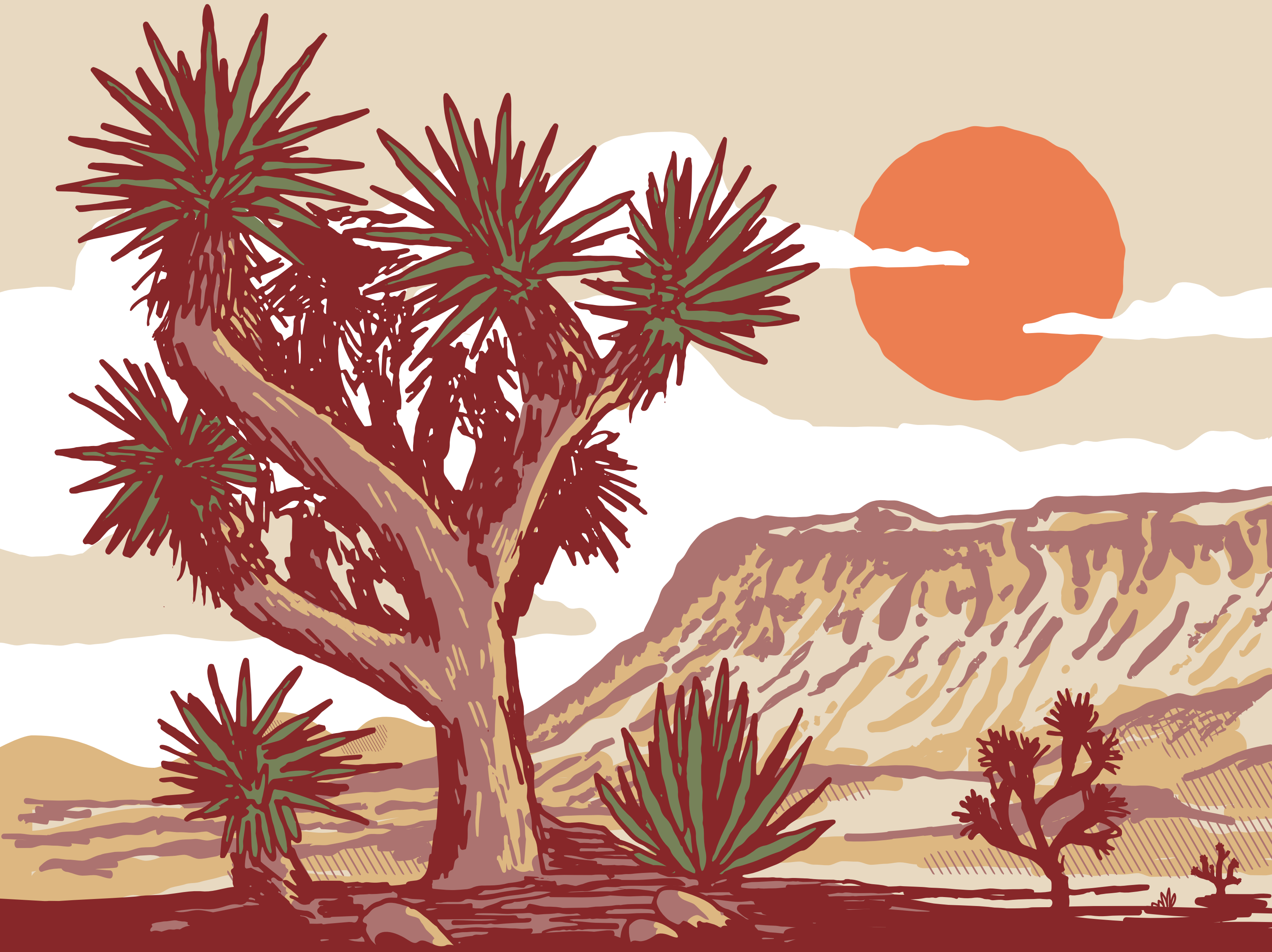
CONGLOMERATE MESA

MINERAL EXPLORATION

Potential Future Mining Scenarios and Impacts

March 2022



This report was commissioned by Friends of the Inyo,
a member organization of the Conglomerate Mesa Coalition.

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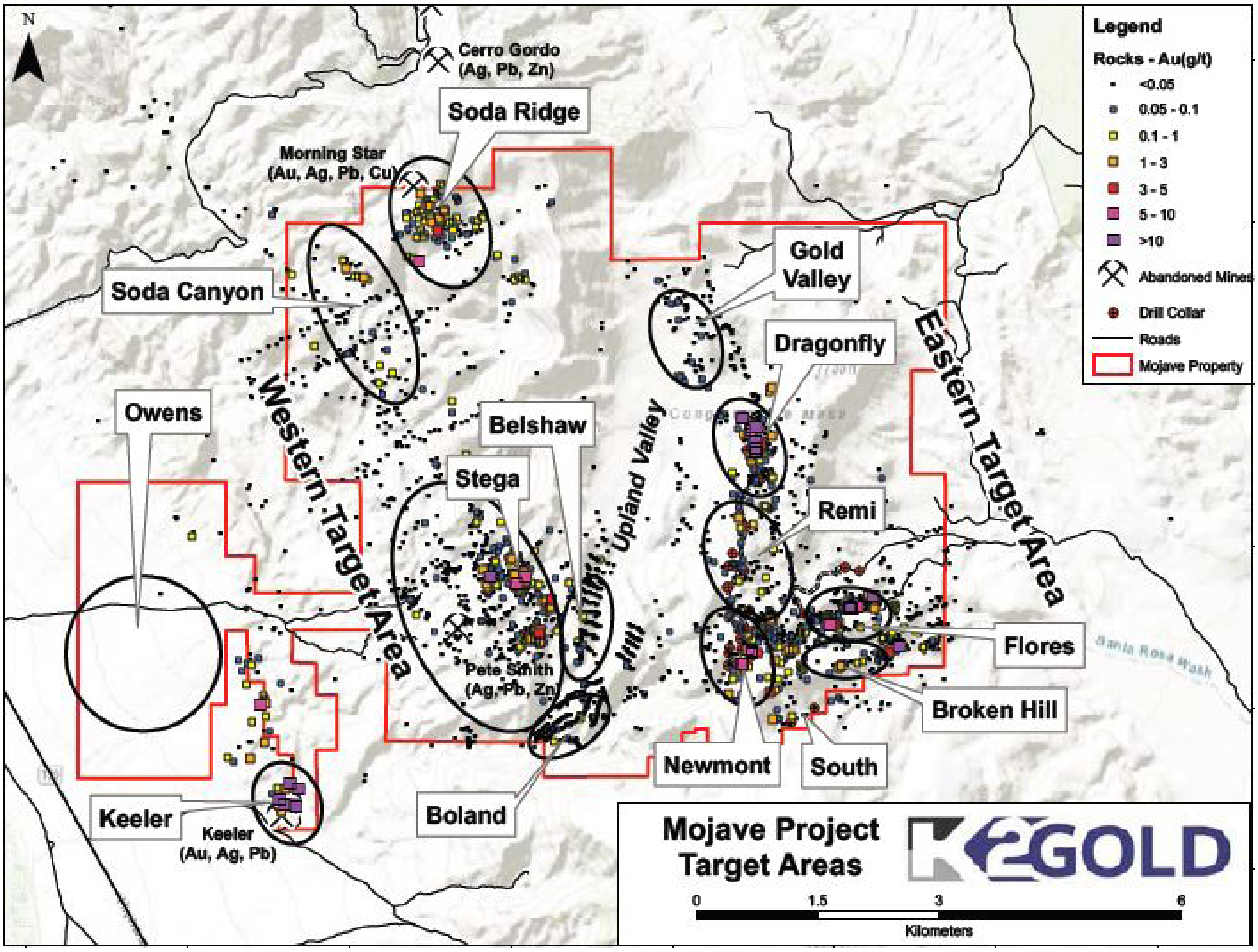
Introduction

Conglomerate Mesa, in the Inyo Mountains of eastern California, is a high desert region of public land administered by the US Bureau of Land Management (BLM). It is mostly roadless and comprises mid-elevation de facto wilderness. The area and its surroundings have a long history of mineral exploration — mostly for gold — but to date no mining has occurred on Conglomerate Mesa itself. Old exploration roads into the Mesa have been reclaimed.

Currently, Canadian junior exploration company K2 Gold continues to explore the district, and has drilled 16 holes in the last 18 months within their federal mining claims via helicopter access. K2 has submitted an application to the BLM to enter Conglomerate Mesa (the least explored target within the district) to drill 120 additional exploration holes on the Mesa[1] — most about 1,000 feet deep — via a combination of helicopter, new road building and the re-establishment of reclaimed roads. Scoping for a federal Environmental Assessment was completed in August 2021, with a Draft Environmental Assessment expected for public release in the spring of 2022. K2 calls their wholly-owned property the Mojave Project.

This report examines the geology of the region to better characterize the size and scope of a future mine, as well as its potential long term environmental liabilities, by comparing its geology to similar existing mines in Nevada. We examine the mining and milling methods and the environmental track records of these other mines to the extent of available information. While it is too early to precisely characterize a future mine's features and impacts, enough information exists to offer a reasonable scenario of a future mine at Conglomerate Mesa. This report was authored by Pete Dronkers for Friends of the Inyo with Assistance from Bryan Hatchell, former Desert Policy Associate for Friends of the Inyo.

1 https://mojavepreciousmetals.com/sites/default/files/Final_MPM_PO.pdf



Geologic Setting

The Mojave Project has several drill targets in an area larger than Conglomerate Mesa[2] (Corporate Presentation, May 2021, p. 12). The area between the Western and Eastern Target Area with the fewest amount of drill holes is Conglomerate Mesa, while K2 calls this broader area the Mojave Project.

In its Corporate Presentation as well as drilling updates[3], K2 describes the regional geology as a sediment hosted oxide gold deposit (SHOG) that is similar to gold deposits within the Carlin Trend in northern Nevada.

K2 states:

- "Eastern Target Area: This area is the current focus of drilling and exploration activity: Oxide gold in structures & sediment hosted adjacent to structures"
- "Sediment-Hosted Gold - Similarities to Carlin and low-sulfidation epithermal systems"

A March 14, 2021 article in the Los Angeles Times[4] by Louis Sahagun also states: "K2 officials have suggested that a mine on the mesa, with approval of the BLM, would operate

2 https://k2gold.com/site/assets/files/6261/corporate-presentation.pdf#viewer.action=download
3 https://k2gold.com/news-media/news/
4 https://www.latimes.com/environment/story/2021-03-14/a-corporation-wants-to-mine-for-gold-near-death- valley-native-tribes-are-fighting-it

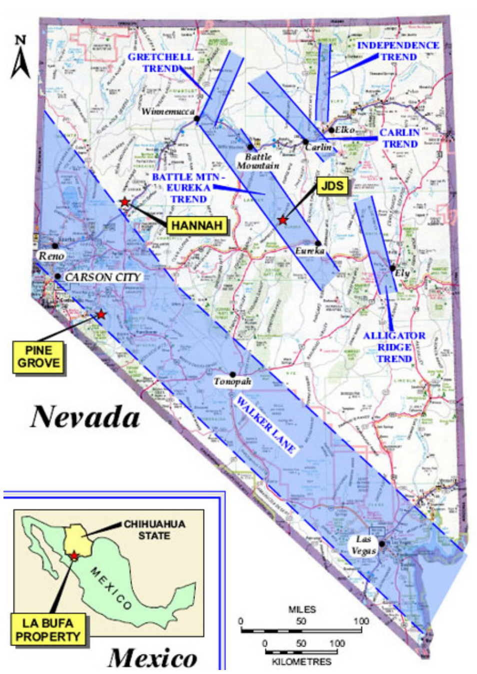
nonstop as an open pit, using tons of cyanide each day to leach gold from heaps of crushed ore, a technique that has transformed previously unprofitable mines into bonanzas."

The Carlin Trend was the site of Nevada's — and probably the world's — first gold mines of this type. While other mineral trends in Nevada may also contain SHOG deposits, the Carlin Trend contains only such deposits and therefore offers the best comparisons to the Mojave Project.

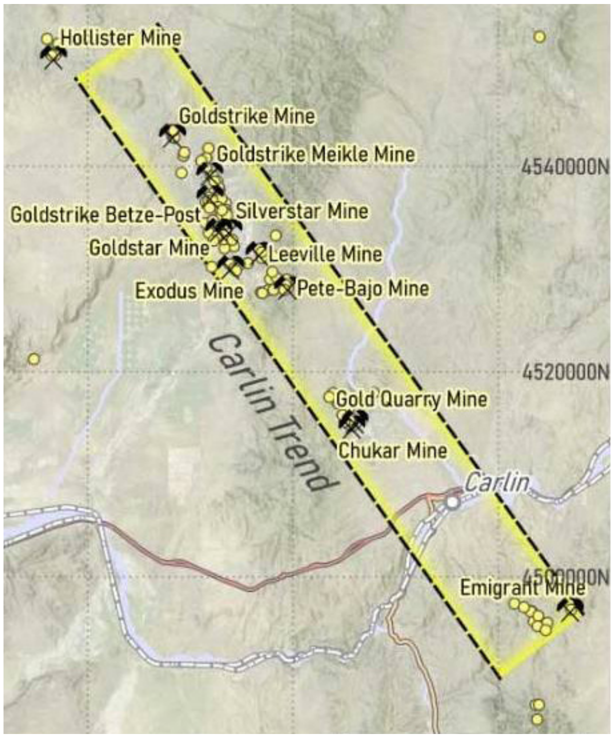
SHOG deposits are found in sedimentary rock types, and contain oxidized, low grade, disseminated ore (USGS, p. 1)[5] with invisible gold particles measured in microns. They are generally shallow, with deposits reaching a maximum thickness of about 1,000 feet (USGS, p. 27). USGS considers two SHOG subtypes: the Carlin subtype and the Chinese subtype. While sharing similar structural geology, the two subtypes have differing mineralogies. This report focuses only on the Carlin subtype, even though Carlin subtype mines are found elsewhere in the world — having received their name because of Nevada's role in the initial exploitation of SHOG deposits in the 1960's.

K2 has suggested that their Western Target Zone may contain a porphyry-type copper, silver and base metal deposit (Corporate Presentation, p.8), but given its lack of gold and current interest, we focus on the sediment hosted, oxide gold deposit that remains K2's main interest and that comprises Conglomerate Mesa.

K2 also draws more complex geologic comparisons to low sulfidation epithermal features of the Walker Lane Trend — a long and relatively underexplored trend that parallels the California/Nevada border. While it is beyond the scope of this report to characterize the highly variable geology of the Walker Lane Trend, the operating gold mines and prospects within this vast region also contain oxidized and relatively shallow ore and generally utilize, or will utilize, cyanide heap leaching to extract gold[6]. While perhaps not geologically identical to Carlin Trend mines, operating mines on the Walker Lane Trend tend to have similar attributes as those on the Carlin Trend, and therefore offer some useful practical comparisons to the Mojave Project.



Mineralization trends of Nevada[7]



Mines of the Carlin Trend[8]

5 https://pubs.usgs.gov/of/2014/1074/pdf/ofr2014-1074.pdf
6 The Mineral Ridge Mine, Rawhide Mine, and Castle Mountain Mines currently operate open pit and heap leaching. The Hasbrouck Project is an oxide deposit suitable for open pit and heap leach. The NorthBullfrog Project proposes heap leaching, as does the Moss Mine, the Borealis Project, the Golden Arrow Project, and many others within the trend.
7 http://www.lincolnmining.com/project_map.html
8 https://www.powermetalresources.com/wp-content/uploads/2021/06/map2.jpg

Overview of Environmental Performance at Carlin Type Mines

Environmental performance at hardrock mines can be split into two categories: performance during mining operations, and long term, post closure performance. During its operational life, a modern mine in the US is bonded to ensure that it has enough money to treat contaminated water, manage other environmental liabilities, and fully reclaim after mining ceases, regardless of commodity prices. While this system can fail catastrophically during the life of a mine and push the liabilities onto taxpayers and the environment, post closure liabilities — which can have time horizons of thousands of years — have impacted, and will continue to impact, communities and the environment essentially forever.

Acid Mine Drainage (AMD):

AMD is arguably the most impactful long term problem of hardrock mines. It occurs when sulfidic rock — commonly pyrite — is exposed to oxygen, water and bacteria, forming sulfuric acid (the same as battery acid). The resulting drainage becomes low in pH (more acidic) and causes surrounding trace metals to leach from the rock, thereby mobilizing metals (mostly heavy metals) into the environment.

Because AMD is a constant process and millions of tons of rock are implicated in it at modern large-scale mines, it can take thousands of years for the rock to reach neutral pH drainage chemistry[9].

AMD is most common at mines processing sulfide ore types rather than oxidized ore. Most Carlin type mines do not have severe and widespread problems with acid drainage in the upper reaches of the mine, but they are not immune from it, nor from other acute failures or major long term environmental liabilities. While acid can still generate, it doesn't typically manifest as a serious environmental problem because of the surrounding sedimentary rock; it is high in carbonate minerals which help to neutralize acid formation from the pyritic sulfide minerals that contain the gold, especially

9 https://earthworks.org/issues/acid_mine_drainage/

when a mine plan of operations and its closure plan includes proper blending and capping of potentially acid generating material.

However, at depth, pyrite/acid generating rock has been observed, usually below the water table. For example, the last rock placed on the AA heap at the Goldstrike mine was acid generating and caused problems with management of that drainage when the heap was closed.

While K2 Gold is currently drilling into the SHOG deposits, and hopes to continue drilling, the company has also referenced "refractory sulfide" ore in its drilling updates. This type of ore can be found underneath SHOG deposits on the Carlin Trend, and when an open pit is exhausted (or in rare cases, refractory ore is targeted exclusively), miners will exploit these more targeted deposits via either open pit or underground techniques. Refractory gold ores are defined as containing sulfur or carbonaceous materials that trap encapsulated gold and make cyanide leaching extraction difficult[10], thereby requiring different processing methods, including roasters or autoclaves that oxidize ore prior to cyanidation.

Because rocks associated with these ores are sulfidic, they are more likely to become acid generating as waste material on the surface, as well as impact water quality in pit lakes (pit lakes are discussed later in this report).

Although it's too early to know whether or not refractory sulfide ore will be found at the Mojave Project, it's important to note that their ultimate potential exploitation could result in a mine that requires water treatment in perpetuity in order to combat AMD.

Cyanide Heap Leaching:

Most Carlin type mines utilize cyanide heap leaching to extract the microscopic gold particles contained in the oxidized ore. Heap leaching involves crushing ore to small gravel size particles, placing them on an impermeable heavy duty liner, and sprinkling or drip irrigating a sodium cyanide solution over the pile of ore. The solution percolates through the pile, and is then collected in channels at the bottom of the heap. This "pregnant solution" contains gold cyanide complexes (as well as other toxic metals such as mercury) and is then pumped back to the processing facility where the solution is then "stripped" of the gold cyanide by passing it over charcoal. The resulting "barren" cyanide solution is again fortified with additional sodium cyanide and reused on the heap leach, and the cycle continues for many years.

Heap leaching allows for low grade gold ore to be exploited. Because the ore does not need to be processed in vats in a warehouse-sized mill, it is sent from the open pit to a crusher and then directly to the heap facility. Heap leaching avoids the need for an engineered tailings storage facility (TSF), because the heaps themselves remain in place indefinitely. However, as we'll see below, Carlin type mines also utilize other milling methods that result in TSFs, although to a lesser degree by ore volume than the primary method of heap leaching.

Sodium cyanide is extremely toxic. One teaspoon of a 2% dilute solution is enough to kill a person[11]. It is applied via large sprinklers or using drip irrigation systems in the open air, where wildlife can become exposed[12]. Collection channels and ponds at the bottom of heap leach facilities are often exposed. In Nevada, during 1990 and 1991 alone, 9,512 carcasses were reported of over 100 species which died from exposure to cyanide-bearing mining solutions, although this was likely an underestimation due to the reporting being voluntary.[13] While still a concern, a variety of methods are commonly used to reduce avian mortality on heaps and in the pregnant and barren process ponds. The Migratory Bird Act allows wildlife agencies to prosecute mining companies that kill birds.

Another major risk with cyanide heap leaching is the failure of the liners underneath them, which can result in widespread ground and surface water contamination. This happened at the

10 https://www.barbenanalytical.com/applications/mining-industry/gold-processing-refractory-sulfide-ores
11 https://earthworks.org/assets/uploads/archive/files/publications/Cyanide_Leach_Packet.pdf
12 https://pubmed.ncbi.nlm.nih.gov/15369321/
13 https://pubmed.ncbi.nlm.nih.gov/17540445/

Example of open pit and heap leach mining operations: the Round Mountain Mine, Nevada, with open pit center left, waste rock dump front, and heap leach pads right and upper right[14]

Summitville Mine in Colorado in the late 1980's. Within weeks after start-up, the vinyl liner under the heap leach pad cracked and started leaking cyanide-laced water into ground and surface water and contributed to what many still consider to be the worst environmental disaster in the state's history.[15]

In addition to the rupture of the liner, the mine operator also underestimated the maximum amount of runoff that could be generated on the heap leach, which eventually created a surplus of contaminated water but with no storage facilities for it. It ultimately went into the Alamosa River, contaminating a 17-mile stretch and resulting in a major fish kill. The site remains one of the most expensive Superfund sites in the nation over thirty years later. Hundreds of millions of dollars have been spent remediating the site, and extensive water treatment will be needed in perpetuity. While many of the ongoing problems at Summitville are associated with highly acid generating rock, a host of smaller abandoned mines, and high levels of precipitation, it's important to recognize the heap leach failure's contribution to the disaster.

Another important case study regarding environmental disasters is the Zortman-Landusky Mine in Montana (see bullets on page 9), which was a major factor in the states'

14 https://pubs.usgs.gov/of/2012/1085/pdf/ofr2012-1085_v1-1.pdf
15 https://crestoneeagle.com/the-summitville-mine-colorados-worst-environmental-disaster-november-2005

subsequent ban on cyanide heap leach mines via ballot initiative in 1998 and which still remains in effect today[16]. A Summary of regulations on cyanide use in gold mining can be found on the Earthworks website[17].

Beyond heap leaching, cyanide can also impact the environment at mines when impoundment dams containing cyanide bearing solutions fail, or when vehicles carrying it crash. In areas of heavier precipitation, the transport of cyanide contamination increases with surface runoff.

Examples of additional cyanide related mine accidents, as of 2001[18]:

- Montana: Pegasus Corporation recently closed the Zortman-Landusky gold mine in Montana. Opened in 1979, it was the first large-scale cyanide heap leach mine in the United States. The mine experienced repeated leaks and discharges of cyanide solution throughout its operating life, resulting in wildlife deaths and severe contamination of streams and groundwater.

- Nevada: Following the failure of a leach pad structure in 1997, the Gold Quarry mine in Nevada released about 245,000 gallons of cyanide-laden waste into two local creeks. In 1989 and 1990, a series of eight cyanide leaks occurred at Echo Bay Company's McCoy/Cove gold mine in Nevada, releasing a total of almost 900 pounds of cyanide into the environment.

- South Dakota: On May 29, 1998, six to seven tons of cyanide-laced tailings spilled from the Homestake Mine into Whitewood Creek in the Black Hills of South Dakota, resulting in a substantial fish kill. It is likely to be years before the stream fully recovers.

- Kyrgyzstan: On May 20,1998, a truck transporting cyanide to the Kumtor mine in Kyrgyzstan plunged off a bridge, spilling almost two tons of sodium cyanide (1,762 kilograms) into local surface waters.

- Guyana: In 1995, more than 860 million gallons of cyanide-laden tailings were released into a major river in Guyana when a dam collapsed at Cambior mining company's Omai gold mine.

- Spain: A dam at the Los Frailes zinc mine in southern Spain ruptured in April 1998, releasing an estimated 1.3 billion gallons of acid, metal-laden tailings into a major river and over adjacent farm lands. While news reports of the associated massive fish kill did not mention cyanide or related compounds in the wastes, their presence seems likely given the nature of the metals extracted at this site.

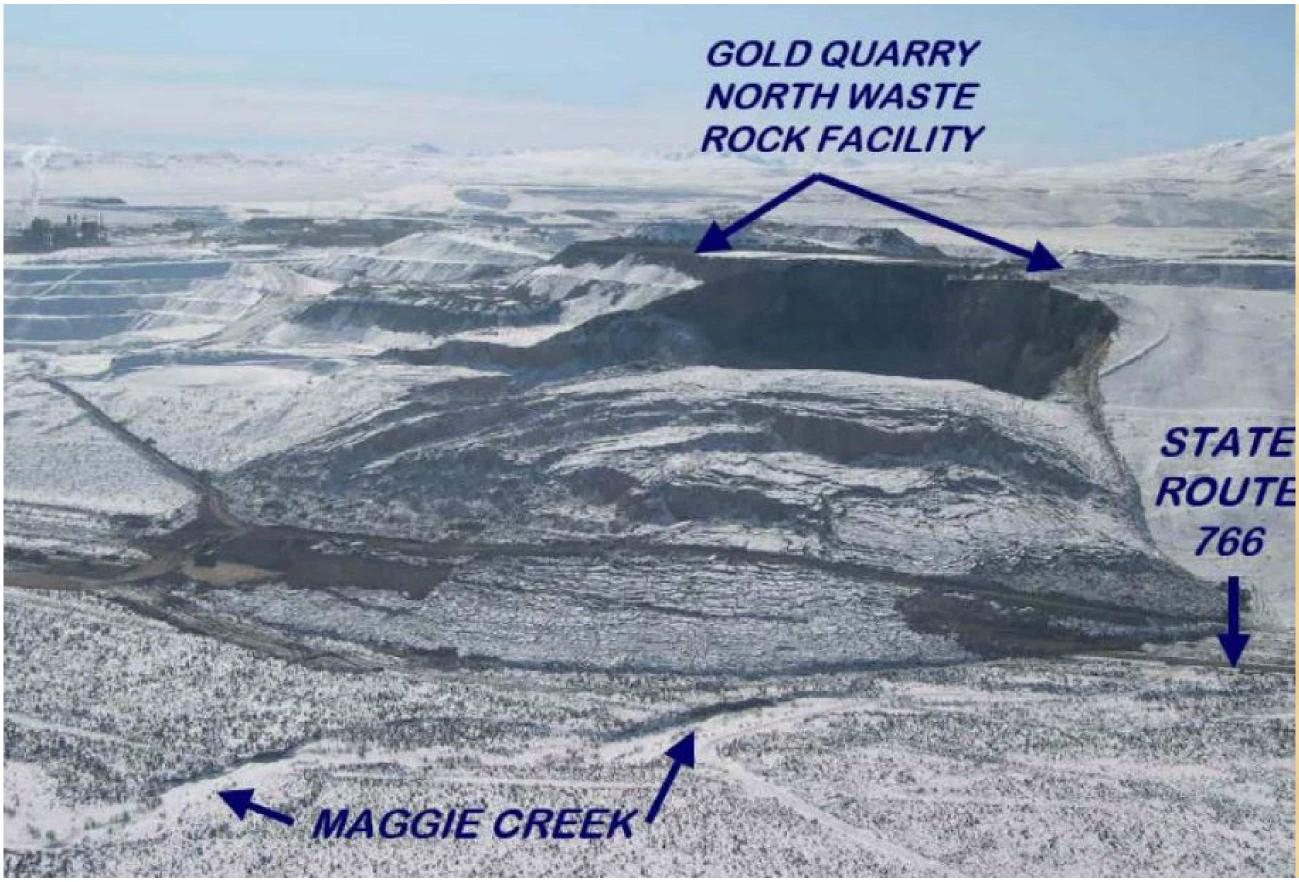
Waste Rock Dumps:

All of the open pit mines on the Carlin Trend have waste rock dumps of varying size. Waste rock is non metal bearing rock (or at such low grades it's not worth crushing and moving to the heap leach) that lies on top of the ore body and to some degree, within it. This rock is blasted and moved away to a location next to the open pit in order to access the more valuable ore.

These dumps are not lined using impermeable high density polyethylene (thick plastic sheets), although some are built on top of highly compacted soil and/or clay, and over long periods of time can impact ground and surface water[19], though this topic remains poorly understood at Carlin Trend mines. One challenge is that due to the depth to groundwater, contamination from waste rock dumps is difficult to detect until it reaches groundwater, at which point it may be too late to remediate the problem and will require ongoing efforts at great expense to prevent it from getting worse.

Waste rock piles on the Carlin Trend have been known to have major geotechnical failures. In 2005, a major portion of a 10 million ton waste rock pile at the Gold Quarry Mine collapsed, burying a state highway in 50 feet of rock[20]. Had this accident been on steeper topography or

16 https://serc.carleton.edu/research_education/nativelands/ftbelknap/environmental.html
17 https://earthworks.org/issues/regulations_on_cyanide_use_in_gold_mining/
18 https://earthworks.org/assets/uploads/archive/files/publications/Cyanide_Leach_Packet.pdf
19 https://www.proquest.com/openview/ee2677c15974e67b70c4d2b5116bd1b5/1?pq-origsite=gscholar&cbl=18750&diss=y
20 https://animas.nmwrri.nmsu.edu/wp-content/uploads/2017Presentations/D2_08_Virginia_McLemore.pdf



Runout zone of waste rock failure at the Gold Quarry Mine (see footnote 16).

closer to human occupation, it could have had human casualties. In addition, failures like these expose more rock to oxygen and water, thereby accelerating any reactions that could potentially lead to water contamination.

Tailings Storage Facilities (TSF) Failures:

While SHOG deposits primarily use heap leaching, many of the Carlin Trend mines also have tailings facilities that are used when unoxidized ore (sulfidic) is encountered and milled within enclosed circuits, or where higher gold grades justify more efficient (and expensive) milling techniques. While probable, it is too early to claim that a mine on Conglomerate Mesa would have a TSF, though it's worth noting the increasing failure rate globally of major TSF facilities. A database of failures can be found on the WISE Uranium website[21]. According to the International Journal of Disaster Risk Reduction, in 2020 the number of catastrophic mine tailings dam failures was increasing globally[22]. One of the most high profile failures in recent history was the Brumadinho Failure in Brazil, which killed over 300 people living in villages downstream of the TSF. Failures like these happen only with aqueous tailings facilities rather than the better practice of filtered tailings facilities. With filtered tailings — often called "dry stack" despite the fact that they contain some moisture — tailings from the mill are dewatered first before being sent to the tailings facility. Instead of a slurry pipeline, tailings are usually sent via a conveyor belt to the waste facility, where they are not held back by a dam and thereby pose little risk of catastrophic failure. They also use, on average, less than half the amount of water of aqueous tailings storage.

21 https://www.wise-uranium.org/mdaf.html
22 https://www.sciencedirect.com/science/article/pii/S2212420919306648

Water Consumption, Mine Dewatering and Pit Lakes:

Hardrock mines use enormous amounts of water for milling and dust suppression during the life of the mine, and many will continue to "use" water in perpetuity after closure due to evaporative loss from the surface of pit lakes. Much of the consumptive loss (net loss) during the life of mine is associated with steam releases at the mill and evaporative loss from the surface of aqueous tailings facilities and/or other liquid waste impoundments that use evaporation to turn liquid waste streams into solid waste for proper land-based disposal. Dust suppression is also a large consumptive water use.

Because a future mine would likely primarily be utilizing heap leaching, thereby largely avoiding enclosed milling circuits and also avoiding, or significantly reducing, tailings impoundments, there is considerably less water consumption than at other types of gold mines. However, given the scale of heap leach facilities constantly spraying a dilute sodium cyanide solution which contains mostly water by volume, there is still evaporative loss from this system. Heap leach mines also require large volumes of water in order to rinse the heaps before they are decommissioned. For example, upon decommissioning a 150 million ton heap leach facility at the Fort Knox Gold Mine in Alaska, it is estimated that 1.8 million liters per hour will be required for 200 days (see footnote 20, page 10). This equates to approximately 2.3 billion gallons, or about 7,000 acre-feet. An average American family of four uses about half an acre foot per year.

Below are some examples of water consumption rates at gold heap leaches from a 2012 USGS report[23]. The table below shows only the water used at the heap leach itself, not at the mine as a whole. Other uses will include water for dust suppression and potable water for mine buildings (offices, maintenance garages, etc), though it's likely that the main consumptive use will be to operate the heaps. Note that large volumes are also needed to commence leaching initially. The table below is selected as a middle of the road scenario at 10 liters solution per hour per cubic meter of ore. It shows that a 10 million ton heap will require approximately 2.3 billion gallons during the first year, and will circulate approximately 264,000 gallons of water per hour after that. Using a 7% annual loss from evaporation and other factors, this amounts to 166 million gallons of consumptive use per year during normal leaching operations.

All open pits that exist below the water table require dewatering during the life of the mine, and will eventually refill with water once mining operations cease. The depth to groundwater at the Mojave Project where an open pit may one day be cited, as well as the ultimate depth of the mine pit, will determine the extent of hydrologic impact.

Water pumped from a sump point at the bottom of an open pit is usually sent to the mill to be treated and used for mining operations, rather than simply discharged to the surface. It is unlikely that water pumped by pit dewatering (and/or the dewatering of underground workings) would be enough to meet the overall demands of the mine given that very few mines

Table 2. Estimated process water and makeup water requirements for modeled gold heap-leach operations at selected annual capacities with an application rate of 10 liters per square meter per hour. All estimates are rounded to two significant digits.

Volume of ore on heap (metric tons)[1]	Square meters of surface area (with 10-meter lifts) under constant leach	Volume of leachate applied in 1 hour (liters)	Volume of leachate applied in 1 year (billion liters)[2]	Annual makeup water requirement at 5 percent of applied solution (billion liters)[2]	Annual makeup water requirement at 7 percent of applied solution (billion liters)[2]	Annual makeup water requirement at 10 percent of applied solution (billion liters)[2]
500,000	5,100	51,000	0.45	0.02	0.03	0.05
1,000,000	10,000	100,000	0.90	0.05	0.06	0.09
5,000,000	51,000	510,000	4.5	0.23	0.32	0.45
10,000,000	100,000	1,000,000	9	0.45	0.63	0.9
15,000,000	150,000	1,500,000	14	0.68	0.95	1.4
20,000,000	210,000	2,100,000	18	0.90	1.3	1.8
40,000,000	410,000	4,100,000	36	1.8	2.5	3.6

[1]Estimated surface area based on 1.6 metric tons per cubic meter (dry weight). Assumes constant rate of ore replacement.

[2]Assumes facility is 100 percent available year round (365 days per year, 24 hours per day). Leach facilities, however, typically operate at 95 to 98 percent availability.

23 https://pubs.usgs.gov/of/2012/1085/pdf/ofr2012-1085_v1-1.pdf

in arid environments have been able to operate solely on mine dewatering water. However, at the Cortez mining operations southwest of the Carlin Trend, mine dewatering has resulted in a 70% surplus of water, which is either sold to farms or placed back into the surrounding aquifer via Rapid Infiltration Basins. This is due to the fact that the groundwater is relatively shallow and has a high infiltration rate into mine workings. But Conglomerate Mesa is not located at or near a valley bottom and therefore likely has a greater depth to groundwater. It is outside the scope of work of this report to characterize the hydrogeology of the Conglomerate Mesa region, but such studies combined with a conceptual mine plan will help determine whether a future mine would be able to operate solely on dewatering water, and to what extent.

It's also important to note that during initial mine construction, all water demands must be met by obtaining water from other sources and/or by drilling freshwater supply wells, as no pit will exist yet to draw infiltrating water from. In the Los Angeles Times article cited above, when asked "Where would a full-blown mine on the mesa get its water from?" K2 officials 'sheepishly' responded: "That's a darn good question." Nevada regulations require mining companies to have water rights for consumptive use, and that surplus water must be returned to the basin of origin.

There are several environmental considerations with pit lakes related to water quality and quantity post closure. California currently has a law requiring the backfilling of open pits, which would eliminate a pit lake, though this law may not always be in effect. Further, the majority of the material placed into a pit at Conglomerate Mesa would be spent heap leach ore and may pose serious groundwater contamination problems and/or pit lake water quality problems. It also requires enormous amounts of energy to move the material back into the pit.

- Pit lakes pull groundwater from their surroundings. Prior to mining, there was rock and soil, which contains only minimum amounts of water in the soil and rock pore space. When mining ends and the pit lake fills, it becomes a lake which is 100% water. This water comes primarily from the surrounding groundwater and tends to exacerbate the "cone of depression" as it forms (the cone of depression already would exist as a result of pit dewatering.) This lowers the depth to groundwater within a certain radius of the pit, or, if a preferential pathway exists in the local hydrogeology, groundwater further away can also be impacted.
- Pit lakes are usually terminal water basins (in rare cases they may be flow-through pit lakes), meaning that contaminants remain infiltrating into the lake — whether natural or human caused — while water continually evaporates, resulting in "evapoconcentration" of those contaminants. While not all closed Nevada mines have severe pit lake water quality issues, some do, including at the Lone Tree Mine where water became extremely acidic and required extensive remediation[24].
- The evaporation from the surface of a pit lake in perpetuity in hot desert environments like Conglomerate Mesa is not trivial. On the high end, using an evaporation rate of 96 inches per year for the Mojave Desert[25], a pit lake covering 500 acres, for example, will result in a net groundwater loss of 4,000 acre-feet (1.3 billion gallons) per year, and will do so in perpetuity. However, rates may be lower when compared to the 400 acre Lone Tree Mine pit Lake in north-central Nevada, which has been estimated at 1,561 acre-feet per year.
- The impacts of pit lakes reducing flows in a nearby river system have been documented in Nevada[26, 27].

24 https://gbrw.org/our-work/mining-pit-lakes/
25 https://agriculture.borax.com/blog/august-2017/using-less-water-environmental-conservation-in-th
26 https://planevada.org/issue/mining/2406/
27 https://nevadanewsgroup.com/Content/PERSHING-COUNTY-NEWS-/NEWS-Pershing-County/Article/Pit- lakes-impact-river-according-to-tudy/30/161/28736

Mercury Pollution and Management:

Gold mines in Nevada, including on the Carlin Trend, produce large amounts of mercury as a byproduct of gold production, both through heap leaching and mill processing. This differs from the old days, in which imported mercury was used as a gold extraction amalgam (gold particles bind to mercury) and created widespread and serious contamination throughout the western US which still persists in the environment today.

Reported volumes of captured liquid byproduct mercury in Nevada have reached 237,708 pounds for a single mine in a single year, at the Paradise Peak Mine (Mercury and Modern Gold Mining in Nevada, p. 9)[28]. Many other mines also report volumes in the tens to hundreds of thousands of pounds per year, but there is evidence that some of these mines have underreported their volumes.[29] Gold mines produce so much mercury that the world now has a net surplus of the liquid metal.

In Nevada's modern mines, mercury originates from the rock at the mine, rather than being imported for milling purposes. Most of this mercury is captured within mill circuits, but releases in the form of air emissions still occur. It is estimated that Nevada precious metal mines currently remove approximately 95%[30] of mercury from milling circuits. However, in 2007 – the second year in which air emissions were measured (rather than estimated) in the state – 4,800 lbs were released into the air. Prior to 2006 and the era of mercury air regulation, these numbers were likely far higher.

Mercury is an extremely powerful neurotoxin in the form of methylmercury — the form it generally ultimately takes after being released into the environment. Once released into the air, it redeposits into the environment and bioaccumulates in the food chain, particularly in fish and other aquatic species. When people — especially children and pregnant women — eat these species, or are otherwise exposed to mercury at industrial sites, they can succumb to acute and chronic mercury poisoning and even brain damage and death.

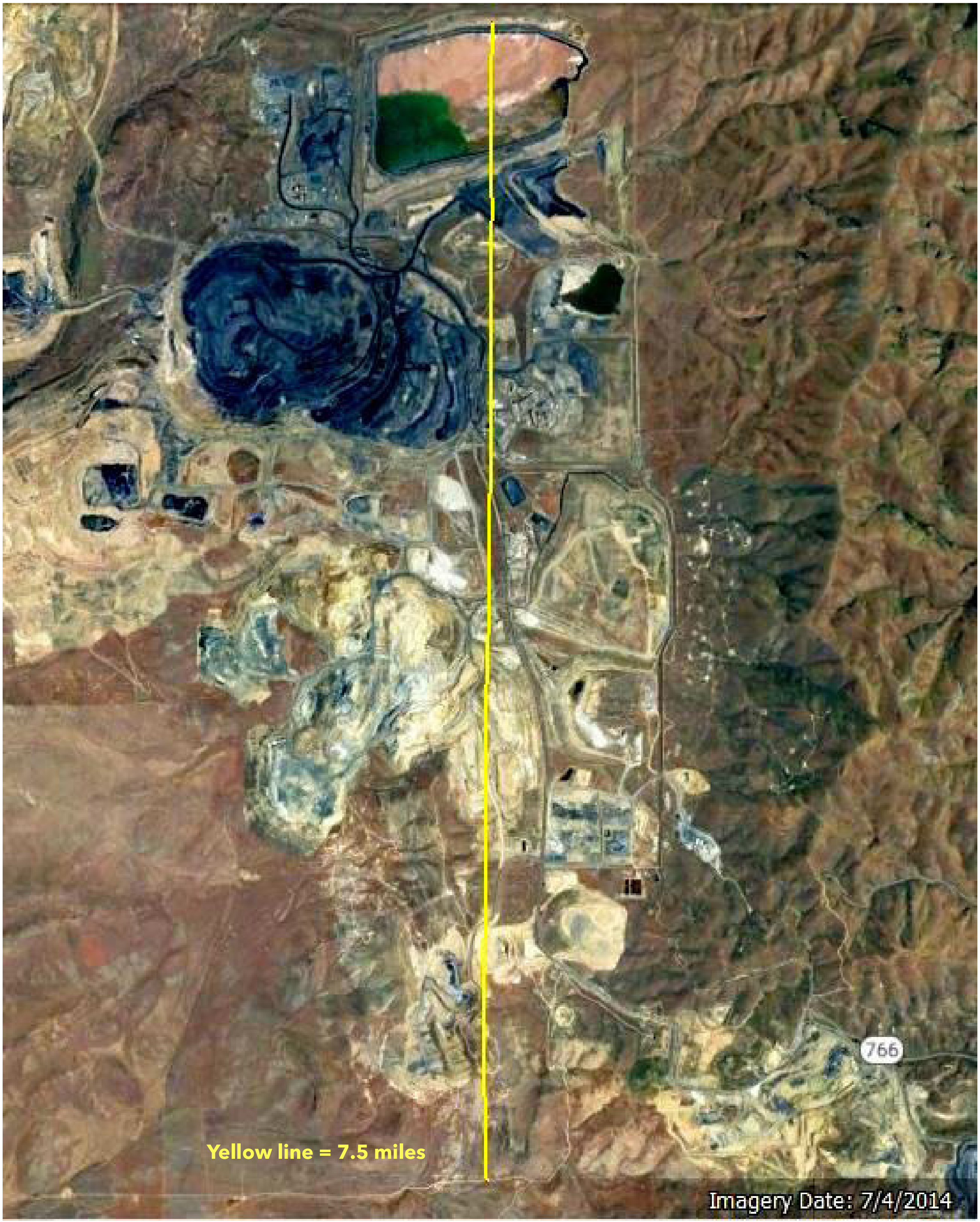
The US Environmental Protection Agency enacted rules in 2010 regulating mercury air emissions from gold mines, following the state of Nevada's 2006 rule.[31] These rules require most airborne mercury to be captured and collected. The mercury is then sent to approved repositories to be stored indefinitely. However, not all mercury is captured, and these rules do not apply to potential fugitive air emissions sources such as tailings ponds and waste rock piles, nor do they apply to ways in which mercury can directly enter ground and surface water from mining wastes, although this aspect of modern gold mining is less well understood.

Potential Size of a Future Mine:

To evaluate the potential size of a future mine on Conglomerate Mesa, we refer to a 2014 USGS study: Sediment-Hosted Gold Deposits of the World—Database and Grade and Tonnage Models[32]. This paper created a Carlin subtype model using 88 deposits with reliable data and indicates that the average amount of contained ore per deposit is 7.1 million tons at an average grade of 2 grams gold per ton of ore. This does not include waste rock, which can substantially add to the overall amount of waste material.

It's important to note that the number of 7.1 million tons is an average for specific deposits, not the total of adjacent deposits. On the Carlin Trend, many deposits are located in three major clusters, with each one containing many mine workings and sharing infrastructure. Many of these mines have also been merged by their respective owners, Barrick and Newmont Corporations, into a joint venture called Nevada Gold Mines.

28 https://www.researchgate.net/publication/228635551_Mercury_and_Modern_Gold_Mining_in_Nevada
29 https://41p14t2a856b1gs8ii2wv4k4-wpengine.netdna-ssl.com/assets/uploads/archive/files/publications/Me rcury_Report_Underreporting.pdf
30 https://ndep.nv.gov/air/nevada-mercury-control-program-nmcp/reporting#
31 https://earthworks.org/issues/mercury_air_emissions_from_gold_mines/
32 https://pubs.usgs.gov/of/2014/1074/pdf/ofr2014-1074.pdf



Above/Right: Google Earth images of the major mine complexes of the Carlin Trend, from top to bottom (north to south): Goldstrike complex, Gold Quarry complex, and Rain/Emigrant complex. Scale of the Goldstrike Complex: the yellow line is a distance measurement showing the complex is approximately 7.5 miles long from north to south.

It is outside the scope this report to document the tonnage of already-mined and existing reserves/resources of every deposit within the Carlin Trend, but for example, the Goldstrike Complex as of 2018 contains 74 million tons of proven and probable mineral reserves (ore), in addition to what's been mined already (Technical Report, p.11)[33].

Economies of scale certainly apply to the Carlin Trend. While an average SHOG deposit of 7.1 million tons would be approximately 1/10th of the remaining proven and probable mineral reserves at the Goldstrike Complex, it's unclear whether a single economically viable yet low grade deposit would be developed in an area such as Conglomerate Mesa, which has no existing mining infrastructure. More probably, either a single larger deposit or a combination of smaller ones would need to be found in order for investors to back a future project given high capital costs in the absence of very high gold ore grades.

Energy Requirements of Gold Mines:

A main distinction regarding energy consumption at gold mines is the percentage of ore that is heap leached versus thermally oxidized in a mill, with the latter being several times more energy intensive.

In the Carlin Complex Technical Report from 2018[34], a breakdown is provided (p. 277) showing key energy and materials inputs for mills 5 and 6. Mill 5 uses 30 kilowatt-hours of electricity per ton of ore, while mill six uses 95 kilowatt-hours per ton, for an average of 62.5 kw/hrs per ton. Mill 6 also requires 12,000 BTU's of propane/natural gas per ton.

Under this consumption scenario, an average size mine milling 10,000 tons of ore per day could expect to use about 625,000 kw/hrs per day and 228 million kw/hrs per year. Using World Bank data showing 13,000 kilowatt-hours average annual American per capita electricity consumption for recent years, a 10,000 ton per day operation using similar milling as the Carlin Complex would use as much electricity as about 17,500 people. Gas consumption would be about 120 million BTU's per day, or 43.8 billion BTU's annually.

Most mines use diesel fuel to haul ore using trucks that can carry hundreds of tons. Many factors determine how much fuel is consumed, but using an average of 1.5 gallons per ton, a 10,000 ton per day operation would consume 15,000 gallons of diesel fuel per day, or 5.4 million gallons per year.

33 https://www.miningnewsfeed.com/reports/Goldstrike_Technical_Report_03222019.pdf
34 https://minedocs.com/20/Carlin_Operations-12312018-TR.pdf

Environmental Performance Case References of Carlin Type Mines

Below is a brief summary of Carlin-type mines both within the Carlin Trend and in nearby areas where perpetual water treatment will be needed or likely needed.

This list is not comprehensive, but it includes notable cases discovered during research for this report. Some of this data was sourced from the Carlin Complex Technical Report, December, 2019[35].

Rain Mine:

Located on the Carlin Trend and closed in 2004, the Rain Mine features an open pit and utilized heap leaching. Water treatment is currently occuring at the site, and will likely be needed in perpetuity[36]. A primary source of acid mine drainage is occuring at the North Waste Rock Dump Facility[37].

Lone Tree Mine:

Located about 70 miles west of Carlin, the Lone Tree Mine is a sediment hosted gold deposit[38].

Pit lake water quality models developed prior to mine cessation indicated that the future pit lake would stabilize at slightly alkaline conditions (pH 9.1) and therefore acid drainage would not develop. Water quality early in the infiltration of the pit lake did indeed test at near-neutral pH, however by December 2007, pH dropped to below 5, and by early 2008 pit lake water quality degraded dramatically, falling to between 3 and 3.5 and becoming highly acidic[39].

This extraordinarily abrupt change may have been attributed or partially attributed to partial pit backfilling of sulphidic waste material, despite being segregated and buffered by non acid-generating mine waste during reclamation. Over the years since closure, many attempts have been made to combat the acidic and metal-rich pit lake. Ongoing modeling and the addition of various types of acid neutralizing agents have helped to correct the problems, yet it is believed that without regular maintenance and expense, the lake would remain toxic for hundreds of years[40]. This is particularly worrisome because

35 http://q4live.s22.clientfiles.s3-website-us-east-1.amazonaws.com/788666289/files/technical-reports/Carlin-Complex-Technical-Report-March2020.pdf
36 https://planevada.org/issue/mining/26704/
37 https://www.blm.gov/press-release/blm-seeks-comments-rain-mine-environmental-assessment
38 https://miningdataonline.com/property/2987/Lone-Tree-Mine.aspx
39 https://www.imwa.info/docs/imwa_2017/IMWA2017_Croall_495.pdf
40 https://gbrw.org/our-work/mining-pit-lakes/

the pit lake is only one mile from the Humboldt River, perhaps the most important river in Northern Nevada and a key agricultural and civil water supply.

The mine also shows that water quality prediction is often highly inaccurate, even in modern times — an inconvenient fact highlighted in an extensive report by Kuipers and Maest, 2006[41].

Gold Quarry Mine Waste Rock Dump Geotechnical Failure:

As covered earlier in this report, in 2005, millions of tons of waste rock detached from a waste rock dump at this mine on the Carlin Trend, burying a state highway in debris and almost reaching a creek. We have not concluded whether the Gold Quarry Mine will require perpetual water treatment.

Jerritt Canyon Mine Groundwater Contamination and Mercury Pollution:

The Jerritt Canyon Mine is an operating Carlin type deposit, yet lies outside the Carlin Trend north of Elko. In 2008, the state of Nevada ordered the mine to shut down its mill after a year-long investigation determined that mercury emissions exceeded allowable levels and two prior state orders to correct the problem had failed to do so[42]. The company had also been sued by civic organizations for failing to comply with requirements set forth by the US EPA's Toxic Release Inventory and failing to comply with the Emergency Planning and Community Right to Know Act[43]. Organizations in Idaho were concerned that these emissions contributed to elevated levels of mercury in lakes and rivers in southern Idaho. The mine was allowed to reopen in 2009[44].

The mine's Tailing Storage Facility #1 — a conventional aqueous design containing between 500 and 800 million gallons of wastewater — was built in 1980 and decommissioned in 2013. As early as 1987, it became apparent that a groundwater contamination plume had developed underneath the TSF, and extensive efforts began to correct the problem[45]. Dozens of pumpback, freshwater infiltration, and monitoring wells were installed surrounding TSF1 in an attempt to manage and mitigate the seepage plume, which was high in chloride concentrations and total dissolved solids. The TSF eventually was drained of all the wastewater.

Water treatment remains ongoing at Jerritt Canyon. We cannot conclude whether or for how long water treatment may be needed post closure, but given the history of groundwater contamination and the nature of current treatment obligations as outlined in the most recent Technical Report (p. 219)[46], it is likely.

41 https://earthworks.org/publications/comparison_of_predicted_and_actual_water_quality_at_hardrock_min es/
42 https://www.nbcnews.com/id/wbna23614296
43 https://earthworks.org/publications/60_day_notice_to_sue_queenstake_resources/
44 https://thisisreno.com/2009/10/jerritt-canyon-mine-to-be-allowed-to-restart-after-court-filing/
45 https://www.srk.com/en/publications/jerritt-canyon-tailings-storage-facility
46 https://www.firstmajestic.com/_resources/reports/SLR-First-Majestic-Jerritt-Canyon-NI-43-101-Report-FIN AL-30-Apr-2021.pdf

About the Author, Commissioning Organization, and Peer Reviewers

This report was commissioned by Friends of the Inyo, an environmental non-profit organization based in Bishop, California. Friends of the Inyo works to protect and care for the public lands of the Eastern Sierra from Death Valley to the eastern slopes of Yosemite. Bryan Hatchell is the former Desert Policy Associate of Friends of the Inyo. Bryan's work with FOI focused on the preservation of Conglomerate Mesa, traditional homelands of the Paiute-Shoshone and the Timbisha Shoshone Tribal Nations, from all potential mining and associated exploration activities.

Pete Dronkers has been analyzing the environmental impact and long term risk associated with the hardrock mining and oil and gas sectors since 2010, primarily in Alaska, Nevada, Colorado, Arizona and New Mexico. Formerly employed by Environment Nevada, The Northern Alaska Environmental Center, and Earthworks, his mining work has focused on the permitting process, including the National Environmental Policy Act, as well as mining law reform at the state and federal levels. He has worked with expert geochemists, hydrologists, geophysicists and environmental toxicologists to file technical comments, appeals, and develop models related to environmental performance, primarily at proposed mine sites.

Bryan Hatchell is the Desert Policy Associate with Friends of the Inyo, an environmental non-profit organization based in Bishop, California. Friends of the Inyo works to preserve, steward and promote the exploration of public lands from Death Valley to the easter slopes of Yosemite. Bryan's work focuses on the preservation of Conglomerate Mesa, traditional homelands of the Paiute-Shoshone and the Timbisha Shoshone Tribal Nations, from all potential mining and associated exploration activities.

This report was peer reviewed by Dr. Glenn Miller and John Hadder: John E. Hadder is the Executive Director for Great Basin Research Watch, and teaches chemistry and math at Truckee Meadows Community College. His academic background is in physical chemistry with a MS from the University of Cincinnati, and continued graduate studies at the University of Nevada, Reno in the area of Theoretical Chemistry. He has served on the board of directors for the Great Basin Community Food Cooperative, Alliance for Nuclear Accountability, and currently serves on the Steering Committee for the Western Action Mining Network.

Glenn Miller, Ph.D, is a retired professor of Environmental Science at the University of Nevada, Reno. His background is primarily as an environmental chemist and has worked on the environmental impacts of mining, particularly related to water quality, mine closure and pit lakes. He has also served on the boards of Earthworks, Environmental Law Alliance Worldwide and the Center for Science in Public Participation.

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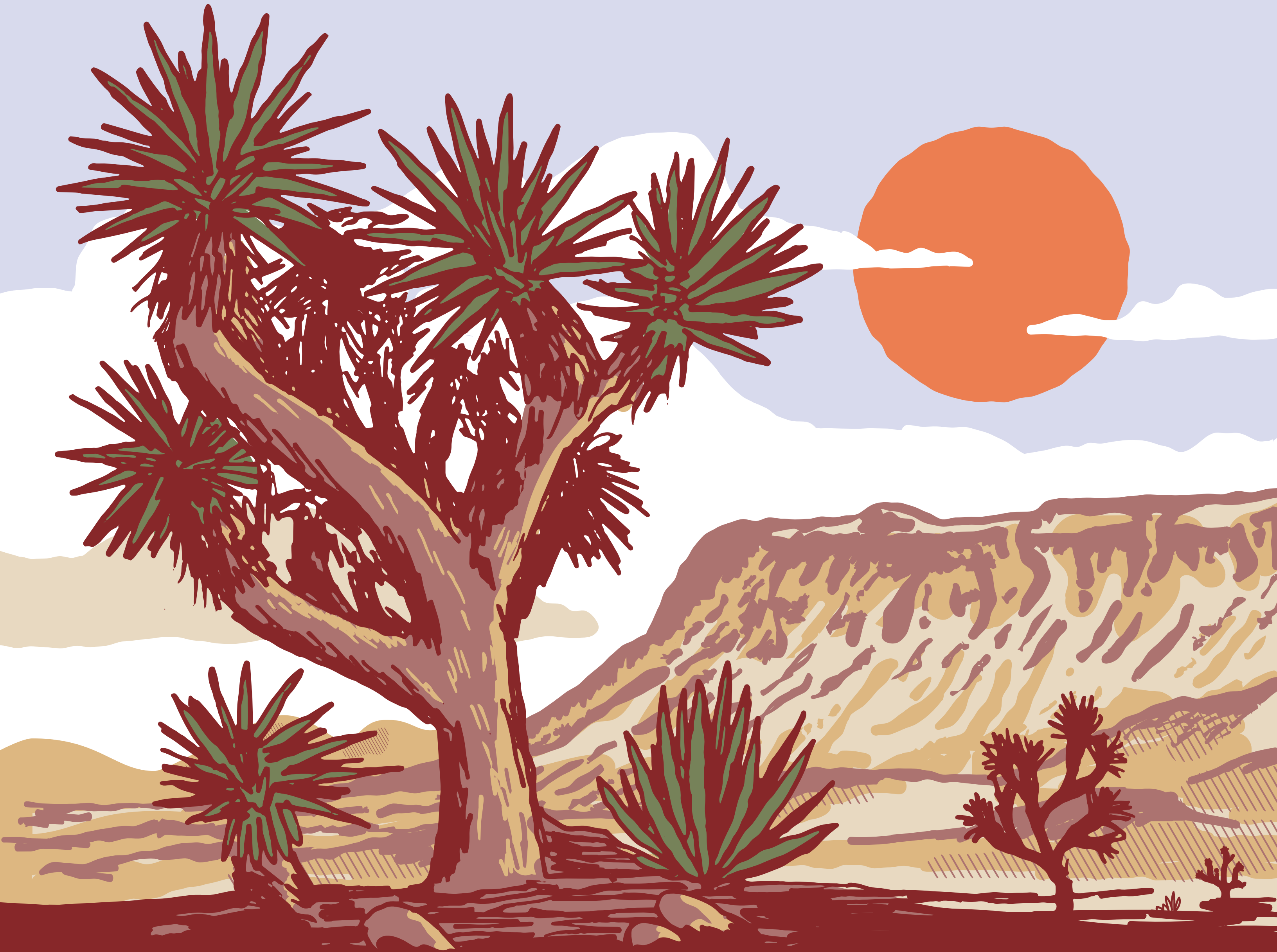

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