March 2016

Ajax Mine Application for Environmental Assessment Certificate/
Environmental Impact Statement

Working Group Comments from
Ministry of Forests, Lands and Natural Resources Operations

This document contains a compilation of review comments from the Ministry of Forests, Lands and Natural Resources Operations (FLNRO) on KGHM Ajax Mining Inc.'s (Proponent's) Application for an Environmental Assessment Certificate / Environmental Impact Statement. These comments are the "round one" Working Group comments from FLNRO.

For the purposes of documenting comments, EAO requires that the Proponent compile all written comments from Working Group members in a comment tracking table. The Proponent must provide responses to the Working Group submissions, in a table format or memo format as necessary. EAO reviews Working Group submissions to ensure that key issues in the environmental assessment are understood and addressed.

EAO's direction to the Proponent regarding Working Group comments is posted at http://a100.gov.bc.ca/appsdata/epic/html/deploy/epic_project_doc_list_362_r_com.html

Environmental Assessment for the proposed Ajax Mine Project
WORKING GROUP ISSUES TRACKING TABLE
*Please refer to "**Instructions**" tab for directions

	For Working Group Use					
ID #	**Comment Date** (i.e., 5-Feb-16)	**Commenter Name/ Agency** (i.e., John Smith, MEM)	**Section of EA** (i.e., 6.1.2)	**Subject** (i.e., Surface Water Quality)	**Category of EA Comment**	**Comment** (include Memo ID as applicable)
	28-Jan-16	Bill Ashman, Thompson Rivers District	2.8.1.7	Timber on Crown land	Permitting Information Requirement	An OLTC can only authorize the harvest of Crown timber; most of the mine appears to be on private land, in which case no harvesting authority is needed from us. The private land wood needs to be scaled and a valid timber mark used to remove the wood from the property. If the volume of Crown timber is significant, my preference would be to see the timber removed by a quota holder, such as BCTS or a licensee. This can be done two ways; the forest licensee could apply for a cutting permit over the mineral claim area and carry out the timber harvesting, or KAM could be issued an OLTC that allows them to cut and deck the wood, then the licensee could remove it under a cutting permit or BCTS can auction the deck.
	28-Jan-16	Bill Ashman, Thompson Rivers District	Table 2.8-1, List of Permits	Special Use Permit / Inks Lake Interchange	Permitting Information Requirement	KAM has questioned us as to whether an SUP can be used to modify the Inks Lake interchange, with the intent that MoTI would take it over as a R0W. It appears that this could be done, but I'd like to learn about MoTI's process for taking on a road, to ensure we put appropriate conditions in the SUP, or possibly KAM's proposed Lands Act tenure. Timber harvesting on the SUP/Lands Act tenure area is done under an OLTC. Looking at the air photos, it appears that some of the Inks Lake interchange may be within the Community Forest Agreement area held by the District of Logan Lake. The CFA is on the west side of the Coqihalla and butts up to Sugarloaf Ranch. This is an area-based tenure with exclusive harvesting rights. If the modification does encroach on the CFA, DLL would have to have first right of refusal on the timber cut within their CFA.
	9-Feb-16	Bill Ashman, Thompson Rivers District	6.9.7.4	Old Growth Forests		KAM has stated that there would be no incursion into the 43 ha Old Growth Management Area located in the LSA. If such an incursion were to occur, and it exceeded the established threshold, it would require an amendment to the OGMA. There is a formal process for this amendment prior to approval by the district manager.

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	11-Mar-16	Darren Bennett, FLNRO	App 6.4-C Sect.3.2.2	Water Quantity-Peterson Creek	Comment	The paragraph below table 3-2 notes that "Sugarloaf Ranches divert streamflows directly into their fields", however Sugarloaf Ranch is not a water licensee in the Peterson Creek Watershed.
	11-Mar-16	Darren Bennett, FLNRO		Freshwater Storage Facilities	Clarification Required	Due to the location of Smith Slough Dams (main and saddle) and Keynes Creek Dam in proximity to the planned location of the TSF, it appears that these dams will require licensing abandonment and removal of the dams. Plans for dam removal will need to be submitted to FLNRO for a Leave to Commence Removal Authorization to be issued. Have these removal plans been developed?
	11-Mar-16	Darren Bennett, FLNRO	App 6.4-C 3.2.4	Freshwater Storage Facilities	Comment	Page 21 of the BGC report states that the spillway of the Edith Lake Dam had been lowerd in elevation during a recent dam upgrade project. This is not true, in fact spillway invert elevation was increased during said project.
	11-Mar-16	Darren Bennett, FLNRO	App 6.4-C 3.2.5	Water Quantity - Davidson Brook	Comment	Neither Howard Pond, nor Anderson Creek, are licensed for diversion, into Davidson Brook watershed.
	11-Mar-16	Darren Bennett, FLNRO	App 6.4-C 3.2.6	Water Quantity - Separation Lake	Comment	Separation Lake and areas to the east and north east are not tributary to Peterson Creek.
	11-Mar-16	Darren Bennett, FLNRO		Water Quantity-PCDP	Clarification Required	Has there been an Inundation Study done for the PCDP? Has there been an attempt to determine the consequence rating of the PCDP?
	11-Mar-16	Darren Bennett, FLNRO		Water Quantity-Jacko Lake	Clarification Required	Since the Inflow Design Flood for the dams at Jacko Lake is expected to be the Probable Maximum Flood, and since it has been stated by FLNRO that an Emergency Spillway will be required, has the elevation been determined for the emergency spillway (JLD4) at Jacko Lake? How much freeboard does this provide at the main dam?

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	22-Feb-16	Gary Brewer, Arch Branch FLNRO	9	Heritage	Comment	The baseline for the project area is complete and the evaluation of potential impacts and recommendations for mitigation measures is consistent with current Provincial standards.
	22-Feb-16	Gary Brewer, Arch Branch FLNRO	9	Heritage	Comment	Any sites that will be directly impacted by the proposed development, and those nearby where potential impacts (direct or indirect) may occur, will require a Site Alteration Permit prior to commencment of land altering activities.
	22-Feb-16	Gary Brewer, Arch Branch FLNRO	9	Heritage	Comment	Several archaeological sites (identified in the EA document) will require additional study under the Site Alteration Permit as part of the impact mitigation strategy. These strategies will be finalized in conjunction with the proponent, interested parties and the Archaeology Branch.

Ajax Mine Environmental Assessment Certificate Application

Date: 09/03/2016

Name: Bruce McFarlane

Title: Water Resources Hydrologist

Agency/Organization: Ministry of Forests, Lands and Natural Resource Operations

Subject of comment: Surface Water Quantity

Category of comment: Provincial EA Information Requirement

Section of the Application: Main Report, Chapter 6.4; and, Appendices 6.4a Hydrometeorology, 6.4c Water Balance Model

Overview of key issues in this memo:

- Compensation to water licensees impacted by reduced water availability
- Standardizing flow metrics and surface water impacts
- Effects of mine on groundwater contributions to stream flow
- Uncertainties relating to climate change

Comment/Issue Description:

Surface water flow metrics appear to have been derived using three approaches (3 models) as follows: a) synthetic flows were provided by Knight Piesold Consultants using basin-flow correlations; b) simulated monthly flows were provided by BGC Engineering Inc. (BGC) using a watershed hydrology model; and, c) 7 day low flow metrics were provided by BGC using a regional hydrology methodology.

The applicant has stated in Table 6.4-12 that there is no mitigation available for streamflow losses on Peterson Creek below the mine site; yet, average monthly losses are expected to be as high as 59 l/s for the average flow in May (Table 6.4-7). A comparison to the 1 in 5 year monthly drought flow (Q5) was not provided.

Reductions in water availability downstream of the mine may require compensation of water licensees that presently hold or will likely hold in near future legal entitlement to surface - (existing) and ground-water (retroactive) rights. To understand this potential, the expression of quantified stream-flow losses in the report during the irrigation season and for low flows should be improved. Much of the anticipated impact of the mine on streamflow has been provided as percentages of reduced watershed area or percent reduction of average monthly stream flow, possibly due to

limitations of the models employed in the analysis. These water abstractions are absolute in that they are directly related to removal of contributing area to Peterson Creek hydrology. In the case of groundwater effects on surface water expression, temporal effects have been estimated in close proximity to the pit, but explanation of the downstream effects, which have been assumed, should be substantiated to determine likely effects on flow duration. These outcomes potentially affect downstream values, including water licensees. While these effects may be fully quantified within the groundwater component of the main report, this section has been reviewed by others. If available, these effects should be reiterated in the surface water quantity section of the EA application to ensure completeness of anticipated effects on surface water quantity.

Typical metrics used for allocating and regulating surface water under licence are 7Q5 and 7Q10 during the period of use, which in the case of irrigation licenses is typically April 1 to September 30. Diversion of stream-flow for storage purpose is typically Oct 1 to June 1. The amount of flow that will be lost from the system and, therefore, unavailable to existing licences, should be quantified and compared to the base condition. Present information indicates that at least one licence with point of diversion downstream of the mine site will be impacted by reduced flows. Other domestic licenses may also be similarly impacted, as may Jacko Lake storage licences during some months.

<u>Additional information request:</u>

1. Provide cumulative effects of water loss from mine footprint, operation and post-closure stages for Peterson Creek downstream of mine operating area (P02.3) - including effects of climate change and evaporation from the proposed Peterson Creek Downstream Pond - expressed in m^3/s for Q5, Q10, Q20 and Q50 monthly flows; and, the 7Q5 over the irrigation season;
2. Provide standardized estimates of the change in timing of available flows, having as a minimum weekly time increment resolution, for the construction, operational, and post-closure stages of the mine. Include future considerations of climate change and groundwater losses/gains from the mine;
3. Provide estimates of stream flow increases/decreases relating to impacts of mine footprint on groundwater contributions to stream flow, as in 1. above; and,
4. Provide hydrologic effects of the mine, standardized as in 1. above, on inflows to Jacko Lake (JacInf) and lake storage, using m^3/s and m^3 respectively, for operation, and post-closure stages. Relate these quantities to spatial and temporal effects on existing water licencing, incorporating the anticipated effects of climate change.

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	10-Mar-16	Christa Pattie/ Colleen Dreger, FLNR		Water Quantity-Jacko Lake- elevation	Permitting Information Requirement	A new bathymetric survey of Jacko Lake will be required to determine new elevation of lake representing storage quantities of water after construction of dams. This new elevation will need to be incorporated into a new release schedule for pumping storage from Jacko to PCDP, and releasing water from PCDP to downstream irrigators. Elevation of 892 masl represents the current elevation of storage in Jacko Lake. Installation of dams may cause changes to the elevation representing storage. New release schedule will need to include inflows from Edith Lake (baseflow, and releases from storage) as well as Humphrey Creek flows.
	10-Mar-16	Christa Pattie/ Colleen Dreger, FLNR		Water Quantity-Kamloops Lake- Joint Works agreement for water licence	Permitting Information Requirement	A joint works agreement or legal agreement to share works will need to be in place for all works intended to be shared by New Afton and KGHM.
	10-Mar-16	Christa Pattie/ Colleen Dreger, FLNR		Water Quantity-Peterson Creek- Joint works agreement for water licence	Permitting Information Requirement	A joint works agreement or legal agreement to share works will need to be in place for all works intended to be shared by KGHM and any downstream water licence holders.
	10-Mar-16	Christa Pattie/ Colleen Dreger, FLNR		Water Quantity-Peterson Creek- existing water licence amendments	Permitting Information Requirement	A letter of agency to apply for licence amendments on behalf of Peterson Creek water licence holders will be required for KGHM to make applications to FCBC.
	10-Mar-16	Christa Pattie/ Colleen Dreger, FLNR		Water Quantity-Keynes Creek and Smith Slough water licences	Clarification Required	Water licences on Keynes Creek and Smith Slough are currently in the name of the former property owner. An application to transfer these licences to KGHM needs to be submitted to FCBC. KGHM needs to clarify what future plans for these licences include. If dams are to be decomissioned, a plan will be required.
	10-Mar-16	Christa Pattie/ Colleen Dreger, FLNR		Water Quantity-Keynes Creek	Clarification Required	The proposed TSF is shown overtop the current location of Keynes Creek. Clarification of plans for Keynes Creek is required.
	10-Mar-16	Christa Pattie/ Colleen Dreger, FLNR		Water Quantity-Low Flow Analysis	Provincial EA Information Requirement	Reduction in stream flows PC lower are as high as 25% (May) during the irrigation season when base flow licence holders would normally irrigate. Max predicted loss is 41% of base flow in August. 100 years after closure losses continue to be expected , up to 34% (August). Stream flow effects are considered irreversible. KGHM must consider how permanent reduction in flow will impact existing water licence holders, including but not limited to affects on irrigation season and which licence holders may be affected by reduced water quantities due to their priority dates. How will the reduction in stream flows be mitigated for existing water licence holders?
	10-Mar-16	Christa Pattie/ Colleen Dreger, FLNR		Water Quantity-Jacko Lake (low flows)	Provincial EA Information Requirement	KGHM must provide information on how low flows will be impacted at the inflow of Jacko Lake including ability of the watershed to provide full storage quantities in Jacko lake to downstream licensee's
	10-Mar-16	Christa Pattie/ Colleen Dreger, FLNR	6.4	Water Quantity- mitigation	Comment	The water management plan does not address how the reduced stream flows to Jacko lake and downstream Peterson creek will be mitigated, only how the stream flow will be managed. Mitgation measures such as stream monitoring and reuse of overland flow in mine operations are not mitigation. Irreversible impacts to water quantity cannot be mitigated, thereby availability of water to down stream licence holders with prior rights must be addressed.

	10-Mar-16	Christa Pattie/ Colleen Dreger, FLNR		Water Quantity-Peterson Creek Downstream Pond	Clarification Required	How much seepage losses are expected to occur from PCDP? How much evaporative losses are expected to occur from PCDP? Evaporative losses were not included in the water balance model, however these need to be quantified.
	10-Mar-16	Christa Pattie/ Colleen Dreger, FLNR		Water Quantity/ Quality- TSF closure	Clarification Required	Upon closure the TSF will have a channel cut directing overland flow into Humphrey Creek. Will this water be compromised in quality by running through the TSF? Will the channel of Humphrey creek be able to handle the increased quantity?
	10-Mar-16	Christa Pattie/ Colleen Dreger, FLNR		Water Quantity- Inks Lake offsetting	Comment	The mitigation plan includes plans to supplement water in Inks Lake indefinitely. As the ministry is unwilling to take over pumping water into the lake the water must come from a locally available source. Alkali Creek, Alkali Lake, Peterson Creek and consequently Jacko Lake are noted in the stream register as having licenses refused in the past due to insufficient water. An acceptable source of water will need to be identified and licenced for the mitigation plan to be feasible.
	10-Mar-16	Christa Pattie/ Colleen Dreger, FLNR		Offsetting- PCDP	Clarification Required	During the January 27, 2016 meeting KGHM stated emphatically that the Peterson downstream pond would not be considered as compensation; however, at the February 23-24 2016 meeting KGHM stated that the Pterson downstream pond would be considered as compenstation. conflicting information is being provided.
	10-Mar-16	Christa Pattie/ Colleen Dreger, FLNR		Water quantity- PCDP	Clarification Required	PCDP is being proposed as a secondary storage facility. KGHM must provide information on quantity of available "live" storage in PCDP for downstream use and quantity to remain in PCDP (below the low level outlet). Is the 68,000m3 cited in the documentation live storage (i.e. available to downstream users) or total storage volume of the pond.
	10-Mar-16	Christa Pattie/ Colleen Dreger, FLNR	6.4-25	Water quantity- PCDP	Clarification Required	Clarification is required on how the PCDP is intended to be established and used. Where will the initial water to fill PCDP come from? How will water levels in PCDP be maintained, and to what level? Will there be water stored at all times or will the PCDP be drained? If the intention is to store water in the balancing reservoir year round, a portion of the existing storage licences would need to be transferred to this new reservoir. If not, during winter months the gates would be open and water would be flowing through. This also has implications to the storage/release schedule that will need to be developed.
	10-Mar-16	Christa Pattie/ Colleen Dreger, FLNR		Water quantity- Jacko Lake	Comment	It was also stated that the water level in Jacko Lake would be an offset as the water level would be raised. KGHM does not hold a storage licence to increase the level.
	10-Mar-16	Christa Pattie/ Colleen Dreger, FLNR		Water quantity- PCDP	Clarification Required	As the dams, diversion pipe and Peterson d/s pond are licenced works for existing downstream users, how will the licensees be authorized to access their works?- Joint Works agreement should address this. While they may not require immediate access to all their works, immediate access to the Peterson d/s pond will be required at all times. PCDP is currently shown within the mine act permit area, thereby access is assumed to be restricted. How will the licensee's (bailiff) be granted access to the PCDP?
	10-Mar-16	Christa Pattie/ Colleen Dreger, FLNR		Water quantity- Humphrey creek licence	Clarification Required	KGHM must clarify plans for this licence- wheter it should remain current (for what purpose, or be abandoned.

	10-Mar-16	Christa Pattie/ Colleen Dreger, FLNR		Water quantity- PCDP dam	Comment	Keeping the PCDP dam after mine closure would place additional burden on water licence holders as they would have to release water from two storage structures and would be responsible to maintain an additional dam that does not provide value to them after mine life. They would also have additional liability for the PCDP. Water Stewardship does not endorse keeping the PCDP in place after mine life.
	10-Mar-16	Christa Pattie/ Colleen Dreger, FLNR		Water quantity- ground water	Permitting Information Requirement	KGHM must address how losses to groundwater will affect groundwater licence holders (existing groundwater wells have rights under the Water Sustainability Act). It has been determined that there is hydraulic connectivity between Peterson Creek and aquifers that are used by groundwater users with prior rights. Losses to these groundwater users must be quantified and mitigated.
	10-Mar-16	Christa Pattie/ Colleen Dreger, FLNR	6.4-26	Water quantity- reclamation	Clarification Required	Will water be required after mine closure for reclamation of the mine site? 6.4-26 says water will be needed for reclamation, however this is the only mention of this requirement and amount was not quantified.
	10-Mar-16	Christa Pattie/ Colleen Dreger, FLNR		Water quantity- Jacko Lake pumping system	Clarification Required	In the event of a power failure or pump failure, what is the alternative plan to convey water from Jacko Lake to the downstream pond?
	10-Mar-16	Christa Pattie/ Colleen Dreger, FLNR		Water quantity- Jacko Lake seepage	Comment	It is expected that seepage losses from Jacko lake into the Open Pit will occur throughout the life of the project. KGHM must advise how this loss of storage water will affect existing water ilcence holders.
	10-Mar-16	Christa Pattie/ Colleen Dreger, FLNR		Water quantity- unnamed stream	Clarification Required	A tributary running North- South into the PCDP will be covered by the EMRSF. Were the flows contributed by this tributary to Peterson Creek included in water balance model as losses? If not, what are the expected losses?
	10-Mar-16	Christa Pattie/ Colleen Dreger, FLNR		Water quantity- central pond	Clarification Required	Will the central pond be decommissioned or reconfigured at closure? If reconfigured, is the pond intended to be on Peterson Creek? This will impact flow regime of the stream and may increase losses to ground water and evaporation.
	10-Mar-16	Christa Pattie/ Colleen Dreger, FLNR		Water quantity- dams	Comment	Construction of dams at Jacko Lake and PCDP should be done during lower flow months and preferably outside of the irrigation season to reduce impacts to existing licence holders.
	10-Mar-16	Christa Pattie/ Colleen Dreger, FLNR		Water quantity- Keynes creek	Permitting Information Requirement	Where is the water this naturally flows from Keynes Creek into Goose Lake going to go? Application (referencing TSF) states no surface water discharge to the environment during the operation phase. Will it all be stored in the TSF?
	10-Mar-16	Christa Pattie/ Colleen Dreger, FLNR		Water quantity- Kamloops Lake licence	Permitting Information Requirement	Water will be pumped from Kamloops Lake to the New Gold – New Afton storage pond and then pumped through the new pipeline. Will the New Gold – New Afton storage pond be able to accommodate this quantity or will it require enlargement
	10-Mar-16	Christa Pattie/ Colleen Dreger, FLNR		Water quantity- mine closure	Clarification Required	Clarification is required on how much water will be required at mine closure and for what purposes.
	10-Mar-16	Christa Pattie/ Colleen Dreger, FLNR	3-111	Water quantity- Jacko lake dam	Comment	Upon decommissioning the intention is to re-establish the Jacko Lake dam spillway to 892m this is the elevation of the current spillway; however, the spillway level will require re-establishment due to the removal of the northeast arm of the lake.
	10-Mar-16	Christa Pattie/ Colleen Dreger, FLNR		Water quantity- snow survey data	Comment	Historical dataset – based on data which doesn't incorporate the closest available data. In fact, the closest available data is not even mentioned. Closest survey stations are at Lac le Jeune (lower- inactive, 50 years of data; upper- active).

	10-Mar-16	Christa Pattie/ Colleen Dreger, FLNR	6.4-12	Water quantity- Jacko Lake inflow	Comment	Return Period Calculations based on JACINF. It was selected as 'flows are not regulated and can therefore be correlated to regional flow record'. What about the licences u/s of JACINF and the dam on Timber Lake?
	10-Mar-16	Christa Pattie/ Colleen Dreger, FLNR		Water quantity- data	Comment	The synthetic dataset for JACINF was produced using monthly derived relations between the long-term streamflow data from 08LF027 and the short-term streamflow data at JACINF. The resulting synthetic dataset provides monthly data. All Water Stewardship allocation decisions are made using 7Q5, 7Q10, etc low flow. This data is required so we can determine any impacts on existing licensees.
	10-Mar-16	Christa Pattie/ Colleen Dreger, FLNR	6.4-61	Water quantity- significance	Comment	Water Allocation does not agree with the assessment of Not Significant (minor) residual effect (including cumulative residual effects) significance as determined by the proponent for change in surface water quantity (all metrics) Jacko Lake. The reduction of water availability is considered irreversable. This watershed is water short for existing water users and decreased water quantites will have further impacts for water licence holders. We suggest the signficance should be not significant (moderate) for this metric.
	10-Mar-16	Christa Pattie/ Colleen Dreger, FLNR	6.4-61	Water quantity- significance	Comment	Water Allocation does not agree with the assessment of Not Significant (minor) residual effect (including cumulative residual effects) significance as determined by the proponent for change in surface water quantity (annual flow volume, monthly flow distribution, peak flow) in Peterson Creek (Lower) at PC02. The reduction of water availability is considered irreversable. This watershed is water short for existing water users and decreased water quantites will have further impacts for water licence holders. We suggest the signficance should be not significant (moderate) for this metric.

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FLNR-001	15-Feb-16	David Thomson/FLNR	6.2B	Groundwater	Comment	Page 180 of PDF: Does not appear to be sufficient test response to perform accurate analysis of DH-BGC15-02
FLNR-002	15-Feb-16	David Thomson/FLNR	6.3, 6.5, App 6.6-A	Groundwater	Provincial EA Information Requirement	SEE MEMO 0215_FLNR-ELFZ. The proponent acknowledges that "a local groundwater flow conduit along strike of the ELFZ may be present in the vicinity of Jacko Lake". The ELFZ was characterized locally but not apparently investigated as potential conduit. The potential effect on groundwater quality may warrant a rank higher than low. Therefore, water quality and elevation monitoring of the ELFZ between the TSF and Jacko Lake would be a logical outcome of a medium ranking of potential effects. This comment also relates to FLNR-031. Please clarify if or how the potential for the ELFZ to act as a sub-regional groundwater conduit was investigated beyond the local-scale packer testing, and please provide a figure showing how and where the ELFZ was incorporated into the numerical model layers
FLNR-003	15-Feb-16	David Thomson/FLNR	App 6.6C	Groundwater	Clarification Required	Pumping test: A hydraulic connection to Peterson Creek may exist, as drawdown is observed at varying radial distances in different lithologies. Instrumentation of shallower zones closer than 200 m offset from the PW would have provided useful data that could more definitively aid understanding. Pie charts are unconventional way to compare groundwater quality changes over time; however increases in bicarbonate over time could relate to increase in fresher water over time (ie connection to surface water). This has implications for dewatering assumptions. Please review groundwater quality and pumping test data to assess whether hydraulic connection to Peterson Creek has definitively been disproved by thorough and adequate testing and monitoring. Please also discuss implications if a hydraulic connection does in fact exist.
FLNR-004	15-Feb-16	David Thomson/FLNR	App 6.6C	Groundwater	Comment	Some borehole logs have draft stamp on them; logs should be finalized.
FLNR-005	15-Feb-16	David Thomson/FLNR	App 6.6C	Groundwater	Comment	MW11-10D analysis with Hantush shows a truncated data set compared to Theis analysis. Drawdown data doesn't appear to plot to maximum of 10.89 m
FLNR-006	15-Feb-16	David Thomson/FLNR	App 6.6C	Groundwater	Clarification Required	The Theis analysis is used for most pumping test analyses, Generally this analysis is applied only to confined aquifers. Discuss choice of this interpretation given the assessment of the aquifer generally as unconfined to semi-confined.
FLNR-007	15-Feb-16	David Thomson/FLNR	Tbl 6.5-1	Groundwater	Clarification Required	PW-01 is screened from 33.5 - 199.9 mbgs across 3 lithologies/aquifers as a sampling location. All other screens are <10m in length. This exceptionally long screened interval may serve to dilute beyond detection any quality changes. It is not located anywhere near the ELFZ. Please clarify the rationale and purpose of this monitoring location. One or more hydrogeological cross sections through the pumping test well and observations wells would aid understanding.
FLNR-008	15-Feb-16	David Thomson/FLNR	App3-D	Groundwater	Provincial EA Information Requirement	"SPs will be used as required downstream of the TSF embankement…to monitor water quality and as an alternative method to the VWP to measure piezometric levels". Please identify on a figure proposed locations of the monitoring wells and analytical schedule, along with the aquifers/lithology/screened intervals to be monitored.
FLNR-009	15-Feb-16	David Thomson/FLNR	6.3; 6.5, App 6.5A	Groundwater	Clarification Required	S 6.3 alludes to the potential that all contact water may not be contained. It's unclear why tailings are not considered a potential source given the potential impacts and statements indicating a proportion of flow is expected to report to the groundwater table.
FLNR-010	15-Feb-16	David Thomson/FLNR	6.5, 11.24, App 6.5-A	Groundwater	Clarification Required	Appendix 6.5-A states that the proposed EMRSF will be unlined and long term seepage is expected. Does the Peterson Creek Aquifer need to be have baseline and compliance groundwater monitoring wells installed at various depths and locations o confirm effectiveness of proposed mitigation measures, and be included in the GWMMQP? If so, please provide these details.
FLNR-011	15-Feb-16	David Thomson/FLNR	App 6.6C	Groundwater	Clarification Required	The Cooper Jacob analyses are difficult to inspect visually due to very large Y-axis scale, relative to drawdown, resulting in a horizontal line. Typically data for this analysis is plotted such that the line is sloped across the page and the majority of the y-axis spread is populated with data. Please present these analyses in a conventionally accepted form.

FLNR-012	15-Feb-16	David Thomson/FLNR	6.6, App 6.6C	Groundwater	Clarification Required	An estimate of hydraulic conductivity of 3 x 10-5 m/s is made, based on interpretation of pumping test results. Those results present transmissivities and appear to assume a uniform aquifer thickness of 53 m, which is the observed thickness at the pumping well. Clarify if this is so, and if this is considered representative of the entire aquifer. Further, discuss whether this value, as a model input, Is reasonably representative.
FLNR-013	15-Feb-16	David Thomson/FLNR	App 6.6C, App 6.6A	Groundwater	Clarification Required	Upper bedrock well BGC14-004 located 273 m east of the PW experienced significant drawdown during the pumping test, suggesting hydraulic connection with the Peterson aquifer. The bedrock well BGC14-0005 located 326 m to the west experienced much less drawdown. This could be a result of different bedrock types. Either way it suggests the effective aquifer thickness to the east of the pumping well is much greater than 53 m, while it is less to the west. Please discuss, noting relevance to model input parameters and sensitivity analysis.
FLNR-014	15-Feb-16	David Thomson/FLNR	6.5, 6.6,App 6.6A	Groundwater	Clarification Required	Regarding FLRN-013 it would be useful to attempt to interpret hydrostratigraphy with respect to the geology shown in Drawing 8E. Potentially, the pumping test results would show a boundary if the bedrock was relatively impermeable, or not, if it was very permeable, leading to an incorporation of the upper bedrock and lower uncondolidated deposits into the same hydrostratigraphic unit. Please include hydrostratigraphic delineation on the cross section.
FLNR-015	15-Feb-16	David Thomson/FLNR	6.5, 6.6, App 6.6-D, 10.5.3	Groundwater	Provincial EA Information Requirement	SEE MEMO 0215_FLNR-CSM. The Conceptual Site Model appears to be limited to a single generic cross section. A CSM should show all hydrostratigraphic units, pathways for contamination and receptors, groundwater levels and hydraulic/vertical gradients, recharge and discharge boundaries and divides, among other features. Borehole logs should be reviewed to filter out poor completions (eg, MW11-08S). Hydrostratigraphic determinations are shown in table format but also could incorporate the extensive major ion chemistry collected to date, and be overlain on the cross sections shown in Appendix 6.6-A. A detailed CSM would likely be the subject of a separate appendix or consultant report.
FLNR-016	15-Feb-16	David Thomson/FLNR	6.5-2, App 6.2B, App6.6-D, 11.24	Groundwater	Provincial EA Information Requirement	SEE MEMO 0215_FLRN_TSF. Appendix 6.2-B states “the likelihood of contact water from the above noted mine facilities infiltrating into the bedrock and travelling through the ELFZ to Edith Lake, Jacko Lake and/or Peterson Creek is being evaluated by BGC as part of the groundwater quantity effects assessment for the Project Application/EIS.” Contact water and the TSF was identified in Table 6.5-2 as having a high potential effect on groundwater quality in several phases of the project. Plume migration models were utilized to model effects at the RES-2 well. Mitigation measures are described, but there are very little details to assess the adequacy of those mitigation measures. Practically, a robust groundwater monitoring program, with numerical targets for response, is required. It's noted that monitoring is a requirement of any "medium" ranked potential effects.
FLNR-017	15-Feb-16	David Thomson/FLNR	App 6.6D	Groundwater	Clarification Required	Appendix 6.6-D states that "simulated and observed groundwater elevations were compared for general magnitude and timing of changes, and not for close agreement with recorded seasonal groundwater elevations." Can a model be considered adequately calibrated if simulated and modelled groundwater elevations are not in close agreement? Is this considered calibrated based on applicable guidelines?
FLNR-018	15-Feb-16	David Thomson/FLNR	11.24, App 6.6-A	Groundwater	Provincial EA Information Requirement	SEE MEMO 0215_FLNR_GWQMMP. The GWQMMP should be of sufficient detail to evaluate, and forms part of the mitigation and management strategy of an undertaking's potential effects. Also, GWMMQP does not list total metals as part of the analytical schedule. Would this be useful given that the mine may generate acidity, which is related to metal mobility in groundwater? When will a detailed GWMMQP be available for review?
FLNR-019	15-Feb-16	David Thomson/FLNR	11.24	Groundwater	Clarification Required	Please confirm VWPs installed proximal to the ELFZ and elsewhere will form part of the GWMMQP.
FLNR-020	15-Feb-16	David Thomson/FLNR	App 6.6-A	Groundwater	Clarification Required	GWMMQP - numerous statistical techniques can be used to evaluate groundwater chemistry (and elevation) data. This should be done prior to beginning construction to ensure an adequate number of samples are present so as to be statistically valid. For instance various control charts or trend analyses can require a minimum of eight valid samples, so prior analysis of the dataset for outliers etc would be useful. Please clarify what statistical techniques will be used to determine reference concentrations, and exceedances or trigger limits. See also MEMO 0215_FLNR_GWQMMP.

FLNR-021	15-Feb-16	David Thomson/FLNR	App 6.6-A	Groundwater	Provincial EA Information Requirement	Appendix 6.6-A, the Baseline Groundwater Hydrology Assessment, does not provide baseline groundwater chemistry results except in the broadest sense (ie, major ion water typing). Sufficient data has been collected in past years, based on the references, to summarize and present chemistry data by location, season, hydrostratigraphic unit, etc, along with statistical measures of trends, correlations, mean, expected baseline range and so on, either here or as part of a GWMMQP. The data must be assembled in one place, understood and gone through quality assurance/control checks as part of the application. It is understood that individual laboratory reports have undergone QA/QC checks; the concern is that once baseline data is assembled and collated, outlier data may present itself and insufficient data may be present to render confident baseline values
FLNR-022	15-Feb-16	David Thomson/FLNR	App 6.6-D, 6.6.3.4, 6.6.4.2	Groundwater	Provincial EA Information Requirement	SEE MEMO 0215_FLNR_3D_MODEL. Appendix 6.6-D: This model is relied on heavily for assessment of some of the potential effects. The model is based on the conceptual site model. Therefore the adequacy of the CSM is critical to the effects assessment.
FLNR-023	15-Feb-16	David Thomson/FLNR	App 6.6-D	Groundwater	Clarification Required	Appendix 6.6-D states that 14 surficial wells and 31 deeper wells within the mine site were used for transient model clarification. Does this relatively small selection of monitoring wells adequately capture the spatial variability of hydrostratigraphic units? That is, 12 layers are used to generate the numerical model, which equates to an average of four monitoring points per hydrostratigraphic layer, across a reasonably large areal extent. Secondly, please confirm that hydrostratigraphic delineation present in the model is consistent with known geologic contacts, and groundwater data, as represented by data collected at all points shown in Drawing 3 of baseline assessment.
FLNR-024	15-Feb-16	David Thomson/FLNR	AIR 0477, Appendix 6.6-A	Groundwater	Provincial EA Information Requirement	The requirement of AIR 0477 was to include "interpretation of aquifer and aquitard locations in the study area". Aquifers mapped by the government are shown. Aquifers and aquitards apparently delineated by the proponent are described to a degree in tables along with hydraulic data. Interpretation of that data should be done in a visual manner. The cross sections in 6.6-A show hydrogeologic information overlaid on geologic cross sections but do not delineate or provide interpretation of hydrostratigraphic units, unless the proponent is proposing that discrete geologic units are also discrete hydrogeologic units (which the Peterson Creek Aquifer pumping test results may not support). Please clarify.
FLNR-025	15-Feb-16	David Thomson/FLNR	6.5, 6.6, Appendix 6.6-A,	Groundwater	Provincial EA Information Requirement	AIR 0478 required, among other things, "rationale and basis for defining hydrostratigraphic units that may include discrete or multiple lithologies". Table 2 of Appendix 6.6-A lists existing monitoring points and attributes them to 'screened/monitored hydrostratigraphy' but this does not appear to be presented in cross sections. Also, some monitoring points are attributed to multiple hydrostratigraphic units. The lack of a clear presentation of such data leads to concerns that the system, as modelled to predict success of mitigative measures, may not be well understood and therefore construction of the model may incorporate that lack of understanding. Please provide hydrostratigraphic cross sections to assist in understanding how the proponent has satisfied this AIR.
FLNR-026	15-Feb-16	David Thomson/FLNR	Appendix 6.6-A	Groundwater	Comment	Photo II 175 showing KAX-14-128 completed shallow and deep installations shows the protective casing appearing to be in a depression and therefore prone to surface water pooling and infiltration. It also shows apparent cracks in the cement surface seal.
FLNR-027	15-Feb-16	David Thomson/FLNR	Appendix 6.6-A	Groundwater	Clarification Required	Photos of KAX-14-121 surface casing shows the hole to be angled, but that is not specified on the borehole log. Please clarify if this hole is angled or if the surface casing is not vertical. If the former, please confirm data such as lithology depth is correct. If the latter, please confirm well integrity has not affected results from the well.
FLNR-028	15-Feb-16	David Thomson/FLNR	Appendix 6.6-A	Groundwater	Comment	Geologic cross sections show some but not all hydrogeologic data collected. For instance, no data from the ELFZ is presented on the sections.
FLNR-029	15-Feb-16	David Thomson/FLNR	Appendix 6.6-B	Groundwater	Clarification Required	KAX-14-128S aquifer test solutions. The test data show 10 or less cm of displacement in a well with a static water column height >5 m. Therefore recovery does not fall within the recommended range (0.2-0.4 of normalized head). Two early time and two late time analyses are run. FLNRO is concerned the potential errors and/or poor quality of this and other test(s) may result in poor data inputs into the numerical model and other proposed monitoring or assessments relying on this data. Please comment.
FLNR-030	15-Feb-16	David Thomson/FLNR	Appendix 6.6-B	Groundwater	Comment	BGC14-008D RH Test1 aquifer test solution. Displacement is shown to be slightly greater than static water column height.
FLNR-031	15-Feb-16	David Thomson/FLNR	Appendix 6.6-B	Groundwater	Clarification Required	BGC14-001D aquifer test analysis. Test displacement (<1 m) is very small relative to the >13 m static height and the first response record is >10 seconds into the test. FLNRO is concerned the potential errors and/or poor quality of the test(s) may result in poor data inputs into the numerical model and other proposed monitoring or assessments relying on this data. Please comment.

FLNR-032	15-Feb-16	David Thomson/FLNR	Appendix 6.6-B	Groundwater	Clarification Required	BGC14-015S RH TEST 1 aquifer test analysis: The first recovery response shown is more than 1000 seconds into the test. The density of data presented suggest a datalogger was use. Please present an analysis of the entire test. Also please verify the result's impact, if any, on inputs into other aspects of the groundwater quality and quantity assessments.
FLNR-033	17-Feb-16	David Thomson/FLNR	11.24.4	Groundwater	Clarification Required	It is states that 'As required, individuals that complete the monitoring and data interpretation will be suitably qualified professionals." Please clarify that the aforementioned professionals will be a third party (e.g., environmental consultant) contracted for this these tasks.
FLNR-034	17-Feb-16	David Thomson/FLNR	11.24.4.2	Groundwater	Clarification Required	For clarity the analytical suite should state specific analytes. Some dissolved anions are explicitly mentioned but dissolved cations are not explicitly mentioned. The intent might be to sample for routine potability, so as to be consistent and comparable with historical data. Also, the detection level sought is not mentioned. Bromide for instance can be subjected to different analyses for different detection limits. Please clarify.
FLNR-035	17-Feb-16	David Thomson/FLNR	Table 11.24-1	Groundwater	Clarification Required	There are 48 locations identified in Table 11.24-1 for groundwater quality monitoring. Of these, 28 are selected for groundwater quality monitoring throughout the project lifecycle, across six or seven of the 11 hydrostratigraphic layers identified for input in to the numerical model. Why are Picrite, Mine Rock, Unidivided Surficial Deposits, Sugarloaf, Kamloops and Undivided Bedrock not included in the groundwater monitoring plan?
FLNR-036	17-Feb-16	David Thomson/FLNR	Table 11.24-1	Groundwater	Clarification Required	Is "Waste Rock backfill" the same hydrostratigraphic grouping as "Mine Rock and Anthropogenic Materials"?
FLNR-037	17-Feb-16	David Thomson/FLNR	Table 11.24-1	Groundwater	Clarification Required	KAX-14-114S is identified as monitoring Glacial Till or Fluvial/Glaciolacustrine. If there is uncertainty regarding which zone this well is monitoring, should it be included in the monitoring plan?
FLNR-038	17-Feb-16	David Thomson/FLNR	Appendix 6.6-D	Groundwater	Clarification Required	Calibration results. There are 11 hydrostratigraphic units identified, but 12 model layers. Please clarify.
FLNR-039	17-Feb-16	David Thomson/FLNR	Appendix 6.6-D	Groundwater	Clarification Required	Model construction. Early on in the text, the model is described as having 15 layers. There are 12 layers calibrated in Figure 14, and a total of 11 hydrostratigraphic units identified in Figure 20, including bedrock. Table 1 lists 11 hydrostratigraphic units above bedrock. Please clarify.
FLNR-040	17-Feb-16	David Thomson/FLNR	Appendix 6.6-D	Groundwater	Clarification Required	Table 2: Summary of Bedrock hydraulic parameters. This table identifies the Sugarloaf unit as being part of the Iron Mask Batholith Group. Table 20 lists the Iron Mask Hybrid and Sugarloaf as separate hydrostratigraphic groups. Also, how are the 'rock types' within the "3D Geologic Model" differentiated from formations within the "Intrusive Rock Type?". It is difficult to reconcile how this information was incorporated in to the modelas presented in Figures 8 and 9. Please clarify
FLNR-041	17-Feb-16	David Thomson/FLNR	Appendix 6.6-D	Groundwater	Clarification Required	Table 2: Summary of Bedrock hydraulic parameters. This table identifies other units not included in Table 20, but that are assigned distinct hydraulic values, such as the Pothook and Cherry Creek Unit. Please clarify
FLNR-042	17-Feb-16	David Thomson/FLNR	Appendix 6.6-D	Groundwater	Clarification Required	Regarding comments FLNR-038 through -041, a table correlating geology with hydrogeology, model layers, and hydrostratigraphy may help understanding these discrepencies.
FLNR-043	17-Feb-16	David Thomson/FLNR	Appendix 6.6-D	Groundwater	Clarification Required	Table 5, Calibration Range. Hydraulic conductivity ranges are provided only for "surficial" and "bedrock" deposits, consistent with Figures 8 and 9, but inconsistent with individual units identified in other tables. This is confusing as Figure 20 suggests calibration was done per hydrostratigraphic unit. Please clarify.
FLNR-042	17-Feb-16	David Thomson/FLNR	Appendix 6.6-D	Groundwater	Clarification Required	Figure 17: The mine site data correlation of 0.725 is lower than the 0.95 threshold for a calibrated model, according to BC MOE (2012). Dozens of data points exist outside of the band outlined by +/- 10m, and extend to nearly 100 m difference in observed vs simulated hydraulic head. Why should this not lead to the province having concern about the model's ability to predict advers effects and the efficacy of mitigation measures?
FLNR-043	17-Feb-16	David Thomson/FLNR	Appendix 6.6-D	Groundwater	Clarification Required	Figure 20: Have these values (actual test data) been subjected to outlier analyses?
FLNR-044	17-Feb-16	David Thomson/FLNR	Appendix 6.6-D	Groundwater	Clarification Required	Figure 20: Colluvium - only one data point is visible, unless the Kz and Kx/y (identical?) overprint another value. Please clarify how the (geometric) mean K was obtained? Also please discuss the potnetial impacts on model predictions given (a) limited data within this unit and, (b) more than 2 orders of magnitude differential between reported mean and calibrated mean K.
FLNR-045	17-Feb-16	David Thomson/FLNR	Appendix 6.6-D	Groundwater	Clarification Required	Figure 20: Could ELFZ be treated as a distinct unit and included here?
FLNR-046	17-Feb-16	David Thomson/FLNR	Appendix 6.6-D	Groundwater	Clarification Required	Figure 20: No Model Kz is shown for bedrock units. Please explain.

FLNR-047	17-Feb-16	David Thomson/FLNR	Appendix 6.6-D	Groundwater	Clarification Required	Figure 20: Is there only a single data point for Lacustrine Unit?
FLNR-048	17-Feb-16	David Thomson/FLNR	Section 11.24	Groundwater	Clarification Required	Are groundwater monitoring sites established in the provincial Environmental Monitoring System as requested by FLNRO 8-Aug-2012? If so, will new data be uploaded regularly?
FLNR-049	17-Feb-16	David Thomson/FLNR	Section 11.24	Groundwater	Clarification Required	FLNRO understands that quarterly monitoring will be conducted. What frequency will reporting occur at? Also, is or will there be a process in place to ensure that water quality data is reviewed between sampling events so as to identify potential exceedances, in between reporting periods?
FLNR-050	17-Feb-16	David Thomson/FLNR	Section 6.5.4	Groundwater	Clarification Required	Temporary Ore, Development of Mine Rock Management Facilities, Deposition to TSF, TSF Development, TSF Decommissioning and Reclamation, Contact Water, Loading Hauling and Deposition of Mine Rock, and Temporary Ore Stockpile are identified a potential High interaction with the groundwater quality VC. Pit Lake Fillin, Open Pit Development, and Drilling and Blasting are ranked Medium. Both Medium and High warrant carry-forward for further assessment. A model is used to predict plume migration to well RES-2. Monitoring is a key component to verify mitigation measures and model predicitions. Please clarify that these carry-forward project effects have been or will be included for groundwater monitoring, based on their location and the particle tracking.
FLNR-051	17-Feb-16	David Thomson/FLNR	Appendix 6.6-D	Groundwater	Clarification Required	BC MOE's Guideline for Groundwater Modelling states that residuals should generally be "a small fraction of the difference between the highest and lowest heads across the site."
FLNR-052	17-Feb-16	David Thomson/FLNR	Appendix 6.6-D	Groundwater	Clarification Required	Section 5.1 states that "the model is not designed to resolve details of groundwater flow at spatial scales smaller than approximately 100 m." Many of the layers in the model are less than 100 m thick. Please clarify this limitation, and what role this may have in the poor calibration noted in FLNR-042.
FLNR-053	17-Feb-16	David Thomson/FLNR	Appendix 6.6-D	Groundwater	Clarification Required	Visually, the transient calibration seems poor as it is largely unable to mimic actual groundwater level fluctuations. Its not clear that calibration to "general magnitude and timing of changes" is adequate. How does this lack of calibration affect the models predictive abilities and particle tracking? Why were specific climate conditions not available for use?
FLNR-054	17-Feb-16	David Thomson/FLNR	Appendix 6.6-D	Groundwater	Clarification Required	What is the hydrostratigraphic distribution of the 418 groundwater elevations used for steady state calibration?
FLNR-055	17-Feb-16	David Thomson/FLNR	Appendix 6.6-D	Groundwater	Clarification Required	What is the hydrostratigraphic distribution of the 45 groundwater elevations used for steady state calibration? Does this provide at least three monitoring points per hydrostratigraphic unit?
FLNR-056		David Thomson/FLNR	Appendix 6.3-A, 6.6-D	Groundwater	Comment	This appendix makes a couple attempts to relate water chemistry to inferred hydrostratigraphy, through tables and plan view "spatial representations" of select ions in groundwater, but does not appear to have been successful. Typically different clusters of data would appear on piper diagrams, generally showing fresher water closer to the surface/recharge areas. This does occur in some nested locations (eg, BGC14-003D/I/S; BGC14-011D/S; BGC14-017D/S). In other cases there are too many colours and symbols to readily identify this (eg MW11-05D/S). In yet other cases the diagrams illustrate that groundwater quality either is changing over time, or has not stabilized since drilling (eg, MW11-06D/S). It is unusualy that groundwater chemistry can not be correlated across individual hydrostratigraphic units.
FLNR-057		David Thomson/FLNR	Appendix 6.6-D	Groundwater	Clarification Required	Figure 30: Will these (and/or other) predicted groundwater elevations be included in the groundwater monitoring program, and the predictions evaluated against the actual groundwater elevations? What amount of deviation will be acceptable, and what action will be triggered if that value is exceeded?
FLNR-058		David Thomson/FLNR	Appendix 6.3-C	Groundwater	Clarification Required	Water quality data from the PW-01 pumping test was used to represent groundwater inputs in the open pit area. This well is completed across several hydrostratigraphic units. As such the analytical results used represent flow from several (three?) hydrostratigraphic units. Is flow expected to be uniform within those three units based on evaluation of those units hydraulic properties? If not, please indicate how the results of the water quality model may be affected. How does this correlate with the calibrated hydraulic conductivities presented in Figure 20 of App 6.6-D? How does the commingled PW-01 chemistry result compare to representative chemistry results from each hydrostratigraphic unit?
FLNR-059		David Thomson/FLNR	Appendix 6.6-A	Groundwater	Provincial EA Information Requirement	Vertical gradients between hydrostratigraphic units are not identified. Please provide these values at select areas of interest (ie, near Jacko Lake, PCDP, etc).

FLNR-060		David Thomson/FLNR	General	Groundwater	Comment	The Province of British Columbia brought into force the Water Sustainability Act on February 29, 2016, subsequent to this application submittal. The proponent should review this Act, and associated published (and forthcoming) regulations that may pertain to this application. Note that the Groundwater Protection Regulation does pertain to monitoring wells.

0215_FLNR_3D_Model

Date: 15/02/2016

Name: David Thomson

Title: Regional Hydrogeologist

Agency/Organization: Ministry of Forest Lands and Natural Resources

Subject of comment: 3D Numerical Model

Category of comment: Provincial EA Information Requirement

Section of the Application: Appendix 6.6-D, Appendix 6.6-A

Overview of key issues in this memo:

The proponent states that the groundwater flow model is the primary tool used to evaluate mitigation measures. Results of the model then dictate whether a potential effect ranking is carried forward in the application for more assessment, or ranked lower. As such, the groundwater flow model must be extremely robust or supplemented with other data. Presently the model has a primary dependence on the existing CSM – consisting of four pages and a generalized cross section - to evaluate proposed mitigation measures for groundwater quality and quantity.

Therefore, the model may not adequately characterize and assess baseline conditions, accurately capture potential impacts or evaluate proposed mitigation measures.

While detailed aquifer hydraulic properties are provided in table format in the model, the dimensions and locations of these units are not depicted or described except in the broadest terms, and in two blocky regional-scale model grids.

Comment/Issue Description:

In addition to the essential aspects of determination of hydrostratigraphy outlined above, additional comments are as follows:

Model calibration:

- Steady state calibration with and without Edith Lake Fault Zone (ELFZ) produced similar results, which seems to have led to discarding it during model simulations. Please verify rationale given regional mapping and the lack of physical testing of a hydraulic connection with Jacko Lake or other water sources.
- Pumping Test calibration. Details of the pumping test and actual physical responses observed have not been provided to review.

- ELFZ was introduced as 50 m wide feature owning to model selection limitation. Did the proponent consider doing a sensitivity analysis of constructing the fault as a 50 m wide feature, versus the actual apparent width based on the ELFZ investigation?

It is acknowledged that the 50 m x 50 m blocks in the model may be related to calibration discrepencies. Would a finite element model be better suited to evaluate potential impacts and mitigation measures?

The conclusions state that the calibrated model is consistent with the interpreted conceptual hydrogeological model. This is literally impossible to ascertain given the lack of detail in the CSM. The concern is that the elements of a detailed conceptual model, while likely present throughout the application, have not yet been tied together in one coherent package at this stage of the EA process.

Table 2: The Edith Lake Fault Zone is assigned a hydraulic conductivity of 3.2×10^{-8} m/s, in contrast with Appendix 6.2-B which states "Hydraulic conductivity is estimated to be greater than or equal to 3×10^{-6} m/s for the zone interpreted to be the intercepted ELFZ…"

- Does assigning a hydraulic conductivity of 3.2×10^{-8} m/s to the ELFZ provide an accurate representation of this feature?
- Appendix 6.2-B also states that the ELFZ has a hydraulic conductivity of at least one to two orders of magnitude greater than the surrounding bedrock. Does assigning the ELFZ a 10^{-8} range hydraulic conductivity provide an adequate and accurate modelled baseline evaluation of potential impacts?

Figure 14: This figure shows the local steady state calibration with twelve model layers, divided into bedrock and overburden. Is the Edith Lake Fault Zone represented by one of the layers?

Figure 19: The pumping well has an apparent screen length of nearly 200 m, and calibration results are shown for piezometers completed in different aquifers at different depths. It is not clear this effectively simulates pumping test responses in discrete aquifers as the PW presumably has caused all the aquifers encountered to become hydraulically connected over time. In the absence of cross sections showing hydrostratigraphic units it is even difficult to evaluate calibration results.

Figure 20 provides a great level of detail regarding the hydraulic conductivity of various hydrostratigraphic units. The thickness, areal extent and hydrochemical nature of these units is not indicated in plan view or cross section. At a minimum, the proponent should provide several two-dimensional representations of the hydrostratigraphy in order for third parties to evaluate the construction of a three-dimensional model being relied upon to evaluate mitigation measures.

Sensitivity Analysis

The figures presenting results of the sensitivity analysis show some results that are counterintuitive. In particular, as it results to the Edith Lake Fault Zone (ELFZ), the model predicts an increase of water table elevation of 100 m beneath the TSF and WMSRF. The near vertical and highly

conductive ELFZ lies beneath these facilities, and groundwater flow is inferred to flow toward it. Figures that require explanation include:

- Figure E-10: Particle tracking flowlines emanating from the SMRSF cross the ELFZ, but flow along the ELFZ is not shown to occur.
- Figure E-11: Particle tracking flowlines emanating from the WMRSF are coincident with the ELFZ, but flow along the ELFZ is not shown to occur.
- Figure E-12: Particle tracking flowlines emanating from the TSF are coincident with the ELFZ, but flow along the ELFZ is not shown to occur.
- Figure E-35: inclusion of the fault zone does not seem to induce groundwater flow along it.
- Drawing 17: The ELFZ is not shown on the figure, but does trend beneath the WMRSF toward Jacko Lake in the vicinity of the particle tracking flowlines, which presumably flow through shallow overburden. The ELFZ has been investigated in the immediate vicinity of the flowlines and found to be extremely conductive. Please explain why it does not appear to be considered in this baseline assessment of potential impacts.
- Drawing 18: Similar to comments above, the ELFZ would serve to transmit seepage water from the TSF toward Jacko Lake but does not appear to be considered.

It's also noted that hydraulic conductivity is varied only by a factor of 5, while this parameter is widely accepted to have much larger (order-of-magnitude) errors. Please explain the choice of the 5-times factor.

0215_FLNR_CSM

Date: 15/02/2016

Name: David Thomson

Title: Regional Hydrogeologist

Agency/Organization: Ministry of Forest Lands and Natural Resources

Subject of comment: Conceptual Site Model (CSM)

Category of comment: Provincial EA Information Requirement

Section of the Application: Appendix 6.6-A

Overview of key issues in this memo:

The proponent identified a CSM as something that will be included in this application, and identified a non-exclusive list of elements that would be present in the CSM. The CSM presented is four pages long, relies on a single cross section that does not show hydrostratigraphic units, and generally focusses on quantity only. This forms the basis for the numerical model, according to App6.6-D, which then is substantially relied upon to predict efficacy of proposed mitigation. A detailed CSM should delineate aquifers areally and in section, and by hydrochemistry and hydrostratigraphy, and exist as a separate document. It should determine as best possible potential flow directions and hydraulic gradients, areas of groundwater-surface water interaction, recharge boundaries, etc.

Comment/Issue Description:

A large number of hydrogeology investigations have been performed at this site. These have provided a great deal of information about the site, and the proponent has identified gaps, uncertainties and assumptions regarding how groundwater flows and how quantity and quality may potentially be affected. This should be included in a CSM, and these uncertainties and assumptions would carry forward into the numerical 3D flow model, which has been identified as the main tool to investigate mitigation measures.

As such, a detailed CSM should be in place prior to project initiation. It appears most of the required information is scattered throughout the application and historical documents, and needs to be amalgamated in one place. For instance, modelled hydrostratigraphic units are shown at a coarse scale in Appendix 6.6-D, geologic sections are in Appendix 6.6-A, and historic groundwater quality and quantity data are in multiple separate consultant reports.

The GWQMMP in particular would benefit from a more detailed Conceptual Site Model (CSM). The proponent advocates that this plan be developed iteratively and in consultation with various stakeholders, and modified on the fly. In the event that the results do not confirm the utility of various mitigation measures, or unexpected results are returned, the groundwater flow regime will

have to be reconceptualised in order to test theories (physically, and/or in a model). Having a CSM in hand prior to construction and operation will allow more rapid adaptation to unexpected results, and can be developed iteratively as the project progresses and changes to groundwater are recorded that can be compared to model predictions.

Please indicate when an adequate CSM will be prepared. Secondly, provide an assessment whether the CSM aligns with construction of the numerical model.

0202_FLNR_ELFZ

Date: 16/02/2016

Name: David Thomson

Title: Regional Hydrogeologist

Agency/Organization: Ministry of Forest Lands and Natural Resources

Subject of comment: Edith Lake Fault Zone

Category of comment: Provincial EA Information Requirement

Section of the Application: Appendix 6.6-A, Appendix 6.2-B, 6.5 and 6.6

Overview of key issues in this memo:

- The Edith Lake Fault Zone (ELFZ) has been identified by the proponent as a potential preferential conduit for groundwater and is assessed for effects with a numerical model. Near-borehole hydraulic characteristics of the fault have been investigated in detail through packer testing. The ELFZ's presence proximal to the TSF and beneath other mine facilities ranks it as a feature that requires adequate assessment. Further, that assessment provides inputs to the numerical model, which is then used to rank other potential effects. It isn't clear this fault has been adequately characterized as a preferential conduit for groundwater.

Comment/Issue Description:

The proponent states "The ELFZ could potentially act as a local groundwater flow conduit along strike in areas of locally enhanced hydraulic conductivity. However, as discussed in Appendix 6.6-A and 6.6-E, some uncertainty remains on the interpretation of the overall hydraulic properties, thickness, orientation and regional extent of the ELFZ. The numerical groundwater flow model considers the potential for the ELFZ as a more permeable zone than the surrounding bedrock as an alternative conceptual hydrogeologic model" (6.6-15 of the application). Appendix 6.2-B investigated the fault zone; however it only provided three potential interpretations related to its existence, and no information supporting or disproving the above statement.
The ELFZ is shown by the proponent to exist in a NW-SE direction through the proposed South MRSF, West MRSF and the SW arm of Jacko Lake. It also is shown to exist ~100 m NW of the TSF North Embankent. The ELFZ was characterized by the proponent in an area between Jacko Lake and the TSF and West MRSF to be infilled with coarse unconsolidated sediments, relatively thick, and an area of high hydraulic conductivity (Appendix 6-6A).

Future hydraulic influences on groundwater in this vicinity, at a gross scale, are shown on Figure 6.6-15 *Change in Water Table* (From Existing Conditions to Post Closure). This figure shows a

minimum difference of 200 m hydraulic head between the TSF (+100 m) and the Open Pit (-100 m) over a lateral distance of approximately 200 m due to a combination of dewatering the open pit, and filling the tailings pond. The figure also shows a diminishing but still positive hydraulic head is projected to extend north from the TSF to vicinity of the ELFZ drill locations. Seepage beneath the TSF is acknowledged to be probable, and therefore hydraulic connectivity to the sub-vertical ELFZ is nearly certain. There is a stated assumption that "20% of the macro flow in the MRSFs reports to the groundwater table." Appendix 6.2-B states "the likelihood of contact water from the above noted mine facilities infiltrating into the bedrock and travelling through the ELFZ to Edith Lake, Jacko Lake and/or Peterson Creek is being evaluated by BGC as part of the groundwater quantity effects assessment for the Project Application/EIS."

The proponent investigated the ELFZ through drilling two boreholes and conducting packer tests. This information was synthesized and apparently incorporated into a numerical model. It is noted that the ELFZ was modeled as having a hydraulic conductivity ten times that of surrounding bedrock. This contrasts with the proponents statement that "Results from packer tests show that hydraulic conductivity within the ELFZ can be locally up to at least two orders of magnitude greater than surrounding competent bedrock", and that this interpretation is further supported by potentiometric evidence of groundwater flow toward the fault.

It is also noted that a sensitivity analysis was conducted on the influence of the ELFZ on the model results. However varying this parameter by a factor of 5 may not represent the true variability that may exist, given the above results. Further, hydraulic conductivity estimations are professionally considered to have order-of-magnitude errors or variability for numerous reasons.

Additional physical monitoring (nested piezometers proximal to the fault during a pumping test) and water quality monitoring during a pumping test, or instrumentation of the fault with pressure recorders, would provide a more robust assessment of the ELFZ. Preceding the testing, a more thorough hydrogeological Conceptual Site Model would aid understanding and planning. The matter of a CSM is the subject of FLNR-015.

Faults can be a hydrogeologic feature of importance in any hydrogeological investigation. The evaluation of the near-vertical Edith Lake Fault Zone has been limited to inter-borehole packer testing. As such the ability to accurately identify or predict significant adverse effects (of the feature as a conduit for groundwater) is not adequate.

FLNR requests the ELFZ be more thoroughly considered in the effects assessment, owing to the numerous uncertainties surrounding the feature, and lack of evidence supporting or disproving the uncertainties. This feature's width, depth orientation and continuity are uncertain, as are its hydraulic connections with the surrounding bedrock. Given these uncertainties and the above discussion surrounding the results of the numerical model calibration discussed above, it is difficult

to assess potential effect as negligible. The multiple uncertainties may rank the potential impact as moderate and therefore warrant proposed mitigation and monitoring, if not further testing.

The numerical model is used by the proponent to predict potential effects and also to predict the efficacy of proposed mitigative measures. It isn't clear the ELFZ is adequately included in the numerical model.

0215_FLNR_GWQMMP

Date: 15/02/2016

Name: David Thomson

Title: Regional Hydrogeologist

Agency/Organization: Ministry of Forest Lands and Natural Resources

Subject of comment: Groundwater Quality Management and Monitoring Program (GWQMMP)

Category of comment: Provincial EA Information Requirement

Section of the Application: Section 6.5, 6.6, 6.6-A, 11.24

Overview of key issues in this memo:

1. The GWQMMP should be of sufficient detail for concerned parties to evaluate its thoroughness prior to mining construction and operation.
2. The GWQMMP should incorporate additional locations, per other FLNR comments, to evaluate the efficacy of mitigation measures and accuracy of model predictions.

Comment/Issue Description:

Some details of groundwater monitoring plans for large projects can not necessarily be provided at this stage of the project. However, based on the summary data provided in Appendix 6.6-A there is an opportunity to provide a more detailed GWQMMP. In particular sufficient samples are present to perform statistical analysis of variability that will define reference/baseline concentrations, and future trigger exceedances.

The Edith Lake Fault Zone (ELFZ) requires monitoring between the TSF and Jacko Lake (see memo FLNR-002). Similarly, memo FLNR-016 describes other areas where monitoring can assist with mitigation and ongoing model verification and calibration. Comments FLNR-007, -008 and -009 also should be incorporated into the monitoring plan.

The GWQMMP would benefit from a more detailed Conceptual Site Model (CSM), incorporating more features and considerations than provided in the generalized cross section. For instance, distinct aquifers and lithologies could be overlain on this and to-be-created cross sections. Delineation of hydrostratigraphic units can be overlain on geological sections shown in Appendix 6.6-A, and is important for both the CSM and GWQMMP. Suggestions regarding an enhanced CSM are provided in memo 0215_FLNR_CSM.

0215_FLNR_TSF

Date: 15/02/2016

Name: David Thomson

Title: Regional Hydrogeologist

Agency/Organization: Ministry of Forest Lands and Natural Resources

Subject of comment: Potential Effects on Groundwater Quality – Contact Water and Tailings Storage Facility

Category of comment: Provincial EA Information Requirement

Section of the Application: Section 6.5 and 6.6, 11.24

Overview of key issues in this memo:

- Contact water and the Tailings Storage Facilitly (TSF) are identified as having "high" potential effects on groundwater quality during several of the project phases. Plume migration models were used to assess potential geochemical reactions. Mitigation measures are proposed, but monitoring is not. Monitoring is typically used to verify model predictions.

Comment/Issue Description:

Section 6.5.4.3 proposes mitigation measures, including a dry cover closure for the TSF and reclamation covers over the MRSFs. The proponent states that despite the mitigation measures "there remains the possibility of unforeseen seepage paths toward Peterson Creek (Upper) and Jacko Lake." Similarly some discharge could go to Peterson Creek, which is subject to diversion and potentially influences of dewatering.

The proponent's stated uncertainties with respect to the efficacy of mitigation measures suggest reliance on models to accurately represent residual effects may not be adequate. Generally, uncertainties in modelling are mitigated to a degree with monitoring. Regular monitoring of groundwater quality and elevations over time will also allow model groundtruthing and recalibration or project adjustments during the project lifetime.

Monitoring of the efficacy of these mitigation measures can be incorporated into the proponent's Groundwater Quality Management and Monitoring Program (GWQMMP). The GWQMMP requires more detail prior to construction.

Environmental Assessment for the proposed Ajax Mine Project
WORKING GROUP ISSUES TRACKING TABLE
*Please refer to "**Instructions**" tab for directions

	For Working Group Use					
ID #	**Comment Date** (i.e., 5-Feb-16)	**Commenter Name/ Agency** (i.e., John Smith, MEM)	**Section of EA** (i.e., 6.1.2)	**Subject** (i.e., Surface Water Quality)	**Category of EA Comment**	**Comment** (include Memo ID as applicable)
	3-Mar-16	Sheryl Wurtz/FLNRO	3.17.3.4	Reclamation	Comment	This will need to change to Water Sustainability Act along with all of the pertinent changes that may apply under the new act
	3-Mar-16	Sheryl Wurtz/FLNRO	3.17.47	Closure and Reclamation Objectives	Clarification Required	What will your 'achieved' criteria be to ensure you are actually getting equivalent land use on a smaller amount of area? Including livestock supporting area and wildlife habitat and the native plant species required
	3-Mar-16	Sheryl Wurtz/FLNRO	3.17.4	Closure and Reclamation Objectives	Clarification Required	Exactly how much land is coming out of the ALR for 'temporary' and exactly how much is going back in because it speaks to amount not just capability
	3-Mar-16	Sheryl Wurtz/FLNRO	3.17.4	Closure and Reclamation Objectives	Clarification Required	Returning to ALR requires same land uses as today……..how will you achieve hunting, wildlife needs, the changes for First Nations traditional plants?
	3-Mar-16	Sheryl Wurtz/FLNRO	3.17.4	Closure and Reclamation Objectives	Comment	having the MCRP at only a conceptual level at this point is not acceptable and is wishy washy
	3-Mar-16	Sheryl Wurtz/FLNRO	3.17.4	Closure and Reclamation Objectives	Comment	using the term replicate in the "returning to…….vegetation communities commits to restoring native grass communities
	3-Mar-16	Sheryl Wurtz/FLNRO	3.17.4.1	Long term stability	Clarification Required	What seed mix are you using to seed your stock piles because this will contribute to the seed bank and impact further reclamation efforts down the road.
	3-Mar-16	Sheryl Wurtz/FLNRO	3.17.4.1	Long term stability	Clarification Required	what fence specifications are you using for post closure fencing?
	3-Mar-16	Sheryl Wurtz/FLNRO	3.17.5.5	Soil stockpiling	Comment	if you seed with agronomics you will compromise the soil seed bank for future use. You need to choose carefully for species.
	3-Mar-16	Sheryl Wurtz/FLNRO	3.17.5.5	Soil stockpiling	Clarification Required	I have seen your seed mixes for reclamation post closure, are you using the same for stock piling
	3-Mar-16	Sheryl Wurtz/FLNRO	3.17.6	Revegetation	Comment	Although I see you have determined that CWG is currently on site, CWG is in no way a native, nor does it mimic native habitat. Infact, when imporperly managed for grazing it becomes very unproductive and unprefereable to livestock. I believe you should rethink using this species in your Spring mix.

	3-Mar-16	Sheryl Wurtz/FLNRO	3.17.6	Revegetation	Comment	you are very 'loose' with your definition of grasslands. You are not seperating native grasslands from domestic or artificial grasslands when talking reclamation. You need to make it very clear that it is not native grassland you are reseeding. Even though you are insinuating that grasslands are adaptive, this is not the case for native grasslands and it is not so easily restored back to native, especially if you are seeding Crested Wheat Grass in the area.
	3-Mar-16	Sheryl Wurtz/FLNRO	3.17.6	Revegetation	Provincial EA Information Requirement	your statement that Afton mine indicates success with grassland establishment (non native right?) please be more clear. Non native grasslands will not provide the same habitat opportunities. Crested Wheat Grass is no appropriate for sharptail grouse.
	3-Mar-16	Sheryl Wurtz/FLNRO	3.17.6	Revegetation	Provincial EA Information Requirement	you talk about seeding with agronomics and natives, targeting grass species that will attract terrestrial invertebretes and birds. Can you provide literature showing that the rye grasses are appropriate here? I know that Crested Wheate grass is not appropriate for sharp tail grouse.
	3-Mar-16	Sheryl Wurtz/FLNRO	3.17.6	Revegetation	Provincial EA Information Requirement	are livestock not intended to graze the slopes where you are porposing the more native seed mix? Cattle behavior will stay on the flats, espeically if you are seeding agronomics. This area will be very heavily grazed and they will be less inclined to use slopes. So are the slopes considered as part of the area back to the ALR that livestock can/will use? Without a clear and enforcable grazing plan, the slopes should not really be considered as much a part of the offsetting for livestock/ranching end land use.
	3-Mar-16	Sheryl Wurtz/FLNRO	3.17.6	Revegetation	Clarification Required	I think I am finding either confilicting or some unclear statements. Here and in the meeting we had in March, we were told that post closure will go 5 years and then the mine can and will walk away from the project because seeding and grasslands should be well on their way to recovery. This isn't acceptable for invasive potential and early detection and rapid treatment as in the Invasive Plant Strategy for BC and teh INvasive Plant Program. Nor does it ensure the grasslands will meet the native species levels required to meet existing levels and required habitat.
	3-Mar-16	Sheryl Wurtz/FLNRO	3.17.6	Revegetation	Provincial EA Information Requirement	Will you be monitoring and carrying out appropriate actions to ensure success long after the 5 year post closure until grasslands are determined by an outside professional or agency to be self sustaining?
	3-Mar-16	Sheryl Wurtz/FLNRO	3.17.7.1		Clarification Required	why will TSF have only 25 cm of overburden but other areas like the ore stockpile will have 50 cm?

	3-Mar-16	Sheryl Wurtz/FLNRO	3.17.7.3	stockpiles	Clarification Required	if you are seeding with a mix like Stump, this is boughten and not locally sourced (and I am referring to on site sourced)? Elsewhere in your document you say you will be collecting seed on site to use, which is it?
	3-Mar-16	Sheryl Wurtz/FLNRO	3.17.7.6	Roads	Provincial EA Information Requirement	what are "appropriate control measures" that will prevent vehicle travel on ripped up, reclaimed surfaces?
	3-Mar-16	Sheryl Wurtz/FLNRO	3.17.7.7	Pipelines	Clarification Required	why will the gasline not be removed once no longer in need rather than decomissioned? There is so much disturbance here, taking the line out should not be any worse in the grand scheme of things. If you bring it in, you should take it out. I see the powerline is scheduled for removal.
	3-Mar-16	Sheryl Wurtz/FLNRO	3.17.7.8	Temporary Waste Storage	Clarification Required	application of overburden/soil and seeding……..what will be seeded?
	3-Mar-16	Sheryl Wurtz/FLNRO	3.17.7.9	Water management	Comment	systems in place until water at TSF is suitable for discharge to environment
	3-Mar-16	Sheryl Wurtz/FLNRO	3.17.7.9	Water management	Provincial EA Information Requirement	Will these levels be pre-determined and published? What happens if they never reach safe levels? You need to state a lifetime and beyond commitment to maintaining the TSF and not releasing water if not appropriate.
	3-Mar-16	Sheryl Wurtz/FLNRO	3.17.7.9	Water management	Comment	Peterson Creek downstream pond will be supplied by Humphrey Creek which is going to be fed by TSF. This will be irrigation and domestic water.
	3-Mar-16	Sheryl Wurtz/FLNRO	3.17.7.9	Water management	Provincial EA Information Requirement	What is garauntee that water won't be released to the sytem if safe levels are not reached.
	3-Mar-16	Sheryl Wurtz/FLNRO	3.17.8.1	Temporary Closure	Clarification Required	What if temporary is due to poor markets. What are garuntees the mine will follow commitments. Will the security be enough to cover costs and what due dillegence will KAM committ to if it isn't?
	3-Mar-16	Sheryl Wurtz/FLNRO	3.17.8.1	Temporary Closure	Clarification Required	grassland commitments and invasive species commitments, will they be followed through on?
	3-Mar-16	Sheryl Wurtz/FLNRO	3.17.8.2	Final Mine Closure	Provincial EA Information Requirement	does your statement "the length of time……." mean you will continue to monitore and reclaim efforts until grasslands are well established?
	3-Mar-16	Sheryl Wurtz/FLNRO	3.17.9	monitoring	Clarification Required	what scientific methods are being used for monitoring?
	3-Mar-16	Sheryl Wurtz/FLNRO	3.17.9.1	reclamation monitoring and maintenance	Provincial EA Information Requirement	Monitoring 1 out of every 2 years or until vegetation is established…….what determines established
	3-Mar-16	Sheryl Wurtz/FLNRO	3.17.9.1	reclamation monitoring and maintenance	Comment	commitmment of 15% replanting is very likely not enough. Native seed may require a greater commitment than that.
	3-Mar-16	Sheryl Wurtz/FLNRO	3.17.10.1	Closure costs	Clarification Required	why are closure costs in 2015 dollars. Can there not be some kind of prediction?
	3-Mar-16	Sheryl Wurtz/FLNRO	3.17.10.4	closure and reclamation plan updating	Provincial EA Information Requirement	updating plan every 5 years. Seems like there is a potential for commitments to be removed or eliminated. What is the garuntee this won't happen?
	3-Mar-16	Sheryl Wurtz/FLNRO	6.10.1.2	Grasslands	Comment	"grasslands provide" paragraph should include grazing and range opportunities for livestock

	3-Mar-16	Sheryl Wurtz/FLNRO	6.10.2.2	Temporal boundaries	Clarification Required	again unclear but 5 years is not enough for monitoring and reclamation efforts.
	3-Mar-16	Sheryl Wurtz/FLNRO	6.10.2.3	Administrative boundaries	Provincial EA Information Requirement	goal is to maintain the 10 ecological regions in a naturally functioning state. How will this be done when using agronomics? Need to see more commitment to carrying resotration through
	3-Mar-16	Sheryl Wurtz/FLNRO	6.10.3	Background	Provincial EA Information Requirement	LRMP states that "maintain natual grassland ecosystem processess including all grassland dependant species". This sums it up here for your requirments. How are you going to achieve that? Need more restoration commitment.
	3-Mar-16	Sheryl Wurtz/FLNRO	6.10.3.3	Historical Activities	Clarification Required	"given time and colonization from neighboring intact habitats, these return to native communites" This is assuming there is neighboring intact communities and though I see you have efforts in creating reference areas during mine life, this takes a very special and committed to managment plan unless you are excluding livestock all together. My concern is not enough adjacent reference condition for the level of recruitment you are indicating will occur.
	3-Mar-16	Sheryl Wurtz/FLNRO	6.10.3.4	Grassland Condition Assessment Results	Comment	representing the overall condition as 38 is not acceptable. Especially when you consider the best condition locations are at the plant site and will be destroyed.
	3-Mar-16	Sheryl Wurtz/FLNRO	6.10.3.4	Grassland Condition Assessment Results	Comment	The plant score of 74 is 1 point below reference condition and should be referenced as such.
	3-Mar-16	Sheryl Wurtz/FLNRO	6.10.3.4	Grassland Condition Assessment Results	Comment	Some areas (ie/ the stockpile) do not have many assessments done.
	3-Mar-16	Sheryl Wurtz/FLNRO	6.10.4.1	Habitat loss	Clarification Required	habitat gain definition is a very misleading definition and should be called what it is such as retained or……? A gain implies you are getting something more than you started with and that is not the case that I could see anywhere. If it is in a new location and you are suggesting that it is new therefore a gain, that is not the case. Seems to be that should be considered more as offset.
	3-Mar-16	Sheryl Wurtz/FLNRO	Table 6-10-5	Habitat loss	Clarification Required	What happens to the grasslands burried under stockpiles for 20 plus years. And if you are reseeding it to non-native it is a loss and should be represented as such.
	3-Mar-16	Sheryl Wurtz/FLNRO	6.10.4.1	Habitat alteration	Comment	seems like sugar coating to term it alteration.
	3-Mar-16	Sheryl Wurtz/FLNRO	6.10.4.1	Habitat alteration	Comment	Ranking of O-L-M-H in effects from project interatctions then chose to only look at effects of M and H. Important components are being missed and ignored.
	3-Mar-16	Sheryl Wurtz/FLNRO	6.10.4.1	Habitat alteration	Clarification Required	dust not expected to alter grassland habitat…….I would say differently that dust is expected to alter habitat. It will affect vegetation quality and the presence of dust in general. Are there any grazing or hay production areas at all around? Dust impacts forage and hay quality. You will not mitigate it all.

	3-Mar-16	Sheryl Wurtz/FLNRO	6.10.4.1	Invasives	Clarification Required	statement that 353.3 Ha supports red and blue listed species. Habitat alteration here is expected to be low based on limited amount of additional habitat affected. But once invasives are spread into small areas, they travel beyond. Labelling them L gets you out of further studies and invasive impacts always require further studies.
	3-Mar-16	Sheryl Wurtz/FLNRO	6.10.4.1	Invasives	Provincial EA Information Requirement	loose terms like "could" in mitigation are not acceptable. Must read "will"
	3-Mar-16	Sheryl Wurtz/FLNRO	6.10.4	Invasive mitigation	Provincial EA Information Requirement	need more mandatory wording.
	3-Mar-16	Sheryl Wurtz/FLNRO	6.10.4	Invasive mitigation	Clarification Required	appropriate seedmixes need to enclude species that will not encroach out into native grasslands (Crested wheatgrass for example will)
	3-Mar-16	Sheryl Wurtz/FLNRO	6.10.5.3	Characterization of Residual Effects	Clarification Required	considered reversible because 1,125 ha will be reclaimed. Issues: 1) grasslands are already at risk and are red and blue listed 2) only 1, 125 ha our of 1, 777 ha 3) not being restored, they are reclaimed and there is a difference. This is not reversible.
	3-Mar-16	Sheryl Wurtz/FLNRO	6.10.5.3	Characterization of Residual Effects	Clarification Required	Statement that grasslands "adapt" over time…….please provide proof of this statement referring to native grasslands
	3-Mar-16	Sheryl Wurtz/FLNRO	6.10.5.3	Characterization of Residual Effects	Comment	Put your money and time where your confidence is and commit to whatever level it takes to make the grasslands restored to native.
	3-Mar-16	Sheryl Wurtz/FLNRO	6.10.5.3	Characterization of Residual Effects	Clarification Required	resiliancy is neutral…….please provide proof of this statement referring to native grasslands
	3-Mar-16	Sheryl Wurtz/FLNRO	6.10.5.3	Characterization of Residual Effects	Clarification Required	Inappropriate to assume that because much of the grassland is in moderatly altered state that the mine impacts are "neutral". These moderatly altered grasslands can recover if the Ranch that the mine owns applied the same management techniques that they say they will do on teh smaller areas if the mine goes throught. You just cannot pass off the impact that this mine will have by tryin to pass it off and imply "it is already a loss" No it isn't already a loss and the mine needs to take more responsibility for its residual and comulative impacts.
	3-Mar-16	Sheryl Wurtz/FLNRO	6.10.5.3	Characterization of Residual Effects	Clarification Required	how is a moderate impact and loss of 500 ha give or take (the size of the pit) not significant? 1125 ha reclaimed not restored unless followed through until it reaches a native state. Impact is real.
	3-Mar-16	Sheryl Wurtz/FLNRO	6.10.5.3	Characterization of Residual Effects	Comment	Agreed that the management techniques to improve condition will be fantastic. But why could these not have been applied without the mine coming in…….so implication that this is a great result of the mine is inappropriate.

	3-Mar-16	Sheryl Wurtz/FLNRO	6.10.5.3	Characterization of Residual Effects	Comment	Just because something is twisted to look like a great thing does not mean there is not a residual or cumulative effect. There are many ways of analyzing data to get the results you want!
	3-Mar-16	Sheryl Wurtz/FLNRO	6.10.5.4	Significance of Residual Effects	Clarification Required	how much area will exclude cattle? And what locations?
	3-Mar-16	Sheryl Wurtz/FLNRO	6.10.5.5	Characterization of Liklihood and Confidence	Clarification Required	total area affected by project will be less than the total grassland habitat lost,,,,,,,,,,how is this good?
	3-Mar-16	Sheryl Wurtz/FLNRO	6.10.5.5	Characterization of Liklihood and Confidence	Provincial EA Information Requirement	based on the comments at the top of this page, how can you say residual effects are reversible and that as per page 6.10-40 grasslands will adapt over time?
	3-Mar-16	Sheryl Wurtz/FLNRO	6.10.5.5	Characterization of Liklihood and Confidence	Provincial EA Information Requirement	Habitat loss is not significant?? Yikes.
	3-Mar-16	Sheryl Wurtz/FLNRO	6.10.6	Cumulateive Effects	Provincial EA Information Requirement	3% loss of an already small # is significant…..how do you determine this number is not significant?
	3-Mar-16	Sheryl Wurtz/FLNRO	6.10.6	Cumulateive Effects	Comment	saying that something may be able to adapt is to uncertain to determine that the resiliancy is neutral.
	3-Mar-16	Sheryl Wurtz/FLNRO	6.10.6	Cumulateive Effects	Comment	because condition is moderatly altered and "assuming' grasslands in RSA would be similar is risky. You cannot say "context is neutral" based on a risky assumption.
	3-Mar-16	Sheryl Wurtz/FLNRO	6.10.6	Cumulateive Effects	Provincial EA Information Requirement	low confidence for cumulative residual effects. 18.5% loss due to past decisions and adding another 3% IS A CUMULATIVE EFFECT.
	3-Mar-16	Sheryl Wurtz/FLNRO	6.10.7	Conclusion	Provincial EA Information Requirement	how are losses not significant, again, what determines your significance?
	3-Mar-16	Sheryl Wurtz/FLNRO			Comment	if native grasslands are not being restored and only reclaimed with no definitive commitment or obligation, then there needs to be more of a mitigation than enhancing a portion of adjacent grasslands. For example but this is not FLNRO saying do this…..a substantial fund available to all BC Grasslands that profides for enhancments such as water developments, fencing, invasive species managment, wildlife habitat creation etc. that will improve existing grasslands with no or some existing uses. Nurseries set up to germinate and grow plants that have been collected from the site. Support to GCC in preserving grasslands from future developments.
	3-Mar-16	Sheryl Wurtz/FLNRO			Comment	Implying that past industrial and agriculture practices have eaten up grasslands so why shouldn't we? And if we don't take it, urbanization and Agriculture will is an unprofessiaonal, greedy implication. Past mistakes don't make it ok to make more or continue irresponsible practices. Predicting future elimination is also unacceptable becasue we can never be sure when groups such as GCC will have success at having grasslands protected from such uses.

	3-Mar-16	Sheryl Wurtz/FLNRO	11.3.3.4	Decommisioning and closure	Clarification Required	What additivis are you referring to that will be added to enhance capabilities?
	3-Mar-16	Sheryl Wurtz/FLNRO	11.3.3.4	Decommisioning and closure	Provincial EA Information Requirement	If 15% reseeding allowance is insufficient, will you get to that amount and say "we have done our part, we are done" or will you committ to doing the taking appropriate measures?
	3-Mar-16	Sheryl Wurtz/FLNRO	11.3.3.4	Decommisioning and closure	Clarification Required	monitoring until vegetation is "well established"……what is well established?
	3-Mar-16	Sheryl Wurtz/FLNRO	11.3.4	Monitoring	Clarification Required	what will the monitoring programs be?
	3-Mar-16	Sheryl Wurtz/FLNRO	11.3.4	Monitoring	Provincial EA Information Requirement	Statement : the waterbodies adjacent to construction and soil stock piles…….may have sampling and trubidity testing if discoloration occurs. This needs to say WILL, not May.
	3-Mar-16	Sheryl Wurtz/FLNRO	11.17.3.2	Treatment and control	Provincial EA Information Requirement	in the event invasive plants are identified on site, why contact SIWMC or apporpriate authority to determine if control is required. It needs to be in the plan that if identified, it will be treated and have treatment methods identified already. Committments need to be transpartent and up front.
	3-Mar-16	Sheryl Wurtz/FLNRO	11.17.3.2	Cleared sites	Provincial EA Information Requirement	invasive monitoring plan should continue on an annual basis to get rapid response as suggested in BC Invasive Plant Strategies.
	3-Mar-16	Sheryl Wurtz/FLNRO	11.17.3.2	Roads	Clarification Required	require annual monitoring as they are hugely susceptible
	3-Mar-16	Sheryl Wurtz/FLNRO	11.17.3.2	Roads	Provincial EA Information Requirement	if they are present, immediate treatment should be part of the plan, not a lengthy process of collecting infor to determine appropriate action
	3-Mar-16	Sheryl Wurtz/FLNRO	11.17.3.2	Roads	Provincial EA Information Requirement	As part of all BC invasive species strategies, early detection and rapid response is a key goal
	3-Mar-16	Sheryl Wurtz/FLNRO	11.17.5	Reporting Requirements	Clarification Required	you are sayin you will monitor bienially during operation but do annual reporting of the environmental monitoring reports. Annual monitoring is important anyway so should be done then it can be reported annually.
	3-Mar-16	Sheryl Wurtz/FLNRO	11.23.4.2	Surface Water Quality Monitoring	Comment	The SWQMMP will aim to prevent changes in surface water quality that may negatively impact all receptors including…….needs to say livestock as well as agriculture.
	3-Mar-16	Sheryl Wurtz/FLNRO	11.23.4.2	Surface Water Quality Monitoring	Clarification Required	the main focus is aquatic life, not human life. Curious why aquatic, will issues be detected quicker this way?
	3-Mar-16	Sheryl Wurtz/FLNRO	11.26.1	Purpose	Provincial EA Information Requirement	End land use is also native habitat….how do you restore ecological function and meet endland use objectives without committing to restoring grasslands?
	3-Mar-16	Sheryl Wurtz/FLNRO	11.26.2	pre and post minining similarities and differences	Clarification Required	would like to see a list of what you are considering appropriate vegetation communities.
	3-Mar-16	Sheryl Wurtz/FLNRO	11.26.2	pre and post minining similarities and differences	Clarification Required	reestablishment of basic ecological processes and simple structural diversity and plant communities that will support wildlife populations: 1) no crested wheatgrass in these areas. Could we see a map showing % and # of hectares that will have this type of reclamation?

	3-Mar-16	Sheryl Wurtz/FLNRO	11.26.2	pre and post minining similarities and differences	Provincial EA Information Requirement	appropriate success would be determined by a predetermined stage, not a predetermined number of years for being released of obligations. Success is too dependant on techniques used, moisture received on site, other uses in the area etc.
	3-Mar-16	Sheryl Wurtz/FLNRO	11.26.2.1	end land use objectives	Permitting Information Requirement	what is number of hectares seeking temporary faarm use vs # of hectares tht will go back to ALR? Lands within ALR must be returned to equal pre-disturbance capability. All lands, not just some so how do you propose to make up for ALR land lost in the pit?
	3-Mar-16	Sheryl Wurtz/FLNRO	11.26.2.1	end land use objectives	Clarification Required	what is number of hectares seeking temporary faarm use vs # of hectares tht will go back to ALR? Lands within ALR must be returned to equal pre-disturbance capability. All lands, not just some so how do you propose to make up for ALR land lost in the pit?
	3-Mar-16	Sheryl Wurtz/FLNRO	11.26.2.1	end land use objectives	Comment	ALR is for protection of lands from things such as this: Mining, urbanization etc so any number less to go back is not acceptable, even if you are seeding to increase productivity. What if they seeded the land now, it would support even more livestock than post mining seeded land.
	3-Mar-16	Sheryl Wurtz/FLNRO	11.26.2.1	end land use objectives	Clarification Required	How do you explain fencing and excluding livestock from ALR for only wildlife habitat?
	3-Mar-16	Sheryl Wurtz/FLNRO	11.26.2.1	end land use objectives	Provincial EA Information Requirement	"An effort" will be made to re-establish key habitat types. What effort? What will be done? Ensure it is appropriate and adequate to achieve something specific.
	3-Mar-16	Sheryl Wurtz/FLNRO	11.26.2.2	Pre and post minining ecosystems	Clarification Required	won't post closure ecosystem unit development also depend on moisture?
	3-Mar-16	Sheryl Wurtz/FLNRO	11.26.2.2	Pre and post minining ecosystems	Provincial EA Information Requirement	need to see this comparison layed out on a map. So you are taking young forest that is not in ALR now and putting it in ALR by seeding agronomics and/or cultivated fields? Is any of this intended as the areas you have indicated will 'adapt' and return to native grasslands? I just wonder if you have soil to include here and if it is appropriate for the BEC zone?
	3-Mar-16	Sheryl Wurtz/FLNRO	11.26.3		Provincial EA Information Requirement	you describe BEC zones in detail. I am assuming from the numbers that you are converting forest to grassland "type". How do you propose to do this and rate its success?
	3-Mar-16	Sheryl Wurtz/FLNRO	11.26.3		Provincial EA Information Requirement	you state soils will be degraded and dry for a number of years. All the more reason to not have a 5 year time frame (or any number of years) after which the mine can walk away from commitments for this plan. It must be a stage.
	3-Mar-16	Sheryl Wurtz/FLNRO	11.26.3		Clarification Required	your comment "if they are suitable, native species will be selected". You should be able to have a list now.

	3-Mar-16	Sheryl Wurtz/FLNRO	11.26.4	Wildlife objectives	Clarification Required	your comment "seed areas after soil placement with a seed mix suitable for erosion protection that "MAY" also provide summer forage and nesting cover" You need to select appropriately and use "MUST" otherwise you are not meeting the wildlife objective.
	3-Mar-16	Sheryl Wurtz/FLNRO	11.26.5	Reclamation species selection	Comment	species that are invasive should never be used. Though Crested Wheatgrass is not a true 'invasive' species, it is invasive to native grasslands in that it does not belong and it can outcompete native bunchgrasses yet provides poor wildlife habitat (thinking specifically of sharptail grouse)
	3-Mar-16	Sheryl Wurtz/FLNRO	11.26.8.1	Vegetation compositiona nd productivity	Clarification Required	monitoring will continue until self-sustaining vegetation cover tht meets end land use objectives has been established. Does this mean indefinitly because there is not end date here. Are you committing to getting native grasslands to self sustaining despite time it takes?
	3-Mar-16	Sheryl Wurtz/FLNRO	11.26.8.1	Vegetation compositiona nd productivity	Clarification Required	if the above comment is a commitment, (even if it isn't) there needs to be a commitment or obligation that you will do something about it if things are heading in the wrong direction and appropriate end land use communities are not establishing.
	3-Mar-16	Sheryl Wurtz/FLNRO	Appendix 3-H 4.1.2	Baseline Vegetation Diversity	Clarification Required	low diversity in species…….isn't this unusual in poor condition grasslands?
	3-Mar-16	Sheryl Wurtz/FLNRO	Appendix 3-H 3.1	Veg Survey design	Clarification Required	were areas chosen limited by the need to have ungrazed transect areas for clipping or were transect sites selected prior to 2013 so there were no such limitations?
	3-Mar-16	Sheryl Wurtz/FLNRO	Appendix 3-H 3.1	Veg Survey design	Clarification Required	there is increased molybdemum in veg and ground water, I assume this is related and veg is taking it up from groundwater. Is there a relation to molybdemum in ground water and past mine activity?
	3-Mar-16	Sheryl Wurtz/FLNRO	Appendix 6.8A	Terrestrial Wildlife and Veg report	Clarification Required	fig. 4-1 you say there are 4 biogeo zones in LSA but I see 5. BGxh2 by the lake on map you have listed as BGxh1 I believe.
	3-Mar-16	Sheryl Wurtz/FLNRO	Appendix 6.8A	Terrestrial Wildlife and Veg report	Clarification Required	page 24/35, you are missing IDFxh2a I believe
	3-Mar-16	Sheryl Wurtz/FLNRO	7.3	Results	Clarification Required	table 7-2 doesn't account for BGxh2 down by the lake
	3-Mar-16	Sheryl Wurtz/FLNRO	7.3	Results	Clarification Required	where is the results for condition plots at the 7 transects - important to relate to biomass and diversity.
	3-Mar-16	Sheryl Wurtz/FLNRO	table 7-6	grasslands condition assessment	Comment	again, 74 is so just barely slightly altered that it needs recognition.
	3-Mar-16	Sheryl Wurtz/FLNRO				at this point, grassland condition is irrelevant. They are intact grasslands so trying to put forth that 'they are so altered that we aren't impacting much' is a gross injustice. Thery are still intact grasslands that could improve in condition, most meeting reference condition with proper management.

	3-Mar-16	Sheryl Wurtz/FLNRO		general comments and questions	Clarification Required	I talked with water reveiwers and though we saw mention of a need for water during reclemation, we did not see a plan of how much and for what. For examle what is required for seed germination and ongoing watering needs etc.
	3-Mar-16	Sheryl Wurtz/FLNRO		general comments and questions	Clarification Required	what is the water plan for livestock requirements within the pastures post closure. A plan that will promote good distribution.
	3-Mar-16	Sheryl Wurtz/FLNRO		general comments and questions	Clarification Required	How is significance determined when accounting for losses for each VC?