June A. Oberdorfer, March 27, 2022

Comments on Groundwater Modeling, Idaho-Maryland Mine

Documents reviewed:

1) Itasca Denver, Inc., March 2020a, *Predictions of Groundwater Inflows to the Underground Mine Workings at the Idaho-Maryland Mine*.
2) EMKO Environmental, Inc., March 2020a, *Groundwater Hydrology and Water Quality Analysis for the Idaho-Maryland Mine Project, Nevada County, California*.
3) EMKO Environmental, Inc., March 2020b, *Appendices, Groundwater Hydrology and Water Quality Analysis for the Idaho-Maryland Mine Project, Nevada County, California*.
4) Itasca Denver, Inc., December 2020b, *Groundwater Monitoring Plan, Idaho-Maryland Mine Project*.

Concerns:

Simulations by Itasca (2020a) of the effects of mine-dewatering produced a map of predicted drawdowns after 25 years of dewatering (Figure 5-7). The contours of equal groundwater drawdown in this figure show a maximum drawdown of approximately ten feet and the extent of drawdown over one foot approximate the limits of Rise Gold's mineral rights. This figure was reproduced by EMKO (2020a) and served as the basis for determining which private wells would experience excessive drawdown and thus need to be mitigated with a supplemental water supply from the Nevada Irrigation District.

An incorrect assumption was made in the running of these future predictions of mining impacts which led to a significant underestimation of groundwater drawdown, both in magnitude and areal extent. This assumption needs to be corrected to get both a more accurate prediction of the extent of the well drawdown caused by the predicted 25 years of mine-dewatering and a more accurate determination of the number of wells needing to be mitigated with supplemental water supply.

The computer model was calibrated to match historic dewatering rates (700 gallons per minute [gpm] toward the end of historic mining in 1956) and one groundwater measurement taken from near the end of the historic mining period at the Union Hill Mine shaft (a small mine that had been inactive for many decades). These calibrations are reflected in Figure 4-7 (Itasca, 2020a). The lower part of this figure shows a hydrograph (water elevation versus time) for simulated water levels within the New Brunswick Mine for the 700-gpm dewatering rate. Simulated water levels in the mine were around 1,150 feet above mean sea level (ft amsl) at the end of historic mining and recovered rapidly to about 2,500 ft amsl after the cessation of mine-dewatering.

The top portion of Figure 4-7 (Itasca, 2020a) shows a hydrograph of the calibration to the historic water level measurement in the Union Hill Mine shaft at the end of mine-dewatering when the water level was approximately 20 feet lower than at present. In order to calibrate to this one historic water level, Itasca had to insert a very low permeability barrier next to the Union Hill Mine into the model to create sufficient hydraulic isolation of the Union Hill Mine from the much lower water levels in the adjacent area. The hydraulic isolation of this Union Hill Mine area is supported by the fact that the current water levels in its shaft are about 165 feet higher than water levels in the New Brunswick Mine.

What is not known, other than at this one point in the Union Hill Mine, are the shallow groundwater levels in 1956. Itasca (2020a) does not present a map of groundwater drawdown for 1956 (as they do for the predictive modeling of 25 years into the future). Those simulated water levels in 1956 would provide important insights into what future water levels during mine dewatering would be and should be presented.

The water level in the Union Hill Mine shaft is shallow, and it is quite likely that the drawdown in 1956 in the shallow groundwater to the west (in the vicinity of the New Brunswick Mine) was significantly greater than the 20 feet observed at the Union Hill Mine, probably on the order of or greater than the 165-foot water level difference observed at present. Water levels to the west could have been on the order of 185 feet or more lower than present (20 feet plus 165 feet). It is a major shortcoming of Itasca's modeling report that they do not provide a drawdown map or hydrographs of the effects of historic mine-dewatering on the shallow aquifer.

The incorrect assumption that was made in the predictive modeling of future 25 years of mine-dewatering was in the initial condition (starting water levels) for that predictive simulation. Rather than taking present day water levels as the starting point for predicting the effects of mining for 25 years starting in 2019, they chose to use the water levels at the end of mining in 1956 (Sec. 5.1). Those water levels don't reflect the fact that there's no current dewatering, but rather reflect dewatering at a rate of 700 gpm. The incremental drawdown from increasing dewatering from 700 gpm to the future rate of 900 gpm is what is reflected in the map of impact (Figure 5-7, Itasca, 2020a) used to determine the area requiring mitigation by Rise Gold. Examining the predicted drawdown in Figure 5-7 in the vicinity of the Union Hill Mine, it would be expected to be greater than the historic drawdown measured of 20 feet if dewatering has increased over the historic rate. With drawdown being proportional to pumping rate, the drawdown would be expected to be on the order of 25 feet in the vicinity of the Union Hill Mine. Instead, drawdown in this area is on the order of a few feet (Fig. 5-7). Drawdowns further to the west in the vicinity of the New Brunswick Mine should be considerably greater than 20 feet, which they are not. This reduced drawdown compared to what was observed historically is the result of the incorrect assumption for the initial condition for predictive modeling.

This incorrect assumption minimizes both the magnitude of drawdown shown on the Figure 5-7 and the extent of the area affected. In addition to underestimating the number of domestic water supply wells impacted and requiring mitigation, this assumption also underestimates the extent of the area requiring groundwater monitoring (Itasca, 2020b). That area needs to be expanded. If the effects on dewatering on the discharge to nearby streams were calculated similarly to the effects on groundwater drawdown, then the amount of decrease in groundwater discharge to adjacent streams could be underestimated as well.

Itasca should clarify the results of their simulations by producing:

1) Both a groundwater drawdown contour map and a groundwater elevation contour map for the shallow aquifer immediately before the cessation of dewatering in 1956.
2) Hydrographs for simulated heads in the shallow aquifer for the historic period 1920 to 2020 plus continuation for the 25 years of predictive modeling for future mining. The hydrographs should be for groundwater elevation in ft amsl versus time for the 125 years and represent the heads in the shallow aquifer near wells labeled WS95, WS216, WS201, WS80, WS 91, and WS85 on Itasca Figure 2-6.
3) Model water budget (all volumetric water inputs and outputs) for the general area of the mineral rights boundary over the 125 years simulated, preferably in plot rather than tabular format, using the one-month time increment used in the modeling.
4) The model should be run using the 2019 water levels as the initial conditions for the predictive simulations. Contour maps, hydrographs, and water budgets should be provided for these revised predictive runs.

Figures Cited

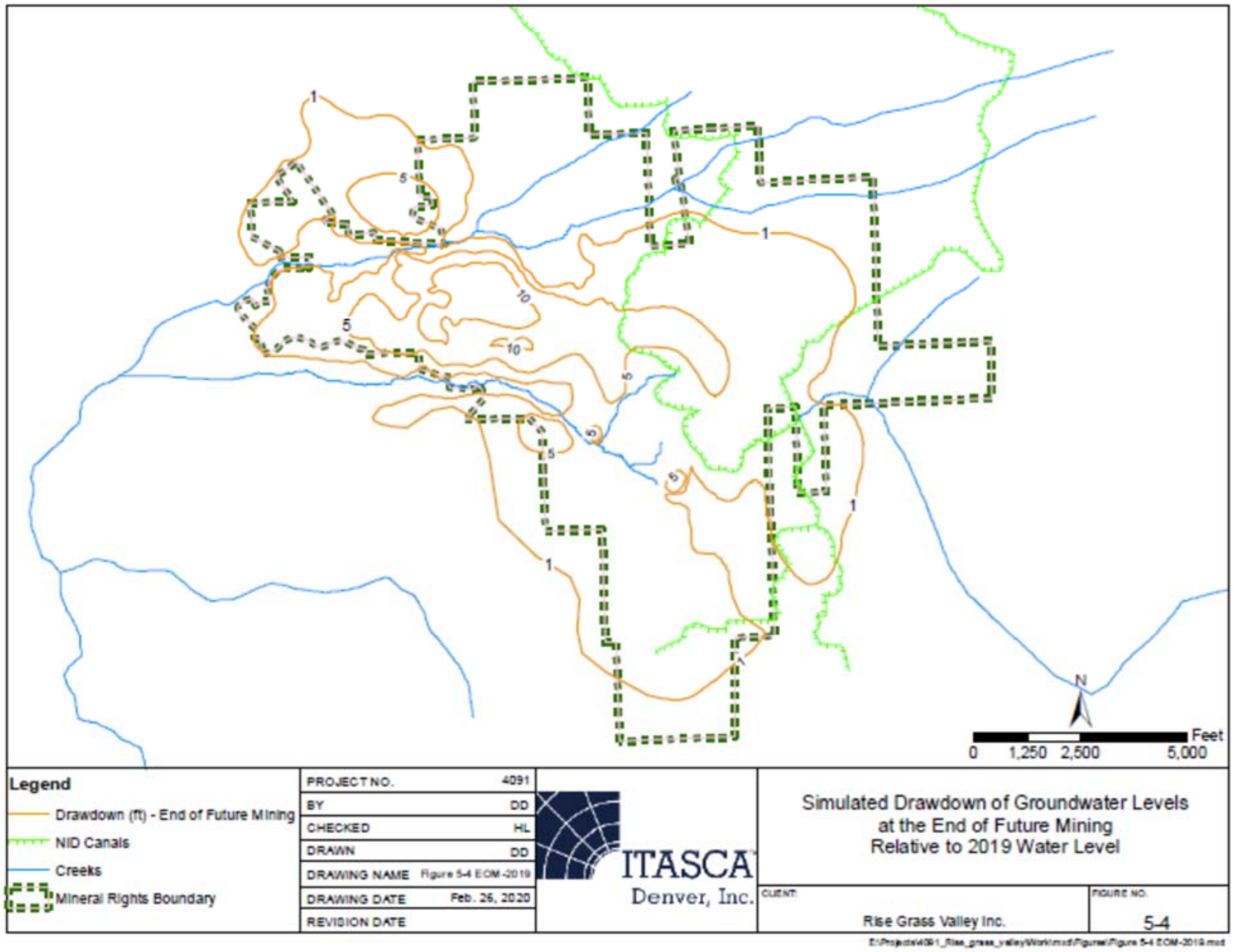
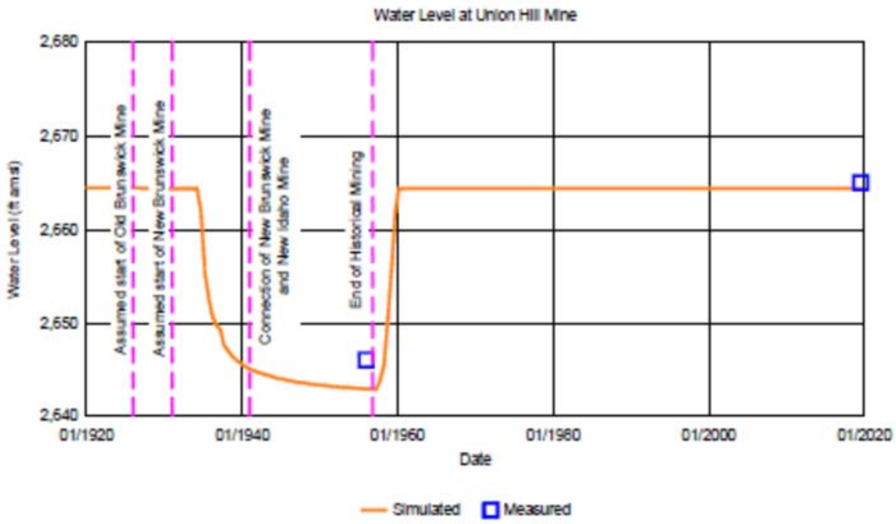
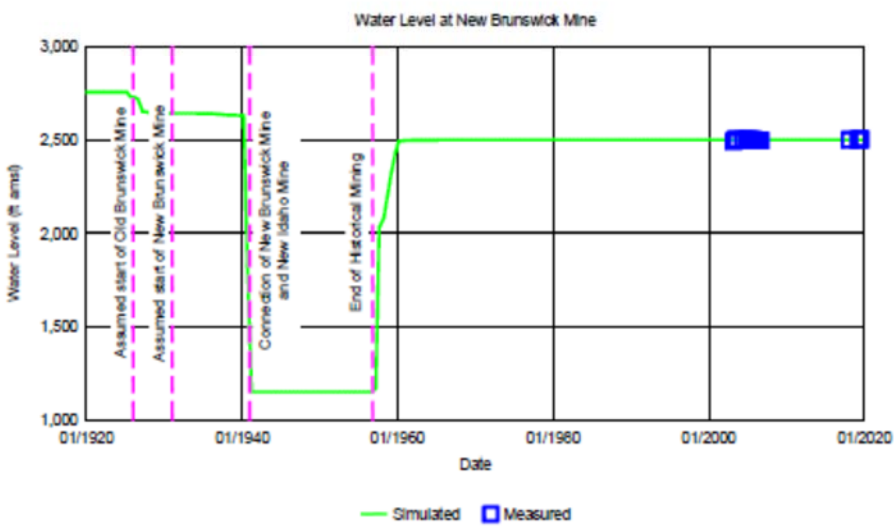


Figure also reproduced as Figure 4-1 in EMKO (2020a) as basis for extent of area of significant impact to shallow domestic wells requiring mitigation.





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DRAWING NAME	UNION
DRAWING DATE	27 FEB 2020
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Simulated and Measured Water Levels at the Union Hill Mine and New Brunswick Mine

CLIENT: Rise Grass Valley Inc.

FIGURE NO. 4-7