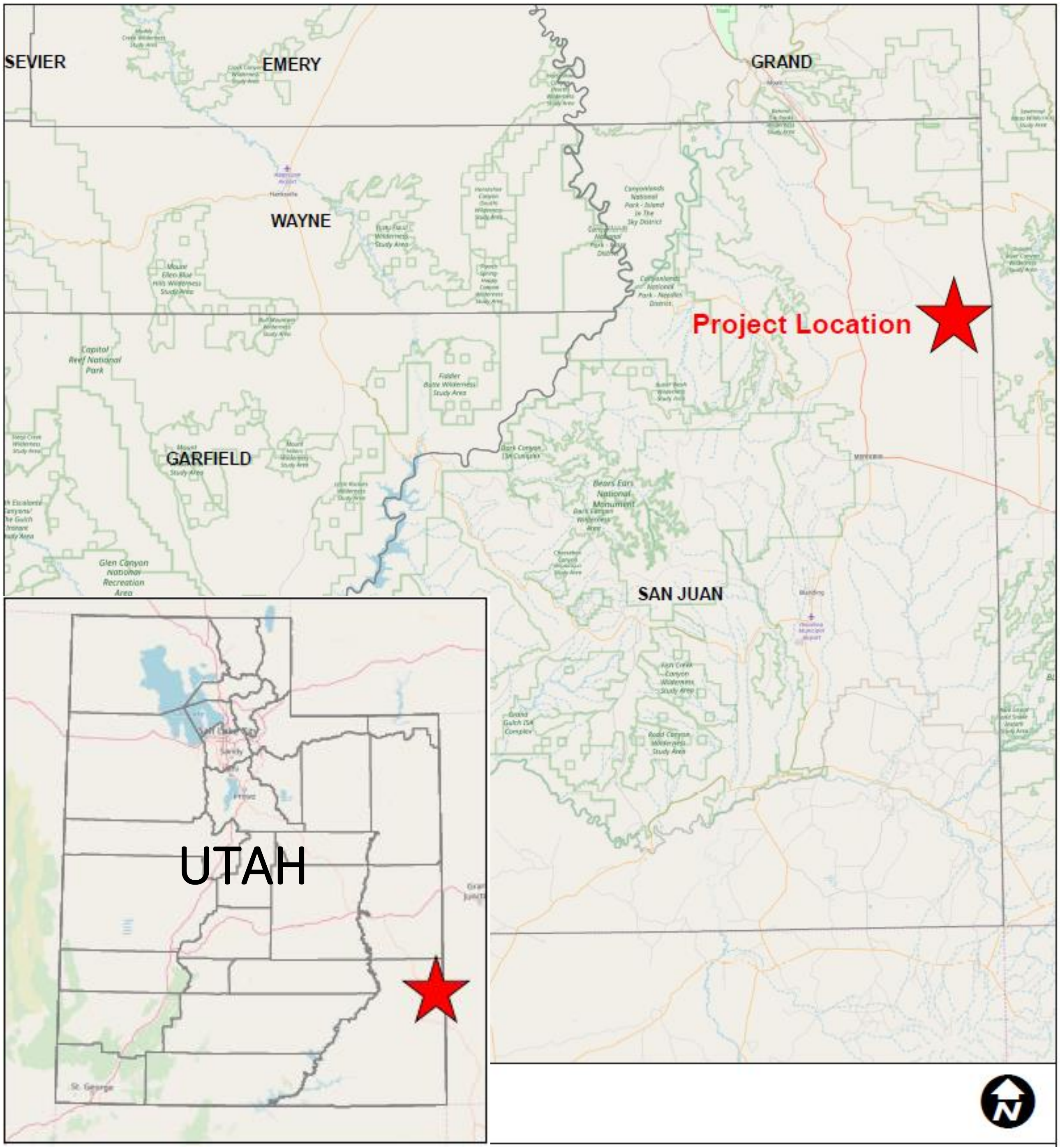
Attachment A

General Location Map of the Lisbon Valley Mine,
San Juan County

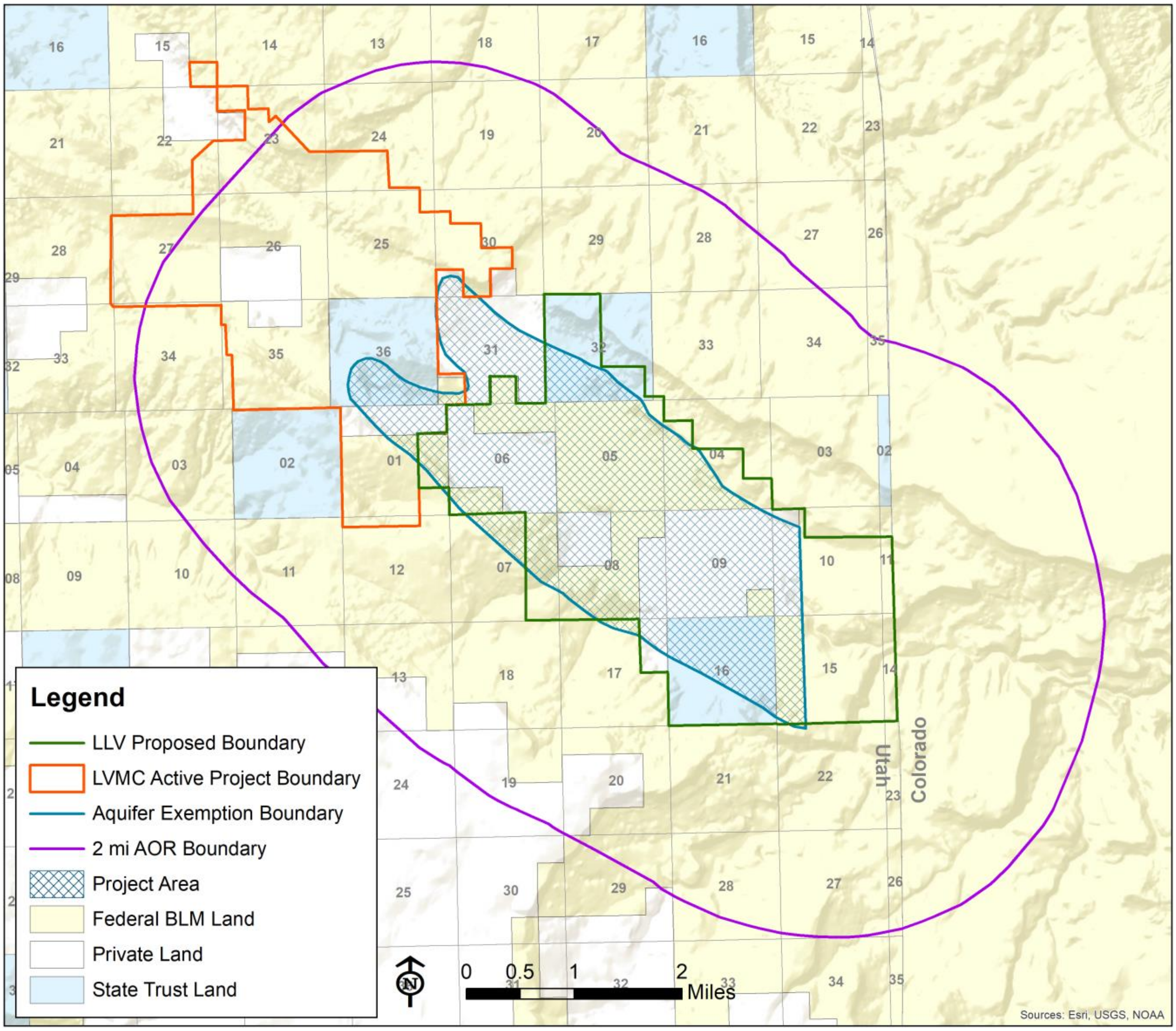
Figure 1.1 Project Location Map



Attachment B

Maps of the UIC Area of Review including Existing and Proposed Wells and the Project Area

Figure 1.2 LVMC Project Area, Mine Boundary, Aquifer Exemption Boundary and Area of Review



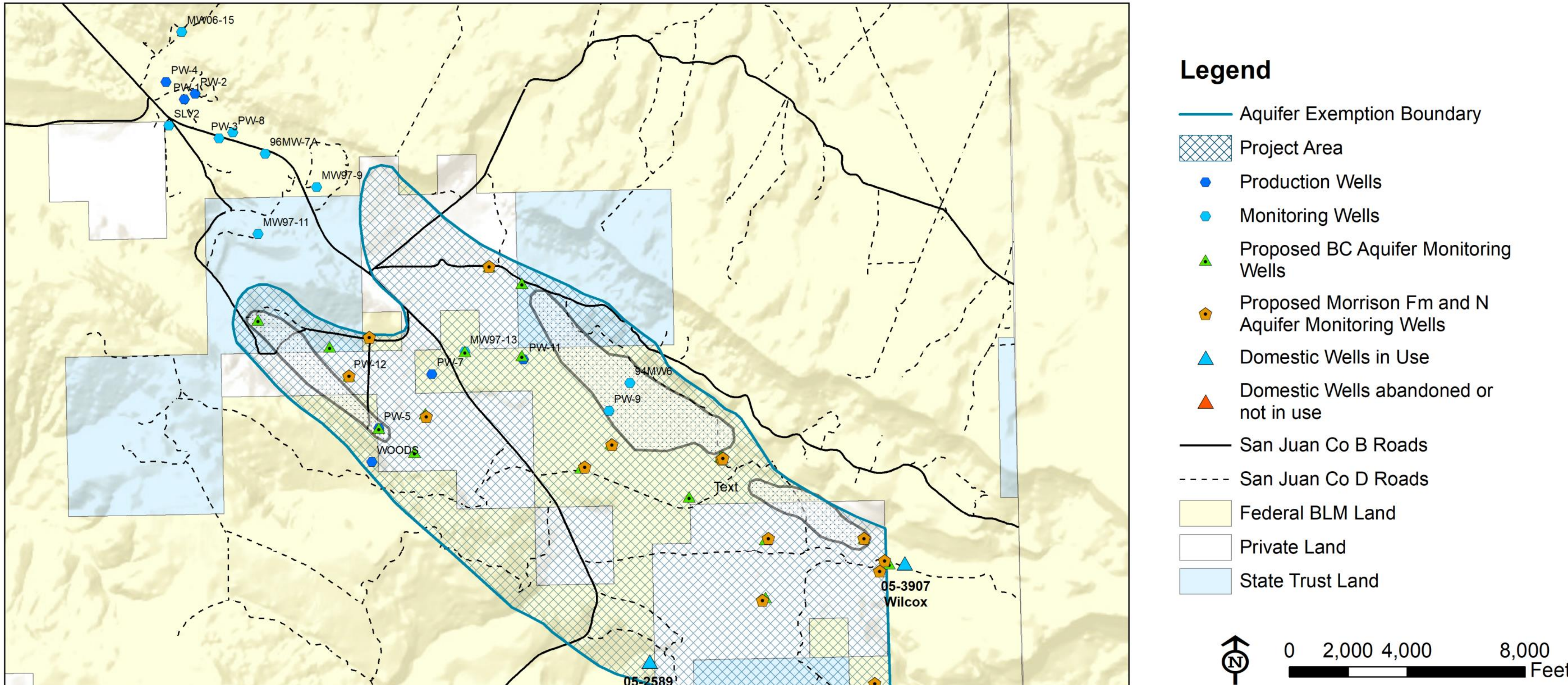


Figure 3.2

Proposed Aquifer Exemption Boundary

Lower Lisbon Valley Project

Drawn By: Brian Sparks	Date: 24 June 2020

File Name: ISR Figure 3.2 Proposed AEB

LISBON VALLEY MINING CO

Attachment C

Corrective Action Plan for Artificial Penetrations into Injection Zone within Area of Review

5.0 PART D - Corrective Action Plan

This section describes the necessary steps or modifications to prevent movement of fluid into USDW through any artificial penetrations into the injection zone. There are no USDW above the injection zone. Artificial penetrations into the N Aquifer below the injection is limited to improperly abandoned boreholes and/or wells.

The Company will use the best available information and best professional practices to locate boreholes or wells in the vicinity of potential well field areas. This will include historical records, aerial surveys, pump tests, and field investigations. Consistent with standard industry operating practices and experience, the following describes the procedures the Company will implement to detect and mitigate any unplugged holes or wells that have the potential to impact the control and containment of well field solutions.

The Company has committed to UDWQ to properly plugging and abandoning or mitigating any of the following should they pose the potential to impact the control and containment of well field solutions within the Project Area.

1. Historical wells and exploration holes
2. Holes drilled by the Company for the purposes of delineation and exploration
3. Any well failing mechanical testing integrity including wells drilled by the Company and well drilled by the Company's predecessors

The Company will attempt to locate with best professional practices any presently unknown boreholes or wells in the vicinity of every potential well field. Historical records will be used to determine the presence of previous boreholes and wells.

Should any drill hole or well at or near potential well fields be suspected of being improperly plugged and abandoned, the Company will use best professional practices to precisely locate and re- enter the suspected problem hole with a drill rig or tremie pipe. The Company will evaluate mitigation alternatives including plugging and abandoning the hole or well with grout as described below. The Company may enter the well with logging equipment prior to plugging and abandoning the well to confirm that the well poses a potential problem.

5.1 Plugging and Abandonment Procedures

The Company's standard operating procedures will include plugging and abandoning all boreholes completed during the process of exploration and delineation drilling. Any wells installed by the Company which fail a mechanical integrity test (MIT) and cannot be repaired also will be plugged and abandoned. Plugging and abandonment procedures are discussed in Section 15.

5.2 Mitigation and Avoidance

Boreholes or wells which may potentially impact control of well field operations will be evaluated using pump test data and groundwater modeling. Should it be determined that it is not possible to mitigate potential adverse impacts from any unplugged borehole or well that is discovered, the affected well field will be designed to minimize any potential impacts. The monitoring system will be designed to demonstrate well field control. This may include monitor wells in addition to those provided for normal well field operations.

Attachment D

Injection Well Construction Plan with
Injection Well Construction Details

6.0 PART E Injection Zone Formation Testing Plan

This attachment discusses the operating data for the injection wells, including the typical and anticipated maximum injection rate, injection pressure range, and range in concentrations of the injected fluids.

6.1 Injection Flow Rate

The injection flow rates for individual Class III injection wells are anticipated to range from approximately 50 to 100gpm. The project-wide injection flow rate will fluctuate depending on the number of well fields undergoing copper recovery and aquifer restoration. The project-wide injection flow rate is expected to increase from the onset of copper recovery in the first well field through the period of concurrent copper recovery and aquifer restoration. The Company estimates that individual well field copper recovery times will be about 5 years, with multiple well fields typically in copper recovery at any given time. Aquifer restoration will be completed following copper recovery in each well field. Therefore, concurrent copper recovery and aquifer restoration is anticipated to begin approximately five years after initial well field operation.

Figure 10.2 in Section 10 depicts the anticipated project schedule. Table 6.1 summarizes the maximum project-wide flow rates during concurrent copper recovery and aquifer restoration. The maximum gross pumping rate from producing well fields is anticipated to range from 5,000 gallons per minute (gpm) (GTO deposit) to 20,000 gpm (Lone Wolf/Fling Diamond deposit). To maintain an inward hydraulic gradient, the injection flow is estimated to range from 0.5% to 5% less than the extraction flow. This demonstrates that the vast majority of water pumped from the production zone will be reinjected, such that the net withdrawal rate will be only a small fraction of the gross pumping rate. The maximum anticipated gross pumping rate from well fields undergoing aquifer restoration will range from 1,000 gpm (GTO deposit) to 4,000 gpm (Lone Wolf/Flying Diamond deposit). The estimates of production flow rates are used for information purposes only; LVMC is not requesting that the proposed Class III UIC permit include flow limits.

Table 6.1 Operational Flow Rates

Deposit	Operation Phase	Injection Flow Rate gpm	Production Flow Rate gpm
GTO	Copper recovery (5 year)	4,975	5,000
	Aquifer restoration (1 year)	950	1,000
Lone Wolf / FD	Copper recovery (5 year)	19,900	20,000
	Aquifer restoration (1 year)	3,800	4,000

6.2 Injection Pressure

The Company will specify the maximum injection pressure for each well. The designated maximum pressure will be posted near the injection trunk line gauge used to monitor injection pressure. The maximum injection pressure will be calculated as the lowest value of the following:

- The lowest value of maximum allowable wellhead pressure for all injection wells based on fracture pressure calculations presented in Section 8.1.
- The manufacturer-specified maximum operating pressure for the well casing.

- The manufacturer-specified maximum operating pressure of the injection piping and fittings.

This pressure will not initiate new fractures or propagate existing fractures in the injection or confining zone or cause the migration of lixiviant into any USDW in accordance with 40 CFR § 144.28(f)(6)(i).

6.3 Injection Fluid Composition

Two different types of fluid will be injected into the well fields. During copper recovery, a lixiviant consisting of production zone groundwater fortified with sulfuric acid and oxygen will be injected into the well fields and recirculated from new and/or existing process collection ponds. Injection solution temperatures are expected to range from 40° F during the winter to 70° F in the summer months. The temperature range results from the temporary residence time in above-grade process ponds. During aquifer restoration, fresh makeup water from the adjacent BC or underlying N Aquifer will be injected into well fields. The BC aquifer may not contain enough water supply to support the ISR project since it does not re-charge or have influent flow. Table 6.2 describes the anticipated range of concentrations for various constituents in the lixiviant injected during copper recovery. The lixiviant formulation illustrated in Table 6.2 is a reflection of metals dissolution in the ore body as a result of the addition of sulfuric acid. This formulation will circulate through the ore body during the mining phase. The formulation will change during restoration when acid is no longer added to the circulation, causing analytes to precipitate.

Table 6.2 Injection Fluid Composition

As	Ba	Cd	Cr	Pb	Hg	Se	Ag	Cu	U	S	Ca	Mg
ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
< 1	< 1	23	< 1	2	< 1	< 1	< 1	637	3		639	2224
< 1	< 1	24	< 1	3	< 1	< 1	< 1	655	3		626	2369

7.0 PART E – Formation Testing Program

This attachment provides a description of the formation testing program for the Project. The formation testing program description includes information about geohydrologic properties of the ore zone and the confining zones from previous tests and information about the pump testing program that will be performed for each well field.

7.1 Fracture Pressure

The Company will not use hydraulic fracturing as part of the ISR process, and no fracture pressure testing is planned. Fracture testing could increase the probability of creating a pathway for loss of fluid control in the immediate vicinity of the tested well. The Company will operate its injection wells below the estimated fracture pressure of the injection zone. Maintaining the native hydraulic properties of the host sand is important to copper recovery and control of well field solutions. Instead of fracture testing the Company will rely on conservative and accepted methods of estimating fracture pressure as described below.

Fracture pressure varies with well depth, strength of formation rock and overburden pressure. Hydraulic pressure is the sum of the overburden pressure and the hydrostatic pressure of fluids within the wellbore. The hydrostatic pressure can be calculated based on the pressure gradient of the fluid multiplied by the fluid depth. The total hydraulic pressure or downhole pressure is calculated as follows:

> total hydraulic pressure (psi) =overburden pressure (psi) + [(fluid pressure gradient (psi/ft) x depth (ft)]

To prevent formation fracturing, the total hydraulic pressure or downhole pressure must not exceed the formation fracture pressure. Since the hydrostatic pressure is calculated as the fluid pressure gradient multiplied by the depth, the maximum surface pressure or maximum allowable well head pressure (max WHP) can be calculated as follows:

> max WHP = formation fracture pressure (psi) – hydrostatic pressure (psi)

The formation fracture pressure can be calculated based on the fracture gradient multiplied by the depth.

Fracture gradient is defined by the EPA (2012) as follows:

> The fracture gradient is a measure of how the pressure required to fracture rock in the earth changes with depth. It is usually measured in units of "pounds per square inch per foot" (psi/ft) and varies with the type of rock and the stress history of the rock. The default value used by Region 8 in Utah is 0.8 psi/ft. This means, for example, that at a depth of 100 ft, a pressure of 80 psi would be required to fracture the rock, while at a depth of 500 ft, the required pressure would be 400 psi; at 1,000 ft, 800 psi

LVMC will use a fracture gradient value of 0.6 psi/ft as a conservative value for the overlying shale in either the Mancos layer or bed 14. Therefore, the max WHP will be calculated based on the following equation, which uses a fluid pressure gradient of 0.433 psi/ft for the injected fluid:

max WHP = [0.6 psi/ft – 0.433 psi/ft] x [depth to top of bed 15 (ft)]

Based on a range of depths to the target mineralization of approximately 125 to 800 feet, the max WHP will range from approximately 20 to 133 psi. The maximum allowable WHP will be calculated on a well-by-well basis, and operational controls will be put in place to prevent exceeding designated pressures. The maximum injection pressure will be designated for each header house as described in Section 6.2. The designated maximum injection pressure will be posted near the injection trunk line gauge used to monitor injection pressure. This practice will ensure the formation fracture pressure is not exceeded according to 40 CFR § 144.28(f)(6)(i).

7.2 Project Area Pumping Tests

7.2.1 Pump Test Summary

Comprehensive aquifer tests have been conducted on seven groundwater production wells in the Project Area. This includes five BC aquifer tests and two N aquifer tests. The Company uses pump tests to determine well yields and aquifer hydraulic conductivities. Step-drawdown tests were conducted to determine well hydraulics. Constant discharge tests were conducted to determine aquifer properties. The pump tests support good permeability of the BC aquifer which supports flow criteria required for successful ISR operations. Additionally, one of the pump tests illustrates geologic confinement of the BC aquifer. Appendix I provides reports documenting pumping tests that have been conducted in the Project Area. A summary of the reports in these appendices is provided below.

7.2.1.1 BC Aquifer

PW-5. Two pumping tests were conducted at well PW-5 shortly after well completion and development in 2004: a step-drawdown test and a constant discharge test. The 4-hour step-drawdown test was conducted at rates of 194, 259, and 307 gpm for 45-60 minutes per step. Water levels did not stabilize at each step, but were continuing to drop at rates of 0.13 ft/min, 0.20 ft/m, and 0.26 ft/min for the three steps, respectively. The non-linear well loss constant (C) was calculated from Jacob (1950) to be 1.8×10^{-4} ft/gpm2 and the linear well loss coefficient was calculated at 0.15 ft/gpm.

A 24-hour constant-discharge pumping test was conducted in PW-5 starting on June 7, 2004 using a 60 hp Grundfos 230S submersible pump (rated for 160 to 320 gpm) which was set at 512 ft bgs on 4-inch drop pipe in PW-5. The test was initially conducted at 315 gpm, but the insulation burned through on one lead wire and the pump kicked off after 1 hour and 10 minutes. The test was re-started after 2.5 hours, and the well was pumped for 24 hours at an average rate of 220 gpm.

Maximum drawdown at the end of 24 hours was 84 feet, which equated to a specific capacity of 2.6 gpm/ft. The 84-ft drawdown was small, relative to the available drawdown of approximately 240 ft. The constant discharge test results were analyzed using the Theis, Theis recovery, Cooper-Jacob, Cooper-Papadapalous, Jacob recovery, and Moench methods. The analysis of drawdown at the pumping well produced higher hydraulic conductivity results during pumping (2.56×10^{-4} to 3.98×10^{-4} cm/sec) than during recovery (1.72×10^{-4} to 1.74×10^{-4} cm/sec). Given an aquifer saturated thickness of 333 ft, the hydraulic conductivity is 1.69x10-4 cm/sec. In conclusion, the hydraulic conductivity of the Burro Canyon aquifer at PW-5 ranges from a low of $1.73x10^{-4}$ cm/sec (the geometric mean of two recovery test analyses) to a high of $3.98x10^{-4}$ cm/sec (the Theis analysis) with a best estimate of $3.48x10^{-4}$ cm/sec.

PW-6. Two pumping tests were conducted at well PW-6 shortly after well completion and development: a 2-hour step-drawdown test on June 5 and a 24-hour constant discharge test on June 6 - 7, 2005. The step-drawdown test in PW-6 was conducted on May 19, 2005 using a 50 hp Grundfos 230S submersible pump was set at 435 ft bgs on 3-inch drop pipe. Step tests were conducted at 245, 260, 272, and 282 gpm. Each step was run for approximately 30 minutes, and water levels stabilized quickly at each flow rate. The maximum drawdown was 59.5 ft at a flow rate of 282 gpm .

The non-linear well loss constant (C) was calculated from Jacob (1950) to be $1.86x10^{-4}$ ft/gpm^2 and the linear well loss coefficient was calculated at 0.16 ft/gpm, as summarized in 7.1. These constants can be used to calculate the expected drawdown for any pumping rate. For example, the expected drawdown resulting from aquifer loss and well loss at a pumping rate of 400 gpm is 92.4 ft

PW-9. An 18.25-hour pumping test was conducted in well PW-9, from September 13 - 14, 2007 using a 15 HP Grundfos 150S submersible pump to accommodate the low flow rates. The pump intake was set at 298 ft below ground surface, and the water level was drawn down to the pump intake with an average pumping rate of 33.9 gpm. Water levels were measured throughout the 18.25-hour pumping test and for 28 hours after the pump was shut off, at which time the water level had recovered to within 2.7 feet of the static, pre-test water level. The pumping and water level recovery data from the 18.25-hour pumping test was analyzed using unconfined and leaky solutions. Analysis of the drawdown data yielded higher hydraulic conductivities (geometric mean = 4.06×10^{-5} cm/sec) than recovery data (geometric mean = 1.57×10^{-5} cm/sec). The best estimate of aquifer hydraulic conductivity at PW-9 is 2.52×10^{-5} cm/sec.

PW-12. An aquifer pumping test was conducted at well PW-12 shortly after well development in October, 2012. The well was pumped at three different flow rates (steps) leading into a constant discharge test and a recovery test. The stepped flow rates of 46 gpm, 62.2 gpm, and 99.5 gpm were selected based on the characteristics of the aquifer and the limitations of the test pump. For the constant discharge test, PW-12 was pumped at an average flow rate of 96 gpm for 24 hours, resulting in 155.7 ft of drawdown. Water levels recovered to within 4 feet of static in less than two hours.

The hydraulic conductivity analysis was conducted using a Theis solution for the step test in a confined aquifer, and was solved as both fully penetrating (where thickness b = 200 ft) and partially penetrating (where b= 400 ft and screen length L = 200 ft). The fully penetrating solution provided more realistic results, as the well efficiency was more reasonable (63% FP vs. 111.3% PP). The fully penetrating solution is plausible since the well is completed with filter pack sand to the top of the aquifer. Storage was fixed at 0.00005 in the analysis, however the solutions are insensitive to this parameter. The best estimate of Burro Canyon aquifer properties at PW-12, based on the fully penetrating analysis, is transmissivity (T) =235 ft^2/day, b = 200 ft, and hydraulic conductivity K= 1.2 ft/d ($4.2x10^{-4}$ cm/sec). Note, however, that aquifer boundary conditions have a more significant effect on actual drawdowns observed during longer-term pumping in Lisbon Valley.

PW-12 is equipped with a permanent submersible pump, and is plumbed into the raw water system. Static water level prior to pumping was 5,830.8 ft amsl (500.6 ft btoc). Well PW-12 currently yields approximately 150 gpm with drawdown of 700 ft. Specific capacity ranges from 0.63 to 0.84 gpm/ft with an average of 0.70 gpm/ft.

17RC-243. An aquifer pumping test was performed in open borehole 17RC-243 on March 13, 2018. The bore hole was pumped for 175 minutes at an average rate of 6.64 gpm (ranging from 0.8 to 25 gpm). Flow rate during the test was highly variable, as valve adjustments were made to achieve a relatively constant discharge rate under changing head conditions. A total of 1,162 gallons were pumped, resulting in a drawdown of 28.55 ft. Plots of residual drawdown showed a change in slope at about t/t' = 2.6 to 2.7, indicating that recovery data were affected by a boundary condition at about 103 to 110 minutes after the pump was shut off, with the water level recovery prior to 103 minutes being affected by higher hydraulic conductivity of the formation closer to the well and recovery after 110 minutes being affected by lower hydraulic conductivity of the formation farther away from the well. The Theis analyses for confined and unconfined conditions considered the entire recovery dataset and provided identical estimates of transmissivity and hydraulic conductivity of 68 ft2/day and 2.3×10^{-4} cm/sec, respectively. The results of the Theis analyses fell between the high and low estimates from the residual drawdown analyses.

7.2.1.2 N Aquifer

PW-7. Two pumping tests were conducted in well PW7 shortly after the well was deepened and cased in June 2006: a 2.5-hour step-drawdown test and a 24-hour constant discharge test. Four steps were conducted for approximately 30 minutes each, at pumping rates of 160, 145, 132, and 130.4 gpm. Drawdown stabilized at 39.2, 37.8, 34.4, and 33.9 for each step, respectively, resulting in a non-linear well loss constant (C) of 5.3×10^{-4} ft/gpm2 and a linear well loss coefficient of 0.18 ft/gpm.

The 24-hour constant-discharge pumping test in PW-7 was conducted at an average flow rate of 147.2 gpm, and a total of 206,700 gallons were pumped. Maximum drawdown at the end of 24 hours was 51 feet, equating to a specific capacity of 2.9 gpm/ft. The results were analyzed using the Theis, Theis recovery, Cooper-Jacob, Cooper-Papadapalous, and Jacob recovery methods, and indicated higher hydraulic conductivity results during pumping (2.56×10^{-4} to 3.98×10^{-4} cm/sec) than during recovery (1.72×10^{-4} to 1.74×10^{-4} cm/sec). The analysis concluded that the hydraulic conductivity of the N-aquifer at PW-7 ranges from a low of 1.19×10^{-4} cm/sec (the Jacob early-time recovery test analyses) to a high of 6.43×10^{-4} cm/sec (the Theis analysis) with a best estimate of 2.89×10^{-4} cm/sec

Water levels were measured in monitoring well MW97-13, which is completed in the N-aquifer 1,358 feet from well PW-7. The monitoring well showed no response to pumping at PW-7.

PW-11. An aquifer pumping test was conducted on well PW-11 in July 2013. The well was pumped at an average rate of approximately 30 gpm for 8.5 hours, for a total of 16,260 gallons discharged. The pump was shut off when the water level drawdown approached the pump intake.

PW-11 was equipped with a permanent submersible pump, and is plumbed into the raw water system. Static water level prior to pumping was 5,183.4 ft amsl (1,148 ft btoc). The well yields approximately 50 gpm with drawdown of 500 – 550 ft. Specific capacity ranges from 0.06 to 0.12 gpm/ft with an average of 0.09 gpm/ft.

7.3 LVMC Pump Test Conclusions

LVMC pump testing supports anticipated hydraulic conductivity in the BC aquifer from 10^{-4} to 10^{-3} cm/sec range. This range is suitable for ISR at the head pressures that will be induced from gravity flow from surface ponds.

Table 7.1 Summary of Hydraulic Conductivity Results

Well	Pump Intake Depth (ft)	Aquifer	Final Drawdown (ft)	Hydraulic Conductivity Low Range (cm/sec)	Hydraulic Conductivity High Range (cm/sec)	Hydraulic Conductivity Best Estimate (cm/sec)	Hydraulic Conductivity Best Estimate (ft/day)
PW-5	512	Burro Canyon	61.54	---	---	---	---
PW-5	512	Burro Canyon	83.57	1.71E-04	3.98E-04	3.48E-04	0.99
PW-6	435	Burro Canyon	59.47	---	---	---	---
PW-6	435	Burro Canyon	65.96	2.23E-03	6.21E-03	2.66E-03	7.53
PW-12	794.6	Burro Canyon	155.71	4.20E-04	4.20E-04	4.20E-04	1.19
LS-243	295.3	Burro Canyon	28.55	1.10E-04	4.50E-04	2.30E-04	0.65
PW-7	1,000	N-aquifer	39.18	---	---	---	---
PW-7	1,000	N-aquifer	51.49	1.19E-04	6.43E-04	2.89E-04	0.82
PW-11	---	N-aquifer	---	---	---	---	---
PW-12		Burro Canyon		---	---	---	---
PW-12		Burro Canyon	155.71	4.20E-04	4.20E-04	4.20E-04	1.19

7.3.1 LVMC Pump Testing 1995-2013

In addition to the tests described above, Adrian Brown Consultants and Whetstone Associates conducted numerous aquifer tests in wells and boreholes, with and without observations wells, from 1995 to the present at the Lisbon Valley site. These tests included constant discharge pumping tests, variable-discharge pumping tests, step-drawdown tests, and slug tests in wells SLV3, PW-1, PW-2, PW-3, PW-4, 95R1, and MW96-7B, and in piezometers 98R3, 98R4, 98R7, 98R8, and PW97-1A.

Based on review of the testing results by LVMC, significant conclusions from the testing indicate:

- Transmissivity of the BC aquifer based on the analysis of late time data averaged about 122 ft^2/day, with a geomean hydraulic conductivity of 0.61 ft/day ($2.1x10^{-4}$ cm/sec). The specific storage of the BC aquifer is estimated at $3x10^{-5}$ (dimensionless).

- The best estimate of transmissivity for the N aquifer is about 400 ft^2/day, with a hydraulic conductivity of 2.9x10-4 cm/sec. The specific storage of the N aquifer is estimated at $1x10^{-5}$ (dimensionless).

- The vertical hydraulic conductivity of the Morrison aquitard calculated using the Field Determination of the Hydraulic Properties of Leaky Multiple Aquifer Systems method (Neuman and Witherspoon, 1972). Vertical conductivities ranged from $5.0x10^{-8}$ to $5.25x10^{-7}$ cm/sec.

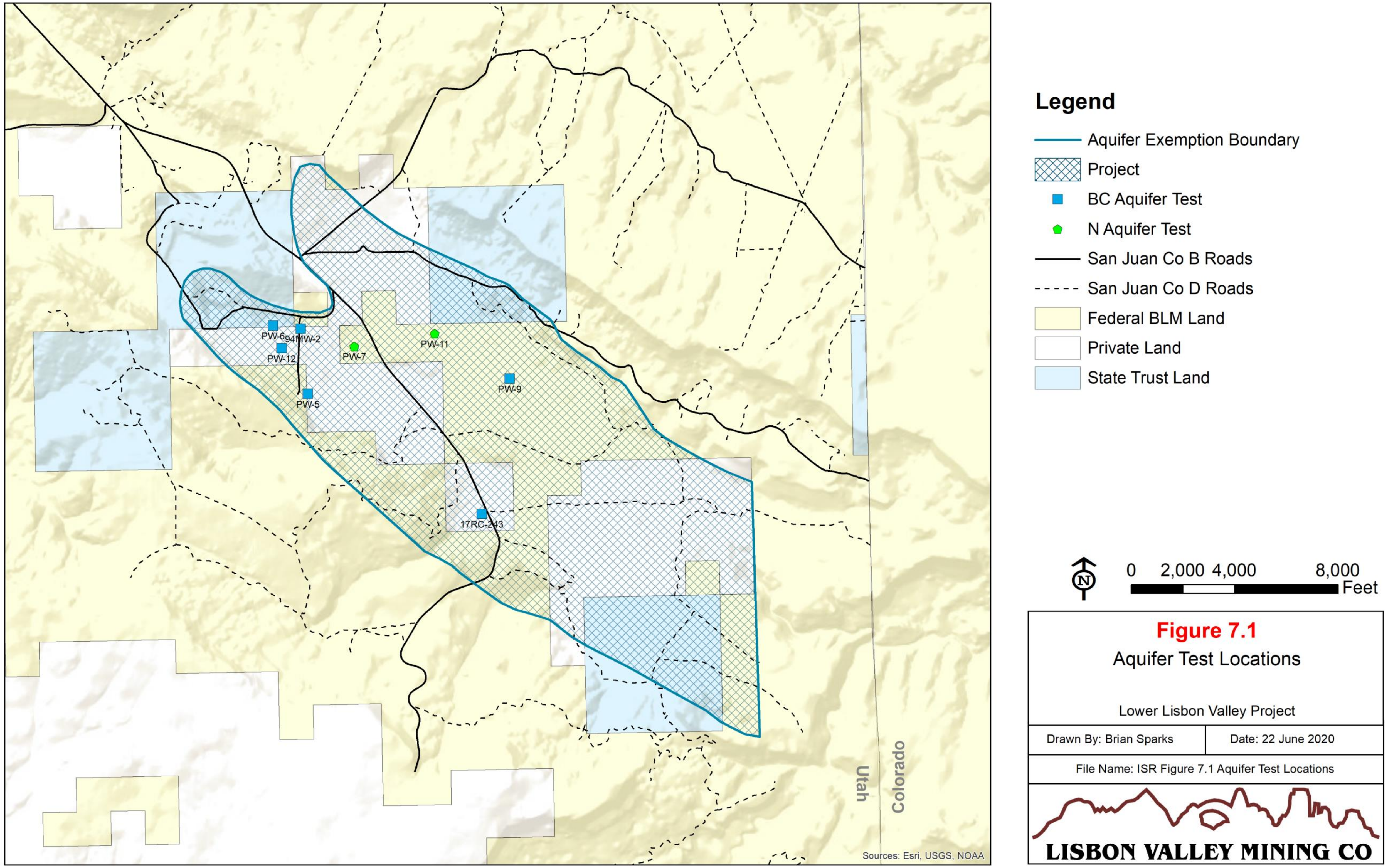


Figure 7.1
Aquifer Test Locations

7.4 PW-5 Transducer Test & Study

LVMC conducted a groundwater elevation study in the summer of 2019 as part of well rehabilitation work on BC aquifer production well PW-12. The study involved intermittent groundwater pumpage from on both sides of the GTO fault. This fault isolates the BC and N aquifers along the 3 Step footwall. The study focused on groundwater monitoring at the fault (PW-5) during intermittent pumpage from the hanging wall (PW-12) and footwall (Woods well). Groundwater elevation monitoring at the GTO fault was accomplished using a pressure transducer in PW-5.

7.4.1 Background

PW-12 is an important supply well located in LLV near the GTO deposit in the BC aquifer. Since installation in 2012, pumpage from PW-12 has locally dewatered the BC aquifer including water levels in former BC production well PW-5. This well is currently used as a piezometer with insufficient water for pumping. The Woods well is located on the 3 Step footwall and pumps groundwater from the N aquifer. The N aquifer head at the Woods wells is >200 feet higher than the BC aquifer head at PW-5. Therefore an influent head gradient occurs across the GTO fault. Both PW-12 and Woods well are aggressively pumped in the summer due to high process water demands at the Lisbon Valley Mine. Well locations and GTO fault are shown on Figure 7.6.

PW-5 terminates in the GTO fault separating the BC aquifer from N aquifer along the 3 Step footwall. It's location and design are ideally located for groundwater elevation changes from PW-12 pumping. It is equally well suited for monitoring potential groundwater elevation changes from water leakage across the GTO fault from the 3 Step footwall.

The summer of 2019 was highly problematic with well pump failures at PW-12 and pump cavitation issues at the Woods well. This resulted in both wells being pumped intermittently and at separate times. The aggressive, yet intermittent pumpage from both aquifers located on separate sides of the GTO fault provided an ideal opportunity to implement transducer monitoring in PW-5.

Figure 7.7 shows the PW-5 pressure hydrograph and 5-week time period extending from July 8 to August 13. Woods well began its seasonal pumpage on July 8 at a rate of 150 gpm. At this time, PW-12 was pumping at a rate of 120 gpm. On July 14, the column pipe failed on PW-12 damaging the pump and taking the well out of service. This resulted in an immediate head inflection at PW-5 (Inflection #1). The pump was reinstalled in in PW-12 on July 17 without knowledge that the pump was damaged. This resulted in a second inflection as PW-12 pumpage decreased PW-5 groundwater elevation (transducer pressure). Near the end of July the flow rate from the damaged pump in PW-12 began to decline. This resulted in 3rd inflection as the pressure head at PW-5 increased. PW-12 was taken out of service at 3rd time on July 31 and the pump replaced on August 11. This resulted in a 4th inflection as pumpage reduced pressure at PW-5.

The Company is continuing PW 5 study and analysis.

Figure 7.2 PW-5 Transducer Study Location Map

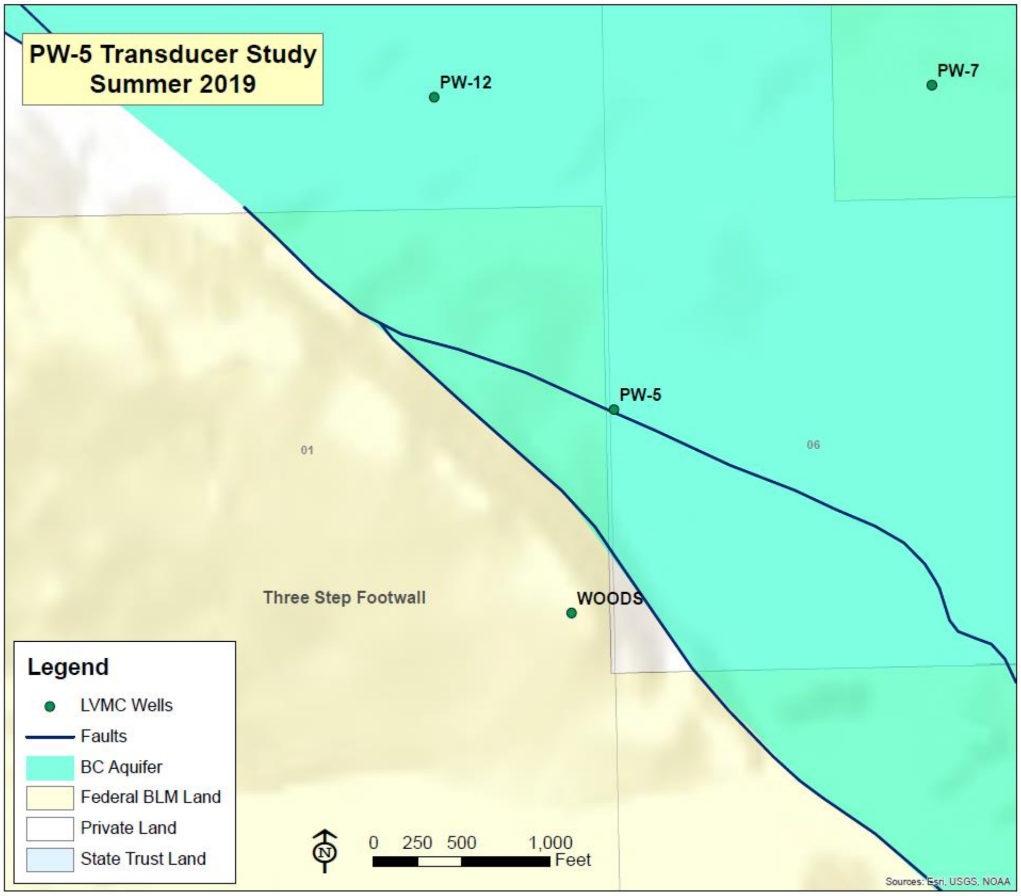
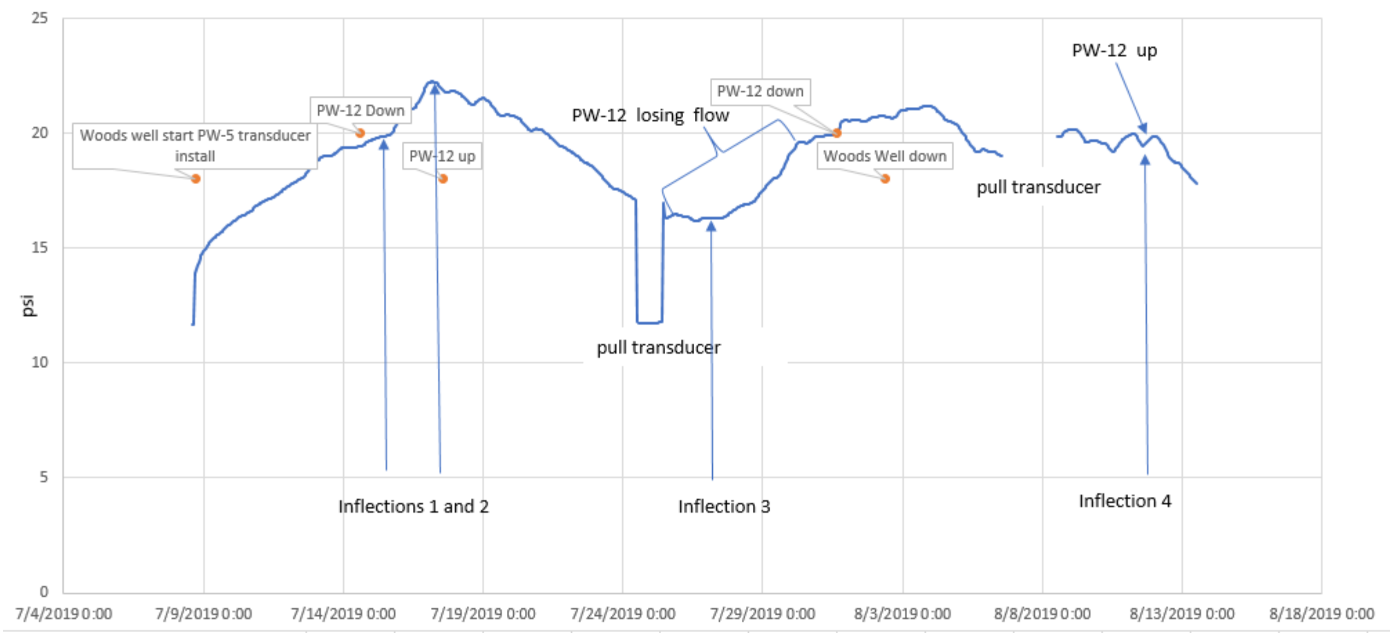


Figure 7.3 PW-5 Transducer Pressure



7.4.2 Summary and Conclusions

The BC and N aquifers occur juxtaposed along the GTO fault near PW-5. The aquifers were both pumped intermittently over a 5-week period at flow rates greater than 100 gpm. Pumpage from the BC aquifer at PW-12 influences the BC aquifer head at PW-5. The pressure influence is almost immediate reflecting hydraulic connection and confined groundwater conditions. Pumpage from the Woods well does not appear to influence the pressure head at PW-5. The GTO fault appears to behave as a hydraulic seal reflecting the occurrence of high SGR material.

7.5 Pre-Operational Pump Testing for Each Well Field

The following pump testing procedures will be used to establish that the production and injection wells are hydraulically connected to the perimeter production zone monitor wells, that the production and injection wells are hydraulically isolated from non-production zone vertical monitor wells, and to detect potentially improperly plugged wells or exploration holes. Pump testing results will be included in the well field hydrogeologic data packages.

7.6 Pump Testing Design

An extensive pump test program will be designed and implemented prior to operation of each well field to evaluate the hydrogeology and assess the ability to operate the well field. Prior to pump testing several important well field development steps will be completed:

1) Delineation drilling at spacing sufficient to finalize well field design. As standard procedure, all delineation holes will be plugged and abandoned after drilling.

2) Detailed mapping of the ore bodies targeted for ISR operations and the lithology of overlying and underlying confining units.
3) Revision of the conceptual geology and hydrogeology including definition of aquitards and ore zone units to be produced or monitored.
4) Design of the production and injection wells including well locations and screened intervals.
5) Design of the monitor well system based on production and injection well locations and refined conceptual geology and hydrogeology.
6) Specification of all monitor well locations and screened intervals.
7) Installation of all monitor wells and production wells to be used during pump testing.

7.7 Pump Test Procedures

Appropriate wells as needed for characterization and regulatory purposes will be monitored during the pumping test, including but not necessarily limited to the following wells:

1) Pumping wells,
2) Monitor wells within the production zone,
3) Perimeter production zone monitor wells,
4) Monitor wells in the immediately overlying non-production zone sand unit,
5) Monitor wells in each subsequently overlying non-production zone sand unit,
6) Monitor wells in the alluvium, if present,
7) Monitor wells in the immediately underlying non-production zone sand unit, if the production zone does not occur immediately above the Morrison,
8) Any additional wells installed for investigating other hydrogeologic features, and
9) Any other wells within proximity to the well field that have been identified as having the potential to impact or be impacted by ISR operations

In general, the monitoring system wells will be monitored using downhole data logging pressure transducers, which will be corrected for variations in barometric pressure. Some manual measurements with electronic meters also may be made.

Prior to testing, static potentiometric water levels will be measured in every well in the monitoring system. Where a sufficient number of data points exist, these data will be used to map the pre-operational potentiometric surface for each unit including alluvium, where present. Because of the high density of wells and, any leakage across aquitards due to improperly plugged boreholes or wells typically will become apparent while preparing potentiometric surface maps. Water samples will be collected from selected N aquifer monitor wells and analyzed for baseline parameters. The N aquifer water quality will be evaluated to identify any potential areas of leakage across aquitards due to improperly plugged boreholes or wells.

Pump testing will involve inducing stress on the production zone ore zone by operating pumping wells. The goal of the test will be to demonstrate suitable conditions for ISR operations. This will be done by causing drawdown in the production zone extending to all perimeter monitor wells, creating a cone of depression across the well field area to test the confinement between the ore zone and the overlying and underlying confining units, if present, and addressing potential leakage through confining units via improperly sealed or unplugged exploration boreholes, or associated with naturally occurring geologic features. The presence or lack of response in vertical monitor wells will be used for evaluation of confinement between these units and for identification of leakage due to anomalies such as improperly plugged boreholes. If leakage is present, the relative responses in the overlying, underlying, and/or alluvial monitor wells will indicate the proximity and direction toward the source of leakage.

The pumping test duration will be sufficient to create a suitable response in the perimeter monitor wells, typically a minimum drawdown of 1 foot. If hydrogeologic conditions dictate, less response may be adequate to show a direct cause and effect from pumping.

The flow rate of the pumping test will be based on well capacity and design requirements. More than one pumping well may be required to create drawdown in all perimeter wells.

Measurements during pump testing will include instantaneous and totalized flow, periodic pressure transducer measurements, barometric pressure, and time. A step rate test will be performed initially. There will be an initial stabilization phase with no flow, a stress period of constant flow, and a recovery period with no flow

7.8 Pump Test Evaluation

Evaluation of pump test data will address the following:

1) Demonstration of hydraulic connection between the production and injection wells and all perimeter monitor wells and across the ore zone.
2) Verification of the geologic and hydrologic conceptual model for the well field.
3) Evaluation of the vertical confinement and hydraulic isolation between the production zone and overlying and underlying units.
4) Calculation of the hydraulic conductivity, storativity, and transmissivity of the ore zone.
5) Evaluation of anisotropy within the ore zone.

7.9 Well Field Hydrologic Data Packages

Pump testing data and results will be included in the well field hydrogeologic data packages, which will be prepared in accordance with UDWQ permit requirements. This section describes the contents and evaluation of the well field hydrogeologic data packages. These will be reviewed by the UDWQ.

Upon completion of field data collection and laboratory analysis, the well field hydrogeologic data packages will be assembled and submitted for review by the UDWQ UIC Program for evaluation. The UDWQ UIC Program evaluation will determine whether the results of the hydrologic testing and the planned ISR operations are consistent with standard operating procedures and technical requirements stated in the UDWQ permit. The evaluation will include review of the potential impacts to human health and environment. Relevant portions also will be included in the injection authorization data packages. If anomalous conditions are present or the evaluation indicates potential to impact human health or the environment, the well field hydrogeologic data package will be submitted to UDWQ for review and approval. The well field hydrogeologic data package and written evaluation will be maintained at the site and available for regulatory agency review.

Each well field hydrogeologic data package will contain the following:

1) A description of the proposed well field (location, extent, etc.).
2) Map(s) showing the proposed production and injection well patterns and locations of all monitor wells.
3) Geologic cross sections and cross section location maps.
4) Isopach maps of the production ore zone and overlying and underlying confining units.
5) Discussion of how pump testing was performed, including well completion reports.
6) Discussion of the results and conclusions of the pump testing, including pump testing raw data, drawdown match curves, potentiometric surface maps, water level graphs, drawdown maps and, when appropriate, directional transmissivity data and graphs.
7) Baseline water quality information including proposed upper control limits (UCLs) for monitor wells and target restoration goals (TRGs).
8) Any other information pertinent to the proposed well field area tested will be included and discussed.

7.10 Injection Authorization Data Packages

Injection authorization data packages will be prepared and presented to UDWQ for each well field. Each injection authorization data package will contain the following: A description of the proposed well field (location, extent, etc.).

1) Map(s) showing the proposed production and injection well patterns and locations of all monitor wells.
2) Geologic cross sections and cross section location maps.
3) Discussion of how pump testing was performed, including well completion reports and MIT results.
4) Discussion of the results and conclusions of the pump testing, including pump testing raw data, drawdown match curves, potentiometric surface maps, water level graphs, drawdown maps and, when appropriate, directional transmissivity data and graphs.
5) The calculated formation fracture pressure for each well and the designated maximum injection pressure for each well.
6) Commitment to completing MIT and preparing well completion reports for all injection wells prior to initiating injection into the well field.
7) Schedule for proceeding with operation of the well field.

8.0 PART F - Well Stimulation Plan

A stimulation program is not proposed for the Project injection wells.

Well development (described in Section 11.4), which will include swabbing, will be used to improve well yield by enhancing hydraulic communication between the aquifer and the well.

9.0 PART G - Injection Well Construction Plan

The Company will install all wells using a downhole hammer and compressed air or reverse circulation. Hole sizes will range from 6 ½ to 9 7/8". Limited additives will be used to form a wall cake in the Mancos Fm.

10.0 PART H - Injection Construction Details

This attachment details the construction procedures that will be utilized for injection, production and monitor wells at the Project. All injection and production wells will be completed in accordance with Utah well construction standards and EPA standards for Class III UIC wells.

10.1 Well Construction Materials

Well casing material will be polyvinyl chloride (PVC) and High Density Polyethylene (HDPE) with minimum SDR 17 wall thickness. Use of this casing material has been approved at other ISR sites, such as the Cameco Resources Smith Ranch Project in Wyoming, also known as the Crow Butte Site (Cameco, 2012; NRC, 2016). The construction of the wells within the AOR will mirror that of the Crow Butte Site, which states:

"The typical well casing used is rigid PVC Standard Dimension Ratio 17 (SDR-17) with a nominal 13 centimeters (5 inches) outside diameter (Certainteed or similar). However, should a larger pump size be required, larger diameter casing may be utilized."

The hole will be cased with 12-inch steel surface casing outside nominal 5 to 6 inches diameter SDR-17 PVC well casing. Fiberglass or steel casing may also be used. The casing will extend from the top of the top of the target zone to approximately 2 feet above ground level. Each joint of SDR-17 casing will be connected by a water tight O-ring seal which is locked with a high strength nylon spline. No glue or screws will be used with these types of well casing materials.

The wells typically will be 4.5 to 6-inch nominal diameter and will meet or exceed the specifications of ASTM Standard F480 and NSF Standard 14. In order to provide an adequate annular seal, the drill hole diameter will be at least 2 inches larger than the outside diameter of the well casing.

The annulus materials will be emplaced using a tremie pipe and sealed with neat cement grout composed of sulfate- resistant Portland cement in accordance with Utah wells construction standards. Water used to make the cement grout will not contain oil or other organic material. Cement grout could contain adequate bentonite to maintain the cement in suspension in accordance with Halliburton cement tables.

Casing will be joined using methods recommended by the casing manufacturer. PVC casing joints approximately 20 feet apart will be joined mechanically (with a watertight O-ring seal and a high strength nylon spline) to ensure watertight joints above the perforations or screens. Casings and annular material will be routinely inspected and maintained throughout the operating life of the wells.

10.1.1 Thermoplastic Well Casing Variance Request

The Company requests a variance from the requirement in 40 CFR § 147.2104(b)(1) that plastic well casing materials, including PVC, ABS or others, not be used in new injection wells deeper than 500 feet in the State of Utah. This variance is requested on the following basis:

1. Collapse pressure calculations and well casing manufacturer specifications indicate that PVC well casing can be used at depths greater than 500 feet considering the site-specific well construction methods (see Section 11.1.1.1).
2. PVC well casing has been used successfully for wells deeper than 500 feet at other

ISR facilities for many years (see Section 11.1.1.2).

3. PVC well casing is commonly used for other wells in Utah deeper than 500 feet (see Section 11.1.1.3).
4. Thermoplastic well casing is the preferred well casing material for ISR facilities due to corrosion resistance. The corrosion resistance of PVC compared to carbon steel well casing is well documented.
5. Each new injection, production and monitor well will be pressure tested to confirm the integrity of the casing prior to being used for ISR operations. MIT will be repeated every 5 years and after any repair where a downhole drill bit or under-reaming tool is used (see Section 11.5).
6. The injection pressure for each injection well will be maintained below the maximum pressure rating of the well casing (see Section 7.2).
7. An extensive excursion monitoring program will be implemented by installing and sampling monitor wells in the perimeter of the production zone and in overlying and underlying hydrogeologic units to detect potential excursions of ISR solutions into USDWs such as would occur with a leaking injection well (see Section 14.2).
8. Injection pressures will be monitored through automated control and data recording systems that will include alarms and automatic controls to detect and control a potential release such as would occur through an injection well casing failure (see Section 14.1).

The variance is requested pursuant to 40 CFR § 147.2104(d)(4), which states that the Regional Administrator may approve alternate casing provided that the owner or operator demonstrates that such practices will adequately protect USDWs.

10.1.2 Hydraulic Collapse Pressure Calculations

When specifying well casing and installation, the Company will adhere to the requirements in ASTM F480, Standard Specifications for Thermoplastic Well Casing Pipe and Couplings Made in Standard Dimension Ratios (SDR), SCH 40 and SCH 80. ASTM F480 requires that “the depth at which thermoplastic well casing can be used is a design judgment.” There is no depth of installation limit in ASTM F480 except that PVC well casing should be “used under conditions that meet manufacturer’s recommendations for its type” and that “the driller shall install the thermoplastic casing in a manner that does not exceed the casing hydraulic collapse resistance.” In accordance with these requirements, the Company will ensure that all thermoplastic well casing meets the manufacturer’s recommendations for its type and is installed in a manner that does not exceed the hydraulic collapse resistance.

The net hydrostatic pressure on the well casing is calculated as the difference between the exterior and interior hydrostatic pressure. The hydrostatic pressure is calculated as the fluid density multiplied by the fluid depth. The Company will use cement to grout the annulus on all injection, production and monitor wells. Using a typical cement grout density of 90 lb/ft3, and recognizing that the inside of the well casing will always be full of water before the cement cures (with a density of at least 62.4 lb/ft3 depending on whether additives are used), the pressure versus depth gradient will be about 27.6 lb/ft3 or about 0.2

psi/ft of depth. According to CertainTeed (2011), the hydraulic collapse pressure for SDR 17 PVC well casing is about 224 psi. Therefore, it would take an installation depth much greater than 1,000 ft to exceed this pressure as long as cement grout is used and the well casing remains full until the cement hardens. Both of these conditions will be met in all injection, production and monitor well casing installations using the installation procedures described in Section 11.2. Water will be used to displace the cement and force it upward into the annulus; therefore, the well casing will always be full of water while the cement cures.

When designing and installing injection, production and monitor wells, the Company will adhere to the requirements of ASTM F480 and manufacturer's criteria to ensure that the installation does not exceed the casing hydraulic collapse resistance.

10.1.3 Use of PVC Well Casing at Other ISR Facilities

There are numerous successful applications of PVC well casing at other ISR projects where the well depths are in excess of 500 feet. For example, at the Crow Butte project, where the average ore depth is 650 feet, 4.5-inch ID PVC well casing has been successfully used for many years. Both Taseko Mines Ltd. and Excelsior Mining Corp.'s copper ISR projects are projected to use either PVC, FRP or fiberglass well casing as part of well design for wells ranging up to 600 feet deep or more (Gunnison NI 43-101, 2017 and Florence NI 43-101, 2017). Both copper ISR projects are located in Arizona.

10.1.4 Utah Well Construction Standards

UAC R317-7-10 provides the Utah State guidelines for the construction of Class III wells as would be installed for the Project. Specifically, the Utah well construction standards state:

> All new Class III wells shall be cased and cemented to prevent the migration of fluids into or between underground sources of drinking water. The Director may waive the cementing requirement for new wells in existing projects or portions of existing projects where he has substantial evidence that no contamination of underground sources or drinking water would result. The casing and cement used in the construction of each newly drilled well shall be designed for the life expectancy of the well. In determining and specifying casing and cementing requirements, the following factors shall be considered:
>
> a. depth to the injection zone;
>
> b. injection pressure, external pressure, internal pressure, and axial loading;
>
> c. hole size;
>
> d. size and grade of all casing strings (wall thickness, diameter, nominal weight, length, joint specification, and construction material);
>
> e. corrosiveness of injected fluids and formation fluids;
>
> f. lithology of injection and confining zones; and
>
> g. type and grade of cement.

The Company will ensure that the Utah well construction standards are met during the engineering and installation of wells associated with the Project and will comply with UAC R317-7-10 monitoring requirements.

10.1.5 Compliance with 40 CFR § 146.32

The injection wells will comply with the 40 CFR § 146.32 regulations for protection of USDWs in Utah. The language stated in 40 CFR § 146.32 is a duplication of that found in the State of Utah R317-7-10.

10.2 Well Construction Methods

10.2.1 Injection Wells

Typical production and injection well installation will begin by drilling a bore hole through the ore zone to obtain a measurement of the copper grade and thickness. The ore depth is anticipated to range from approximately 200 to 900 feet. For all wells, the bore hole will be sampled and geologically logged. Samples will be collected at 5-10 ft intervals.

Injection wells will be constructed for use with packers. This will require a discontinuous screened interval and gravel pack separated by bentonite seals. A typical well is planned to have 4 to 8 20ft screened intervals separated by 5 ft intervals of blank casing. Casing centralizers will be installed as appropriate to allow uniform annular space. Gravel and bentonite will be tremied from the surface using separate gravel and bentonite tanks. The uppermost bentonite seal will extend a minimum of 10 feet above the uppermost screen. Following this the remaining annular space will be grouted to the surface using tremie pipe. Injection well design is shown on Figure 10.1. Injection wells

10.2.2 Extraction Wells

Extraction wells will be constructed with a continuous screened interval extending from the bottom of the well to a depth 10-20 feet below the top of the BC (Bed 15). The gravel pack will be tremied to a depth 10 feet above the top of screen. This will be followed with a minimum 10ft bentonite seal. The bentonite seal will be allowed to hydrate before grouting the well to surface. Extraction well design is shown on Figure 10.2.

10.3 Well Development

The primary goals of well development will be to allow formation water to enter the well screen, flush out drilling fluids, and remove the finer clays and silts to maximize flow from the formation through the well screen. This process is necessary to allow representative samples of groundwater to be collected, if applicable, and to ensure efficient injection and production operations. Wells will be developed immediately after construction using air lifting, swabbing, pumping or other accepted development techniques which will remove water and drilling fluids from the casing and borehole walls along the screened interval. Prior to obtaining baseline samples from monitor wells, additional well development will be conducted to ensure that representative formation water is sampled. The water will be pumped sufficiently to show stabilization of pH and conductivity values prior to sampling to indicate that development activities have been effective.

10.4 Well Rehabilitation

Extraction wells and injection wells may be rehabilitated over the course of mining in the event chemical precipitates affect yields. This will be conducted by acid-washing the screened intervals and reversing flows, and/or utilizing a work over drilling rig to surge and swab the wells using a surge block. Both injection and extraction wells are suitable submersible pump installation, acid washing and flows reversal. The primary goals of well rehabilitation will be to gently dissolve precipitates to open screened intervals and gravel pack.

Figure 10.1 Injection Well Construction Diagram

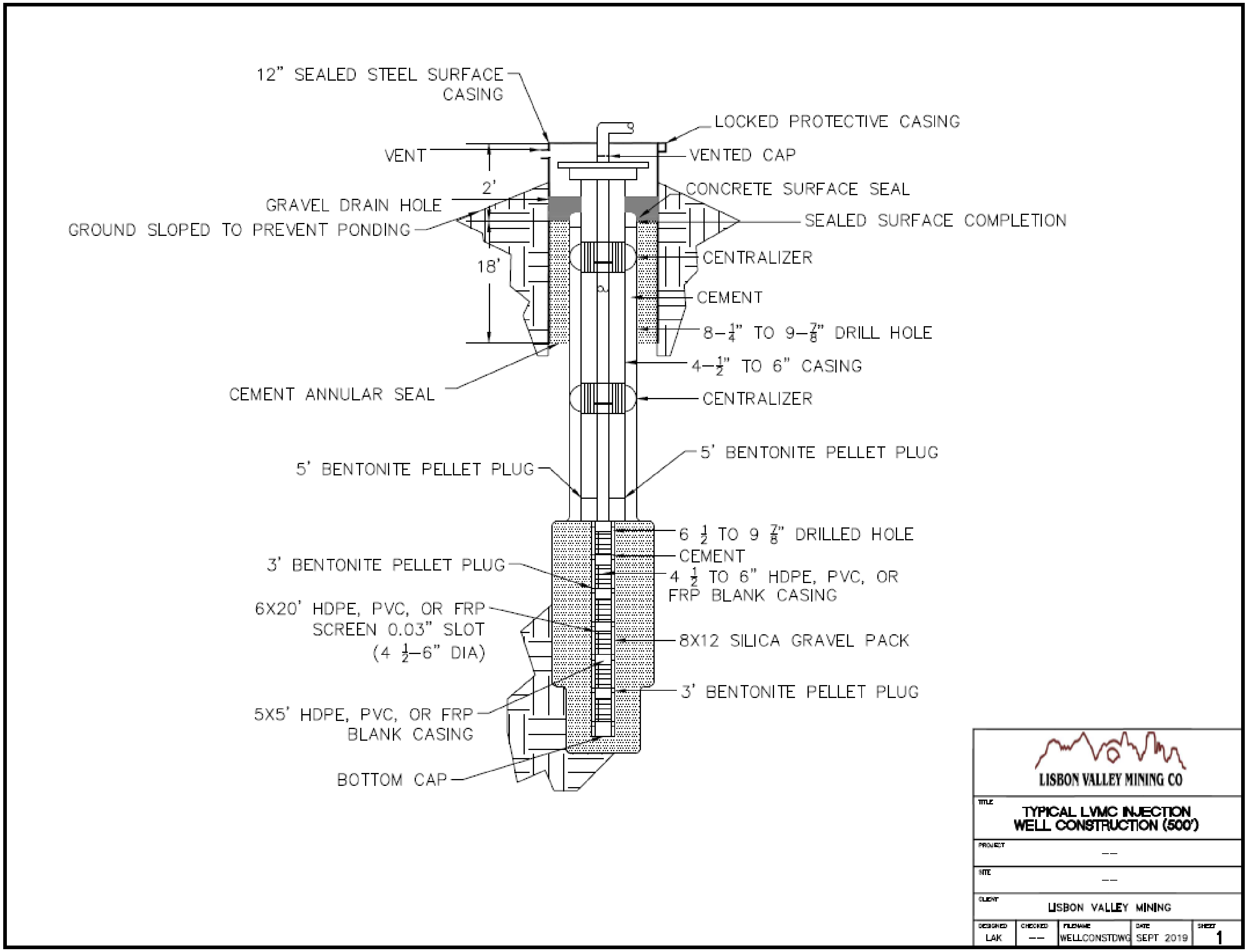


Figure 10.2 Production Well Construction Diagram

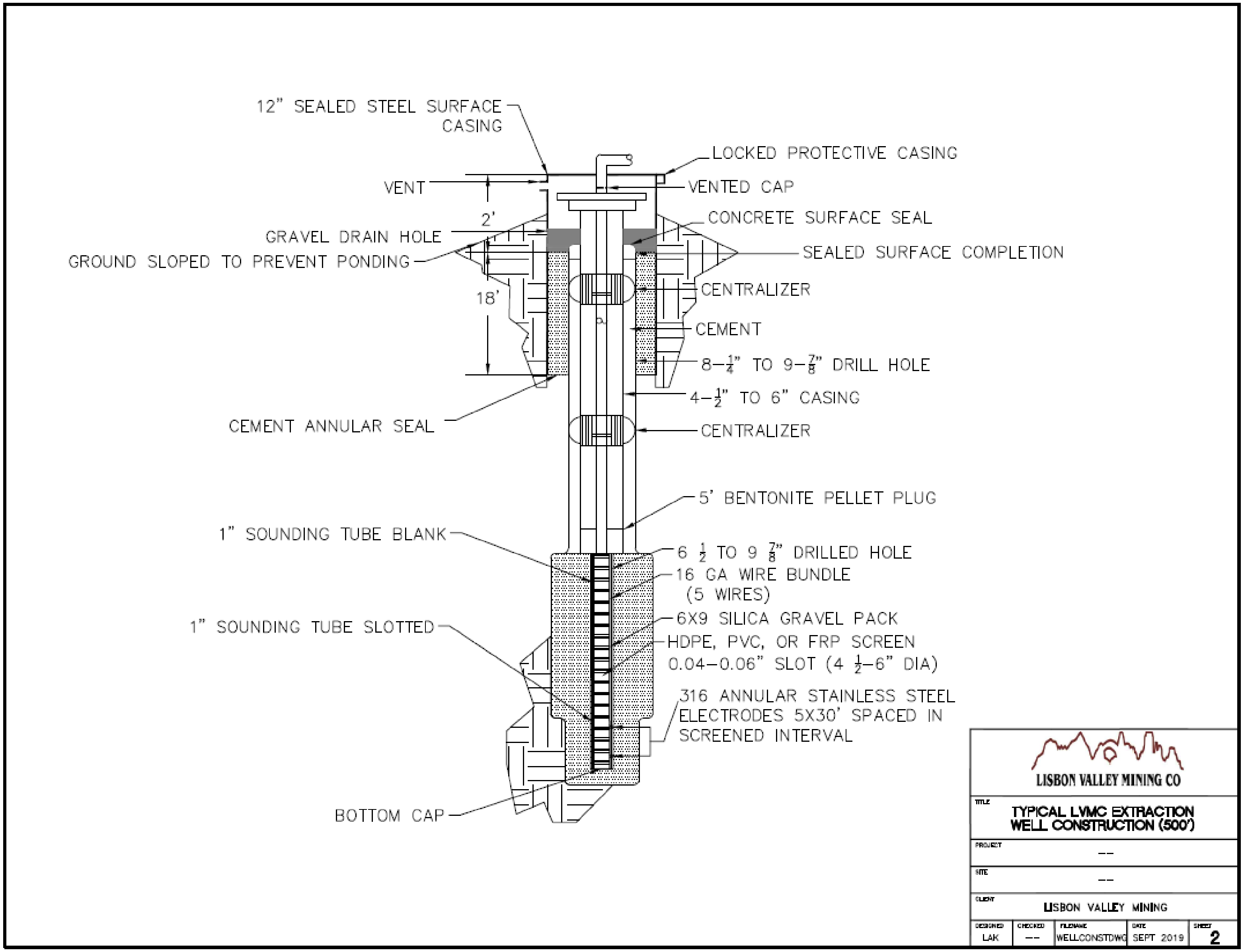


Figure 10.3 Injection Wellhead Construction Diagram

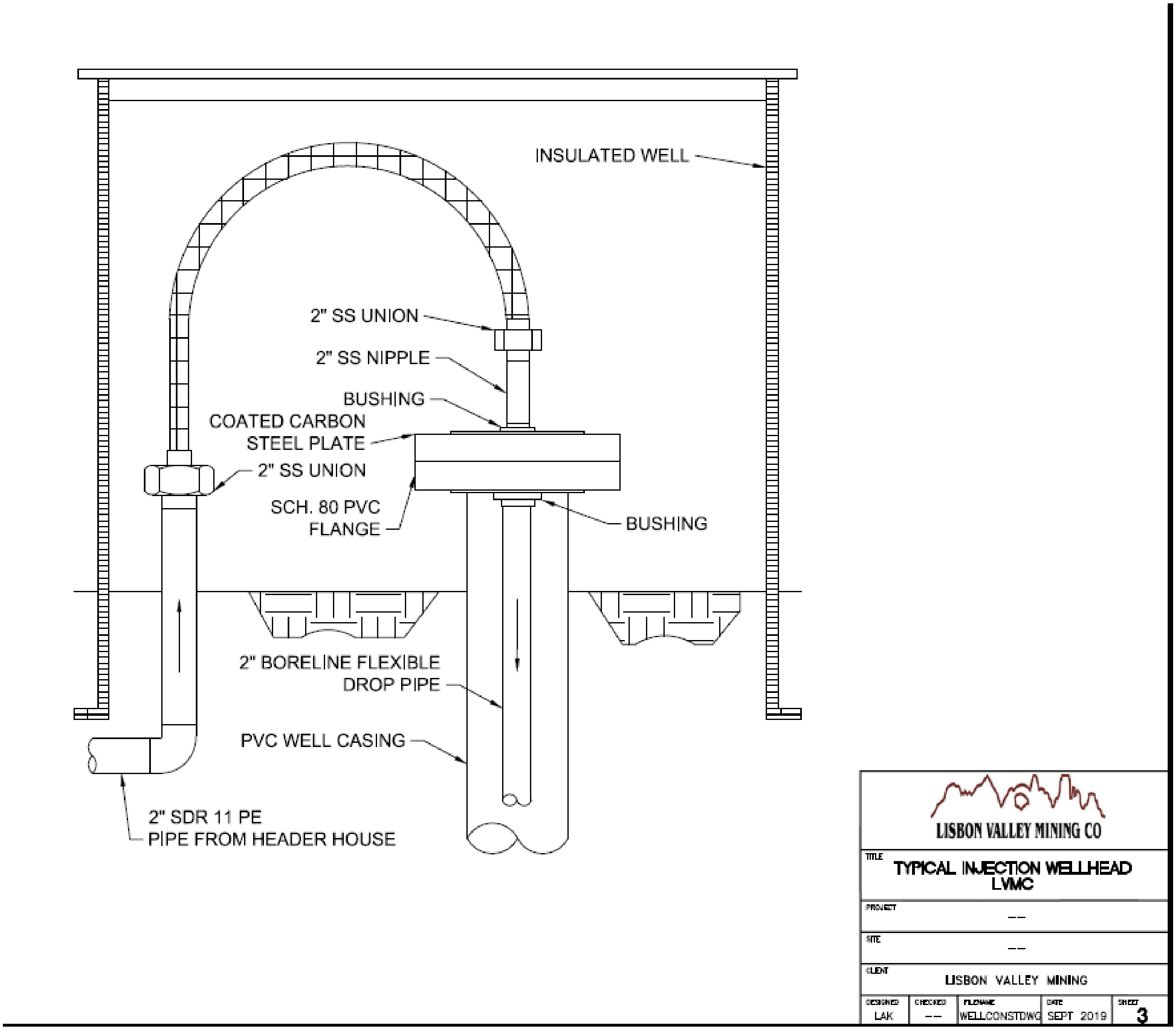
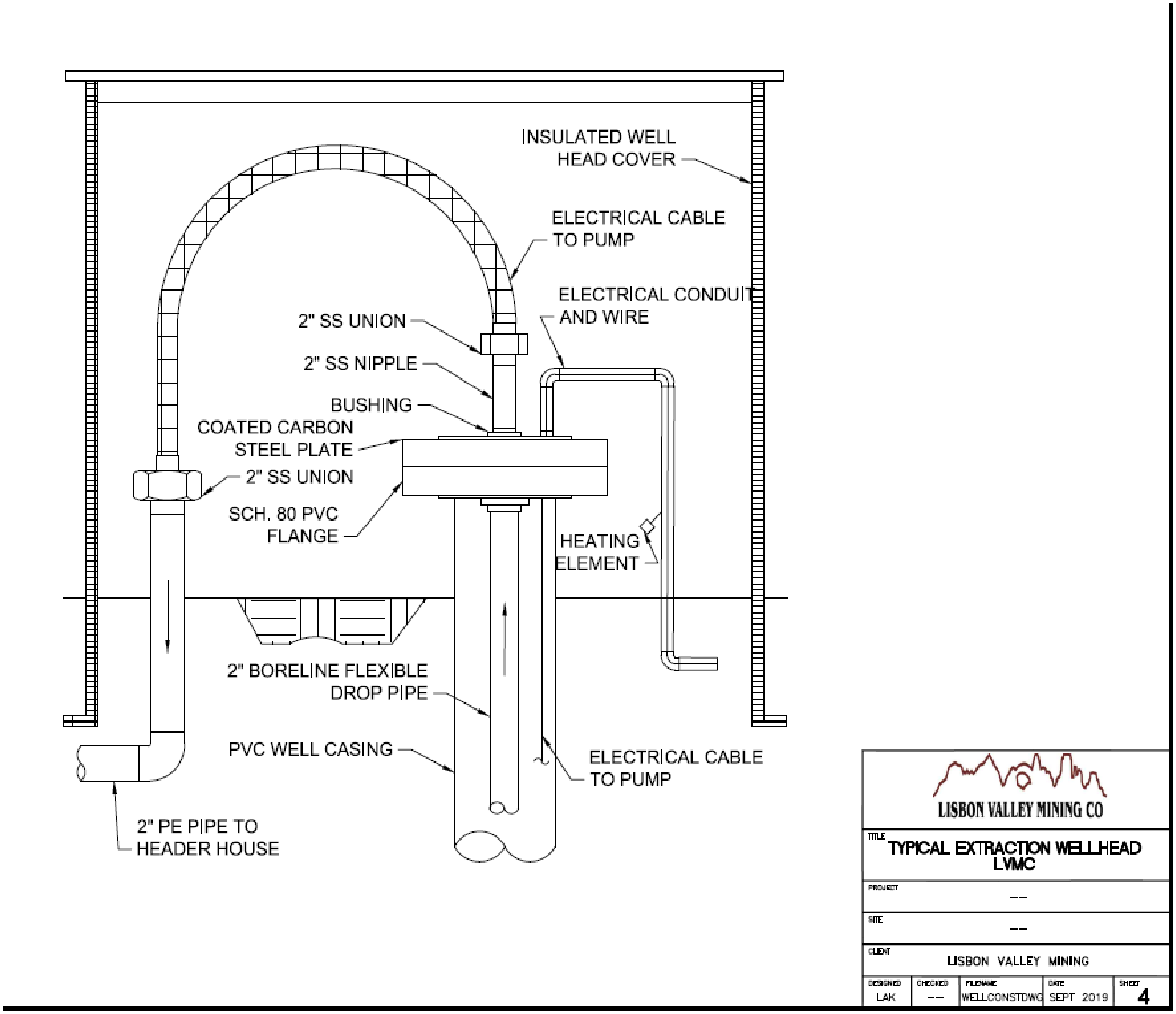


Figure 10.4 Production Wellhead Construction Diagram



Attachment E
Injection Well Operating Plan and Procedures

11.0 PART I - Injection Well Operating Plan and Procedures

This attachment presents an overview of ISR operations, including injection procedures. It describes the general design of ISR well fields and specific design considerations It also discusses hydraulic well field control, lined process ponds, groundwater restoration, and the project schedule.

11.1 Overview of Operations

The Project will implement ISR methods for copper extraction using existing process facilities and collection ponds and associated well fields for the first three deposits identified within the Project Area. These include GTO, Lone Wolf Deposits and Flying Diamond Deposits.

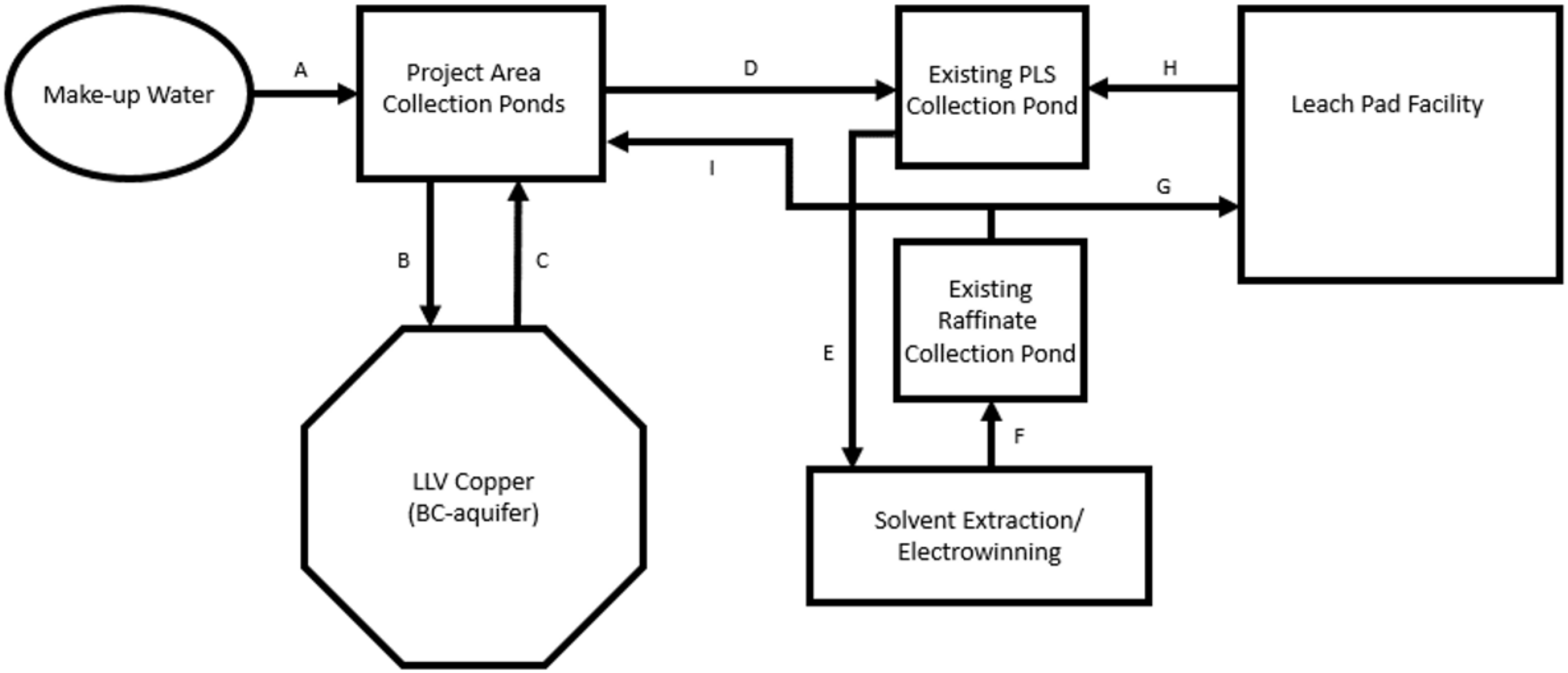
Copper will be recovered by injecting lixiviant fortified with oxygen into injection wells and recovering the resulting solution (pregnant lixiviant) from production wellfields. Copper solutions will be collected into three process collection ponds, a low copper grade solution collection pond (LLS), an intermediate copper grade solution collection pond (ILS), and high copper grade solution collection pond (PLS). The ILS collection pond will be used to recirculate ILS back though the deposit through injection to increase grade. When the ILS injection circuit reaches PLS concentration it will be redirected to the PLS collection pond. PLS will be piped to the Lisbon Valley Copper Mine and recovered via the Company's existing process facilities and solution will be returned to the well fields from the process facility collection ponds.

A fourth collection pond will be used for groundwater restoration at each deposit. It will be used to facilitate recirculation of groundwater from the mined-out areas of the wellfields. Restoration ponds will be plumbed to land application and/or wetland treatment cells. In addition, these ponds may be equipped with evaporation systems to concentrate TDS for deep well disposal.

The vast majority of water withdrawn from the production wells will be reinjected as part of the ISR process, such that the net withdrawal rate will be only a small fraction of the gross circulation rate. A small portion of the production and restoration streams will not be reinjected to maintain an inward hydraulic gradient within each well field for the duration of ISR mining and aquifer restoration activities.

Water for the ISR supply will be supplied from the BC aquifer to the extent possible. The BC aquifer is projected to be able to support ISR operations as well field operations are staged over time despite inconsistent productivity and presence throughout the Project Area. To the extent required, N aquifer water will be used to support ISR operations and also for BC aquifer restoration activity. Below is a schematic of the process flow.

Figure 11.1 Illustrative Flow diagram of the fluid flow associated with the ISR activities.



Stream ID	Description
A	Make-up water for leach operations
B	LLV injection
C	LLV extraction
D	Pregnant leach solution from ISR
E	Process plant feed
F	Copper barren solution to existing raffinate pond
G	Raffinate flow to existing heap leach operations
H	Pregnant leach solution from heap leach
I	Raffinate flow to ISR retention pond (Optional)

Monitoring systems will be implemented to ensure mining activities and changes in aquifer chemistry are contained to minimize potential impacts to the environment and public health. Monitoring systems will include both production wells and non-production wells along with related equipment to monitor groundwater chemistry in and surrounding the wellfields. Non-production monitoring wells will be equipped with pressure transducers prior to production. This will provide baseline information with which to correlate with ISR mining withdrawals, to further verify adequate confinement of mining fluids. Alert levels will be identified after production begins in accordance with pump testing at each wellfield for each monitoring well.

Aquifer restoration will be completed following copper recovery in each well field. During aquifer restoration, the groundwater in the well field will be restored in accordance with UDWQ requirements. Restoration will involve recirculation and rinsing the respective aquifers to restore a neutral pH and precipitate total dissolved solids (TDS). Final restoration may involve evaporation, land application, wetlands, and deep well injection.

A reclamation plan will be implemented in accordance with UDWQ permit and UDOGM large scale mine permit conditions to abandon wells, piping, wellfield controls, ancillary equipment, reclaim disturbed areas, and ensure that the Project Area meets all postmining land uses following ISR activities. See Section 14 for additional information.

11.2 Chemistry and Hydraulics of copper ISR

There are three primary components of successful copper ISR: i) mineral receptiveness to leaching or chemistry, ii) permeability of the host rock and iii) maintaining appropriate leaching conditions in the target ore zone.

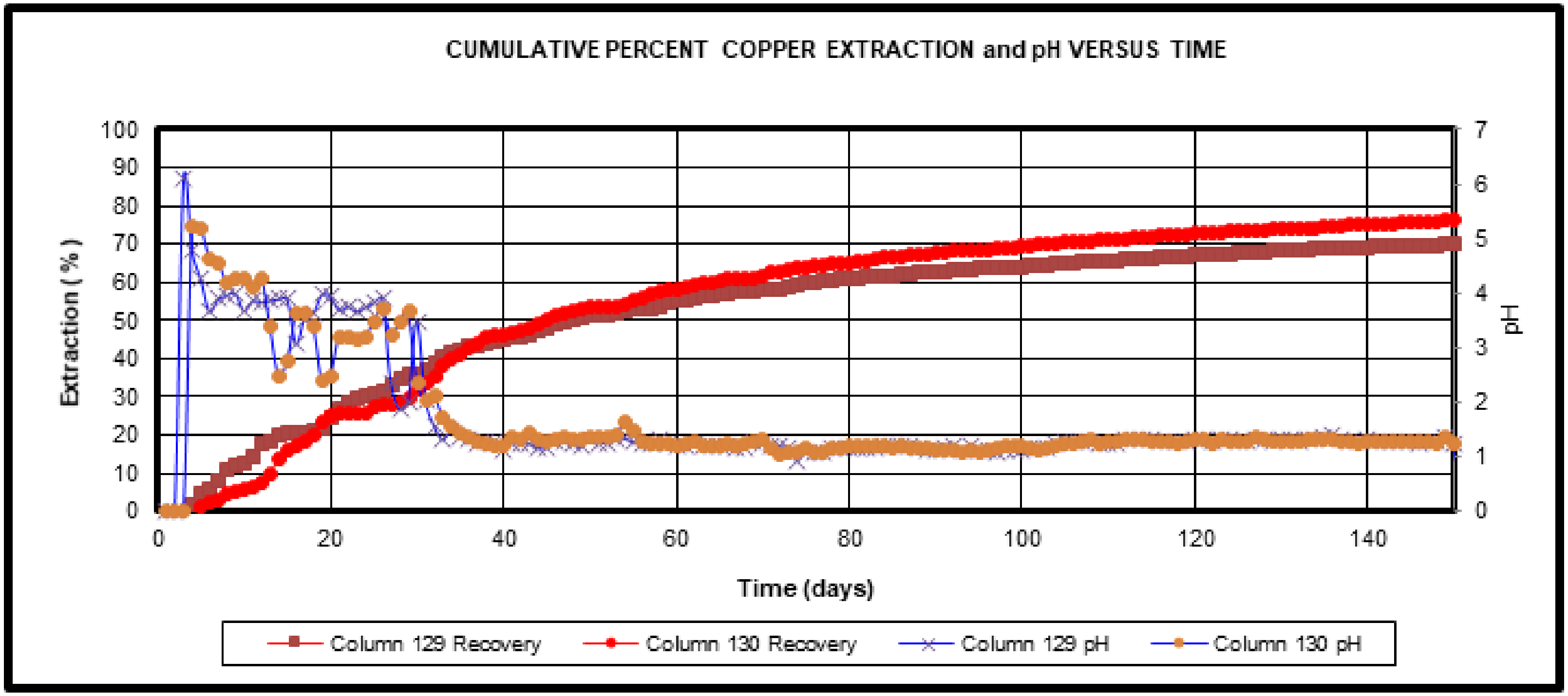
The ISR process involves the oxidation and solubilization of copper sulfide minerals in-situ, meaning "in-place" using a leaching solution (lixiviant). The lixiviant will consist of groundwater, dilute sulfuric acid gaseous oxygen. The lixiviant will be circulated through the ore deposit to oxidize and dissolve copper minerals into a copper-bearing solution consistent with leaching chemistry used to leach ore from open pit mining. The chemistry of copper sulfide oxidation and dissolution is described below:

$Cu_2S + 10Fe^{3+} + 15SO_4^{2-} + 4H_2O = 2Cu^{2+} + 10\ Fe^{2+} + 12SO_4^{2-} + 4H_2SO_4$

The Company will employ the iron based lixiviant where total iron and ferric iron levels are increased from baseline water level by lowering pH and adding dissolved air or oxygen. Ferric iron is the key leaching agent for copper mineralization at the LVMC and air or oxygen helps promote the amount of ferric iron in the leaching lixiviant. Copper recovery at Lisbon Valley has been approximately 65 – 75% using the same leaching chemistry over thirteen years in its open pit mining operations (this copper recovery chemistry is used throughout the copper industry).

Additionally, the Company has performed substantial column test work analyzing ISR copper chemistry in its laboratory which has confirmed 70% plus copper recovery which is commercially economic, an example of a set of column tests is show below in Figure 11.2. The Company has also performed confirmatory bench-scale core testing focused on copper recovery and rock permeability under anticipated operational pressures.

Figure 11.2 ISR Column Test Copper Recovery Relative to pH



ISR requires permeable ore bodies to facilitate introduction and extraction of lixiviant. The Company has performed multiple comprehensive aquifer tests in addition to collection of thirteen years of groundwater quality data from the BC aquifer, all of which indicate permeability and chemistry supportive of the ISR. The Company projects ISR operational flow rates (Section 6.10) based on the Company's pump test as well as planned well and pump design. 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 Company projects using a well packer system in order to control and monitor lixiviant sweep through the aquifer and related target zones. The Company has substantial operational and test data the support copper recovery when appropriate chemistry conditions are maintained under hydraulic pressure and flow.   The Company projects using water from throughout the BC aquifer in the Project Area in order to support ISR required hydraulics and flow rates and may augment water usage with water from the N aquifer.

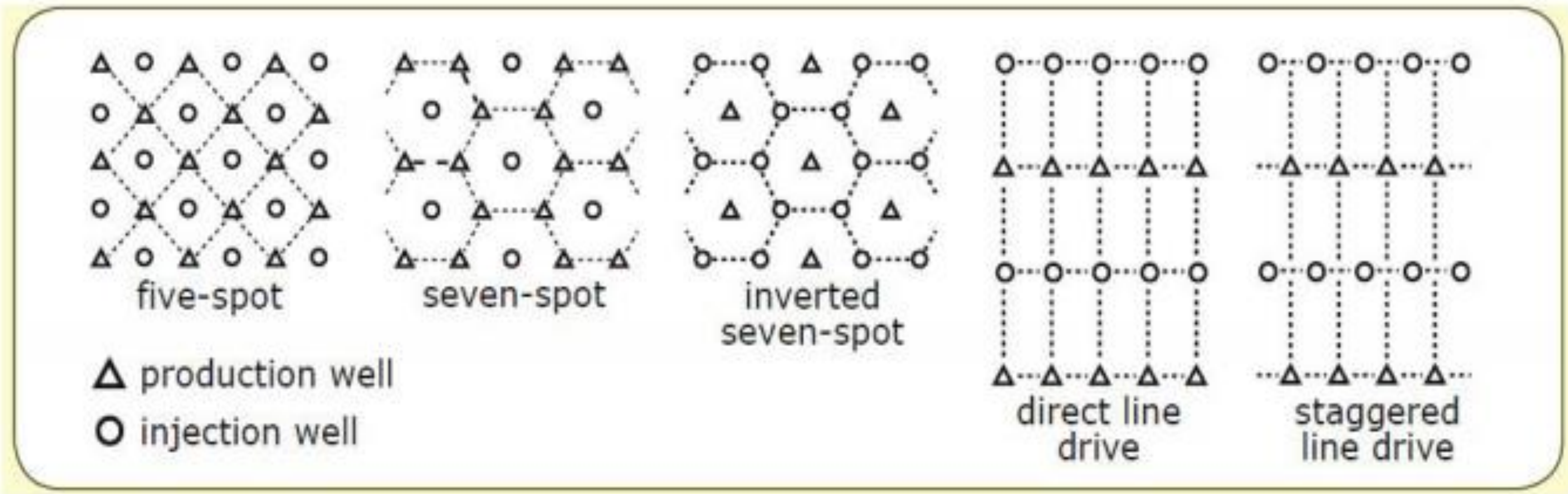
Finally, The Company already owns and operates an SX/EW processing facility and infrastructure that will be used to process copper bearing lixiviant from the ISR project into pure copper cathode identical to the Company's current finished copper product from open pit mining operations. The Company projects its ISR project to be commercially viable for approximately 28 years based on development of existing 508 million pounds of measured, indicated and inferred resources contained in three copper deposits, GTO, Lone Wolf and Flying Diamond plus additional resource potential associated with these deposits (LVMC, 2019).The Company maintains its copper resources in compliance with US and International Resource reporting standards.

11.3 Well Field Design

Each ISR well field will consist of a series of injection and production wells completed within the target mineralization zone. Prior to design and layout of the wells, the ore bodies will be delineated with exploration holes. These holes will be geologically logged and sampled. Before drilling, each injection and production well will be assigned lateral coordinates, a ground surface elevation, depth to top of screened interval, and length of screened interval.

Conventional ISR wellfield operation utilizes vertical injection wells and extraction wells in roughly orthogonal patterns. Figure 11.3 shows variations of ISR wellfield patterns. The Company intends to begin production using a conventional 5-spot pattern with wells spaced 150-ft. Other patterns will be considered and potentially implemented after the sweep efficiency of the initial 5-spot pattern is measured and evaluated.

Figure 11.3 Conventional ISR Patterns



11.3.1 Injection and Production Wells

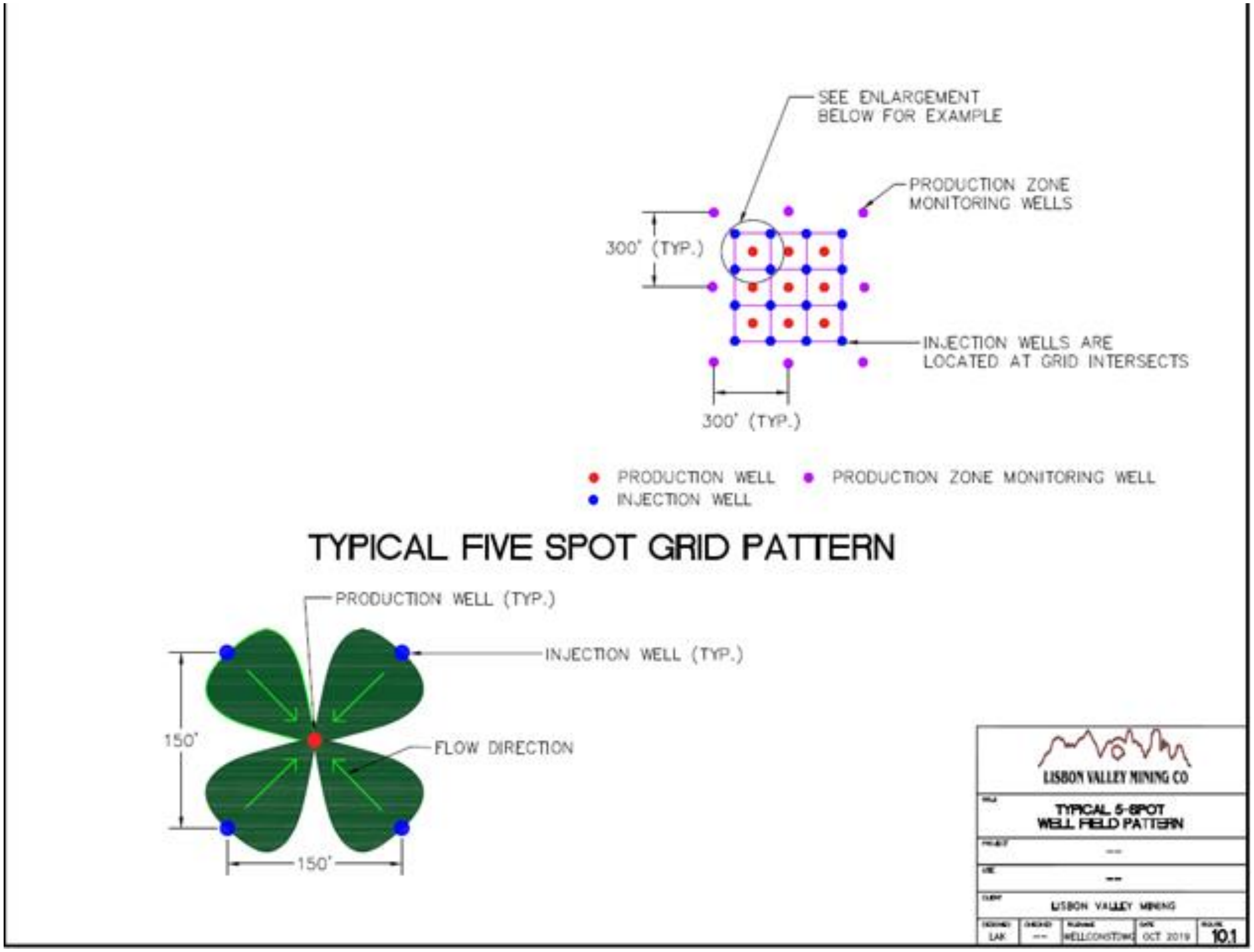
For all injection and production wells, the top of the screened interval will be at or below the base of the confining unit overlying the mineralized zone. The screened interval will be completed only across the targeted ore zone.

A typical (150 x 150 ft grid) well field layout is illustrated on 10.1. This typical layout is based on the lateral distribution and grade of the GTO copper deposit.

The well patterns and spacing may differ from well field to well field, but a typical pattern will consist of five wells, with one well in the center and four wells surrounding it oriented in four corners of a square. Typically, a production well will be located in the center of the pattern, and the four corner wells will be injection wells. Injection wells are further surrounded with monitoring wells. These wells are sequentially converted to extraction wells as the wellfield expands. This allows the configuration to support injection, extraction, and monitoring. Figure 11.4 depicts the proposed typical 5-spot well field pattern. It is important to note that the spacing and configuration can and will change in response to geologic structure and hydraulic continuity.

All wells will be completed for use as either injection or production wells, so that flow patterns can be changed as needed to recover copper and restore groundwater quality in the most efficient manner.

Figure 11.4 Proposed 5-Spot Wellfield Pattern and Production Zone Monitoring Wells



11.4 Wellfield Installation and Operation Sequence

ISR wellfields will be installed and sequenced along the long axis of each deposit in the Project Area. At each of the current deposits this will expand the wellfield in the NW/SE directions. The operation sequence will begin with mining and convert to restoration as well field rolls out. The Company intends to add approximately 200-250 wells/per year. Individual wells are intended to operate as mining wells for 5 years, or until they are no longer commercial. Following completion of copper recovery, a subset of the extraction wells will be converted to restoration and used to recirculate groundwater within the wellfield. This operational sequence allows for concurrent restoration of the aquifer. No well fields will interact with any domestic water wells.

11.4.1 Process Ponds

Each wellfield will be plumbed to the process ponds through a series of headers and common valving. The headers will direct wellfield flow to one of three ponds. All process and reclamation ponds are designed to contain 6MM gallons.

- Intermediate leachate solution (ILS)
- Pregnant leach solution (PLS)
- Reclamation pond
- Contingency pond(s)

Wellfield circulation will begin through the ILS pond. Here the ILS pond will serve to recirculate acid, water, and metals dissolved from the deposit through the respective wellfield until the copper grade approaches a commercial level (PLS). ILS pond solutions will be maintained at a prescribed pH through the addition of makeup acid. This process will continue for the duration of the commercial mining sequence.

As the copper concentration in the extraction wells approaches a commercial level, a fraction of the wellfield flow will be re-directed to the PLS pond. The PLS pond will be further concentrated through continued circulation of ILS through the wellfield. The PLS will be pumped to the Company's SX/EW plant at the Lisbon Valley Copper Mine though the ISR pipeline corridor. Here the SX/EW will extract the copper and recirculate the barren solution through the mine's raffinate pond. The raffinate from the beneficiation process will be pumped back to the ILS pond through the ISR wellfield corridor back to each wellfield for continued recirculation.

Aquifer restoration will begin after portions of the wellfield no longer produce commercial levels of copper. Barren wellfield flow will be redirected to the reclamation pond. Here the reclamation pond will be used to rinse and reclaim the water by continued circulation through barren portions of the wellfield without makeup acid. The absence of makeup acid will quickly consume the remaining acid and solids will precipitate back into the aquifer. Recirculation will continue until restoration standards are obtained, either through continued recirculation, land application, deep well disposal or combination of all.

11.4.2 Monitor Wells

Monitor wells will be installed in and around each well field to detect the potential migration of ISR solutions away from the target production zone. Perimeter monitor wells will be completed in the production zone around the perimeter of each well field. Non-production zone monitoring wells will be completed within each well field in the adjacent and overlying and underlying aquifers. A detailed description of the monitor well design and sampling procedures is contained in Section 12.

11.4.3 Hydraulic Well Field Control

The Company will maintain hydraulic control of each well field from the first injection of lixiviant through the end of aquifer restoration. During copper recovery, the groundwater removal 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 removal rate in each well field will exceed the injection rate of permeate and clean makeup water from the BC or N aquifers. If there are any delays between copper recovery and aquifer restoration, production wells will continue to be operated as needed to maintain water levels within the perimeter monitor rings below baseline water levels. This activity may be intermittent or continuous.

Inward hydraulic gradients will be maintained and monitored through use of flow meters and wireless dataloggers at each wellfield. Flow meters will be installed at all extraction and injection wells to ensure extraction rates exceeds injection. Wireless pressure and conductivity dataloggers will be installed and operated in each perimeter production monitoring well surrounding each wellfield (see Fig 11.4). Pressure dataloggers will be monitored to verify an inward hydraulic gradient. Conductivity dataloggers will be monitored to detect any changes in conductivity indicative of lixiviant excursion. Both water levels and conductivity measurements will be conducted at a frequency appropriate to confirm hydraulic well field control as described in Section 14.2.3. In the event an excursion is detected, corrective action measures will be taken in accordance with Section 13.1.

Verification of hydraulic control will be performed through water level measurements in perimeter monitor wells and non-production monitoring wells Water levels will be measured using pressure transducers or manual electronic meters and recorded at a frequency appropriate to confirm hydraulic well field control as described in Section 14.2.3.

11.5 Approach to Wellfield Control with Respect to Partially Saturated Conditions

Refer to Section 5.2.2.5 for a description of partially saturated conditions. The only instance where hydrologically unconfined (partially saturated) conditions exist within an area proposed for ISR operations occurs at the GTO deposit. The GTO deposit will be treated like a conventional saturated deposit however extraction wells will be located in the saturated portion of the deposit. Lixiviant injection will report to the saturated portion of the deposit as a function of geologic control features such as faults and impermeable layers.

11.6 Approach to Wellfield Control with Respect to Historical Mine Workings

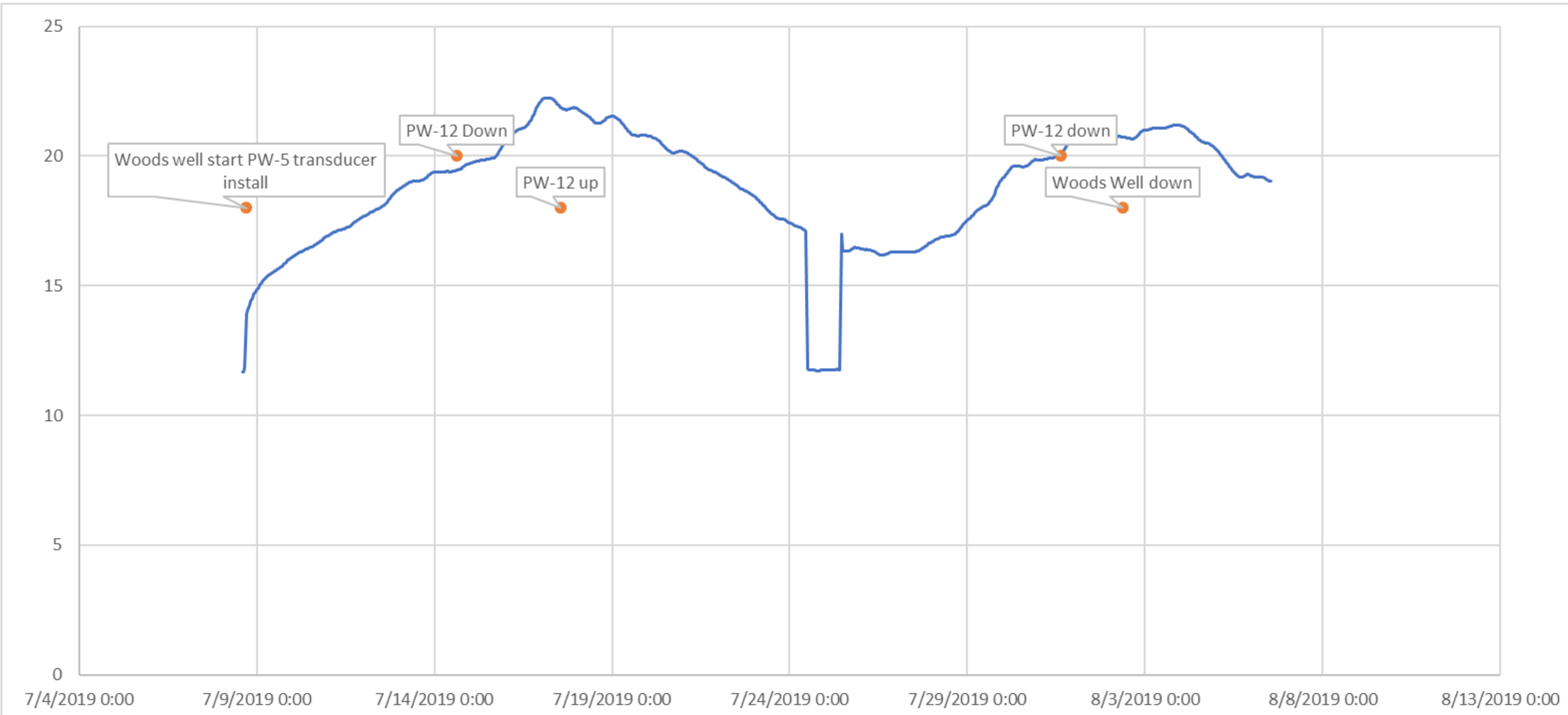
As described in Section 3.2 the former Woods mine extracted ore from the Chinle Formation which borders the GTO deposit. All mining was done in the footwall and therefore remains hydraulically isolated from any potential ISR activities by the Flying Diamond Fault. A map of the historical Woods mine workings was shown on Figure 3.4. Hydraulic isolation of the historical mine workings has been demonstrated by pressure transducer monitoring in the workings (footwall) and in the Project Area (hanging wall). This was described previously in Section 7.2.3. Figure 11.5 shows the transducer testing results showing isolation of the historical mine workings.

There is one small existing open pit, GTO, in the Project Area. ISR operations target GTO ore will not have any operational relationship with the GTO pit or existing open pit operations.

If any additional open pits are mined in the Project Area, ISR may be used a complimentary copper recovery strategy however ISR solution will not interfere with any open pits. An open at a similar depth as the ore zone in the Project Area would create an influent hydraulic gradient toward the pit which would only further increase the control of the fluid flow in addition to well field hydraulic control. After open pit mining, open pits are backfilled eliminating the existence of pit pools so in addition to restoration of the BC aquifer, no BC aquifer water will pool anywhere in the Project Area.

Figure 11.5 Transducer Testing Woods Mine Area

Figure 11.5 shows the response of transducer testing across the Woods mine area. The transducer response supports the hydraulic isolation of the BC aquifer from the adjacent historical mine workings as a function of the Lisbon Valley fault dividing the two areas.



11.7 Groundwater Restoration

Groundwater restoration in each well field will be conducted in accordance with UDWQ Class III permit requirements. Per the UDWQ UIC Guidelines, the purpose of the Class III UIC Permit for which the Company is proposing, is to "inject fluids for the in situ extraction of minerals or metals from ore bodies that have not been previously mined by conventional methods." (deq.utah.gov, 2020). As stated on the UDWQ UIC program, the purpose of a Class 5B6 well or wellfield is: "Subsurface Environmental Remediation – Used to clean up, treat, or prevent contamination of groundwater."

Before and during the ongoing ISR operations, the Company will collect data in regard to baseline ground water quality, natural acid neutralization as a function of sweep, and other pertinent information that will be used to prepare a comprehensive Groundwater Restoration Plan.

11.7.1 Target Restoration Goals

Groundwater restoration, or aquifer restoration, will be performed pursuant to UDWQ requirements to protect USDWs. The groundwater restoration program for all well fields will be conducted pursuant to UAC R317-7.

Prior to operation, the baseline groundwater quality will be determined through the sampling and analysis of water quality indicator constituents in wells screened in the mineralized zone(s) across each well field. Section 12.2 describes the methods used to select baseline wells, sample the wells, and calculate baseline water quality statistics. The target restoration goals (TRGs) will be established as a function of the average baseline water quality and the variability in each parameter according to statistical methods approved by UDEQ.

11.7.2 Groundwater Restoration Process

Groundwater restoration will be conducted in accordance with UDWQ permit requirements in a manner that will protect USDWs, human health and the environment. The methods for achieving this objective are discussed in the following sections.

11.7.4 Groundwater Rinse and Neutralization

Closure of the wellfield will begin with include the elimination of make-up acid to the ILS pond. This will be followed by recirculation of the groundwater inside each wellfield. In general, recirculation will involve perimeter wells pumping to the interior of the wellfield. This approach recirculates groundwater within the wellfield and brings in fresh groundwater from the perimeter, effectively recirculating and rinsing the former copper deposit. Neutralization and TDS reduction will occur as a function of the highly calcic aquifer characteristics combined with the fact no additional acid is added. This water will be used for land application and evapo-concentrated or for deep well disposal, if either is necessary. Land application will include conventional irrigation of salt-tolerant plant species and/or wetland species. Figure 11.6 shows planned locations of land application. Rinsing, deep well disposal and land application will be continued until asymptotic TDS concentrations are identified, or as long as technically and economically feasible.

The Company shall monitor the rinsing progress by analyzing fluids recovered from all recovery wells in the first mine block after rinsing. This data will then be used to determine the minimum number of sampled wells needed to confirm that rinsing has been successful in the rinsing and closure of subsequent mine blocks. The results of that evaluation shall be submitted for UDWQ review and approval. The wells to be retained for sampling during rinsing operations in subsequent mine blocks shall be identified and the locations of those wells shall be provided before closure of other wells in a mine block is approved by UDWQ.

11.7.5 Land Application Option

In the land application liquid waste disposal option, the primary method of aquifer restoration will be incremental groundwater circulation and rinse followed by land application. Land application will include surface irrigation via 300-1000ft pivots and/or engineered wetlands. Wetlands will require permitting through US Corp of Engineers. Land application targets are shown on Figure 11.6.

11.7.6 Deep Disposal Well Option

In the deep disposal well option the primary method of aquifer restoration will be incremental groundwater circulation and rinse followed by deep well disposal in an existing Class III Disposal Well. Deep well disposal is shown on Figure 11.7.

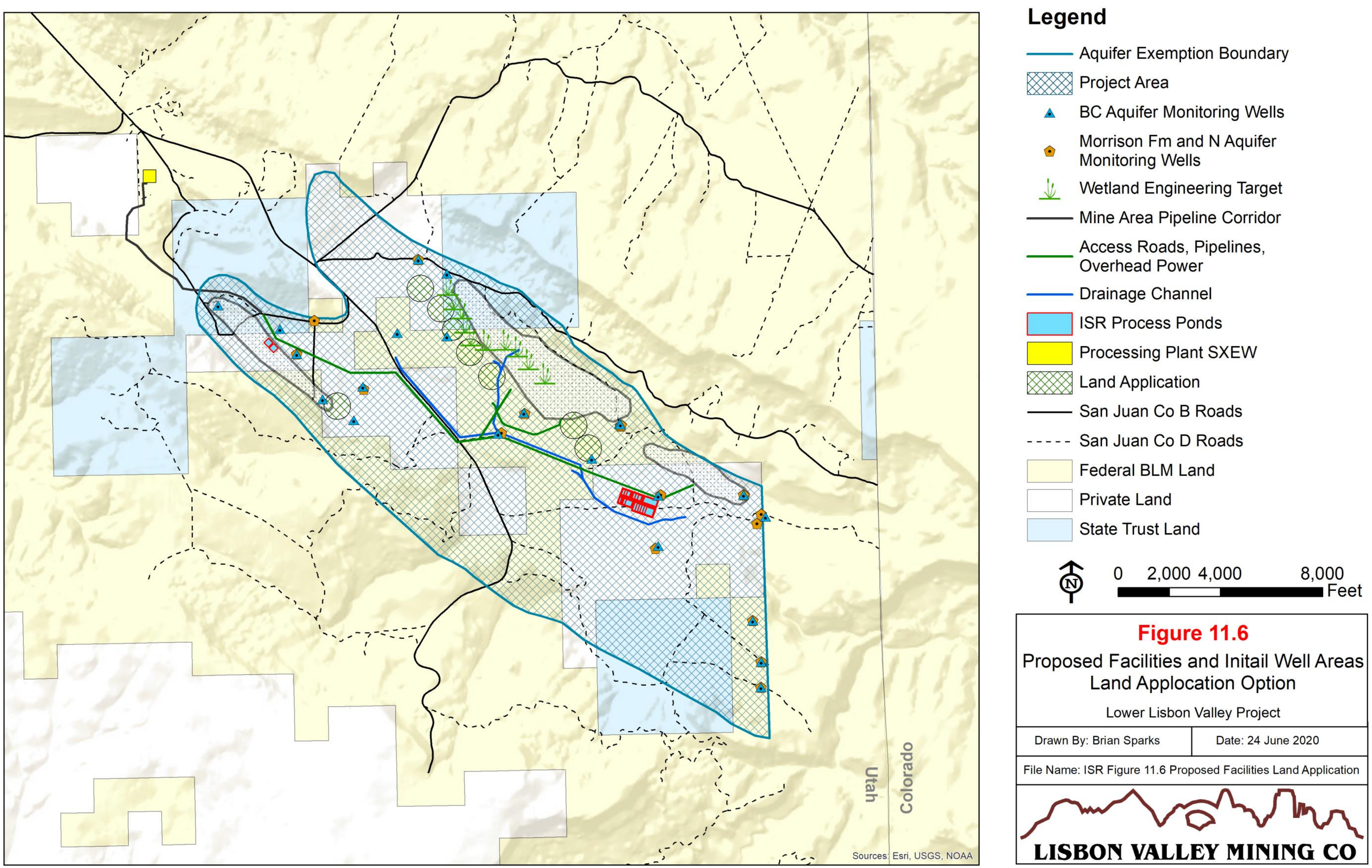


Figure 11.6

Proposed Facilities and Initail Well Areas
Land Applocation Option

Lower Lisbon Valley Project

Drawn By: Brian Sparks	Date: 24 June 2020

File Name: ISR Figure 11.6 Proposed Facilities Land Application

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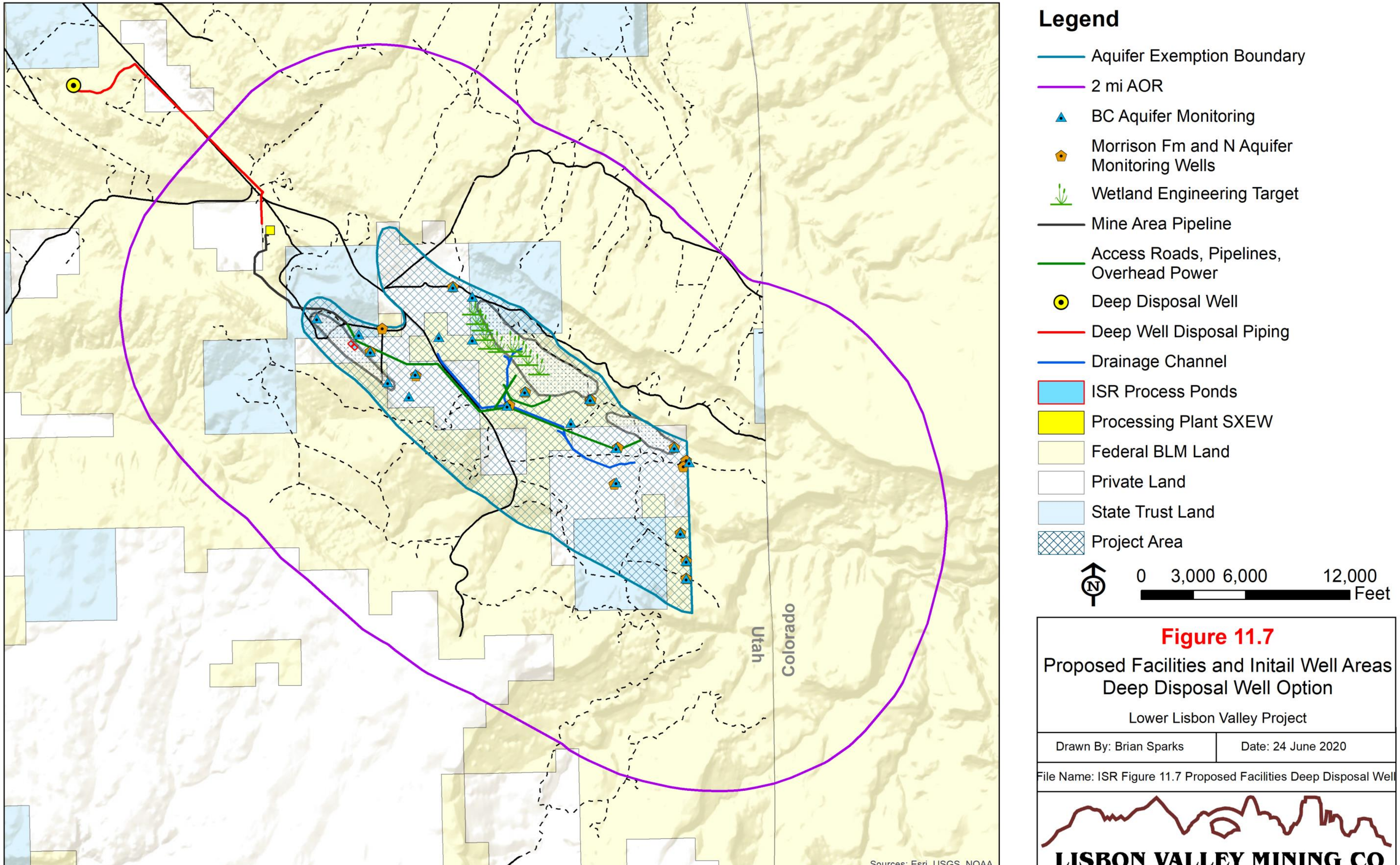

Figure 11.7

Proposed Facilities and Initail Well Areas
Deep Disposal Well Option

Lower Lisbon Valley Project

Drawn By: Brian Sparks	Date: 24 June 2020

File Name: ISR Figure 11.7 Proposed Facilities Deep Disposal Well

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11.7.7 Groundwater Restoration Monitoring

Groundwater restoration monitoring will be conducted quarterly during the restoration process and continue for 2 years after restoration is complete (post-rinse monitoring) in accordance with UDWQ requirements. Post-rinse monitoring may be extended to a longer term dependent on monitoring results and UDWQ interpretation.

The Company will submit a post-rinsing notification and report, with documentation, to UDWQ within thirty (30) days following completion of the post rinsing monitoring program.

11.8 Stormwater Control and Mitigation

The Company has evaluated flood inundation boundaries and will construct ISR facilities outside of these boundaries to avoid potential impacts to facilities from flooding and potential impacts to the surface in the event of any potential spills or leaks.

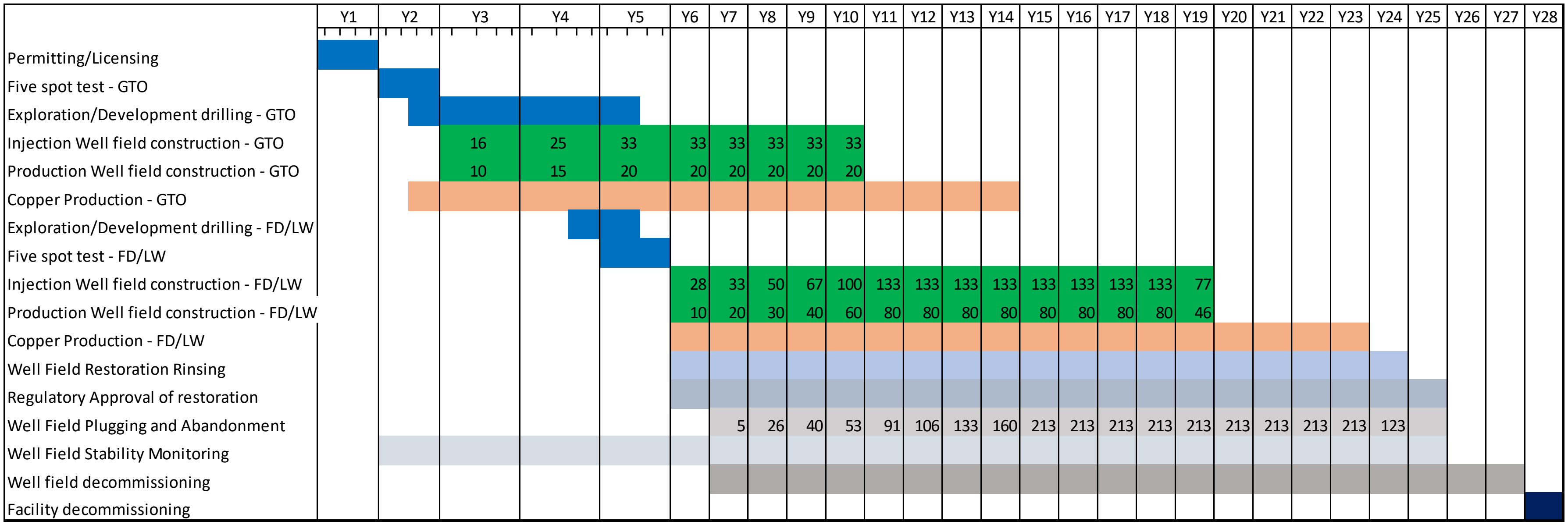
The Company has completed surface flow modeling to calculate peak discharges, and HEC-RAS models were used to compute water-surface profiles and inundated areas during runoff events. The results of this modeling were used to engineer drainage around all LLV mining facilities including ISR and open pit. All facilities will be located out of the 100-year flood inundation boundaries. Final design is subject to federal jurisdiction under Section 404 of the Clean Water Act (CWA). The drainage design concept is depicted in Figures 11.7 and 11.8 and detailed in Appendix J.

11.9 Schedule

Construction of ISR wellfields and facilities will begin at the GTO followed by Lone Wolf Deposit following the issuance of an UDOGM ISR mine permit, UDWQ Class III UIC permit, EPA aquifer exemption permit and other relevant permits. It is anticipated that construction of the second well field, GTO, and ancillary facilities will occur at the same time or follow shortly thereafter. Alternately, the Company may develop either the GTO or Lone Wolf area well fields first, followed by the well fields in the other area. Copper recovery operations within the permit area will continue for approximately 7 to 20 years during which additional well fields will be completed. Each well field will be decommissioned and plugged and abandoned when copper recovery is complete.

LVMC projects plugging and abandonment activity to begin approximately five years after ISR operations commence and continue annually until all well fields have completed copper recovery and been decommissioned. This will have the effect of keeping total wells requiring plugging and abandonment at a relatively static level after five years as new ISR wells are drilled and older ISR wells are decommissioned. It is likely that the process facilities will continue to operate for several years following decommissioning of the well fields. The entire Project will then be decommissioned and reclaimed in accordance with UDEQ, EPA, BLM and requirements. The projected construction, operation, restoration and decommissioning schedule is provided in Figure 11.8.

Figure 11.8 LVMC ISR Project Schedule



Attachment F

Monitoring, Recording, and Reporting Plan

12.0 PART J - Monitoring, Recording and Reporting Plan

This attachment describes the monitoring programs directly related to the proposed Class III UIC permit, including monitoring the pressure, flow rate and chemical characteristics of the injection fluid. It also describes monitoring programs that will be conducted in accordance with UDWQ permit requirements designed to protect groundwater quality outside of the exempted aquifer. These programs include excursion monitoring at POC wells surrounding each ISR wellfield. These programs are a supplement to the natural hydrologic confinement of the BC aquifer to LLV and from the N aquifer.

12.1 ISR FacilityMonitoring

The Company will implement control and data recording systems at the ISR facilities which will provide centralized monitoring and control of the process variables including the flow rate and pressure of the injection stream at each wellfield. Pressure gauges installed at each injection wellhead or in the injection manifold also will be manually recorded at least daily.

The volumetric flow rate of oxygen will be measured at the point of injection into the barren lixiviant using calibrated gas flow meters. The flow meters will be routinely calibrated according to manufacturer recommendations.

The injection fluid in each operating well field will be sampled monthly. Samples will be collected from the ILS process pond and analyzed for copper, sulfuric acid, pH, total iron, ferrous iron, ferric iron, and Eh.

ISR facility monitoring will include subsidence monitoring of selected extraction wells in each wellfield. In addition to visual wellhead observations, this will include installation of a continuous GPS (CGPS) system at each of the three deposits, GTO, Lone Wolf, and Flying Diamond. CGPS sub-centimeter capabilities will be correlated with groundwater elevation measurements to evaluate any changes in surface subsidence.

12.2 Point of Compliance Monitoring

Following is a brief summary of the point of compliance monitoring program that will be conducted in accordance with UDWQ permit requirements to detect potential horizontal or vertical exceedance of two or more control limits of N aquifer water and BC aquifer water outside the well fields.

As is currently implemented by the Company for the Active Mine Area, the Company will monitor point of compliance (POC) wells associated with ISR activities. As described above, prior to commencement of ISR activities, baseline water quality data for the BC and N aquifers in the areas surrounding the proposed ISR wellfields will be determined. The baseline water quality data will be used to build a ground water protection level database. The ground water protection level to which the Company will monitor will consist of a mixture of Utah Drinking Water Quality Standards and site-specific standards. The higher of the two standards will be used as the ground water protection level.

The Company will monitor ground water on a quarterly basis during active ISR operations. While performing monitoring activities, the ground water chemistry will be tracked and measured against the ground water protection levels. Exceedance of the ground water protection limit shall occur if:

1. For parameters that have been defined as detectable in the background and for which protection levels have been established based on 1.5 times the mean background concentration,

exceedance shall be defined as two consecutive samples exceeding the protection level and the mean background concentration by two standard deviations.

2. For parameters that have been defined as detectable in the background and for which protection levels have been established based on 0.5 times the ground water quality standard, exceedance shall be defined as 2 consecutive samples exceeding the protection level and the mean background concentration by two standard deviations.
3. For parameters that have background data set between 50-85% non-detectable analyses, exceedance shall be defined as 2 consecutive samples from a compliance monitoring point exceeding the established protection level.
4. For parameters that have been defined non-detectable in the background and for which protection levels have been determined based on 0.5 times the ground water quality standard or the limit of detection exceedance shall be defined as 2 consecutive samples from a compliance monitoring point exceeding the established protection limit.

Upon determination of an exceedance ground water quality standards, the Company shall:

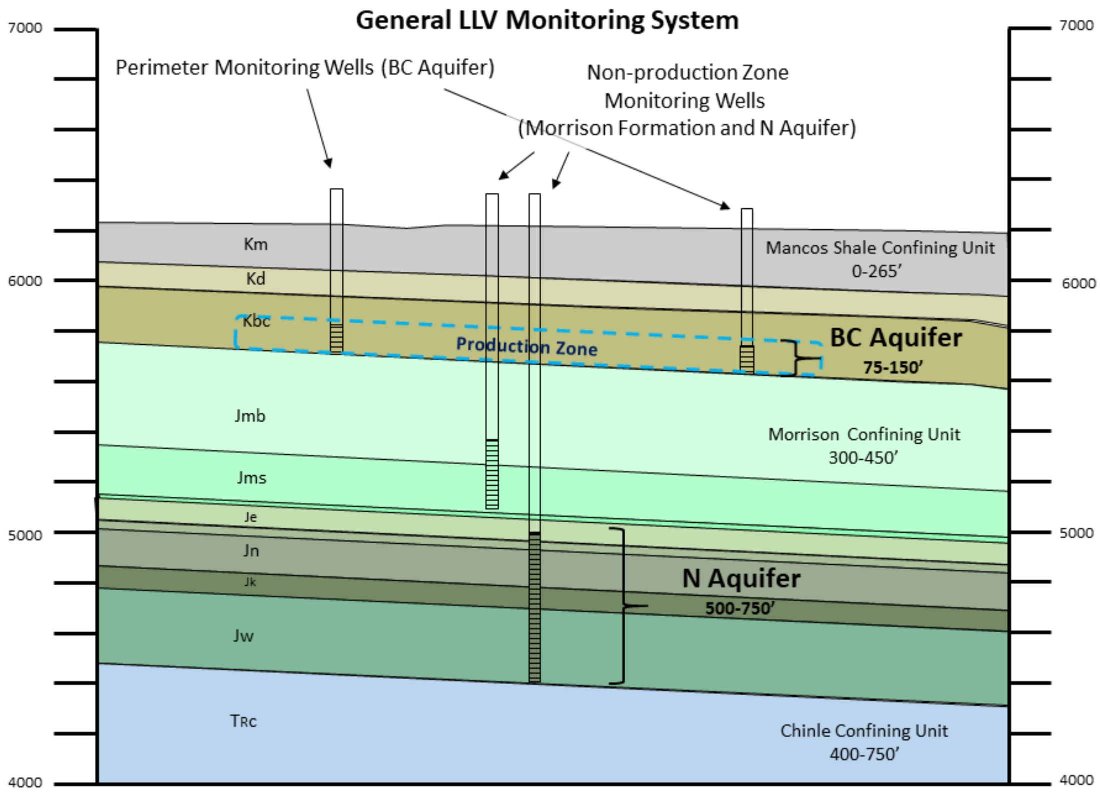
1. Verbally notify the Director of the exceedance within 24 hours of receipt of data, and
2. Provide written notice within 5 days of determination, and
3. Continue an accelerated schedule of monthly ground water monitoring for at least two months and continue monthly monitoring until the operation is brought into compliance.

12.2.1 Monitoring Network Design

The monitoring network will consist of production and non-production monitoring wells. Production monitor wells are part of each ISR wellfield as shown on Figure 11.2. These wells will be monitored to support to ensure inward hydraulic gradients at each wellfield and to detect lixiviant excursion. Water levels will be measured using downhole pressure transducers or manual electronic meters. These measurements will alert operators to any significant change in the water levels that would affect hydraulic control of lixiviants.

POC wells are located outside each wellfield and are monitored to detect changes in groundwater chemistry in the BC, M and N aquifers outside and below the respective wellfields, as well as outside the Project Area. A schematic of this plan is shown on Figure 12.1.

Figure 12.1 Point of Compliance Monitor Well Network Design



12.2.2 Point of Compliance Monitoring Wells

A total of 40 POC monitoring well locations have been identified. Six of the proposed monitoring wells already exist. The monitoring wells are configured in two perimeters, and will be monitored in two phases as necessary. The perimeter 1 (phase 1) are located approximately 1,000 ft outside each well field. The perimeter 1 monitor well configuration will be drilled and an enhanced baseline water quality monitoring program implemented prior to commencement of any ISR activities within the corresponding well field. The enhanced baseline water quality monitoring will provide the baseline data for the purposes of monitoring potential changes in ground water quality, as lined out in Section 12.2 above.

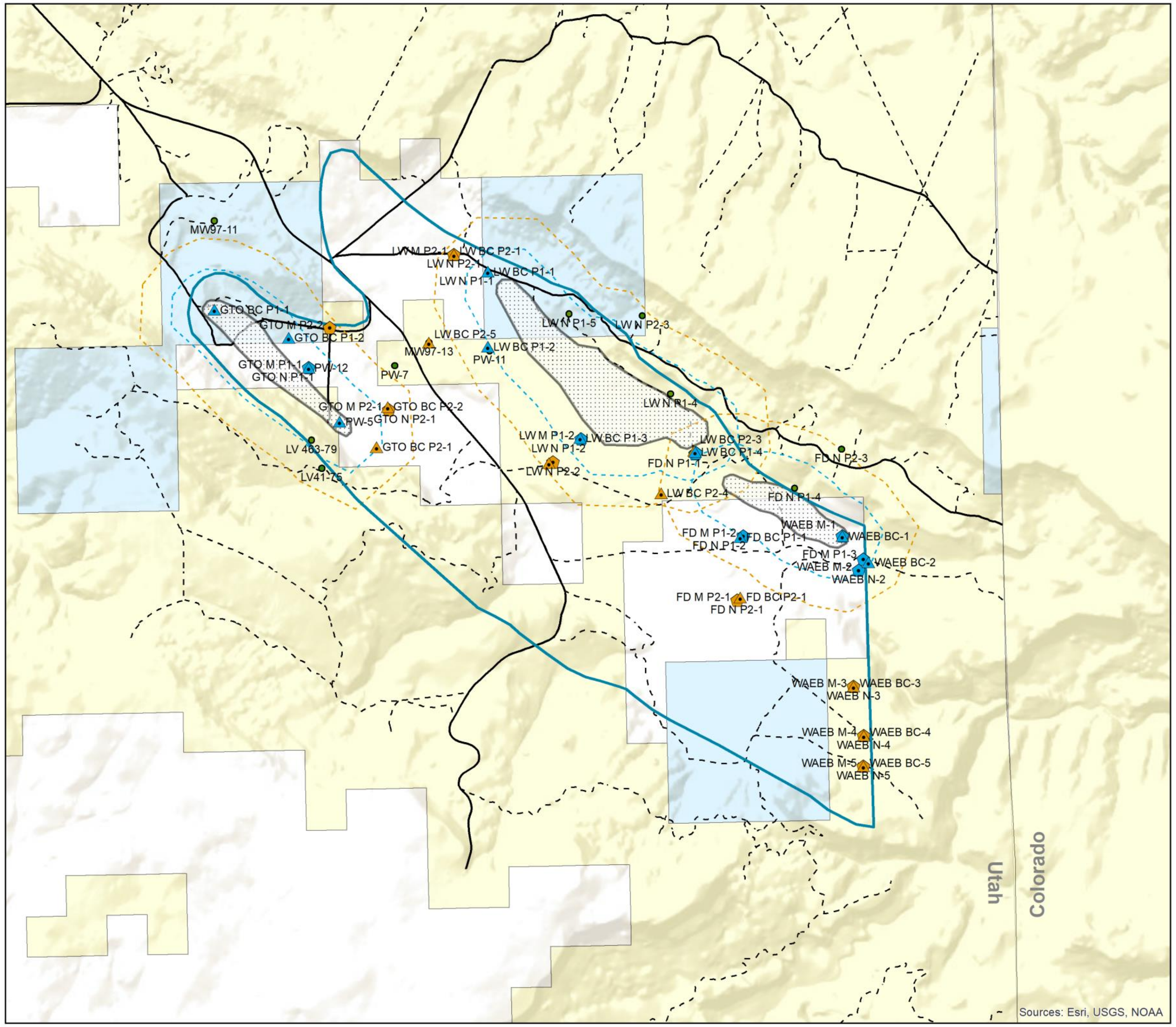
Perimeter 2 (phase 2) wells are located an additional 1,000 feet laterally. Perimeter 2 wells will be drilled (if not already in place) upon indication of an exceedance in any Perimeter 1 monitor well. Each active monitoring well will be sampled quarterly.

In accordance with Section 12.2, if an exceedance is detected in a phase 1 monitoring well, phase 2 wells in the same area will be installed or activated. Figure 12.2 shows proposed locations of all POC monitoring wells. Locations, depths, and formationsare tabulated in Table 12.1.

Table 12.1 Proposed Monitoring Wells

Phase 1 Well	Easting	Northing	Depth	Well Type	Formation
FD BC P1-1	668,990	4,219,650	600	Piezo	BC
FD BC P1-2	670,270	4,219,400	600	Piezo	BC
GTO BC P1-1	663,740	4,221,920	700	Piezo	BC
GTO BC P1-2	664,480	4,221,640	700	Piezo	BC
LW BC P1-1	666,470	4,222,300	600	Piezo	BC
LW BC P1-2	666,470	4,221,550	600	Piezo	BC
LW BC P1-3	667,390	4,220,640	600	Piezo	BC
LW BC P1-4	668,540	4,220,500	600	Piezo	BC
PW-12	664,680	4,221,340	1000	Production	BC
PW-5	664,989	4,220,802	650	Production	BC
FD N P1-1	668,540	4,220,480	800	Piezo	N
FD M P1-1	668,540	4,220,480	600	Piezo	M
FD N P1-2	669,020	4,219,660	1500	Piezo	N
FD M P1-2	669,020	4,219,660	1300	Piezo	M
FD N P1-3	670,220	4,219,430	800	Piezo	N
FD M P1-3	670,220	4,219,430	600	Piezo	M
FD N P1-4	669,530	4,220,140	800	Piezo	N
GTO N P1-1	664,680	4,221,340	1500	Piezo	N
GTO M P1-1	664,680	4,221,340	1300	Piezo	M
LV 463-79	664,710	4,220,620	750	Piezo	N
LW N P1-1	666,470	4,222,300	800	Piezo	N
LW N P1-2	667,400	4,220,630	1500	Piezo	N
LW M P1-2	667,400	4,220,630	1300	Piezo	M
LW N P1-3	668,550	4,220,490	800	Piezo	N
LW M P1-3	668,550	4,220,490	600	Piezo	M
LW N P1-4	668,290	4,221,080	800	Piezo	N
LW N P1-5	667,280	4,221,880	800	Piezo	N
MW97-11	663,738	4,222,810	1500	Piezo	N
PW-11	666,487	4,221,512	1800	Production	N

Phase 2 Well	Easting	Northing	Depth	Well Type	Formation
GTO BC P2-1	665,360	4220 550	700	Piezo	BC
GTO BC P2-2	665,470	4,220,950	700	Piezo	BC
LW BC P2-1	666,130	4,220,470	700	Piezo	BC
LW BC P2-2	667,080	4,220,390	700	Piezo	BC
LW BC P2-3	668,530	4,220,510	700	Piezo	BC
LW BC P2-4	668,200	4,220,090	700	Piezo	BC
LW BC P2-5	665,880	4,221,592	700	Piezo	BC
FD BC P2-1	668,990	4,219,050	700	Piezo	BC
FD BC P2-2	670,500	4,219,280	702	Piezo	BC
LV41-75	664,810	4,220,340	750	Open Hole	N
GTO N P2-1	665,480	4,220,920	1500	Piezo	N
GTO M P2-1	665,480	4,220,920	1300	Piezo	M
GTO N P2-2	664,890	4,221,740	1500	Piezo	N
GTO M P2-2	664,890	4,221,740	1300	Piezo	M
PW-7	665,537	4,221,361	1501	Production	N
LW N P2-1	666,130	4,222,470	800	Piezo	N
LW M P2-1	666,130	4,222,470	600	Piezo	M
LW N P2-2	667,120	4,220,400	1500	Piezo	N
LW M P2-2	667,120	4,220,400	1300	Piezo	M
LW N P2-3	668,010	4,221,860	1000	Piezo	N
MW97-13	665,880	4,221,592	1500	Piezo	N
FD N P2-1	668,960	4,219,020	1500	Piezo	N
FD M P2-1	668,960	4,219,020	1300	Piezo	M
FD N P2-2	670,590	4,219,340	800	Piezo	N
FD M P2-2	670,590	4,219,340	600	Piezo	M
FD N P2-3	670,000	4,220,530	1200	Piezo	N



Legend

- BC Aquifer P-1 Monitoring Wells
- BC Aquifer P-2 Monitoring Wells
- Morrison Fm and N Aquifer P-1 Monitoring Wells
- Morrison Fm and N Aquifer P-2 Monitoring Wells
- Aquifer Exemption Boundary
- ISR Well Fields
- P-1 1,000' Boundary
- P-2 2,000' Boundary
- San Juan Co B Roads
- San Juan Co D Roads
- Federal BLM Land
- Private Land
- State Trust Land

N

0 2,000 4,000 8,000 Feet

Figure 12.2

Existing and Proposed Monitoring Wells

Lower Lisbon Valley Project

Drawn By: Brian Sparks	Date: 24 June 2020

File Name: ISR Figure 12.2 Proposed Monitoring Wells

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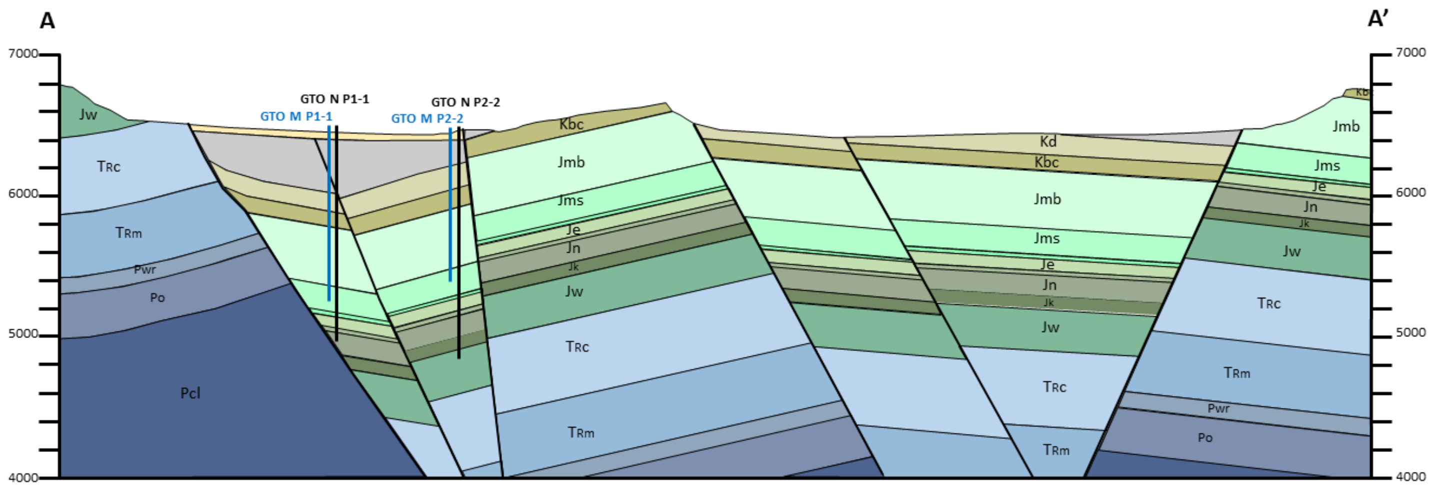
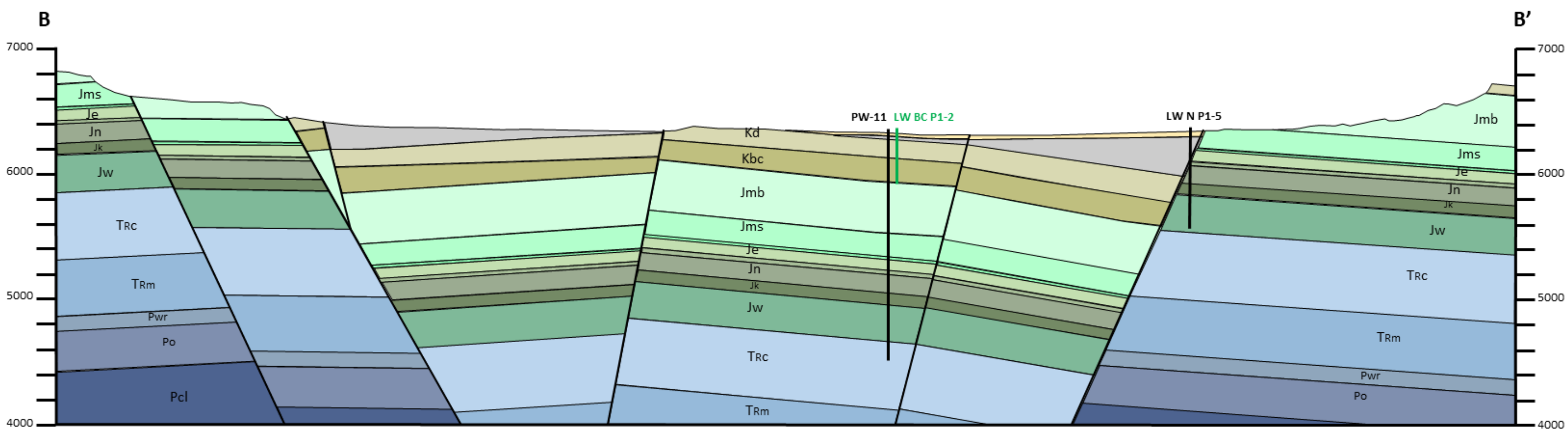
12.2.3 POC Monitor Well Concept

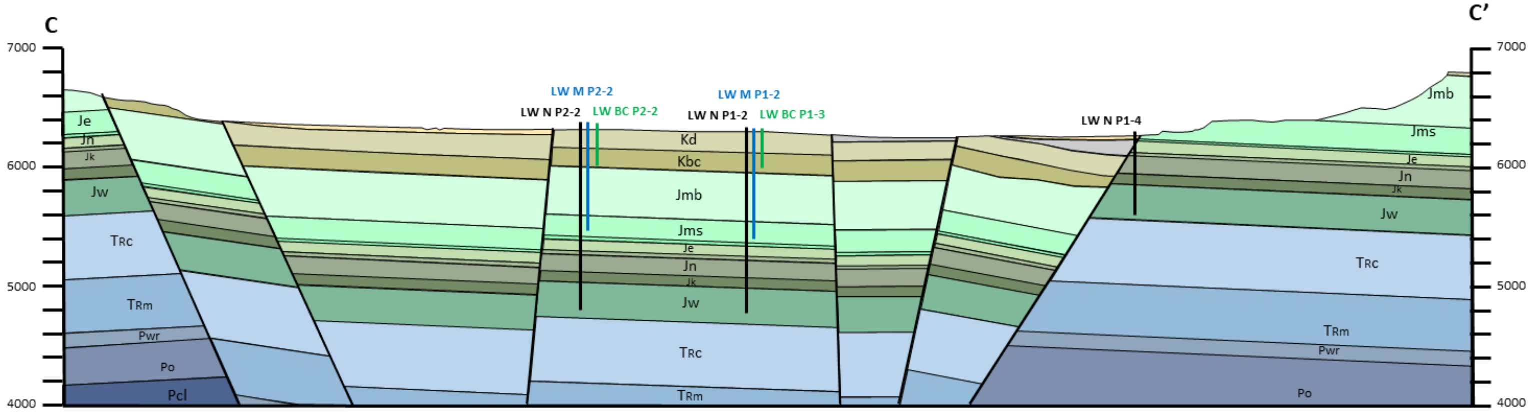
As introduced in Section 12.1, POC monitoring wells will be located outside each wellfield in both BC and N Aquifers. The BC Aquifer will be monitored by BC wells surrounding each wellfield. The N Aquifer will be monitored by N Aquifer wells which both surround and underly each wellfield. Section-view examples of N Aquifer POC monitor wells around each copper deposit are shown on Figures 12.3-12.6.

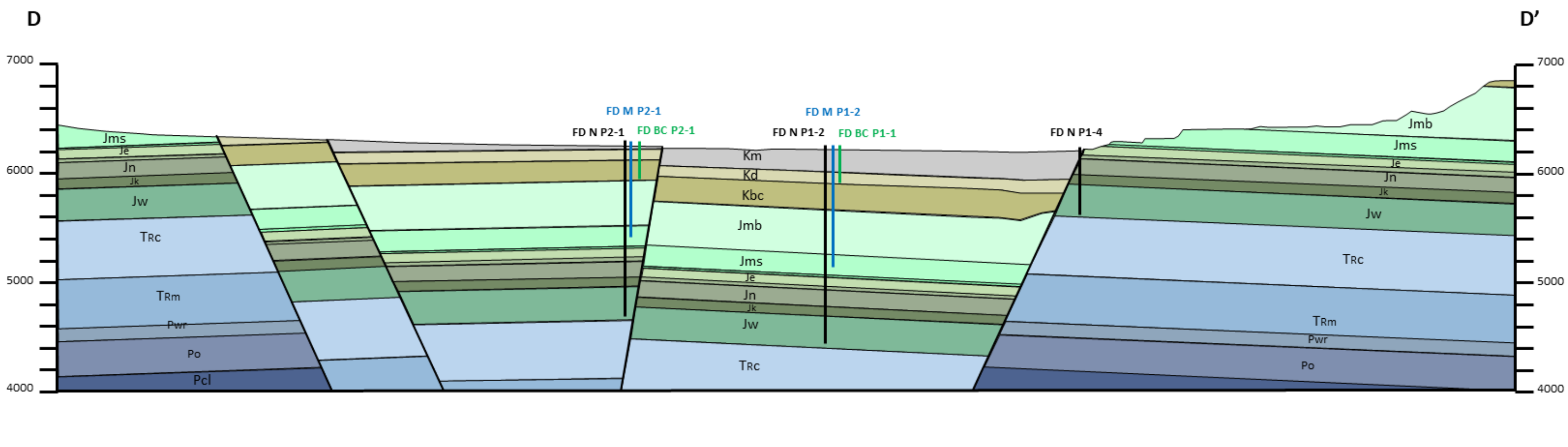
Figures 12.3 and 12.4 Monitoring Well Cross-Sectional Layout at GTO Deposit and Lone Wolf Deposit
NW





Figures 12.5 and 12.6 Monitoring Well Cross-Sectional Layout Lone Wolf Deposit SE and Flying Diamond Deposit





12.2.4 Point of Compliance Monitoring

POC monitoring will be conducted quarterly in accordance with UDWQ permit requirements. This will include water level measurements and groundwater sampling for constituents detailed in Table 12.2 Groundwater sampling will be conducted using low-flow submersible pumps.

Table 12.2 Groundwater Analyte List and Methods

Test Analyte/Parameter	Units	Analytical Method
Physical Properties		
pH ⁄	pH units	A4500-H B
Total Dissolved Solids (TDS) +	mg/L	A2540 C
Conductivity	µmhos/cm	A2510 B
Common Elements and Ions		
Alkalinity (as $CaCO_3$)	mg/L	A2320 B
Bicarbonate Alkalinity (as $CaCO_3$)	mg/L	A2320 B (as HCO_3)
Calcium	mg/L	E200.7
Carbonate Alkalinity (as $CaCO_3$)	mg/L	A2320 B
Chloride, Cl	mg/L	A4500-Cl B; E300.0
Magnesium, Mg	mg/L	E200.7
Nitrate, NO_3^- (as Nitrogen)	mg/L	E300.0
Potassium, K	mg/L	E200.7
Sodium, Na	mg/L	E200.7
Sulfate, SO_4	mg/L	A4500-SO4 E; E300.0
Trace and Minor Elements		
Arsenic, As	mg/L	E200.8
Barium, Ba	mg/L	E200.8
Boron, B	mg/L	E200.7
Cadmium, Cd	mg/L	E200.8
Chromium, Cr	mg/L	E200.8
Copper, Cu	mg/L	E200.8
Fluoride, F	mg/L	E300.0
Iron, Fe	mg/L	E200.7
Lead, Pb	mg/L	E200.8
Manganese, Mn	mg/L	E200.8
Mercury, Hg	mg/L	E200.8
Molybdenum, Mo	mg/L	E200.8
Nickel, Ni	mg/L	E200.8
Selenium, Se	mg/L	E200.8, A3114 B
Silver, Ag	mg/L	E200.8
Uranium, U	mg/L	E200.7, E200.8
Vanadium, V	mg/L	E200.7, E200.8
Zinc, Zn	mg/L	E200.8
Radiological Parameters		
Gross Alpha††	pCi/L	E900.0
Gross Beta	pCi/L	E900.0
Radium, Ra-226§	pCi/L	E903.0

⁄ Field and Laboratory

+ Laboratory only

††Excluding radon, radium, and uranium

§ If initial analysis indicates presence of Th-232, then Ra-228 will be considered within the baseline sampling program or an alternative may be proposed.

12.3 Groundwater Restoration Monitoring

During all phases of groundwater restoration, including active restoration and stability monitoring, POC monitoring will continue in accordance with UDWQ permit conditions. The following additional monitoring associated with groundwater restoration will be conducted in accordance with UDWQ permit requirements.

12.3.1 Establishing Production Zone Baseline Water Quality

Production zone baseline water quality and TRGs will be established according to UDWQ permit requirements. Prior to copper ISR, a subset of wells within each well field to be utilized as production wells will be identified for baseline water quality sampling. Baseline water quality and TRGs will be established according to statistical methods approved by UDWQ.

The Company has identified up to 55 wells in the Project Area for water quality monitoring. This would include 19 BC monitoring wells, 12 Morrison Formation wells, and 24 N Aquifer wells (Table 12.1). The expected sample frequency is one sample per monitoring well per quarter, with samples analyzed for the constituents listed in Table 12.2.

The Company has a comprehensive understanding of aquifer water quality, both at the Lisbon Valley Mine and the Project Area. Current baseline water quality for groundwater monitoring wells is shown in Table 12.3. MCL exceedances are shaded gray. Historic cumulative water quality for LVMC is compiled in Appendix K.

Table 12.3 LLV Baseline Groundwater Quality BC and N Aquifers

		Water Quality Range Lower Lisbon Valley	
		BC Aquifer	N-Aquifer
Major Ions + Indicator Parameters			
Alkalinity, dissolved (as $CaCO_3$)	mg/l	105 - 163.2	185.4 - 328.1
Alkalinity (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	mg/l	16.2 - 184	16.7 - 141
Magnesium	mg/l	11.4 - 108	5.3 - 46.1
Potassium	mg/l	7.7 - 17	3.72 - 12.6
Sodium	mg/l	71.6 - 1,540	50.1 - 248
Chloride	mg/l	9.3 - 81.9	4.9 - 310
Fluoride	mg/l	0.09 - 1.30	<0.1 - 1
Silica	mg/l	1.5 - 24.8	8.3 - 25.9
Sulfate	mg/l	131 - 2,800	6 - 533
Sodium Absorption Ratio (SAR)	%	1.61 - 1.79	3 - 4.7
Total Dissolved Solids	mg/l	542 - 5,340	260 - 1,440
Total Suspended Solids	mg/l	<5 - 11,700	<5 - 6,280
pH, Lab	s.u.	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	<0.01 - 0.26	0.01 - 2.3
Nitrate as N, dissolved	mg/l	<0.02 - 1.59	0 - 0.5
Nitrite as N, dissolved	mg/l	0 - <0.05	0 - 0.094
Nitrate/Nitrite as N, dissolved	mg/l	<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 - 0.98	<0.03 - 1.12
Antimony, dissolved	mg/l	0.0004 - 0.012	<0.0002 - <0.02
Arsenic, dissolved	mg/l	<0.0002 - <0.04	<0.0002 - 0.0476
Barium, dissolved	mg/l	0.006 - 0.715	0.031 - 1.29
Beryllium, dissolved	mg/l	<0.00005 - <0.01	<0.00005 - <0.005
Cadmium, dissolved	mg/l	<0.00005 - 0.0597	<0.00005 - <0.003
Chromium, dissolved	mg/l	<0.0001 - 0.014	0.0001 - 0.1055
Copper, dissolved	mg/l	<0.002 - <0.05	<0.01 - 0.04
Iron, dissolved	mg/l	<0.01 - 39.3	0.01 - 15.7
Lead, dissolved	mg/l	<0.0001 - 0.069	<0.0001 - 0.0152
Manganese, dissolved	mg/l	0.008 - 1.18	0.017 - 5.4
Mercury, dissolved	mg/l	<0.0002 - 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	<0.0001 - 0.027	0.0001 - 0.012
Silver, dissolved	mg/l	<0.00005 - 0.526	<0.00005 - <0.5
Strontium, dissolved	mg/l	2.39 - 4.48	1.62 - 5.75
Thallium, dissolved	mg/l	<0.00005 - 0.014	<0.00005 - 0.009
Uranium, total	mg/l	0.0002 - 0.293	0.0000846 - 0.138
Vanadium, dissolved	mg/l	<0.002 - <0.04	<0.005 - 0.014
Zinc, dissolved	mg/l	0.01 - 1.7	<0.01 - 20.8
Radiological			
Gross Alpha, total	pCi/l	0.3 - 888	-0.73 - 277
Gross Beta, total	pCi/l	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 228, total	pCi/l	0.32 - 1.27	-0.29 - 2.7
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

Table 12.4 Statistics of LLV MCL Exceedance BC and N Aquifers

		Burro Canyon Aquifer Summary Statistics						N-Aquifer Summary Statistics					
		Range						Range					
		Min.	Max.	Mean	Median	# Samples	# Non-Detects	Min.	Max.	Mean	Median	# Samples	# Non-Detects
Major Ions + Indicator Parameters													
Alkalinity, dissolved (as $CaCO_3$)	mg/l	105	163	144	162	3	0	185	328	259	254	9	0
Alkalinity (as $CaCO_3$)	mg/l	125	1,517.0	282.6	258.0	101	0	179.0	430.0	265.3	254.0	129	0
Bicarbonate (as $CaCO_3$)	mg/l	125	1,517.3	279	258	101	0	179	429.8	261	248	129	0
Carbonate (as $CaCO_3$)	mg/l	<1.7	31	5	<2	97	77	<1	19	3	<2	129	91
Hydroxide (as $CaCO_3$)	mg/l	<2	<14.7	3	<2	97	96	<1	5.9	2	<2	129	123
Hardness (as $CaCO_3$)	mg/l	109	748	433	473	101	0	64	556	219	188	129	0
Calcium	mg/l	16.2	184	103	117	101	0	16.7	141	53.3	45.2	129	0
Magnesium	mg/l	11.4	108	42.4	43.9	101	0	5.3	46.1	20.6	18.9	129	0
Potassium	mg/l	7.7	17	9.5	9.21	101	0	3.72	12.6	7.2	6.8	129	0
Sodium	mg/l	71.6	1,540	146	124	101	0	50.1	248	121	119	129	0
Chloride	mg/l	9.3	81.9	23	22	101	0	4.9	310	64	43	129	0
Fluoride	mg/l	0.09	1.30	0.5	0.40	101	5	<0.1	1	0.6	0.6	129	1
Silica	mg/l	1.5	24.8	10.9	11.8	101	1	8.3	25.9	14.4	13.9	129	0
Sulfate	mg/l	131	2,800	463	480	101	0	6	533	150	110	129	0
Sodium Absorption Ratio (SAR)	%	1.61	1.79	1.70	1.70	2	0	3	4.7	3.66	3.38	6	0
Total Dissolved Solids	mg/l	542	5,340	986	1,010	101	0	260	1,440	605	540	129	0
Total Suspended Solids	mg/l	<5	11,700	832	9.0	101	38	<5	6,280	509	83	129	21
pH, Lab	s.u.	6.3	8.8	7.8	8	101	0	6.4	8.5	7.8	8.2	129	0
E.C. Lab	µS/cm	861	6,680	1,358	1,370	101	0	267	1,715	951	936	129	0
Nutrients													
Phosphorus, total as P	mg/l	<0.01	0.26	0.03	<0.02	43	24	0.01	2.3	0.33	0.10	42	16
Nitrate as N, dissolved	mg/l	<0.02	1.59	0.16	0.04	101	49	0	0.5	0.07	0.02	129	79
Nitrite as N, dissolved	mg/l	0	<0.05	0.01	<0.01	100	79	0	0.094	0.01	<0.01	129	113
Nitrate/Nitrite as N, dissolved	mg/l	<0.02	1.59	0.16	0.05	101	49	0	0.5	0.08	0.03	129	75
Nitrogen, ammonia	mg/l	<0.05	8.85	0.24	0.050	100	68	<0.05	1.7	0.15	0.08	129	62
Metals													
Aluminum, dissolved	mg/l	0.01	0.98	0.06	<0.03	101	80	<0.03	1.12	0.05	<0.03	129	91
Antimony, dissolved	mg/l	0.0004	0.012	0.0014	<0.0004	100	82	<0.0002	<0.02	0.0024	0.0005	129	94
Arsenic, dissolved	mg/l	<0.0002	<0.04	0.0035	0.002	101	33	<0.0002	0.0476	0.0091	0.0064	129	25
Barium, dissolved	mg/l	0.006	0.715	0.034	0.013	101	0	0.031	1.29	0.151	0.088	129	0
Beryllium, dissolved	mg/l	<0.00005	<0.01	0.0004	<0.0001	101	98	<0.00005	<0.005	0.0004	<0.0001	129	121
Cadmium, dissolved	mg/l	<0.00005	0.0597	0.0076	0.0034	101	29	<0.00005	<0.003	0.0005	<0.0001	129	112
Chromium, dissolved	mg/l	<0.0001	0.014	0.0015	<0.0005	101	88	0.0001	0.1055	0.0046	<0.0005	129	85
Copper, dissolved	mg/l	<0.002	<0.05	0.01	<0.01	101	93	<0.01	0.04	0.01	<0.01	129	117
Iron, dissolved	mg/l	<0.01	39.3	1.37	0.35	101	7	0.01	15.7	0.85	0.31	129	14
Lead, dissolved	mg/l	<0.0001	0.069	0.0019	0.0002	100	58	<0.0001	0.0152	0.0018	0.0005	129	96
Manganese, dissolved	mg/l	0.008	1.18	0.153	0.12	101	1	0.017	5.4	0.349	0.12	129	6
Mercury, dissolved	mg/l	<0.0002	0.0003	0.0002	<0.0002	101	98	<0.0002	0.00079	0.0002	<0.0002	129	119
Molybdenum, dissolved	mg/l	<0.01	0.566	0.04	0.02	101	36	0.01	0.84	0.08	<0.02	129	58
Nickel, dissolved	mg/l	<0.008	0.109	0.01	<0.01	101	71	<0.008	17.3	0.44	<0.01	129	73
Selenium, dissolved	mg/l	<0.0001	0.027	0.002	<0.001	100	60	0.0001	0.012	0.002	<0.001	129	107
Silver, dissolved	mg/l	<0.00005	0.526	0.01772	<0.00005	101	94	<0.00005	<0.5	0.01191	<0.00005	129	117
Strontium, dissolved	mg/l	2.39	4.48	3.13	2.53	3	0	1.62	4.81	2.93	2.645	4	0
Thallium, dissolved	mg/l	<0.00005	0.014	0.0005	0.0002	100	55	<0.00005	0.009	0.0006	<0.0001	129	118
Uranium, total	mg/l	0.0002	0.293	0.0395	0.0288	94	0	0.000085	0.138	0.0113	0.0041	129	23
Vanadium, dissolved	mg/l	<0.002	<0.04	0.007	<0.005	101	98	<0.005	0.014	0.007	<0.005	129	119
Zinc, dissolved	mg/l	0.01	1.7	0.15	0.03	101	22	<0.01	20.8	0.50	0.02	129	52
Radiological													
Gross Alpha, total	pCi/l	0.3	888	73	22	104	0	-0.73	277	24	13	130	0
Gross Beta, total	pCi/l	9	678	63	20	104	0	2.5	310	34	15	130	0
Radium 226, total	pCi/l	0.91	14	7	6.05	20	0	0.2	5.3	1	1.0	64	0
Radium 228, total	pCi/l	0.7	6	3	2.4	19	0	0	13.2	2	1.5	55	0
Thorium 228, total	pCi/l	0.32	1.27	1	0.97	5	0	-0.29	2.7	0	0.03	18	0
Thorium 230, total	pCi/l	0.4	7.5	3	3.1	20	0	-0.88	4	1	0.675	56	0
Thorium 232, total	pCi/l	0.2	1.8	1	0.80	20	0	-1.2	1.75	0	0.30	52	0

12.4 Monitoring during Active Restoration

The Company will monitor the progress of aquifer restoration by sampling ore zone monitor wells in each well field at a frequency sufficient to determine the success of aquifer restoration, optimize the efficiency of aquifer restoration, and determine if any areas need additional attention.

12.5 Reporting

Prior to operation of each well field, the Company will prepare and submit an injection authorization data package. The data package will provide the planned locations of injection, production and monitor wells and the results of formation testing. The data packages will request authorization to initiate injection into each well field. The Company will complete MIT and a well completion report for each injection well prior to initiating injection into that well.

Quarterly monitoring reports will be submitted to UDWQ. At minimum, the quarterly monitoring reports will include the following information:

- Physical, chemical and other relevant characteristics of injection fluids
- Monthly average, maximum and minimum values for injection pressure, flow rate and volume
- Quarterly MIT results, a list of any wells failing MIT and corrective actions taken, and a list of wells anticipated to undergo MIT during the next quarter
- Any well maintenance activities

Signed quarterly reports will be submitted electronically unless otherwise directed by the UDWQ. If required, a signature letter from the Company Representative will accompany the electronic submission to certify the report. Reports will consist of monthly summary information for the project. Monitoring reports will include raw data and graphical analysis for the current reporting period to date. Each calendar quarter, the maximum, minimum, and average monthly values for each continuously monitored parameter specified for the injection wells will be tabulated. A narrative description of any deviations from permit limitations will be given. Maintenance activities, MIT activities, and other significant events that took place during the reporting period will be described. If an excursion has potential to impact a USDW, it will be reported verbally to UDEQ within 24 hours and followed up within 5 days in written form.

12.6 Record Keeping

Well completion records and all monitoring information, including calibration and maintenance records and data from the continuous monitoring instrumentation will be retained for at least three (3) years after all wells have been plugged and abandoned. This includes:

- Injection well completion reports.
- Information on the nature, volume, and composition of all injected fluids.
- MIT results, description and results of any other tests required by UDEQ, and any well work-overs completed.

The records discussed above (originals or copies) will be retained on site unless written approval to discard the records is provided by the UDWQ. Copies of these records (or originals) will be maintained for all observation records throughout the operating life of each well. The Company also will maintain an electronic database containing well completion and MIT records for all injection wells. The database will be provided for UDWQ use upon request.

12.7 Quality Assurance

After permit issuance but prior to operations, the Company will prepare and submit to UDWQ a Quality Assurance Project Plan (QAPP). The purpose of the QAPP is to ensure that all groundwater quality measurements are reasonably valid and of a defined quality. These programs are needed (1) to identify deficiencies in the sampling and measurement processes and report them to those responsible for these operations so that permittees may take corrective action and (2) to obtain some measure of confidence in the results of the monitoring programs to assure the regulatory agencies and the public that the results are valid.

Attachment G

Contingency Plan for Well Shut-ins or Well Failures

13.0 PART K - Contingency Plan

This attachment outlines contingency plans to cope with system shut-ins or failures to prevent migration of fluids into any USDWs.

13.1 Introduction

The endangerment of USDWs may occur via any combination of at least three contamination pathways in which fluids can escape the injection zone and enter USDWs. These pathways include:

1) Migration of fluids vertically through a faulty N Aquifer monitoring well
2) Migration of fluids laterally into the N Aquifer
3) Migration of fluids vertically into the N Aquifer

The extent to which a USDW is threatened will depend on a number of factors including:

- The nature of the fluid being injected;
- The volume of the fluid being injected;
- The hydraulics of the flow system (pressure in the injection zone and overlying USDWs); and
- The amount of fluid that may enter the USDW via one or more of the pathways.

Proper construction and MIT of injection wells as outlined in Section 11 and effective monitoring as described in Section 14 will reduce the likelihood that any USDWs will be threatened.

13.2 Prevention Measures

13.2.1 Integrity Testing of Casing

Each new injection, production and monitor well will be logged using a cement bond log to determine the quality of cement bond on the exterior casing wall. This will be followed with pressure tested to confirm the integrity of the casing prior to being used for ISR operations. Mechanical integrity will be demonstrated after a well is constructed and before it is put into use. MIT procedures are discussed in Section 11.5. Wells that fail MIT criteria will be repaired or plugged and abandoned and replaced as necessary.

13.2.2 General Shutdown

All production, injection and monitor wells will be constructed of well casing that is cemented on the exterior to prevent vertical migration of ISR solutions up the annulus between the drill hole and the casing. Both production and injection wells will be piped into a collection header piping and collection ponds.

Each production well will have a submersible pump associated with a circuit breaker that will be labeled with the corresponding well number (e.g., GTO-50 or LW-100). Each circuit breaker will have a start and stop switch that can be used to energize or de-energize the pump motor. The circuit breaker will be the main source of electrical power and will be used to de- energize and lock out the pump motor as necessary for repairs or maintenance.

Each injection well will have a block valve between the header and the flow meter so that the injection well may be blocked off to service the meter and the well. There will be a manual flow control valve and a flow meter on each production and injection well to regulate the flow to and from each well and to balance the individual well patterns. The flow meters will be labeled with designated well identification numbers. The block valves will be closed for the appropriate injection or production well for shutdown and tag out.

13.2.3 Emergency Shutdown

The Company will install automated control and data recording systems at the GTO, Lone Wolf, and Flying Diamond facilities which will provide centralized monitoring and control of the process variables including the flows and pressures of production and injection streams. The systems will include alarms and automatic shutoffs to detect and control a potential release or spill.

Pressure and flow sensors will be installed, for the purpose of leak detection, on the main trunk lines that connect the process facilities to the well fields. In addition, the flow rate of each production and injection well will be measured automatically. Measurements will be collected and transmitted to both the process facilities control systems. Should pressures or flows fluctuate outside of normal operating ranges, alarms will provide immediate warning to operators which will result in a timely response and appropriate corrective action.

Both external and internal shutdown controls will be installed at well head to provide for operator safety and spill control. The external and internal shutdown controls will be designed for automatic and remote shutdown of each well head. In the event of a well shutdown, an alarm will occur and the flows of all injection and production to that well will be automatically stopped.

13.2.4 Point of Compliance Exceedance Control

During production operations, lixiviant will be injected into the production zone through the injection wells, and recovery solution will be withdrawn by the submersible pumps in the production wells. During aquifer restoration, permeate and/or clean makeup water from the N Aquifer will be injected into injection wells and recovery solution pumped from the production wells. Recovering more groundwater than is injected during production and restoration will maintain a localized cone of depression for each well field. This induced gradient from the surrounding area toward the well field will serve as a control over the movement of ISR solutions and minimize the potential for lateral excursions.

Pre-operational POC exceedance preventative measures will include, but will not be limited to:

1) Proper well construction cement bond log, and MIT of each well before use;
2) Monitor well design schema based upon delineation drilling to further characterize the zones of mineralization and to identify the target completion zones for all monitor wells; and
3) Pre-operational pumping tests with monitoring systems in place to obtain a detailed understanding of the local hydrogeology and to demonstrate the adequacy of the monitoring system.

Operational POC exceedance preventative measures will include but will not be limited to:

1) Regular monitoring of flow and pressure on each production and injection well;
2) Regular flow balancing and adjustment of all production and injection flows

appropriate for each production pattern;

3) Monitoring of hydrostatic water levels in monitor wells to verify the inward hydraulic gradient; and

4) Regular collection of samples from all monitor wells to determine the presence of any indicators of the migration of ISR solutions horizontally or vertically from the production zone.

Monitor wells will be positioned to detect any ISR solutions that may potentially migrate away from the production zone due to an imbalance in well field pressure. Prior to injecting lixiviant into each well field, pre-operational pump testing will be conducted to demonstrate hydraulic connection between the production and injection wells and all perimeter monitor wells. Sampling of monitor wells will occur according to the schedule described in Section 12.2.

Controls for preventing migration of ISR solutions to overlying and underlying aquifers consist of:

- Regular monitoring of hydrostatic water levels and sampling for analysis of indicator species;
- Routine MIT of all wells on a regular basis (at least every 5 years) to reduce any possibility of casing leakage;
- Completion of MIT on all wells before putting them into service or after work which involves drilling equipment inside of the casing;
- Proper plugging and abandonment of all wells which do not pass MIT or that become unnecessary for use;
- Proper plugging and abandonment of exploration holes with potential to impact ISR operations; and
- Sampling monitor wells located within the overlying and underlying hydrogeologic units on a quarterly schedule.

13.3 Point of Compliance Exceedance Corrective Action

The Company will implement the following corrective action plan for POC exceedances occurring during production or restoration operations. Corrective actions to correct and retrieve an POC exceedance will include but will not be limited to:

- Adjusting the flow rates of the production and injection wells to increase the aquifer bleed in the area of the excursion;
- Terminating injection into the portion of the well field affected by the excursion;
- Installing pumps in injection wells in the portion of the well field affected by the excursion to retrieve ISR solutions;
- Replacing injection or production wells; and
- Installing new pumping wells adjacent to the well on excursion status to recover ISR solutions.

13.4 Mitigation Measures for Other Potential Environmental Impacts

13.4.1 Spills and Leaks

Well field features such as header houses, well heads or pipelines could contribute to pollution in the unlikely event of a release of ISR solution due to pipeline or well failure. Potential impacts will be minimized by routine MIT of all injection, production and monitor wells and hydrostatic leak testing of all pipelines during construction; implementing an instrumentation and control system to monitor pressure and flow and immediately detect and correct an anomalous condition; and implementing a spill response and cleanup program in accordance with UDEQ and UDOGM permit conditions.

13.4.2 Potential Natural Disaster Risk

See Seismology Section 3.7.

13.4.3 Potential Fire and Explosion Risk

The design criteria for chemical storage and feeding systems include applicable sections of the MSHA regulations and RCRA regulations and the Company will expand any current training and protocols to include the ISR project. The Company will maintain firefighting equipment on site.

13.4.4 Potential Power Outage

Power outages in the Project area would not be likely to last more than a few days or weeks under most conceivable scenarios. The Company will use generators onsite and may also contract for temporary generators to operate well field pumps sufficiently to maintain an inward hydraulic gradient within each well field if unforeseen power outages occur with expected duration of more than two weeks. Backup generators will be installed to maintain continuous instrumentation monitoring and alarms in the process facilities and well fields. Backup power also will be provided for lights.

14.0 PART L - Wellfield Closure Plan

This attachment describes the wellfield closure plan for the Class III injection and extraction wells. This includes i) wellfield rinsing ii) plugging and abandonment, and iii) post-closure closure monitoring.

The Company has evaluated closure costs associated with one and three years of ISR operations (Table 14.1) . The Company does not believe modeling closure scenarios beyond year three years of ISR operations is practical given the Company will be reviewing projections vs. actual operations as part of ongoing review of closure costs. The Company plans to conduct concurrent closure of portions of the wellfields that have completed copper leaching as new areas of the wellfield come into production.. The Company projects installing a total of 71 ISR well including a small test well array over the first three years of ISR operations that the Company will bond, see figure 11.8 for preliminary well installation schedule. The Company plans to review the adequacy of its bond with UDWQ within three years of commencing ISR operations to adjust the amount as necessary based on project advancement and review of actual ISR operating data.

Attachment H

Groundwater Restoration Plan

13.4 Mitigation Measures for Other Potential Environmental Impacts

13.4.1 Spills and Leaks

Well field features such as header houses, well heads or pipelines could contribute to pollution in the unlikely event of a release of ISR solution due to pipeline or well failure. Potential impacts will be minimized by routine MIT of all injection, production and monitor wells and hydrostatic leak testing of all pipelines during construction; implementing an instrumentation and control system to monitor pressure and flow and immediately detect and correct an anomalous condition; and implementing a spill response and cleanup program in accordance with UDEQ and UDOGM permit conditions.

13.4.2 Potential Natural Disaster Risk

See Seismology Section 3.7.

13.4.3 Potential Fire and Explosion Risk

The design criteria for chemical storage and feeding systems include applicable sections of the MSHA regulations and RCRA regulations and the Company will expand any current training and protocols to include the ISR project. The Company will maintain firefighting equipment on site.

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14.1 Wellfield Rinsing

If the proposed ISR wellfield needs to be closed at any time during the first three years of operation,, the Company will initiate an approximate two year closure plan. The closure plan will involve cessation of acid addition, rinsing with fresh water, aquifer rest/neutralization, and wellfield recirculation. The total projected rinsing and recirculation will comprise approximately five pore volumes. Rinse water will be pumped and extracted from the wellfield(s) and evaporated at the ISR collection ponds using forced and natural evaporation (750 gpm capacity).

The Company's closure plan is based on geochemical modeling and metallurgical test results that indicate neutralization and constituent concentration reduction to appropriate levels can be accomplished in approximately two years. The rate and capacity of pH neutralization is well-understood and projected as a function of 15 years of leach pad operation and monitoring which requires daily pH control and observation of the same ore host rock targeted by ISR operations.

The closure plan involves three primary steps. First, following cessation of acid addition, the acidified leaching solution is rested in place to take advantage of the well-documented neutralization capacity of the gangue remaining in the ore body. Sufficient extraction of the leach solution will be maintained to ensure an inward hydraulic gradient while also injecting fresh water using the Company's 300+ gpm wellfield capacity. The initial rest will extend approximately 7 months. Leaching solution extracted during the initial step will be piped to a forced evaporation system and evaporated. Following this, the wellfield will be recirculated for a period of 9 months. Recirculation during phase 2 will allow solution which has not been neutralized to sweep through the acid consuming host rock while continuing to dilute with fresh water. The pH changes during all phases will be measured using pH probes dedicated to selected wells. After five pore volumes of recirculation, the Company projects a third step of replacing one pore volume with fresh water. Rinse water is projected to be supplied by the Company's existing water well supply which will predominantly withdraw groundwater from the BC aquifer. Hydraulic control wells, located along the perimeter of the wellfields are projected to provide additional fresh water for rinsing as the wellfields expand. These wells may be augmented by a water treatment facility as needed to increase rinsing capacity. The final step is anticipated to extend over the balance of the second year of restoration, or sufficient time to normalize pH in the BC aquifer. As pH returns to the projected neutral level, the Company projects being able to meet a water quality standard protective of human health and USDWs.

The Company has projected its wellfield rinsing and evaporation costs based on actual operating data and information used for bonding open pit operations with DOGM. In addition, the Company currently operates infrastructure needed to support ISR. This includes overhead power, monitoring wells, piping, and process ponds.

14.1.1 Mobilization

In the event that the Company defaults on its obligations under the permit, it is assumed the State of Utah would likely hire a remediation contractor to conduct the necessary closure and post closure operations, using subcontractors where necessary to perform such services as rinsing, well abandonment and pump replacement. It is also assumed the contractor would need to assemble a team and mobilize to the site in order to begin rinsing and closure operations. A lump sum estimate of $[75,000] is assumed for preparation and planning and $[20,000] to mobilize and demobilize from site.

14.1.2 Labor

Labor costs for bonding assume manager-level, staff-level, and admin-level rates using RS Means. These costs are included in Table 14.1.

14.1.3 Power Consumption

The Company has estimated the number of gallons required to achieve five pore volumes of recirculation rinsing plus the cost of pumping water from fresh-water wells. This estimation multiplies the average pump horsepower by time using the Company's prevailing power cost of $0.06 per KWh. The Company has significant experience operating its existing water wells for over ten years which it has used as a basis for estimating rinsing power costs.

14.1.4 Well Rehabilitation and Maintenance

The Company has projected pump maintenance, spares, and replacement based on actual operating data from its existing portfolio of wells for the past ten years. Well rehabilitation is anticipated to include reverse flushing wells, swabbing, surging, and replacement as necessary to maintain hydraulic control and commercial sweep efficiency.

14.1.5 Rinse Verification Sampling

Rinsing verification consists of groundwater monitoring of injection/recovery wells after rinsing is completed. The cost is calculated based on the number of injection and recovery wells completed by year of operation. Rinse verification sampling will be conducted on 10% of extraction wells. Assuming three years of ISR operation the Company projects having approximately 71 extraction wells in operation. Sampling 10% of these wells equates to one well for every 2.8 acres. A sample size of 10% is considered statistically significant for quality assurance (QA) verification.

14.1.6 Quarterly Reporting

Closure employees will conduct quarterly sampling, rinse verification sampling, and provide quarterly reporting to UDWQ during the well field closure and well abandonment process. This process is estimated to take two years so eight quarterly reports are projected for submission.

14.1 Well Plugging and Abandonment Plan

The plugging and abandonment methods are designed to prevent movement of fluids through the well, out of the production zone, and into USDWs or the land surface. The same procedures will be followed for production and monitor wells. The rinsing method is designed to neutralize ISR leach solutions and restore water quality to a standard mutually agreed upon with UDWQ. The attachment also summarizes the surface reclamation, decontamination and decommissioning activities that will be carried out in accordance with UDWQ permit and UDOGM permit requirements, as well as requirements stipulated by the BLM for public lands within the Project Area.

The Company will plug all wells in accordance with UAC R317-7-10.5 (40 CFR 146.10). Plugging and abandoning will be performed with bentonite or cement grout and will be placed so as to not allow the movement of fluid either into or between underground sources of drinking water. The weight and composition of the grout will be sufficient to control artesian conditions and meet the well abandonment standards of the State of Utah. Cementing will be completed from total depth to surface using a drill pipe.

Attachment I

Plugging and Abandonment Plan

14.1.2 Labor

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Cementing wells with damage to casing and/or formation may require additional cement. This will be recorded along with the following information:

- well ID, total depth, and location
- driller, company, or person doing the cementing work
- total volume of grout placed down hole
- viscosity and density of the grout

The Company will remove surface casing or cut off surface casing below ground and set a cement surface plug on each well plugged and abandoned.

The Company estimates well plugging and abandonment costs of approximately $5.00 per foot based on current pricing from a local drilling contractor plus a $200 per well capping charge. For the first three years of ISR operations, the Company projects drilling a total of approximately production 71 wells and 13 monitoring wells, all of which would require abandonment. The Company projects plugging and abandonment cost of these wells to be approximately $708,000.

14.2 Plugging and Abandonment Reporting

According to 40 CFR § 144.51(p) the operator is to notify the EPA within 60 days after plugging or at the time of the next quarterly report (whichever is less). In accordance with this requirement, a Plugging and Abandonment Report will be submitted to the EPA. The person that performs the plugging operation will certify the report as accurate. The report will contain either:

- A statement that the well was plugged in accordance with the approved Plugging and Abandonment Plan; or

- If the actual plugging differed from the Plugging and Abandonment Plan, a statement specifying the different procedures followed.

Documentation will be provided to verify that the quantity of sealing material placed in the well is at least equal to the volume of the empty hole.

The Plugging and Abandonment Reports will be retained for at least 3 years from the date of the submission unless the EPA requests an extension. If requested, at the conclusion of the retention period, the reports will be delivered to the EPA.

14.3.7 Post Closure Monitoring

Post closure monitoring will comprise of five years of annual monitoring at 16 monitor well locations; 9 at Lone Wolf and 7 at GTO. The wellfield will be considered closed once five consecutive annual rounds of monitoring meet TRGs for the N Aquifer. The Company conservatively projects post closure monitoring for ten years even though it projects only requiring five years to reach well field closure status.

14.4 Facility Decommissioning

Following regulatory approval of successful aquifer restoration in all well fields, the Company will decommission all well fields, processing facilities, ponds, and equipment within the Project Area. Decommissioning activities will be done in accordance with UDWQ permit and UDOGM large scale mine permit requirements. Surface reclamation and revegetation will be conducted in accordance with

UDOGM large scale mine permit requirements and requirements stipulated by the BLM. The decommissioning program will ensure that the Project Area is closed in a manner that permits release for unrestricted use.

14.5 Necessary Resources

The Company projects closing approximately the same number of wells that it drills annually beginning approximately five years after ISR operations commence (the Company estimates approximately five years to complete copper recovery of a respective ore block). This concurrent closure planning adheres to current Company operating practices employed for open pit mining operations and limits the closure costs from becoming excessively large at the end of the project.

Following review and approval of the closure plan, a financial assurance instrument will be submitted to UDWQ to assure the required activities will be completed to safeguard potential USDWs.

Each year the Company will submit a financial assurance update indicating the anticipated number of injection wells to be installed during the next year and wells to close as well as providing an updated financial assurance instrument to include closure costs for the net additional wells. During decommissioning, the financial assurance instrument will be updated annually to reflect the wells closed during the previous year.

During the ongoing ISR operations, the Company will evaluate sweep efficiency, well efficiencies, changes in groundwater quality, neutralization rates, and rinse/recirculation efficiencies. This data, and other pertinent information will be used to prepare a comprehensive Groundwater Restoration Plan and augment planning herein with actual operating data.

Attachment J

Financial Responsibility

The Standby Trust Agreement along with Schedule A and the Associated Financial Guarantee Bond will be approved and delivered to the DEQ's Office of Support Services prior to Director Authorization to Inject.

These documents shall be updated every five years from the effective date of this permit renewal:

Memorandum

To: Lisbon Valley Mining Company

Utah Department of Environmental Quality, Division of Water Quality

Date: August 20, 2021

From: Alison H. Jones

Doug Bartlett

Subject: Independent Financial Assurance Bonding Estimate

1. Introduction

Lisbon Valley Mining Company LLC (LVMC) is the applicant for an underground injection control (UIC) permit for an in situ mining project in La Sal, Utah. A draft permit (UTU-37-AP-5D5F693) has been issued by the Utah Department of Environmental Quality, Division of Water Quality (UDWQ), which included an estimate for three years of financial assurance (FA) bonding for closure of the project. UDWQ requested an independent third-party estimate of the FA amount for the first three years of operation. LVMC retained Clear Creek Associates, LLC (Clear Creek) to conduct the review and formulate an independent estimate for the FA.

The objective of this review is to arrive at an independent FA bonding estimate that is sufficient to meet the conditions required by Part III, Section L.1 of the draft permit. The estimate is based on Clear Creek's understanding of this project and our experience with in situ copper recovery. In situ mining for copper is not a widespread practice at this time. Industry-wide experience related to in situ mining for copper is limited, and to our knowledge, there have been no closures of in situ copper mines in the United States.

1.1 Background

LVMC owns and operates an open-pit copper mine and heap leach operation in lower Lisbon Valley approximately 17 miles southeast of the unincorporated town of La Sal, Utah. LVMC has identified a copper resource immediately south and east of their current operation that they have found to be suitable for in situ mining. Three deposits have been identified: the GTO, Lone Wolf, and Flying Diamond deposits, which are estimated to contain greater than 800 million pounds of copper suitable for in situ (ISR) recovery. This closure estimate was prepared for 3 years of mining at the GTO deposit. GTO is deeper and more expensive to mine than Lone Wolf and Flying Diamond. Closure costs for the initial three years of mining Lone Wolf and Flying Diamond deposits will be lower than costs for GTO closure.

Disseminated copper is primarily hosted in the Burro Canyon (BC) aquifer and to a lesser extent the deeper Navajo (N) aquifer. The UIC application allows for in situ mining in the BC aquifer only. The BC aquifer water quality is poor, and according to the LVMC application, there are no registered residential, municipal, or other commercial water wells in the BC aquifer within the Project area other than those owned by LVMC.

1.2 Scope of Work

The following tasks were conducted for this review:

- Review of UIC application and draft permit to understand the scope of the project and the steps involved in the closure.
- Discussions with LVMC regarding assumptions made in the initial bond amount.
- Discussion with Peter Brinton at Utah Division of Oil, Gas and Mining (UDOGM) regarding indirect costs and escalation.
- Review/revise and update as necessary for completeness, unit costs, and quantities.
- Preparation of this document summarizing the review with conclusions.

2. Project Description

2.1 Wellfield Operations

ISR is a method of mining where a metal, in this case copper, is dissolved from rock while it is still in the ground (i.e. in situ). There are no open pits, waste rock, or tailings produced in this type of mining. Low pH water, called "raffinate", is injected into wells that are screened in the mineralized zone. As the raffinate travels through the mineralized rock from the injection well to the recovery well, it dissolves the disseminated copper. The raffinate containing dissolved copper flows toward pumping (or recovery) wells, where it is pumped to the surface.

The recovered raffinate (which is now called pregnant leachate solution or "PLS") is processed in a solution extraction and electrowinning plant. In this process, the metal precipitates out as copper cathode plates. After the copper is removed, the low pH raffinate is then re-circulated into the wellfield.

Injection and recovery wells are generally installed in a grid of "5-spots" where each injection well is surrounded by 4 recovery wells and each recovery well is surrounded by 4 injection wells. The grid may be modified to take advantage of fractures or other features that are identified by geologists as the wellfield expands. Injection wells can be converted to recovery wells (and vice versa), if needed. The injection and recovery wells will be screened in the BC aquifer. Due to low conductivity strata above and below the BC aquifer, solutions will be confined to this aquifer.

At the end of Year 3, the GTO wellfield will contain 71 wells (26 5-spots made up of 26 injection wells, 45 extraction wells) in an approximate 150 foot by 150 foot grid). In addition there will be 7 monitoring wells outside of the wellfield.

2.2 Hydraulic Control

An important element of operating a wellfield is hydraulic control. This is the mechanism by which raffinate/PLS in the aquifer is prevented from escaping the wellfield. Maintaining hydraulic control is important from an economic perspective (PLS is a valuable commodity) and an environmental perspective. A slight inward gradient is maintained so that groundwater flows toward the wellfield from all directions. This inward gradient is achieved by pumping out slightly more water than is pumped into the wellfield, resulting in a cone of depression centered on the wellfield. Maintaining inward gradients is a key principle used for all ISR projects. For this reason, it is important to maintain the proper balance of injection and extraction flow rates.

2.3 Wellfield Closure

After copper grades in the PLS decline, the mine block will undergo closure to neutralize the low pH water in the wellfield and abandon the wells. LVMC has proposed a multi-year closure process that will consist of:

- Rinsing
- Closure Monitoring

- Well Plugging and Abandonment
- Post-Closure monitoring

Each of these steps is summarized in the following sections.

2.3.1 Rinsing

A two-year rinsing process will include the following steps:

- **Step 1**--Wellfield resting: Injection will cease and solution will rest in place for 7 months. During this rest period, solutions will neutralize and hydraulic control will be maintained by pumping a subset of the extraction wells that are spatially distanced throughout the wellfield. Solutions will be pumped to the ISR dedicated collection ponds for evaporation.
- **Step 2**--Wellfield recirculation: over the course of 9 months, approximately five pore volumes of solution will be circulated through the wellfield. Solution removed from the wellfield will pumped to collection ponds for evaporation as described above. During this time, a lesser amount (approximately 300 gpm) of fresh makeup water will be injected into the wellfield. This strategy will continue to maintain hydraulic control.
- **Step 3**--One pore volume will be pumped from the wellfield and evaporated. As it is removed it will be replaced with a pore volume of fresh water from LVMC's nearby wells.

2.3.2 Closure monitoring

During the two-year rinsing process, eight rounds of quarterly groundwater monitoring, will be conducted to evaluate the rinsing process. Six monitoring wells and four extraction wells will be monitored eight times during the rinse, as described in the permit application. Monitoring results will be reported to the regulators as required in the draft permit.

2.3.3 Well Abandonment

After rinsing and closure monitoring, pumping will be discontinued and the wellfield injection/recovery wells will be plugged and abandoned. The monitoring wells will be filled with a cement to a few feet below the land surface. The annulus above the screened interval will be cemented during initial installation to prevent vertical movement of groundwater and leaching solutions outside the casing.

At the land surface, approximately 2-5 feet of the casing will be removed and the surface will be regraded.

Monitoring wells will remain in service for the 5-year post-closure monitoring period. They will be plugged and abandoned using the same methodology as the injection/extraction wells.

2.3.4 Post-Closure Monitoring

Annual post-closure monitoring will be conducted as described in the permit application. Monitoring results will be reported to the regulators as required in the draft permit.

3. Closure Costs

3.1 Assumptions

This bond review was conducted for the wellfield only. Closure costs for the ISR surface disturbance, which includes surface collection ponds and associated infrastructure will be included in the Company's existing open pit reclamation surety which is active and overseen by UDOGM. Also, all LVMC copper production facilities associated with ISR are covered in the existing reclamation surety with UDOGM. All evaporation activities associated with ISR will be conducted using collection ponds dedicated to the ISR project only and will not have any association with the open pit operation. After completion of ISR evaporation activities, the ISR collection ponds and related surface facilities will be reclaimed per standard UDOGM bonding requirements. Clear Creek reviewed the LVMC UIC permit application, including the closure cost estimate. Assumptions included in this bond estimate are:

- The bond estimate is for closure for the first 3 years of the ISR operations. Year 1 (2022) is primarily construction costs. No in situ leaching will occur in Year 1. Leaching will occur during years 2 (2023) and year 3 (2024). The bond calculation was conducted for the year of greatest reclamation cost liability, which is at the end of Year 3 when the maximum number of injection and recovery wells will exist. All of the activities for Years 1-3 are at the GTO deposit.
- RSMeans (Gordion Group, 2021) labor rates include overhead and profit.
- Costs for labor, monitoring, well abandonment, and maintenance were escalated to the year in which they are anticipated to be incurred. A 2.69%/year escalation rate, compounded annually, was used based on the past 5 years of RSMeans historical cost indices (Gordian, 2021), as recommended by DOGM.

- The wellfield is staffed in 2025-2026 for rinsing operations. Employees remaining in 2027 will be employed for 3 months to close the wellfield.
- Electrical costs for wellfield rinsing were based on the current rate of $0.06/kw-hr. Electrical costs were not escalated.
- Well abandonment costs were based on the UDOGM guidance (UDOGM, 2021), using $5.50 per linear foot for the plugging cost, $210 for wellhead removal, and $12,000 for mobilization. These costs were escalated from 2021 to the year they will be incurred. The wellfield wells will be abandoned in 2027 and the monitoring wells will be abandoned in 2031 after 5 years of post-closure monitoring.
- Closure and post-closure monitoring labor costs and expenses are based on Clear Creek's experience in monitoring groundwater at mining sites. Costs for sample shipping, generator rental, mileage (from Salt Lake City) and laboratory analyses are included.
- Laboratory costs for closure and post-closure monitoring were based on a laboratory quote from a commercial laboratory, and escalated to the year the cost will be incurred. Subcontracted laboratory costs were marked up 15%, as is customary.
- Water treatment is not expected to be necessary, based on LVMC's understanding of the acid neutralizing capacity of the rock. However, the cost for sodium bicarbonate addition, including mixing equipment, is included in the bond estimate because, as the permit notes this treatment may be implemented. The mixing will be done in an existing impoundment that is included in the surface mine bond.
- Indirect costs of 21.8% were applied. This includes 5% for insurance, permits and bonds, 5% contingency, 2.5% for engineering redesign, 6.8% for main office expense, and 2.5% for project management (UDOGM Tech 007, 2017).
- The UDOGM Tech 007 (2017) guidance recommends a 10% indirect cost for mobilization (which also includes insurance, permits and bonds). Instead, we used 5% for insurance, permits and bonds (see bullet point immediately above). Mobilization costs are included in the labor and subcontractors' costs. It is worth noting that this project will require very little equipment for reclamation, since all surface reclamation will be covered by the UDOGM open pit reclamation surety, and thus mobilization costs are small. The only mobilizations are for the drill rigs (for abandonment) and monitoring staff (who we have assumed will come from Salt Lake City).

3.2 Closure Costs

Clear Creek estimates the closure costs, using the assumptions provided in Section 3.1, will be $6,184,000. A spreadsheet summarizing the costs is attached.

4. Conclusions

Clear Creek Associates prepared this independent third-party estimate of closure costs for the first three (3) years of in situ mining at the Lisbon Valley Mining Company GTO deposit. In general, our analysis confirms the accuracy of the Company's operational closure cost estimate but differs from LVMC's estimate in the following ways:

- This estimate escalates costs from 2021 to the year in which they are expected to be incurred.
- This estimate used DOGM's guidelines for indirect costs, with the exception of mobilization costs.
- This estimate includes costs for water treatment during the second year of rinsing. LVMC's experience with leaching in the surface mine indicates this will not likely be necessary. However, because it is referenced in the UIC application as a possibility, we recommend that it be included.

5. References

Gordian Group, Inc., 2020. Heavy Construction Costs with RSMeans data, 2021. Derrick Hale, PE, editor.

State of Utah Department of Natural Resources Division of Oil, Gas and Mining (UDOGM), 2017. Calculation guidelines for determining coal mining reclamation bond amounts, Directive number Tech-007.

State of Utah Department of Natural Resources Division of Oil, Gas and Mining (UDOGM), 2021. 2021 Reclamation Surety Amounts for Exploration and Small Mining Operations Including

Small Mine Three- and Five-Year Escalation, memo to Utah Board of Oil Gas and Mining from Wayne Western, Peter Brinton, and Kim Coburn dated March 24, 2021.

Independent Third-Party Financial Assurance Bonding Estimate
Lisbon Valley Mine, La Sal, Utah

		Rinsing Y1	Rinsing Y2	FIVE YEAR POST-CLOSURE PERIOD					
Closure Summary		**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	
	Mining Area (tons)	7,521,429	7,521,429						
	Pumping Volume	359,640,000	272,975,409						
	Pore Volume Circulated (including final rins	3.5	2.7						
	Cume Rinsing Volume	359,640,000	632,615,409						
	Duration of Rinsing (days)	165	365						
	Wellfield Wells to Abandon			71					
	Monitor Wells to Abandon							7	
	Well Footage to Abandon			47,390					
	Monitoring Well Footage to Abandon							6,600	
	Wells Rinsing	23	23						
	$Kwh	$ 0.06	$ 0.06						
Labor									
	Project Manager	250,093	256,821	65,932	-	-	-	-	
	Wellfield Supervisor	232,746	239,007	-	-	-	-	-	
	Wellfield Operations	209,616	215,254	-	-	-	-	-	
	Wellfield Ops	160,464	164,781	-	-	-	-	-	
	Wellfield Electrician	262,711	269,778	69,259	-	-	-	-	
	Laborer	153,236	157,358	40,398	-	-	-	-	
	Site Security	204,816	210,326	53,996	-	-	-	-	
	Overhead, vehicles & expenses	27,801	28,548	14,658	-	-	-	-	
	Total	1,501,483	1,541,873	244,243	-	-	-	-	
Rinsing, Capital & Power									
	Rinse Recovery Pumping Power	75,091	59,246	-	-	-	-	-	
	Evaporation Pumping Power	227,902	311,604	-	-	-	-	-	
	Water Supply Power	54,872	54,872	-	-	-	-	-	
	Total	357,865	425,722						
Water Treatment		-	178,969	-	-	-	-	-	for 50% neutralization
Qtrly Monitoring, Rinse Verification Sampling, and Reporting		47,986	49,277						
Well Rehabilitation and Maintenance		56,491	58,010						
Well Abandonment									
	Wellfield	-	-	337,202	-	-	-	-	includes $12000 mobe, escalated
	Monitoring Wells	-	-	-	-	-	-	64,901	includes $12000 mobe, escalated
	Total	-	-	337,202	-	-	-	64,901	
Post Closure Monitoring		-	-	65,875	67,647	69,467	71,336	73,254	
Total Closure Cost by Year of Operation		**1,963,825**	**2,253,851**	**647,320**	**67,647**	**69,467**	**71,336**	**138,155**	**5,211,600**
Indirect Costs									
Insurance, permits, bonds	5.0%	23,117	35,599	20,154	3,382	3,473	3,567	6,908	96,200
Contingency	5.0%	98,191	112,693	32,366	3,382	3,473	3,567	6,908	260,580
Engineering Redesign	2.5%	49,096	56,346	16,183	1,691	1,737	1,783	3,454	130,290
RS Means Main Office Expense	6.8%	133,540	153,262	44,018	4,600	4,724	4,851	9,395	354,389
Project Management Fee	2.5%	49,096	56,346	16,183	1,691	1,737	1,783	3,454	130,290
Subtotal Indirect Costs	21.8%	353,040	414,246	128,904	14,747	15,144	15,551	30,118	971,749
									TOTAL FA Estimate
PROJECT TOTAL BY YEAR		**2,316,864**	**2,668,096**	**776,223**	**82,394**	**84,611**	**86,887**	**168,273**	**6,183,349**

Attachment K

Expected Changes Due to Injection

16.13 Future Operations

With future exploration drilling, there is the potential of locating additional recoverable resources within the Project Area that are outside the currently requested AEB. A future amendment for a modified AEB might be requested by the Company if additional potential well field areas are delineated.

17.0 PART O - Expected Changes Due to Injection

Expected changes due to injection include changes in aquifer chemistry, head pressures, and local gradients. All changes are transient and will be restored after mining.

17.1 Chemistry Changes

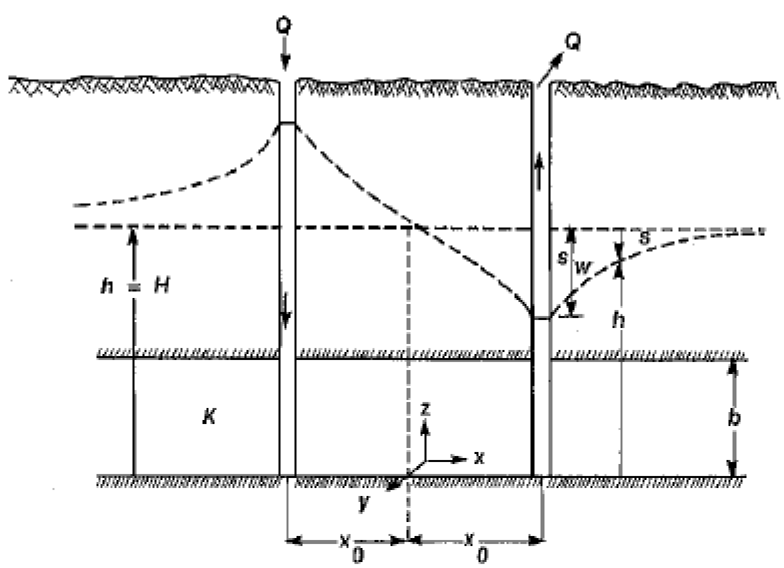
The LLV BC Aquifer chemistry and head levels will change during the ISR mining process. The anticipated groundwater chemistry within each wellfield is detailed in Section 6.3.

17.2 Head Changes

The head level changes will be the result of concurrent injection/extraction. A section is included below describing the dynamics of concurrent injection/extraction in the ISR wellfields.

17.2.1 Hydrology of ISR

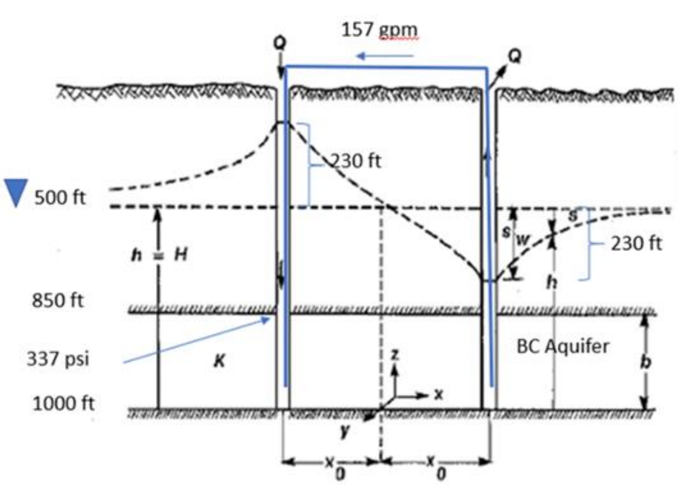
ISR operation involves injection and extraction wells operating in tandem which increases flow between wells as a function of increased pressure head. The inter-well pressure head between wells is a sum of injection pressure and drawdown pressure. Stated another way, the drawdown (Sw) is equal to the increase in head above the water table at the injection well. Sw between a single extraction and single injection well is shown below. The injection well can be pressured to heads above ground surface with a surface booster pump of sufficient pressure rating and capacity.



The GTO simulation is based on pump testing at PW-12, located near the deepest part of the GTO graben. Injection pressure w/o boost is simulated @ 337psi. This pressure can be boosted to 459 psi and stay 10% below 0.6 ft/ft frac gradient. The extended 5-Spot wellfield flow can be operated at flow rates greater than 50 gpm/well.

Depth Bed 15	hydrostatic ft	psi	frac psi	90% frac	delta
850	780	337.74	510	459	121.26

GTO Injection Pressure and Extended Wellfield Flow



The extended five spot flow equation expressed with the intrinsic permeability and SI units is:

$$Q = \frac{k_i \Delta P_{IP}}{\mu}\left[\frac{\pi b}{\ln(S_5/\sqrt{2}r_w) - 0.619}\right]. \quad (11.11)$$

Q=($k_i DP_{IP}$/m)*[pb/(ln(S/(sqrt(2)r_w))-0.619)]

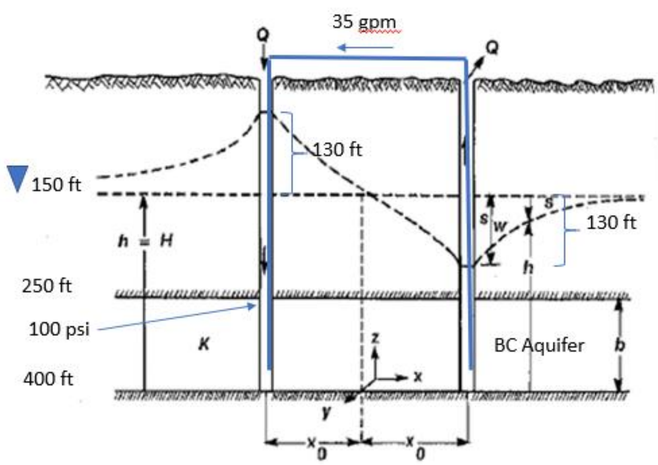
Q	gpm	**156.6877**
k_i	mD	400
DP_{IP}	psi	130.05
m	psi*s	1.45E-07
b	ft	150
S5	ft	150
S/sqrt(2)	ft	106.066
r_w	in	4

Bartlett R.W 2009 Solution Mining Leaching and Fluids Recovery of Materials Second Edition

The changes in head pressure at Lone Wolf is shown below and added to Section – of the report. The Lone Wolf simulation is based on pump testing at PW-9, a low permeability well located on the perimeter of the Lone Wolf depost. Injection pressure w/o boost is simulated @ 100 psi. This pressure can be boosted to 135 psi and stay 10% below 0.6 ft/ft frac gradient

Depth Bed 15	hydrostatic ft	psi	frac psi	90% frac	delta
250	230	99.59	150	135	35.41

Lone Wolf Pressure Injection Pressure and Extended Wellfield Flow



The extended five spot flow equation expressed with the intrinsic permeability and SI units is:

$$Q = \frac{k_i \Delta P_{IP}}{\mu}\left[\frac{\pi b}{\ln(S_5/\sqrt{2}r_w) - 0.619}\right]. \quad (11.11)$$

Q=($k_i DP_{IP}$/m)*[pb/(ln(S/(sqrt(2)r_w))-0.619)]

Q	gpm	35.25472
k_i	mD	90
DP_{IP}	psi	130.05
m	psi*s	1.45E-07
b	ft	150
S5	ft	150
S/sqrt(2)	ft	106.066
r_w	in	4

Bartlett R.W 2009 Solution Mining Leaching and Fluids Recovery of Materials Second Edition

17.4 ISR Wellfield Design

Injection rates and extraction rates will be controlled during ISR operation to hydraulically capture all of the injected lixiviant and minimize excursion. The wellfield pattern, combined with flow rate controls, will capture the injected lixiviant by either operating more extraction wells than injection wells, or otherwise adjusting injection flow below extraction flow. This maintains an inwards hydraulic gradient for life of mining activities. Production monitoring wells, described in Section 12, ensure that head levels and chemistry changes are restricted to the wellfields for the life of the ISR mining process.

Attachment L

Mechanical Integrity Demonstration Protocols

10.5 Mechanical Integrity Testing

All injection, production, and monitor wells will be field tested to demonstrate the mechanical integrity of the well casing. The MIT will be performed using pressure-packer tests. The bottom of the casing will be sealed with a plug, downhole inflatable packer, or other suitable device. The casing will be filled with water and the top of the casing will be sealed with a threaded cap, mechanical seal or downhole inflatable packer. The well casing then will be pressurized with water or air and monitored with a calibrated pressure gauge. Internal casing pressure will be increased to 125 percent of the maximum operating pressure of the well field, 125 percent of the maximum operating pressure rating of the well casing (which is always less than the maximum pressure rating of the pipe), or 90 percent of the formation fracture pressure (see Section 8.1), whichever is less. A well must maintain 90 percent of this pressure for a minimum of 10 minutes to pass the test.

If there are obvious leaks, or the pressure drops by more than 10 percent during the 10-minute period, the seals and fittings on the packer system will be checked and/or reset and another test will be conducted. If the pressure drops less than 10 percent the well casing will have demonstrated acceptable mechanical integrity.

10.5.1 Loss of Mechanical Integrity

If a well casing does not meet the MIT criteria, the well will be removed from service. The casing may be repaired and the well re-tested, or the well may be plugged and abandoned. Well plugging procedures are described in Section 15. EPA will be notified of any well that fails MIT following the reporting procedures described in Section 14.5. If a repaired well passes MIT, it will be employed in its intended service following demonstration that the well meets MIT criteria. If an acceptable test cannot be demonstrated following repairs, the well will be plugged and abandoned.

10.5.2 Subsequent Mechanical Integrity Testing

In addition to the initial testing after well construction, MIT will be conducted on any well following any repair where a downhole drill bit or under-reaming tool is used. Any well with evidence of subsurface damage will require new MIT prior to the well being returned to service. MIT also will be repeated once every 5 years for all active wells.

10.5.3 Reporting

MIT documentation will include the well designation, test date, test duration, beginning and ending pressures, and the signature of the individual responsible for conducting each test. MIT documentation will be available for inspection by the EPA. MIT results will be reported on a quarterly basis as described in Section 14.5 (Attachment P).

Attachment M

Aquifer Exemption Request

UTAH DEPARTMENT of ENVIRONMENTAL QUALITY
WATER QUALITY

State of Utah

Underground Injection Control Program

Aquifer Exemption Request

Submitted to the

U.S. Environmental Protection Agency Region 8

Prepared by the State of Utah,
Department of Environmental Quality,
Division of Water Quality

June, 2022

TABLE OF CONTENTS

List of Figures

List of Tables

Key Acronyms and Definitions

ADEQ	Arizona Department of Environmental Quality
AE	Aquifer Exemption
amsl	above mean sea level
AOR	Area of Review
Aquifer	a saturated bed, formation, or group of formations that yields water in sufficient quantity to be economically useful (Driscoll, 1986)
BC Aquifer	Burro Canyon Aquifer
BLM	Bureau of Land Management
Director	Utah UIC Director
Division	Division of Water Quality
DWQ	Division of Water Quality
EPA	U.S. Environmental Protection Agency
FW	footwall block, the block of rock on the lower side of a fault plane
gpm	gallons per minute
injection interval	within a well, the injection interval refers to the specific range of depths below the ground surface at which fluids will be injected into the aquifer; within the injection interval, well casing screens or perforated casing allows fluids to enter the permeable rock formation; above the injection interval, a solid casing is used

	for the well and forms a barrier between the well and the surrounding rock or aquifer
ISR	in-situ recovery
LLV	lower Lisbon Valley
LVMC	Lisbon Valley Mining Company, LLC
MCL	maximum contaminant levels
N Aquifer	Entrada, Navajo, Kayenta, and Wingate Formations, sandstone aquifers
National Instrument 43-101	National Instrument 43-101 is a national instrument for the *Standards of Disclosure for Mineral Projects* within Canada. The Instrument is a codified set of rules and guidelines for reporting and displaying information related to mineral properties owned by, or explored by, companies which report these results on stock exchanges within Canada.
mg/L	milligrams per liter
Perched water	unconfined groundwater separated from an underlying main body of groundwater by an unsaturated zone (Driscoll, 1986); in some cases it may be confined by low permeability formations above and below the perched water
Permit	Utah Division of Water Quality Class III Area Permit, Underground Injection Control (UIC) Program, UIC Permit Number: UTU-37-AP-5D5F693
SDWA	Safe Drinking Water Act
SLB&M	Salt Lake Base and Meridian
TDS	total dissolved solids
UAC	Utah Administrative Code
UIC	Underground Injection Control
USDW	underground sources of drinking water

INTRODUCTION

The Lisbon Valley Mining Company, LLC (LVMC), has submitted a permit application (LVMC, 2019) to the Utah Division of Water Quality (DWQ or Division) for work in the lower Lisbon Valley (LLV), Utah. LVMC is proposing to use a portion of the Burro Canyon (BC) Aquifer in the LLV in San Juan County, Utah, for in-situ recovery (ISR) of copper. The Director has prepared an Underground Injection Control, Class III Permit (UTU-37-AP-5D5F693), hereafter referred to as the Permit (DWQ, 2022) based on LVMC's permit application.

This Aquifer Exemption (AE) request is part of the Permit. This document provides background information and the basis for the Director's decision to request that the U.S. Environmental Protection Agency (EPA) approve an AE for a portion of the BC Aquifer. The basis of the AE request includes selected material and data contained in LVMC's Technical Report (LVMC, 2020) submitted with the permit application (LVMC, 2019), but the Technical Report, in its entirety, is not the permit or part of the permit (DWQ, 2022). The Director required LVMC to include the Technical Report as part of its application for the permit to provide information relevant to the Director's review of the application and to use when writing the Permit and this AE request. The Technical Report was provided to the public in response to a request from the public, but it is not part of this public notice package because the Technical Report itself in its entirety is not part of the Permit (DWQ, 2022) or this AE request. Moreover, LVMC revised and updated the Technical Report during the permit review process in response to requests from the Director for more information and for modifications to the proposed plan and AE request. The Final Permit (DWQ, 2022) is the legal regulatory document that defines all permit conditions. The objective of the Director's review of LVMC's application and Technical Report is not to edit, critique, and finalize those documents, but rather to use those documents to prepare the Permit and this AE request, which is subject to public notice comment under UIC regulations (40 CFR §§ 124.10, 124.11, 124.12, and 124.17 as incorporated in Utah Administrative Code [UAC] R317-7-1). Specific information from the Technical Report used to support this AE request is cited, quoted, or reproduced in this AE request.

Under Part III, Section E.1 of the Permit (DWQ, 2022), an AE and an approved Aquifer Restoration Plan are required prior to commencement of ISR wellfield construction and operations by LVMC in the LLV. LVMC provided justification for the AE in its permit application (LVMC 2019), and information in that application and Technical Report (LVMC, 2020) is used to support this AE request.

Aquifer to Be Exempted: A portion of the BC Aquifer as described herein.

Exemption Criteria: The portion of the BC Aquifer proposed for exemption qualifies under 40 CFR § 146.4 because it is not currently serving as a source of drinking water and cannot serve as a potential future source of drinking water because LVMC has demonstrated that it contains minerals that are expected to be commercially producible.

Primacy Agency: State of Utah, Department of Environmental Quality, Division of Water Quality, under Section 1422 of the Safe Drinking Water Act (SDWA) and the Utah Underground Injection Control (UIC) Rules in UAC R317-7. The Utah Bureau of Water Pollution Control, now the Utah Division of Water Quality, received primacy from EPA on February 10, 1983, according to 40 CFR §§ 145 and 147 to administer the program in Utah under section 1422 of the SDWA for Class I, III, IV, and V wells (the Utah 1422 UIC Program). All Utah UIC regulations are enforced by the Division under the authority of the Director of DWQ who is also the designated Utah UIC Director (Director).

Date of AE Request: June 2022

SUBSTANTIAL OR NON-SUBSTANTIAL APPROVAL: NON-SUBSTANTIAL

Under 40 CFR § 144.7(b)(3) and § 145.32, this AE request to EPA is a state program revision and requires EPA to determine whether approval of the AE request is a major or minor (i.e., substantial or non-substantial) amendment to Utah's UIC Program. The Director believes this AE decision is minor, or non-substantial, because it is associated with the issuance of a site-specific UIC Class III permit action, not a statewide programmatic change or a revision with implications for the national UIC program. The basis for characterizing this AE as a minor, non-substantial program revision is also consistent with the corresponding state program revision process detailed in EPA Guidance #34: *Guidance for Review and Approval of State Underground Injection Control (UIC) Programs and Revisions to Approved State Programs* (EPA, 2000). Guidance #34 explains that determining whether a program revision is substantial or non-substantial is done 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. While this is the first Class III AE in the state of Utah, there are several Class II AEs in the state.

Current Operator: Lisbon Valley Mining Company, LLC (LVMC)

Well/Project Name: Lisbon Valley In-Situ Copper Recovery Project

Well/Project Permit Number: Permit No. UTU-37-AP-5D5F693

Well/Project Location: All of Sections 4, 5, 6, 7, 8, 9, 10, 11, 14, 15, 16, and 17 of Township 31 South, Range 26 East, Salt Lake Base and Meridian (SLB&M). All of Sections 31 and 32 of Township 30 South, Range 26 East, SLB&M. All of Section 36 of Township 30 South, Range 25 East, SLB&M. All of Section 1 of Township 31 South, Range 25 East, SLB&M.

County: San Juan

State: Utah

Well Class /Type: Class III in-situ copper recovery

DESCRIPTION OF THE PROPOSED COPPER RECOVERY PROCESS

BACKGROUND

LVMC currently operates an existing open pit and heap leach copper mine in southeastern San Juan County, Utah, about 20 miles north-northeast of Monticello and east of U.S. Route 191 (Figure 1). The current Lisbon Valley mine has been using open pit and heap leaching methods for 13 years. The mine has recovered approximately 65%–75% of available copper using these methods, which are used throughout the copper industry.

Additional copper resources in the LLV are currently uneconomical to develop using open pit mining methods. Therefore, LVMC proposes to extend the life of the Lisbon Valley mine by adopting ISR technology. ISR methods involve injecting lixiviant (which is defined and explained below in the In-Situ Recovery Process section) into injection wells (classified by the Director as Class III injection wells). LVMC's proposal requires a Class III Area Permit from the UIC Director (Permit, DWQ 2022). LVMC requested this AE as part of its application for a UIC permit (LVMC, 2019). This AE request is part of the Permit, and the Director is submitting this AE request to the EPA for approval.

Figure 1 shows the Permit Area boundary in dark green and the Area of Review (AOR) considered by the Director in its permit application review in light green. Under UAC R317-7-1, the AOR extends 2 miles from the circumscribed Permit Area for an area permit.

LVMC has identified three ore bodies with commercial grades of copper suitable for ISR. Figure 2 shows the LVMC Permit Area and the Lone Wolf, GTO, and Flying Diamond deposits where ISR wellfields are proposed. Other areas with potential copper resources within the Permit Area, as indicated in Appendix D of LVMC's Technical Report (LVMC 2020: Appendix D), may also be amenable to ISR. Other copper resources that may exist in LLV outside of the area considered in the Permit cannot be developed by ISR under UIC regulations unless the Permit is revised at a future date or a separate permit is applied for and approved.

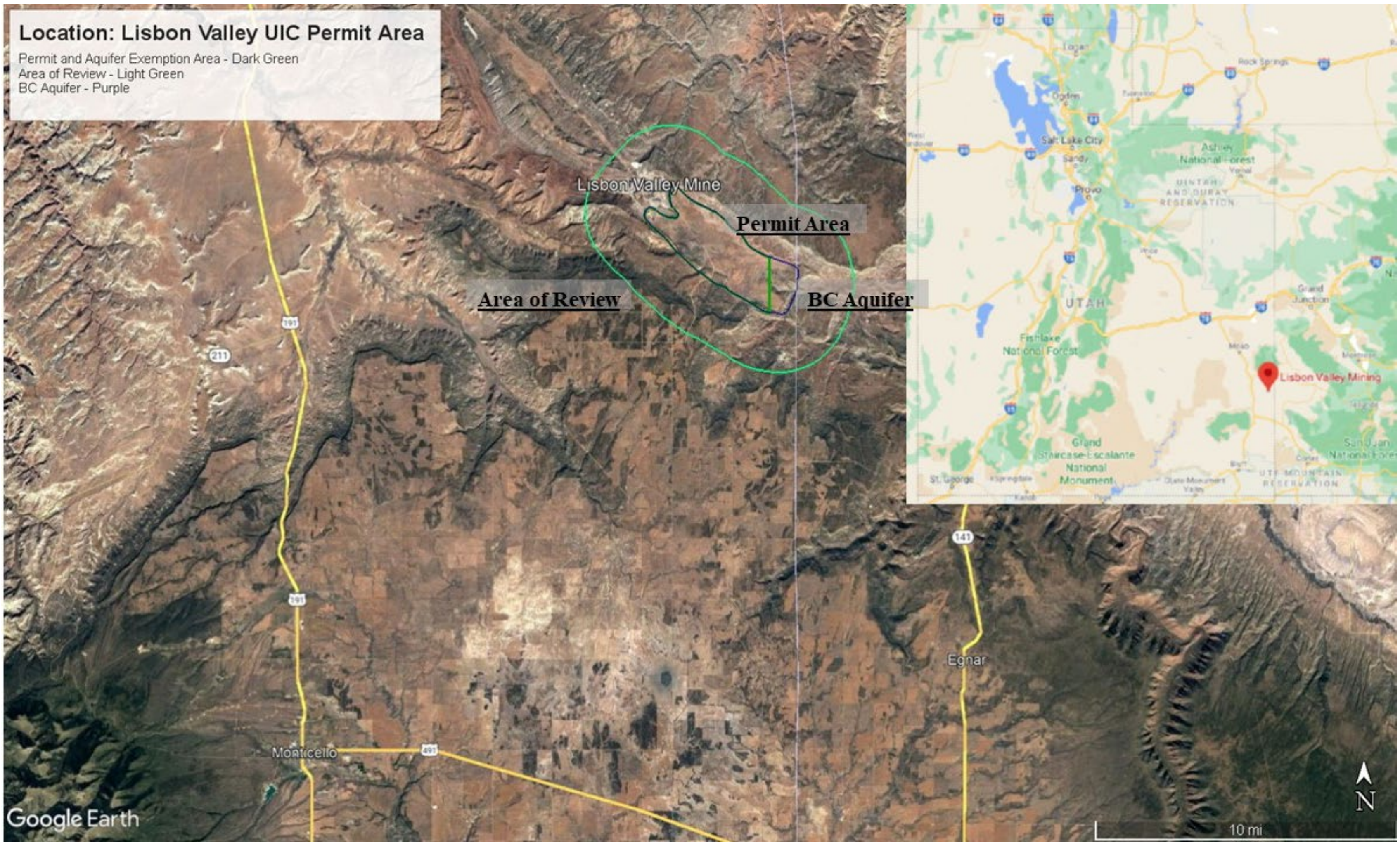


Figure 1. Location of the Lisbon Valley Mining Company proposed Permit Area and Aquifer Exemption Area, Area of Review, and BC Aquifer.

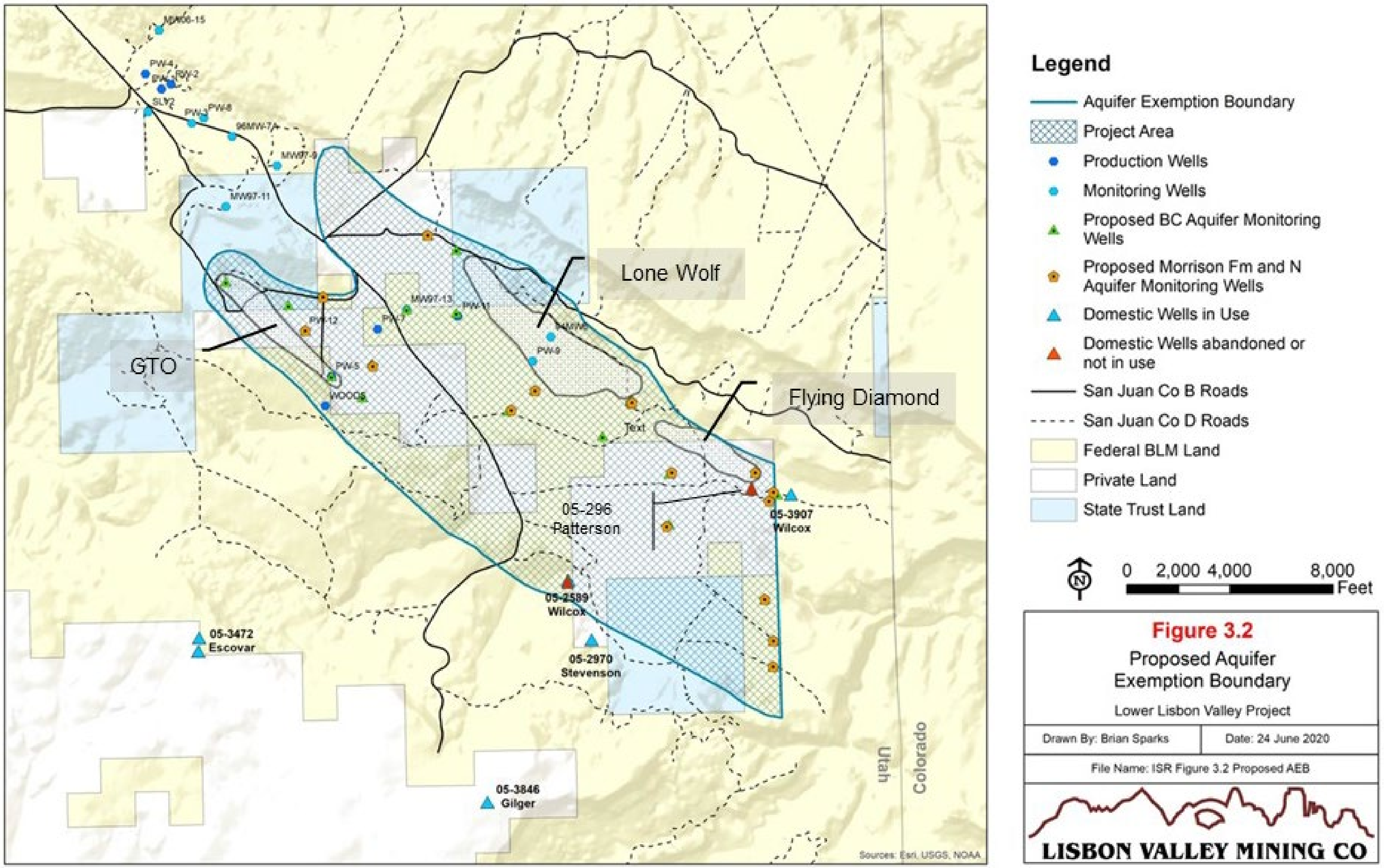


Figure 2. Proposed Aquifer Exemption boundary, Project Area, existing water production and monitoring wells associated with current open pit mining, proposed point of compliance monitoring wells for the Permit, and GTO, Lone Wolf, and Flying Diamond copper deposits that are targets for ISR. Adapted from the Lisbon Valley Mining Company Technical Report (LVMC 2020: Figure 3.2).

PROPOSED INJECTION, PRODUCTION, AND MONITORING WELLS

LVMC proposes to construct and operate up to approximately 2,650 Class III ISR injection wells to continue extraction of copper from ore in the LLV within mineralized zones of a portion of the BC Aquifer, which includes the Dakota and Burro Canyon Formations. These formations exist generally between 200 and 900 feet below the ground's surface in the LLV, east of the current mining operation.

Figure 3 shows the proposed typical arrangement of injection wells, production wells, and monitoring wells. Each ISR wellfield will have a perimeter ring of monitoring wells around the wellfield as shown in Figure 3.

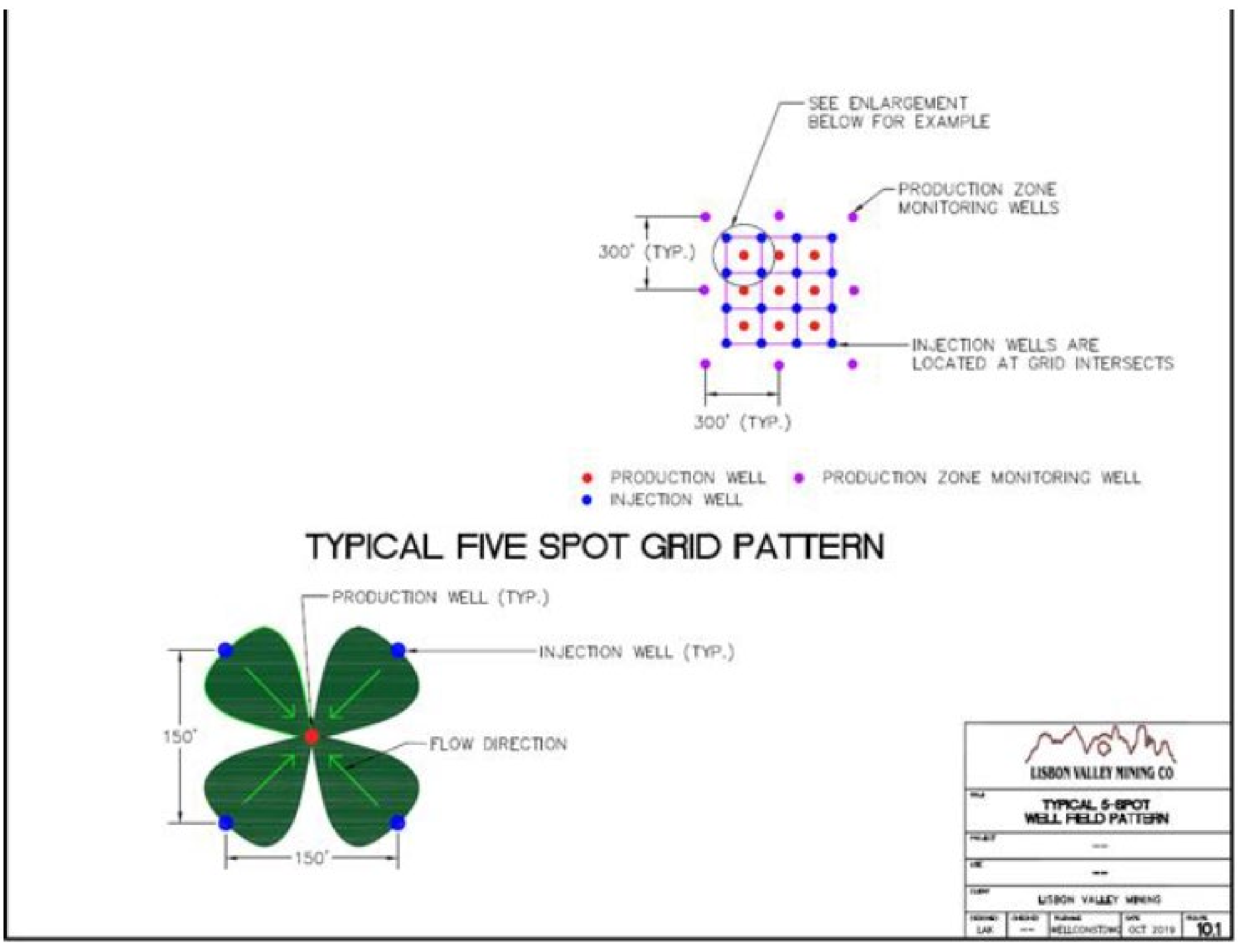


Figure 3. Spacing between perimeter monitoring wells will be no greater than 300 feet or close enough to ensure no undetected excursions at the nearest injection well. Reproduced from the Lisbon Valley Mining Company Technical Report (LVMC 2020: Figure 11.4); also reproduced in Permit Attachment E.

Each perimeter ring of monitoring wells will be located about 150 feet from the injection and production wells. Perimeter monitoring wells will be spaced approximately every 300 feet along the perimeter of the wellfield. LVMC anticipates the construction of up to approximately 200 Class III injection wells and production wells per year over the expected 20 years of ISR operations. Approximately 200 to 700 ISR wells will be operational at any given time during the project. The total rate of flow of lixiviant (which is defined below in the In-Situ Recovery Process section) that will be recirculated in the ISR wellfields ranges from approximately 5,000 to 20,000 gallons per minute (gpm).

IN-SITU RECOVERY PROCESS

If approved, this AE request would allow the injection of sulfuric acid lixiviant into the copper-bearing portions of the BC Aquifer. Injecting this solution will facilitate ISR of copper by solubilization of copper currently suspended in the copper-bearing mineral deposits within the BC Aquifer.

The ISR process involves the injection of lixiviant into a water body that contains copper ore deposits. For this project, lixiviant will consist of groundwater to which sulfuric acid and oxygen have been added. The lixiviant will be pumped into the copper-bearing portions of the BC Aquifer through the injection wells. When the lixiviant displaces groundwater in the aquifer, it will dissolve the copper within the solid matrix of the aquifer. The chemistry of copper sulfide oxidation and dissolution is characterized by the reaction:

$$\mathbf{Cu_2S + 10Fe^{3+} + 15SO_4^{\ 2-} + 4H_2O = 2Cu^{2+} + 10\ Fe^{2+} + 12SO_4^{\ 2-} + 4H_2SO_4}$$

LVMC will employ an iron-based lixiviant because chalcocite (Cu_2S) is the primary form of copper in the Lisbon Valley deposits. Ferric iron will be the key leaching agent for copper ISR at the LVMC. Air or oxygen may be injected with the lixiviant to increase the amount of ferric iron in the leaching lixiviant. The lixiviant will increase total iron and ferric iron levels in the groundwater from baseline water concentrations by lowering the pH and adding dissolved air or oxygen.

Production wells will pump the copper-bearing lixiviant out of the ground. The copper-bearing lixiviant will then flow via pipeline from the wellfield to the solvent extraction plant. At the plant, gravity will be used to separate the lixiviant into copper-laden organic material and aqueous material. The insoluble organic extraction liquid will be mixed with a leach solution, and then a sulfuric acid solution will be used to extract the copper from the organic material. The copper sulfate solution will then be sent to an electrowinning facility where copper will be plated onto cathodes from the solution. The copper cathodes will be stripped to produce copper plates for commercial sale on the market. The barren lixiviant will be pumped from the solvent extraction plant back to the ISR wellfield where sulfuric acid and oxygen will be added before the solution is injected back into the copper deposits through the wellfield injection wells.

INJECTATE (LIXIVIANT) CHARACTERISTICS

The Class III Area Permit allows the following types of fluids to be injected into the Class III injection wells:

1. During the ISR process, the injection fluid is limited to ISR lixiviant consisting of SXEW raffinate (sulfuric acid solution with dissolved solids similar to current heap leach solutions) with ferric iron and oxygen added. Per the Permit, Part III, Section M, other chemicals, grout, and fresh groundwater may be injected for the purposes of facilitating the movement of or containing leach solutions and protecting domestic and livestock watering wells based on the Director's order(s) and approval(s).
2. During the groundwater restoration phase, the injectate will be limited to recycled spent leach solution and clean groundwater extracted from the post-ISR wellfields. Per the Area Permit, Part III, Section M, neutralizing agents and other chemicals may be injected for the purposes of enhancing groundwater restoration based on the Director's order(s) and approval(s).

DESCRIPTION OF THE LAND USE, GEOLOGY, AND WATER QUALITY IN THE PERMIT AREA

LAND USE IN THE PERMIT AREA

Two residences are within the Permit Area: a ranch and a seasonal bed and breakfast commercial operation. Seven people reside permanently within the Permit Area. An additional two residences are located outside the Permit Area in the AOR.

Land ownership within the AOR is roughly 80% Bureau of Land Management (BLM) (24,338 acres), 12% private (3,587 acres), and 8% State of Utah (2,552 acres). Hence, development in the area is highly restricted by the predominance of Federal jurisdiction.

The predominant land uses within the Project Area are mining and ranching. Most of the land surface serves as grazing land for cattle. Some of the land is used for recreational activities—primarily off-road motorsports and hunting. Additional studies of any surface impacts may be conducted the BLM or DOGM or other land use authority.

GEOLOGICAL STRUCTURE OF THE BURRO CANYON AQUIFER

LVMC is seeking an AE for a portion of the BC Aquifer, which includes the saturated portions of the Dakota and Burro Canyon Formations (Figure 4). The BC Aquifer is generally between 200 and 900 feet below the ground's surface in the LLV. Appendix D of the LVMC Technical Report (LVMC, 2020: Appendix D), which was submitted with LVMC's permit application, describes the perched water within the BC Aquifer as being vertically and laterally confined by the geological structure of the LLV. The geological structure is a large graben, which is a large block of land between two faults that has dropped down relative to the surrounding area. The major confining formations of the BC and the N Aquifers are illustrated in Figure 5. The N Aquifer is a sandstone aquifer in the Entrada, Navajo, Kayenta, and Wingate Formations. The N Aquifer is not artesian in the LLV, and pumping is required to bring water to the surface.

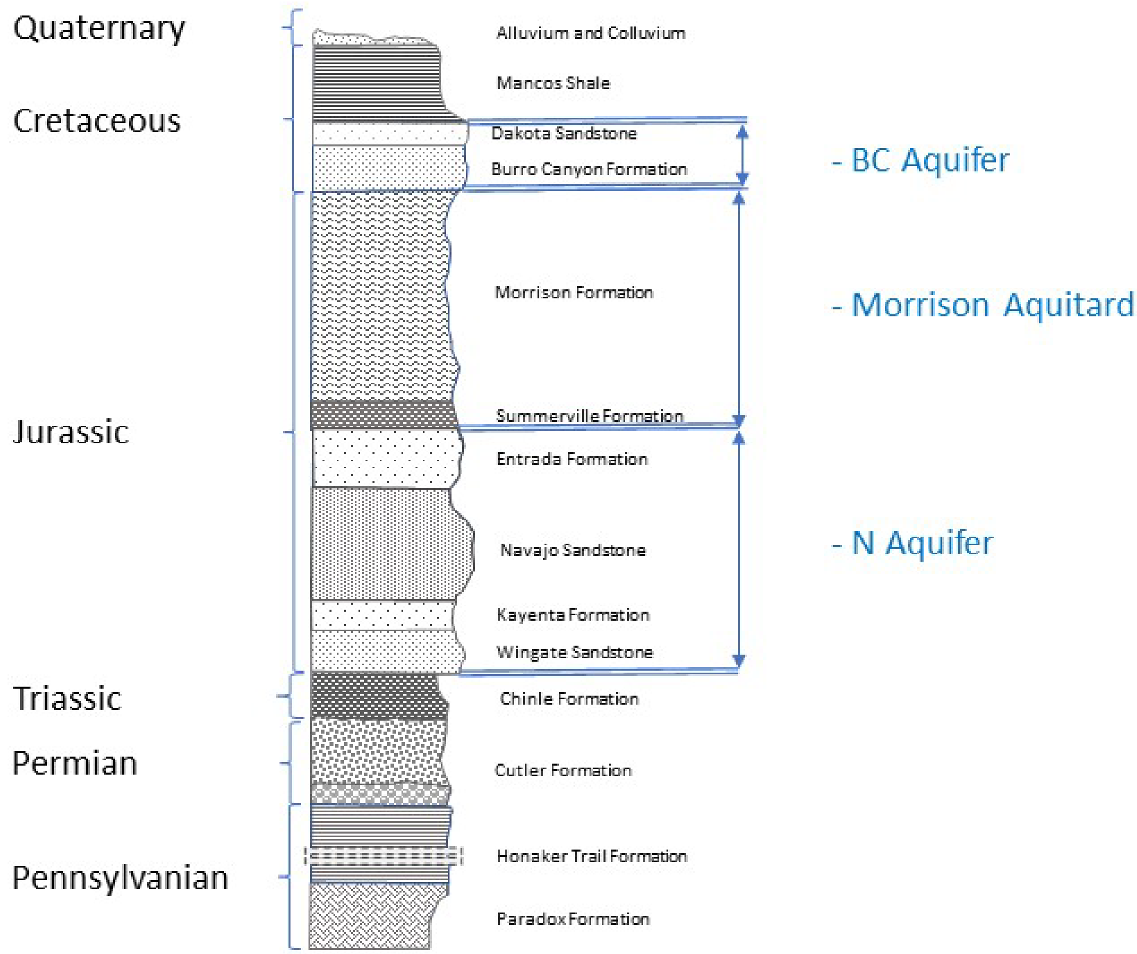


Figure 4. Stratigraphic column of the BC Aquifer, the major confining zone (the Morrison Aquitard), and the N Aquifer. Adapted from the Lisbon Valley Mining Company Technical Report (LVMC, 2020: Figure 3.12).

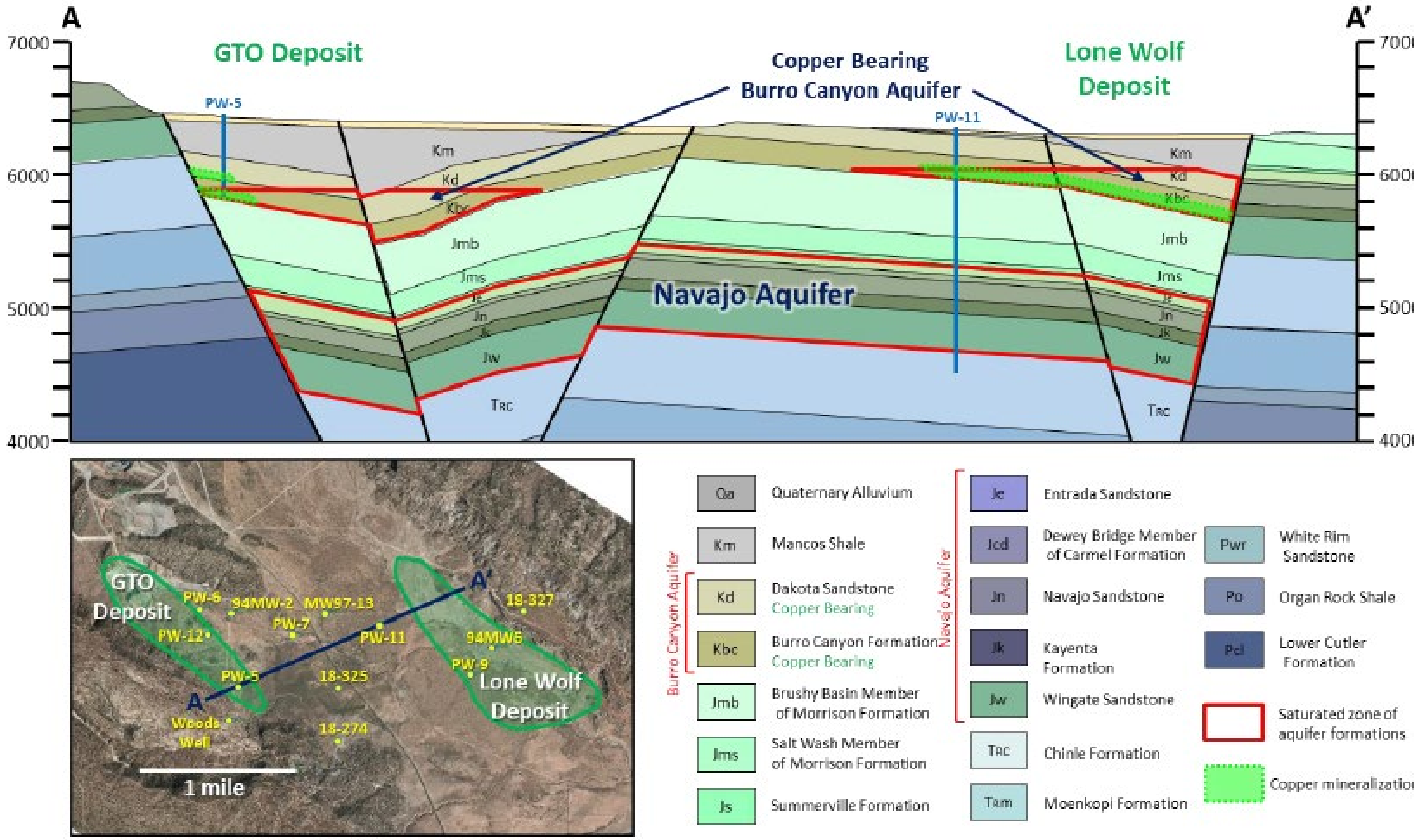


Figure 5. Southwest to northeast cross section A–A' of the GTO and Lone Wolf Deposits in the lower Lisbon Valley. The schematic shows the Burro Canyon Aquifer, the major confining formations (Morrison and Mancos Aquitards), and the N Aquifer.
Reproduced from the Lisbon Valley Mining Company Technical Report (LVMC, 2020: Figure 3.23).

The LLV graben's large down-dropped structure causes groundwater in the Dakota-Burro Canyon Formations (the BC Aquifer) to be confined to those geological strata. The BC Aquifer is vertically confined by the underlying Morrison Formation and overlying Mancos Shale, both of which are unsaturated aquitards. The BC Aquifer is laterally sealed by fine-grained fault gouge on the major northeast and southwest fault sections and by the relative elevations of surrounding geologic structures.

The LLV is part of the Colorado Plateau and includes thick sedimentary stratigraphic sequences (see Figure 4) that are regionally horizontal and relatively continuous (Williams et al., 2014). However, local warping, faulting, salt doming, salt dissolution, and the collapse of overlying beds within the Paradox Formation have caused the bedded sequences to become offset. The LLV was created by normal faulting on the northeast and southwest flanks of the valley along the LoneWolf/Flying Diamond and Lisbon Valley faults, respectively. Hence, in the LLV, the BC and N Aquifers are contained within a closed basin isolated by the regional geologic anticlinal structure within a graben bounded by faults with low hydraulic conductivity owing to the occurrence of fine-grained fault gouge material (LVMC, 2020: Appendix M).

The BC Aquifer within the LLV is perched water, which means it is separated from a lower body of regional groundwater (i.e., the N Aquifer) by an unsaturated zone (Driscoll, 1986) and does not contribute to the regional groundwater system (i.e., it does not flow to the Dolores or Colorado Rivers). The N Aquifer groundwater in the LLV flows east to the Dolores River rather than west to the Colorado River, which is where the regional groundwater system flows (Avery, 1986). The N Aquifer is a much greater source of regional groundwater for southeastern Utah than the BC Aquifer (Avery, 1986).

The central part of the LLV graben is largely unsaturated where the Mancos shale has been eroded and the Burro Canyon and Dakota Formations are at ground surface or have been partly eroded owing to greater down dropping of these formations at the fault-bounded edges of the graben where the copper resources occur (see Figure 5).

Groundwater elevations range from 5,900–6,200 feet above mean sea level (amsl). Elevations have no overall regional or lateral gradient because the BC Aquifer is bounded on all sides and is segmented by block faulting within the graben. These hydrogeologic conditions exist across the entire LLV.

CONFINING ZONE(S)

Table 1 lists the major confining zones and their minimum and maximum thicknesses at wellfield locations beneath the Permit Area. The thickness values for the upper and lower confining zones for the BC Aquifer (the subject of this AE request) are based on cross sections and logs from drill holes located throughout the Permit Area. These overlying and underlying confining zones comprise shale and silty shale horizons.

Table 1. Major Confining Zones of the BC Aquifer in Lower Lisbon Valley

Injection Interval	Confining Zone Formation Name	Minimum Thickness (feet)	Maximum Thickness (feet)
GTO (Section A–A')	Upper Confining Zone: Mancos Shale	150	600
	Lower Confining Zone: Morrison Formation	350	600
Lone Wolf (Section B–B')	Upper Confining Zone: Mancos Shale	0	225
	Lower Confining Zone: Morrison Formation	450	600
Flying Diamond (Section C–C')	Upper Confining Zone: Mancos Shale	0	200
	Lower Confining Zone: Morrison Formation	600	800

Cross sections A through E from the LVMC Technical Report (LVMC, 2020: Figures 3.16–3.20) show the BC Aquifer is discontinuous, segmented by faults, and locally confined vertically and horizontally as perched groundwater. The lack of continuity within the BC Aquifer is also supported by the highly variable groundwater chemistry, given the relatively small size of the aquifer. For example, the oxygen isotope $\delta^{18}O$ ratios range from −10.2‰ to −16.5‰ and are relatively evenly distributed across that range. This is a remarkably wide range for such a small-volume and partially confined aquifer hosted by relatively homogeneous sedimentary formations. This range spans the known range of the combined surface and groundwater values in the region (LVMC, 2020: Appendix C). In contrast, the N aquifer $\delta^{18}O$ values are below the range for the BC Aquifer and vary by only about 1‰.

The isotopic data and other geochemical indicators show that the perched water in the BC Aquifer is actually composed of separate perched water zones that have very limited lateral connections among blocks via unsaturated pore connections with the N Aquifer. Hence, groundwater production from individual wells is limited to the yield from individual blocks of the BC Aquifer within the compartmentalized BC Aquifer volume.

Block faulting has compartmentalized the BC Aquifer laterally. Each wellfield will have operational vertical confining units as described in Table 1. The upper confining unit is the Mancos Shale Formation, and the lower confining unit is the Morrison Formation. In some locations the Mancos Shale (the upper confining unit) may not be present because it has been eroded in the central part of the LLV. The Morrison Formation separates the BC Aquifer from the N Aquifer, as shown in Figure 5. The formation testing required under Part III, Section D.7, and Attachment D of the Class III Area Permit (DWQ, 2022) will verify whether these local confining units are sufficient to direct the injected lixiviant to flow through the ore deposit in the intended injection, flow, and production pattern shown in Figure 3.

Depth and Thickness of the Burro Canyon and N Aquifers

In the Permit Area, the geologic strata dip variably across and along the axis of the LLV graben structure because of the normal block faulting within the graben. Therefore, the depth to the top and bottom of the BC and N Aquifers varies across the Permit Area. The local normal faulting within the LLV graben results in down-dropped blocks, which causes the depth to the top of the Dakota and BC Formations to vary locally (Table 2). The average thickness of the BC Aquifer does not vary substantially and is approximately 370 feet. Table 2 presents an approximate average depth of the BC and N Aquifer units in the Permit Area based on cross sections A through E presented in Figure 3.15 of the LVMC Technical Report (LVMC, 2020: 53) and shown in Figures 3.16 through 3.20 of the LVMC Technical Report (LVMC, 2020: 54–58).

Table 2. Depth Below Ground Surface and Thickness of the BC and N Aquifers

Cross Section	BC Aquifer Maximum and Minimum Depth and Thickness			N Aquifer Maximum and Minimum Depth and Thickness		
	Max. Depth (feet)	Min. Depth (feet)	Thickness (feet)	Max. Depth (feet)	Min. Depth (feet)	Thickness (feet)
A–A'	500	0	350	1300	450	700
B–B'	375	0	500	1400	400	900
C–C'	200	0	400	1000	900	750
D–D'	300	0	300	1400	1000	700
E–E'	50	0	300	950	800	600

Source: Data from the Lisbon Valley Mining Company Technical Report (LVMC, 2020: 53–58, Figures 3.15–3.20).

The thickness of the BC Aquifer formation is relatively constant (with an average of approximately 370 feet) across the Permit Area. Portions of the BC Aquifer are confined along the bounding faults by low-permeability Mancos Shale (see Figure 5, which is a typical northeast–southwest cross section of the LLV).

Water Quality—Total Dissolved Solids

The Director evaluated the groundwater quality of the BC Aquifer within the proposed AE volume, which is the portion of the BC Aquifer within the AE boundary, with respect to drinking water quality for potential future use. A summary of analytical results from the BC Aquifer groundwater samples are included in

Table 12.4 of the LVMC Technical Report (LVMC, 2020: 155) submitted with the LVMC Permit Application (LVMC, 2019).

In the BC Aquifer, total dissolved solids (TDS) concentrations range from 542 to 5,340 milligrams per liter (mg/L) with a mean TDS of 986 mg/L (median = 1,010 mg/L). These measurements are based on 101 samples. The concentrations of other contaminants, including uranium and radioactivity, in some groundwater samples exceeded maximum contaminant levels (MCLs).

Because of the characteristics described above, BC Aquifer groundwater from some wells would necessarily require treatment by reverse osmosis, electrocoagulation, or other appropriate water treatment technology to decrease TDS, iron, manganese, and sulfate concentration below the secondary drinking water standards before it is palatable for human consumption. In addition, some BC Aquifer groundwater has high radium and gross alpha and uranium concentrations above MCLs. Radon risk is also high in the Lisbon Valley area (Black, 1993). While the BC Aquifer groundwater is treatable using best available technologies, the cost to make this relatively small and localized groundwater resource suitable for human consumption will be relatively high depending upon its location within the LLV.

In the N Aquifer, TDS ranges from 260 to 1,440 mg/L with a mean TDS of 605 mg/L (median = 540 mg/L) based on 129 samples. The TDS and other groundwater quality analyses are provided in Table 12.4 of the LVMC Technical Report (LVMC, 2020: 155) submitted with the LVMC permit application (LVMC, 2019). The concentrations of other contaminants, including uranium and radioactivity, in some groundwater samples exceeded MCLs.

PERMIT AREA FOR THIS AQUIFER EXEMPTION

The Permit Area for this AE is approximately 4,803 acres and is depicted in Figure 1 and Figure 2 of this document. The proposed Permit Area for this AE includes the location of commercially producible copper ore from the GTO, Lone Wolf, and Flying Diamond ore deposits plus a buffer zone beyond the perimeter monitoring well ring for each wellfield. The Permit Area encompasses other exploration areas of interest as well.

While the wellfield monitoring perimeter ring is located about 150 feet from the boundary of the wellfield, the horizontal extent of the proposed Permit Area includes all likely Class III ISR wellfield areas and the permit area monitoring well rings will be located approximately 1,000 feet from the wellfields.

BASIS FOR DECISION

Regulatory Criteria Under Which the Exemption Is Requested

Regulations in 40 CFR § 146.4(a) require that a request for an AE demonstrate that the aquifer does not currently serve as a source of drinking water.

Regulations in 40 CFR § 146.4(b)(1) require that the portion of the aquifer proposed for the AE (in this case, the portion of the BC Aquifer) cannot now and will not in the future serve as a source of drinking water because of the following characteristics:

> *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. 40 CFR § 146.4(b)(1)*

Regulation 40 CFR § 144.7(c)(1) requires a UIC Class III Permit Application that "necessitates an aquifer exemption under 40 CFR §146.4(b)(1) to furnish the data necessary to demonstrate that the aquifer is expected to be mineral or hydrocarbon producing. Information contained in the mining plan for the proposed project, such as a map and general description of the mining zone, 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 timetable of planned development of the mining zone" shall be considered by the UIC Director.

These regulatory requirements are addressed in the subsequent subsections of this document.

Assessment of the BC Aquifer as a Source of Drinking Water

A Portion of the BC Aquifer Is Not an Underground Source of Drinking Water (USDW)

UIC regulations in 40 CFR § 144.3 define an underground source of drinking water (USDW) as an aquifer or its portion:

(a) (1) Which supplies any public water system; or

  (2) Which contains a sufficient quantity of groundwater to supply a public water system; and

    (i) Currently supplies drinking water for human consumption; or

    (ii) Contains fewer than 10,000 mg/L total dissolved solids; and

(b) Which is not an exempted aquifer.

The portion of the BC Aquifer requested for use by LVMC does not qualify as a USDW because it does not currently supply any public water system and does not contain a sufficient quantity of water to supply a public water system. The BC Aquifer is a perched water system and is laterally and vertically confined from regional aquifer systems and USDWs. Perched water is of little importance for municipal water supplies (Goetz, 2010). Moreover, the confinement restricts groundwater recharge, and local recharge is limited owing to low rainfall (15.5 inches) and high rates of evaporation (38.8 inches) as summarized in the LVMC Technical Report, 2020 (LVMC, 2020: Appendix J). Groundwater age data presented in the LVMC Technical Report (LVMC, 2020: Table 3.4 and Appendix C) shows that the BC Aquifer groundwater has an average residence time between 3,300 and 11,000 years despite being exposed at the ground surface in some parts of the LLV. The long residence times indicate that the rate of recharge to the BC Aquifer is very low. Using a conservative (i.e. with respect to higher recharge estimates) residence time of 5,000 years, the rate of recharge can be calculated using the equation:

Recharge = Volume / Residence Time

Using a continuous BC Aquifer volume beneath the proposed Permit Area based on an average area of 220 million square feet (5,000 acres), an average saturated thickness of 370 feet, and a porosity of 25 percent, the calculated rate of BC Aquifer groundwater recharge is approximately 58 gpm. However, approximately half of the BC Aquifer area is either unsaturated or partially saturated (see Figure 5) because the entire BC Aquifer thickness is only fully saturated below an elevation of 6,200 feet amsl (LVMC, 2020: Appendix D). Hence, if it is assumed that half of the aquifer is only half saturated, then the average rate of BC Aquifer recharge is only about 43.5 gpm. The regional BC Aquifer recharge in southeastern Utah is estimated to be about 24,200 gpm (Avery, 1986), which means that the proportional amount of BC Aquifer recharge in LLV is only about 0.2 percent of the total.

The estimated rate of recharge within the BC Aquifer in the LLV (43.5 gpm) is about three times greater than the minimum criteria for a public water system (approximately 15 gpm). However, it is likely that the present rate of groundwater recharge in the LLV is much lower than it was in the Pleistocene. The oldest age of BC Aquifer groundwater is approximately 11,000 years. This was determined by C^{14} age dating (LVMC, 2020: Appendix C). Approximately 11,000 years ago, at the end of the Pleistocene and during the last period of alpine glaciation, the climate was much cooler and wetter than it is today. The Pleistocene climate would have resulted in greater rates of infiltration and groundwater recharge. Hence, the present-day rate of recharge is likely much lower than the average recharge calculated on the basis of the past 11,000 years.

Tritium concentration in BC Aquifer groundwater samples is near or below the method detection limit (LVMC, 2020: Appendix C). Very low levels of tritium indicate little or no modern recharge, which is consistent with the semi-arid climate of southeastern Utah. In addition, given the groundwater withdrawals from the BC Aquifer by LVMC, local ranchers, and future mining operations, the actual amount of groundwater in the BC Aquifer available for sustainable supply to public water systems in the future is limited.

The BC Aquifer does not serve as a regional source of drinking water because of its separation from the regional system by the LLV graben. Section 4.1 of the LVMC Technical Report (LVMC, 2020: 92) documents that the boundary of the Permit Area/AE Area is 14 miles from the nearest public drinking water well.

Moreover, because most of the land is government owned, it is unlikely that the population in the area can increase to a size that would require a centralized public water system. In addition, owing to the low rate of recharge, high rate of mining use, and partial saturation (perched water), it is unlikely that the remaining BC Aquifer groundwater within the AE boundary can or will be used in the future to supply drinking water.

Private and Public Wells Within the Permit Area / Aquifer Exemption Boundary

The boundary of an aquifer exemption contains the portion of the aquifer that may be affected by the injection activity (EPA, 2019). Figure 2 shows that no domestic drinking water wells inside the Permit Area / AE boundary are currently in use. Two abandoned wells are within the Permit Area:

- The very shallow Patterson 05-296 livestock watering well (total depth of 60 feet) is recorded as a dry hole that is out of use. It is in the alluvial wash of an arroyo, not the BC Aquifer. The Patterson well draws from an isolated, perched water source within Quaternary alluvium. That source is not considered an active aquifer because it has limited water availability and is only recharged by infrequent precipitation (LVMC, 2020: Appendix J).

- The Wilcox domestic well 05-2589 that draws from the BC Aquifer is recorded as abandoned.

The technical analysis demonstrated that water within the Permit Area / AE boundary is not a current source of drinking water for any existing wells. Within the Permit Area no domestic or livestock watering wells draw from the N Aquifer because of how deep the aquifer is within the Permit Area.

Private and Public Wells Outside the Permit Area / Aquifer Exemption Boundary

When considering the capture zone for a well, it is possible that water within the Permit Area / AE boundary could serve as a current source of drinking water for wells outside the Permit Area / AE boundary. To identify any such instances, the Director looked for wells within the AOR , which extends 2 miles beyond the Permit Area / AE boundary per UAC R317-7-1.1B and R317-7-1.2B. The AOR area is greater than the minimum 0.25-mile buffer zone from the Permit Area boundary discussed in EPA

Guidance #34 (EPA, 2000). A complete inventory of wells within the AOR is included in Part C of the LVMC Technical Report (LVMC, 2020: Part C).

Figure 2, Figure 6, and Figure 7 show the locations of the two domestic drinking water wells located within the AOR but outside the Permit Area that are being used, or have been used, for drinking water:

- The Wilcox well 05-3907 is relatively shallow (151 feet) and extends only into the Dakota Formation, which is the uppermost part of the BC Aquifer (see Figure 2, Figure 4, Figure 6, and Figure 7). This well is located outside of the portion of the BC Aquifer included in the AE request—this AE request does **not** include the Dakota Formation from which the Wilcox well draws its water.

- The Stevenson well 05-2970 is located near the Permit Area / AE boundary on the southeast side of the Lisbon Valley Fault just outside the Permit Area and proposed AE boundary. Well logs show that it draws from the N Aquifer and is upgradient of the Permit Area / AE boundary and is separated from the Permit Area by the Lisbon Valley Fault on the footwall block side (see Figure 2, Figure 4, Figure 6, and Figure 7).

Well records are provided by the Utah Department of Natural Resources, Division of Water Rights (https://waterrights.utah.gov/wrinfo/query.asp).

Water for the City of Monticello, which is approximately 20 miles southwest of the Permit Area / AE boundary (see Figure 1), is supplied from municipal wells drawing from the N Aquifer. Furthermore, the city's water supply is hydrologically isolated from the LLV by the Lisbon Valley Fault (see Figure 6). The town of La Sal is approximately 13 miles upgradient of the LLV and is also hydrologically isolated from the LLV by the Lone Wolf / Flying Diamond Fault. The town of Egnar is located in the state of Colorado and is cross gradient from the regional groundwater flow system (Avery, 1986) and is similarly hydrologically isolated from the LLV because the BC Aquifer pinches out to the southeast (see Figure 6).

Hydrologists have determined that the occurrences of Dakota, Burro Canyon, and Navajo Formations in the Lisbon Valley down-dropped graben are separate from the regional aquifer system (Avery, 1986) that is used by La Sal, Monticello, and other towns in San Juan County (see Figure 1). Hence, groundwater withdrawals in Lisbon Valley for mining, stock watering, and irrigation will not affect water levels in wells located near La Sal or Monticello.

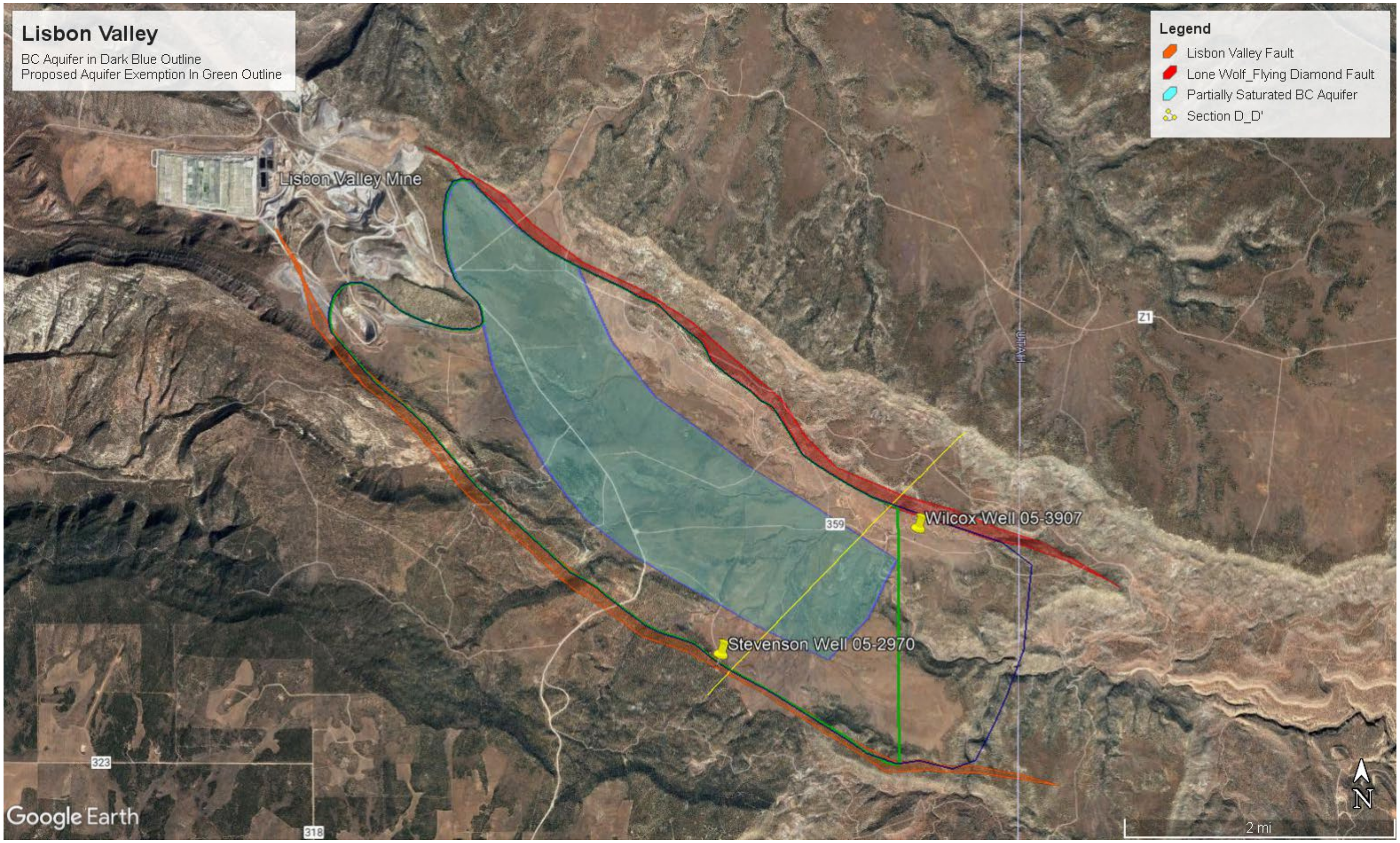


Figure 6. The BC Aquifer, Aquifer Exemption area, hydrologic features of interest in the lower Lisbon Valley, and two wells in the AOR but outside the Permit Area.

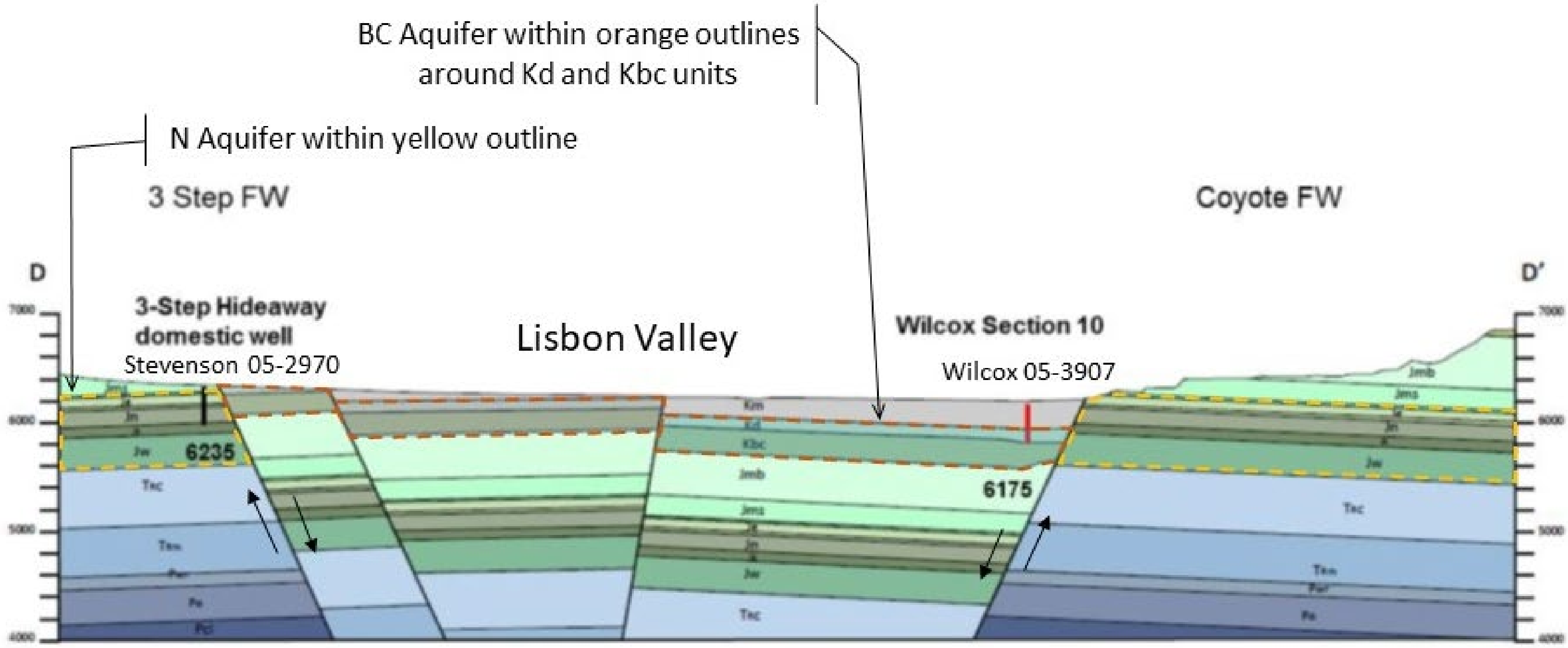


Figure 7. Cross section D–D' (see Figure 6) showing the total depths of the Stevenson well 05-2970 (3-Step Hideaway domestic well) and the Wilcox well 05-3907 (Wilcox Section 10 projected from outside the AE onto D-D') with respect to the lower Lisbon Valley graben faults and footwall blocks (FW). The Stevenson well is outside the Aquifer Exemption boundary. The Wilcox well penetrates the Dakota Formation at the top of the BC Aquifer just outside the Aquifer Exemption boundary on the southeast (see Figure 2 and legend in Figure 5). Adapted from the Lisbon Valley Mining Company Technical Report (LVMC 2020: Figure 3-26).

Mining Plan

Commercial Producibility

The commercial producibility of acid-soluble copper from the Lower Lisbon Valley Project is demonstrated by (1) current heap leach and SXEW operations, (2) the long period of copper exploration and mine development in the area, and (3) the fact that the BC Aquifer host rock formation supports the commercial potential for copper ISR. The LVMC Technical Report (LVMC, 2020) discloses the existence of abandoned uranium mines in the AOR, and exploration for and production of uranium has occurred throughout Lisbon Valley for several decades (Chenoweth, 2006). In addition, oil and natural gas wells tap resources in the Paradox Formation in Lisbon Valley. Exploration for lithium brines is also occurring in Lisbon Valley. Hence, Lisbon Valley is a well-known mineral district for copper and other mineral resources that could be produced by drilling and well production operations that may require UIC permits.

LVMC is a private mining company and not subject to public financial and technical feasibility disclosure requirements like National Instrument 43-101. The commercial producibility of the Project is demonstrated by the extensive exploration and academic research on the Lisbon Valley Mineral District (Weir and Puffett, 1981; Hitzman et al., 2005; Hahn and Thorson, 2006; and Person et al., 2019) that has been conducted recently. These studies indicate the technical and economic feasibility of copper recovery by ISR methods within the Permit Area. The combined exploration database indicates that the existing copper resources total approximately 800 million pounds of copper suitable for ISR contained in three deposits along the northwest-to-southeast-trending Lisbon Valley mineral district (Krahulec, 2006) within the Permit Area. Additional exploration by LVMC has indicated commercial copper resource potential and is documented in information submitted with the LVMC Technical Report (LVMC, 2020: Appendix D). In addition, LVMC currently operates an SXEW plant that will be used for copper cathode production by processing of ISR pregnant leach solutions. Hence the investment risk in an ISR wellfield is very low as capital expenditures for plant construction costs are low but some plant upgrades and modifications may be necessary in the future.

Demonstration of Amenability of Mining Method

Two commercial copper ISR projects have been approved by the EPA for AEs and are operating in Arizona: the Florence (EPA, 2016) and Gunnison (EPA, 2018) copper projects. Both of these operations are UIC facilities permitted by EPA Region 9. The Dewy-Burdock uranium ISR project in South Dakota is located within the Inyan Kara aquifers, which are similar to the BC Aquifer in that the Morrison Formation is the bottom confining unit within that project area (EPA, 2020).

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 have demonstrated commercial copper recovery. All test work has been performed by the Company in its laboratory, and additional confirmatory third-party laboratory test work is planned. LVMC has extensive experience leaching target mineralogy in its existing open-pit heap-leach operations, which have been in operation since 2006, and which use comparable leaching metallurgy and chemistry. Furthermore, the necessary processing plant and infrastructure is already owned and operated by the Company.

Hydraulic properties of the BC Aquifer have been determined through pumping tests as described in Sections 7.2 and 7.3 of the LVMC Technical Report (LVMC, 2020: 101–105). 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 BC Aquifer. Table D in the Groundwater Assessment section of Appendix D of the Technical Report summarizes the best estimates of hydraulic conductivity determined from these tests (LVMC, 2020: Appendix D). The average hydraulic conductivity of the BC Aquifer is approximately 2.6×10^{-4} cm/second. This hydraulic conductivity is within the range for fine or silty sandstone and the minimum hydraulic conductivity necessary for ISR without matrix modification (Bartlett, 1998). The hydraulic properties of each well will be determined prior to operations as required in the Area Permit, Part III, Section E.2 (DWQ, 2022). The aquifers are saturated in the target ore bodies, which are well suited for ISR operations.

Geochemistry and Mineralogy of the Mining Zone

The copper deposits are hosted by the clastic sedimentary rocks of the Burro Canyon and Dakota Formation as shown in Figure 5. 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 the BC 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 BC 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.

Copper sulfide minerals may have precipitated by reduction reactions owing to natural organic material in the ore deposit. The oxide mineralization was likely created by fluctuation of the water table and unsaturated conditions at the top of the ore zone and oxidation of primary copper sulfide minerals.

Project Timetable

The proposed timetable for project development is shown in Figure 8. LVMC anticipates that the LLV copper ore deposits will be commercially produced by ISR for approximately 20 years.

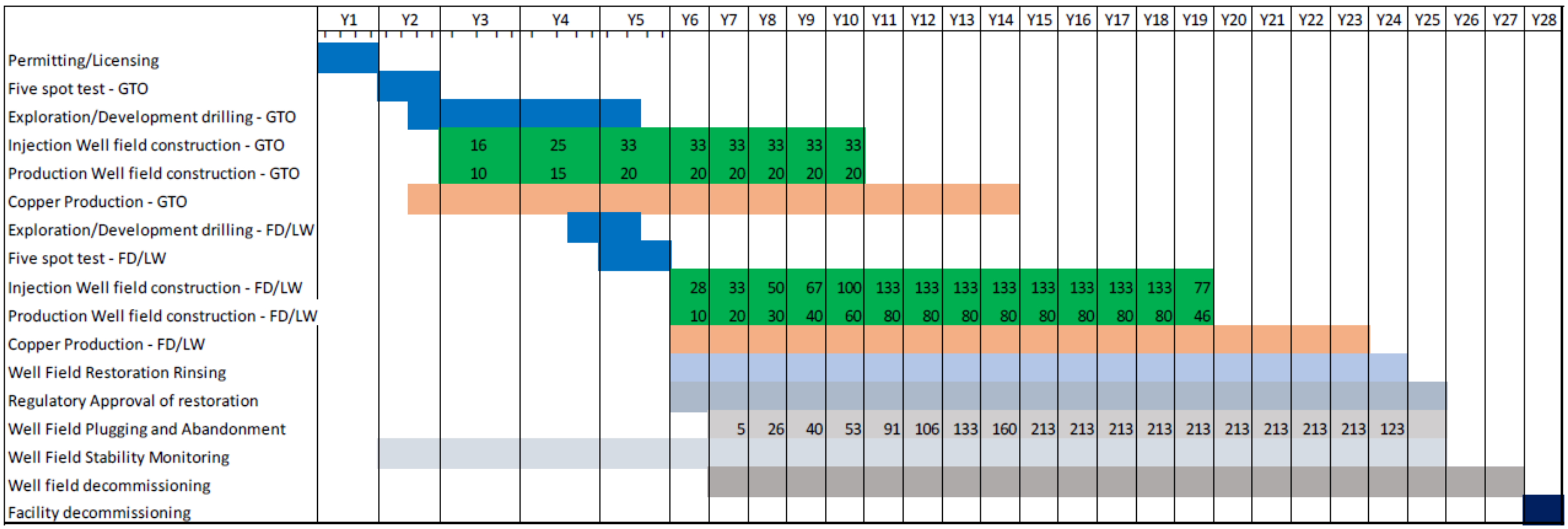


Figure 8. Lisbon Valley Mining Company's timetable for project development.
Reproduced from Figure 11.8 of the Lisbon Valley Mining Company Technical Report (LVMC, 2020: 141).

OTHER CONSIDERATIONS

NATURAL ATTENUATION

While not discussed in LVMC's Technical Report, natural attenuation will provide additional confinement of leach solutions in the ISR wellfield. The ore and formation contain natural carbonate mineralization and organic matter that will reverse the leaching reaction and neutralize leach solutions at the boundary of the wellfield(s) according to the generalized reaction:

$$\mathbf{2Cu^{2+} + Fe^{2+} + 3SO_4^{2-} + H_2SO_4 + CaCO_3 + CH_2O = Cu_2S + FeS_2 + CaSO_4{\cdot}(2H_2O) + 2CO_2 + 5O_2}$$

The presence of abundant calcite (calcium carbonate) in the BC Aquifer host formations is described in the LVMC Technical Report (LVMC, 2020) and in Barton et al. (2021).

DEMONSTRATION THAT THE INJECTION ZONE FLUIDS WILL REMAIN WITHIN THE AQUIFER EXEMPTION AREA

EPA Guidance #34 states that if the exemption pertains to only a portion of an aquifer, a demonstration must be made that the waste will remain in the exempted portion (EPA, 2000). Such a demonstration should consider, among other factors, the pressure in the injection zone, the waste volume, and injected waste characteristics (i.e., specific gravity, persistence, etc.) throughout the life of the facility. Given the nature of the ISR operation, waste fluids are not being injected into the exempted portion of the aquifer. The concern in the case of the ISR operation is whether contaminants from ISR activities will cross the AE boundary laterally or migrate vertically into USDWs. A number of factors, including Class III Area Permit requirements, led the Director to the conclusion that adjacent USDWs will not be impacted by ISR contaminants crossing the AE boundary laterally or migrating vertically.

The Class III Area Permit includes the following requirements:

- Injection interval confining zones will be evaluated during pre-ISR operation wellfield pump tests for their capacity to contain injection interval fluid vertically within the approved injection interval per Permit conditions in Part III, Section E, and cited attachments (DWQ, 2022).

- LVMC must demonstrate the ability of the confining zones to contain injection interval fluids before the Director will issue an authorization to commence injection per Permit conditions in Part III, Section E, and cited attachments (DWQ, 2022).

- LVMC must demonstrate the ability of the monitoring network to detect any movement of injection interval fluids out of the approved injection interval before the Director will issue an authorization to commence injection per Permit conditions in Part III, Section G, and cited attachments (DWQ, 2022).

- 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 that is withdrawn from the production wells. Hydraulic control will be verified by continuous monitoring of injection rate and volume and the measurement of water levels in the wellfield perimeter monitoring well ring to verify a cone of depression per Permit conditions in Part III, Sections F and G, and cited attachments (DWQ, 2022). This is also consistent with Arizona Mining—BADCT Guidance for copper ISR (ADEQ, 2004).

- The extensive monitoring well network 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, the 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 cited attachments (DWQ, 2022).

- The requirements to demonstrate initial mechanical integrity for all injection, production, and monitoring wells and ongoing mechanical integrity tests for injection wells will prevent vertical migration of injection interval fluids through confining zones per Permit conditions in Part III, Sections G and I, and cited attachments (DWQ, 2022).

- 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).

Vertical Confinement

Throughout most of the ore zones in the LLV, the BC Aquifer is bounded above by shale units of the Mancos Shale, which serve as the uppermost confining zone for ISR operations. However, the Mancos Shale pinches out in the center of the LLV owing to block faulting and erosion within the Lisbon Valley graben (see Table 2). Well drilling records and a shallow downward gradient within the BC Aquifer indicate that the BC Aquifer is perched water on top of the Morrison Formation. The hydraulic conductivity of the Morrison Formation Brushy Basin Member reported in the LVMC Technical Report (LVMC 2020, Section 3.8.2, p. 61) is 1.27×10^{-8} to 5×10^{-9} cm/second. The 400-foot thickness of the Morrison Formation and the unsaturated conditions below the perched BC Aquifer result in a high degree of confinement. Fracture flow under unsaturated conditions is also low.

Distinct water chemistries for the BC and N Aquifer groundwaters presented in the LVMC Technical Report (LVMC, 2020: Appendix C) indicate that minimal communication is occurring between the BC and N Aquifers. Major ion chemistry indicates that the BC and N Aquifers have distinct geochemical signatures. Groundwater in the BC Aquifer is a Ca-Mg-SO_4-type water, and N Aquifer wells generally plot as an Na-HCO_3-type water. In addition, BC Aquifer wells, on average, had higher concentrations of ore-forming trace and base metal elements, such as cobalt, copper, iron, manganese, and uranium, than the N Aquifer wells.

Other chemical lines of evidence presented int the LVMC Technical Report (LVMC, 2020: Appendix C) include isotopic analyses, such as stable isotopes of water ($\delta^{18}O$ and δD), stable isotopes of dissolved carbon and sulfur ($\delta^{13}C$-DIC, $\delta^{34}S$-SO_4, and $\delta^{18}O$-SO_4), and $^{87}Sr/^{86}Sr$ ratios. All such evidence indicates that the BC and N Aquifers have distinct water compositions. Based on radiogenic carbon analysis, the water in the BC Aquifer has an age range of 3,300 to 11,000 years BP, while the water in the N Aquifer has an age range of 15,000 to 36,000 years BP (LVMC, 2020: Appendix C, Table 5). This also indicates a lack of connection between the BC and N Aquifers.

The depth to the top of the BC Aquifer (the Dakota Formation or Burro Canyon Formation, depending on erosion) ranges from approximately 0 feet where the Dakota and Burro Canyon Formations crop out in the central and southeastern part of the LLV to approximately 500 feet below the ground surface near the bounding faults of the LLV graben where the Mancos Formation occurs as a confining layer on top of the BC Aquifer. The Mancos Shale is considered a barrier to recharge wherever it is present. Based on various down-well methods (e.g., packer tests, bailer recovery tests, etc.) conducted around the region, hydraulic conductivity of the BC Aquifer ranges from 1.59×10^{-7} to 2.72×10^{-6} cm/second (LVMC, 2020: Appendix C). The saturated hydraulic conductivity of the Dakota Sandstone and Burro Canyon Formations ranges from 10^{-2} to 10^{-4} cm/second.

The Morrison Formation Brushy Basin Member is composed of gray and red-brown bentonitic mudstone. It is a regional confining unit with vertical saturated hydraulic conductivities ranging from about 1×10^{-8} to 5×10^{-9} cm/second (LVMC, 2020: Section 3.8.2, p. 61). However, the unsaturated hydraulic conductivity is lower, depending upon moisture content. The Brushy Basin member is approximately 400 feet thick in the Permit Area. It separates the BC and N Aquifers vertically by approximately 600 feet and creates a BC to N Aquifer head contrast ranging from 500 to 650 feet. The vertical head contrast is shown on Figures 3-26 and 3-27 of the Lisbon Valley Technical Report (LVMC, 2020: 67, 69), underscoring the robust perching characteristics of the Morrison Formation.

Part III, Sections B and E, of the Permit requires investigation of the confining zone for each wellfield through formation testing and reporting before the Director will authorize any injection activities. If a confining zone breach is caused by an improperly plugged historic exploratory borehole or a well causes a pathway through a confining zone, the Permit requires LVMC to take corrective action (see DWQ 2022: Part III.C and Attachment C) to prevent the breach from resulting in the vertical migration of injection interval fluids out of the injection interval. Exploration records from the Utah Department of Natural Resources, Division of Oil Gas and Mining, indicate that most of the exploration activity has occurred in the BC Aquifer zones, but some limited deeper drilling has likely occurred outside the bounding faults of the LLV graben where uranium mineralization is present in the Chinle Formation below the N Aquifer (see Figure 4). Hence, these boreholes into the Three-Step footwall block (see Figures 6 and 7) are separated from the AE volume and BC Aquifer by low hydraulic conductivity fault gouge. In addition, hydraulic head is higher on the footwall block side such that any groundwater seepage through the fault would flow towards Lisbon Valley and not towards the N Aquifer.

To verify that no wellfield fluids migrate vertically out of the approved injection interval, monitoring wells will be completed within each wellfield in the overlying and underlying hydrogeologic units above and below the ISR injection interval. Hydraulic control will be verified by continuous monitoring of injection rate and volume and the measurement of water levels in the wellfield perimeter monitoring well ring (see Figure 3). Furthermore, the Permit and AE will require LVMC to verify containment per Permit conditions in Part III, Sections F and G, and cited attachments (DWQ, 2022). Even though the Morrison Formation is a thick and impermeable confining zone, the Permit requires monitoring of the aquifer underlying the Morrison Formation during wellfield operation and restoration. In addition, the Permit requires observation wells below the Morrison Formation in the N Aquifer to be monitored to verify the containment of the Morrison Formation as a confining zone in the AE volume. These wells will be monitored during wellfield operation, after ISR groundwater restoration, and after restoration monitoring to detect any potential vertical migration of ISR solutions out of the approved injection interval. The Director may require additional overlying or underlying monitoring wells beyond the network shown in Figure 2 to detect potential vertical excursions in areas where the integrity of a confining zone is in question. If any injection interval fluids begin to migrate out of the approved injection interval, the 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 cited attachments (DWQ, 2022). The Permit requires LVMC to demonstrate mechanical integrity for all wells installed, including injection, production, and monitoring wells, to ensure that the cement-filled annulus between the well casing and drillhole wall does not contain any channels that could potentially allow migration of injection interval fluids out of the injection interval through confining zones.

Lateral Confinement

The portion of the BC Aquifer included in this AE is bounded by the Lone Wolf/Flying Diamond Fault and extensions on the northeast and the Lisbon Valley Fault and extensions on the southwest that formed the LLV graben. Fault gouge analyses conducted under Dr. Krantz at the University of Arizona are summarized in the LVMC Technical Report (LVMC, 2020). These analyses concluded that the bounding graben faults have very low hydraulic conductivity and laterally confine the BC Aquifer in the Permit Area. It is noted that copper mineralization is also limited within the Permit Area by these faults, which may have formed a structural trap for the mineralized fluids that formed the deposit (Krahulec, 2006).

In addition, cross sections A through E from the LVMC Technical Report (LVMC, 2020: Figures 3.16–3.20) show the BC Aquifer is discontinuous and segmented and confinement of perched water is local. Hence, the BC Aquifer in the AE volume is likely discontinuous. As summarized in the LVMC Technical Report, previous work completed at LVMC indicates that lateral flow in the BC Aquifer is influenced by geologic structures (i.e., faults; LVMC, 2020: Figures 3.24), which prevent flow and compartmentalize the BC Aquifer into many disconnected blocks. These blocks will be managed individually or as wellfield segments. In addition, the Permit requires LVMC to demonstrate and maintain hydraulic control of injection fluids during the copper recovery process and post-ISR groundwater restoration. To accomplish this, the wellfield pumping rate in the perimeter pumping wells must exceed the injection rate and result in a net extraction of injection interval fluids and groundwater that flows towards the wellfield (DWQ 2022: Part III, Section F). Continuous monitoring of injection and production flow rates and volume is required for each wellfield to verify that these conditions are being met (DWQ, 20220: Part III, Section G).

The net extraction of injection interval fluids and groundwater creates a cone of depression within each wellfield indicating that an inward hydraulic gradient is pulling groundwater into the wellfield. The measurement of water levels in observation wells during the pump tests performed by LVMC demonstrate that a cone of depression formed in the pumped aquifer during the pump tests (LVMC, 2020: Appendix D). The presence of a cone of depression verifies that hydraulic control of injection interval fluids can be maintained within the BC Aquifer. The required monitoring of water levels in the wellfield perimeter monitoring well ring will verify whether the cone of depression is being maintained during wellfield operations and post-ISR groundwater restoration (DWQ, 2022: Part III, Section G).

Monitoring Requirements

A combination of monitoring and response actions required during the operational, the post-ISR groundwater restoration, and the post-restoration phases will ensure that any effects from the ISR operations will remain within the exempted portion of the aquifer. Monitoring wells will be installed in and around each wellfield, up- and down-gradient, and in overlying and underlying aquifers to detect the potential migration of ISR solutions away from the approved injection interval.

The Permit operating conditions in Part III, Section F, and Attachment E, require LVMC to maintain hydraulic control of injection interval fluids within each wellfield at all times to prevent horizontal movement of lixiviant out of the wellfield and include a rigorous monitoring program to verify hydraulic control (DWQ, 2022: Part III, Section G, and Attachment F).

Baseline water quality parameters for the BC and N Aquifers are stated in Table 3. Analytical results of groundwater samples collected from the overlying and underlying monitoring wells required in the Permit may provide additional baseline water quality data from which the compliance limits for the overlying and underlying aquifers may be revised if new data indicates that the baseline concentrations in Table 3 are statistically different with the acquisition of additional data (DWQ, 2022; Part II Section D.6.a.1.ii).

Table 3. BC and N Aquifer Baseline Water Quality (mean values from Table 12.4 of LVMC, 2020)

Major Ions and Water Quality Indicator Parameters	Units	BC Aquifer, Mean	N Aquifer, Mean
Alkalinity dissolved, as CaCO3 equivalents	milligrams per liter	144	259
Alkalinity, as CaCO3 equivalents	milligrams per liter	282.6	265.3
Bicarbonate, as CaCO3 equivalents	milligrams per liter	279	261
Carbonate, as CaCO3 equivalents	milligrams per liter	5	3
Hydroxide, as CaCO3 equivalents	milligrams per liter	3	2
Hardness	milligrams per liter	433	219
Calcium	milligrams per liter	103	53.3
Magnesium	milligrams per liter	42.4	20.6
Potassium	milligrams per liter	9.5	7.2
Sodium	milligrams per liter	146	121
Chloride	milligrams per liter	23	64
Fluoride	milligrams per liter	0.5	0.6
Silica	milligrams per liter	10.9	14.4
Sulfate	milligrams per liter	463	150
Sodium Absorption Ratio	percent	1.70	3.66
Total Dissloved Solids	milligrams per liter	986	605
Total Suspended Solids	milligrams per liter	832	509
pH		7.8	7.8
Electrical Conductivity	micro seimens per centimeter	1358	951
Nutrients			
Phosphorous total, as P equivalents	milligrams per liter	0.03	0.33
Nitrate dissolved, as N equivalents	milligrams per liter	0.16	0.07
Nitrite dissolved, as N equivalents	milligrams per liter	0.01	0.01
Ammonium	milligrams per liter	0.24	0.15
Dissolved Metals			
Aluminum	milligrams per liter	0.06	0.05
Antimony	milligrams per liter	0.0014	0.0024
Arsenic	milligrams per liter	0.0035	0.0091
Barium	milligrams per liter	0.034	0.151
Beryllium	milligrams per liter	0.0004	0.0004
Cadmium	milligrams per liter	0.0076	0.0005
Chromium	milligrams per liter	0.0015	0.0046
Copper	milligrams per liter	0.01	0.01
Iron	milligrams per liter	1.37	0.85
Lead	milligrams per liter	0.0019	0.0018
Manganese	milligrams per liter	0.153	0.349
Mercury	milligrams per liter	0.0002	0.0002
Molybdenum	milligrams per liter	0.04	0.08
Nickel	milligrams per liter	0.01	0.44
Selenium	milligrams per liter	0.002	0.002
Silver	milligrams per liter	0.01772	0.01191
Strontium	milligrams per liter	3.13	2.93
Thallium	milligrams per liter	0.0005	0.0006
Uranium,	milligrams per liter	0.0395	0.0113
Vanadium	milligrams per liter	0.007	0.007
Zinc	milligrams per liter	0.15	0.50
Radiological			
Gross Alpha total	picocuries per liter	73	24
Gross Beta total	picocuries per liter	63	34
Radium 226 total	picocuries per liter	7	1
Radium 228 total	picocuries per liter	3	2
Thorium 228 total	picocuries per liter	1	0
Thorium 230 total	picocuries per liter	3	1
Throrium 232 total	picocuries per liter	1	0

DECISION

LVMC provided mineral exploration information to the Director to support the conclusion that the proposed Permit Area / AE Area within the BC Aquifer cannot now and will not in the future serve as a source of drinking water. Furthermore, the dominance of Federal land ownership in the LLV and the combined legal, technical, and economic challenges to the development of wells capable of producing enough water to sustainably supply public water systems from the proposed AE volume support the Director's determination that the BC Aquifer is not a USDW.

The Director reviewed the information provided by LVMC and has concluded that the portion of the BC Aquifer proposed for exemption does not currently serve as a source of drinking water. Based on the information reviewed, the Director has determined that the following regulatory criterion has been met:

> ***40 CFR § 146.4(a)*** *It does not currently serve as a source of drinking water.*

LVMC demonstrated in the Class III permit application for the copper ISR operation that the portion of the aquifer proposed for exemption contains minerals in a quantity and location that is expected to be commercially producible.

The portion of the BC Aquifer proposed for the AE cannot now and will not in the future serve as a source of drinking water because of the following characteristics:

> ***40 CFR § 146.4(b)(1)*** *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 Director's findings indicate that this portion of the BC Aquifer may be exempted as a source of underground drinking water based on UAC R317-7-4 and following the procedures and requirements outlined in 40 CFR § 144.7 and 40 CFR § 146.4. The exemption is subject to approval by the EPA UIC Program Administrator following public notice and comment per 40 CFR § 144.7(b)(3).

CONCLUSION

The Director requests this exemption pursuant to Aquifer Exemption criteria in 40 CFR § 144.7 and 40 CFR § 146.4 and based on strong evidence for natural containment as well as operational containment systems required in the Permit (DWQ, 2022). Based on review of the information LVMC provided, the Director finds that exemption criteria in 40 CFR § 146.4(a) and § 146.4(b)(1) have been met. Therefore, the Director is seeking EPA approval of the AE request as a minor/non-substantial program revision for the AE area and volume depicted in Figure 2.

07/05/2022

John K. Mackey, P.E. Date
Director, Water Quality Division

DWQ-2022-017757

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