

U.S. EPA Region 8

Underground Injection Control Program

AQUIFER EXEMPTION RECORD OF DECISION

This Record of Decision provides EPA's aquifer exemption (AE) decision, background information concerning the AE request, and the basis for the AE decision.

Primacy Agency: Utah Department of Environmental Quality (UDEQ) 1422 Program

Date of Aquifer Exemption Request: June 18, 2024

Substantial or Non-Substantial Program Revision: Non-Substantial

This AE decision is a non-substantial program revision because it is associated with the issuance of a site-specific Class III UIC permit action, not a state-wide programmatic change or a revision with implications for the national UIC program. This decision is consistent with the EPA's "Groundwater for Review and Approval of State Underground Injection Control (UIC) Programs and Revisions to Approved State Programs" (Guidance 34). This document explains that the determination as to whether a program revision is substantial or non-substantial is made on a case-by-case basis, and with the exception of AEs associated with certain Class I wells or exemptions not related to action on a permit, AE requests are typically treated as non-substantial program revisions.

Operator: Lisbon Valley Mining Company, LLC (LVMC)

P.O. Box 400

Moab, UT 84532

Well Class/Type: Class III Copper ISR

Project Name: Lisbon Valley Copper Mine Project, GTO In-Situ Recovery (ISR) Wellfield

Well/Project Permit Number: UIC Permit Number: UTU-37-AP-5D5F693

Well/Project Location: GTO ISR Wellfield AE Area

SW¼ Sec 36 T30S, R25E

NW¼ SE¼ Sec 36 T30S, R25E

S½ SE¼ Sec 36 T30S, R25E

NE¼ Sec 1 T31S, R25E

NE¼ NW¼ Sec 1 T31S, R25E

NE¼ SE¼ Sec 1 T31S, R25E

SW1/4 NW1/4 Sec 6 T31S, R26E

NE1/4 SW1/4 Sec 6 T31S, R26E, Salt Lake Principal Meridian.

County: San Juan

State: Utah

BACKGROUND

LVMC currently operates an existing open pit and heap leach copper mine in San Juan County, Utah (Figure 1). The current Lisbon Valley mine has been using open pit and heap leaching methods for over a decade. The mine has recovered approximately 65–75% of available copper using these methods.

LVMC proposes to extend the life of the Lisbon Valley mine by adopting ISR technology. ISR methods involve injecting lixiviant into Class III injection wells to liberate copper from the ore bodies. Three copper deposits have been identified for ISR within the project area. These are the GTO, Lone Wolf, and Flying Diamond deposits (Figure 1). LVMC's proposal requires a Class III Area Permit from the UDEQ. LVMC also requested an AE as part of its application for the UIC permit (LVMC, 2019). An AE is needed to inject into an aquifer that is an underground source of drinking water (USDW). In June 2022, UDEQ submitted a request to the EPA to exempt a portion of the Burro Canyon aquifer in Lower Lisbon Valley (LLV) that encompasses the entire project area. In a letter dated April 5, 2024, the EPA responded that LVMC had not yet demonstrated that the threshold for commercially producible ore in accordance with EPA's criteria for AEs at 40 C.F.R. § 146.4(b)(1) had been met for the Lone Wolf and Flying Diamond deposits, but the EPA could continue to review the proposed smaller AE area for the GTO ore deposit provided that a revised package with information concerning only the GTO area was submitted. The UDEQ Director issued a UIC Class III copper ISR permit, effective July 6, 2022 (DWQ, 2020) and revised its original AE request on June 18, 2024, to limit the AE to the GTO area. The area described as the GTO, is an approximation of the GTO exemption area relative to the initial AE request.

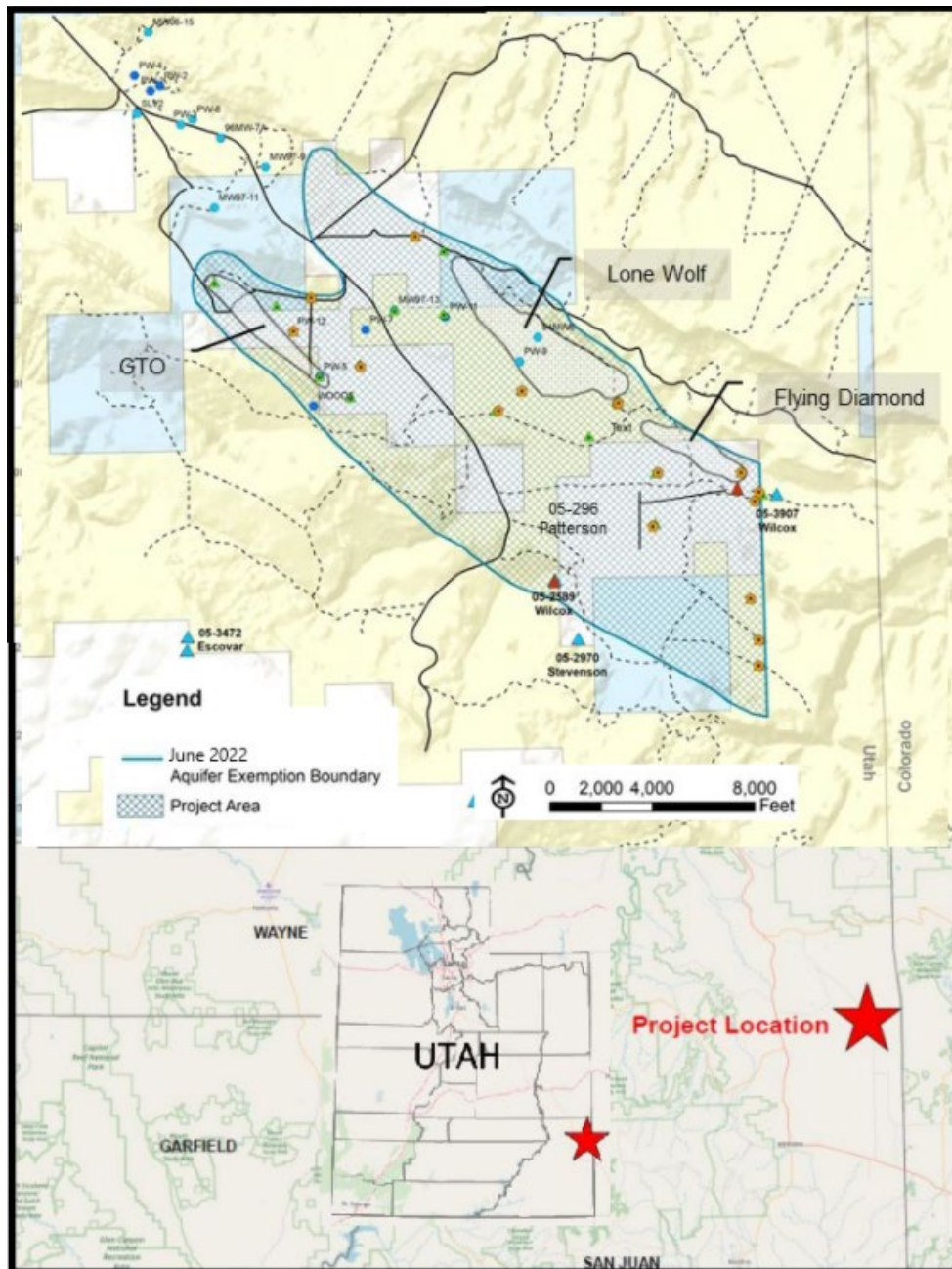


Figure 1. Location of the Lisbon Valley Mining Company Class III Permit Area

DESCRIPTION OF PROPOSED AQUIFER EXEMPTION

Aquifer(s) to be Exempted: Burro Canyon Formation Bed 15 (Kbc Bed 15)

As shown in Figure 2, Kbc Bed 15 is a bedding layer of the Burro Canyon Formation, which in turn is part of the Burro Canyon aquifer.

Kbc Bed 15 is described as buff to bleached white fine to medium-grained sandstone with interbedded chert pebble conglomerate. Within Lisbon Valley, Kbc Bed 15 is bleached. Kbc Bed 15

typically has interbedded green shale beds originating from altered volcanic ash, has weak to strong silicification throughout Lisbon Valley and contains ore grade copper mineralization.

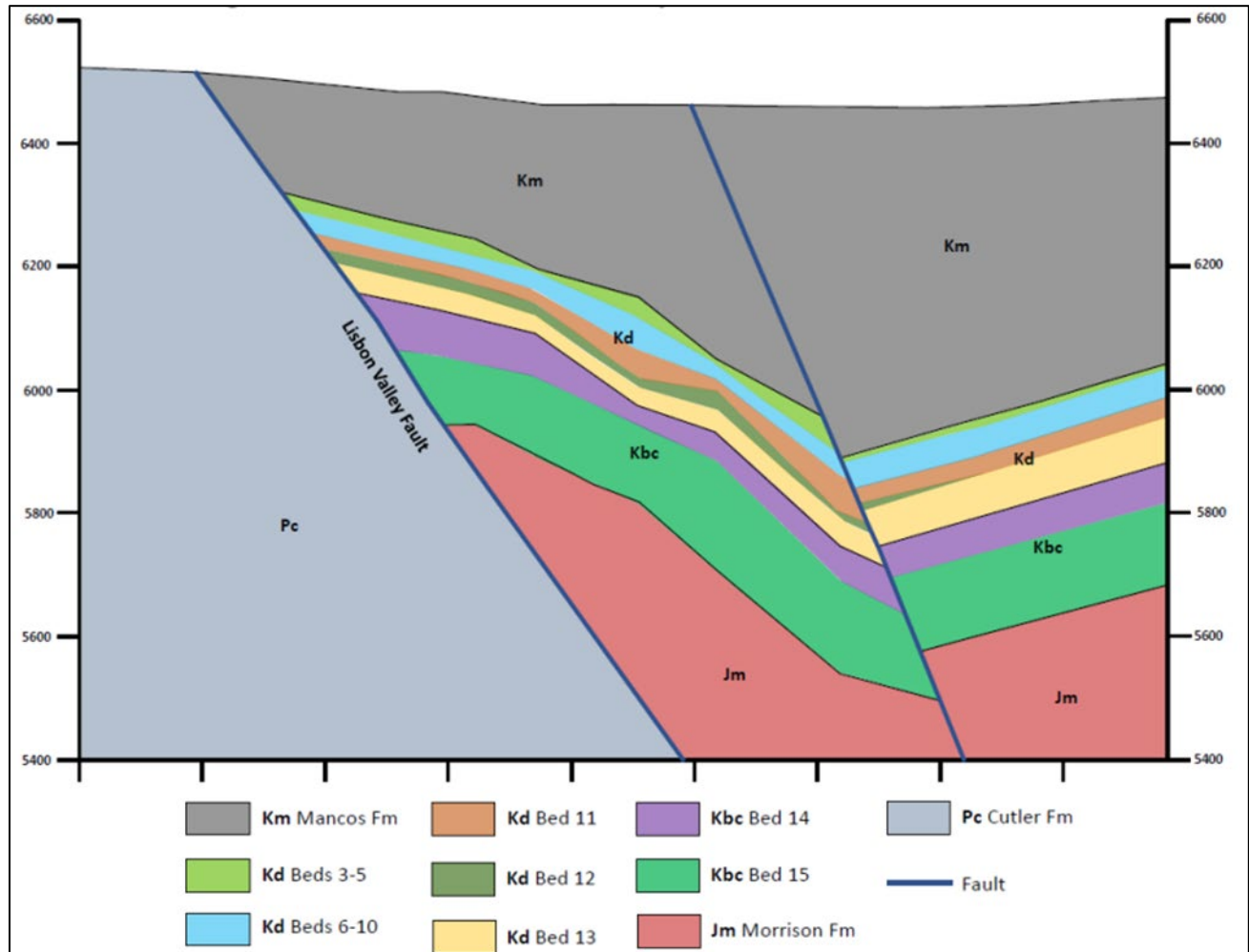
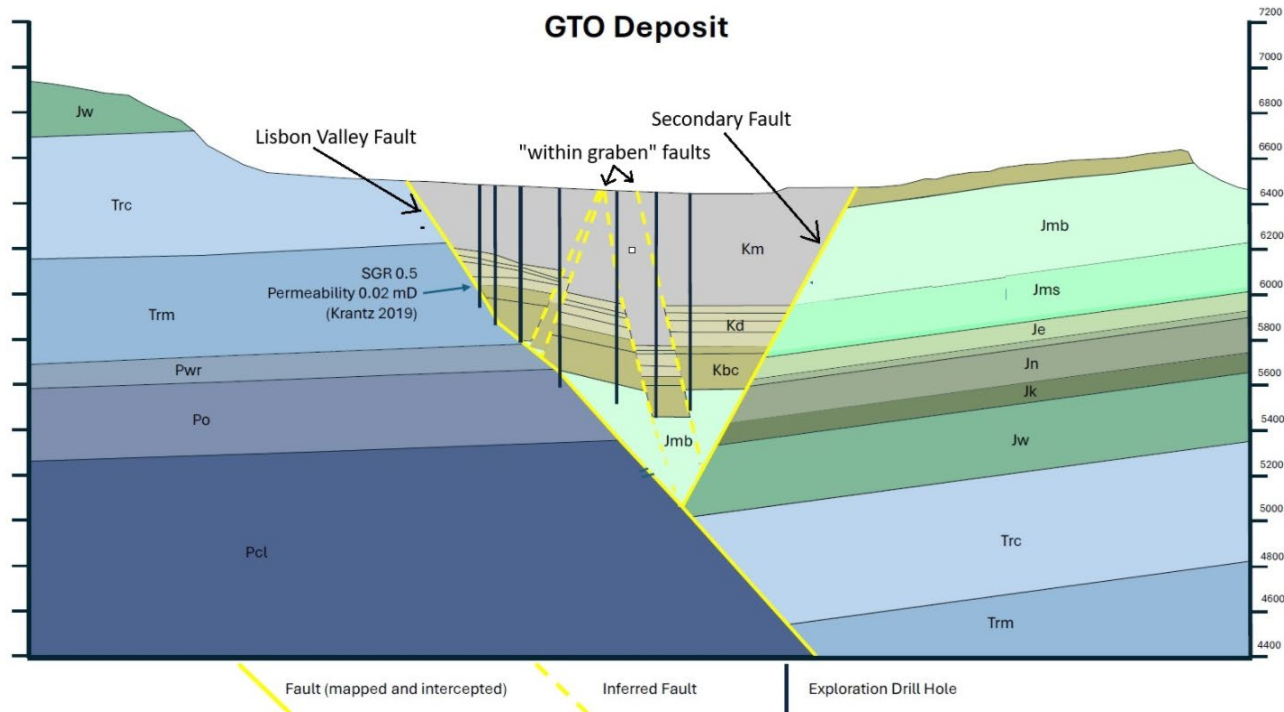


Figure 2 Generalized Burro Canyon Aquifer Cross-Section with Bed Delineation. The Burro Canyon aquifer is composed of the Dakota Sandstone (Kd) and Burro Canyon Formation (Kbc). Kbc is further separated into Bed 14 and Bed 15.

The cross-sections in Figures 2 and 3 are provided to define the formations and associated beds in the GTO that will be used throughout this document. The GTO is situated in a graben, a type of valley formed by the Earth's crust sinking between faults. Due to the complexity of the GTO geology, thicknesses and depths and even the presence of these units can vary greatly across the GTO.



Description of Geologic Units

Qa	Quaternary Alluvium: Sand, silt, clay and gravel, 0 – 40 ft thick.	Js	Summerville Formation: Red-brown, finely bedded siltstone. 20 ft thick	Trc	Chinle Formation: Inter-bedded sandstone, siltstone, conglomerate and mudstone, 540 ft thick.
Km	Mancos Shale: Thinly laminated shale to silty limestone, 0 – 150 ft thick.	Je	Entrada Sandstone: Fine grained, cross-bedded sandstone, 120 ft thick.	Trm	Moenkopi Formation: Laminated to thinly bedded siltstone and sandstone, 450 ft thick.
Kd	Dakota Sandstone: Inter-bedded sandstone, shale and coal beds, 180 ft thick.	Jcd	Dewey Bridge Member of Carmel Formation: Fine grained sandstone to siltstone, 30 ft thick.	Pwr	White Rim Sandstone: Cross-bedded sandstone, 120 ft thick.
Kbc	Burro Canyon Formation: Silty limestone in upper bed, massive sandstone in lower bed, 200 ft thick.	Jn	Navajo Sandstone: Massive, cross-bedded eolian sandstone, 150 ft thick.	Po	Organ Rock Shale: Siltstone and sandy shale, 250 ft thick.
Jmb	Brushy Basin Member of Morrison Formation: Variegated siltstone, mudstone and clay, 410' ft thick.	Jk	Kayenta Formation: Inter-bedded sandstone and siltstone, 90 ft thick.	Pcl	Lower Cutler Formation: Interbedded sandstone, siltstone and cherty limestone. 1000-2000 ft thick.
Jms	Salt Wash Member of Morrison Formation: Inter-bedded sandstone and siltstone, 210 ft thick.	Jw	Wingate Sandstone: Massive, cross-bedded eolian sandstone, 300 ft thick.		

Figure 3 Geological Units and Structure in the GTO

Water Quality – Total Dissolved Solids (TDS): 610–1,290 mg/L based on samples collected from monitoring wells PW-5, PW-6, and PW-12 from 2004 through 2018. (LVMC, 2019; Appendix J, Water Quality Data)

Depth and Thickness of Exempted Aquifer: The Kbc Bed 15 occurs at different elevations at the location of the GTO ore deposit due to fault movement as shown in Figures 2 and 3. Figure 4 provides the location of wells used to estimate the thickness of Kbc Bed 15. PW-12 is located near the deepest part of the GTO graben.

Well	Kbc Bed 15 Top (feet below ground surface) [†]	Kbc Bed 15 Bottom (feet below ground surface) [†]	Thickness (feet)
PW-5	540	580	40
PW-6	545	620	75
PW-12	850 ^{††}	1000 ^{††}	150

[†] Estimated from well logs. ^{††} LVMC, 2019; p. 182. ^{†††} BLM, 2015; p. 201 .

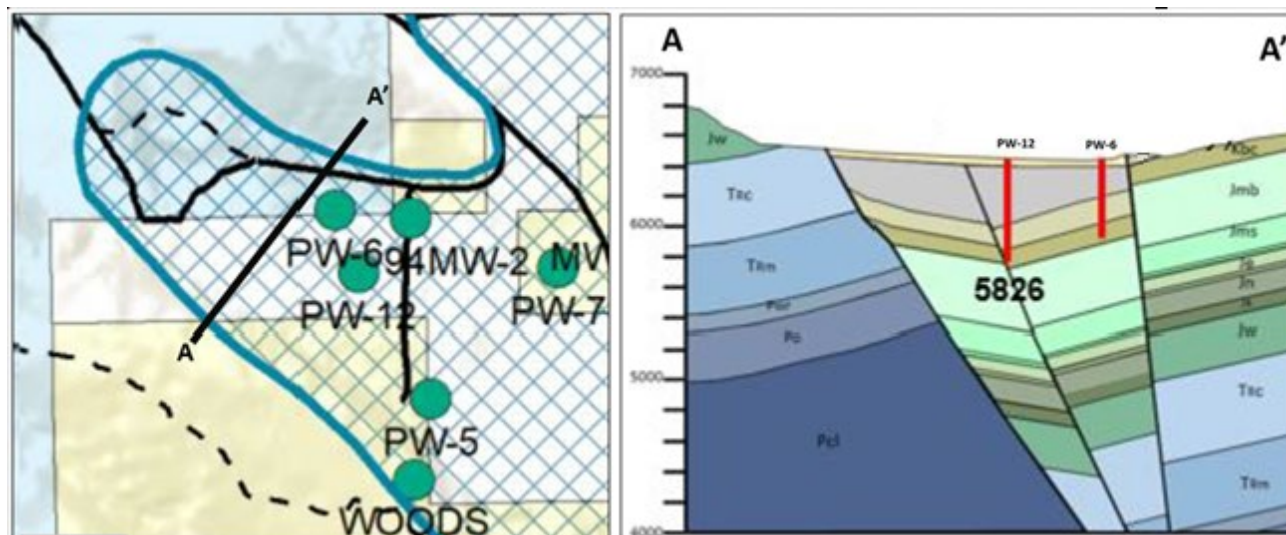


Figure 4. Well locations where the EPA estimated depth and thickness of the Burro Canyon Injection Zone Description of geologic units is shown in Figure 3.

Areal Extent of AE: Approximately 150 acres (0.23 square mile)

Figure 5 shows the approximate areal extent of the GTO AE boundary. It is described by the blue line circumscribing the copper mineralization shown in orange. The dotted line delineates LVMC's placement of the monitoring well ring (MWR) 300 feet away from the mineralized copper, where the monitoring wells are spaced 300 feet apart around the mineralized area.

Because Kbc Bed 15 is not present in the footwall of the Lisbon Valley Fault (Figures 2 and 3), the Lisbon Valley Fault serves as the AE boundary along the southwest edge of the GTO (Figure 5) where it intersects the top of Kbc Bed 15. Similarly, secondary faulting along a portion of the northeast side of the GTO has truncated Kbc Bed 15 and constitutes the AE boundary in this area. Elsewhere, the AE boundary has been calculated to be 69 feet from the MWR, such that should an excursion be detected at a monitoring well, there is sufficient time to implement corrective action measures to prevent the excursion from reaching the AE boundary. Where the AE boundary is defined by faulting, monitoring wells in the MWR will be completed in juxtaposed aquifers adjacent to the injection zone outside of the AE area.

The 69-foot value accounts for the distance (DT) an excursion could travel beyond the MWR before it is detected at a monitoring well, plus the effect of dispersion (DF):

Distance of AE boundary from MWR = DT + DF = 69 feet, where

DT is the furthest distance an excursion could travel before detection occurs between two monitoring wells spaced 300 feet apart = 35 feet.

DF is a dispersion factor to account for potential flowpath variation; calculated by multiplying the excursion travel distance of 335 feet (300 feet to MWR + 35 feet DT) by a coefficient of 0.1 (Gelhar, 1992) = 33.5 feet.

As depicted in the figures above, the GTO is a complex system due to faulting in the area and varies in depth and width laterally and longitudinally. The area exempted is described by the aquifer exemption boundary shown in Figure 5, where Kbc Bed 15 is present.

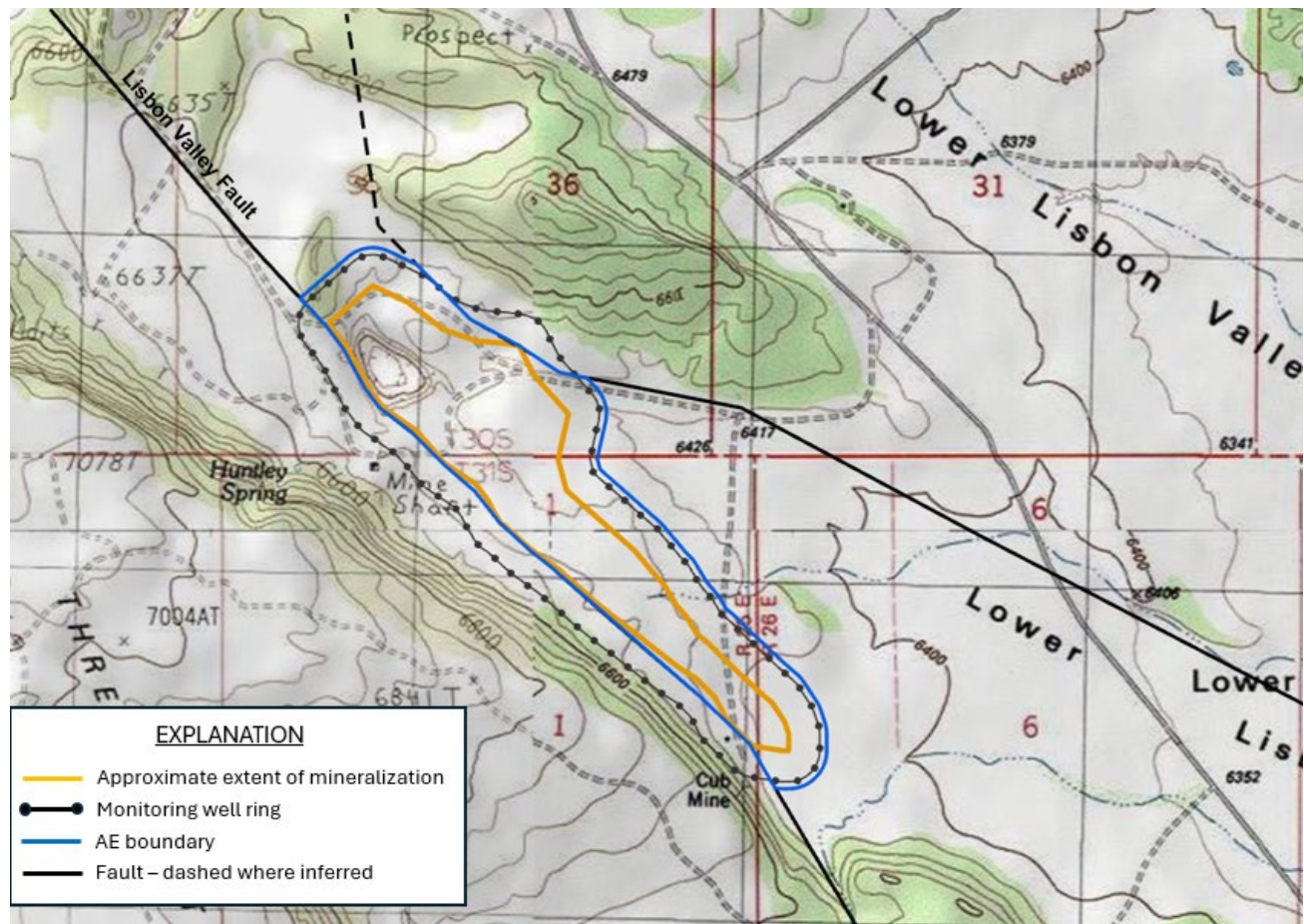


Figure 5. GTO Mineralization and Aquifer Exemption Boundary The black fault lines represent where the faults intersect the top of the Burro Canyon aquifer in the subsurface.

Confining Zones:

Upper Confining Zone: Burro Canyon Formation Bed 14 (Kbc Bed 14) forms the overlying confining zone above Kbc Bed 15 throughout the LLV. Kbc Bed 14 is composed of red, purple, and green shales, silty to sandy limestone and massive chert beds. At the location of the GTO deposit, Kbc Bed 14 ranges in thickness from 65 to 105 feet.

Well*	Kbc Bed 14 Top (feet below ground surface)†	Kbc Bed 14 Bottom (feet below ground surface)†	Thickness (feet)†
PW-5	475	540	65
PW-6	470	545	75
PW-12	745	850	105

† Estimated from well logs. *See Figure 4 for well locations.

Lower Confining Zone: The Morrison Formation Brushy Basin Member is the underlying confining zone beneath Kbc Bed 15 throughout the project area and ranges from 400 to 600 feet across the Lisbon Valley. PW-7 is the closest well to the GTO deposit that intersects the Morrison Brushy Basin Member, where the member occurs from 305 to 1,000 feet below ground surface. The Morrison Brushy Basin Member consists of laterally continuous silt and clay rich mudstones with discontinuous lenticular sandstones. At the location of the GTO deposit, the Morrison Brushy Basin Member is expected to be about 300 feet deeper than at PW-7 based on the depth to the bottom of Morrison monitoring wells at the GTO (LVMC, 2020; Table 12.1).

Well*	Brushy Basin Top (feet below ground surface)†	Brushy Basin Bottom (feet below ground surface)†	Thickness (feet)†
PW-7	305	1,000	695

† Estimated from well log. *See Figure 4 for location.

Injectate Characteristics: During mining, the injection fluids will include the copper leaching fluid, or lixiviant, consisting of groundwater pumped from the production zone and fortified with dilute sulfuric acid and oxygen. During the groundwater restoration phase, native groundwater or treated groundwater will be injected and recirculated throughout the wellfield area impacted by lixiviant.

Underground Sources of Drinking Water (USDWs)

Burro Canyon Aquifer – Together the Dakota Sandstone and Burro Canyon Formation form the Burro Canyon aquifer. The Dakota Sandstone (Kd) overlies Kbc Bed 15 and is hydraulically separated from it by Kbc Bed 14. The Dakota Sandstone is composed of brown and yellow sandstone and conglomerate and interbedded gray-black carbonaceous mudstone and local coal. The Dakota is a copper host in the Lisbon Valley area and is approximately 150 feet thick. The depth to the top of the Dakota ranges from land surface, where it crops out in the central and southeastern part of the LLV, to approximately 500 feet near the bounding faults of the LLV graben. Individual beds within the Dakota vary in thickness from 5 to 50 feet, with specific beds featuring coal, shale, siltstone, and conglomerate compositions. Notable beds include coal grading to carbonaceous shale or sandstone (5-20 feet thick), gray shale to siltstone (10 feet thick), shaley siltstone (35 feet thick), and medium-grained sandstone with chert pebble conglomerate (20-50 feet thick). Throughout the project area, the Dakota Sandstone is primarily unsaturated. The Water Quality Portal is a database that contains data supplied by the EPA and the U.S. Geological Survey (UDNR, 2025). Water-quality data from the Water Quality Portal for this area indicate that the TDS concentration for this aquifer ranges from 292 to 954 mg/L. Because the TDS values are below 10,000 mg/L, the Dakota Sandstone meets the definition of a USDW.

The Burro Canyon Formation is composed of brown-orange and gray sandstone and conglomerate. Thin beds of dense gray limestone and green-purple mudstone are also present. The thickness of

the Burro Canyon Formation is variable in the Lisbon Valley area, generally ranging from 150 to 300 feet because of an unconformity that defines the formation top. Within the GTO area, the Burro Canyon is estimated to be 470–745 deep (top of Kbc Bed 14) with a thickness of 105–255 feet (combined thickness of Kbc Beds 14 and 15). Because the TDS values are below 10,000 mg/L (610–1,290 mg/L), as noted above in the Water Quality section above), the Burro Canyon Formation meets the definition of USDW. However, in parts of the GTO it is not clear that the Burro Canyon aquifer can be pumped for a sufficiently long period to provide a sustainable source of drinking water. Mineralized copper ore has been identified in both the Dakota Sandstone and the Kbc Bed 15. However, the AE request is only for the Kbc Bed 15 of the Burro Canyon aquifer.

Navajo Aquifer – The Navajo aquifer consists of moderate to low-permeability sandstones and siltstones of the Entrada Sandstone, Dewey Bridge member of Carmel Formation, Navajo Sandstone, Kayenta Formation, and Wingate Sandstone, which generally behave as a single hydrostratigraphic unit and range in depths between 1,100 to 1,800 feet below ground surface within the GTO area. Outside the GTO graben, formations that comprise the Navajo aquifer crop out at land surface. The Navajo aquifer is hydraulically separated from the overlying Burro Canyon aquifer by the Morrison Formation Brushy Basin Member. The 2020 technical report includes sampling data for the Navajo aquifer, indicating that the TDS concentration for this aquifer ranges from 260 to 1,440 mg/L. Because these TDS values are below 10,000 mg/L, the Navajo aquifer qualifies as a USDW.

BASIS FOR DECISION

Regulatory Criteria under which the exemption is approved

40 C.F.R. § 146.4(a) *It does not currently serve as a source of drinking water*

The Kbc Bed 15 does not currently serve as a source of drinking water for the area near the proposed aquifer exemption. Figure 6 shows the locations of the nearest private wells to the GTO ore deposit. An October 2025 search of the Utah Division of Water Rights Well Information database was conducted for a search radius of 3 miles from the approximate center of the GTO to identify nearby water wells and their distances. Three miles was selected to include the area within the Class III UIC Permit's area of review, which is defined as 2 miles circumscribing the permit area. The result of this search shows that the nearest active well is the Stevenson 05-2970, which is located outside of the GTO graben about 2.7 miles southeast of the GTO AE and is hydraulically separated from the Burro Canyon aquifer in the GTO area. The Stevenson well is about 200 feet deep which would indicate it is in the Navajo aquifer.

Two wells and one dry hole were drilled at the Wilcox 05-2589 location about 2.2 miles southeast of the GTO AE. The first well was drilled in 1996 to a depth of 330 feet and was screened from 274.8 to 284.8 feet. It is not clear in the record in which aquifer the well was screened. A second replacement well was drilled in 2006 to a depth of 300 feet with perforations at 189 to 200 feet and 250 to 265 feet. The well information database shows that the Wilcox 05-2589 well has been plugged, and the Well Abandonment Report was received by the Utah Division of Water Rights on August 24, 2006. All of these wells are located outside of the GTO graben.

Three test holes were drilled for the Escovar well 05-3472, located approximately two miles from the GTO AE; however, all three were dry and subsequently plugged and abandoned. The EPA's October 2025 review also showed three new drinking water wells farther away from the Escovar well that are currently active. These three new wells are located more than 2.5 miles from the GTO AE, and their depths range from 100 to 300 feet from the surface. These wells are located outside of the GTO graben. The Gilger 05-3846 is located approximately 3.3 miles from the GTO AE. The Gilger well is not active. The Wilcox 05-3907 well is about 3.5 miles from the GTO AE and is 151 feet deep. The Wilcox 05-3907 is completed in the Dakota Sandstone and is hydraulically separated from the Kbc Bed 15 by the Kbc Bed 14 confining zone.

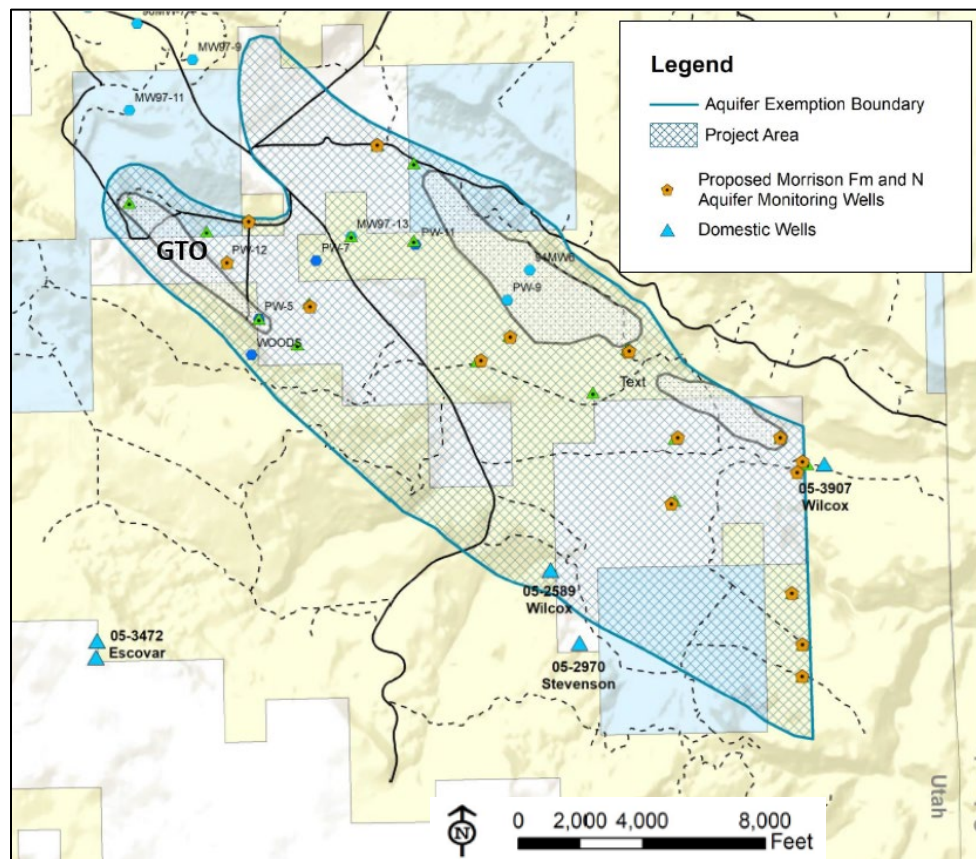


Figure 6. Nearby private wells to the GTO AE Area. Adapted from the Lisbon Valley Mining Company Technical Report (LVMC, 2020: Figure 3.2).

40 C.F.R. § 146.4(b)(1)

It cannot now and will not in the future serve as a source of drinking water because:

It is mineral, hydrocarbon, or geothermal energy producing, or can be demonstrated by a permit applicant as part of a permit application for a Class II or III operation to contain minerals or hydrocarbons that considering their quantity and location are expected to be commercially producible.

The UDEQ provided information to the EPA that support the conclusion that Kbc Bed 15 at the location of the GTO ore deposit cannot now and will not in the future serve as a source of drinking water. The information contained in the UDEQ AE request to EPA and supporting documentation

demonstrates that the portion of the GTO aquifer proposed for exemption contains minerals in a quantity and location that is expected to be commercially producible.

Commercial Producibility

The commercial viability of extracting acid-soluble copper from the Lower Lisbon Valley Project is demonstrated by ongoing heap leach and solvent extraction electrowinning (SX-EW) operations, alongside a long history of copper exploration and mine development in the area. The current proven and probable mineral reserves for the GTO are tabulated and supported by mine designs, schedules, and cash flow models (LVMC, 2023). The extent of copper mineralization in the GTO shown in Figure 5 was created using these exploratory holes.

The GTO area contains commercial-grade copper suitable for ISR, as detailed in the Stantec Technical Report (LVMC, 2023). This report adheres to Canadian National Instrument (NI) 43-101 international reporting standards and was completed by Stantec to independently confirm resource calculations and assess the technical and economic feasibility of copper recovery via ISR methods at the Lisbon Valley Project. The report estimates that the ISR recovery for the GTO deposit is 12,607 kTons, with a copper grade of 0.35% and a total contained copper of 88,962 klbs. Drill holes referenced in the 1997 and 2014 BLM FEIS were used to determine the average ore thickness in the GTO, indicating copper presence in the Burro Canyon aquifer, with copper deposits averaging 50 to 100 feet in thickness.

40 C.F.R. § 144.7(c)(1) requires a UIC Class III Permit Application that “necessitates an aquifer exemption under 40 C.F.R. § 146.4(b)(1), to furnish the data necessary to demonstrate that the aquifer is expected to be mineral or hydrocarbon producing. Additional information to be considered by the UIC Director include: the mining plan for the proposed project, such as a map and general description of the mining zone (Figures 1, 2, 3 and 5), general information on the mineralogy and geochemistry of the mining zone, analysis of the amenability of the mining zone to the proposed mining method, and a time-table of planned development of the mining zone.”

Geochemistry and Mineralogy of the Mining Zone

The copper deposits in Kbc Bed 15 are hosted by clastic sedimentary rocks. Copper minerals are finely disseminated within the interstices of the coarse- and medium-grained sandstone units, and less common occurrences are in lenses and nodules along fractures, are around organic matter, or replace calcareous nodules or concretions, primarily within sandstone units. Extensive calcite-bearing layers have been mapped in Burro Canyon aquifer exposures in mine pit walls at the LVMC open pit cuts (Barton et al., 2021), which may increase acid consumption, which is negative for ISR economics but positive for leach solution containment and neutralization of residual leach solution during groundwater restoration. The fine dissemination of copper mineralization in the host sandstone is ideal for ISR, which utilizes the sandstone’s permeability to access fine copper mineralization with lixiviant for recovery.

The copper deposits are divided into oxide and sulfide mineralogical zones:

- **Oxide/Sulfide Interface**—The oxide/sulfide interface is approximately 0–250 feet below the surface, although it varies according to lithology and permeability of the individual host beds. Oxide minerals primarily include malachite, azurite, tenorite, cuprite, and other unidentified oxidized copper minerals.

- Sulfide Zone—The sulfide zone consists mainly of chalcocite or djurleite, with minor amounts of bornite and chalcopyrite on the fringes of the deposits. Chalcocite is fine-grained and “sooty” near the oxide/sulfide interface, where it might be secondary (supergene) in origin. Chalcocite disseminated in the Burro Canyon Formation at depths greater than 250 feet is crystalline and steely and is primary (hypogene) in origin. Native copper is found only rarely at the oxide/sulfide interface at depth and is secondary in origin.

Demonstration of Amenability of Mining Zone to the Proposed Mining Method

The proposed mining method associated with the AE request is ISR mining. The lixiviant will consist of groundwater pumped from the production zone and fortified with dilute sulfuric acid and oxygen. The effectiveness of this type of lixiviant is demonstrated by leach amenability studies conducted on core samples collected within the Project Area using standard industry column testing as well as pressurized vessel testing that has demonstrated commercial copper recovery (Whetstone, 2014). LVMC has experience leaching the target mineralogy in its existing open-pit heap-leach operations, which have been in operation since 2006, and that use comparable leaching metallurgy and chemistry.

Hydraulic properties of the Burro Canyon aquifer have been determined through pumping tests (LVMC, 2020). The measurement of water levels in observation wells completed in the pumped aquifers confirmed that during all three pump tests a cone of depression formed in the pumped aquifer (LVMC, 2020: Appendix D). The development of a cone of depression verifies that hydraulic control of injection fluids (i.e., lixiviant) can be maintained within the Burro Canyon aquifer.

Project Timetable

The proposed timetable (DWQ, 2022: Figure 8) for project development anticipates that the GTO copper ore deposits will be commercially produced by ISR for approximately 10 years.

The information in the record and summarized above supports a finding that the copper at this site is commercially producible.

Demonstration that Fluids are Expected to Remain in Exemption Area

There are a number of strategies that exist or will be employed to prevent fluids from leaving the exemption boundary that include physical barriers and operational controls. The GTO copper ore is located in a graben that is bounded by the Lisbon Valley Fault and secondary fault that can serve as barriers to fluid movement. Confining layers have been identified immediately above and below Kbc Bed 15 for vertical fluid movement.

Integral to protection of USDWs and prevention of fluids moving out of the exemption boundary are permit requirements found in the UDEQ Class III UIC permit, especially in areas where there is uncertainty with the physical barriers. These permit requirements include: hydraulic control of mining fluids by maintaining an inward flow, a monitoring well ring network designed to provide early detection of migration prior to fluids reaching the AE boundary, and pump tests to determine the hydraulic connection between the production and injection wells and all perimeter monitoring wells prior to beginning mining activities. Additionally, monitoring wells placed outside of the AE

boundary (both laterally in Kbc Bed 15 and the Navajo aquifer across faults and vertically in the overlying Dakota) will be periodically monitored and sampled throughout the project's life.

Whetstone, et al. reported that water levels in drill holes associated with the Wood Mine (Figure 4) were about 167–182 feet higher than in well PW-5, which indicates the presence of a large hydraulic gradient across the Lisbon Valley Fault from the Navajo aquifer toward the Burro Canyon aquifer near the southeastern end of the AE area (Whetstone, 2006). The presence of a large inward hydraulic head gradient across the fault would provide additional hydraulic control to prevent fluids from leaving the AE area across the fault.

GTO Physical Barriers

A detailed discussion of the GTO physical barriers can be found in the EPA's Lisbon Valley Mining Company (LVMC) GTO Aquifer Exemption Request technical memorandum.

Lisbon Valley Fault

Where low permeability formations are juxtaposed against opposite sides of the Lisbon Valley Fault, the likelihood of horizontal movement of groundwater across the fault is low. Where permeable formations are juxtaposed against the fault, LVMC's GTO-area evaluations are based largely on SGR modeling fault splays south of the mineralized zone and pump tests. Pump tests evaluating potential communication between the Navajo Woods well and boreholes in the footwall of the Lisbon Valley Fault, and a Burro Canyon production well, PW-5, drilled through the hanging wall and completed in the Lisbon Valley Fault suggests potential communication between the Burro Canyon aquifer and Navajo aquifer across the Lisbon Valley Fault in the Wood Mine area. Major ion data presented as a series of Stiff diagrams for PW-5 (and other wells in Lisbon Valley) demonstrate an evolution in groundwater chemistry that "almost appears to be a mix of BC [Burro Canyon] aquifer and Coyote Wash N [Navajo] aquifer," and "require[s] further investigation" (LVMC, 2023). While the Lisbon Valley fault may generally act as a barrier to horizontal flow, there are indications that there may be exceptions, or that it may act as a conduit for vertical flow. The evidence provided that the Lisbon Valley Fault acts as a hydraulic barrier continuously across the entirety of its length is inconclusive.

Secondary Fault

The secondary fault bounds the eastern edge of the GTO graben and has been identified as a barrier to horizontal flow out of the northern reaches of the GTO production area, but limited data exists to evaluate the sealing potential of the secondary fault. Between the Lisbon Valley Fault and secondary fault there are several high-angle faults within the graben ("within-graben" faults). Because of the similarities in stratigraphic offset and fault displacement, it can be anticipated that the secondary fault is more likely to share common properties with the within-graben faults than with the Lisbon Valley fault. Both the within-graben and secondary faults are discussed because of a lack of available data specific to the secondary fault.

Data from pump tests conducted on a single pair of wells (PW-7 and MW97-13) completed in the Navajo aquifer on either side of the secondary fault (but outside of the GTO deposit) did not appear to demonstrate a hydraulic connection across the fault (Whetstone, 2006). However, LVMC (2024) suggests that water levels in Navajo wells (MW97-11, MW97-13) in the inferred location of the footwall of the secondary fault respond to pumping in a Navajo well (PW-7) within the GTO graben, in the hanging wall of the secondary fault, which could indicate communication across the

secondary fault. Additionally, pump tests and water level data from wells within the mid-to-southern portion of the GTO graben indicate that even when separated by (within-graben) faults (see Figure 3), wells completed in the Burro Canyon aquifer (PW-5, PW-6, PW-12, 94MW-2) remain hydraulically connected (Whetstone, 2006; LVMC, 2020). Because no well data are available for the northwest portion of the GTO within the graben, it is difficult to assess whether the secondary fault would act as a barrier to flow. The evidence provided that the secondary fault acts as a continuous hydraulic barrier is inconclusive.

Vertical barriers

The Mancos Shale overlying the Dakota Sandstone and the Morrison Formation underlying the Burro Canyon Formation are described as the vertical confining units in the GTO graben. While the Salt Wash Member of the Morrison Formation is identified as an aquifer, the Mancos Shale and Brushy Basin Member of the Morrison Formation (Kbc) are widely accepted as confining units where they are not fractured (Avery, 1986; Gloyn et al., 1995). Vertical communication between the Burro Canyon aquifer and Navajo aquifer through ~500 feet of the Brushy Basin Member is unlikely, but vertical movement of fluids through open faults and fractures is possible in this geologically complex setting. Locally, the upper confinement is the Kbc Bed 14 and the lower confinement is the Morrison Formation Brushy Basin Member and Summerville Formation. The latter two formations restrict fluid movement downward into the Navajo aquifer as shown by Noyes, et al. In their study that included wells within and outside the GTO, “geochemical and isotopic tracers collected showed distinct groupings of groundwater from the BCA and NA in the Lisbon Valley, indicating minimal hydraulic connectivity between the two aquifers.”

Although the information reviewed indicates the Lisbon Valley and secondary faults may not provide a continuous barrier, additional operational controls applicable for the entire GTO mining project described below are integral to the protection of USDWs.

Operational Controls

Prior to beginning mining operations, pump testing will be conducted to determine the hydraulic connection between the production and injection wells and all perimeter monitor wells. These pump tests can provide additional information to determine the ability of the Lisbon Valley and secondary faults to serve as barriers to contain the mining fluids within the AE boundary and protect adjacent aquifers.

Further, strategically-placed injection and recovery wells will be used to employ hydraulic control within wellfields to prevent movement of fluids vertically out of the injection zone or laterally beyond the AE boundary. Production zone monitoring wells also will be installed to provide early detection of potential excursions from wellfields.

During copper recovery, the groundwater withdrawal rate in each well field will exceed the lixiviant injection rate, creating an inward hydraulic gradient within each well field. During aquifer restoration, the groundwater withdrawal rate in each well field will exceed the injection rate of permeate and clean makeup water from the Burro Canyon or Navajo aquifers.

Production zone monitoring wells will be used to ensure inward hydraulic gradients are maintained at each wellfield and to detect lixiviant excursion, as described in Attachment E of the Permit. LVMC intends to initially mine a subsection of the mineral ore deposit and gradually expand out

toward the AE boundary. Circumscribing each subsection is a set of production zone monitoring wells spaced 300 feet apart (Figure 7) to measure groundwater levels and conductivity, indicators that may suggest an inward hydraulic gradient is not being maintained. As the mine operation expands out, these production zone monitoring wells will be converted to injection wells and new production zone monitoring wells will be drilled circumscribing the expanded mine operation. When the mining operation approaches the AE boundary, these monitoring wells will be used to detect any excursions prior to reaching the AE boundary. The final set of production monitoring wells for the GTO is the MWR, which are described in *Areal Extent of AE* and shown in Figure 5. In cases where the ore body is proximate to the Lisbon Valley fault or Secondary fault, these monitoring wells will be located on the other side of the fault from the GTO ore body and can also serve to monitor the effectiveness of these faults as barriers to fluid movement.

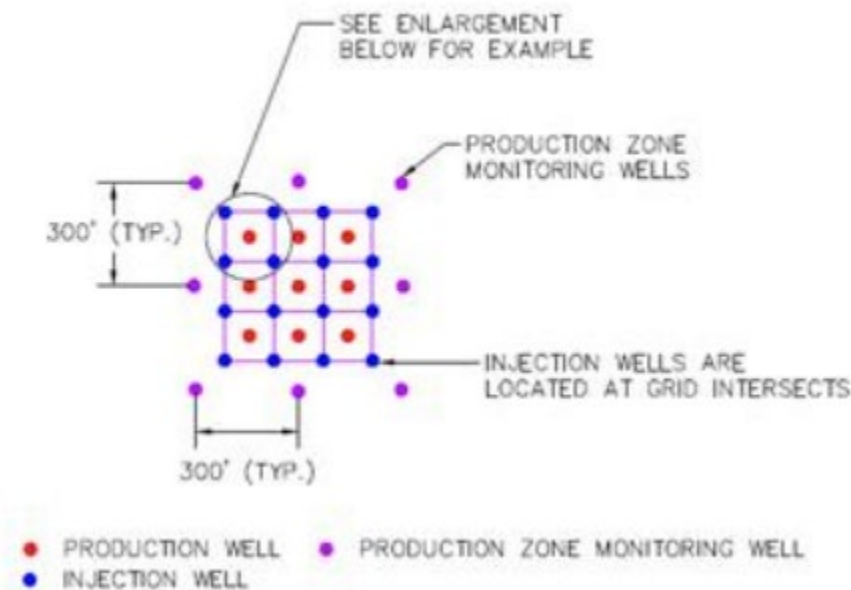


Figure 7 Schematic of 5-Spot Wellfield Pattern and Production Zone Monitoring Wells

Class III Area Permit Requirements

The Class III Area Permit includes a number of requirements that help to both ensure and demonstrate that fluids will remain within the exempted portion of the aquifer. For example:

- Part III Section F.3 requires the injection pressure to remain below the formation's fracture pressure to prevent fracture of confining zones and contain fluids within the targeted copper-bearing strata.
- The permit conditions outlined in Part III, Section E.2. Well Completion Report, require the submission of a well completion report (DWQ, 2022). This report includes the necessary tests and logs to provide additional assurance that the injection interval confinement in that location of the GTO is present to contain the injection fluids within the approved injection zone. The report is required before authorization to inject is granted.

- Attachment G Section 13.2.4. requires that prior to injecting lixiviant into the wellfield, pre-operational pump testing will be conducted to determine the hydraulic connection between the production and injection wells and all perimeter monitor wells. These pump tests can help ascertain the sealing properties of faults in the GTO project area.
- Part III, Section F.5.g. requires ISR operations that target GTO ore will not have any operational relationship with the GTO pit or existing open pit operations. If fluid migrations are detected within existing mine workings, injection activities will be halted until the source and composition of detected fluids is determined and mitigation of injectate migration to these workings is complete.
- Hydraulic control of the wellfield must be maintained by ensuring that the volume of lixiviant injected into the periphery of the wellfield is less than the amount of groundwater and lixiviant withdrawn from the production wells. This control will be verified through continuous monitoring of injection rate and volume, along with measuring water levels in the wellfield perimeter monitoring well ring to confirm a cone of depression. This continuous monitoring of injection rate and volume will be conducted in accordance with permit conditions outlined in Part III, Section B.5. *Installation of Continuous Monitoring System*, Section D.9. *Monitoring Wells*, and Section G.6. *Injection Pressure, Injection Rate, and Injection Volume*.
- Part III, Section F.5.g. requires that to maintain an inward hydraulic gradient, the injection flow will range from 1 to 5% less than the extraction flow depending upon local hydrogeologic conditions and operational variability.
- The monitoring well network required by Permit Attachment F will verify both lateral and vertical containment of injection interval fluids. If any injection interval fluids begin to migrate out of the approved injection interval, water level measurements in the monitoring well network will provide early detection to allow LVMC to implement timely corrective response actions to reverse the migration per permit conditions in Part III, Sections C, G, and H and Attachment G.
- The permit conditions outlined in Part III, Section D.9. *Monitoring Wells*, require the installation of monitoring wells. The ISR perimeter monitoring wells is intended to detect movement of injection fluids beyond the approved injection interval.
- As described in Attachment F of the Permit, perimeter monitoring wells will be constructed in two phases, as necessary. For Perimeter 1, the wells are located approximately 1,000 ft outside the wellfield and baseline water quality data will be gathered prior to commencement of any ISR activities to monitor potential changes in ground water quality. Perimeter 2 wells are located an additional 1,000 feet beyond the Perimeter 1 and will be drilled (if not already in place) upon exceedances of any Perimeter 1 monitor well. The monitoring wells will be sampled quarterly.
- Part III, Sections E, G, and J (and cited attachments), of the permit requires LVMC to develop a groundwater restoration plan for each wellfield that includes monitoring to evaluate the long-term stability of restored ISR contaminant concentrations to ensure that no ISR contaminants cross the AE boundary (DWQ, 2022).
- Part III, Sections G and I, and cited attachments of the permit, requires demonstration of initial mechanical integrity for all injection, production, and monitoring wells and ongoing mechanical integrity tests for injection wells to prevent vertical migration of injection interval fluids via the wellbore through confining zones (DWQ, 2022).

- Part III, Section M *Additional Conditions*, requires the Director to impose on a case-by-case basis additional conditions to prevent the migration of fluids into underground sources of drinking water.

PUBLIC COMMENTS

Initially, the UDEQ held a Public Comment and Hearing on the LVMC UIC ISR Draft Class III Permit and AE from October 31, 2020, to January 11, 2021. The notice for the comment period was provided in the *San Juan County Record* and posted on the Utah Division of Water Quality (DWQ) website. As a result of the comments, UDEQ elected to revise the AE request and require the operator to obtain a third-party financial assurance estimate. The revised AE and financial assurance were the subject of a second Public Comment period from December 8, 2021 to February 8, 2022 and Public Hearing on January 19, 2022. In a document dated June 2022, DWQ responded to all comments received during both public comment periods. The EPA considered public input received, including its review of these comments, and the UDEQ's responses to them, to help inform the basis of its Record of Decision for this AE request.

CONCLUSION AND DECISION

Based on review of the information EPA received , EPA finds that exemption criteria 40 C.F.R. §§ 146.4(a) and 146.4(b)(1) have been met and EPA approves the AE request for the GTO portion of Burro Canyon aquifer as a non-substantial program revision.

Sarah Bahrman, Acting Director
Water Division

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