LAC Minerals' Cunningham Hill Mine, Ortiz Mountains, Continuing Remediation
Report for San Marcos Association, by Tom Parker, February 17, 2022

Background Gold Fields Operating Co. - Ortiz produced gold at the Cunningham Hill Mine from 1979 to 1987. LAC Minerals (USA) ended up with the property.

The environmental issues at the site were the subject of a citizen lawsuit under the Clean Water Act, with the plaintiffs Jeanie Cragin and Friends of Santa Fe County represented by Doug Wolf of the New Mexico Environmental Law Center. The process involved Val Green, Dr. Art Montana, and Tom Parker as expert witnesses for the plaintiffs; lots of support from the community; and the creation of a panel of respected independent experts to develop a program for the remediation of the site. That program, and the donation of part of the LAC property to Santa Fe Botanical Garden, became the basis for settlement of the lawsuit in 1996. The donated property subsequently passed to Santa Fe County. The San Marcos Association signed the settlement agreement.

The site is regulated by both the Mining and Minerals Division of the New Mexico Energy, Minerals and Natural Resources Department (MMD) under Permit SF002RE; and by the New Mexico Environment Department (ED) under DP-55, for the bulk of the site, and AP-27, for the quality of the water in the lake that has developed in the open pit since the end of mining. (DP stands for discharge plan, reflecting the fact that the site discharges to the ground water; AP stands for abatement plan, reflecting the fact that the quality of the water in the pit is problematic.)

Revision 20-1 to the SF002RE Closure/Closeout Plan MMD is responsible for oversight of the reclamation of the site to a self-sustaining ecosystem under the New Mexico Mining Act. That encompasses such things as grading of slopes, adding soil cover, and establishing vegetation. Those activities have been largely accomplished at the site, though some ponds are still in use, rather than remediated; and the remediation of the open pit and the Waste Rock Pile (WRP) is unfinished.

MMD initiated review of SF002RE in September, 2019 by a letter to LAC requesting a Permit Revision Application to the Closure/Closeout Plan. John Shomaker and Associates, Inc. (JSAI), LAC's principal environmental consultant, provided the first response in July of 2020. The subsequent process and associated documents can be reviewed on the Energy, Minerals and Natural Resources Department website, emnrd.nm.gov. Click on Mining and Minerals Division on the home page; then click on the magnifying glass (search) icon; then enter SF002RE in the search box; on the subsequent page, click on the top item "SF002RE...". All the steps in the process subsequent to the first LAC response are there, and can be examined by clicking on the links to the right of the dates.

Briefly, MMD has solicited comments from other state agencies, Native American tribes, and the public; the New Mexico Mining Act Network provided comments authored by Jim Kuipers; LAC has filed a revision to the initial document; and requests for a public hearing (including from the San Marcos Association) have been accepted after public notice. No notice of the time and place of a public hearing, if one occurs, has been issued yet. As we understand it, MMD and LAC are "perfecting the record". For example, ensuring important technical references cited in the revised Closure/Closeout Plan (CCP) are on the website.

Friends is working with the NM Environmental Law Center and has retained Jim Kuipers as its independent technical consultant for the matter. Both the Law Center and Jim have multiple existing commitments and in no way endorse the views presented here. The views expressed here are from one person's review of documents, at a point in time, and are subject to change.

The opportunity to review the information supporting the application online, at the public's convenience, is a treasure; we encourage anyone interested to make use of the opportunity. And we commend in the highest possible terms MMD's making that possible.

Remaining issues at the site There are three significant problem locales remaining within the site, which are potentially linked: the water in the pit does not meet some of the standards under the settlement agreement and AP-27, because acid-generating minerals in the pit walls and on and under the surface of the pit watershed contaminate the water in the pit with sulfate and TDS (total dissolved solids). The water quality in the pit is ED's responsibility, but ED and MMD share responsibility for some other aspects of the site.

The pit is surrounded from its western to northeastern peripheries with a waste rock pile (WRP), which continues to generate acidic water which flows underground along the buried Dolores Gulch drainage to an Interceptor Wall system, where it is captured, then treated. Finally, Dolores Gulch downstream of the Interceptor Wall is host to a ground water contaminant plume from acid-contaminated water bypassing the Interceptor Wall.

Pit waiver The Mining Act, consistent with its relatively short-term horizons, provides an out for problems likely to be intractable; the out is a waiver allowing some portion of the site not to achieve the status of a self-sustaining ecosystem. Because open pits are likely to be the most difficult parts of a mine site to remediate in arid country, the term "pit waiver" finds frequent application. MMD has pushed LAC to request a pit waiver for the Cunningham Hill site as part of its CCP revision. Friends' initial reaction is that a pit waiver without stringent conditions does not make sense. Further, conclusive evidence has not yet been presented that no other path forward is possible.

The regulatory requirements for a pit waiver are defined in 19.10.5.507 New Mexico Administrative Code (NMAC) Performance and Reclamation Standards and Requirements:

B. Waiver for Pits and Waste Units An operator may apply for a waiver for open pits or waste units from the requirement of achieving a post-mining land use or self-sustaining ecosystem. The operator must show that achieving a post-mining land use or self-sustaining ecosystem is not technically or economically feasible or is environmentally unsound. The Director may grant the waiver for an open pit or waste unit if he finds:
(1) measures will be taken to ensure that the open pit or waste unit will meet all applicable federal and state laws, regulations and standards for air, surface water and ground water protection following closure; and
(2) the open pit or waste unit will not pose a current or future hazard to public health or safety. [CCP, Appendix H, p. 4.]

LAC's claims are that the original strategy for the pit agreed to in the Settlement can not be accomplished; that no other strategy is economically feasible or environmentally sound; that the source control measures they have installed will keep the water quality in the pit within the standards in the future (after the current program of treatment of the pit water to repair historic degradation is concluded); and that those source controls must be maintained, requiring [perpetual] human intervention. Therefore, the pit cannot be a "self-sustaining ecosystem", and is worthy of a waiver. Friends disputes that any of these claims have been demonstrated with sufficient evidence.

The agreed strategy cannot succeed The approach to remediating the pit in the Settlement Agreement, subsequently endorsed by AP-27, was to "drown" the acid-generating minerals in the pit walls with diversions of fresh surface water from Upper Cunningham Gulch. Simplified, the production of acid drainage from minerals such as pyrite (iron sulfide) requires oxygen and

water. Because the dissolved oxygen content of stagnant water is relatively low, rates of acid production below the water level of a pit lake will typically be low. This is a classic remediation strategy for acid-generating materials at mines, though clearly a difficult one to accomplish in arid regions.

Friends' position is that there is incomplete evidence to demonstrate that this approach is doomed to failure. LAC's performance at implementing the strategy has been indifferent, to be polite. And that performance has not generated sufficient real data to evaluate the likelihood of success, if actions are taken to augment Upper Cunningham Gulch flows.

Friends does not have complete information on the diversion channel that conveys Upper Cunningham Gulch flows to the pit. LAC apparently replaced an existing unlined channel with a lined channel in 2000. At the upstream end of the new channel a weir and stilling well were installed to measure flows from upper Cunningham Gulch into the channel, to satisfy New Mexico Office of the State Engineer reporting requirements. This is the "Upper Cunningham Gulch diversion channel" shown on Figure 8 of the CCP main report, Fig 8 attached.

A brief report (The MINES Group , Inc., 2000) gives the details of the new channel. The most significant fact is that the channel apparently terminated on a Reno Mattress Erosion Control Blanket with a gabion end wall, high up the pit wall rather than at the water surface of the pit lake. So some portion of the water from every precipitation event that made it through the weir would dribble down the pit wall, presumably generating acid as it went.

By 2011, water in the pit was again above some standards, and LAC had proposed a new remediation plan, focused on source controls (JSAI, August 2011). Among these were storm water management within the open pit watershed and repairs to the Upper Cunningham Gulch diversion channel. The repairs were completed in August of 2011, and are detailed in Appendix C of the report. Note that "The diversion channel currently discharges at the top of the southern pit wall..."(p. 5).

In 2014, LAC reported that the purpose of the 2011 repairs was to prevent infiltration of storm water from Upper Cunningham Gulch into the Golden Fault zone and formation of AWS (JSAI, 2014, p. 6). "Inspections after the work was performed revealed that the contractor did not install the liner to industry standards. As a result, storm water generated during the September 2013 event infiltrated where the liner was not properly installed, and likely contributed to southwest AWS". (P. 6; "AWS" is an abbreviation for acid wall seepage.) The report Recommendations include completing engineering designs for fixing the Upper Cunningham Gulch diversion channel repairs, (p. 8).

CCP Appendix E summarizes (p. 5) "It was identified in 2009, that the Upper Cunningham Gulch diversion channel infiltrated storm-water up-gradient of the weir rather than convey storm water to the open pit. Measurable quantities of diverted storm water began in 2015 after the diversion channel was fixed (Table 1)." Table 1 then compiles annual precipitation and "measured" diversions as if diversions in years before the 2015 repairs are data.

Friends does not currently have access to the engineering for the 2015 rebuilding of the diversion, but the response by MMD to an Inspection of Public Records Act request by the New Mexico Environmental Law Center contained pictures of the new system, after it had been unearthed and disassembled by a large precipitation event in August of 2019. The diversion apparently consisted of buried corrugated black plastic pipe, from the weir to the top of the pit highwall, then (perhaps) turning and following the slope down to the water level in the pit. Friends has no information on the repairs subsequent to the 2019 event. It is not unreasonable to suggest that the diversion pipeline should have been sized larger. Friends has no information about whether it has been upsized since the August 2019 event.

To know if the agreed strategy could succeed, it is necessary to understand the distribution and concentrations of the acid-generating materials in three dimensions, along the pit walls and within the pit watershed; and the flow paths that bring infiltrating water within the boundaries of the pit watershed into contact with them. Friends believes at this time there is insufficient information to do either. If it exists, it has not been presented.

No other strategy is economically feasible or environmentally sound LAC evaluates the alternative of backfilling the pit to 6945 foot elevation, requiring at least 2 million cubic yards of fill (CCP, Appendix H, p. 12-13). That fill can only come from a quarry in Moriarty, so it will take 15.4 years of trucks through Madrid five days a week, and cost $ 229 million. Friends readily concedes that the alternative as described is absurd. LAC asserts that material in the WRP is unsuitable, because it is acid-generating. It certainly generates acid where it is unsaturated and water infiltrates through it; whether it would generate much acid continuously submerged is not evaluated. Also not evaluated is the use of some other on-site material that is not acid-generating as a cap for the vertical interval of the filled pit that is subject to water level fluctuations, and thus alternately saturated and unsaturated. LAC's straw man does not mean there are no other alternatives.

Friends regards the pit as an optimization problem: find the *combination* of actions most likely to keep the water in the pit within standards at the lowest cost and with minimum associated environmental impacts. Possible actions include the following.

Grade acid-producing portions of the western pit walls to slopes capable of supporting soil and vegetation, to isolate any remaining acid-generating material from the environment. The material removed would go into the pit, raising the water level. Grout the flow paths generating and conveying acidic water within the boundaries of the pit watershed. If additional surface or ground water resources are required to raise the water level in the pit to an optimum level that is higher than the current one, develop them.

Friends is unaware of any studies that determine the optimum level for water in the pit. It's a trade-off between a very high water level in the pit that inundates all the acidic seeps, but potentially puts any contaminated water into the regional ground water system; and a water level in the pit low enough to foreclose regional effects, but allowing acid generation and virtually guaranteeing poor-quality water in the pit. Note that some level of fluctuation in pit water levels is inevitable, and likely will require management, whatever specific level is chosen.

There are ways to increase the flow of surface water into the pit to raise water levels, plus the pumping of ground water. LAC has dismissed each of them it has considered, as a single stand-alone item; but nowhere considered a combination of all of them. The most environmentally benign alternative is thinning of the watershed, desirable on its own terms to reduce the risk of catastrophic fire. LAC thinned 90.2 acres within the Upper Cunningham Gulch drainage on its property in 2017 and 2018 (CCP Appendix E, Table 1 and Figure 4). There remain 135 acres in the watershed wholly controlled by LAC (Area 1B) about which the Forest Management Plan (CCP, Appendix C, pp. 35-36, and Forest Management Map) states "Thin as many acres as possible in this area to reduce the stand density to a healthier level." Earlier in the document (p. 33), there is this: "...Cunningham Gulch in the southwest corner has a very high rating for the hazard of wildfire. The only place with that ranking on the property. This is the most important area to treat."

The entire Upper Cunningham Gulch watershed consists of about 1300 acres (CCP main report, p.16); much of it is owned by Santa Fe County or Lone Mountain Ranch (CCP Appendix

E, Figure 1). LAC opines "With partial ownership of the watershed, it is technically not feasible to fully implement management programs for increasing watershed yield." (CCP, Appendix H, p.12) Friends has no information about interactions between LAC and its neighbors, though clearly all would benefit from the prevention of catastrophic fires.

The strategies employed by LAC have controlled the acid seeps, and this round of treatment of water in the pit will be the last LAC reports that since the diversion channel was "properly" repaired, no acid wall seepage has been observed (CCP Appendix H, p. 9). Given the complexity of the site and the intermittent nature of the seepage, caution in relying on that conclusion is warranted. Note that since the third quarter of 2020, LAC has been removing water from the lake, presumably with some effect on the flow system of the pit watershed. Note also that no details are provided as to how that fact was determined - how long after what size storm events were the pit walls inspected; for the safety of its personnel, LAC restricts the timing of entry to the pit after storm events.

The current round of treatment of the pit water began in the third quarter of 2020 (AP-27 monitoring report for that quarter), and has continued when seasonal temperatures permit. That monitoring report indicated that of the 3.8 ac-ft removed from the pit and treated in the period, 2.8 ac-ft (74%) were returned to the pit. CCP Appendix H, p. 14 indicates that the treatment is expected to conclude in 2024. Confusingly, it also indicates treatment "began in the summer of 2021"; 4.9 ac-ft had been treated as of August 2021 (p. 11). The total volume of water that must be treated to reduce sulfate in the pit water to 600 mg/L is estimated in JACOBS ch2m (2018, Appendix E, p. 5) as 77 million gallons (236 ac-ft), which suggests the stated timeframe may be optimistic.

The source controls must be maintained by human intervention [perpetually], so a pit waiver is appropriate "NF [nanofiltration] treatment is expected to be completed by 2024, at which time it is expected that pit-lake water quality will be sustained by the continued maintenance of source controls that ae [sic] currently in place." (CCP Appendix H, p. 14.) The predicate assumes that no other solution now exists, or will *ever* be found. Even if the predicate were correct, the conclusion is dubious. The one thing that is sure is that LAC has now stated that it is likely to need to be at the site in perpetuity. That admission has implications for the granting of a pit waiver *at this time*; and, if granted, for how a pit waiver should be conditioned. See below.

Wildlife use of pit The CCP includes "Appendix D. Photographs of native vegetation and wildlife in the Open Pit area at Cunningham Hill Mine Reclamation Project". Photographs of mammals and birds within the pit, and birds floating on the pit lake are presented. There are no pictures of wildlife drinking the water in the pit, but Friends has seen no evidence that birds or mammals would be injured by doing so. In a small percentage of monitoring events in the past, water in the pit has exceeded the acute standards for aquatic life; Friends has no information about whether or not there are any fish in the pit. LAC is required to keep the pit water within standards that are protective of wildlife; doing so was part of the Settlement Agreement and AP-27. Note that AP-27 has provisions requiring LAC to take a series of actions if wildlife are threatened by the quality of the pit water. Friends believes that none of those provisions has ever been invoked.

What is driving the current treatment of the water in the pit is that it is exceeding the negotiated site-specific standards for the possible discharge of water in the pit to the ground water system. The history of water quality monitoring in the pit demonstrates that if those standards are met, wildlife will be able to drink the pit water or swim in it. So what, precisely, is the point

of "An 8-ft chain-link fence will be installed around the Open Pit to restrict access to *wildlife* and humans (see updated CCP)." (CCP Appendix H, p. 11.) If LAC is truly concerned about wildlife, it must somehow deter birds. And no determined human is going to be stopped by a chain-link fence. Access control at the property line seems a better option.

Stability of the pit walls This subject gets shortchanged in the CCP. Call & Nicholas, Inc. (1994) is the sole reference concerning pit wall stability. It describes a site visit on 3 and 4 August, 1994 by Mr. David Nicholas. Nicholas noted that the data available included topography and pre-mine geology reports. "The geologic work performed by Gold Fields was not available at the time of the site visit." (P. 1.) The conclusions of the report were that the probability of a slope failure greater than 100 feet in height is low, but the pit slopes will continue to ravel. "The pit should be fenced-in to prevent people from entering the pit area." "Geology maps, cross sections, and slope monitoring data should be obtained from Gold Fields..." Finally, LAC "may wish" to install a survey monument at the tops of the east, north, and west walls. (There already was a monument at the top of the south wall.) The monuments should be surveyed every 3 to 6 months "until mine closure is complete." (P. 1.) Friends has no information about installation of monuments or periodic surveys.

The Cunningham Hill Mine Reclamation Project Pit Lake Remediation Study, Final Report (JACOBS ch2m, July 23, 2018) included a section titled Risk Assessment Results, beginning on p. 61. "The first high risk associated with this project is damage or personnel safety risk associated with the instability of the CHMRP Pit. As the site is not an active mine site, the Pit is not being actively maintained and is therefore susceptible to unpredictable weathering and erosion. The site has experienced Pit rockfall and washout in recent years, and further erosion is likely." Note that this document was finished before the August 2019 storm event, and that it is not the document included in the CCP as Appendix B to CCP Appendix E. Friends has photos of the aftermath of the August 2019 storm event, but is not aware of any followup reporting of the impacts of that event on the stability of the pit walls.

Reasonable conditions on a pit waiver, if MMD is determined to grant one Friends sees no reason for a pit waiver at this point in time. There is no hurry in the matter of a pit waiver, since LAC has admitted that it expects to remain at the site for the foreseeable future. The treatment of the pit water will continue through 2024, at least. LAC's most recent report on the remediation of the plume of contaminated water in Dolores Gulch estimates that "The proposed enhanced recharge and plume recovery plan is expected to take 12 years if operated seasonally; however, the time frame will depend on permitting approval, and seasonal operation issues." (JSAI, May 2021, p. 35.) To Friends' knowledge, ED has not approved the proposal. As is explained below, the time should be used to determine if the LAC fixes under way actually work over a reasonable amount of time, and to fully investigate alternatives that might remove the need for perpetual care, or at least reduce it to the minimum possible.

If MMD insists on granting a pit waiver, several conditions are appropriate:

- Investigate completely the distribution and concentration of acid-forming materials in the pit walls.
- Investigate completely the distribution of faults and fractures in the pit watershed that control the flow paths of water interacting with the acid-generating materials.
- Any pit waiver granted should be subject to review at appropriate intervals, so long as LAC has a presence at the site.
- A program to mitigate the risks posed by the instability of the pit walls should be undertaken, including the installation of survey monuments and an investigation of the current condition

of the pit walls; development of mitigation proposals for the risks; and ongoing surveys at appropriate intervals.
- The bonds associated with the site should be reviewed, to ensure that they are sufficient for the additional investigations, pit wall fixes, and monitoring.

Help This is a reasonably complex site, with a long history. Friends needs your help, in both the short- and long- terms. This report is a work in progress; any comment on this analysis is welcome, at: Ross Lockridge <murlock@raintreecounty.com> and Dennis Kurtz <dennisdkurtz@gmail.com> . As noted, much of the material supporting the request for a pit waiver is available online at the EMNRD website, and public comment likely will be allowed for some period after the hearing, assuming that there is one. Individuals with specific technical expertise will be particularly welcome: earth scientists, hydrologists, atmospheric scientists, ecologists, foresters. There is plenty to chew on. And the technical support available to Friends is dwindling, as its experts age. If the site is indeed forever, new blood will be required. Internet researchers are welcome to find Friends an example of an acid-affected pit lake in arid country that has been successfully remediated.

Both Friends and the New Mexico Environmental Law Center are public-interest community organizations. Financial contributions to either will go to pay attorneys and independent expert witnesses such as Jim Kuipers. How to give:

Donations:
1) for Friends of Santa Fe County can be made through their tax exempt 501(c)(3) fiscal agent, via check or money order payable to the "Concerned Citizens of Cerrillos." Please write "Friends fund" on the check, and post to CCC, PO Box 245, Cerrillos, NM 87010.
2) for the NM Environmental Law Center, also an exempt 501(c)(3) organization, go to nmelc.org/donations/ and click "Give Now."

Thanks Thanks to Jeanie Cragin, for her courage in being the plaintiff in the citizen suit, at risk of a countersuit; to the New Mexico Environmental Law Center and its attorneys and staff, Doug Wolf, Eric Jantz, Doug Meiklejohn, Charlie de Saillan, and Kendra Palmer; to our current expert, Jim Kuipers, and our past experts, Val Green and Dr. Art Montana; and to all the members of the community who have been a part of Friends over the years; [and special thanks to Tom].

An olive branch for LAC and John Shomaker and Associates, Inc. Thanks you for all your work on the site over the years. You and Friends are united in the desire to return the site to good condition.

Ross Lockridge, Acting President, Friends of Santa Fe County
Tom Parker, Member of Friends