaging on-site Project components. Project components of primary risk from fire include bridges and culverts along the access road, the transmission line, and wooden transmission structures. The main concern related to forest fire is the ability for the HLF to continue operating safely (i.e., no discharges to the environment) if the Project site loses power or needs to be evacuated. This potential scenario is discussed in further detail in Section 8.

Mitigation measures proposed to minimize potential effects to the Project associated with forest fires include:

- Firefighting equipment will be located throughout the mine site. The process offices, laboratory and shop/warehouse will be fitted with sprinkler systems.
- Brushing and clearing along the transmission line and road RoWs will be conducted to minimize the risk of wildfires.
- Vegetation that could provide fuel for fire will be removed from around mine infrastructure.
- A Fire Response Plan will be developed as part of the Emergency Response Plan for the site that includes procedures for dealing with wildfire hazards and site evacuations.
- The HLF will be designed to ensure safe operation and/or shutdown in the event of a site evacuation and/or power failure.

10.6 Climate Change

The International Panel on Climate Change (IPCC), established by the World Meteorological Organization and the United Nations Environment Programme in 1988, represents the most widely accepted scientific knowledge on the current and future effects of climate change. The IPCC findings on climate change are based on climate models that simulate past and current estimates, taking into account relevant physical, geophysical, chemical and biological processes, driven by a range of socio-economic assumptions. In 2007, the IPCC issued its fourth (and most recent) assessment report on climate change. This report confirms previous findings that the warming of the global climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and a rising average sea level (IPCC 2007).

A greenhouse gas (GHG) is any gas which contributes to potential climate change. Common GHGs include carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). Greenhouse gases absorb heat radiated by the earth and subsequently warm the atmosphere, leading to what is commonly known as the greenhouse effect. Increasing concentrations of greenhouse gases in the atmosphere are believed to be causing global warming (IPCC 1990; IPCC 1995). Increased temperatures may contribute to a sea level rise. Although estimates vary, a global sea level rise is expected to be +0.5 m by 2100 (Wigley and Raper 1992; IPCC 1995; Forbes, et al. 1997). Other atmospheric changes relating to climate change may include increased storm intensity and other changes relevant to coastal stability such as surface winds, ocean waves, storm surges, and ice conditions (Forbes, et al., 1997).

The northern and arctic regions are particularly vulnerable to climate change. For instance, warmer winters could result in the melting of permafrost, which in turn could cause building foundation failures, slope failures, erosion of bridges and dykes, and other infrastructure built on permafrost. The Arctic Climate Impact Assessment (Hassol 2004) predicted climate change associated higher year-round temperatures, more precipitation in winter, and more extreme weather events in both summer and winter for Yukon.

Effects of climate change could affect the Project in a number of ways including:

- Permafrost melt causing potential instability
- Increased forest fire risk due to increased temperatures, changes in precipitation, and increased thunderstorms
- Increased extreme weather events (snow, rain, wind) potentially affecting Project infrastructure
- Changes to hydrological flow regimes in watercourses around the Project site affecting water conveyance and storage systems or surrounding infrastructure.

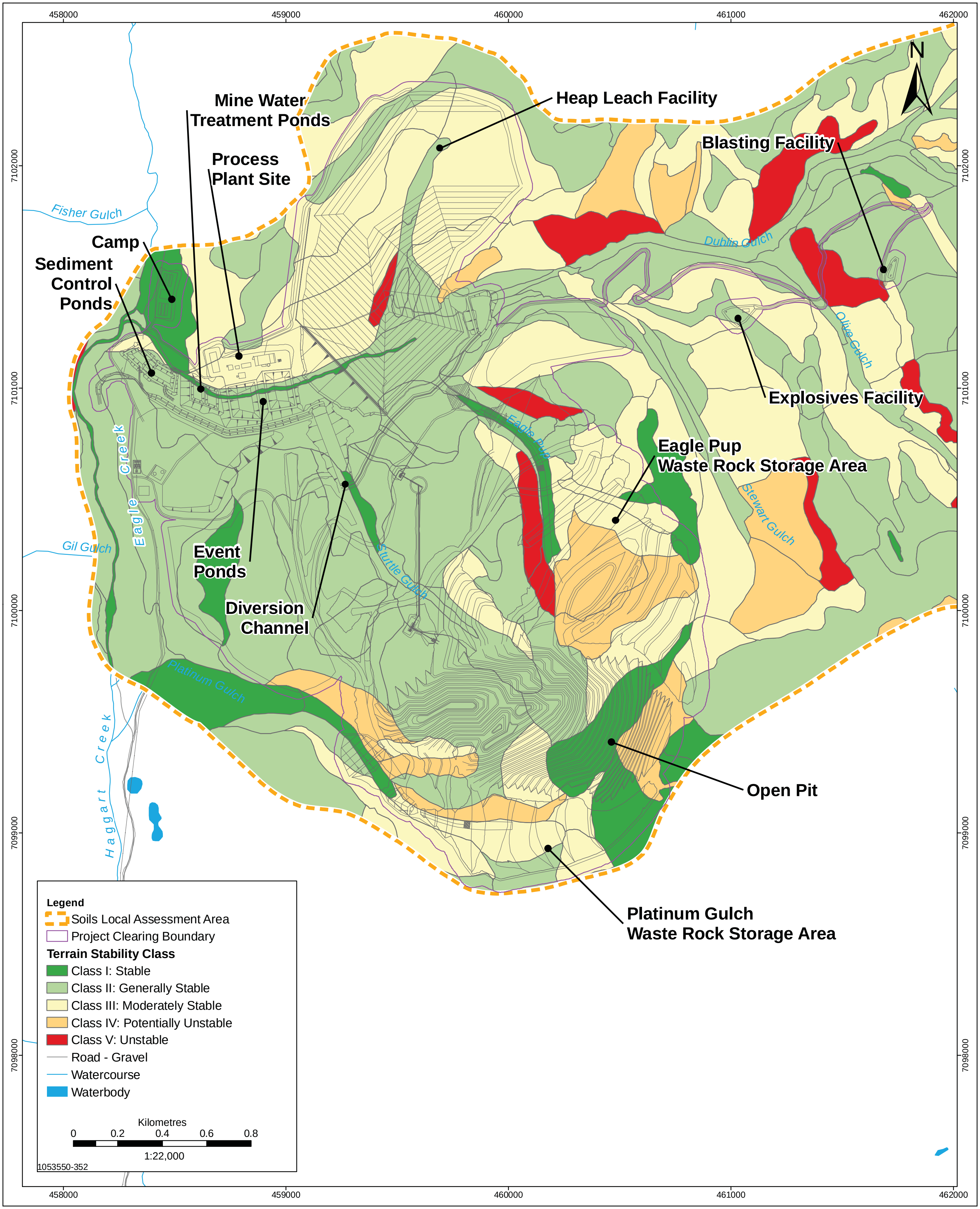
Mitigation measures to address these potential effects of climate change on the Project have been addressed in the preceding sections.

10.7 Summary of Potential Effects of the Environment on the Project

The design specifications for the Project have taken into account the potential for extreme events and effects of the environment, including climate change; therefore, no adverse effects to the Project or Project timing are anticipated due to effects of the environment.

10.8 Figures

Please see the following pages.



Data Sources; Government of Canada, Victoria Gold Corp.

Stantec
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Burnaby, British Columbia
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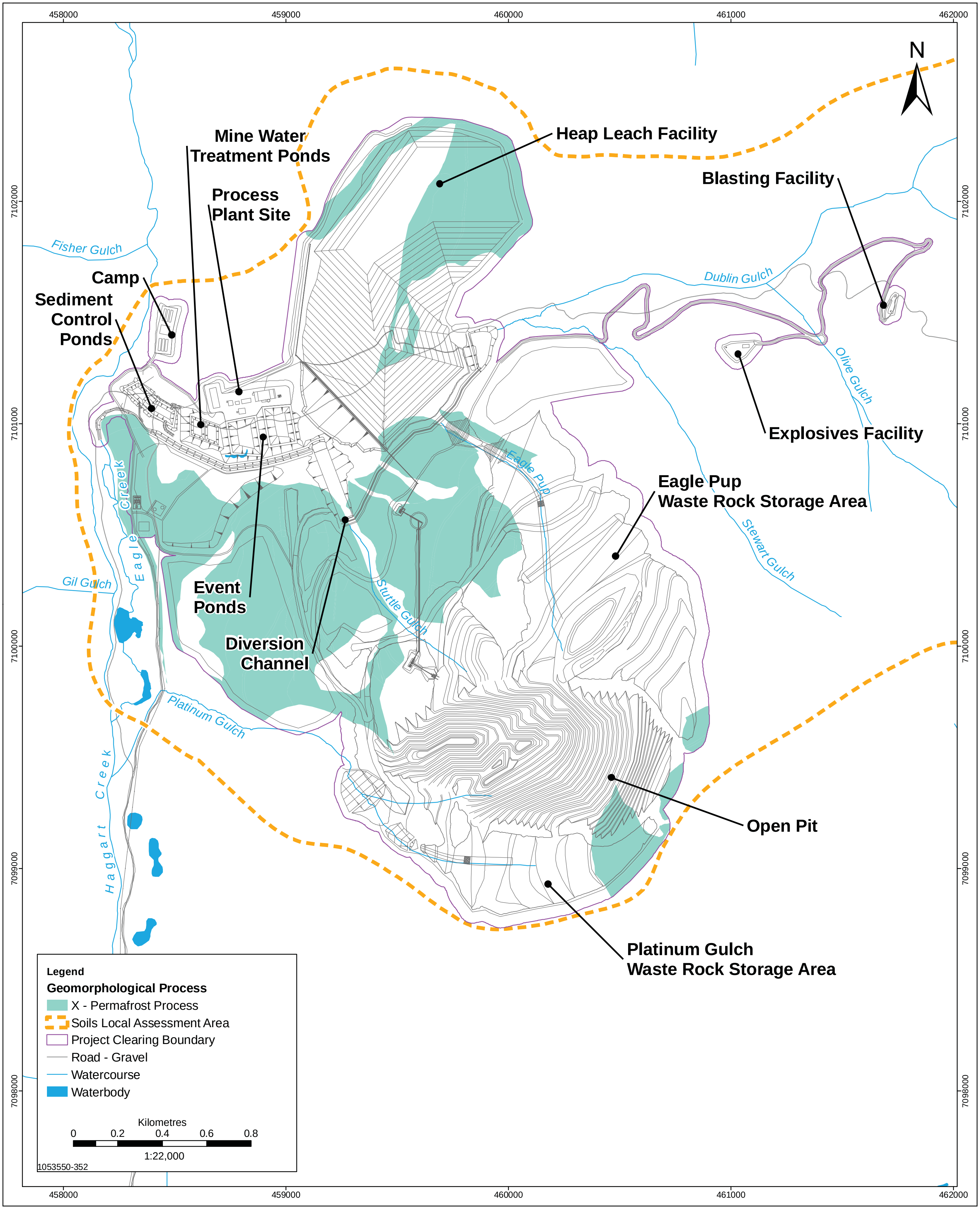
Tel. (604) 436 3014
Fax. (604) 436 3752

Victoria Gold Corp

TERRAIN STABILITY IN THE PROJECT AREA

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION	DRAWN BY
UTM - ZONE 8	LS
DATUM	CHECKED BY
NAD 83	RS
DATE	FIGURE NO.
3-November-2010	10-1



Data Sources; Government of Canada, Victoria Gold Corp.

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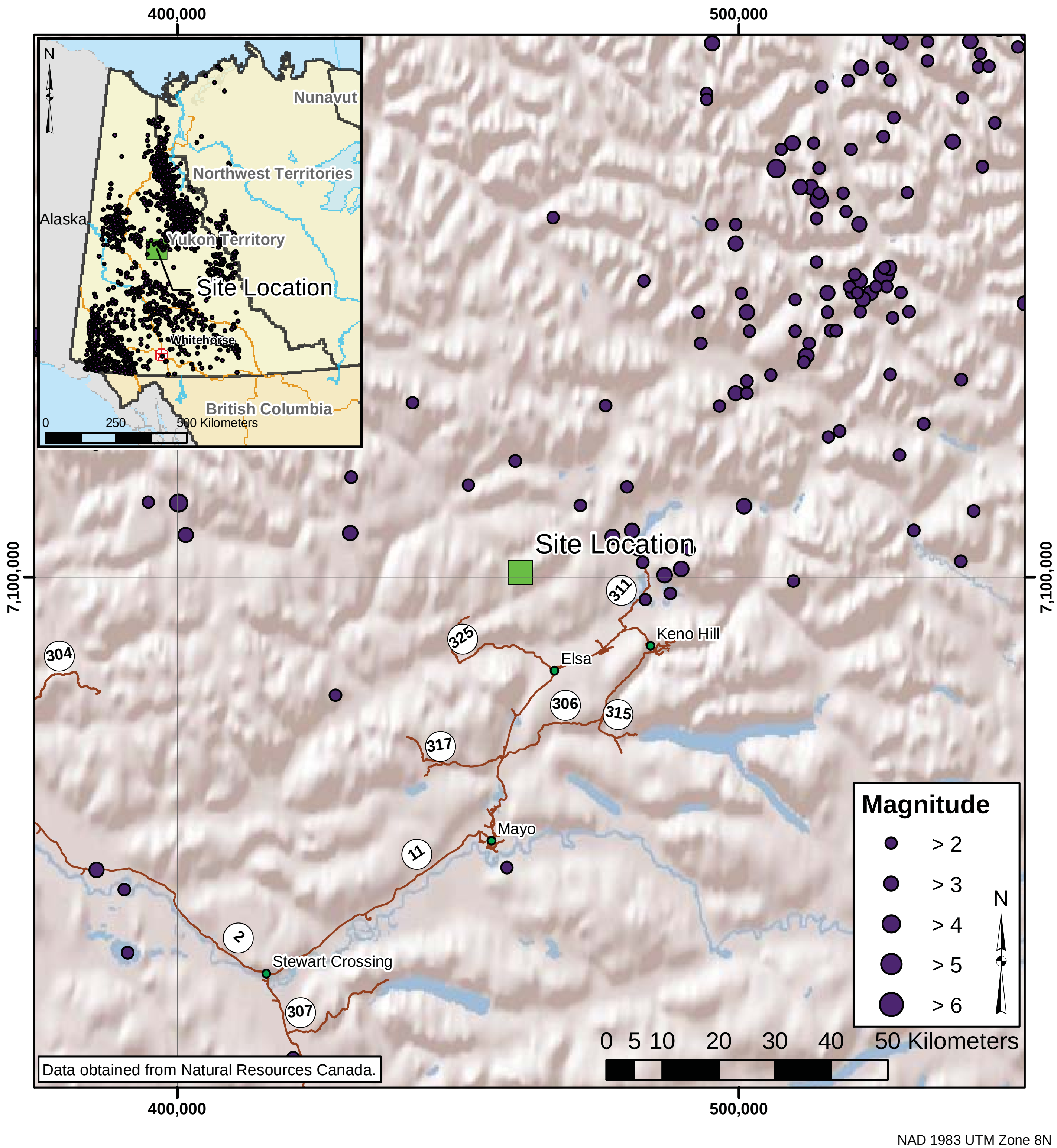
Victoria Gold Corp

PERMAFROST ZONES IN THE PROJECT AREA

EAGLE GOLD PROPERTY
YUKON TERRITORY

PROJECTION	DRAWN BY
UTM - ZONE 8	LS
DATUM	CHECKED BY
NAD 83	RS
DATE	FIGURE NO.
16-November-2010	10-2



SCALE:	1:1,000,000	DESIGNED:	PQ
DATE:	MAR 2010	CHECKED:	PQ
DRAWN:	GLT	APPROVED:	JTCS

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

PROJECT:
EAGLE GOLD PROJECT
SITE FACILITIES GEOTECHNICAL ASSESSMENT

TITLE:
DISTRIBUTION OF RECORDED SEISMIC EVENTS

CLIENT:
VICTORIA GOLD

PROJECT No.:	FIG No.:	REV.:
0792-002	10.1	

X:\Projects\0792 Victoria Gold\002 Eagle Creek\Workspace\20091015_Final_Report_Figures\Figure7_Seismic.mxd Date: Monday, March 01, 2010 Time: 10:50 AM

11 SUMMARY OF SIGNIFICANCE

The *Yukon Environmental and Socio-economic Assessment Act* (Sec 42(1) (c) (d)) requires that proponents conduct an analysis of significance as part of the assessment of potential Project effects:

> *42(1)… In conducting an assessment of a project or existing project, a designated office, the executive committee or a panel of the Board shall take the following matters into consideration:*
>
> > *…(c) the significance of any environmental or socio-economic effects of the project or existing project that have occurred or might occur in or outside Yukon, including the effects of malfunctions or accidents;*
> >
> > *(d) the significance of any adverse cumulative environmental or socio-economic effects that have occurred or might occur in connection with the project or existing project in combination with the effects of (i) other projects for which proposals have been submitted under subsection 50(1), or (ii) other existing or proposed activities in or outside Yukon that are known to the designated office, executive committee or panel of the Board from information provided to it or obtained by it under this Act;…*

The methods used in the Project Proposal for assessment of potential environment and socio-economic effects are based on a structured approach corresponding to YESAB's approach as found in the Proponent's Guide to Information Requirements for Executive Committee Project Proposal Submissions. A detailed description of the methods to assess potential Project-specific effects, residual effects, and potential cumulative effects is provided in Sections 6.1-6.3.

11.1 Environmental Valued Components

For environmental VCs, potential effects and predicted residual effects have been characterized as significant or not significant. Confidence in significance determination predictions for environmental VCs is rated as low, moderate and/or high. Because effects and the measurable parameters by which they are measured or predicted vary extensively amongst VCs, the rationale for each confidence rating is provided within the respective environmental VC assessments (Sections 6.4 to 6.10).

Each VC assessment concluded that with the application of mitigation measures the residual effects are not significant. Consequently, no significant adverse residual effects as a result of this Project are predicted. Prediction confidence in these determinations is moderate to high except for the following:

- The residual change in soil moisture conditions in the upper reaches of Dublin Gulch may result in a low magnitude and local residual effect to riparian ecosystems. Therefore, the effect of changes in abiotic conditions to riparian landscapes (i.e., decreased soil moisture) is considered not significant. The effect mechanism is not fully understood as the prediction of the change to riparian ecosystems is based on the predicted effects of the Project on soil moisture via groundwater modeling. Changes to near surface moisture levels may not occur due to potential discrepancy between actual changes in groundwater quantity compared to predicted (modeled) results. Because of these uncertainties confidence in the prediction is low to moderate. Therefore, the overall confidence in residual effects and significance determination to riparian ecosystems as a result of a decrease in soil moisture is low to moderate.

Table 11.1-1 provides a summary of potential effects, significance determination and confidence rating for each environmental VC. VC specific mitigation measures and potential residual effects are described within Sections 6.4 to 6.10.

Table 11.1-1: Summary of Potential Environmental Effects, Significance Determination, and Confidence in Determination

VC	Potential Effects	Significance Prediction	Confidence in Prediction
Surficial Geology, Terrain, and Soils	▪ Adverse Change in Terrain Stability	Not significant	Moderate
	▪ Adverse Change in Soil Reclamation Suitability	Not significant	Moderate
Water Quality and Aquatic Biota	▪ Change in Water Quality	Not significant	Moderate to High
	▪ Change in Aquatic Biota	Not significant	Moderate to High
Air Quality	▪ Change in Criteria Air Contaminants	Not significant	High
Fish and Fish Habitat	▪ Change in Fish Habitat Availability	Not significant	High
	▪ Change in Fish Mortality Risk	Not significant	High
Vegetation Resources	▪ Vegetation Loss	Not significant	Moderate to High
	▪ Changes to Abiotic Conditions	Not significant	Low to Moderate
	▪ Changes to Community Structure and Composition	Not significant	Moderate to High
Wildlife Resources	▪ Change in Wildlife Habitat	Not significant	High
	▪ Change in Wildlife Mortality	Not significant	Moderate
	▪ Change in Wildlife Movement Patterns	Not significant	Moderate to High
Heritage Resources	▪ Disruption of Heritage Resources	Not significant	High

11.2 Accidents and Malfunctions

The potential for accidents and malfunctions exist with every project. While the possibility cannot be totally eliminated, their likelihood and effect can, with adequate safety measures and response plans, be reduced to the point the potential risk does not pose a significant threat. Accordingly, for accidents and malfunctions, significance was evaluated within the context of the potential effect from the event, the likelihood of the event occurring, and consequently the significance of the resulting risk posed.

Based on the events assessed, the risk of occurrence of accidents and malfunction events is predicted to be not significant after application of proposed design and mitigation measures. Consequent to this prediction, it has been determined that accidents and malfunctions do not pose a significant threat to the VCs assessed in the Project Proposal.

11.3 Socio-economic Valued Components

Significance characterizations for potential socio-economic effects differ from those utilized for environmental effects, as there are few if any quantitative standards or thresholds for evaluating the significance of social or economic effects. Furthermore, significance determination of socio-economic effects is context-specific. An effect that may be considered significant in one community may not be in another, depending on factors such as experience with change, current socio-economic conditions, and future goal and aspirations. The level of uncertainty in characterizing the significance of an effect is particularly challenging at the regional and national level where the activities that could influence outcome are more numerous and diverse than at the local level.

With respect to potential effects on socio-economic VCs, significance predictions are characterized as positive, significant, not significant, or positive and significant.

No significant adverse socio-economic effects as a result of this Project are predicted.

- Positive effects are predicted for Employment Opportunities, Contracting Opportunities and Local Tourism.
- The socio-economic effects that are rated positive and significant are predicted to be substantial. These include Royalties, Taxes and Expenditures.

It should be noted electrical power demands were assessed as part of the infrastructure and services socio-economic VC. It has been determined that electrical power demands associated with the operations phase of the Project (approximately 95 GWh/year) represent approximately 13% of the existing installed generation capacity (hydroelectric and diesel, 750 GWh annually) in Yukon. While this represents a relatively substantial demand, it lies within existing installed capacity.

In addition, the potential effect of the Project on the Mayo landfill was assessed. The Project is currently designed to transport all waste off-site for disposal, and there have been early discussions with the VoM about the capacity of the community landfill to accept waste from the Project. The effect on the capacity of the Mayo landfill as it currently exists could be moderate to substantial without mitigation. An objective of the 2006 *Village of Mayo Integrated Community Sustainability Plan* identified is to decrease the amount of solid waste entering the landfill. However, the VoM has also indicated that it is considering the development of an enlarged or regional landfill and possibly a recycling facility, both of which would require a steady source of waste to be economically sustainable. The VoM is working with Yukon Government to identify plans and options for the community landfill. To ensure the Project's effect on the landfill is not significant, VIT will continue discussions with the VoM and the Yukon Government to identify a waste management approach that satisfies community objectives and economic development opportunities for the landfill. VIT is confident that with mitigation measures, there will not be a significant adverse effect on the Mayo landfill.

Table 11.3-1 provides a summary of potential effects and significance determination for each socio-economic VC.

Table 11.3-1: Summary of Potential Socio-Economic Effects and Significance Determinations

VC	Potential Effects	Significance Determination
Employment and Economic Opportunities	▪ Employment Opportunities	Positive
	▪ Contracting Opportunities	Positive
	▪ Royalties and Taxes	Positive and significant
	▪ Expenditures	Positive and significant
	▪ Other Local and Regional Activities	Not significant (placer mining, outfitting or commercial trapping) Positive (local tourism)
Traditional Activities and Culture	▪ Subsistence Harvesting	Not significant
	▪ Language Preservation and Revitalization	Not significant
	▪ Other Cultural Activities	Not significant
	▪ Heritage Sites and Special Places	No effects predicted – Not significant
Community Vitality	▪ Effects on Population and Demographics	Not significant
	▪ Local Educational Facilities and Services	Not significant
	▪ Crime	Not significant
	▪ Community involvement	Not significant
Human Health and Well-being	▪ Local Health and Social Facilities and Services	Not significant
	▪ Mental Health and Addiction	Not significant
Infrastructure and Services	▪ Facilities for emergency services	Not significant
	▪ Landfill	Not significant
	▪ Sewage lagoons	Not significant
	▪ Child Care	Not significant
	▪ Roads	Not significant
	▪ Mayo Airport	Not significant

11.4 Cumulative Effects

The assessment of potential cumulative effects was conducted for all bio-physical and socio-economic VCs. Each assessment begins with a screening that involves determining whether or not all three of the following conditions are met:

1. The Project results in a demonstrable or measurable residual effect on the VC.
2. The Project-specific residual effect on the VC does or is likely to act in a cumulative fashion with the effects of past, existing, or future projects and activities in the area (i.e., there is a temporal and spatial overlap of effects).
3. There is a reasonable expectation that the Project's contribution to cumulative effects will affect the viability or sustainability of the VC.

The cumulative effects assessment proceeded beyond the screening assessment-level for an effect only when all three conditions are met. A detailed description of the methods to assess potential cumulative effects is provided in Section 6.3.

The proposed Project is located in an isolated area. Aside from placer mining the closest industrial activity; an exploratory drilling program, is 19 km away. The next closest industrial activity is 35 km away. Activities in the vicinity of the Project in addition to placer mining include hunting, fishing, trapping, plant gathering, and outfitting. For the bio-physical VCs, the isolation of the area makes it highly unlikely that residual effects resulting from the Project could interact with effects of any other projects or activities (screening condition 2 above) except for placer mining, fishing, hunting trapping and plant gathering. For these exceptions, with mitigations in place there is not a reasonable expectation that the Project's contribution to cumulative effects could affect the viability or sustainability of any of the bio-physical VCs.

For the socio-economic VCs, distance from the Project is not as critical a factor in determining whether or not cumulative effects with other projects and activities could occur. For example the increased tax revenue that could be derived from the Project could have Yukon-wide positive effects. As another example, competition among distant projects could occur for works in a limited workforce environment. Consequently, for the socio-economic VCs there were substantial cumulative effects predicted. Overall it has been determined that socio-economic cumulative effects will result in positive outcomes. The predicted potentially adverse effects can be readily mitigated if they occur. Most noteworthy, the Project, in combination with other Projects in the local area and Yukon, will result in significant positive cumulative effects on employment, contracting, taxation and royalties. The competition for the eligible labor pool may result in capacity challenges for local organizations or businesses, but improved capacity and skills development of both individual workers and contractors will result from the combined market produced by the Project and other mining projects in the region.

A summary of residual effects is provided in Section 6.4 to 6.11. VIT is not aware of any industrial or other activity with which the Eagle Gold Project would interact to create significant cumulative effects that are adverse.

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12 ACKNOWLEDGEMENT AND CERTIFICATIONS

The information submitted in this Project Proposal is required for the purpose of conducting a screening under the *Yukon Environmental and Socio-economic Assessment Act.* I acknowledge that, pursuant to section 119 of the Act, a copy of this Project Proposal will be placed on a public register and be available to any member of the public to review.

I understand that misrepresenting or omitting information required for the evaluation may cause delays in the screening or render the recommendation invalid.

I certify that the information provided is true and correct to the best of my knowledge and belief.

Proponent's Signature

July 6, 2011
Date

Mark Ayranto
Vice President, Yukon Projects
Victoria Gold Corp.

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13 REFERENCES

13.1 Literature Cited and Internet Sites

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