Ground Water Resources Report

Lisbon Valley Mining Company LLC
Lower Lisbon Valley Project
Supplemental Environmental Impact Statement

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Under the Guidance Of:
Data Adequacy Standard

March 2020

Executive Summary

Lisbon Valley Mining Company, LLC (the Company) proposes to expand its current mining operations in San Juan County, Utah (**Figure 1-1**). Presently, the Company mines copper-bearing ore through open pit mining methods under a Record of Decision issued by the Moab Field Office of the Federal Bureau of Land Management in 1997. The Record of Decision, with File Number UTU-72499, is further supported by the Company's Large Mining Operation Permit with the Utah Division of Oil, Gas and Mining, which has the File Number M/037/0088, and the Company's Ground Water Discharge Permit with the Utah Division of Water Quality, which has the File Number UGW370005. The Company also maintains other permits as found in **Appendix A** of this Document. Under the existing mining permits, the Company extracts copper from the host rock by treating the copper-bearing ore with sulfuric acid. The copper-bearing ore is crushed to minus six inches, then stacked on the existing heap leach facility, then treated with sulfuric acid. The copper-laden sulfuric acid solution is piped to various solution ponds for further processing. The copper-laden solution exiting the heap leach pad is segregated into high-concentration solution, called pregnant-leach solution, and low-concentration solution, called intermediate leach solution. The ILS is re-circulated back onto the heap leach facility, and the PLS is pumped from the solution pond to the process facilities, where it first undergoes a solvent-extraction beneficiation method. This method concentrates the copper into a copper sulfate in solution for final processing. The copper sulfate in solution is then sent to an electrowinning circuit where the copper is plated onto steel cathodes. The final product of the existing operation is 99.9999% Copper cathode.

The current Active Mining Plan Boundary, as defined by the 1997 ROD and amended as recently as 2019 (**Appendix A**), is approximately 4,480 acres. Within that 4,480-acre Plan Boundary, the Company is approved for disturbance of up to 1,232 acres (**Figure 1-2**).

The Company is proposing to expand operations into the area termed Lower Lisbon Valley (LLV), which is located southeast of the existing operations. Under the Company's Proposed Action as described in more detail below, the proposed expansion would include an LLV Plan Boundary encompassing approximately 5,683 acres (**Figure 1-3**). Within that 5,683-acre Plan Boundary, the Company would construct open pits, waste dumps, access roads, well fields, power lines, pipeline corridors, heap leach facilities, and ancillary supporting facilities. All beneficiation following the initial leaching would be performed in the Company's existing SX/EW Process Facilities.

The purpose of this Resource Report is to identify the Affected Environment and potential Environmental Consequences related to the Proposed Action, and two alternative actions as described in Section 1.0 below. Furthermore, this Resource Report will evaluate proposed monitoring and mitigation measures to reduce any Cumulative Effects that may arise from the Proposed Action or alternatives.

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1.0 Introduction

Lisbon Valley Mining Company (Company) intends to submit a Plan of Operations (Plan) and Modified Notice of Intent (NOI) for Large Mining Operations (LMO) for the Lower Lisbon Valley (LLV) Mine Expansion to the Moab Field Office of the Canyon Country District Bureau of Land Management (BLM) and Utah Division of Oil, Gas and Mining (UDOGM). The Plan will be submitted to comply with Title 43 Code of Federal Regulations (CFR), subpart 3809 (43 CFR 3809.401 *et seq*., as amended) and the State of Utah regulations governing the reclamation of mined lands (Utah Administrative Code (UAC) R647-4). The 43 CFR 3809 regulations require that the BLM fulfill its obligation under the National Environmental Policy Act (NEPA) by analyzing and disclosing the potential environmental impacts of the LLV Mine Expansion which, for the purposes of this Report, will be known as the proposed Project.

The proposed Project is located approximately 17 miles southeast of La Sal, Utah in the Lisbon Valley Mining District in San Juan County, Utah. Approximately 5,683 acres would occur within the proposed Plan boundary, including approximately 3,064 acres of BLM land, 1,563 acres of private land, and 1,056 acres of lands owned by the Utah School Institutional Trust Lands Administration (SITLA). The Plan boundary, which would include all proposed Project activities, is located entirely within Sections 4, 5, 6, 7, 8, 9, 10, 11, 14, 15, 16, and 17, Township 31 South, Range 26 East, Salt Lake Base Meridian (SLBM), and Sections 31 and 32, Township 30 South, Range 26 East, SLBM.

1.1 Proposed Action

The Company is planning to expand current conventional open pit mining operations as well as implement in-situ recovery (ISR) operations in the Lower Lisbon Valley Mining District of San Juan County, Utah. The Proposed Action would include the following components:

- Open pits;
- Crushing facilities, conveyors, and associated stockpiles;
- Waste rock storage (WRS);
- Storm water diversion channels, sediment basins, and berms;
- Heap leach pad (HLP);
- Solution pipelines;
- Access roads;
- Injection wells;
- Pump-back wells;
- ISR monitor wells;
- Exploration activities; and
- Ancillary facilities including: power supply; reagent, fuel, and explosives storage; maintenance shop; ready line; vehicle wash; plant growth media stockpiles; area for temporary storage of petroleum-contaminated soils; ground water monitoring wells; water supply pipeline and facilities; and construction laydown yards.

Anticipated disturbance associated with the Proposed Action would include:

- 200 acres of open pit disturbance;
- 350 acres of WRS disturbance;
- 60 acres of growth media stockpiles;

- 170 acres of HLP; and
- 70 acres of support facilities and access routes.

The Proposed Action has an anticipated mine life of up to 26 years.

1.2 No Action Alternative

The development of new facilities that comprise the Proposed Action would not be constructed under the No Action Alternative. Under this alternative, the Company would continue to exhaust its existing resource within the Active Mine Plan Boundary, and not engage in any of the proposed mining operations. The Company would be permitted to continue exploration activities under existing approved authorizations (E/037/0115). Exploration has been permitted on 19.1 acres of federally administered land, private lands owned or leased by the Company, and SITLA lands leased by the Company.

Exploration methods include drilling (reverse circulation and diamond coring) and minor trenching. Authorized activities include water exploration and installation of ground water monitoring wells.

1.3 Alternative A – No ISR

The Alternative A would consist of the same overall activities as described for the Proposed Action, with the exception of the disturbance related to the ISR injection wells, pump-back wells, and monitor wells. Moreover, under Alternative A, the proposed open pits, WRS, and HLP would be significantly larger and more numerous than in the Proposed Action. There would also be additional access roads, pipelines, and power corridors.

Overall, this alternative would result in approximately 570 acres of increased disturbance over the Proposed Action.

This alternative would also shorten the anticipated mine life to 12-15 years.

2.0 Affected Environment

2.1 Study Area

The study area for direct impacts to surface water resources is the Active Mine Plan boundary and the LLV Plan boundary. The study area for direct impacts to ground water resources and geochemistry is the extent of the Aquifer Exemption Boundary as defined by the LVMC UIC Permit Application (LVMC 2020).

2.2 Regulatory Framework

The regulation, appropriation, and preservation of water in Utah falls under both state and federal jurisdiction. Surface water and ground water use are regulated in Utah by the Utah Division of Water Rights (UDWR) and the Utah Division of Water Quality (UDWQ). Approval of the Proposed Action or any alternative would require authorizing actions from state agencies and federal agencies with jurisdiction over water resources in the study area. When a project has the potential to directly or indirectly affect waters in the State of Utah jurisdiction, the State of Utah is authorized to implement its own permit programs under the provisions of the state law or the Clean Water Act (CWA). The Utah State Engineer of the UDWR is responsible for the administration and adjudication of water rights and the issuance of water appropriation permits.

The CWA and Utah water rights regulations provide the primary regulatory framework for the surface water component of water resources. The CWA includes part 404, dealing with the placement of fill material in

Waters of the US, and includes the protection of water quality via federal and state regulations. Water rights are state-regulated through a permitting process and control the use of surface water and ground water. Regulatory programs relevant to the proposed Project are briefly described below.

The Underground Injection Control (UIC) branch of the UDWQ is responsible for the administration and adjudication of underground injection and subsequent ground water quality as a result. Through the UIC program, aquifers in portion or in whole are exempted from the Waters of the US through coordination and approval of an Aquifer Exemption Permit (AEP) with the Federal Environmental Protection Agency (EPA) Region 8.

2.3 Existing Conditions

2.3.1 Hydrologic Setting

The study area is located partially within the Coyote Wash subregion to the northwest, the Summit Canyon-Dolores River subregion to the southeast, and a sliver of the East Canyon Hatch Wash along the easternmost portion the Active Mine Plan Boundary. All subregions are located within the Upper Colorado Water Resource Region (HUC 1403) (USGS, 2020) (**Figure 2-1**). The Utah State Engineer designation for the water resources district is the Price District. The study area is characterized by semiarid benchlands and canyonlands, and has an overall drainage pattern toward the south east. Within the study area, the surface water drains down from the upper benches formed during the collapsed salt domes (Geology Resource Report). Within the northwestern portion of the study area, the and flows toward the southeast of the LLV via ephemeral drainages (**Figure 2-2**).

Average annual precipitation in the study area, as recorded by the onsite meteorological station, is 13.2 inches. Average annual evaporation in the study area is measured to be 38.78 inches. Net annual evaporation for the study area is 24.35 inches (**Table 2-1**).

Table 2-1 Monthly and Annual Evaporation Rates, Lisbon Valley Mine

Gross Annual Evaporation, inches	38.78
Net Annual Evaporation, inches	24.35
Elevation above mean sea level, feet	6,500

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Gross Evaporation, in.	0.92	1.16	1.93	3.06	4.95	5.61	6.07	5.59	4.31	2.8	1.43	0.95	38.78
Avg. Monthly Precip. in.	1.41	1	1.18	0.85	0.92	0.57	1.57	1.9	1.58	1.62	1.37	1.49	15.46
Net Evaporation, in.	-	0.16	0.75	2.21	4.03	5.04	4.50	3.69	2.73	1.18	0.06	-	24.35

NOTES: Gross Evaporation, Avg Monthly Precip, and Net Evaporation Information can be found at http://www.waterrights.utah.gov/techinfo/consumpt/i5805.htm

As noted by the net annual evaporation, most rainfall and snowmelt are removed by evaporation and evapotranspiration; the remainder is estimated to recharge groundwater (Whetstone, 2018). Periodic storm flows and runoff in ephemeral streams also provide groundwater recharge as surface water infiltrates to alluvium.

2.3.2 Surface Water Resources

This section describes surface water resources in the study area, including streams, ponds, springs, and seeps.

Streams

There are no perennial or intermittent streams or ponds located within the study area. There is one primary ephemeral drainage that runs along the northeastern extent of the LLV project boundary in which all other ephemeral drainages connect (**Figure 2-2**). This primary ephemeral drainage flows to the southeast and eventually connects with the Dolores River, located approximately seven miles east of the easternmost extent of the LLV project area. None of the drainages within the study area have been named or recognized as essential drainages according to the EPA WATERS GeoViewer.

The LLV portion of the study area was modeled in 2019 for potential flooding along the drainages during a 100-year 24-hour storm event. While localized ponding is predicted to occur, no significant amount of water accumulation is modeled for anywhere within the LLV (**Figure 2-3**). A similar model was performed for the Active Mine Plan boundary during the original ROD.

Seeps and Springs

There are no seeps or springs within the study area.

Waters of the US

In April 2018 ERO Resources Corporation prepared a Waters of the US Delineation report for the LLV project area. The results of the study concluded that all of the drainage features within the LLV drain, via the primary drainage, toward the Dolores River. For this reason, any modification to the drainage system in the LLV would be subject to federal jurisdiction under Section 404 of the CWA.

There are no wetlands identified within the study area.

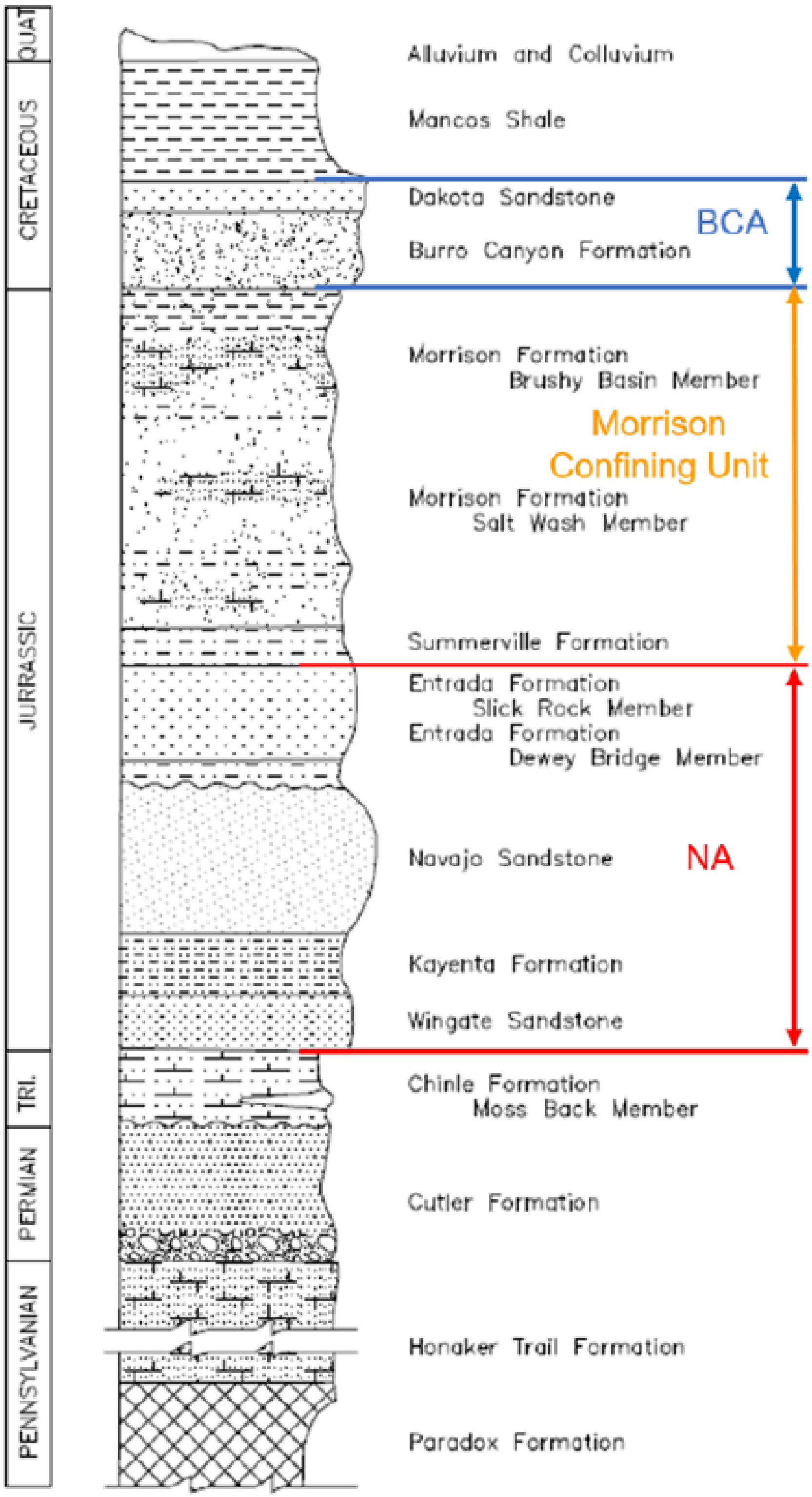
2.3.3 Ground Water Resources

Recharge, storage, and movement of ground water depends on bedrock and alluvial geologic conditions, climate, and topography of a site. In 2018, Whetstone Associates drafted a 20-year review of the hydrogeologic conditions that exist within the study area. This review incorporated the 20+ years of monitoring data gathered from the monitoring wells and production wells throughout the study area (**Figure 2-4**).

There are two distinct aquifers within the study area: the Burro Canyon (BC) Aquifer, which is hosted within the Cretaceous Dakota Sandstone and Burro Canyon formations, and the Navajo (N) Aquifer, which is hosted within the Jurassic sandstones ranging from Entrada (youngest) to Wingate (oldest). An isolated, perched aquifer within the Quaternary alluvium is also present however this is not considered an active aquifer due to the limited water availability as this aquifer is only recharged by precipitation.

The BC and N aquifers are vertically separated by a confining unit made up of 300-450 feet of impermeable to low-permeability clays. Furthermore, the BC aquifer is confined from the upper alluvium by impermeable to low-permeability clays (**Figure 2-5**).

Generalized Description of Geologic Units within the Study Area.



Burro Canyon Aquifer

The BC Aquifer is comprised of the Dakota Sandstone and the Burro Canyon Formation. The aquifer is approximately 450 feet thick, and is generally intercepted between 100 and 270 feet below surface. There are some areas within the study area that the Burro Canyon geologic formation daylights. In these areas, the Burro Canyon formation is dry. Throughout the Project Area, the Dakota Sandstone is primarily unsaturated and aquifer water is located is the relatively high-permeability sandstone of the lower unit (Bed15) of the Burro Canyon Formation. The BC aquifer is the also the ore host in the Project Area and therefore has been extensively drilled, cored, sampled and tested.

The BC Aquifer is confined within the Project Area. The north boundary of the aquifer is defined by the Lone Wolf/Flying Diamond fault which terminates the BC Aquifer against the Coyote Footwall. The south boundary is defined by the Lisbon Valley Fault which terminates the aquifer against the Three Step Footwall. The east boundary is defined by geologic structure which elevates the Burro Canyon formation above the piezometric surface, effectively pinching out the aquifer, and above the ground surface, exposing the Burro Canyon Formation in Little Indian Canyon. The west boundary is defined by geologic structure which elevates the Burro Canyon formation above the piezometric surface, effectively pinching out the aquifer.

Navajo Aquifer

The N aquifer consists of moderate to low-permeability sandstones and siltstones of the Entrada, Navajo, Kayenta, and Wingate formations, which generally behave as a single hydro stratigraphic unit (Avery, 1986). The N aquifer is 500-750 feet thick and is generally intercepted between 400 and 800 below surface. Because the Navajo is the most permeable of those formations, references to the “deep aquifer” in Lisbon Valley generally refer to the saturated Navajo Formation. In the study area, faulting has limited the areal extent and the hydraulic connection of the N-aquifer.

Regional Groundwater Flow

The La Sal Mountains modified the structure of the overlying formations and influence groundwater flow into the points south. These include the coyote Syncline and Lisbon Valley Anticline.

South of the La Sal Mountains, water moves west and southeast from a groundwater divide that extends in a southwest direction. Further south, water is confined in the non-collapsed north limb of the Lisbon Valley anticline.

Five discrete regional flow systems are known in the BC aquifer. Near La Sal, groundwater flow generally coincides with surface water. East of La Sal, the flow is toward the southeast. On the west flank of the La Sal Mountains, flow is down dip.

2.3.4 Water Rights

An inventory of active water rights in the study area was used to identify the location and status of water rights points of diversion within potentially affected areas. The inventory was based on water rights records on file with the UDWR (UDWR 2019).

According to the findings, the Company is the primary user of water within the study area, with a total annual allowable usage of 2,664.56 acre-feet. Table 2-2 provides information regarding the Company’s water right annual usage approved by the Utah Division of Water Rights.

Table 2-2: LVMC Water Rights Information

Water Right Number	Annual Usage (acre-feet)
05-762	179.255
05-2593	2,419.95
05-407	65.35
TOTAL	**2,664.56**

Within the LLV ground water study area, there exists only one other user of the BC aquifer water. This use is for stock water purposes from the period of November 1 through April 1 of each subsequent year. The total annual use allotted to this purpose is 4.66411 acre-feet, which accounts for less than one percent of the total water usage within the ground water study area.

Using a 2-mile search radius beyond the LLV ground water study area, other water rights users were identified. These are summarized as follows:

A total of 50 wells have been identified within the 2-mile radius search. 41 of these wells belong to the Company. There are an additional five domestic wells, two livestock well and two monitoring wells in the 2-mile radius. Well locations are shown in **Figure 2-6**.

The well inventory is divided into the following uses:

- Groundwater Production Wells (PW prefix): 13 wells currently used by the Company for mining water supply (non-drinking water wells) or available for mining water supply.
- Groundwater Monitoring Wells (MW prefix): 30 wells currently used for groundwater quality and water level monitoring. 28 of the monitoring wells are owned and operated by the Company and two are owned by a uranium mining company.
- Domestic: Of the 5 registered domestic water wells in the 2-mile radius, only two are in use (e.g., drinking, washing, sanitary use, etc.) and are outside the Project Area. The other 3 registered domestic wells identified in the 2-mile radius are recorded as being dry and/or out of use.
- Stock: 2 stock wells are in the 2-mile radius and study area. One stock well is registered as existing and active in the BC aquifer and the other stock well is recorded as a shallow dry hole and out of use.

2.4 Water Quality

Water quality standards for ground water in the State of Utah are established by the Director of the UDWQ, and stated in Utah Annotated Code Rule 317-6-3. The ground water quality of the BC and N aquifers within the study area are both classified as Class III Ground water:

UIC Rule 317-6-3 Ground Water Classes

3.5 CLASS II - DRINKING WATER QUALITY GROUND WATER

Class II ground water has the following characteristics:

A. Total dissolved solids greater than 500 mg/l and less than 3000 mg/l.

B. No contaminant concentrations that exceed ground water quality standards in Table 1.

3.6 CLASS III - LIMITED USE GROUND WATER

Class III ground water has one or both of the following characteristics:

A. Total dissolved solids greater than 3000 mg/l and less than 10,000 mg/l, or;

B. One or more contaminants that exceed the ground water quality standards listed in Table 1.

Table 2-3 below shows the comparison of BC aquifer ground water quality, N aquifer ground water quality, and the Utah Ground water quality standards. The BC and N aquifer data is an average taken from the 20+ years of groundwater monitoring. Complete records of the ground water quality monitoring can be made available upon request.

Table 2-3 Ground Water Quality Comparison of BC, N, and Utah Groundwater Standards

Station Name Field Sample ID Lab Sample ID Sample Date	Units	Utah Groundwater Quality Standard [1]	**BC Aquifer**	**N-Aquifer**
Major Ions + Indicator Parameters				
Alkalinity (as $CaCO_3$)	mg/l	-----	105 - 163.2	185.4
Alkalinity, dissolved (as $CaCO_3$)	mg/l		125 - 1,517	179 - 430
Bicarbonate (as $CaCO_3$)	mg/l	-----	125 - 1,517.3	179 - 429.8
Carbonate (as $CaCO_3$)	mg/l	-----	<1.7 - 31	<1 - 19
Hydroxide (as $CaCO_3$)	mg/l	-----	<2 - <14.7	<1 - 5.9
Hardness (as $CaCO_3$)	mg/l	-----	109 - 748	64 - 556
Calcium, dissolved	mg/l	-----	16.2 - 184	16.7 - 141
Magnesium, dissolved	mg/l	-----	11.4 - 108	5.3-46.1
Potassium, dissolved	mg/l	-----	7.7 - 17	3.72-12.6
Sodium, dissolved	mg/l	-----	71.6 - 1,540	50.1 - 248
Chloride	mg/l	-----	9.3-81.9	4.9 - 310
Fluoride	mg/l	4.0	0.09-1.3	<0.1 - 1
Silica	mg/l	-----	1.5-24.8	8.3-25.9
Sulfate	mg/l	-----	131 - 2,800	6 - 533
Total Dissolved Solids	mg/l	10,000	542 - 5,340	260 - 1,440
Total Suspended Solids	mg/l	-----	<5 - 11,700	<5 - 6,280
pH, Lab	s.u.	6.5 - 8.5	6.3-8.8	6.4-8.5
E.C., Lab	µS/cm	-----	861 - 6,680	267 - 1,715
Nutrients				
Phosphorus, total as P	mg/l	0.05	<0.01 - 0.26	0.01-2.3
Nitrate as N, dissolved	mg/l	10.0	<0.02 - 1.59	0 - 0.5
Nitrite as N, dissolved	mg/l	1.0	0 - <0.05	0 - 0.094
Nitrate/Nitrite as N, dissolved	mg/l	10.0	<0.02 - 1.59	0 - 0.5
Nitrogen, ammonia	mg/l	-----	<0.05 - 8.85	<0.05 - 1.7
Metals				
Aluminum, dissolved	mg/l	-----	0.01-.98	<0.03 - 1.12
Antimony, dissolved	mg/l	0.006	0.0004	<0.0002 - <0.02
Arsenic, dissolved	mg/l	0.05	<0.0002 - <0.04	<0.0002 - 0.0476
Barium, dissolved	mg/l	2.0	0.005-0.715	0.031-1.29
Beryllium, dissolved	mg/l	0.004	<0.00005 - <0.01	<0.00005 - <0.005
Cadmium, dissolved	mg/l	0.005	<0.00005 - 0.0597	<0.00005 - <0.003
Chromium, dissolved	mg/l	0.1	<0.0001 - 0.014	0.0001-0.1055
Copper, dissolved	mg/l	1.3	<0.002 - <0.05	<0.01 - 0.04

Station Name Field Sample ID Lab Sample ID Sample Date	Units	Utah Groundwater Quality Standard [1]	**BC Aquifer**	**N-Aquifer**
Iron, dissolved	mg/l	-----	<0.01 - 39.3	0.01-15.7
Lead, dissolved	mg/l	0.015	<0.0001 - 0.069	<0.0001 - 0.0152
Manganese, dissolved	mg/l	-----	0.008-1.18	0.017-5.4
Mercury, dissolved	mg/l	0.002	<0.0002 - 0.0003	<0.0002 - 0.00079
Molybdenum, dissolved	mg/l	-----	<0.01 - 0.566	0.01-0.84
Nickel, dissolved	mg/l	-----	<0.008 - 0.109	<0.008 - 17.3
Selenium, dissolved	mg/l	0.05	<0.0001 - 0.027	0.0001-0.012
Silver, dissolved	mg/l	0.1	<0.00005 - 0.526	<0.00005 - <0.5
Strontium, dissolved	mg/l		2.39-4.48	1.62-5.75
Thallium, dissolved	mg/l	0.002	<0.00005 - 0.014	<0.00005 - 0.009
Uranium, total	mg/l	0.03	0.0002-0.293	0.0000846-0.138
Vanadium, dissolved	mg/l	-----	<0.002 - <0.04	<0.005 - 0.014
Zinc, dissolved	mg/l	5.0	0.01-1.7	<0.01 - 20.8
Radiological				
Gross Alpha, total	pCi/l	15	0.3 - 888	0.73 - 277
Gross Beta, total	pCi/l	8 [4]	9 - 678	2.5 - 310
Radium 226, total	pCi/l		0.91 - 14	0.2-5.3
Radium 228, total	pCi/l		0.7 - 6	0 - 13.2
Thorium 230, total	pCi/l		0.4-7.5	0.88 - 4
Thorium 232, total	pCi/l		0.2-1.8	1.2 - 1.75

3.0 Environmental Consequences

The primary issues related to water resources include:

- Reduction in surface water and ground water quantity for current users and water-dependent resources from ground water withdrawal from active mining and processing;
- Impacts to ground water and surface water quality from the construction, operation, and closure of open pit mines, waste rock storage facilities, heap leach facilities, and ISR activities;
- Impacts associated with storm water management; and
- Impacts to ground water quality related to pit lake development.

3.1 Effect Assessment Methodology

The impact analysis for water resources using the following qualifiers to describe potential impacts in terms of intensity, duration, and context:

Intensity

Negligible: Effects to water resources could occur, but they would be so slight as to not be measurable or distinguishable from natural fluctuations.

Minor: Effects to water resources would occur, but would be small and just measurable using normal methods. Effects are unlikely to affect beneficial uses of the receiving water.

Moderate: Effects to water resources would occur and would be readily detectable and could affect the beneficial uses of the surface or ground water resources.

Major: Effects to water resources would be large, measurable, and easily detected and would substantially change beneficial uses of surface or ground water resources, or hydrologic regime over the area.

Duration

Short-term: One year or less.

Long-term: Greater than 1 year.

Context

Localized: Effects would occur at specific sites or within the project boundary.

Regional: Effects would extend beyond the project area.

3.2 Proposed Action

3.2.1 Open Pit Mining & Beneficiation

Surface Water

As stated in Section 2 above, the high net evaporation within the study area indicates very low likelihood for surface water ponding to occur. This is supported by the lack of perennial or intermittent streams or ponds located within the study area. The small ephemeral drainages within the Active Mine Plan Boundary of the study area are already diverted via culverts and other measures around the active disturbance. The small ephemeral drainages that flow from the south/southwest into the LLV portion of the study area will be diverted around the active mining areas so as to not interrupt the natural flow of surface water. Precipitation runoff flowing into the LLV from the north/northeast have been modeled to have natural ponding occur prior to intercepting the large ephemeral drainage, and therefore will be left alone. The proposed diversion drainages would be designed under the guidance of the Army Corps of Engineers, as stipulated by their Section 404 status. These designed and installed drainages would survive post-mining and post-reclamation in order to ensure long-term stability of surface water movement through the LLV. **Figure 3-1** depicts the proposed path of the designed drainage, and how the drainage will intercept and divert the small ephemeral drainages so as to not impede flow toward the eastern end of the LLV. **Figure 3-2** shows how the designed drainage and proposed stormwater catchments relate to the modeled 100-year 24-hour storm event. The size of the proposed catchments are shown in **Table 3-1** below.

Table 3-1 Estimated Holding Capacity of Proposed Catchment Ponds

Water Depth (ft)	Catchment Pond 1		Catchment Pond 2		Catchment Pond 3		Catchment Pond 4		TOTAL	
	cft	gallons	cft	gallons	cft	gallons	cft	gallons	cft	gallons
1	44,867	335,627	43,952	328,784	78,408	586,533	113,256	847,214	280,483	2,098,157
2	65,057	486,659	63,730	476,737	113,692	850,472	164,221	1,228,460	406,700	3,042,328
3	87,827	656,990	86,036	643,595	153,484	1,148,138	221,699	1,658,421	549,045	4,107,143
4	109,783	821,237	107,545	804,494	191,855	1,435,172	277,123	2,073,026	686,306	5,133,929
5	126,251	944,423	123,677	925,168	220,633	1,650,448	318,692	2,383,980	789,252	5,904,018

The catchments were designed in order to hold at least 110% of all of the ponding volume modeled in the 100-year 24-hour storm event. The maximum ponding volume modeled for the entire LLV was 670,322 cubic feet. However, not all of that will pond within the LLV planned disturbance area.

The Company has a Storm Water Pollution Prevention Plan (SWPPP) in full force for the Active Mine Plan area. This SWPPP would be extended to include all activities within the LLV Project Boundary.

Ground Water

Open pit mining would have the potential to create pit ponding as the open pits deepened. The effects of pit ponding on ground water quality is covered in detail in the Whetstone 2018 report. The findings, after 20 years of data collection and 13 years of active mining, indicate little to no impacts to ground water quality will occur as a result of pit ponding. This conclusion is further supported by the 2015 BLM Environmental Assessment Centennial Pit Backfilling Mine Plan Modification (BLM, 2015).

Waste Rock storage facilities would be constructed as part of the Proposed Action. The Company has a Waste Rock Handling Plan that is in full force within the Active Mine Plan Boundary. This Plan would be extended to include all waste rock encountered during open pit mining activities within the LLV. To date, no adverse effects to ground water or surface water has been encountered as a result of the waste rock storage facilities.

A heap leach pad would also be constructed as part of the Proposed Action. The Company has a Best Available Technology Plan that is in full force within the Active Mine Plan Boundary. This Plan would be extended to include the heap leach pad to be constructed within the LLV.

There would be no new beneficiation facilities constructed as a result of the Proposed Action. Moreover, the water usage for the Active Mine Plan would be more or less the same for the Proposed Action, as the Proposed Action is a phased process that will replace the depleted resources within the Active Mine Plan boundary. Therefore, no increase in water consumption would be anticipated as a result of the proposed open pit mining activities.

Based upon the data collected through the monitoring of the current activities within the Active Mine Plan Boundary, as well as the evaluation of proposed activities as they compare to what is already being performed, it is concluded that the effects on water resources for the Proposed Action would be minor, localized, and long term; and in line with what is already approved for the Active Mine Plan.

3.2.2 ISR

ISR activities would involve the exempting of the BC aquifer only as it exists within the LLV ground water study area. The localized and perched alluvial aquifer would not be exempted, nor would the N aquifer. As the BC aquifer is confined geologically and structurally within the study area, the effects to the BC aquifer would be considered major, localized, and long-term.

There would be no effects to surface water quality, minor effects to surface water quantity, as some of the surface water may be rediverted for beneficiation purposes. There would be negligible to minor effects to the ground water within the alluvial and N aquifer due to use of the water for rinsing and processing purposes. No change in water quality is expected to occur within the alluvial aquifer or the N aquifer as a result of the Proposed Action. According to the 2018 Whetstone report, there is a large unsaturated zone that exists between the BC and N aquifers. Moreover, both the BC and N aquifers are highly segmented, with faults generally acting as barriers to flow across faults. The barriers to horizontal flow across faults are a result of fault gouge along the fault planes and the juxtaposition of permeable units against low-permeability units.

Of note, active mining has been performed within the Lisbon Valley Active Mine Area, with open pits being deepened yearly. Over the twenty-year monitoring event, there has been no indication of communication between the BC and N aquifers, as would have resulted in change in water quality and overall water chemistry of the distinct aquifers.

The implementation of a schedule for drilling of the ISR wellfields and subsequent rinsing and restoration of the BC aquifer within the LLV ground water study area would help to mitigate the size of the impact. The proposed schedule for ISR is found in Table 3-2 below.

Table 3-2 Preliminary Schedule of ISR Activities (refer to Figures 3-3 through 3-7 of the Plan of Operations for locations of proposed wellfields)

LLVM - ISR Projected Construction, Operation and Decommissioning Schedule

	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12	Y13	Y14	Y15	Y16	Y17	Y18	Y19	Y20	Y21	Y22	Y23	Y24	Y25	Y26	Y27	Y28
Permitting/Licensing																												
Five spot test - GTO																												
Exploration/Development drilling - GTO																												
Injection Well field construction - GTO			16	25	33	33	33	33	33	33																		
Production Well field construction - GTO			10	15	20	20	20	20	20	20																		
Copper Production - GTO																												
Exploration/Development drilling - FD/LW																												
Five spot test - FD/LW																												
Injection Well field construction - FD/LW						28	33	50	67	100	133	133	133	133	133	133	133	133	77									
Production Well field construction - FD/LW						10	20	30	40	60	80	80	80	80	80	80	80	80	46									
Copper Production - FD/LW																												
Well Field Plugging and Abandonment							5	26	40	53	91	106	133	160	213	213	213	213	213	213	213	213	213	123				
Well Field Stability Monitoring																												
Well Field Restoration Rinsing																												
Regulatory Approval of restoration																												
Well field decommissioning																												
Facility decommissioning																												
Injection Wells			16	25	33	61	66	83	100	133	133	133	133	133	133	133	133	133	77									
Production Wells			10	15	20	30	40	50	60	80	80	80	80	80	80	80	80	80	46									
Total Wells			26	40	53	91	106	133	160	213	213	213	213	213	213	213	213	213	123									

*FD = Flying Diamond; LW = Lone Wolf

3.2.3 Recommended Monitoring and Mitigation Measures

The Company has a robust monitoring system that includes the monitoring of both surface water and ground water throughout the study area. This monitoring plan is overseen by the UDWQ, UDOGM, and the BLM. This plan would be extended to include all activities within the LLV Plan Area. Specifically, this plan will be extended to meet specifications within the Aquifer Exemption Permit, the UDWQ Class III UIC Permit, and the eventual UDWQ Class V UIC Permit, for the eventual rinsing and restoration of the ground water within the localized BC Aquifer.

3.3 No Action Alternative

3.3.1 Effects

Under the No Action Alternative, the proposed Project would not be developed and associated impacts to water resources would not occur. Under this alternative, LVMC would be permitted to continue exploration activities under existing approved authorizations and continue with open pit mining and processing activity under existing approved authorizations.

3.3.2 Recommended Monitoring and Mitigation Measures

No monitoring or mitigation measures are recommended.

3.4 Alternative A – No ISR

3.4.1 Effects

If LVMC does not pursue ISR, open pit mining activity may be increased which would increase size of the open pits, the size of the waste rock storage facilities, and the size of the heap leach pads. More water would be required as more heap leach pad is being wetted. Also, a larger surface water diversion drainage would have to be constructed. Overall effect to water resources would be minor.

3.4.2 Recommended Monitoring and Mitigation Measures

No monitoring or mitigation measures are recommended.

4.0 Cumulative Effects and Residual Impacts

4.1 Introduction

Surface Water

The cumulative effects study area (CESA) boundary for surface water resources will be the drainage from the LLV to the Dolores River system (**Figure 4-1**). The purpose of the Cumulative Effects and Residual Impacts study is to evaluate the potential effects the Proposed Action would have on past, present, and future surface water resources as they relate to the Dolores River system.

Ground Water

The CESA boundary for the ground water resources would be the BC aquifer as it is constrained and represented by the aquifer exemption boundary within the LLV (**Figure 4-2**). The reason for this is because the ground water in the BC aquifer is shown to be localized within the LLV, therefore no cumulative effects would occur outside of the LLV study area. The purpose of the Cumulative Effects and Residual Impacts study, therefore, would be to evaluate the potential effects the Proposed Action would have on past water users, present water users, and future water users within the LLV ground water study area.

4.2 Past, Present, and Reasonably Foreseeable Future Actions

Surface Water

Past usage of surface water within the surface water CESA was for beneficial use in mining activities, and grazing. No past farming existed within the CESA. No past surface water recreation existed within the CESA.

Present and reasonably foreseeable future usage of surface water within the surface water CESA would include mining activities and grazing. According to the watershed drainage report performed for the LLV, more than 98 percent of all precipitation that intercepts the LLV continues to flow as uncontained runoff. Because no large catchments or diversions are planned, there would be no effect to the surface water reporting to the Dolores River as a result of the Proposed Action.

As the proposed diversion drainage will survive post-closure, no long-term impacts to the CESA is anticipated.

Ground Water

Past usage of the BC aquifer within the ground water CESA was for beneficial use in mining activities, and grazing.

As stated in Section 2, present usage of the BC aquifer within the ground water CESA is predominantly for beneficial use in mining activities. One stock water well exists within the ground water CESA. This well has an annual use between November 1 and April 1, with an overall quantity of 4.66411 acre-feet per year (Water Rights, 2019).

Future use of the BC aquifer within the ground water CESA would result in the removal of the aquifer from the Public Water System and Drinking Water status. Because more than 99 percent of the use of the BC aquifer within the ground water CESA is currently for beneficial use in mining activities, the removal of the BC aquifer within the ground water CESA would result in nominal changes in overall future usage.

4.3 Cumulative Effects

4.3.1 Proposed Action

Surface Water

There would be nominal to no long-term cumulative effects to surface water resources.

Ground Water

There would be nominal to no long-term cumulative effects to the ground water within the N aquifer and the alluvial aquifer. There would be nominal to no long-term cumulative effects to the BC aquifer outside of the Aquifer Exemption Boundary. There would be major long-term cumulative effects to the BC aquifer within the Aquifer Exemption Boundary. However, as the use of water would not change from what it is currently, the actual proposed effects as they relate to the usage of water resources would be nominal.

4.3.2 No Action Alternative

The No Action Alternative would not authorize additional development, and previously permitted mining activities would continue, including closure and reclamation, as well other past, present, and RFFAs in the CESA. Cumulative impacts to water resources under the No Action Alternative would be the same as what is already occurring from permitted open pit mining activity and would still be anticipated to be localized, short-term, and negligible.

4.3.3 Alternative A – No ISR

Impacts to surface water resources would be modestly increased versus the Proposed action due to more open pit mining activity. That said, the effects would still be anticipated to be localized, short-term, and minor. Impacts to ground water resources in the N aquifer and alluvial aquifer would be much the same as for the Proposed Action. Impacts to ground water resources in the BC aquifer would be much the same as the No Action Alternative, other than a slightly increased usage of water due to the increase of open pit mining activities.

4.4 Residual Impacts

Residual impacts associated with the Proposed Action would include the removal of the stock water well from use in the BC aquifer within the Aquifer Exemption Boundary. This can be mitigated, however, by drilling a replacement well either outside of the Aquifer Exemption Boundary, or deeper to intercept the N aquifer.

5.0 List of Acronyms & Abbreviations

BLM	Bureau of Land Management
CEA	Cumulative Effects Analysis
CFR	Code of Federal Regulations
CWA	Clean Water Act
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ISR	In-situ Recovery
LLV	Lower Lisbon Valley
LMO	Large Mining Operation
NEPA	National Environmental Policy Act
RMP	Resource Management Plan
ROD	Record of Decision
SITLA	School Institutional Trust Lands Administration
SLBM	Salt Lake Base Meridian
UAC	Utah Administrative Code
UDOGM	Utah Division of Oil, Gas and Mining
UDWR	Utah Division of Water Rights

6.0 References

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