MEMORANDUM

To: Kevin Inouye (CEAA), Tracy James (BC EAO) **Date:** 8 July 2016

From: Todd Goodsell, Senior Permitting Specialist

Subject: **Response to Comment CEAA-038 re: Alternatives Assessments**

Introduction

This memo has been prepared in response to the CEAA Information Request 038 regarding the alternatives assessment for avoidance of impacts to Jacko Lake and Peterson Creek.

CEAA Information Request 038

DFO's Fisheries Protections Policy Statement establishes the requirement for proponents to take measures to avoid and mitigate impacts to the extent possible. The Policy specifies that proponents should demonstrate that measures and standards have been fully applied before considering measures to minimize (mitigate) impacts in question.

The current assessment of alternative open pit designs does not demonstrate whether alternatives are available or have been considered, which may include a combination of open pit relocation farther away from Jacko Lake and the application of both open pit and underground mining technology.

In addition, the current assessment of Peterson Creek diversion alternatives does not appear to consider the redesign of infrastructure to avoid the necessity to relocate Peterson Creek.

To support the proponent's assertion that avoidance of impacts to Jacko Lake is not possible, provide an assessment of alternative open pit development options, including other mining methods that demonstrate that avoidance of impacts to Jacko Lake is not possible.

To support of the proponent's assertion that relocation of Peterson Creek is necessary, provide an assessment of alternatives to demonstrate that avoidance of impacts to fish habitat in Peterson Creek is not possible.

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KAM Responses

Chapter 17.4 of the Application/EIS provides the assessment of Alternative Means of Carrying Out the Project. This chapter describes the approach used to select preferred options from a variety of alternative means of developing the Project. The assessment of alternatives demonstrates the key decisions that KAM has made to undertake mining activities to minimize the potential adverse effects from the Project whilst maximizing beneficial environmental, cultural, and socio-economic effects, and remaining technically and economically feasible. Throughout the process of development planning for the Project, KAM has made numerous decisions and taken steps to improve the Project's performance based on economic, technical, environmental, and social criteria. The concerns and preferences of Aboriginal groups and local community have been solicited and incorporated to the extent possible.

The alternatives assessment describes the mining methods evaluated and open pit limits assessed to avoid or limit impacts to advance an economically feasible Project.

Mining Method Alternatives

Section 17.4.4 provides the assessment of Mining Method Alternatives. Below is text excerpted from this section.

17.4.4.1 Introduction

The mining method affects other aspects of mine development such as production rates, development schedules, and mine rock volume. The main methods for recovering ore from hard rock mines are open pit and underground mining. Both methods use drilling, blasting, and heavy equipment, but have different environmental, social, technical, and economic considerations. In-situ leaching is a method for extraction of metals from an ore body without the need for conventional mining. The process involves drilling of holes into the ore deposit, fracturing the rock, and pumping leaching solution into the deposit. The solution bearing the dissolved ore content is then pumped to the surface and processed.

17.4.4.2 Technical and Economic Feasibility

In BC, copper-gold porphyry deposits such as the Ajax deposit are commonly mined using open pit mining methods. Open pit mining is ideal for extraction of irregular shaped ore bodies that extend from the surface to considerable depths and have substantial horizontal dimensions with relatively little overburden. The method is flexible, allowing for large variations in production schedules at relatively short notice, and can be highly mechanized, making open pit mining the most productive mining method. For the Project, open pit mining produces ore at a fraction of the cost of underground mining. There is also significant local experience in open pit mining and it has a lower incident frequency rate than underground mining.

Underground mining is generally more selective, producing less mine rock than open pit mining and less surface disturbance. However, underground mining is also associated with greater equipment needs, longer worker hours to retrieve ore, and additional expenditures for air ventilation, electricity, and water pumping, resulting in higher overall costs.

Open pit mining of the low grade, high tonnage deposit is the most cost-effective and technically viable alternative for the Ajax Project. Employment and business opportunities would be realized with development by all the mining method alternatives; however, underground mining requires more specialized training that may limit opportunities for the local and regional economies.

In-situ leaching is not technically feasible for sulphide deposits since reagent consumption is too high. This method is more suited to oxide and carbonate ore.

17.4.4.3 Preferred Alternative

The grade of the Ajax orebody is too low for underground mining methods alone. In-situ leaching of the ore body is not technically feasible. The deposit is located near surface and mining using proven open pit methods would be more cost efficient than underground mining methods (Wardrop 2011). Open Pit mining is preferred based on technical and economic feasibility (Table 17.4-6).

Table 17.4-6. Technical and Economic Feasibility Ratings for Mining Method

Performance Objective	Underground Mining	Open Pit	In-situ Leaching
Technical Feasibility	Typically for high grade deposits at depth. Greater equipment needs and lower production compared to open pit mining	Ideal for low grade ore bodies extending from surface to depth with little overburden. Flexible and highly mechanized allowing high production rates	Method is not suitable for sulphide ores
	Acceptable	Acceptable	Unacceptable
Economic Feasibility	Lower production and higher unit costs compared to open pit method would make Project uneconomic	Most cost effective and produces ore at a fraction of underground methods	Not assessed
	Unacceptable	Preferred	
Overall Rating	**Unacceptable**	**Preferred**	**Unacceptable**

CEAA states that the current assessment of alternative open pit designs does not demonstrate whether alternatives are available or have been considered, which may include a combination of open pit relocation farther away from Jacko Lake and the application of both open pit and underground mining technology. The Ajax project is highly dependent on production rate due to the metal grades of the deposit. In Section 17.4.5 of the Application/EIS, production rates between 40,000 and 90,000 tpd were evaluated. As mentioned previously, underground mining methods rely on higher deposit grades to support lower production rates than open pit mining methods, among other factors. For comparison, the New Afton mill is designed to process 11,000 tpd of ore at full capacity.

The combination of an open pit/underground mining method requires that a high grade zone be present at depth beyond the feasible limits of an open pit. Significant high grade zones near surface or at depth have not been identified through exploration to date, which effectively eliminates any practical application of an underground or combination open pit/underground method for mining the Ajax deposit. Furthermore, a combined open pit/underground operation for the Ajax project would face the following challenges which would impact the feasibility of the project and potentially limit resource maximization.

- Inefficient use of mining equipment – surface mining equipment would be retired well before the end of its useful life at time of transition to underground mining, which requires different types of equipment.
- Inefficient use of ore processing equipment – a transition to an underground mining method would reduce production rates well below the design capacity of the processing plant, which would need to be sized for the open pit production rates.
- Parts of the Ajax orebody may become sterilized in the transition zone between an open pit and underground operation or in the underground operation itself, depending on underground mining method. Maximizing resource extraction is always preferable for a given level of disturbance.

Therefore Open Pit mining is the preferred and only viable alternative for the Ajax Project. KAM has considered all available technology and mining methods for a technically and economically feasible project in order to avoid environmental impacts.

Open Pit Alternatives Assessment for Avoidance of Jacko Lake Impacts

Section 17.4.6 provides the assessment of Open Pit Limits Alternatives. Below is text excerpted from this section.

17.4.6.1 Introduction

The Project's pit limits are constrained along its western extent due to the presence of Jacko Lake. The western parts of the deposit contain some of the highest grade ore at depth; however, to access all of this ore, the western pit limits would need to significantly intrude on Jacko Lake and Peterson Creek. The SSN assert rights and title to Jacko Lake and surrounding area (known as "Pipsell") for traditional land uses including food harvesting and maintenance of cultural values, practices and traditions. In developing alternatives to the pit extent, KAM has been attentive to Aboriginal concerns and community values associated with Jacko Lake and have selected a design that attempts to strike a balance between preserving the lake and maximizing the extraction of the in-situ resource.

The extent of the pit's limit is based on an optimal 'pit shell contour' that maximizes the material selected for extraction while satisfying operational requirements for safe pit wall slopes. The open pit limits were determined in this way for the Project and resulted in three technically feasible alternative pit designs (each extracting a different quantity of total ore):

- Alternative 1: unconstrained pit infringing on Jacko Lake;
- Alternative 2: constrained pit completely outside of Jacko Lake; and
- Alternative 3: constrained pit with minimal infringement on Jacko Lake.

The pit shell extents as it affects Jacko Lake are shown in Plate 17.4.-1.

17.4.6.2 Economic Feasibility

Constraining pit limits can substantially affect the size, shape and value of the Open Pit. The three alternatives are all technically feasible; however there is 'opportunity cost' associated with the alternatives. The unconstrained pit which infringes on Jacko Lake (Alternative 1) maximizes the resource and value of the pit. The opportunity cost for completely avoiding Jacko Lake completely (Alternative 2) compared to the maximized pit is approximately US$886M and reduces the mineral inventory by about 88 Mt and 3.7 years of mine life at 65 ktpd (KAM internal memo). Infringing on Jacko Lake by removing the northeast arm but preserving the southeast arm (Alternative 3) has an opportunity cost of approximately US$334M and reduces the mineral inventory by 44 Mt and 1.9 years of mine life at a processing rate of 65 ktpd (Table 17.4-9).

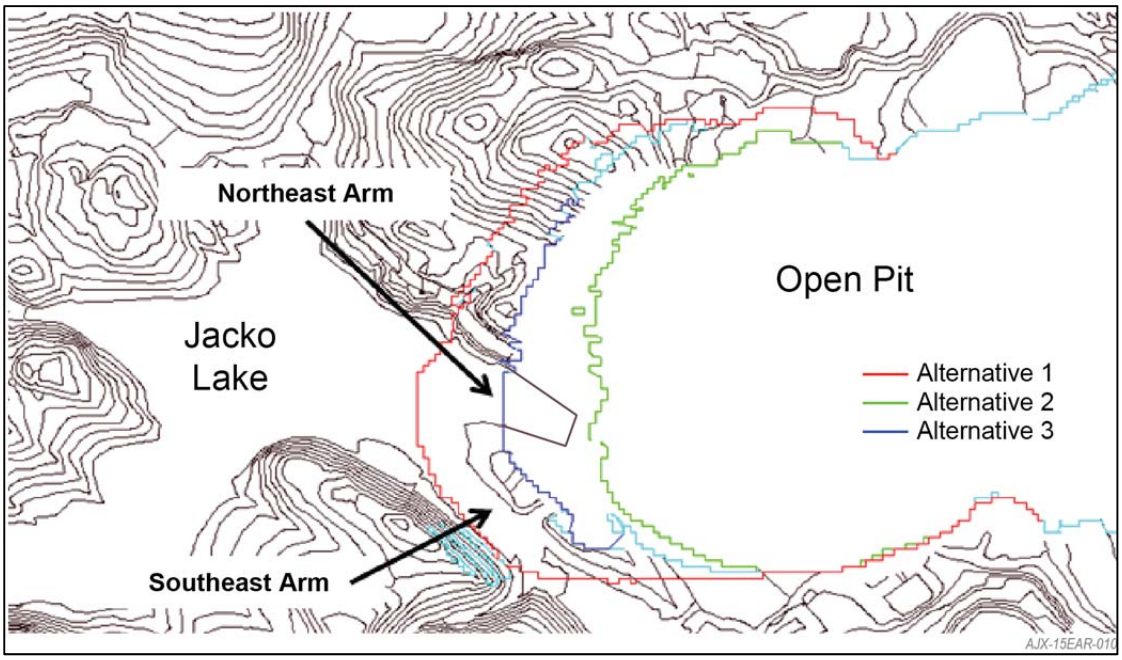

Plate 17.4.-1. Pit Shell Extents

Table 17.4-9. Economic Feasibility Rating for Open Pit Limits Alternatives

Performance Objective	Alternative 1 - Unconstrained Pit Infringing on Jacko Lake	Alternative 2 - Constrained Pit, Completely Outside of Jacko Lake	Alternative 3 -Constrained Pit - Minimal Infringement on Jacko Lake
Economic Feasibility	Maximizes the return on the project by accessing all of the high grade zone on west of deposit	Not able to access high grade zone: opportunity cost of US$886M; considered economically unviable for Project	Optimizes return on the project where encroachment into Jacko Lake is a constraint to accessing some of the high grade zone on west of deposit. Opportunity cost of $334M
Overall Rating	Preferred	Unacceptable	Acceptable

A constrained Open Pit completely outside of Jacko Lake is not economically feasible for the Project. The unconstrained alternative is preferred from an economic perspective and the minimally constrained alternative is rated as "acceptable". The unconstrained and minimally constrained alternatives were carried forward for further assessment using 'natural environment and 'human environment' performance objectives.

17.4.6.3 Natural and Human Environment Acceptability

KAM recognizes local community and Aboriginal Group concerns and the values associated with Jacko Lake related to (among others) fish, recreation, water supply, archaeology, and Aboriginal Interests and that the SSN prefers the option that does not have an impact on Jacko Lake or Peterson Creek. KAM is seeking a balance of minimal disturbance to Jacko Lake and having an economically feasible project.

Natural Environment

The unconstrained pit (Alternative 1) will infringe further into Jacko Lake compared to a minimally infringing pit (Alternative 3) and result in greater effects on aquatic habitat as well as require additional fill materials to construct a dam to separate the pit from the lake. An unconstrained open pit implies increased production rates or a longer mine life with associated noise and air emissions. Relative to the other alternatives, this alternative has the greatest potential for aquatic and terrestrial effects and requires significant offsetting in the local area.

Human Environment

The unconstrained pit (Alternative 1) will have a longer mine life resulting in economic benefits for the local community and government. The unconstrained pit will infringe further into Jacko Lake compared to a partially constrained pit and result in greater effects on Aboriginal interests and on recreational users. Re-establishment of Peterson Creek would be more challenging for the unconstrained pit alternative and drainage from Jacko Lake may need to be routed to the west. This would be problematic for downstream users of water supplied by Jacko Lake.

The minimally-infringing pit option (Alternative 3) will result in the loss of the northeast arm of Jacko Lake but preserve the southeast arm. The southeast arm is the lake discharge location and reportedly popular with fishermen. Two small dams (< 5 m high) would be installed to hold the PMF and excess water diverted around the pit. At closure,

the dams would remain and excess water will flow through the spillway on the southeast dam connecting to a re-established Peterson Creek. The Open Pit is not expected to fill to ground elevation and discharge to the environment. The area surrounding the Open Pit would be reclaimed. A rock berm would be constructed around the Open Pit perimeter to limit access. Constraining the pit boundaries, such that the infringement into Jacko Lake is minimized (Alternative 3), balances maximizing pit boundaries for safe and economical operations while minimizing the effects to local community / Aboriginal Groups and potential aquatic and terrestrial impacts (Table 17.4-10).

17.4.6.4 Preferred Alternative

A constrained pit completely outside of Jacko Lake (Alternative 2) is not feasible as it renders the Project uneconomical. An unconstrained pit (Alternative 1) would have increased disturbance and loss of fish habitat and reduce the traditional land use and recreational use of Jacko Lake. Re-establishing Peterson Creek may be more difficult and the overall rating for an unconstrained pit is “challenging”.

The preferred alternative is a pit that minimally infringes on Jacko Lake (Alternative 3). Constraining the pit boundaries such that the infringement into Jacko Lake is minimized is considered to be acceptable as it balances maximizing pit boundaries for safe and economical operations and minimizing effects of the Project on the human and natural environments.

Table 17.4-10. Natural and Human Environment Acceptability Ratings for Open Pit Limits

Performance Objective	Alternative 1 - Unconstrained Open Pit	Alternative 3 - Constrained Open Pit - Minimal Infringement on Jacko Lake
Natural Environment Acceptability	Longer mine life with associated noise and air emissions. Increased loss of fish habitat and increased terrestrial habitat disturbance. Potential post-closure flow reductions to Peterson Creek.	Reduction of fish habitat limited to northeast arm of Jacko Lake and less terrestrial habitat disturbance compared to unconstrained open pit. Peterson Creek connection re-established at closure.
	Challenging	Acceptable
Human Environment Acceptability	Longer mine life resulting in economic benefits to local community and government. Greater loss of land and aquatic resources less acceptable to local community and Aboriginal Groups.	Minimizes effects to land and aquatic resource users and maintains an economical project.
	Challenging	Acceptable
Overall Rating	Challenging	Preferred

In response to this information request, KAM has re-reviewed the findings related to pit extent. No new alternatives were identified. A pit extent that completely avoids Jacko Lake remains a non-viable option. A minimally-infringing pit remains the preferred alternative. It is important to note that the best pit design from an economic perspective is Alternative 1 which would result in greater impacts to Jacko Lake. KAM has opted not to pursue this alternative in favor of avoiding these impacts.

Peterson Creek Diversion Alternatives Assessment

While KAM was not able to identify other alternatives for open pit extent, the Project team was able to identify some additional alternatives related to the Peterson Creek Diversion.

A section of Peterson Creek will need to be diverted around the Project facilities, as a portion of the current creek configuration will be lost during excavation of the Open Pit. Additional infrastructure including site access roads and the central collection pond will also be located in the current alignment of the creek. Mine rock storage facilities and ore stockpiles will be located in close proximity to the creek creating contact water management challenges to prevent contamination of Peterson Creek. A flow diversion system is therefore required to maintain flow in Peterson Creek downstream of the mine site.

Section 17.4.12.3 of the Application/EIS describes the diversion alternatives assessed. Multiple options were considered for the re-routing or diversion of Peterson Creek including gravity flow through the Peterson Creek corridor, both through an open diversion channel and through a gravity pipeline as well as options for pumping flows around the northern perimeter of the open pit.

Four pipeline diversion alternatives of varying lengths from about 3.5 km to 10.3 km were considered as alternative routes (Appendix 17.4-D). In addition, an open channel diversion along the South Route (Peterson Creek corridor) was assessed as it is preferred by the SSN (Appendix 17.4-E):

- Alternative A – pipeline along north route: The intake would be located on the northeast end of Jacko Lake for conveyance of flows north of the Open Pit along the main access road.
- Alternative B – pipeline along south route: The intake would be located on the southeast arm of Jacko Lake for conveyance of flows south of the Open Pit through the Peterson Creek corridor.
- Alternative C – pipeline along southwest route: The intake would be located on the southeast arm of Jacko Lake for conveyance of flows around the west perimeter of Jacko Lake and connecting with the main access road.
- Alternative D – pipeline along southeast route: The intake would be located on the southeast arm of Jacko Lake for conveyance of flows around the east perimeter of Jacko Lake and connecting with the main access road.
- Alternative E – open channel along south route: an upgraded spillway on the southeast arm would connect to an engineered channel between the Open Pit and MRSF and convey flow through the mining area (Peterson Creek corridor). The channel would follow a similar alignment to that for the re-established Peterson Creek at the end of mine life and require extensive cut and fill to assure gravity drainage through the channel.

For reasons described in Section 17.4.12.3 the preferred option for diversion of Peterson Creek selected and presented in the Application/EIS was around the northern perimeter of the open pit (Alternative A).

In response to this information request, KAM commissioned Norwest Corporation to undertake an additional alternatives assessment for the Peterson Creek Diversion System design to account for working group comments and concerns related to: impacts to the Aboriginal fishery in Peterson Creek, fish habitat losses in Peterson Creek, water rights on Peterson Creek and fish habitat in Jacko Lake related to changes in flow through the southeast arm of the lake. The objectives of the second alternatives assessment are to:

1) Develop options that would avoid impacts to the reach of Peterson Creek directly downstream of the existing and proposed replacement dam on Jacko Lake. These impacts include direct loss of fish habitat and the Aboriginal spring trout fishery asserted by the SSN. The alternatives design basis also considered potential impacts to water quality in the creek from adjacent mine facilities.
2) Avoidance of impacts to water rights of downstream water license holders on Peterson Creek in the event of accidents or malfunctions such as spills on adjacent roads and road crossings.

Please see details of the revised PCDS design described in ***0706_KAM_Peterson Creek Diversion System Update***. The preferred alternative / revised design includes retaining an open section of Peterson Creek downstream of the replacement dam and diverting flows into a 2.7 km buried culvert that will discharge to Peterson Creek east of the mine site. The revised design no longer includes the intake and pumphouse in and on Jacko Lake, the 3.6 km pipeline north of the Open Pit, or the Peterson Creek Downstream Pond. Peterson Creek will flow in an open channel along the natural alignment for 150 m from the base of JLD1 before entering a 1 m diameter culvert. Flows will be diverted around the south edge of the Open Pit through this approximately 2.7 km long culvert before discharging back into Peterson Creek at an elevation of 876 masl. The inlet will have a fish screen to prevent entrainment of rainbow trout into the culvert and will be designed to prevent impingement of fish. The culvert will have a slope of 0.7% for the first 1.6 km and a slope of 0.1% for the remaining distance. The Peterson Creek Downstream Pond is no longer required to store flood flows, as the culvert has been sized for a design flow of 0.3 m^3/s (with maximum capacity of 1 m^3/s). The Peterson Creek Downstream Pond is no longer part of the Project design. The Peterson Creek Diversion will therefore result in a loss of 2.7 km of stream channel for up to approximately 25 years.

Please also refer to the updated Fish Habitat and Fisheries Offsetting Plan (***0706_KAM_Fish Habitat and Fisheries Offsetting Plan***). The revised offsetting plan includes measures proposed to offset the expected impacts for the design changes to the Peterson Creek Diversion System and removal of the Peterson Creek Downstream Pond from the Project design. Based on DFO criteria, the impact to Peterson Creek in the 2.7 km diversion section is classified as destruction of fish habitat.

The preferred alternative / revised design of the Peterson Creek Diversion System is an improvement to Project design, as it avoids potential impacts to fishery productivity in the southeast arm of Jacko Lake, direct instream fish habitat loss and loss of the asserted Aboriginal fishery on upper Peterson Creek. The revised design that includes diversion of the creek into a buried culvert mitigates potential water quality impacts from surrounding mine facilities and accidents and malfunctions during mine operations. At closure, KAM proposes to update the conceptual closure and reclamation plan submitted with the Application/EIS during permitting to

include fish habitat restoration to the realigned section of Peterson Creek. This commitment will be included in the planned application for a Fisheries Act Authorization. Restoration efforts will include re-alignment of the channel using natural channel design to ensure a stability and hydraulic habitat complexity that mimics low gradient channels in the region. Additionally the channel will include adequate substrate recognizing sediment transport conditions, instream features, cover and riparian planting.