MEMORANDUM

To: Tracy James, B.C. Environmental Assessment Office

Date: October 5, 2017

From: Nicola Banton, KGHM Ajax Mining Inc.

CC: Kevin Inouye, Canadian Environmental Assessment Agency

Subject: Response to Environmental Law Center / KAPA public comment

KGHM Ajax Mining Inc. ("KAM") submits this memorandum as a response to a comment submitted to you by Calvin Sandborn of the Environmental Law Center on behalf of the Kamloops Area Preservation Association (KAPA) on September 12, 2017 ("ELC Letter"). Our memo provides additional context for consideration in evaluating KAPA's request for a Drinking Water Health Hazard Prevention Order regarding the proposed Ajax Mining project, pursuant to section 25 of the Drinking Water Protection Act ("Request").

The request from KAPA is based largely upon the professional opinion provided in the GW Solutions report dated August 8, 2017 and attached to KAPA's August 14, 2017 letter to the Kamloops Public Health Unit ("Report"). The Report states that it is based upon review of the following sources of information:

- BC Wells Database;
- BC Aquifer Mapping;
- Ajax Project Application for an Environmental Assessment Certificate / Environmental Impact Statement and its Appendices by KAM and its consultant BGC Engineering Inc.;
- Ajax Project Review - Review of predicted water contamination by Minesite Drainage Assessment Group, Kevin A.Morin, Ph.D., P.Geo.;

KGHM Ajax Mining Inc.
124 Seymour St
Kamloops, BC V2C 2E1 Canada

T +1 250 374 5446
www.ajaxmine.ca
www.kghm.com

- Review of KGHM Ajax Project EA Application by GW Solutions, Gilles Wendling, Ph.D., P.Eng.; and
- Technical Peer Review Proposed Ajax Mine by SLR Consulting (Canada) Ltd.

This list of information sources is substantially incomplete for this topic, thereby leading to inaccurate statements that are misleading. In particular, this list of information sources gives no recognition to the work that has been completed by KAM through the environmental assessment review process. Through this review process, KAM and its consulting team have provided numerous technical responses and completed additional modelling and analyses, which are publicly available for review on the Environmental Assessment Office website (link), but do not appear to have been considered by GW Solutions in forming its opinion.

KAM acknowledges the proximity of the Project to local aquifers that are used as a drinking water source and recognizes the importance of designing the Project to ensure that groundwater resources are protected. As such, KAM has employed qualified technical consultants from multiple companies, each of whom bring a wealth of professional expertise related to effects of mining to the groundwater systems. All work has been reviewed internally and professionally stamped by the consultants prior to circulation, and in some cases, KAM has taken the extra step of having the work reviewed by independent third-parties.

In response to the report, we have asked our team to review and comment on the apparent weaknesses identified by GW Solutions. As you will see from the responses included below, GW Solutions has provided a professional opinion based upon review of a very narrow set of information, and, in some cases, has made statements (based on this narrow scope of review) that are false when considered against the complete body of technical work developed for the Application/EIS and subsequent review.

The ELC Letter submits that, due to effects on groundwater, “operation of the Ajax mine is likely to create “a significant risk of an imminent drinking water health hazard”.” KAM argues that since this conclusion is based on the GW Solutions report, it is not based on the complete set of information available. With respect to the immediacy of the concern, we also provide below some important context related to next steps in the Project’s development.

Responses to apparent weaknesses identified by GW Solutions

- GW Solutions: *KAM has focused its study on the assessment of potentially negative impact on the nearest receptor from the closest potential source of contamination (the PCDP). KAM has not considered the cumulative effect of potential contaminants released by all the components of the proposed operation (i.e., waste-rock storage facilities, tailings storage facility, open pit, etc.). KAM has not quantified how the cumulative impact may affect the quality of the groundwater flowing through the bedrock aquifer, and through both the Peterson Creek and the Davidson Creek aquifers, which are both used as a source of drinking water.*

  Response:

  The statement that cumulative effects of the mine facilities on water quality have not been considered for the Peterson Creek, Davidson Creek (sand and gravel) Aquifers and the Knutsford (bedrock) Aquifer is misleading.

  Hydrogeological assessments and modelling (Appendix 6.6-A and 6.6-D) were completed for the Application/EIS to identify potential sources of groundwater contamination from the project. Facilities identified as posing a potential concern were examined in greater detail using contaminant transport (Appendix 6.5-A) and water quality models (Appendix 6.3-C; 0706_KAM_KP Water Quality 2016 Update; 1207_KAM_KP WQ Predictions Update for Changes to Conceptual Fish Offsetting Plan) to assess the "cumulative effect of potential contaminants released by all the components of the proposed operation". As stated in Section 6.5.4.2 of the Application/EIS, "The groundwater quality models were developed to account for potential loading from advection and dispersion from the three sources (PCDP, EMRSF Pond, and EMRSF) to RES-2.", not just the PCDP as incorrectly stated in the GW solutions report.

  In the Knutsford area (i.e., near the Peterson Creek, Davidson Creek and Knutsford Aquifers) results from groundwater flow modelling (Appendix 6.6-B) suggest that mine water could infiltrate into groundwater area through the following facilities:

  - East Mine Rock Storage Facility (EMRSF)
  - Peterson Creek Downstream Pond (PCDP)
  - East Mine Rock Storage Facility Pond (EMRSF Pond)

  Potential seepage from the Tailings Storage Facility, (TSF), West Mine Rock Storage Facility (WMRSF) and South Mine Rock Storage Facility (SMRSF) was considered, but is not predicted to infiltrate the groundwater in the Knutsford area (Appendix 6.6-B).

The open pit will not be a source of contamination to surrounding aquifers because the open pit excavation is predicted to lower the water table creating the conditions for groundwater to flow towards the pit and not away from it (Appendix 6.6-B). Additional particle tracking simulations from the facilities identified as potential sources of mine water to groundwater with potential to reach the Peterson, Davidson and Knutsford aquifers (i.e., the EMRSF, PCDP and EMRSF Pond) were completed to inform more detailed assessments of contaminant transport (Appendix 6.5-A). The results of the particle tracking indicated that Davidson Creek and Knutsford Aquifers would not likely be receptors of mine affected water. More specifically, the simulations predict that groundwater flow from the EMRSF, PCDP and EMRSF Pond would migrate preferentially through the Peterson Creek Aquifer, and discharge to surface before reaching the Davidson Creek and Knutsford Aquifers. This is the result of a mapped separation of the Peterson Creek and Davidson Creek Aquifers by a zone of lower permeability material at the ground surface (i.e., till), which acts to force groundwater towards a more conductive path (i.e., to surface water flows).

The results of the particle tracking simulations were used to inform contaminant plume migration simulations to assess the impact of potentially contaminated water emerging from the EMRSF, EMRSF pond and PCDP and flowing into the Peterson Creek Aquifer (Appendix 6-5A).

- GW Solutions: *The particle tracking simulation only considers advective transport (transport with the mean velocity of groundwater flow). Other transport phenomena such as dispersion, or the spreading of a plume that occurs due to mixing have not been considered; however, such models of contaminant transport could still bring water containing contaminants to RES-2 from the EMRSF and EMRSF pond, both located directly north of the PCDP.*

  Response:
  GW Solutions has provided incorrect information regarding the assessment of transport phenomena in the Application/EIS. The effect of dispersion on transport of solutes potentially emerging from the EMRSF, EMRSF pond and PCDP to RES-2 was considered in Appendix 6.5-A of the Application/EIS. In this case, the above statement by GW Solutions has neglected to acknowledge the work that was completed for and submitted with the Application/EIS itself, as well as subsequent technical response memoranda to address concerns related to the topic of

contaminant transport to RES-2 during the Application/EIS review. It is noted that this body of technical work includes a direct response to the concerns raised in the submission by Morin (2016).

Analytical mass transport models that consider both advective and dispersive transport of solutes were used in Appendix 6.5-A to predict the migration of potential mine affected water through groundwater. A plume migration analysis from the EMRSF and PCDP to RES-2 was completed using the Domenico and Robbins (1985) continuous-source solution. A plume migration analysis from the EMRSF pond to RES-2 was completed using the Baetsle (1969) pulse-source solution. Contaminant velocities were calculated by dividing the length of the predicted plume migration path by the simulated travel time. The simulated plume path length and travel times were obtained from the groundwater model particle tracking simulations. Water quality model outputs for solutes (i.e., monthly source concentrations) potentially emerging from the EMRSF, EMRSF pond and PCDP were considered as discrete and combined sources of contamination in the advection-dispersion calculations completed in Appendix 6.5-A.

- GW Solutions: *KAM only considered seepage from PCDP to groundwater as a contamination pathway. KAM did not consider direct contaminated runoff from EMRSF toward Peterson Creek and groundwater-surface water interaction at the vicinity of Peterson Creek. Based on the water balance studies by KAM, Peterson Creek is the receptor of the runoff and shallow groundwater (interflow) downstream of the EMRSF, as indicated by KAM water balance flow charts presented in Figure 8 (pre-mining) and Figure 9 (during operation).*

  Response:
  GW Solutions has provided incorrect information by stating that the assessment did not consider direct contaminated runoff from the EMRSF toward Peterson Creek. Direct runoff from project facilities was considered in Appendix 6.4-C of the Application/EIS. Consideration of runoff in this area is also illustrated in Figures 8 and 9 of the GW Solutions' report:
  - Figure 8 shows the water balance flow chart for existing conditions, prior to the construction of the EMRSF. In Figure 8, there will be no contaminated runoff from the EMRSF since the facility has not been built. Thus, while Peterson Creek is currently a receptor of runoff from the area where the

EMRSF will be built, there is no contaminated runoff to the creek prior to construction.

- Figure 9 shows that surface water runoff from the EMRSF (east and west segments) during operation will be directed to a lined water collection pond (i.e., the EMRSF Pond) by a natural drainage channel (for the west portion of the EMRSF) and a diversion channel (for the east portion). Runoff reporting to the EMRSF Pond will then be pumped to the Central Pond, and will be used as a source of water for the process plant.

During closure and post-closure and decommissioning, runoff from the EMRSF will continue to report to the water collection pond, but as opposed to operation where the runoff will be pumped to the Central Pond, the EMRSF pond will be allowed to fill and discharge to the environment provided water quality criteria are met. If water quality criteria are not met, runoff reporting to the pond will be pumped to the Open Pit (which will be a permanent groundwater sink due to lowering of the water table, as outlined above). Infiltration into the mine rock will also be minimized by the placement of a compacted till cover on the EMSRF.
The statement by GW Solutions that groundwater seepage was not considered as a potential contaminant pathway is also incorrect. The assessment considered transport of mine contact water emerging from the EMRSF, EMRSF pond and PCDP (discussed above and in Appendix 6-5A).

- GW Solutions: *KAM did not use the historical geochemical data during operation at the earlier Ajax mining operation for its assessment. It would be very important to assess whether the data indicates a degradation of the water quality downstream of the mine, due to the historical mining activities.*

  Response:
  A comparison of water quality data pre-, syn- and post-mining (1985-present) has been completed by Knight Piésold – the filename posted on the EAO website is *1205_KAM_KP Responses to MOE Review of Historical WQ Data Assessment*. Please refer to this document to assess the geochemical effect of the historic mine site on the downstream aquatic environment.

- GW Solutions: *KAM did not consider the seasonal fluctuation of the concentration of targeted parameters. KAM considered the average annual concentration. As an example,*

dissolved copper in the seep from waste-rock (WR) had an average value of 0.02 mg/L, but reached a maximum of 0.0637 mg/L (3 times higher than average). Higher concentrations during certain times of the year may result in certain parameters exceeding the drinking water guidelines.

Response:

It is agreed that seasonal fluctuation in copper (Cu) concentrations are likely to occur in waste rock seepage. The highest dissolved Cu concentration noted above for the historic WR seepage is 0.0637 mg/L. The BC drinking water guideline for Cu is 0.5 mg/L, well above the reported maximum value. Thus, Cu is not expected to be a concern in drinking water. Other parameters of potential concern were modelled in a manner to provide a conservative estimate, generally significantly higher than the expected average concentration. Thus, the water quality model already provides a conservative estimate that accounts for seasonal fluctuations by incorporating upper end dissolved concentrations. Any potential drinking water exceedances should therefore be captured by the current model.

The Base Case surface water quality model was developed using the life of mine water balance for average conditions and median baseline water quality inputs. Thirteen sensitivity models were run to assess the sensitivity of the predicted concentrations to variation in climate conditions and to variation of some of the key input assumptions specific to baseline water quality inputs, hydrogeological assumptions, dustfall assumptions, and assumptions regarding the timing of seepage. Predicted seasonal concentrations for the various parameters at the surface water quality nodes, with comparison to applicable guidelines, are provided in the Water Quality Model Report (Appendix 6.3-C; 0706_KAM_KP Water Quality 2016 Update; 1207_KAM_KP WQ Predictions Update for Changes to Conceptual Fish Offsetting Plan). Therefore, seasonal fluctuation of the concentration of targeted parameters was considered in the EA, contrary to the statement by GW Solutions.

It must also be recognized that in the groundwater quality assessment completed for the Peterson Creek Aquifer (Appendix 6.5-A) that the maximum geochemical source term concentrations for each parameter were used for each source zone (i.e., EMRSF, EMRSF Pond, PCDP) to evaluate the potential effects of the project on groundwater potentially used as drinking water in the study area.

- GW Solutions: *It is important to note that the drinking water quality guidelines are based on total metals (dissolved plus suspended, except for aluminum and iron). However, KAM's application (Appendices 3-A and 3-B) only considers and reports dissolved concentrations, which by definition will be equal or less than the total concentrations. Therefore, their assumption of the risk of exceeding the drinking water guidelines may be underestimated.*

  Response:
  The water quality model combines four major inputs: (1) mine site and receiving environment surface water and groundwater hydrology data from the water balance model, (2) baseline water quality data, (3) geochemical source term data, and (4) dustfall deposition data.

  The majority of loading from the mine site will be due to seepage from the mine facilities; geochemical source terms are quantified in the dissolved form, therefore all loading from the mine site can only be predicted for the dissolved fraction.

  For the Human Health risk assessment, Future Case concentration in groundwater from RES-2 was calculated as a sum of the existing Baseline Case water quality data and the predicted increase in dissolved metal concentrations. Dissolved metal concentrations were used for the Baseline Case and Future Case in preference to total metals because it is the dissolved metals that will move with groundwater - particle-bound metals are not expected to move with groundwater.

  Modelling dissolved parameter loadings for groundwater is therefore valid and the use of dissolved metal concentrations to estimate future exposures to metals in drinking water will not under-estimate the associated changes in human health risk between Baseline Case and Future Case conditions.

- GW Solutions: *KAM's particle tracking model is based on KAM's assessment of the groundwater flow in the study area. GW Solutions has observed that the hydrogeological knowledge of the mine site is limited; therefore, the reliability of the results provided by the particle tracking model is limited by the quality of the hydrogeological model used by KAM.*

Response:

GW Solutions' conjecture that KAM's understanding of groundwater flow in the study area is limited is an opinion and is not based on the collective study data, the comprehensive work completed to investigate and understand the hydrogeological system at the proposed project or technical argument. Concerns raised by GW Solutions in their August 8, 2017 report, and in their previous authored reports have been previously and explicitly addressed by KAM through several technical memoranda, most notably:

- 0414_KAM_JL_Ptest_BGC-012 (April 14, 2016)
- 1213_KAM_BGC-023_SSN (December 13, 2016)
- 032917_KAM_BGC Response to SSN-GW Solutions (March 29, 2017)

While GW Solutions have had access to these response memoranda (i.e., either by direct receipt from KAM or through the Environmental Assessment Office website (link)), they have failed to acknowledge the work already completed to address their stated concerns to the Kamloops Public Health Unit, and as such have carried forward incomplete information about groundwater resources near the Ajax Project.

The hydrogeologic investigations carried out to date were completed to a high level of detail and the groundwater flow modeling assessment completed for the Ajax Project was robust when submitted with the Application/EIS. This was clearly demonstrated in the Application/EIS and in subsequent supplementary memoranda prepared during the Project review.

Response to request for a Drinking Water Health Hazard Prevention Order

KAM notes that the EAO and CEA Agency have taken all of the technical information from the EA review into consideration, incorporating perspectives from KAM, from the EAO's technical working group (of which GW Solutions acted as technical expert on behalf of SSN, and SLR acted as technical expert on behalf of the City of Kamloops), and from the public (including KAPA) when forming their conclusions with respect to the potential environmental impact of the project on the groundwater resource and human health. During the review process, KAM committed to conducting additional groundwater investigations related to Peterson Creek Aquifer and to the Edith Lake Fault Zone prior to the start of Construction, and to further developing a detailed groundwater monitoring and management

plan. If the Project is approved through the EA process, it is KAM's understanding that the EAO has developed proposed conditions that would require KAM to complete these studies prior to the start of Construction.

Further, KAM will be required to apply for and receive numerous provincial permits prior to the start of Construction. This will include permits under the *Mines Act*, the *Environmental Management Act*, and the *Water Sustainability Act*. The permitting process will be coordinated through the Major Mines Permitting Office, and will have the support of a technical Mine Review Committee. The Mine Review Committee will include groundwater technical experts who will represent the various government agencies. Preparation of these permit applications will utilize updated groundwater information generated from the investigative work that KAM has committed to. As part of this, the groundwater and surface water models presented in the EA application will be updated and re-run to generate improved estimates of future water quality. When evaluating these permit applications, the statutory decision makers will each have opportunity to include permit conditions that could provide assurance that groundwater quality will be adequately protected.

Assuming the above listed permits are received, operation of the mine would be accompanied by a substantial monitoring program, which will include an adaptive management feedback loop, where proactive actions are taken to ensure that groundwater quality is not adversely affected beyond limits identified in the permits.

Within the context of the above processes, there is no significant risk of an imminent drinking water health hazard. KAM has expressed a strong commitment to developing this Project in a manner that is protective of the environment. KAM is always committed to continued investigation to improve current understanding and to modify the Project design as necessary to remain protective of water users.