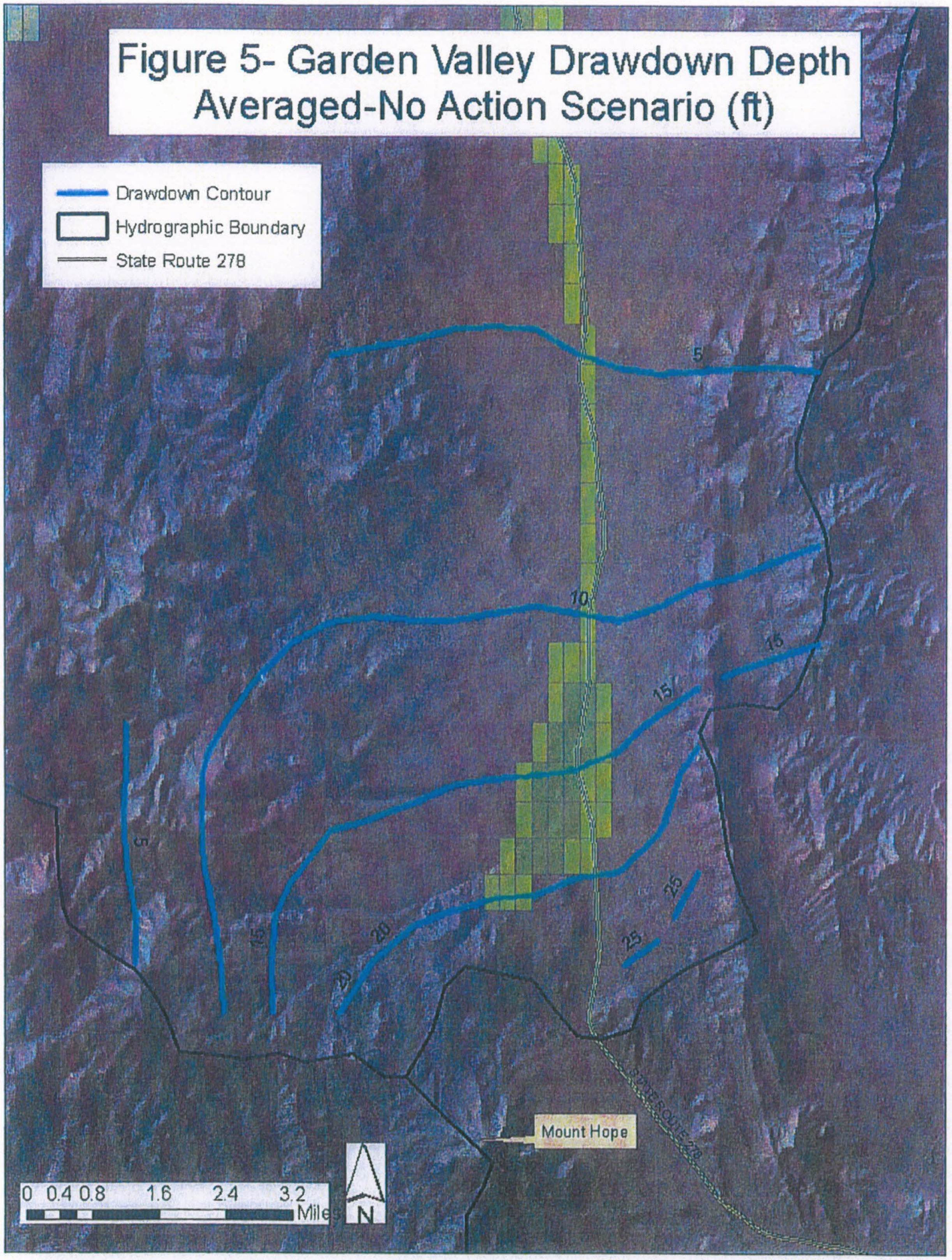


Figure 5- Garden Valley Drawdown Depth
Averaged-No Action Scenario (ft)
Drawdown Contour
Hydrographic Boundary
State Route 278
5
10
15
15
15
5
20
20
25
25
Mount Hope
STATE ROUTE 278
0 0.4 0.8 1.6 2.4 3.2
Miles
N

In summary both Diamond and mine pumping causes drawdown in Garden Valley where Henderson and Vinini Creeks are located. An abrupt shift in flux into Garden subvalley occurs in the year that mining ceases indicating a direct impact to groundwater flux between Garden and Kobeh Valley from mining pumping. The drawdown in the hydrographs do not show abrupt changes indicating drawdown continues to spread out at a continuous rate to about year 300 at the Henderson Creek target well. The maximum drawdown amount and location will vary with location and time as seen in Figure 4.4-16 in the Bugenig memorandum.

4 USE OF LARGE TOTAL HEAD CHANGE VALUES

When evaluating the acceptability of a model for use in predicting impacts statistical analyses are used. In particular the root mean square error (RMSE) or residual standard deviation (RSD) are divided by the total head change over the model. If this value is less than approximately 10 to 15%, the model is considered acceptable. In this case the total head change over the model is 1962 feet. There still is no explanation as to where the data points were selected to achieve this value. Presumably, they were selected from the highest and lowest groundwater elevations throughout the entire regional model consisting of six separate hydrographic basins or sub-basins and regardless of the degree of limited interconnectedness between the basins that comprise the regional model.

The total head change should be related to the area being investigated and be representative of one interconnected hydrogeologic system. Discussions with other modelers, such as the technical consultant with MODFLOW SURFACT, one of the models used to run the simulations, indicates that there is general agreement among many experts that this total head change is unusually large and can act to swamp out errors that should be more directly addressed. For example, with such a large total head change used to divide the residuals, the error can be well over 100 feet and be considered "acceptable". Since this model is dealing with six (6) separate basins the use of one total head change value seems to be stretching the original intent of the use of the total head change to evaluate the acceptability of the calibration. The examples of models using the total head change method provided in the April 2010 Report seem to support this idea as the areas being modeled are specific to one location or aquifer such as the San Joaquin Valley, or the Ogallala or Edwards aquifers. When evaluating Diamond Valley alone, the modelers used a total head change of 873 feet, not 1962 feet. This presumably represents the Diamond Valley aquifer alone and is technically preferable to using the larger head value, which represents the entire regional multi-basin aquifer. Changing the total head change value used could significantly impact the model calibration and predictive abilities and continues to be a source of concern to the model reviewers. This is not a matter of "philosophy" but directly affects the validity of the model as a reliable predictor of impacts from mine pumping.

5 SENSITIVITY ANALYSES

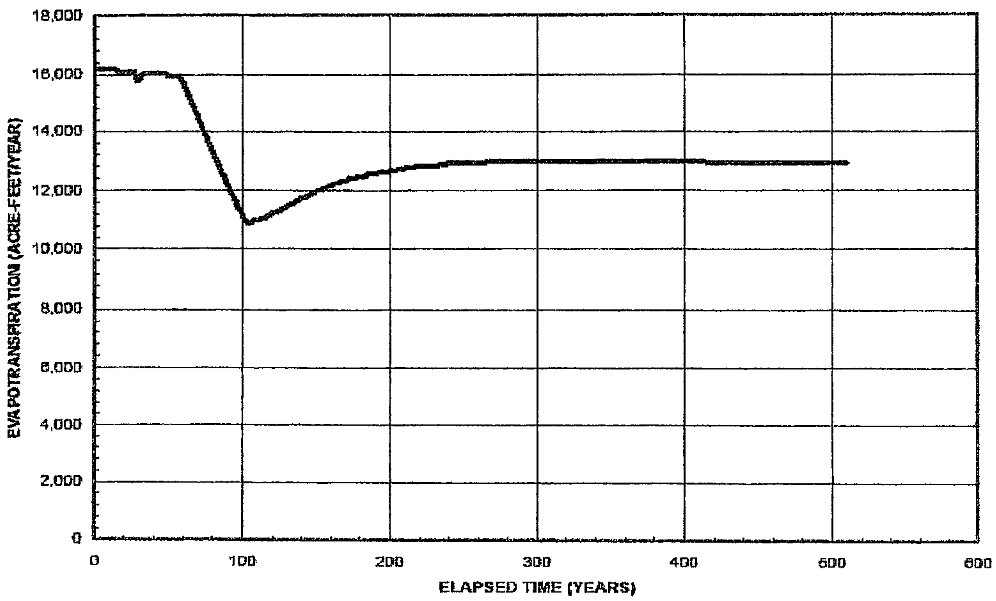
The same limited range in model parameters used to perform the sensitivity analyses in the previous model version continue to be used in this model. As a result the model sensitivity and predictive ability were not tested as thoroughly as they could be. In this model the parameters were varied by multiplying them by a range of values from the multiplier minimum of 0.45 to maximum of 1.5. This was done regardless of whether the parameter itself might realistically vary more than this, for example hydraulic conductivity or storativity. Variation of an order of magnitude which could change the model predictions is quite reasonable but was not used for the sensitivity analyses. The explanation for this in the April 2010 Report was that varying the parameters would cause confusion due to the necessity of using different scales on figures. This does not seem to address the question of why limiting the range of values is acceptable. This continues to be an area of concern and again directly impacts the model results and predictive reliability.

6 EVAPOTRANSPIRATION SIMULATION

Evapotranspiration (ET) was reviewed to evaluate changes at particular private parcels particularly in Kobeh Valley related to mining activities. ET rates occur inconsistently beginning in 1955 as seen in Table 1. The Bartine properties, Bean Flat and a zigzag shaped parcel a few miles northwest of Bean Flat were evaluated in detail. In all these areas there is little to no ET occurring, even in 1955. Since the vegetation is present in these areas, ET is occurring, suggesting a problem with the model. In most cases the land surface and 10 foot extinction depth is located above the steady state groundwater surface, not allowing ET to occur. Shifting the land surface would rectify this. Even though the total ET flow in Kobeh Valley is equal to the amount predicted in the report, it occurs largely in the zone with the 40 foot ET depth (ET Zone 6), thereby incorrectly predicting ET impacts and water level changes in the parcels referenced (ET Zone 6) and perhaps other areas as well.

To further evaluate this affect, a HSU (Hydrostratigraphic Unit) report was generated for all fluxes in the model per the Kobeh Valley HSU for all years through year 222. ET is depicted in Figure 6 as a graph of ET over time in Kobeh Valley. As seen in this figure, ET begins at about 16,000 A/Y (acre-feet per year) in year 0 representing 1955, it drops around year 56 when mining pumping begins and decreases to about 11,000 A/Y when mining stops. ET then rebounds a little when mining stops at year 2055 around year 101 on the x axis of the graph. The ET amount stabilizes at around 12,000 A/Y after this time indicating a semi-permanent reduction. The issues regarding the ET not occurring where expected and the semi permanent ET impact need to be addressed.

FIGURE 6. KOBEH VALLEY ET



7 FLOODED CELLS

In the original model there were numerous flooded cells that had to be corrected to accurately recreate the water balance in the model. Most of these cells had been removed improving the model overall. However, there are still some cells left. Surprisingly, when reviewing the steady state model a total of 127 flooded cells were found in Layer 1. The water sitting on top of these cells varied in height from 1 to 461 feet above land surface. Due to the large amount of cells, some of the larger cells were selected and the A/YA/Y totaled up by multiplying the cell area by the height of the water on top of the cell. Only cells with at least 50 feet of water on the cell were calculated to save time. Using about ten cells with water heights ranging from 50 to 143 feet, there was a total of approximately 77,000 A/Y sitting on top of the land surface and unaccounted for in the water balance. This represents about 30% of the cells completed. Figure 7 depicts the cells in red that contain this water. This discrepancy needs to be cleared up to proceed with the model use.

8 DRAINS

A total of four drains simulating springs are found in the model. The four drains simulate Tonkin, Shipley, Thompson, and an unnamed spring in Kobeh Valley. In most cases instead of returning the flux from the drain set at the spring at depth to the top layer, the drain flux is left in place and a well is added as an injection point at the top layer. This is briefly described in the report. It would be helpful for the actual data to be included in the report to avoid confusion. For example, for the spring in Kobeh Valley at location row 117 column 32 there is no flux coming out of the drain set at layer 3 but a well is injecting 255 A/Y into the top layer. In other cases, the flux is generated in the drain location at depth and also in the top layer which suggests the spring flux is being simulated twice. A table of the drain flux over time compared to the well flux injected over time would aid in answering these questions. An explanation of why the return to layer 1 function in the model wasn't used would be helpful. If the flux estimated in the cell is also injected into the top layer using a separate well it seems appropriate that either the drain return function be used and the well injection stopped or the drain flux be stopped and the well injection continued. Otherwise the potential for overestimating the amount of spring flow into the model is a possibility.

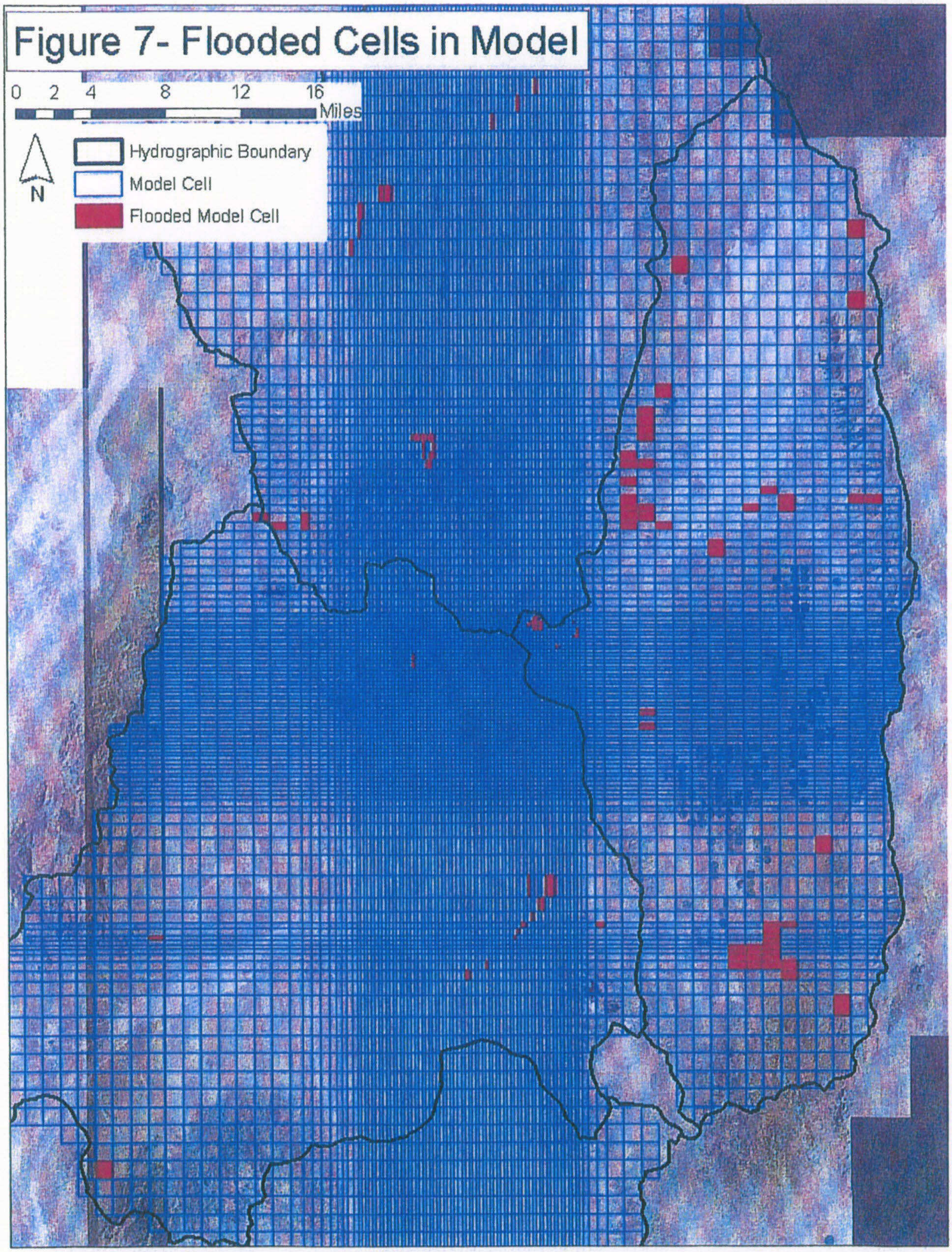
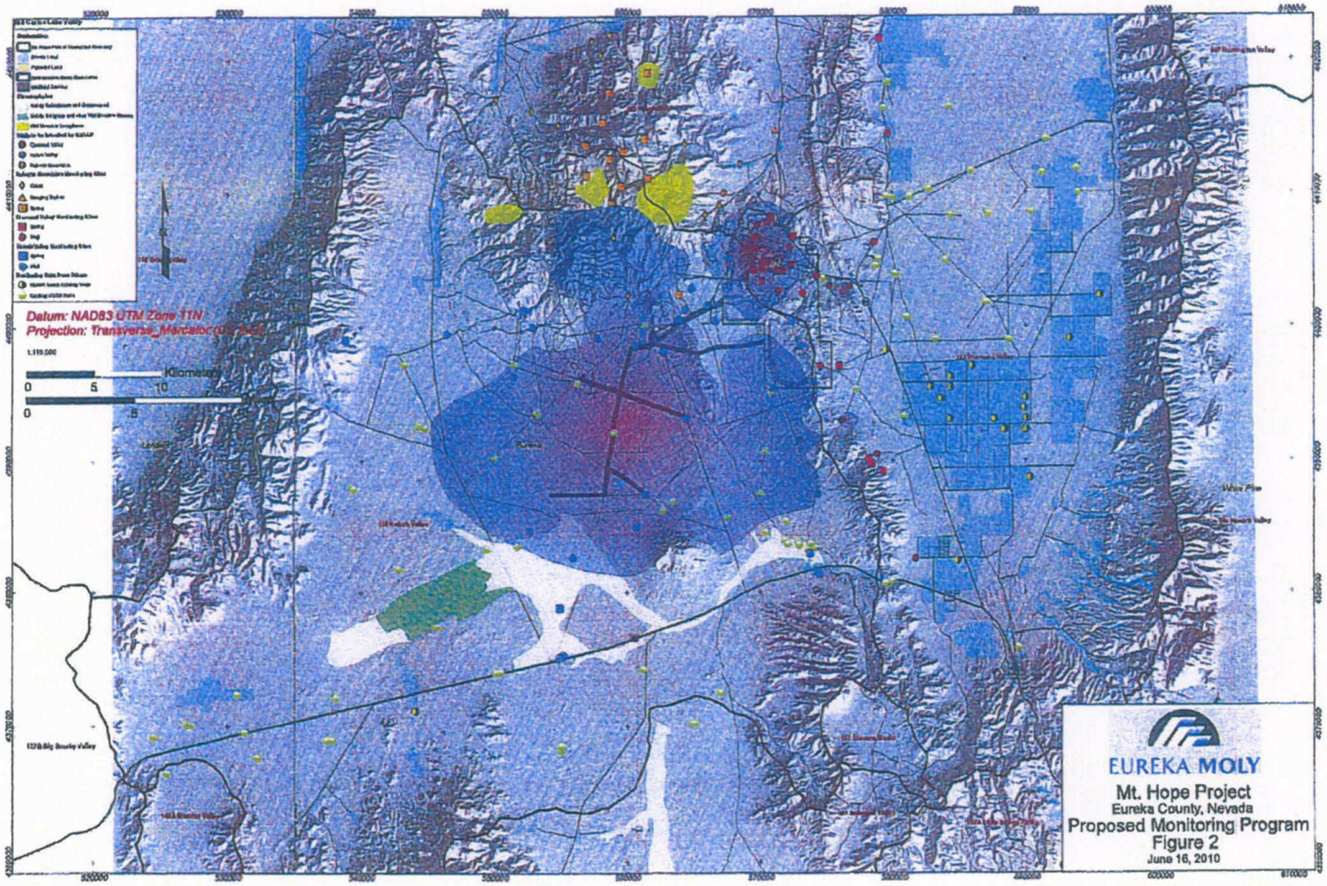


Figure 7- Flooded Cells in Model
0 2 4 8 12 16
Miles
N
Hydrographic Boundary
Model Cell
Flooded Model Cell

9 HFB (HYDRAULIC FLOW BOUNDARY)

To evaluate the amount of water coming from Pine Valley and the Garden Valley Sub-basin of Pine Valley to Kobeh Valley, a HFB or hydraulic flow boundary was placed between the two boundaries between the east side of Roberts Creek and the mine pit. In the steady state model simulation (Figure 8) the model was run. Simulating the influence of the hydraulic flaw barrier (HFB) results in minimal impact to flow with some velocity vector magnitudes reduced. Flow continues with the assigned hydraulic conductivity value in the HFB. Increasing the K value would no doubt decrease the flow through the barrier further.


Datum: NAD83 UTM Zone 11N
Kilometers
0
5
10
EUREKA MOLY
Mt. Hope Project
Eureka County, Nevada
Proposed Monitoring Program
Figure 2
June 16, 2010

Also absent from the figures are a number of monitoring wells associated with each of the proposed production wells in the Kobeh Valley Central Wellfield. During a discussion with Pat Rogers and Steve Boyce on October 12, 2010, I was told that an exploratory well would be constructed at the site of each production well and that each exploratory well would be maintained as an observation well. Granted "not all locations have been determined" but preliminary locations consistent with the points of diversion for the current crop of water rights applications should have been plotted on the figures and a footnote added indicating the locations were preliminary.

An important aspect of the monitoring program is "sentinel" wells. These are monitoring wells in areas where no impacts are anticipated, but located between the mine operations and wellfield and important environmental and water-resource features. For example, Tonkin Springs is an important resource. No impacts are anticipated under the current version of the model, yet continuous monitoring of the flow is anticipated. Unfortunately, if a reduction in flow is realized, it is anticipated that impacts could continue even after mine pumping is stopped. A more conservative approach is to install monitoring sites between the well field and Tonkin Spring that may allow impacts to the system to be identified before an irreversible impact occurs. A previous version of the model showed substantial drawdown at Tonkin Spring. Clearly, anticipated impacts are really a function of the current understanding of the geology and model construction. Because the geology is not clearly understood by the mine, more rather than less monitoring is appropriate and prudent to ensure no impacts to existing rights.

During the discussion with Pat Rogers and Steve Boyce, they conceded that quarterly water-level measurements from monitoring wells may not be adequate to differentiate between anthropogenic and natural causes of water level changes and that relatively low cost data loggers (integral pressure transducers and data recorders) would be preferable. This is especially true for the proposed "sentinel" wells to be installed by the mine just prior to the onset of mining. The mine obviously recognizes the importance of continuous data because they propose continuous recorders for the streams in the Roberts Mountains and in their production wells.

Similar to the Model Report, the proposed monitoring program did not explicitly address decreed water rights, which require consideration. See, April 2010 9th Circuit Court of Appeals decision (600 F.3d 1152 (9th Cir. 2010)). Of particular interest is the flow in the headwaters of the south fork of Henderson Creek. The springs that provide the source of streamflow would be susceptible to small changes in water level, which would in turn impair the decreed rights of the stream. Surprisingly, the sole sentinel well for this area is proposed for the north fork of Henderson Creek, where the stream is intermittent. More appropriately, the Henderson Creek sentinel well should be installed near the perennial reach of the south fork. Although data from one sentinel well may indicate changes in the groundwater regime, a minimum of two wells in the same general area are often needed to identify the specific cause of the change. It was my impression that the mine recognizes this concept given the well pairs discussed by Mr. Rogers and Mr. Boyce, but the mine has not proposed this concept in its current monitoring plan.

The proposed monitoring also includes groundwater-dependent wet meadow complexes on Roberts Mountain as well as phreatophytic vegetation areas in lower Kobeh Valley and lower Roberts Creek. All of these areas are associated with groundwater at shallow depth, yet no shallow monitoring wells are proposed. Shallow monitoring wells must be installed and co-located in these areas and each well must be equipped with a water-level data logger to collect continuous water level measurements. Otherwise, impacts to these areas due to water level decline can never be attributed to a specific cause.

The proposed monitoring plan does not include any surface water monitoring in the Coils Creek watershed and should be expanded to include it, especially given the fact that previous modeling efforts predicted impacts in this area.

Conclusions and Recommendations

The real value of the model is to estimate potential impacts, where these impacts might occur and provide an indication of the likelihood that impacts will occur. Where a large amount of data is available, predictions have a higher level of confidence. Where little or no subsurface geologic and water-level data are available and the geology is complex, intuitively, there must be a lower level of confidence in the predictions. The model does show widespread water level declines in Kobeh Valley and that these declines are expected to capture a significant proportion of the phreatophyte discharge along the Highway 50 corridor, including areas where the amount of drawdown is significantly less than 10 feet. This capture is consistent with Nevada water law that promotes beneficial use of the resource. Where the model falls short is its ability to predict the effects on springs in the Roberts Mountains, particularly in the headwaters of Roberts and Henderson Creeks. The mine's consultants clearly admit to the shortcomings of the model with respect to replicating the very complex geology and groundwater flow regime in the mountains. The report falls short by insisting that the extent of the projected composite 10-ft drawdown contour marks the area where impacts to water resources are expected to occur.

<u>Large-Scale Aquifer Stress Test</u>

Given a lack of a complete understanding of the carbonate flow system in southern Nevada, the State Engineer required an extended aquifer stress test to be conducted (State Engineer Order 1169) prior to granting additional applications to appropriate groundwater. Based upon the mine's consultants' opinion that the current model cannot accurately portray the complex geologic conditions in the Robert's Mountains and because the mine and Kobeh Valley

Ranch's Bobcat Ranch will consume nearly all of the perennial yield of the basin, a similar testing program is recommended in the event that the State Engineer approves the current applications. It is our expectation that this comprehensive aquifer test would take place over the first year of operation. The data should be rigorously analyzed beginning early in the test, followed by a comparison with model predictions as testing proceeds. The model should be updated soon after testing is completed to include new information and data and new predictive scenarios run, including mitigation scenarios to provide bright-line mitigation thresholds.

Monitoring and Mitigation

Assuming the State Engineer approves the pending applications, we recommend a monitoring program that is much more comprehensive than the one proposed by the mine and which takes into account our comments and provides for active participation of Eureka County (not just receipt and review of data). In concert with the monitoring program is a rational plan to mitigate impacts, should they occur. It must be recognized that some mitigation measures themselves have consequences and may need to be regulated by the State Engineer or the Federal Government and therefore ultimately may be analyzed under the National Environmental Policy Act. The plausible mitigation measures, too, should be the subject of analysis before the project is allowed to commence. It is our opinion that the monitoring program proposed by the County should be considered by the State Engineer if he finds there is sufficient cause to approve the applications for the Mt Hope Project.

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Eureka Moly, 2010. *Mt. Hope Tour*: information pamphlet.

Montgomery & Associates, Interflow Hydrology, Inc.; & Barranca Group, LLC. July 2010. *Hydrogeology and Numerical Flow Modeling Mt. Hope Project, Eureka County, Nevada*: consulting report prepared for Eureka Moly (revised September 2010).

Nevada State Engineer, 2002. Order 1169

Tóth, J.A., 1962. A theory of ground-water motion in small drainage basins ins central Alberta, Canada;: Jour. of Geophys. Research 67, no. 11, 4375-87.

United States Court of Appeals for the Ninth Circuit, 2010. USA vs Orr Ditch Company; 600 F.3d 1152 (9th Cir. 2010).

Other

Crist, Elliot, 2010. personal communication.

Technical Memorandum

Prepared For: **Eureka County Board of Commissioners**

Prepared By: **Carol Oberholtzer (Lahontan GeoScience, Inc.)**

Reviewed By: **Dale Bugenig (Dale C. Bugenig, Consulting Hydrogeologist, LLC)**

Date: **November 24, 2010**

The Eureka County Board of Commissioners engaged Lahontan GeoScience, Inc. (LGS) to review Volumes 1 and 2, including the model files and output, of the September 2010 *Hydrogeology and Numerical Modeling, Mount Hope Project, Eureka County, Nevada,* report. The report, compiled by Montgomery and Associates, Interflow Hydrology, Inc. and Barranca Group LLC represents the latest version as of September 2010 of the model that simulates the hydrogeology of the groundwater flow system.

As with any groundwater flow model there is a degree of uncertainty inherent in the simplification of a complex natural system in order to analyze it by numerical methods. For this reason, monitoring the response of the groundwater flow system to the stress of pumping by the Mount Hope project will be critical. Even more critical will be the plan to meaningfully mitigate any adverse impact such as a reduction in spring discharge or stream flow or unreasonable lowering of the water level in wells.

The following items are important in evaluating the model and its predictive ability.

1 PROJECTED EXTENT OF THE 10-FOOT DRAWDOWN CONTOUR

The July 9, 2010 cover letter to the report contains responses to comments related to the April 2010 *Hydrogeology and Numerical Flow Modeling, Mount Hope Area, Eureka County Nevada* ("April 2010 Report"). These include the comments provided by Lahontan GeoScience, Inc. in a memorandum dated December 31, 2009. In the memo, the County's consultants suggested that the contour line depicting the projected maximum extent of 10 feet of drawdown arising from the mine's groundwater extractions (Figure ES-5) provides ". . . a false sense of security with respect to future changes . . .". In other words, the extent of the 10-foot contour may be larger than the figure indicates and the figure does not provide any sense of the potential error. For that reason we suggested a figure that depicts the extent of the 5-foot drawdown (Figure 3.4-8 of Dale Bugenig's memorandum). This figure generated by the same model constructed by EMLLC's consultants depicts the 5 foot contour line in both the cumulative and mining only scenarios. As seen in the cumulative scenario and, as would be expected, the 5 foot contour line a larger area is encompasses than the 10 foot line. There is also a greater area for the mining only scenario, but not as large as for the cumulative scenario.

The use of the five foot drawdown contour line on these figures allows the reader to better evaluate the potential for the pumping to impact sensitive areas such as areas where evapotranspiration occurs or where stream flow is present. In these cases, 5 feet of drawdown can make the difference between ET occurring or not, thereby impacting vegetation, streams and/or springs.

Performing sensitivity analyses of the predictions of the 5 and 10 foot drawdown lines made in the report would also aid in characterizing how reliable these predictions are. (Anderson and Woessner, pg 257). For example, the recharge rate could be varied within reasonable bounds and the model predictions performed. The change in the head distribution as shown by the 10 foot contour line location from the different recharge rates would indicate the uncertainty of the head distribution and predicted impacts to well levels, spring flow, underflow and other hydrologic factors. To assess the impacts to the drawdown in the cumulative pumping scenario a transient cumulative simulation was performed while varying the hydraulic conductivity (K) in Kobeh Valley by increasing certain areas by an order of magnitude, within the accepted range in K values for this type of lithology. As a result the drawdown distribution changed and the five foot contour line for the year 2054 shifted to the east further into the Bartine Ranch. This could result in a change in the evapotranspiration rates in this area, indicating the importance of the K values used in the model and uncertainty in the model predicted drawdown.

Another approach would be to verify the model by calibrating it to a new set of data, for example a different year selected to represent steady state conditions, if available. This model was calibrated to the year 1955 for steady state conditions. Data from a different early time year could possibly be used to re-calibrate the steady state model and the results compared. If the new data can generate a similar head distribution without having to change calibration parameters such as K values, then the model has been verified and model predictions would be considered more reliable. No such analysis has been performed to date so the uncertainty associated with the model predictions is unclear.

2 POTENTIAL IMPACT TO DECREED WATER RIGHTS OF HENDERSON CREEK

Figure ES-5 of the report depicts the maximum extent of the water-table 10-foot drawdown contour arising from the proposed action alternative. In later time model predictions during post project pumping, the 10-foot contour extends into the headwaters of Henderson Creek and to the Creek itself. The waters of Henderson Creek have been fully adjudicated. On page 6 of the Pete Hanson and Henderson Creek Decree (Third Judicial District Court of the State of Nevada, in and for the County of Eureka, 1976), it is stated:

> "These proceedings adjudicate *all stream waters* [emphasis added] tributary to both Pete Hanson Creek and Henderson Creek.

> Henderson Creek, the principal east tributary to the drainage basin, transports stream waters from the east flank of the Roberts Mountains and the western slopes of the Sulphur Springs Range south of Table Mountain.
>
> Several perennial springs situated in the stream system as well as snow melt waters, contribute to the stream system flow."

Figure ES-5 also shows six springs within the 10-foot contour, two of which are identified as having "impacted water rights." Two additional springs are situated along upper Henderson Creek coincident with the 10-foot contour. Consequently, the model results show a potential for a decrease in spring discharge and stream flow in the headwaters of Henderson Creek. Considering that *all* water in Henderson Creek has been adjudicated, *any* decrease in spring or stream flow must be mitigated, no matter how small. Granted, there is an unknown level of uncertainty in the accuracy of the drawdown determinations, which underscores the need for a well-defined monitoring and mitigation plan.

3 IMPACTS TO VININI AND HENDERSON CREEKS FROM PROJECT AND BASELINE PUMPING

It is clear from the 10 foot contour line discussed previously and the 5 foot drawdown line for year 2055 shown in Figure 1 that the 5 foot line extends well north of the Henderson and Vinini Creeks in the cumulative scenario. These 5 foot contour lines represent a depth average drawdown for the Garden subregion of Pine Valley for all eight model layers. It is therefore more representative of what the groundwater flow model predicts regionally than in individual artificially created layers.

Using the mine pumping alone, the 5 foot line is adjacent to the S Fork of Henderson Creek (See Figure 3.4-8 the mining only pumping 5 foot contour figure used in Dale Bugenig's memorandum) thereby potentially impacting flows to or from the creek. However, as stated before showing just the 5 foot contour does not tell the whole story. When taking the mining only scenario and allowing the maximum 35 feet of drawdown near the southern end of Garden Valley, as depicted in Figure 1, groundwater flow clearly is southerly for year 2055. Hydrographs of drawdown versus time for the wells in the north fork of Henderson Creek, and the confluence of the Henderson Creek forks for layer 1 in the cumulative pumping scenario (Figures 2 and 3) show drawdown increasing linearly until approximately the year 200 where the rate of increase decreases slightly.

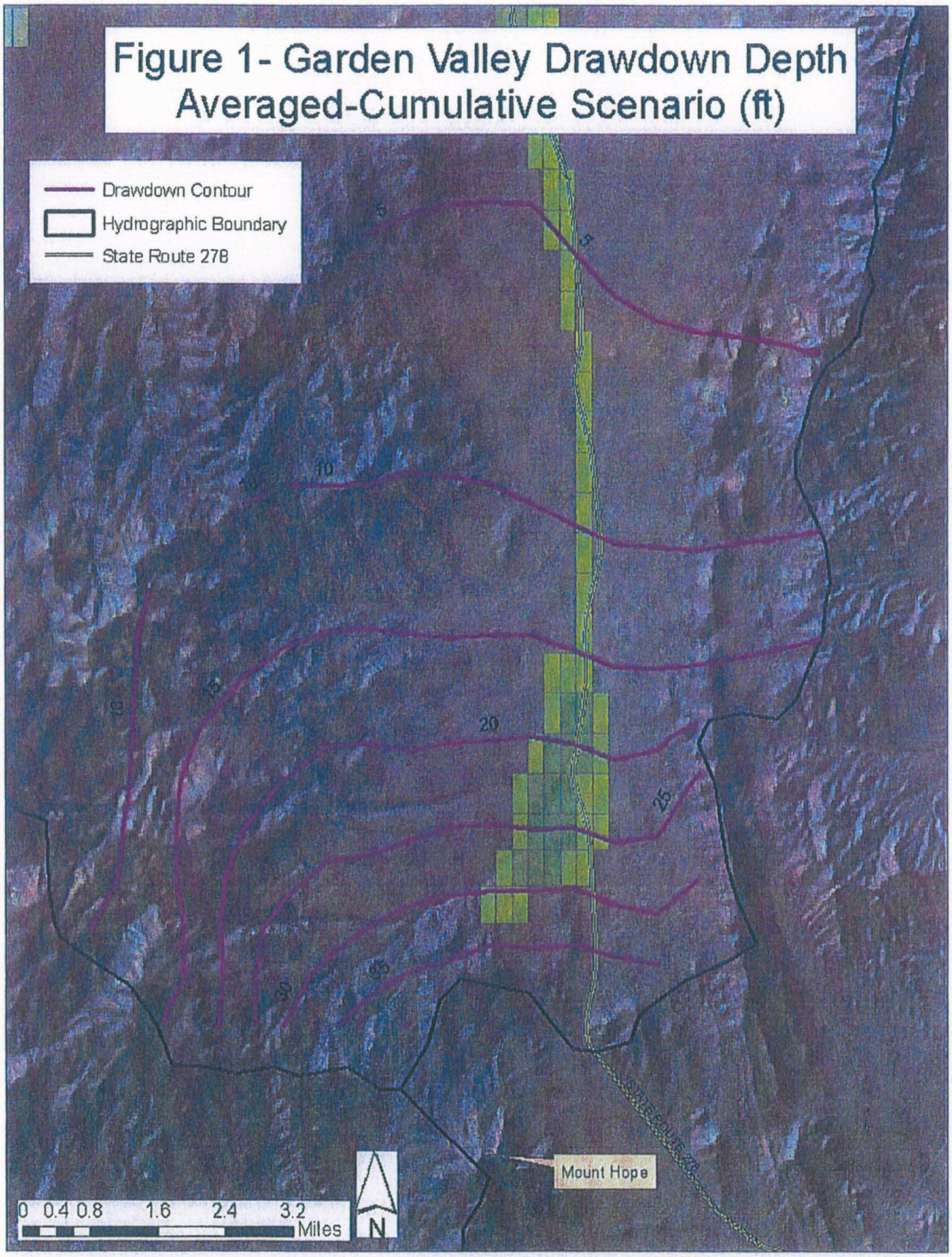
Figure 1- Garden Valley Drawdown Depth
Averaged-Cumulative Scenario (ft)
Drawdown Contour
Hydrographic Boundary
State Route 278
5
5
10
10
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25
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35
Mount Hope
State Route 278
0 0.4 0.8 1.6 2.4 3.2
Miles
N

FIGURE 2. DRAWDOWN AT HEADWATERS OF HENDERSON CREEK

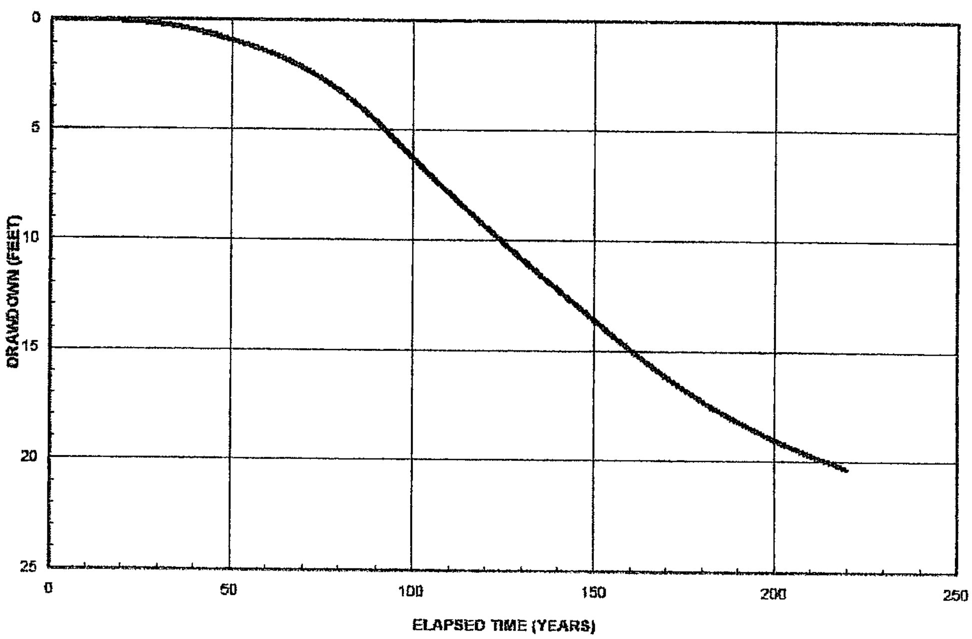
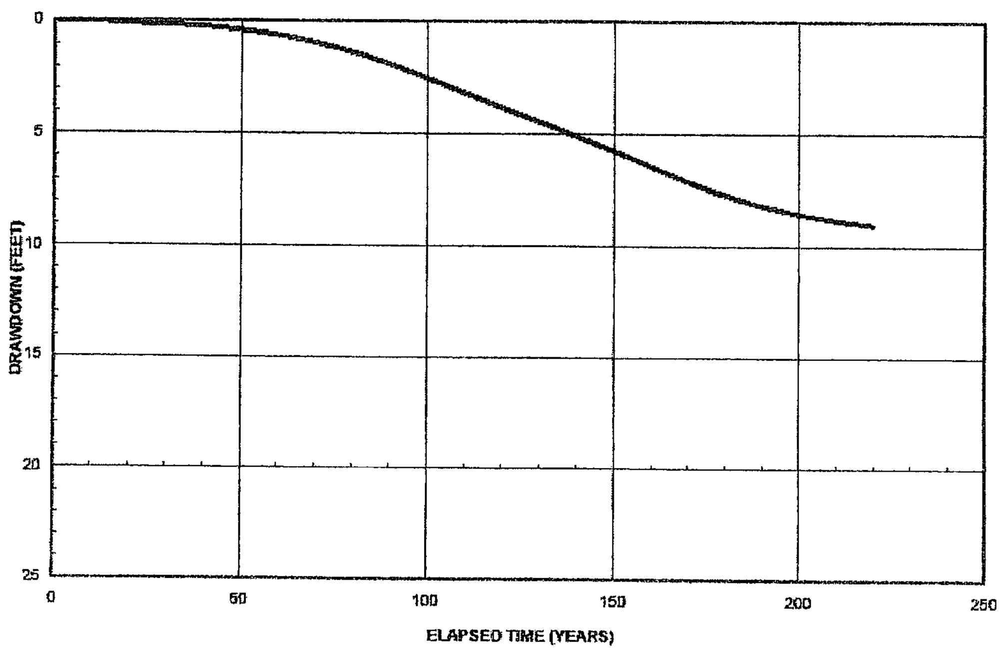
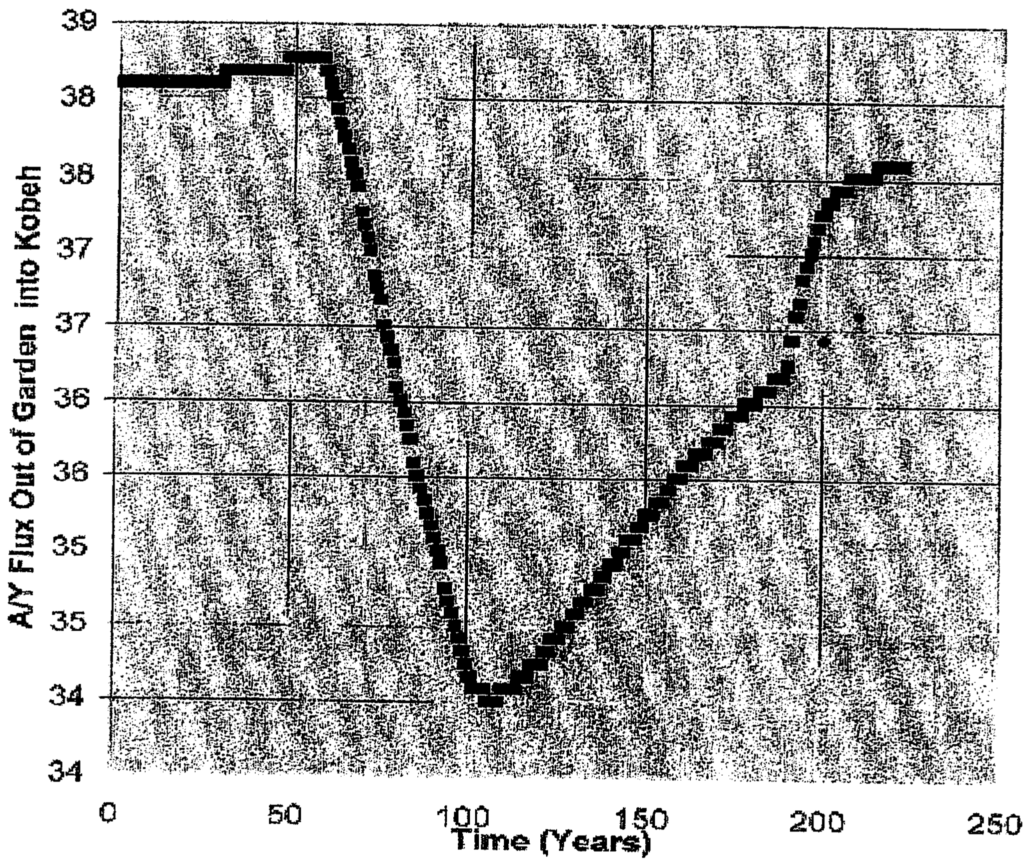


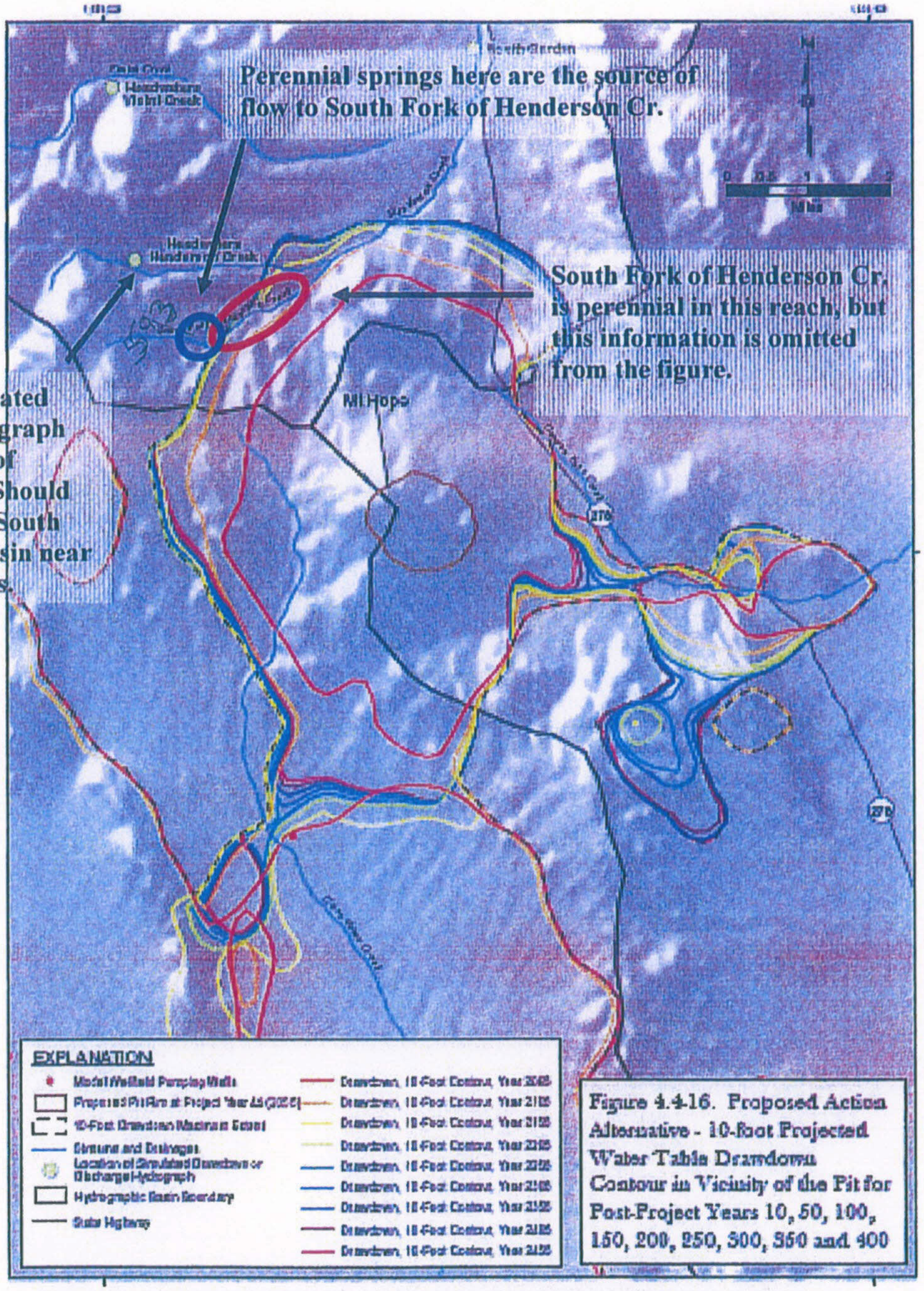
FIGURE 3. DRAWDOWN AT SOUTH GARDEN VALLEY



Flux between Garden and Kobeh Valleys was evaluated for the entire model period as shown in the attached graph for the cumulative scenario. As seen in Figure 4, the flux out of Garden Valley, where the creeks in question are located, began to decrease when mine pumping began in about year 56 after steady state year 1955. It decreases until year 101 when mining pumping stops. This may be due to the flow direction shifting due to the influence of pumping in Kobeh Valley. It then increases dramatically after mining stops in year 101 or 2055. This indicates a direct influence on Henderson Creek and Garden Valley from mine pumping.



A similar analysis was made for the Diamond Only pumping scenario. Figure 5 depicts Garden Valley only with drawdown from Diamond Valley pumping only. The drawdown ranges from 25 feet in the south to 5 feet north of the confluence of Henderson Creek south and north. This indicates that the total drawdown occurring from Diamond Valley is more than from Diamond alone as there is a total of 35 feet of drawdown under the cumulative scenario. Subtracting 25 feet from the same area for Diamond only pumping indicates that mining is causing about 10 feet of drawdown in this same area. It should be remembered that these contours are averaged over the entire model, so drawdown will be the same for all layers, therefore, drawdown in a specific layer may differ from the average depicted in the figure.



Location of simulated drawdown hydrograph for headwaters of Henderson Cr . Should be located in the South Fork drainage basin near the source springs.

Figure 4.4-16. Proposed Action Alternative - 10-foot Projected Water Table Drawdown Contour in Vicinity of the Pit for Post-Project Years 10, 50, 100, 150, 200, 250, 300, 350 and 400

003284

Downplaying the significance of inter-basin groundwater flow between Kobeh Valley and Diamond Valley

The perennial yield of Diamond Valley has been estimated in previous reports by the USGS to be between 20,000 and 30,000 acre-feet per year (AF/yr). The current version of the model indicates 1,583 AF/yr of groundwater flow from Kobeh to southern Diamond Valley (Montgomery, *et al.*, 2010, Table 4.4-6) prior to groundwater resource development. This quantity amounts to 4.6 to 6.8 percent of the total estimated perennial yield of Diamond Valley.

The mine has attempted to trivialize the contribution of inter-basin flow from Kobeh Valley to Diamond Valley. As an example of this bias, they distributed a leaflet to residents in the summer of 2010 that estimated ". . . 40-260 acre feet per annum (afa*) flows from Kobeh to Diamond Valley, about equivalent to a strong garden hose." (*A Eureka Moment*, Eureka Moly LLC, 2010). This statement flies in the face of their own groundwater model which calculates 1,583 AF/year combined groundwater flow from Kobeh to Diamond Valley (Table 4.4-4). When compared to the estimated recharge to southern Diamond Valley (12,400 AF/yr, based on Table 4.1-5 of the model report), the flow from Kobeh Valley to southern Diamond Valley amounts to thirteen percent (13%) of the recharge to southern Diamond Valley, which is **not** trivial.

The numerical model was constructed such that most of this flow occurs in deep bedrock north of Whistler Peak. The model predicts that the extractions by the mine will not intercept any of this deep groundwater flow, yet future pumping in Diamond Valley is shown in the model to increase the flow from Kobeh Valley (Table 4.4-6, Montgomery, *et al.*, 2010). The reason relatively shallow wells in Diamond Valley can influence flow from Kobeh Valley, yet deep wells in eastern Kobeh Valley do not intercept outflow to Diamond Valley, is simply a function of model construction.

Specific Issues with the Current Groundwater Model

The County's consultant team identified a number of issues with the groundwater model provided to the State Engineer in 2008. Since then, the groundwater model has undergone a number of revisions, some of which incorporated new data and others which considered comments by the County's consultant team. Not all of our comments and concerns were incorporated. Some of these comments were dismissed as differences in philosophy and were ignored. Current issues and comments are highlighted below.

Construction water supply wells

Two construction water supply wells are planned to be located between the Kobeh Valley Central Wellfield and the Tailings Storage Facility. They are anticipated to each pump 300 gpm until such time that the Kobeh Valley Central

Well Field is operational. It is conceivable that these wells could withdraw as much as 960 acre-feet per year, yet they were omitted from the simulation without any justification in the report.

Transient model calibration

- Diamond Valley

Historical water levels in wells in Diamond Valley were vital to calibrating the transient groundwater flow model necessary for predicting changes arising from the mine's pumping. Review of the hydrographs for selected wells provided in the current report compare observed and model-simulated water levels versus time (Montgomery, *et al.*, 2010; Figures 4.1-33 through 4.1-46) show generally good correlation from the beginning of the simulation through about 1985, after which there is a departure between observed and simulated water levels, *e.g.*, the model simulates more drawdown than that which was observed in many of the wells. Another way to look at the overall trend is to plot the residuals from the wells used as calibration targets on a single graph. The residuals for calibration points in the model are provided in the report appendix and these were plotted versus time in Figure DCB-2, below. A second-order polynomial trend line can be fit to the data that accounts for approximately 80% of the variance of the residuals. This trend suggests that predictions of future drawdown in Diamond Valley may over-predict drawdown. A fifth-order polynomial provides a slightly better fit to the residuals, accounting for 83% of the variance (Figure DCB-3).

Alternatively, the trend of residuals might be construed to mean the model may not accurately portray the agricultural pumping in Diamond Valley since the early 1990's. The information provided in Figures DCB-1 and -2 may represent a "step function" indicated by the two groupings shown in figures, suggesting that model input (agricultural consumptive use in Diamond Valley) since the 1990s simply may be incorrect. Whatever the cause, prior to the 1980s, computed water levels were higher than observed levels by generally 10 to 20 feet and after the 1990s computed water levels were lower than observed levels by 10 to 30 feet. The mine's consultants expended considerable effort to identify the cause for the observed data trend, to no avail, and finally concluded the calibration was good enough.

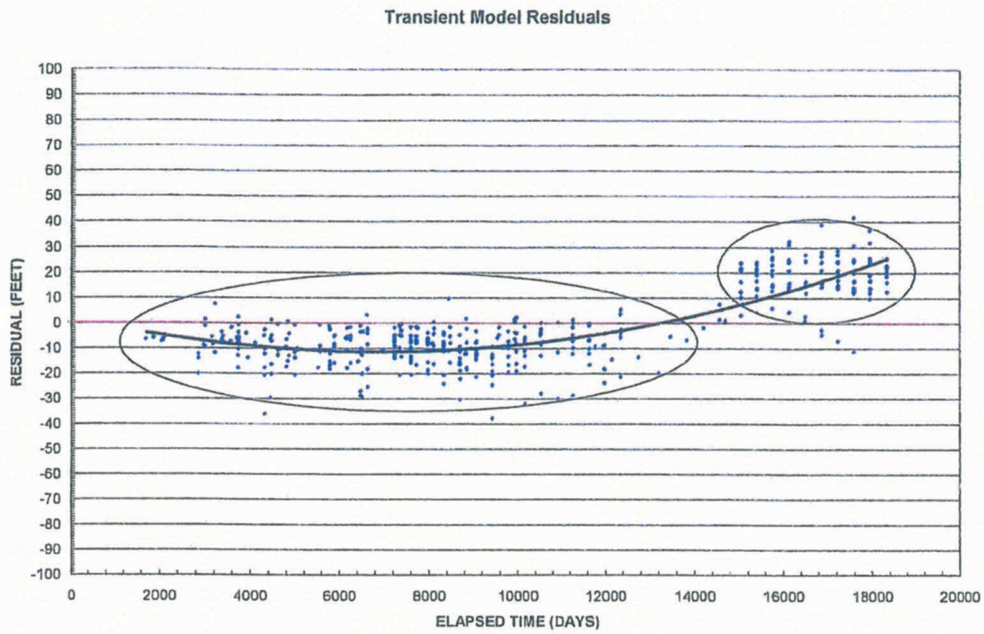


Figure DCB-2

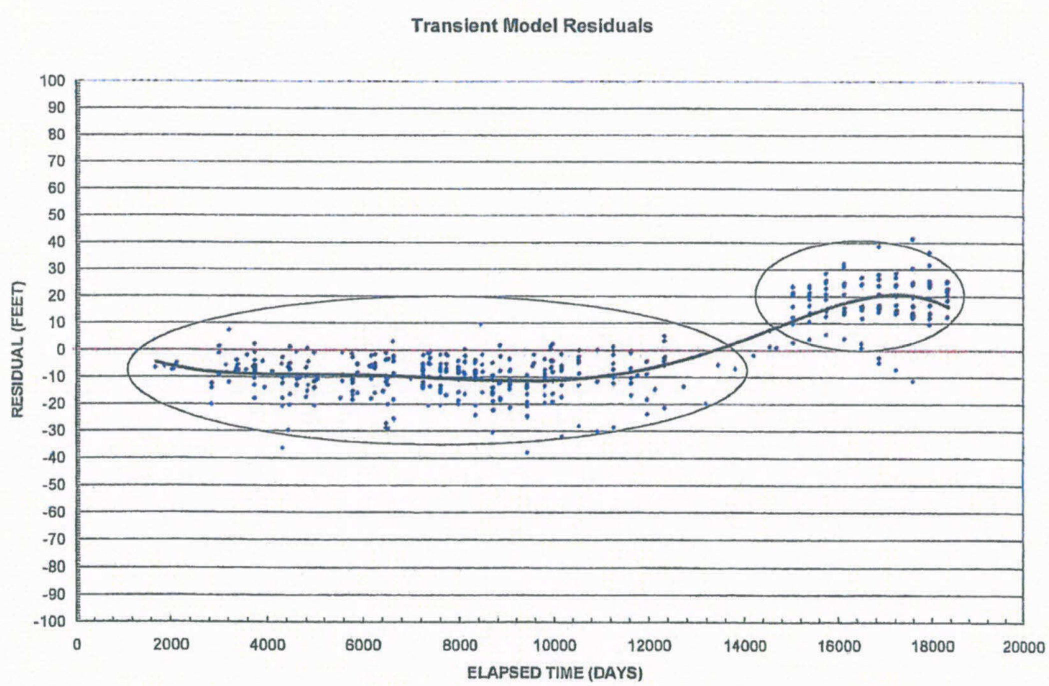


Figure DCB- 3

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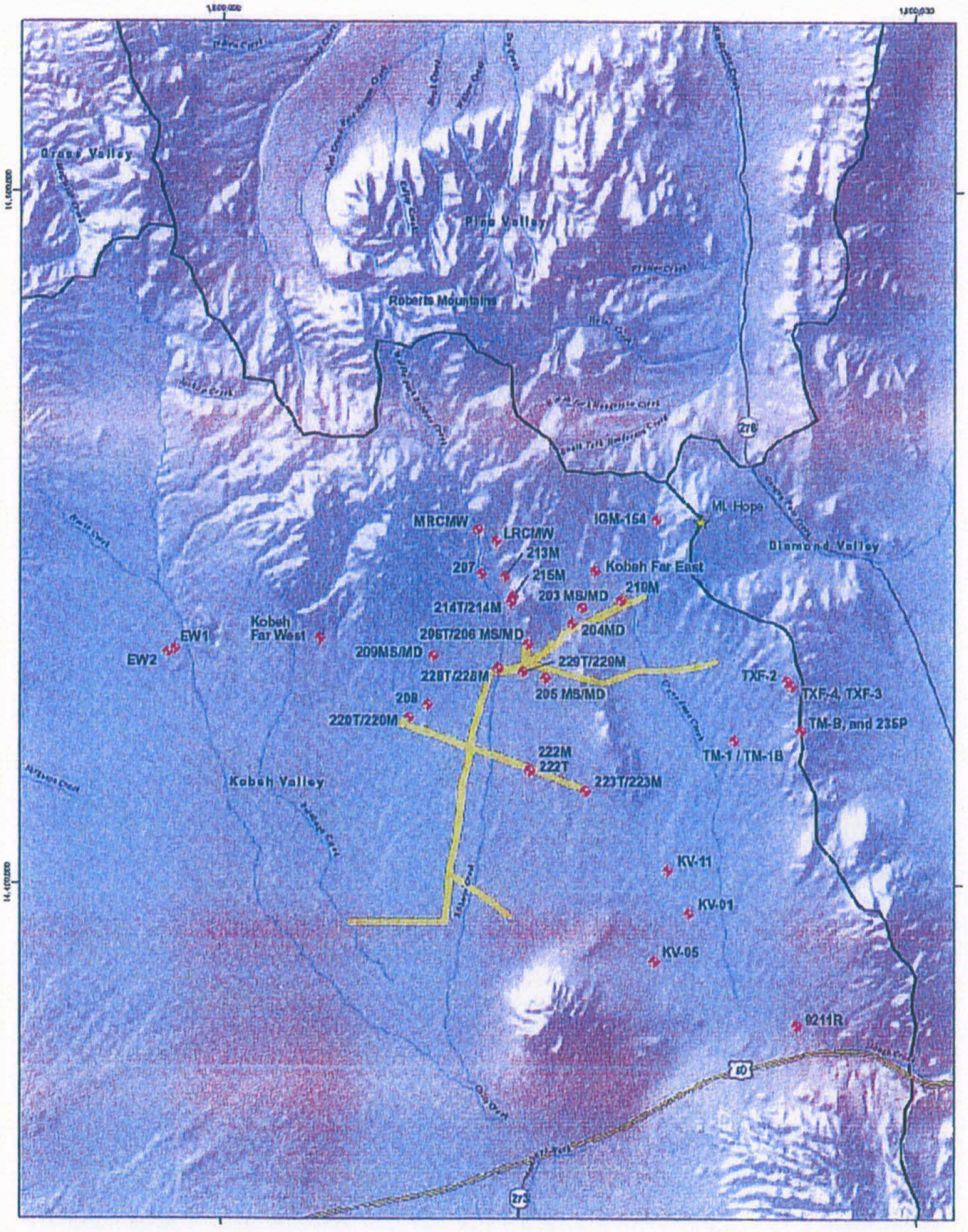
Whatever the reason, the inference drawn from the plots is that the model may over-predict future drawdown due to pumping in Diamond Valley. This is important because the model suggests the effects of Diamond Valley pumping will propagate to the adjacent basins. If, in fact, the model over-predicts drawdown in Diamond Valley, and drawdown in adjacent basins arising from Diamond Valley pumping should be less, then the proportion of impacts in adjacent basins attributable to the mine's groundwater extractions in Kobeh Valley and at Mt Hope will be larger than the model predicts.

Regardless of the cause for the different groupings of residuals, the current model appears to over-estimate future drawdown in Diamond Valley by approximately 10 to 40 feet. The projected future impacts associated with the mine's pumping were derived from the difference between the proposed action alternative (mine and other pumping) and the no action alternative (pumping primarily by wells in Diamond Valley). The no-action alternative model scenario (continued Diamond Valley pumping, but no mine pumping) predicts that drawdown arising from Diamond Valley propagates into Kobeh Valley and the Roberts Mountains in the southern part of Pine Valley. If the model over predicts the effects of Diamond Valley pumping in adjacent basins, then the modeled impacts arising from the mine's pumping will be proportionately greater.

- Kobeh Valley

There are little historical data available with which to calibrate the transient model for Kobeh Valley, in general, and the wellfield area, in particular. The pumping tests of exploratory wells in Kobeh Valley (see Figure 4.1-47 below) offered an opportunity to provide aquifer properties needed for predicting future changes in water level near the wellfield. Analysis of the test data was accomplished by both analytical means and by using MODFLOW. Figures 4.1-48b, 4.1-50 and 4.1-52 (Montgomery, *et al.*, 2010), below, were proffered in the report as evidence that the model accurately portrays the response in the aquifer to testing:

> "Several criteria were used to gauge success of the effort: the magnitude of the drawdown, the shape of the drawdown and recovery trends, and consideration of the proximity of the observation well to the pumping well."
>
> "The calibrated model captures the magnitude of observed drawdown, including the lack of response noted at some locations due to geologic structures and fault barriers. This achieved the goal of calibrating the model to observed results from the transient aquifer testing."



EXPLANATION

- EMLLC Test or Monitor Well
- Proposed Well Field Corridor
- Streams and Drainages
- Federal Highway
- State Highway
- Hydrographic Basin Boundary

N

0 1 2 4
Miles

Figure 4.1-47. Test and Monitoring Well Locations, Kobeh Valley

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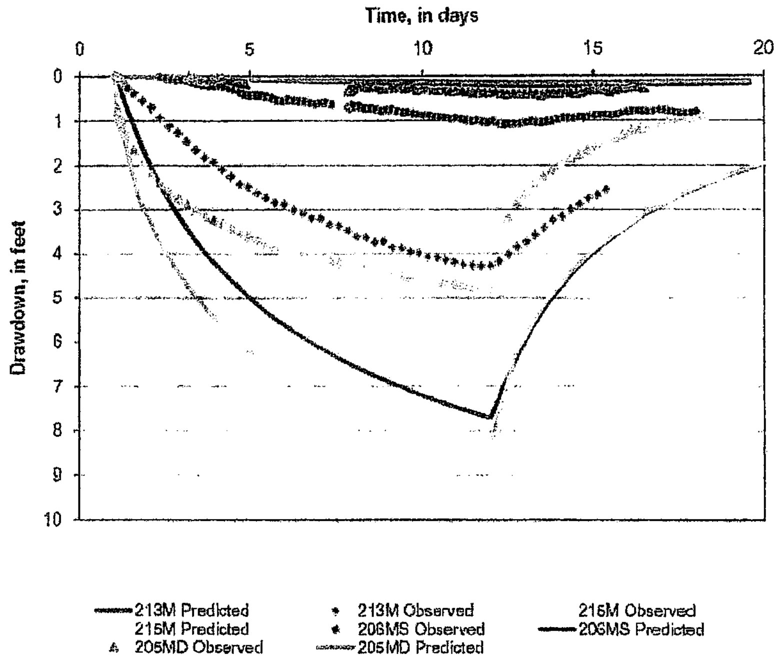

Figure 4.1-48b. Observed and Simulated Water Level Drawdown during Testing at Well 214P

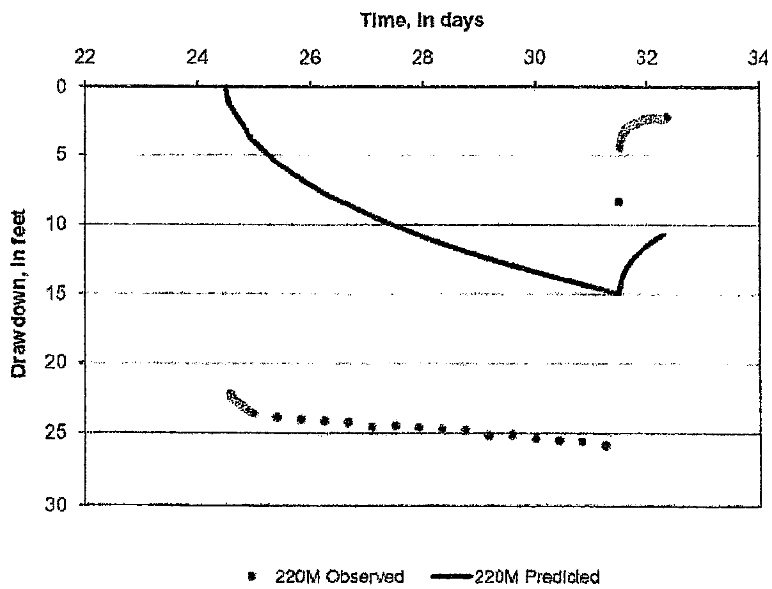

Figure 4.1-50. Observed and Simulated Water Level Drawdown during Testing at Well 220P (Cumulative Run)

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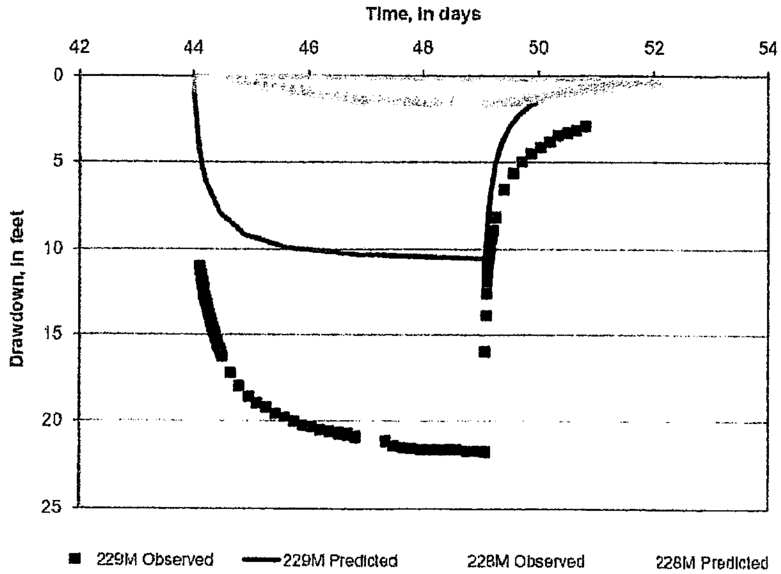

Figure 4.1-52. Observed and Simulated Water Level Drawdown during Testing at Well 229P (Cumulative Run)

In the absence of a quantitative assessment of the data analysis in the model report, I would draw a much different conclusion, based on my experience analyzing test data from literally thousands of aquifer tests. At the very best, the graphs show that water levels decline when the pump is turned on and begin to recover when the pumps are turned off. The simulated data do not capture the shape of the observed data plots nor do they replicate the observed drawdown.

<u>*Discrepancies with South-Central Kobeh Valley Aquifer properties*</u>

Four mineral exploration holes drilled northwest of Lone Mountain penetrated geologic materials similar to the formations described in the log of Lone Mtn Federal #15-1 (Montgomery, *et al*, 2010, Figure 3.1-5). The wells were located within an area of several square miles, suggesting the drilling results were not simply for an isolated area for this part of the valley. The carbonate rocks encountered approximately 1,400 feet below the land surface in each borehole were highly fractured and two of these boreholes, located approximately one mile apart flowed under artesian pressure at approximately 1,000 gpm once drilling fluids were evacuated from the boreholes when the drilling process changed to air-rotary. The other two boreholes did not flow because drilling fluid was not removed prior to drilling deeper. The water was "warm" (Eliot Crist, personal communication) indicating deep circulation. Large artesian flows from the deep carbonate rocks suggest large hydraulic conductivity, yet the model shows low hydraulic conductivity of the rocks below a depth of 1,400 feet. The point is that the geologic materials at depth in southern Kobeh Valley may be more permeable than the current model suggests. If these materials extend farther south and to the east, there is potentially more flow to the east to Diamond Valley.

Water Monitoring and Mitigation

It is clear that a project of this scope requires comprehensive resource monitoring and a plan to deal with impacts to the resources resulting from the mine's pumping. The *Mount Hope Mine Project Water Resources Monitoring Plan* was provided as Exhibit 34 in the *Submission of Witnesses, a Summary of Their Testimony, and Accompanying Exhibits* dated October 19, 2010. Figures 1 and 2 (*ibid.*) depict the sites included in the Proposed Monitoring Program. At first blush, the program appears to be very extensive, showing a large number of stations with which to monitor water levels in wells, spring flow, and surface water flow (Figure 2 of the Monitoring Plan is attached below). It also depicts wet meadow complexes and phreatophyte areas to be monitored, but no specific sites. What is not immediately apparent is that many of the data points are part of "other" monitoring networks, primarily the Nevada Division of Water Resources (NDWR) and the United States Geological Survey (USGS) that are not intended to be monitored by the mine. Only after reviewing Table 1 of Exhibit 34 does it become patently obvious that the mine will not be monitoring the "other" sites in Figures 1 and 2.

The USGS and NDWR monitoring network contains numerous wells for which only a few data points exist over large temporal periods. Not every USGS site depicted is currently monitored and not every NDWR site has measurements taken every year. So, just because numerous sites are identified, the amount of data may not be as large as one might imagine. Furthermore, the USGS typically requires a joint funding source, such as the current cooperative agreement with Eureka County for the current Diamond Valley Flow System Study. However, once the study is completed, there is no guarantee the USGS will continue to monitor all of the sites identified on the map and the plan does not address a source of funding to continue USGS monitoring. Perhaps the funding should be obligated by Eureka Moly to continue the USGS monitoring program. Of particular note is that all of the data that USGS has collected within the Diamond Valley Flow System in the past decade was due to funding by Eureka County. The monitoring program as proposed contemplates saddling Eureka County with funding USGS data collection well into the future unless another funding source is committed.

Figure 3.4-8 below shows locations of wells and springs located within the 5-ft mine-only drawdown contour calculated by the County's consultant team. Comparison with Figure ES-5 shows an additional five wells and two springs in the Grub Flat area potentially impacted by the mine's pumping.

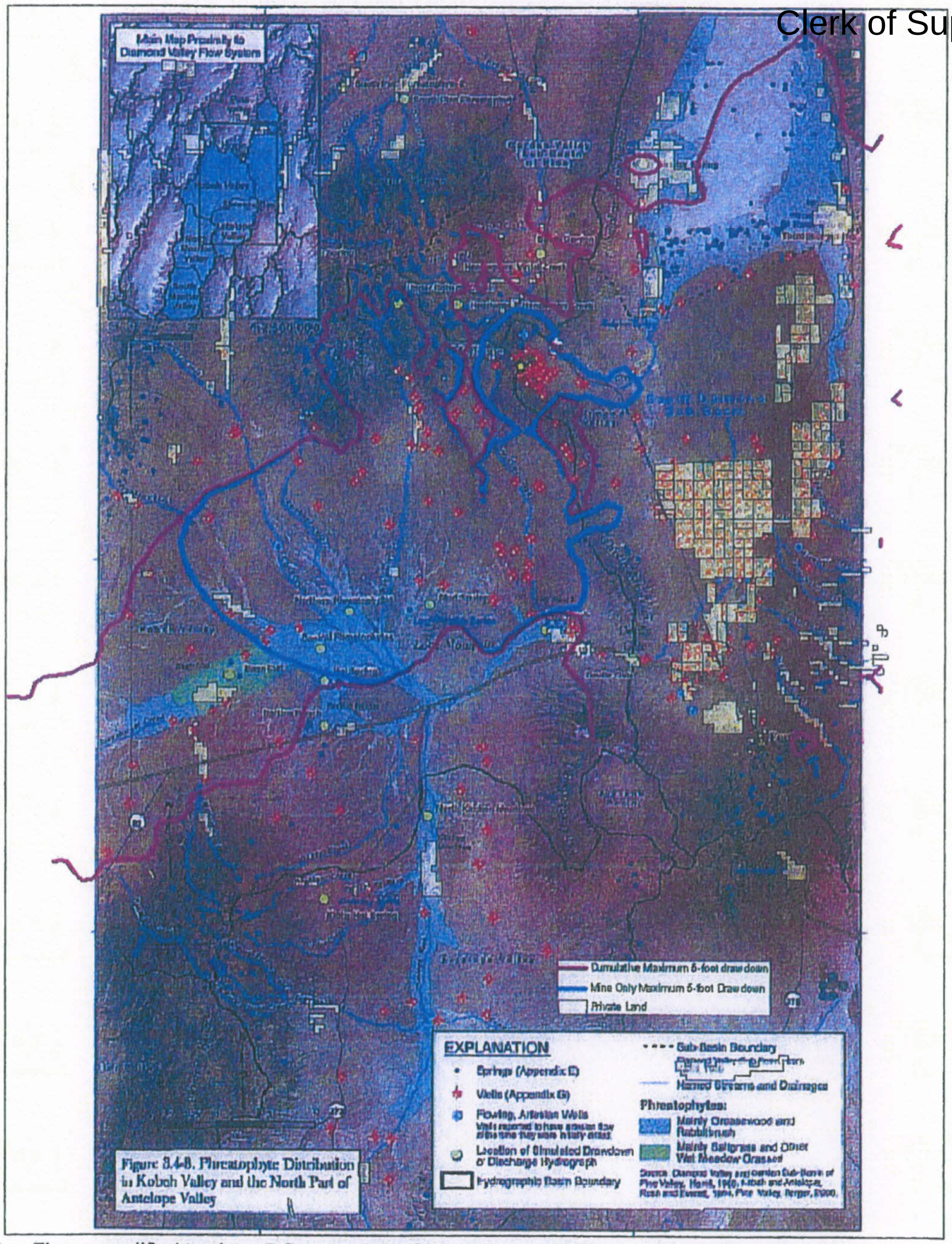

Figure 3.4-8. Phreatophyte Distribution in Kobeh Valley and the North Part of Antelope Valley

(Note: Figure modified to show 5-ft contour for Cumulative and Mine-only pumping scenarios)

<u>The postulated presence of flow barriers between the mine and the Henderson Creek drainage</u>

The mine's consultants expressed an opinion that the model does not represent the complex geology of the Roberts Mountains very well. They surmise that geologic structures or lithologies probably exist that will prevent the effect of the mine's pumping from extending northward into the headwaters of Henderson Creek and beyond, but they admit that they have not been able to find any evidence that these structures exist.

> "Springs and flowing wells in the model are situated on valley floors or peripheries. Many springs exist in the mountain blocks but are not simulated. The model resolution, geologic complexity, topographic relief, and calibration abilities in the mountainous portions of the model limit the ability to represent mountain block springs. In addition, many of the mountain block springs are ephemeral and are not simulated." (*ibid.*, Section 4.1.3.4)

However, some of these springs **are** perennial and provide a source of flow in the creeks. The recognized uncertainty in the model for the Roberts Mountains is all the more reason for a comprehensive management, monitoring and mitigation plan.

Again, statements of this kind downplay the potential for an impact on existing water rights, particularly in the Roberts Mountains north of the mine's Kobeh Valley Central Wellfield. While it is true that the geology of the model area is complex, repeated statements of this kind seem to interject doubt that there will be impacts without any proof to the contrary and complicate issues due to the perceived bias.

Section 4.4.4.5 of the Model Report (*ibid.*) lists potential impacts to water resources due to proposed pumping of groundwater for the Mt. Hope project. These include:

> "• Diminished flow from springs
> • Diminished flow in perennial streams
> • Diminished density and/or occurrence of phreatophytes, including shrub and grass communities
> • Increased depth to water in wells"

> "Water resources were considered to be potentially impacted if located within the predicted 10-foot water table drawdown contour. Because the 10-foot drawdown occurs at different times at different places, the "composite" 10-foot drawdown contour was used to show the maximum lateral extent of the 10-foot water table drawdown contour over time. The composite 10-foot drawdown

contour represents the maximum extent of the 10-foot drawdown contour over the simulation period."

"Roberts Creek and Henderson Creek are the only perennial streams within the predicted Proposed Action composite 10-foot drawdown contour. The base flows in Roberts Creek and Henderson Creek may depend in part on springs that may be connected to the regional groundwater system. If flow from those springs is diminished, base flow in Roberts Creek and Henderson Creek may also be diminished. However, a portion of flow in both streams is supported by spring discharge outside the predicted Proposed Action composite 10-foot drawdown contour, and seasonal runoff due to precipitation and snowmelt would not be affected by regional groundwater pumping "(*ibid.*, Section 4.4.4.5).

As stated previously, to assume that a spring that might experience less than 10 feet of drawdown, say 9 feet, and would not be impacted interjects unreasonable bias into the report. While the mine's drawdown might not have much affect on snowmelt, it is definitely has the potential to impact spring discharge later in the year.

There is little argument to statements in the report that the geology in the Roberts Mountains is complex. Because so little water-level and subsurface geologic data are available for the Roberts Mountains, the ability of the model to replicate the groundwater conditions is a not as good as, say, the alluvial aquifers in Kobeh and Diamond Valley where there are considerably more data. In the Roberts Mountains, the Steady-State Model residuals (difference between observed and simulated water levels at calibration points) range from a negative 90 to a positive 110 feet (a variation of 200 feet) over a small distance as illustrated in the lavender circle drawn on Figure 4.1-27 on the following page (*ibid.*, Figure 4.1-27). While not a rigorously quantitative measure of model accuracy in the Roberts Mountains, wild oscillations in residual is suggestive of a much lower level of confidence in the mountains than for the alluvial aquifer in Kobeh Valley where residuals vary by a few tens of feet. This lower level of confidence should trigger heighted awareness of a potential for impacts not identified by the model--not a relaxation of a threshold for assessing whether or not an impact occurs. The mine's consultants' opinion that the model may not accurately portray the groundwater flow system in the Roberts Mountains is justification enough for a comprehensive monitoring, management and mitigation program based on scientific principles and developed through active involvement of all stakeholders, specifically Eureka County.

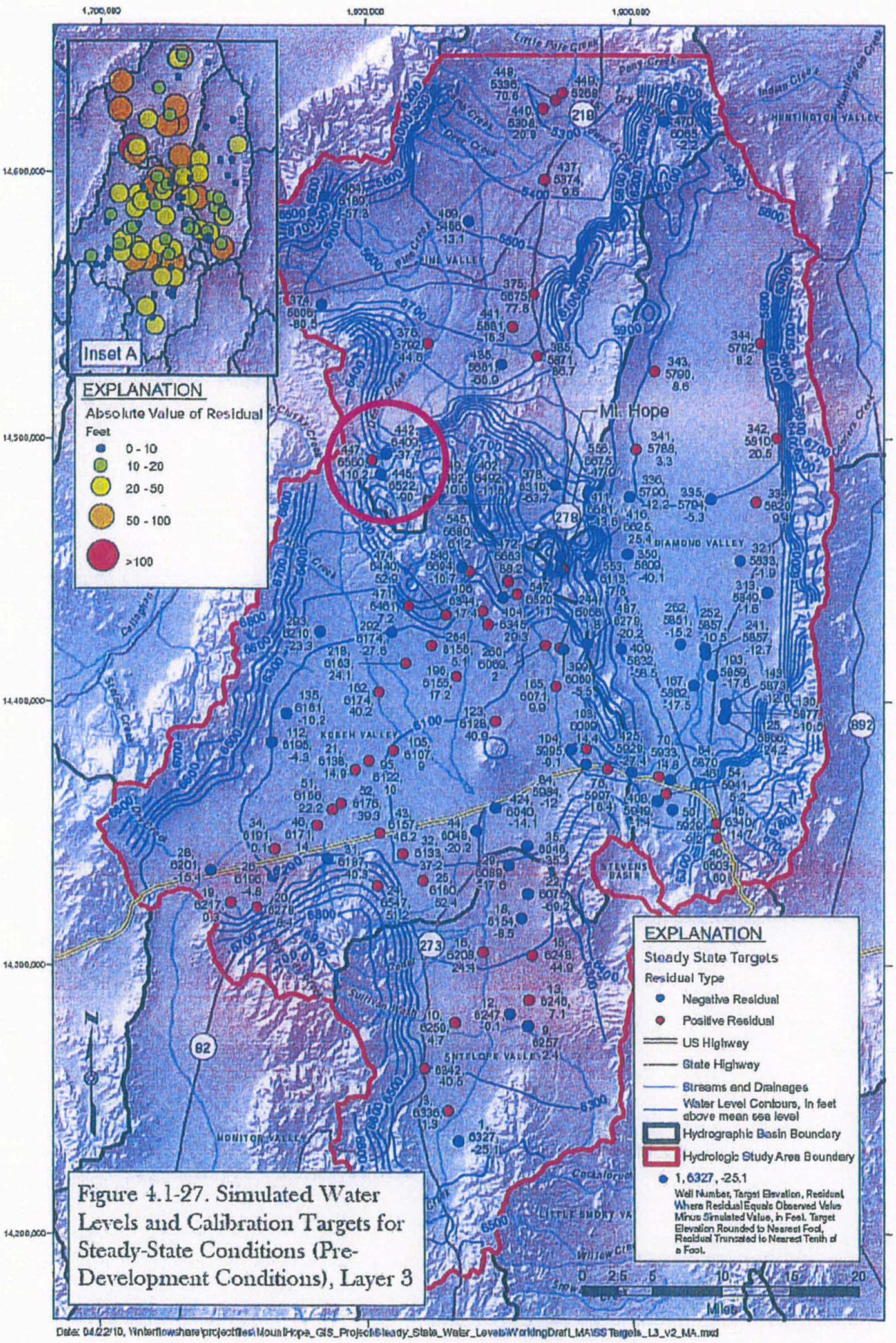

Figure 4.1-27. Simulated Water Levels and Calibration Targets for Steady-State Conditions (Pre-Development Conditions), Layer 3

The isotope chemistry from wells, piezometers, and boreholes in the vicinity of the proposed pit at Mt Hope ". . . may indicate high-elevation recharge sources as they have the lightest (most negative) isotope ratios within the Roberts Mountains" (ref.: Montgomery, *et al.,* 2010, Section 3.7.2.1). The likely high-elevation recharge area is the Roberts Mountains northwest of Mount Hope. This origin is further suggested by a depletion of heavier isotopes with increased depth in the Mt Hope area where water becomes depleted in heavier isotopes with depth. "The cause for the decrease is unknown but may be related to flow system paths" (*ibid.*, Section 3.7.2.4). In other words, the suggestion is that the deeper water has a source of recharge higher in elevation than the water derived from shallower depths beneath Mt Hope. The likely source of the water is in the higher elevations of the Roberts Mountains, which recharges a regional flow system consistent with Tóth's concept of the interrelationships between local and regional flow systems (Tóth, 1962).

Failure to address the potential impacts to decreed water rights on Henderson Creek

The list of potentially impacted water rights (those rights within the projected maximum extent of the 10-ft drawdown contour) ignores the decreed water rights associated with Henderson Creek (*ibid.,* Figure ES-5 and Table 4.4-9). The projected maximum extent of the 10-ft drawdown contour extends into the headwaters of Henderson Creek, actually extending north of the stream in one area. 100% of the water in Henderson Creek is subject to the Pete Hanson Creek Decree, including ***all*** springs that contribute to the flow in the creek whether or not they are specifically identified. The recent 9th Circuit Court of Appeals decision (USA v. Orr Ditch Company; 600 F.3d 1152 (9th Cir. 2010)) prevents the State Engineer from approving any water rights applications that affect decreed water rights. Because the mine's model clearly simulates impacts to flows in the springs, based on the mine's proposed pumping, it is unclear how the State Engineer can approve the current applications.

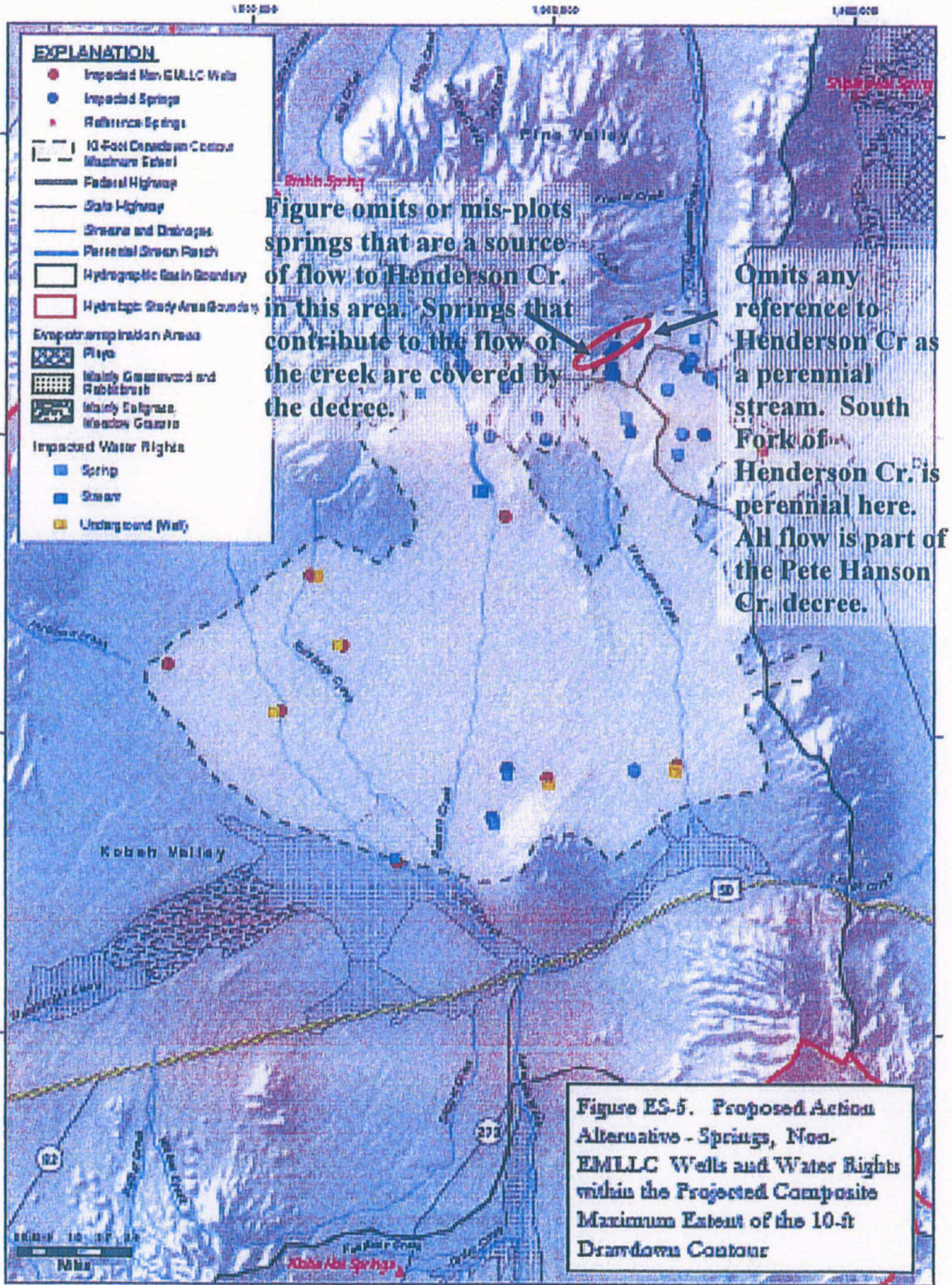

Figure ES-5. Proposed Action Alternative - Springs, Non-EMLLC Wells and Water Rights within the Projected Composite Maximum Extent of the 10-ft Drawdown Contour

Section 3.3.2.1.2 of the model report states ". . . perennial (spring-fed) segments [of Henderson Creek] exist . . . upstream of the confluence of the North and South Forks of Henderson Creek." A reconnaissance by Jake Tibbitts and me in October 2010 confirmed the south fork of the creek originates from a well-defined spring source. A strong spring flow at high elevation in the fall of the year points to a large recharge area with sufficient recharge to sustain spring flow long after the snow pack is gone. Any drawdown at the spring source can be expected to result in a reduction in spring flow and impair the decreed water rights of the creek.

Section 4.4.4.3 of the report provides simulated drawdown hydrographs for the headwaters of Henderson and Vinini Creeks in an attempt to show that drawdown from the mine's pumping is expected to be small in the headwaters of Henderson Creek. The locations in the model for these hydrographs are shown in Figure 4.4-16 below. Note that the location depicted in Figure 4.4-16 is in the headwaters of the north fork of Henderson Creek located farther from the mine compared to the south fork. A more appropriate location is the headwaters of the south fork of Henderson Creek where the stream is perennial and originates from a group of springs very close to the point where the maximum extent of the 10-ft drawdown contour crosses the south fork. It is unclear why the mine's consultants selected the point they did, when a location coincident with the springs that are the source of the perennial reach of the south fork of Henderson Creek would have been more appropriate.

Again, Figure 4.4-16 downplays the potential for impact to flow in the Creek by virtue of the 10-ft drawdown metric as an indicator of impact. At present, the model offers the best available tool for making predictions, and it suggests a potential for impacts to spring flows in the Roberts Creek and Henderson Creek watersheds.