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(Via email: Amanda@stkemlupsemc.ca)

Attention: Amanda Watson KGHM Ajax Timcw Coordinator

Re: Review of KGHM Ajax Project EA Application

GW Solutions Inc. (GW Solutions) is pleased to present the following letter-report summarizing our findings following the review of KGHM Ajax Project EA Application.

GW Solutions has focused its review on adequacy of the methodology, data, interpretation, and conclusions of the EIA with the objectives of identifying information that should have been collected, and flaws in interpretation and conclusions.

Background

KGHM Ajax Mining Inc. is proposing to develop, construct, operate, close, decommission, and reclaim the proposed Ajax mine. The project is a nominal 65,000 tons per day open pit copper and gold mine, with an estimated 23-year mine life, 2.5 year construction and 5 year decommission. The proposed Project is partially located on a historical mine site and mining activities in the immediate project area began in 1989. Previously mined areas on site include, two mine rock piles, the partially backfilled Ajax East open pit, and the Ajax West open pit, within which lakes are developing.

Temporal Boundaries

Hydrogeological data, specific to the development proposed by KAM and used in this baseline assessment, were collected between 2007 and 2014. This includes data collected by BGC and others through site investigations (SI) associated with a Preliminary Economic Assessment (PEA), a Feasibility Study (FS) and in support of the current EA.

A hydrogeology study completed by Klohn Leonoff in 1988 on behalf of Afton Mining Corporation to support a previous phase of development of the Project (i.e., during the 1980s and 1990s) was also considered in this assessment.

According to SSN, the temporal boundaries refer to pre-contact conditions.

Spatial Boundaries

- Local Study Area (LSA) is defined as the Project footprint and surrounding area
- Regional Study Area (RSA) is defined based on the Cumulative Effects Assessment Practitioners Guide

Cumulative effects may include drawdown of groundwater levels due to open pit dewatering, alterations in the groundwater flow regime, changes (location, magnitude and timing effects) to groundwater recharge and/or discharge, and changes (location, magnitude and timing effects) to groundwater chemistry.

The project is located in the south-central interior of BC, south of the city of Kamloops, within the Thompson-Nicola Regional District.

According to SSN, the spatial boundaries refer to the entire Thompson River watershed.

Key Weaknesses and Issues

A review has been completed of the surface water quantity content of the following parts of the Ajax Mine EA, downloaded from the BC Environmental Assessment Office website 19 January 2016:

Review comments are provided below. Comments are split into two groups. Comments on what we perceive to be potentially significant issues are presented first, with a brief discussion of each issue and, where appropriate, a request for additional information. This is followed by a short table of comments which we currently consider to be less significant; nevertheless, should be addressed. These latter comments include typographical errors and inconsistencies which should be corrected to improve the overall clarity of the surface water content of the EA.

Jacko Lake Water Level Regime

Issue:
The EA provides no discussion of change to the Jacko Lake water level regime during project construction and operation, or the impact of such changes on valued components.

Discussion:
The project proposes to replace the existing spillway and low level gravity outlet from Jacko Lake by a pumped outlet. The outlet would revert to a spillway at project closure.
The present Jacko Lake outlet consists of a spillway with crest elevation 892 m and low level outlet. Since the spillway capacity is much larger than typical freshet inflows to the lake (see EA Appendix 6.4-A, Figure A3), the present spillway outlet can be expected to restrict maximum Jacko Lake levels during the spring freshet to a little above the spillway crest.

The project proposes to replace the present outlet facilities with a pumped system (the Peterson Creek Diversion System or PCDS) “designed to handle a peak flow of 0.08 m^3/s” (EA page 6.4-41). Water from Jacko Lake would be pumped around the open pit and discharged back into Peterson Creek roughly 3 km downstream from Jacko Lake.

The EA (page 11.7-27) states that “During the spring freshet, the normal water level of Jacko Lake will be maintained at an elevation of 892.0 masl using the PCDS”. However, the proposed peak pumping capacity is less than the expected average monthly freshet inflows to Jacko Lake under wet conditions (EA Table 6.4-3), implying storage of freshet flows and higher Jacko Lake water levels and a larger range of freshet water levels than with the current outlet configuration. The EA recognizes that Jacko Lake will experience elevated water levels in wet months only in Appendix A of Appendix 17.4-D (analysis results for maximum water level in a 10-year wet month are presented); however, the potential impacts of the changed water level regime are not addressed. Based on our experience elsewhere, a change in water level regime could adversely affect environmental values (e.g. potentially impact spawning amphibians), or, possibly, the stability of the open pit wall. We assume potential impacts of a changed water level regime will be evaluated by others.

Information Request:
A comparison should be provided of the Jacko Lake water level regime under existing conditions, during project operations and post-closure. An evaluation should be provided of the impact of changed water level regime on valued components.

Inks Lake Post-Closure Sustainability of Offsetting Habitat

Issue:
Proposed measures to ensure the post-closure sustainability of Inks Lake offsetting habitat are poorly defined and there is no assurance that the measures are viable.

Discussion:
The EA proposes to provide offsetting habitat at Inks Lake (EA page 11.7-54), with lake water quality being maintained throughout the Project operation phase through pumped inflow (between April and October) of 23 m^3/h from Kamloops Lake (EA page 11.7-60). Closure and post-closure water supply to Inks Lake will rely on a "passive water supply system" (EA page 11.7-67). Two options for this "passive supply" are mentioned, namely:

- a valve-controlled gravity fed system from Jacko Lake (which implies that this is not actually a true passive system), dependent on approval of water allocation from Jacko Lake.
- diversion of flow from upper Alkali Creek.

There is insufficient information in the EA to demonstrate that either of these options is viable, calling into question the post-closure sustainability of Inks Lake offsetting habitat. We assume that the need for an assured post-closure water supply to Inks Lake will be evaluated by others.

Information Request:
A more detailed assessment should be provided to demonstrate the post-closure viability of the proposed Inks Lake water supply.

Post-Closure Treatment of South TSF Embankment Pond

Issue:
The current post-closure design does not appear to appropriately account for runoff to the south embankment pond from undisturbed areas in the headwaters of Keynes Creek.

Discussion:
The post-closure water management “strategy” for the south and southeast embankment ponds (page 11.7-62 and Figure 11.7-15) assumes that “small ponds will develop against the [TSF] embankments where inflows to the ponds are balanced against evaporation losses from the pond surface”. While this assumption may be appropriate for the southeast pond, it is not clear that it is appropriate for the south pond. The south embankment pond has a catchment area of undisturbed ground (essentially the headwaters of Keynes Creek south of the south pond) in excess of 200 ha. Using an estimated ratio of basin area/lake surface area of 25 for endorheic basins (Appendix 6.4-C, Section 6.1) implies that a south pond area of the order of 8 ha would be required to balance inflow and pond evaporation. This is considerably larger than implied in the EA. A more detailed analysis of post-closure hydrology and water management is required for the south embankment pond, including an assessment of the impacts to neighbouring property.

Information Request:
A detailed analysis of post-closure hydrology and water management for the south embankment pond should be provided.

Jacko Lake Dams - Design Storm Selection and Inflow Design Flood

Issue:
There are major inconsistencies within the EA documents regarding the design storm and resulting inflow design flood (IDF) to be used in the design of the proposed Jacko Lake Dams for both the project operation phase and post-closure. These and associated inconsistencies (such as in the proposed dam crest elevations) need to be resolved.

Discussion:
Throughout project operations, Jacko Lake will be reconfigured by adding dams on several of the lake arms to fully contain the inflow design flood (IDF), which in the case of Jacko Lake has been specified at the Probable Maximum Flood (PMF). Whether or not an emergency spillway will be provided for the period of project operations is unclear. The existing spillway in the southeast arm will be removed during project construction. In the absence of a spillway, the only outflow from the lake would be via the proposed Peterson Creek Diversion System (PCDS), which is a pumped system with a capacity of 0.08 m^3/s. Appendix 3-F (page 3-15 and drawing C135-

KA39-5620-10-003) makes reference to an emergency spillway (drawing C135-KA39-5620-10-003 shows a "potential" emergency spillway) which would direct any spill to the open pit. However, there is no mention of an emergency spillway in the main body of the EA.
On project closure, a spillway would be constructed in the southeast dam directing water in to an engineered channel and thence into Peterson Creek. The spillway would have a crest elevation of 892.0 m (the same as the crest elevation of the existing spillway) and would be designed to safely pass the IDF, again defined as the PMF.

Different sections of the EA provide widely varying estimates of the IDF/PMF:

- Section 11.7.3 (page 11.7-27) defines the IDF as the "runoff associated with a 24-hour Probable Maximum Precipitation (PMP)" and goes on to state that the IDF volume "has been estimated as 580,000 m^3 ". This represents runoff of only 15 mm from the 40 km2 catchment area to Jacko Lake, or less than 7% of the PMP (assuming a PMP of 226 mm from Appendix 3-F, page 2-8).

- Appendix 3-F, which includes the preliminary design for the Jacko Lake Dams, selected as a design storm a 24-hour summer/autumn Probable Maximum Precipitation (PMP) of 226 mm. The resulting design flood (the PMF) has an estimated peak flow of 63 m^3/s and a runoff volume of 800,000 m^3 (Appendix 3-F, Table 2.3), or 20 mm of runoff from the 40 km2 catchment area. A spring PMP with 100-year snowmelt with a total moisture input of 233 mm was considered (Appendix 3-F, page A1-3); but, was apparently discounted on the grounds that historical rainfall amounts have been greatest in the summer/autumn (page A1-5), this despite the fact that soils are much wetter in the spring and hence runoff potential is much greater.

- Appendix A of Appendix 17.4-D provides more detailed discussion of the PMF at Jacko Lake than elsewhere in the EA. Estimates of the IDF are presented for the PMP only and for a spring 24-hour PMP with 100-year snow accumulation. The spring 24-hour PMP with snowmelt (PMP of 221 mm plus 108 mm of snowmelt) produces a PMF with a peak flow of 200 m3/s and a volume of 9,650,000 m^3. The runoff volumes presented in this Appendix are more than 10 times greater than the volume assumed for the Jacko Lake dam design in Appendix 3-F (9.65 million m^3 in Appendix 17.4-D compared with 0.8 million m^3 in Appendix 3-F).

Information Request:
The basis for design of the Jacko Lake dams should be clarified and the various inconsistencies in the EA resolved. We note that in the absence of a spillway during the operation phase, the facilities should a) be able to retain all the runoff from the design storm, and b) be designed with a high degree of conservatism, since higher than expected runoff volumes could lead to dam failure. In this vein, adoption of a 24-hour design event is non-conservative. For a facility that has a limited outflow capacity (pump discharge of 0.08 m^3/s), the duration of the inflow design event should be selected considering the duration of time inflows to Jacko Lake exceed the outflow capacity.

Peterson Creek Downstream Pond - Design Storm Selection and Inflow Design Flood

Issue:
The proposed inflow design flood (the Probable Maximum Flood) for the Peterson Creek Downstream Pond (PCDP) dam is non-conservative in the light of various estimates of the PMF for Jacko Lake dam discussed above. The PMF at the PCDP should be revisited once differences in the estimate of the Jacko Lake PMF have been resolved.

Discussion:
The preliminary dam and spillway design selected the Probable Maximum Flood (PMF) as the inflow design flood (IDF) for the PCDP. Different sections of the EA provide widely varying estimates of the runoff potential from the PMF, and the preliminary design appears to be based on the least conservative scenario:

- Appendix 3-F, which includes the preliminary design for both the Jacko Lake and PCDP dams, selected as a design storm a 24-hour summer/autumn Probable Maximum Precipitation (PMP) of 226 mm. The resulting design floods (the PMF) for Jacko Lake and the PCDP have estimated peak flows of 63 m^3/s and 153 m^3/s respectively (Appendix 3-F, Table 2.3). A spring PMP with 100-year snowmelt and a total moistures input of 233 mm was considered (Appendix 3-F, page A1-3); but, was apparently discounted on the grounds that historical rainfall amounts have been greatest in the summer/autumn (page A1-5), this despite the fact that soils are much wetter in the spring and hence runoff potential much greater. The PCDP is designed as a "run of river" facility with little storage, so designing for the peak flow is critical. The spring PMP condition may well produce higher peak flows that necessitate a larger spillway, and should be investigated further.

- Appendix A of Appendix 17.4-D provides more detailed discussion of PMF (at Jacko Lake) than elsewhere in the EA. Estimates of the Jacko Lake IDF are presented for the PMP only and for a spring 24-hour PMP with 100-year snow accumulation. The spring 24-hour PMP with snowmelt (PMP of 221 mm plus 108 mm of snowmelt) produces a Jacko Lake PMF with a peak flow of 200 m^3/s, compared with 63 m^3/s for a summer/autumn event. Appendix A of Appendix 17.4-D did not calculate flows for the PCDP, but a similar difference between spring and summer PMF estimates would be expected based on the Jacko Lake results.

Information Request:
The basis for dam and spillway design at the Peterson Creek Downstream Pond should be reconsidered in the light of PMF estimates at Jacko Lake for a spring PMP event with snowmelt.

Post-Closure Sustainability of Peterson Creek Channel Alignment

Issue:
The conceptual post-closure alignment for Peterson Creek downstream from Jacko Lake raises long-term concerns regarding its sustainability. Furthermore, there is conflicting information in the EA on the post-closure alignment.

Discussion:
The conceptual plan for re-establishment of Peterson Creek on completion of project operations calls for the construction of an engineered channel downstream from Jacko Lake weaving between the open pit and the Mine Rock Storage Facility (MRSF). The Detailed Project Description (page 3-112) states that the alignment is conceptual in nature and that the ultimate alignment will be “determined by further studies”.

Figure 3.17-4 in the Detailed Project Description (Main Report, Chapter 3) shows one conceptual alignment and profile, while Appendix 3-F drawing C135-KA39-5640-00-003 shows another. There are major differences between the drawings, with Figure 3.17-4 showing a channel perched on fill for much of its length, while the Appendix 3-F drawing shows a channel primarily excavated below the surrounding terrain.

The conceptual alignment shown in both figures raises concerns. Of particular concern, is the sharp bend around Sta 1+500. At this location the open pit is on the outside of the bend, only meters away from the channel, and (in the Figure 3.17-4 profile) the channel itself is perched above the natural ground in an elevated arrangement.

This is an unstable alignment with multiple potential modes of failure. The sharp bend will create scour at the toe of the embankment along the outside of the bend, potentially leading to failure of the embankment. In addition, overtopping of the embankment for whatever reason (e.g., storm larger than design event, channel rougher than assumed in design, sediment accumulation or vegetation growth reducing conveyance capacity) could lead to rapid erosion of the embankment fill perched above the surrounding terrain (at least according to Figure 3.17-4).

Information Request:
An assessment should be made of the risk of a channel avulsion into the open pit and the implications of such an avulsion should be discussed. In addition, the inconsistencies between various report sections, showing fundamentally different concepts for the creek design, should be rectified.

Peterson Creek Ecological Function

Issue:
The EA appears to contain no discussion of post-closure restoration measures for Peterson Creek which emphasize returning the stream function to as close to its natural state as possible.

Discussion:
The post-closure plan for Peterson Creek currently addresses only the necessary task of conveying surface flows through the project site. There is little consideration in the closure plan for restoring the ecological function of the creek.

Information Request:
Please indicate whether the post-closure design for the Peterson Creek channel is intended to provide any ecological function or habitat value.

Dam Breach Analysis

Issue:
No dam breach analyses are presented for dams other than the TSF embankments.

Discussion:
Appendix 17.6B studies the dam failure consequences for the embankments comprising the TSF. However, dam breach analysis does not appear to have been conducted for other facilities, notably Jacko Lake Dam and Peterson Creek Downstream Pond Dam.

Information Request:
Results of dam breach analyses for Jacko Lake and Dam and Peterson Creek Downstream Pond Dam should be provided.

Existing Water Licenses and Water Uses

Issue:
There is no discussion of the effect of the project on existing water licenses and existing water uses.

Discussion:
Appendix 6.4-C, Section 3.2 provides detailed information on existing water licenses in the regional and local study areas but no information is provided on the impact of the project on licenses affected or potentially affected by the project. For example, the Keynes Creek water licenses (license C102915) appear to have points of diversion (and presumably associated land) which would be covered by the TSF.

Information Request:
Information should be provided on all licenses where water use may be affected by the project including any proposed changes in points of diversion, beneficial use, or quantity of water used or stored. Information should be provided for both the project operational period and for closure and post-closure.

Similarly, data and analyses should be provided to demonstrate that the proposed modifications to the Jacko Lake outlet (change from a gravity to pumped outlet plus construction of the Peterson Creek Downstream Pond) does not adversely affect the ability to meet downstream water demands.

Hydrometric Program Documentation

Issue:
For a project of this scope we would have expected the hydrometric data collection program to comply with the Manual of British Columbia Hydrometric Standards (RISC, 2009). While the standards are referenced in several places in the EA (e.g. Appendices 6.4-A and 6.4-B), documentation of the hydrometric program is insufficient to confirm data quality and compliance with the standards.

Discussion:
The hydrometric program is discussed in several appendices to the EA:

- Appendix 6.4-A: 2012 Hydrometeorology Report;
- Appendix 6.4-B: Baseline Hydrology Report – 2014 Streamflow Monitoring; and

- Appendix 6.6-B: Ajax South Groundwater and Surface Water Site Investigation.

None of these documents, however, provide a comprehensive description of the hydrometric monitoring program, making an assessment of the quality of the hydrometric data difficult. Several data quality indicators listed in the standards requirement criteria table in the Manual of British Columbia Hydrometric Standards (RISC, 2009) are not discussed in any of the EA documents, or are not discussed to an extent that would allow assessment of hydrometric data quality. For example:

- The brand of water level sensors used at each monitoring station is provided, but not the type, range, or sensor accuracy;
- Details on water level sensor field verification, including comparison of sensor readings to manual staff gauge measurements, are not provided;
- Discussion of channel condition, including vegetation growth, is limited, and not provided in the context of how it affects stage-discharge relations;
- The accuracy of rating curves is not quantified;
- A comprehensive list of available high quality water level data, as well as periods of missing or lower quality data for each monitoring station by date is not provided; and
- There is no mention of the data and calculations being reviewed for anomalies or results being compared with other stations and/or other years for quality assurance/quality control purposes.

Of particular concern is the lack of clear information on the amount and period of record of good quality data available for and used in the various analyses.

Information Request:
Additional documentation of the hydrometric monitoring program is needed to allow a better informed assessment of data quality and suitability for its intended used.

Water Balance Model Development and Calibration

Issue:
Calibration and validation of the site water balance model are inadequate to provide confidence in model results.

Discussion:
The Appendix 6.4-C water balance model is a monthly time step model calibrated to long-term average monthly synthetic flows from the JACINF gauge site. The synthetic JACINF flows were developed using a ranked regression model relying on the short record of measured flows at JACINF and the long-term WSC record from the Deadman River at Criss Creek. In other words, the water balance model is a model based on a model, implying a potentially significant increase in model uncertainty.

The level of uncertainty in model results is further raised by calibration of the model against long-term average data. There is no calibration or validation of the model against flow data from dry or wet periods; however, we recognize that the model was validated, with encouraging results, against flow data from 2014 (slightly wetter than normal). Nevertheless, comparison of synthetic JACINF time series against JACINF time series developed for water balance modeling (compare Appendix 6.4-A Figure 3.9 against Appendix 6.4-C Figure 5.6) shows significant year to year differences.

Information Request:
More rigorous validation of the time series developed for water balance modeling is needed to demonstrate that the time series reasonably reflects the actual flow regime. At a minimum, this should include validation against observed JACINF flows for the period 2008 -2011 and comparison of flow duration data from the simulated water balance time series and the synthetic JACINF time series. Uncertainty in flow data should be considered in the water balance analysis.

Jacko Lake Inflows in Water Balance Analysis

Issue:
Jacko Lake average annual inflow appears to be overstated in the Appendix 6.4-C water balance analysis.

Discussion:
Appendix 6.4-C, Figure 8.1 shows an average annual inflow to Jacko Lake (drainage area 40.9 km^2) of 160 m^3/h (0.044 m^3/s) under existing conditions, based on precipitation data for the period 1897-2011.

The long-term term average annual runoff at the JACINF gauge (drainage area 31.1 km^2) is given as 26.1 mm for the period 1963-2008 (Appendix 6.4-C, Table 5.2), equivalent to an average annual flow of 93 m^3/h (0.026 m^3/s).

Differences between the average annual flow at JACINF and the average annual inflow to Jacko Lake could arise both from differences in drainage area and differences in the period of analysis. Scaling the JACINF value by the ratio of drainage areas, and accounting for precipitation on the surface area of Jacko Lake, gives an average annual inflow to Jacko Lake for the period 1963-2008 of 140 m^3/h (0.039 m^3/s). From Appendix 6.4-C, page 62 (footnote), the average annual precipitation at Kamloops was 244 mm for the period 1897-2011. From Environment Canada data, the annual average precipitation at Kamloops Airport for the period 1963-2008 was 274 mm. Adjusting the JACINF data for both drainage area and period of analysis would therefore result in average annual inflows to Jacko Lake for the period 1897-2011 of less than 140 m^3/h compared with 160 m^3/h reported in the water balance analysis. The apparent discrepancy should be explained.

Information Request:
The apparent discrepancy between synthetic JACINF time series (from Appendix 6.4-C, Table 5.2) and Jacko Lake inflows reported in the water balance analysis should be explained and any inconsistencies resolved. The Excel-based water balance model should be provided to facilitate further review.

Parameters analyzed for baseline water quality

Issue:
No radioactive parameter was analyzed such as Radium-226 which is indicated in the Metal Mining Effluent Regulations[1].

Discussion:
Radium-226 should be tested at least in a few strategic locations for baseline groundwater and surface water and proving it is not present.

Information Request:
SSN requests that KGHM complete an adequate assessment of the proposed mine site for radioactive parameters.

[1] http://laws-lois.justice.gc.ca/eng/regulations/SOR-2002-222/

Sampling density and distribution

Issue:
Some strategic locations are not covered by the baseline sampling for both surface water and groundwater (e.g. around the TSF and north of the open pit). Reference sites (JC03-PC10 and MW11-08) were not chosen adequately as they may be influenced by the project.

Discussion:
For surface water: there are 38 water sampling sites in total, mostly (28/38) located in Peterson Creek watershed near the mine project area. Historical mine site features were also specifically targeted (8/38). More sampling stations are required:

1) upstream in Peterson Creek where there will not be any anticipated impacts due to the project. JC03-PC10 station cannot be used as a reference point because it is too close to the mine site and may be affected by mine activity especially if there is a connection with groundwater. There is a contradiction with the proponent's choice of JC03-PC10 as a reference site and its interpretation of water quality results for this site stating that: "Anthropogenic activity in the area make is difficult to differentiate changes in water chemistry that may have natural origins, from those that do not".
2) in the creek upstream of the TSF.

For groundwater: there are 51 monitoring wells that cover the different lithologies and aquifers, some monitoring wells are built as nested piezometers (deep and shallow). In total there are 58 sample locations. More sampling stations should be added:

1) around the TSF to get a better baseline and to monitor for potential leakage;
2) north of the open pit as regional groundwater flows south to north.

These additional stations location should be chosen based on the analysis of fracture network in the area to make sure the stations are located along preferential flow paths.

MW11-08 should not be used as a reference site because it may be affected by the project or other surrounding anthropogenic activities in the area. Another location should be chosen for reference site.

Information Request:
SSN requests that sampling be completed from additional surface water stations and from additional monitoring wells (to be completed) in order to adequately define the baseline conditions for both the surface water and groundwater quality. These stations and monitoring wells should be included in the long-term monitoring program.

Historical data and background concentrations

Issue:
Historical water quality data (dated before the old mine) has not been integrated in the baseline report. The definition of natural background concentration is based post-mining and may be consequently biased.

Discussion:
The sampling period used for the baseline water quality analysis in the area is from 2007 to 2014 (continuing to present day). However, due to the presence of an old mine (1987 – 1997) at the Ajax future proposed project location, historical water quality data (dated before the old mine) has to be integrated in the baseline report in order to make sure that background concentrations found between 2007 and 2014 are natural background concentrations. Three (3) historical hydrogeological reports were briefly mentioned; their data should be integrated in the graphs and maps of the baseline report.

Elevated concentration of some metals and ions such as sulphate, selenium, molybdenum, arsenic, are found in the historical mine site area (open pits and collection ponds). These elements are common tracers for mine activity. These values cannot be taken as natural background concentrations. Diffusion of these contaminants may affect surface water and groundwater quality down-gradient, which may bias the background concentrations found for the stations down-gradient. This is important but has not been taken into account when defining natural background concentrations for the down-gradient stations. In addition, site-specific water quality objectives have been reassessed for parameters where background concentrations were found to exceed the generic water quality guideline, according to the water and air baseline monitoring guidance document ("when natural concentrations exceed water quality guidelines, site-specific water quality objectives may be developed by the MOE to define acceptable receiving water quality"). This is not acceptable if the exceedance of water quality is due to former mine contamination. Therefore, anthropogenic effect versus natural background must be deeply and better assessed. This is the reason why historical data prior to the old mine is needed.

Information Request:
The historical data (i.e., pre 2007) should be integrated in the graphs and maps of the baseline report. Conclusions about observed trends and potential degradation of the water quality should refer to water quality before any mining activities.

Site-specific water quality objectives should be reassessed based on concentration values representative of natural conditions prior to any mining activities.

Effect of climate change in the water quality model

Issue:
Effect of climate change was not considered in the sensitivity analysis.

Discussion:
The water quality model is based on the water balance model. They used a mass balance approach in an Excel spreadsheet to predict concentrations of dissolved elements in the receiving water quality model nodes (Jacko Lake, Peterson Creek downstream pond, Humphrey Creek). This model only considers surface water.

The model was calibrated with baseline concentrations. Then, the Base Case water quality predictions were generated using median baseline water quality and average climate conditions as inputs to the water balance model. Thirteen (13) sensitivity scenarios related to climate conditions, hydrogeological conditions, baseline water quality inputs, dust fall, and timing of seepage were also assessed. Extreme historical climate events were considered in the sensitivity analysis but effect of climate change were not. Effects of climate change should be included in the model.

Information Request:
SSN requests that the effect of climate change be properly integrated in estimating the impact of the proposed activities on water quality in the developed numerical model. The conclusions and recommendations should be revisited based on the new information that will result from the revised model taking into account climate change.

Cyanide concentration in the water quality model

Issue:
Evolution of cyanide concentration due to mine activity was not predicted.

Discussion:
Cyanide concentration should be predicted if proposed to be used in the mining process. Cyanide was detected below the detection limit for the baseline water quality but half of the detection limit should be used in the model as done with the other elements.

Information Request:
SSN requests that the concentration of Cyanide be modeled, if proposed to be used in the mining process, similar to what was done for the other parameters modeled.

Plume migration analysis

Issue:
RES-2 was considered to be the nearest residential well down-gradient from Ajax mining infrastructure in this aquifer. Two other wells (RES-3 and RES-5) are also in the overburden and closer than RES-2 from mine sites. The migration of potential contaminant of concern (PCC) to potential sensitive receptors should not be limited to the study of PCC towards RES-2.

Discussion:
The objectives of the model are to assess the potential change in groundwater quality in the vicinity of the residential wells due of the proposed project in the Peterson Creek aquifer. RES-2 was considered to be the nearest residential well down-gradient from Ajax mining infrastructure in this aquifer.

This is the only model related to groundwater. It is very local as it considers only the plume migration to RES-2. Other wells, RES-3 and RES-5, are also in the overburden and closer than RES-2 from mine sites. RES-3 is not within the mapped Peterson Creek aquifer but it is very likely completed in the Peterson Creek aquifer, according to the lithology of the well. RES-3 and RES-5 are not downstream of the collection pond (PCDP) but contaminated groundwater can reach these wells from other features, resulting from uncaptured seepage.

Information Request:
SSN requests that the groundwater quality model be modified to estimate the potential change in groundwater quality in RES-3 and RES-5. Also, the modification of quality of the groundwater flowing in the fractured bedrock should be taken into account.

Significance of potential environmental effects

Issue:
GW Solutions does not agree with the fact that an exceedance of parameter (e.g. selenium) or an estimated partially reversible effect on a receptor area can be considered as *Not Significant* in the final report on assessment of the potential environmental effect.

Discussion:
Once the potential environmental residual effects have been assessed on the receptor areas, the *significance* of these effects is assessed, based on the magnitude of the exceedance, its frequency, its duration, the geographic extent, its reversibility etc.
GW Solutions disagrees with the fact that an exceedance of a parameter can just be considered as *Not Significant*. For example, Selenium concentrations are predicted to be elevated in Humphrey Creek watershed even after implementing mitigation measures. The proponent considered this as not significant. GW Solutions disagrees with this rating, especially for Selenium that already has a site-specific water quality objective less conservative than the generic water quality guideline.

In the case of an effect characterized as *partially reversible* (such as Molybdenum in domestic groundwater wells), GW Solutions disagrees that this is not significant. The assignation of significance is qualitative and subjective.

Information Request:
SSN requests that KGHM provides an objective rationale to support the rating of the significance of potential environmental effects. if such rationale cannot be provided, then KGHM has to revise its significance rating.

Interpretation of pumping test in BGC10-PW01 (bedrock)

Issues:
1) GW Solutions disagrees with the conclusion of the interpretation of the pumping test, in particular that the drawdown data indicates the presence of a barrier boundary;
2) The choice of the conceptual model used to describe the hydraulic properties of the aquifer is questionable. The selection of the wrong model results in erroneous T and S values.
3) The absence of hydraulic connection with Jacko Lake is not proven;
4) Data from several monitoring wells has not been interpreted because it showed drawdowns of less than 10 cm. Even of small amplitudes, these drawdowns should be interpreted.

Discussion:

1) The proponent has concluded that there is a barrier boundary based on the fact that late time drawdown data is rising (Figure 1a). GW Solutions disagrees with this conclusion. GW Solutions has completed an interpretation of the test using the raw data provided by KGHM's consultants. First, the drawdown curve is actually not rising but starts stabilizing at the very end of the pumping test after around 150 h (Figure 1b). This indicates that recharge (additional influx of water) is occurring. In addition, the log-derivative curve (bottom curve, Figure 1b), shows a strong negative slope before the end of the test and this confirms the presence of a recharge boundary.

2) KGHM's consultants have used the Moench Pricket (1972) model for the analysis of the data from the pumping well although the data does not fit well with this model and the hypotheses required for the use of the model do not apply (i.e., the model applies to isotropic porous granular media). KGHM's consultants have also used several other models for the interpretation of the drawdowns observed in the monitoring wells without considering whether assumptions and limitations for the use of these models applied. This inconsistency in the selection of models, without confirming that these models can actually be used, result in the calculation of transmissivity (T) and storativity (S) values that are incorrect. Based on the shape of the log-derivative drawdown versus time curve for the pumping well, GW Solutions believes that a bilinear flow model is more adequate and realistic. The behaviour of this aquifer is clearly governed by the presence of a conductive fault as shown by the typical slope of 0.25 in the log-derivative curve (Figure 2). Hydraulic properties of both the fault and the matrix can then be estimated. The fault transmissivity (T_f) equals 2.3 x 10^{-6} m^2/s and the matrix transmissivity is around 2 orders of magnitude lower. In addition, the delayed signature of the bilinear flow indicates that the fault is not physically directly connected to the well; it is a major drain close to the well. The recharge boundary is probably localized along the axis of this fault. The proponent has calculated a final K value considering an aquifer thickness of 100 m (by dividing T by 100). It appears that this 100 m was used as a rough average for estimating the hydraulically active saturated thickness of the bedrock. The proponent's approach is too simplistic and does not reflect the complexity of the groundwater flow in bedrock and the role played by the fractures and fault(s).

3) KGHM has concluded that Jacko Lake and the bedrock aquifer proposed to be mined were not connected based on the drawdown and recovery curves obtained from the pumping test data, and their interpretation of the presence of a barrier boundary. Based on points 1 and 2 discussed above, this conclusion is invalid.

4) The interpretation of the observed (or not observed) drawdowns in monitoring wells is poorly described. First, the report only mentions wells where drawdowns greater than 10 cm have been observed. However, it is still important to account for any drawdown even less than 10 cm to assess potential hydraulic connections. There is no comment on the drawdowns in monitoring wells BGC10-MWA and BGC10-MWB that are very close to the pumping well, although the data for these monitoring

wells seems to indicate a change in pressure during the pumping test. Also, data from observation wells KAX-14-124D and KAX-14-124S are missing (they are actually entered in the provided information as duplicates of KAX-14-128S and KAX-14-128D).

For this proposed project, it is essential to have the best definition of K and this should be based on the available lithological and geophysical information. GW Solutions observes that the knowledge available from the numerous boreholes drilled at the site was not integrated to adequately define the hydraulic conductivity of the bedrock.

Furthermore, GW Solutions recommends that due to the size and complexity of the proposed project, the groundwater regime be better defined in the area of the pit and Jacko Lake. Additional pumping tests would have to be completed on both side of the Edith Lake Fault Zone and immediately near the Northeast and Southeast dams proposed on Jacko Lake.

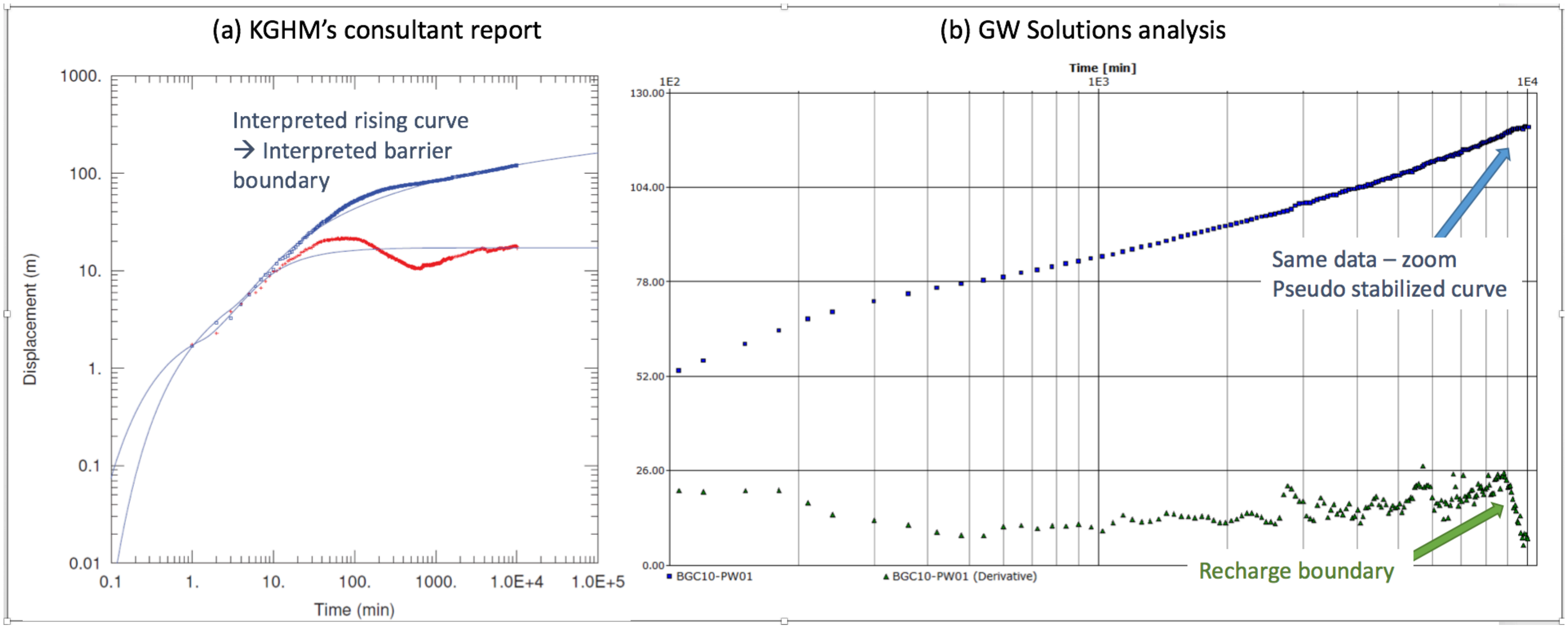


Figure 1: Drawdown and Log derivative curves – Pumping Test BGC10-PW01 – Comparison of KGHM and GW Solutions Interpretation

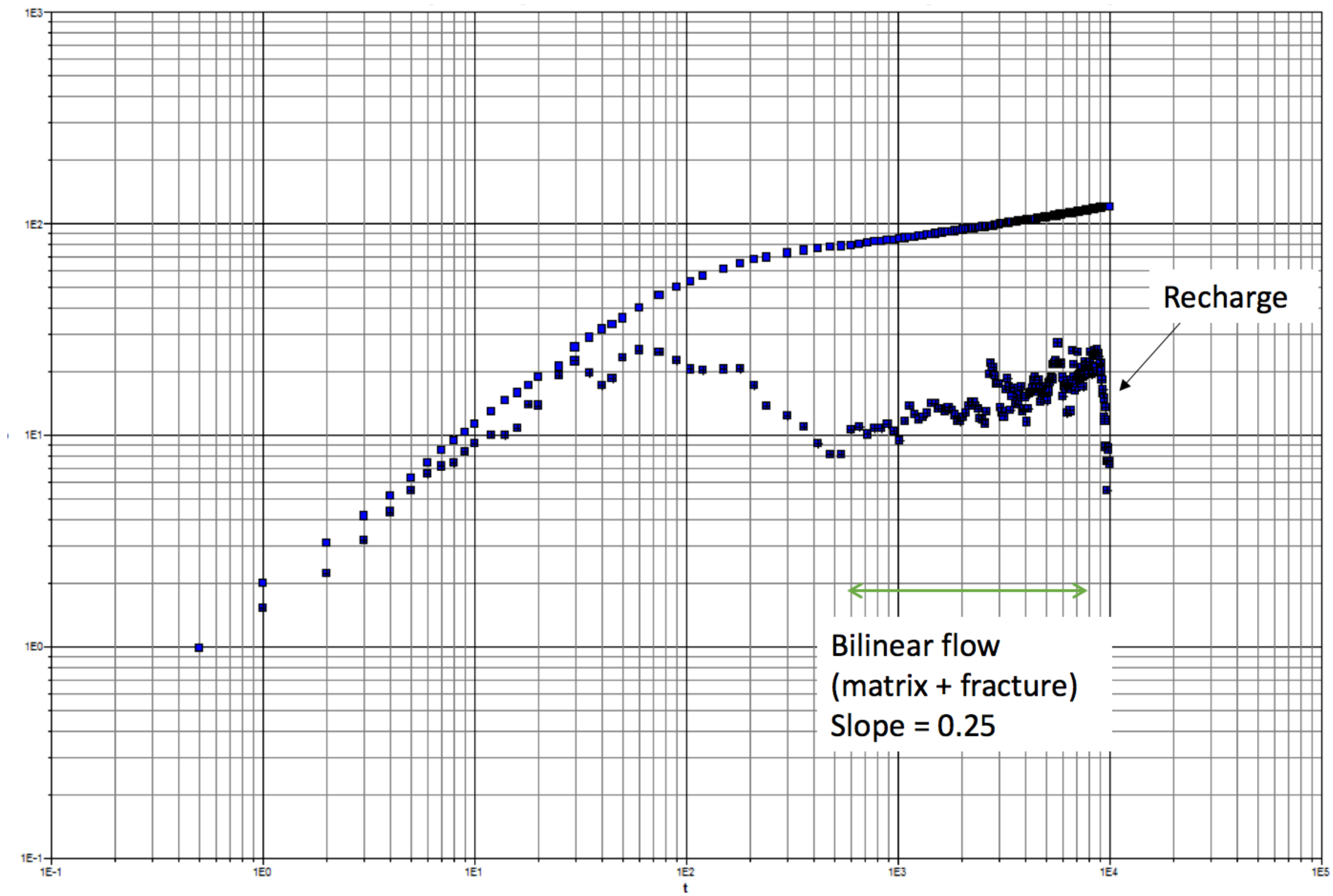


Figure 2: Drawdown and Log derivative curves – Pumping Test BGC10-PW01 – Details and slope indicating bilinear flow

Information Request:

SSN requests that long enough pumping tests at relevant pumping rates and location be completed to adequately assess the potential connection between Jacko Lake and the pit area, and correlate the results with available lithological and geophysical information (bedrock type, degree of fracturation, bathymetric analysis, etc.) to better assess connectivity and orientation of the fracture network and zones of high-K/low-K paths in the area. Relevant locations would be around the proposed dam, especially north of the arm of Jacko Lake, where overburden thickness is reported as small.

Surface water – groundwater interactions between Jacko Lake and bedrock aquifer near open pit using water chemistry

Issue:
The interactions between surface water and groundwater are insufficiently studied, especially in the area of Jacko Lake.

Discussion:
Even if the pumping test in PW-01 did not show any drop of Jacko Lake, water quality comparison between the surface water of Jacko Lake and nearby wells must be done to support/refute the absence of connection. Ratio diagrams should be used to better assess the potential interaction between surface water and groundwater.
If other pumping tests are going to be performed nearby Jacko Lake, several sampling events should be done during the test to assess potential participation of surface water.

Information Request:
SSN requests that KGHM complete a water quality comparison between the surface water of Jacko Lake and nearby wells using ratio diagrams to adequately assess the surface water and groundwater interactions.

Surface-water – groundwater connection assessment between Peterson Creek aquifer and Peterson Creek

Issue:
KGHM suggests there is no hydraulic connection between Peterson Creek Aquifer and Peterson Creek. GW believes there is not enough data to confirm or refute this assumption.

Discussion:
The proponent interprets the decreasing of water level in Peterson Creek station as natural recession (i.e., natural drop of the water level in the creek at the time of the pumping test – February 2015) based on the reported data in the Thompson River for that period. Although GW Solutions agrees that the water level in Peterson Creek may be in a recession period, the observed decreasing slope of water level in Peterson Creek station during the pumping test may be a cumulative effect of both the natural recession and the pumping of BGC14-PW01. Data from a reference site upstream and a better set of data prior to the pumping would have provided the required information.

Similarly, GW considers that using water quality fingerprinting to characterize the connectivity between the sand and gravel aquifer (Peterson Creek Aquifer) and Peterson Creek would require pumping for a longer period of time to draw valid conclusions.

Based on the information provided by KGHM, the absence of connection between Peterson Creek Aquifer and Peterson Creek is not proven.

Information Request:
SSN requests that KGHM complete a more thorough analysis of surface water groundwater interaction between Peterson Creek and Peterson Aquifer. This should be completed through more than one pumping test and should be representative of the whole length of the Peterson Creek Aquifer.

Pumping tests in the proposed mine area

Issue:
There are not enough pumping tests to properly characterize aquifers and aquitard located under the proposed mine site, especially under the TSF.

Discussion:
Pumping tests should be also performed at least under the TSF. The advantage of performing a pumping test rather than other test or in combination with other tests in that it often allows to describe the horizontal extent of the aquifer and diagnose the different hydraulic structure successively met during the pumping (faults) and to detect boundary conditions if the duration of the test is sufficient. It considers a much larger volume/extent of the medium compared to a permeability test or a packer test that solicit only a small volume of the aquifer.

Information Request:
SSN requests that KGHM complete pumping tests in all of the five (5) aquifers identified in the LSA. This is particularly needed at key locations, such as at the proposed TSF and the northwest corner of the pit, to better assess the local groundwater regime.

Aquifer Compressibility below TSF and MRSF report (6.6-F)

Issue:
In Appendix 6.6-F the proponent states that “the estimated bedrock aquifer compaction below the East MRSF is 0.02 and is negligible and is therefore not expected to change the hydraulic capacity of the aquifer”.

Discussion:
The TSF and each MRSF will increase the total stress and the effective stress on the natural materials below the storage facilities. The footprint of the East MRSF, is located over mapped bedrock aquifer NO.0276- the Sugar Loaf Hill Aquifer.

The degree of compaction that may result will depend on the compressibility of the natural materials. Table 1 presents the range of values of compressibility for some geological materials from the literature (Freeze and Cherry, 1979)

Table 1

Table 2.5 Range of Values of Compressibility	
Materials	Compressibility, a (m^2/N or Pa^{-1})
Clay	10^{-6} - 10^{-8}
Sand	10^{-7} - 10^{-9}
Gravel	10^{-8} - 10^{-10}
Jointed rock	10^{-8} - 10^{-10}
Sound rock	10^{-9} - 10^{-11}
Water (β)	4.4×10^{-10}

The foundation soils of the East MRSF are primarily glacial till (up to 30 m, often silty sand or sandy silt) underlain by the Iron Mask Batholith (Cherry Creek Unit and Hybrid Unit), which is mapped as part of bedrock aquifer 0276. Based on literature values presented in Table 1, the range of 10^{-8} to 10^{-10} Pa^{-1} would be appropriate for aquifer compressibility (α) for this bedrock unit.

The potential compaction of the bedrock aquifer below the East MRSF can be estimated from aquifer compressibility (α) as follows:

$$\alpha = (-dH/H)/d\sigma e; \quad dH = -\alpha\, H\, d\sigma e \text{ (Freeze and Cherry, 1979)}$$

Where H = aquifer thickness, dH = change in aquifer thickness (or compaction), and dσe is equal to the change in effective stress, resulting from the load of the mine facility in question. For a maximum height of 100 m for the East MRSF, and a typical unit weight of 21 kN/m^3 for Structural Fill and 21.5 kN/m^3 for Anthropogenic Mine rock (Table 9, Mine site infrastructure Report, Knight Piésold Consulting, 2015), the resulting change in stress over the facility would be between 2,100 to 2,1500 kPa. The estimated bedrock aquifer compaction for the upper 100 m of bedrock would therefore be between:

$$dH=-\alpha H\, d\sigma e = -10^{-10}\ Pa^{-1} \times\ 100\ m \times 2{,}100{,}000\ Pa = 0.02\ m, \quad \text{and}$$

$$dH=-\alpha\ H\, d\sigma e = -10^{-8}\ Pa^{-1} \times\ 100\ m \times 2{,}150{,}000\ Pa = 2.15\ m$$

As a result, the bedrock aquifer compaction below the East MRSF could reach 2.15 m. This is not negligible. In this case, the aquifer compaction will likely modify the hydraulic characteristics of the aquifer.

Information Request:
With compaction beneath some parts of TSF and MRSF calculated to be approximately 2 m, there is an increased risk of embankment failure during operation or closure. Therefore, SSN requests that more soil and rock mechanic studies be completed. Vertical compressibility α is the main parameter used in estimating aquifer compressibility. The proponent has used literature values for α to conduct their compressibility analysis. Values for α should be determined by laboratory testing, using representative samples from the site.

Groundwater Flow Model (6.6-D)

GW Solutions has identified ten (10) issues/weaknesses regarding the completed groundwater model:

Issue 1:
Evapotranspiration was not simulated within streams or in the adjacent grid cells representing the surrounding hyporheic zone (i.e., the area of interaction between groundwater and surface water adjacent to the stream bed).

Discussion - 1:
MODFLOW models are generally not able to accurately simulate surface water exchange between stream reaches and the atmosphere due to model discretization limitations. Consequently, total stream flows are overestimated.

In the Modflow model completed by KGHM, water that would normally be lost to evaporation from streams and the hyporheic zone was instead included in the recharge boundary conditions and the stream cell boundary condition water balances, respectively.

Issue 2:
There is no discussion about the calculation and estimation of the groundwater recharge or flux in the LSA or RSA.

Discussion - 2:
In both the water balance and baseline reports, there is no discussion about the estimation, calculation, or measurement of the parameters defining the groundwater recharge, discharge, or flux. How was the model calibrated using the groundwater balance data? Why did the modeller use the “Zone Budget” package when there is no estimated nor calculated data to compare to during model calibration/simulation? The proponent should provide the input data.

Issue 3:
Groundwater divides are interpreted to exist along the south and south-west boundaries of the domain and were set as no flow boundaries.

Discussion - 3:
Based on the conceptual hydrogeological model and the elevation of groundwater, the south boundary of the Model Domain should be assumed as a General Head Boundary (GHB) and not as a no flow boundary.

Issue 4:
Hydraulic conductivity values within the modeled zones were specified based on hydrogeologic testing and modified within measured and expected ranges during model calibration. Model calibrated hydraulic conductivity and storage parameters (i.e., specific storage and specific yield) are summarized by material type in Tables 01 and 02 for surficial deposits and bedrock, respectively. We consider that the assumed range for calibration of the Hydraulic Conductivity was not adequate for each layer.

Discussion - 4:
Based on Table 2, the model always chose the minimum hydraulic conductivity in every range during calibration. For example, the hydraulic conductivity of the Sugar Loaf aquifer is the same as other non fractured bedrock. This is likely not representative of the hydrogeological characteristics of this aquifer.

Table 2: Summary of bedrock hydraulic parameters in the Calibrated Numerical Groundwater Flow Model

Main Rock Type	Age (Epoch)	Stratigraphic Unit		Rock Type	K (m/s)	Ss (m^{-1})	Sy (-)	Porosity (-)
		Group	Formation					
Sedimentary and Volcanic	Miocene	-	-	Basaltic volcanic rocks	3.5E-09	1.0E-03	2.0E-02	0.25
	Eocene	Kamloops Group	-	Undivided volcanic rocks	1.0E-09	1.0E-06	5.0E-03	0.05
			Tranquille Formation	Mudstone, siltstone, shale fine clastic sedimentary rocks	1.0E-09	1.0E-06	5.0E-03	0.05
	Upper Triassic	Nicola Group	Eastern Volcanic Facies	Basaltic volcanic rocks	3.2E-09	1.0E-06	5.0E-03	0.05
			-	Mudstone, siltstone, shale fine clastic sedimentary rocks	1.0E-09	1.0E-06	5.0E-03	0.05
			-	Lower amphibolite/kyanite grade metamorphic rocks	3.5E-09	1.0E-06	5.0E-03	0.05
	Devonian to Permian	Harper Ranch Group	-	Mudstone, siltstone, shale fine clastic sedimentary rocks	1.0E-09	1.0E-06	5.0E-03	0.05
Intrusive	Eocene	-	Battle Bluff Plutonic Complex	Diabase, basaltic intrusive rocks	3.5E-09	1.0E-06	5.0E-03	0.05
			-	Feldspar porphyritic intrusive rocks	3.5E-09	1.0E-06	5.0E-03	0.05
	Late Triassic to Early Jurassic	Iron Mask Batholith	Cherry Creek Unit	Dioritic intrusive rocks	1.9E-08	1.0E-06	5.0E-03	0.05
			Sugarloaf Unit	Dioritic intrusive rocks	1.0E-09	1.0E-06	5.0E-03	0.05
			Pothook Unit	Dioritic intrusive rocks	5.9E-09	1.0E-06	5.0E-03	0.05
			Hybrid Unit	Dioritic intrusive rocks	1.5E-09	1.0E-06	5.0E-03	0.05
		-	-	Granodioritic intrusive rocks	3.5E-09	1.0E-06	5.0E-03	0.05
			-	Ultramafic rocks	3.5E-09	1.0E-06	5.0E-03	0.05
3D Geologic Model	NA			Mafic volcanics - Nicola Group	1.0E-09	8.2E-06	5.0E-03	0.05
				Picrite unit	1.0E-09	2.0E-07	5.0E-03	0.05
				Sugarloaf Diorite	2.6E-08	1.0E-07	5.0E-03	0.05
				Sugarloaf Volcanic Hybrid	1.8E-08	6.3E-07	5.0E-03	0.05
				Iron mask hybrid	1.0E-09	9.1E-06	5.0E-03	0.05
				Pyroxene Plagioclase Porphyry	1.2E-09	1.0E-06	5.0E-03	0.05
Undifferentiated Bedrock				Outcrop	4.6E-08	1.0E-03	5.0E-02	0.25
				Shallow	5.8E-08	1.0E-04	5.0E-02	0.25
				Deep	4.6E-10	1.0E-06	5.0E-03	0.05
Fault Zone[2]				Fault	3.2E-08	1.0E-06	5.0E-03	0.05

Notes:

1. Compiled from Massesy et al. (2005).
2. Edith Lake Fault Zone included in sensitivity analysis as 50 m wide zone.
3. Porosity estimates are based on professional judgment.

Issue 5:
The proponent states: "The amplitude of the simulated responses was somewhat lower than the observed responses in transient Model. The cause of the differences is uncertain, however, the observed variations may be larger than simulated due to processes not represented in the model".

Discussion - 5:
In a model that will be used for prediction scenario, the uncertainties should be reduced to a minimum. So, the proponent should determine the cause of the differences between observed variation and simulated variations. For example, seasonal pumping and surface water diversions related to agricultural land uses, fluctuations in surface water elevations in the ungauged Mine Site ponds, or pumping and drilling activities in the Mine Site, and vadose zone (i.e. unsaturated) flow may explain some of these uncertainties. In addition, we understand pumping from domestic water wells was not simulated in the Model.

Issue 6:
In the transient simulation of the pumping test, there is no discussion about the modification of the specific yields, specific storage and hydraulic conductivity of the layers near Jacko Lake. In addition, there is no sensitive analysis completed.

Discussion - 6:
It appears that the modeller did not take into account the results of the pumping test in the adjustment of the parameters for the two layers for which the pumping test provided specific information. Also, sensitive analyses are standard practice in modelling.

Issue 7:
Based on the modeling results, the simulated changes to groundwater elevations during operation do not extend to the Aberdeen area.

Discussion - 7:
Streams and creeks outside of the Peterson Creek watershed and close to Aberdeen area were simulated using the MODFLOW drain package (DRN). The drain package is similar to the river package except that only outflow of groundwater from the model is simulated. Where the simulated hydraulic head in a grid block falls below the specified water elevation, no water is removed at the boundary cell. It is more accurate to use River Package instead of Drain Package for whole streams in RSA to evaluate the effect of changing groundwater elevation during operation.

Issue 8:
In the predictive models, the proponent has not created a scenario that takes into account climate change. Only present recharge conditions are used to model construction, operation, closure and post closure.

Issue 9:
In the predictive models it appears that the change in hydraulic conductivity due to a) compaction beneath the Tailings Storage Facility (TSF) and the Mine Rock Storage Facilities (MRSFs) and b) blasting and isostatic rebound have not been taken into account.

Issue 10:
A critical assumption of the model is that dewatering of the pit will rely on a passive method of dewatering. What will happen if observed conditions are different from assumed, and that for slope stability reason dewatering wells need to be drilled? How will that change the outputs of the model?

Information Request:
SSN requests that the Modflow model be revised. The recharge zones and the recharge rates should be modified to consider the indirect evaporation from shallow groundwater and direct evaporation from streams. Details must be provided about the steps, data, and assumptions used when applying the Zone Budget package. KGHM needs to provide the input data, information about its source, and explain the processes followed during the creation and calibration of the model. The south boundary of the Model Domain should be assumed as a General Head Boundary (GHB) and not as a no flow boundary.

SSN requests that the model be refined enough and that the difference between simulated and observed results be adequately explained.

SSN requests that the model integrate hydrogeological parameters (i.e., hydraulic conductivity) obtained from representative field testing and long-term pumping tests. In particular, SSN requests that the proponent explains how they have integrated the information gained through the completion of pumping test BGC10-PW01 in the model and why the model calibration process resulted in the selection of K of 10^{-9} m/s, very different (28 times smaller) from what the pumping test provided (2.8×10^{-8} m/s).

SSN requests that the proponent use the River Package, instead of the Drain package for all the streams and creeks in the RSA. Proper sensitive analyses should be conducted.

SSN requests that the modeled scenarios take into account the impact of climate change.

SSN requests that compaction under the TSF, blasting, and isostatic rebound be also taken into account in predictive modelling.

Finally, SSN requests that KGHM thoroughly addresses the alternative of having to use dewatering wells at the periphery of the pit, should higher groundwater flow than expected prevent using a passive dewatering method.

Groundwater Monitoring plan

Issue:
There are not enough groundwater monitoring wells to adequately characterize the hydrogeological conditions and their distribution does not cover some key areas, in particular south of TSF, west of the Mine site, and the Regional Study Area for both surficial and bedrock layers.
There is no discussion about a future monitoring plan and the schedule for improving the groundwater monitoring network during construction and operation. It is obvious that some of the monitoring wells will be destroyed during construction and mine site development.

Information Request:
SSN requests that a detailed monitoring plan describing the deployment of new monitoring wells and a proposed testing program, both for water quality and quantity, be provided.

Other Comments

1	Main Report, page 6.4-4	Incorrect catchment area for Kamloops Lake – stated as 29,050 km^2, should be 39,050 km^2.
2	Main Report, Figure 11.7-9	There appears to be inconsistencies in final elevations for the TSF supernatant pond. Figure 11.7-9 shows elevation 1043 m at the end of mine life whereas Figure 4-2 of Appendix 3-D shows an elevation of about 1053 m.
3	Main Report Chapter 11 Section 11.13, page 11.13-4.	This section states that the inflow design flood for the TSF was a 24-hr PMP plus snowmelt. This is inconsistent with Appendix 3-D which states that a 72-hr PMP plus snowmelt was used for TSF design. Given the large storage volume available in the TSF to attenuate runoff in major storms, design storm for the TSF should be a long duration, large volume event (i.e. a 72-hour as opposed to 24-hour event). The documents should be revised to resolve inconsistencies.
4	Appendix 3-D, Section 9.2-1, page 9-1	On closure, it is proposed that TSF runoff be passed “into an engineered channel towards the south of the TSF and into Humphrey Creek”. Information should be provided on the conceptual alignment and geometry of this channel, similar to that provided for the Peterson Creek channel downstream from Jacko Lake. Appendix 3-D refers to a post-closure TSF spillway shown in drawing C180-KA39-5000-00-014. The referenced drawing is not included in the appendix; the drawing should be provided.
5	Appendix 3-D, page A1-2	The recommended inflow design flood for the TSF is given as “runoff from a 72-hour PMP + 100-year return period snow pack – average annual snowpack”. The logic for subtracting the average annual snowpack is not explained and is inconsistent with CDA guidelines. The IDF should be computed from the 72-hour PMP plus 100-year snowpack.
6	Appendix 6.1-A, page 8	1:200 year wet and dry annual precipitation values given in text (452 and 168 mm) are not consistent with values in Table 2.10 (490 and 182 mm). Values of 1:200 year wet annual precipitation (either 452 or 490) seem low given that Appendix 6.4-C, Figure 7.1 shows 3 years in the synthetic 115-year precipitation record (1897 to 2011) with annual precipitation greater than 490 mm.

7	Appendix 17.4-E, Table 2	Table 2 references an "Immediate Catchment Area" to Jacko Lake of 211 ha and to Peterson Creek Downstream Pond of 480 ha and 300 ha depending on alternative. It is not clear what is meant by "Immediate Catchment Area". From a design perspective it would be more useful to provide the total catchment area tributary to each facility.
8	Appendix 6.4-A, Figure 3.4	It is difficult to tell from Figure 3.4 what period of data was available from JACINF for model development. Period of record and periods of data gaps should be tabulated for JACINF and all other gauge sites.
9	Appendix 6.4-A Section 3.4.2, and Appendix 6.4-B	There is no independent validation of the regression relationships used to generate the synthetic JACINF discharge time series in Appendix 6.4-A. The regression relationships were developed using data from 2008 through 2011. The regression equations should be validated against the 2014 JACINF discharge data reported in Appendix 6.4-B.
10	Appendix 6.4-A, Appendix A	Tables A1 through A5 (stream discharge measurement summaries) are missing from Appendix A of Appendix 6.4-A.
11	Appendix 6.4-C, page 6	Incorrect catchment area for Kamloops Lake – stated as 29,050 km^2, should be 39,050 km^2.
12	Appendix 6.3-A, p116 table 5.1	Well RES-6 coordinates provided in the table are incorrect.
13	Appendix 6.6-C p113 to 122 and Appendix 6.6-A p618sq	Time – drawdown/log derivative drawdown plots do not have legend
14	Appendix 6.6-C Table 5 p31	Error in BGC14-PW01 coordinates: Northing = 5609**4**57 instead of 5609957

15	Raw data provided on BGC14-PW01 pumping test	• Given elevations of logger in Dec 2014 and February 2015 do not allow continuity in the water level data between these months and do not fit with the given groundwater elevation in Table 5 Appendix 6.6-C. There is no information whether the provided data were corrected for barometric pressure. Barometric pressure raw data was not provided.
16	Raw data provided on BGC14-004 during pumping test in BGC14-PW01	• Water level data for BGC14-004 during pumping test in BCG14-PW01 could not been entirely recorded with the level logger, probably due to the fact that it was installed too high in the well. In the graph, the missing part was probably completed with the manual data, but this data was not provided to us.

Summary

The key weak points and elements that require additional information and investigations are the following:

- The water balance and how the movement of water (including storage in ponds and lakes) will change over time have been defined with a relatively high level of uncertainty. They need to be better defined.
- Climate change has not been taken into account. An increase in temperature is expected due to climate change. This will likely exacerbate the deficit in water which is already estimated to augment over time due to the proposed mining.
- The impact of the proposed mine on the modification of the groundwater regime has been poorly defined. In particular, our review of KGHM data contradicts the conclusion drawn by KGHM's consultants that Jacko Lake will not be affected by the proposed 450 m deep mine. Additional hydrogeological investigations have to be completed to improve the understanding of the groundwater regime and to better estimate how Jacko Lake and Peterson Creek could be negatively impacted by the proposed project.
- The estimated change in water quality has to be quantified compared to water quality before any mining activity were carried out, and the significance of potential environmental effects has to be presented with more objectivity.

Closure

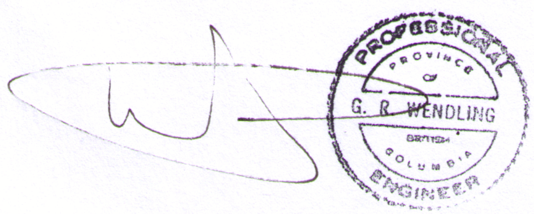
Conclusions and recommendations presented herein are based on available information at the time of the study. The work has been carried out in accordance with generally accepted engineering practice. No other warranty is made, either expressed or implied. Engineering judgement has been applied in producing this letter-report.

This letter report was prepared by personnel with professional experience in the fields covered. Reference should be made to the General Conditions and Limitations attached in Appendix 1.

GW Solutions is pleased to produce this document. If you have any questions, please contact me.

Yours truly,

GW Solutions Inc.



Gilles Wendling, Ph.D., P.Eng.
President

Appendices

Appendix 1: GW Solutions Inc. General Conditions and Limitations
Appendix 2: Documents reviewed by GW Solutions Team

APPENDIX 1

GW SOLUTIONS INC. GENERAL CONDITIONS AND LIMITATIONS

This report incorporates and is subject to these "General Conditions and Limitations".

1.0 USE OF REPORT

This report pertains to a specific area, a specific site, a specific development, and a specific scope of work. It is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site or proposed development would necessitate a supplementary investigation and assessment. This report and the assessments and recommendations contained in it are intended for the sole use of GW SOLUTIONS's client. GW SOLUTIONS does not accept any responsibility for the accuracy of any of the data, the analysis or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than GW SOLUTIONS's client unless otherwise authorized in writing by GW SOLUTIONS. Any unauthorized use of the report is at the sole risk of the user. This report is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of GW SOLUTIONS. Additional copies of the report, if required, may be obtained upon request.

2.0 LIMITATIONS OF REPORT

This report is based solely on the conditions which existed within the study area or on site at the time of GW SOLUTIONS's investigation. The client, and any other parties using this report with the express written consent of the client and GW SOLUTIONS, acknowledge that conditions affecting the environmental assessment of the site can vary with time and that the conclusions and recommendations set out in this report are time sensitive. The client, and any other party using this report with the express written consent of the client and GW SOLUTIONS, also acknowledge that the conclusions and recommendations set out in this report are based on limited observations and testing on the area or subject site and that conditions may vary across the site which, in turn, could affect the conclusions and recommendations made. The client acknowledges that GW SOLUTIONS is neither qualified to, nor is it making, any recommendations with respect to the purchase, sale, investment or development of the property, the decisions on which are the sole responsibility of the client.

2.1 INFORMATION PROVIDED TO GW SOLUTIONS BY OTHERS

During the performance of the work and the preparation of this report, GW SOLUTIONS may have relied on information provided by persons other than the client. While GW SOLUTIONS endeavours to verify the accuracy of such information when instructed to do so by the client, GW SOLUTIONS accepts no responsibility for the accuracy or the reliability of such information which may affect the report.

3.0 LIMITATION OF LIABILITY

The client recognizes that property containing contaminants and hazardous wastes creates a high risk of claims brought by third parties arising out of the presence of those materials. In consideration of these risks, and in consideration of GW SOLUTIONS providing the services requested, the client agrees that GW SOLUTIONS's liability to the client, with respect to any issues relating to contaminants or other hazardous wastes located on the subject site shall be limited as follows:

(1) With respect to any claims brought against GW SOLUTIONS by the client arising out of the provision or failure to provide services hereunder shall be limited to the amount of fees paid by the client to GW SOLUTIONS under this Agreement, whether the action is based on breach of contract or tort;

(2) With respect to claims brought by third parties arising out of the presence of contaminants or hazardous wastes on the subject site, the client agrees to indemnify, defend and hold harmless GW SOLUTIONS from and against any and all claim or claims, action or actions, demands, damages, penalties, fines, losses, costs and expenses of every nature and kind whatsoever, including solicitor-client costs, arising or alleged to arise either in whole or part out of services provided by GW SOLUTIONS, whether the claim be brought against GW SOLUTIONS for breach of contract or tort.

4.0 JOB SITE SAFETY

GW SOLUTIONS is only responsible for the activities of its employees on the job site and is not responsible for the supervision of any other persons whatsoever. The presence of GW SOLUTIONS personnel on site shall not be construed in any way to relieve the client or any other persons on site from their responsibility for job site safety.

5.0 DISCLOSURE OF INFORMATION BY CLIENT

The client agrees to fully cooperate with GW SOLUTIONS with respect to the provision of all available information on the past, present, and proposed conditions on the site, including historical information respecting the use of the site. The client acknowledges that in order for GW SOLUTIONS to properly provide the service, GW SOLUTIONS is relying upon the full disclosure and accuracy of any such information.

6.0 STANDARD OF CARE

Services performed by GW SOLUTIONS for this report have been conducted in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions in the jurisdiction in which the services are provided. Engineering judgement has been applied in developing the conclusions and/or recommendations provided in this report. No warranty or guarantee, express or implied, is made concerning the test results, comments, recommendations, or any other portion of this report.

7.0 EMERGENCY PROCEDURES

The client undertakes to inform GW SOLUTIONS of all hazardous conditions, or possible hazardous conditions which are known to it. The client recognizes that the activities of GW SOLUTIONS may uncover previously unknown hazardous materials or conditions and that such discovery may result in the necessity to undertake emergency procedures to protect GW SOLUTIONS employees, other persons and the environment. These
procedures may involve additional costs outside of any budgets previously agreed upon. The client agrees to pay GW SOLUTIONS for any expenses incurred as a result of such discoveries and to compensate GW SOLUTIONS through payment of additional fees and expenses for time spent by GW SOLUTIONS to deal with the consequences of such discoveries.

8.0 NOTIFICATION OF AUTHORITIES

The client acknowledges that in certain instances the discovery of hazardous substances or conditions and materials may require that regulatory agencies and other persons be informed and the client agrees that notification to such bodies or persons as required may be done by GW SOLUTIONS in its reasonably exercised discretion.

9.0 OWNERSHIP OF INSTRUMENTS OF SERVICE

The client acknowledges that all reports, plans, and data generated by GW SOLUTIONS during the performance of the work and other documents prepared by GW SOLUTIONS are considered its professional work product and shall remain the copyright property of GW SOLUTIONS.

10.0 ALTERNATE REPORT FORMAT

Where GW SOLUTIONS submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed GW SOLUTIONS's instruments of professional service), the Client agrees that only the signed and sealed hard copy versions shall be considered final and legally binding. The hard copy versions submitted by GW SOLUTIONS shall be the original documents for record and working purposes, and, in the event of a dispute or discrepancies, the hard copy versions shall govern over the electronic versions. Furthermore, the Client agrees and waives all future right of dispute that the original hard copy signed version archived by GW SOLUTIONS shall be deemed to be the overall original for the Project. The Client agrees that both electronic file and hard copy versions of GW SOLUTIONS's instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except GW SOLUTIONS. The Client warrants that GW SOLUTIONS's instruments of professional service will be used only and exactly as submitted by GW SOLUTIONS. The Client recognizes and agrees that electronic files submitted by GW SOLUTIONS have been prepared and submitted using specific software and hardware systems. GW SOLUTIONS makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

APPENDIX 2

Reviewed documents

Main Report Chapters or Sections:

Chapter 3 Detailed Project Description

Chapter 5 Effect Assessment Methodology

Chapter 6 Assessment of Potential Environmental Effect

Section 6.3 Surface Water Quality

Section 6.4 Surface Water Quantity

Section 6.5 Groundwater Quality

Section 8.7 Supporting Topic – Jacko Lake

Section 11.7 Water Management and Hydrometric Monitoring Plan

Section 11.12 Risk Management Plan (Accidents and Malfunctions)

Section 11.13 Natural Hazards Management Plan

Section 11.14 Emergency Response Plan

Appendices:

3-C Open Pit Geo Design

3-D Tailings Storage Facility Design Report

3-F Jacko Lake and Peterson Creek Downstream Pond Engineering – Preliminary Design

3-I Mine Site Infrastructure

6.1-A 2014 Climatology Report

6.3-A Baseline Water Quality Report

6.3-C Water Quality Model Report

6.4-A 2012 Hydrometeorology Report

6.4-B Baseline Hydrology Report – 2014 Stream flow Monitoring

6.4-C Water Balance Model

6.5-A Plume Migration Analysis to RES-2

6.6-A Baseline Groundwater Hydrology Assessment

6.6-B Ajax South Groundwater and Surface Water Site Investigation (incl. Appendix 2 - Pumping test interpretation)

6.6-C Peterson Creek Aquifer Pumping Test

6-6-D Groundwater Flow Model

6.7-E Thompson River Hydrologic and Hydraulic Impacts

17.4-D Peterson Creek Diversion Alternatives Assessment

17.4-E Jacko Lake and Downstream Pond Alternatives Assessment

17.6-B Ajax Mine: Tailings Dam Failure Mode Assessment and Dam Breach Inundation Evaluation