Geo-Logic ASSOCIATES

July 26, 2024

Aren Hall
Environmental & Permitting Manager
Equinox Gold Corp-Castle Mountain Venture
980 American Pacific Dr., Suite 102
Henderson, NV 89014

Re: Revised Groundwater Monitoring Plan, Castle Mountain Mine

Dear Aren:

Equinox Gold Corporation—Castle Mountain Venture (Equinox) has requested that Geo-Logic Associates (GLA) prepare a revised groundwater monitoring plan for the Castle Mountain Mine (CMM) that will replace a 1990 plan prepared by The Mark Group. A supplemental plan (*Supplemental Plan for Groundwater Monitoring*) was also prepared in 2019 to address the closure of historic monitoring wells and addition of new monitoring wells. The purpose of the monitoring plan is to collect data that can be used to assess the potential mine-induced impacts to groundwater levels in Lanfair Valley and specific receptors like Piute Springs. The plan also defines thresholds that if triggered, would require specific mitigation measures be employed to reduce or eliminate potential resource impacts.

Introduction

Lanfair Valley is part of the Mojave National Preserve which is overseen by the National Park Service (NPS). Access within the Mojave Preserve is significantly limited as compared to the situation prior to 1990, therefore it is unlikely that new groundwater monitoring wells could be installed within the Preserve. The groundwater system at CMM is part of the Lanfair Valley groundwater basin. Piute Spring is a major discharge point for groundwater in the basin about 12 miles southeast of the mine. This plan will satisfy U.S. Bureau of Land Management (BLM) requirements that mining activities such as groundwater pumping and open pit operations do not produce effects that could be considered *unnecessary or undue degradation* (UUD), specifically as it relates to sensitive receptors like Piute Springs.

This letter reviews the components of the original 1990 monitoring plan and presents an approach to groundwater monitoring and mitigation which is similarly protective of this resource. However, the proposed methodology differs from the 1990 monitoring plan owing to additional land use (access) restrictions present today across Lanfair Valley.

Review: The 1990 Mark Group Monitoring Plan

A groundwater monitoring and contingency water supply plan was originally prepared by The Mark Group (1990) on behalf of Viceroy Gold Corporation as part of a Draft

Environmental Impact Statement/Environmental Impact Report (DEIS/EIR). The plan involved periodic measurement of groundwater levels in five monitoring wells located around the mine and in Lanfair Valley to evaluate how groundwater levels might be affected by mining activities. An associated contingency plan was developed based on the amount of groundwater drawdown observed in Lanfair Valley well W-37. The contingencies included installation of a sixth well in Lanfair Valley (W-40), recalibration of CMM's MODFLOW groundwater model, installation of a water pipeline to augment flow at Piute Springs, and reductions of mine-related groundwater pumping. As shown below, Table 4 of the 1990 monitoring plan provides a listing of the triggers and contingency actions required by the plan.

Actions to be Taken Based on Water Level Decline in W-37 After Project Pumping Starts (Mark Group, 1990, Table 4)

Actions Taken	Years 1, 2	Years 3, 4, 5	Years 6, 7, 8	Years 9, 10
A	4.0 feet	10.0 feet	16.0 feet	20.0 feet
B	6.0 feet	13.0 feet	20.0 feet	25.0 feet
C	8.0 feet	15.0 feet	24.0 feet	30.0 feet
D	10.0 feet	18.0 feet	28.0 feet	35.0 feet

A. Construct new monitor well W-40 approximately 1.5 miles south of W-37, and monitor W-40 at same frequency as W-37, after W-40 is completed.

B. Recalibrate ground water model and rerun to evaluate if ground water level declines might decrease flow in Piute Spring. The modeling report and other information shall be submitted to BLM to enable that agency to issue a decision document, with notice and comment period, on a course of action to be implemented.

C. In the event that ground water level declines at W-37 exceeded those shown in Row C prior to BLM's decision referenced in B becoming final, ground water pumping rates shall be reduced to 300 gpm until BLM's decision document has been given public review and BLM has determined that the declines in water levels at W-37 will not adversely affect flows at Piute Spring.

D. In the event that ground water level declines at W-37 exceeded those shown in Row D prior to BLM's decision referenced in B becoming final, ground water pumping rates shall be reduced to 150 gpm until BLM's decision document has been given public review and BLM has determined that the declines in water levels at W-37 will not adversely affect flows at Piute Spring.

After substantial reclamation of the CMM in the early 2000s, the monitoring wells in Lanfair Valley were destroyed and the well pads and roads were reclaimed. Since the 1994

designation of the Mojave National Preserve and Castle Mountains National Monument (2016) in Lanfair Valley, access to Lanfair Valley has been increasingly limited. Equinox is interested in revising the groundwater monitoring plan for the CMM to reflect the planned CMM expansion and considering the access limitations imposed by several land conservation designations. This document provides the basis for a draft, revised monitoring plan.

Proposed Monitor, Model, Mitigate Plan

The only available water supply for the mining operations at the CMM is local groundwater. CMM is currently authorized by the project lead agencies[1] to use 625 acre-feet of groundwater per year (AFY). Water is currently obtained using wells located near the mine in the Lanfair Valley Basin. Mining operations beginning in the 1990's relied mostly on West Well Field (WWF) production wells that at one time consisted of almost a dozen operating wells. Only three water wells remain active in the WWF, W-14P, W-18P, and W-45P; these are installed in shallow basin fill sediments two miles northwest of the mine (Figure 1). In 2017, the West Well Field was augmented with two new East Well Field (EWF) production wells (CMM-W-01 and CMM-W-02) which are installed in the rhyolite volcanic bedrock adjacent to the Jumbo South, Leslie-Ann (JSLA) open pit (Geo-Logic Associates, 2017). In 2021, well CMM-W-03 was installed in rhyolite-dominated volcaniclastic rocks south of the mining operation in Lanfair Valley (Geo-Logic Associates, 2021). These wells constitute the current water supply for mine production water. Since planned mine expansion will require an increase in groundwater production, additional wells may be required to support pit dewatering and/or to increase mine production.

Groundwater modeling, presented in the Water Supply Assessment Report (Geo-Logic Associates, 2022; revised, June 2023), has been used to assess the potential effect of mine pumping on Lanfair Valley groundwater levels and downgradient discharge at Piute Spring. The model was developed using the U.S. Geological Survey (USGS) model code "MODFLOW-NWT" and the graphical user interface "Groundwater Vistas." The model domain encompasses about 738 square miles. The model was used to simulate a steady-state condition to represent pre-mining conditions. An acceptable calibration was achieved using 69 wells distributed throughout Lanfair Basin. The model was then used to simulate transient conditions at the mine when pumping occurred from 1991 through 2016. Three scenarios were simulated to evaluate various long-term (post-2016) groundwater pumping scenarios. These simulations included:

- *Baseline Scenario*: The baseline run approximates current groundwater pumping rates projected through 2045. This scenario simulates historical and future pumping with aggregate rates of 387 gallons per minute (gpm), or 625 AFY, from 2024 through 2045. It

1 U.S. Bureau of Land Management (federal agency) and County of San Bernardino, California (state agency)

also anticipates five years of heap rinsing at 350 gpm and then 100 years of groundwater recovery with no pumping.

- *Scenario 1*: This case simulates proposed increased pumping with aggregate rates up to 830 gpm (1,339 AFY) from 2024 through 2045, five years of heap rinsing at 350 gpm and then 100 years of groundwater recovery with no pumping. Seven pit dewatering wells were included in this simulation.
- *Drought Scenario*: This scenario was developed to consider a sustained 10-year-long drought in the basin from 2024 through 2034. Groundwater pumping rates during this period are assumed to be the same as for Scenario 1. The drought is integrated in the model setup by assuming a 10 percent reduction in recharge within the highlands recharge areas.
- To estimate the impacts from future recharge rates based on climate modeling, the steady-state model was run with recharge rates multiplied by factors ranging from 1.2 to 0.8, representing a reasonable range of possible outcomes as suggested by climate models[2]. The steady-state model of Lanfair Valley was run to predict Piute Spring flow rates. Because time is not included in the steady-state model, the predictions from it essentially represent long-term impacts with permanent declines or increases in recharge. The flow at Piute spring was predicted to vary significantly, ranging from 37.9 gpm with a 20% decline in recharge rates, to greater than 224 gpm with a 20% increase in recharge.

An uncertainty analysis was conducted on the model results using a probabilistic modeling approach. Uncertainty was tested by implementing a Monte Carlo scheme to run 1,000 realizations using PEST and allowing variations of hydraulic conductivity in zones in and around the mine for each realization. The results suggest that the calibrated hydraulic conductivity values in the model around the mine have only a fractional impact on Piute Spring Flow predictions.

The groundwater modeling results indicate that groundwater table reductions near the EWF bedrock pit dewatering extraction wells will be nearly the same for all three scenarios (200 to 300 feet) but that drawdown will be most significant in a limited area near CMM and surrounding the mine pits. Groundwater table "drawdown" further out into the valley area will be considerably less and water levels will recover relatively quickly once mining ends. Piute Springs is located 12 miles southeast from the CMM, at this distance mine related pumping effects, if any, would occur slowly over time. The model provides a

2 Pierce, D. W., J. F. Kalansky, and D. R. Cayan, (Scripps Institution of Oceanography). 2018. Climate, Drought, and Sea Level Rise Scenarios for the Fourth California Climate Assessment. California's Fourth Climate Change Assessment, California Energy Commission. Publication Number: CNRA-CEC-2018-006.

conservative estimate of potential effect of a maximum 9% decline in spring discharge by 2150 (100 years after mining ends) compared to the current baseline condition.

It should be noted that the groundwater model has been constructed using conservative assumptions that have the effect of increasing impacts from mining. For instance, prior studies have suggested the possible presence of one or more faults that could act as barriers to groundwater flow thereby limiting impacts to Piute Springs. These faults have not been included in the model allowing direct connection through the aquifer to Piute Springs. Considering our cautious approach to modeling that incorporates conservative assumptions, the inclusion of probabilistic model iterations, and the substantial distance between the mine and Piute Spring, the likelihood of a measurable effect of mine-related pumping at Piute Spring is considered low.

Monitor, Model, Mitigate Program

The monitoring plan envisioned for CMM would need to be comprised of three components: (1) monitoring groundwater levels in existing wells in the vicinity of the mine, (2) modeling the impacts of pumping over time to predict the change in water levels in the area of the mine and the potential effects on Piute Spring flow over time, and (3) implementing periodic model calibration to predetermined thresholds, if a threshold is exceeded, then pre-defined mitigation measures would be triggered to prevent or reduce impacts to Piute Springs. For brevity, we refer to this plan as the "Monitor, Model, and Mitigate," or 3M program. This monitoring plan approach has been approved by regulatory agencies at other mining sites in the Western U.S. in situations where impacts of mining operations may not measurably propagate to vulnerable ecosystems for years or decades into the future.

Figure 2 shows the locations of existing monitoring wells around CMM that can be regularly monitored to identify changes in water level elevations. Table 1 lists the proposed existing and virtual monitoring wells that would be part of the 3M program for CMM. It also identifies the locations for "virtual" monitoring locations that would be used to synthetically evaluate the magnitude of groundwater elevation changes. The program includes five (5) existing wells, two (2) virtual wells, and one contingency well.

The 3M program for the Castle Mountain Mine is envisioned to have the following components:

- *Monitoring:* Monthly, collect water level data from the existing wells listed in Table 1. Annually, compile the data and record water level changes in each well.
- *Modeling:* Annually, update the existing groundwater model using actual production well pumping rates for the prior year and re-run the model. Compare observed changes in water levels in the monitoring wells with model-predicted changes. Assess the model calibration using standard statistical methods including the mean error, the absolute

mean error, and the scaled root mean squared error. The current calibration of the steady state model results in a mean error of 14.7 feet, an absolute mean error of 55 feet, and a scaled root mean squared error of about 3.0 percent. If the calibration using current water levels for all monitoring wells results in values significantly higher than these, then recalibration of the model is warranted. The significance of the difference in statistics is subjective and must therefore be reviewed with regulators to reach agreement on whether recalibration of the model should be undertaken.

With acceptable calibration, run two future simulations for 50 years after planned mine closure[3]; one without mine pumping and one with expected mine pumping rates through the end of mine life. The model would be run to compare the predicted discharge flow from Piute Spring with and without mine pumping 50 years after mine closure. Continuation to mitigation steps would be determined based on the magnitude of predicted flow reductions as follows:

Table 2. Piute Spring Flow Impacts and Planned Actions

Amount of Modeled Piute Spring Flow Reduction 50 years after mine closure (gpm)	Percent Change	Proposed Action
Zero to 8	<7	Mitigation Action A
9 to 12 gpm	7 to 10	Mitigation Action B
13 to 17 gpm	10 to 14	Mitigation Action C
18 to 22 gpm	14 to 18	Mitigation Action D

Mitigation. Depending on the modeled change in Piute Spring flow 50 years after mine closure, mitigation steps listed in Table 2 would be implemented as follows:

A. *Action A*: No further action.

B. *Action B:* Synthetically redistribute mine pumping and re-model potential impacts. If re-simulation results in less than an 10% decrease in Piute Spring flow, re-distribute the pattern of pumping at the mine. If modeled redistribution of pumping does limit discharge reductions at Piute Spring to less than 10%, go to Action C.

C. *Action C:* Add existing well W-25P as a new monitoring well east of the south extension pit. Begin monthly monitoring.

3 Model predictions become less reliable the further in time the simulations go from the time at which the model was calibrated. 50 years after mine closure would be about 75 years after the current model calibration. Model predictions up to 75 years from calibration are reasonably reliable for the purposes of this plan.

D. *Action D:* Rerun the model to simulate mine pumping conditions that support a 10% or less decrease in flow at Piute Spring, then implement a reduced pumping plan for mine production wells in Lanfair Valley and increase water use from Ivanpah Valley production wells.

The 1990 monitoring plan was designed to include the triggering of mitigation options based on measured changes in water levels in wells within Lanfair Valley. In the proposed plan presented in this document, the mitigation trigger would be implemented if model predictions 50 years into the future indicated reductions in Piute Spring flows in excess of specified amounts. Observed changes in water levels would no longer be the trigger but would be incorporated in model calibration and recalibration. Several reasons are cited for this change in strategy as follows:

1. Monitoring wells no longer exist in the central part of Lanfair Valley as had existed in 1990. In addition, changes in access to this area has been prohibited by the designation of the Mojave National Preserve. As a result, replacement wells cannot be installed.
2. Groundwater modeling suggests that impacts to Piute Spring from mining activity could require years or decades to propagate to the spring. Groundwater monitoring data collect today may not clearly establish whether Piute Spring will be impacted in the future. Modeling future conditions is the only way to assess whether mine pumping operations will have an impact on Piute Spring.
3. Modeling groundwater changes can be done such that impacts from mine operations can be distinguished from impacts caused by drought. This is not possible from interpretation of groundwater level changes.

This approach allows pre-emptive changes in mine operations long before impacts to Piute Spring are observable.

Summary

The proposed 3M plan described herein involves collection of monitoring well data and comparison of the data with modeled groundwater levels throughout Lanfair Valley Basin to evaluate the potential for changes in Piute Spring flow. The advantages of this plan include:

1. Avoidance of environmental impacts to the Mojave National Preserve that would be associated with installation of new monitoring wells in remote parts of Lanfair Valley,
2. The linkage of mitigation actions with Piute Spring flow, and

3. Limiting changes in Piute Spring flow to less than 10 percent of the current flow condition.

This proposed plan differs from the 1990 plan in that the trigger for mitigation actions would be model predictions of changes in Piute Spring flow after 50 years of mining rather than measured water level changes in key monitoring wells. Several reasons are cited for changing the mitigation trigger including: 1) the lack of existing monitoring wells within the Mojave National Preserve in Lanfair Valley, 2) the fact that impacts to Piute Spring flow may require years or decades to propagate to the spring, and 3) modeling allows the ability to isolate mining impacts from other influences such as drought. This approach allows pre-emptive changes in mine operations long before impacts to Piute Spring are observable.

Conclusion

Geo-Logic Associates appreciates the opportunity to assist Equinox Gold Corp—Castle Mountain Venture with development of this monitoring plan. If you have any questions or concerns, please contact me.

Sincerely,

GEOLOGIC ASSOCIATES, INC.

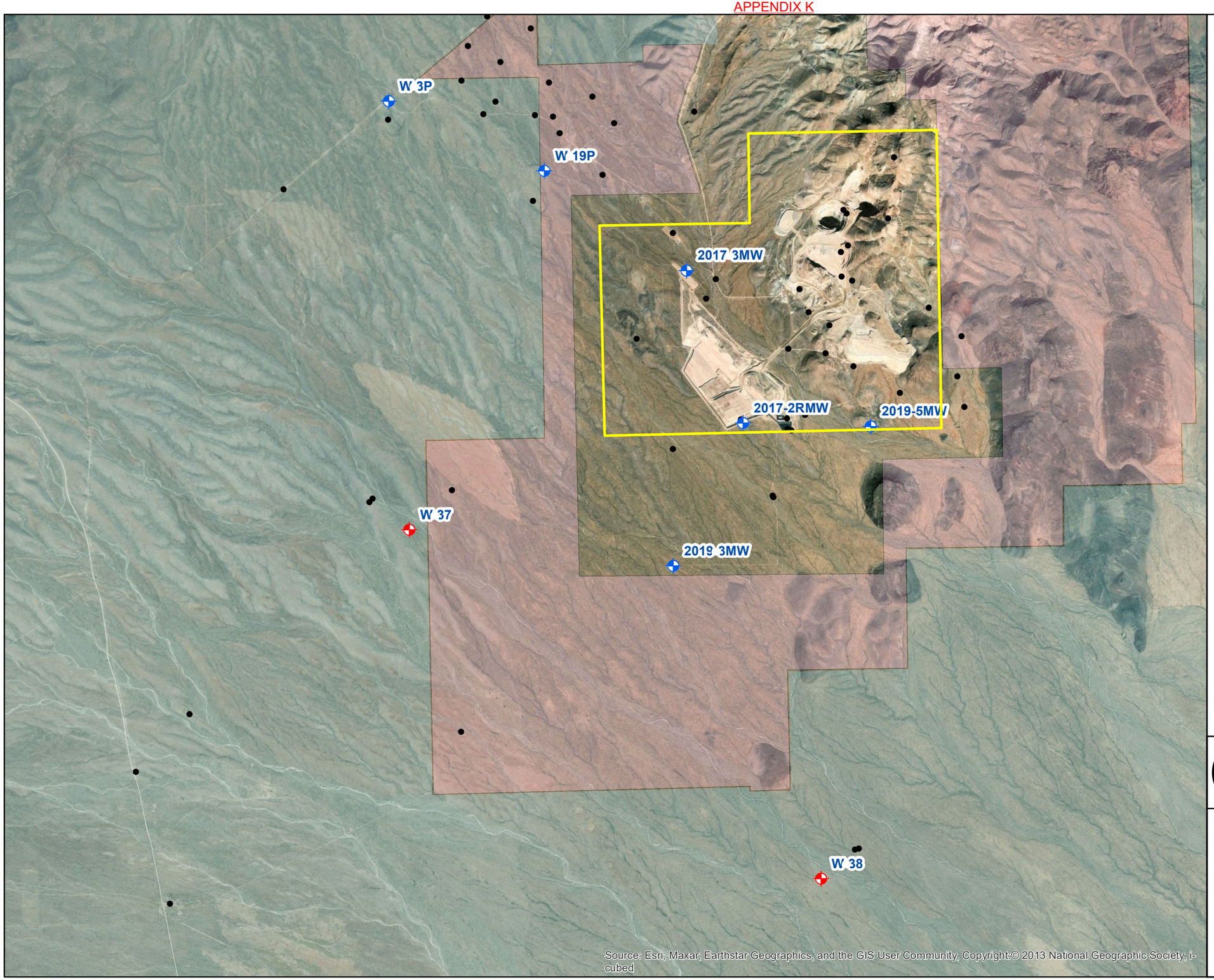
R. Douglas Bartlett, PG, CHG
Principal

Paul Plato, RG
Senior Hydrogeologist

Attachment

Table 1. Proposed Monitoring Well Network

Well Name	Northing	Easting	Current Status	Year Installed	Casing Diameter (in)	Total Depth	Screened Interval (ft)	Most Recent Depth to Water (ft)	Water Level Elevation (ft AMSL)	Date of WL Reading
W-45P	35°18'28.35"	-115° 8'44.88"	Existing	1997	8	800	530-630	458.90	4,100.5	12/31/2003
2017-2RMW	35°15'34.80"	-115° 6'56.16"	Existing	2020	4	640	580-640	537.88	3,673.64	6/1/2022
2017-3MW	35°16'41.40"	-115° 7'23.91"	Existing	2017	4	690	630-690	161.83	4,154.65	6/1/2022
2019-3MW	35°14'33.20"	-115° 7'34.73"	Existing	2020	4	650	500-650	451.18	3,711.14	4/7/2023
2019-5MW	35°15'32.26"	-115° 5'48.08"	Existing	2020	4	581	430-581	439.18	3,696.90	4/7/2023
W-25P	35°16'23.58″	-115° 5'16.29″	Existing	1988	8	960	350-940	275.6	3,924.20	2/24/1988
W-37	35°14'51.72"	-115° 9'55.34"	Virtual	1990	8	1,000	640-1000	858.65	3,691.35	1/28/1997
W-38	35°12'14.13"	-115° 6'15.14"	Virtual	1990	8	1,100	800-1100	758.02	3,193.98	1/28/1997



Explanation

Wells

- Other Wells
- Proposed Monitoring Point
- Virtual Monitoring Point
- CMM Property Boundary
- Castle Mountain Monument
- Mohave Preserve

Notes:

0 0.5 1 2 Miles

Revision Date: 3/25/2024

Job Number: CC20.1105

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Figure 1

Proposed Monitor Wells

Equinox Gold
Castle Mountain Mine, CA

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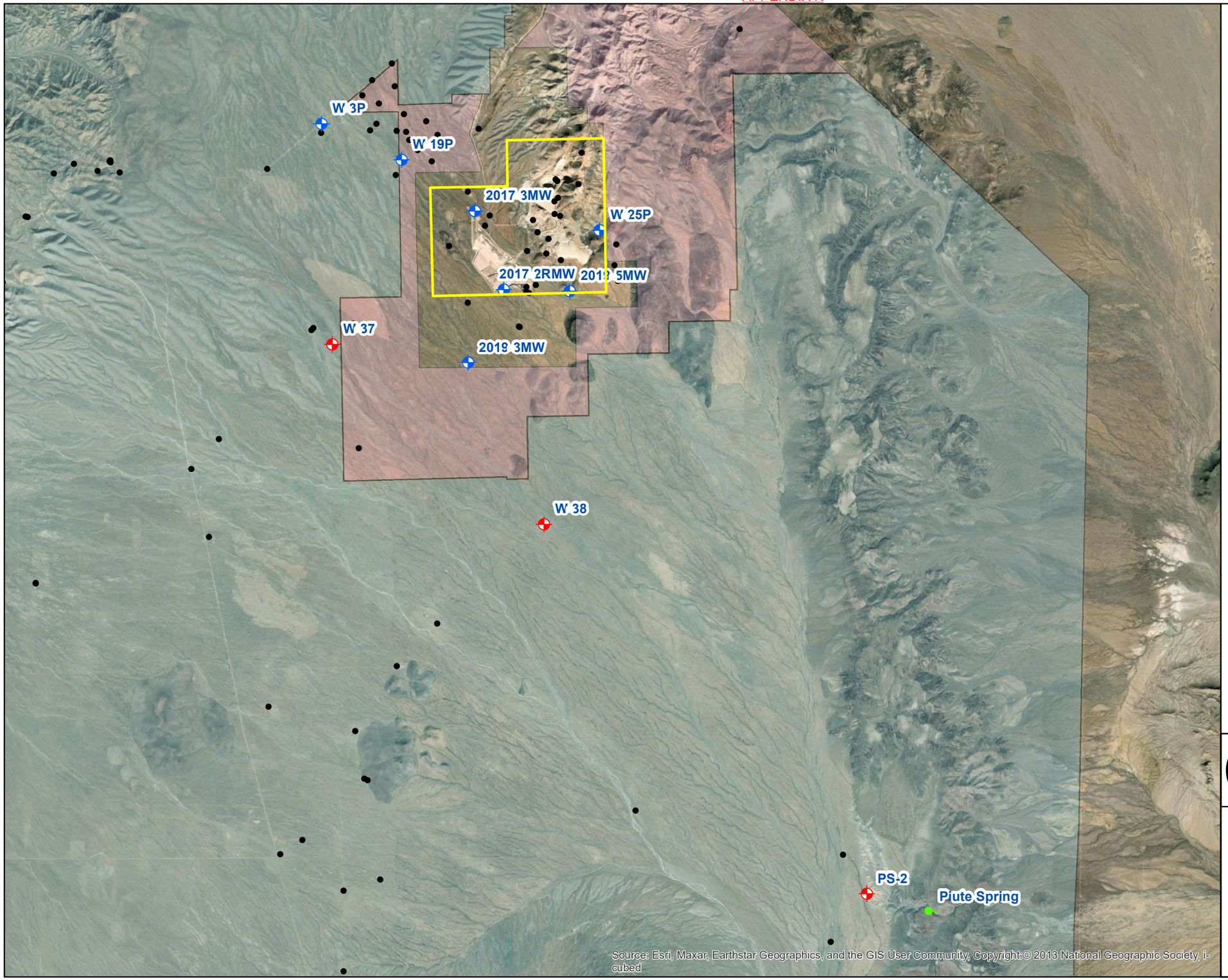

Explanation

Wells

- Other Wells
- Proposed Monitoring Point
- Virtual Monitoring Point
- Piute Spring
- CMM Property Boundary
- Castle Mountain Monument
- Mohave Preserve

Notes:

0 0.5 1 2 3 4 Miles

Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community, Copyright:© 2013 National Geographic Society, i-cubed

Revision Date:	7/26/2024
Job Number:	CC20.1105

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Figure 2

Proposed Monitor Wells and Piute Spring
Equinox Gold
Castle Mountain Mine, CA

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