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To: Matt Kelley, Senior Planner
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Dear Matt Kelley,

Please include these comments to the Idaho-Maryland Mine DEIR.

Review of the Idaho-Maryland Mine DEIR Groundwater Model

This review of the predictions on the impacts to groundwater and wells for the Idaho-Maryland Mine is based primarily upon two DEIR documents: "Appendix K.2_Groundwater Hydrology and Water Quality Analysis.pdf" by Emko (EMKO) and "Appendix K.3_Groundwater Model Report.pdf" by Itasca (ITASCA).

1. Mine water Outflow Issues

The Hydrology Study uses data on mine water outflow rates that are based on approximations and estimates taken on only a few widely separated instances. These data are contradicted by more reliable historical data.

a) Estimated Mine Drain Flow Rates per DEIR
There are 3 identified discharge points for the mine at Wolf Creek: The Eureka Drain (ED-1), the 24" East Eureka Shaft Drain from the Navo building (IMD-1), and the East Eureka Shaft steel pipe from the Navo building (IMD-2). All drains are at or below 2502 feet elevation. A fourth potential drain is questioned as to source.

The ITASCA groundwater model used the following outflow data that was provided in EMKO Section 3.3.4, summarized here:

Flow data, ED-1:
- "...in the range of 100 gpm (Condor, 1994)
- "...only a few gpm" (EMKO Feb 2018, Dec 2018)
- "...in the range of 20 to 25 gpm" (EMKO, April 17, 2019)

Flow data, IMD-1:
- "...to be about 60 gpm." (Todd Engineers, 2007)
- "...consistent with Todd..." (EMKO Feb 2018, Dec 2018)
- "...approximately 100 gpm." (EMKO April 17, 2019)

Flow data, IMD-2:
- "...in the range of 1-2 gpm." (EMKO Feb, 2018)

Flow data, D-1:
- "...only a few gallons per minute" (EMKO? Feb, Dec 2018, April 2019)

This scant data is the basis of the outflow values of 60-125 gpm reported in the DEIR. [DEIR 4.8-19]

In order to establish a viable model of the hydrology for the mine, these critical questions should be unanswered:

- What is the actual measured outflow?

- How does it vary seasonally?
- What are the current outflows at the Wolf Creek drains under the current model?
- How do the model flows compare with the measured outflows?

b) Measured Mine Drain Flow Rates per Historical Records

More thorough and inherently precise measurements were provided by an earlier study. According to the Technical Assessment by James Askew Associates Inc, which was prepared in 1991 for the 1995 Empire Gold permit application to dewater the mine:

"ED-1 is estimated to be discharging 100 gallons per minute [gpm] of water. IMD-1 and IMD-2, which are located about 25 ft upstream of ED-1 **discharge in the range of 500 gpm to 1,200 gpm depending upon the season. Weir measurements are made by NID at IMD-1.***"* [Askew, Section 5.3.2 Hydrology - Surface Water, pg 5.3.]

This implies that the total current discharge from the mine into Wolf Creek is likely in the range of 600 to 1300 gpm, depending upon the season, or almost ten times the amount reported in the DEIR.

The reported outflow in the EMKO report appears to be grossly understating the actual outflow. ITASCA did not report any water/mass balance for any of their simulations. Inherent in any numerical simulation, like ITASCA's, is a water balance (so that balance errors can be evaluated):

- Year-round accurate outflow measurements taken daily should be collected.
- Data should be collected for several years, including at least a year with normal rainfall and a year with low rainfall, in order to establish a baseline for groundwater modeling and impact assessment.
- Assessment of the fractional contributions of surface runoff and percolation can be better achieved by outflow volume logging.
- Water balances for the mine area should be provided and verified with the model.

2. Mine Water Inflow and Transmissivity Estimation Issues

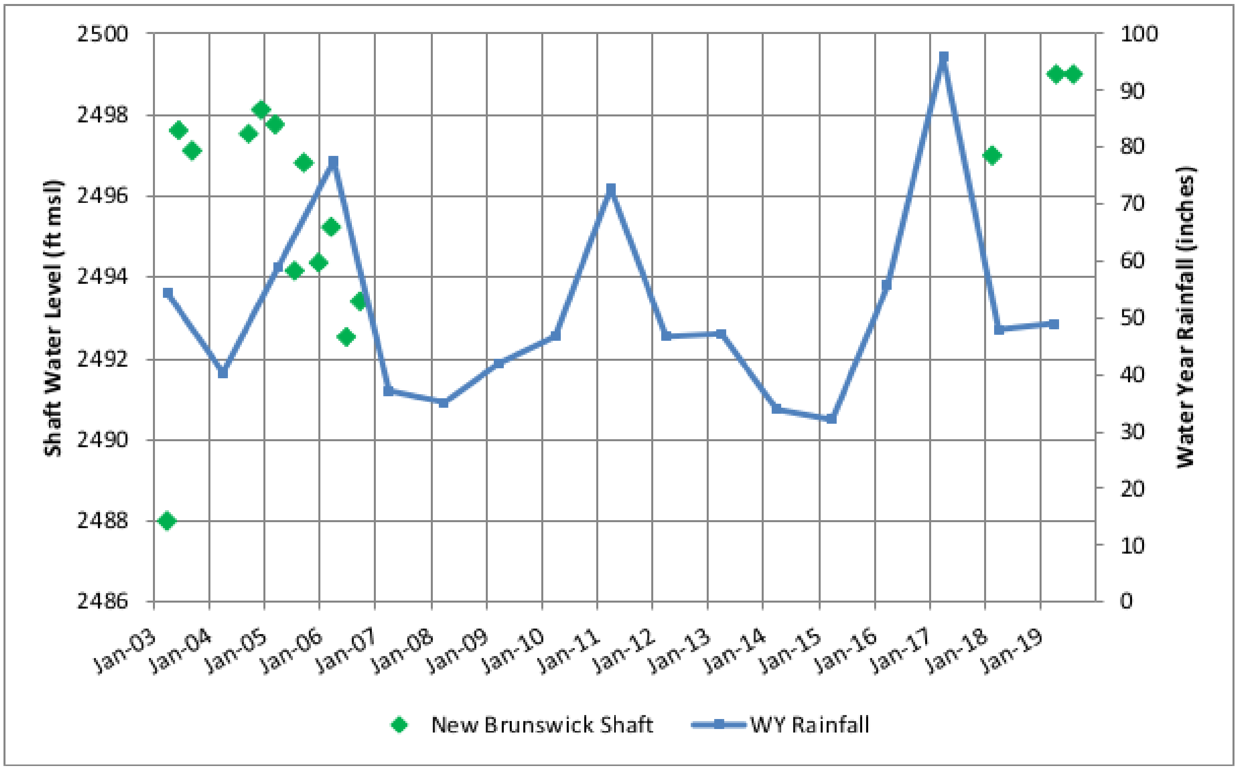
a) The analysis of seasonal measurements of the level of water in the mine is flawed and does not support the transmissivity assumptions used in the model.

The Hydrologic study concludes that there are no correlations between the elevation of the water surface in the mine and the seasonal precipitation. It uses this point to support the position that there is little volumetric transmission of the water from the upper five hundred feet of fractured rock down into the mine. There are a number of reasons why the mine water level data is not useful as a basis for determining transmissivity.

First, note that the mine is flooded, and Measurements were taken in 2003-2007 and 2018-2019 at the New Brunswick (NB) Shaft (EMKO Fig 3-7). The water level in the mine, averages 2497 ft elevation. A few measurements have been lower, with one at 2488, and they have a maximum of around 2499 feet.
Second, note that minewater drains out of the mine at the drains located along the main branch of Wolf Creek, which is over 1.5 miles away from the NB Shaft: the East Eureka drain (IMD-1) is at 2497 ft elevation. A diagram of waterflow through the mine is in Figure 3-20 (EMKO).
Mine water level data - EMKO argues that the levels of water in the NB Shaft are independent of the seasonal rainfall and provides a graph showing both rainfall and NB Shaft water levels. (see Figure 3-7 below) Unfortunately, the NB Shaft data are very limited. Only about 15 measurements are provided. (Additional issues with the interpretation of the data are discussed in 4, below.) Note that of these, nine are at or above 2497', which is the drain level.
Obviously, if the water level exceeds the drain level, the water will flow out. The higher the NB Shaft level, the higher the rate of drain outflow. Thus, water levels in the NB Shaft would not provide a valid assessment of the amount of water flowing into the mine unless the outflow is measured.

Additionally, inflow and outflow is complicated by the fact that the near-surface region around the shafts in the area may be quite fractured and/or weathered and so seepage could occur through those more permeable zones.

Figure 3-7 Comparison of Shaft Water Levels with Rainfall



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[3] IMMC used an estimated collar elevation of 2,750 ft msl. Since the collar elevation has been confirmed at 2,756 ft msl, the water elevations reported by IMMC (2007) have been increased by six feet in this report.

[4] One measurement, from June 2004, had a reported elevation of 2,581 ft msl, or about 100 feet higher than the other 12 measurements made by IMMC (2007). Review of the data presented by IMMC (2007) suggests that the anomalous June 2004 elevation may be due to a data recording or reporting error. Thus, it is not considered further in this report.

EMKO Environmental, Inc. 31

b) Invalid interpretations of seasonal precipitations vs mine water levels.

The seasonal interpretation of the New Brunswick Shaft water levels data is flawed. Even without considering the fact that the mine drain outflow rates will create an upper limit to the change in water levels in the NB Shaft, the data does not support the claims made in the EMKO report. EMKO claims that the data "*...demonstrate that the variations in the water level in the shaft do not occur on a seasonal basis, and that there is not a consistent correlation between water levels in the shaft and rainfall.*" [p30, and Figure 3-7]

There are several errors to this reasoning. First, note that data is sparse, with only 12 samples over a four year period in 2003-2006, plus a single sample in 2018, and two samples in 2019. Also note that the data is taken at various times of the year, making direct year to year correlations limited. Also note that the annual rainfall year is based upon precipitation from October thru September, and a single data point for each year's rainfall is apparently placed on April 1, in the middle of that year's rain season. (Figure 3-7).

The chart lacks sufficient granularity to be useful. For example, a year's rainfall may be above average, but an NB Shaft measurement taken in December of that year may reflect that the first few months of the rainy season and the preceding last 6-9 months of the prior year's seasonal rainfall, which could be below average even though the rainfall year was recorded as above normal due to rains after December for that year.

In order to detect variation seasonally, it is more useful to look at the total rainfall in the months preceding any particular NB Shaft measurement. Thus, for the NB Shaft value at ~2497' elevation on around Feb 2018, the total rainfall from June 2017 through Feb 2018 was only 25.98". This is below normal. This correlates with a lowered level in NB Shaft. But the higher value of the 2017 total rainfall year reflects higher precipitation from more than 9 months earlier, giving the false impression of non-correlation.

Note also that the 2019 precipitation data is invalid according to precipitation records. The 2019 precipitation should be graphed at 68.15 inches, the correct precipitation for that period. But it is graphed at an incorrect value of 48 inches. Correcting the graph would show a direct correlation between higher precipitation and NB Shaft levels.

In addition, in close examination of the data for 2005, there is a clear drop in levels between the late Winter sample and the mid Summer sample followed by a Fall rebound. Also, again in 2006, there is a clear drop from late Winter to mid Summer followed by a rebound. Thus, data from both of those years **seems to imply that there actually is a seasonal correlation.**

Complicating this, an unknown amount of surface water or near surface percolation from seasonal precipitation may impact mine water inflows. However, the model report assumes that the entire seasonal pumping variations as reported in historical records are from surface leakage and not due to transmission through the bedrock: *"...during the rainy season, total pumping would probably be in excess of 900 gpm, perhaps in the range of 1,400 to 1,600 gpm. This estimate is based on the observation that the rainy season flows would increase by approximately 500 gpm for the historical Idaho-Brunswick Mine. [Itasca, pg 23 (35/93)]* ITASCA goes on to assume that this is not an indication of any bedrock transmissivity: *"...the excess inflows are due to surface-water runoff and percolation."*

It seems surprising that an argument would be made that there is no seasonal correlation between mine water levels as a basis for determining low transmissivity while failing to consider that there are maximum water levels in the mine due to the drain elevation, and then acknowledge that there is a seasonal variation in pumping rates. Why wouldn't seasonal variations in pumping rates show up as seasonal variations in the mine water levels?

However, all of this may be a moot point because water migration downwards to depths may be delayed. Latency in water conductance time from surface percolation through the bedrock to depths may take a year or two and produce a smoothing effect on variations in mine water levels. This should be taken into consideration. Data for the years prior to 2003 would be needed to make that assessment.

Looking at the graph based upon annual precipitation over multiple years, there does appear to be a downward trend in shaft levels from 2004 to mid 2006. And the annual precipitations were notably below normal from 2003 to December of 2005. So the graph seems to show a multiyear downward trend in the NB Shaft levels with a clear seasonal variations signal also showing in the measurements.

In conclusion, the given EMKO conclusions from the comparison between NB Shaft water levels and seasonal precipitation using figure 3-7 do not hold water. The following are needed:

- Year-round logging of mine water level and outflow should be collected.

- Data should be collected for several years, including at least a year with normal rainfall and a year each with low and high rainfall, in order to establish a baseline for groundwater modeling and impact assessment.
- The data from the outflow and the data showing changes in mine water level can then be compared with granular rainfall data to legitimately make an assessment of the amount of seasonal variation in mine water inflows.
- The data could then be used to provide an estimate of transmissivity from the surface.

c) Data from monitoring of wells is old, limited to a few years, and with no well owner's usage data.

Monitoring of wells was conducted in 1995-2001, 2003-07 ((DEIR Appendix pg 4.8-11))
Well log records show seasonal variability but there is no data provided on how much of the well water level changes are due to dry season water usage and how much is a reflection of the actual lowering of the ground water level overall.

No recent well monitoring was conducted during drought years, and no assessment was made on the long term predicted impacts of climate change. These impacts include: warmer weather, changing rainfall amounts, shifting of rainfall periods, as well as consideration of water usage changes by property owners due to drought.

d) Surface Infiltration - Groundwater Recharge
The study fails to account for a substantial decrease in groundwater recharge from precipitation as a result of planned project development.

The EMKO hydrology report (Appendix K.2) claims that groundwater recharge due to surface infiltration would be essentially unchanged: "Thus, the project would not result in any appreciable new areas of compacted soils or impermeable surfaces that could substantially restrict or otherwise interfere with groundwater recharge." (p 121-122)

The analysis of changes in surface infiltration needs to include changes due to the engineered fill which covers 31 acres on the Brunswick site. In addition, infiltration would be reduced on the Centennial site, where the engineered fill will reduce permeability over 44 acres, bringing the total of near-impermeable engineered fill to 75 acres.

Even if Rise Gold abandons the use of the Centennial site for mine waste dumping, as in DEIR Alternative 2, there is a cumulative impact from the planned DTSC cleanup of reduced groundwater recharge in the areas of remediation tailings placement, based upon the draft RAP. (Note, the Final RAP has not been prepared.)
From DTSC Remedial Action Plan draft, p27 (52 of 623):

"The evaluation considers the on-site placement of tailings with elevated metals concentrations at a location that is not subject to surface water erosion or leaching (e.g., engineered fill with appropriate surface and subsurface drainage controls), and assumes that the engineered fill will have a simplified environmental attenuation factor of 100 for protection of surface water and groundwater quality, pursuant to the Designated Level Methodology (DLM; RWQCB, 1989 Jun)." and
"Consolidation and capping of the tailings as engineered fill with appropriate surface and subsurface drainage controls at a location away from Wolf Creek **will significantly reduce the potential for storm water erosion and infiltration.***"*

In addition, the impervious surfaces of the Brunswick site will increase by 6 acres. (DEIR Project Description p14):
"The site currently has approximately 9 acres of impervious asphalt paving from previous land uses. Some of the existing asphalt areas will be removed and some will be reused. After completion of construction, the impervious surfaces and buildings will cover a total of approximately 15 acres of the Brunswick Industrial Site"

In total, 81 acres will have a reduced infiltration which should be included in the ground water calculations.

e) Estimated surface areas in the mine works have limited reliability
Estimates of groundwater transmissivity rely in part upon estimates about the subterranean surface area of the mine works as compared to the amount of mine water outflow. In the hydrology report the typical drift dimensions are assumed to be 7.5ft x 8.5ft (WxH) [pg 12]. However, in prior studies (DEIR Appendix F.2, Hydrogeological Overview, Geosolutions, 2008, p 9) 6ft x 6ft is used as the average cross section for stopes, raises, winzes, shafts, and drifts. Further details followed:

"Because of the type of equipment utilized in mining during early to mid 1900s beneath Grass Valley it is reasonable to assume that drifts now located throughout the Idaho-Maryland mine have a cross sectional dimension of about six feet wide and six feet high." (p17)

The following must be explored:

- Given this contradiction, what is the justification for using the larger size for the surface area estimates?
- What is the source of the 7.5ft x 8.5ft measurement?
- How would the reduction of surface area per running foot from 24.5 ft (2H +W) to 18ft, or about 25%, affect the assumptions of transmissivity and the overall hydrological model?
- For the same amount of measured water outflow, a decrease in the transmitting surface area indicate a corresponding increase in transmissivity of bedrock.
- The model should use those higher values as a starting point.

3. Groundwater Model Elements

a.) Additional drawdown from the proposed new access shaft
A new access shaft is proposed close to the creek, but a cone of depression of groundwater levels like the one indicated at the New Brunswick Shaft is not shown. This new shaft is particularly worrisome because of its proximity to South Fork Wolf Creek.

The following questions must be answered:

- Was the new access shaft included in the Itasca ground water model?
- What is it's precise location? The shaft should be located on all maps.
- How far is it from South Fork Wolf Creek, a perennial stream?
- Is it within 100 ft?
- Was there analysis of the impact of the groundwater caused by the significant 60 ft deep excavation needed to build a permanent access shaft?
- Will this lead to more draw down of near surface groundwater?
- How will the creation of a large excavation and a new access shaft impact the near surface ground waters that feed SFWC?

b.) Does the model include numerous existing near surface features from the historical mining?
There is no indication that the many other near surface features of the Idaho-Maryland Mine were included in the analysis as additional areas of groundwater drawdown and/or conduits for water movement. In addition to the existing NB Shaft, the technical study "near surf.." identifies 14 other shafts, drifts, and drain features which pass through the more transmissive top few hundred feet of fractured bedrock. Each of these features will potentially impact the model by increasing transmission out of the top fractured rock zone. And most of them currently have water levels that are close to the surface. Hence the impacts would be noteworthy.

In addition, there are likely additional unidentified legacy mine near surface features which may affect the model. For example, note the unexplained sinkhole area noted in "Geotechnical Assessment of Near Surface Mine Features":

“The property owner indicated that approximately two years ago settlement of the ground surface was observed near the shaft location and was backfilled with boulders and soil. No documentation available. Additional settlement at the shaft location, measuring approximately four feet by five feet wide and 18 inches deep, was observed in February 2020.” (DEIR Appendix H.6, p5)

There are numerous other nearby mines, both documented and undocumented. A survey of mines adjacent to and nearby, and a survey of reported sinkholes or other features identifying mining activity should be conducted to determine whether other near surface mine features may impact the groundwater model.

c) Did the mining model include all potential mining areas?

The model assumes the areas to be mined will be confined to very limited areas at depths greater than 1000’ (DEIR Appendix K.3, pgs 11, 30). However, the mineral rights provide no restriction to mining anywhere within the 2585 acres and to within 200’ of the surface. Furthermore, mining activity is indicated for within 500 feet of the surface:

“New underground workings, except for the service shaft and new ventilation raise, would be below 500 feet of the ground surface.” (DEIR 3.19)

The groundwater model needs to assume that all areas within the mineral rights zone could be mined.

d) The model simulations were conducted with the assumption that mining would be only for 25 years.

All computer models that attempt to simulate real world conditions are based upon assumptions. Even minor differences between input data and actual real world conditions can result in errors that increase exponentially over time. The longer that the computer model is run, the greater the potential for deviation from actual outcomes.

From page 23 of “Appendix K.3_Groundwater Model Report” by Itasca: *“The predictive numerical simulations were conducted to assess the potential inflows to the mine workings, the effect on nearby domestic wells, and the potential effects on the creeks in the Mine area during mine development and production* ***between the assumed years of 2020 and 2045 (Year 1 to Year 25), which is the current mine plan.****”*

The permit request is for 80 years. Simulations in the model extended the calculations for 40 years to a total of 65 years. This is still short of almost 80 years of mining expansion.

The following must be considered:

- The model should be run for 80 years if possible.
- The model authors should justify the simple extension of the run times, along with an analysis of the reliability of a model over such an extended period of time.
- Examples of actual real life validation of similar numerical simulations over this extraordinary length of time and similar complex geological conditions must be provided.
- What is the model predictive success rate?
- How does the range of deviation change over longer periods?
- In order to assess the relevance and accuracy of the model, a listing of the initial conditions and additional data inputs must be provided.
- The complete model data used in the simulation is a key assessment component and must be included in the documentation.

g) Assumptions of transmissivity and anisotropy ratios based upon homogeneity of the rock are questionable. Faulting compounds the issue.

The model also relies upon assumptions regarding a K value anisotropic ratio of 10:1 horizontal to vertical conductivity. (Ten times more horizontal groundwater transmission than vertical transmission.) This value for anisotropy is very frequently assumed. It holds up particularly well for sediments and sedimentary rocks that haven't been tilted. It wouldn't necessarily hold for bedrock where most of the permeability is related to fractures.

There are numerous faults in the area. The Brunswick block, which is the primary mass of rock in which the proposed mine will operate, is an immense wedge of rock cleaved by 3 major faults, and numerous lessor subfaults.Within this zone are also numerous lessor faults. The mine project is targeting potential ore bodies that are more or less bounded by the Morehouse fault, the 6-3 fault (Weimar), and the Idaho fault.

The transmissivity through the fault planes may be significantly lower than the surrounding rock, and groundwater movement may be routed by these barriers. In the Hydrogeological Technical Memo prepared by GeoSolutions in 2008 for the Emgold project:

"Movement along interfacing rock blocks located within stress fields of this type usually produce grinding and crushing of materials within the interface of those structures. Materials produced by this action are commonly called mylonite and are a fine grained laminated material formed by extreme microbrecciation of the rock along the structural surfaces during movement. Because of the pulverization of these rock materials the mylonite generated by thrusting can behave like clay with very low permeability and hydraulic conductivity. Therefore, it is likely the migration of fluids through these structures will be limited or highly routed along lines or planes adjacent to the faults." (Emgold 2008 DEIR Appendix F.2 pgs 12, 14, 16)

This implies that the 6-3 fault and Morehouse faults, which trend generally in a North-South direction, may form effective walls constraining the horizontal movement of groundwater. The model uses the concept that groundwater movement is predominantly in the East to West direction. *"all of the geologic units were assigned with an anisotropy ratio (i.e., a K x /K z value) of 10."* [note: x is E-W horizontal and z is vertical]

The assumptions that the bedrock can be characterized by assuming homogeneity is a big assumption on its own, but the complexities of numerous faults which may or may not transmit or block groundwater flow raises the uncertainty to new heights. There are likely other faults east of the project which are not mapped. The model sensitivity analysis was run with the consideration that faults may be more transmissive of groundwater. The opposite case should be evaluated.

- The groundwater model should be run with faults having significantly lower transmissivity or K values.
- The model should be run with different anisotropic ratios having proportionally lower horizontal transmissivity.
- There are numerous lessor faults identified within the I-MTech_Report which should be added to the model. (see https://www.risegoldcorp.com/uploads/content/I-M_Tech_Report.pdf)

The following must be answered:

- What are the potential impacts when mining activities penetrate or remove portions of an impermeable fault wall?
- Are there measurable drop offs in groundwater surface topography that would indicate an impermeable or lessor permeable barrier?

3. Conclusion

The ITASCA groundwater model has significant issues with data reliability, initial conditions, and modeling assumptions, calling into question its reliability. The questions raised throughout this report must be answered in the DEIR. In particular, additional model runs should be conducted to verify the reasonableness of the assumptions of the model in terms of mine water discharge, current well logs, and other more adequately measured data as detailed above. Additional sensitivity analyses should be conducted to look at how changing anisotropic values or applying decreased permeability at the faults would affect the predicted drawdowns. This would increase the likelihood that the model approaches reality.

The unreliability of the groundwater model in this situation cannot be used to conclude that groundwater impacts due to the Mine operations will be less than significant.

Thank you,
Ralph Silberstein, President
CEA Foundation