Memorandum

Date: July 27, 2016

To: KGHM Ajax Mining (KAM)

From: ERM

Subject: **Ajax Project – Summary of Round 1 Technical Working Group Comments and Responses – Air Quality**

1. INTRODUCTION

This memorandum is one of a set of high-level summaries that integrates the proponent's response to key issues raised by technical reviewers as part of 'Round 1' comments in the review of the Ajax Application/EIS:

- **Air Quality** (*this memo*)
- Groundwater and Surface Water Quantity and Quality
- Peterson Creek Diversion System
- Fish Habitat and Fishery Offsetting Plan
- Terrestrial/Wildlife Mitigation

The set of memos is intended to support the BC Environmental Assessment Office (EAO) and the Canadian Environmental Assessment Agency (the Agency) in their adjudication of the review process. The memos are also intended to help provide summary level information for reviewers on the technical working group where there may be overlapping interest but where a topic may be outside of their technical expertise. The memos summarize the key issues raised to date; the proponent's approach to addressing and responding to these issues; and, importantly, the implications these responses may have to other Valued Components, Aboriginal Rights and Title, and the effects assessment conclusion.

2. SUMMARY OF ISSUES AND PROPONENT RESPONSES

Technical air quality comments have been received from numerous groups/agencies represented on the technical working group. Information requests were also provided by the EAO and the Agency in consideration of comments and concerns raised by other reviewers, including the public.

Key issues related to Air Quality generally fall into the following topics:

- Approach to modelling;
- Effectiveness of mitigation; and
- Implementation of mitigation, monitoring and enforcement.

2.1 Approach to Modelling

2.1.1 Engagement with Reviewers

The technical working group has acknowledged that the air quality model that has been developed for the Project is more comprehensive than has typically been developed for other mining projects in the province. The approach taken by KAM is reflective of the value of air quality expressed by the community members, and the proximity of the Project to Kamloops. Through the Round 1 response process, KAM has met with the technical working group on multiple occasions to discuss the selected modelling approach, to walk through example calculations, and to discuss the findings of the air quality studies. In addition, KAM has provided supplemental materials; including raw model inputs and outputs; spreadsheets; and wind roses. Responses to comments have also provided additional rationale to justify the selection of base meteorology data for the model.

A number of supplemental documents were developed in response to detailed technical comments from reviewers, as summarized in the following table. In general, these supplemental documents provide technical clarifications or additional rationale behind the work that has been completed.

Title of Supplemental Information	Summary of Content
Model_Output_Spreadsheets	Folder with a set of 133 files. Spreadsheets containing the raw model output for concentration and deposition files, full and sensitive receptor grid, base, project, and application cases. These files have then been further processed to produce what is in the application.
Final_Filtered_Spreadsheets	Folder with a set of 36 files. Spreadsheets containing the filtered model output used in the application. These have receptors that are filtered out. The receptors are removed if they fall within the mine boundary or within a regional facility fenceline.
0331_KAM_CALMET Wind Rose_Ajax Upwind	Wind roses for Ajax Upwind station (measured vs modelled).
0331_KAM_CALMET Wind Rose_Kamloops Airport	Wind roses for Kamloops airport (measured vs modelled).
0331_KAM_Air dispersion model outputs	Clarification on approach and decisions related to air quality model.
0331_KAM_Air Dispersion modelling_CALMET FILES	Clarification on approach to land use and precipitation inputs to air quality model.
0428_KAM_Fugitive Dust Mitigation Plan	Management of Fugitive Dust and Fugitive Dust Mitigation Plan

Title of Supplemental Information	Summary of Content
0510_KAM_AQ 17 Mar 2016 Meeting Minutes	Minutes from meeting held on March 17, 2016 to clarify Air Quality emissions factors.
0510_KAM_Applied Mitigation Descriptions	Summary of the mitigations applied to the emission calculations for the Project.
0516_KAM Response to EAO 005	Additional information on the relative contribution of sources of particulates at key locations.
0624_KAM_Stantec Calpuff Source Locations	Spatial extents of the area and volume source locations employed in the CALPUFF dispersion assessment.
0705_KAM_Revised Project Alone Case Dispersion Modelling	Revised Project Alone case dispersion modelling results, accounting for updates in assumptions associated with haul trucks and blasting.
0725_Combined Responses to EAO-001-006	Memos (5) responding to 0428_Air Quality Information Request_EAO-001-006
0721_KAM_Model Sensitivity_EAO004	Additional sensitivity analysis for roads and TSF in accordance with the approved addendum modelling plan.

It is important to note that as part of the standard process in BC, prior to submission of the Application/EIS, KAM filed a modelling plan with the MOE, which was reviewed and signed off before the modelling was completed. As part of Round 1 responses, a similar approach has been taken. Where additional modelling has been requested by reviewers, KAM filed a 'modelling plan addendum', which was also reviewed by technical reviewers and signed off by MOE before modelling updates were completed. Meeting notes and the approved addendum modelling plan have been made available to the entire working group.

It is important to clarify here a few key aspects of the approach to modelling, with respect to the application of mitigation measures:

1. Most of the Project components that have been modelled have no mitigation applied in excess of that provided by nature (e.g., precipitation). This includes soil stockpiles, mine rock storage facilities, the plant site, etc. This is because these components are not active sources of fugitive dust except under extreme environmental conditions.
2. There are two modelled sources that do have additional mitigation applied: roads and the tailings storage facility (TSF). The roads will be regularly disturbed by heavy equipment, and can be a substantial dust source if not actively managed. The TSF is a source of fine-grained material that, without mitigation, could be more susceptible to exposure and wind erosion.

For these reasons, the ensuing discussion regarding the effectiveness of mitigation is focussed on roads and the TSF.

2.1.2 *Updates to the Air Quality Model*

A few errors in the modelling inputs and assumptions or subsequent analysis were identified through Round 1 review, related to:

- Unit conversion for blasting assumptions;
- Horsepower criteria for haul trucks; and
- Calculation of the annual TSP.

Corrections to these errors have been made, and documented in the following supplemental documents:

- *0705_KAM_Revised Project Alone Case Dispersion Modelling;* and
- *0725_KAM_Combined Stantec Responses to EAO 001-006.*

Updated tables, graphs, and isopleths have been presented, which show the following:

- Changes for particulate matter parameters (dustfall, TSP, PM_{10}, $PM_{2.5}$) are negligible.
- NOx, SOx and CO predictions associated with the blasting assumptions result in substantially higher concentrations compared to the original model results; however all predicted concentrations remain below applicable ambient air quality guideline levels at the Project fenceline, and decrease rapidly away from the site.

Reviewers also questioned the rationale for the sizing and location of the tailings beach, as presented in the Application/EIS. The original assumptions used a 140 ha tailings beach, and assumed that 10% (14 ha) would be dry and potentially susceptible to wind erosion. The tailings beach was sited at the south end of the TSF, where the finest particles, which would be most susceptible to erosion, are expected to deposit.

In response to reviewer comments, a new basis for assumption was provided as an addendum to the modelling plan (Attachment A of *0721_KAM_Model Sensitivity_EAO004*) and reviewed by technical experts prior to sign-off of the addendum modelling plan. The updated tailings beach begins with a Year 8 TSF size of 230 ha. The TSF design engineers expect that during winter months, with cold temperatures and snow cover, particulate emissions from the TSF would be near zero, but during worst case (dry and hot) environmental conditions, they estimate that up to 60% of the TSF could become dry. Therefore, a monthly variable emission rate is used, where 10% (23 ha) is assumed to be dry during the winter months (Dec-Jan), and 60% (138 ha) is assumed to be dry during the summer months (Jul-Aug). The % dry area is scaled linearly between the low and high values for the remaining months. The tailings beach was also conservatively sited further to the north (closer to the city), near the TSF embankment. The results of the updated tailings beach assumptions are provided in the supplemental document *0721_KAM_Model Sensitivity_EAO004*.

2.2 Effectiveness of Mitigation

Technical reviewers requested that additional sensitivity analysis be completed in the air quality model in order to ensure that modelling specialists understand and have reasonable confidence in the model behaviour and reliability. In particular, KAM has carried out two areas of additional sensitivity analysis:

- Effectiveness of dust mitigation for road sources
  - alternate scenarios consider 90% vs 80% vs 70% effectiveness
- Time-varying effect of wind speed on the TSF as a dust source
  - the original modelling applied a constant emission rate from the TSF when wind speed exceeded a threshold value;
  - the sensitivity scenario applies a variable emission rate from the TSF that is calculated based on the hourly wind speed.

The approach to completing this additional sensitivity analysis was the focus of the 'modelling plan addendum' referenced above (Attachment A of *0721_KAM_Model Sensitivity_EAO004)*.

The results of these additional sensitivity analyses are documented in the supplemental memo: *0721_KAM_Model Sensitivity_EAO004*. Updated tables, graphs, and isopleths are presented, which show the following key findings:

- The model responds as expected to changes in the level of dust mitigation. Reducing mitigation from 90% to 80% doubles the particulate emissions, and also doubles the resulting ambient concentrations. A decrease in control mitigation efficiency shows the growing influence of roads on the Project Alone Case.
- The time varying effect of wind speed on the TSF results in a four-fold increase in total annual emission. The maximum 1-hr predicted concentrations increase substantially, but the long term averages essentially stay the same.
- The changed location of the tailings beach has some influence on the location of the predicted maxima, as would be expected.

2.3 Implementation of Mitigation, Monitoring and Enforcement

The additional sensitivity analyses show that effective mitigation of dust on the haul roads will be key to successfully minimizing emissions from the operating mine. This is consistent with KAM's conclusions, which is what drove KAM's proactive commitment to maintaining a high degree of mitigation (e.g., 90% effective) as part of the original Application/EIS submission. KAM remains committed to achieving an effective management program, and has provided literature review (*0725_KAM_Combined Stantec Responses to EAO 001-006*) that supports the assertion that a well-designed dust management program that incorporates proper haul road construction and maintenance, selection and application of water and chemical dust suppressants, monitoring of road dust levels and continuous improvement, can reasonably be expected to regularly and consistently achieve 90% effectiveness. Scenarios of lower effectiveness (e.g., 70% or 80%) are considered failure modes that would be infrequent and short duration episodes, especially when tracked through an effective monitoring and adaptive management system.

In addition to the modelling work, KAM developed a supplemental submission that provides more detail related to how dust mitigation measures will be implemented. This is documented in supplemental memo *0428_KAM_Fugitive Dust Mitigation Plan*. As outlined in this plan, KAM will implement both preventative procedures and reactive control measures in order to minimize dust emissions from the Project. Some key examples include:

- Daily visual inspections of the TSF and active haul roads;
- Application of water on the tailings beach and haul roads;
- Routine road maintenance of haul roads;
- Application of dust suppressants on the TSF tailings beach and haul roads;
- Application of surfactants to the haul roads;
- Rotation of tailing spigot points; and
- Use of polymers in the tailings thickening process and direct application to the tailings beach when required.

It is anticipated that during 'Round 2' of the review, there will be a requirement to advance the approach and process to further develop the plan around monitoring and enforcement, recognizing that this will continue to be further advanced through permitting processes.

3. IMPLICATIONS TO EFFECTS ASSESSMENT CONCLUSIONS

As described in Section 2, KAM has carried out substantial effort as part of Round 1 review to support a detailed interrogation of the modelling approach and the model results. With the submission of responses to Round 1 comments, KAM looks forward to reviewer feedback on the additional work completed.

A number of updates have been made to the model which, each independently, have been shown to have a relatively minor effect on the outputs and conclusions. This increases confidence that the base model functions as expected and that it is reasonably representing baseline conditions. The additional sensitivity analyses show that the predictive capacity of the model is sound and that the model functions as expected.

The air quality modelling results have linkages to other components of the effects assessment. As a part of Round 2 review/response, following receipt of feedback from technical reviewers, KAM anticipates running an additional air quality model scenario, which combines the various updates described above, which to date have been analyzed independently, into a single "Updated Project Case". New maps and tables would be generated comparing the original Project Case with the Updated Project Case.

In general, reviewers have agreed that the approach used to link the dust deposition from the air model to the water quality model has been overly conservative. As evidenced by the results from supplemental work completed to date, the proposed Updated Project Case will not substantially change particulate deposition rates at an annual time scale; therefore it is not proposed to re-run the water quality model to account for the Updated Project Case as part of the EA review process. However, updated dust deposition rates would be incorporated into any future runs of the water quality model, which will be required to support future permitting efforts.

The Human Health VC did consider short-term (e.g., hourly) model outputs in the context of inhalation risk. Therefore there is a potential linkage with the new time-varying emission assumptions for the TSF in the air quality model. Such increases in particulate matter concentrations are expected to be moderate in magnitude; short in duration, infrequent, and limited in geographic extent. However, for transparency and completeness, it is proposed that the results from the Updated Project Case be run through the HHERA model to re-calculate the inhalation risk component of the assessment.

The water quality and HHERA models represent the direct linkages of the air quality model to subsequent analysis. There are other tertiary linkages associated with the assessments of wildlife species (chemical hazards), property values (perception of risk), current use of lands and resources for traditional purposes (quality of experience), and outdoor recreation (quality of experience). The updates to the air quality model described above, in combination with the additional information provided related to implementation of mitigation, do not substantially change the basis of input to these VC assessments and therefore do not change the assessment finding and conclusions for the residual effects associated with these VCs.