REVISED OPEN PIT REMEDIATION PLAN, CUNNINGHAM HILL MINE RECLAMATION PROJECT ABATEMENT PLAN AP-27

prepared by

Steven T. Finch, Jr., CPG

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prepared for

LAC Minerals (USA) LLC
582 County Road #55
Cerrillos, New Mexico 87010

August 2011

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REVISED OPEN PIT REMEDIATION PLAN
CUNNINGHAM HILL MINE RECLAMATION PROJECT ABATEMENT PLAN AP-27

1.0 INTRODUCTION

The New Mexico Environment Department (NMED) issued alternative abatement plan AP-27 for the open pit remediation and potential discharge to surrounding groundwater. The remediation plan for the Cunningham Hill Mine Reclamation Project open pit included filling with diverted storm water from Upper Cunningham Gulch (Fig. 1). The project is owned and managed by LAC Minerals (USA) LLC (LAC). AP-27 has permit conditions that include performance standards (APS-1) and a contingency plan (APC-1). APS-1 relates to open pit pool performance standards (expected goals with remediation by pit filling). The clock for APS-1 started after reverse osmosis (RO) was completed by the end of 2002 (1^{st} quarter 2003). The performance standard triggers include the following:

Trigger No. 1 – open pit pool exceeds 1,000 milligrams per liter (mg/L) sulfate for a period of eight consecutive quarters. Trigger No. 1 occurred at the end of the 2^{nd} quarter 2007.

Trigger No. 2 – open pit pool exceeds 600 mg/L sulfate but remains below 1,000 mg/L sulfate for a consecutive period of 8 years (32 quarters). Trigger No. 2 occurred at the end of the 4^{th} quarter 2010.

A graph of time-series open pit pool sulfate concentration and Triggers No. 1 and 2 time periods is shown as Figure 2. Between 2007 and 2010, LAC submitted notification of Trigger No. 1 and performed two pilot remediation programs (Fig. 2). LAC submitted notification of Trigger No. 2 to the NMED on March 1, 2011. A copy of the notification letter is attached as Appendix A.

Required actions for AP-27 Trigger No. 2 include the following:

- Recalibration of open pit chemistry model within 90 days of notification
- Recalibration of transport model within 90 days of notification
- Submit remediation plan and implementation schedule within 180 days of notification

The chemistry and transport model recalibrations have been completed and were submitted to the NMED on July 31, 2011.

1.1 Previous Work

Approximately 5 years after RO treatment ceased in 2002, it became apparent that sulfate concentrations were increasing as a result of source control issues and lack of pit filling with storm water. It was also realized that RO treatment had resulted in negative after effects that far outweighed sulfate removal, such as reduction in pit volume and exposing sulfide minerals to oxidation and stripping alkalinity and buffering capacity. Previous work related to complying with AP-27 has included RO treatment, pH control measures, sulfate source investigations, pilot programs, and model recalibration.

1.1.1 pH Control and Liming

Maintaining pH control in the open pit pool is required for meeting surface water quality standards and for preventing the effects of acidity resulting in dissolved metal concentrations. LAC has monitored open pit pool pH weekly, as weather and other safety conditions allow, to ensure pH remains at 6 or above. During past acid wall seepage (AWS) events, the open pit pool pH has dropped below 6, and the pool was treated with hydrated lime. The lime treatment events are summarized in Table 1. Since 2005 lime treatment events have been limited to approximately every 2 years.

Table 1. Summary of pH mitigation events for the open pit pool

year	number of pH mitigation events	quantity of hydrated lime added (tons)
1997	3	2.9
1998	9	10.5
1999	10	41.1
2000	*4	23.1
2001	*2	11.2
2005	4	120.6
2006	1	23.5
2008	1	11.2
2010	1	20.1

* lime added during RO treatment
No lime added for 2002, 2003, 2004, 2007, 2009

1.1.2 Sulfate Source Investigation

LAC and John Shomaker & Associates, Inc. (JSAI) have performed several field investigations to identify sources for AWS into the open pit. Two sources for AWS were identified 1) storm water runoff onto benches and ponding on benches, and 2) storm water infiltration through a network of fractures oriented southwest to northeast. In pit storm water runoff was addressed by maintenance of storm water diversion features (berms, etc), as allowed under AP-27 permit condition number 3.

The 2009 JSAI fracture study (see Appendix B) established that the source of AWS on the southwest pit wall was likely from infiltration of ponded storm water in a land depression near the Upper Cunningham Gulch diversion channel. During the last several months, repairs to the diversion channel were made and included 1) infill of the land depression, 2) restoring the grade of the diversion channel upstream of the weir, and 3) modification of the weir for allowing low flow storm water events. A report on the Upper Cunningham Gulch diversion channel repairs is attached as Appendix C.

1.1.3 Pilot Programs

During 2007, LAC proposed to the NMED and Friends of Santa Fe a pilot program for pit remediation. A temporary permit was issued on September 17, 2008 to discharge 10 gallons per minute (gpm) of mixed water sources into the open pit pool during the Fall of 2008. A second pilot program was performed in the Fall of 2009. The pilot programs (Fig. 2) were successful in reducing sulfate concentrations while maintaining open pit volume and increasing buffering capacity. A detailed evaluation of the pilot programs and open pit remediation options can be referenced from JSAI (2010). Source controls were identified as an ongoing issue that would need to be mitigated before implementing sulfate reduction in the open pit pool.

1.1.4 Model Recalibration

As part of the requirements for AP-27 Trigger No. 2, LAC contracted JSAI to revise and update the groundwater flow and solute transport model used for developing the AP-27 open pit pool remediation strategy. A report detailing the model updates and revisions was submitted to NMED on July 31, 2011 (JSAI, 2011). Revised storm water inflow calculations for Upper Cunningham Gulch indicate that the open pit will not likely fill with storm water because increasing vegetative cover is significantly reducing watershed yield. It is possible that the current open pit pool maybe in hydraulic equilibrium with surrounding groundwater.

1.2 Objectives

AP-27 requires submittal of a revised remediation plan and implementation schedule within 180 days of Trigger No. 2 notification. The objective is to develop a revised remediation plan that will help meet the goals of alternative abatement plan AP-27. The revised remediation plan includes methods for 1) pH mitigation, 2) source control, 3) sulfate reduction, and 4) long-term maintenance.

2.0 PROPOSED REMEDIATION PLAN

The proposed plan does not rely entirely on storm water diversions from Upper Cunningham Gulch to meet AP-27 remediation goals. The second pilot program report (JSAI, 2010) provided a summary of potential open pit pool remediation options, which included:

1. source control measures
   a. improved storm-water diversion
   b. watershed management
2. sulfate removal measures
   a. reverse osmosis (RO)
   b. filtration with mixed water
   c. bioremediation

Of those listed above, watershed management and bioremediation have been determined infeasible. LAC does not control land ownership of the Upper Cunningham Gulch watershed (see Fig. 1), and therefore cannot perform the required watershed maintenance. In addition, the open pit pool may not be able to maintain oxygen-poor conditions for bioremediation to work effectively.

To evaluate the importance of AWS source control, two future scenarios were modeled. The first scenario includes sulfate removal to 600 mg/L in 2012, continued AWS input with predicted average storm-water inflow combined with a large storm-water runoff event occurring in 2020. The second scenario includes sulfate removal to 600 mg/L in 2012, no AWS input (effective source control) with predicted average storm-water inflow combined with a large storm-water runoff event occurring in 2020. Figure 3 is a graph showing model simulated sulfate concentrations for each of the two scenarios. Implementing effective source controls make a 550 mg/L difference in model- simulated sulfate concentration in the open pit pool, and the ability to met APS-1 performance standards.

2.1 pH Mitigation

Past pH mitigation has involved the addition of hydrated lime ($CaOH\text{-}H_2O$) to the open pit pool. Hydrated lime neutralizes acidity with hydroxyl (^-OH), with calcium and water as bi-products. The end result is short-term buffering capacity and added calcium and total dissolved solids (TDS) to the pit pool system. As observed during LAC's pilot program, addition of groundwater with elevated bicarbonate alkalinity provides a long-term buffering capacity.

LAC has identified the Guest House Well as a potentially viable source for groundwater elevated with bicarbonate alkalinity. The location of the Guest House Well is shown on Figure 1, and a letter report on the Guest House Well is presented as Appendix D. Currently the Guest House Well is not a point of diversion permitted with the New Mexico Office of the State Engineer (NMOSE). As described in Section 3.0 below, LAC proposes to submit an application to permit the Guest House Well, so it can be pumped to the pit and use for pH mitigation.

2.2 Source Controls

Source controls to cut off AWS sources include storm water management within the open pit watershed, and repairs to the Upper Cunningham Gulch diversion channel. Initial storm-water runoff controls within the open pit watershed were performed by LAC between the two pilot programs (2009). A reduction in AWS on the northeast and eastern sides of the open pit was observed after those storm-water runoff controls were completed. LAC is currently performing additional storm-water runoff controls such as road and berm maintenance to minimize infiltration on the benches and AWS.

Maintenance to the Upper Cunningham Gulch channel where it meets the diversion structure have been performed (correspondence with the USACE 404 compliance section and repair details can be found in Appendix C). These repairs were completed in August 2011. It will require several rainfall events to determine how effective the repairs are in controlling AWS sources.

The diversion channel currently discharges at the top of the southern pit wall, but there is a poorly defined conveyance channel from the diversion channel to the open pit pool. To date there has been no known storm water flowing from the diversion toward the southern pit wall. However, since the completion of the August 2011 Upper Cunningham Gulch channel maintenance work (see Appendix C), LAC expects flow will occur in the future. LAC will inspect the open pit storm water conveyance channel after storm flows and determine if repairs are required.

2.3 Sulfate Removal

Over the last 10 years, LAC has evaluated several options for sulfate removal in the absence of sufficient storm water inflows. Reverse osmosis alone has proven ineffective over the long term, and the open pit pool chemical conditions are not favorable for bioremediation. Discussed below are two remaining options for open pit pool sulfate removal.

2.3.1 Filtration Supplemented with Guest House Well

Using micro-filtration supplemented with high-alkalinity groundwater would provide a viable method for sulfate removal. By replacing the volume of water consumed by filtration with high-alkalinity groundwater from the Guest House Well, the volume of water in the pit would not decrease, and the treated water delivered to the pit would contain valuable alkalinity. If filtration efficiency is 80 percent, water containing 150 mg/L sulfate can be added to the pit at a rate of 250 gpm. These values are fixed by the 50 gpm capacity of the Guest House Well.

The filtration treatment plant could be located at the existing CN ponds. Water pumped from the pit could gravity flow to this location, thereby reducing power cost. Reject could be piped to the evaporation ponds in Dolores Gulch, assuming there is no need to treat acid rock drainage (ARD) from the Waste Rock Pile and the ponds are available. The filtration permeate could then be blended with the water pumped from the Guest House Well and pumped back to the pit. Operating at 200 gpm, this strategy would require continuous operation for approximately 2 to 4 months to drop sulfate concentration below 1,000 mg/L (Trigger No. 1) and around 10 months to drop sulfate concentration below 600 mg/L (Trigger No. 2). The RO ponds may be used if the available capacity of the Dolores Gulch evaporation ponds is not adequate.

2.3.2 Addition of Barium Chloride

Another alternative for sulfate removal is treatment with barium chloride di-hydrate to precipitate the sulfate as insoluble barite mineral (barium sulfate). LAC has contracted EDE Consultants to evaluate the application of barium chloride as a treatment option for sulfate reduction in the open pit pool. Two principal concerns this type of treatment alternative include: 1) The water quality and potential environmental effects of the treated water, and 2) The residue (precipitate) quality and potential environmental effects.

Initial results of the evaluation indicate precipitated barite will settle to the floor of the pit and remain there as geochemically stable barite, eventually becoming inter-bedded with lime and ferric iron as well as silicate sediments. The precipitate has been tested using a TCLP leach procedure and found to be non-hazardous. The end result of this treatment alternative is the formation of a stable, insoluble barite mineral precipitate and a water quality that is geochemically stable as well as meeting the benchmark standards for sulfate. Potential benefits of the process include 1) no creation of hazardous or harmful waste byproducts, 2) no issues with sludge disposal, and 3) no concentrate is generated that must be separately handled. The feasibility and economics of barium chloride treatment are still being evaluated.

3.0 PROPOSED SCHEDULE

Source controls and pH mitigation need to be implemented and confirmed before sulfate removal occurs. Without addressing source control and pH mitigation sulfate removal becomes a temporary fix rather than a long-term solution.

The recalibrated transport model confirms the current observed conditions, where pit filling does not occur and subsequently there is less hydraulic gradient to transport discharges to groundwater than previously projected. Monitoring results do not indicate discharge from the open pit pool to groundwater. If the open pit pool is currently discharging to groundwater, the model simulates a rate of 7.5 gpm at a calculated travel velocity of 37 ft/yr (JSAI, 2011). This means there is no urgency for sulfate removal and open pit pool treatment as long as surface water standards are maintained. Successful sulfate mitigation can be achieved after implementation of effective of source control.

The proposed schedule for the revised AP-27 remediation plan can be referenced from Table 2. Based on the proposed schedule, the clock for Triggers No. 1 and 2 will start after sulfate removal is completed.

Table 2. Proposed schedule for revised AP-27 open pit pool remediation plan

time period	action
Fall 2011 to Fall 2012	➢ improve storm-water runoff controls within the open pit watershed ➢ if viable, perform repairs to, or replace, Guest House Well and apply for NMOSE permit to use well for pH control
Summer 2012	➢ perform repairs to conveyance channel from diversion channel to open pit pool
2013	➢ monitor effectiveness of source controls
2014	➢ implement sulfate removal if source controls are successful

4.0 REFERENCES

[JSAI] John Shomaker & Associates, Inc., 2010, Results of AP-27 open pit pool second pilot remediation program, Cunningham Hill Mine Reclamation Project: consultant's report prepared by John Shomaker & Associates, Inc. for LAC Minerals (USA) LLC, 25 p.

[JSAI] John Shomaker & Associates, Inc., 2011, Update and recalibration of groundwater-flow and solute-transport model for predicting potential effects from the Cunningham Hill Mine open pit, Santa Fe County, New Mexico: consultant's report prepared by John Shomaker & Associates, Inc. for LAC Minerals (USA) LLC, 29 p.

ILLUSTRATIONS

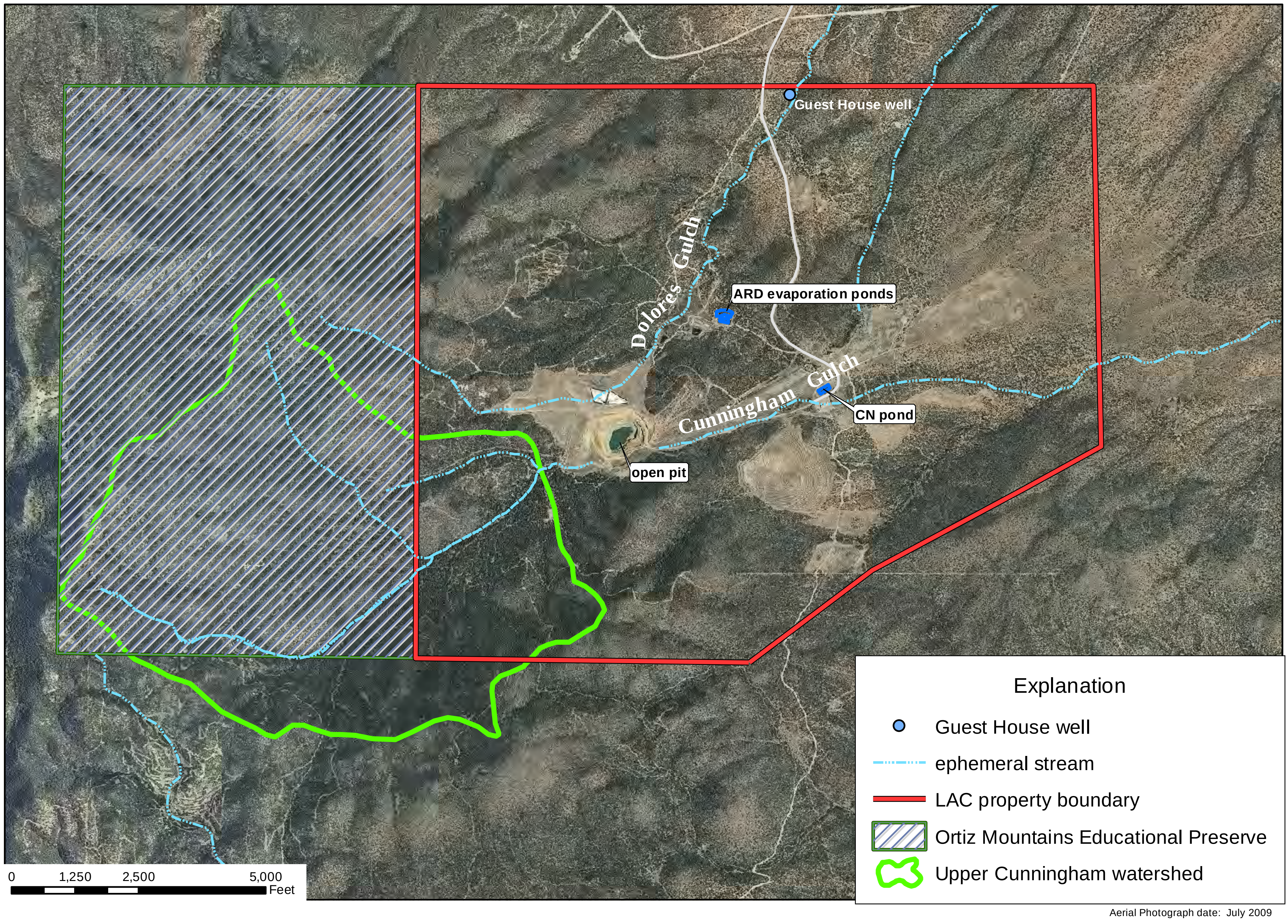

Figure 1. Aerial photograph showing location of Cunningham Hill Mine Reclaimation project, pit, and selected facilities.

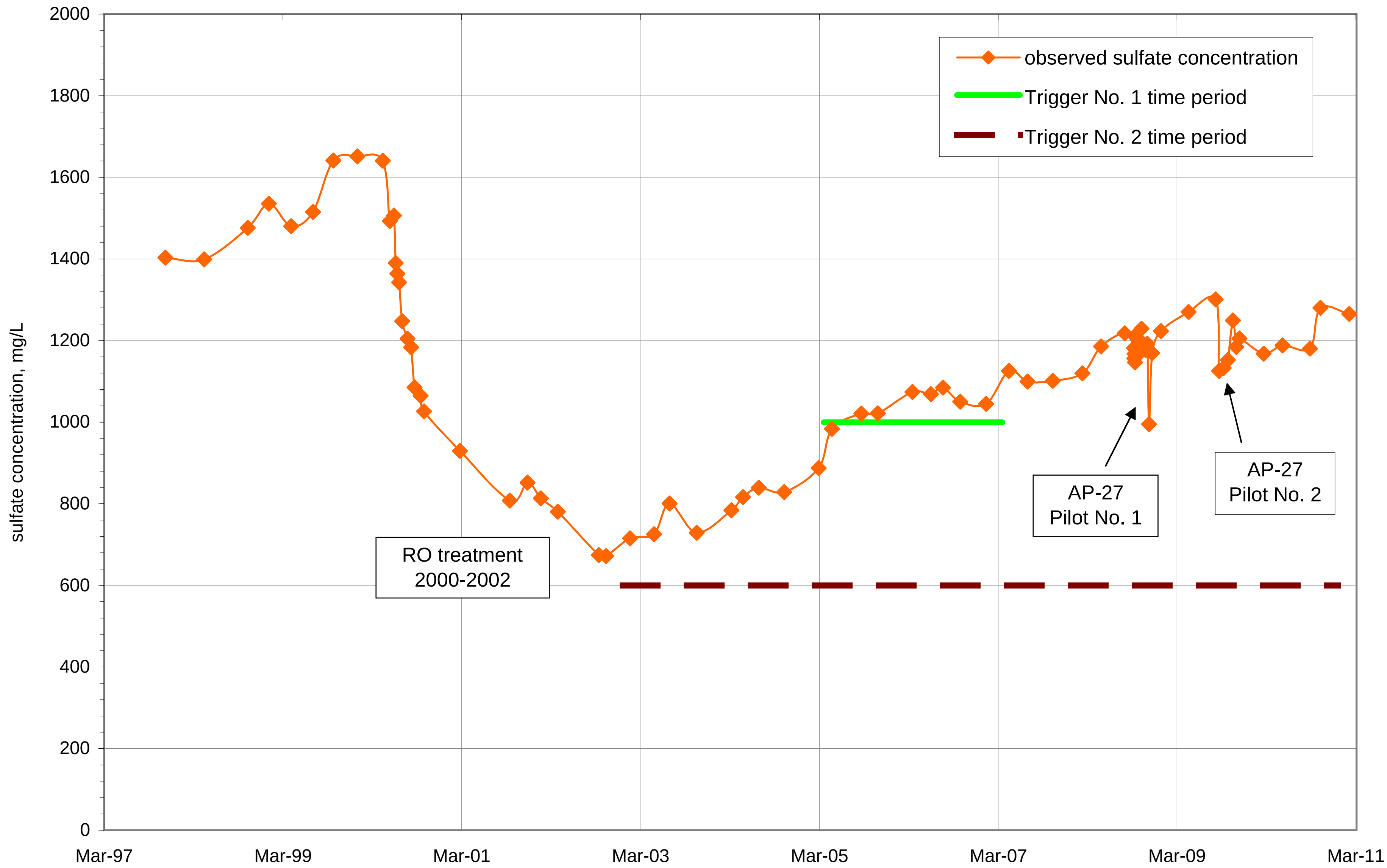

Figure 2. Graph of sulfate concentration versus time for the open pit, Cunnigham Hill Mine Reclamation Project.

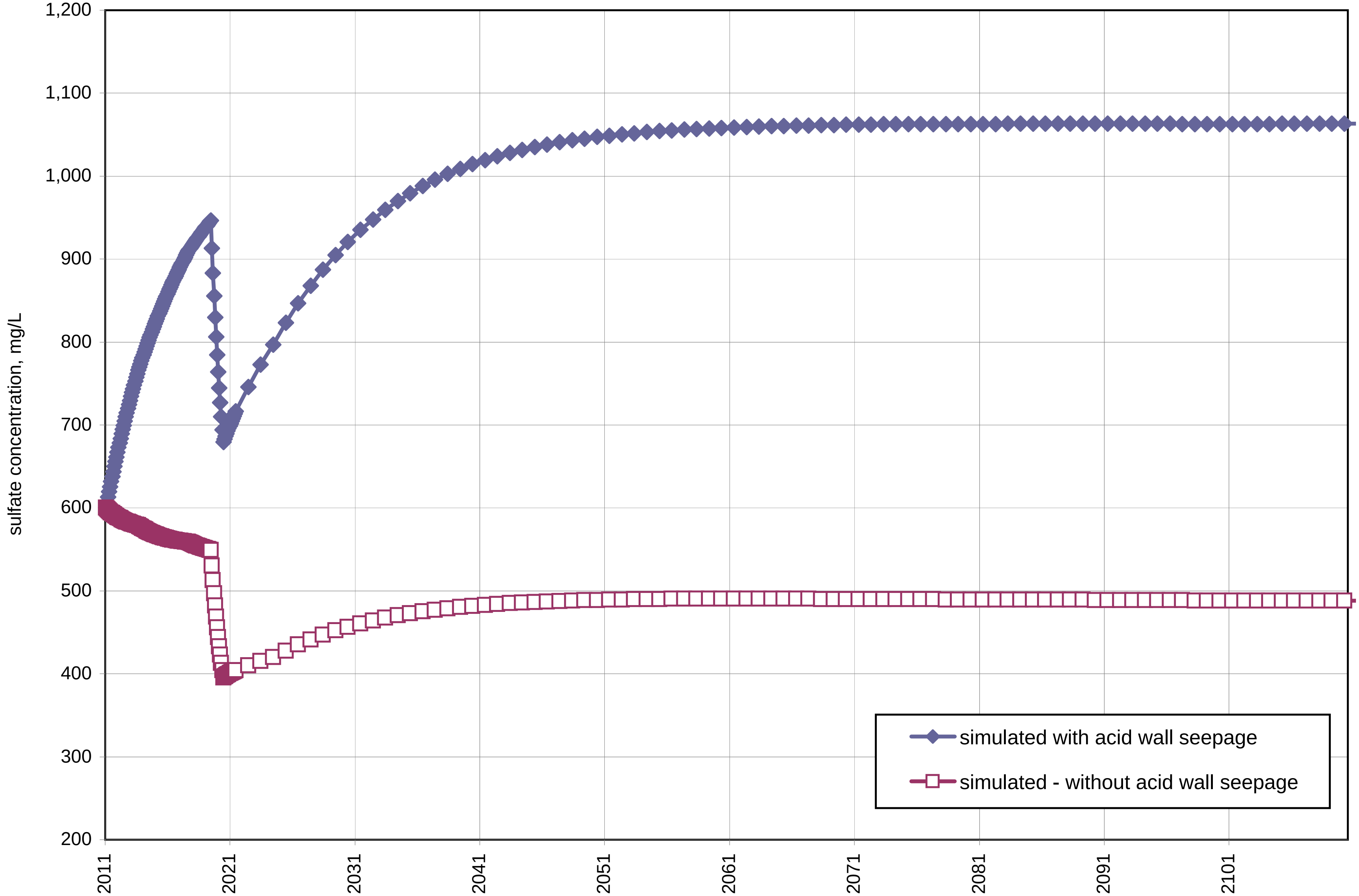

Figure 3. Graph showing recalibrated model-simulated sulfate concentrations in open pit through year 2111, assuming initial sulfate concentration of 600 mg/L and recovery Scenario D (14.5 ac-ft/yr storm flow with 172 ac-ft in 2020), Cunningham Hill Mine Reclamation Project.

JOHN SHOMAKER & ASSOCIATES, INC.

APPENDICES

Appendix A.

AP-27 Trigger No. 2 notification letter

LAC MINERALS (USA) LLC
CUNNINGHAM HILL MINE RECLAMATION PROJECT
582 COUNTY ROAD #55
CERRILLOS, NM 87010
TELEPHONE: 505.471.0434
FAX: 505.474.8582

VIA CERTIFIED MAIL # 7009 2250 0003 2437 0855
RETURN RECEIPT REQUESTED

March 1, 2011

Mr. Greg Huey
Ground Water Bureau
New Mexico Environment Department
Harold Runnels Bldg.
11 90 St. Francis Drive
PO Box 26110
Santa Fe, NM 87501

RE: AP-27 Performance Standard APS-1, Trigger No. 2 Notification

Dear Mr. Huey:

LAC Minerals (USA) LLC (LAC) is hereby providing notification that the Cunningham Hill Mine Reclamation Project open pit pool has exceeded 600 mg/L sulfate for a consecutive period of 32 quarters (Trigger No. 2 of Performance Standard APS-1 of Abatement Plan AP-27).

As identified in AP-27, the long-term solution for controlling water quality in the open pit pool and surrounding groundwater includes the diversion of Upper Cunningham Gulch storm water directly into the open pit. Storm water diversions will

1. Dilute concentrations of contaminants in pit pool
2. Inundate most of the ARD occurring from the pit walls
3. Reduce impact on surrounding groundwater

Performance Standard APS-1 relates to open pit pool performance standards (expected goals with remediation by pit filling). The clock for APS-1 started after reverse osmosis treatment was completed by the end of 2002 (1st quarter 2003). APS-1 triggers include:

Trigger No. 1 – open pit pool exceeds 1,000 mg/L sulfate for a period of eight consecutive quarters

Trigger No. 2 – open pit pool exceeds 600 mg/L sulfate but remains below 1,000 mg/L sulfate for a consecutive period of eight years (32 quarters)

The following compliance issues have occurred:

- APS-1 – Trigger No. 1 exceeded 2nd quarter 2007 (NMED notified 6/25/2007)
- APC-1 – Implemented pilot remediation programs (adding mixed water to pit)
  - First pilot (9/17/2008 - 12/9/2008), Second pilot (8/5/2009 - 12/2/2009)
- APS-1 – Trigger No. 2 exceeded 4th quarter 2010

LAC is aware that Contingency Plan APC-1 provides procedures for mitigating APS-1 trigger levels, which includes:

- Re-sampling to confirm test results causing trigger and NMED notification
- Re-calibration of open pit pool Chemistry model within 90 days of notification
- Re-calibration of the transport model within 90 days of notification
- Remediation plan to mitigate Trigger No. 1 or Trigger No. 2:
  - Submit plan with schedule within 180 days of notification
  - Plan may include treatment of open pit pool water, another technically feasible method to achieve compliance, or a petition for an alternative abatement standard

LAC has already provided a preliminary evaluation of proposed remedies in the John Shomaker and Associates, Inc. second pilot remediation program report (submitted to NMED on 3/2/2010). We intend to proceed with development of a remediation plan(s) based upon further evaluation of mitigation options that will include, as appropriate, the mitigation review procedures outlined in the Contingency Plan as described above.

Do not hesitate to contact me at 505-471-0434 if you have any questions or concerns regarding this matter.

Sincerely,

LAC Minerals (USA) LLC
Desiree Forbuss
Environmental Coordinator

CC: R. Chase, SLC
P. Malone, SLC
A. Cox, Grants

Bcc: Friends of Santa Fe County (2)
Gold Fields Mining Company

Appendix B.

John Shomaker & Associates, Inc. (JSAI) 2009 fracture study

JOHN SHOMAKER & ASSOCIATES, INC.
WATER-RESOURCE AND ENVIRONMENTAL CONSULTANTS
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MEMORANDUM

To: Ms. Desiree Forbuss, LAC Minerals (USA) LLC, Cunningham Hill Mine Reclamation Project

From: Erwin A. Melis, Ph.D., John Shomaker & Associates, Inc.

Date: March 25, 2009

Subject: Fracture study and geologic cross-sections through the Cunningham Hill Mine, Santa Fe County, New Mexico

John Shomaker & Associates, Inc. (JSAI) performed a detailed structural analysis of the Cunningham Hill Mine open pit and the Upper Cunningham Gulch. The analysis is based on field mapping conducted on July 31, 2008 and previous work. The purpose of the structural analyses is to better define the subsurface distribution of faults, which could identify pathways for recharge and groundwater flow to the open-pit walls.

This study is a follow-up of an earlier fracture study by Myers (2008) that identified three (3) dominant fracture orientations, with the most continuous fracture orientation between azimuth 060° and 070° aligning with Upper Cunningham Gulch. However, Upper Cunningham Gulch follows a linear trend for 1.5 miles to the northeast (about 045°) toward Cunningham Hill Mine. Field mapping conducted by JSAI delineated numerous intersecting fractures, one set of which is sub-horizontal and not previously implicitly identified.

Geologic Units

The geology near the Cunningham Hill Mine consists of Tertiary-age intrusives intruding Tertiary- and Mesozoic-age sedimentary rocks. At the Cunningham Hill Mine, sedimentary rocks can be assigned to the Eocene-age Galisteo Formation, which is conformably underlain by the Paleocene-age Diamond Tail Formation. The rocks consist of fine to coarse, tan to whitish sandstone with lesser percentages of multi-colored mudstones, which are intruded and contact metamorphosed to hornfels (Maynard, 2002). Intrusives consist of late Eocene-age to early Oligocene-age andesite, augite monzonite, and quartz latite in order of intrusion. An extrusive, and locally extensively brecciated, lithic tuff has its extrusive center slightly offset from Cunningham Hill Mine and is interpreted as the vent facies of the quartz latite (Maynard, 2002). The vent facies contains within it extensively mineralized sequences of quartzite breccia, mapped as jointed, metamorphosed and metasomatized xenoliths of the

Galisteo Formation (Maynard, 2002). At the Cunningham Hill Mine, intrusive rocks provide a low permeability barrier around the more permeable breccias of the vent facies. Unconsolidated terrace gravels, colluvium, alluvium, and artificial fill make up the remainder of the units near the Cunningham Hill Mine.

Seeps at Cunningham Hill Mine occur in the vadose zone above the regional water table and are disconnected from the groundwater system at the mine. The regional water table is about 6,795 ft above mean sea level (amsl) (measured at well MW 96-55). The seeps flow after extreme precipitation events, and appear to have a limited storage capacity. Two prominent seeps are identified. The southwest pit wall seep has bedding planes dipping to the southwest, and the northeast pit wall seep has bedding planes dipping into the pit. The southwest pit wall seep perhaps has a greater storage, as the beds in this area dip away from the pit. Storage on the northeastern pit wall is less, possibly only on the benches of the pit, due to the short response time of the seep after precipitation events. The relatively recent flowing of the seep on the northeastern pit wall is perhaps due to changes in fracture permeability or pathways within this pit wall and in the hill side to the north. These changes could also cause enhanced conditions for a slope collapse in this area.

Structural Setting

The study area lies within the Ortiz Mountains, near the mapped trace of the Tijeras-Cañoncito fault zone. The Tijeras-Cañoncito fault zone is a multiply-reactivated sub-vertical fault zone that trends to the northeast-southwest (about 045°) from the Sandia Mountains to the southern end of the Sangre de Cristo Mountains, for a length of about 58 miles. Cumulative fault displacement is mostly dextral strike-slip, with a component of north-side-down normal displacement. The fault has both an early Tertiary (Laramide) and a late Tertiary (Rio Grande rifting) movement history (Abbott et al., 2004). Various workers suggest that intrusion, faulting, and mineralization were broadly contemporaneous (Woodward, 1984; Maynard et al., 1991); in the Cunningham Hill Mine area the Tijeras-Cañoncito fault zone is partially obscured by Tertiary igneous intrusions (Lisenbee et al., 1979).

Near the Cunningham Hill Mine, the Tijeras-Cañoncito fault zone consists of two inferred faults bounding the stratigraphically-defined Ortiz graben (Maynard, 1995). The southern bounding fault is named the Buckeye Hill fault and has a stratigraphic separation of 3,000 ft; the northern bounding fault is the Golden fault, with a stratigraphic separation of 1,500 ft diminishing to the northeast (Maynard, personal communication). The Golden fault has a mapped surface exposure in Upper Cunningham Gulch, approximately 1.5 miles southwest of the Cunningham Hill Mine (Maynard, 2002). The exact trace of the Golden fault near the Cunningham Hill Mine is unknown due to a lack of stratigraphic control. It could have been intruded by quartz latite and/or have a scissors-type geometry. Some maps have the Golden fault passing directly through the pit (e.g., JSAI, 1999; Shomaker, 1995; figure 2), and a fault identified by Myers (2008; figure 6) shows a fault with a north-side down geometry in the location of the inferred trace of the Golden fault. The displacement of this fault is the opposite of what would be expected for a normal fault bounding the Ortiz graben, but may represent displacement after reactivation during Rio Grande rifting, and might support the argument for a scissors-type geometry.

Fractures Measured in the Field

On July 31, 2008, JSAI personnel measured fractures at four locations along the pit wall of the Cunningham Hill Mine and in the Upper Cunningham Gulch area about 500 ft west-southwest of the pit. Seven fracture-orientation measurements were obtained within the vent-facies (Tv of Maynard, 2002), whereas 11 measurements were taken along the pit wall within variously brecciated, and metamorphosed sedimentary units present as blocks within the quartz latite or the lithic tuff. Two of the four locations along the pit wall are locations with acid wall seepage, and during the JSAI field visit, extensive iron-staining was observed both along steeply-dipping and sub-horizontal fractures (Figure 1). The seepage locations are near the base of the northeastern pit wall at 6,870 ft amsl, and high along the west-southwestern pit wall at 6,950 ft amsl (Figures 1 and 2, respectively).

The fracture orientations measured in the field were analyzed statistically using the freeware EZ-ROSE 1.0 (see Baas, 2000). The sum of the data is statistically uniform, showing no preferred orientation. Separated out by lithology the data are also uniform. The Galisteo Formation data fall into three sub-vertical orientations including the following: 1) north-south 160° to 208°, 2) northwest-southeast 105° to 110°, and 3) northeast-southwest 053 to 070° azimuth. The third orientation corresponds closely to the fracture orientation of between 060° and 070° identified by Myers (2008). The primary fracture orientation in the lithic tuff is north-south, and includes a set of conjugate fractures. In addition to these sub-vertical orientations, a sub-horizontal fracture surface was identified in the metamorphosed sedimentary rocks and loosely corresponds to a bedding surface that according to Maynard (2002) dips variably to the west and south. Intersections between the sub-horizontal surface and sub-vertical fractures may provide preferential pathways for fluid-flow. Indeed, seeps are located near these intersecting fractures (Figure 2).

Geologic History

The presence of north-south fractures in both lithic tuff and sedimentary country rocks suggests a uniform stress regime post-dates volcanism in the Ortiz Mountains at approximately 31.7 million years ago (Abbott et al., 2004), and is generally aligned with Rio Grande rift margins. Fractures with this orientation, and their conjugate structures, may be the youngest fractures in the area. Fractures of other orientations occurring in the brecciated Galisteo Formation may predate volcanism, and their relationship to the Tijeras-Cañoncito fault zone is unknown. Zones of weakness near the Tijeras-Cañoncito fault zone may exist in Upper Cunningham Gulch and near the Cunningham Hill Mine because rocks in these areas are extensively fractured, often with visible open apertures.

Discussion

The age/composition of the bedrock units at the Cunningham Hill Mine relates to their fracture density. Older sedimentary units near intrusions are more extensively fractured and brecciated, whereas younger volcanic units are less fractured. The Galisteo Formation may have higher fracture permeability than the volcanic units, and in fact the hydraulic conductivity for the brecciated Galisteo Formation has been estimated at 3 to 5 ft/day (JSAI, 1999). Seepage from the pit walls at the Cunningham Hill Mine is likely localized in areas where the Galisteo Formation is present.

The north-south fractures measured in the field at the Cunningham Hill Mine are parallel to two mapped faults that intersect the pit walls (Maynard, 2002). The westernmost of these faults is mapped as a normal fault with west-side down displacement (Maynard, 2002). JSAI's mapping, about 100 to 120 ft above pit lake level, identified a sub-vertical fracture surface that trends 345° about 200 ft west of this fault, defining the surface of the western pit wall at the source of the historically most prolific seeps (Figure 3 west-east cross-section). The orientation of the fracture surface orientation suggests it could be a conjugate of the fault mapped by Maynard (2002). Sub-vertical fractures at high angles to this fault and that crop out at the surface could channel runoff to connect through sub-horizontal bedding planes within the brecciated Galisteo Formation to the pit walls.

The easternmost of the north-trending faults cuts the eastern pit wall above the seep identified along the northeast pit wall (about 20 ft above pit lake level; Figure 1). JSAI's mapping in addition identified a northeast-southwest (070°) sub-vertical fracture surface cutting the northeast pit wall. Its intersection with the north-trending fault above the northeast pit wall seep, in addition to intersecting bedding planes in the sedimentary rocks that dip to the southwest, toward the pit may result in seepage at the northeast pit wall.

The many intersecting sub-horizontal and vertical fractures documented at the Cunningham Hill Mine make it unlikely that grouting would be successful in curtailing groundwater flow that appears as seepage along the pit wall.

Conclusions

1. Within the pit area, the oldest sedimentary rock unit (brecciated Galisteo Formation) has higher fracture permeability than the younger volcanic units.
2. The intersection of two sets of sub-vertical fractures and sub-horizontal fractures provides preferred pathways for groundwater flow.
3. Seeps in the pit wall are best understood to coincide with these intersecting fracture sets and fault planes.
4. The many intersecting fractures suggest that grouting is an ineffective solution to seepage problems in the pit wall of the Cunningham Hill Mine.

EAM:em

Enc: References
Figures 1 through 6

REFERENCES

Abbott, J.C., Goodwin, L.B., Kelley, S.A., Maynard, S.R., McIntosh, W.C., 2004, The Anatomy of a Long-Lived Fault System: Structural and Thermochronological Evidence for Laramide to Quaternary Activity on the Tijeras Fault, New Mexico: New Mexico Bureau of Geology and Mineral Resources, Bulletin 160, p. 113 – 138.

Baas, J.H., 2000, EZ-ROSE: A Computer Program for Equal-Area Circular Histograms and Statistical Analysis of Two-Dimensional Vectorial Data: Computers & Geosciences, v. 26, p. 153-160.

EZ-ROSE, 2008, Equal Area Circular Histograms and Statistical Analysis for Vectorial Data: last accessed on 08/11/2008; http://www.bangor.ac.uk/~oss40d/

[JSAI] John Shomaker & Associates, Inc., 1999, Ground-Water Transport Model for Predicting Potential Effects from the Cunningham Hill Mine Open Pit, Santa Fe County, New Mexico: Consultants Report, 34 p. plus figures and appendices.

Lisenbee, A.L., Woodward, L.A., and Connolly, J.R., 1979, Tijeras-Cañoncito fault system – A Major Zone of Recurrent Movement in North-Central New Mexico: New Mexico Geological Society Guidebook to the 30th Field Conference, Geology of the Santa Fe Region, p. 89-99.

Maynard, S.R., 1995, Gold Mineralization Associated with mid-Tertiary Magmatism and Tectonism, Ortiz Mountains, Santa Fe County, New Mexico: New Mexico Geological Society Guidebook to the 46th Field Conference, Geology of the Santa Fe Region, p. 161-166.

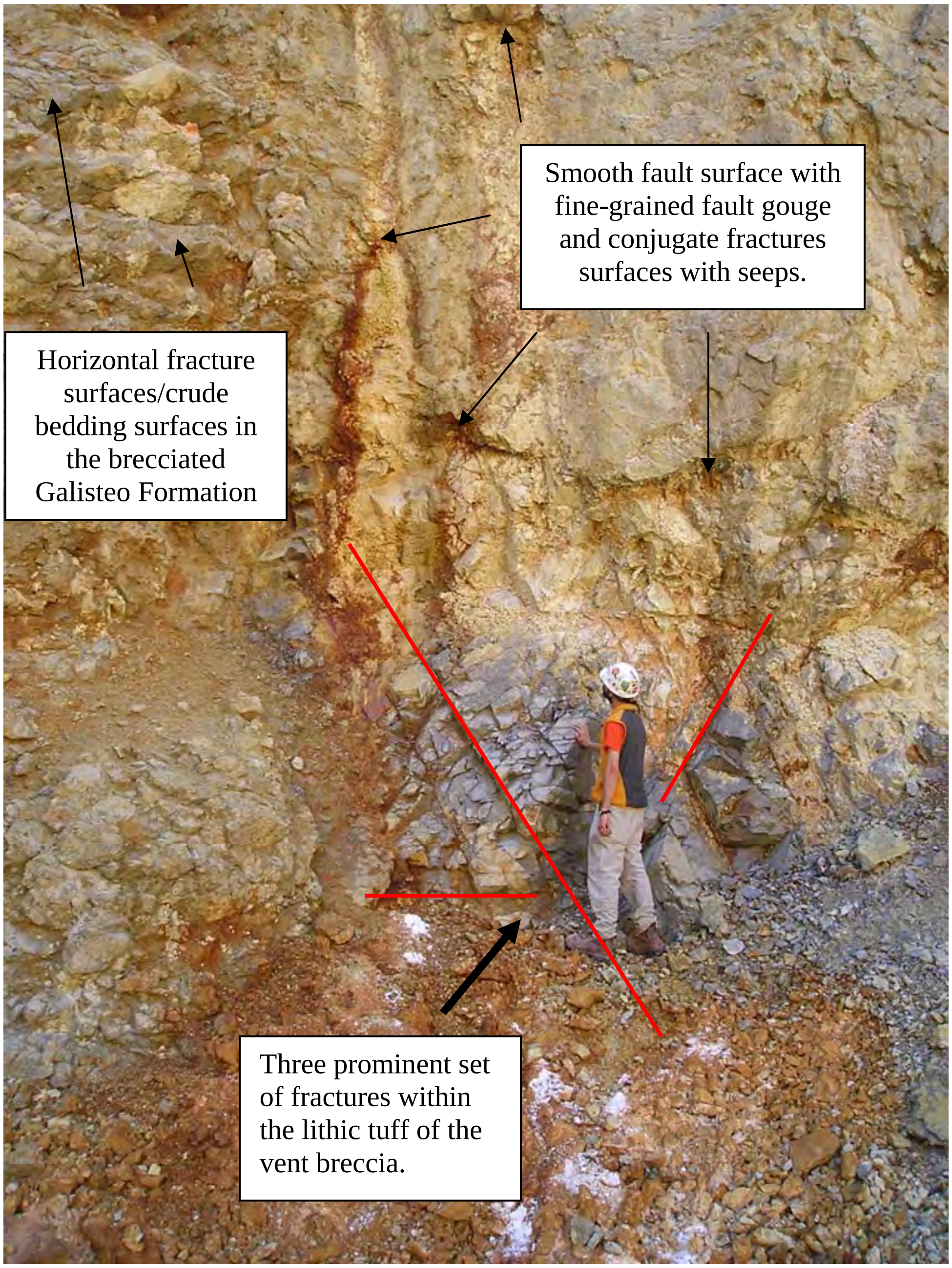
Maynard, S.R., 2002, Preliminary geologic map of the Golden 7.5-minute quadrangle, Santa Fe and Sandoval Counties, New Mexico: New Mexico Bureau of Mines and Mineral Resources, Open-file Digital Map DM-36, scale 1:24,000, map and 26 pg report.

Maynard, S.R., Woodward, L.A., and Giles, D.L., 1991, Tectonics, Intrusive Rocks, and Mineralization of the Ortiz – San Pedro Porphyry Belt, north-central New Mexico: New Mexico Bureau of Geology and Mineral Resources, Bulletin 137, p. 57 – 69.

Myers, K., 2008, Ortiz Mine, Pit Wall Seepage: Memorandum from the Mines Group (Ken Myers) to Al Cox, 5 pgs including 6 figures.

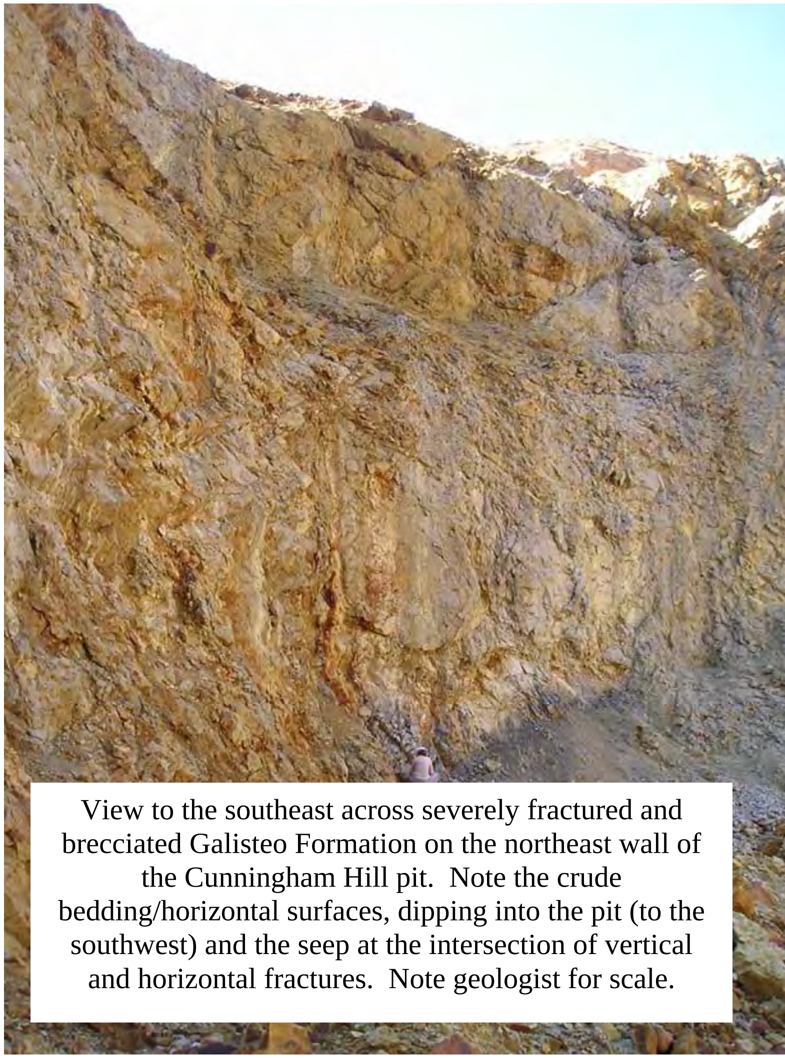
Shomaker, J.W., 1995, Hydrogeology of the Ortiz Mountains and vicinity: New Mexico Geological Society Guidebook to the 46th Field Conference, Geology of the Santa Fe Region, p. 313-318.

Woodward, L.A., 1984, Basement Control of Tertiary Intrusions and Associated Mineral Deposits along Tijeras-Cañoncito Fault System, New Mexico: Geology, v. 12, n. 9, p. 531-533.

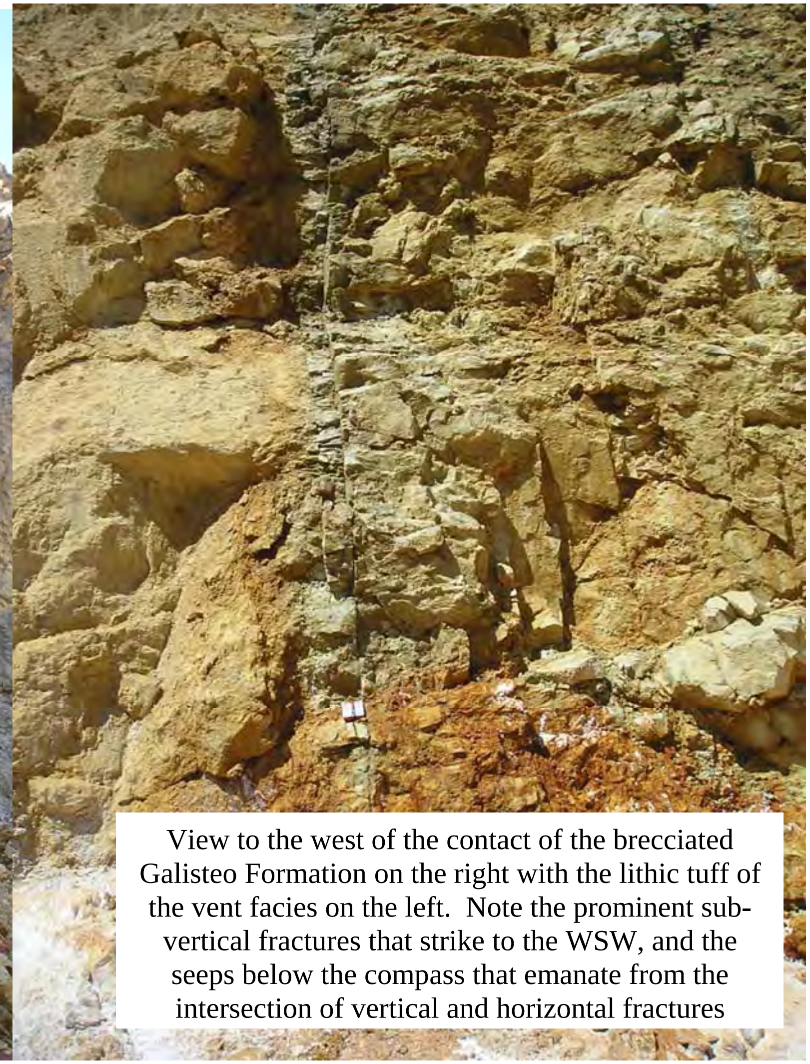


trace of fracture measured in the field

Figure 1. Photograph of fault surface and three set of fractures found within the Galisteo Formation near the intrusive contact with the quartz latite, at the northeast Cunningham Hill Mine pit wall, Santa Fe County, New Mexico.



View to the southeast across severely fractured and brecciated Galisteo Formation on the northeast wall of the Cunningham Hill pit. Note the crude bedding/horizontal surfaces, dipping into the pit (to the southwest) and the seep at the intersection of vertical and horizontal fractures. Note geologist for scale.



View to the west of the contact of the brecciated Galisteo Formation on the right with the lithic tuff of the vent facies on the left. Note the prominent sub-vertical fractures that strike to the WSW, and the seeps below the compass that emanate from the intersection of vertical and horizontal fractures

Figure 2. Photographs of fractures found within and near the Cunningham Hill Mine, Santa Fe County, New Mexico.

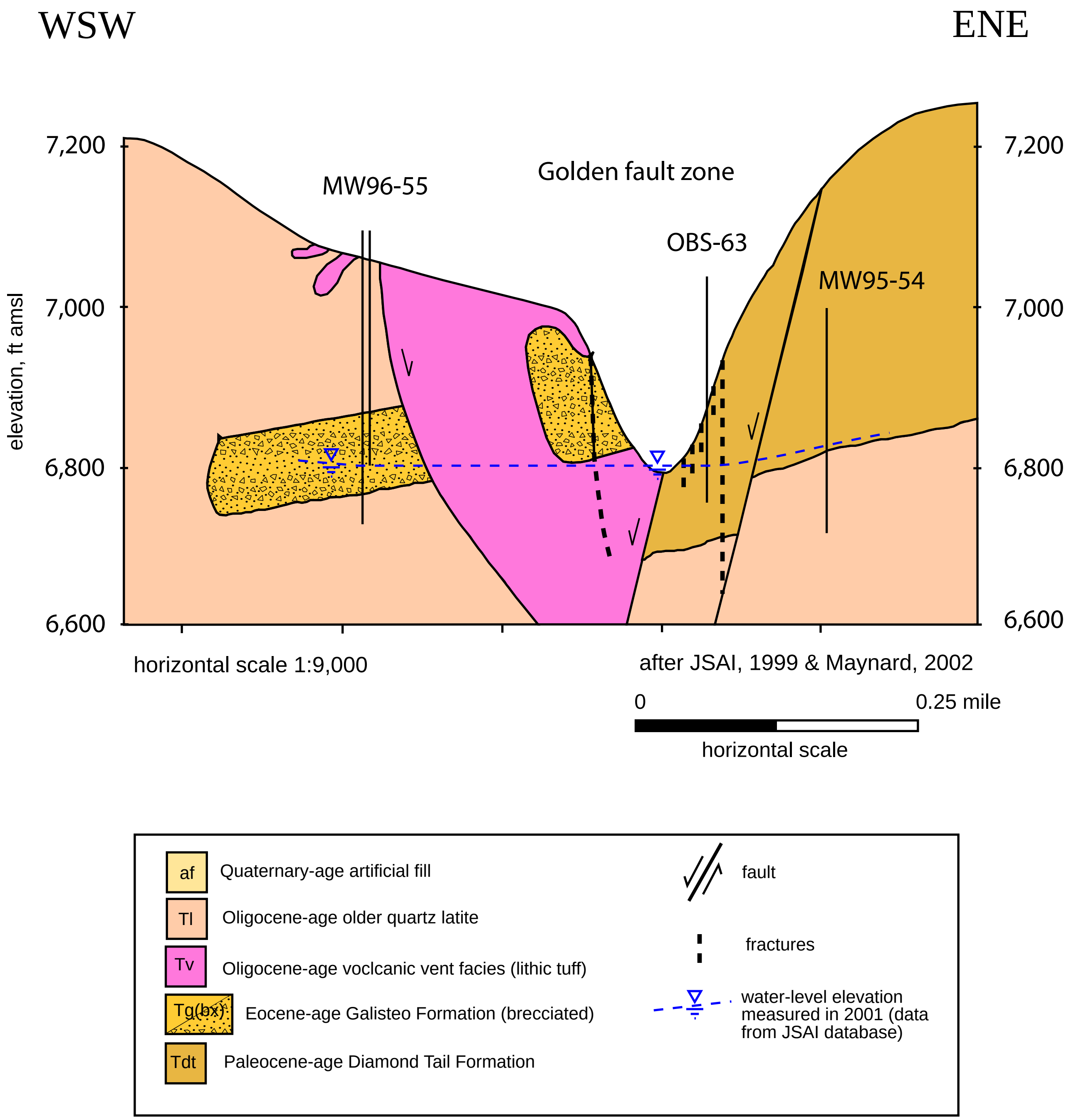


Figure 3. West-southwest to east-northeast geologic cross-section across the Cunningham Hill Mine including several monitoring wells, Santa Fe County, New Mexico.

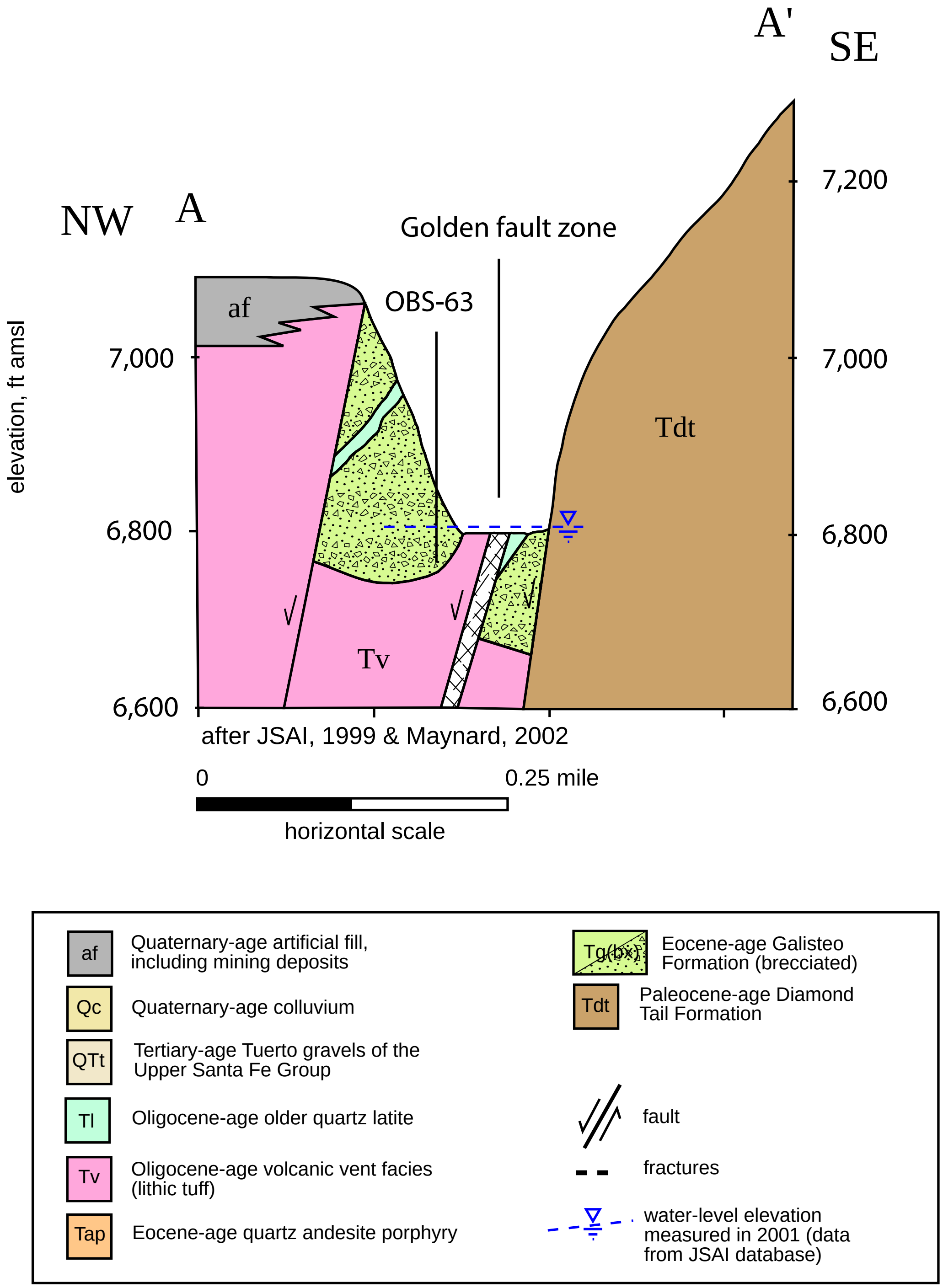


Figure 4. Northwest to southeast geologic cross-section across the Cunningham Hill Mine including monitoring wells, Santa Fe County, New Mexico.

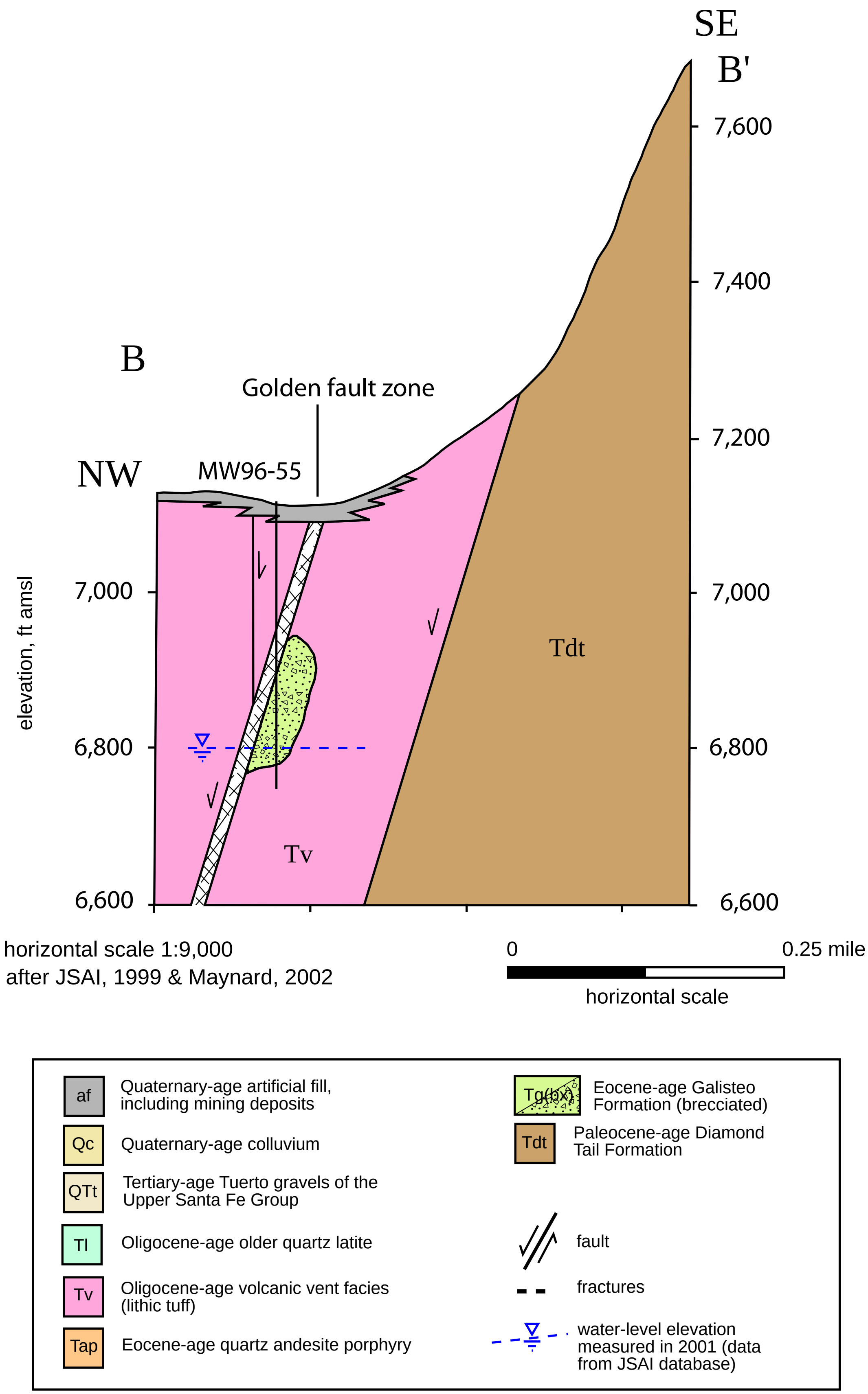


Figure 5. Northwest to southeast geologic cross-section across the Cunningham Hill Mine including several monitoring wells, Santa Fe County, New Mexico.

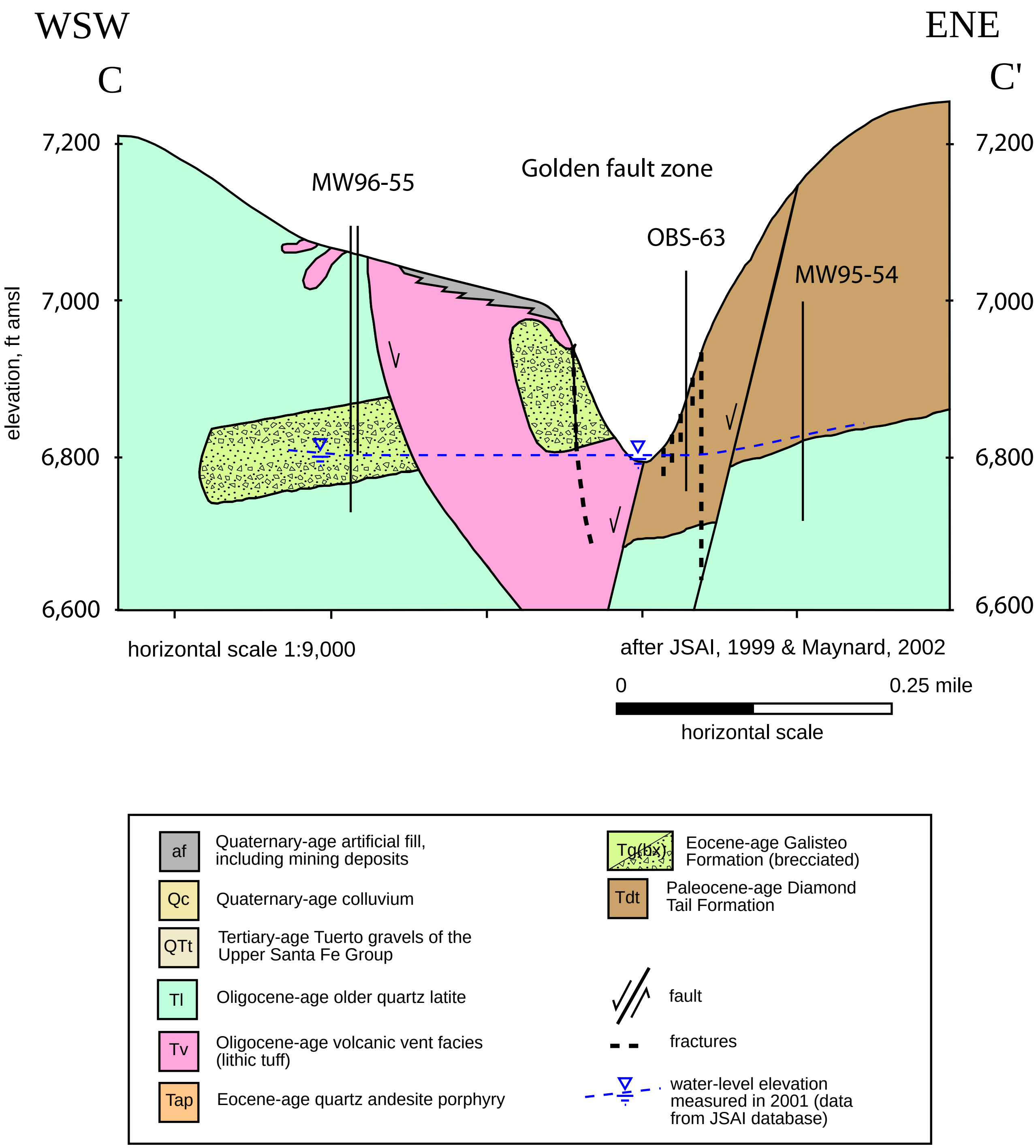


Figure 6. West-southwest to east-northeast geologic cross-section across the Cunningham Hill Mine including several monitoring wells, Santa Fe County, New Mexico.

Appendix C.

Report describing repairs to Upper Cunningham Gulch diversion channel

LAC Minerals (USA) LLC
Cunningham Hill Mine Reclamation Project
582 County Road #55
Cerrillos, NM 87010
Telephone: 505.471.0434
Fax: 505.474.8582

Via Certified Mail # 7009 2250 0003 2437 0923
Return Receipt Requested

May 19, 2011

Branch Chief
U. S. Army Corps of Engineers
Albuquerque District Office, Regulatory Branch
4101 Jefferson Plaza, NE
Albuquerque, New Mexico 87109-3435

RE: Cunningham Hill Mine Reclamation Project, Santa Fe County, New Mexico

Dear Branch Chief:

LAC Minerals (USA) LLC (LAC) is the operator of the Cunningham Hill Mine Reclamation Project located in Santa Fe County near Cerrillos, New Mexico. A location map is attached. Over 15 years ago, the former mine site was reclaimed, and modifications to Cunningham Gulch were performed under Nationwide Permit 26. As part of the modifications, a channel for diverting stormwater from Upper Cunningham Gulch to the open pit was constructed. Filling of the open pit with stormwater is part of the long-term remediation plan approved by the New Mexico Environment Department (NMED) issued permit AP-27. Upper Cunningham Gulch is an ephemeral stream in the Ortiz Mountains that terminates at the open pit (see insert on attached map).

NMED AP-27 permit condition 3 states "LAC shall routinely inspect the Upper Cunningham Gulch diversion, and perform maintenance as necessary, to insure protection of water quality." LAC has identified a land surface depression near the Upper Cunningham Gulch diversion that ponds and infiltrates stormwater. The infiltrated stormwater reports as acid wall seepage in the open pit. The depression is a result of subsided disturbed topography related to the former open pit mine that was not adequately addressed during the 1996 post-mining land surface reclamation. LAC proposes to fill in the land surface depression to improve stormwater flow in the channel. The proposed diversion channel maintenance is within the area shown on the attached map.

It is our understanding that there are activities which involve placement of fill in a waterway that are not subject to the Section 404 regulatory program. The proposed fill for the diversion channel repairs will not change the use of the water and will not impair the flow. The proposed repairs can be classified as maintenance or emergency repair of a currently serviceable structure such as dams, riprap, abutments, and levees. Furthermore, LAC does not propose to change the original design. The maintenance is scheduled for the 2011 summer field season.

LAC is requesting guidance from the U. S. Army Corps of Engineers (USACE) regarding 404 permitting requirements for the proposed diversion channel repairs. Please let us know if a meeting with the USACE to discuss the project in more detail would be beneficial. Feel free to call or email me (acox@barrick.com, 505-287-4456 ext. 25) or Desiree Forbuss, the site Environmental Coordinator (dforbuss@barrick.com, 505-471-0434) if you require additional information or would like to schedule a meeting. Thank you for your attention on this matter.

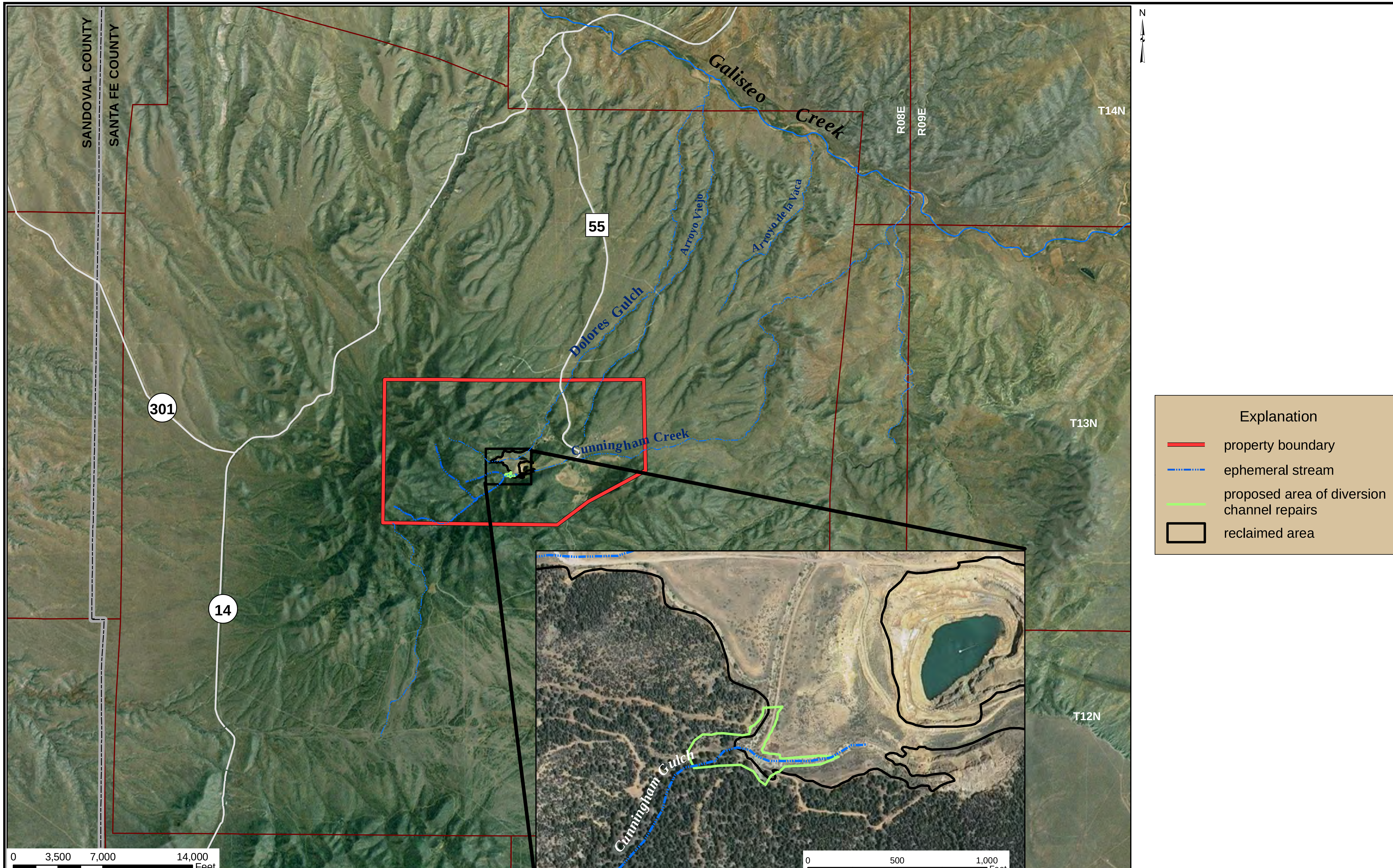
Sincerely,

LAC Minerals (USA) LLC
Alan Cox
Project Manager

Enclosure

CC: D. Forbuss, CHMRP, w/enclosure
P. Malone, SLC, w/enclosure
R. Chase, SLC, w/enclosure

Bcc: Friends of Santa Fe County w/enclosure (2)
Gold Fields Mining Company w/enclosure



Map showing location of proposed area of diversion channel repairs in Upper Cunningham Gulch, Cunninghma Hill Mine Reclaimation Project, Santa Fe County, New Mexico.

JOHN SHOMAKER & ASSOCIATES,

Steven Finch
John Showalter
& Assoc

DEPARTMENT OF THE ARMY
ALBUQUERQUE DISTRICT, CORPS OF ENGINEERS
4101 Jefferson Plaza NE
Albuquerque, NM 87109-3435
505-342-3284
FAX 505-342-3498

June 20, 2011

REPLY TO
ATTENTION OF:

Regulatory Division
New Mexico/Texas Branch

SUBJECT: Action No. SPA-2011-00287-ABQ, LAC Minerals, Cunningham Hill Mine Restoration Site, Cunningham Gulch, Diversion Channel Repairs, Santa Fe County, NM

Mr. Alan Cox
LAC Minerals (USA) LLC
582 County Road 55
Cerrillos, NM 87010-9776

Dear Mr. Cox:

The U.S. Army Corps of Engineers (Corps) is in receipt of your letter dated May 20, 2011, concerning maintenance to the Cunningham Gulch diversion channel. The activity involves maintenance of existing structure. We have assigned Action No. SPA-2011-00287-ABQ to this activity. To avoid delay, please include this number in all future correspondence concerning this project.

We have reviewed this project in accordance with Section 404 of the Clean Water Act (CWA) and Section 10 of the Rivers and Harbors Act of 1899 (RHA). Under Section 404, the Corps regulates the discharge of dredged and fill material into waters of the United States, including wetlands. The Corps responsibility under Section 10 is to regulate any work in, or affecting, navigable waters of the United States. Based on your description of the proposed work, other information available to us, and current regulations and policy, we have determined that this project will not involve any of the above activities. Therefore, it will <u>not</u> require Department of the Army authorization under the above laws. However, it is incumbent upon you to remain informed of any changes in the Corps Regulatory Program regulations and policy as they relate to your project.

The Corps based this decision on an approved jurisdictional determination (JD) that there are no jurisdictional waters of the United States on the project site. The basis for this approved JD is Cunningham Gulch including the associated diversion channel are isolated, intrastate waters with no nexus to interstate or foreign commerce. The JD form is available at http://www.spa.usace.army.mil/reg/Jurisdictional_Determinations/jurisdictional_determinations.asp. This approved JD is valid for a period of no more than five years from the date of this letter unless new information warrants revision of the determination before the expiration date.

You may accept or appeal this approved JD or provide new information in accordance with the Notification of Administration Appeal Options and Process and Request For Appeal (NAAOP-RFA). This form is available at http://www.spa.usace.army.mil/reg/Administrative%20Appeals/appeals_process.asp. If you elect to appeal this approved JD, you must complete Section II (Request For Appeal or Objections to an Initial Proffered Permit) of the form and return it to the Army Engineer Division, South Pacific, CESPD-PDS-O, Attn: Tom Cavanaugh, Administrative Appeal Review Officer, 1455 Market Street, Room 1760, San Francisco, CA 94103-1399 within 60 days of the date of this notice. Failure to notify the Corps within 60 days of the date of this notice means that you accept the approved JD in its entirety and waive all rights to appeal the approved JD.

If you have any questions concerning our regulatory program, please contact me at 505-342-3284 or by e-mail at William.M.Oberle@usace.army.mil. At your convenience, please complete a Customer Service Survey on-line available at http://per2.nwp.usace.army.mil/survey.html.

Sincerely,

William M. Oberle

William M. Oberle
Project Manager

Copies furnished:

Steven T. Finch, Jr.
John Shomaker & Associates, Inc.
2611 Broadbent Parkway NE
Albuquerque, NM 87107-1664

Neal Schaeffer
NM Environment Dept.
Surface Water Quality Bureau
PO Box 5469
Santa Fe, NM 87502-5469

LAC Minerals (USA) LLC
Cunningham Hill Mine Reclamation Project

Upper Cunningham Gulch Diversion Channel Maintenance Modifications Project

Santa Fe County, New Mexico

COMPLETION REPORT

Completed and Prepared by:

Duran Bokich Enterprises, LLC
PO Box 1474, 307 Catfish Road
Elephant Butte, New Mexico 87935
Ph: 575-740-2840
email: jbokich@dbe-usa.com

August 2011

Cunningham Hill Mine Reclamation Project
Upper Cunningham Gulch Diversion Channel Maintenance Modifications Project
Completion Report

Introduction

The Cunningham Hill Mine Reclamation Project is a reclaimed gold mining and processing facility located about 6 miles south of the village of Cerrillos, Santa Fe County, New Mexico. The facility is located on private lands owned by LAC Minerals (USA) LLC.

Alan Cox, Project Manager and Desiree Forbuss, Project Environmental Coordinator for the Cunningham Hill Mine Reclamation Project, contracted Duran Bokich Enterprises, LLC (Duran Bokich), to perform the work for maintenance modifications to the weir and diversion channel in Upper Cunningham Gulch, an ephemeral drainage located west of the open pit. This channel drains a watershed to the south and west of the pit and empties into the pit. John Shomaker and Associates of Albuquerque, New Mexico provided background and advice on design, and Telesto Solutions, Inc. of Fort Collins, Colorado, provided engineering services related to elevations and design for the maintenance modifications to the weir, channel, and areas surrounding the channel.

The Cunningham Gulch drainage channel was previously modified to provide drainage of the watershed into the pit, and was lined with a Geomembrane Composite Liner (GCL) and then had one to three feet of D^{50} 12-inch limestone riprap. A constructed weir is in place about 300 yards upgradient of the pit, which is constructed of gabion baskets filled with the same sized Riprap material, and the top and upgradient face of the weir stabilized with a 3 to 6 inch thick concrete layer. The previously constructed modification resulted in water being retained upgradient of the concrete weir, and pooling and infiltration was occurring. Photos of the existing condition are provided in Appendix A.

A depression outside and to the north of the channel upgradient of the weir was believed to be retaining storm water. During high storm events water would infiltrate into the ground and was believed to migrate downgradient and contact a near vertical, structural mineralized vein system before emptying into the pit.

This project was to lower the elevation of the weir by removing a portion of the existing concrete weir structure and constructing a "V" notch metal weir cemented into the channel structure that was removed from the existing concrete structure. This would lower the elevation of water flow through the channel. Portions of the channel upgradient and downgradient of the channel would then be lowered to match the elevation of the new "V" notch. Lastly, the area upgradient of the weir where water had been ponding, which was located outside of the water channel, was filled with material taken from the riprap excavated from the channel as well as soil materials from areas surrounding the project work areas.

Scope of Work

Initially the entire channel and weir were surveyed by Telesto Solutions, and a map with elevations of the project area developed. At the initiation of maintenance construction activities, the area was again checked for elevations and work demolishing the portion of the existing concrete weir was initiated. The existing concrete weir was constructed by placing gabion baskets across the channel and filling these with D^{50} 12-inch limestone riprap. Concrete was then worked into the riprap filled gabion baskets on the top and upgradient face of the structure to form the weir.

The partial demolition consisted of breaking out a rectangular channel in the existing concrete weir to allow the placement of a sheet of ¼ inch steel with a “V” notch cut into it. The notch was cut 27 inches (2.25 feet) in depth, and 58 inches across at the top. This had the effect of lowering the overall channel low elevation by 27 inches (2.25 feet). After the rectangular channel was removed from the existing weir structure, the sides and bottom were concreted in with approximately 6 inches of 5-sack concrete Ready Mix, with remesh used for structural integrity. The constructed steel sheet with the “V” notch were incorporated into the concrete pour. The upgradient edge of the concrete weir then had a ¼ inch x 6 inch steel plate installed with anchor bolts across the entire leading edge of the weir to obtain a constant elevation across the upgradient edge of the structure (the existing concrete weir structure varied in elevation by nearly 0.3 feet. The final elevation of the bottom of the “V” as constructed is 7088.35 feet.

Once the weir had been modified to construct the new “V” notch, the concrete was treated and allowed to cure.

Next, the portion of the channel upgradient of the weir was marked with cut stakes as to the desired elevation of excavation to provide for a 1 ½ % gradient from the bottom of the “V” notch upstream until the slope met the native elevation of the channel. This occurred approximately 150 feet upgradient of the weir.

The existing riprap and GCL fabric, and any underlying materials that were above the new channel design elevations, were excavated utilizing a Volvo Model EC 210 BLC Excavator. The channel bottom was then graded to a width of 8 feet with the side slopes constructed to a 2V:1H slope to a vertical depth of approximately 30 inches, and an anchor trench of approximately 18 inches excavated by hand at the top of the side slope. For a distance of approximately 150 feet upgradient of the concrete weir, the channel bottom was lined with a 60 mil HDPE liner. The liner was anchored on the sides of the channel in anchor trenches that were backfilled with soils and compacted using a “jumping jack” portable compactor in 12 inch lifts. The upgradient edge of the liner was anchored in two 3 foot deep anchor trenches located about 12 feet apart. The first 3 feet deep channel anchor trench was installed, and then another section of liner was installed and bonded to the first liner, overlapping the anchor trench by 3 feet. The upgradient edge of this overlap section was then again anchored in a 3 foot anchor trench. The liner was anchored on sides of the channel and on the upgradient edge in the anchor trenches that were backfilled with soils and compacted using a “jumping jack” portable compactor in 12 inch lifts. Once all anchor trenches were backfilled and compacted to surrounding grade, they were armored with riprap.

The section of channel down gradient of the weir and “V” notch was then excavated to 1 foot below the elevation of the “V” notch, and sloped downgradient at a 1.0% grade approximately 300 feet until it reached the drop down structure in the channel which drops off 3 to 4 feet. The 1 foot sub-excavation was then backfilled with Riprap to grade to stabilize the channel and bring it up to final grade.

Upgradient of the lined portion of the channel, the channel was regraded and fill from the channel maintenance excavations used to raise the elevation of areas outside and adjacent to the channel to ensure flow back into the channel. Grade of fill was at 1 to 1 ½ % from channel to fill slope to intersection of the hillside to the north. Three berms, approximately 3 feet high, were constructed in the filled side areas to divert any flows back to the channel.

To complete the project, an old roadway located at the top of the ridge above the channel to the north was reworked to route any flows into the main lined channel that leads to the Upper Cunningham Gulch Diversion Channel, downgradient of the existing constructed berm in that channel. This will prevent water from the old roadway from discharging into the fill area below which is north of the main Cunningham Gulch Channel, and will not be directed into the lined and armored channel of Cunningham Gulch.

These areas and features are identified in Figure 1. Photos of all work areas are provided in Appendix A.

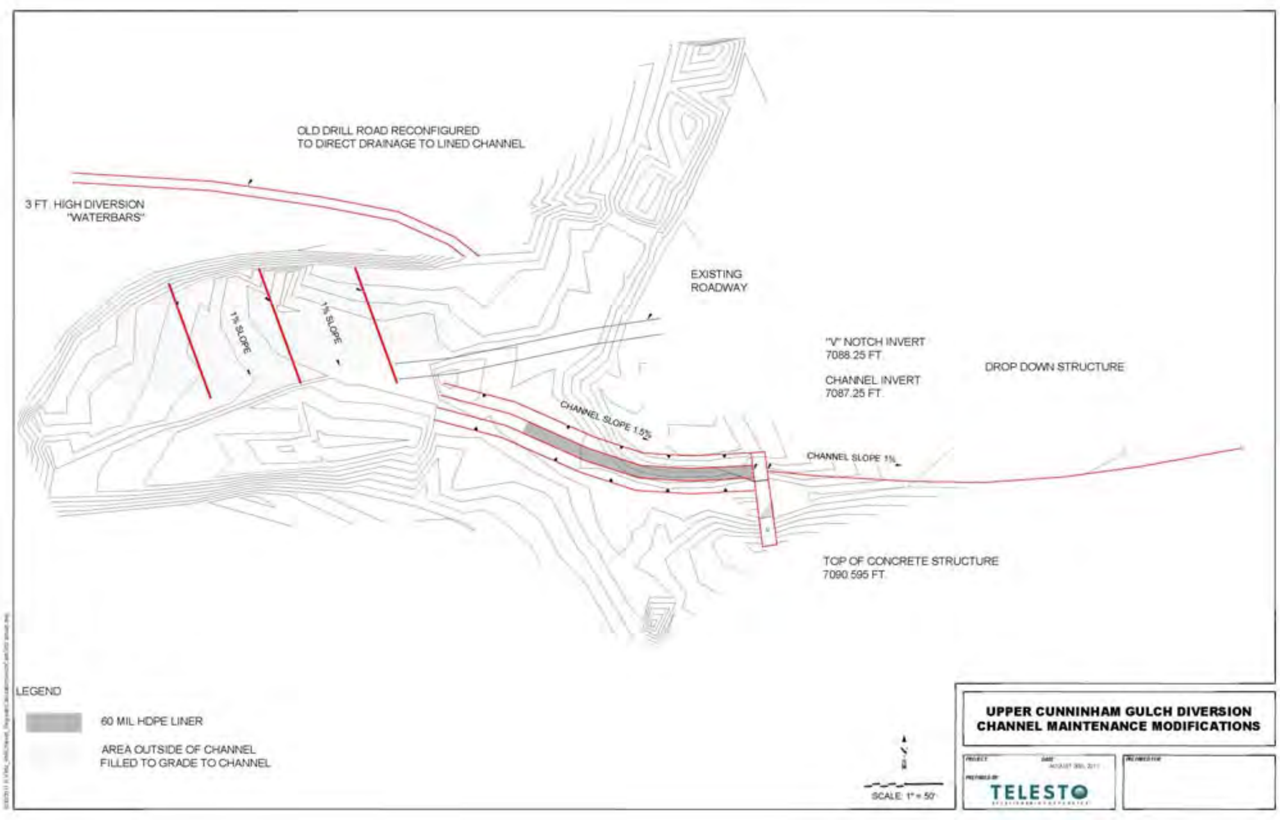


Figure 1. Cunningham Gulch Drainage and Weir Maintenance Project

APPENDIX A

PHOTOGRAPHS OF CUNNINGHAM GULCH CHANNEL MAINTENANCE PROJECT

Cunningham Gulch Channel concrete weir with riprap prior to maintenance work.

Upgradient face of existing concrete weir with riprap removed.

Downgradient side of existing weir. Concrete over gabion basket with riprap.


Cutting concrete weir for construction of channel for “V” notch weir

Channel demolition in existing concrete, gabion & riprap for construction of new “V” notch weir.

Channel demolition complete and ready for “V” notch weir construction.

Construction of new “V” notch weir and concrete channel.


“V” notch weir, new concrete channel and steel “leading edge” of weir construction complete.

Channel upgradient of weir construction to slope at 1 ½ % and prepare for liner.

“Leading edge” 3 foot deep anchor trench for liner being compacted in 12 inch lifts.

Upgradient liner edge anchor trench near completion with compaction.

Channel upgradient of weir with HDPE liner installed.

Filling and grading low area upgradient and north of channel.

Upgradient area with oversized "waterbars" at completion of construction and after 2 inch rainstorm.

Channel downgradient of weir being excavated to 1% slope.

Roadway north of main channel and filled low area reconfigured to prevent flow onto filled area.

Appendix D.

Letter report regarding Guest House Well

JOHN SHOMAKER & ASSOCIATES, INC.
WATER-RESOURCE AND ENVIRONMENTAL CONSULTANTS
2611 BROADBENT PARKWAY NE
ALBUQUERQUE, NEW MEXICO 87107
(505) 345-3407, FAX (505) 345-9920
www.shomaker.com

December 3, 2010

Ms. Desiree Forbuss
Cunningham Hill Mine Reclamation Project
LAC Minerals (USA), LLC
582 Country Road #55
Cerrillos, New Mexico 87010

Re: Guest House Well No. 1 (GH-1), Cunningham Hill Mine Reclamation Site

Dear Desiree:

The following summarizes the construction and testing of a well drilled under the exploratory permit of RG-36607-Explore 2. Originally, this well was drilled to search for a suitable water supply for the Amcon Ortiz Lodge. The well, known as Guest House Well No. 1 or GH-1, was drilled in 1981 by Thompson Drilling and Pump Co. of Española, New Mexico. The well has also been identified as Amcon No. 2.

Well GH-1 is located near the main property entrance on the west bank of Dolores Gulch, approximately 30 ft from the arroyo, at an elevation of 6,541 feet above sea level. The geographic location is 35°21'21" N, 106°07'31" W, NAD 83.

Drilling began on December 3, 1981 and was completed on December 18, 1981. A borehole of 6-1/2-inches was drilled to a depth of 300 feet below ground level (ft bgl). Thompson Drilling and Pump Co. then ran 5-9/16-inch (outer diameter) iron casing on December 19, 1981. Figure 1 shows an as-built diagram of the well. Three different sections of slotted casing were put in place to take advantage of water and fractures noted during drilling. Loose sediments from 0 to 11.5 ft bgl created problems early in the drilling program. Below these sediments, Well GH-1 was drilled into alternating sandstone, siltstone, shale, and volcanic rock (latite) in varying sequences (Summers, 1982[1]).

A step-drawdown pumping test was performed on January 6, 1982. The test consisted of pumping the well at five different steps in 30-minute intervals for a total of 150 minutes. After the completion of the pumping test, recovery measurements were taken for 5 hours. The non-pumping water level was 98.23 ft bgl. Figure 2 shows a plot of the drawdown during the pumping test on a numerical scale, and Figure 3 shows the recovery of the well, after the test, on a logarithmic scale.

---

[1] Summers, W.K., and Associates, 1982, Guest House Well No. 1, Amcon No. 2: consultant's draft well report and work file.

The following conclusions and recommendations have been taken directly from the analysis performed by Summers (1982). The calculated transmissivity value for the portion of the aquifer tapped by the well equals 7,500 gallons per day per foot (gpd/ft). Using the construction parameters for GH-1, results of the test, and a general storage coefficient for the area, a value of 64.4 gallons per minute (gpm) is given as the optimum discharge rate. This would result in a drawdown of 34.1 ft after 40 years of pumping (Summers, 1982).

The quality of water from GH-1 was sampled and analyzed. The samples were evaluated by Orlando Laboratories, Inc., on February 9, 1982. Table 1 is a summary of the water-quality results.

Table 1. Water-quality results for Guest House Well No. 1 (GH-1)

constituent	unit	concentration
total dissolved solids	mg/L	986
total alkalinity, as $CaCO_3$	mg/L	236
carbonate alkalinity, as $CaCO_3$	mg/L	0
bicarbonate alkalinity, as $CaCO_3$	mg/L	236
carbonates, as CO_3	mg/L	0
bicarbonates, HCO_3	mg/L	287
chloride	mg/L	20
sulfate	mg/L	500
fluoride	mg/L	1.4
pH (laboratory)	standard units	7.3
turbidity	NTU	24
total hardness, as $CaCO_3$	mg/L	732
calcium	mg/L	230
magnesium	mg/L	38
sodium	mg/L	15
iron	mg/L	0.7
manganese	mg/L	0.7
copper	mg/L	<0.03
silica	mg/L	6.3
potassium	mg/L	<0.04
specific conductance	µS/cm	1,600

mg/L - milligrams per liter
NTU - Nephelometric Turbidity Unit
µS/cm - microSiemens per centimeter

Upon review of the Summers (1982) data and files, Well GH-1 appears to be a viable source of groundwater for Open Pit pool remediation, including as a source for buffering the pit pool, and as make-up water for potential water-treatment projects; however, the well should be retested and the current condition assessed. A water rights permit would be required to use GH-1 for reclamation projects. Two options may exist (1) submit a 72-12-1.3 application for 3 acre-feet per year (ac-ft/yr) (does not require public notice), or (2) make GH-1 supplemental to your existing water rights permit for an amount more than 3 ac-ft/yr (subject to public notice and protest).

If you have any questions, or would like to discuss this further, please let me know.

Sincerely,

JOHN SHOMAKER & ASSOCIATES, INC.

Steven T. Finch, Jr.
V.P., Senior Hydrogeologist-Geochemist

STF:cc

Enc: Figures 1 through 3

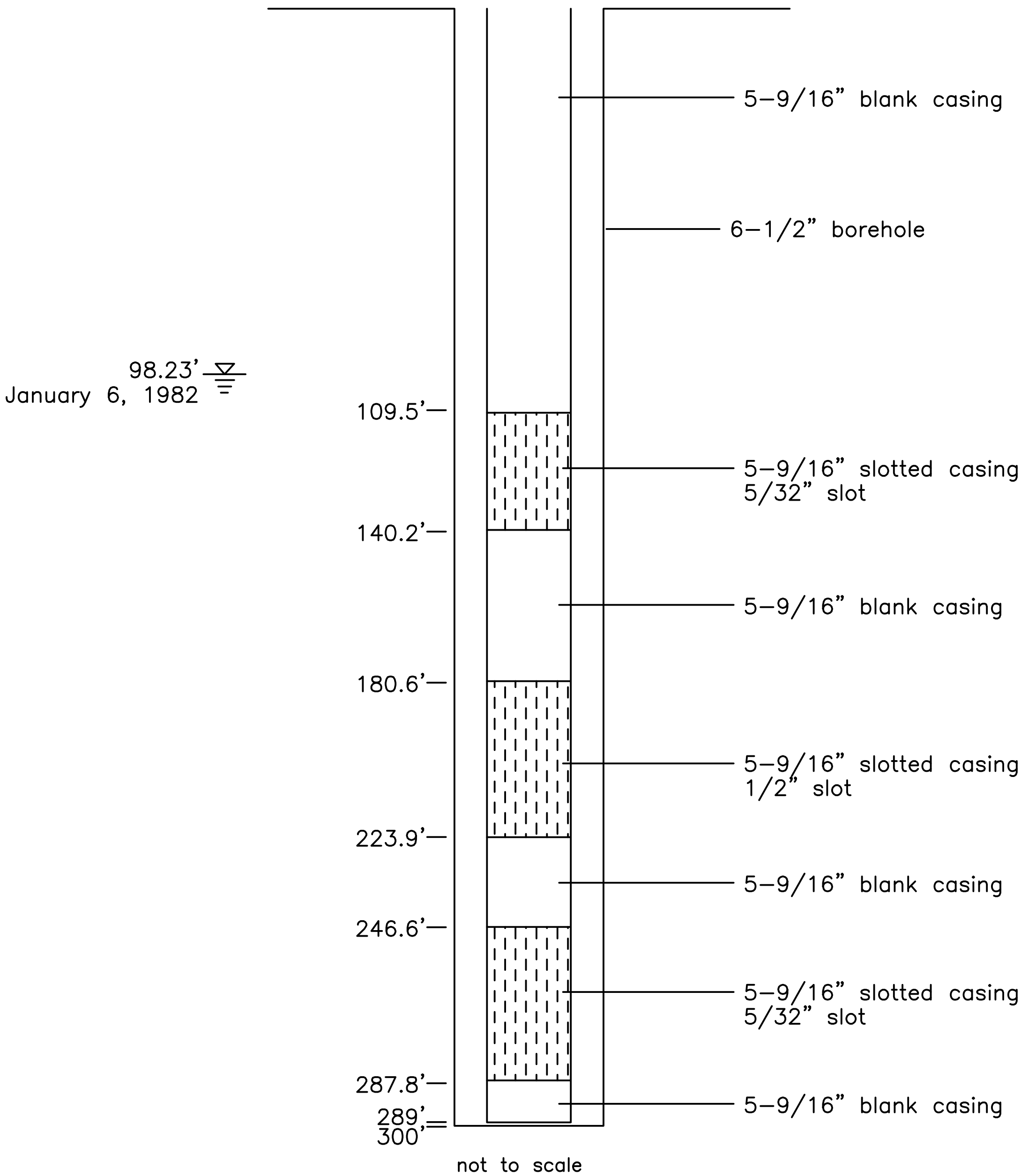


Figure 1. Guest House Well No. 1 as-built diagram showing details of casing installation on December 19, 1981.

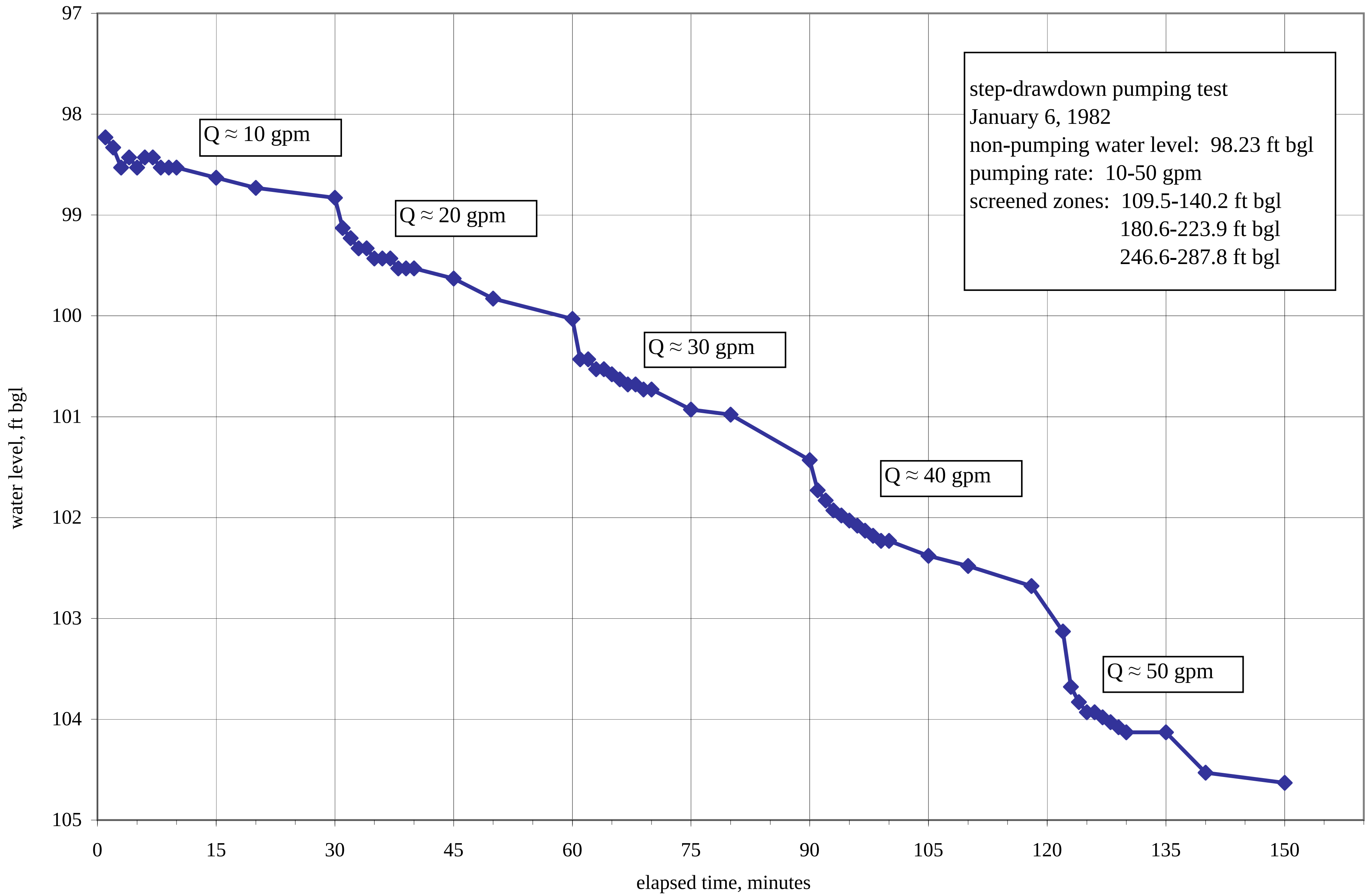


Figure 2. Graph of step-drawdown pumping test performed on Guest House Well No. 1 (GH-1).

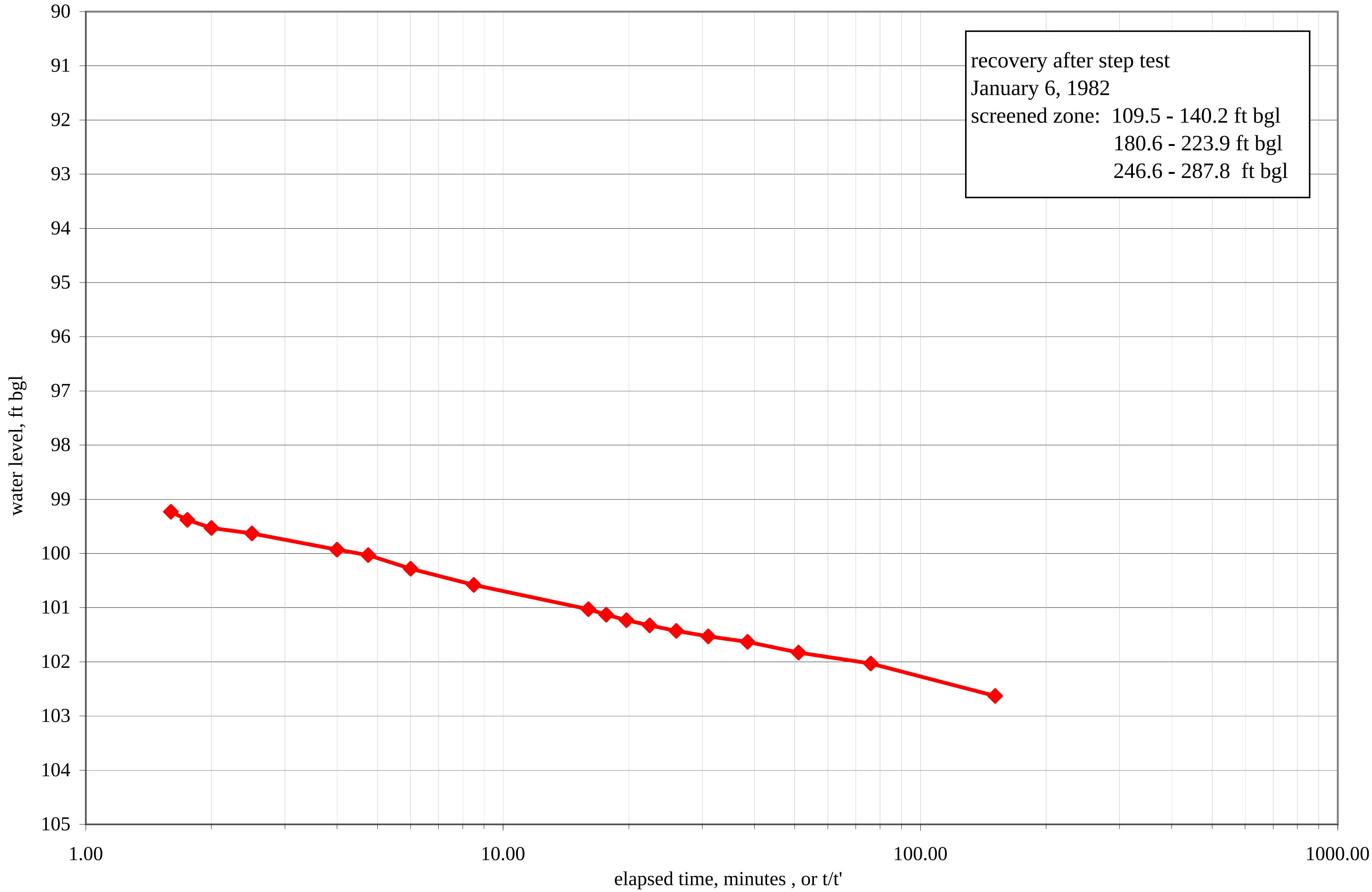


Figure 3. Semi-logarithmic graph of recovery after step-drawdown pumping test Guest House Well No. 1 (GH-1).