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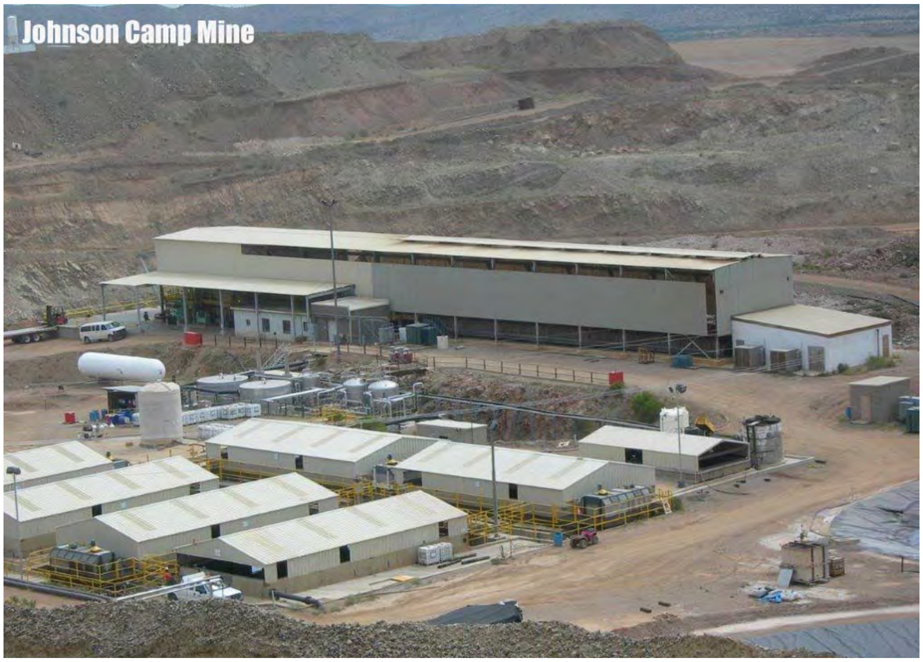
Gunnison Copper Project



NI 43-101 Technical Report

Feasibility Study

Cochise County, Arizona, USA

REVISION 0
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DATE AND SIGNATURES PAGE

The effective date of this report is December 17, 2016. The issue date of this report is January 16, 2017. See Appendix A, Feasibility Study Contributors and Professional Qualifications, for certificates of qualified persons. These certificates are considered the date and signature of this report in accordance with Form 43-101F1.

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GUNNISON COPPER PROJECT
NI 43-101 FEASIBILITY STUDY

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1 SUMMARY

M3 Engineering & Technology Corporation (M3) was commissioned by Excelsior Mining Corp. ("Excelsior") to prepare a feasibility study (FS) in accordance with the Canadian National Instrument 43-101 ("NI 43-101") standards for reporting mineral properties, for the Gunnison Copper Project (the "Gunnison Project" or the "Project") in Cochise County, Arizona, USA. The Project utilizes in situ recovery (ISR) methods to leach copper from a buried copper oxide deposit and extract the copper by conventional solvent extraction-electrowinning (SX-EW) technology. The ISR process involves injecting leach solutions acidified with sulfuric acid into the oxidized mineralization to get soluble copper into solution. Recovery wells pump the copper-bearing pregnant leach solution (PLS) to the surface for copper recovery by SX-EW into salable copper cathodes.

The Project envisages development in three production "stages" with capacities of 25 million pounds per annum (mppa) in Stage 1, 75 mppa in Stage 2, and 125 mppa in Stage 3. The stages to ramp up production were meant to minimize capital at risk until the in situ recovery (ISR) process at the Gunnison Project is better understood. For Stage 1 operations, Excelsior will use the neighboring Johnson Camp Mine (JCM) that has a functional 25 mppa SX-EW plant north of the Gunnison Project wellfield on the north side of Interstate 10 that it purchased in 2015.

In the current mine plan, Stage 2 production will commence in Year 4 of the mine life and will utilize the JCM SX-EW plant, as well as a new 50 mppa Gunnison SX-EW plant which will be located on the south side of Interstate 10, next to the Gunnison wellfield. Stage 3 production will commence in Year 7 of the mine life by doubling the size of the Gunnison SX-EW plant.

The Gunnison Project is located about 62 miles east of Tucson, Arizona on the southeastern flank of the Little Dragoon Mountains in the Cochise Mining District. The property is within the copper porphyry belt of Arizona. The Gunnison Project contains copper oxide and sulfide mineralization with associated molybdenum, in potentially economic concentrations. The material deposit within the Project area is the North Star (formerly known as I-10) deposit.

Excelsior's method of extraction will be ISR of copper in oxidized, mineralized bedrock that lies 300 feet to 800 feet beneath of alluvial basin fill. The basin fill is typically above the water table and most of the oxidized mineralization is below the water table. The North Star copper deposit shows significant fracturing and jointing of the host rocks resulting in broken ground that is below the water table (saturated zone) and permeable. The copper silicates and oxides occur preferentially as coatings on the fracture planes and as veinlets or matrix fill to the broken fragments. This should result in preferential exposure of the copper minerals to leaching solution (lixiviant), thus reducing the amount of acid consumed by the un-exposed gangue rocks. The above features, combined with the large size of the deposit, suggest ISR is a viable approach to mining.

The techniques for ISR have evolved to the point where it is considered a controllable, safe, and environmentally friendly mining method with low capital and operating costs. The mining method has been demonstrated, with over 90% of uranium production in the United States coming from ISR operations. In addition to uranium, the technique has been successfully applied to the mining of oxide and sulfide copper, gold, sulfur, salt, phosphate and boron.

ISR is a closed-loop mining system, where ground water from the aquifer is utilized as the transport medium. Minerals or metals are dissolved in situ within the host formation using an appropriate lixiviant. Water wells constructed in a distinct pattern are used to deliver (inject) the lixiviant to the ore horizon as it is drawn toward other (recovery) wells in the pattern, resulting in contact with the mineralization. The recovery wells are equipped with pumps that deliver the pregnant leach solution (PLS), which is the lixiviant plus dissolved metals, to the surface for processing. After processing, the solution is recycled to the wellfield to continue the leaching cycle, making ISR a continuous mining operation.

Several ISR operations for copper have operated or been permitted in Arizona including Miami (BHP-Billiton), San Manuel (BHP-Billiton), Silver Bell (ASARCO), Old Reliable (Ranchers Exploration), Santa Cruz (ASARCO et al.), Florence (BHP-Billiton), and Safford area (Kennecott Copper). Considerable expertise in copper oxide ISR mining is available in Arizona and elsewhere in the USA.

Excelsior selected M3 and other respected third-party consultants to prepare mine plans, resources/reserve estimates, process plant designs, and to complete environmental studies and cost estimates used for this report. All consultants have the capability to support the Project, as required and within the confines of their expertise. The costs are based on fourth quarter 2016 US dollars.

1.1 KEY DATA

The key results of this study are as follows.

- The average annual Stage 3 production is projected to be approximately 125 million pounds of copper. Total life of operation production is projected at approximately 2,165 million pounds of copper.
- The Project currently has 873 million short tons of measured and indicated oxide and transitional mineral resources (0.29% Total Copper Grade) at a 0.05% Total Copper cutoff grade, as well as 187 million short tons of inferred mineral resources (0.17% Total Copper Grade).
- The Project currently has a diluted mineral reserve of 782 million short tons of probable mineral reserves (0.29% Total Copper Grade).
- ISR is anticipated to recover 48.4% of the total copper with an average “sweep efficiency” of 74%.
- The average life-of-mine direct operating cost estimated to be $0.655 per pound of copper for the Base Case, which includes building a sulfuric acid plant that commences operation in Year 7 (Stage 3). The average life-of-mine direct operating cost for the Alternative Case (No acid plant) is $0.97 per pound of copper.
- The estimated initial capital cost is $46.9 million.
- The total life-of-operation sustaining capital cost for the Base Case is estimated to be $742 million while the total life-of-operation sustaining capital cost for the Alternative Case is $661 million.
- The total cost for reclamation and closure is estimated to be $51.9 million and averages $0.024 per pound of copper recovered.
- The economic analysis for the Base Case before taxes indicates an Internal Rate of Return (IRR) of 48% and a payback period of 4.6 years. Based on a copper price of $2.75 per pound, the Net Present Value (“NPV”) before taxes is $1,173 million at a 7.5% discount rate.
- The economic analysis for the Base Case after taxes indicates that the Project has an IRR of 40.0% with a payback period of 6.5 years. The NPV after taxes is $807 million at a 7.5% discount rate.

1.2 PROPERTY DESCRIPTION AND LOCATION

The Project is located in Cochise County, Arizona, approximately 62 miles east of Tucson and 1.5 miles southeast of the historic Johnson Camp mining district. Figure 1-1 is a general location map and property location near the US Interstate 10 (I-10) freeway. Total area is approximately 9,560 acres (3,869 hectares).

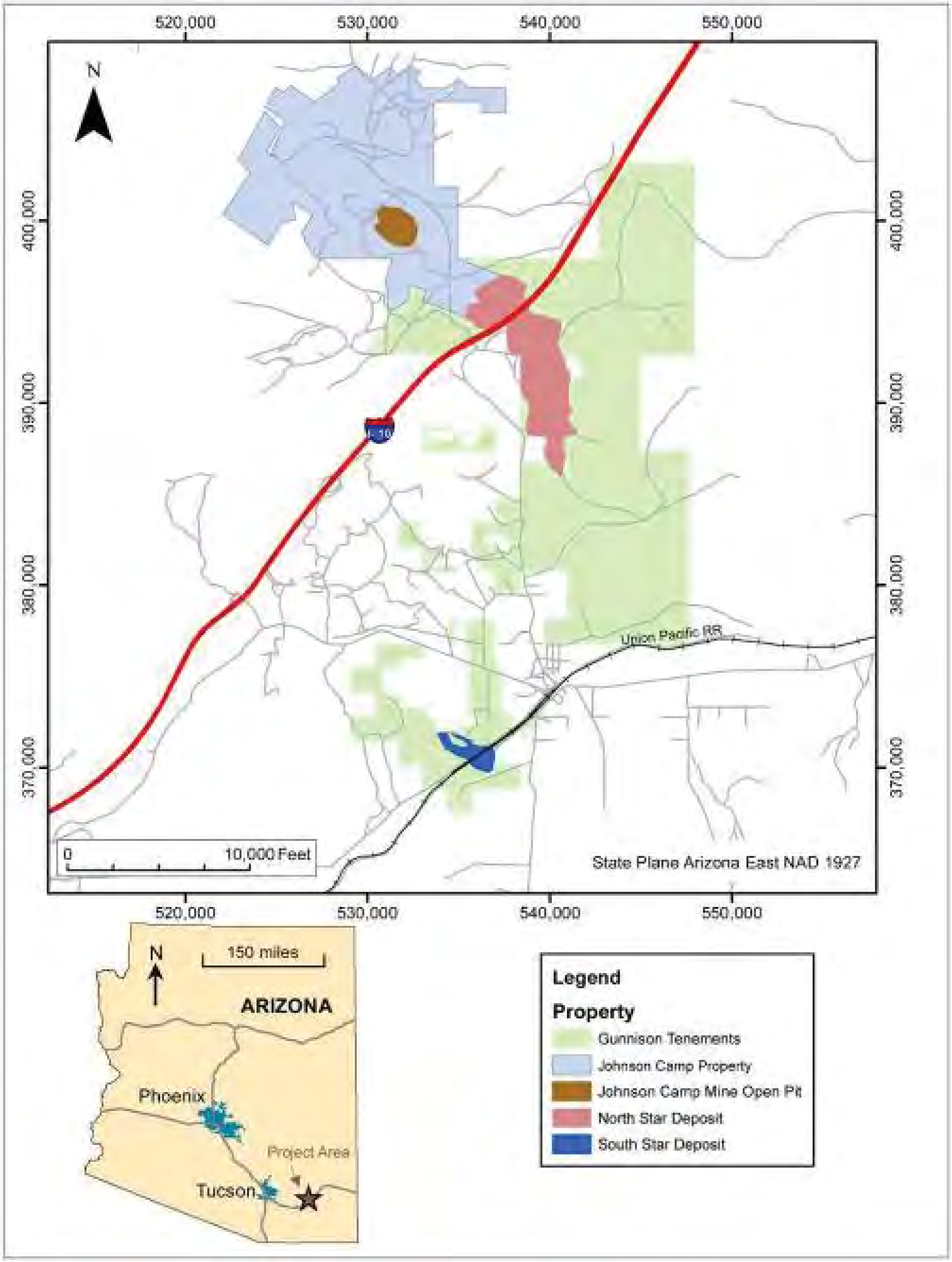


Figure 1-1: Project Location Map, North and South Star Deposits

The Project is held by Excelsior through is wholly-owned subsidiaries Excelsior Mining Arizona, Inc. (Excelsior Arizona) and Excelsior Mining JCM, Inc. (Excelsior JCM). Acquisition of all mineral interest from the James L. Sullivan Trust was completed in January of 2015. These assets represent, among other things, the mineral rights to the North Star and South Star Copper deposits (the Gunnison Project). Additionally, in December 2015 Excelsior purchased all assets of Nord Resources Corporation, as they relate to the JCM, through a court-appointed receiver.

1.3 ACCESSIBILITY, CLIMATE, LOCAL RESOURCES, INFRASTRUCTURE AND PHYSIOGRAPHY

The Project is located in a sparsely populated, flat to slightly undulating ranching and mining area about 65 road miles east of Tucson, Arizona. The Tucson metropolitan area is a major population center (approximately 1,000,000 persons) with a major airport and transportation hub and well developed infrastructure and services that support the surrounding copper mining and processing industry. The towns of Benson and Willcox are nearby and combined with Tucson can supply sufficient skilled labor for the Project.

Access to the Project is via the I-10 freeway from Tucson and Benson to the west or Willcox to the east. The North Star deposit can be accessed via good quality dirt roads heading approximately 1 mile east from the south side of “The Thing” travel center and roadside attraction on the Johnson Road exit from I-10.

The elevation on the property ranges from 4,600 to 4,900 feet above mean sea level in the eastern Basin and Range physiographic province of southeastern Arizona. The climate varies with elevation, but in general the summers are hot and dry and winters are mild.

Vegetation on the property is typical of the upper Sonoran Desert and includes bunchgrasses, yucca, mesquite, and cacti.

1.4 HISTORY

There is no direct mining history of the North Star deposit; however, the district has seen considerable copper, zinc, silver and tungsten mining beginning in the 1880’s and extending to the present day. Modern mining and leaching operations at the Johnson Camp Mine, began in the 1970s by Cyprus Minerals. Successor owners and operators include Arimetco, North Star, Summo Minerals, and Nord Resources Corporation. Nord mined fresh material until mid-2010 and maintained leaching operations until late 2015, when the property was purchased by Excelsior.

In 1970, a division of the Superior Oil Company (“Superior”) joint ventured into the northern half of the North Star deposit with Cyprus and the private owners (J. Sullivan, pers. com.). During the early 1970’s, Superior did most of the drilling and limited metallurgical testing on North Star and by early 1974 had defined several million tons of low-grade acid-soluble copper mineralization.

1.5 GEOLOGICAL SETTING AND MINERALIZATION

There are two oxide copper deposits controlled by Excelsior, North Star and South Star, both situated in the Mexican Highland section of the Basin and Range physiographic province. The province is characterized by fault-bounded mountains, typically with large igneous intrusives at their cores, separated by deep basins filled with Tertiary and Quaternary gravels.

The Gunnison Project (North Star) lies on the eastern edge of the Little Dragoon Mountains. The ages of the rocks range from 1.4 billion-year-old Pinal Group schists to recent Holocene sediments. The southern portion of the Little Dragoon Mountains consists predominately of the Tertiary Texas Canyon Quartz Monzonite whereas the Pinal Group schists and the Paleozoic sediments that host the regional copper mineralization dominate the northern half.

Copper sulfide mineralization has formed preferentially in the proximal (higher metamorphic grade) skarn facies, particularly along stratigraphic units such as the Abrigo and Martin Formations near the contact with the quartz monzonite and within structurally complex zones. Primary mineralization occurs as stringers and veinlets of chalcopyrite and bornite. Primary (unoxidized) mineralization remains “open” (undetermined limits) at depth and to the north, south, and east.

Oxidation of the mineralization occurs to a depth of approximately 1,600 feet, resulting in the formation of dominantly chrysocolla and tenorite with minor copper oxides and secondary chalcocite. The bulk of the copper oxide mineralization occurs as chrysocolla, which has formed as coatings on rock fractures and as vein fill. The remainder of the oxide mineralization occurs as replacement patches and disseminations.

1.6 DEPOSIT TYPES

The North Star deposit is a classic copper-bearing, skarn-type deposit (Einaudi et al., 1980; Meinert et al., 2005). Skarn deposits range in size from a few million to 500 million tons and are globally significant, particularly in the American Cordillera. The North Star deposit is large, being at the upper end of the range of size for skarn deposits, and is associated with a mineralized porphyry copper system that has been virtually unexplored.

1.7 EXPLORATION

Since North Star's discovery, numerous companies have explored the area. During this time period, extensive drilling and assaying, magnetic and IP geophysical surveys, metallurgical testing, hydrological studies, ISR tests, and preliminary mine designs and evaluations have occurred. The focus since the 1970's has been to utilize ISR or a combination of ISR and open pits as a potential mining strategy.

Stephen Twyerould first became involved with the Gunnison Project in mid-2005 and AzTech (Excelsior precursor) became involved in mid-2006. Since that time, significant work has been completed such as cataloguing, reviewing and compiling high-quality historical data spanning over thirty years of investigations by Superior Oil and Gas, Cyprus, Quintana, CF&I, Magma Copper Corporation, Phelps Dodge Corporation, and James Sullivan. Excelsior conducted detailed ground magnetics over the exploration targets in June 2011.

Excelsior initiated a re-logging program in December 2010 that was completed in the third quarter of 2011. In addition, a re-assaying program began in March 2011 during which all of the Magma holes were re-assayed. In May 2011, a re-assay program was initiated for the Quintana Minerals holes (DC, S, and T series) to include sequential copper analyses for acid-soluble copper (ASCu). Previous results only included total copper (TCu) assays.

1.8 DRILLING

The North Star deposit drillhole database includes 88 historical drillholes that were completed by several companies. These holes extend to a depth of approximately 2,450 ft below the surface at North Star and cover an area of approximately 310 acres, with additional drilling extending beyond this area. There is a slightly higher density of drilling along the central axis of the North Star deposit. The 88 holes drilled by previous owners include 5,585 assays for total copper (TCu) and 2,754 assays for acid soluble copper as well as other assays for molybdenum, gold, silver, and tungsten.

Between 2010 and 2015, fifty-four diamond core holes have been drilled by Excelsior for a total of 78,615 feet of drilling. Fifteen of these holes were for metallurgical samples and the rest were drilled for resource definition or exploration purposes (Table 10-6; Figure 10-2).

1.9 SAMPLE PREPARATION, ANALYSIS AND SECURITY

All of the drilling, sample preparation and analysis of the samples presented in this report was under the control of the previous property owners.

The laboratory sample preparation and analysis procedures used by the previous owners of the deposits are unknown; however, major commercial laboratories using best practices at the time completed the majority of analyses.

The data, information, samples and core from the deposits have been under the control and security of AzTech Minerals since November 2006 and then Excelsior since October 2010. The original Information and samples are stored at the Sullivan's core storage facility in Casa Grande, with numerous copies held by Excelsior at its Phoenix, Arizona office. It is the opinion of Mine Development Associates (MDA), the reviewer of the assay data for this report, that the sample procedures, processes and security are reasonable and adequate.

1.10 DATA VERIFICATION

The verification of location and assay data in the drillhole database covers historic drilling and the verification of the data collected by Excelsior. No significant issues have been identified with respect to the data provided by Excelsior's quality assurance/quality control ("QA/QC") programs. QA/QC data are not available for the historical drilling programs at North Star, but Excelsior analyses dominate the assays used directly in the estimation of the mineral resources. Additionally, most of the historical data were generated by well-known mining companies, and the Excelsior drill data are generally consistent with the results generated by the historical companies.

Assaying and QA/QC procedures were industry standard. The TCu and ASCu assays used to estimate grades in the North Star model are acceptable for estimating mineral resources, based on MDA's review of the available data for repeat, check, duplicate, standard and blank assays, and on paired comparisons of assay data from different drilling campaigns.

1.11 MINERAL PROCESSING AND METALLURGICAL TESTING

There are two fundamental parameters to estimate overall copper recovery and acid consumption for a commercial-scale ISR operation: metallurgical recovery and sweep efficiency. In essence:

- Metallurgical recovery determines the amount and rate at which the copper dissolves from, and acid is consumed by, the rocks when contacted by the leach solution.
- Sweep efficiency determines how much of the copper in the ground will be effectively contacted by leach solution during the mining process.

In addition to historic testing, Excelsior has commissioned several rounds of varied metallurgical testing from as early as 2011 through 2015 that were intended to demonstrate the copper recovery and acid consumption which could be expected in an ISR operation for the Gunnison Project. The most recent testing was conducted at Mineral Advisory Group Research & Development, LLC (MAG) in Tucson, Arizona under the direction and control of Dr. Ronald J. Roman, P.E. of Leach, Inc., Tucson, Arizona. The primary objectives of this most recent group of tests were to:

- Determine the amount of copper that could be leached from the different ore types,
- Determine the relationship between the percentage of copper leached and the acid consumption for the different ore types, and
- Establish ISR metallurgical parameters at a feasibility level of confidence.

In addition to these tests, several rinsing tests were conducted for the purpose of determining a rinsing protocol to be employed after a block of ore had been leached by the ISR technique.

1.11.1 New Column Testwork

Since the 2014 PFS, two addition test programs have been completed. In the first of these 19 modified column tests were run. The purpose of the new column testing was to determine how different ore samples would respond to the same leaching parameters to determine the variability of the ore with respect to the leachability.

Column tests were run on 51 to 52 kg of material crushed to minus 1 inch using 15 g/l sulfuric acid solution for up to 80 days. Separate columns were run for Lower Abrigo, Middle Abrigo, Upper Abrigo, and combined Martin/Escabrosa formations. The results show that the recovery of acid soluble copper ranges from 65% to +90% but was dependent on rock type with Lower Abrigo formation having the highest and shortest duration leach cycle and the Martin/Escabrosa column tests having the lowest recovery over the longest period. Nearly all of the column leach plots of recovery vs time had positive slopes at the end of leaching, indicating the leaching process had not completed in 80 days. As with prior test work, additional copper was recovered from the solubilization of minerals which do not report to the traditional ambient acid-soluble copper assay. These minerals include slowly soluble oxide copper minerals and transitional sulfides. Therefore the conventional “acid-soluble copper assay” gives a good, if not conservative, approximation of the amount of copper which can be leached from the ore in the presence of a weak sulfuric acid solution.

1.11.2 Core Tray Tests

The second new test program termed “Core Tray” tests was intended to more closely simulate the in situ recovery process than the modified column tests. In the Core Tray test pieces of core were mounted in epoxy in a tray with only the natural fracture surface exposed to the leach solution flowing across the top through the core tray.

Initially, the leach solution contained approximately 1.0 gpl free acid. The free acid was increased in steps with time until it reached 15 gpl free acid. The data collected were recorded and an estimate of the following information about the response of the sample to leaching made:

- Incremental and cumulative recoverable copper, lbs/100 ft2 of fracture surface
- Incremental and cumulative recoverable copper, wt%
- Incremental and cumulative gangue acid consumption, lbs/100 ft2 of fracture surface
- Incremental and cumulative net acid consumption, grams of acid/gram of copper leached
- From these results the following were determined:
    - Recovery/time relationship
    - Acid Consumption/recovery relationship

The results of the Core Tray tests were stratified by rock type. Figure 1-2 is an example of the results for the Upper Abrigo formation. For all formations the time vs recovery curves still have positive slopes during the test times of up to 200 days. Figure 1-3 is the Core Tray acid consumption data for the Upper Abrigo formation that indicates that the acid consumption curve steepens with recovery as expected.

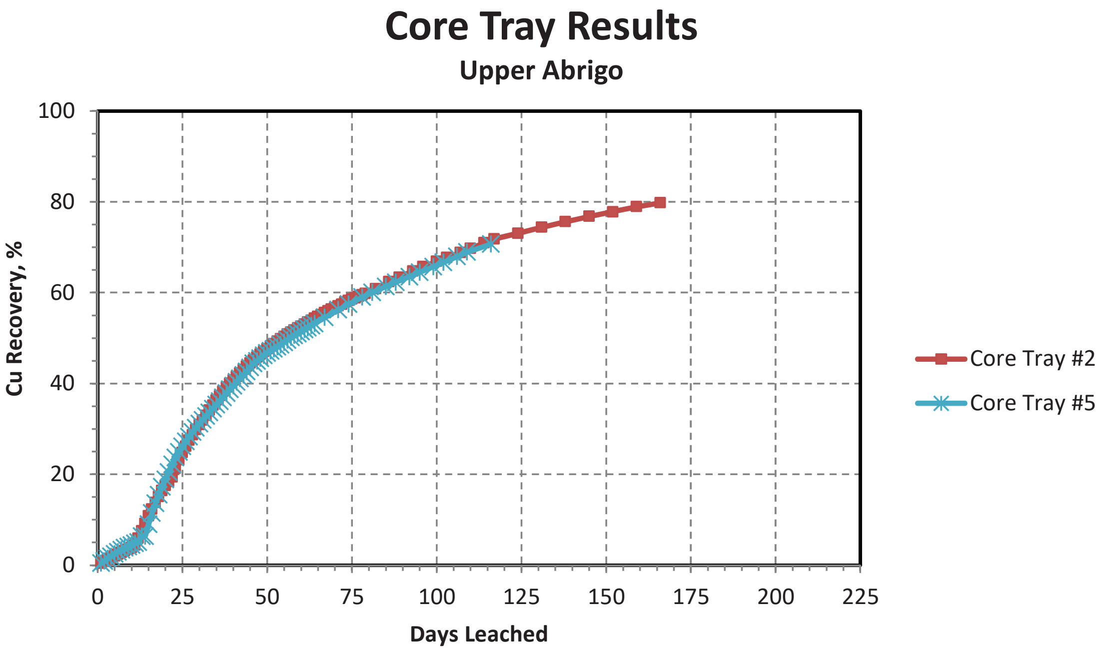


Figure 1-2: Core Tray Time vs Copper Recovery Results for Upper Abrigo Formation

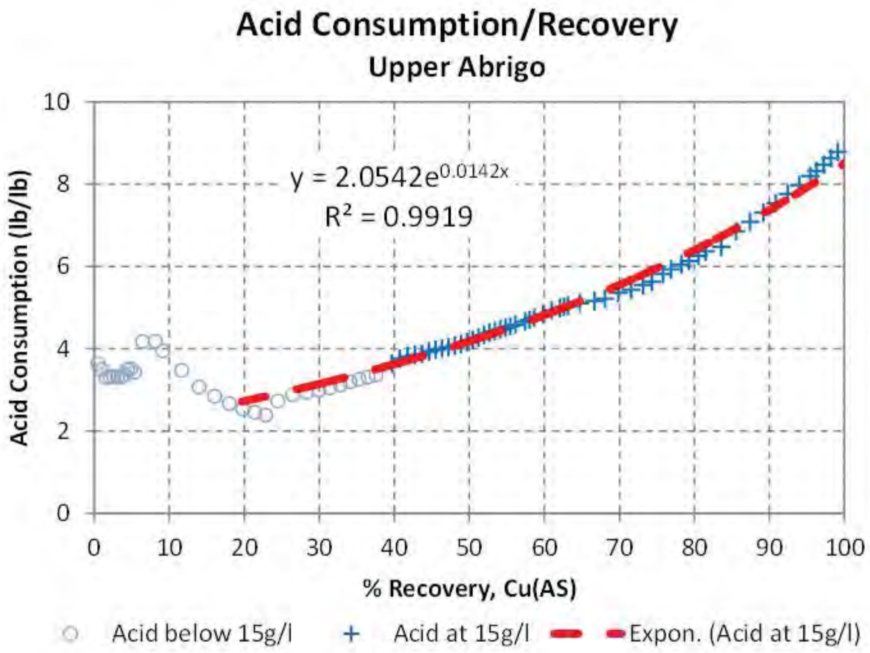


Figure 1-3: Core Tray Copper Recovery vs Acid Consumption Results for Upper Abrigo Formation

Sweep efficiency (or mining efficiency) for the North Star deposit is considered a function of fracture intensity. The most highly fractured rocks where the majority of pieces of core are 4" or less are considered to have a sweep efficiency of 100%. In contrast, rocks that exhibit very weak fracturing are considered to have a low sweep efficiency of approximately 20%. The rocks at North Star exhibit a continuum of fracture intensities from very low (Fracture Intensity value of 1), to very high (Fracture Intensity value of 5), as determined by geological logging, geophysics and three-dimensional interpretation and modeling. To reflect this continuum, a polynomial algorithm was used to derive a predictive relationship between sweep efficiency and fracture intensity of the rocks.

Combining sweep efficiency with metallurgical test results and modelling of copper recovery it is possible to estimate cumulative copper recovery and acid consumption over a period of time for a 5-spot well pattern. The results of such calculations are shown in Table 1-1 below. The overall effect is for a weighted average total copper recovery of approximately 48% (acid soluble recovery of 74%).

Table 1-1: Predictive Model for Sweep Efficiency Factored, Cumulative Acid Soluble Copper Recovery and Acid Consumption for a 5-Spot Well Field Pattern

Cumulative Acid Soluble Cu Recovery (%)	Year 1	Year 2	Year 3	Year 4
Martin	40.2	55.8	65.9	72.8
Upper Abrigo	43.5	58.7	68.2	75.0
Middle Abrigo	42.0	57.6	67.6	74.9
Lower Abrigo	43.6	58.8	67.3	74.5
Bolsa, TQM, other*	43.6	58.7	67.2	74.4
Weighted average	41.9	57.3	67.0	74.0
Cumulative Acid Consumption (lb/lb)	**Year 1**	**Year 2**	**Year 3**	**Year 4**
Martin	5.2	6.8	8.6	10.1
Upper Abrigo	4.7	6.0	7.5	8.9
Middle Abrigo	5.1	6.9	8.6	10.2
Lower Abrigo	3.7	5.0	5.8	6.9
Bolsa, TQM, other*	4.5	4.6	4.9	5.2
Weighted average	4.8	6.4	7.9	9.3

* The Bolsa Quartzite, TQM and other minor host rocks make up less than 2% of the Probable Reserve and were not tested but are expected to perform similar to or better than the Lower Abrigo.

1.12 MINERAL RESOURCE ESTIMATE

The North Star deposit mineral resource reported by MDA (2015) have been updated to include resources on lands newly acquired by Excelsior with the purchase of the Johnson Camp property. Table 1-2 is a summary of the oxide, transitional, and sulfide mineral resource tabulated at a total copper cutoff of 0.05% for oxide and transitional and 0.30% for sulfide. Table 1-3 is a summary of the sulfide portion of the deposit at a 0.50% TCu cutoff. Measured and indicated oxide and transition mineral resources are inclusive of mineral reserves.

Table 1-2: North Star Oxide, Transition, and Sulfide Mineral Resource Summary

Effective October 1, 2016

Resource Category	Short Tons (millions)	Total Cu (%)	Contained Copper (million pounds)
Measured	200.7	0.36	1,439
Indicated	710.8	0.27	3,875
Measured + Indicated	911.6	0.29	5,315
Inferred	240.9	0.22	1,070
0.05% TCu cutoff for oxide and transitional, 0.30% TCu cutoff for sulfide			

Table 1-3: North Star Sulfide Mineral Resource Summary

Effective October 1, 2016

Resource Category	Short Tons (millions)	Total Cu (%)	Contained Copper (million pounds)
Measured	0.2	0.55	2
Indicated	6.3	0.6	76
Measured + Indicated	6.5	0.6	78
Inferred	5.3	0.58	62
0.50% TCu cutoff			

1.13 MINERAL RESERVE ESTIMATE

The mineral resource estimate discussed in Section 14 is used to estimate the probable mineral reserve estimate for the North Star deposit. Table 1-4 shows the diluted Probable mineral reserve estimate as defined for the FS. The mineral reserves are in the Probable category. The estimate includes material from the measured and indicated categories of the mineral resource and excludes inferred mineral resources. It does not include material from the sulfide zone.

Table 1-4: Probable Diluted Reserve Estimate (October 2016)

Short Tons	782,153,183
TCu Grade (%)	0.29
TCu Contained Copper (lbs)	4,505,267,997
Average Total Copper Recovery (%)	48.4
Recoverable Copper (lbs)	2,179,489,338
*Probable reserves were defined from measured and indicated resources. Inferred resources were not converted into reserves.	

The Probable mineral reserve estimate summary prepared for the FS was created using data and input from MDA and Excelsior. It is based on MDA's resource estimate detailed in Section 14. It assumes the use of ISR as a mining method, which requires a wellfield (injection and recovery wells) and pumps pregnant leach solution to an SX-EW plant to recover the copper. The boundaries of the Probable mineral reserve were defined using economic parameters and then further modified to take into account lost production under the freeway and along some lease boundaries. Excelsior developed a wellfield / production schedule for the Project, and the mineral reserve estimate is the sum of the production schedule, which is discussed in Section 16.

1.14 MINING METHOD

Excelsior proposes to use the ISR method to extract copper from oxide mineralization located within the North Star Deposit (see location map on Figure 1-1). The ISR mining method was based on the fractured nature of the host rock, the presence of water-saturated joints and fractures within the ore body, copper mineralization that preferentially occurs along fracture surfaces, the ability to operate in the vicinity of Interstate 10, and to avoid the challenges of open pit mining in an area with alluvium overburden thickness ranging from approximately 300 feet to 800 feet.

The forecasted copper production for the Gunnison Project commences with an initial stage of 25 million pounds per annum (mppa) from Years 1 through 3, followed by a second stage of production of 75 mppa in Years 4 through 6, and followed a third stage reaching 125 mppa from Year 7 through Year 20 with a decline in production beginning in Year 21 through the end of the mine life in Year 24. The total amount of copper production forecast over the 24-year LOM is approximately 2,165 million pounds. The following inputs and assumptions were used to generate the copper extraction forecast:

- Key physical parameters from MDA's 100 foot x 50 foot resource block model such as rock type, specific gravity of each rock type, total copper percentage and acid soluble copper percentage, fracture intensity, ore thickness, water table elevation, ore greater than 0.05% total copper, and lease boundaries (see Section 14 for details);

- Incremental acid soluble copper recovery curves over a 4 year recovery period and recovery factor (as discussed in Section 13.3); and

- Recovery well production rates described in Section 16.4.3.

ISR process injects a barren leach solution ("lixiviant") with weak sulfuric acid into the ore body using a series of injection wells. The acidified solution dissolves oxide copper minerals as it migrates through the joints and fractures within the mineralized bedrock. Recovery wells surrounding each injection well extract copper-bearing pregnant leach solution (PLS) and combine to form the feed solution for the SX-EW process.

The SX-EW facility is designed to recover copper from PLS at a copper feed grade of 1.63 gram per liter (gpl) (1.52 gpl net copper grade) to produce cathode-quality copper with 99.99% purity. The anticipated PLS flow rates are 3,800 gallons per minute (gpm) for Stage 1, 11,500 gpm for Stage 2, and 19,500 gpm for Stage 3. The process solutions are piped to and from the SX-EW plants in high density polyethylene (HDPE) piping. The process consists of the following elements (schematic representation in Figure 1-4):

- ISR wellfield
- Wellfield and drilling services building
- Lined PLS and raffinate ponds
- Solvent Extraction (SX) plant
- Tank Farm for handling process liquids;
- Electrowinning (EW) Tankhouse equipped with an Automatic Stripping Machine
- Electrical substation
- Sulfuric Acid Receiving/Storage
- Administration offices, Security Building, and a Change House

- Plant Warehouse, Laboratory, and Plant Maintenance buildings
- Water treatment plant with a Clean Water Pond, Evaporation Ponds, and Solids Impoundments

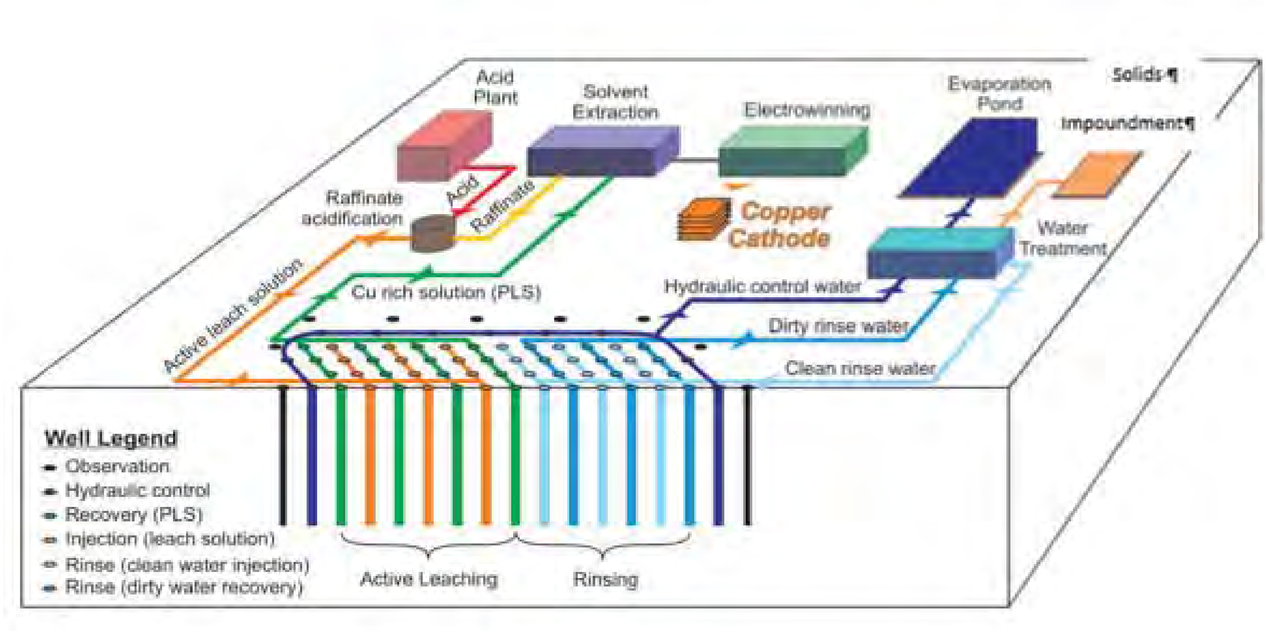


Figure 1-4: Recovery Process

Depleted portions of the mineralized zone are rinsed by injecting non-acidic (clean) water to flush out the leach solution and reduce the metals and other constituents to acceptable concentrations. A block of mineralization is considered depleted when the copper grade of the recovered PLS falls below an economic cut off. The rinsing process consists of a three-stage process consisting of an early rinse, rest period, and late rinse. Early rinsing flushes and dilutes the PLS remaining in the formation.

At a certain level of dilution, typically 90 percent, the wellfield is shut in allowing the intrinsic neutralization capacity of the formation to neutralize the acid in the diluted solution. The final stage of rinsing flushes out the neutralized solution until all regulated constituents are below stipulated concentrations. Injection and recovery wells are abandoned by grout injection from the bottom of the well when wellfield closure criteria have been satisfied.

Production wells will be designed to meet Underground Injection Control Class III requirements and will be constructed in accordance with the guidelines of ADEQ's Mining BADCT Guidance Manual (2004). Boreholes will be drilled using air rotary, direct mud rotary, reverse circulation mud rotary, or casing advance drilling methods. Borehole diameters will be sufficient to allow for installation of casing that will accommodate the pumps. The cased portions of the boreholes will be 12-inch nominal (small diameter injection/recovery wells and hydraulic control wells), 15-inch nominal (large diameter injection/recovery wells), and 10-inch nominal (observation and POC wells). The open borehole sections within bedrock will be 5 and 7 inches in nominal diameter. Well screen may be used if the borehole is unstable. The outer annulus of the cased portions of Class III wells will be grouted to 100 feet above the basin fill/bedrock contact (or static groundwater level, whichever is shallower). The ISR operations do not require hydraulic fracturing of the mineralized formation.

1.14.1 Water Treatment Plant

The water treatment plant (WTP) is planned for construction in Year 6 and 7, when the earliest producing wells are depleted and wellfield rinsing begins. The WTP is designed to provide treatment for mine-influenced water (MIW) primarily composed of raffinate bleed, wellfield conditioning return, and rinse water return from the ISR recovery wellfield. The WTP is conceptually designed with a capacity of approximately 1,600 gpm. Rinse water, wellfield conditioning return, and excess raffinate produced in Years 1 through 7 will be re-used in the copper recovery process, with any excess going directly to the evaporation ponds.

1.14.2 Acid Generation Plant

Producing sulfuric acid (H2SO4) onsite from molten sulfur was evaluated against purchasing sulfuric acid delivered to site. The analysis is based on a long term delivered contract at a cost of $125 per (short) ton of sulfuric acid. The alternative of purchasing molten sulfur on a long term contract, also at $125 per ton and converting the sulfur to sulfuric acid onsite was determined to be more economical. Waste heat from the acid making process produces steam as a by-product to cogenerate electrical power which will be credited to the acid facility operating costs thereby lowering the effective cost of sulfuric acid to $46 per ton. Facilities required for onsite acid generation include molten sulfur rail unloading and storage facilities, sulfur burning plant, acid absorption area, steam turbine generation plant, water treatment, acid storage tanks, and cooling towers. The sulfuric acid plant is scheduled to be built in Year 6 as part of the Stage 3 expansion.

The results of the evaluation indicate that the internal rate of return (IRR) between purchasing acid and making acid onsite are the same but the increase in Net Present Value clearly favors making sulfuric acid onsite. For this reason, the sulfuric acid plant is considered as a component of the Base Case. Omitting the acid plant is termed the Alternative Case.

Acid requirements for the Project are approximately 9 pounds of acid per pound of copper produced. The proposed acid plant is a double-contact, double-absorption acid plant which will provide the highest conversion rate and lowest emission of sulfur dioxide gas, less than 500 parts per million by volume. The sulfur-burning sulfuric acid plant is sized for 1,625 tons per day (100% H2SO4), with the product acid strength of 98.5% H2SO4. Allowing for 2 weeks down time each year for maintenance, the acid plant operates at an average of 85% capacity.

1.15 PROJECT INFRASTRUCTURE

The primary access to the site will be from Interstate 10 via the Johnson Road exit between Benson and Willcox, Arizona. The mine access road to the Johnson Camp side of the property is approximately one mile long to the north. An new, asphalt paved access road to the Gunnison wellfield and plant site will head south and east from the Interstate exit for a distance of one mile.

The Johnson Camp mine, currently in care and maintenance mode, has existing plant facilities, ponds and infrastructure in operable condition. This site will be used for Stage 1, 2, and 3 production at its rated capacity of 25 mppa.

The Gunnison SX-EW plant will be constructed for Stage 2 production in Year 3 for operation in Year 4 at an initial rate of 50 mppa. The electrowinning building (tankhouse) will be a steel building with corrugated metal roofing and siding. It will contain 80 electrowinning cells on one end of the building and the Automatic Stripping Machine and the cathode handling equipment are on the other, with a paved cathode storage area outdoors. For Stage 3 production, 80 EW cells will be added to the opposite side of the building, mirroring the first 80 cells.

The Gunnison Tank Farm will be built for Stage 2 and have tankage added in Stage 3. It is uncovered and located downhill from the SX area and the tankhouse to facilitate gravity drainage of solutions to the Tank Farm. The Tank

Farm has a concrete containment that drains to a sump with an oil-water separator to return spilled liquid to the proper location for recycling. There is a Plant Runoff Pond located downstream of the Tank Farm to capture any surface flows in the event of an upset condition at the plant.

Ancillary facilities needed to support the Gunnison Project include buildings, ponds, tanks, and trenches. Ancillary buildings include an Administration Building, Warehouse, Plant Maintenance building, Change House, Security Building (gatehouse), Wellfield Maintenance Building, Water Treatment Plant, and Sulfuric Acid Plant-Cogeneration complex. Other facilities will include ponds, and tanks. The Gunnison Project will use the existing assay lab located at the Johnson Camp mine.

Power for the facility will be taken from an existing 69 kilovolt (kV) power line feeding the existing Johnson Camp Mine located on the north side of I-10. The existing power line is owned by the Sulfur Springs Valley Electric Cooperative Inc. located in Willcox, Arizona. The power line approaches the plant site along the eastern boundary of Section 31 shown on Figure 4-2. A tap will be taken from the existing power line and a short, 0.3-mile power line will be constructed to connect to the plant main electrical substation, located near the EW building.

Fresh well water will be taken from existing wells and mine shafts on the Johnson Camp property and pumped to an existing 500,000 gallon fresh water/fire water storage tank located on Water Tank Hill at the JCM site. The lower 300,000 gallons in the storage tank will be reserved for fire water. Process water for plant use will be taken from the storage tank above this reserve level for fire suppression. The JCM site has an existing potable water system. The Gunnison site will be served by an additional 7,000 gallon potable water tank and chlorination system, which will use a water supply well to be constructed east of the operation during Stage 2 development.

1.16 MARKET STUDIES AND CONTRACTS

No market study has been conducted for the Project and there are no contracts in place related to metal sales at the time of this report. No direct marketing has been done for the copper cathode that would potentially be produced at the Project and therefore no off-take agreements exist. These options will be reviewed in detail when the Project proceeds. The Project will produce high-purity copper (LME Grade A) cathodes which are suitable for use without further refining.

The FS has selected $2.75/lb copper as the study price for the Base Case, which is consistent with the price used in the 2016 PFS Update. It also agrees with the current three-year trailing (historic) average for copper price, which is $2.62/lb.

1.17 ENVIRONMENTAL AND PERMITTING

1.17.1 Environmental Studies

Anthropological and floral and faunal studies were carried out by Excelsior in 2010 over the wellfield area. There is no potential for U.S. Fish and Wildlife Service endangered, threatened, proposed, and candidate species (special-status species) to occur in the study area.

An archaeological study was conducted that showed no cultural resource sites in the mining area. Further archeological and floral/faunal studies were conducted by WestLand Resources (2014) for areas covered by infrastructure such as the SX-EW plant, evaporation ponds, sulfuric acid plant and railway facilities. No cultural resource sites were identified.

1.17.2 Groundwater Modeling

A groundwater model was constructed by Clear Creek Associates (CCA) to cover the greater Gunnison project area of 87.8 square miles in support of the Aquifer Protection Permit (APP) and Underground Injection Control Permit (UIC) applications. The model was constructed using a number of extensive datasets created by Excelsior, including a detailed mapping of fracture intensity, which is key to groundwater flow in the Project area.

The model demonstrates that control of mining solutions can be maintained with hydraulic control wells located around the wellfield. Predicted pumping rates for hydraulic control presently range from a total of 15 gpm to approximately 200 gpm in later years. Water produced during hydraulic control will be used in the process, recycled or evaporated.

1.17.3 Water Management

The Project's water management plan was designed to make the most efficient use of water resources and eliminate discharges. During Stage 1 of the Gunnison Project, existing lined ponds at JCM will be used. As production increases and Stage 2 and Stage 3 facilities are constructed south of Interstate 10, new solution and water management ponds will be constructed to support the project. These include: the PLS pond, Raffinate pond, Plant Runoff pond, Clean Water pond, Recycled Water pond, Evaporation ponds, and Solids Impoundments, which contain the precipitate from the Water Treatment Plant. With the exception of the Plant Runoff and Clean Water ponds, the ponds will be constructed with a double liner and a leak detection and recovery system between the liners according to prescriptive BADCT design.

Excess solutions will initially be routed to evaporation ponds where mechanical evaporators will be installed. During later stages of the Project, when the Water Treatment Plant is in operation, approximately 80% of the influent will be treated for reuse in the process or for rinsing, and it will report to the Clean Water Pond. The solids from the WTP process will be pumped to the Solids Impoundments as precipitated solids and the concentrate brine and filter backwash from the WTP will be pumped to the evaporation ponds. Groundwater produced from hydraulic control pumping will be conveyed to the Clean Water Pond or, if impacted by PLS, to the Evaporation Pond.

1.17.4 Geochemical Modeling

Geochemical modeling of raffinate and rinsing solutions indicates that the following 3-step closure strategy will result in concentrations of regulated constituents below Aquifer Water Quality Standards:

- Step 1: Rinsing 3 pore volumes
- Step 2: A rest phase (approximately 200 days or more) until near neutral pH conditions are attained
- Step 3: Rinsing at least 2 additional pore volumes
- Hydraulic control is maintained during rinsing

1.17.5 Community Relations

Excelsior has developed a broad-based community relations and stakeholder outreach program in support of the Gunnison Project. Elements of this program include:

- Targeted stakeholder outreach to government, community, business, non-profit and special interest groups, and leaders at the local, county and state level.

- Development of community relation and communication tools and resources (e.g. Project website, Project e-newsletter, and presentation materials);
- Public open houses and technical briefings when appropriate.

Crucial elements of Excelsior's community relations efforts will involve ensuring consistent and ongoing communication with all stakeholders, and providing opportunities for meaningful two-way dialogue and active public involvement. Excelsior will focus on ensuring the public benefits related to the Gunnison Project, such as employment opportunities, supplier services, infrastructure development and community investment are optimized for the local communities.

1.17.6 Economic Benefits

Excelsior commissioned an Economic Impact Study through Arizona State University's W. P. Carey School of Business which forecasts the increase in economic activity within Arizona during the construction phase and life of the mine. The economic impact of mine development to surrounding communities and the State in general:

- Over 800 direct and indirect new jobs;
- Employment benefits are distributed in mining, construction, professional & technical services, and government sectors as well as other sectors.
- The annual average value added to Arizona's Gross State Product (GSP) during the entire Project life – pre-production, production and closure – is approximately $109 million with approximately $28 million added within Cochise County. The total addition to the GSP is $2.9 billion, with $757 million locally within Cochise County.
- Economically modeling predicts the Project will have an average annual impact on state revenues of $10.9 million for a total impact of $295 million.

1.17.7 Permitting

The Gunnison Project operations will require a number of Federal, state, and local government environmental permits. The environmental and permitting process involves, among other things, preparing a mine closure and reclamation plan for the Arizona State Mines Inspector. In addition, several permits must be obtained; the most important of which are an Aquifer Protection Permit (APP) from the State of Arizona, an Underground Injection Control permit (UIC) from the US Environmental Protection Agency ("USEPA") and the air quality permit from the State of Arizona. Currently, there are no known environmental liabilities for the Gunnison Project. The APP application was submitted to ADEQ on January 13, 2016 and it was found to be administratively complete. The UIC application was received by USEPA on February 3, 2016.

The Project facilities regulated by APP are the ISR wellfield and nine impoundments: Solids Ponds 1a and 1b, 2a and 2b, and Solids Pond 3, Evaporation Ponds 1 and 2, the Recycled Water Pond, PLS Pond, Raffinate Pond and the Plant Runoff pond. BADCT for the wellfield includes the following elements: (1) balanced injection and recovery volumes, (2) hydraulic control pumping to maintain hydraulic gradients toward the wellfield, (3) operational controls regarding flow volumes and injection pressures, (4) well construction according to 40 CFR Subpart D, Section 146.30, (4) rinsing for closure, and (5) wellfield plugging and abandonment. The UIC permit will focus on the design, construction, operation, and closure of the wellfield.

Table 1-5: Required Permits

Required Permits	Issuing Agency	Regulatory Program or Statute
Underground Injection Control (UIC) Permit (Application submitted February 2016)	United States Environmental Protection Agency (USEPA)	Safe Drinking Water Act
USEPA Identification Number (RCRA Subtitle C Site Identification Form 8700-12)	USEPA	Resource Conservation and Recovery Act (RCRA)
APP Individual Permit (for wellfield and impoundments) (Application submitted January 2016)	ADEQ	Environmental Quality Act – APP program
APP General Permits (for sewer system, other minor facilities)	ADEQ	Environmental Quality Act – APP program
Air Quality Permit	ADEQ	Clean Air Act
Drinking Water System Approval to Construct and Approval of Construction	ADEQ	Safe Drinking Water Act
Mined Land Reclamation Permit	Arizona State Mine Inspector	ARS. § 27-901
Intent to Clear Land	Arizona Department of Agriculture	ARS. § 3-904
Sewage System Permit	Cochise County Department of Health and Social Services	Environmental Quality Act – APP program
Encroachment Permit (for utility corridors under I-10)	Arizona Department of Transportation (ADOT)	AAC. R17-3-502
Dam Safety (for regulated impoundments)	ADWR	ARS. 45-1203 & 1206

1.18 CLOSURE AND RECLAMATION COSTS

All closure activities described in Section 20 of this report refer only to APP facilities. Non-APP facilities, such as buildings and infrastructure, will be reclaimed in accordance with the Mined Land Reclamation Program overseen by the Arizona State Mine Inspector's Office. This program requires the development of reclamation plans that will ensure safe and stable post-mining land use. The plans must include cost estimates and financial assurance for implementing the reclamation plans.

Prior to recovery operations, Excelsior will provide a bond to ensure future mine closure expenses will be met. The amount of the bond will be based on the closure-remediation-reclamation cost estimates. Final closure of operational infrastructure including the containment ponds, tanks, and plants will commence once copper recovery has ended.

Closure of the ISR wellfield requires rinsing and neutralization of the portions of the formation that have been exposed to leaching. Clean water for rinsing will be provided by water supply wells and water from the Water Treatment Plant. Extracted rinse water will be treated with greater than 80 percent returned for additional rinsing and the remainder being entrained in the Solids Impoundment or disposed of in the Evaporation Ponds.

Rinsing is considered complete when the concentrations of all constituents are at or below acceptance criteria. Wells that are accepted as being sufficiently rinsed will be abandoned in accordance with ADWR criteria and the UIC permit.

Process ponds, including PLS, Raffinate, Recycled Water, and Evaporation Ponds will be closed in accordance with Arizona BADCT requirements.

1.19 CAPITAL AND OPERATING COSTS

Capital and operating costs for the Gunnison Copper Project were estimated on the basis of the prefeasibility design, estimates of materials and labor based on that design, analysis of the process flowsheets and predicted consumption of power and supplies, budgetary quotes for major equipment, and estimates from consultants and potential suppliers to the Project.

1.19.1 Capital Cost

Capital cost (CAPEX) is divided into initial and sustaining capital costs, as summarized in Table 1-6, below. Initial capital costs include separate estimates for wellfield development and improvements to the existing Johnson Camp plant to get the project into production, including the wellfield piping and electrical infrastructure, solution piping from the wellfield to the Johnson Camp plant and minor improvements to the Johnson Camp plant. The sustaining capital costs include the ongoing additions to the wellfield, the two stage development of the Gunnison SX-EW plant, the construction of a sulfuric acid plant, the installation of a railroad siding and railcar unloading facility at the sulfuric acid plant, the addition of the Water Treatment Plant, and capital equipment replacement. Estimates have been prepared to a Class 4 level as defined by AACE (Association for the Advancement of Cost Engineering).

Table 1-6: Summary of Capital Cost Spending Over the Life-of-Project

Stage	Copper Production	Description	Total ($000s)
Initial Capital (Stage 1)	25 mppa	Initial Wellfield Development; JCM SX-EW improvements, Pipelines between wellfield & JCM; Gunnison Evaporation Pond; Powerline rerouting.	$46,941
Stage 2 (Year 3)	75 mppa	Gunnison 50 mppa SX-EW; 80 EW cells; New PLS, Raffinate ponds; Gunnison ancillary bldgs.;	$117,030
Stage 3 (Year 6 & 7)	125 mppa	Wellfield Expansion; Gunnison 50 mppa SX-EW; 80 EW cells; Water Treatment Plant (WTP); Clean & Recycled Water Ponds; Solids Ponds 1A & 1B; Wellfield expansion; Railroad Siding & Railcar Unloading	$147,254
Acid Plant (Years 5 & 6)		Sulfuric Acid Plant, Molten Sulfur Handling, Cogen Plant; Boiler Water Treatment (Optional)	$81,246
Sustaining Capital		All wellfield drilling costs after Stage 1	$309,961
Sustaining Capital		All wellfield infrastructure expansion after Stage 1, Solids Impoundments 2 & 3.	$86,596
Total		**Initial & Sustaining Capital Cost**	**$789,028**

The capital cost estimates were based on general arrangement (GA) drawings for all Project plant areas. M3 used both escalated original and updated capital equipment quotations. Plant piping, plant electrical, and plant instrumentation disciplines were estimated with material take-offs (MTOs) based on piping and instrumentation diagrams (P&IDs) in conjunction with the GAs. Long runs of field piping, wellfield piping, infrastructure, and overhead powerlines were also estimated using MTOs. MTOs for civil excavation and ponds, concrete, steelwork, and architectural disciplines were based on civil drawings and GAs. Construction labor hours and wages were adjusted for current Davis-Bacon prevailing wages in Arizona.

- Indirect capital costs were factored from the direct field cost.

- Indirect field mobilization is 1.5% of the direct field cost without mobile equipment.
- Temporary construction facilities is 0.5% of direct cost less mobile equipment.
- Construction power is 0.1% of direct cost less mobile equipment.
- Engineering Procurement and Construction management is 16.8% of the direct cost plus the indirect cost listed above.
- EPCM temporary facilities and utility setup were estimated as 0.5% of total constructed cost.
- Commissioning was estimated to cost 1% of plant equipment less mobile equipment.
- Vendor supervision is estimated as 1.5% of plant equipment costs during construction and 0.5% of plant equipment costs, each, for pre-commissioning and commissioning.
- Capital spare parts are estimated as 2.0% of plant equipment and commissioning spares are 0.5% of plant equipment.

Contingency for both wellfield development and plant improvements have been included at 20% of the total direct and indirect costs.

Owner's costs include items for the initial capital cost that fall into the Owner's responsibility. The Owner's costs are estimated to be $5.5 million of which the largest item is the first fills three months of sulfuric acid for the wellfield ($2.0 million or 36%). Other major costs include:

- Replacing the diluent and extractant for the Johnson Camp settlers
- Sulfuric acid for electrolyte make-up
- Staffing build-up and training
- Construction insurance
- Vehicle replacements

The accuracy range of the estimate is +15% to -15% suitable to support a feasibility study.

Sustaining capital costs include all capital expenditures that occur after production begins. For the Gunnison Project, major sustaining capital expenditures are planned for Year 3 when Stage 2 of the Project is constructed and Year 6 with Stage 3 of Project construction. Stage 2 includes construction of a 50 mppa SX-EW plant at the Gunnison site. Major facilities include a SX Facility with two extraction and one strip settlers; an 80-cell EW Tankhouse with an Automatic Cathode Stripping Machine; a Tank Farm to receive, store, process, and transfer process solutions; PLS and Raffinate Ponds, Sulfuric Acid Storage Tanks, a new Electrical Substation; and ancillary buildings including a Security Building with truck scale, Administration Building, Change House, Plant Warehouse, Plant Maintenance Building, and Wellfield Maintenance Building.

Stage 3 construction includes an 80 EW-cell expansion of the Gunnison SX-EW plant for an additional 50 mppa copper production (125 mppa total). Stage 3 also includes the installation of a Sulfuric Acid Plant with railroad siding/railcar unloading. The Water Treatment Plant will be added in Year 7. Separate capital cost build-ups were constructed for the Stage 2 and Stage 3 SX-EW plants, and the sulfuric acid plant. The Water Treatment Plant

CAPEX was included in the Stage 3 expansion CAPEX. Indirect costs and 20% contingency were applied to the separate CAPEX build-ups but Owners Costs were only applied to the initial CAPEX.

Sustaining capital beyond Year 7 is primarily related to wellfield development, the installation of additional evaporation ponds and solids impoundments for water management, wellfield rinsing and abandonment, and the expansion of the Water Treatment Plant.

Some of the costs and quantity estimates used by M3 were provided by others.

- Veolia (2016) provided capital equipment and operating cost information for the Water Treatment Plant to be constructed in Year 7 to treat water returned from rinsing operations in areas of the wellfield that have been depleted of economically recoverable copper. These costs were not changed.
- Kinley Exploration LLC (Kinley), Overland Park, Kansas, prepared revised cost estimates in accordance with the FS production schedule for installation and development of extraction, injection, and hydraulic control wells, as well as well abandonment costs for existing wells and core holes and production wells that have been rinsed and are out of service.
- For the 2014 PFS, NORAM Engineering and Constructors Ltd. Vancouver, British Columbia, Canada, provided capital and operating cost for the acid plant to be constructed in Year 6. These costs were scaled up mathematically to increase the sulfuric acid plant from 1350 stpd to 1625 stpd capacity.
- MHF Services of Wexford, Pennsylvania estimated the capital costs to install a railroad siding off of the Union Pacific Southern Pacific railroad and rail transfer and unloading yard for deliveries of acid and/or sulfur.

1.19.2 Operating Cost

Operating costs for the Gunnison Project are separated into three basic categories: Wellfield, SX-EW, and General and Administrative (G&A). Operating costs for the Sulfuric Acid/Cogeneration Plant and Water Treatment Plant are also treated separately upon their addition to the Project.

1.19.2.1 ISR Wellfield Operating Cost

Wellfield operations involve injection of acidified raffinate from the SX-EW plant into injection wells, recovery of PLS from production wells, pumping the recovered PLS to a tank or pond for treatment in the SX-EW plant, maintenance of the wells and wellfield, reconfiguring well equipment, and revising piping and electrical equipment within the wellfield as required.

Wellfield drilling and development are capitalized and are not included as an annual expense. The operating costs for the wellfield include labor to manage solutions, power to run the pumps, acid, maintenance, and supplies and services, which are summarized in

Table 1-7 below.

Table 1-7: ISR Wellfield Operating Cost Breakdown

Item	Stage 1 (Year 3)		Stage 2 (Year 6)		Stage 3 (Year 9)	
	Annual cost ($000s)	Cost per lb. Cu	Annual cost ($000s)	Cost per lb. Cu	Annual cost ($000s)	Cost per lb. Cu
Wellfield Labor	818	0.032	1,180	0.016	1,542	0.012
Electrical power	706	0.028	1,997	0.027	3,403	0.027
Sulfuric Acid (Wellfield Make-up)	13,813	0.538	41,502	0.555	26,006	0.206
Maintenance	1,046	0.041	1,834	0.025	1,882	0.015
Supplies & Services	66	0.003	198	0.003	331	0.003
Total Wellfield Operating Costs	16,448	0.641	46,711	0.625	33,164	0.262

1.19.2.2 SX-EW Operating Cost

The operating cost for the SX-EW facility includes the Johnson Camp and Gunnison SX-EW plants. The operating costs vary by stage from approximately $0.34/lb Cu in Stage 1 to $0.26/lb in Stage 2, to $0.22/lb in Stage 3. The decrease in plant operating cost with increasing copper production is largely due to the relatively small additions of labor with increasing plant output. The SX-EW operating costs are summarized in Table 1-8 below.

Table 1-8: Summary SX-EW Operating Cost ($000)

Cathode Copper Produced	Stage 1 (Year 3)		Stage 2 (Year 6)		Stage 3 (Year 9)	
	Annual cost ($000s)	Cost per lb. Cu	Annual cost ($000s)	Cost per lb. Cu	Annual cost ($000s)	Cost per lb. Cu
Operating Labor	$1,749	$0.070	$3,325	$0.044	$3,871	$0.031
Reagents	$4,138	$0.166	$9,661	$0.129	$14,590	$0.116
Electric Power	$1,009	$0.040	$3,031	$0.040	$5,072	$0.040
Maintenance Parts & Services1	$1,265	$0.051	$2,816	$0.038	$3,503	$0.028
Operating Supplies & Services	$197	$0.008	$514	$0.007	$797	$0.006
Total Operating Cost	$8,359	$0.335	$19,346	$0.258	$27,833	$0.222

1Includes maintenance labor costs.

1.19.2.3 General and Administrative Operating Costs

General and Administrative (G&A) costs include labor and fringe benefits for administration and support personnel and other support expenses detailed in Section 25.5.3. G&A expenses are projected to increase slightly with Stages 2 and 3, but decrease in cost per pound of copper produced as shown in Table 1-9.

Table 1-9: Summary SX-EW Operating Cost ($000)

Cost Item	Stage 1 Annual cost ($000s)	Cost per lb. Cu	Stage 2 Annual cost ($000s)	Cost per lb. Cu	Stage 3 Annual cost ($000s)	Cost per lb. Cu
Production Basis (mppa)	25,648		74,773		126,433	
Labor & Benefits	$3,495	$0.136	$3,884	$0.052	$3,884	$0.031
Other G&A Expenses	$2,700	$0.106	$2,918	$0.039	$2,918	$0.023
Total G&A Cost	$6,195	$0.242	$6,802	$0.091	$6,802	$0.054

1.19.2.4 Water Treatment Plant Operating Costs

The Water Treatment Plant (WTP) operation is related to rinsing operations and is therefore not an operating expense for copper production. An estimate of annual OPEX has also been developed based on vendor data, previous estimates for similar treatment systems and plant operating experience (Veolia, 2016). Major OPEX categories include labor, utility power, chemical reagents, process consumables, waste disposal and compliance sampling, analysis and reporting. Annual wages for operators and electrical power cost are site specific, and were provided by M3. LOM operating costs for the WTP are projected to total $103 million, or approximately $ 0.048 per pound of copper produced.

1.19.2.5 Sulfuric Acid Plant

Operating costs for the sulfuric acid plant, power cogeneration plant, and associated facilities is composed of labor, reagents, fuel (propane), power (which is a credit), maintenance, and operating supplies. Annual operating expenses are projected to average approximately $27.38 million or $46.45 per ton of sulfuric acid produced at a rate of approximately 589,500 tons per year. At average peak copper production of 125.4 mppa, the average acid production cost is approximately $0.22 per pound of copper.

1.19.3 Reclamation and Closure Cost

The reclamation and closure costs for the Project include reclamation and closure activities at both JCM and Gunnison plant sites, reclamation of legacy heaps and stockpiles at JCM, well abandonment and closure of the ISR wellfield, and bonding costs. ISR rinsing and water treatment activities are not included in this category. Much of the well abandonment will be conducted concurrently with production. Table 1-9 summarizes the total reclamation and closure costs for the Project. Details of the activities included in reclamation and closure are provided in Section 21.6. Approximately 50% ($24.2 million) of these expenses are projected to be made prior to the end of production.

Table 1-9: Summary of Reclamation and Closure Costs

Area	Reclamation & Closure Costs ($000s)
JCM Buildings, Ponds, Waste Dump & Heap	5,580
Well Abandonment	17,569
Gunnison Plant, Ponds	18,917
Bond Fees	8,334
Total	50,400

1.20 Economic Analysis

The financial evaluation presents the determination of the Net Present Value (NPV), payback period (time in years to recapture the initial capital investment), and the Internal Rate of Return (IRR) for the Project. Annual cash flow projections were estimated over the life of the operation based on the estimates of capital expenditures and production cost and sales revenue. The sales revenue is based on the production of a copper cathode.

The economic analysis was conducted on two cases: 1) a base case that includes the construction of a sulfuric acid plant in Year 7 of operation, lowering the price of acid from $125/ton to $46/ton (Base Case and 2) an alternate case that uses purchased sulfuric acid at $125/ton for the life of the operation (Alternate Case). Both cases use a copper price of $2.75/lb.

Table 1-10 compares the financial indicators for both the Base Case and the Alternate Case. The payback period does not represent the payback solely for initial CAPEX. Rather, it includes the accumulation of initial capital to start the Project using the existing Johnson Camp SX-EW plant and sustaining capital from two successive stages of construction for the Gunnison SX-EW plant, sulfuric acid plant, the rail spur, and water treatment plant. The payback period on initial capital, were Stage 2 is pushed out by three more years is 1.9 years pre-tax and 2.7 years after taxes.

Table 1-10: Financial Indicators

	Base Case	Alternate Case
	Base Case	Alternate Case
Years of Commercial Production	24	24
Total Copper Produced (million lbs)	2,165	2,165
LOM Copper Price (avg $/lb)*	$2.75	$2.75
Initial Capital Costs (million $)	$46.9	$46.9
Sustaining Capital Costs (million $)	$741.8	$660.6
Payback of Capital (pre-tax/post-tax)	4.5/6.4	4.4/4.9
Internal Rate of Return (pre-tax/post-tax)	48.4% / 40.2%	48.5% / 40.6%
Life of Mine Direct Operating Cost ($/pound Cu Recovered)	$0.65	$0.97
Life of Mine Total Production Cost ($/pound Cu Recovered)	$0.87	$1.18
Pre-tax NPV at 7.5% discount rate (million $)	$1173.1	$980.4

*Price provided by Excelsior

Table 1-11 provides a sensitivity analysis for the Base Case project financial indicators with the financial indicators when other different variables are applied. The results indicate that Project economics are impacted the most by fluctuation in the copper price. Fluctuation in the initial capital cost has the least impact on Project economic indicators.

Table 1-11: Base Case After – Tax Sensitivities ($millions)

	Copper Price		
	NPV @ 7.5%	IRR%	Payback (yrs)
Base Case	$ 808.0	40.2%	6.4
20%	$ 1,115.7	51.7%	4.0
10%	$ 962.4	46.0%	4.6
-10%	$ 651.6	34.2%	6.9
-20%	$ 495.3	28.2%	7.4
	Operating Cost		
	NPV @ 7.5%	IRR%	Payback (yrs)
Base Case	$ 808.0	40.2%	6.4
20%	$ 735.6	36.7%	6.7
10%	$ 771.8	38.4%	6.6
-10%	$ 843.3	41.9%	5.3
-20%	$ 878.0	43.6%	4.9
	Initial Capital		
	NPV @ 7.5%	IRR%	Payback (yrs)
Base Case	$ 808.0	40.2%	6.4
20%	$ 802.7	38.5%	6.5
10%	$ 805.4	39.3%	6.5
-10%	$ 810.6	41.1%	6.4
-20%	$ 813.1	42.1%	6.4

Note: $ in millions

The Alternate Case economic after tax sensitivities are shown below.

Table 1-12: Alternate Case After – Tax Sensitives ($millions)

	Copper Price		
	NPV @ 7.5%	IRR %	Payback (yrs)
Base Case	$ 693.7	40.6%	4.9
20%	$ 1002.2	52.6%	4.0
10%	$ 848.0	46.7%	4.4
-10%	$ 536.3	34.1%	6.4
-20%	$ 378.4	27.3%	7.1
	Operating Cost		
	NPV @ 7.5%	IRR %	Payback (yrs)
Base Case	$ 693.7	40.6%	4.9
20%	$ 593.1	36.3%	6.3
10%	$ 643.7	38.5%	6.1
-10%	$ 742.4	42.6%	4.7
-20%	$ 791.0	44.6%	4.5
	Initial Capital		
	NPV @ 7.5%	IRR %	Payback (yrs)
Base Case	$ 693.7	40.6%	4.9
20%	$ 688.5	38.8%	5.0
10%	$ 691.1	39.6%	4.9
-10%	$ 696.3	41.6%	4.8
-20%	$ 698.8	42.7%	4.8

Note: $ in millions

1.21 ADJACENT PROPERTIES

The Gunnison Project lies within the porphyry copper metallogenic province of the southwestern United States. It is located in the Cochise Mining District, which is dominated by Cu-Zn skarns. With the acquisition of the Johnson Camp Mine, Excelsior now controls a majority of historical producing properties in the district. Tungsten and minor lead-silver-gold have been produced in adjacent properties in the district (Cooper and Silver, 1964). In particular, tungsten has been historically produced in the area west of the Gunnison Project in the northern half of the Texas Canyon quartz monzonite stock before and during World War I. Lead-silver was also historically produced from Paleozoic limestones in the Gunnison Hills east of the Gunnison Project in the early 1900s (Cooper and Silver, 1964). Mineralization on adjacent properties is not necessarily indicative of the mineralization on the Gunnison Project. The author has relied on reports by others (as referenced) for the information presented in this section and has been unable to verify the information.

1.22 INTERPRETATION AND CONCLUSIONS

A production schedule has been developed using input from independent consultants and existing Project data. The production schedule anticipates recovery of 48.4% of the mineral reserves resulting in production of 2,165 million pounds of cathode copper over a mine life of 25 years.

The base-case economic analysis indicates an after-tax NPV of $806.6 million at a 7.5% discount rate with a projected IRR at 41.4%. The Base Case includes a sulfuric acid plant constructed in Year 6 to supply the acid for ISR copper extraction. If the sulfuric acid plant is replaced by purchased sulfuric acid supplied by rail, the NPV at a 7.5% discount rate is $691.2 million with projected IRR of 40.5%. Payback is anticipated in 6.5 years of production for the acid plant case and in 4.9 years in the case using purchased sulfuric acid.

The economics are based on $2.75/lb long-term copper price, a staged production schedule of 25 mppa for Years 1-3, 75 mppa for Years 4-6 and a full production design copper production rate of 125 mppa for Years 7-16, decreasing in the final 8 years of the mine life. Direct operating costs are estimated at $0.66/lb of copper in the acid plant case and $0.97/lb of copper using purchased acid. Initial capital costs are estimated at $46.9 million. Sustaining capital costs of $741.8 million are projected in the sulfuric acid plant case and $660.6 million using purchased sulfuric acid.

1.23 PROJECT RISKS

Project-specific risks are identified in Section 25.2 along with the measures that Excelsior envisages to mitigate these risk. The risks are primarily associated with the ability of the ISR wellfield to deliver copper to the SX-EW plant(s) at the rate, grade, reagent cost, and well installation and operation costs as predicted in the financial model. These risks can be mitigated by operational flexibility, use of the acid plant to reduce the cost of reagents, and/or modification of the wellfield design. Permitting difficulties are a common issue for mine development projects in this era. The mitigation strategy is to develop support in the community and work closely with stakeholders, regulators, and community leaders to develop a realistic schedule for permit acquisition.

1.24 PROJECT OPPORTUNITIES

Several opportunities have be identified which could enhance the viability and economic attractiveness of the Project. Opportunities, detailed in Section 25.3, include higher copper recoveries than predicted, increases in the price of copper, identification of additional resources, wellfield optimization, and reductions to capital costs, particularly in the initial stage of operation.

1.25 RECOMMENDATIONS

Based on the results of this Feasibility Study, it is recommended that Excelsior proceed with development of the Project through basic and detailed engineering, once permitting has been obtained and financing is secured. The engineering for the project is relatively complete. The drilling, mineral resource estimation, wellfield mine planning, wellfield drilling and infrastructure development and the staged SX-EW plant have all been adequately defined. Until the initial wellfield is drilled and solution is pumped for processing, there is not much left to investigate. Recommendations for the Project are detailed in Section 26. Additional work is recommended to advance the efforts to obtain the necessary environmental permits, refine the design and cost estimates for water treatment, and advance the design of the sulfuric acid/cogeneration plant to enable more conclusive evaluation of its economic benefit to later stages of the Project. Table 1-13 provides a proposed budget for the additional work recommended.

Table 1-13: Feasibility Budget for the Gunnison Project

Detail	Cost US$
Permitting Work	
Gunnison APP	$150,000
Gunnison UIC	$150,000
JCM APP Amendment	$100,000
Other Permits	$50,000
Subtotal Permitting Work	$450,000
Sulfuric Acid Plant	
Sulfuric Acid Plant proper (NORAM or other)	$350,000
Sulfuric Acid Storage	$50,000
Cogeneration Facilities	$50,000
Molten Sulfur Storage	$50,000
Railcar sulfur/sulfuric acid unloading	$50,000
Subtotal Sulfuric Acid Plant	$500,000
Total	950,000

2 INTRODUCTION

Excelsior Mining Corporation commissioned M3 Engineering & Technology Corporation (M3) to prepare a Feasibility Study (FS) covering the process and infrastructure design, capital cost, operating cost, and an independent Technical Report prepared in accordance with the Canadian National Instrument 43-101 ("NI 43-101") standards for reporting mineral properties, for the Gunnison Copper Project (the "Project") – North Star Deposit in Cochise County, Arizona, USA. The FS is based on a new mine plan but follows Excelsior's "staged" development of the project by first developing the wellfield to produce 25 million pounds of cathode copper per year for the first three years (Stage 1), and then ramping up to 75 million pounds per year for Years 4 through 6 (Stage 2) and finally to 125 million pounds per year for Year 7 through 23 (Stage 3). The staging of copper production impacts the project cash flow as well as the capital requirement to develop the Gunnison solvent extraction-electrowinning (SX/EW) hydrometallurgical plant. Excelsior purchased the Johnson Camp Mine which includes a complete SX/EW plant that is capable of producing 25 million pounds of copper per year as it is currently configured. The impact to the project is to eliminate the cost to build an initial SX/EW plant for the first stage of production. The Johnson Camp Mine will also provide process solution ponds, utilities, and infrastructure for Stage 1 production.

This FS focuses primarily on the engineering design, capital improvements, and costs/financial model to advance the project towards Stage 1 production. It details the development of the Gunnison wellfield, the pumping system to send pregnant leach solution (PLS) to the Johnson Camp mine site, to make the necessary improvements to the JCM plant, to develop the needed infrastructure for the Gunnison wellfield including power and piping, and the installation of a solution evaporation pond at the Gunnison site. This report also includes the process methodology, infrastructure requirements, capital and operating costs, and financial analysis with a feasibility level of engineering for the Project for Stages 2 and 3. It also includes a revisited process design, layout, and cost estimates for the Water Treatment Plant which is planned to be first operated in Year 8.

No additional engineering has been done for the sulfur burner sulfuric acid plant or the railroad spur and siding which will support the acid plant. These facilities remain at a PFS level of engineering. However, they are not introduced until Stage 3 of the project so their impact to the discounted cash flow is not great. Given that these facilities are not constructed until Year 6 at the earliest, their lower cost accuracy will not impact the overall feasibility study margin of error of +/- 15%.

The Gunnison Copper Project contains copper oxide and sulfide mineralization with associated molybdenum, in potentially economic concentrations. There is one material deposit within the Project area, the North Star (formerly known as I-10) deposit.

On October 15, 2010, Excelsior Mining Corporation (the "Company" or "Excelsior"), completed a reverse takeover ("RTO") by acquiring all of the issued and outstanding common shares of AzTech Minerals, Inc. ("AzTech") through a plan of merger with Excelsior Mining Arizona, Inc. ("Excelsior Arizona"). Excelsior Arizona was the surviving corporation in the plan of merger and acquired all of the assets of AzTech, including the Gunnison Copper Project. The Company is listed on the TSX-V under the symbol "MIN".

Legally, the Company is the parent of AzTech, (Excelsior Arizona) however, as a result of the share exchange described above, control of the combined companies passed to the former shareholders of AzTech. This type of share exchange is referred to as a "reverse takeover." The executive management of AzTech continued on as the executive management of Excelsior.

Excelsior Mining Corp. retained a number of consultants, including M3, to provide a review of prior work on the Project and to prepare technical and cost information to support a FS and this Technical Report compliant with the Canadian NI 43-101 reporting standards. Mr. Richard Zimmerman, P.G. of M3 is the principal author and Qualified Person responsible for the preparation of this report. Mr. Zimmerman visited the Project site on numerous occasions between 2013 and 2016 in support of the 2014 PFS, 2016 PFS Update, and 2016 FS. Other contributing authors and Qualified Persons responsible for preparing sections of this report include Dr. Ron Roman, metallurgical consultant; Thomas Drielick P.E. of M3 for process engineering, capital and operating cost estimating, and economic analysis, Doug Bartlett and Alison Jones of Clear Creek Associates (CCA) for hydrology; mining methods, and environmental/social/permitting topics, Colin Kinley of Kinley Exploration for well design and well field development; Alfred Guenkel of NORAM Engineering and Constructors Ltd., and Neil Prenn and Dr. Michael Gustin of Mine Development Associates (MDA).

Neil Prenn of MDA is the Qualified Person responsible for geology, mineralization, sample preparation and security, data verification, and mineral reserves. Dr. Michael Gustin of MDA is responsible for the mineral resource estimates Information on sample preparation and security, and data verification was taken from or updated since the *"Gunnison Copper Project, Cochise County, Arizona, USA, Mineral Resource of the North Star Deposit"* Technical Report dated August 2011 and revised October 2011 prepared by Herb Welhener of IMC for Excelsior. Dr. Michael Gustin of MDA, visited the Project site and the core storage facility in 2015. The mineral resource in support of this FS has been updated from the mineral resource published in the 2016 PFS Update. The mineral reserve from the 2016 PFS Update has also been updated.

Douglas Bartlett P.G., of Clear Creek Associates (CCA) is responsible for the preparation of Section 16 - Mining Methods. Mr. Bartlett visited the site. Alison Jones of CCA visited the Project site in 2015.

Thomas L. Drielick of M3 is responsible for the preparation of Section 17 – Recovery Methods, Section 21 Capital Costs and Section 22 Economic Analysis. Mr. Drielick visited the Johnson Camp Mine and site on August 29, 2012 but Mr. Drielick did not visit the Gunnison Project site. Mr. Drielick received the details of the site visit from his colleagues at M3 and determined that a site visit was not necessary.

Dr. Ron Roman of Leach Inc. was responsible for review of the historical metallurgical testing programs and preparation of Section 13 - Mineral Processing and Metallurgical Testing. Dr. Roman visited the Project site on September 13, 2013. Dr. Roman has worked extensively on the ores at the Johnson Camp Mine for its previous Owner's, Nord Resources Corporation.

Golder Associates developed the water treatment process, equipment list, general arrangement of facilities, capital and operating cost estimate for the water treatment plant. This study has not been updated.

M3 was responsible for developing process design criteria, process flow sheets, an equipment list, general arrangements of the site plan and process facilities, process ponds, infrastructure, capital cost, operating cost, feasibility-level financial assessment, and integrating the work by other consultants into a final Technical Report prepared in accordance with Canadian NI 43-101 standards.

Noram Engineering and Constructors prepared feasibility- level engineering design and a capital cost estimate for the sulfuric acid plant. This estimate was augmented to include sulfur and unloading and storage, sulfuric acid storage and cogeneration. For the FS, M3 factored up the cost of sulfuric acid plant to account for a 20% increase in sulfuric acid. The operating cost for the sulfuric acid plant has also been modified accordingly.

LIST OF QUALIFIED PERSONS

Table 2-1: Dates of Site Visits and Areas of Responsibility

Author	Company	Designation	Site Visit Date	Section Responsibility
Richard Zimmerman	M3 Engineering & Technology Corp. – Tucson, AZ	P.G.,	numerous	Sections 1, 2, 3, 4, 5, 18, 19, 23, 24, 25, 26, 27
Neil Prenn	Mine Development Associates – Reno, NV	MMSA-QPM	April 13, 2011	Section 15
Dr. Michael Gustin	Mine Development Associates – Reno, NV	P.G., Ph.D.	April 13, 2011	Sections 6, 7, 8, 9, 10, 11, 12, & 14
Thomas L. Drielick	M3 Engineering & Technology Corp. – Tucson, AZ	P.E.	August 29, 2012, Johnson Camp Site visit only	Section 17, 21, & 22
Dr. Ronald J. Roman	Leach Inc.	P.E., D.Sc.	September 13, 2013	Section 13
Douglas Bartlett	Clear Creek Associates	P.G.	July 1, 2015	Sections 16, 20

DEFINITIONS OF TERMS USED IN THIS REPORT

- **In Situ Recovery:** A closed loop mining system, where ground water from the aquifer is utilized as the transport medium of the lixiviant and minerals or metals are dissolved in situ within the host formation using an appropriate lixiviant.

- **Lixiviant:** Aqueous media, in this case, sulfuric acid, to extract copper from the oxide copper mineralization.

- **Pregnant Leach Solution (PLS):** Lixiviant after it is loaded with dissolved copper. PLS is stripped of copper in the solvent extraction process.

- **Raffinate:** Lixiviant after has been stripped of copper in the solvent extraction process. Raffinate is re-acidified and pumped back to the wellfield to dissolve more copper.

- **Diluent:** Organic medium in which solvent extract takes place in the SX settlers.

- **Extractant:** Organic chemical that is used to extract copper from PLS into the diluent and then transfer the copper from the diluent to the electrolyte.

- **Electrolyte:** The aqueous solution carrying concentrated copper in solution which is pumped into the EW Tankhouse to electrowin copper onto steel blank sheets. The depleted electrolyte is recirculated to the SX circuit to load more copper.

- **Sulfuric acid:** A dense, colorless liquid chemical (H_2SO_4) used extensively to leach oxide copper ores.

- **Sulfurous acid:** The chemical species, H_2SO_3, which is formed by dissolving sulfur dioxide, SO_2, in water was used briefly as a lixiviant for copper in the 1920's.

UNITS AND ABBREVIATIONS

This report is in English units. Tons are short tons and ktons mean 1000 short tons. Copper grades are in percentage by weight. All tonnages reported in this document are in dry tons. Lengths are in feet (except where noted) and currency is in US dollars (except if noted otherwise).

Table 2-2: Units, Terms and Abbreviations

Abbreviation	Unit or Term
%	percent
°	degree (degrees)
°C	degrees Centigrade
µ	micron or microns, micrometer or micrometers
A	Ampere
a/m^2	amperes per square meter
AA	atomic absorption
ADEQ	Arizona Department of Environmental Quality
ADWR	Arizona Department of Water Resources
APP	Aquifer Protection Permit
AQL	Aquifer Quality Limit
ASCu	Acid-soluble copper
AzTech	AzTech Minerals, Inc.
BADCT	Best-Available Demonstrated Control Technology
BLM	US Department of the Interior, Bureau of Land Management
cfm	cubic feet per minute
cm	Centimeter
cm^2	square centimeter
cm^3	cubic centimeter
CoG	cut-off grade
Crec	core recovery
Cu	Copper
dia.	Diameter
EA	Environmental Assessment
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
FA	fire assay
famsl	feet above mean sea level
FS	Feasibility Study
ft	foot (feet)
ft^2	square foot (feet)
ft^3	cubic foot (feet)
ft^3/st	cubic foot (feet) per short ton
g	Gram
g/L	gram per liter
g/st	grams per short ton
GA	General Arrangement

Abbreviation	Unit or Term
gal	Gallon
g-mol	gram-mole
gpl	gram per liter
gpm	gallons per minute
Ha	hectares
HDPE	High Density Polyethylene
hp	horsepower
IMC	Independent Mining Consultants
in	Inch
IRR	Internal Rate of Return
ISR	In Situ Recovery
kg	kilograms
km	kilometer
km^2	square kilometer
kst	thousand short tons
kst/d	thousand short tons per day
kst/y	thousand short tons per year
kV	kilovolt
kW	kilowatt
kWh	kilowatt-hour
kWh/st	kilowatt-hour per short ton
L	liter
L/sec	liters per second
lb	pound
LHD	Load-Haul-Dump truck
LoM	Life-of-Mine
M	meter
m.y.	million years
m^2	square meter
m^3	cubic meter
M3	M3 Engineering & Technology Corp.
Ma	million years ago
mg/L	milligrams/liter
mi	mile
mi^2	square mile
MIW	Mine-influenced water
MM lb	million pounds
mm	millimeter
mm^2	square millimeter
mm^3	cubic millimeter
Mst	million short tons
Mst/y	million short tons per year
MVA	megavolt ampere
MW	million watts

Abbreviation	Unit or Term
NI 43-101	Canadian National Instrument 43-101
NPV	Net Present Value
PAST	Professional Archeological Services of Tucson
PFS	Pre-Feasibility Study
PLS	Pregnant Leach Solution
PMF	probable maximum flood
POO	Plan of Operations
ppb	parts per billion
ppm	parts per million
psi	pounds per square inch
QA/QC	Quality Assurance/Quality Control
RC	reverse circulation drilling
RQD	Rock Quality Description
RT	Reverse takeover
SEC	U.S. Securities & Exchange Commission
sec	second
SG	specific gravity
st	short ton (2,000 pounds)
st/d	short tons per day
st/h	short tons per hour
st/y	short tons per year
SX-EW	Solvent Extraction (SX) / Electrowinning (EW)
t	tonne (metric ton) (2,204.6 pounds)
TCu	Total copper
TSF	tailings storage facility
TSP	total suspended particulates
UIC	Underground Injection Control
USEPA	United States Environmental Protection Agency
V	volts
VFD	variable frequency drive
W	watt
WTP	Water treatment plant
XRD	x-ray diffraction
yd^2	square yard
yd^3	cubic yard
yr	year

3 RELIANCE ON OTHER EXPERTS

The authors, as Qualified Persons, have examined the historical data for the Gunnison Copper Project provided by Excelsior Mining Corp., and have relied upon the basic data to support the statements and opinions presented in this Technical Report. In the opinion of the authors, the Gunnison historical data, in conjunction with borehole assays conducted by Excelsior, are present in sufficient detail to prepare this report and are generally correlative, credible, and verifiable. The Project data are a reasonable representation of the Gunnison Copper Project. Any statements in this report related to deficiency of information are directed at information that, in opinion of the authors, is recommended by the authors to be acquired.

Mine Development Associates (MDA) is relying on information provided by Excelsior regarding property description and property rights (Section 4). MDA did not verify any of the claim or exploration permit boundaries in the field but reviewed the claim, lease, deed and fee simple land location documentation as provided by Excelsior. Jerry L. Haggard, P.C. of Phoenix, AZ, was the attorney who provided Excelsior with legal determinations of the lands and claims on the Gunnison side of the property. Excelsior relied on reports by John C. Lacy of the law firm, DeConcini, McDonald, Yetwin, & Lacy, for legal determination of lands on the Johnson Camp side of the property. Excelsior also obtained an ALTA Title Insurance Policy from First American Title Insurance Company for the patented mining claims and fee lands of the Johnson Camp property.

Clear Creek Associates (CCA) reviewed the environmental status of the Gunnison properties and relied on information provided by Excelsior. A report by Haley & Aldrich (2014a) documents the environmental condition of the Gunnison property in the vicinity of the wellfield. A Phase I Site Assessment by Golder (2015) of the Johnson Camp Mine site documented the environmental condition of the Johnson Camp Mine.

For the FS, M3 provided designs for the Gunnison process ponds, evaporation and solids ponds, and surface water diversions. As built designs for the JCM process ponds were supplied by The Glasgow Engineering Group (2016). Updated designs for the JCM process ponds that require earthen partitions were provided by Axelrod, Inc.

Veolia Water prepared an updated Water Treatment Plant (WTP) design criteria, flowsheet, equipment list, capital cost estimate and operating cost estimate for the 2016 FS. This information is included in Chapter 17- Recovery Methods and Chapter 21 - Capital and Operating Costs.

NORAM Engineering and Constructors Ltd. provided information for the design and capital costing for a sulfuric acid plant in the 2014 PFS in Chapters 17- Recovery Methods and Chapter 21 – Capital and Operating Costs. This information has not been updated in the 2016 FS except to scale the plant to 1,625 mtpd of sulfuric acid from 1,350 mtpd.

4 PROPERTY DESCRIPTION AND LOCATION

The Project is held by Excelsior through its wholly-owned subsidiary Excelsior Mining Arizona, Inc. (Excelsior Arizona). JCM is held by Excelsior through its wholly-owned subsidiary Excelsior Mining JCM, Inc. (Excelsior JCM). Acquisition of all mineral interests comprising the Gunnison Project from the James L. Sullivan Trust was completed in January of 2015. These assets represent, among other things, the mineral rights to the North Star and South Star Copper deposits of (the Gunnison Project). Additionally, in December 2015 Excelsior purchased all assets of Nord Resources Corporation, as they relate to the Johnson Camp property, through a court-appointed receiver.

The Project and JCM are located in Cochise County, Arizona, approximately 65 miles east of Tucson. Figure 4-1 is a general location map and property location near the I-10 freeway. The Project and JCM include portions of Section 22, 23, 24, 25, 26, 27, 34, 35 and 36 T15S R22E, Sections 1, 11, 12, 13, 23, 24, 25, and 26 T16S R22E, Sections 5, 6, 7, 8, 17 and 18 T16S R23E, and Sections 29, 31 and 32 T15S R23E and is centered at 32º 04’ 55” N latitude and 110º 02’ 40” W longitude. Total area of the Project and JCM is approximately 9,560 acres (3,869 Ha), approximately 3,092 of which was added with the Johnson Camp property acquisition.

Figure 4-2 shows the claim status for the Gunnison Project and JCM as of January 2015. Table 4-1 contains a summary of the land packages that constitute the Gunnison Project. Table 4-2 contains a summary of the land packages that constitute the Johnson Camp property. Following the tables are brief descriptions of the claims, permits, deeds and land holdings. Appendix B contains a detailed list of all the mining claims and land packages.

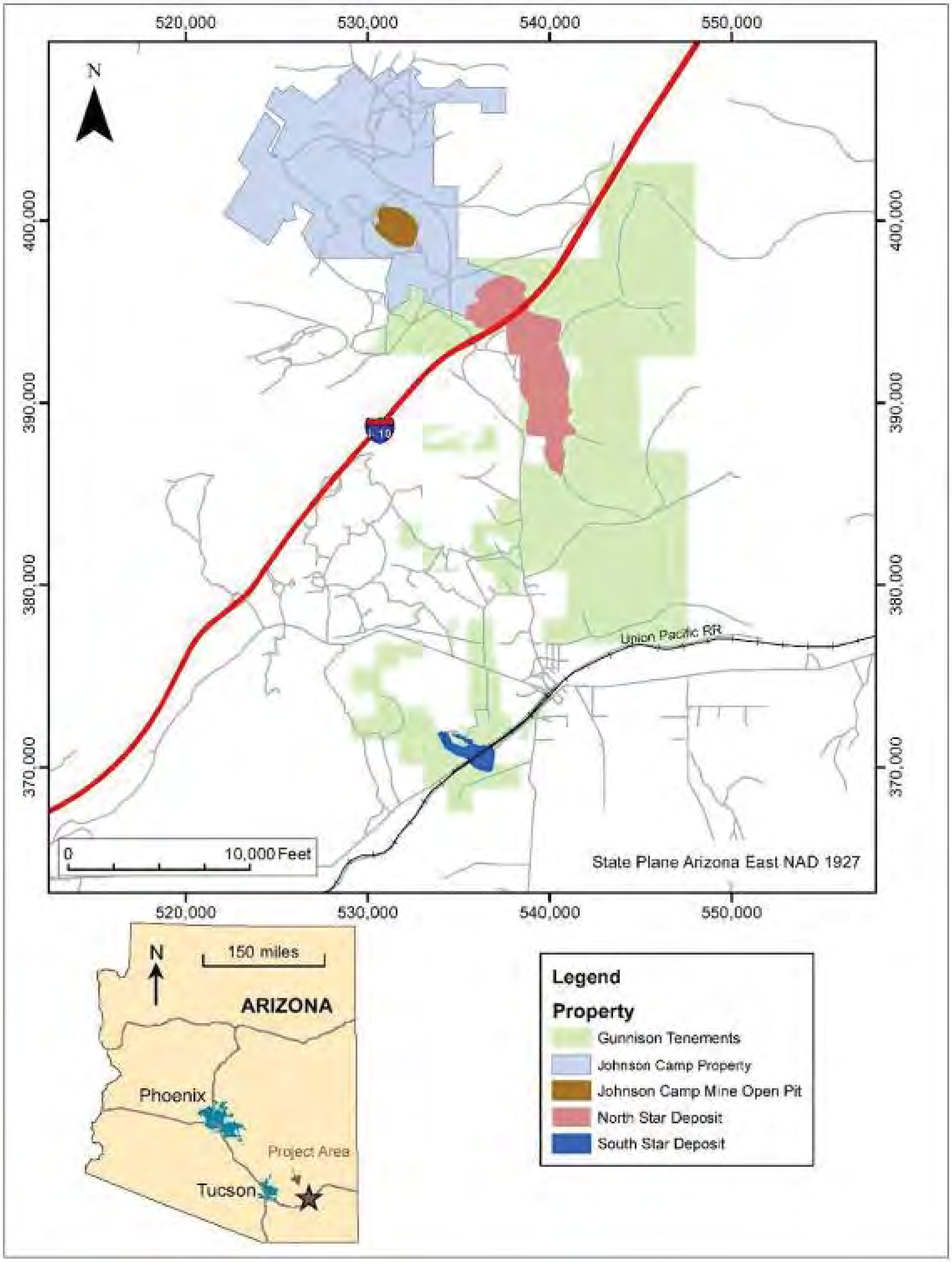


Figure 4-1: Location of the Gunnison Project, North Star and South Star Deposits and Johnson Camp Property – January 2017

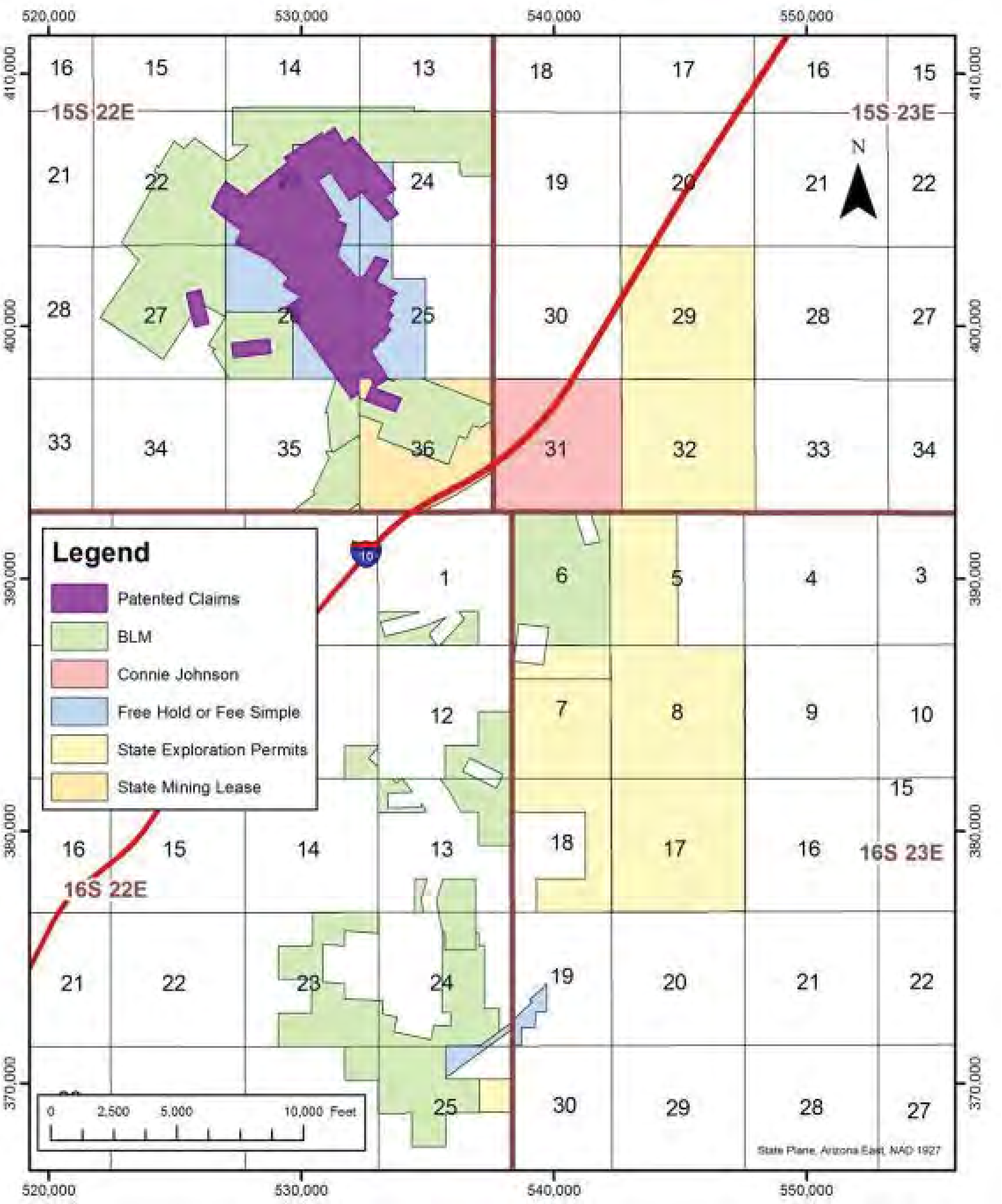


Figure 4-2: Project Mineral Rights by Claim Type – January 2017

Table 4-1: Summary of Land Packages that Constitute the Gunnison Project

Claim Type	# of Claims	Approximate Area	Approximate Holding Costs	Surface Rights
Federal Unpatented Mining Claims	128	1,753 acres 709 hectares	Annual $19,840.00	Subject to US mining law
Arizona State Mineral Lease	1	319 acres 129 hectares	Annual $18,345.95	Subject to AZ state laws
Arizona State Exploration Permits	8	3,654 acres 1,479 hectares	Annual up to $80,736.73	Subject to AZ state laws
North Star Freehold Mineral Rights via "Connie Johnson" Deed	1	616 acres 249 acres	Nil	Subject to deed of trust (see below)
South Star Freehold land and mineral rights.	4	62 acres 25 hectares	Annual $32.00	Controlled by Excelsior
Total	143	6,404 acres 2,592 hectares	Annual $118,954.68	

Table 4-2: Summary of Land Packages that Constitute the Johnson Camp Property

Claim Type	# of Claims	Approximate Area	Approximate Holding Costs	Surface Rights
Federal Patented Lode Mining Claims	59	871 acres 352 hectares	Annual $1,589.94	Controlled by Excelsior
Federal Unpatented Mining Claims	117	1,667 acres 675 hectares	Annual $18,135.00	Subject to US mining law
Fee Simple Lands	4	617 acres 250 hectares	Annual $658.47	Controlled by Excelsior
Total	143	3,155 acres 1,277 hectares	Annual $20,383.41*	

4.1 PATENTED MINING CLAIMS

There are 59 patented mining claims held in the name of Excelsior JCM totaling 871 acres (352 ha). A completed list of the claims is provided in Appendix B. The claims include all surface and mineral rights. The claims are located on the ground and have no expiration dates.

4.2 UNPATENTED MINING CLAIMS

There are 128 unpatented mining claims held in the name of Excelsior Arizona totaling 1,753 acres (710 ha) and 117 unpatented mining claims held in the name of Excelsior JCM totaling 1,667 acres (675 ha). Collectively, Excelsior controls 245 unpatented mining claims totaling 3,420 acres (1384 ha). A completed list of the claims is provided in Appendix B. The claims are administered by the US Bureau of Land Management and are for minerals only, that is, there is no surface ownership. Surface rights include the right to use the surface for exploration, mining, mineral processing and related activities subject to the General Mining Law of 1872 as amended and the Federal Land Policy and Management Act of 1976. Maintenance for the claims is limited to an annual fee of $155 per claim for an annual total of $37,975 and all payments are current. The claims have no expiration dates and under current mining law can be held indefinitely if properly maintained. The claims are located on the ground and the location descriptions are filed with the US Bureau of Land Management.

4.3 STATE MINERAL LEASE AND PROSPECTING PERMITS

Excelsior Arizona holds the Arizona State Mineral Lease and Prospecting Permits. The tenements are administered by the Arizona State Land Department and are for minerals only. Rents, fees and expenditure commitments are due each year and all payments and expenditure commitments are current. The 2016 expenditure commitment will be up to $73,082.60 with fees of up to $19,618.88. A detailed list of these fees and the due dates is supplied in Appendix B. A state royalty is payable on state leases for copper that is produced and sold. The amount is set by the Arizona State Land Department using a sliding scale royalty. The sliding scale royalty uses an upper and lower limit based on copper price and has a highest possible royalty rate of 8% and a lowest possible royalty rate of 2%. Excelsior is required to pay a minimum annual royalty regardless of production. The minimum annual royalty is $6,381.20 and is due each year on or before the anniversary of the commencement date of the lease and shall be a credit for Excelsior, fully recoupable against production royalties. Mineral lease and prospecting permit boundaries are described by the Arizona State Land Department. Surface rights include the right to use the surface for exploration, mining, mineral processing and related activities subject to a state approved Mineral Development Report or Exploration Plan as the case may be. The mineral lease was renewed by the Arizona State Land Department June 16, 2014 and expires on June 15, 2034. The individual expiration dates of the Prospecting Permits are shown in Appendix A and range from January 8, 2016 to June 23, 2020. There are provisions in the Arizona State mining law to retain the area held by the permits, subject to meeting certain state requirements, by converting the permits to mineral leases or by applying for new exploration permits.

4.4 "CONNIE JOHNSON" DEED

Excelsior owns the mineral rights in Section 31, T15S., R23E, that were subject to the provisions of a Deed of Trust dated January 22, 1998 between Excelsior Arizona and the seller of the mineral rights. The Deed of Trust was released and the mineral rights transferred to Excelsior Arizona through a Beneficiary Deed of Full Release and Full Reconveyance that was recorded on February 6, 2015.The area (approximately 616 acres or 249 ha) covers about 1/3 of the North Star deposit, is for the minerals only and is defined by the boundaries of Section 31, T15S.and R23E. Surface and mineral rights are defined by the Deed of Trust and include "All mines and minerals in and under Section 31, Township 15 South, Range 23 East, Gila and Salt River Base and Meridian, containing 615.62 acres, more or less, together with the power to take all usual, necessary or convenient means for working, getting, laying up, dressing, making merchantable, and taking away the said mines and minerals, and also for the above purposes, or for any other purposes whatsoever, to make and repair tunnels and sewers, and to lay and repair pipes for conveying water to and from any manufactory or other building…".

4.5 FEE SIMPLE LAND

Mineral and in some cases mineral and surface rights to a small portion of the South Star deposit are held directly by Excelsior Arizona. Mineral rights only pertain to Parcel F (approximately 15.3 acres), Section 25 T16S., R22E and Parcel A (approximately 39 acres), Section 19, T16S., R23E., Union Pacific Railroad that covers an easement along the Union Pacific Railroad. Surface and Mineral rights are held via Parcel D (approximately 14.24 acres), Section 19 T16S., R22E., and Parcel E (approximately 4.28 acres), Section 19 T16S., R23E. Holding costs for the fee simple land amount to approximately $32 per year in property taxes. Property boundaries are defined by the property descriptions on public record.

The Johnson Camp property acquired by Excelsior JCM includes additional Fee Simple Lands to those listed above at the Gunnison Project. There are four parcels of Fee Simple Lands all situated in Township 15S, Range 22E. Parcel 1 is situated on Section 26 and covers approximately 139 acres. Parcel 2 is situated on Section 26 and covers approximately 1 acre. Parcel 3 is situated on Sections 24 and 25 and covers approximately 53.44 acres. Parcel 4 is situated on Sections 23, 24, 25, and 26 and covers approximately 116.27 acres.

4.6 ADDITIONAL ROYALTIES

Gunnison Project

Callinan Royalties Corporation (now a wholly-owned subsidiary of Altius Minerals Corporation) holds a 1.0% gross revenue royalty over the Gunnison Project. The gross revenue royalty is defined as royalty percentage times receipts which is the sum of physical product receipts and deemed receipts.

Greenstone Excelsior Holdings L.P. holds a 3.0% gross revenue royalty over the Gunnison Project. The gross revenue royalty is defined as royalty percentage times receipts which is the sum of physical product receipts and deemed receipts.

Johnson Camp Property

The Johnson Camp property is subject to the terms of a “Royalty Deed and Assignment of Royalty,” recorded with the Cochise County Recorder’s Office on June 19, 2009, at No. 2009-14847 and the “Grant of Production Payment” recorded with the Cochise County Recorder’s Office on June 10, 1999 at No. 1999-18419 as modified by that certain “Assignment of Production Payment” between Arimetco, Inc. and Styx Partners, L.P. (collectively, the “Production Payment Agreements”). The Production Payment Agreements provide for a non-participating payment of $0.02 per pound out of production during the calendar month in which copper produced from the Johnson Camp Property is sold. The production payment is only payable when copper prices are in excess of $1.00 per pound and is capped at an aggregate of $1,000,000, of which $409,740 has been paid.

Royal Crescent Valley, Inc. holds a 2.5% net smelter returns royalty interest in the minerals produced and sold from the Johnson Camp Property.

Greenstone Excelsior Holdings L.P. holds a 3.0% gross revenue royalty over the Johnson Camp property. The gross revenue royalty is defined as royalty percentage times receipts which is the sum of physical product receipts and deemed receipts.

4.7 ADDITIONAL PROPERTY TAXES

The Johnson Camp property is subject to an annual property tax from Cochise County based on the full cash value of the deposit. The total property taxes for 2016 were $314,203.04.

4.8 ENVIRONMENT AND PERMITTING

Gunnison Project

Gunnison Project operations will require a number of permits that are identified and discussed in Section 20.7. Currently, there are no known environmental liabilities for the Gunnison Project.

Johnson Camp Mine

The Johnson Camp Mine (JCM) operates under an Aquifer Protection Permit (APP), Air Quality Permit (AQP), a Resource Conservation and Recovery Act (RCRA) site specific ID number. All of these permits are issued and administered by the Arizona Department of Environmental Quality (ADEQ). The on-site septic system is grandfathered under the APP regulations and therefore, does not require a permit. These permits will remain in force during the care and maintenance and be amended to accommodate processing of the Gunnison Project ore prior to startup of the wellfield. JCM will prepare a site wide Reclamation Plan and submitting it to the Arizona State Mine Inspector.

Existing closure liabilities at the JCM are covered under the APP. These include closure of the existing ponds, and the leach pad. There is an existing bond in place to cover all closure obligations. The amended APP is expected to include a compliance schedule item for updating closure costs and subsequent bonding of the leach pad closure in ten years from issuance of the amended APP.

5 ACCESSIBILITY, CLIMATE, LOCAL RESOURCES, INFRASTRUCTURE AND PHYSIOGRAPHY

The Gunnison Copper Project (the Project) and the Johnson Camp Mine (JCM) are located in a sparsely populated, flat to slightly undulating ranching and mining area about 65 road miles east of Tucson, Arizona. The Tucson metropolitan area is a major population center (approximately 1,000,000 persons) with a major airport and transportation hub including well developed infrastructure (highways and rail) and services that support the surrounding copper mining industry. The towns of Benson and Wilcox are nearby and combined with Tucson can supply sufficient skilled labor for the Project.

Access to the Gunnison Project and JCM is via the Interstate10 (I-10) freeway from Tucson and Benson in the west or Wilcox in the east. The North Star deposit can be accessed via a short improved dirt road heading approximately 1 mile east from the south side of the “Thing” roadhouse on the Johnson Road exit from I-10. JCM can be accessed from the same Johnson Road exit but along 1.5 miles of improved dirt roads.

The Project area encompasses approximately 10 square miles within Cochise County, Arizona and includes unpatented mining claims, private land, Arizona State Prospecting Permits, a single Arizona State Mineral Lease and direct ownership of mineral rights. Unpatented mining claims give the Owner exclusive right to possess the ground (surface rights) covered by the claim, as well as the right to develop and exploit valuable minerals contained within the claim, so long as the claim is properly located and validly maintained.

For the Fee Simple lands (private), both the land and mineral rights are owned by Excelsior. The Connie Johnson Deed grants the mineral right to Excelsior as well as access to mining. The Arizona State Prospecting Permits gives lessee the right to explore and convert mineral discoveries to Arizona State Mineral Leases so long as the claim is validly maintained. Surface rights for the various land packages appear sufficient for Excelsior to conduct its mining operations, subject to applicable laws and permits. The proposed mining technique, In Situ Recovery, is comprised of a wellfield developed over the deposit, requiring minimal surface disturbance. The SX-EW plants and ponds have a relatively small surface footprint compared with conventional mines requiring waste dumps, open pits, and tailings impoundments.

The Project has existing, well-developed infrastructure sufficient for copper exploitation. The Excelsior-owned Johnson Camp Mine is located 1.5 miles north of the Johnson Road exit. JCM has an existing complete SX-EW plant, process ponds, 69 kV powerline, fresh water supply wells, a complete road network, and an assortment of ancillary buildings that can be used administration, maintenance, laboratory, warehousing, and safety. These buildings can be minimally modified and improved to support the Gunnison wellfield copper exploitation.

The Gunnison SX-EW plants (Stages 2 and 3) and ancillary facilities have been located on hill tops that will be accessed by existing roads on State lands covered by State permits northeast and south of the North Star deposit.

The main Union Pacific Southern Pacific railway runs 3 to5 miles south of the North Star deposit. Engineering plans, cost estimates, and preliminary discussions have been made to construct a siding and rail spur to the Gunnison Project to supply tanker cars of sulfuric acid and/or molten sulfur for the production of sulfuric acid onsite after the initial years of copper production. A railroad spur could also be used to ship cathode copper, as well as other non-metallic products that could be produced on the Johnson Camp site such as crushed rock for railroad ballast.

The existing 69 kV electrical power line skirts the eastern border of the Gunnison Project and lands at the main Johnson Camp Mine substation. A tap will be taken off the existing power line to provide 69 kV power to the Gunnison wellfield substation where it will be stepped down to 24.9 kV for distribution to the wellfield header houses. Once the sulfuric acid plant for the Gunnison plant is built in Stage 3 of the Project, approximately 17 MW of cogenerated power will be available from waste heat from the sulfur burning process. This power will be placed back into the local power grid and credited to the project.

If the sulfuric acid plant, for whatever reason, is not built, it may be necessary to build a powerline and substation to tap a higher voltage transmission line (115 kV or 230 kV) to augment power available from AEPCO's Apache power plant southeast of Willcox. AEPCO's distribution subsidiary, Sulphur Springs Valley Electrical Cooperative (SSVEC) has mentioned that the capacity of the Apache power plant may not be enough to supply power to the project by itself in Stage 3. SSVEC has given a scoping level estimate of $6.4 million to tie into another transmission power line for the Project. Fresh water supply will be provided from existing wells and mine adits located on or near the Johnson Camp property. There are sufficient water resources on the Johnson Camp side of the property to satisfy fresh water make-up for the Wellfield, tankhouse operations, and Water Treatment Plant reagent mixing as well as potable water supply for human consumption. Because the Gunnison deposit is saturated, and nearly all the water pumped from the Wellfield is recycled back to the Wellfield, net water consumption is minimized.

On the Gunnison side of the property, the Dragoon Water Company, which is owned by the former owner of the Gunnison mineral rights, can supply additional water.

The elevation on the property ranges from 4,600 to 4,900 feet above mean sea level in terrain of the eastern Basin and Range physiographic province of southeastern Arizona. The climate varies with elevation, but in general the summers are hot and dry and winters are mild.

The area experiences two rain seasons in general, one during the winter months of December to March and a second summer season from July through mid-September. The summer rains are typical afternoon thunderstorms that can be locally heavy. Average annual rainfall for Dragoon is 13.2 inches and the average highs range from 58ºF in January to 94º F in June. Occasional light snow falls at higher elevations in the winter months. Exploration programs and mining activities operate year around in the region.

Vegetation on the property is typical of the upper Sonoran Desert and includes bunchgrasses, yucca, mesquite and cacti.

Figure 5-1: Typical Vegetation and Topography of the Gunnison Project

6 HISTORY

There is no direct mining history of the North Star deposit, but the adjacent Cochise district has seen considerable copper, zinc, silver and tungsten mining beginning in the 1880's and extending to the present day. Between 1882 and 1981, the district produced 12 million tons of ore containing 146 million pounds of copper, 94 million pounds of zinc, 1.3 million pounds of lead, 720 thousand ounces of silver, and minor quantities of gold (Keith et. al., 1983). Much of the historical production came from small-scale underground copper-zinc mines located on what is now the Johnson Camp property controlled by Excelsior. The most significant of these producers were the Republic and Moore mines. From 1904-1940, the ore from these mines reportedly contained 4 to 4.5 percent copper and 0.5-0.75 ounces of silver per ton (Cooper, 1964). The zinc content for this period was not reported. Post 1940, the ore contained 1.5 to 3 percent copper, 5 to 10 percent zinc, and about 0.3 ounces of silver per ton. The Republic mine was the site of the historic concentrating plant in the district. Smaller underground mines in the area, such as the Peabody, reportedly yielded very high grade ore which averaged 7.5 percent copper, 4 ounces of silver per ton, and contained as much as 44 percent zinc (Cooper, 1964).

Copper-oxide mineralization has been mined 1.5 miles northwest of North Star at the Johnson Camp open-pit operation since 1975, most recently by Nord Resources Corporation from 2008 until 2010. This property is now controlled by Excelsior. Overall approximately 39 million tons of ore and 187 million pounds of copper have been produced out of the Johnson Camp open pits.

In the 1960's, it was recognized that potentially economic copper-skarn mineralization could be identified remotely by magnetic highs related to the magnetite content of these mineralized bodies. As a result, a magnetic high lying southeast of the now nonexistent town of Johnson was drilled in the 1960's and the North Star deposit was discovered.

Since North Star's discovery, several companies have explored the area. During this time period extensive drilling and assaying, magnetic and IP surveys, metallurgical testing, hydrological studies, In-situ Recovery (ISR) tests, and preliminary mine design and evaluations have been undertaken.

By the late 1960's, the North Star deposit was partly controlled by Cyprus and partly by private owners. In 1970, a division of the Superior Oil Company ("Superior") joint ventured into the northern half of the North Star deposit with Cyprus and the private owners. During the early 1970's, Superior did most of the drilling and limited metallurgical testing of the North Star deposit, and by early 1974 had defined several million tons of low-grade, acid-soluble copper mineralization. During this time, the southern portion of the North Star deposit was controlled by Quintana Minerals Corporation, who drilled several diamond holes and conducted metallurgical testing.

By the late 1970's, Superior had relinquished its rights to North Star. Cyprus maintained the ground holdings on North Star for a period of time but did very little work. Cyprus handed most of the ground covering the North Star back to the private owners in 1977.

The focus since the 1970's has been to utilize in-situ recovery ("ISR") or a combination of ISR and open pits as a potential mining strategy. By the early 1980's, Mr. James Sullivan had gained full control of Section 6 of the North Star deposit and by 1991 had gained control of Section 31 and Section 36 via the State Mineral Lease. Apparently no work was done from the early 1980's through 1992.

6.1 1993 TO 1998: MAGMA COPPER AND PHELPS DODGE

Magma Copper Company ("Magma") optioned North Star from Mr. Sullivan in 1983. Magma drilled 8 holes, completed several metallurgical tests (some on six-inch diameter core), undertook limited hydrological studies, and calculated a copper-oxide resource. Magma's interest in the project was for ISR of the copper-oxide resource.

Metallurgical test work completed by Magma indicated that greater than 70% recovery is possible with ISR. Shortly after being acquired by BHP-Billiton ("BHP"), Magma (BHP) relinquished the project in 1997.

After BHP relinquished its option on North Star in 1997, Phelps Dodge Mining Company ("Phelps Dodge") optioned the North Star deposit and, in conjunction with Mr. Sullivan, drilled several holes on the periphery of the deposit. In 1998, before Phelps Dodge finished their investigation of both deposits, the company decided to focus its exploration activities outside the continental U.S. and returned the project to Mr. Sullivan.

6.2 1999 – 2006

No work was done at the Gunnison Project in 1999 through 2006.

6.3 2007 – 2010: AZTECH MINERALS

AzTech Minerals Inc. ("AzTech") acquired an option for the Project in May 2007. Prior to this, Mr. Steven Twyerould and AzTech had spent nearly two years compiling, summarizing, and digitizing historical project data from over thirty years of investigations by Superior, Cyprus, Quintana, CF&I, Magma, Phelps Dodge and James Sullivan. This process involved building a digital database, verifying historical data, re-interpreting the geology in 3D, and calculating a copper mineral resource.

Biological surveys were conducted for AzTech by Darling Environmental & Surveying, Ltd (Darling). It was found that no federally listed, endangered, threatened species, or proposed and candidate species for listing were present in the survey area from their known distributions and ranges. In addition, the survey area does not contain suitable habitat necessary for survival or life-history requirements of such species. Anthropological surveys conducted for AzTech by Darling indicated only random artifacts were present and occasional clusters of artifacts scattered outside of the area of mineralization. No burial sites or significant cultural sites were identified. Nine lines of ground magnetic data were also obtained and a water-table depth study was completed in June 2010.

In June 2010, AzTech and Excelsior announced their intent to merge. The merger was completed in October 2010 when AzTech merged with Excelsior Arizona, with Excelsior Arizona as the surviving corporation.

6.4 HISTORICAL RESOURCE ESTIMATES

Historical resource estimates for the North Star deposit were completed by Superior in 1974, Phelps Dodge in 1998, AzTech in 2010, and Excelsior in 2011 and 2014 (Table 6-1). The Superior and Phelps Dodge estimates were not prepared in accordance with the requirements of NI 43-101 and CIM definitions. A qualified person has not done sufficient work to classify these historical estimates as current mineral resources or mineral reserves and Excelsior is not treating the historical estimate as current mineral resources or mineral reserves. All of these historical estimates are superseded by the mineral resource estimates presented in Section 14 of this report and are not to be relied upon; they are presented here only for ease of reference and historical completeness.

Table 6-1: Comparison of Previous Oxide Copper Resource Estimates to AzTech 2010 Estimate

Source	TCu Cutoff	North Star	
		Million Tons	TCu Grade
AzTech	0.1%	404	0.35%
Phelps Dodge	0.1%	440	0.39%
AzTech	0.3%	242	0.45%
Phelps Dodge	0.3%	300	0.47%
Superior Oil	0.3%	304	0.47%

TCu = Total Copper

7 GEOLOGICAL SETTING AND MINERALIZATION

The Gunnison Project including the North Star copper deposit, are located in southeastern Arizona within the Mexican Highland section of the Basin and Range province (Figure 7-1). The province is characterized by fault-bounded mountains, typically with large intrusive cores, separated by deep basins filled with Tertiary and Quaternary gravels. Generalized stratigraphy of the Project area is shown in Table 7-1 below.

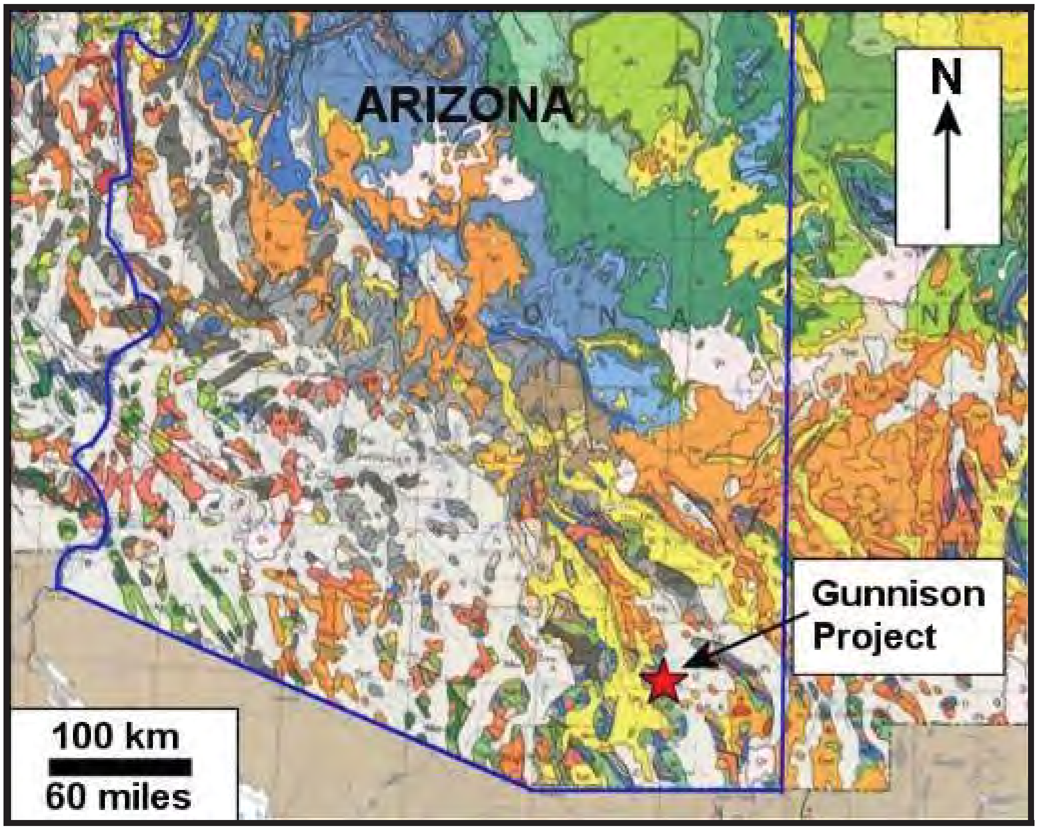


Figure 7-1: Regional Geologic Setting of the Gunnison Project (Modified from King and Beikman, 1974)

Table 7-1: Stratigraphy of the Gunnison Project Region
(Modified from Weitz, 1979; Clayton, 1978)

Rock Unit or Formation	Age	Gunnison Geology	Regional Geology
Basin Fill/Alluvium	Upper Tertiary and Quaternary	Unconsolidated boulders, sand, and gravel.	Stream laid gravels, sand and silt.
Texas Canyon Quartz Monzonite	Lower Tertiary	Quartz monzonite and related intrusions.	Intrusions important in mineralizing event.
Horquilla Limestone	Middle Pennsylvanian	Pyroxene rich calc-silicate hornfels and skarn, marble.	Limestone with abundant thin beds of shale.
Black Prince Limestone	Lower Pennsylvanian	Pyroxene rich calc-silicate hornfels and skarn, marble.	Limestone with thin shale at the base.
Escabrosa Limestone	Lower Mississippian	Garnet rich skarns and calc-silicate hornfels, marble.	Cliff forming limestone and dolomite. Copper skarns.
Martin Formation	Upper Devonian	Diopside-garnet skarns with diagnostic magnetite.	Dolomite with some shale and sandstone. Copper skarns.
Abrigo Formation	Upper Cambrian	Garnet-epidote-pyroxene-amphibole skarns and calc-silicate hornfels.	Shale, impure limestone and sandy dolomite. Copper skarns.
Bolsa Quartzite	Middle Cambrian	Red-brown to white quartzite and green hornfels.	Red-brown to white quartzite.
Apache Group	Upper Precambrian	Quartzite and metadiabase sills.	Basement rocks.
Pinal Schist	Lower Precambrian	Sericite schist.	Basement rocks.

7.1 REGIONAL GEOLOGY

The Gunnison Project including the North Star copper deposit are situated on the eastern edge of the Little Dragoon Mountains (Figure 7-2). The Little Dragoon Mountains are an isolated, fault bounded, up thrown block within the Basin and Range province in southeastern Arizona. The ages of the rocks range from the Proterozoic Pinal Schist to Holocene sediments. The southern portion of the Little Dragoon Mountains consists predominantly of the Eocene age Texas Canyon Quartz Monzonite, whereas the Pinal Schist and the Paleozoic sedimentary units that host the regional copper mineralization dominate the northern half.

The oldest rocks in the area, the Pinal Schist, are composed of Proterozoic sandstones, shales and volcanic flows that have been metamorphosed to greenschist and amphibolite facies. The Proterozoic Apache Group unconformably overlies the Pinal Schist and is composed of conglomerates, shales and quartzite that were subsequently intruded by diabase sills. The Apache Group is then unconformably overlain by the Paleozoic rocks that host the mineralization including the Bolsa, Abrigo, Martin, and Escabrosa Formations. Overlying the mineralized rocks are the Black Prince and Horquilla Limestones. Tertiary/Quaternary basin fill has filled in the valleys.

The Texas Canyon Quartz Monzonite is thought to be the source of the copper mineralization at the North Star and South Star deposits, and is coarsely porphyritic, with potassium feldspar phenocrysts from 1 to 10 cm. Livingston *et. al.* (1967) determined the age to be 50.3 ± 2.5 million years ("Ma"), which is uncorrected for current decay constants, and Reynolds *et. al.* (1986) list eight determinations ranging from 49.5 to 55.0 Ma. The intrusion crops out to the west of the North Star deposit.

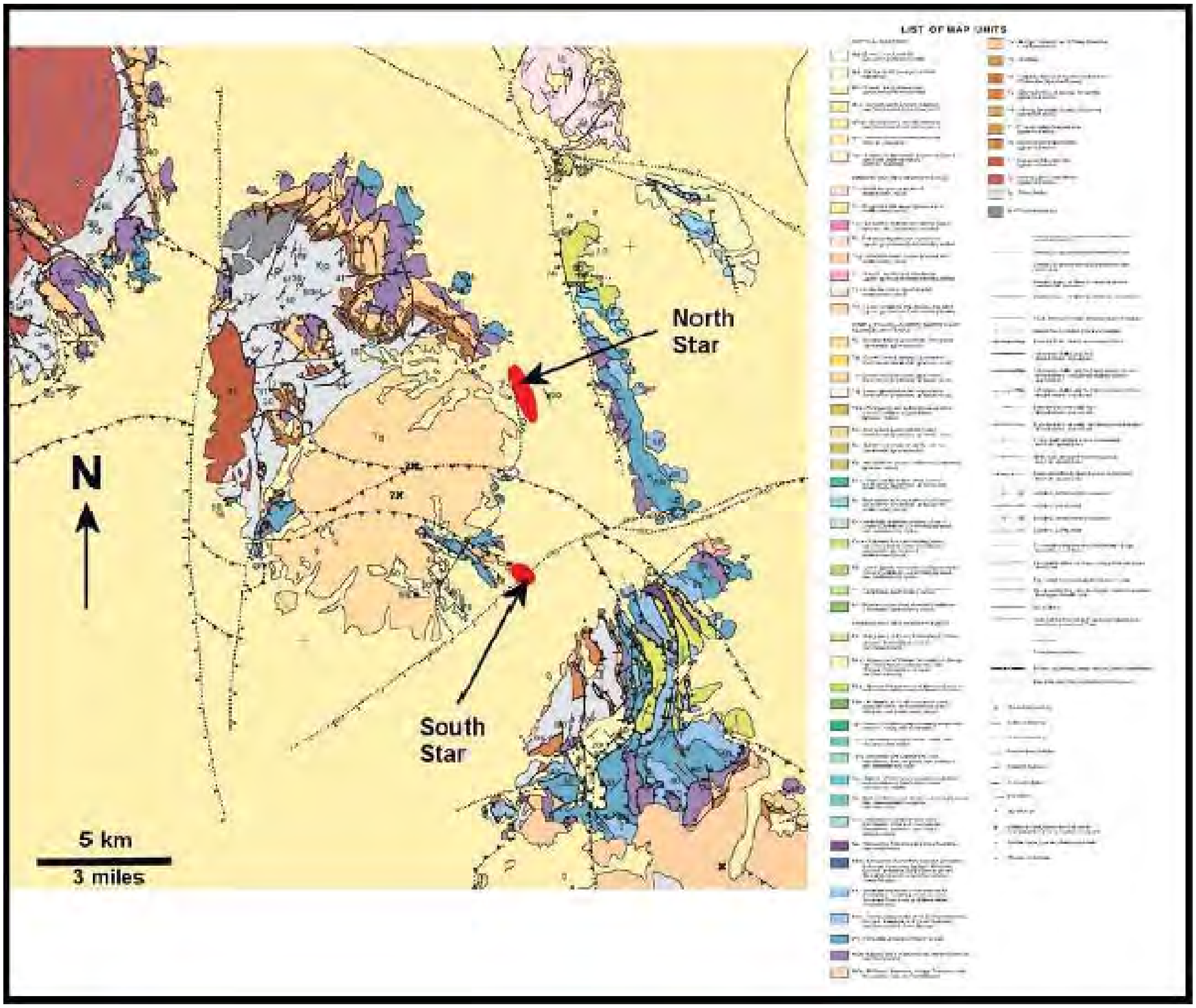


Figure 7-2: Geologic Map of the Little Dragoon Mountains (Modified from Drewes et al, 2001)

Several deformations have occurred in the project area, with the most relevant being the Laramide Orogeny, to which the mineralization is related, and Basin and Range extension that has modified the topography to its current appearance. Much earlier, Pre-Apache Group deformation of the Pinal Schist included isoclinal folding with steep to overturned fold axes with a general northeastern structural trend. Minor deformation took place in the late Precambrian Era and between the end of the Paleozoic Era, but prior to the Cretaceous Period. The post Paleozoic, but pre-Cretaceous deformation produced steep northeast-to easterly-striking faults with offsets up to hundreds of feet.

The Laramide deformation was at right angles to the Pre-Apache Group deformation, with structures striking in a northwesterly direction. Older faults were reactivated and modified, and folding and thrust faulting are common features of the Laramide deformation. The Centurion Fault of Laramide age is located south of the North Star deposit.

Structural trends at the regional scale include: lithological units that strike approximately north-northwest and dip 20° to 45° NE; recurrent northeast-striking normal faults, and local north-northwest striking faults of variable slip directions. Regional geology and structure have been described extensively by Cooper and Silver (1964).

Two episodes of block faulting prior to the Quaternary Period have created the Basin and Range topography that dominates the current landscape and postdates the mineralization.

7.2 NORTH STAR GEOLOGY

The North Star deposit is covered by un-mineralized basin fill, varying between 300 and 800 feet in thickness. The mineralized Paleozoic host rocks below the basin fill strike approximately north-northwest and dip 20° to 45° east-northeast. Baker (1953) recognized three sets of faults in the Johnson Camp area and similar faults have been interpreted in the North Star area. These faults include the "Northeaster" (N10° to 30°E striking; 70° to 75° dip to the SE), "Easter" (N60° E to S60° E striking; 30° to 50° S and higher angle reverse faults dipping 75° S) and "Northwestern" orientations (N15° W strike; steep E or W dip). Only minor displacements are thought to have occurred in the North Star area; however numerous sheared and brecciated faults, generally filled with copper-oxide mineralization, cut through the deposit.

The Paleozoic host rocks have been intruded by the Texas Canyon quartz monzonite along the western margin of the deposit. The intrusion has formed wide zones of calc-silicate and hornfels alteration, as well as extensive low-grade copper sulfide mineralization within the Paleozoic rocks. Metamorphic alteration grading outward from the stock includes: garnet-wollastonite- idocrase, diopside, tremolite and chlorite-talc (Kantor, 1977) (Figure 7-3). More specifically, the Martin Formation grades from a wollastonite-diopside rich rock near the porphyry, to a distal diopside-tremolite-actinolite assemblage, and finally to dolomite. The Abrigo has garnet-actinolite-epidote-diopside alteration with some biotite hornfels near the porphyry, and this grades to a distal tremolite alteration leading into un-metamorphosed limey shale. Quartz-orthoclase-carbonate ± magnetite and chalcopyrite veins are characteristic of the lower Abrigo where it is mineralized.

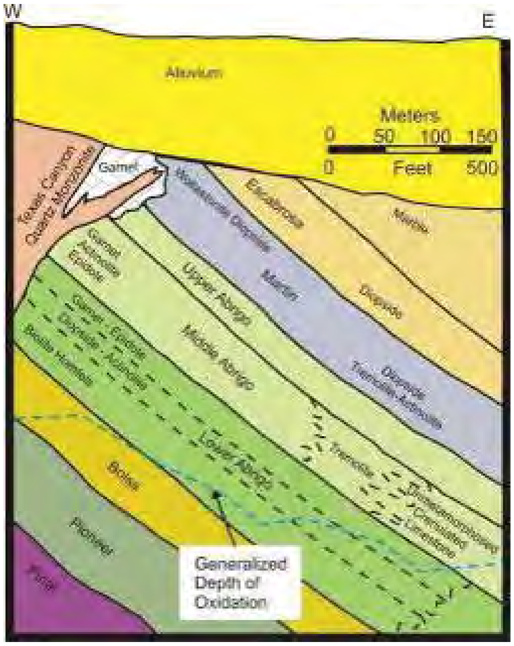


Figure 7-3: North Star Generalized Geological Cross Section (after Kantor, 1977)

7.2.1 Structural Framework of the North Star Deposit

At North Star, the mineralized formations strike approximately N10° to N40° W and dip from 30° to 45° NE. The strong regional trend of N10° to N30° E striking normal faults is overprinted by an abundance of N10° to N40°W striking reverse faults, joint sets, and normal faults which range in dip from 35° NE, sub-parallel to bedding, to 75° NE. The reverse faults strike parallel to the long axis of the deposit. Late-stage N70° E to S70° E striking vertical faults at the north end of the deposit contain local zones of high grade copper-oxide mineralization. Porphyrytic quartz monzonite intrusions occur along the western margin of the mineralization. At the southern end, the intrusion forms a sill between the Lower Abrigo Formation and the Bolsa Quartzite. At the northern end of the deposit, the intrusion commonly occurs as thin dikes and sills which cut the strata in numerous locations.

Excelsior has carried out on-going studies to model and understand the subsurface structural geology of the North Star deposit and its relation to mineralization and hydrology. Excelsior’s methods and procedures for collecting and analysis of subsurface structural data, and the resulting interpretations and models are summarized in Section 9.

7.3 MINERALIZATION

Within the project area the important mineralized host rocks include the Abrigo and Martin Formations and, to a lesser extent, the Horquilla Limestone and the lower parts of the Escabrosa Limestone. Mineralization is also found in the Bolsa Quartzite and Precambrian basement rocks. Copper mineralization is related to calc-silicate skarns that have replaced these carbonate rocks adjacent to the Texas Canyon quartz monzonite (“TQM”).

Oxidation has occurred to a depth of approximately 1,600 feet, and has resulted in the formation of dominantly chrysocolla with minor tenorite, copper oxides and secondary chalcocite. Copper-oxide mineralization is present in the calc-silicate skarns as fracture coatings and vein fillings mainly in the form of chrysocolla. The remainder of the oxide mineralization occurs as replacement patches and disseminations. Copper-oxide mineralization extends over a strike length of 11,100 feet, has an aerial extent across strike of up to 3,000 feet, and is more than 900 feet thick in places. Figure 7-4 shows the plan view geology of the deposit and Figure 7-5 and Figure 7-6 are east-west cross sections. Note the thickness and continuity of the mineralization. The north-south long-section view in Figure 7-7 also confirms the thickness and continuity of the mineralization.

Copper sulfide mineralization has formed preferentially in the proximal (higher metamorphic grade) skarn facies, particularly within stratigraphic units such as the Abrigo and Martin Formations, and within structurally complex zones. There are three types of sulfide mineralization within the skarns. In decreasing order of abundance these are fracture coatings and vein fillings, distinct quartz-orthoclase-carbonate ± magnetite and chalcopyrite veins 0.2 to 10 cm wide (Weitz, 1976), and disseminations. The veins have retrogressive haloes of chlorite, actinolite and epidote. Primary mineralization also occurs as stringers and veinlets of chalcopyrite and bornite.

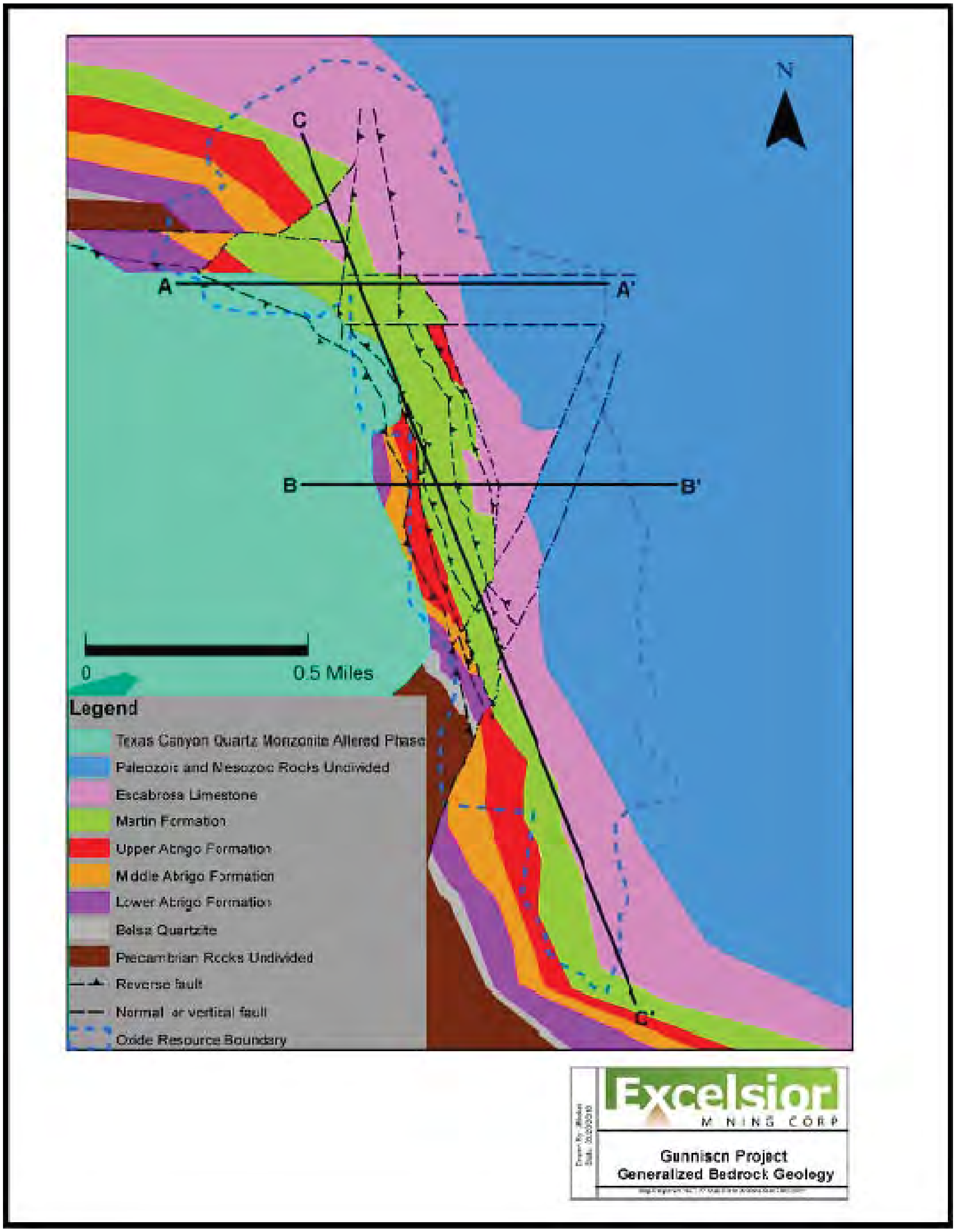


Figure 7-4: North Star Generalized Geology in Plan View, Below Basin Fill

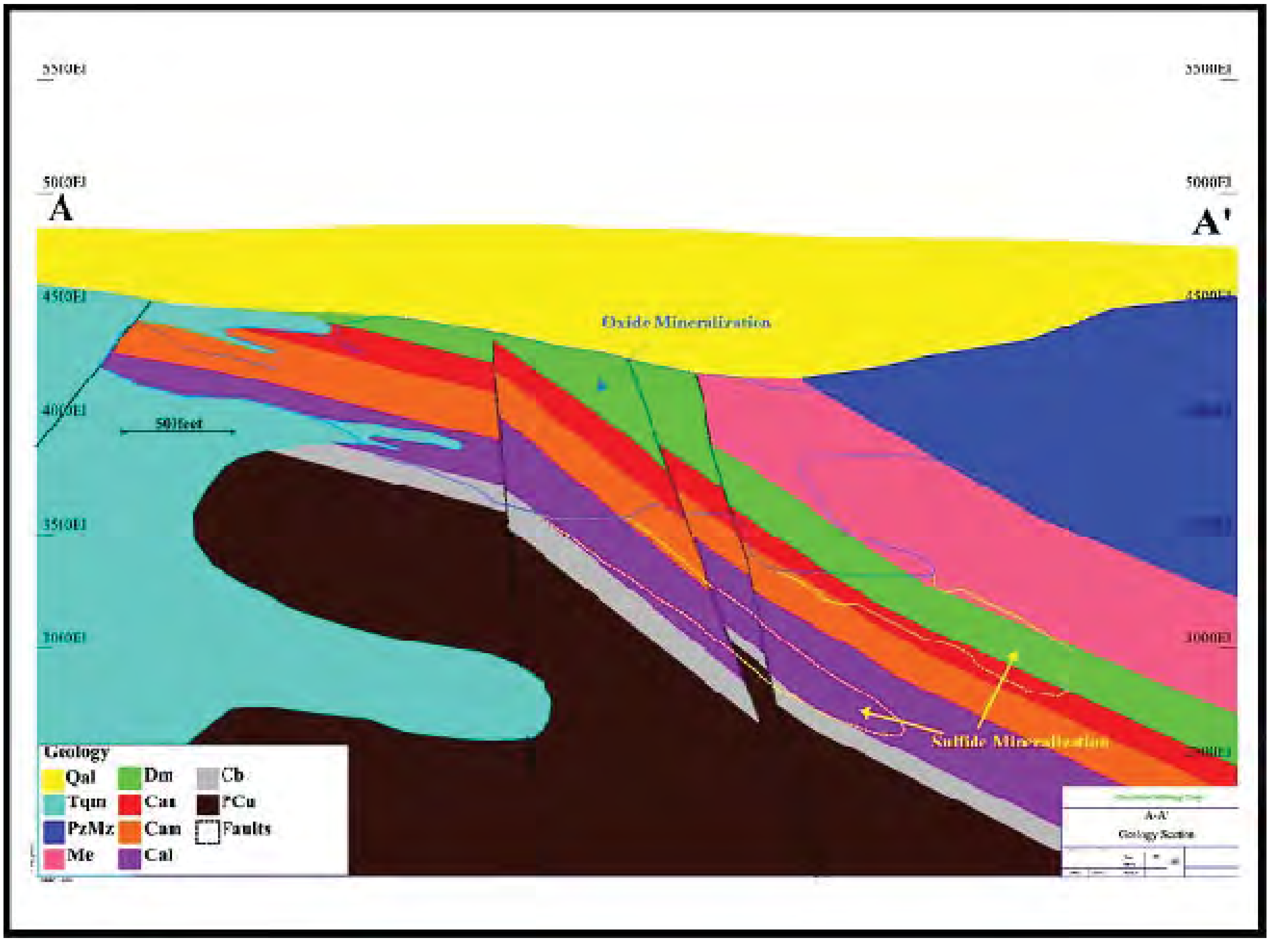


Figure 7-5: North Star East – West Geology Section at 394,400N Looking North

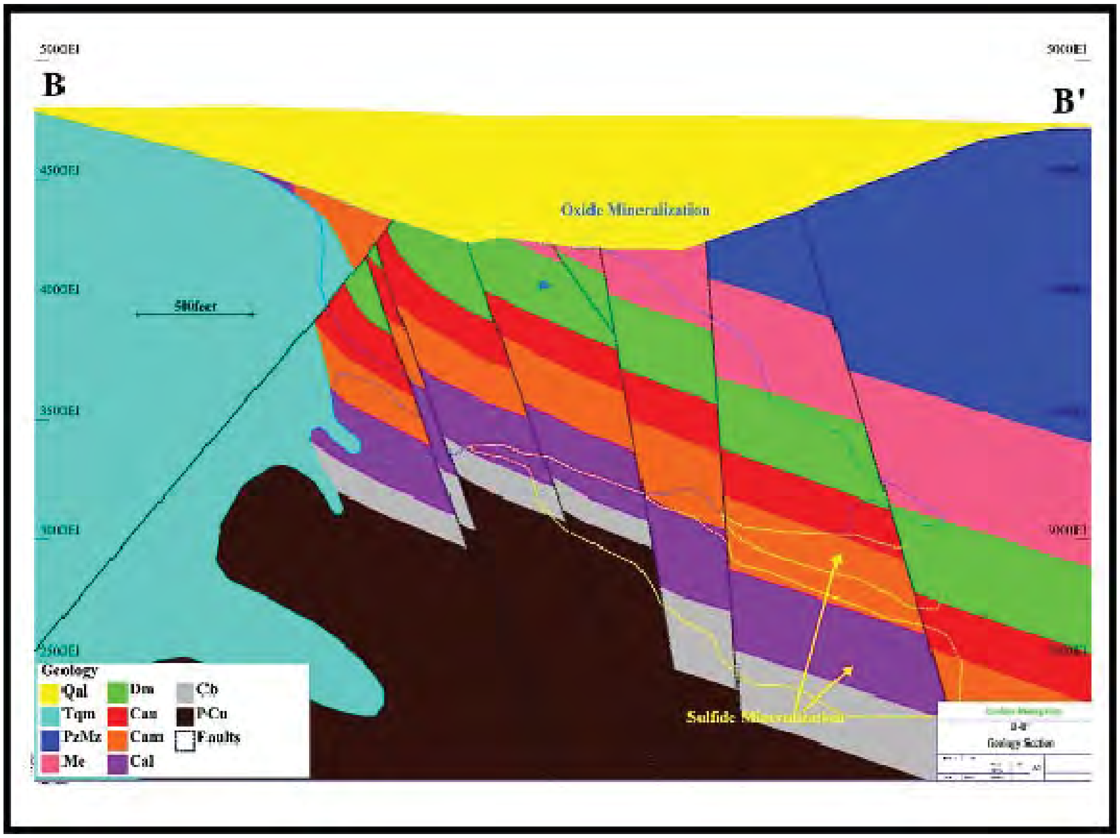


Figure 7-6: North Star East – West Geology Section at 392,000N, Looking North

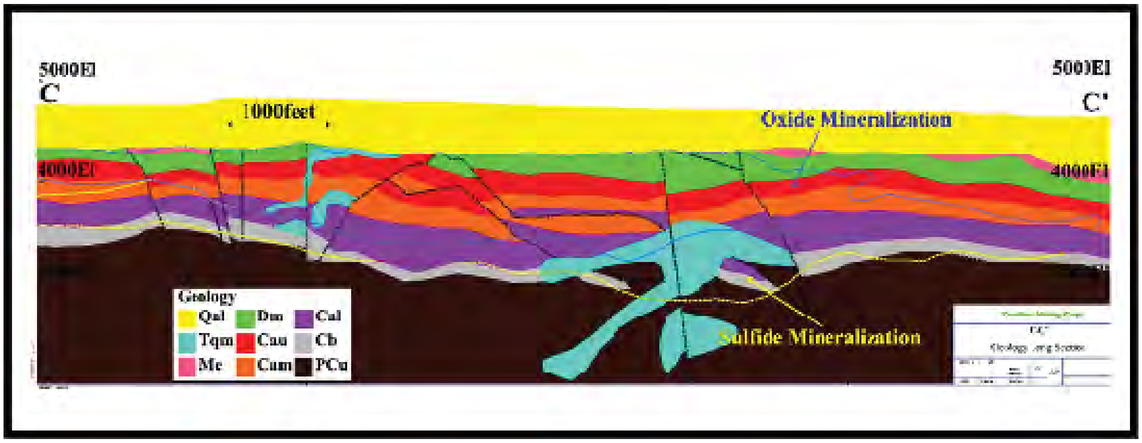


Figure 7-7: North Star North – South Geology Section, Looking East

Figure 7-8: Photograph of Typical Oxide Mineralization for North Star
Hole J-9: 780 to 806 feet

Texturally, pyrite and magnetite are later than and replace the skarn minerals, and chalcopyrite formed last. The magnetite occurs as disseminated 0.2 to 0.5 mm euhedral to anhedral grains and is closely associated with pyrite. Ninety percent of the magnetite is in the skarns and may compose up to five percent by volume of the rock. The disseminated magnetite and magnetite bearing veins are most likely what is giving the magnetic response for the deposit (Colburn and Perry, 1976).

Primary chalcopyrite-molybdenite disseminations and veins also occur in the mineralized porphyry below and to the west of the skarn mineralization at North Star. Only nine drillholes intersected the quartz monzonite over significant lengths (lengths > 100 feet). Most were mineralized with a best interval of 289 feet averaging 0.31% Cu and 0.028% Mo, including 30 feet at a grade of 1.35% Cu. This mineralization has never been fully assessed.

Both oxide and sulfide mineralization exhibit strong fracture control. This fracturing and faulting are best developed in terms of width and close spacing in a zone around the intrusive contact, and this decreases away from the intrusive contact in the less altered rocks to the east. The initial formation of the skarn created denser minerals and liberated CO_2 resulting in a volume reduction of the rocks. This in turn created significant fracturing, and therefore an increase of porosity and permeability, allowing penetration by the later copper-bearing fluids. Weitz (1976) calculated a 30% volume reduction in the skarn-altered portions of the Abrigo and Martin formations at North Star.

Oxide copper also exists within the transition zone. It mainly occurs along fractures and in quartz vein selvages as chrysocolla. Secondary supergene copper sulfide minerals such as chalcocite are often associated with the oxide mineralization in the transition zone. The transition zone is typically 100 feet to 200 feet in thickness and is strongly fractured and broken, similar to the oxide zone.

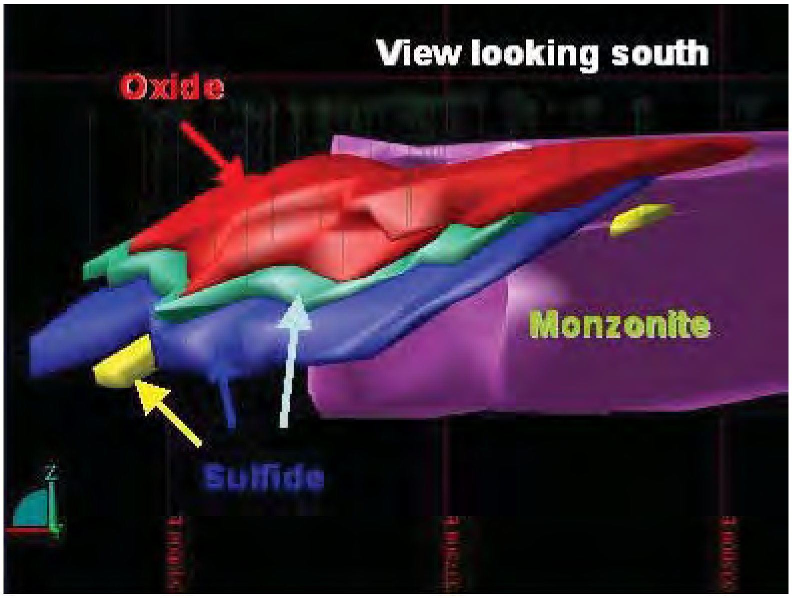


Figure 7-9: Generalized 3D View of Mineralization Looking South

8 DEPOSIT TYPES

The North Star copper deposit is a classic copper skarn (Einaudi et al, 1980 and Meinert et al, 2005). Skarn deposits range in size from a few million to 500 million tonnes and are globally significant, particularly in the American Cordillera. They can be stand-alone copper skarns, which are generally small, or can be associated with porphyry copper deposits and tend to be very large. The North Star deposit is large, at the upper end of the range of size for skarn deposits, and is likely associated with a mineralized porphyry copper system that has not been discovered.

Copper skarns generally form in calcareous shales, dolomites and limestones peripheral or adjacent to the mineralized porphyry. Copper mineralizing hydrothermal fluids are focused along structurally complex and fractured rocks and convert the calcareous shales and limestones to andradite rich garnet assemblages near the intrusive body, and to pyroxene and wollastonite rich assemblages at areas more distal to the stock. Retrograde hydrothermal fluids produce actinolite-tremolite-talc-silica-epidote-chlorite assemblages that overprint earlier garnet and pyroxene. The mineralization is typically pyrite-chalcopyrite-magnetite proximal to the mineralizing porphyry and chalcopyrite-bornite more distally from the body. The copper-gold porphyry and skarn model by Sillitoe (1989) (Figure 8-1) is being used as a conceptual exploration model for the North Star deposit. Application of the model entails testing magnetic highs (potential skarns) around magnetically quiet areas (copper porphyry).

Copper-zinc skarns are important in the region and have been historically mined from the Republic, Copper Chief, Moore, and Mammoth mines from underground operations (Baker, 1953). These copper and zinc rich skarns are probably more distal to the mineralized porphyry, whereas the North and South Star skarns contain only Cu and are proximal to the mineralizing porphyry system. Mineralization similar to that at the North Star deposit has been mined 1.5 miles to the north at Johnson Camp. Tungsten and minor lead-silver-gold have also been produced in the district (Cooper and Silver, 1964).

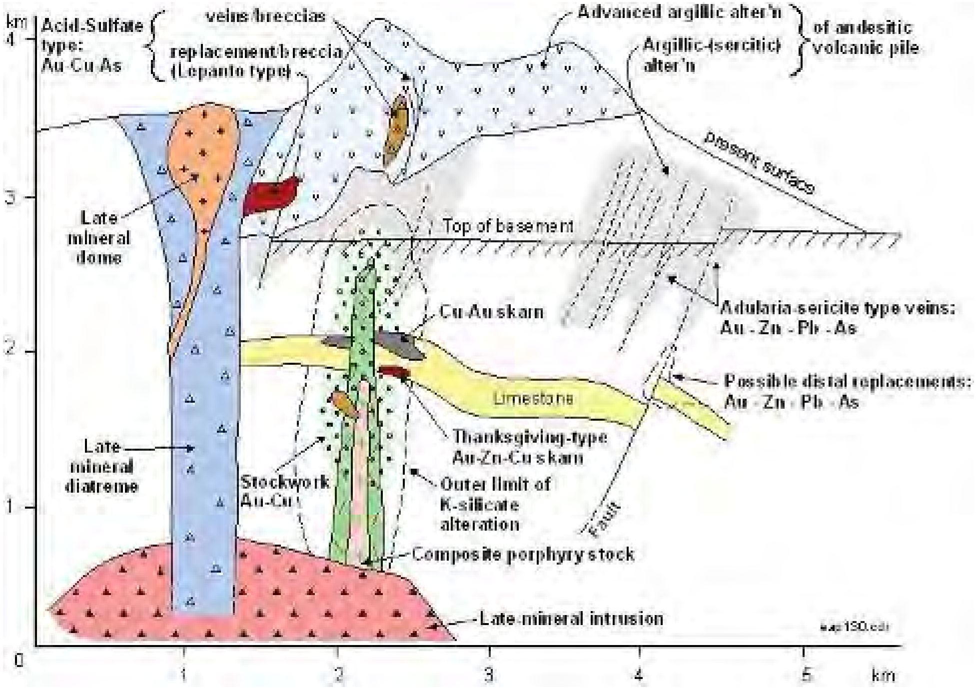


Figure 8-1: Porphyry Copper and Skarn Model (from Sillitoe 1989)

9 EXPLORATION

Excelsior initiated a re-logging program in December, 2010 that was completed in 2011. In addition, a re-assaying program began in March, 2011 during which all of the Magma Copper drillholes were re-assayed. Prior to the re-assay, historical CS holes that had both total copper (TCu) and acid-soluble (ASCu) results were re-split and check assayed at Skyline Labs in Tucson. The results are described in Section 12. In May 2011, a re-assay program was initiated for the Quintana Minerals holes (DC, S and T series) to include sequential Cu analysis. Previous results only included TCu assays.

From late in 2010 through early 2015, Excelsior has drilled 54 diamond drillholes, totaling 78,615 feet, for metallurgical samples and copper resource definition and expansion. Commencing in 2011, Excelsior also drilled 33,077ft in 32 rotary holes for hydrologic testing and observation in the North Star deposit area.

Southwest Exploration Services, LLC and COLOG were contracted by Excelsior to complete down-hole geophysical surveys during the 2011 to 2015 drill programs. Due to bad ground conditions some holes were not surveyed, and in others the surveys were shortened and did not reach the total drilled depths. Altogether, down-hole geophysical data were obtained from a total of 66 drillholes in the deposit. Data collected included temperature, caliper log, sonic log and acoustic televiewer. The down-hole geophysical data have been analyzed and evaluated as described in Section 9.2.1.

9.1 EXCELSIOR STRUCTURAL GEOLOGIC METHODS

Excelsior's technical team has made a substantial effort to understand the structural geology of the North Star Deposit, particularly as it relates to controls on oxide copper mineralization and ground water hydrology. High-quality data collection and research regarding the structural nature of the subsurface has been fundamental to advancing the project. This subsection summarizes how Excelsior has collected, interpreted, and modeled subsurface structural data as part of its exploration program to aid resource estimation, mine planning and extraction. Excelsior collects structural data by the following four main methods.

9.1.1 Structural Logging

As a part of the core logging process, Excelsior's geologist logged structure type (fault, shear, breccias, etc.), took angle to core axis measurements of the structures, and noted the mineralogy existing on the feature planes, infill, gouge, and selvages.

9.1.2 Down-hole Geophysical Surveys

For Excelsior's drilling programs since 2011, borehole geophysical tools including an acoustic borehole televiewer, were used to collect geophysical data down the holes. Images produced by the televiewer are used by Excelsior's geologist to identify and interpret structures by comparing the geophysical logs with the core, characterize structures by type and infill or gouge mineralogy, and obtain their true structural orientation using WellCad software. Other data collected from the surveys included caliper, sonic, and temperature logs.

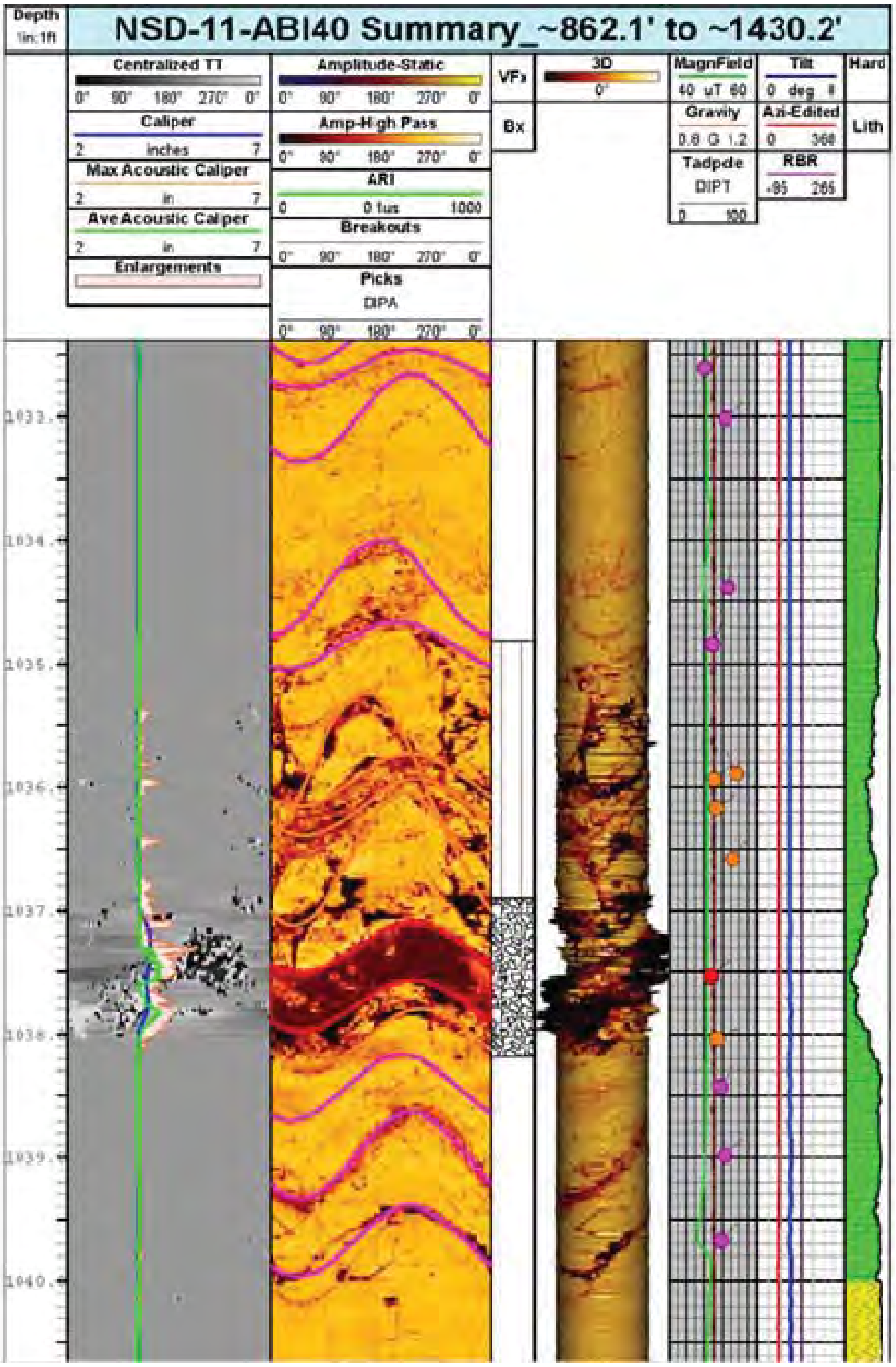


Figure 9-1: Graphical Example of Geophysical Log

9.1.3 Fracture Intensity

Fracture Intensity is defined as the relative brokenness, and hence permeability control, of the rock based on pieces of drill core that are less than or equal to 4 inches in length. Beginning in 2011, Excelsior geologists logged Fracture

Intensity for each drillholes based on a scale of 1-5, with a value of 5 representing the most fractured rock. Definitions for the scale of Fracture Intensity are described in Table 9-1.

Table 9-1: Fracture Intensity Definitions

Fracture Intensity	Description
1	Very Weak (0-5% ≤4")
2	Weak (5-20% ≤4")
3	Moderate (20-50% ≤4")
4	Strong (50-80% ≤4")
5	Very Strong (80-100% ≤4")

Examples of Fracture Intensity are shown below by rock unit. In general, the Fracture Intensity rankings are consistent regardless of formation (see Figure 9-2 and Figure 9-3). Higher Fracture Intensity levels tend to be characterized by large amounts of iron and copper-oxide minerals.

Intensity = 5

Intensity = 4

Intensity = 3

Intensity = 2

Intensity = 1

Figure 9-2: Fracture Intensity Examples from the Abrigo Formation

Intensity = 5

Intensity = 4

Intensity = 3

Intensity = 2

Intensity = 1

Figure 9-3: Fracture Intensity Examples from the Martian Formation

9.1.4 Fracture Mapping

For every assay sample (every 10ft unless truncated by a lithologic boundary), Excelsior's geologist logged "Fracture Mapping". This is the quantity of fractures per assay sample in the drill core, which can be used to calculate fractures per foot. The following categories were logged for Fracture Mapping:

- quantity of mineralized, open fractures per assay sample;
- quantity of mineralized closed fractures per assay sample;
- quantity of non-mineralized open fractures per assay sample; and
- quantity of non-mineralized closed fractures per assay sample.

9.2 EXCELSIOR STRUCTURAL DATA ANALYSIS, INTERPRETATION AND MODELING

The data collection described in Section 9.1.1, Section 9.1.2, Section 9.1.3 and Section 9.1.4 was used to create the following relevant outputs:

- Structural Analysis of the deposit;
- 3-D Wireframe Structural Model; and
- Structural Block Model.

9.2.1 Structural Analysis

Excelsior staff performed a Structural Analysis that examined all of the collected structural data outlined in Section 9.1 in detail and was the fundamental building block for all other structural interpretations. It was also used to aid the geology interpretation.

Figure 9-4 shows the major faults which displace stratigraphy in the deposit projected at the bedrock surface. Their spatial locations and orientations were defined in the Structural Analysis. The numerous parallel reverse faults which strike approximately N-NW cause repetition in stratigraphic section. All of the reverse faults dip steeply (70-80°) to the NE, except the westernmost reverse fault which dips approximately 60°SW. A subset of NE-striking normal faults, which dip steeply to the SE, is located on the margins of the deposit to the north and south. Also at the north end, E-W sub-vertical faults intersect the deposit along its short axis.

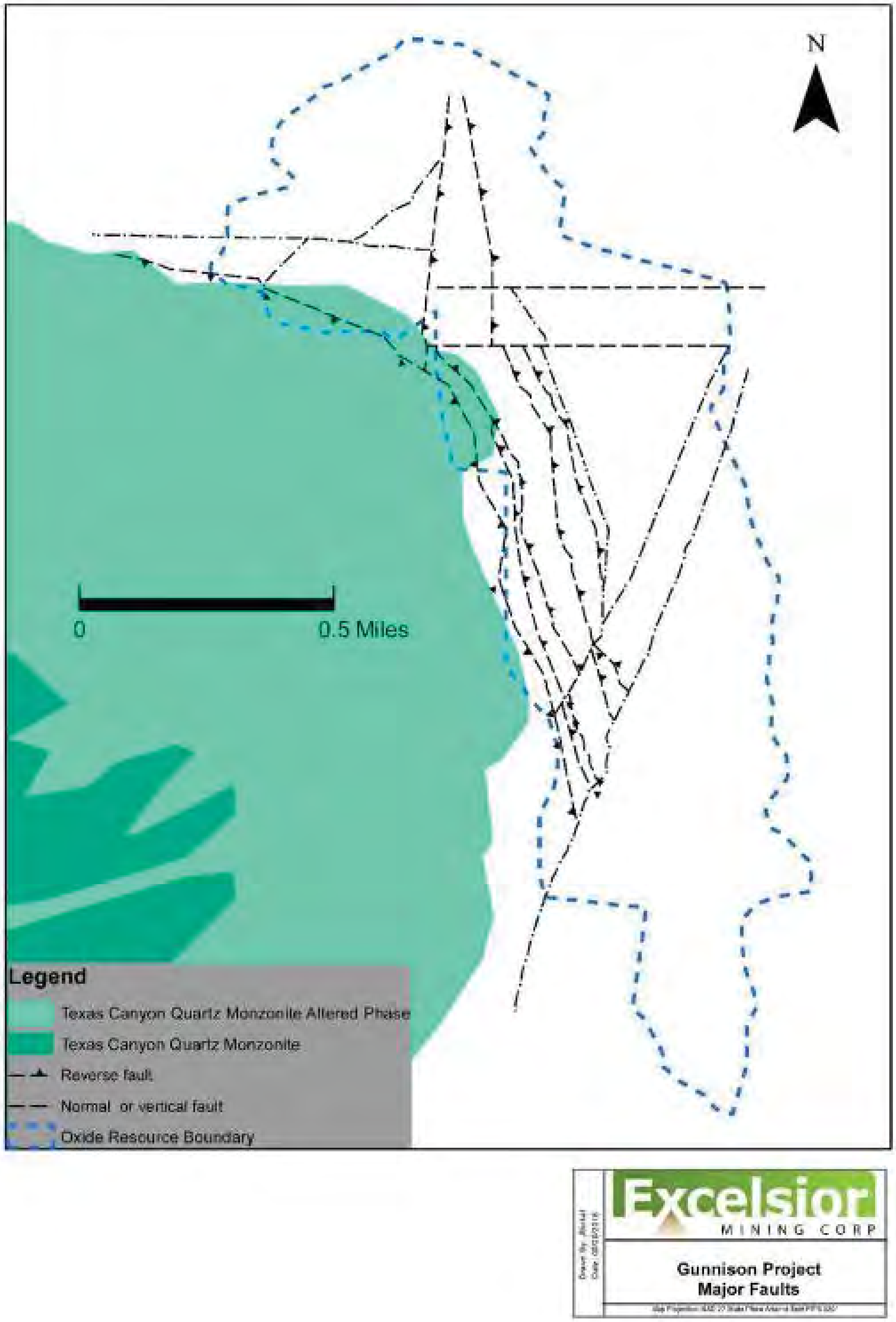


Figure 9-4: Plan View of Major Faults at Bedrock Surface which Displace Stratigraphy

The Structural Analysis also showed that, aside from the major faults which displace stratigraphy, the deposit is dominantly cut by faults, fractures, and joints which strike and dip sub-parallel to bedding. Figure 9-5 is a contour plot of structural data from the geophysical surveys. It contours the poles to dip directions for all structural features measured in the deposit (excluding bedding orientations). Note the strong presence of features which dip moderately to the NE and strike N-NW. These features are approximately sub-parallel to the strike and dip of the stratigraphic units at Gunnison.

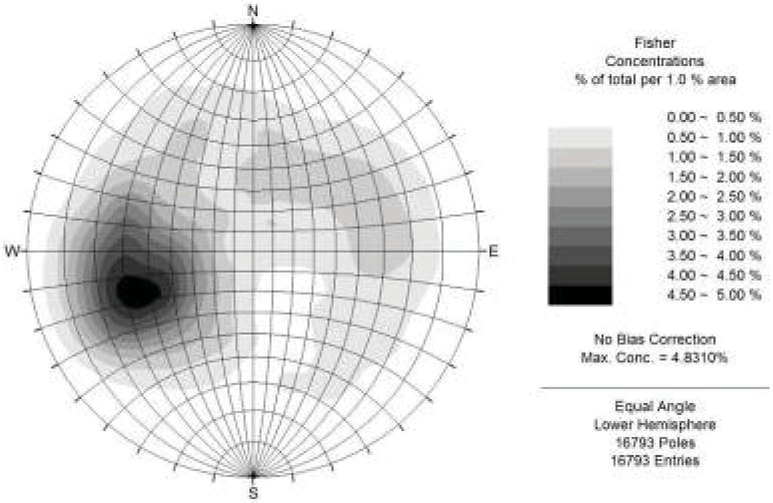


Figure 9-5: Contour Plot of Poles to Dip Directions for Structural Features, Excluding Bedding Orientations

The structural architecture of the subsurface resulting from the interpretations made in the Structural Analysis is a framework of high angle structures with numerous conjugate structures which are sub-parallel to bedding. Figure 9-6 is a schematic east-west cross section showing this framework. The cross section shows the approximate thickness of the structural zones as defined by the Structural Analysis.

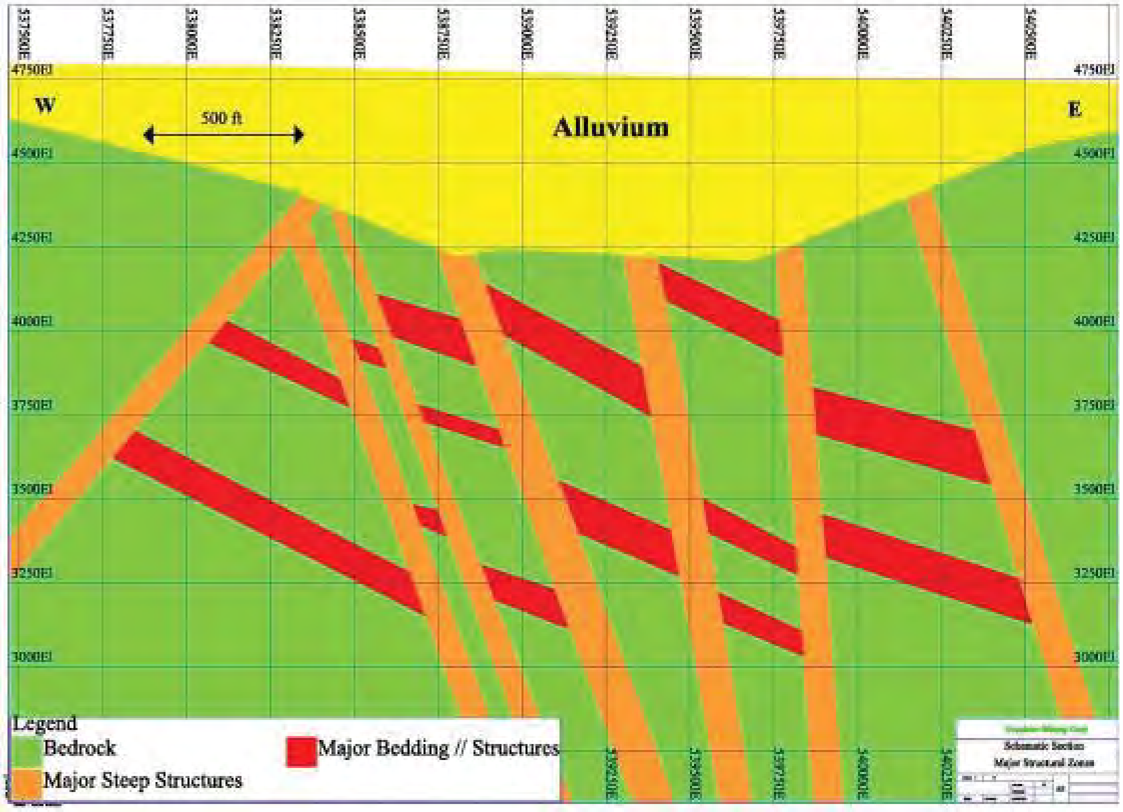


Figure 9-6: Schematic East – West Cross Section Showing the Structural Framework of the Deposit

Much of the copper-oxide mineralization in the North Star Deposit occurs on or proximal to fractures in the rock. Highly fractured zones are typically enriched in chrysocolla. The Structural Analysis validated this relationship through the examination of structural data. Figure 9-7 is a chart which shows a positive correlation between Fracture Intensity and the average total copper grade (TCu) for each Fracture Intensity ranking, at a 0.05% TCu cutoff in the approximate oxide zone of the deposit.

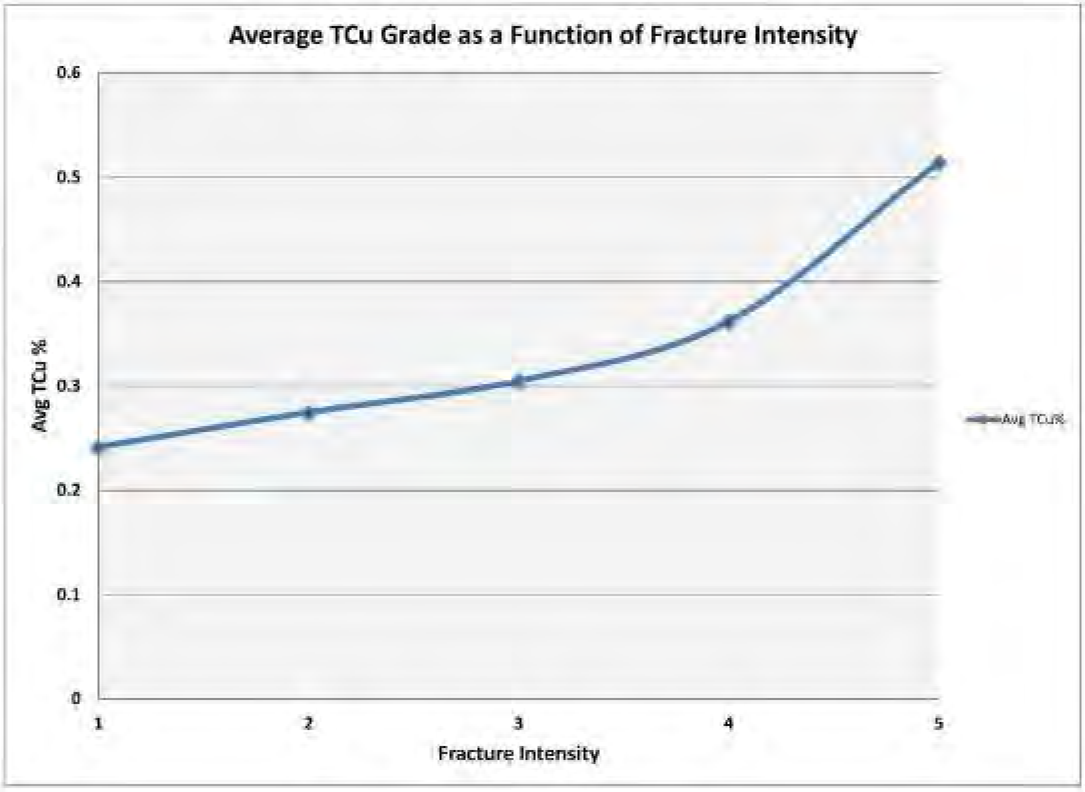


Figure 9-7: Correlation between Fracture Intensity and TCu Grade

Analysis of the Fracture Mapping data also yielded results which validated the relationship between fracturing and mineralization. Figure 9-8 shows the average number of fractures per foot as a function of the assay grade. Note that there are less data available on Fracture Mapping than Fracture Intensity because Fracture Mapping could not be performed on historical core.

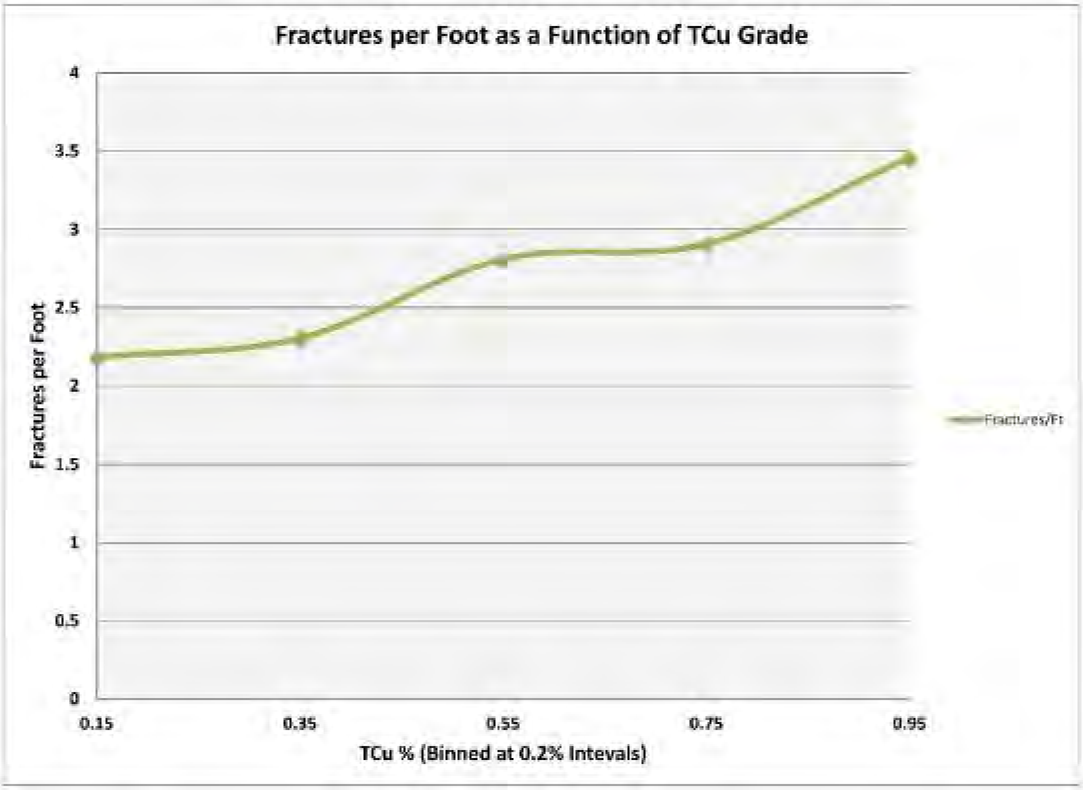


Figure 9-8: Relationship between Fractures per Foot and Assay Grade (TCu)

9.2.2 3-D Wireframe Structural Model

Excelsior geologists constructed a 3-D Wireframe structural model (or "Structural Domains" model) that consists of three-dimensional volumes that encapsulate significant structurally affected zones in the deposit. Their spatial locations and orientations were defined by the Structural Analysis. To be considered significant for the purposes of the model, these highly fractured and/or faulted zones were required to envelop drillhole intersections that have a minimum thickness of 30ft and a Fracture Intensity value of 3 or above. The outlines of the shapes were wire framed and subsequently used to triangulate volumes using Surpac software. This model is discussed further in Section 14.2.3.

9.2.3 Structural Block Model

Excelsior staff constructed a three dimensional Structural Block Model, or "Fracture Intensity Model", based on the logged Fracture Intensity data, the Structural Analysis, and the 3-D Wireframe Structural Model. The Structural Block Model blocks are coded with the Fracture Intensity value for each block and have dimensions of 100ft x 50ft x 25ft. Specific details regarding its generation are discussed in Section 14.2.5.

9.3 REGIONAL HYDROLOGY

A regional groundwater study was completed in April 2011 and updated in November 2015 by compiling available data for the region surrounding the North Star deposit. This compilation shows groundwater flows mainly to the east and southeast from the North Star deposit. Section 16 contains additional details regarding hydrology.

10 DRILLING

Excelsior's digital database for the North Star deposit includes 217 drillholes totaling 245,509 feet. A total of 122 core and RC holes were drilled in the deposit area, and 96 of these, totaling 140,034 feet, directly contributed assay data to the estimation of copper resources.

Historical drilling was primarily conducted by diamond drilling methods, although a small amount was done by reverse circulation. The majority of drillholes have vertical orientations, which cross the predominant, generally shallow-dipping mineralized zones at North Star. A small number of angle holes were also completed by Excelsior, in attempts to intersect and validate interpreted geology and structure within the deposit.

The predominant sample length for the drill intervals in the Excelsior database is 10 feet (3.048 meters), with a relatively small percentage of shorter or longer intervals based on lithologic factors. MDA believes the drillhole sample intervals are appropriate for the style of mineralization at the North Star deposit. Furthermore, MDA is unaware of any sampling or recovery factors that may materially impact the accuracy and reliability of the results, and believes that the drill samples are of sufficient quality for use in resource estimations.

Figure 10-1 is a plan map showing the North Star drillholes by company.

10.1 HISTORICAL DRILLING

The database includes 88 historical drillholes that were completed by several companies as shown in Table 10-1. These holes extend to a depth of approximately 2,450ft below the surface at North Star and cover an area of approximately 310 acres, with additional drilling extending beyond this area. There is a slightly higher density of drilling along the central axis of the North Star deposit.

The historical drillholes are vertical and the mineralization ranges from flat lying to a 30° dip to the east, resulting in a ratio between sample length and true thickness of 1 to 0.87 depending on the true dip of the mineralization.

Table 10-1: Pre-Existing Drilling at North Star
(Diamond Drilling Includes Percussion Pre-Collar)

Company	Date	Type	Pre-fix	# of holes	Feet drilled
Cyprus	early 1970's	Diamond core	K	4	3,755
Cyprus/Superior	early 1970's	Diamond core	CS	36	45,786.6
Cyprus/Superior	early 1970's	Diamond core	CYS	1	887
Cyprus/Superior	early 1970's	Diamond core	J	10	12,167
Cyprus/Superior	early 1970's	Diamond core	K-20-X	1	983
James Sullivan	late 1980's	Diamond core	JS	3	1,665.5
Magma Copper	mid 1990's	Diamond core	MCC	6	8,099
Minerals Exploration	early 1970's	Diamond core	JD	4	2,206
Phelps Dodge	late 1990's	RC chip	SullyI97	6	6,026
Quintana	early 1970's	Diamond core	DC	1	1,080
Quintana	early 1970's	Diamond core	S	3	3,394
Quintana	early 1970's	Diamond core	T	12	20,756
Superior	early 1970's	Diamond core	D	1	1,500
			Total	88	108,305.1

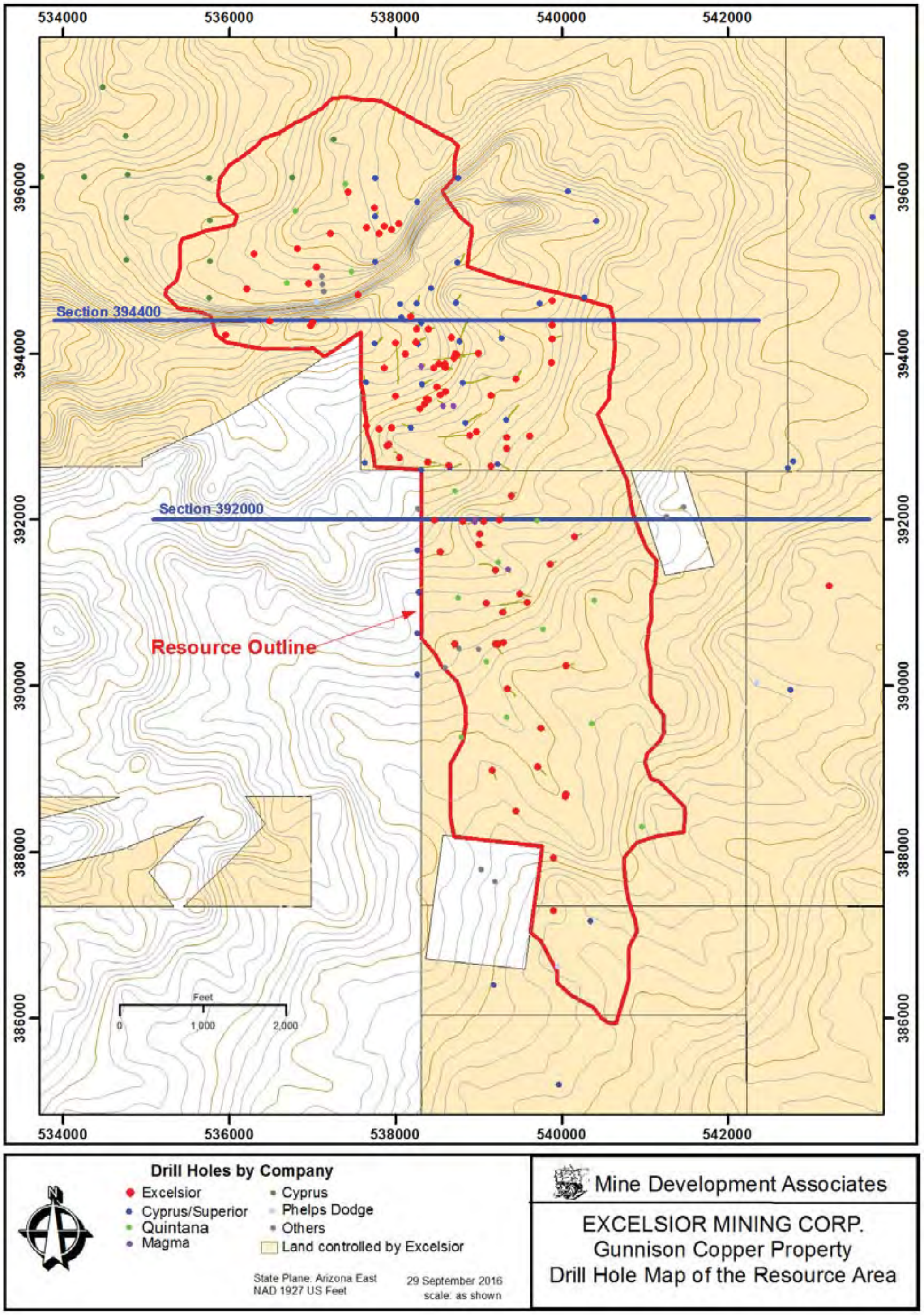


Figure 10-1: North Star Drillhole Collar Locations

Historical core drilled by Cyprus-Superior, Magma, and Quintana is NQ diameter with the exception of two Magma holes (MCC-7 and MCC-8), which were 6-inch metallurgy core holes. James Sullivan diamond drillholes were drilled with HQ-diameter core. The Cyprus-Superior holes used Joy Manufacture Co as a drilling contractor. Magma drillholes were drilled by Christensen Boyles Corp. MDA has no further information on the drilling contractors, rig types, core sizes, and rotary or reverse-circulation drill-bit diameters used to perform the historical drilling.

Sampling of the drill core was on irregular downhole intervals based on geology using half-core splits. For the most part, the entire mineralized intersections have been sampled without any indication of sampling biases towards "high-grading". Individual down-hole sample intervals ranged from less than 2 feet to about 30 feet. Sample intervals larger than 25 feet generally represent intervals in the overburden (composite chip sampling). All historical drill core was split manually, divided in half and placed in sample bags for transport to the assay laboratories. Samples have been assayed at commercial laboratories or in-house laboratories as listed in Table 10-2. All laboratories were located in Arizona.

Table 10-2: List of Assay Laboratories Used by Historical Operations

Company	Assay Laboratory	Comments
Superior	American Analytical and Research Laboratories	
Quintana	Southwest Assays and Chemists	
Phelps Dodge	Actlabs / Skyline Lab[1]	Some check assays at Morenci[2]
Magma	Magma's San Manuel mine laboratory[2]	

[1] Certified by American Association of Laboratory Accreditation
[2]-Denotes non-independent analytical lab

10.1.1 Historical Collar Position Surveys

Excelsior has located 46 historical drillhole collars and had them surveyed by Darling Geomatics using a Trimble Global Positioning System (GPS), which can be accurate to 0.05ft horizontally and 0.2ft vertically.

10.1.2 Historical Down – Hole Surveys

Historical borehole deviation data, where available, has been documented and added to the Excelsior database. Twenty-nine total historical holes have available survey data. The data came from either gyroscopic or down-hole camera surveys as a part of the initial procedures for the historical drillholes.

Table 10-3: Summary of Historical Borehole Deviation Surveys

Company	Hole Series	# of Holes Surveyed	Survey Types
Cyprus - Superior	CS	17	Gyroscopic
Cyprus - Superior	J	5	Gyroscopic
Magma	MCC	6	Survey Camera

10.2 EXCELSIOR DRILLING 2010 – 2015

Fifty-four diamond core holes have been drilled by Excelsior for a total of 78,615 feet of drilling. Fifteen of these holes were for metallurgical samples and the rest were drilled for resource definition or exploration purposes (Table 10-4; Figure 10-2). Twenty holes were completed from December 2010 to May 2011, eleven holes were drilled from March 2012 to May 2012, and an additional 23 diamond holes were drilled from September 2014 to January 2015. 6 ¼ inch pre-collars were drilled with rotary methods to the base of alluvium (100 to700 feet) and then cased with 4 ½ inch steel casing. HQ-size diamond core was drilled to a maximum depth of 2,000 feet, except where conditions required reduction to NQ size. Five metallurgy holes were drilled with PQ diameter core. Excelsior also completed diamond drilling through the entire section of alluvium for 2 holes in the 2012 program (NSM-001 and NSD-032). Of the 54 holes drilled, 44 have been assayed for inclusion into the mineral resource estimate described in Section 14. Excelsior has also drilled 32 rotary holes for hydrologic purposes between 2010 and 2015. Assays from these holes do not influence the mineral resource, but the rock chips collected from drilling were logged and used to aide in geologic interpretations of the deposit.

The Excelsior drillholes are mostly vertical. All Excelsior drillhole collars have been surveyed by Darling Geomatics using a Trimble GPS, which can be accurate to 0.05ft horizontally and 0.2ft vertically. Borehole deviation surveys were conducted for each drillholes using a Reflex down-hole camera survey for each Excelsior drillholes. Additionally, borehole geophysical logging was carried out on 84% of the Excelsior drillholes. Where available, the deviation surveys acquired from the geophysical logging supersede the camera surveys due to higher precision of the data.

Table 10-4: Listing of Excelsior Diamond Drilling 2010 – 2015

Hole ID	Northing (feet)	Easting (feet)	Elevation (feet)	Azimuth	Dip	Pre- Collar Depth (feet)	Diamond Depth (feet)	Total Depth (feet)	Purpose
NSD-001	393496.2	537998.1	4827.2	0	-90	460	1045.5	1505.5	Resource
NSD-002	392910.0	537923.6	4809.8	0	-90	580	1327	1907	Resource
NSD-003	392651.2	538646.0	4805.0	270	-70	565	1443	2008	Resource
NSD-004	391619.2	538540.6	4781.7	0	-90	510	799	1309	Resource
NSD-005	390510.7	538711.4	4740.2	0	-90	420	1488	1908	Resource
NSD-006	391109.8	539499.2	4753.6	0	-90	390	1610	2000	Resource
NSD-007	391470.0	539858.8	4737.0	0	-90	430	1370	1800	Resource
NSD-008	392291.2	539398.8	4783.4	0	-90	560	1212.5	1772.5	Resource
NSD-009	393007.0	539614.5	4788.2	0	-90	620	1173	1793	Resource
NSD-010	391983.3	538810.4	4768.2	0	-90	540	969	1509	Resource
NSD-011	393882.5	538523.0	4834.3	0	-90	650	788	1438	Metallurgy
NSD-012	390998.4	539093.0	4749.0	0	-90	400	1331.5	1731.5	Resource
NSD-013	391010.1	539587.2	4748.9	270	-70	480	1527	2007	Resource
NSD-014	390507.0	539202.9	4733.7	0	-90	400	1512.5	1912.5	Resource
NSD-015	389971.5	539349.6	4730.6	0	-90	400	1556	1956	Resource
NSD-016	389026.0	539713.0	4731.4	0	-90	420	1268.5	1688.5	Exploration
NSD-017	387936.5	539900.7	4695.4	0	-90	400	949	1349	Exploration
NSD-018	382749.3	538255.3	4688.2	210	-70	140	1264	1404	Exploration
NSD-019	393832.7	537871.0	4848.3	0	-90	620	834	1454	Resource
NSD-022	391700.4	539007.9	4759.5	0	-90	500	839	1339	Metallurgy
NSD-023	394132.1	538004.1	4857.3	180	-70	557	989	1546	Resource
NSD-024	394009.6	538994.7	4823.3	270	-70	672	1300	1972	Resource
NSD-025	393019.7	538893.5	4789.8	270	-70	637	1006.5	1643.5	Resource
NSD-026	394710.5	537551.9	4846.6	0	-90	466	702	1168	Resource
NSD-027	394377.4	537002.1	4883.3	0	-90	404	600.5	1004.5	Resource
NSD-028	394391.7	536487.3	4880.6	0	-90	396	359	755	Resource
NSD-030	394780.8	536207.8	4784.9	0	-90	240	527	767	Resource
NSD-031	395445.8	537220.3	4770.2	0	-90	416	592	1008	Resource

Hole ID	Northing (feet)	Easting (feet)	Elevation (feet)	Azimuth	Dip	Pre- Collar Depth (feet)	Diamond Depth (feet)	Total Depth (feet)	Purpose
NSD-032	395280.2	536824.0	4786.4	0	-90	338	905	905	Resource
NSD-033	392745.5	538051.5	4809.1	0	-90	499	1080	1579	Resource
NSD-034	388494.6	539451.3	4708.7	0	-90	343	654	997	Resource
NSD-035A	388985.8	539165.4	4713.4	0	-90	321	838.9	1159.9	Resource
NSD-036	394225.5	535954.6	4888.2	0	-90	504	289.3	793.3	Resource
NSD-037	395565	538041.6	4751.3	0	-90	524	760.4	1284.4	Resource
NSD-038	388669.9	540044.5	4719.4	0	-90	402	1191	1593	Resource
NSD-039	389494	539748.4	4729.3	0	-90	383	1131.8	1514.8	Resource
NSD-040	390249.4	540050.5	4722.9	0	-90	222	1658	1880	Resource
NSD-041	391796.5	540151.9	4746.9	0	-90	383	1383	1766	Resource
NSD-042	391998.8	538464.7	4793.1	0	-90	460	1053	1513	Resource
NSD-043	393699.3	539451.7	4802.4	0	-90	628	1108	1736	Resource
NSD-044	387296.5	539902.7	4684.9	0	-90	322	445	767	Resource
NSM-001	394139.3	538247.4	4850.5	0	-90	0	1150	1150	Metallurgy
NSM-002	392695.2	538391.1	4809.4	0	-90	507	493	1000	Metallurgy
NSM-003	392892.6	537897.0	4810.2	0	-90	608	420	1028	Metallurgy
NSM-004	393948.5	538702.4	4829.1	0	-90	596	518.3	1114.3	Metallurgy
NSM-005A	393065.2	538976.9	4786.9	0	-90	592	579.5	1171.5	Metallurgy
NSM-006	393997.1	538123.5	4847.5	0	-90	529	688	1217	Metallurgy
NSM-007	394447.2	538182.6	4844.2	0	-90	604	563.9	1167.9	Metallurgy
NSM-008	393344.9	538291.6	4815.6	0	-90	548	725	1273	Metallurgy
NSM-009	392647.8	539150.5	4794.1	0	-90	585	764.1	1349.1	Metallurgy
NSM-010A	390508.5	539236.6	4732.7	0	-90	424	414.9	838.9	Metallurgy
NSM-011	391996.1	539252.3	4774.9	0	-90	540	799.7	1339.7	Metallurgy
NSM-012	391397.3	539202.4	4765.4	270	-70	584	298	882	Metallurgy
NSM-013	394341	536980.7	4881.1	0	-90	404	549	953	Metallurgy

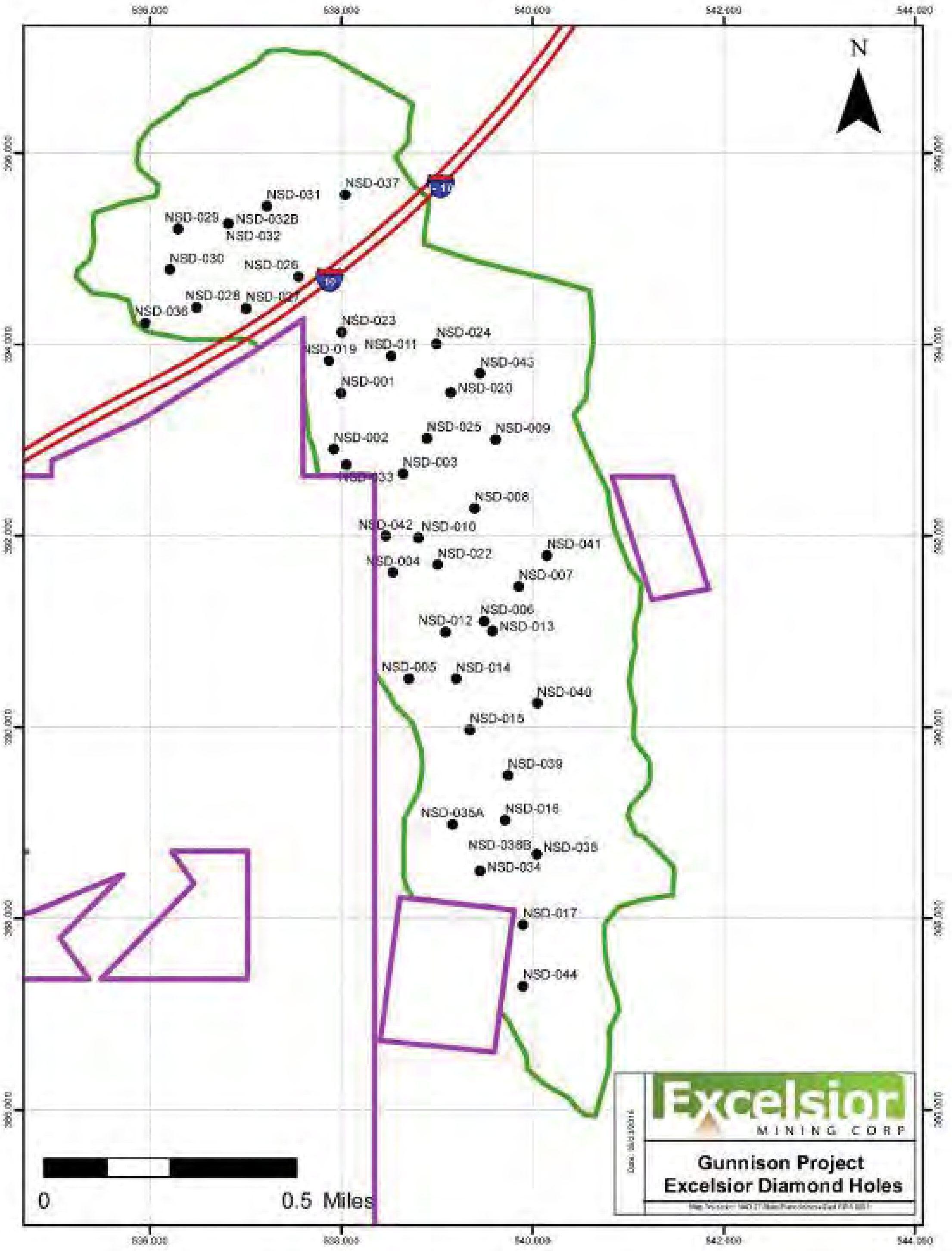


Figure 10-2: Excelsior Drillhole Collar Locations

10.2.1 Excelsior Drill Logging and Sampling Procedures

Following delivery of drill core from the drill sites to Excelsior's core storage facility in Casa Grande, Arizona, the core was laid out to check labeling, identify any missing intervals, and cleaning. Excelsior technicians measured and recorded core loss and RQD. The core was then logged digitally using customized AcQuire data-entry forms, which were then forwarded to the Excelsior database administrator. Additional logging of individual fractures from the borehole geophysical data was done in WellCad software.

The logging geologist marked up the core for sampling and splitting prior to photographing the core. Sample intervals were standardized at 10 feet; however, sample intervals were terminated at lithological boundaries. Other geological factors also led to shorter sample intervals at the discretion of the geologist. The core was then photographed wet and dry, and magnetic susceptibility was measured within each sample interval using a SM-30 handheld susceptibility meter.

Specific-gravity measurements were made using the water-displacement method for every assay sample in zones of mineralization, and every 10 feet outside of mineralized zones. The geologist made the determination on where SG measurements were taken in consideration of mineralized and un-mineralized materials, but measurement intervals most typically respected the assay intervals. The core was not wrapped or waxed for the density measurements. A quartz (SG = 2.65) and marble (SG = 2.71) standards were measured alternatively every 20 samples for quality control of the SG measurements. Readings outside of acceptable limits (three standard deviations) resulted in re-measurement of all samples back to the previous successful standard measurement. Duplicate SG measurements were made every 20 samples.

Samples were split using hydraulic splitters and bagged for shipment to the assay laboratory. Care was taken to ensure that no bias was introduced into the splitting by visually observing the mineralization in the core and splitting appropriately. The fines produced were also manually split and included in the sample.

10.2.2 Excelsior Core Recovery and RQD

Core recovery and RQD were measured for each drill run in every Excelsior diamond drillholes. Recovery was very high (average of 95%) with only rare occurrences of poor recovery due to discrete structures and/or narrow voids. RQD averaged 66%. Table 10-5 below defines RQD and Core Recovery as they relate to the total copper resource domains described in Section 14.2.7. The RQD and recovery values for geotechnical intervals lying within the modeled low-grade and high-grade domains are similar, and are also close to the values for intervals lying outside of the modeled domains.

Table 10-5: Core Recovery and RQD for Excelsior Diamond Drilling 2010 – 2015

	All Excelsior Drilling	Inside Low-Grade Domain	Inside High Grade Domain	Inside All Domains	Outside All Domains
%RQD	66%	63%	67%	65%	68%
% Recovery	95%	96%	96%	96%	95%
Intervals Measured	7,752	2,139	2,309	4,448	3,304

11 SAMPLE PREPARATION, ANALYSES AND SECURITY

The following sections summarize the extent of MDA's knowledge regarding the sample preparation, analysis, security, and quality assurance/quality control protocols used in the various drilling programs at North Star.

11.1 HISTORICAL SAMPLE PREPARATION, ANALYSIS AND SECURITY

The laboratory sample preparation and analytical procedures used by the previous owners of the deposits are unknown. However, the commercial analytical laboratories known to have been used by the historical operators at North Star are, or were at the time, well recognized and widely used in the minerals industry. In addition, all of the historical operators were reputable, well-known mining/exploration companies, and there is ample evidence that these companies and their chosen commercial laboratories followed accepted industry practices with respect to sample preparation, analytical procedures, and security.

For the most part, James Sullivan maintained security of the project information and drill samples since the early 1980's to 2006. Information and samples collected by Superior, Cyprus and Quintana in the 1970's to 1980's were handed over to James Sullivan and relocated to his core facility in Casa Grande, Arizona between 1980 and 1998. Magma Copper had security and control of its own information and samples from approximately 1993 to 1997, after which Magma relinquished control to James Sullivan who relocated all the Magma Copper information and samples to his core facility. Phelps Dodge maintained its information and samples until 1998, after which time they were transferred to James Sullivan and were relocated to his core facility.

From November, 2006 and until October 2010, the original information and samples were under the control of AzTech Minerals at the former James Sullivan core facility. Excelsior has maintained control of the core facility since October 2010.

11.2 EXCELSIOR SAMPLE PREPARATION, ANALYSES AND SECURITY

Excelsior's drill core sampling procedure is as follows:

- Assay tickets are placed at the start of the assay interval.
- Sample intervals are recorded within the AcQuire form as well as written within paper ticket books.
- All skarn and porphyry units are sampled. Additional sampling of rock types and/ or mineralization is left up to the discretion of the geologist, under the guidance with senior staff.
- Sample intervals are based on lithologic boundaries and are not taken across the boundary with the following exceptions:
    - short intervals (~<1 foot) can be included within a larger sample where isolating the unit would be problematic; and
    - thin lithologic units can be included within a larger sample when sampling such a unit is impractical.
- Sample length is 10 feet within all rock types. It is understood that irregular sample lengths may be needed at geological boundaries.
- In areas of poor ground conditions or poor recovery, sample lengths may extend up to 20 feet.
- Samples must be bracketed on either side by an additional sample (no isolated samples).

The core samples were manually split by an Excelsior technician using a hydraulic splitter, with one half placed in a numbered sample bag and the other half retained in the core box. Quality Assurance/Quality Control processes are discussed below in Section 12.3.

11.2.1 Excelsior Analytical Methods

Skyline Assayers and Laboratories (Skyline) in Tucson, AZ has been Excelsior's primary assay lab for drill samples since 2010. Skyline is accredited with international standard ISO/IEC 17025:2005 General Requirements for the Competence of Testing and Calibration Laboratories. Total copper (TCu), acid-soluble copper (ASCu) and cyanide-soluble copper (CNCu) were analyzed. Samples were also assayed for molybdenum in some cases at the discretion of the geologist. Excelsior has no relationship with Skyline other than Skyline being a service provider.

Upon receipt at Skyline, Excelsior's drill samples were lined up and coded into Skyline's lab information system. Any missing, illegible, or damaged samples were reported. Samples were crushed to 70-80% passing minus 10 mesh. The crushed samples were then split and recombined 3 times, and 250 to 280 grams of material were split and pulverized to 95% passing 150 mesh. Washed river rock was used to clean the crusher between samples.

The analytical methods for copper assays are as follows:

Total Cu (TCu) analysis: Samples are digested in a mixture of hydrochloric, nitric and perchloric acids. This solution is heated and taken to dryness. The contents are treated with concentrated hydrochloric acid and the solution is brought to a final volume of 200 mL with de-ionized water. This solution is read by Atomic Absorption using Standard Reference Materials made up in 5% hydrochloric acid.

Sequential Analysis of Acid-Soluble Cu (ASCu) and Cyanide-Soluble Cu (CNCu): Samples are digested in 5% sulfuric acid and supernatant solution is diluted to 100 mL with de-ionized water. The residue is digested in 10% sodium-cyanide solution and diluted to 100 mL. The ASCu samples are read on Atomic Absorption units using 0.5% H_2SO_4 calibration standards. The CNCu samples are read on Atomic Absorption units using 1% NaCN calibration standards.

11.2.2 Excelsior Sample Security

Drilling was carried out 24 hours a day, 7 days a week, during the drilling periods. Drill core was temporarily stored at the drill rig, supervised by both the driller and the site geologist. The drilling occurred on isolated ranch land behind a locked gate, limiting the access to authorized Excelsior and drilling personnel. The core was placed in closed core boxes on pallets and banded for pick up by a transport service. A transfer form was signed by both parties upon pickup and delivery of the core to Excelsior's core facility in Casa Grande. Once in Casa Grande, the core was stored in a locked facility. Core samples ready for assaying were transported from the core facility to the assay laboratory by Skyline personnel.

The sample preparation, analysis, and security protocols of Excelsior for the Gunnison Project meet current industry standards.

12 DATA VERIFICATION

The major contributors to the current North Star deposit database include Excelsior and Cyprus-Superior, with smaller quantities of data from and Quintana and several other companies. MDA experienced no limitations with respect to its activities related to the verification of the project data related to these companies.

No significant issues have been identified with respect to the data provided by Excelsior's quality assurance/quality control ("QA/QC") programs. QA/QC data are not available for the historical drilling programs at North Star, but Excelsior analyses dominate the assays used directly in the estimation of the mineral resources, most of the historical data were generated by well-known mining companies, and the Excelsior drill data are generally consistent with the results generated by the historical companies. MDA believes the North Star data as a whole are acceptable as used in the estimation of the mineral resources presented in this report.

12.1 INTRODUCTION

In order to place the following discussions of database auditing and QA/QC into context, it is helpful to understand the origin of the most relevant project data. There are 122 holes in the project database that were drilled in the North Star deposit area; these holes have a total of 9,996 assayed sample intervals in the database. Of these sample intervals, 7,573 directly contribute data to the estimates of resource grades discussed in Section 14.

Table 12-1 lists the drillholes by company, as well as the percentages of the 7,573 sample intervals that are attributable to each company. Note that the percentages shown for all companies have been adjusted to reflect Excelsior's analyses of historical sample pulps and resampled historical core, as these Excelsior analyses replaced the historical assays in the project database where available.

Table 12-1: Drillhole Data by Company

Company	Hole Series	Number of Holes	Percent of Coded Assays	
			Total Copper	Acid-Soluble Copper
Excelsior	NSD, NSM	44	69%	70.70%
Cyprus - Superior	CS,CYS, J	43	24.00%	24.90%
Quintana	S, T, DC	15	5.50%	2.60%
Magma	MMC	8	0.00%	0.00%
Cyprus	K	2	0.40%	0.50%
Phelps Dodge	SullyI97	2	0.30%	0.10%
Others	D,JS	8	1.20%	1.20%
Totals		122	100.00%	100.00%

12.2 DATABASE AUDITING

12.2.1 Collar Table

Excelsior provided MDA with two spreadsheets described as originating from Darling Environmental & Surveying, Ltd. of Tucson, Arizona – one spreadsheet with 2012 survey data and the other with 2015 surveys. MDA used this information to audit the locations of 71 Excelsior, 26 Cyprus-Superior, 13 Quintana, and 7 Magma drillholes. With the exception of one hole in which the survey location was based on an open hole in the ground, all of the locations of the historical holes were based on drill casing in the ground.

Out of the 117 holes audited, two discrepancies between the database and surveyed locations were identified, one of which was resolved by Excelsior. The other discrepancy involved a Cyprus-Superior hole, whereby the x, y, and z coordinates in the database differed from the survey coordinates provided to MDA by 0.2 to 1.5 feet. The database coordinates are correctly derived from a 2015 survey, while the audit records used by MDA have older coordinates.

In addition to MDA's auditing of the database, "M3, 2014" state that, "*During the author's site visit in 2007, a number of the drillholes locations were checked with a hand held GPS and found to reasonably match the recorded collar coordinated* [sic]."

12.2.2 Survey Table

MDA audited the down-hole deviation survey data for the Excelsior drillholes using both original digital files generated as part of the down-hole geophysical-survey data and scanned copies of original handwritten paper documentation of Reflex EZ-Shot measurements. The survey data for eight of the 45 Excelsior NSD-series core holes were audited, which includes 2,804 individual surveys out of the 10,233 surveys of the Excelsior holes. Six discrepancies between the database and the original records were identified, all in the azimuth readings. Two of the discrepancies exceed 0.1 degrees (0.4 and 0.6 degrees) and none are considered material.

MDA audited down-hole deviation data from three Magma holes and four Cyprus-Superior CS-series holes. No errors were found in the Magma deviations in the project data, which were audited using scans of original paper records from Eastman Whipstock, Inc. The depths of two out of the four CS-holes audited have discrepancies in the depths of the down-hole readings, whereby the down-hole back-up data have readings at depths of 200, 300, and 400 feet, for example, while the database has these same readings at depths of 300, 400, and 500 feet. Excelsior examined all of the data for these two holes and found that the information used by MDA in the audit is actually derived from averaged values of multiple readings over 100-foot intervals. The data used by MDA in the audit represent the "from" depth of each averaged interval, while the database has the same data at the "to" depth. Excelsior is investigating the deviation data for all CS holes in detail, and will make corrections if warranted. However, all of the CS-series holes are vertical, and the dip changes for each 100-foot data point are usually small (the average dip change for each 100-foot interval in the four holes audited is less than 0.4 degrees), so any changes are very unlikely to materially affect the modeling of the project resources.

12.2.3 Assay Table

A total of 6,427 sample intervals were analyzed by Skyline for Excelsior, including intervals from Excelsior drillholes, as well as intervals from historical (pre-Excelsior) core holes and re-analyses of historical sample pulps. MDA obtained and compiled Excelsior's digital analytical data directly from Skyline and used a computer script to complete an automated audit of the database values. A total of 5,141 TCu values and 6,413 CuAS and CNCu (sequential-leach) values were audited using the automated routine. A small number of discrepancies between the Skyline and database values were identified, all but one of which were found to be re-analyses in the database due to quality assurance/quality control issues. No errors were found in the ASCu and CNCu data.

MDA used historical paper records to audit the database values of five CS-series and two J-series holes drilled by the Cyprus-Superior joint venture. Out of the total of 1,858 CS-series sample intervals in the database that have historical analyses, 656 TCu and 650 ASCu values were audited using scanned copies of original American Analytical assay certificates. Five discrepancies were found in the TCu data (<1% of the audited data), only one of which was significant. Six discrepancies in the ASCu data were also identified (<1% of the audited data), with two of them being significant. One of the significant errors in the ASCu data is from the same sample interval as the single significant TCu error; these are the result of incorrect repeating of the analyses from the previous sample interval in the hole. Excelsior found that the other discrepancies are due to the derivation of the database values from handwritten geologic logs, as opposed to the copies of the original assay certificates used by MDA in the auditing; Excelsior corrected their database to match the values on the certificates.

In the J-series holes, 173 TCu values and 103 ASCu values in the project database were checked against typed Cyprus Mines assay sheets; there are 425 J-series sample intervals in the project database. No discrepancies were identified.

12.3 QUALITY ASSURANCE/QUALITY CONTROL PROGRAMS

12.3.1 Historical QA/QC

QA/QC data are not available for any of the historical drilling programs, if any ever existed. Excelsior has attempted to validate, and has partially replaced, the historical assay data through a resampling and re-assaying program.

12.3.2 Excelsior QA/QC

The QA/QC program instituted by Excelsior for the North Star 2011 to 2015 drilling programs included the systematic analyses of certified analytical standards, coarse blanks, and field duplicates. Skyline performed copper analyses on all of Excelsior's original drill samples and their related QA/QC samples. The QA/QC program was designed to ensure that at least one standard, blank, or field duplicate was inserted into the drill-sample stream for every 10 drill samples. The 2011 and 2012 drill programs also employed check assaying by ALS. All holes drilled by Excelsior at the North Star deposit have been subject to this QA/QC program.

12.3.3 Certified Standards

Certified standards were used to evaluate the analytical accuracy and precision of the Skyline analyses during the time the drill samples were analyzed. Two certified standards were purchased from African Mineral Standards ("AMIS"), located in Eastern Johannesburg, South Africa. These standards were chosen by Excelsior because they are derived from oxidized copper deposits. The certified values and standard deviations for these standards are listed in Table 12-2.

Table 12-2: Excelsior Certified Standards

Standard ID	Standard Source	Certified Value (TCu%)	Standard Deviation (%)	Standards Analyzed
AMIS0118	AMIS	0.4615	0.0135	419
AMIS0249	AMIS	0.3692	0.0072	42

Prior to each drilling campaign, Excelsior attempted to obtain certified standards for ASCu but could not locate any.

Of the standards listed in Table 12-2, only the 301 standards submitted with Excelsior NSD-series core holes were evaluated by MDA, all of which were the AMIS0118 standard. Standards submitted with samples from the NSH-series rotary holes were not reviewed; these drill data were not used in the resource estimation.

Excelsior assigned sample numbers for the standards in sequence with their accompanying drill samples, and the standards were inserted into the drill-sample stream submitted for analysis.

Figure 12-1 charts the Skyline analyses of standard AMIS0118.

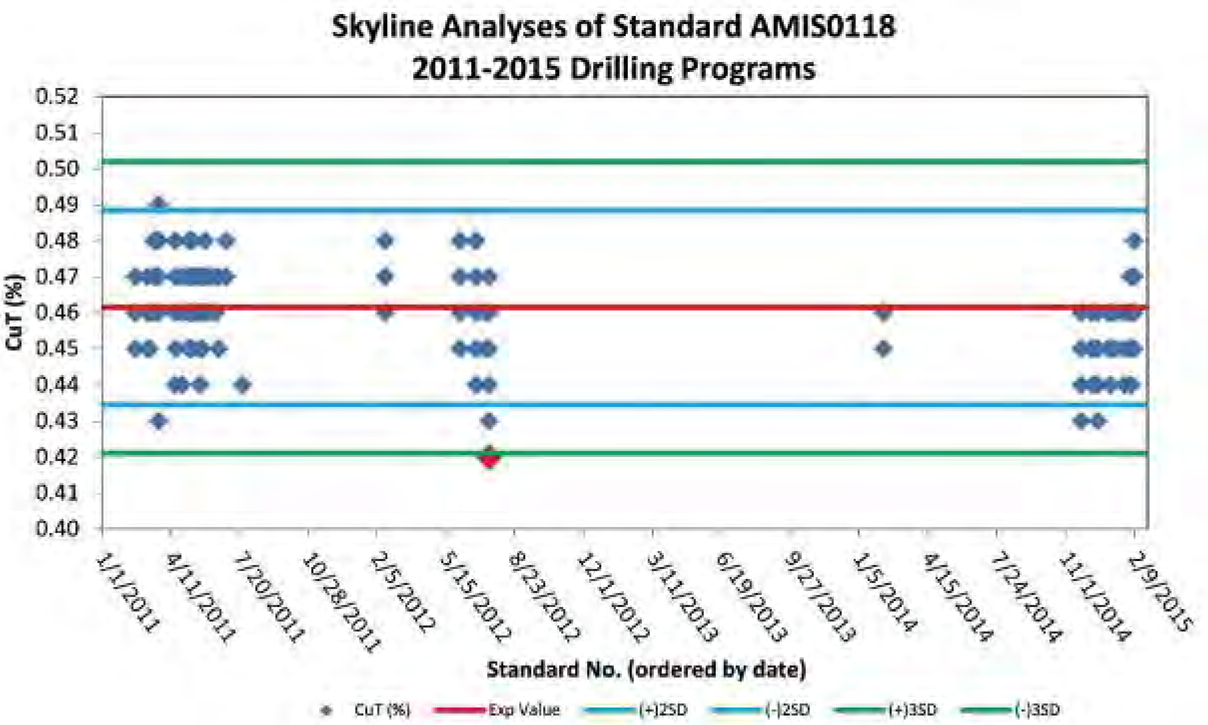


Figure 12-1: Plot of Certified Standard AMIS0118 Analysis

In the case of normally distributed data, 95% of the standard analyses are expected to lie within the two standard-deviation limits (shown as blue lines) of the certified value (shown as the red line), while only 0.3% of the analyses are expected to lie outside of the three standard-deviation limits (green lines). Samples outside of the three standard-deviation limits are therefore considered to be failures. As it is statistically unlikely that two consecutive analyses of standards would lie between the two and three standard-deviation limits, such samples could be considered failures, unless further investigation proves otherwise.

Only one sample of the 301 assays evaluated lies outside the three standard-deviation limits, and therefore could be considered as a failure (shown as a red diamond in Figure 12-1). However, the failure exceeds the limit by only 0.001% Cu. If the certified standard values and standard deviations were rounded to two decimal places, as the Skyline assays are, instead of three, this standard analysis would not be considered a failure.

There is one case of consecutive analyses that lie between the two and three standard-deviation limits, and these two analyses were performed in the same laboratory batch. However, one of the standards lies above the two standard-deviation limits while the other is below, an instance worth investigating further but that does not qualify as a 'failure'.

Table 12-3 compares the mean of Skylines analyses of the standard against its certified value.

Table 12-3: Skyline Analyses of Standard AMIS0118

Drill Program	Standard Analyses		Count
	Mean	%Diff	
2011	0.47	1.00%	178
2012	0.46	-0.50%	43
2014 - 2015	0.45	-1.80%	80
All	0.46	0.10%	301

The data reviewed indicate no bias in the Skyline analyses of the standards inserted with the 2011 and 2012 drill samples, with a slight low bias of about 2% in Skyline's analyses of the standards associated with the 2014-2015 drill samples.

12.3.4 Coarse Blanks

Coarse blanks are samples of barren material that are used to detect possible laboratory contamination, which is most common during sample-preparation stages. Therefore, in order for analyses of blanks to be meaningful, they must be sufficiently coarse to require the same crushing and pulverizing stages as the drill samples. It is also important for blanks to be placed in the sample stream within a series of mineralized samples, which would be the source of most contamination issues.

Blank results that are greater than five times the lower detection limit of the analysis are typically considered failures that require further investigation and possible re-assay of associated drill samples (0.05% and 0.005% Cu for the Excelsior copper analyses, based on the 0.01% and 0.001% Cu detection limits, respectively).

Excelsior used landscape river rock purchased from a local home-improvement store as coarse blank material. These blanks were coarse enough to require the same primary and secondary crushing applied to the drill samples.

A total of 236 coarse-blank analyses were analyzed from the 2011 through 2015 drill programs. Of these, 47 were associated with drillholes not used in resource estimation (NSH-series holes), leaving a total of 189 blanks with TCu, ASCu, and/or CNCu analyses that were evaluated by MDA. Of these, 126 blanks were preceded by mineralized (above background) drill samples.

There were no failures in the TCu analyses of the blanks and no systematic contamination issues were found in the blank analyses. While two 0.007% ASCu analyses of blanks slightly exceeded the threshold limit of 0.005%, these clearly are not material to the resource modeling discussed in Section 14.

12.3.5 Field Duplicates

Field duplicates are secondary splits of drill samples. Field duplicates are mainly used to assess inherent geologic variability and subsampling variance. The field duplicate samples were submitted to Skyline with, and immediately following, their associated original drill samples. Only drillholes used in the resource estimate, all of them core holes, are considered in this discussion. Duplicate samples produced by other drilling methods, such as the NSH-series holes which employed conventional-rotary drilling, were not evaluated.

In the case of Excelsior's core drilling, field duplicates consisted of quarter core splits, with the paired originals being half core splits; (quarter)¼-core was left in the core library. The field duplicates were collected at regular intervals which resulted in a large percentage of duplicates being derived from original samples with values at or below the analytical detection limit.

A total of 107 core duplicates were collected by Excelsior and analyzed by Skyline. The core-duplicate data for TCu are presented in Figure 12-2; 17 pairs in which both the duplicate and original analyses are below the detection limit were removed from the dataset.

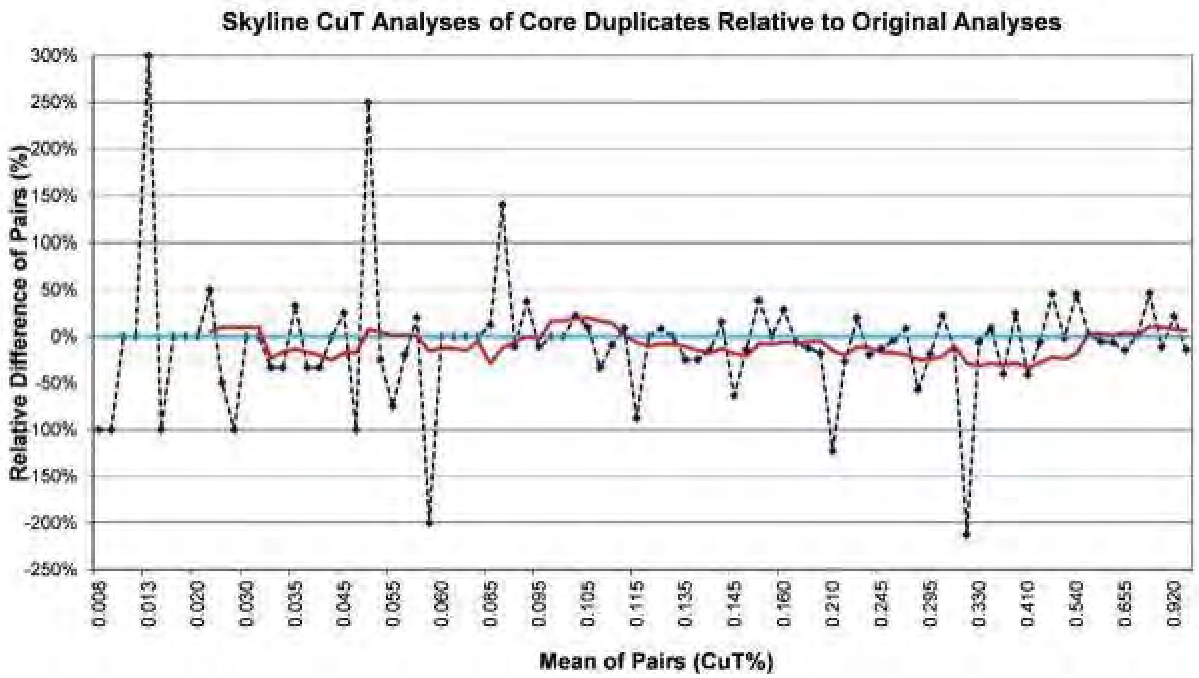


Figure 12-2: Core – Duplicate TCu Analyses Relative to Original Assays

Figure 12-2 is a relative-difference graph, which shows the percentage difference (plotted on the y-axis) of each duplicate assay relative to its paired original analysis. The x-axis of the graph plots the means of the TCu values of the paired data in a sequential, non-linear fashion. The red line is the moving average of the relative differences of the pairs and provides a visual guide to trends in the data. Positive relative-difference values indicate that the duplicate analysis is greater than the original. Relative-difference graphs are very useful in determining biases in the data that may not be evident using basic descriptive statistics.

The TCu mean of the core-duplicate analyses is 4% lower than the original samples, but this difference decreases to 2% if the single duplicate pair at a mean of the pair ("MOP") of 0.330% is removed from the dataset. While there is an indication of a low bias in the core duplicates relative to the originals in the MOP range of ~0.15 to ~0.4% TCu, there are insufficient data to make statistically meaningful conclusions. The average of the absolute values of the relative differences is 25% at a MOP cutoff of 0.1% TCu, indicating a moderate amount of variability between the original and core-duplicate assays.

Figure 12-3 shows the 80 core-sample field-duplicate pairs for ASCu in which both the originals and duplicates were above the lower detection limit; 27 pairs with both below the detection limit were excluded. The mean ASCu grade of the core duplicates is 3% lower than the mean of the original analyses, although the means are identical if five pairs with relative differences exceeding ±150% are removed. The average of the absolute values of the relative differences is 34% at a MOP cutoff of 0.1%, lowering to 23% if the five high relative-difference pairs are removed. As with the TCu data, there is a suggestion of a low bias in the ASCu analyses of the core duplicates in the MOP range of ~0.08 to 0.2%, but no statistically valid conclusions can be drawn due to insufficient data in this grade range.

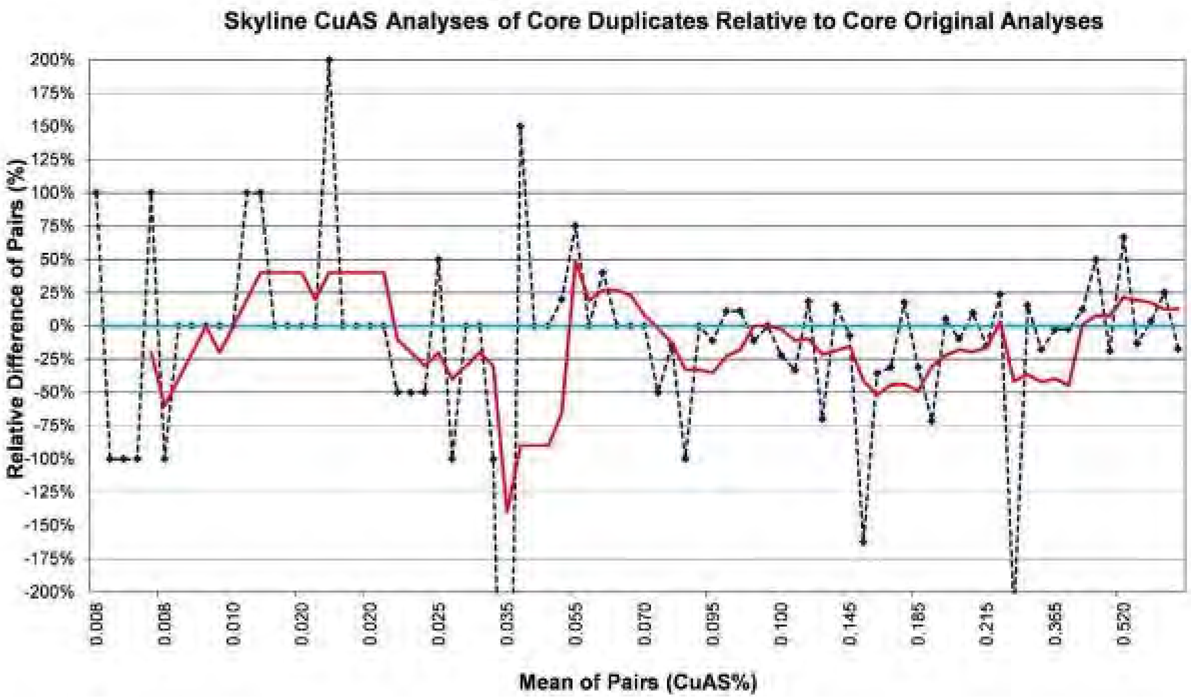


Figure 12-3: Core – Duplicate Analyses Relative to Original ASCu Assays

The mean of the ASCu/TCu ratios derived from the core duplicates is identical to that of the original analyses for all pairs where both TCu analyses exceed 0.03% (low TCu values can lead to meaningless ratios).

While these statistical analyses of the core-duplicate TCu and ASCu show no statistically significant issues, more data are needed to properly evaluate Excelsior's subsampling of the core.

12.3.6 Replicate Analyses

Replicate analyses are secondary splits of the original sample pulps that are analyzed by the original laboratory in the same assay batch as the original analysis. These are mainly used to assess variability instilled by the subsampling of the pulp and the analysis itself.

The replicate analyses were analyzed regularly by Skyline as part of its internal QA/QC program. Only the 814 replicates of samples derived from Excelsior's NSD core holes are evaluated in this discussion.

The TCu replicate data are presented in Figure 12-4; 138 pairs in which both the duplicate and original analyses are below the detection limit were removed from the dataset.

No bias is evident in the replicate data, and the means of the replicates and the originals are identical at a range of MOP cutoffs. Removal of extreme relative-difference pairs does not affect the means of the datasets because they occur on both sides of the 0% line. Variability of the replicate data is low, as measured by the average of the absolute values of the relative differences, which is 4% for all of the data and 2% at a MOP cutoff of 0.1%.

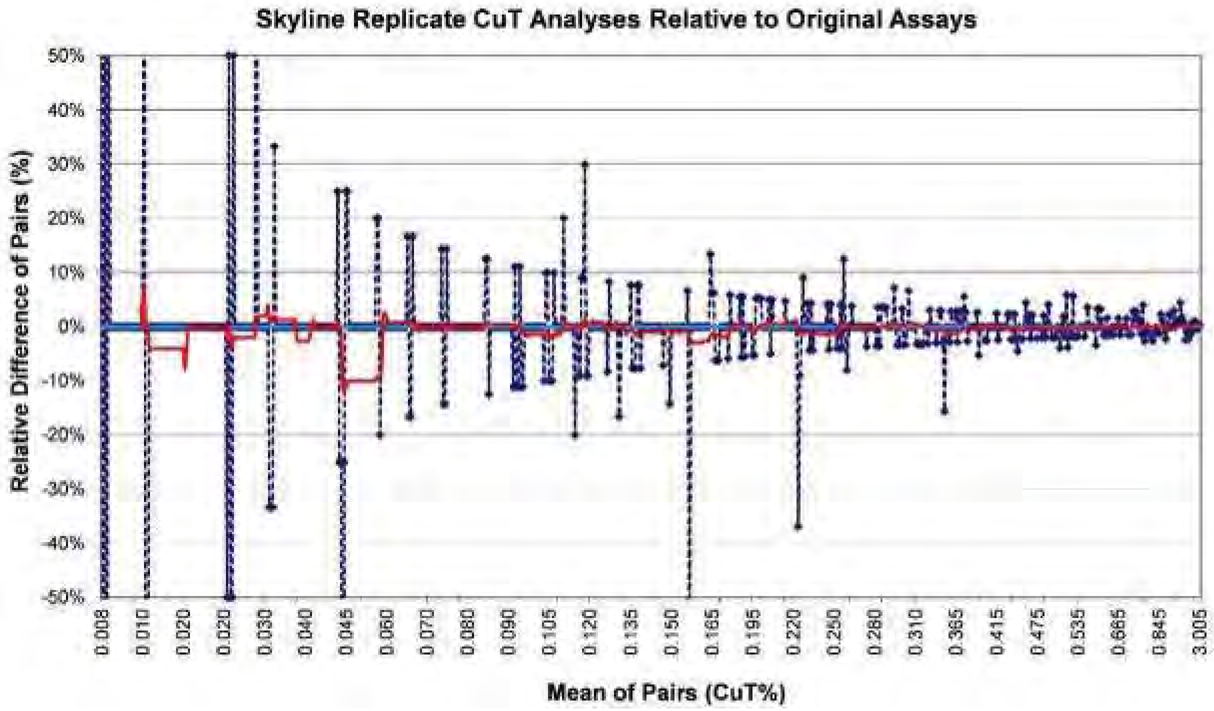


Figure 12-4: Replicate TCu Analyses Relative to Original Assays

Figure 12-5 shows the 975 of 1,289 total replicate-original pairs for ASCu in which both the originals and duplicates were above the lower detection limit; 314 pairs in which both analyses are below the detection limit were excluded. The relative differences displayed at the lowest-grade portion of the ASCu chart are an artifact of variable detection limits that cause extreme, but artificial, variability.

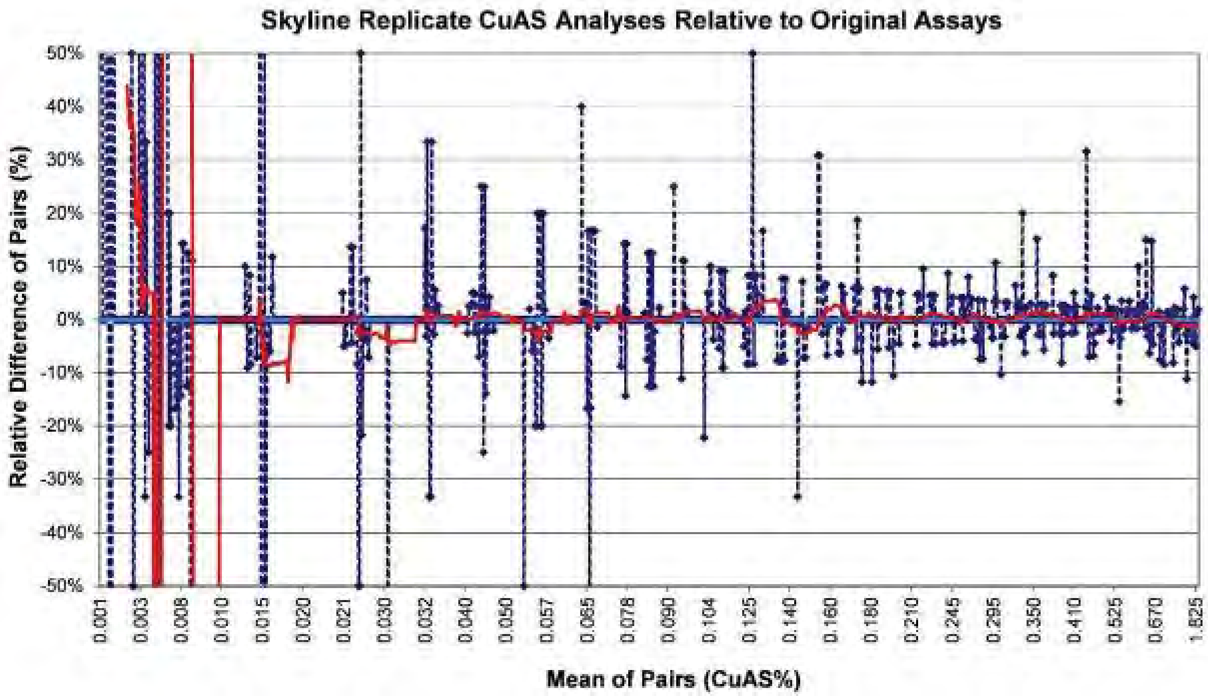


Figure 12-5: Replicate ASCu Analyses Relative to Original Assays

As with TCu, no bias is evident in the ASCu replicate data, and the means of the replicate and original analyses are identical. The average of the absolute values of the relative differences is ~3% at a MOP cutoff of 0.1% ASCu, which indicates slightly higher variability than for TCu.

The mean of the ASCu/TCu ratios derived from the replicate analyses (0.52) is slightly lower than that of the original analyses (0.53) in pairs where both TCu analyses exceed 0.03%.

12.3.7 Check Assays

As a further check on analytical accuracy, Excelsior selected a portion of the original sample pulps from each yearly drill program and sent these to ALS for re-assaying of the original Skyline pulps. Roughly every 20th sample, or approximately 5% of the total sample data, was selected for re-assay. A total of 220 pulps from the 2011, 2012 and 2014/2015 programs were sent to ALS for check assaying.

Figure 12-6 compares the ALS check TCu assays to the original Skyline assays from NSD-series core holes from the 2011 and 2012 drilling programs, the ALS check-assay results from which are very consistent. Eight data pairs in which both the check and original analyses are less than the detection limit are removed. Their graph shows a very consistent low bias of about 5% in the ALS check assays relative to the Skyline original analyses at MOP greater than about 0.07% TCu. The variability of the duplicate TCu analyses above this MOP is ~7%.

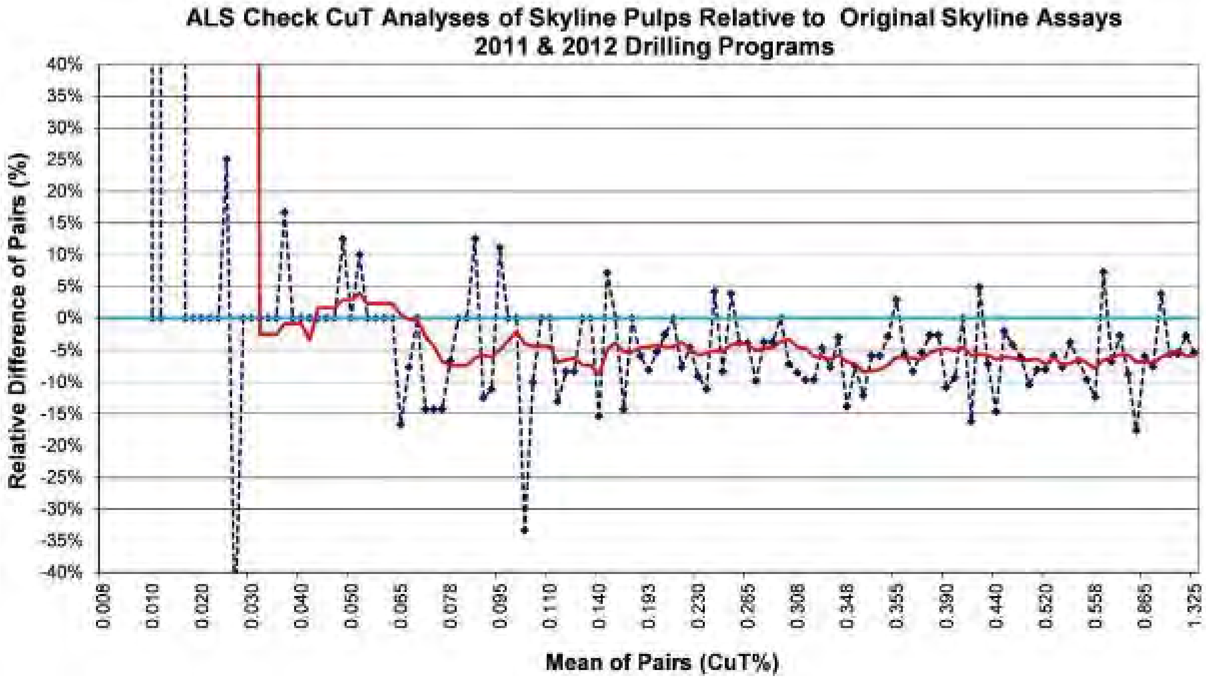


Figure 12-6: ALS Check TCu Assays Relative to Original Skyline Analyses

The check-assay data for ASCu for the 2011 and 2012 drilling programs are very similar to the TCu data, with a consistent low bias in the ALS analyses in this case of about 8% to 10% relative to the original Skyline assays. The variability of the ASCu duplicate pairs is ~10%.

The check-assay data for the 2014-2015 drilling program yield different results. While there are fewer duplicate pairs, with only 29 pairs above a MOP cutoff of 0.1% TCu, the ALS check TCu assays of the samples from the 2014-2015 program are higher than the original assays up to a MOP grade of ~0.3% TCu, although the extent of the high bias continually decreases over this grade range; in the range MOP range of 0.1 to 0.3% TCu, the ALS analyses are ~5% higher than the original assays. It is worth noting that the Skyline standard analyses for the 2014-2015 drilling program are also biased low. The limited data above the 0.3% TCu cutoff shows reasonably close agreement between the check and original analyses. The variability in the paired data is ~5% above a MOP cutoff of 0.1% TCu.

The ASCu paired data is again similar to the TCu data for the 2014-2015 drilling program, with a high bias in the check assays of about 10% up to a MOP of ~0.07% ASCu. At higher grades, the check analyses are close to the original analyses. Variability is ~4% above a MOP cutoff of 0.05% ASCu.

Excelsior included standard pulps with the submissions of Skyline drill-sample pulps to ALS for check assaying at the end of each drill program. ALS analyzed a total of 28 AMIS0118 standard pulps in the check assaying of pulps from the 2011 and 2012 drilling programs and three AMIS0249 standards with the 2014-2015 sample pulps. Figure 12-7 charts the results of the ALS analyses of standard AMIS0118 from the 2011 and 2012 drilling programs, and Table 12-4 summarizes the results for all ALS analyses of the standards.

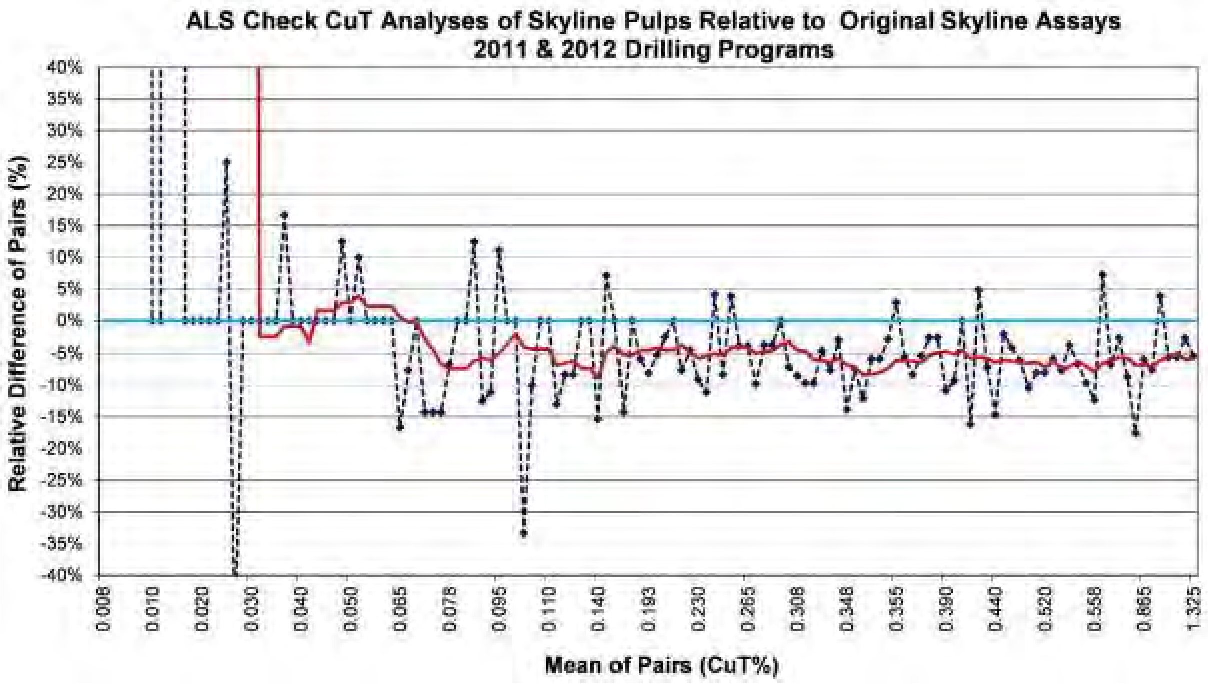


Figure 12-7: Plot of ALS Check Assay Analyses of Standard AMIS0118

Table 12-4: Summary of ALS Analyses of Standards from Check – Assaying Programs

Drill Program	ALS Mean	Certified Value	%Diff	Count
2011 & 2012	0.44	0.4615	-4.70%	28
2014 & 2015	0.36	0.3692	-3.00%	3

The 2011 and 2012 ALS TCu analyses of AMIS0118 are systematically biased low at a level consistent with the low bias in the ALS analyses of 2011 and 2012 Skyline drill-sample pulps relative to the original Skyline analyses. While the 2014-2015 ALS analyses of the three AMIS0249 are slightly low, there are insufficient standard analyses to determine a definitive bias. Excelsior does not have ASCu standards.

In the evaluation of the TCu and ASCu check-assay data, it is important to note that the analytical procedures employed by ALS differed significantly from those used by Skyline. Skyline analyzed TCu by atomic absorption following multi-acid digestion. A sequential-leach procedure was performed separately for the ASCu and CNCu analyses. In the case of ALS, ASCu and CNCu were also obtained from sequential-leach analyses. A third analysis was then run on the residua of the sequential-leach analyses. TCu is indirectly determined by adding the three values (ASCu + CNCu + residual Cu). This means that an error in any of the three analyses will similarly affect the calculated TCu value as well. It is unfortunate that ALS did not complete TCu analyses directly on the sample pulps in addition to the sequential-leach analyses.

12.3.8 Excelsior Inter – Laboratory Check Program

In light of the discrepancies between the original Skyline and ALS check assays, “M3, 2014” recommended additional inter-laboratory check-assaying programs. Following these recommendations, Excelsior selected 30 coarse rejects from the original Skyline drill samples at the end of each of the 2011, 2012, and 2014-2015 drill programs and sent them to ALS. ALS prepared and analyzed the 30 pulps at the end of each program and then sent the pulps to Skyline for check assaying.

MDA completed a detailed analysis of this inter-laboratory program using techniques described above for the other duplicate datasets. The data were examined as a whole as well as by drill program. Consistent TCu and ASCu biases were found between the ALS analyses and both the Skyline check assays of the ALS pulps and the original Skyline analyses of the drill core for all three drill programs. In all cases, the Skyline TCu and ASCu analyses are biased high relative to those of ALS. These biases are consistent with those identified in the original check-assaying of the 2011 and 2012 drilling programs discussed above, but are not consistent with the check-assay data from the 2014-2015 program.

Table 12-4 compares the means of the original Skyline analyses of core, the ALS analyses of the Skyline coarse rejects, and the Skyline check analyses of the ALS pulps. One of the 90 samples was removed from due to an extreme outlier in a 2011 ASCu analysis. Based on detailed reviews, as well as the exclusion of this single outlier sample, MDA believes the means shown in Table 12-5 provide a reasonable summary of the results of the inter-laboratory check program.

Table 12-5: Summary of the Inter – Laboratory Check Program

	2011			2012			2014-2015			All Data					
	Skyline		ALS	Skyline		ALS	Skyline		ALS	Skyline		ALS	Skyline	ALS vs Skyline	
	Core	ALS Chk	Cse Rej	Core	ALS Chk	Cse Rej	Core	ALS Chk	Cse Rej	Core	ALS Chk	Cse Rej	Chk vs Core	vs. Core	vs Chk
TCu	0.52	0.53	0.5	0.79	0.79	0.77	0.35	0.35	0.34	0.55	0.56	0.54	0.40%	-3.20%	-3.60%
ASCu	0.4	0.42	0.39	0.66	0.64	0.63	0.21	0.23	0.2	0.43	0.43	0.41	0.90%	-4.50%	-5.30%
ASCu/TCu	0.76	0.79	0.77	0.84	0.8	0.8	0.6	0.65	0.59	0.73	0.75	0.72	2.30%	-1.20%	-3.50%
CNCu	0.007	0.008	0.009	0.026	0.037	0.017	0.048	0.04	0.032	0.27	0.022	0.022	7.40%	18.50%	24.10%

Note: one 2011 sample removed due to spurious ASCu analysis

In contrast to the Skyline – ALS biases, comparisons between the original Skyline analyses and the Skyline check analyses of the ALS pulps (which are derived from Skyline coarse rejects) show no biases. The close correspondence between the two sets of Skyline analyses suggests that laboratory sample preparation is not the cause of the Skyline – ALS biases. This leads to the conclusion that the biases are probably rooted in either the subsampling of pulps to obtain aliquots for analysis or in the analyses themselves; MDA believes the former explanation is very unlikely.

Excelsior inserted standards with the coarse rejects analyzed by ALS and the ALS pulps analyzed by Skyline (Table 12-6). All of the ALS and Skyline analyses of these standards yielded values within two standard-deviations of the certified standard grades. While the data are not sufficient to derive definitive conclusions, the Skyline analyses of the standards tend to be higher than the certified values in the 2011 and 2014-2015 data, while the ALS analyses are generally lower. Note that Skyline's much more numerous analyses of the same standard inserted with the original drill samples show no high bias whatsoever.

Table 12-6: Skyline and ALS TCu Analyses of Standards – Inter – Laboratory Program

Drilling Program	Standard		ALS		Skyline	
	Certified Value	Std Dev	Analysis	%Diff	Analysis	%Diff
2011	0.4615	0.0135	0.45	-2.50%	0.48	4.00%
			0.49	6.50%	0.48	4.00%
			0.45	-2.50%	0.47	1.80%
2012	0.4615	0.0135	0.47	1.80%	0.46	-0.30%
			0.46	-0.30%	0.46	-0.30%
			0.45	-2.5	0.45	-2.50%
2014-2015	0.3692	0.0072	0.365	-1.10%	0.38	2.90%
			0.355	-3.8	0.38	2.90%
			0.355	-3.80%	0.38	2.90%

12.3.9 Summary of Excelsior QA/QC Results

No significant issues were identified in the results of Skyline's TCu and ASCu analyses of the certified standards, coarse blanks, and replicates. While the TCu and ASCu analyses of the core duplicates are slightly lower than the original analyses over certain TCu and ASCu grade ranges, there are insufficient data at these grades to allow for definitive conclusions.

The check-assay data indicate that Skyline TCu and ASCu analyses are systematically higher (~5% for TCu and ~8% for ASCu) than ALS at relevant grades for the two copper species. ALS analyses of standards inserted with the drill-sample pulps for check assaying are systematically ~5% lower than the certified values, however, while Skyline analyses of the same standards submitted with the original drill samples show no biases or other issues. The inter-laboratory program undertaken to further examine the ALS versus Skyline discrepancies accomplished little more than largely confirming the biases identified in the check-assaying program. Based on all of these data taken as a whole, as well as the differences between the analytical methods employed by Skyline and ALS, MDA concludes that there are no significant issues with the Skyline TCu analyses of the original Excelsior drill samples, although there may be a slight low bias in the 2014-2015 data.

The accuracy of the ASCu analyses in the project database cannot be directly assessed. An ASCu analysis only measures a portion of a sample's copper content, and this portion will vary laboratory to laboratory based on the specifics of the analytical methodologies. Key variables include the leaching time, the temperature of the leach solution, the strength of the leach solution, and the degree of agitation. In other words, there is no 'correct' value for ASCu in any particular sample. What is important to any particular project, however, is the consistency in the ASCu analyses, which in the case of North Star can be evaluated by examining the ASCu/TCu ratios of the core duplicates and the replicate analyses. In both cases, the differences between the duplicate and original ratios are very close (less than one percent). MDA finds no issues with the ASCu analyses in the project database.

The core-duplicate data are useful in estimating variability in the copper analyses that is attributable to geological heterogeneity, subsampling by Excelsior and the laboratory, and analytical precision. At a cutoff of about 0.1% for both TCu and ASCu, the variability in the core duplicates is about 20%. Since the core duplicates are comprised of ¼-core samples, and the original drill samples are ½-core samples, this variability probably overstates the variability inherent in the original ½-core samples. The data therefore suggest that the total uncertainty in any single TCu or ASCu analysis in the existing North Star data is less than ± 20%. Approximately 3% of this total is attributable to analytical precision, as evidenced by the replicate data.

12.3.10 QA/QC Recommendations

MDA recommends that Excelsior consider the following changes to their QAQC protocols:

- The addition of two certified TCu standards, one at a grade lower than the standard presently in use and the other at a higher grade;
- The addition of preparation duplicates to the QA/QC protocols. Preparation duplicates are analyses by the primary assay laboratory of second pulps prepared from the original coarse rejects. These duplicates monitor the subsampling undertaken by the primary lab;
- The TCu and ASCu analytical procedures used by the check-assay laboratory should be identical to those used by Excelsior's primary lab; and
- The use of the present inter-laboratory check program should be terminated. In the event that discrepancies between check assays and the original analyses cannot be resolved by the laboratories' analyses of certified standards, the check-assay pulps should be sent to a third 'umpire' lab along with the same standards analyzed by the primary and check-assay labs.

12.4 EXCELSIOR RESAMPLING AND RE-ASSAYING OF HISTORICAL CORE AND SAMPLE PULPS

12.4.1 Resampling of Cyprus – Superior Drill Core

Core Duplicates: Excelsior resampled selected intervals of Cyprus-Superior core from holes CS-02 and CS-06 and sent the 40 core-duplicates to Skyline for preparation and analysis. "M3, 2014" state that the mean of the Skyline TCu analyses is 12% lower than the mean of the original analyses (0.37 *vs*. 0.42%, respectively), and the mean of the Skyline ASCu analyses is 8% lower (0.21 versus 0.23%). "M3, 2014" concluded that "*these results indicate that* [the original analyses] *may be biased high relative to Skyline for* [TCu and ASCu]*, but the number of pairs is too small and the scatter of points too large to confirm that a systematic bias is present.*" MDA independently analyzed the data and agrees with this conclusion. While the potential bias is more evident in the TCu data than ASCu, the mean of the ASCu/TCu ratios of the original and core-duplicate datasets are very close, which suggests any bias in the Skyline TCu data is mirrored in their ASCu analyses. Approximately 25% of the data directly used in the estimation of TCu and ASCu resource grades are derived from the original Cyprus-Superior analyses.

12.4.2 Pulp – Check Analyses and Resampling of Quintana Drill Core

Core Duplicates: The core from 101 sample intervals in holes T-01 and T-05 was resampled by Excelsior and analyzed for TCu by Skyline). A systematic low bias in the Skyline analyses is evident at mean grades of the pairs greater than ~0.08% TCu, and the mean of the Skyline analyses is 10% lower than the mean of the original assays.

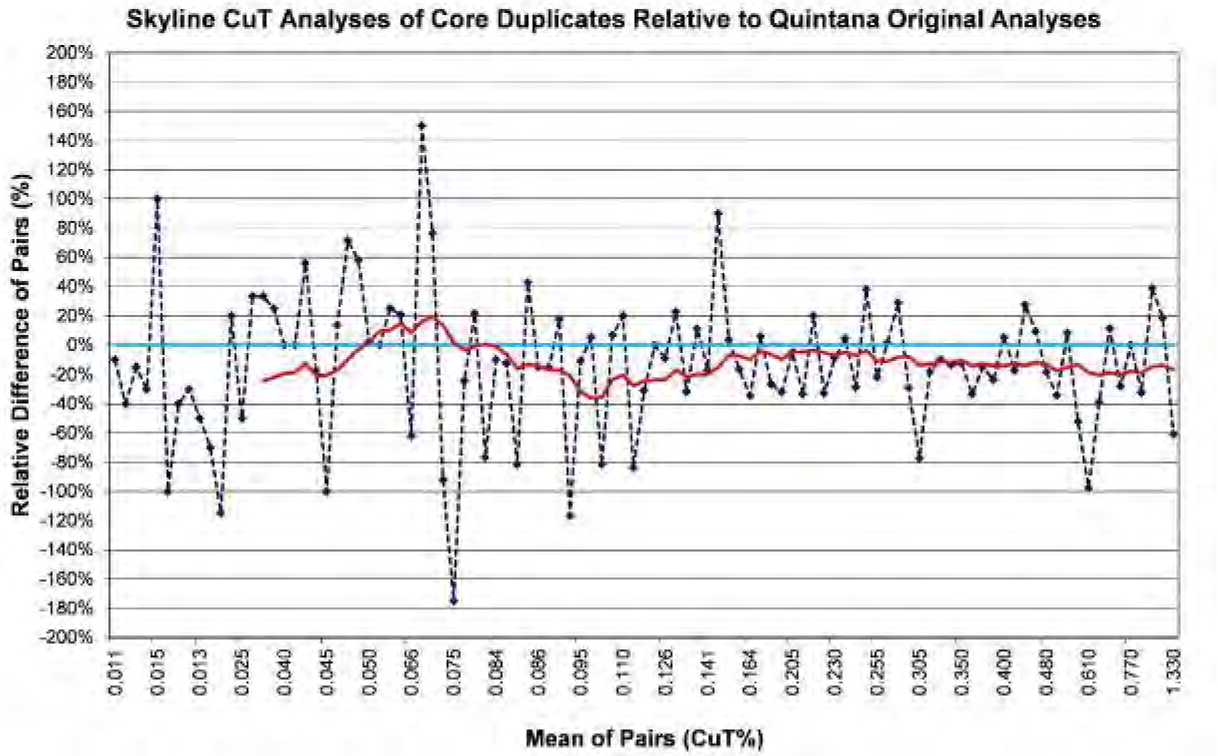


Figure 12-8: Skyline TCu Analyses of Core Duplicates Relative to Original Quintana Assays

Skyline also completed ASCu analyses on 274 core duplicates from seven T-series holes and holes S-3 and DC-09 (Figure 12-8).

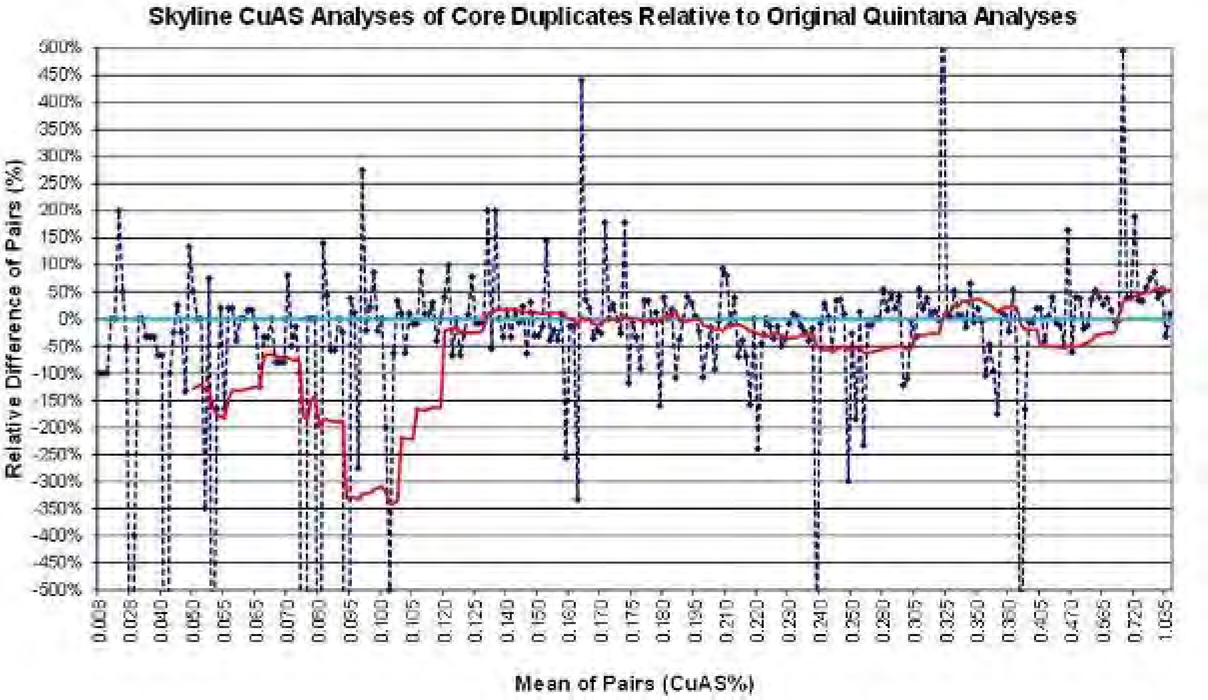


Figure 12-9: Skyline ASCu Analyses of Core Duplicates Relative to Original Quintana Assays

The mean of the Skyline data is close to the mean of the original analyses (1% higher). However, the Skyline mean includes an anomalous number of instances in which the Skyline analyses are significantly lower than the originals (as seen in pairs with relative differences >~-150 to -200%). These pairs, in part, lead to an apparent low bias in the Skyline analyses for pairs with means up to about 0.1% ASCu, as well as in the range of ~0.2 to 0.3% ASCu.

MDA also investigated the core-duplicate data for the 58 sample intervals within the dataset in Figure 12-9 for which paired ASCu analyses are available. These pairs also show a low bias in the Skyline analyses within a similar range of the MOP of ~0.15 to ~0.3% ASCu, although there are not enough data to make definitive conclusions. The mean of the Skyline ASCu/TCu ratios is identical to the mean of the ratios of the original analyses.

Re-Assays of Original Pulps: Skyline completed ASCu analyses on original Quintana sample pulps from seven T-series holes (S-01, S-04, and DC-09). A total of 331 of these pairs are compared in Figure 12-9.

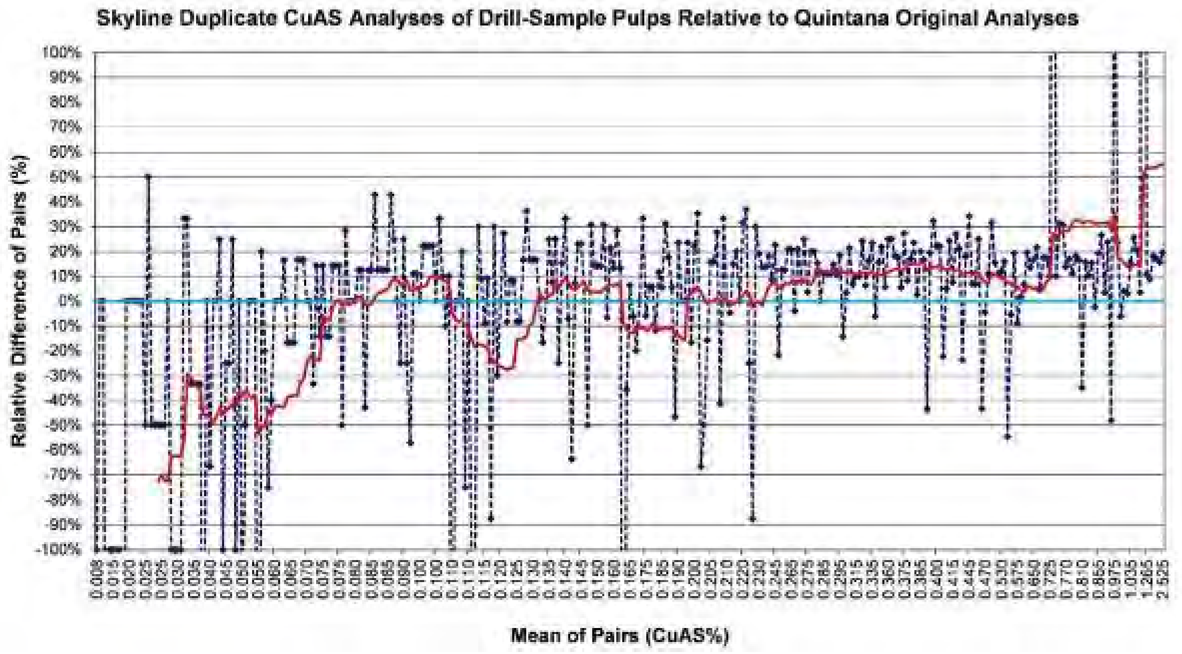


Figure 12-10: Skyline ASCu Analyses of Pulp Relative to Original Quintana Assays

The mean of the Skyline analyses of the original pulps is 12% higher than the original assays (0.30 *vs*. 0.27% ASCu, respectively); removal of all pairs with relative differences >100% decreases the difference to 9%. A strong and systematic high bias in the Skyline analyses is seen at MOP's greater than about 0.25% ASCu.

There is a distinct bias in the pairs with relative differences in excess of about 40%, and relative differences of this magnitude are high for check analyses of pulps. Instances in which the Skyline analyses are significantly lower than the originals dominate these pairs. If not for these high relative-difference pairs, the high bias in the Skyline analyses would be exacerbated, and it would extend the bias to MOP's greater than ~0.12% ASCu. There are no Skyline TCu analyses that accompany this ASCu dataset.

Quintana TCu and ASCu analyses in the project database represent 5.5% and 2.6%, respectively, of the data directly used in the estimation of the project resources.

12.4.3 Resampling of Magma Copper Drill Core

Core Duplicates: Excelsior resampled historical Magma drill core and sent the 519 core-duplicate samples to Skyline for preparation and analysis of both TCu and ASCu. Skyline's core-duplicate results differ significantly from the original Magma analyses, which led Excelsior to completely replace the Magma analytical data with analyses of resampled core. The Skyline TCu analyses of the core duplicates are compared to the original analyses in Figure 12-10. While the ASCu comparison is similar that shown in Figure 12-11, the magnitude to the differences in the two datasets is less. This leads to the Skyline mean of the ASCu/TCu ratios (0.74) in the duplicate analyses being significantly higher than the mean of the ratios of the original analyses (0.62).

Note that the pairs with extreme relative differences are highly biased towards those in which the Skyline analyses are lower than the originals.

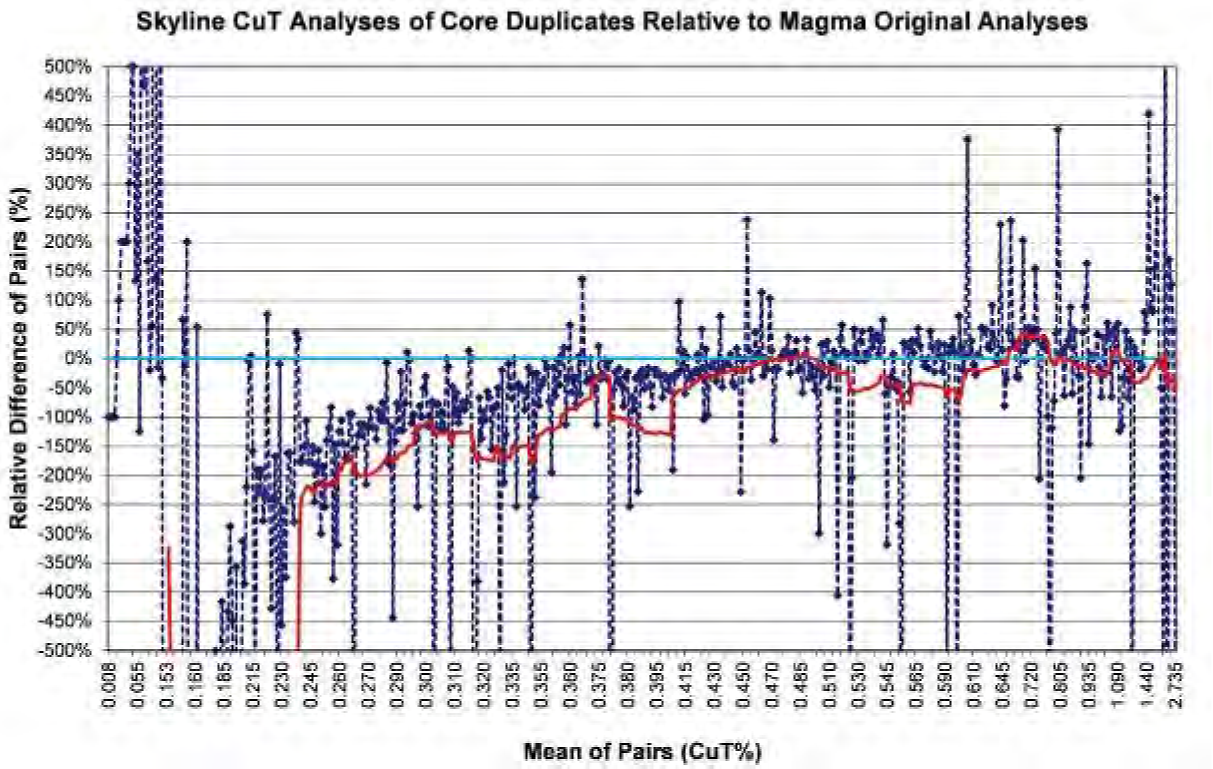


Figure 12-11: Skyline TCu Analyses of Core Duplicates Relative to Original Magma Assays

Excelsior completely replaced all original Magma assays in the project database with Skyline's duplicate-core analyses.

12.5 INDEPENDENT VERIFICATION OF MINERALIZATION

MDA visited the Gunnison Project core shack on January 15, 2015. Core from several holes drilled at the North Star deposit was examined, and procedures for logging, sampling, sample handling, and SG determination were reviewed. A site visit was conducted on January 16, and a review of digital data was undertaken at Excelsior's Phoenix office.

MDA did not collect samples of core for the purposes of verifying the presence of copper mineralization at North Star. Outcrops a short distance to the east of the deposit with visible copper-oxide mineralization were inspected and significant copper mineralization in long intervals of Excelsior core was visually confirmed by MDA during the site visit. The existence of the North Star deposit has been known widely in the industry for many years prior to Excelsior's involvement, based on the results of drilling programs conducted by major copper-mining and exploration companies (*e.g.*, Magma, Cyprus, and Superior).

13 MINERAL PROCESSING AND METALLURGICAL TESTING

13.1 INTRODUCTION

Numerous historical metallurgical tests have been performed on samples from the North Star deposit. Most of the historical test work was either so poorly described that it is of limited use, or the test procedures were not applicable to ISR and are useful only from a qualitative perspective.

In response to the inadequacies of the historical data, Excelsior commissioned several independent laboratories to perform modern metallurgical testing. Recognizing the difference between conventional leaching operations and the proposed in situ leach to be used by Excelsior on the Gunnison project the test protocols were modified to reflect these differences.

The initial testing by Excelsior included a “Box Test” in which whole core was placed in a sealed box packed with sand. An acid leach solution was passed through the box and the amount of copper recovered in the PLS determined. Following this test program, a “Series 2” test program was conducted in which crushed core was leached in a column test similar to the conventional column tests except that saturation of the column with leach solution was maintained for the duration of the test. In this test program, all columns were run using splits of a single composite sample of the mineralized core. The purpose of the test program was to determine how the response of the mineralization is affected by changes in irrigation rate and acid concentration of the leach solution. Crushing the core created man-made surfaces on the individual core fragments on which acid is consumed by the gangue minerals but on which little copper is available for leaching. Copper in the North Star deposit is concentrated on the naturally occurring fracture surfaces with only small concentrations dispersed in the interior of the ore fragments. To demonstrate the effect of the man-made fracture surfaces on the acid consumption, a “Bucket Test” was devised in which similar samples of the ore were leach in the sulfuric acid leach solution. One sample was leached with the man-made fracture surfaces exposed to the leach solution and a second sample was leached in which the man-made fracture surfaces were epoxy coated to prevent any reaction with the leach solution. The results of Excelsior’s initial tests have also been described in a previous report (M3, 2014).

Based on the results of these initial tests additional testing has been undertaken and are summarized in Section 13.2. The in-situ leaching performance parameters derived from the modern test work that have been incorporated in the study are presented in Section 13.3.

13.2 ADDITIONAL METALLURGICAL TESTING

Additional metallurgical testing has been undertaken to evaluate the response of the ore from the North Star deposit to the conventional sulfuric acid leach process used in dump and heap leaching operations in conjunction with many copper mines.

Two additional test programs have been completed. In the first of these (Series 3), 19 column tests similar to those of Series 2 were run. In Series 2, the purpose was to determine how the mineralization would respond to differences in the leaching parameters, while in Series 3, the purpose was to determine how different ore samples would respond to the same leaching parameters: that is to determine the variability of the mineralization with respect to the leachability. The second test program, termed “Core Tray” tests, is intended to more closely simulate the in situ leach process than the modified column test of test Series 2 and Series 3. This test protocol was developed in response to the results of the “Bucket Tests” which demonstrated the effect on the acid consumption of the man-made surfaces of the ore fragments being leached during the leach test. In the Core Tray test, pieces of core were mounted in epoxy in a tray with only the natural fracture surface exposed to the leach solution flowing through the core tray.

Column Leach Test – Series 3

Twenty four core samples were selected for the column tests. Each sample was crushed to minus 1 inch then screened into five sized fractions (1” x 3/4”, 3/4” x 5/8”, 5/8” x 1/2”, 1/2“x 1/4”, and minus 1/4”). Each screen fraction was assayed for ASCu and TCu and the results used to calculate a head grade for the entire sample. The column tests were run at Mineral Advisory Group Research & Development, LLC (MAG) in Tucson, Arizona. Of the 24 columns started, six columns plugged, resulting in 18 column tests completed. Column 6 was repeated as Column 6B giving a total of 19 tests. Table 13-1 lists a description of the ore samples used in this column test program.

Table 13-1: Column Test Samples

MAG Column #	Formation	Fracture Intensity	Cu(tot), %	Cu(AS), %	SI	Sample Source
2	Upper Abrigo	Low	0.431	0.312	0.724	NSM-001 (156 lbs),NSM-002 (175 lbs),NSM-004 (19 lbs)
3	Abrigo Undivided	High	0.581	0.326	0.562	NSM-001 (71 lbs),NSM-002 (112 lbs),NSM-003 (27 lbs),NSM-004 (19 lbs),NSM-006 (126 lbs)
6 & 6B	Martin/Escabrosa	High	1.701	1.163	0.684	NSM-001 (66 lbs),NSM-002 (23 lbs),NSM-004 (50 lbs),NSM-006 (98 lbs),NSM-007 (131 lbs),NSM-010 (17 lbs),NSM-005A (11.5 lbs)
9	Martin/Escabrosa	Low	0.316	0.259	0.818	NSM-005A (350 lbs)
10	Martin/Escabrosa	High	0.895	0.683	0.763	NSM-005A (61 lbs), NSM-010A (142 lbs), NSM-011 (159 lbs)
11	Upper Abrigo	Low	0.409	0.320	0.784	NSM-005A (350lbs)
12	Abrigo Undivided	High	0.451	0.288	0.639	NSM-006 (58 lbs),NSM-007 (35 lbs),NSM-005A (257 lbs)
13	Abrigo Undivided	High	1.081	0.142	0.132	NSM-005A (118 lbs), NSM-011 (282 lbs)
14	Upper Abrigo	Low	0.601	0.363	0.605	NSM-005A (350 lbs)
15	Upper Abrigo	Low	0.525	0.365	0.695	NSM-005A (84 lbs), NSM-011 (267 lbs)
16	Middle Abrigo	Low	0.759	0.556	0.732	NSM-003 (32 lbs), NSM-006 (46 lbs), NSM-007 (17 lbs), NSM-008 (256lbs)
17	Middle Abrigo	Low	0.748	0.539	0.720	NSM-008 (114 lbs), NSM-011 (237.5 lbs)
18	Lower Abrigo	Low	0.634	0.450	0.710	NSM-008 (349.5 lbs)
19	Lower Abrigo	Low	0.826	0.480	0.581	NSM-008 (91 lbs), NSM-013 (265 lbs)
21	Middle Abrigo	Low	0.397	0.273	0.687	NSM-011 (97 lbs), NSM-013 (253 lbs)
22	Abrgo Undivided Transition	Low	0.510	0.353	0.693	NSM-011 (291 lbs), NSD-022 (59 lbs)
23	Abrgo Undivided Transition	Low	0.279	0.142	0.509	NSD-022 (350 lbs)
24	Middle Abrigo	Low	0.393	0.285	0.723	NSD-013 (356 lbs)

The columns used in this test program (see Figure 13-1) are set up the same as the columns used in the Phase 2 column tests program conducted by SGS-Metcon.

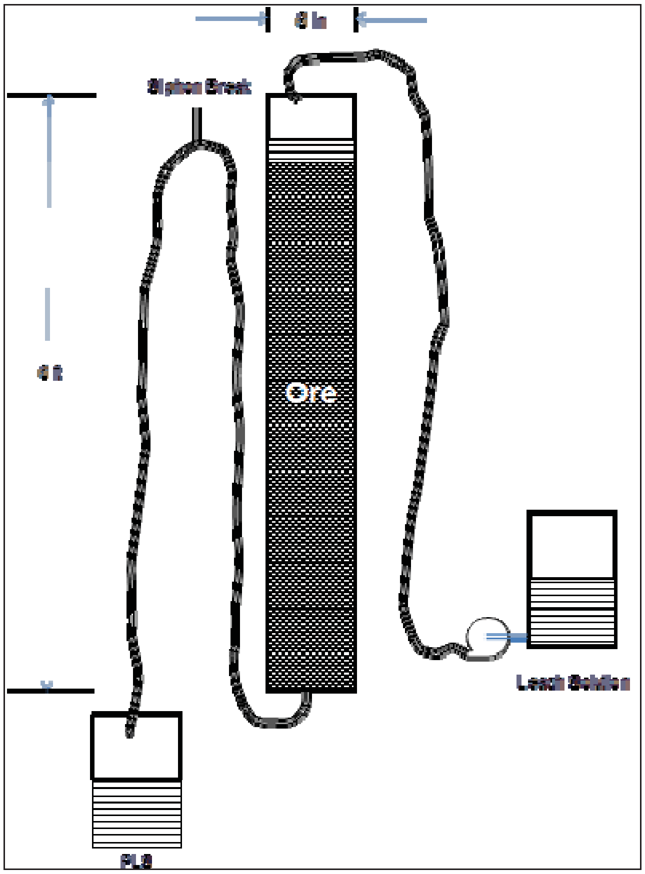


Figure 13-1: Column Test Set-Up

This arrangement ensures that the ore is completely saturated with the leach solution as it would be in an in situ operation. After filling each column with a sample of mineralization, the columns were filled with leach solution made from raffinate from the Johnson Camp mine that had been adjusted with sulfuric acid to 15 gpl free acid. The irrigation rate was initially set to 1 liter per day (L/d) for the first 15 days then increased to 7 L/d. Difficulties occurred at the slower application rate of 1 L/d due to neutralization of the acid by excessive man-made surface area of the samples, resulting in insufficient acid availability for effective leaching. Each column was filled with between 51 and 52 kg of ore, resulting in 45-46 percent void space which was filled with between 16 and 17 liters of leach solution. PLS samples were collected daily. The pH and oxidation-reduction potential (ORP) of each PLS sample were measured, and the solution was then assayed for free acid and copper. Initially there were 24 columns to be leached. Six of the columns plugged and were discontinued leaving 18 columns. It is believed that these six samples, having been crushed to minus 1 inch, contained excessive fines which restricted their permeability. An additional column was added containing a duplicate of the Column 6 sample. This column was designated Column 6B. Column 6B was irrigated at a rate of 20 L/d.

When a column test was to be terminated, the leach solution was replaced with water, the irrigation rate increased slightly, and the column rinsed for five days. The column residue was dried, sampled, prepped for assay, and assayed for TCu [“Cu(total)”] and ASCu [“Cu(As)”]. The recovery/time curves for both the TCu and ASCu were developed based on the calculated head of the column. It was assumed that the solubility index of the assay head sample and the column feed were identical. Figure 13-2 is the recovery/time curve for ASCu from column CL-03. The effect of the increase in the rate of copper recovery due to the increase in the irrigation rate from 1 L/d to 7 L/d after the first 15 days of the tests is apparent. All columns displayed similar results.

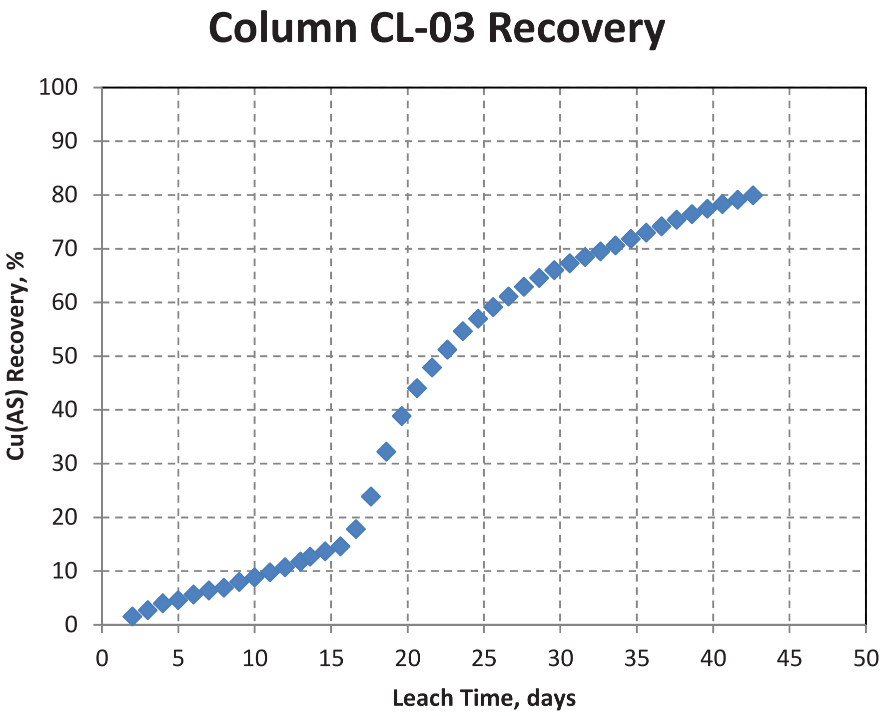


Figure 13-2: ASCu Recovery/Time Curve Column CL-03

Figure 13-3 to Figure 13-7 show the recovery/time curves for the different ore type's tests. In addition Figure 13-8 shows a comparison of column CL-06 and CL-06B which differ in acid concentration of the leach solution and the irrigation rate during the first 15 days of the leach.

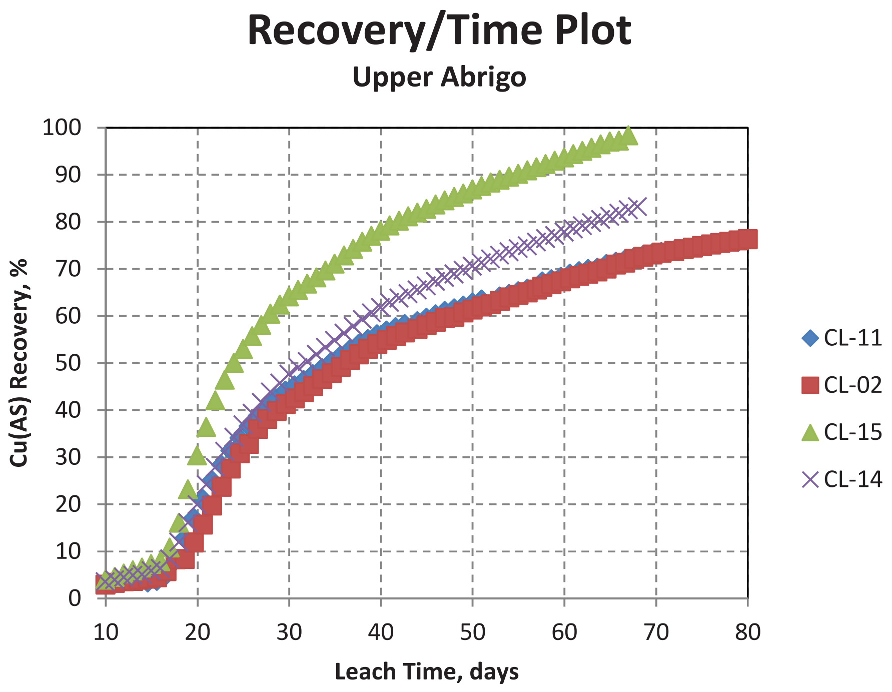


Figure 13-3: ASCu Recovery/Time Curves – Upper Abrigo Ore

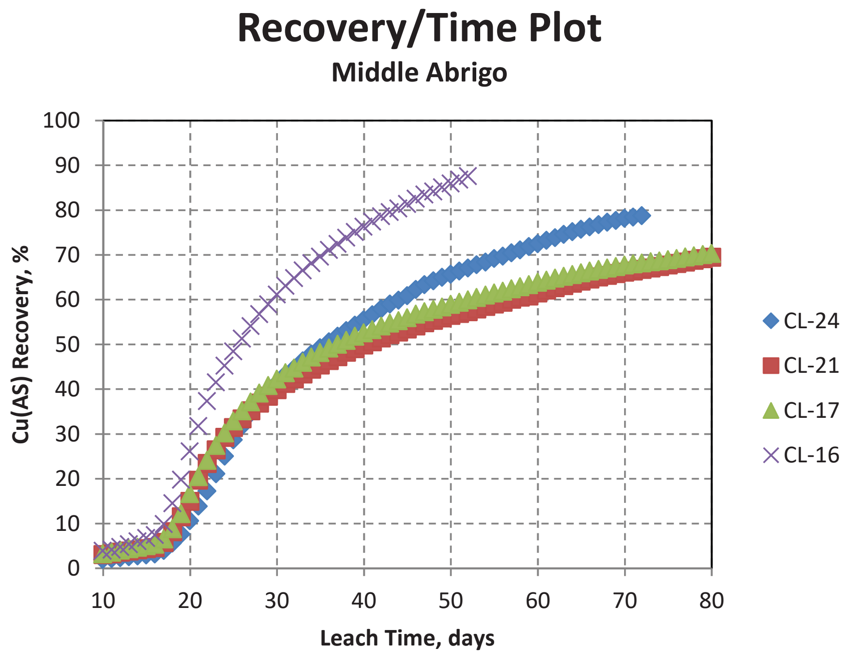


Figure 13-4: ASCu Recovery/Time Curves – Middle Abrigo Ore

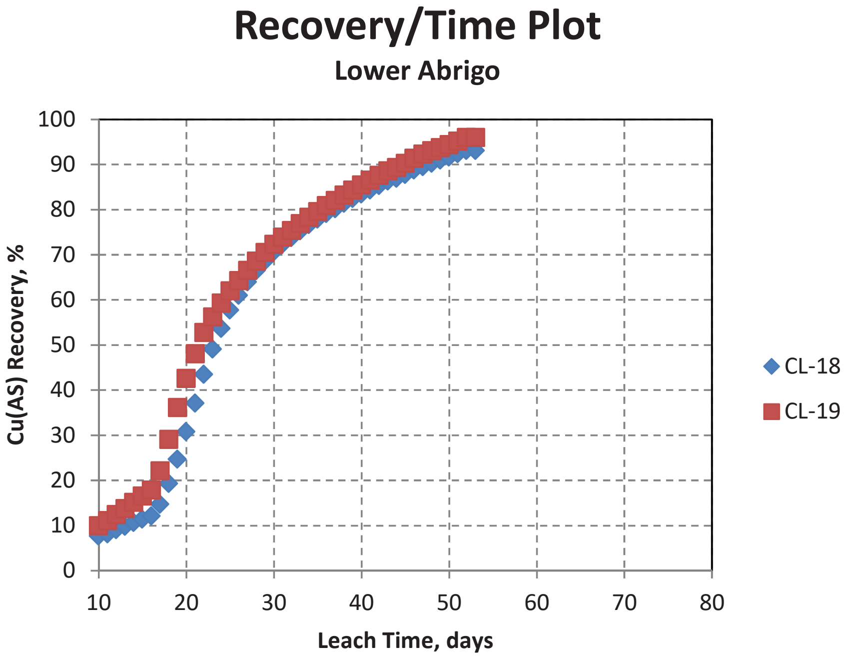


Figure 13-5: ASCu Recovery/Time Curves – Lower Abrigo Ore

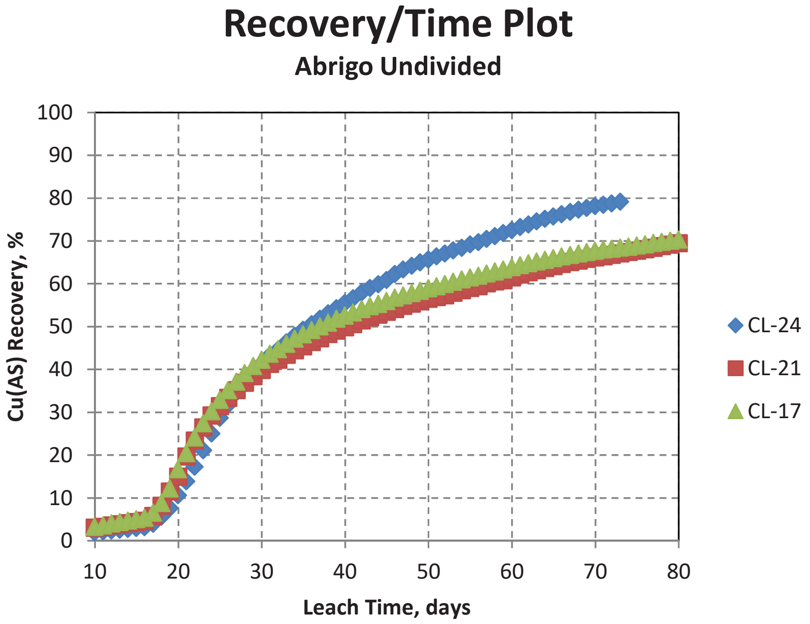


Figure 13-6: ASCu Recovery/Time Curves – Abrigo Undivided Ore

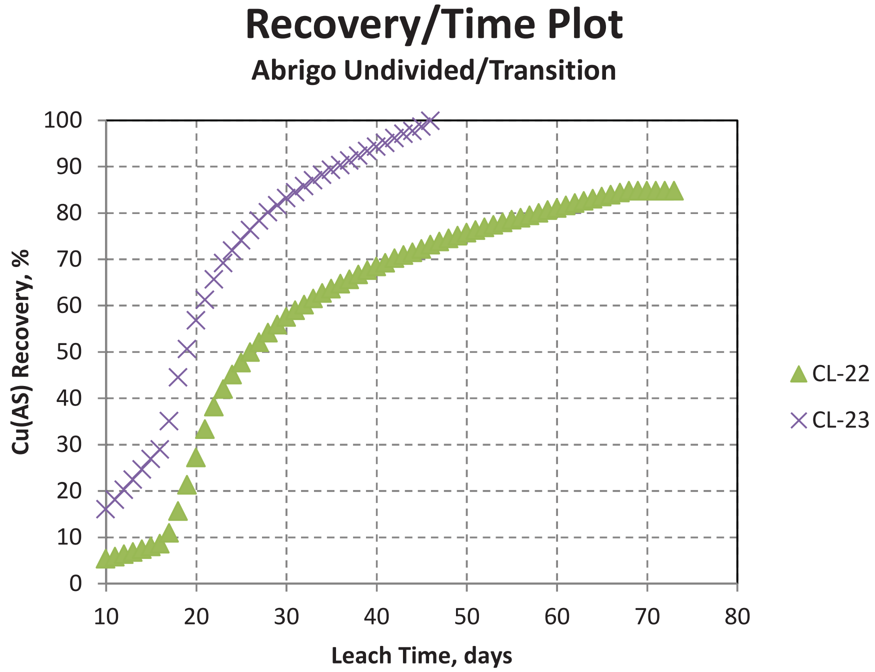


Figure 13-7: ASCu Recovery/Time Curves – Abrigo Undivided/Transition Ore

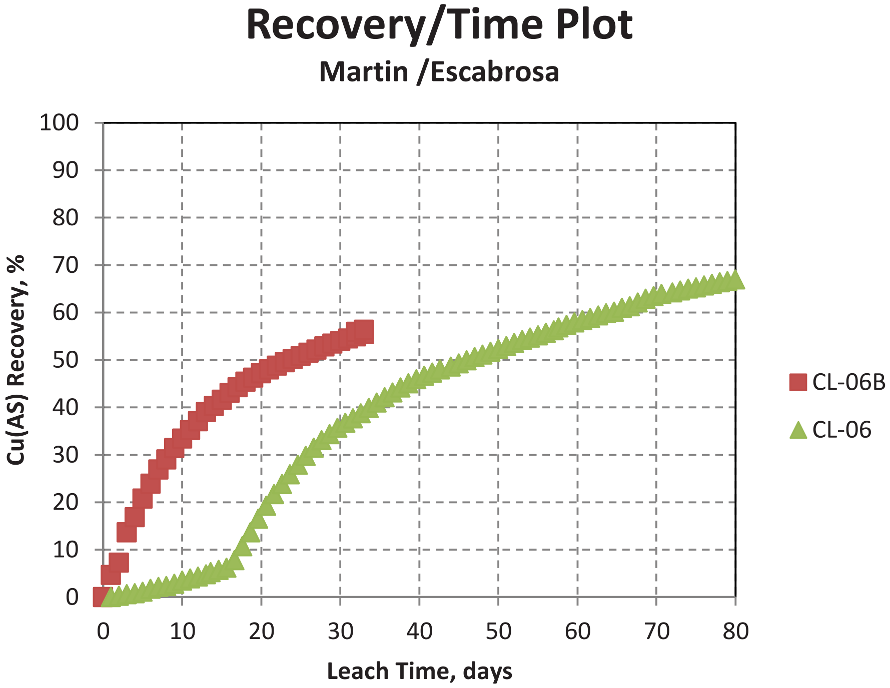


Figure 13-8: ASCu Recovery/Time Curves – Martin/Escabrosa Ore

The core samples used in the column tests each contain copper in forms other than acid soluble copper as defined by the standard sequential copper assay procedure. This copper is identified as the Cu(Insol) value which has been calculated by subtracting the ASCu assay result from the TCu assay result. Cu(Insol) then represents the sum of the secondary copper sulfides (e.g. chalcocite), primary copper sulfides (chalcopyrite), and insoluble copper oxide minerals. Secondary copper sulfides are slowly soluble under the column leach test conditions and will result in the recovery of ASCu occasionally being reported as above 100 percent. An estimation of the Cu(Insol) which has been leach in each of the column tests is made by comparing the amount of Cu(Insol) in the column feed and in the column test residue. Table 13-2 lists the estimated Cu(Insol) recovered in the column tests. On average approximately 20 percent of the Cu(Insol) in the column feed has solubilized over the duration of the leach test.

Table 13-2: Estimation of the Cu(Insol) Recovered in the Column Tests

Column	Formation	Column Feed			Column Residue			Cu(Insol) Rec, %	Average Cu(Insol) Rec, %	Cu(AS) Rec, %	Average Cu(AS) Rec, %	% of leached copper from Cu(Insol)
		Cu(total)	Cu(AS)	Cu(Insol)	Cu(total)	Cu(AS)	Cu(Insol)					
CL-22	Abrgo Undivided Transition	0.510	0.353	0.157	0.160	0.080	0.080	49.0	35.3	77.3	66.2	22
CL-23	Abrgo Undivided Transition	0.279	0.142	0.137	0.130	0.040	0.090	34.4		71.9		32
CL-24	Abrgo Undivided Transition	0.393	0.285	0.108	0.190	0.100	0.090	16.9		64.9		9
CL-12	Abrigo Undivided	0.451	0.274	0.178	0.190	0.090	0.100	43.7	43.2	67.1	68.6	30
CL-13	Abrigo Undivided	1.081	0.766	0.314	0.410	0.230	0.180	42.7		70.0		20
CL-18	Lower Abrigo	0.634	0.450	0.184	0.240	0.120	0.120	34.8	37.0	73.3	73.1	16
CL-19	Lower Abrigo	0.826	0.480	0.346	0.340	0.130	0.210	39.3		72.9		28
CL-16	Middle Abrigo	0.759	0.556	0.203	0.360	0.230	0.130	36.1	32.7	58.6	67.8	18
CL-17	Middle Abrigo	0.748	0.539	0.209	0.240	0.120	0.120	42.6		77.7		18
CL-21	Middle Abrigo	0.397	0.273	0.124	0.190	0.090	0.100	19.5		67.1		12
CL-02	Upper Abrigo	0.431	0.312	0.119	0.200	0.120	0.080	32.7	41.8	61.5	66.8	17
CL-11	Upper Abrigo	0.409	0.320	0.088	0.150	0.100	0.050	43.4		68.8		15
CL-14	Upper Abrigo	0.601	0.363	0.238	0.310	0.140	0.170	28.4		61.5		23
CL-15	Upper Abrigo	0.525	0.365	0.160	0.150	0.090	0.060	62.5		75.3		27
CL-06	Martin/Escabrosa	1.701	1.163	0.538	0.790	0.410	0.380	29.3	17.5	64.8	58.7	17
CL-09	Martin/Escabrosa	0.316	0.259	0.057	0.210	0.150	0.060	0*		42.1		
CL-10	Martin/Escabrosa	0.895	0.683	0.212	0.410	0.210	0.200	5.6		69.3		2

Core Tray Test

A new test procedure was developed to assess the in situ leaching characteristics of the North Star deposit. Alternatively named a “Core Tray leach test” and ”Box test” (not to be confused with the original Box Tests run by SGS-Metcon). The Core Tray leach test consisted of carefully mounting selected core samples with exposed natural fracture faces lined up with the fracture faces facing up in a bed of epoxy. The fracture faces were not coated by the epoxy but exposed to the leach solution which flowed through the tray over the fracture surfaces. Figure 13-9 is a photograph and Figure 13-10 is a schematic of a core tray loaded with core. The core tray, nine feet long, was made from sheets of Plexiglas and was sealed water tight except for the solution inlet and outlet connections. The surface area of the exposed core fracture faces was measured as was the weight of core in the tray. Between the core surfaces and the Plexiglas cover of the core tray there was sufficient space for about 2.5 liters of leach solution. The leach solution feed rate could be varied to control the residence time of the solution in the core tray, which was typically 2.5 days.

Figure 13-9: Core Tray

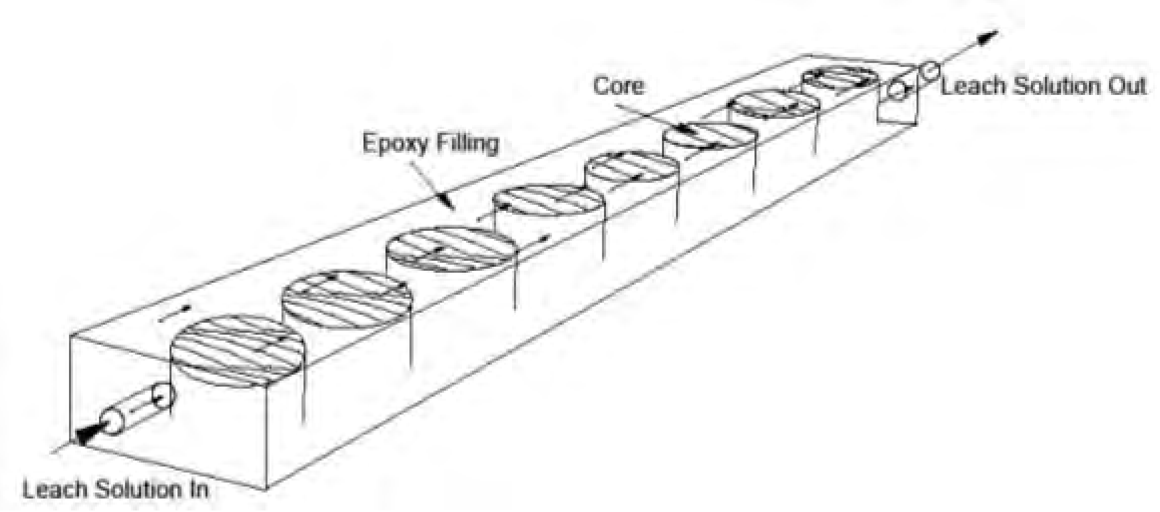


Figure 13-10: Schematic Diagram of a Core Tray Loaded with Core Samples

The leach solution was made up from raffinate from the Johnson Camp mine to which sulfuric acid was added to give the desired leach solution free acid concentration. The volume of the PLS discharged from the core tray was measured, and PLS samples were analyzed for pH, ORP, free acid, and copper. Samples were either composites of PLS from multiple consecutive days or single day samples.

Initially, the leach solution contained 1.0 gpl free acid. The free acid was increased in steps with time until it reached 15 gpl free acid. The data collected were recorded and an estimate of the following information about the response of the sample to leaching made:

- Recoverable copper, lbs/100 ft^2 of fracture surface
- Recoverable copper, wt%
- Incremental total acid consumption, grams of acid/gram of copper leached
- Incremental gangue acid consumption, grams of acid/gram of copper leached

From these results the following were determined:

- Recovery/time relationship
- Acid Consumption/recovery relationship

Table 13-3 lists the ore samples selected for testing in the 10 core trays, the surface area of the natural fracture surface exposed to the leach solution, and the volume of leach solution contained in each core tray. Two samples of Lower Abrigo, Middle Abrigo, and Upper Abrigo plus four samples of Martin were selected. Excelsior selected the samples, loaded the core trays, and delivered them to MAG. MAG conducted the test under the supervision of Leach, Inc.

Table 13-3: Core Tray Sample and Parameters

Core Tray #	Formation Ore Type	Surface Area of Cores, ft^2	Volume of Void Space, liters	Total Weight of Core Samples, kg	Estimated leachable, grams Cu(Sol)	Estimated surface Cu(Sol), lbs/100 ft^2	Estimated core grade, % Cu(Sol)
1	Lower Abrigo	2.98	1.8	N/A	36.8	2.72	NA
2	Upper Abrigo	3.47	1.6	27.8	57.8	3.67	0.21
3	Martin	3.33	2.7	31.1	157.4	10.42	0.51
4	Martin	3.43	2.4	29.0	63.9	4.11	0.22
5	Upper Abrigo	3.54	2.8	31.0	50.8	3.17	0.16
6	Middle Abrigo	3.14	2.1	33.0	77.8	5.46	0.24
7	Martin	2.77	2.5	41.5	64.2	5.11	0.15
8	Martin	2.26	2.5	25.0	202.2	19.72	0.81
9	Middle Abrigo	3.05	2.4	41.0	70.6	5.10	0.17
10	Lower Abrigo	3.39	2.9	40.0	80.7	5.25	0.20

Included in Table 13-3 is the estimated grade of soluble copper for each core tray sample which was calculated in lbs/100 ft^2 of fracture surface and in weight percent for each core tray sample. These values are for "recoverable copper" not total copper or acid soluble copper. They are calculated based on the estimated total copper leachable from each sample. Figure 13-11 shows an example of how this recoverable copper was determined. Extrapolating the Core Tray #2 curve for the last 50 days of leaching to infinite time (1/day = 0) results in an estimate that 57.8 grams of copper can be leached from the cores in Core Tray #2. Based on that value, the measured surface area of the exposed fracture surface in the cores in the tray, and the weight of the cores in the core tray the weight of copper per 100 ft^2 of fracture surface and weight percentage of leachable copper can be calculated.

The operating parameters of the tests were adjusted during the test. Initially the flow rate of leach solution through each tray was held at a nominal 1 L/d. Toward the end of the test, the flow of leach solution was turned off for several days allowing the retention time of the solution in the core tray to increase. This resulted in an increase in the copper grade and a decrease in the acid concentration of the PLS.

In addition to the change in solution flow rate the free acid concentration of the leach solution was increased from a low of 1 gpl to 5 gpl then to 10 gpl and finally to 15 gpl. This was done in an attempt to maintain a high level of copper in the PLS as the leach cycle progressed. Figure 13-12 and Figure 13-13 show example plots of the data obtained from each of the 10 core tray tests.

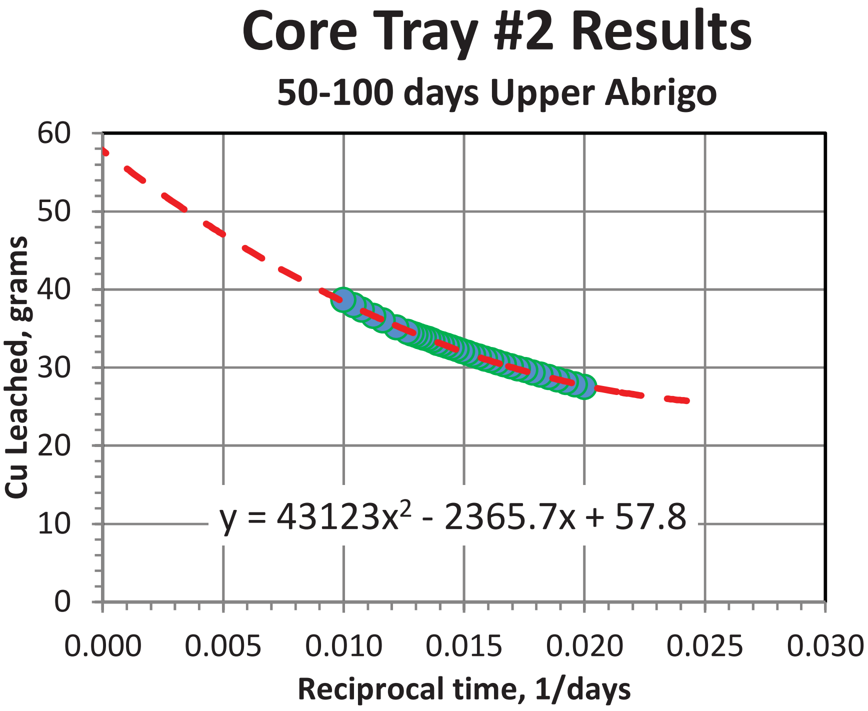


Figure 13-11: Copper Leached Versus Reciprocal Leach Time

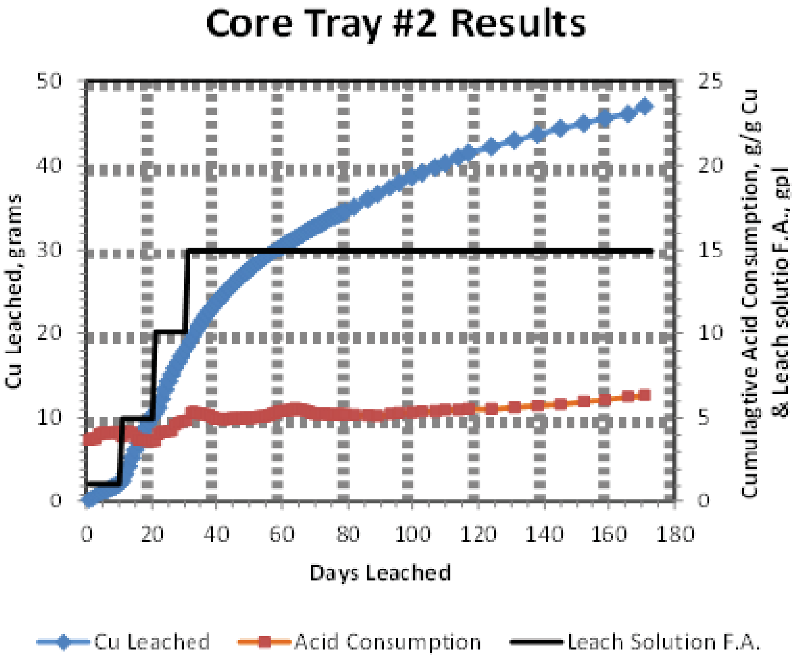


Figure 13-12: Operating Parameters and Results of Core Tray #2, Plot 1

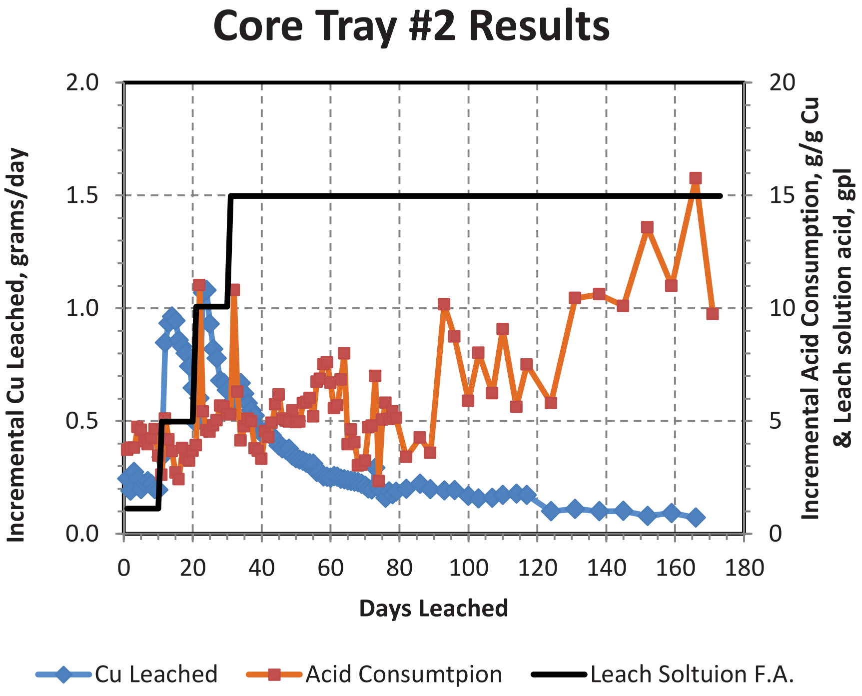


Figure 13-13: Operating Parameters and Results of Core Tray #2, Plot 2

In Figure 13-14 to Figure 13-17 the recovery/time curves from the core tray tests of samples of the Lower Abrigo, Middle Abrigo, Upper Abrigo, and Martin formations are plotted. In the following figures “Cu Recovery, %” refers to the percent copper recovery of the estimated “leachable copper” as defined in Figure 13-11.

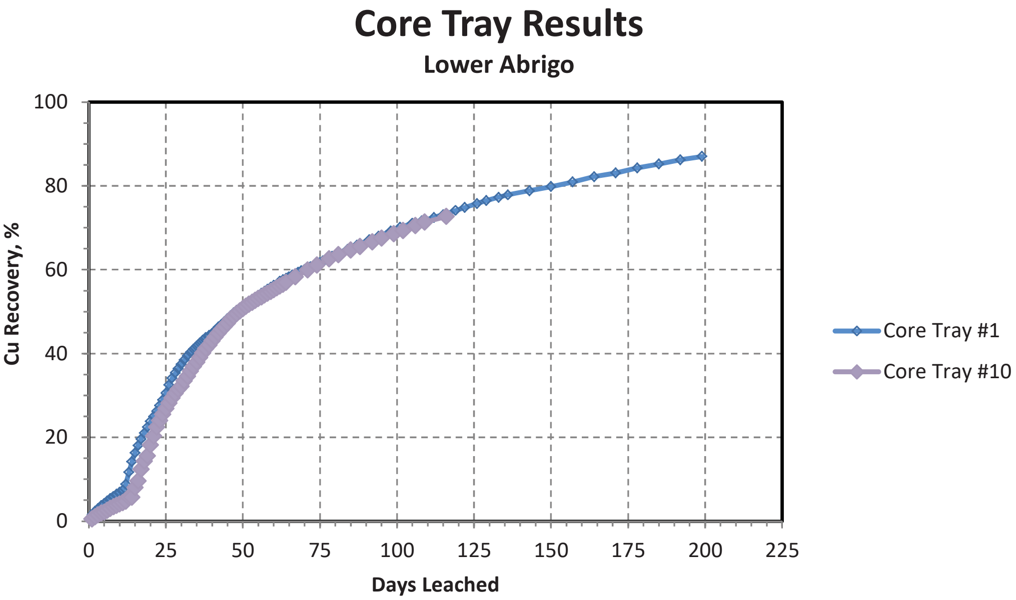


Figure 13-14: Lower Abrigo Core Tray Test Results – Recovery/Time Curves

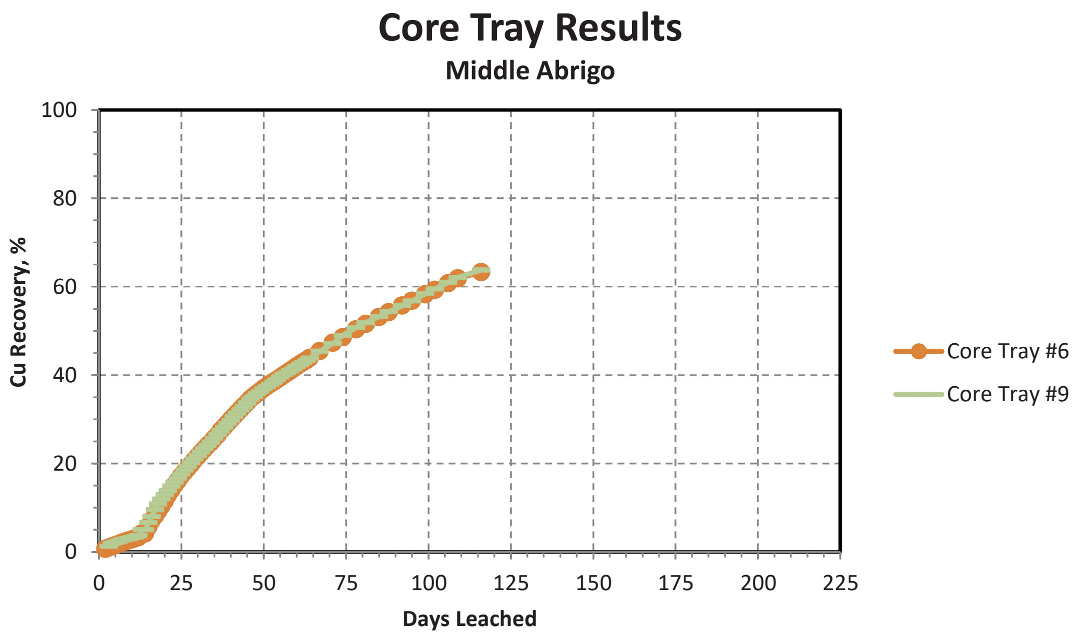


Figure 13-15: Middle Abrigo Core Tray Test Results – Recovery/Time Curves

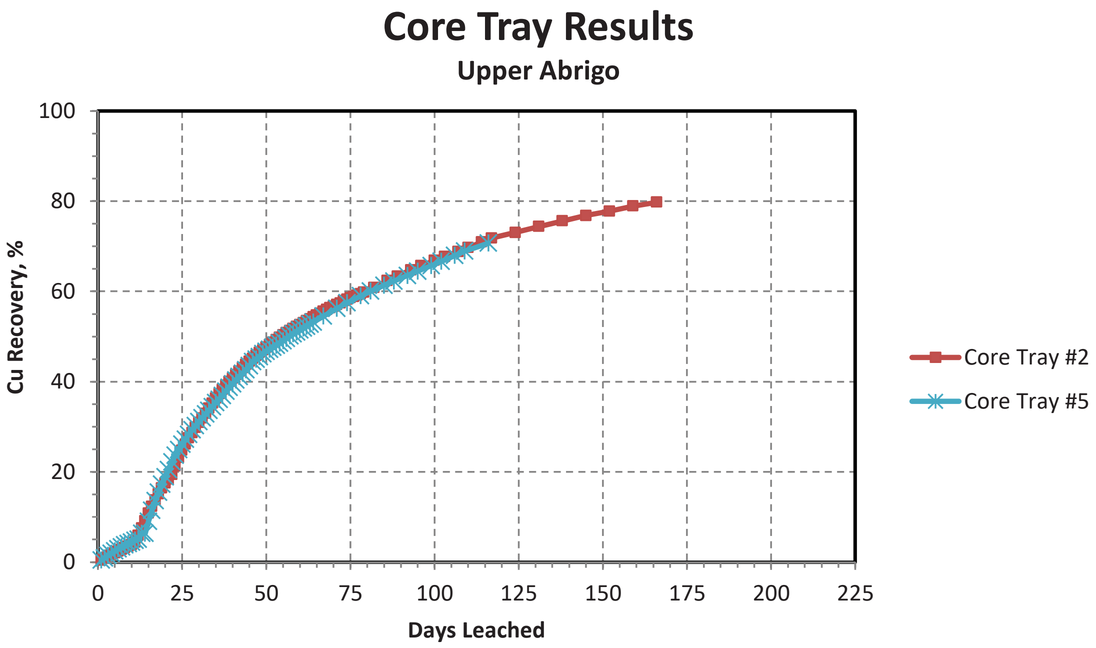


Figure 13-16: Upper Abrigo Core Tray Test Results – Recovery/Time Curves

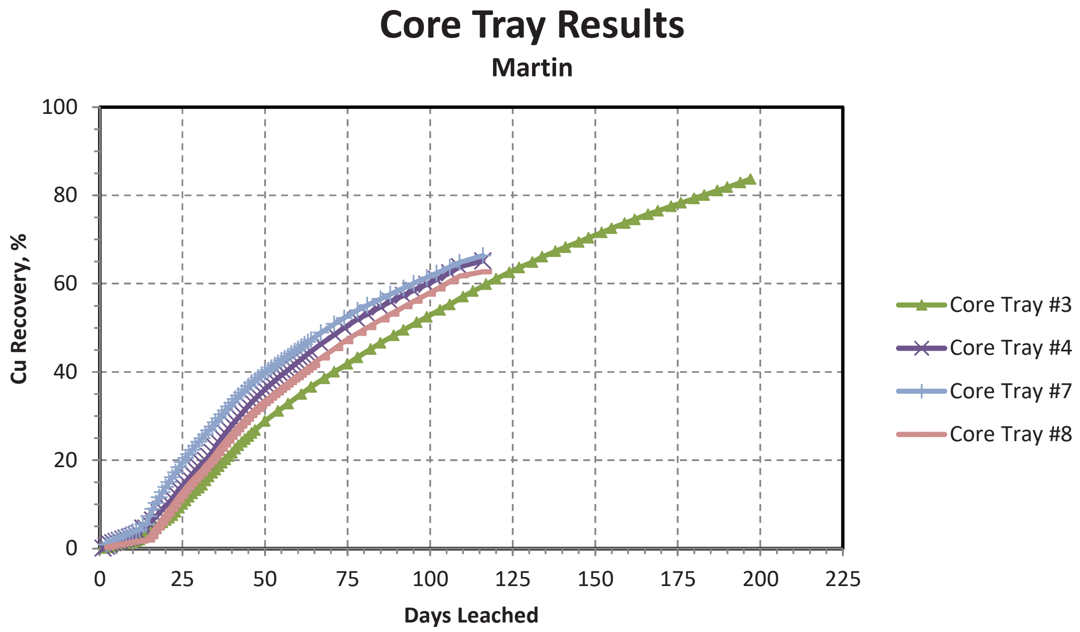


Figure 13-17: Martin Core Tray Test Results – Recovery/Time Curves

In Figure 13-18 to Figure 13-21, the average gangue acid consumption for each ore type from the core tray tests are plotted against copper recovery. The results of the Core Tray tests for each ore type have been averaged and extrapolated to 100 percent recovery of the leachable copper.

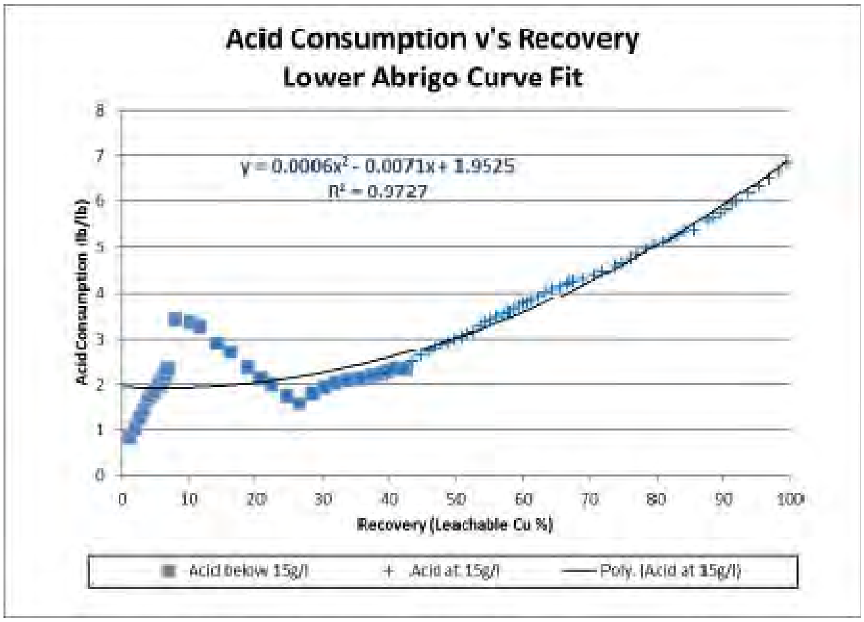


Figure 13-18: Acid Consumption/Recovery – Average of Lower Abrigo Core Trays

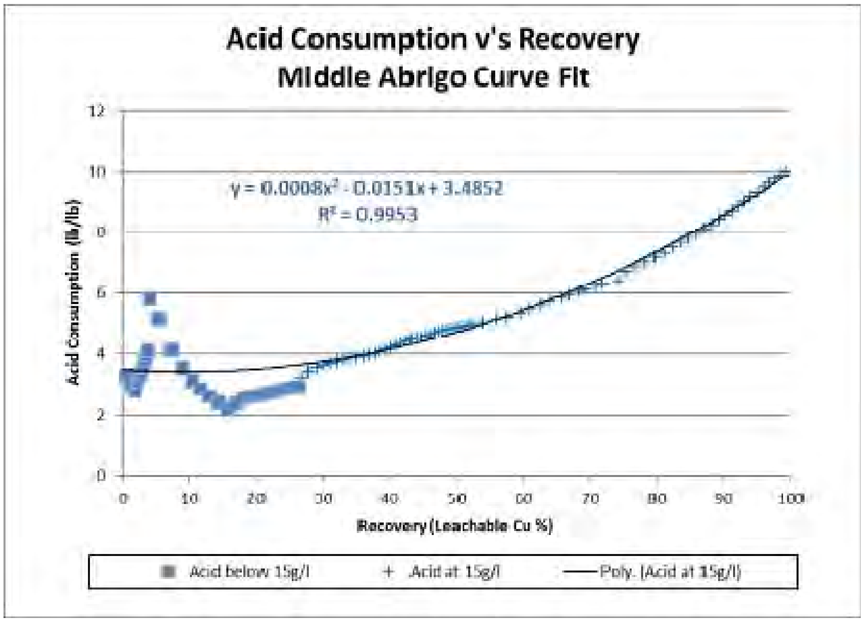


Figure 13-19: Acid Consumption/Recovery – Average of Middle Abrigo Core Trays

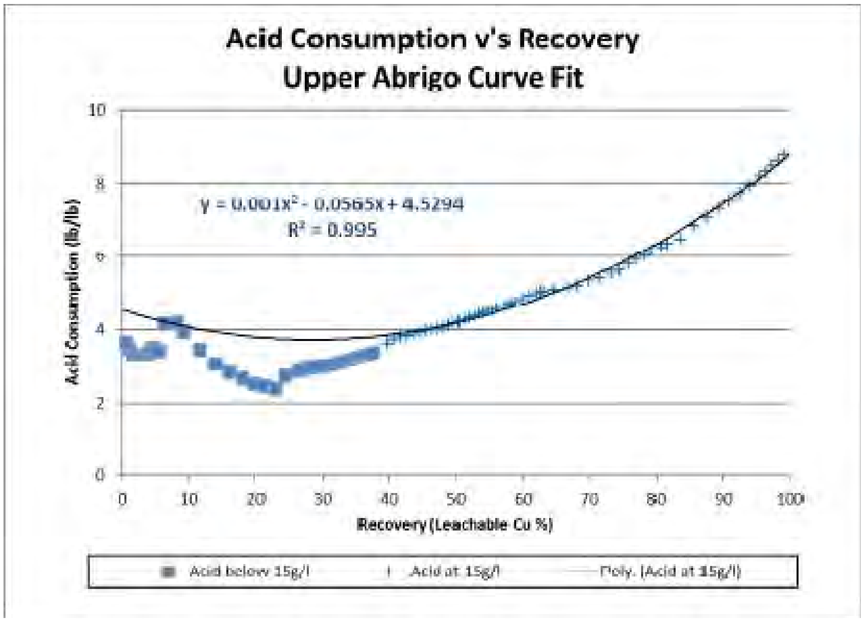


Figure 13-20: Acid Consumption/Recovery – Average of Upper Abrigo Core Trays

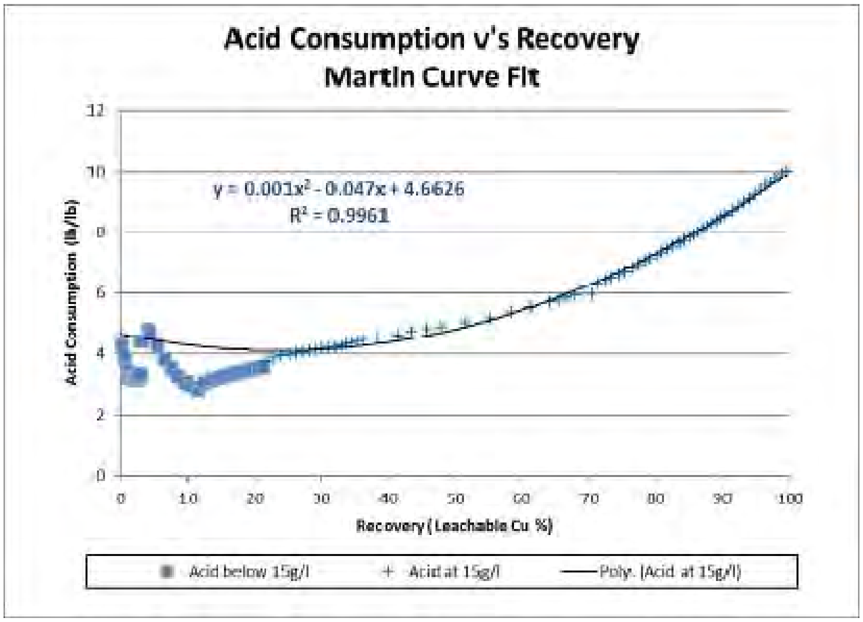


Figure 13-21: Acid Consumption/Recovery – Average of Martin Core Trays

Selected data points from Figure 13-14 to Figure 13-21 are listed in Table 13-4.

Table 13-4: Core Tray Recovery and Gangue Acid Consumption

Core Tray #	Formation Ore Type	20 % Recovery		30 % Recovery		40 % Recovery		60 % Recovery		80 % Recovery	
		days	Acid Cons, lbs/lb Cu	days	Acid Cons, lbs/lb Cu	days	Acid Cons, lbs/lb Cu	days	Acid Cons, lbs/lb Cu	days	Acid Cons, lbs/lb Cu
1	Lower Abrigo	18	2.9	25	3.1	34	3.6	70	5.3	150	6.1
10	Lower Abrigo	21	1.0	28	1.6	37	2.4	71	3.9	NA	NA
6	Middle Abrigo	28	2.6	40	3.6	56	4.3	102	5.7	NA	NA
9	Middle Abrigo	28	3.0	40	4.3	56	5.2	102	6.7	NA	NA
2	Upper Abrigo	22	2.5	29	2.9	39	3.1	79	3.3	166	4.2
5	Upper Abrigo	21	2.6	29	3.7	41	5.2	81	7.9	NA	NA
3	Martin	38	3.9	54	4.0	71	4.4	117	5.3	183	6.3
4	Martin	32	8.6	42	9.7	56	10.3	99	12.7	NA	NA
7	Martin	25	4.4	37	5.9	50	7.1	95	9.2	NA	NA
8	Martin	33	2.2	45	2.6	61	3.0	106	3.6	NA	NA
Average		27	3.4	37	4.1	50	4.9	92	6.4	166	5.5

The results of the core tray tests can be used together with the characteristics of the well field and the block of ore being leached to estimate the copper recovery from the commercial in situ leach operation.

13.3 METALLURGICAL RECOVERY AND ACID CONSUMPTION

Excelsior uses two fundamental parameters or factors to estimate overall copper recovery for a commercial scale ISR operation. The first of these parameters, “metallurgical recovery,” is based solely on core tray test results and defines the rate of copper recovery. The second parameter known as “sweep efficiency” is defined by a combination of hydrological, geological and well field conditions and is an estimate of the percentage of the available copper that is contacted by the leach solution. This parameter is less well defined by test work and has previously functioned as an “efficiency factor” or “conservative recovery factor” for ISR copper projects. Overall copper recovery is the product of metallurgical recovery and sweep efficiency. In essence;

- Metallurgical recovery determines the amount and rate at which the copper dissolves from the rocks when contacted by the leach solution.

- Sweep efficiency determines how much of the copper in the ground will be effectively contacted by leach solution during the mining process.

The two parameters or factors as they relate to copper recovery from North Star are discussed in more detail below.

Acid consumption is measured in the core tray tests and is a function of the copper recovery. Acid consumption is not expected to be a function of sweep efficiency as the rock not contacted by the leach solution will neither produce copper nor consume acid. As a consequence the acid consumption/copper recovery relationship is not affected by sweep efficiency. However, it is conceivable that the acid consumption/copper recovery relationship will be affected by the physical dimensions of the 5-spot well pattern.

Scale-up of the core tray tests to the expected results of a 5-spot in situ leach is based on the acid availability during the in situ leach and the distance the leach solution travels from the injection point to the recovery point. The core trays were each nine feet in length (see Figure 13-9 and Figure 13-10). In the proposed 5-spot pattern with the well spacing of 100 ft and the injection well in the center of the 100 ft pattern the leach solution will travel between 71 ft and 100 ft or between eight and 11 times the distance it traveled in the core tray depending on its path from the injection well to the extraction well. The leach solution retention time in the core tray ranged from two to three days during most of the test. Assuming three percent porosity in the ore and an injection rate of 0.1 gpm/ft of well length the average retention time of the leach solution in the 5-spot pattern will be about 16 days or 5-8 times as long as the retention time in the core tray tests. During this time the leach solution will react with any available copper provided the solution contains acid. In the core tray tests not all the acid contained in the leach solution was consumed as the solution passed through the core tray. Based on the acid content of the leach solutions and the core tray PLS solutions on average 32 percent of the acid in the leach solution was consumed as it passed through the nine foot length leaving 68 percent of the acid available to react with additional copper as it continued to flow towards the extraction point. This leach solution therefore, is capable of solubilizing at about three times the amount of copper that was dissolved in the core tray tests. Summarizing - in the 5-spot the leach solution will solubilize three times the copper it did in the core tray because of the increase in retention time but has about 8-11 times the copper to solubilize. Based on this logic and the proposed operating parameters of the 5-spot in situ leach a scale-up factor of six was selected in the 2016 Pre-Feasibility study (M3, 2016) as a multiple of the time required for the 5-spot in situ leach to achieve the same recovery as the core tray. This did not include effects for expected dilution due to the incorporation of surrounding groundwater in the start-up phase of an in-situ mining block, or the effects of higher acid consumption early-on in the same start-up phase of the mining block. In order to estimate these several approaches were taken including two forms of numerical modelling, comparison to uranium in-situ operations, and using hydrological data and modelling from the North Star deposit. These approaches are discussed below.

Note that the recovery from the core tray tests are based on the percentage of soluble copper, Cu(Sol), in the sample being leached as determined as shown in Figure 13-11. The geologic model of the deposit contains the acid soluble copper (ASCu), and the total copper (TCu). The insoluble copper, Cu(Insol), is the difference between the total and acid soluble copper. Column test – Series 3 indicated that some of the Cu(Insol) does solubilize during leaching. To adjust the core tray recovery (based on Cu(Sol)) to recovery based on the geologic model's acid soluble copper, the core tray recoveries have been recalculated based on 85 percent of the Cu(Sol) for the Abrigo samples and 90 percent for the Martin samples.

5-Spot Simulation

One simple numerical modelling approach is to assume linear plug-flow from injection to recovery well along a single fracture in a 5-spot wellfield pattern. Five linear flow streams (paths) were considered for half of a single quarter (quadrant) of a typical 100' x 100' 5-spot pattern, an example of which is shown in Figure 13-22 below. Each flow stream (linear path from injection to recovery) is made up of 10 cells of equal volume. Therefore, the 5-spot pattern is divided into a total of 400 individual cells. The simulation uses a "finite element" technique for solving an integral. In addition, a "finite difference" technique is used to solve for the rate of copper dissolution from each of the 400 cells.

The time increment used is the time to fill the pore space in the cell volume. Since the flow rate of solution in each of the five flow stream paths is different the time increment used for each of the five paths is different.

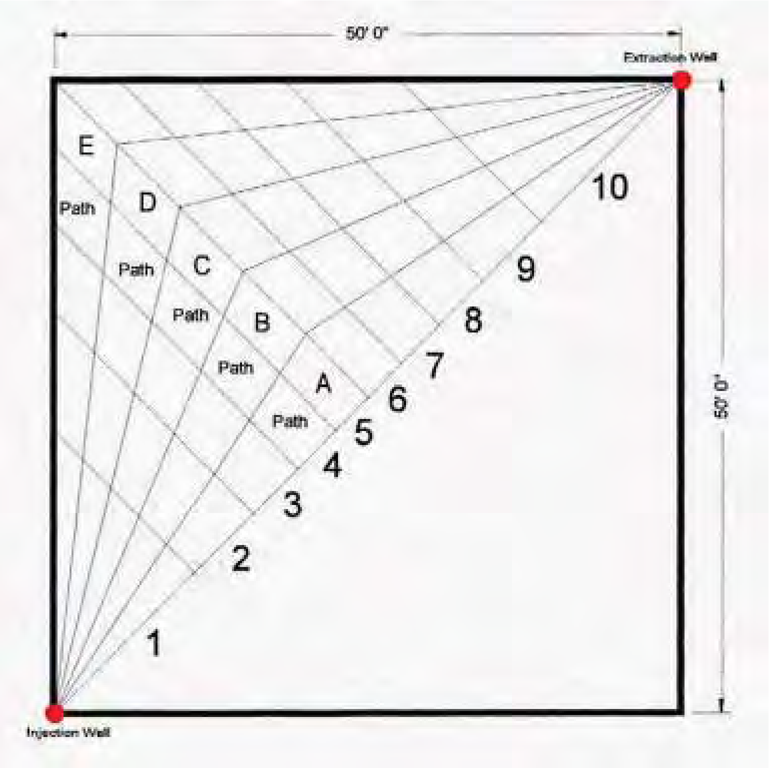


Figure 13-22: Example of simplified flow paths from injection to recovery well along a single fracture surface

Input parameters include:

- First order rate equation with respect to both copper concentration and acid concentration for the dissolution of copper (based on core tray tests),
- Average copper grade, porosity and specific gravity for a given rock/ore type
- Incremental acid consumption rate (lb/lb) from the core tray tests for the given rock/ore type
- Pump rate for injection and recovery wells.

In essence, the simulation fills the first cell along a given flow path, with retention time based on flow (pump) rate and porosity. Copper recovery, acid consumption, and resulting acid concentration are calculated. The resulting PLS solution (now containing some copper and reduced acid concentration) is then used to fill the next cell along the flow path. This process continues until all 10 cells along a given flow path have been “reacted”. A summary of the results for each rock type using a starting acid concentration of 15 gpl and the average; flow path, ore grade, porosity and pumping rate is shown in Figure 13-23.

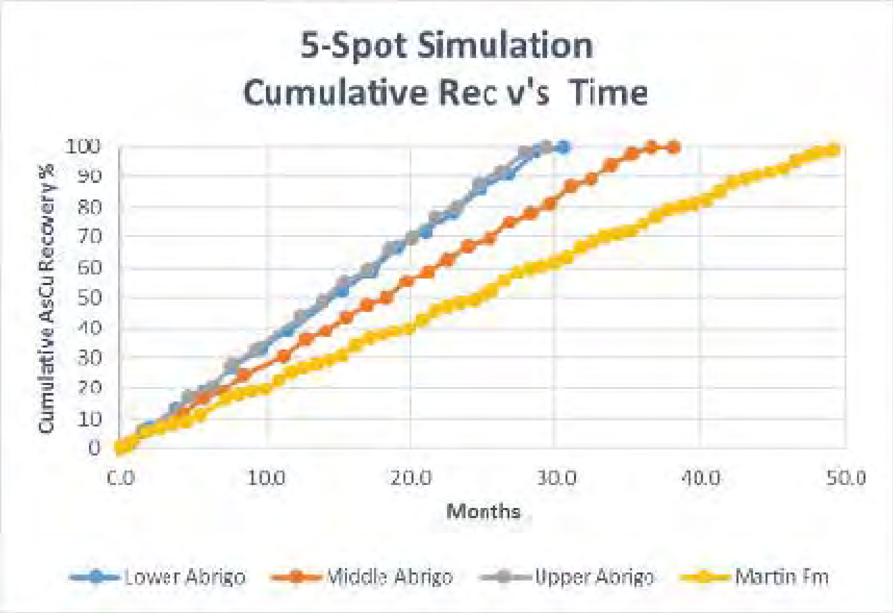


Figure 13-23: Results of average 5-Spot simulation

The results predict straight-line recovery curves for all rock types for a given flow path. This is the result of the acid contained in the injected leach solution (15 gpl) being completely consumed by the time the solution reaches the extraction well. However the modelling does not take into consideration initial dilution effects from surrounding groundwater, multiple and complex flow paths, and the complexity of rock – acid reactions. Nevertheless, the modelling was useful in predicting that: on average 100% acid soluble copper recovery is expected over a period of between 30 to 48 months for a 100’ x 100’ 5-spot well pattern where fractures receive average solution flow.

Geochemist Workbench Modelling

In order to try to address some of the limitations of the simple 5-Spot simulation, detailed geochemical modelling was undertaken by Dusty Early using the Geochemist Workbench (GWB) software program (Early, 2016). The modelling was performed in two stages:

1. Replicate the core tray test data by building a geochemical model using actual (analyzed) mineral assemblages, rock chemistry and test conditions (e.g. acid concentrations, retention time, and flow rates), and then calibrating the model back to the original test data.
2. Using the calibrated model, expand the model to represent flow paths in a simulated 5-spot well pattern.

This modelling was essentially a more sophisticated version of the 5-spot plug-flow model described above. Examples of the calibration of the models to the core tray tests are shown in Figures 13-24 and 13-25. Calibration was successful on individual and average core tray test results.

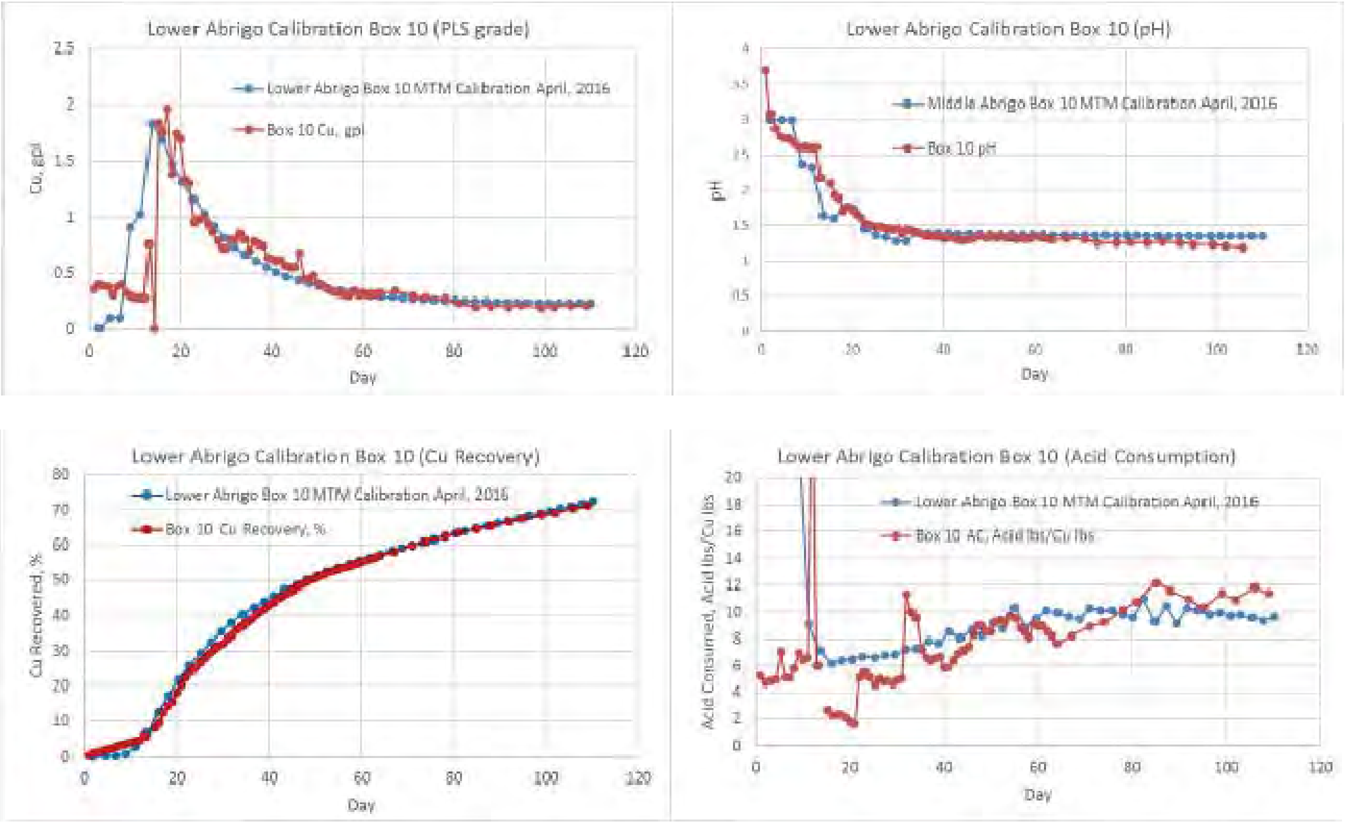


Figure 13-24: Comparison of Lower Abrigo core tray 10 (box 10) test results (PLS, pH, cumulative recovery and incremental acid consumption), with the Lower Abrigo calibrated geochemical model (“Lower Abrigo Box 10 MTM Calibration April, 2016”).

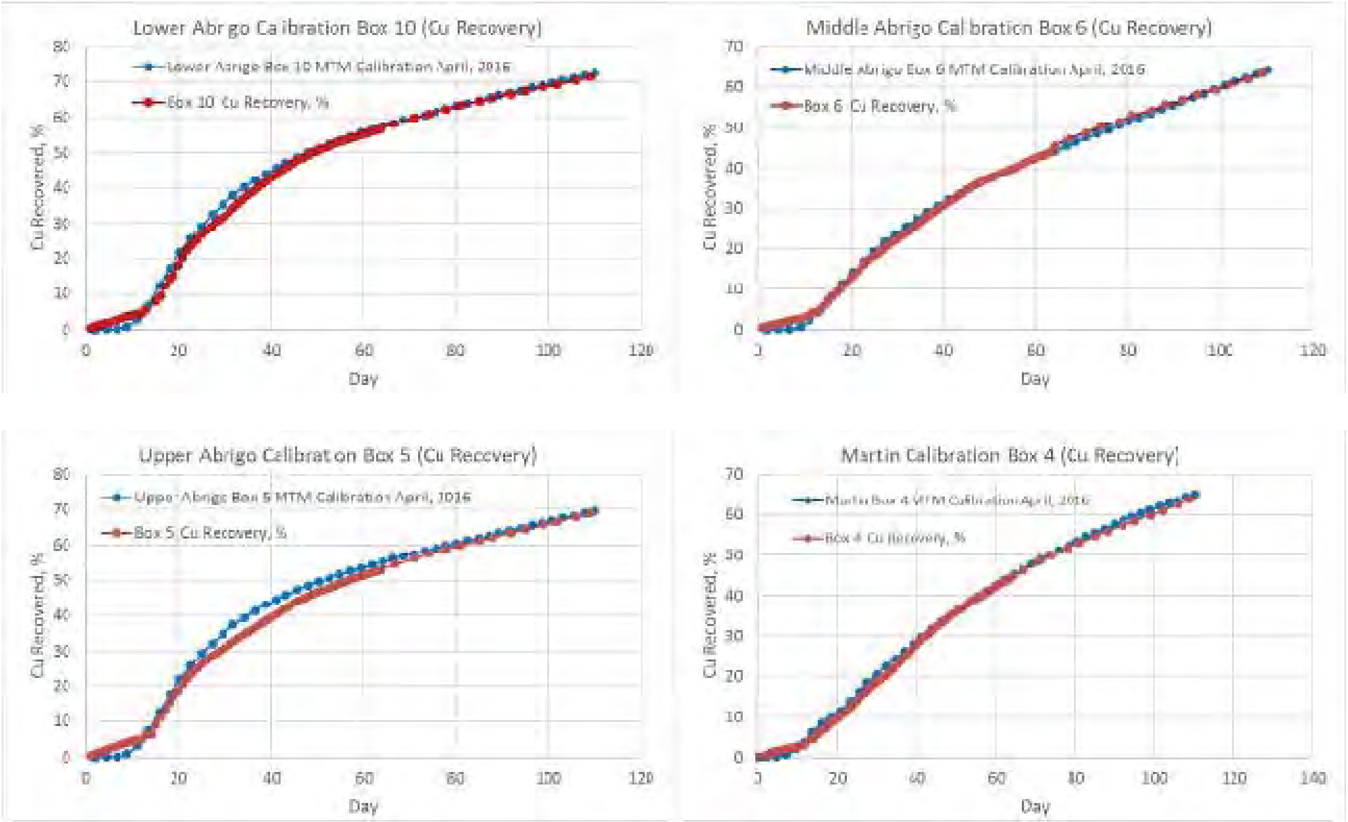


Figure 13-25: Comparison of leachable copper recovery (Lower Abrigo, Middle Abrigo, Upper Abrigo and Martin formation), with the equivalent calibrated geochemical model ("…. MTM Calibration April, 2016")

The calibration models for the individual and average core trays were successful in generating geochemical models that accurately represented the core trays. Modelling was then expanded to simulate much longer flow paths by essentially chaining together, in series, multiple calibrated models such that the output of the proceeding interval became the input to the successive interval in a "plug-flow" approach, the number of intervals chained together thus representing different flow path lengths. A summary of the leachable copper recovery results using an input acid concentration of 15 gpl, average rock compositions, grades and flow rates, and for the average path length of 95', are shown in Figure 13-26.

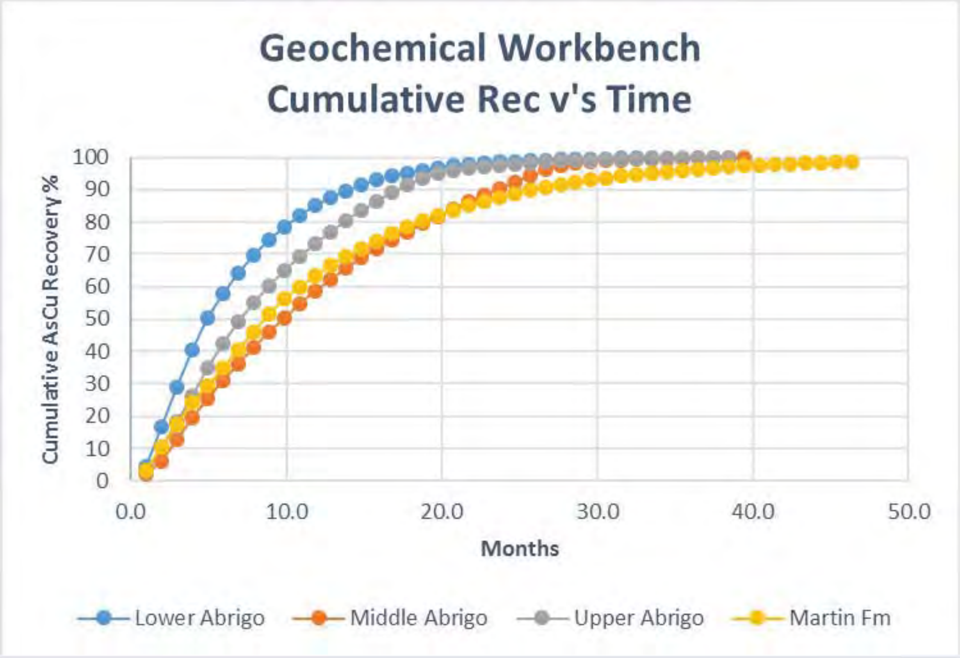


Figure 13-26: Example of results from geochemical modelling of leachable copper recovery (Lower Abrigo, Middle Abrigo, Upper Abrigo and Martin formation), using a 95' path length and average input parameters

Although this modelling gave some valuable insights into the leaching process, the “plug-flow” approach and lack of modelling for initial groundwater dilution did not generate metallurgical model data useful for production scheduling. Nevertheless, the modelling once again indicated approximately 100% recovery of leachable copper within 30 to 48 months, consistent with previous estimates of 5-spot recovery times.

Lognormal distribution

Intuitively, it is expected that the cumulative recovery/time curve for an in-situ mining block should have a generalized “S” shaped appearance, or more precisely the incremental copper recovery curve should have a lognormal distribution. This lognormal distribution is a function of aggregating or averaging the countless and variable flow paths the mining solution can take from one well to another, while incorporating initial low recovery due to dilution and early acid neutralization. Sophisticated modelling combined with actual data from the uranium in-situ industry as well as data from commercial copper heap leaching operations supports the overall lognormal distribution of recovery (Figure 13-27).

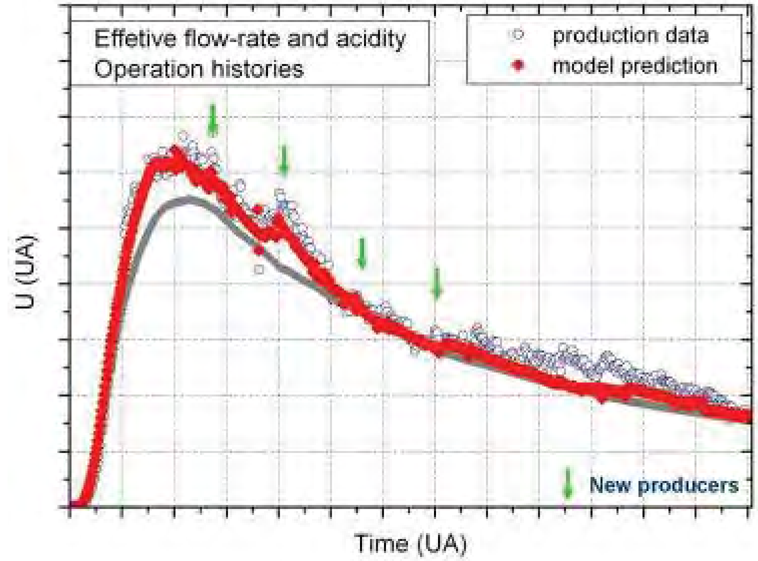


Figure 13-27: Incremental recovery-time curve for uranium in-situ (from: Regnault et. al., 2013)

The countless different flow paths each result in a retention time for the leach solution which is a function of both the length of the flow path and the permeability of the ore along that path. For example, some solution could travel along a highly permeable fracture, taking only a few days to travel from the injection well to the recovery well ("fast path"), while other solutions could take a "slow path" along a different fracture, taking weeks to travel between the wells. The "slow path" results in an initial PLS (actually just the ground water being pushed ahead of the injected leach solution) with little or no copper and low acid concentrations, followed by a large "slug" of copper when the leaching front finally reaches the recovery well. The "fast path" results in an initial PLS with higher copper grades and higher acid concentrations, but without the large "slug" of later copper, because the leach front rapidly reaches the recovery well.

Given that the recovery-time curve is a function of retention time, which is a function flow path, then the variable flow paths (flow velocities) are related to the hydrological conditions of the area being mined. These hydrological conditions have been investigated extensively at the North Star deposit by the Excelsior hydrological team. These investigations demonstrate that the hydraulic conductivity ("K" value) is in fact lognormally distributed (Figure 13-28). Hydraulic conductivity in fractured rock aquifers tends to be log-normally distributed (Neuman, 1982). This is deduced from the observation that in consolidated rock, fracturing appears to have the greatest influence on the hydraulic conductivity and fracture development is in essence a process of growth. The bedrock K values from the Gunnison site pump testing have been statistically analyzed (Kuhnel, 2016), and show a lognormal distribution (Figure 13-28).

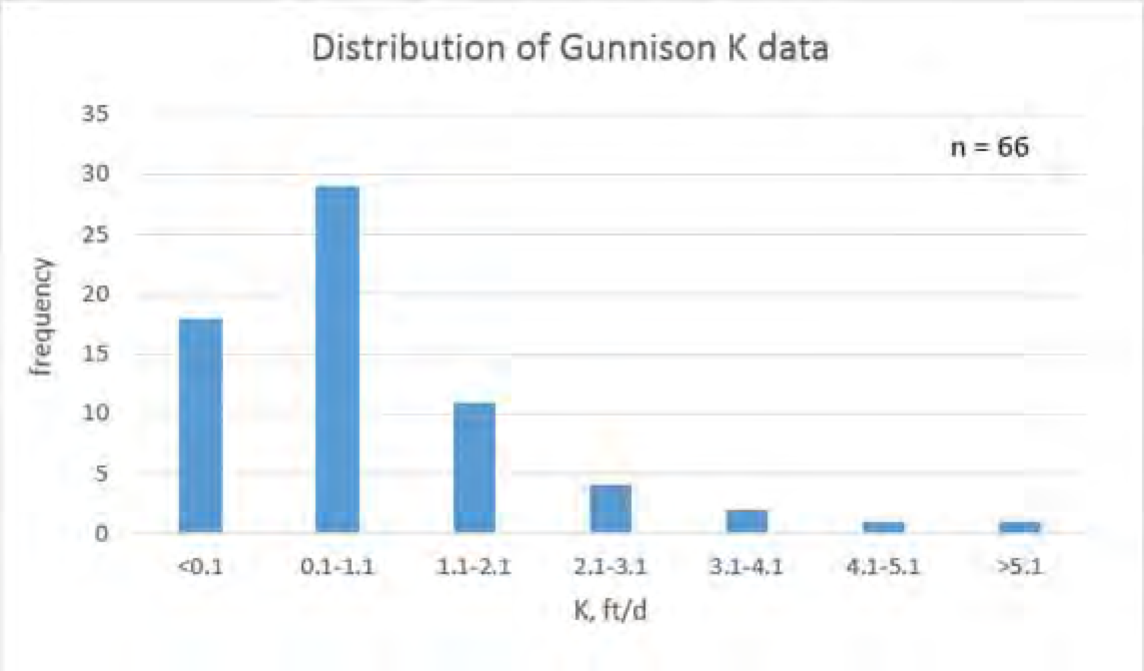


Figure 13-28: Lognormal distribution of K values from the North Star deposit

Using the geological and hydrological characteristics of the rocks at North Star, lognormal K distributions were estimated for the four major rock types. These lognormal distributions of hydraulic conductivity for the major rock types were used as a proxy for the distribution of the flow paths and hence residence times, for the equivalent metallurgical recovery curves. The transformations of the core tray metallurgical recovery-time curves so calculated are shown in Figure 13-29 below. Note that for each curve, a month one delay for any recovery to occur was added to each rock type. This was a manual adjustment representing the initial groundwater pore volume removal/replacement and groundwater dilution effects at well start-up, as modelled by Excelsior's in-house hydrologist.

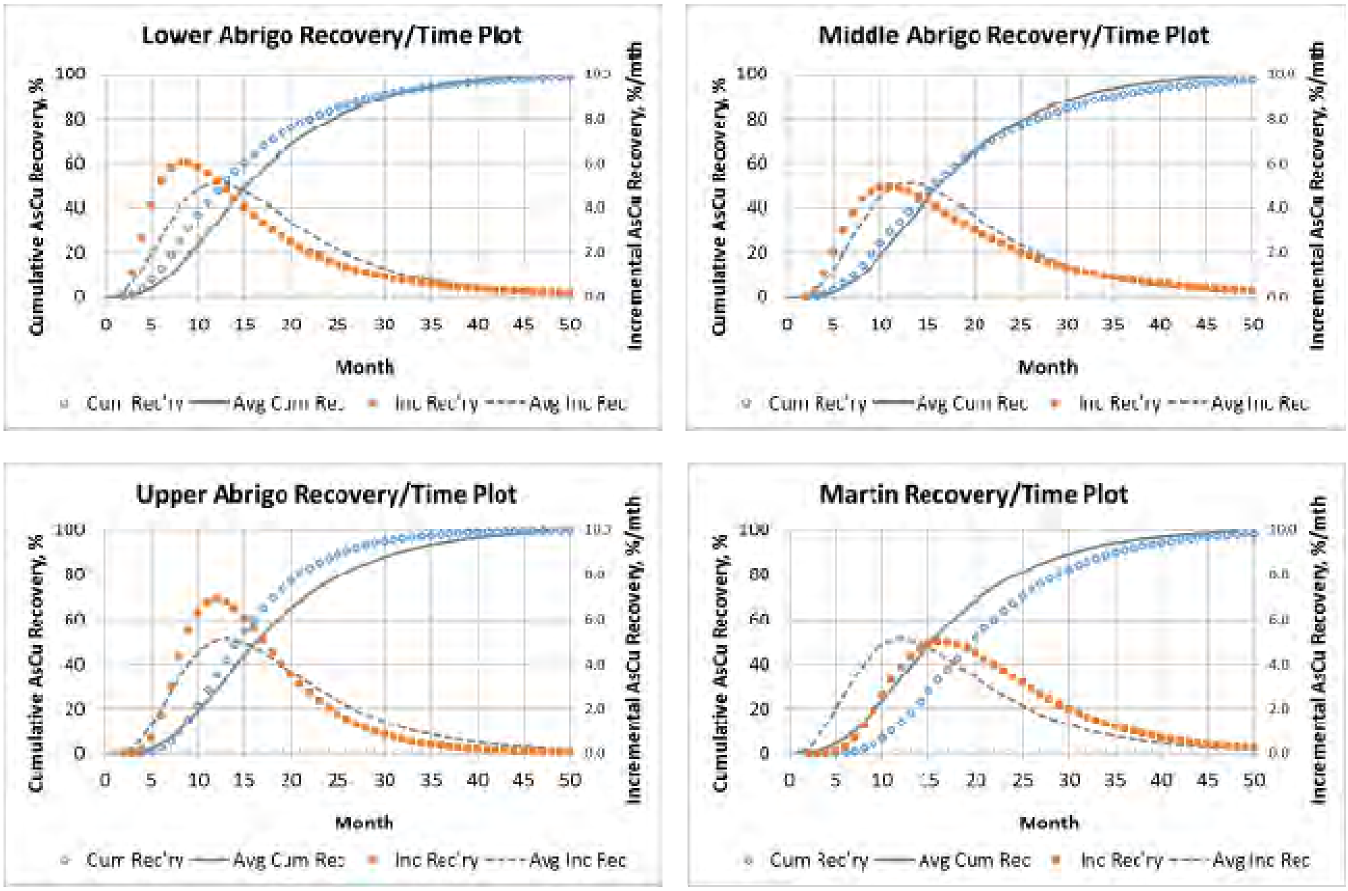
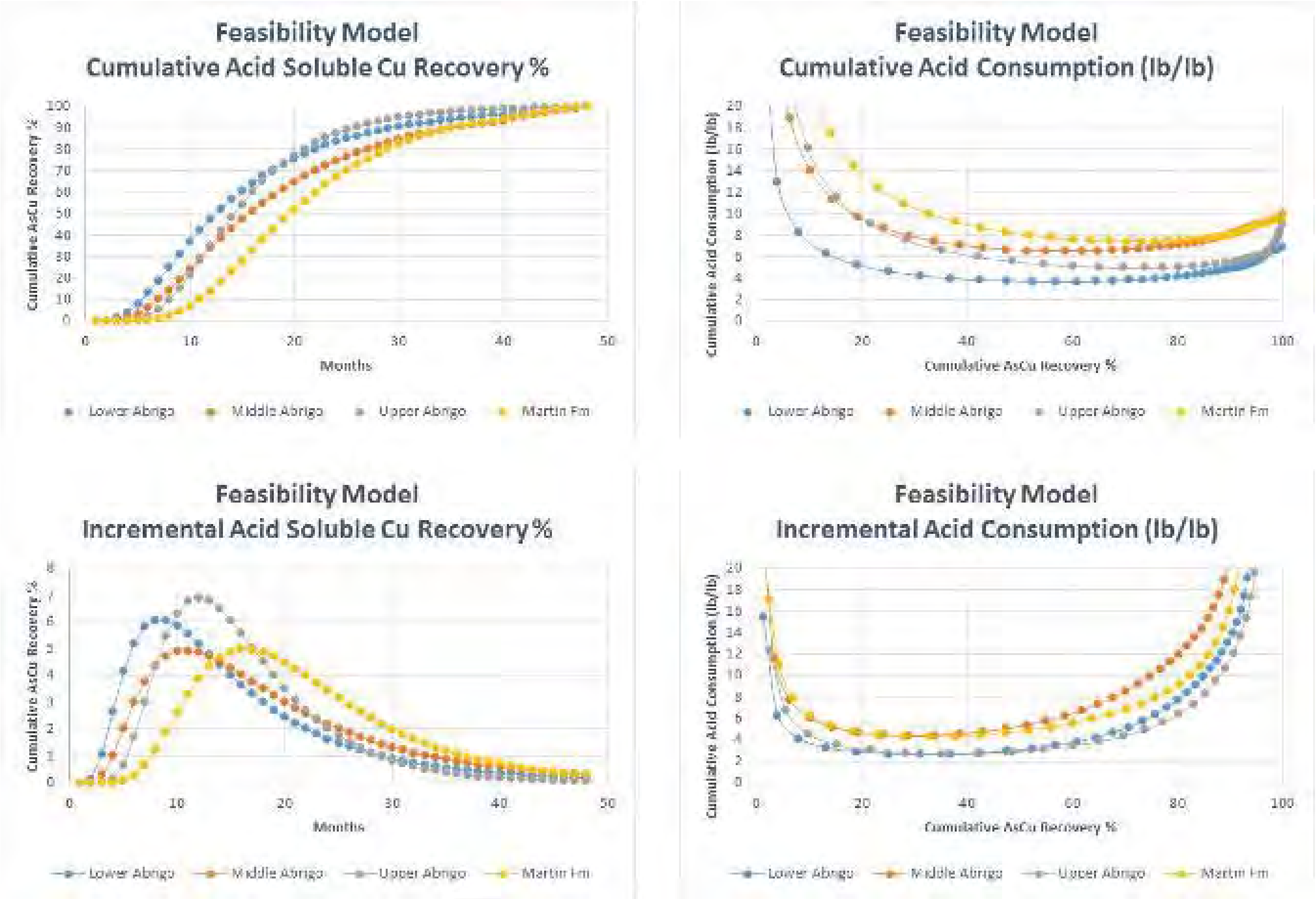


Figure 13-29: Recovery-time curves for the four major rock types including a comparison to the average recovery-time curve for all rock types combined. Note that a one-month recovery delay has been manually added to represent the initial groundwater pore volume removal and dilution

Three methods for estimating the acid consumption in the 5-spot operation were considered: the raw core tray results, the results from the 5-spot simulation, and the results from the GWB simulation. Excelsior made the decision to use the core tray results based on the assumption that the gangue acid consumption per unit surface area of exposed fractures in the 5-spot is the same as the gangue acid consumption per unit area of exposed core in the core tray tests. This assumption is reasonable given the core samples in the core tray tests were from a wide range of representative rock types and oxidation levels, distributed spatially about the deposit. The cumulative and incremental acid consumption curves so derived (along with cumulative and incremental recovery) are shown in Figure 13-30.


Feasibility Model
Cumulative Acid Soluble Cu Recovery %

Feasibility Model
Cumulative Acid Consumption (lb/lb)

Feasibility Model
Incremental Acid Soluble Cu Recovery %

Feasibility Model
Incremental Acid Consumption (lb/lb)

Figure 13-30: Cumulative and incremental acid consumption and recovery curves for the North Star feasibility metallurgical model

For comparative purposes the cumulative acid soluble recovery for the feasibility model versus the pre-feasibility, 5-spot simulation and the GWB models are shown in Figure 13-31. In general, the feasibility model is the most conservative.

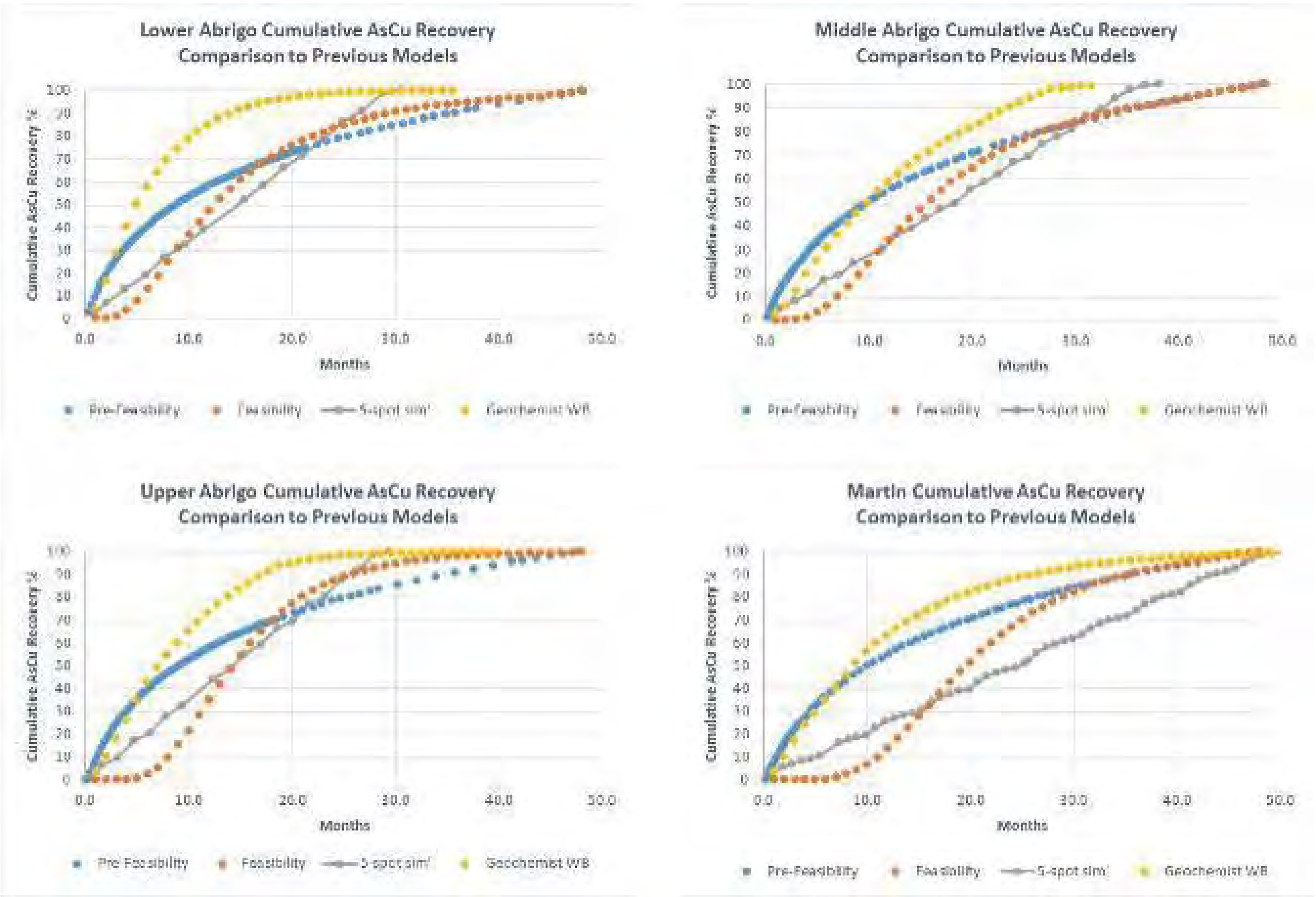


Figure 13-31: Comparison of cumulative acid soluble recovery for the various metallurgical models

The above figures show the expected recovery assuming all of the ore in the 5-spot is contacted by the leach solution. "Sweep efficiency" defines the relative effectiveness of the leach solution/ore contact compared to that of the most fractured ore in the deposit (M3, 2014). The recovery from a 5-spot ISR is the metallurgical recovery times the sweep efficiency. The sweep efficiency improves as the fracture intensity (the inverse of the distance between fracture faces) increases – the more fractured the ore the higher will be the sweep efficiency. The degree of fracturing in the ore has been divided into five groups designated 1 to 5, with 5 indicating the most severe fracturing and 1 the least fracturing. The relationship between fracture intensity and sweep efficiency is being assumed by Excelsior to follow the relationship shown in 32. Multiplying the metallurgical recovery by the sweep efficiency gives an estimate of the recovery from the 5-spot in situ leach. The expected recoveries are based on a well spacing of 100 feet, a leach solution injection rate of 0.1 gpm/ft of well length, the average ore grade, and a leach solution acid strength of 15 gpl or greater as needed to supply the acid required to satisfy the gangue acid consumption for the recovery projected.

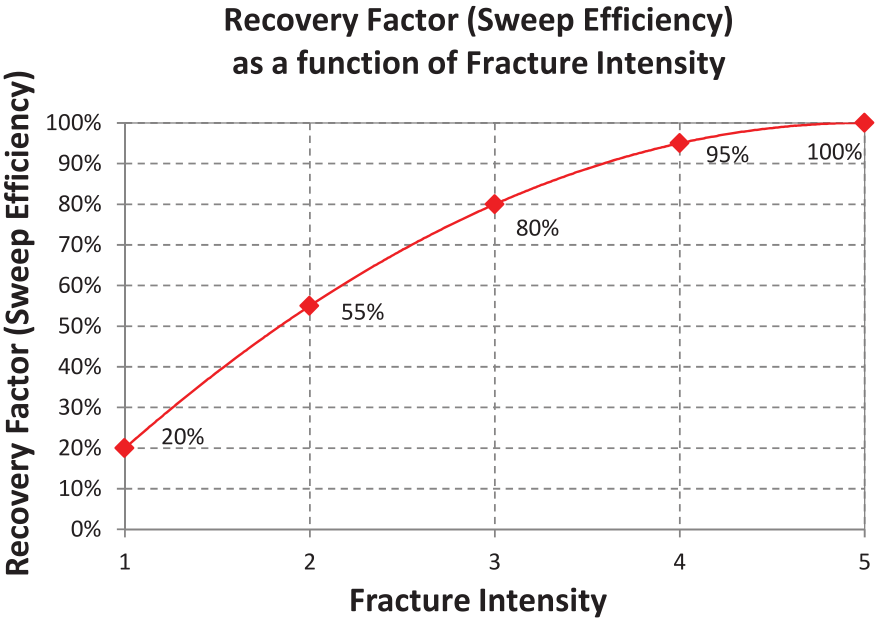


Figure 13-32: Sweep Efficiency as a Function of Fracture Intensity

Combining the information in Figure 13-30 with the sweep efficiency factors from Figure 13-32, the sweep efficiency factored cumulative acid soluble copper recovery and acid consumption (weighted average by the Probable Reserve), can be estimated for a 5-spot well pattern over a four-year period is shown in Table 13-5 below.

Table 13-5: Sweep Factored Cumulative Recovery and Acid Consumption

Cumulative Acid Soluble Cu Recovery (%)	Year 1	Year 2	Year 3	Year 4
Martin	10.2	48.9	66.1	72.8
Upper Abrigo	26.2	65.1	72.9	74.5
Middle Abrigo	25.4	56.0	67.9	75.0
Lower Abrigo	35.5	62.2	70.4	74.6
Bolsa, TQM, other*	35.5	62.2	70.3	74.5
Weighted average	21.0	56.2	68.8	73.9
Cumulative Acid Consumption (lb/lb)*	**Year 1**	**Year 2**	**Year 3**	**Year 4**
Martin	17.5	7.5	8.1	9.7
Upper Abrigo	6.6	5.3	6.8	9.0
Middle Abrigo	7.4	6.8	8.2	10.0
Lower Abrigo	3.7	4.3	5.4	6.9
Bolsa, TQM, other*	3.7	4.3	5.4	6.9
Weighted average	8.2	6.2	7.4	9.1

Although the data in Table 13-5 is on an annual basis, the graphs and supporting data from Figure 13-30 allow the cumulative and incremental acid soluble Cu recovery and acid consumption to be calculated on a monthly, quarterly or any time basis. When combined with reserve data these relationships can be used to generate modelled production schedules. Note that the feasibility metallurgical model is capped at a maximum of 100% AsCu recovery and therefore does not include metal contributions from Cu(Insol).

13.4 METALLURGICAL CONCLUSIONS

With the recent purchase of the JCM adjacent to the North Star property Excelsior now has a solvent extraction (SX) plant capable to processing approximately 5,000 gpm of PLS and an electrowinning (EW) plant which can produce approximately 25 million pounds of cathode copper per year. The Johnson Camp SX-EW plant is compatible with an in situ leach start-up operation commencing with an appropriate number of injection and recovery wells. In addition, the staff at Johnson Camp has years of experience in operating the SX-EW plant and processing solutions from mineralization which is very similar to the mineralization in the North Star deposit.

Test results have confirmed that conventional acid soluble copper content reported by the sequential copper assay underestimates the amount of copper that can be solubilized in the ore. This has been noted in other oxide copper deposits and is attributed to the presence in secondary copper sulfide minerals and weakly or slowly soluble copper oxide minerals which require long leach times or ferric iron that is in a commercial leach solution. Tests on samples from the North Star deposit have shown that about 10 percent of the non-acid soluble copper will solubilize under commercial leaching conditions.

14 MINERAL RESOURCE ESTIMATES

14.1 INTRODUCTION

This updated mineral resource estimation for the North Star deposit of the Gunnison Project was completed in accordance with the requirements of Canadian National Instrument 43-101 ("NI 43-101"). Modeling and estimation of the mineral resources of the North Star deposit were undertaken in April through June 2015 under the supervision of Michael M. Gustin, a Qualified Person with respect to mineral resource estimations under NI 43-101. Mr. Gustin is independent of Excelsior by the definitions and criteria set forth in NI 43-101; there is no affiliation between Mr. Gustin and Excelsior except that of an independent consultant/client relationship.

The resources reported herein are updated from those previously reported (M3, 2016) to reflect land subsequently acquired by Excelsior. A relatively minor amount of the previously modeled mineralization lies within the newly acquired ground and is now included in the Gunnison Project mineral resources. The effective date of the updated mineral resources estimate is October 1, 2016.

Although MDA is not an expert with respect to any of the following topics, as the date of this report, MDA is not aware of any unusual environmental, permitting, legal, title, taxation, socio-economic, marketing, or political factors that may materially affect the North Star mineral resources and that are not otherwise discussed in this report.

The North Star resources are classified by MDA in order of increasing geological and quantitative confidence into Inferred, Indicated, and Measured categories in accordance with the "CIM Definition Standards - For Mineral Resources and Mineral Reserves" (2014) and therefore Canadian National Instrument 43-101. CIM mineral resource definitions are given below, with CIM's explanatory text shown in italics:

Mineral Resource

Mineral Resources are sub-divided in order of increasing geological confidence, into Inferred, Indicated and Measured categories. An Inferred Mineral Resource has a lower level of confidence than that applied to an Indicated Mineral Resource. An Indicated Mineral Resource has a higher level of confidence than an Inferred Mineral Resource but has a lower level of confidence than a Measured Mineral Resource.

A Mineral Resource is a concentration or occurrence of solid material of economic interest in or on the Earth's crust in such form, grade or quality and quantity that there are reasonable prospects for eventual economic extraction.

The location, quantity, grade or quality, continuity and other geological characteristics of a Mineral Resource are known, estimated or interpreted from specific geological evidence and knowledge, including sampling.

Material of economic interest refers to diamonds, natural solid inorganic material, or natural solid fossilized organic material including base and precious metals, coal, and industrial minerals.

The term Mineral Resource covers mineralization and natural material of intrinsic economic interest which has been identified and estimated through exploration and sampling and within which Mineral Reserves may subsequently be defined by the consideration and application of Modifying Factors. The phrase 'reasonable prospects for eventual economic extraction' implies a judgment by the Qualified Person in respect of the technical and economic factors likely to influence the prospect of economic extraction. The Qualified Person should consider and clearly state the basis for determining that the material has reasonable prospects for eventual economic extraction. Assumptions should include estimates of cutoff grade and geological continuity at the selected cut-off, metallurgical recovery, smelter payments, commodity price or product value, mining and processing method and mining, processing and general and administrative costs. The Qualified Person should state if the assessment is based on any direct evidence and testing.

Interpretation of the word 'eventual' in this context may vary depending on the commodity or mineral involved. For example, for some coal, iron, potash deposits and other bulk minerals or commodities, it may be reasonable to envisage 'eventual economic extraction' as covering time periods in excess of 50 years. However, for many gold deposits, application of the concept would normally be restricted to perhaps 10 to 15 years, and frequently to much shorter periods of time.

Inferred Mineral Resource

An Inferred Mineral Resource is that part of a Mineral Resource for which quantity and grade or quality are estimated on the basis of limited geological evidence and sampling. Geological evidence is sufficient to imply but not verify geological and grade or quality continuity.

An Inferred Mineral Resource has a lower level of confidence than that applying to an Indicated Mineral Resource and must not be converted to a Mineral Reserve. It is reasonably expected that the majority of Inferred Mineral Resources could be upgraded to Indicated Mineral Resources with continued exploration.

An Inferred Mineral Resource is based on limited information and sampling gathered through appropriate sampling techniques from locations such as outcrops, trenches, pits, workings and drillholes. Inferred Mineral Resources must not be included in the economic analysis, production schedules, or estimated mine life in publicly disclosed Prefeasibility or Feasibility Studies, or in the Life of Mine plans and cash flow models of developed mines. Inferred Mineral Resources can only be used in economic studies as provided under NI 43-101.

There may be circumstances, where appropriate sampling, testing, and other measurements are sufficient to demonstrate data integrity, geological and grade/quality continuity of a Measured or Indicated Mineral Resource, however, quality assurance and quality control, or other information may not meet all industry norms for the disclosure of an Indicated or Measured Mineral Resource. Under these circumstances, it may be reasonable for the Qualified Person to report an Inferred Mineral Resource if the Qualified Person has taken steps to verify the information meets the requirements of an Inferred Mineral Resource.

Indicated Mineral Resource

An Indicated Mineral Resource is that part of a Mineral Resource for which quantity, grade or quality, densities, shape and physical characteristics are estimated with sufficient confidence to allow the application of Modifying Factors in sufficient detail to support mine planning and evaluation of the economic viability of the deposit.

Geological evidence is derived from adequately detailed and reliable exploration, sampling and testing and is sufficient to assume geological and grade or quality continuity between points of observation.

An Indicated Mineral Resource has a lower level of confidence than that applying to a Measured Mineral Resource and may only be converted to a Probable Mineral Reserve.

Mineralization may be classified as an Indicated Mineral Resource by the Qualified Person when the nature, quality, quantity and distribution of data are such as to allow confident interpretation of the geological framework and to reasonably assume the continuity of mineralization. The Qualified Person must recognize the importance of the Indicated Mineral Resource category to the advancement of the feasibility of the project. An Indicated Mineral Resource estimate is of sufficient quality to support a Prefeasibility Study which can serve as the basis for major development decisions.

Measured Mineral Resource

A Measured Mineral Resource is that part of a Mineral Resource for which quantity, grade or quality, densities, shape, and physical characteristics are estimated with confidence sufficient to allow the application of modifying factors to support detailed mine planning and final evaluation of the economic viability of the deposit.

Geological evidence is derived from detailed and reliable exploration, sampling and testing and is sufficient to confirm geological and grade or quality continuity between points of observation.

A Measured Mineral Resource has a higher level of confidence than that applying to either an Indicated Mineral Resource or an Inferred Mineral Resource. Measured mineral resources may be converted to a Proven Mineral Reserve by designing and scheduling the Measured mineral resources into the mine plan and having positive economics.

Mineralization or other natural material of economic interest may be classified as a Measured Mineral Resource by the Qualified Person when the nature, quality, quantity and distribution of data are such that the tonnage and grade or quality of the mineralization can be estimated to within close limits and that variation from the estimate would not significantly affect potential economic viability of the deposit. This category requires a high level of confidence in, and understanding of, the geology and controls of the mineral deposit.

14.2 RESOURCE MODELING

14.2.1 Data

The North Star copper resources were modeled and estimated using data generated primarily by Excelsior, including information derived from core, reverse circulation, and conventional rotary drillholes. Additional drill data used in the modeling were derived from historical exploration programs completed by Cyprus Minerals, Superior Minerals, Quintana Minerals, Magma Copper, Phelps Dodge, Minerals Exploration, and James Sullivan. No holes were drilled subsequent to the previously reported resources of M3 (2016). These data, as well as digital topography of the project area, were provided to MDA by Excelsior in a digital database in Arizona State Plane, East Zone coordinates in US Survey feet using the NAD27 datum. This database is summarized in more detail in Section 10.

All modeling of the North Star deposit resources was performed using proprietary software developed at MDA as well as GEOVIA Surpac™ mining software. The North Star resource block-model extents and block dimensions are provided in Table 14-1.

Table 14-1: Block Model Summary

In Feet (ft.)	x	y	z
Min Coordinates	529000	384750	0
Max Coordinates	549450	398250	5200
Block Size	50	100	25
Rotation	0	0	0

The project database includes drillhole information from holes drilled immediately adjacent to lands controlled by Excelsior. The modeling of the project resources incorporated the results from these holes, but the reported project mineral resources include only modeled mineralization that lies within Excelsior-controlled lands.

14.2.2 Deposit Geology Pertinent to Resource Modeling

The North Star copper mineralization occurs primarily in Paleozoic sedimentary units adjacent to the Texas Canyon Quartz Monzonite, although the quartz monzonite and Precambrian rocks host minor quantities of mineralization as well. The primary controls on the North Star mineralization include: (i) proximity to the Texas Canyon Quartz Monzonite; (ii) carbonate-bearing stratigraphic units altered to various calc-silicate/skarn mineral assemblages; and (iii) the degree of fracturing. The development of primary copper-sulfide skarn mineralization is related to the proximity to the intrusion. The skarn mineralization preferentially developed in carbonate-bearing units, with the combination of this and proximity to the intrusion leading to the Martin and Abrigo Formations being the primary host units. Fracture intensity is controlled by two factors: fracturing related to volume loss during skarn development, and fracturing related to pre- and post-mineral faulting. The effects of oxidation overprint the primary copper mineralization to depths of approximately 1,600 feet.

Geologic factors critical to the modeling of the North Star copper mineralization therefore include lithology, structure, and oxidation.

14.2.3 Modeling of Geology

Excelsior completed stratigraphic interpretations on a set of east-west vertical cross sections that were used for all modeling of the North Star deposit. These sections are spaced at 100-foot intervals over a north-south extent of 9,000 feet, which covers the resource area, with four 500-foot spaced sections appended to the north and south of the 100-foot sections. The stratigraphic units modeled on the cross sections include the Naco Group, Escabrosa Limestone, Martin Formation, Abrigo Formation (subdivided into the upper, middle, and lower units), Bolsa Quartzite, undivided Precambrian rocks (including the Pinal Schist and Apache Group), Texas Canyon Quartz Monzonite, and Tertiary/Quaternary basin fill. The Excelsior stratigraphic cross sections were used to assign a single lithologic code to each block in the model (Figure 14-1 and Figure 14-2).

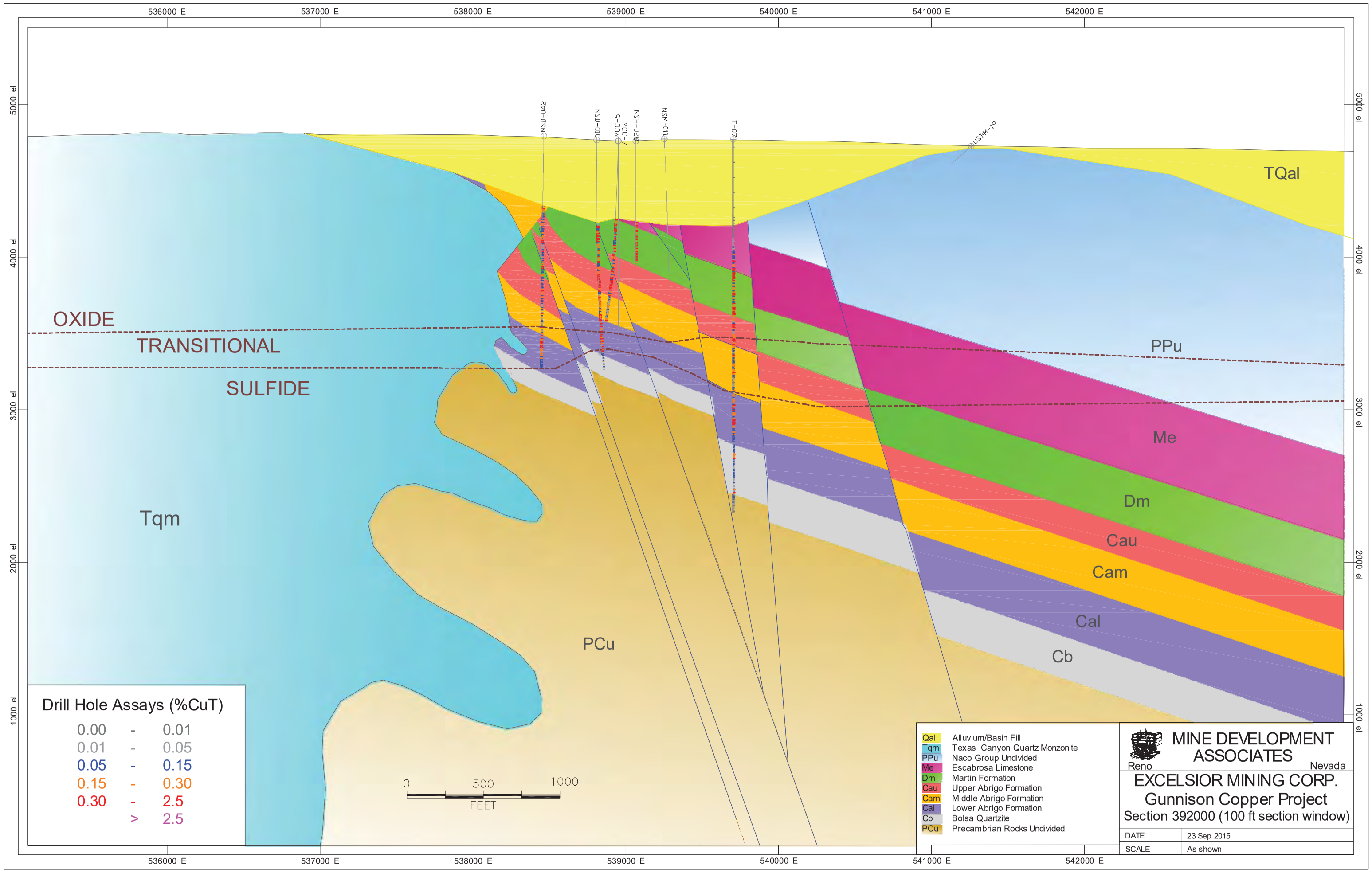


Figure 14-1: Cross Section 392000N Showing North Star Geologic Model

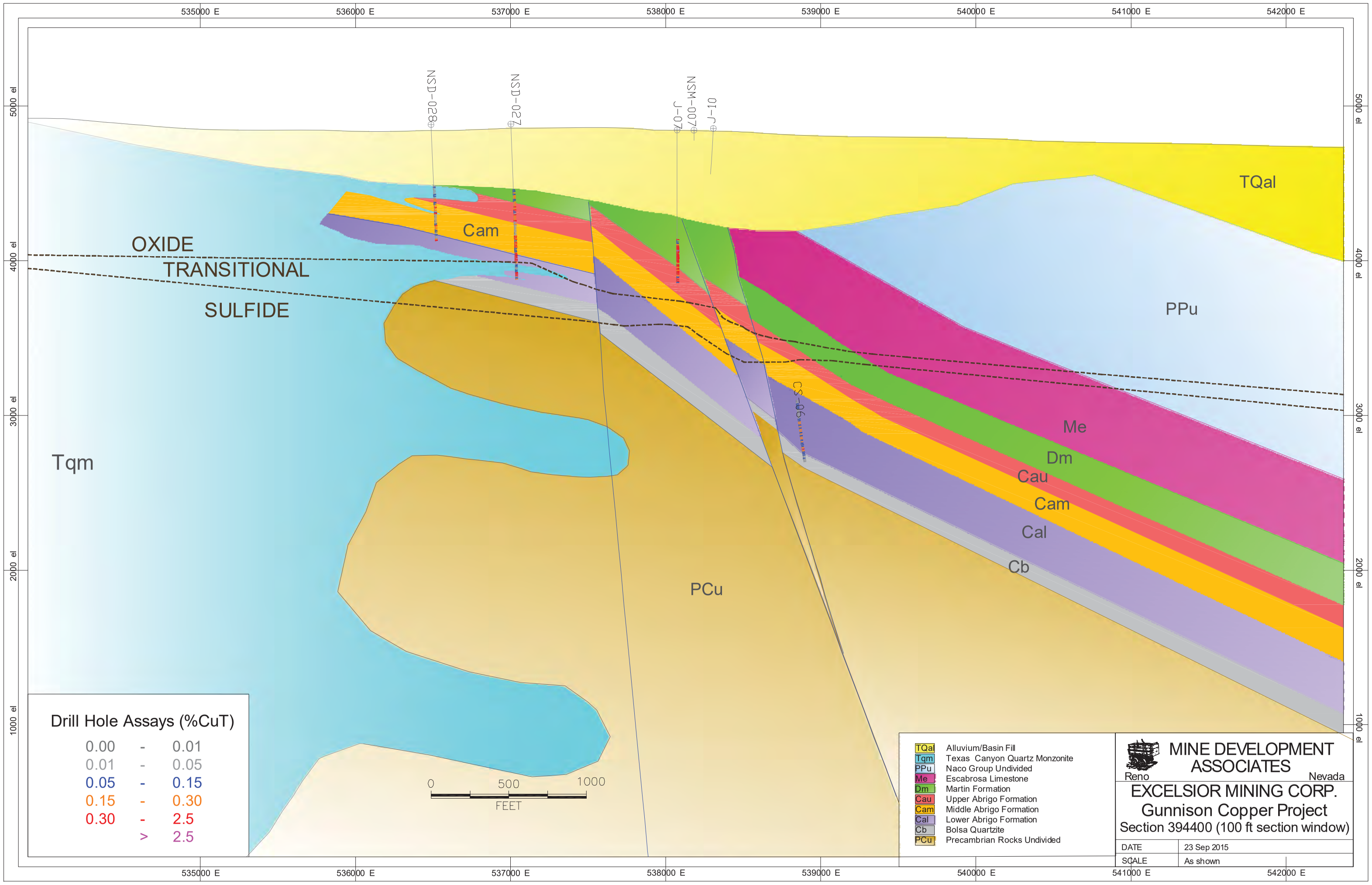


Figure 14-2: Cross Section 394400N Showing North Star Geologic Model

As part of the geologic modeling, Excelsior also completed detailed structural interpretations. A total of 61 individual structural domains were modeled as three-dimensional wire-framed solids (Figure 14-3). These solids were used to code model blocks to each of the 61 modeled structural domains. A block that encompasses any volume of one of the structural domains was assigned the code of that domain, which effectively expands the volumes of the structural domains from those represented by the structural solids.

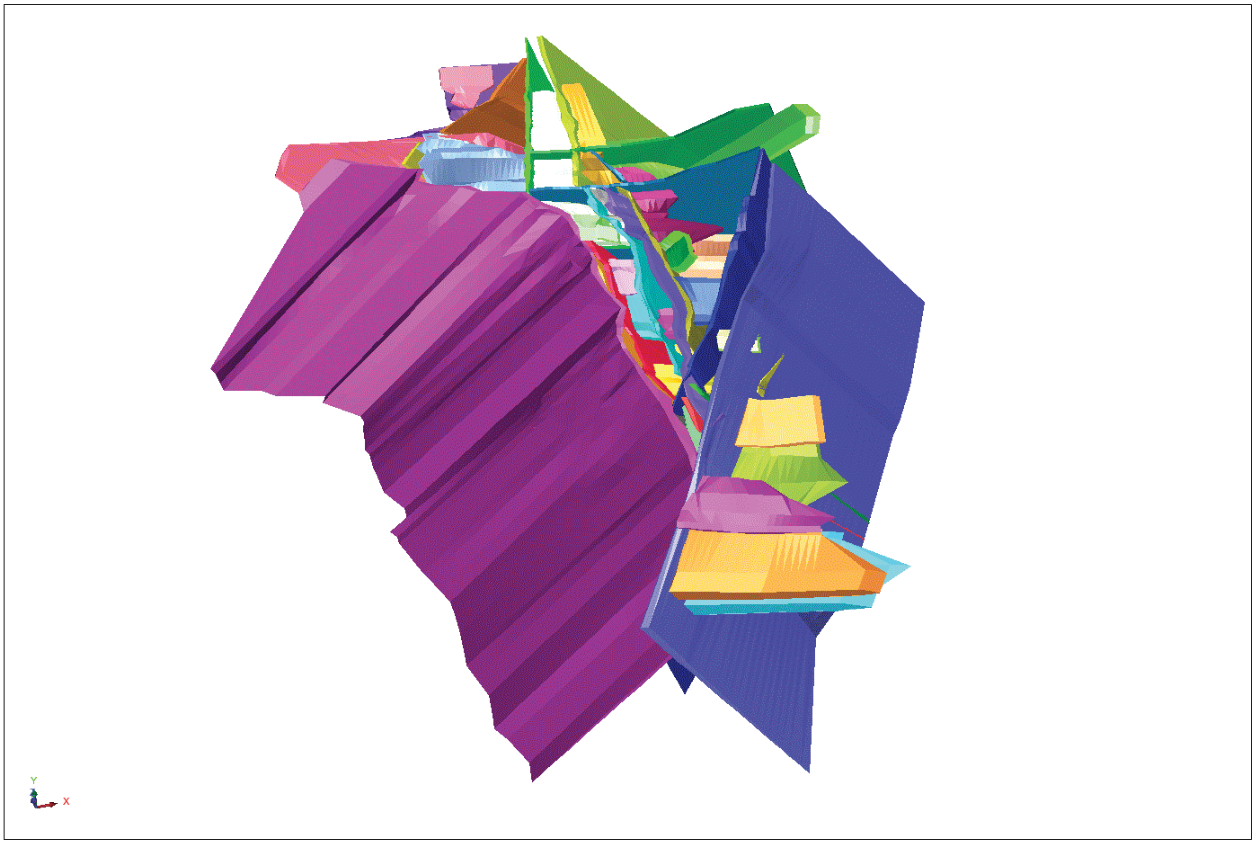


Figure 14-3: Oblique Northerly View of Structural – Domain Wire – Frame Solids

14.2.4 Oxidation Modeling

Using drillhole logging and copper sequential-leach data (total copper ("TCu"), acid-soluble copper ("ASCu"), and cyanide-soluble copper ("CNCu"), Excelsior modeled both the base of more-or-less complete oxidation and the bottom of oxidation/top of unoxidized materials on a set of 100-foot spaced, east-west vertical sections. In general, if the ASCu to TCu ratio was greater than or equal to 50%, the mineralization was assigned to oxide. If the ASCu to TCu ratio ranged between 49% to 20%, the mineralization was assigned as transitional material. These oxidation ratio rules were modified primarily by geological common sense.

The outcome of the modeling was to interpret three dimensional surfaces between oxide, transitional, and sulfide portions of the North Star deposit. The surfaces were then used to code each model block to one of the three oxidation zones.

14.2.5 Fracture – Intensity Modeling

Fracture intensity at the North Star deposit is defined based on geological logging and down-hole geophysical data. A relative fracture-intensity value was assigned to each logged interval in the project database on a scale of one to five, irrespective of the rock unit, with a value of "5" representing the most fractured rock (Table 14-2).

Table 14-2: Fracture – Intensity Scale

Intensity Code	Description (% of Core ≤ 4 inches)
1	Very Weak (0-5%)
2	Weak (5-20%)
3	Moderate (20-50%)
4	Strong (50-80%)
5	Very Strong (80-100%)

The wireframe solids discussed in Section 14.2.3 were used to code the fracture-intensity intervals in the project database to the structural domains. Fracture-intensity intervals lying outside of the structural domains were also assigned a code, leading to a total of 3,485 coded fracture-intensity intervals in the database, 26% of the intervals inside of the solids and the remainder outside. The intervals inside and outside of the structural domains have length-weighted mean fracture intensity values of 3.4 and 2.3, respectively.

The coded fracture-intensity values were composited to 25-foot lengths for use in inverse-distance-to-the-fifth-power interpolations of the fracture intensity into the resource-model blocks. All composites coded to the 61 structural domains were used for the interpolation of values into each of the structural domains coded into the model, and outside-domain composites were used to estimate the values in the remainder of the model. The inside-domain estimations used one of eight search-ellipse orientations to match the average strike and dip of each modeled structural domain. Fracture intensity values of the Paleozoic sedimentary units and Precambrian rocks outside of the structural domains were estimated using an ellipse that is consistent with the average strike and dip of the sedimentary units, while the Texas Canyon Quartz Monzonite was estimated using an isotropic search ellipse (Table 14-3). These search ellipses for fracture intensity were also used in the estimation of TCu grades and ASCu to TCu ratios ("ASCu/TCu"); see Table 14-11 for details of the search-ellipse orientations.

Table 14-3: Fracture – Intensity Estimation Parameters

Structural Domains, Paleozoic Sediments, Precambrian Rocks						
	Search - Ellipse Ranges (ft)			Composite Constraints		
Estimation Pass	Major	Semi-Major	Minor	Min	Max	Max/hole
1	700	700	233	4	10	4
2	1000	1000	333	1	10	4
Texas Canyon Quartz Monzonite						
	Search-Ellipse Ranges (ft)			Composite Constraints		
Estimation Pass	Major	Semi-Major	Minor	Min	Max	Max/hole
1	700	700	700	4	10	4

Figure 14-4 is an east-west cross section showing the fracture-intensity model in the deposit.

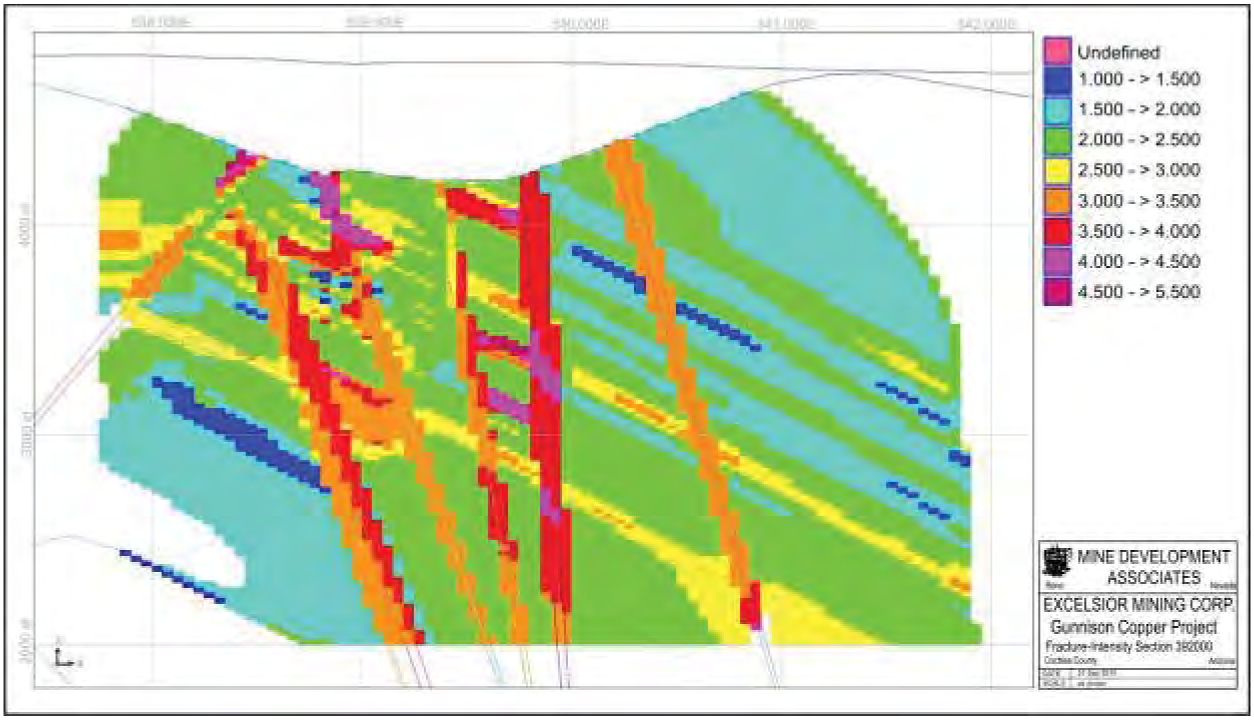


Figure 14-4: Fracture – Intensity Model Cross Section 392000N

14.2.6 Density Modeling

Specific-gravity ("SG") determinations were made by Excelsior for every assay sample in zones of mineralization and an additional 10 feet beyond the limits of each mineralized zone. The logging geologist determined where SG measurements were taken with regards to mineralized and non-mineralized materials; determinations were made on core from the NSD-series holes as well as the NSM-series metallurgical holes. The water-displacement method was used to determine the SG values using whole-core samples, which were not wrapped or waxed for the measurements. MDA notes that this methodology does not allow for the determination of actual in situ bulk specific gravity in zones of highly broken core, because natural void spaces cannot be properly measured, leading to some overstatement of SG in these cases.

Model tonnage factors were assigned based on the combination of lithologic, oxidation, and total-copper mineral-domain coding of each block in the model. The TCu mineral-domain codes (discussed in Section 14.2.7) include domain 100 (low-grade), domain 200 (high-grade), or domain 0 (un-modeled/un-mineralized). Table 14-4 shows descriptive statistics of the underlying SG data by these categories, as well as the tonnage factors assigned to the model blocks (calculated from the SG means).

Table 14-4: Specific Gravity Statistics and Model Coding of Tonnage Factors

Unit	TCu Domain	Oxidation Zone	Specific Gravity					Tonnage Factor
			Mean	Median	Min	Max	Count	(ft^3/ton)
Qal	0	ox	2.5	2.54	2.28	2.74	17	12.81
Tqm	200	ox + trans	2.61	2.59	2.27	3.14	35	12.27
	100	ox + trans	2.57	2.58	2.33	3.06	115	12.47
	0	ox + trans	2.56	2.58	2.14	2.88	177	12.51
	100	unox	2.59	2.6	2.16	3.18	237	12.37
	0	unox	2.56	2.59	2.21	2.7	80	12.51
Ppu	100	ox + trans	2.72	2.67	2.58	3.47	27	11.78
	0	ox + trans	2.71	2.67	2.36	3.46	137	11.82
Me	200	ox + trans	2.96	3.04	2.03	3.58	63	10.82
	100	ox + trans	2.84	2.7	2.42	3.67	101	11.28
	0	ox + trans	2.68	2.66	2.26	3.69	125	11.95
Dm	200	ox + trans	2.79	2.76	2.18	3.81	478	11.48
	100	ox + trans	2.82	2.75	2.12	3.66	125	11.36
	0	ox + trans	2.72	2.71	1.97	4.23	444	11.78
	200	unox	2.9	2.85	2.6	3.25	31	11.05
	100	unox	2.85	2.86	2.46	3.21	26	11.24
	0	unox	2.86	2.85	2.7	3.11	10	11.2
Cau	200	ox + trans	2.82	2.83	2.14	3.75	337	11.36
	100	ox + trans	2.85	2.85	2.27	3.32	277	11.24
	0	ox + trans	2.75	2.77	2.07	3.54	332	11.65
	200	unox	2.98	2.99	2.46	4.11	89	10.75
	100	unox	2.88	2.87	2.44	3.42	59	11.12
	0	unox	2.85	2.81	2.42	3.43	42	11.24
Cam	200	ox + trans	2.85	2.81	2.1	4.55	368	11.24
	100	ox + trans	2.96	2.96	2.1	3.41	201	10.82
	0	ox + trans	2.91	2.88	2.24	3.84	239	11.01
	200	unox	2.9	2.89	2.38	3.65	81	11.05
	100	unox	2.98	2.96	2.47	3.48	79	10.75
	0	unox	3.05	3.03	2.41	3.67	177	10.5
Cal	200	ox + trans	2.71	2.7	1.79	3.72	269	11.82
	100	ox + trans	2.66	2.66	2.32	3.01	97	12.04
	0	ox + trans	2.66	2.66	2.34	3.01	32	12.04
	200	unox	2.75	2.73	2.15	3.59	472	11.65
	100	unox	2.72	2.69	2.3	3.57	293	11.78
	0	unox	2.81	2.76	2.42	3.41	90	11.4
Cb	100	ox + trans	2.75	2.64	2.61	3	3	11.65
	200	unox	2.62	2.61	2.47	2.9	30	12.23
	100	unox	2.64	2.64	2.31	3	173	12.14
	0	unox	2.63	2.62	2.48	2.99	48	12.18
Pcu	0	ox + trans	2.7	2.7	2.26	3.01	85	11.87
	200	unox	2.69	2.69	2.56	2.87	15	11.91
	100	unox	2.74	2.73	2.43	3.11	94	11.69
	0	unox	2.69	2.69	2.25	3.01	155	11.91

14.2.7 Total Copper and Acid – Soluble Copper Modeling

The North Star deposit mineral domains were modeled jointly by MDA and Excelsior to respect the detailed lithologic, structural, and oxidation modeling completed by Excelsior. Following a statistical evaluation of the drillhole copper data, TCu mineral domains were interpreted on 100-foot spaced, east-west vertical cross sections that span the 2.1-mile north-south and 1.3-mile east-west extents of the deposit. The TCu domains were then used to explicitly constrain the estimation of copper grades into 50 x 100 x 25 foot (x, y, z) model blocks using 20-foot composites and inverse-distance interpolation. The total copper grade estimation was further controlled by the incorporation of a number of unique search ellipses that reflect the various orientations of the modeled structural domains, as well as the strike and dip of the favorable stratigraphic units in areas outside the structural domains. The estimation of the ASCu/TCu ratios was constrained by modified versions of the TCu mineral domains, as well as by oxidation zone (oxide, transitional, and sulfide).

Mineral Domains. A mineral domain encompasses a volume of ground that is ideally characterized by a single, natural, population of a metal grade that occurs within a specific geologic environment. In order to define the mineral domains at the North Star deposit, the natural TCu grade populations were identified on population-distribution graphs for all drillhole samples in the North Star deposit area. This analysis led to the identification of low-grade and high-grade populations, with a gradational change between the two. Ideally, each of these populations can be correlated with specific geologic characteristics that are captured in the project database, which then can be used in conjunction with the grade populations to interpret the bounds of each of the TCu mineral domains. The approximate grade ranges of the low-(domain 100) and high- (domain 200) grade domains are listed in Table 14-5.

Table 14-5: Approximate Grade Ranges of Total – Copper Mineral Domains

Domain	Total Copper %
100	~0.01 to ~0.15
200	> ~0.15

Using these grade populations in conjunction with Excelsior's lithologic and structural interpretations, the North Star TCu mineralization was modeled by interpreting mineral-domain polygons on the set of 100-foot spaced cross sections described in Section 14.2.3. The interpretation of the TCu mineral-domain polygons was guided by the lithologic, structural, and fracture-intensity controls described in Section 14.2.2.

Representative cross sections showing the TCu mineral-domain interpretations are shown in Figure 14-4 and Figure 14-5.

As discussed further below, ASCu was not estimated directly into the block model, but was instead derived from the estimations of TCu grade and ASCu/TCu ratio. In addition to other constraints discussed below, an ASCu/TCu ratio domain was created to envelope an area of anomalously low ratios in the Paleozoic sedimentary rocks and Precambrian rocks within the oxide zone. This low-ratio mineral domain, interpreted on the project cross sections, models a low-ratio rind that more-or-less lies along the contact of the sedimentary units with the Texas Canyon Quartz Monzonite. This low-ratio contact zone appears to be related more to clay mineralogy than to oxidation.

Assay Coding, Capping, and Compositing. The TCu cross-sectional mineral-domain polygons were used to code drillhole TCu intervals to their respective mineral domains. The ASCu database intervals were coded to the oxide, transitional, sulfide, and low-ratio domains using the oxidation surfaces and low-ratio sectional polygons. Only those intervals that were also coded to one of the two TCu mineral domains were coded to one of the four ASCu domains.

As an additional constraint, ASCu intervals were not coded if the TCu value was less than 0.03%, in order to alleviate spurious ASCu/TCu ratios caused by analyses of either species close to, or at, the analytical detection limits.

Descriptive statistics of the coded TCu analyses and ASCu/TCu ratios are provided in Table 14-6 and Table 14-7 respectively.

Table 14-6: Descriptive Statistics of Coded Total – Copper Analyses

Domain	Assays	Count	Mean (Cu%)	Median (Cu%)	Std. Dev	CV	Min. (Cu%)	Max. (Cu%)
100	Cu	3075	0.09	0.07	0.15	1.57	0.00	9.00
	Cu Cap	3075	0.09	0.07	0.09	1.04	0.00	1.50
200	Cu	4498	0.40	0.30	0.37	0.94	0.00	10.95
	Cu Cap	4498	0.40	0.30	0.37	0.94	0.00	10.95
All	Cu	7573	0.27	0.17	0.34	1.23	0.00	10.95
	Cu Cap	7573	0.27	0.17	0.34	1.21	0.00	10.95

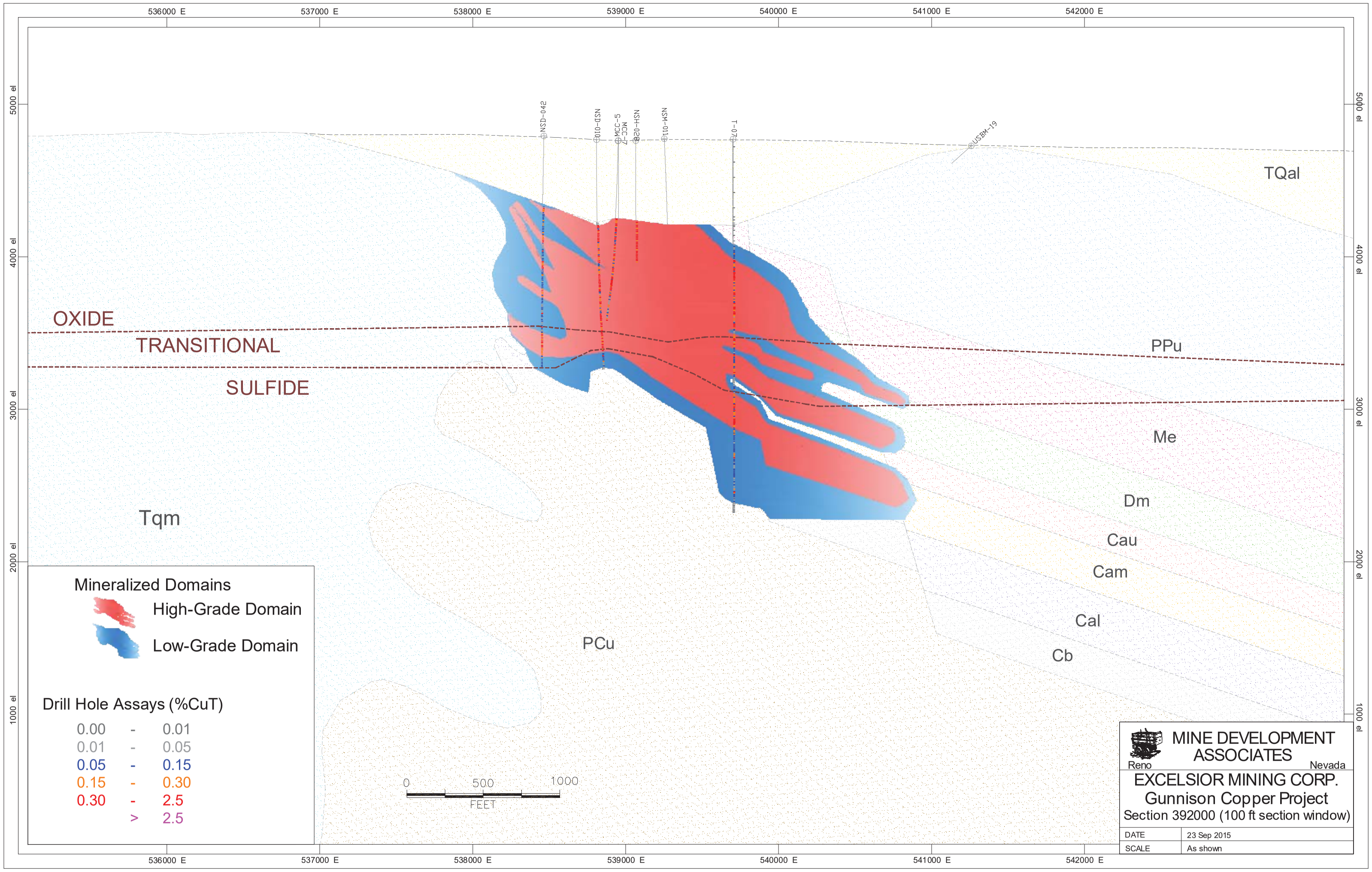


Figure 14-5: Cross Section 392000 N Showing Total – Copper Mineral Domains

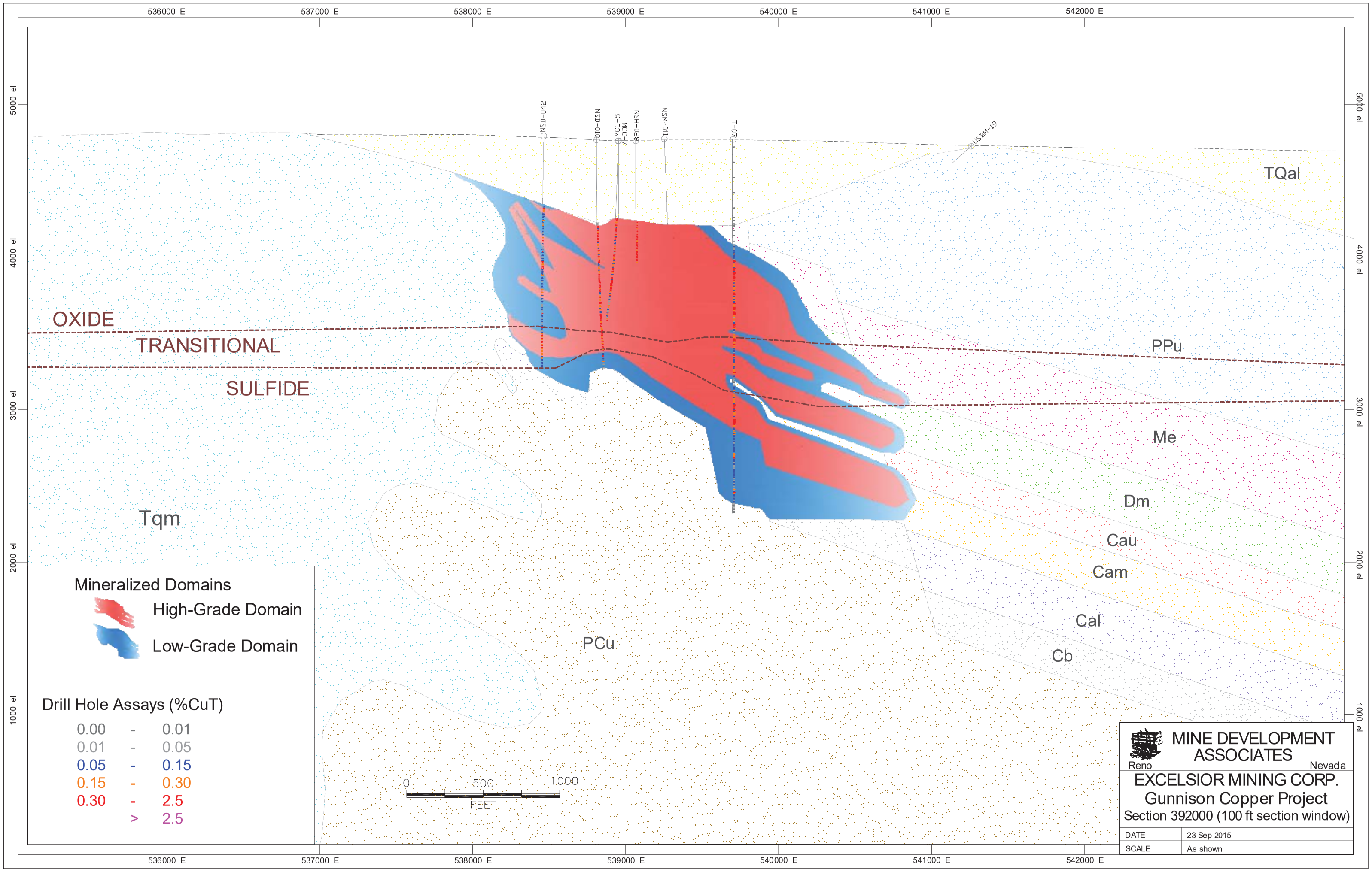


Figure 14-6: Cross Section 394400 Showing Total – Copper Mineral Domains

Table 14-7: Descriptive Statistics of Acid – Soluble to Total – Copper Ratios

Domain	Count	Mean	Median	Std. Dev.	CV	Min.	Max.
Oxide	4079	0.75	0.78	0.16	0.22	0.01	1.00
Low-Ratio	292	0.45	0.44	0.19	0.43	0.01	1.00
Transition	1540	0.31	0.25	0.24	0.78	0.00	1.00
Sulfide	1040	0.09	0.06	0.10	1.12	0.00	0.97
All	6951	0.54	0.65	0.31	0.58	0.00	1.00

The process of determining TCu capping levels (Table 14-8) included the evaluation of population distribution plots of the coded analyses by domain to identify potential high-grade outliers. Descriptive statistics of the coded assays by domain and visual reviews of the spatial relationships of the possible outliers and their potential impacts during grade interpolation were also considered. ASCu/TCu ratios were capped at 1.00.

Table 14-8: Total – Copper Assay Caps by Mineral Domain

Domain	TCu%	Number Capped (% of Samples)
100	1.5	7 (<1%)
200	-	-

The capped TCu analyses and ASCu/TCu ratios in the database were composited at 20-foot down-hole intervals that respect the mineral domains; composites less than 10 feet in length were eliminated. The 20-foot composite length was chosen because it is a multiple of the dominant 10-foot sample length.

Descriptive statistics of TCu and ASCu/TCu-ratio composites are shown in Table 14-9 and Table 14-10, respectively.

Table 14-9: Descriptive Statistics of Total – Copper Composites

Domain	Count	Mean (Cu%)	Median (Cu%)	Std. Dev.	CV	Min.(Cu%)	Max. (Cu%)
100	1352	0.09	0.08	0.06	0.71	0	0.81
200	1915	0.4	0.33	0.29	0.72	0.01	2.9
All	3267	0.27	0.19	0.27	1	0	2.9

Table 14-10: Descriptive Statistics of Acid – Soluble to Total – Copper Composites

Domain	Count	Mean	Median	Std. Dev.	CV	Min.	Max.
100	139	0.44	0.43	0.17	0.37	0.1	0.81
210	17766	0.75	0.77	0.14	0.18	0.03	1
220	694	0.31	0.28	0.23	0.73	0.01	1
230	428	0.09	0.07	0.09	1	0.01	0.74
All	3027	0.54	0.65	0.3	0.56	0.01	1

Block Model Coding. The percentage of each block that lies below the topographic surface was coded into the block model, as well as the lithologic, structural, fracture intensity, oxidation, and density coding discussed in previous subsections of this report. The TCu domains were coded using the 100-foot spaced mineral-domain polygons, and the low-ASCu/TCu ratio domain was similarly coded. All of this coding was done on a block-in-block-out basis (i.e., each block received only one lithologic code, one oxidation code, one TCu domain code, etc.).

The model was also coded by land, including the unpatented claims on BLM lands, State of Arizona lands, and Connie Johnson mineral rights, all controlled by Excelsior, as well as "Other" lands (not controlled by Excelsior).

*Variograph*y. Using all TCu composites, variogram ranges of 1,200 feet along the strike of the sedimentary units (340°) and 700 feet in the dip direction (-35° at 070°) were obtained. Due to the inclusion of composites in this analysis from the structure domains and the Texas Canyon Quartz Monzonite, which have a variety of orientations and whose strikes and especially dips are quite different than the orientation of the sedimentary units, these ranges are considered to be minimums.

Acid-Soluble Copper Modeling. There are two methods for estimating ASCu: directly, using composites of the ASCu analyses in the database; or indirectly, by estimating ASCu/TCu ratios. In the latter case, the ratios are determined for each drill interval that has both ASCu and TCu analyses, and these ratios are then coded, composited, and used to estimate the ratios into the model blocks. The estimated ASCu model values are then derived by multiplying the estimated ASCu/TCu ratio by the estimated TCu value in each block.

There is no evidence of significant leaching and remobilization of the supergene copper at the North Star deposit, which is probably due to remnant carbonate minerals in the host units that would have restricted the movement of acidic solutions during oxidation. In a scenario of limited to no remobilization of oxidized copper species, ASCu/TCu ratios reflect the degree of oxidation of the hypogene copper mineralization. At North Star, the ASCu/TCu ratios are relatively uniform within each of the oxidation zones, with some indication of decreasing ratios (decreasing oxidation) with depth.

The use of ASCu/TCu ratios in the estimation of ASCu values can negate possible biases created by sample intervals that were selectively analyzed for TCu but not ASCu. There are 259 sample intervals coded to the TCu domains that have no ASCu analyses, which represents approximately 3.5% of the coded intervals.

MDA decided to use estimated ASCu/TCu ratios to model the North Star ASCu values. The ASCu/TCu ratio estimation was confined to blocks with estimated TCu values. The ratios of blocks coded to the oxide, transitional, and sulfide zones, as well as the low-ratio zone discussed above, were all estimated independently.

Estimation. The search ellipses used for the TCu and ASCu/TCu ratio interpolations are shown in Table 14-11 and other estimation parameters are summarized in Table 14-12.

Table 14-11: Search Ellipse Orientations

Search Ellipse Orientations			
Total Copper and Fracture Intensity	Major Bearing	Plunge	Tilt
Inside Structural Domains: All Rock Types	005°	0°	-85°
	025°	0°	-80°
	045°	0°	-65°
	090°	0°	-90°
	145°	0°	-50°
	165°	0°	-35°
	340°	0°	-25°
	345°	0°	-70°
Outside Structural Domains: Paleozoic + Precambrian Units	340°	0°	-35°
Outside Structural Domains: Texas Canyon Quartz Monzonite	0°	0°	0°
Acid-Soluble to Total-Copper Ratio	Major Bearing	Plunge	Tilt
All Domains	0°	0°	0°

Table 14-12: Estimation Parameters

Total Copper – All Units Except Quartz Monzonite						
Estimation Pass	Search Ranges (ft)			Composite Constraints		
	Major	S-Major	Minor	Min	Max	Max/hole
1	300	300	100	3	12	3
2	700	700	233	3	12	3
3	2000	2000	667	1	12	3
Total Copper – Quartz Monzonite						
1	300	300	100	3	12	3
2	700	700	233	1	12	3
Acid-Soluble to Total-Copper Ratio						
1	700	700	233	3	12	3
2	2000	2000	667	1	12	3

The estimation passes were performed independently for each of the TCu mineral domains, so only composites coded to a particular domain were used to estimate grade into blocks coded by that domain.

Inverse-distance to the third power (ID3) and ordinary kriging estimations were run for both total copper and the ASCu/TCu ratios; nearest-neighbor estimations were also completed for evaluation purposes. Ultimately, the (ID3) results were selected for reporting of the project resources.

14.3 NORTH STAR DEPOSIT MINERAL RESOURCES

The North Star deposit mineral resources are reported at cutoffs that are reasonable given anticipated mining methods, processing costs, and economic conditions, which fulfills regulatory requirements that a resource exists "in such form, grade or quality and quantity that there are reasonable prospects for eventual economic extraction."

The oxide + transitional mineral resources are tabulated using a cutoff grade of 0.05% TCu, representing resources potentially available for in situ recovery. The sulfide mineral resources are reported at a 0.30% TCu cutoff to capture mineralization that is potentially available for open-pit extraction. Both of these cutoffs are the same as the cutoffs used for the previously reported resources (M3, 2016).

No resources were estimated within overburden (Tertiary/Quaternary alluvium), and the reported resources are restricted to lands controlled by Excelsior.

The North Star deposit TCu resources are listed in Table 14-13.

Table 14-13: North Star Deposit Total – Copper Resources

Oxide Resources @ 0.05% TCu Cutoff

Resource Class	Short Tons (millions)	Total Cu (%)	Cu Pounds (billions
Measured	157.2	0.38	1.201
Indicated	502.1	0.28	2.782
Measured + Indicated	659.3	0.30	3.983
Inferred	108.0	0.16	0.351

Transitional Resources @ 0.05% TCu Cutoff

Resource Class	Short Ton (millions	Total Cu (%)	Cu Pounds (billions)
Measured	41.9	0.27	0.227
Indicated	172.0	0.23	0.785
Measured + Indicated	213.9	0.24	1.02
Inferred	79.2	0.18	0.279

Oxide + Transitional Resources @ 0.05% TCu Cutoff

Resource Class	Short Tons (millions)	Total Cu (%)	Cu Pounds (billions)
Measured	199.1	0.36	1.427
Indicated	674.0	0.27	3.567
Measured + Indicated	873.2	0.29	4.995
Inferred	187.2	0.17	0.630

Sulfide Resources @ 0.30% TCu Cutoff

Resource Class	Short Tons (millions)	Total Cu (%)	Cu Pounds (billions)
Measured	1.6	0.39	0.012
Indicated	36.8	0.42	0.308
Measured + Indicated	38.4	0.42	0.32
Inferred	53.7	0.41	0.44

Notes:

1. Mineral Resources are inclusive of Mineral Reserves.
2. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.
3. Oxidized + Transitional Mineral Resources are reported at a 0.05% total-copper cutoff in consideration of potential mining by in situ recovery.
4. Sulfide Mineral Resources are reported at a 0.30% total-copper cutoff in consideration of potential mining by open-pit extraction.

5. Rounding may result in apparent discrepancies between tons, grade, and contained metal content.
6. The Effective Date of the mineral resource estimate is October 1, 2016.

The North Star deposit resources are classified on the basis of a combination of: (i) a minimum number of composites used to interpolate TCu grades into a block; (ii) the number of holes from which the composites are derived; and (iii) the distance of the composites to the block (Table 14-14).

Table 14-14: North Star Deposit Classification Parameters

Class	Min. Number of Composites	Additional Constraints
Measured	2	Minimum of 2 holes within an average distance of 200 feet from the block
Indicated	2	Minimum of 2 holes within an average distance of 400 feet from the block
Inferred	all other estimated blocks	

When evaluating the results produced by the classification criteria, it became apparent that a small, isolated zone of blocks classified as Inferred occurred within a mass of Indicated blocks near the southern limit of the well-drilled portion of the deposit. This Inferred material created a classification discontinuity in the deposit, where confidence in the modeling is high, and the classification was therefore changed to Indicated. This change resulted in an increase of one percent of the resource tonnes classified as Indicated.

The average ASCu/TCu ratios estimated for the oxide, transition, and sulfide resources reported in Table 14-13 are 0.74, 0.30, and 0.09, respectively.

Total project resources, obtained by adding the oxide, transitional, and sulfide resources in Table 14-13, are tabulated in Table 14-15.

Table 14-15: Combined Oxide, Transitional, and Sulfide Resources

Total Resources (Oxide + Transitional + Sulfide)			
Resource Class	Short Tons (Millions)	Total Cu (%)	Cu Pounds (billions)
Measured	200.7	0.36	1.439
Indicated	710.8	0.27	3.875
Measured + Indicated	911.6	0.29	5.315
Inferred	240.9	0.22	1.070
0.05% TCu Cutoff for Oxide + Transitional; 0.30% TCu Cutoff for Sulfide			

The average ASCu/TCu ratio of the combined resources is 0.57.

The modeled North Star deposit mineralization is tabulated at additional cutoffs in Table 14-16 to provide grade-distribution information, as well as to evaluate the sensitivity of the reported resources to economic conditions and/or mining scenarios other than those envisioned in this study.

Table 14-16: Modeled Mineralization at Various Cutoffs

Oxide + Transitional Mineralization @0.10% TCu Cutoff

Resource Class	Short Tons (millions)	Total Cu (%)	Cu Pounds (billions)
Measured	165.7	0.42	1.378
Indicated	495.7	0.33	3.302
Measured + Indicated	661.4	0.35	4.680
Inferred	93.2	0.26	0.490

Oxide + Transitional Mineralization @ 0.30% TCu Cutoff

Resource Class	Short Tons (millions)	Total Cu (%)	Cu Pounds (billions)
Measured	113.9	0.51	1.167
Indicated	264.5	0.45	2.372
Measured + Indicated	378.4	0.47	3.539
Inferred	34.0	0.41	0.277

Oxide + Transitional Mineralization @ 0.50% TCu Cutoff

Resource Class	Short Tons (millions)	Total Cu (%)	Cu Pounds (billions)
Measured	42.5	0.72	0.615
Indicated	67.3	0.63	0.852
Measured + Indicated	109.8	0.67	1.467
Inferred	5.6	0.59	0.066

Sulfide Mineralization @ 0.50% TCu Cutoff

Resource Class	Short tons (millions	Total Cu (%)	Cu Pounds (billions)
Measured	0.2	0.55	0.002
Indicated	6.3	0.6	0.076
Measured + indicated	6.5	0.6	0.078
Inferred	5.3	0.58	0.062

Figure 14-7 and Figure 14-8 show cross section of the block model that correspond to the mineral-domain cross sections presented above.

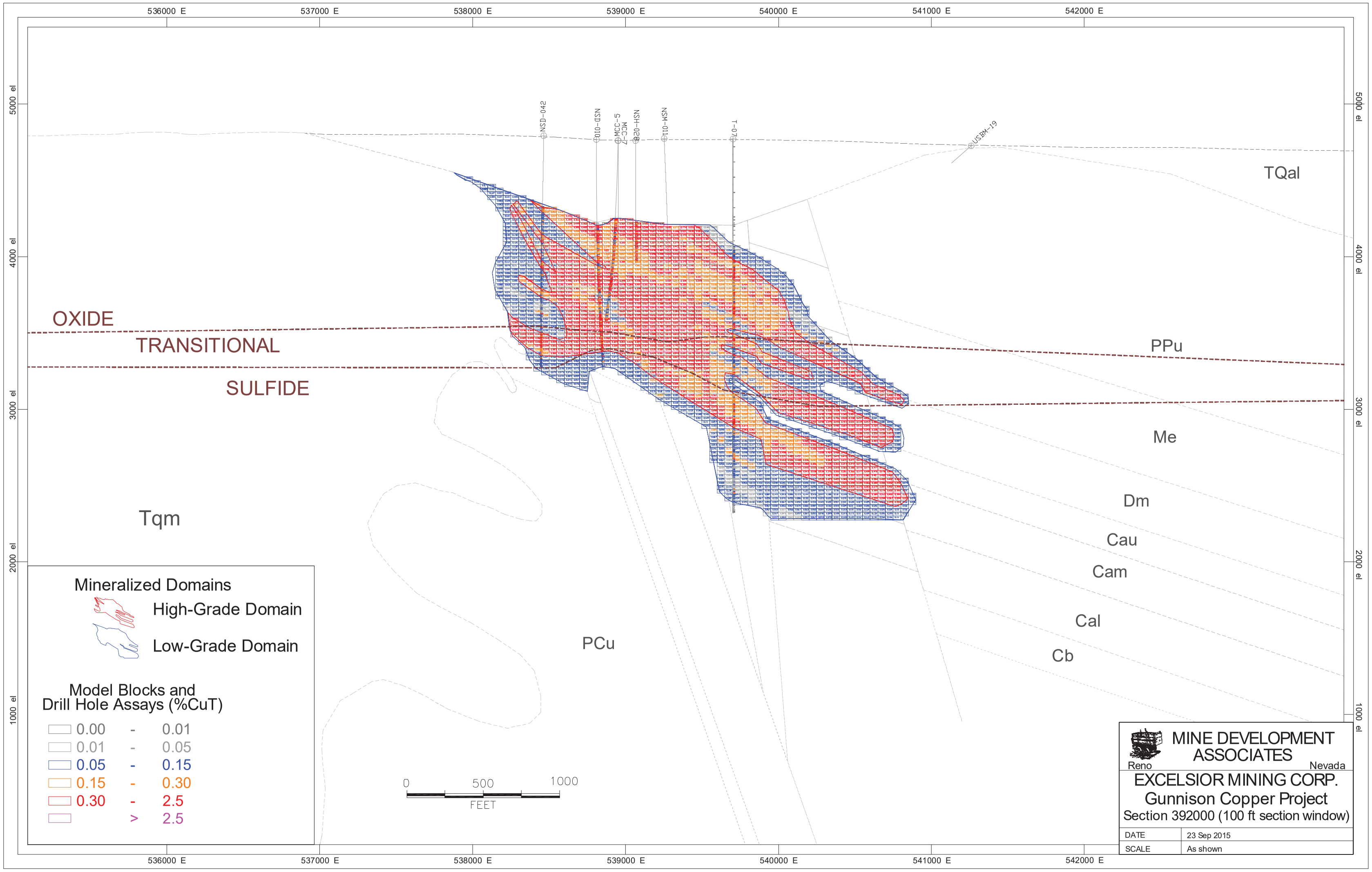


Figure 14-7: North Star Cross Section 392000 Showing Block Model Copper Grades

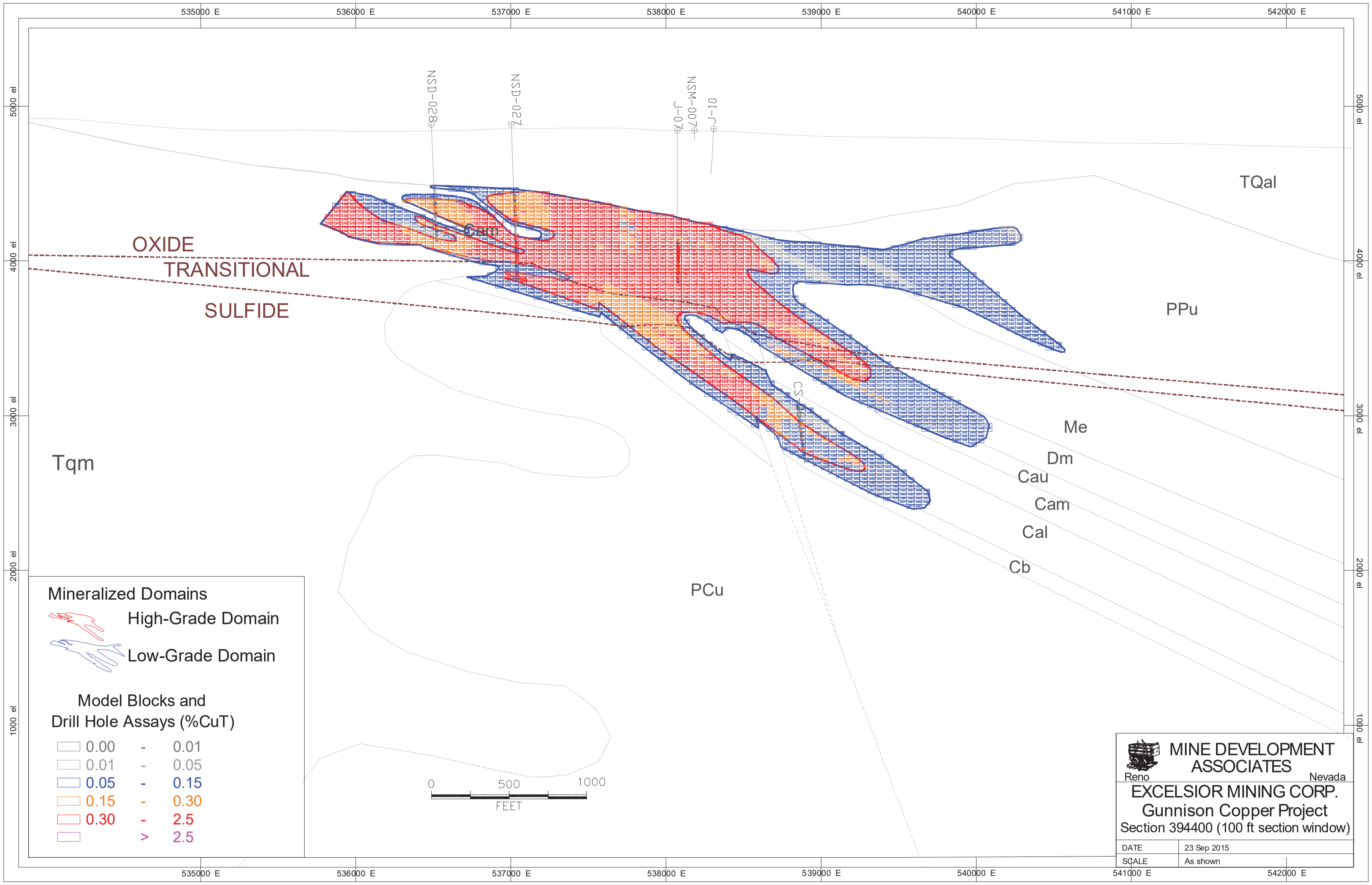


Figure 14-8: North Star Cross Section 394400N Showing Block Model Copper Grades

14.3.1 Copper Block Model Checks

Volumes derived from the sectional mineral-domain modeling were compared to the coded block-model volumes to assure close agreement, and all block-model coding described herein was checked visually. The inverse-distance results, from which the reported project resources are tabulated, were compared to those from: (i) a polygonal estimate based on the cross-sectional interpretations; and (ii) the nearest-neighbor and ordinary kriging estimates of the modeled resources, all at 0 cutoff grade. The ID3, ordinary kriging, and nearest-neighbor grades are identical, and the polygonal tons and grade are as expected. Various grade-distribution plots of assays, composites, and nearest-neighbor, ordinary kriging, and ID3 block grades were evaluated as a check on the both the global and local estimation results, with no anomalous relationships. Finally, the ID3 grades were visually compared to the drillhole assay data to assure that reasonable results were obtained.

14.3.2 Comments on the Resource Block Model Estimates

A subsequent estimate of the project resources could be improved with the incorporation of additional geologic input into the modeling. Specifically, the modeling of the western extremities of the deposit could be improved where the large mass of mineralization that typifies the core, central portion of the deposit breaks up into lenses that follow favorable stratigraphic horizons. The correlations of some of these ‘arms’ of mineralization with specific stratigraphic units might be improved with additional drill data and further review and consideration.

15 MINERAL RESERVES ESTIMATES

The mineral resources discussed in Section 14 (Table 14-1) were used to estimate the Probable Mineral Reserve for North Star (Gunnison Project). Details of the process to determine the mineral reserve are outlined in this section.

Table 15-1 shows the diluted Probable mineral reserves as defined for the Gunnison Project's Prefeasibility Study. The Probable mineral reserves include material classified in the Measured and Indicated categories of the mineral resource estimate. No Inferred mineral resources were added to the tabulation of mineral reserves. No material from the sulfide zone was included in the mineral reserves either.

Table 15-1: Probable Diluted Reserve Estimate (October 2016)

Item	Value
Tons	782,153,183
TCu Grade (%)	0.29
TCu Contained Copper (lbs)	4,505,267,997
Average Total Copper Recovery (%)	48.4
Recoverable Copper (lbs)	2,179,489,338

**Probable reserves were defined from measured and indicated resources. Inferred resources were not converted into reserves.*

The Probable mineral reserves summary prepared for the Gunnison Prefeasibility Update were estimated using data and input from MDA and Excelsior. Probable mineral reserves were mainly defined using economic mining cost and metal recovery parameters. They were also constrained to take into account lost mineral resources beneath Interstate 10 and along some of the lease boundaries. The production from blocks under Interstate 10 is factored by 50% to estimate mining losses there. MDA's mineral resource estimate detailed in Section 14 and the ISR mine production schedule developed by Excelsior that is discussed in Section 16 served as the basis for the mineral reserves. Figure 15-1 shows the resulting outline for the Probable Mineral Reserve as the black outline within the limits of the mineral resource (blue outline).

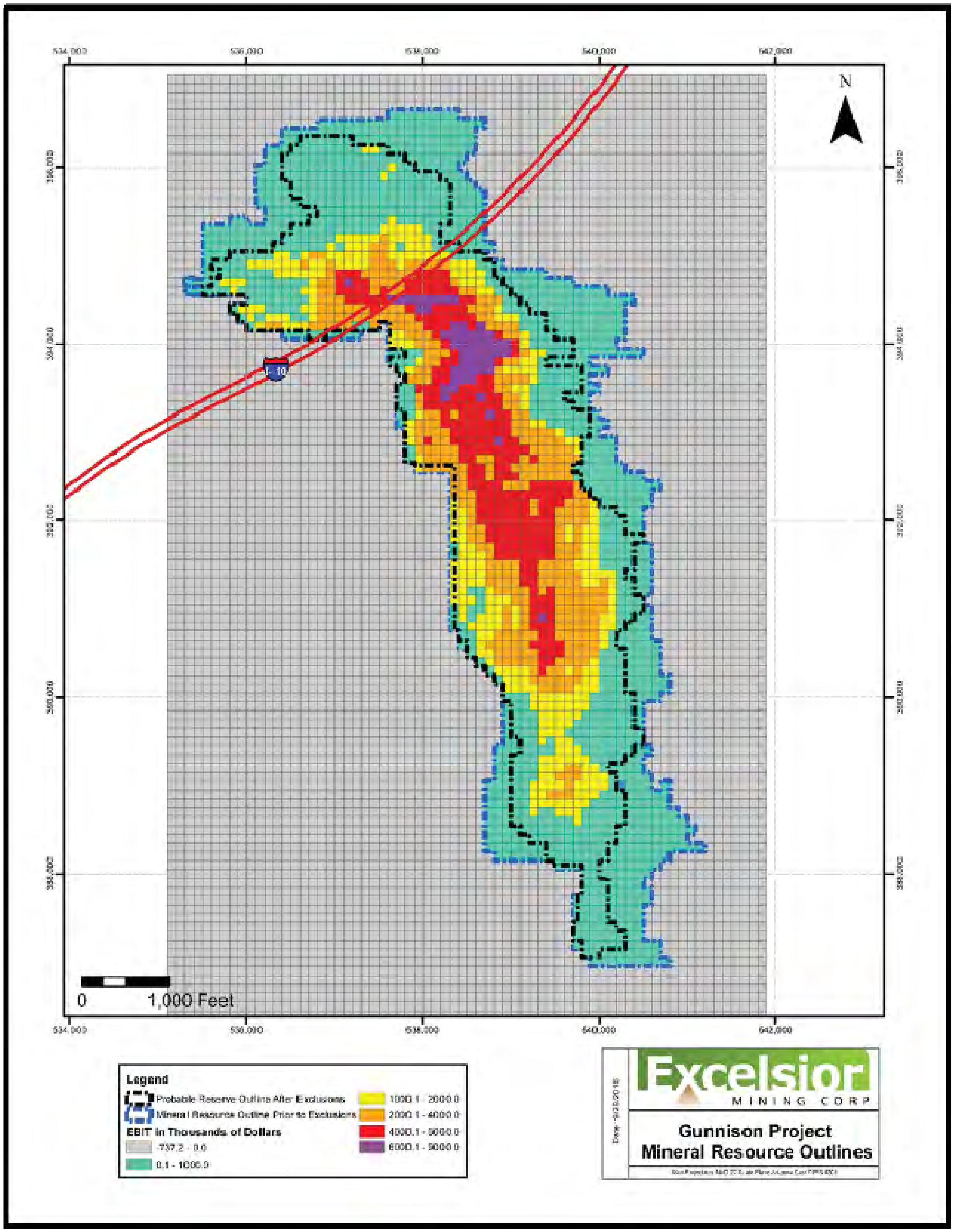


Figure 15-1: Mineral Resource and Mineral Reserve Outlines

15.1 ECONOMIC EVALUATION

The economic evaluation of the MDA's mineral resource model was the starting point for developing the mine plan. The block resource model contains 100' x 50' x 25' resource blocks which were individually coded with estimated tons, total and acid soluble copper grades, oxidation designation, resource class (Measured, Indicated, or Inferred), specific gravity, formation (rock type), fracture intensity, and mineral lease designation. For the purpose of the in-situ mining plan, two columns of resource blocks (100' x 100' x 25') from the model are combined to represent a production cell (5 spot pattern of one injection well surrounded by four recovery wells). Figure 15-2 shows a typical wellfield layout with the repeated 5 spot patterns. The recovery wells are spaced 100' apart at each corner of the production cell. The injection well is positioned in the middle of the production cell.

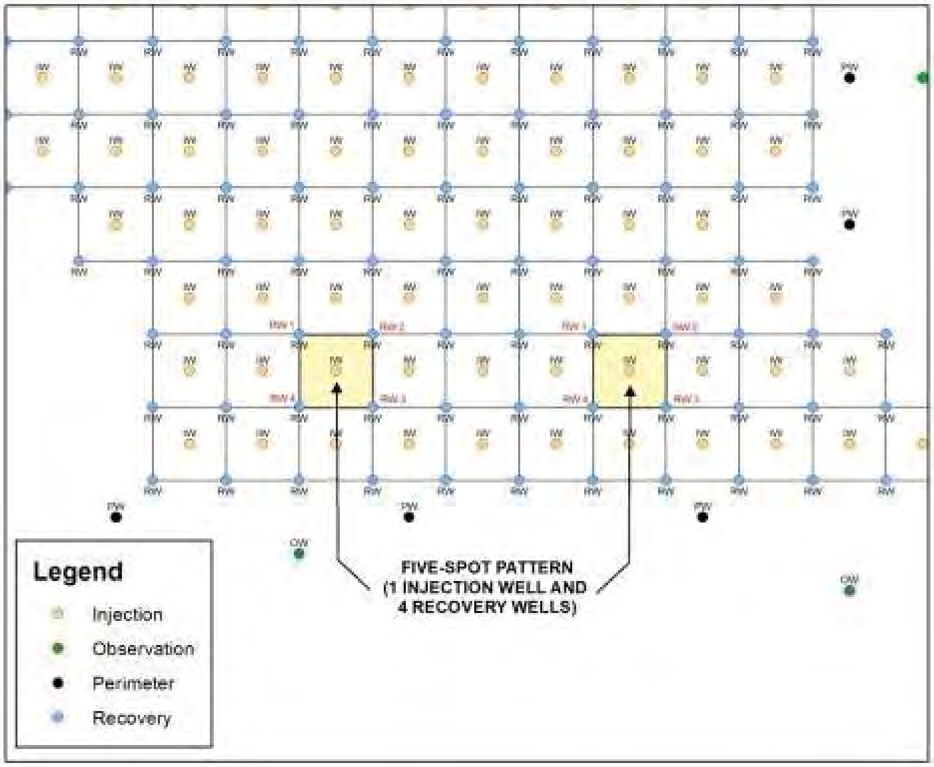


Figure 15-2: Wellfield Design Layout

The economic value for each individual resource block in the model was calculated as earnings before interest and tax value (EBIT). The EBIT is the total revenue for each pair of resource blocks subtracting the operating and capital costs associated with each pair of resource blocks. Table 15-2 defines the parameters that were used in the calculation of EBIT. The economic parameters that were used came from the 2014 Prefeasibility Study ("2014 PFS").

Table 15-2: Economic Variables for the Calculation of EBIT

Item	Description
Revenue	Recoverable Metal Pounds *$2.75 (Cu price/lb)
Operating Cost Less Acid	$0.693/lb Cu
Operating Cost Acid	Acid Consumption (variable on formation *$0.05/lb Cu and assumes $100/ton acid price
Capital Cost of Drilling Wellfield Establishment (drilling, pumps, equipment, casing)	$152/ft

An example of the EBIT calculation for a single 100’ x 100’ x 25’ resource block is shown below. The block model inputs are shown in Table 15-3 and the fixed inputs from the 2014 PFS are shown in Table 15-4.

Table 15-3: Model Variables Used for EBIT Calculation

Model Variable	Description
TCu	Total copper grade, estimated from drillholes assays
ASCu/TCu	Acid soluble to total copper ratio, calculated from ratio estimates
ASCu	Acid soluble copper grade; equals total copper grade x ASCu/TCu
Land	Model blocks within lease boundaries; lease = 1, 2, 3
Class_Model	Resource classification: 3=measured, 2=indicated, 1=inferred
Oxidation	Oxidization zones; 10=oxide, 20=transition, 30=sulfide
Geo	Formation (rock type) code
Frint	Fracture intensity model
Sweep fact	Sweep factor based on fracture intensity
Consumption	Acid consumption, based on rock type

Table 15-4: Summary of Fixed Cost from 2014

Cost Center	Description
Operating cost per Lb, less acid	$0.383 for wellfield development, evaporation and neutralization $0.222 for SX/EW operation $0.088 for G&A $0.693 per Cu lb, operating cost
Operating cost for acid	$0.05/lb acid x acid consumption in wellfield
Capital Cost - drilling	$76 per foot, assuming 1 recovery well and ¼ of shared 4 injection wells (2 equivalent wells = $152/ft)

The block model values for the block used for the EBIT calculation shown below are:

- Acid soluble copper grade = 0.366%
- Sweep factor = 0.89%
- Class = measured
- Acid consumption = 8.9 lb/lb

- Specific gravity or tons per block = 2.82
- Short tons per block = 22,007

The EBIT calculation:

- Recovered Cu lbs = 0.366% x 22,007 tons x 20 x 0.89% = 143,371 lbs
- Recovered Cu lbs = 0.366% x 22,007 tons x 20 x 0.89% = 143,371 lbs
- Revenue = 143,371 (recovered Cu lbs) * 2.75 (Cu price/lb1) = $394,270
- Operating Cost Less Acid = 143,371 (recovered Cu lbs) * 0.693 (operating cost/lb) = $99,356
- Operating Cost Acid = 143,371 (recovered Cu lbs) * 8.9 (acid consumption lb/lb2) * 0.05 (cost of acid//lb) = $63,800
- Capital Cost of Drilling: 152 (cost/ft) * 25 (vertical length of block) = $3,800
- Combined Capital and Operating Costs = $99,356+ $63,800+ $3,800= $166,956
- EBIT = $394,270 (revenue) – $166,956 (operating costs plus capital costs) = $227,314

The variable inputs to the EBIT equation are the acid soluble copper grade, recovery factor and acid consumption, which vary by model block.

1. Recovered copper pounds depends on sweep factor, specific gravity and acid soluble copper grade for that 100' x 100' x 25' block of the resource block model. The sweep factor represents the calculated recovery based on the fracture intensity assigned to the resource block model discussed in Section 7.4. The more fractured the rock, the greater ability of solutions to move through the rock mass and thus a greater contact of the acid with the copper minerals. Leach, Inc. developed the sweep efficiency factor and further discussion of it can be found in Section 13.4.2. Table 15-5 shows the relationship of the fracture intensity assigned to the block model and the sweep factor.

2. Acid consumption as pounds of acid per pound of recoverable copper (lb/lb) depends on rock type for that model block. Table 15-6 shows the acid consumption assigned to the rock types in the block model. The acid consumption is based on work completed for the 2014 PFS and more recent metallurgical test work.

Table 15-5: Relation of Fracture Intensity to Sweep Factor

Fracture Intensity	Sweep Factor	Polynomial Fit (ASCu Recovery)	Polynomial Fit (TCu Recovery)
1	20%	20%	14%
2	55%	55%	39%
3	80%	80%	56%
4	95%	95%	67%
5	100%	100%	70%
Average	70%	70%	49%

Table 15-6: Acid Consumption by Rock Type

Formation	Acid Consumption lb/lb Cu
PPu (Naco Group Undivided)	10.2
Dm (Martin)	10.2
Me (Escabrosa)	10.2
Cau (Upper Abrigo)	8.9
Cam (Middle Abrigo)	10.2
Cal (Lower Abrigo)	6.9
Cb (Bolsa)	5.2
PCps (Pinal Schist)	5.2
Tqm (Monzonite Porphyry)	5.2

The assignment of EBIT to each resource block allowed for the economic evaluation of the mineral resource and wellfield. Below is a summary of the evaluation process.

- The mineral resource model was constrained to contain resource blocks that existed inside Excelsior’s mineral leases, had a total copper (TCu) value of 0.05% or greater, and were in the oxide or transition zone of the deposit.
- The resource model was additionally constrained to include only measured and indicated resource blocks.
- The EBIT value was calculated for blocks which met the above criteria and was displayed in 3-D and 2-D and manually reviewed on 100’ east-west cross sections.
- The horizontal and vertical limits of the economic mineralization were defined by only including areas of consistent positive EBIT (i.e. isolated economic blocks or irregular shapes were not included).

The above process defined a consistent volume of indicated and measured resource encompassing resource blocks with a positive EBIT. It was then necessary to remove areas of the resource where the value of the resource to be extracted did not compensate for the cost of drilling through the overlying formations to access the resource. This was accomplished in a second pass of evaluation in cross sectional and plan view (2-D and 3-D). The EBIT values for all resource blocks in each vertical 100’ x 100’ column of blocks that make up a 5-spot production cell were summed. The combined EBIT sum represents the net revenue available for that production well or cell (gross revenue from the production cell minus the operating costs for the mineralized interval). This EBIT sum was then compared to the capital costs of drilling and establishing the wells necessary to produce copper from the production cell. If the costs of establishing the production cell exceeded the revenue from the cell, the production cell (5-spot well pattern) was removed from the potential mineral reserve as noted in Figure 15-1.

The potential production cells on the eastern edge of the deposit where the mineralization is thinnest and deepest were most likely to be uneconomic. Areas where economic production cells formed isolated pods or irregular shapes were removed from the production schedule and hence reserve estimate. The resulting shape (Figure 15-1) represents the Probable Reserve at Gunnison.

15.2 TABULATION OF MINERAL RESERVE

A summary of the diluted mineral reserve is shown in Table 15-1 and Table 15-7 shows the diluted mineral reserve by rock or formation type as tabulated by Excelsior from the production schedule. The formations have been combined with like acid consumption. The dilution included in the mineral reserve is from blocks within the well that are below the 0.05% TCu cutoff grade but are within the production column for a particular well. The drilling cost through these dilution zones is carried by the positive value blocks located below them. The diluting tonnage is 30,151 kilotons (ktons) at an average grade of 0.041% TCu.

The effective date of the mineral reserve is October 1, 2016 and MDA feels it is a fair representation of the mineral reserve. The mineral reserve tabulated by Excelsior is from a database extracted from the mineral resource block model to develop the well extraction columns and EBIT values. MDA has checked the tabulation of the undiluted mineral reserve by flagging the blocks within the mineral resource model that constitute the mineral reserve and tabulating them from the block model. This tabulation checks are within 1 percent of the tonnage and grades. In addition, MDA spot checked a number of the reserve blocks for model data, and calculated data. Calculated data includes copper recovery, pounds of copper recovered, and the time period of copper recovery and found no issues with the calculations of the reserves, MDA checked the production schedule with the blocks scheduled and found no errors. The MDA checks of the EBIT calculations and the well column summations are within the same percentage of differences.

Table 15-7: Diluted Mineral Reserve by Formation Type

Formation (1)	Ktons	TCu %	ASCu %	Lbs Cu x 1000	Lbs ASCu x 1000	Recoverable Lbs x 1000	Average Recovery, %	
							TCu	ASCu
OXIDE								
Dm	226,137	0.33	0.26	1,486,729	1,180,788	860,046	0.58	0.73
Cau	142,830	0.32	0.24	900,548	677,449	504,984	0.56	0.75
Cam	129,548	0.29	0.21	755,486	536,662	402,065	0.53	0.75
Cal	75,563	0.27	0.17	405,812	262,740	199,745	0.49	0.76
Cb	14,400	0.10	0.05	28,053	14,742	11,310	0.40	0.77
Total	588,479	0.30	0.23	3,576,627	2,672,381	1,978,149	0.55	0.74
TRANSITION								
Dm	8,489	0.27	0.08	45,819	13,172	9,301	0.20	0.71
Cau	21,962	0.21	0.06	92,979	24,402	17,967	0.19	0.74
Cam	39,740	0.29	0.08	227,948	65,720	49,457	0.22	0.75
Cal	83,896	0.28	0.08	473,961	140,881	101,193	0.21	0.72
Cb	39,587	0.11	0.04	87,934	31,866	23,422	0.27	0.74
Total	193,674	0.24	0.07	928,641	276,041	201,340	0.22	0.73
TOTAL								
Dm	234,626	0.33	0.25	1,532,549	1,193,960	869,346	0.57	0.73
Cau	164,792	0.30	0.21	993,527	701,850	522,951	0.53	0.75
Cam	169,289	0.29	0.18	983,433	602,382	451,522	0.46	0.75
Cal	159,459	0.28	0.13	879,773	403,621	300,938	0.34	0.75
Cb	53,987	0.11	0.04	115,987	46,608	34,732	0.30	0.75
Total	782,153	0.29	0.19	4,505,268	2,948,422	2,179,489	0.48	0.74

Notes:
Formation: Dm = Martin, Escabrosa, and Naco Group Undivided; Cau = Upper Abrigo; Cam = Middle Abrigo; Cal = Lower Abrigo; Cb = Texas Quartz Monzonite, Bolsa Qtz, & Undivided Precambrian Rocks
Ktons = short tons x 1000
Lbs Cu = pounds of copper in the ground
Lbs ASCu = pounds of soluble copper in the ground
Recoverable Lbs = pounds of expected recoverable copper using sweep (recovery) factor

15.3 POTENTIAL FOR RESERVE EXPANSION

An upgrade of the mineral reserve at Gunnison is possible with continued resource drilling by Excelsior. Material categorized as inferred within the resource has the potential to be converted into the measured and indicated resource categories as it spatially borders the existing measured and indicated resources. Table 15-8 lists the inferred resources at Gunnison as defined by 2016 Resource Model described in Section 14. Inferred mineral resources that are considered too speculative geologically to have the economic considerations applied to them that would enable them to be categorized as mineral reserves, and there is no certainty that any economic assessment will be realized. Mineral resources that are not mineral reserves do not have demonstrated economic viability.

Table 15-8: Inferred Mineral Resources at Gunnison (October, 2016)

Tons	187,164,002
TCu Grade (%)	0.17
TCu Contained Copper (lbs)	630,178,689
**Inferred resources as defined by MDA's resource model. Calculated for blocks existing inside Excelsior lease boundaries, within the oxide and transition zones, and at a 0.05% TCu cutoff.*	

16 MINING METHODS

16.1 IN-SITU RECOVERY

Excelsior proposes to use the In-Situ Recovery (ISR) method to extract copper from oxide mineralization located within the North Star deposit (Figure 4-1). ISR was chosen based on the fractured nature of the host rock, the presence of water saturated joints and fractures within the ore body, copper mineralization that preferentially occurs along fracture surfaces, the ability to operate in the vicinity of Interstate 10, and to avoid the challenges of open pit mining in an area with alluvium overburden thickness ranging from approximately 300 feet to 800 feet.

In the ISR process, a low pH raffinate solution ("lixiviant") is injected into the ore body via a series of injection wells. As the lixiviant migrates through the joints and fractures within the mineralized bedrock, copper is dissolved. This pregnant leach solution (PLS) is recovered by a series of recovery wells that surround each respective injection well (Figure 16-1).

The PLS is pumped to the surface where the copper is stripped from the solution using the solvent extraction/electro-winning (SX-EW) process. The SX-EW process begins with the SX plant extracting and concentrating the dissolved copper from the PLS, after which the EW plant reduces the concentrated copper to copper cathode. Once the copper is recovered by SX, the barren solution is re-acidified with sulfuric acid to create new lixiviant which is pumped back to the well field and re-injected. The total volume of lixiviant injected and PLS extracted will remain effectively equal throughout ISR operations.

After ISR in a production block is complete, as determined by degradation of the PLS grade below the economic cutoff, the bedrock within the completed production block will be rinsed in compliance with appropriate permit conditions.

Economic recovery of acid soluble copper using ISR requires certain hydrogeological conditions be present within an ore body, such as: (1) a saturated ore body; (2) sufficient hydraulic conductivity within the fractured bedrock; (3) hydraulic connection between the injection and recovery wells so lixiviant can circulate through the mineralized bedrock; and (4) lixiviant/mineral contact and adequate lixiviant retention time. These conditions allow for lixiviant to be circulated through the ore body, with sufficient contact and retention time with acid soluble copper in the ore body to meet the required PLS grade. Site characterization efforts described in this chapter have focused on gathering data to assess these hydrogeological conditions.

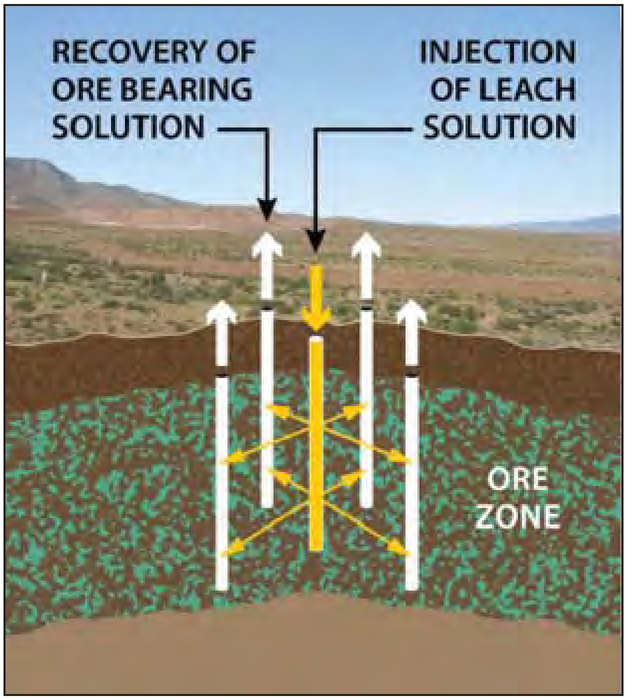


Figure 16-1: Conceptual Schematic of ISR Injection and Recovery

16.2 HYDROGEOLOGICAL CHARACTERIZATION

The rock units in the study area range in age from Precambrian to Quaternary. The basement rock is comprised primarily of the Pinal Schist, Lower Precambrian in age. The mineralized ore is hosted by the Abrigo (Upper Cambrian), Martin (Upper Devonian) and, to a limited degree, Escabrosa (Lower Mississippian) Formations. Bounding the sub-basin to the east are the Horquilla Formation of the Naco Group (Middle Mississippian) with outcrops in the Gunnison Hills, and to the west the Texas Canyon quartz monzonite (a Lower Tertiary intrusive unit), cropping out as the Texas Canyon Summit. The bedrock formations are uncomformably overlain by Basin Fill of upper Tertiary and Quaternary age. The thickness of the Basin Fill over the ISR wellfield varies from 300 to 800 feet and increases in thickness towards the Gunnison Hills.

16.2.1 Water-Bearing Units

The following water-bearing units have been identified within and adjacent to the Project area:

- Basin Fill Aquifer; and,
- Bedrock Aquifer.

16.2.1.1 Basin Fill

Depending on the location, basin fill in the area may be unsaturated or partially saturated. The basin fill aquifer is used for water supply in the Dragoon area, and also historically as a source of water for the Johnson Camp Mine, north of the Site.

At the Project site within the ISR wellfield, the thickness of basin fill ranges from approximately 300 to 800 feet. In general, the basin fill within the boundary of the ISR wellfield is unsaturated, and thus, not an aquifer. Thin, isolated occurrences of saturated basin fill were identified within the ISR wellfield during drilling in 2011 at two locations: NSH-

006 and NSD-030. Thirty to 40 feet of saturation were observed at these locations which are within a low spot on the bedrock surface. The thickness of basin fill to the east of the Project site increases to approximately 1800 feet along the western flank of the Gunnison Hills (Harshbarger, 1973). The saturated thickness also increases toward the east.

16.2.1.2 Bedrock

Data collected from hydrogeological investigation wells completed in bedrock at the Project indicate that the mineralized zone in bedrock is mostly saturated. In general, groundwater is present at or near the bedrock-basin fill contact. Depending on the location, there may be an interval of unsaturated bedrock, generally under 50 feet in thickness, above the saturated bedrock. In other locations (as discussed above), the potentiometric surface has been observed slightly above the bedrock-basin fill contact.

Figure 16-2 shows the geology of the bedrock surface and locations of cross sections A-A’ (Figure 16-3), and C-C’ (Figure 16-4).

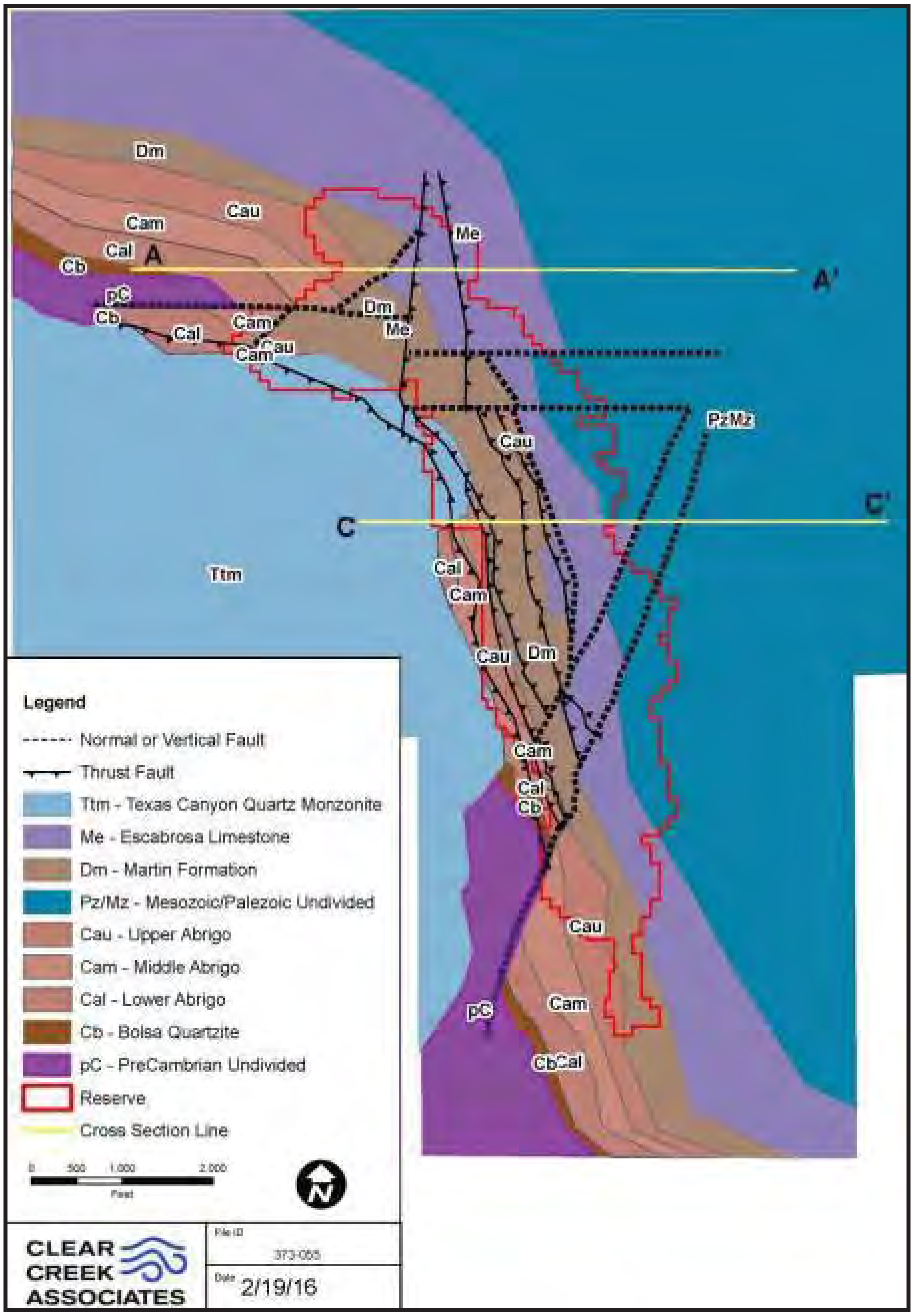


Figure 16-2: Geologic Map of Bedrock Surface

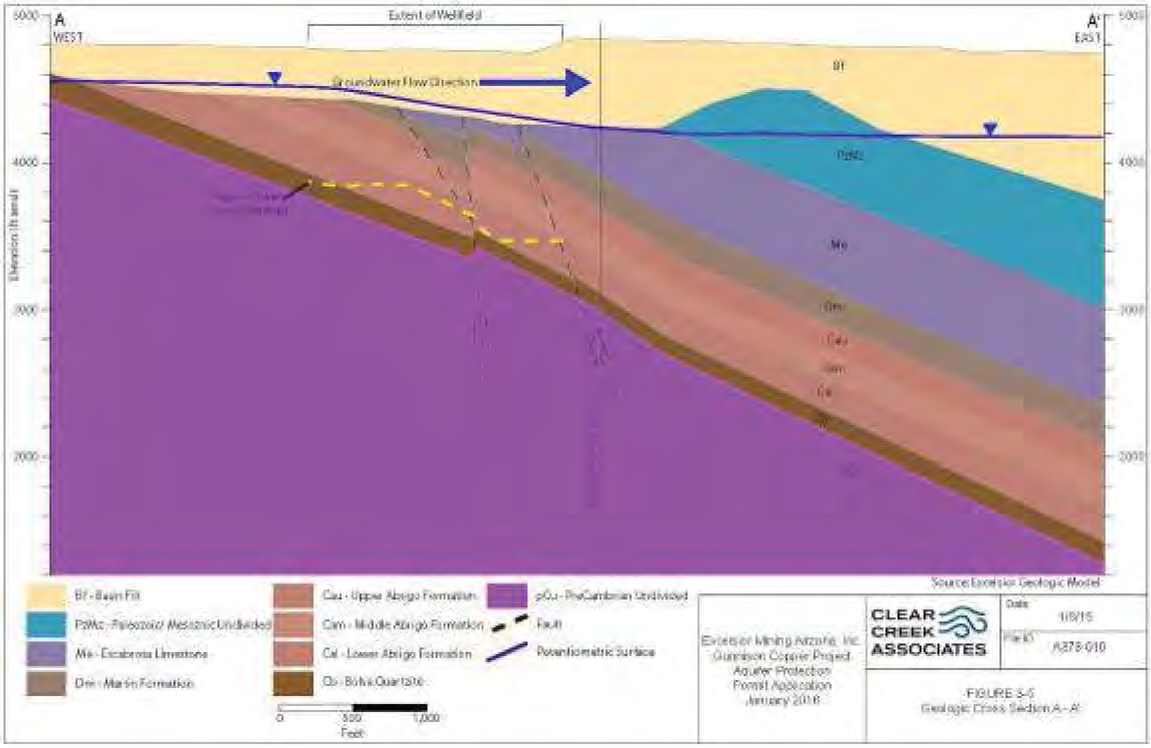


Figure 16-3: Cross Section A-A (EMC, 2016)

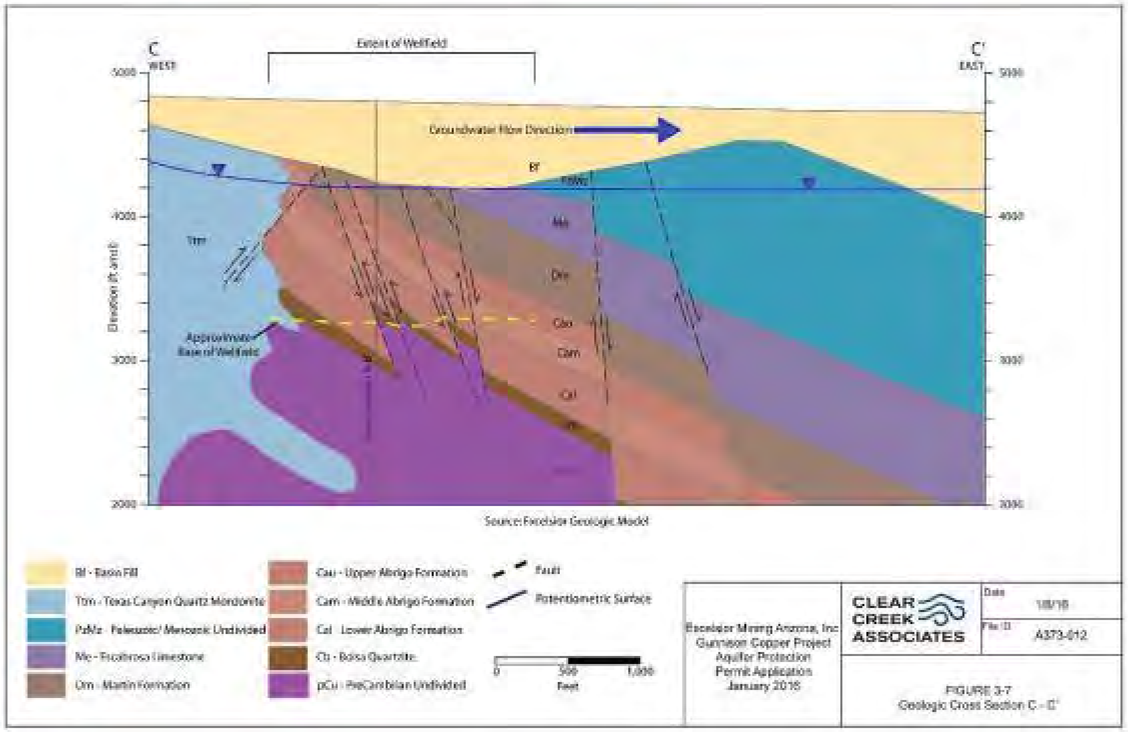


Figure 16-4: Cross Section C-C (EMC, 2016)

16.2.2 Depth to Groundwater

A depth-to-groundwater map, based on a water level sweep conducted in June 2015, is presented on Figure 16-5. Depths to water ranged from 244 feet below land surface (bls) at exploration drillholes NSD-030 in the northwest part of the Project, to 655 feet bls at hydrology study well NSH-013 near the middle of the orebody.

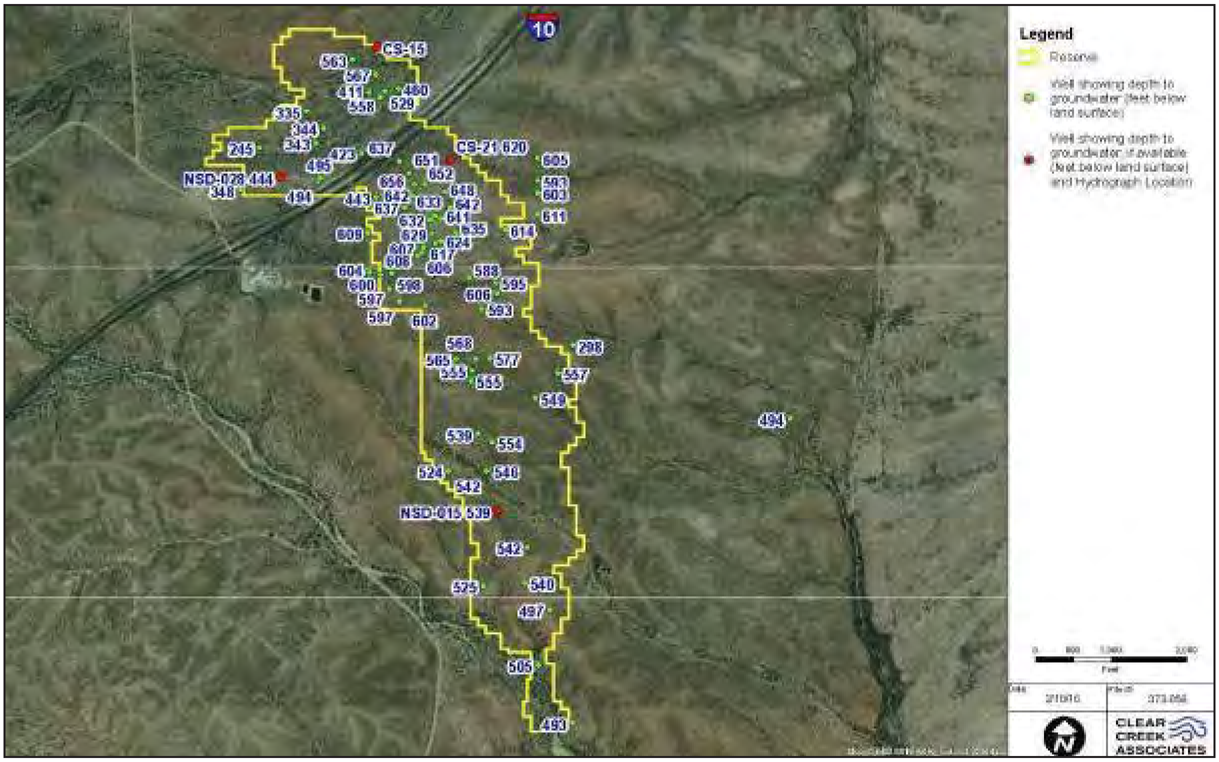


Figure 16-5: Depth to Groundwater, June 2015

Bedrock water level elevations ranged from 4,184 to 4,539 feet above mean sea level and indicate an overall regional groundwater flow direction to the east, towards the center of the Dragoon sub-basin. Groundwater levels in wells at the site and in the surrounding area do not vary significantly with time. The overall groundwater flow direction at the Site is consistent with a west to east regional groundwater flow direction reported at the Johnson Camp mine (Dickens, 2003).

16.2.3 Fractured Bedrock Characteristics

The North Star deposit is the result of the intrusion of the Texas Canyon Quartz Monzonite into the Paleozoic sedimentary rocks. The formation of the skarn deposit created denser minerals and removed carbon dioxide, resulting in a volume reduction of the rocks. This volume reduction resulted in significant fracturing that allows for hydraulic connection within the ISR wellfield. Weitz (1976) calculated a 30% volume reduction in some of the Paleozoic sediments at the Project site. The resulting fractures allowed for the mineralizing fluids to coat the fracture faces with copper-bearing sulfide minerals. The copper sulfide minerals were subsequently oxidized by circulating meteoric groundwater.

Hydrologic characterization activities indicate that groundwater is present within open joints and fractures within the ore body. The permeability of the bedrock varies depending upon the degree of fracturing present. At the Project site, the Paleozoic sedimentary rocks are more permeable than the Pinal Schist or Texas Canyon Quartz Monzonite.

Furthermore, the skarn deposit is more fractured than the un-mineralized Paleozoic sedimentary rocks due to the intrusion of the quartz monzonite and the subsequent volume reduction.

16.2.3.1 Porosity

Excelsior estimated the porosity of bedrock at the Project by reviewing published values in the literature, analyzing pumping test results, and analyzing gamma-gamma density logs from seven boreholes. Porosity values consistent with these sources were used in the groundwater flow model and rinsing for closure strategy.

- Literature review data indicate porosities of bedrock range from less than 1% (for fresh igneous plutonic rock) to up to 10% for fractured rock. A study by Kim et al. (2015) for a skarn deposit in Korea found porosities that ranged from less than 1% to over 8% and averaged approximately 4%.
- Aquifer testing data from the Project site were analyzed to evaluate porosity using a method created by Ramsahoye and Lang (1961). The method resulted in estimated porosities ranging from 0.1% to 1.6%. However, the results are considered underestimates because the analysis is based on key assumptions (a homogeneous and isotropic aquifer and a cone of depression at equilibrium) that were not observed during aquifer testing.
- Measurements of fracture porosity were calculated from eight gamma-gamma density logs. Average porosity values for the boreholes ranged from 1.31% to 5.73%; the overall average (weighted to account for different borehole lengths) was 2.77%.

16.2.3.2 Hydraulic Conductivity

Excelsior has conducted aquifer testing at the Project to determine the hydraulic conductivity and storativity of the ore body. The tests also provide valuable information and data regarding the hydraulic communication between pumping wells and observation wells and core holes. The tested locations covered the range of hydrogeological conditions observed at the site and included tests in typical fractured zones within the different geologic bedrock units, fault intersects, rock masses with limited faulting and highly mineralized zones as well as unmineralized rock formations. Twenty-seven (27) tests were conducted in wells completed in fractured bedrock and water level responses were recorded in observation wells. Tested wells are shown on Figure 16-6.

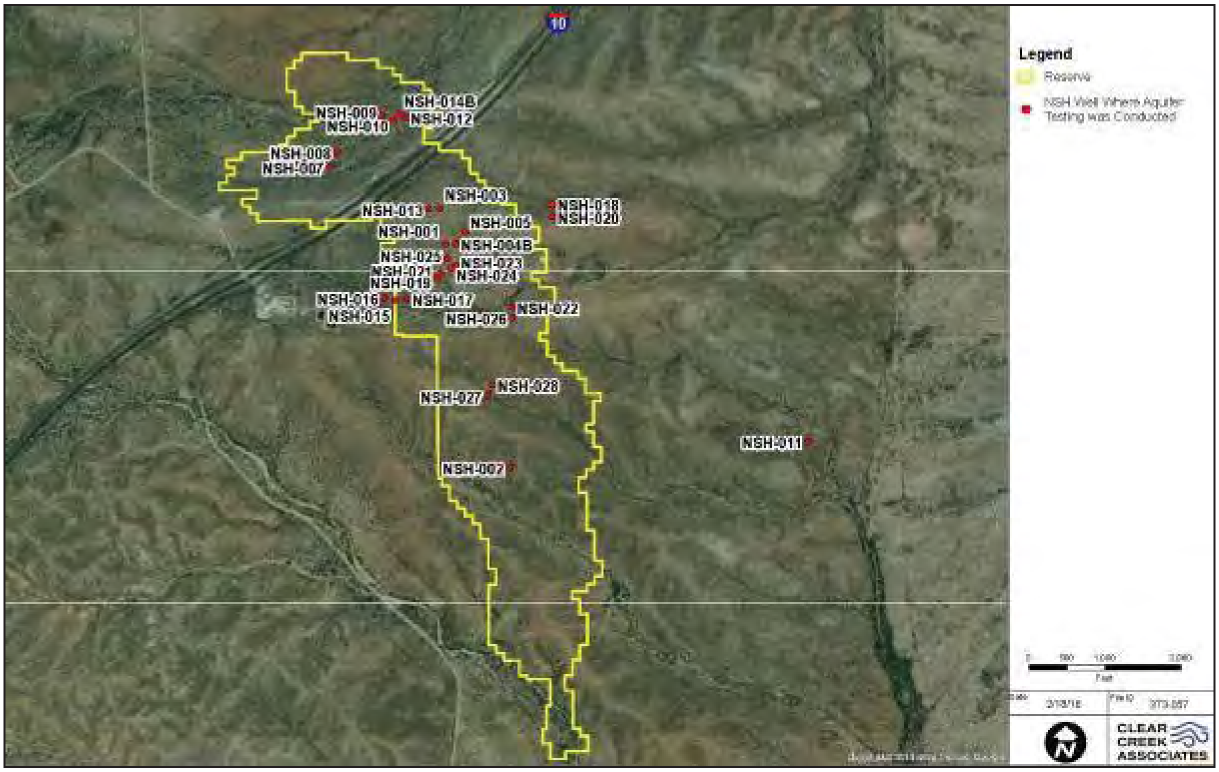


Figure 16-6: Hydraulic Testing Location Map

Testing showed significant variation in hydraulic conductivity values depending upon the fracture density and faulting. The minimum hydraulic conductivity in bedrock was 0.01 ft/day, the maximum was 9 ft/day, and the average was 1.1 ft/day. Testing results were consistent with a confined bedrock system based on the following observations:

- propagation of signal (i.e. connection between wells) over large distances (>1400 feet)
- instantaneous to rapid response to pump start in observation wells
- calculated storativities of less than 10^{-5} (dimensionless)

Two bedrock wells completed in the sulfide zone below the oxide zone, NSH-014B and NSH-025, were tested to characterize the permeability of this zone with regard to penetration of lixiviant into an ore where it is not effective for in-situ recovery. The testing showed that the average hydraulic conductivity of the sulfide zone was significantly lower (two orders of magnitude) than the oxide zone, indicating that lixiviant will be maintained within the oxide zone where it can be effective in copper recovery.

Finally, packer testing was conducted in nine wells. Results were generally consistent with the pumping tests. The limited variability in fracture gradients with depth within the ore body supports the concept that hydraulic conductivity is evenly distributed across the vertical dimension in the oxide ore.

Based on the testing results, the significant degree of fracturing, and the responses to pumping in observation wells, modeling bedrock as an equivalent porous medium is a justifiable approach. This is also a reasonable assumption based on the observed hydraulic conductivity and fracture orientations.

16.2.4 Fracture Intensity versus Hydraulic Conductivity

Excelsior estimated fracture intensity from core samples from numerous boreholes, including direct inspection of core and borehole televiewer logs. These data were used for establishing the model hydraulic properties using a correlation relationship between hydraulic conductivity and fracture intensity from the geology block model. Figure 16-7 illustrates a comparison of hydraulic conductivity estimates from aquifer testing with average fracture intensity for each tested zone. The dots represent individual test data, and the fracture intensity interpretation was provided by Excelsior. A power law fit was estimated, and is presented on Figure 16-7.

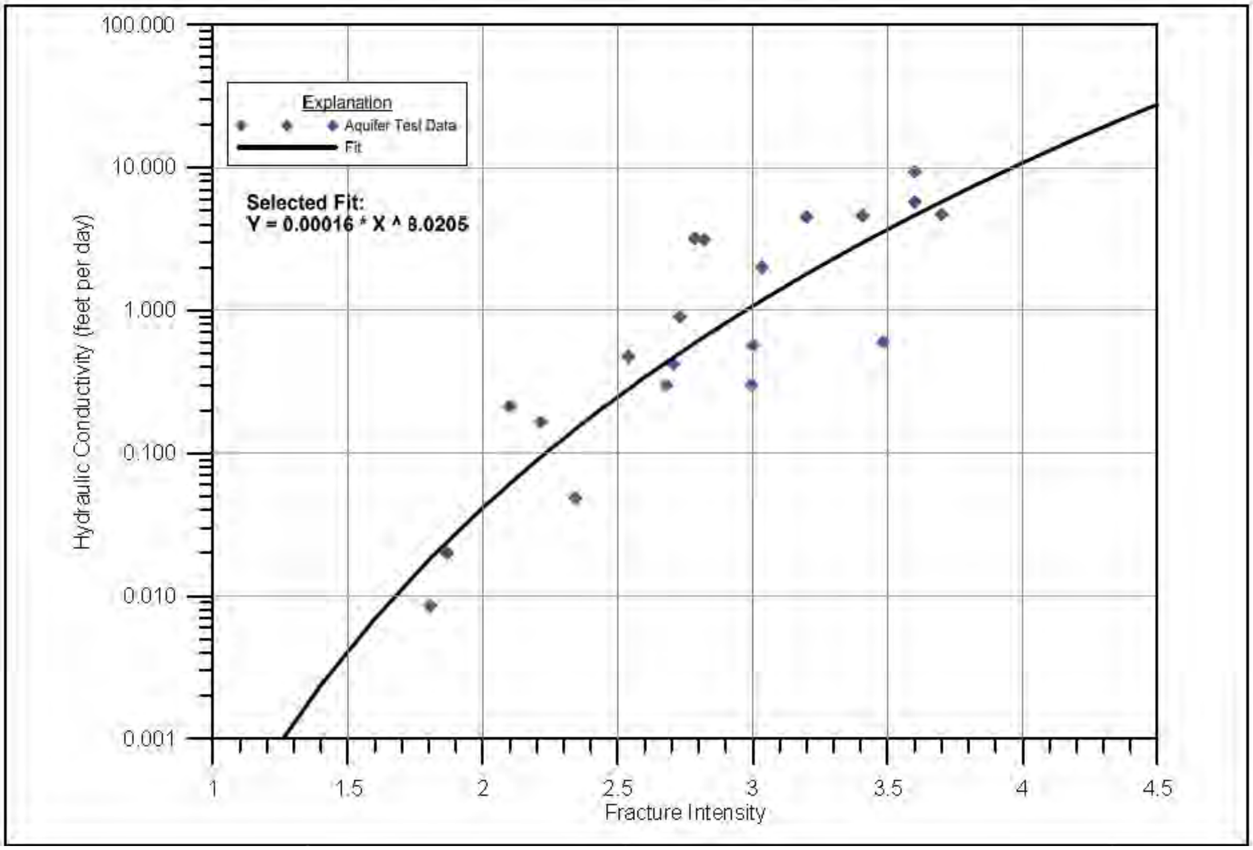


Figure 16-7: Relationship of Fracture Intensity and Hydraulic Conductivity (Data Provided by Excelsior Mining Corp., 2015)

16.2.5 Sweep Efficiency

The sweep efficiency is defined as the percentage of mineralized fractured bedrock that is in contact with the lixiviant as it circulates between the injection well and surrounding recovery wells. The sweep efficiency is a component of the “recovery factor” applied to the Gunnison resource block model and is based on the fracture intensity of the rocks, which in turn is based on the 3D geologic structural model.

Because the lixiviant must be in contact with the mineralized fractures to recover acid soluble copper, the sweep efficiency influences the amount of acid soluble copper recovered during ISR. "The overall copper recovery from the ore is calculated by multiplying the "metallurgical recovery" by the "sweep efficiency." The metallurgical recovery factor applied to the resource block model was developed by Leach, Inc. The sweep efficiency factor has been selected by Excelsior. A discussion of Excelsior’s assumed relationship between the fracture intensity and corresponding sweep efficiency used in the resource block model is provided in Section 13.3. Overall, Excelsior has estimated an average fracture intensity of 2.79, which translates to a sweep efficiency for the deposit of approximately 74%.

16.2.6 Hydraulic Control and Net Groundwater Extraction

The Gunnison Project groundwater flow model was constructed in 2015 by Clear Creek Associates. The model uses the finite difference model code “MODFLOW-NWT” as implemented in the graphical user interface known as “Groundwater Vistas” (v.6.78; Environmental Simulations, Inc., 2011). The finite difference grid consists of 209 rows, 209 columns and 7 layers for a total of 305,767 calculation cells, 173,523 of which are active. The model domain covers an area of 87.8 square miles and encompasses the major hydrologic drainages in the vicinity of the Project (Figure 16-8).

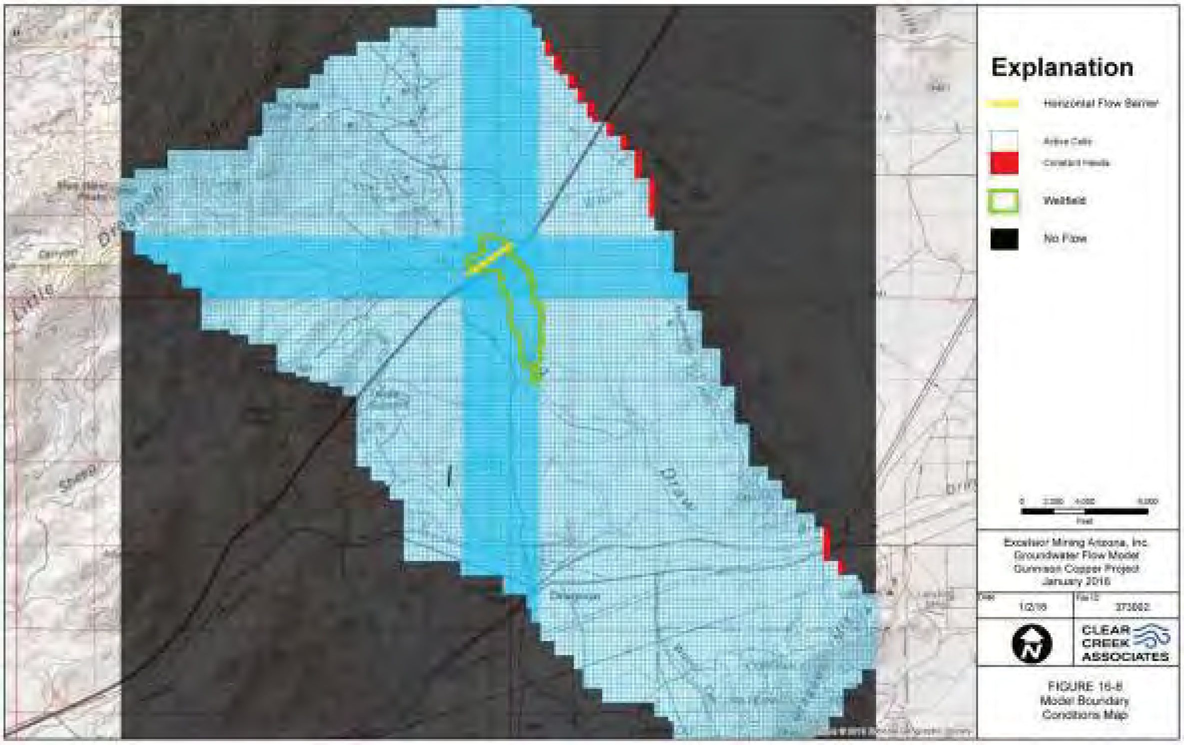


Figure 16-8: Model Grid and Boundary Conditions

The model was constructed using a number of extensive datasets created by Excelsior, including a detailed mapping of fracture intensity, which is key to groundwater flow in the Project area, and the other hydrogeological characterization data discussed above. The model calibrated acceptably, and the statistical match of measured water levels and simulated levels was good. The model demonstrates that control of mining solutions can be maintained with hydraulic control wells located around wellfield. Hydraulic control wells (which will supply water to the Project) will generate cones of depression to contain solutions within the ISR wellfield.

16.2.7 Conceptual Hydrogeological Model

Based on the hydrogeological characterization studies discussed above, the conceptual hydrogeological model for the Project consists of the following elements:

- The Project is located within a structurally-controlled basin filled with sediments (basin fill). The basin fill thickness in the Project area ranges from about 300 to 800 feet.
- Bedrock beneath the basin fill consists of Paleozoic sediments which have been fractured and altered by the intrusion of the Texas Canyon Quartz Monzonite which is also present in the subsurface at the Project site.
- Bedrock is generally saturated in the Project area. Groundwater flow is within secondary porosity (fractures) that are related to the intrusion of the Texas Canyon Quartz Monzonite and the resulting mineralization. The basin fill is generally unsaturated within the wellfield.
- Aquifer testing results indicate that there is hydraulic communication between wells through bedrock fractures.
- Control of lixiviant in the subsurface can be maintained by pumping of hydraulic control wells around the ISR wellfield.

16.3 WELL DESIGN

Wells installed at the Project will include injection, recovery, hydraulic control, observation wells, and point-of-compliance (POC) monitoring wells. With the exception of the POC monitoring wells, these wells will be constructed to meet Underground Injection Control Class III requirements and will be constructed consistent with the guidelines of ADEQ's Mining BADCT Guidance Manual (2004). Several possible well designs, including varying diameters, are planned for the injection, recovery, and hydraulic control wells to allow for operational flexibility. The injection, recovery, and hydraulic control wells are proposed to have open-hole completions within the ore body, which ranges from approximately 50 to 1250 feet in thickness. Observation wells and POC wells will be constructed with well screen. Proposed well constructions are as shown on Figure 16-9 through Figure 16-12.

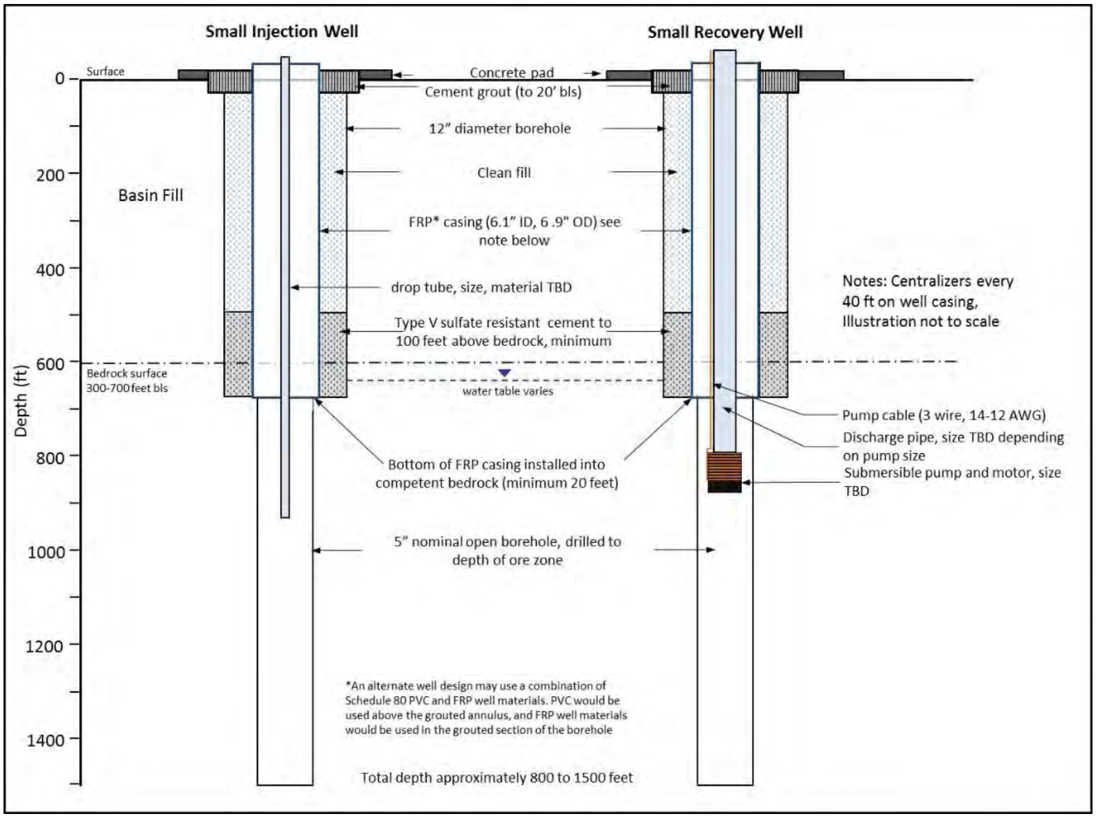


Figure 16-9: Small Diameter Injection and Recovery Well Design

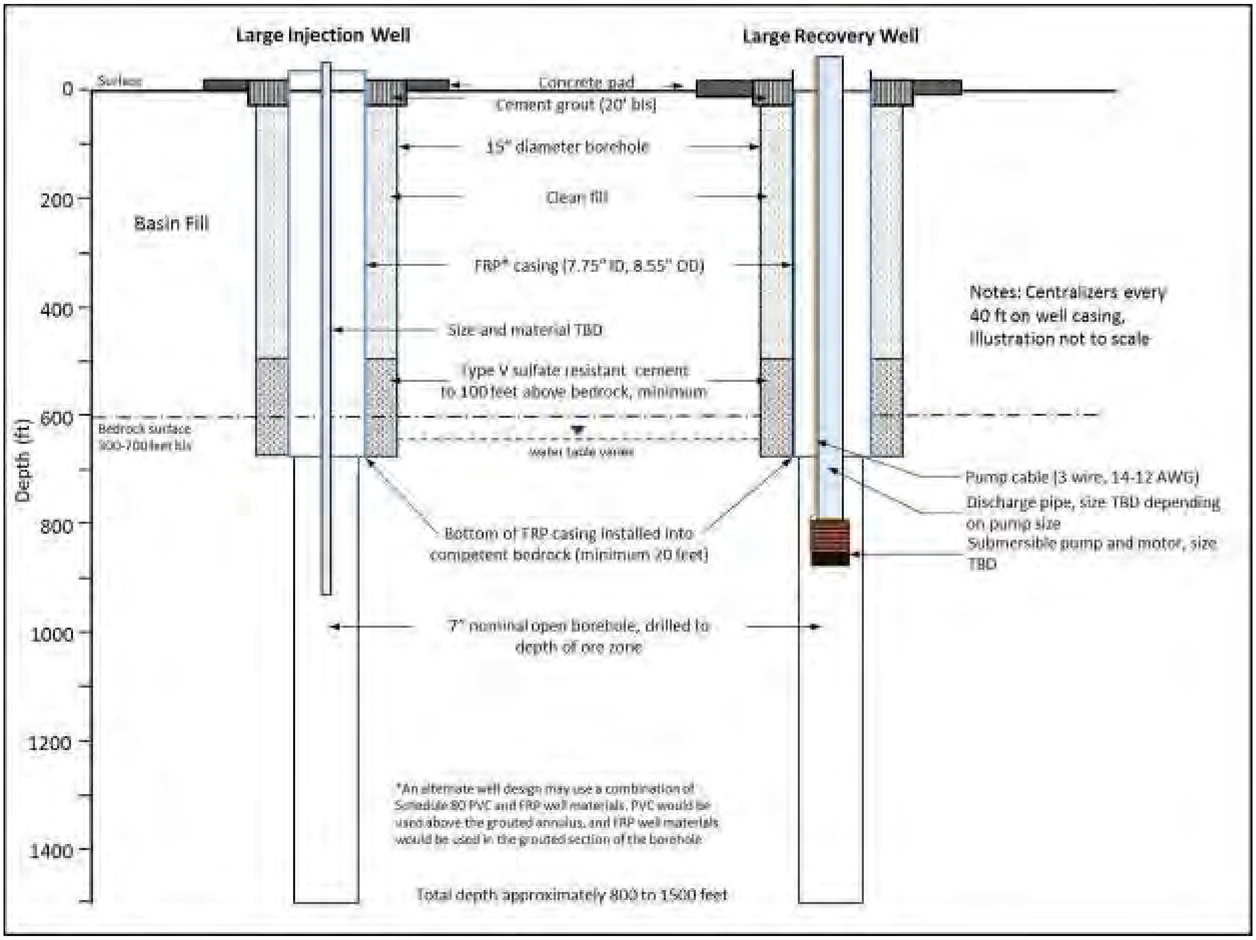


Figure 16-10: Large Diameter Injection and Recovery Well Design

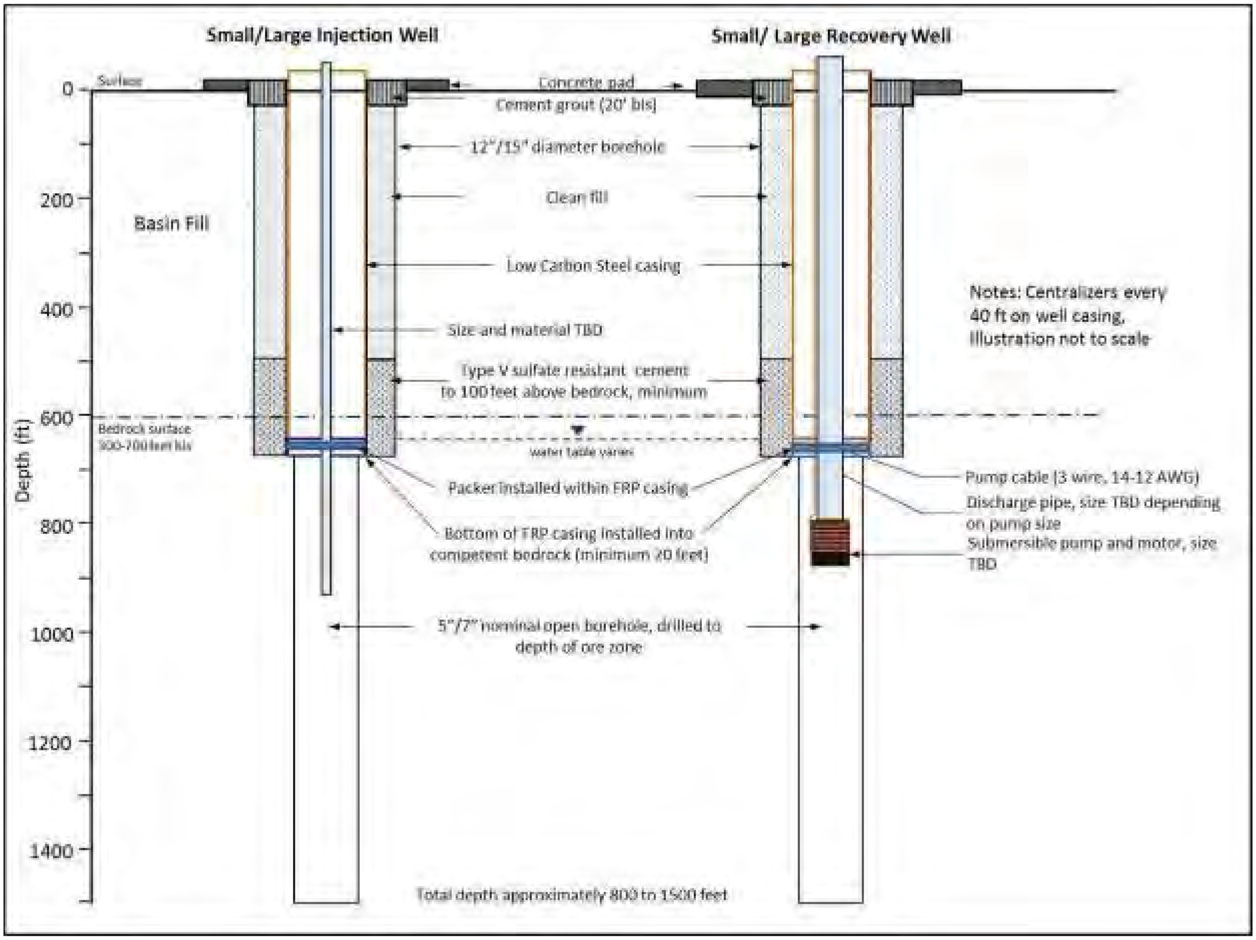


Figure 16-11: Large/Small Diameter Injection and Recovery Well with Packer Completion

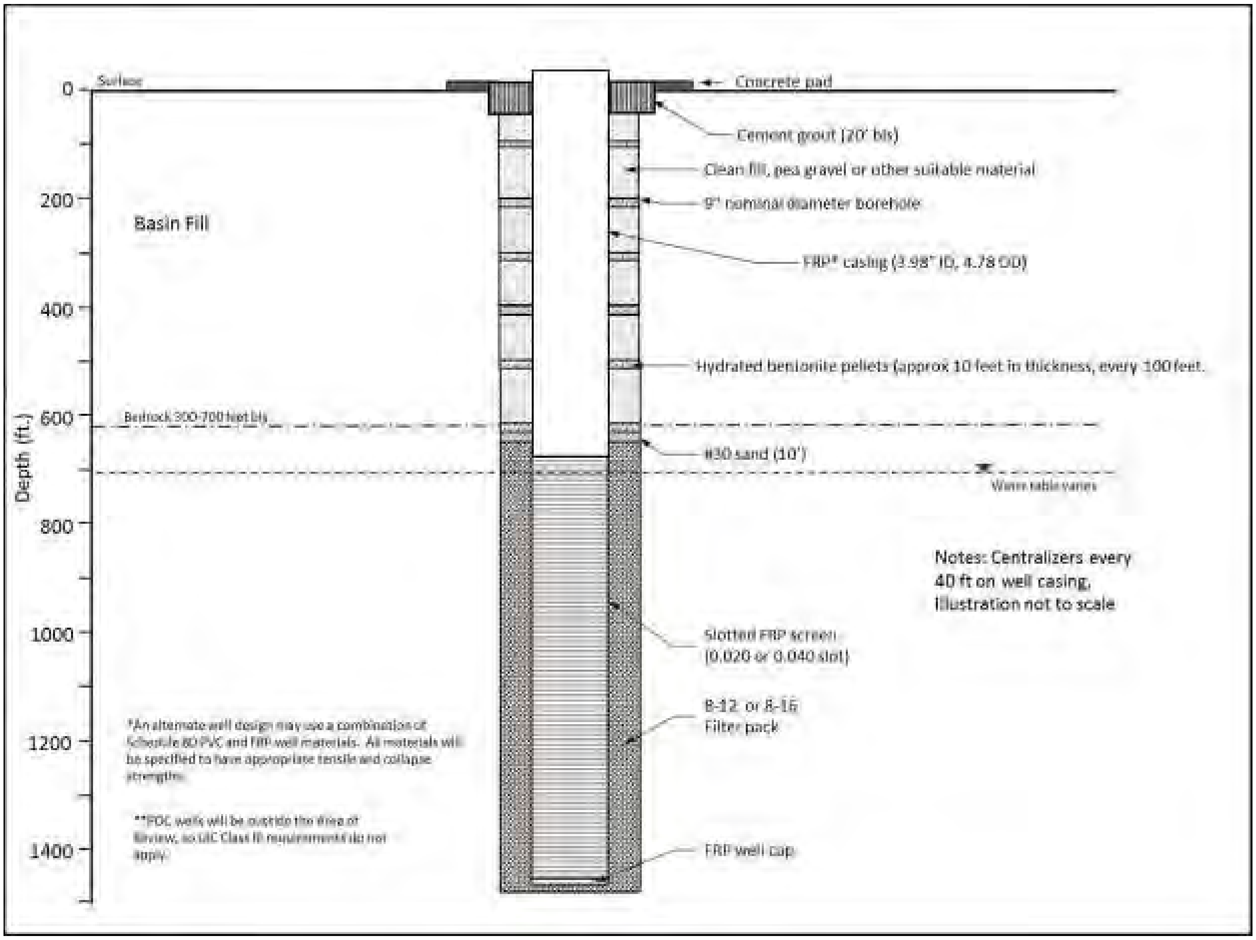


Figure 16-12: Observation Well Design

Boreholes will be drilled using air rotary, direct mud rotary, reverse circulation mud rotary, or casing advance drilling methods. Borehole diameters will be sufficient to allow for installation of casing that will accommodate the pumps. The cased portions of the boreholes will be 12-inch nominal (small diameter injection/recovery wells and hydraulic control wells), 15-inch nominal (large diameter injection/recovery wells), and 10-inch nominal (observation and POC wells). The open borehole sections within bedrock will be 5- and 7-inch nominal. Well screen may be used if the borehole is unstable.

Casing strings (including the well screen if the well has a screened completion) will be of appropriate size and grade to have sufficient collapse, pressurization, and tensional strengths to maintain integrity during well construction and for the life of the well. Well materials will be compatible with injected fluids and formation fluids with which they are expected to come into contact. Casing centralizers will be placed every 40 feet along the casing (and screen, if used) length. The casing string will be suspended in the borehole until the annular materials are installed.

The casing annulus of all Class III wells will be grouted to 100 feet above the basin fill/bedrock contact (or static groundwater level, whichever is shallower).

16.4 COPPER EXTRACTION FORECAST

The copper production for the Gunnison Project increase in stages. From years 1-4, production will range from 12 to 55 million pounds per year. In Years 5 and 6 production will be 75 million pounds per year. Starting in Year 7, production will be approximately 125 million pounds per year, and in Year 20 production will drop below 100 million pounds per year. Production will average approximately 98 million pounds per year from Years 1 through 20, with a decline in production beginning in Year 20 (85 million pounds) through the end of the mine life (8.7 million pounds in Year 24). The total amount of copper production forecast over the 24-year LOM is approximately 2,165 million pounds.

Predicted PLS throughput to the SX-EW plant increases from 3,722 gpm in Year 1 to 18,930 gpm in Year 10, with relatively consistent PLS throughput of approximately 18,000-19,000 gpm from Year 7 through Year 18. Predicted average net PLS grade ranges from 0.5 g/L to 1.99 g/L, with the average net PLS grade of 1.51 g/L for the LOM. The copper extraction schedule is provided in Table 16-1.

Table 16-1: Copper Extraction Schedule

Copper Production Schedule (Summary)			Totals	Year -2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
						25	25	25	75	75	75	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125
Recovered Cu Metal	MM lb		2,165.031			12.1	25.8	25.6	58.0	75.9	74.8	125.8	125.4	126.4	125.6	125.4	124.5	124.8	125.2	125.7	123.6	119.2	106.4	117.5	84.8	96.1	77.1	30.4	8.7
Copper Produced & Sold	MM lb		2,165.031			12.1	25.8	25.6	58.0	75.9	74.8	125.8	125.4	126.4	125.6	125.4	124.5	124.8	125.2	125.7	123.6	119.2	106.4	117.5	84.8	96.1	77.1	30.4	8.7
Copper Produced & Sold from Arizona State Lease	MM lb		211.28			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	45.1	69.6	42.8	39.5	10.1	4.2	-
Net Acid Consumed	MM lb		19,450			113	161	212	537	463	779	1,043	998	1,215	1,182	1,099	1,206	1,075	1,154	1,087	1,132	879	1,062	800	800	1,097	589	520	248
Average acid consumption	lb/lb		8.98	average		7.93	6.24	8.26	9.26	6.10	10.42	8.29	7.95	9.61	9.41	8.77	9.69	8.61	9.22	8.65	9.15	7.38	9.98	6.81	9.44	11.41	7.63	17.07	28.51
Number of Production CELLS in service	#		229	average		13	18	23	62	54	113	156	172	213	213	197	218	192	302	285	511	367	534	352	346	486	271	259	140
Number of Production WELLS in service	#		303	average		22	28	36	83	78	161	205	237	276	264	234	259	225	353	325	605	589	673	675	419	614	373	349	198
Average Pump Rate per Recovery well	Gpm/well		45.5	average		211	149	105	111	120	77	90	77	68	72	79	72	82	53	56	30	26	27	24	31	26	28	25	20
Average Flow rate to SXEW	Gpm		13,747	average		3,722	3,746	3,780	9,250	9,350	12,415	18,370	18,250	18,875	18,930	18,465	18,650	18,450	18,610	18,325	18,376	15,236	18,383	16,381	12,950	16,260	10,620	8,584	3,960
Average PLS grade	g/l		1.50	average		1.00	1.57	1.55	1.43	1.85	1.37	1.56	1.57	1.53	1.51	1.55	1.52	1.54	1.53	1.56	1.53	1.78	1.32	1.64	1.49	1.35	1.66	0.81	0.50

The following inputs and assumptions were used to generate the copper extraction forecast:

- Key physical parameters from Mine Development Associates (MDA) 100 foot x 50 foot resource block model such as rock type, specific gravity of each rock type, percent total copper and percent acid soluble copper, fracture intensity, ore thickness, water table elevation, ore greater than 0.05% total copper, and lease boundaries (see Section 14 for details);
- Incremental acid soluble copper recovery curves over a 4 year recovery period and recovery factor (as discussed in Section 13.4.3); and
- Recovery well production rates described in Section 16.1.6.

As discussed in Section 14, the resource block model consists of stacked cells with dimensions of 100 feet x 50 feet x 25 feet thick. Because each vertical column of the resource block model is 100 feet x 100 feet in area, it corresponds to a 100 foot x 100 foot 5-spot well pattern. The resource block model after averaging side by side blocks therefore approximates the well field model.

Based on the estimated incremental acid consumption and copper recovery from metallurgical testing (see Section 13.4.3), copper recovery in each resource block is expected to be complete in four years for all rock types. The resource block model therefore estimates the mineral reserve available for extraction (see Section 15). The copper production schedule uses the reserve estimate and assigns recovery rates that will extract the copper resource over a 4 year time period using desired PLS flow rates and PLS grade.

16.4.1 Copper Extraction Sequence

Nine geographical subdivisions were identified to facilitate well field design and production scheduling, resulting in mine “Groups” 1 through 9 (Figure 16-13). The Groups were further subdivided into 29 mine “Blocks” to aid in production scheduling (Figure 16-14).

As shown in Figure 16-14, the production schedule sequence is generally from north to south along the western perimeter of the ISR area (Blocks 1 through 25) followed by south to north production along the eastern perimeter (Blocks 25, 26, and 27), generally following land surface topography from high to low elevation, and the overall west to east groundwater flow direction. The blocks north of Interstate 10 (Blocks 28 and 29)are scheduled to go into production near the end of the LOM, in Years 18 and 20. The production schedule was generated with the goal of producing an average of approximately 125 million pounds of copper per year once the ramp up is complete. Wells are brought on line in sequential blocks over the LOM to maintain this desired production rate.

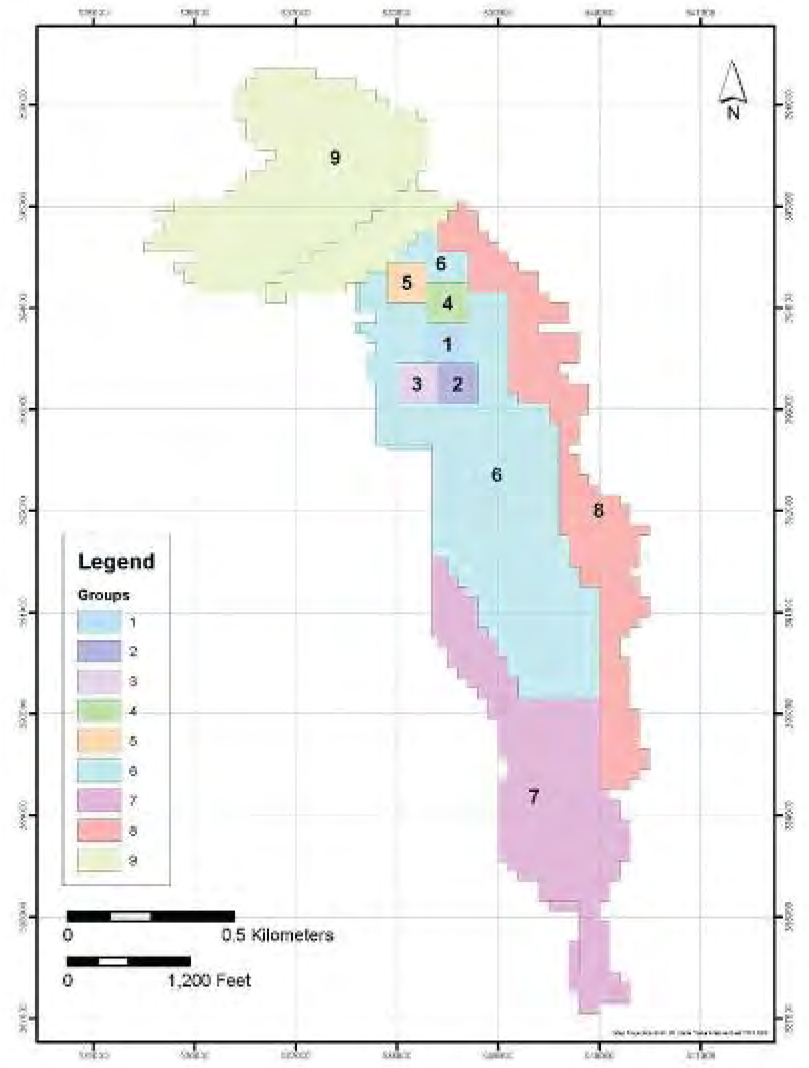


Figure 16-13: Mine Groups

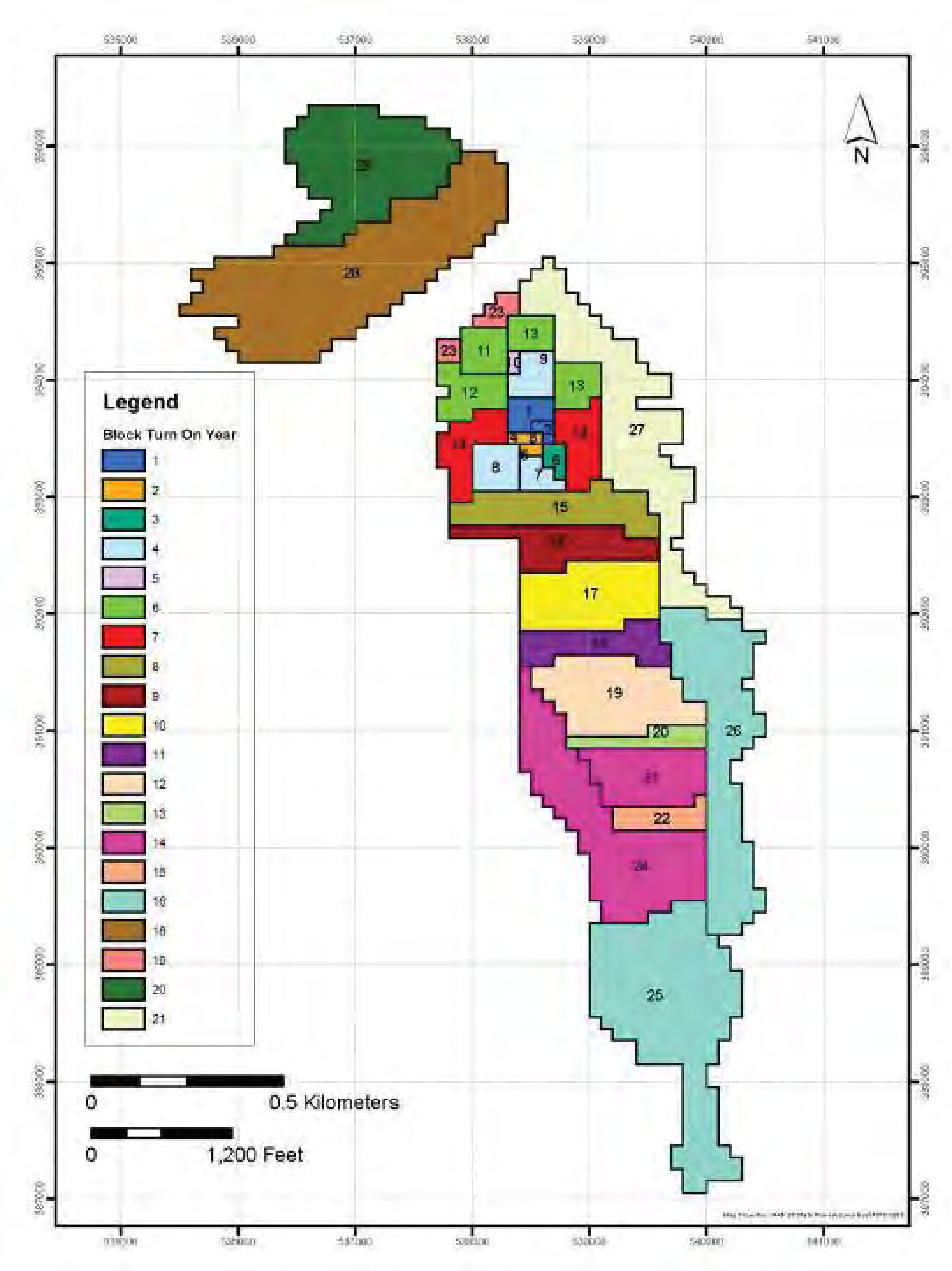


Figure 16-14: Mining Block Sequence Map

16.4.2 Number of Operational Wells

ISR requires injection, recovery, hydraulic control, and observation wells during operation. Injection and recovery wells will be interspaced in an alternating and repeating pattern throughout the wellfield. According to Excelsior's production schedule, there will be a total of 3000-3100 Class III injection/recovery wells in the wellfield during the life of mine. New wells are anticipated to be installed the year prior for each block brought on line for production. Because injection and recovery wells will be constructed alike, a well can be converted from injection to recovery (and vice versa) by changing out the equipment and wellhead instrumentation.

Figure 16-15 shows a five-spot pattern in which each injection well is surrounded by four recovery wells with a 100-feet spacing between wells in a row and 50 feet between rows. This configuration results in approximately 71 feet between each injection and recovery well. In practice, this arrangement may be revised to optimize recovery, based on geologic and hydrogeological conditions observed during the installation of the wellfield. Aquifer testing will be performed at installation, and used to determine the optimal wellfield array configuration.

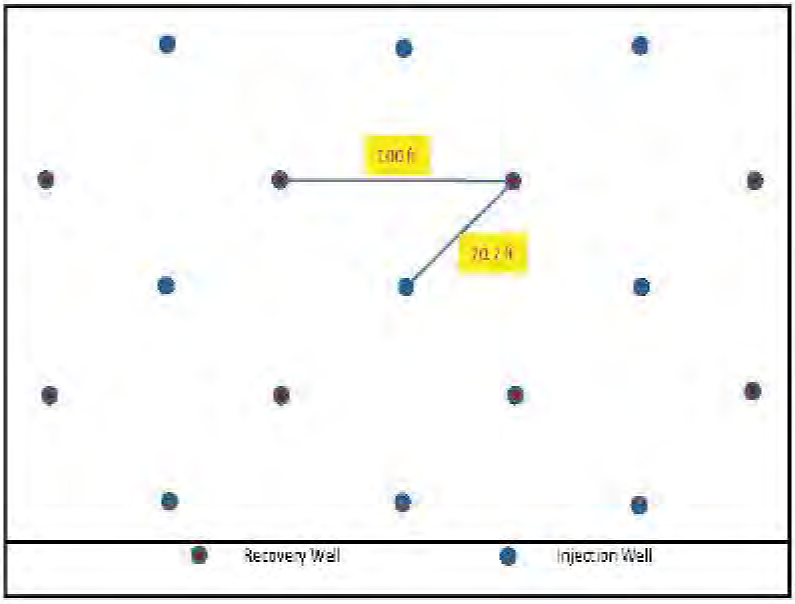


Figure 16-15: Conceptual 5-Spot Pattern
(Source: 2012 Preliminary Economic Assessment)

Hydraulic control wells will be located around the perimeter of the wellfield, at locations indicated by the groundwater flow model, to prevent the flow of solutions from the ISR area. Observation well pairs will be used to monitor groundwater levels and demonstrate hydraulic gradients toward the ISR wellfield. POC wells for monitoring groundwater quality will be located outside the wellfield to meet monitoring requirements of the Aquifer Protection and Underground Injection Control permits.

16.4.3 PLS Solution and Flow Rates

The annual PLS flow rate for each resource block was estimated using the number of recovery wells per resource block during the operational year and per well recovery rates. Recovery (and injection) rates are expected to vary and will depend on the thickness of the mineralized material under leach (i.e., the recovery well screen length) and the degree of fracturing. Recovery rates will be approximately equal to injection rates to avoid de-watering the ore zone. The average annual PLS grade is predicted to range from 0.5 g/L to 1.99 g/L during the LOM, with an average net PLS grade of 1.51 g/L after adjusting for copper in the raffinate.

Individual recovery well pumping rates are anticipated to range from 20 gpm to 250 gpm (Table 16-2), with an average of approximately 68 gpm during the LOM. Aquifer testing conducted in support of the Aquifer Protection Permit and Underground Injection Permit Applications indicates that these flow rates are achievable. The annual PLS flow to the SX-EW plant is expected to range from a peak of 18,930 gpm in year 10 to 3722 gpm during year 1, with an average PLS flow rate of 13,661 gpm over the LOM.

Table 16-2: Individual Recovery and/or Rinse Well Pumping Rates in GPM

Block	Year 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
1	208	139	100	40	17	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
2	250	146	100	80	80	9	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
3	-	191	150	80	80	30	4	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
4	-	179	150	80	80	30	-	-	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
5	-	100	100	80	80	30	-	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
6	-	-	85	85	85	15	54	-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7	-	-	-	109	109	70	70	9	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8	-	-	-	130	130	70	70	18	-	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
9	-	-	-	107	107	50	50	19	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
10	-	-	-	-	150	150	100	80	10	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	100	100	80	20	7	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	80	80	80	55	11	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	80	80	80	55	11	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	120	75	75	50	8	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	80	80	80	50	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-
16	-	-	-	-	-	-	-	-	80	80	80	50	9	-	5	-	-	-	-	-	-	-	-	-	-	-	-
17	-	-	-	-	-	-	-	-	-	80	80	80	80	10	-	6	-	-	-	-	-	-	-	-	-	-	-
18	-	-	-	-	-	-	-	-	-	-	80	80	80	50	10	-	5	-	-	-	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-	-	-	-	80	80	60	50	12	-	6	-	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-	-	-	-	-	80	80	80	45	12	-	4	-	-	-	-	-	-	-	-
21	-	-	-	-	-	-	-	-	-	-	-	-	-	80	80	22	22	10	-	5	-	-	-	-	-	-	-
22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	140	80	80	70	7	-	4	-	-	-	-	-	-
23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	120	80	80	80	4	-	2	-	-
24	-	-	-	-	-	-	-	-	-	-	-	-	-	35	35	20	16	7	-	4	-	-	-	-	-	-	-
25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	35	35	24	18	6	-	4	-	-	-	-	-
26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30	30	20	13	5	-	3	-	-	-	-	-
27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30	30	22	12	4	-	3
28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30	30	20	15	5	-	3	-	-	-
29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	40	20	20	20	5	-	3	-

16.4.4 Hydraulic Control Solution Flow Rates

Hydraulic control wells located around the perimeter of the ISR wellfield will be pumped at rates needed to maintain a hydraulic gradient toward the wellfield. The gradient will be demonstrated by water levels measured in observation well pairs. Hydraulic pumping rates will vary from year to year, based on the extent of ISR operations. Hydraulic pumping will continue until rinsing is complete. The groundwater flow model has demonstrated that individual hydraulic control pumping rates will range from 2 to 17 gpm. These rates will be sufficient, according to model simulations, to contain solutions within the ISR wellfield.

16.4.5 Rinse Solution Control Flow Rates

Each block is scheduled for rinsing once ISR is completed based on the PLS grade economic cutoff. A rinse solution will be injected and recovered within the mining block with the goal of returning formation water quality to Aquifer Water Quality Standards (AWQSs) using a rinse-rest-rinse strategy. Since ISR duration is anticipated to be four years rinsing operations will not start until Year 5 and will continue until year 27.

A geochemical model utilizing industry standard software was prepared using a combination of host rock mineralogical and geochemical data, hydrological data and rinsing data from prior and the most recent metallurgical test work. The geochemical modeling indicates that five pore volumes, based on a 3% porosity[1], will be required to adequately flush the formation during rinsing. This volume was scheduled over a 2 to 4 year time period for each block under rinse to accommodate waste water treatment system flow capacity and to take advantage of the natural attenuation properties of the host rocks. After three pore volumes of rinsing, the system will be allowed to rest. During the rest period, the solution will reach circumneutral pH. Two additional pore volumes of rinsing will follow the rest period. Individual rinsing well production rates range from 2 to 19 gpm, with an average rinsing pumping rate of 7

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[1] Based on weighted gamma-gamma borehole logging results, with an added safety factor.

gpm per rinsing well over the LOM. The annual total flow rate from rinsing ranges from 36 to 2,900 gpm, with an average of 839 gpm over the LOM.

16.4.6 Limitations/Opportunities

The copper extraction forecast only includes measured and indicated copper oxide mineral resources as defined in the resource block model prepared by MDA (see Section 14). The inferred copper oxide mineral resources present within the ISR area are not included in the copper extraction forecast or the economic analysis. Opportunity exists to add inferred mineral resources to future production by appropriately converting these inferred mineral resources to measured or indicated mineral resources. However, recovery of this additional copper would also result in additional acid consumption not accounted for in the current copper production schedule[2].

Prior to production of the ISR wellfield, the pre-development well installation will undergo geological, geophysical and hydrological testing and modelling. This newly collected hydrological data and modelling will be used to optimize the wellfield design, pumping rates and the production schedule. The recently acquired data will refine aspects of the extraction plan, well design, and hydrologic performance of the ore body, and will help define the effects of individual geologic structures on well field geometry and refinement the well field geometry and hydraulic control.

16.5 CONVENTIONAL MINING FLEET

This Project is an in-situ recovery project, and as such, does not have a conventional mining fleet. The Project includes drilling and well servicing equipment required to develop the ISR wellfield. This equipment, which is included in the sustaining capital cost estimate and financial model, includes:

Table 16-3: Equipment Quantity

Quantity	Equipment
3	Air Compressor/ Booster
1	Water Truck
1	Forklift
1	Boom Truck
3	Reverse Circulation Rigs
3	Service Rigs
1	Wire Line Logging Truck
1	Fuel Truck
1	10yd Dump Truck

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[2] Acid consumption is currently based on pounds of copper produced, not tons of material in contact with the leaching solution.

17 RECOVERY METHODS

The Gunnison Copper Project uses solvent extraction (SX) and electrowinning (EW) to recover copper from an in situ recovery (ISR) wellfield. The Gunnison Project is planned for development in three stages. In Stage 1, the existing JCM plant is used to recover 25 million pounds per annum (mppa) of copper cathode from the Gunnison wellfield. In Stage 2, a 50 mppa SX-EW plant will be constructed in the Gunnison Project area south of I-10. This new plant will be independent of the JCM plant. In Stage 3, the Gunnison plant capacity will be doubled to 100 mppa, resulting in an aggregate capacity of 125 mppa of copper cathode. The SX-EW facilities are designed to recover copper from pregnant leach solution (PLS) to produce cathode-quality copper with 99.99% purity. The process consists of the following elements (schematic representation in Figure 17-1):

- ISR wellfield
- SX mixer-settlers which transfer copper from PLS to the electrolyte solution
- EW cells which recover copper on cathodes that are then stripped with an automatic stripping machine
- Tanks which store and handle process liquids at a centralized tank farm
- Evaporation ponds and a water treatment plant which handle excess solutions and provide clean water for rinsing leached blocks

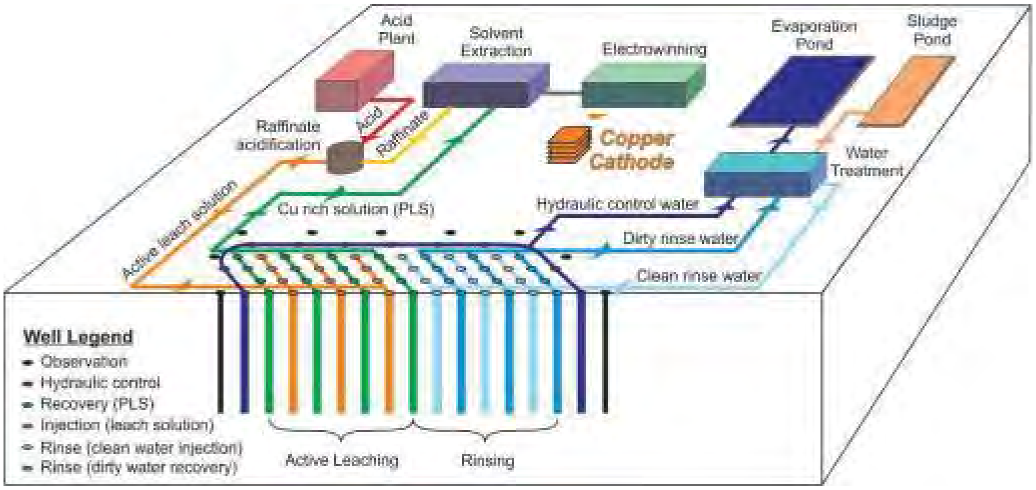

Figure 17-1: Recovery Process

All three stages of the Gunnison production use essentially the same process, as described in Section 17.1. There are minor differences in the design of the Stage 1 JCM plant and the Gunnison Stage 2 and 3 plant. Table 17-1 provides the design criteria for each stage.

Table 17-1: Process Design Criteria by Stage

Parameter	Units	Stage 1 JCM Plant	Stage 2 Gunnison Plant	Stage 3 Gunnison Plant
Nominal production	million pounds per year	25	50	100
Nominal flow rate to SX	gallons per minute	3,890	7,800	15,600
PLS Concentration	copper grams per liter	1.63	1.63	1.63
Extractant	type / concentration	AGORA M5774 or equal	LIX 984N or equal / 11.6%	LIX 984N or equal / 11.6%
Copper/iron transfer ratio	design	1,200:1	1,200:1	1,200:1
Number of SX trains	design	2	1	2
Extraction				
Extraction arrangement	extraction stages / arrangement	2 / series	2 / parallel	2 / parallel
Extraction flow rates	overall / per settler	3,880 / 1,940	7,800 / 3,900	15,600 / 3,900
Organic to Aqueous	ratio	1:1	1:1	1:1
Settler-specific flow rate	gallons per minute per foot	2.0	2.0	2.0
Linear flow velocity maximum	inches per second	2.76	2.76	2.76
Combined SX copper recovery	percent	92	92	92
Stripping				
Stripping arrangement	stripping stages	1	1	1
Stripping flow rates	overall / per settler	3,880 / 1,940	3,900 / 3,900	7,800 / 3,900
Organic to Aqueous	ratio	1:1	1:1	1:1
Settler-specific flow rate	gallons per minute per foot	2.0	2.0	2.0
Linear flow velocity maximum	inches per second	2.76	2.76	2.76
Nominal change in concentratio	copper grams per liter	15	15	15
Electrowinning				
Number of EW cells	number	Block 1 = 56 Block 2 = 32	80	160
Cell construction	material / type	polymer concrete / cross flow	polymer concrete / cross flow	polymer concrete / cross flow
Current density	amperes per square foot operating / design	Block 1 = 28.8 / 28.8 Block 2 = 21.9 / 21.9	22.8 / 28	22.8 / 28
Cathodes	type	316L SS mother blanks	316L SS mother blanks	316L SS mother blanks
Cathodes per cell	number	Block 1 = 21 Block 2 = 36	63	63
Cathode plating dimensions	width x height in inches	36.4 x 46.25	39.375 x 39.375	39.375 x 39.375
Anodes	type	Pb-Ca-Sn rolled	Pb-Ca-Sn rolled	Pb-Ca-Sn rolled
Anodes per cell	number	Block 1 = 22 Block 2 = 37	64	64
Anode dimensions	width x height in inches	33.5 x 46.5	37.0 / 47.75	37.0 / 47.75
Rectifers	number	2	1	2
Rectifer voltage	volts	Block 1 = 120 Block 2 = 70	276	276
Rectifier amps	nominal / maximum	Block 1 = 13,000 / 13,000 Block 2 = 17,000 / 17,000	30,500 / 38,000	30,500 / 38,000
Rich electrolyte concentration	copper grams per liter, nominal	46	46	46
Rich electrolyte concentration	sulfuric acid grams per liter	165	159	159
Rich electrolyte concentration	cobalt parts per million	150	90	90
Lean electrolyte concentration	copper grams per liter, nominal	36	36	36
Lean electrolyte concentration	sulfuric acid grams per liter	180	183.2	183.2
Cell Feed solution concentratio	copper grams per liter, nominal	38	36.5	36.5
Cell Feed solution concentratio	sulfuric acid grams per liter	176	180	180
Cell Feed solution flowrate	gallons per minute per square foot	0.049	0.049	0.049
Cell Feed solution flowrate	gallons per minute per cell	Block 1 = 24 Block 2 = 41.2	67	67

17.1 PROCESS DESCRIPTION

The copper recovery process for the Gunnison Project uses a conventional SX-EW flowsheet to recover soluble copper from in situ mineralization using injection and recovery wells. Acidified leach solution from SX raffinate is injected into oxide copper mineralization in the subsurface below the water table through a network of wells. The injection wells are interspersed with recovery wells that pump copper-bearing pregnant leach solution (PLS) from the subsurface at an equal rate of flow. The PLS from the recovery wells is combined to provide the feed for the SX-EW process. Copper is extracted from PLS and transferred to a high-acid electrolyte in the SX process. The copper-bearing electrolyte is pumped to EW where the copper is plated on cathodes. Sheets of plated copper are stripped from the cathodes, bundled, tested, and weighed prior to being shipped to market. The following sections provide details of the copper recovery process. When a block of mineralized material has been depleted of its recoverable copper, the same injection and recovery wells are then used to rinse the formation.

17.1.1 Leaching

Leaching of copper from the subsurface mineralization is accomplished by using injection and recovery wells in the ISR wellfield, as described in Section 16. Raffinate from the SX-EW plant is acidified and pumped to the ISR wellfield through a network of process piping to a series of injection wells that are each surrounded by four recovery wells. The recovery wells create a hydraulic gradient that promotes flow of the acidified raffinate through the mineralized formation. Acid-soluble copper is drawn into solution as it migrates toward the recovery wells. The PLS extracted by the recovery wells is collected in the PLS pond through a network of process piping.

Production wells are arranged in a repeating 5-spot pattern with the central injection well being surrounded by recovery wells. Each of the recovery wells in the interior of the wellfield is surrounded, in turn, by four injection wells. The rate of PLS extraction must be adjusted to meet or exceed the rate of leach solution injection, both on a local scale and on the operating wellfield as a whole.

Blocks of injection and recovery wells are connected by buried piping (typically 3” diameter) to a header house in a central area of the block. The header house contains headers, piping connections, and the instrumentation and controls needed to monitor the wellfield operation and adjust the flows (Figure 17-2 [300-GA-A101]). The headers are located near the ceiling of the header house with instrumentation and controls for the individual wells situated between the header and the floor grating for ease of access. Buried lateral header pipes (typically 12” diameter) convey solutions between each header house and the larger diameter above ground main header piping that conveys flows to and from the SX-EW plant.

Barren leach solution is delivered to the injection header with sufficient pressure to distribute through injection piping to each of the injection wells served by an individual header house. The header house injection piping includes an isolation valve, flow meter, control valve, and pressure gauge (Figure 17-3).

17.1.2 Solvent Extraction

PLS is collected from the ISR wellfield into a PLS collection pond and then pumped to the SX circuit for extraction of copper. The SX circuits for the Gunnison Project consist of trains of mixer-settlers that strip copper from the PLS and transfer it to the lean electrolyte solution. Each train has two extraction settlers and one stripper settler (Figure 17-4). The extraction settlers use an extractant contained in a petroleum-based liquid (“organic”) to extract the copper from the aqueous phase. The stripper settlers (one in each train) use a high-acid aqueous phase (electrolyte) to strip the copper from the organic phase. The electrolyte is then pumped to EW for recovery by electrowinning.

The SX trains for the Gunnison Project are designed to operate in parallel, which means that half the PLS goes to each extraction settler in the train. The SX trains for the JCM plant are operated in series such that the entire PLS flow through each train passes through both of extraction settlers in the train. The organic passes through both extraction settlers, extracting copper from the PLS and becoming “loaded organic.” The copper-bearing loaded organic is mixed with lean electrolyte in the stripper pumper mixers to transfer the copper from the extractant in the organic phase to electrolyte solution. The stripper settler allows the immiscible liquids to separate in laminar flow. The rich electrolyte then flows to the Electrolyte Filter Feed Tank.

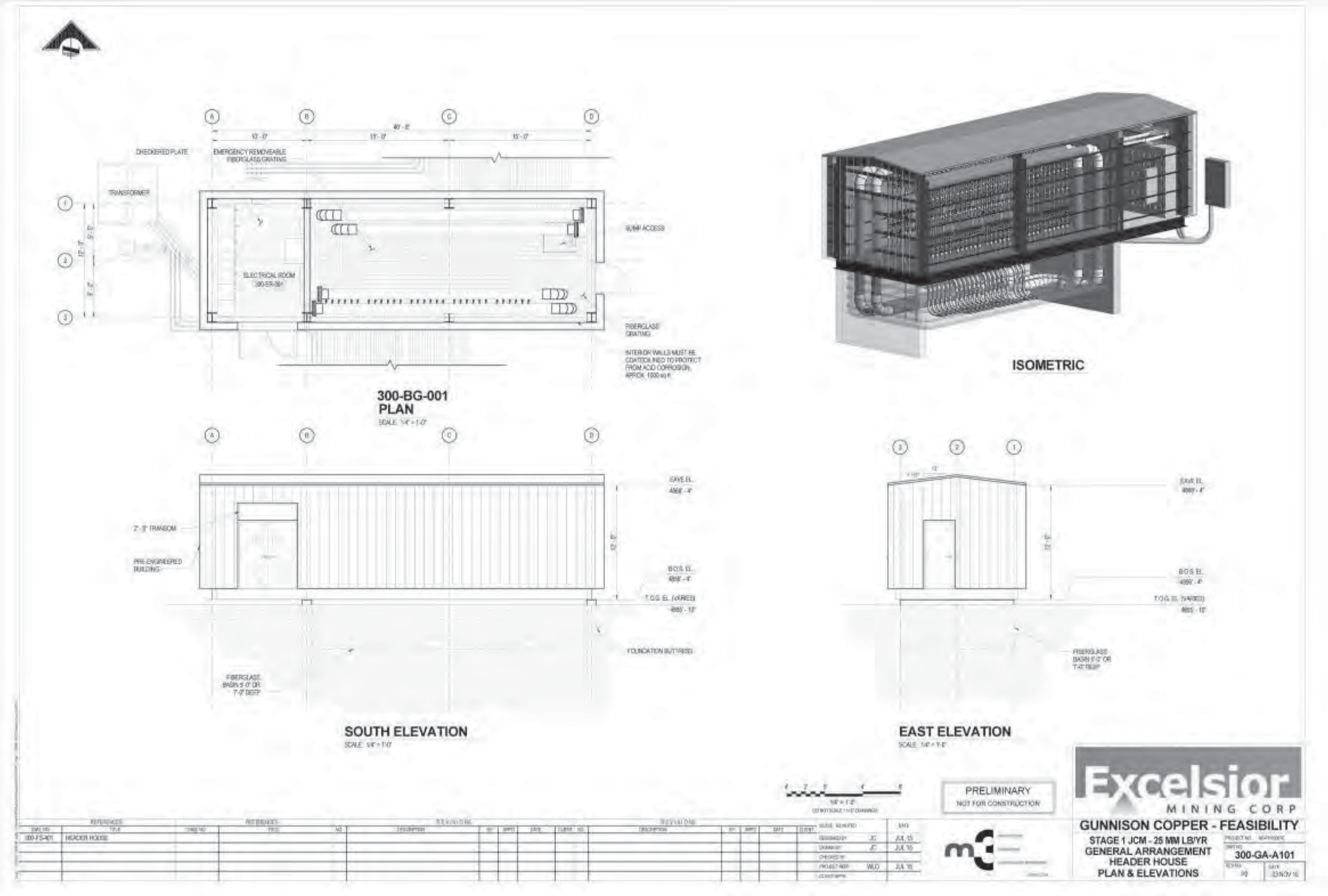

Figure 17-2: Header House Plan and Elevations

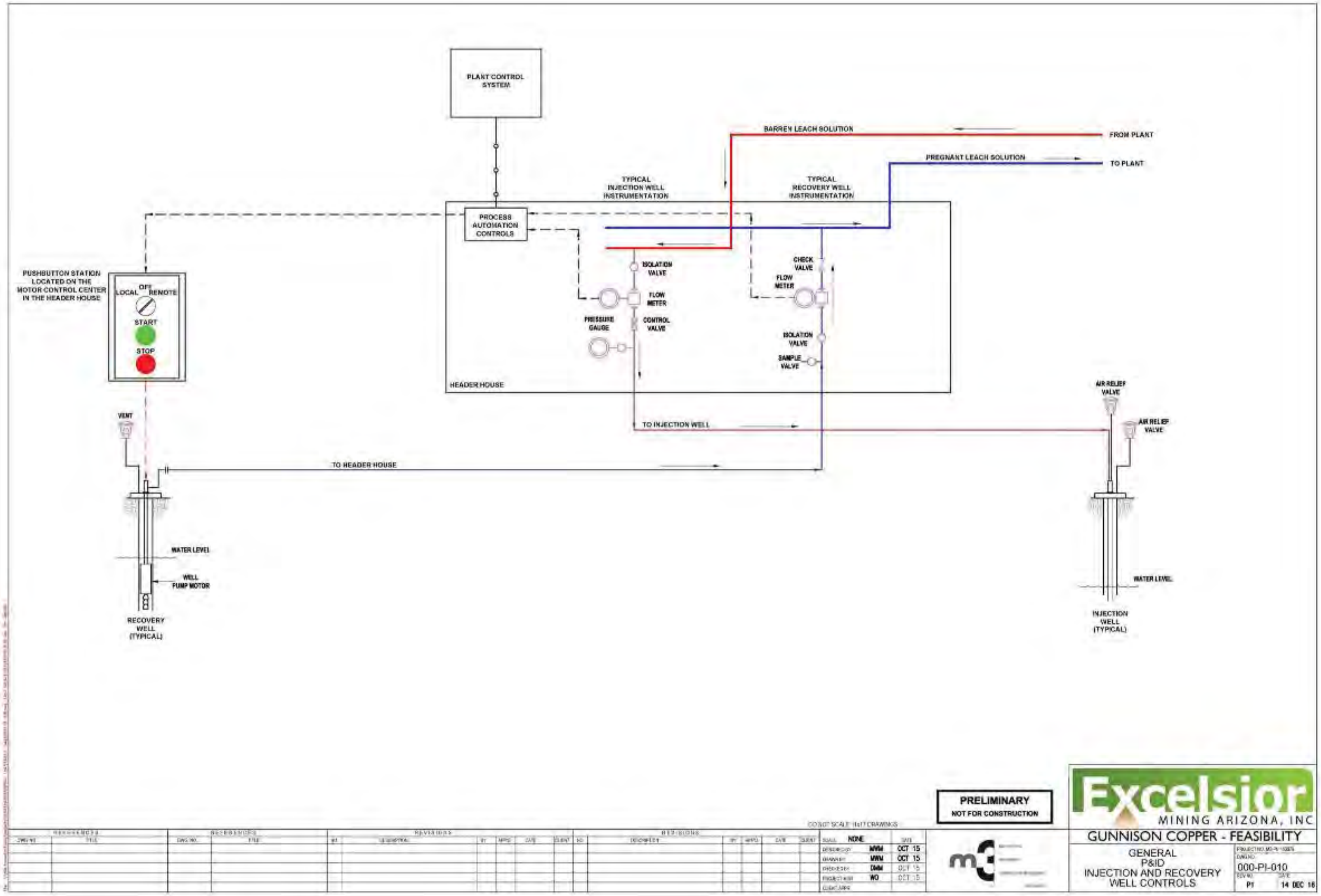

Figure 17-3: Injection and Recovery Well Controls

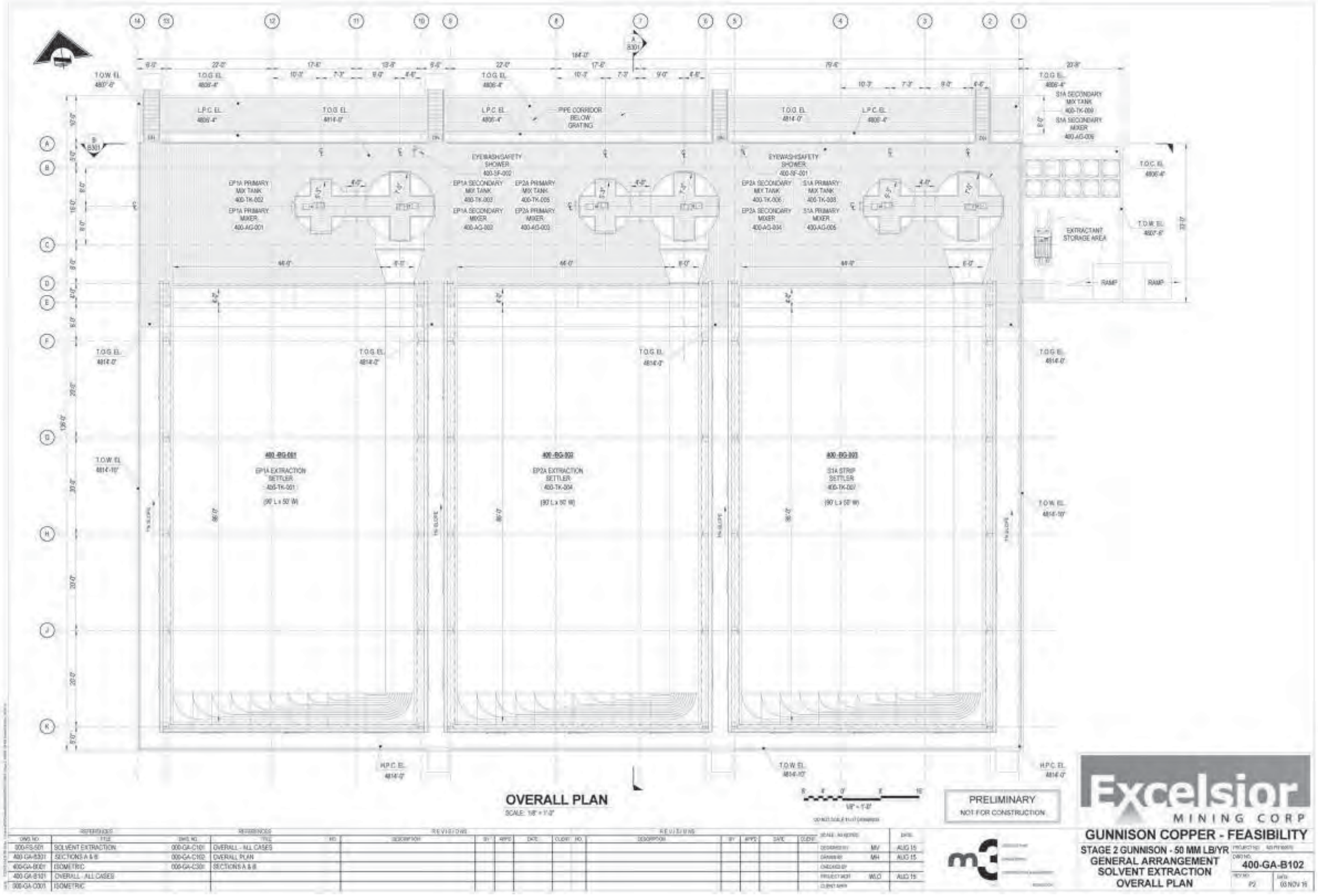

Figure 17-4: Solvent Extraction General Arrangement

Stripped organic is sent to the extraction pumper mixers where agitated contact between the organic and PLS solutions promotes adsorption of the copper by the extractant in the organic phase. The extraction settlers allow the immiscible liquids to separate in laminar flow so that the aqueous solution (raffinate) and organic solution can be collected in separate launders at the end of the settler. Raffinate is re-acidified in the aqueous launder of the second extraction settler and flows by gravity to the Raffinate Pond. The partially loaded organic from the second extraction settler flows to the pumper mixers of the first extraction settler and adsorbs copper from the other half of the PLS stream. Fully loaded organic from the first extraction settler flows to the Loaded Organic Tank. The SX process is designed to extract 92% of the copper contained within the PLS at an incoming copper grade of 1.63 grams per liter (g/L).

17.1.3 Electrowinning

Removing copper from the rich electrolyte solution is accomplished by electrowinning and takes place in the Electrowinning Building or “Tankhouse” (Figure 17-5). Rich electrolyte solution advanced from the solvent extraction area flows by gravity to the Electrolyte Filter Feed Tank. Electrolyte is pumped from this tank through two electrolyte filters to remove entrained organic emulsion and particulates from electrolyte prior to electrowinning. The filters are backwashed periodically with water (or lean electrolyte solution) and air from an air scour blower. In Stage 1, filter backwash solution flows by gravity to the JCM Raffinate Pond. In the Stage 2 and 3 plant, the filters are backwashed with lean electrolyte and the backwash solution is pumped to the PLS Pond.

Filtered electrolyte solution is pumped to an electrolyte recirculation tank through the electrolyte heat exchangers. The filtered rich electrolyte flows through one heat exchanger and is warmed by lean electrolyte returning to solvent extraction from electrowinning. Rich electrolyte is heated in the trim heater, when required, with supplemental heat from a hot water heating system, to the final temperature for electrowinning. When supplemental heat is not required, lean electrolyte flows through the trim heater, countercurrent to the flow of rich electrolyte being heated.

Heated electrolyte solution enters an electrolyte recirculation tank, and is mixed with electrolyte solution flowing in from the Lean Electrolyte Tank, in Stage 1 and the lean electrolyte portion of the tank in Stages 2 and 3. The electrolyte solution exits the EW cells and flows by gravity to the Lean Electrolyte Tank (Stage 1) or the lean side of the Electrolyte Recirculation Tank (Stages 2 and 3), which are equipped with pumps for sending electrolyte to the SX stripping circuits. Excess lean electrolyte is mixed with rich electrolyte for feeding the electrowinning cells.

Copper is plated onto stainless steel cathode blanks in the EW cells. The copper cathodes are harvested on a weekly basis. The tankhouse has an overhead bridge crane for transporting cathodes (and anodes) to and from the cells using a cathode (anode) lifting strongback. Harvested cathodes are washed in the Cathode Wash Tanks using circulation pumps. Washed cathodes are removed from the stainless steel blanks, sampled, weighed and banded using a semi-automatic stripping machine. Copper produced by this process is LME Grade A for sale on the world market in 2 to 3 ton packages.

17.1.4 Tank Farm

The tank farm (Figure 17-6) for each plant contains tanks, pumps, and filters for handling solutions needed for the SX-EW process. The primary process function of the tank farm is storage and transfer of solutions. There are two process functions that take place in the tank farm: electrolyte filtration and crud treatment.

Electrolyte filters in the tank farm remove impurities from the rich electrolyte returning from SX to prevent contamination of the tankhouse and electrolyte system. Rich electrolyte flows by gravity to the Electrolyte Filter Feed Tank and is pumped through one or more anthracite-garnet filters to remove entrained organic and particulates that could interfere with the electrowinning process. Filtered rich electrolyte flows to the Electrolyte Recirculation Tank. The filters are periodically backwashed to remove impurities and maintain design flow rates through the filter media.

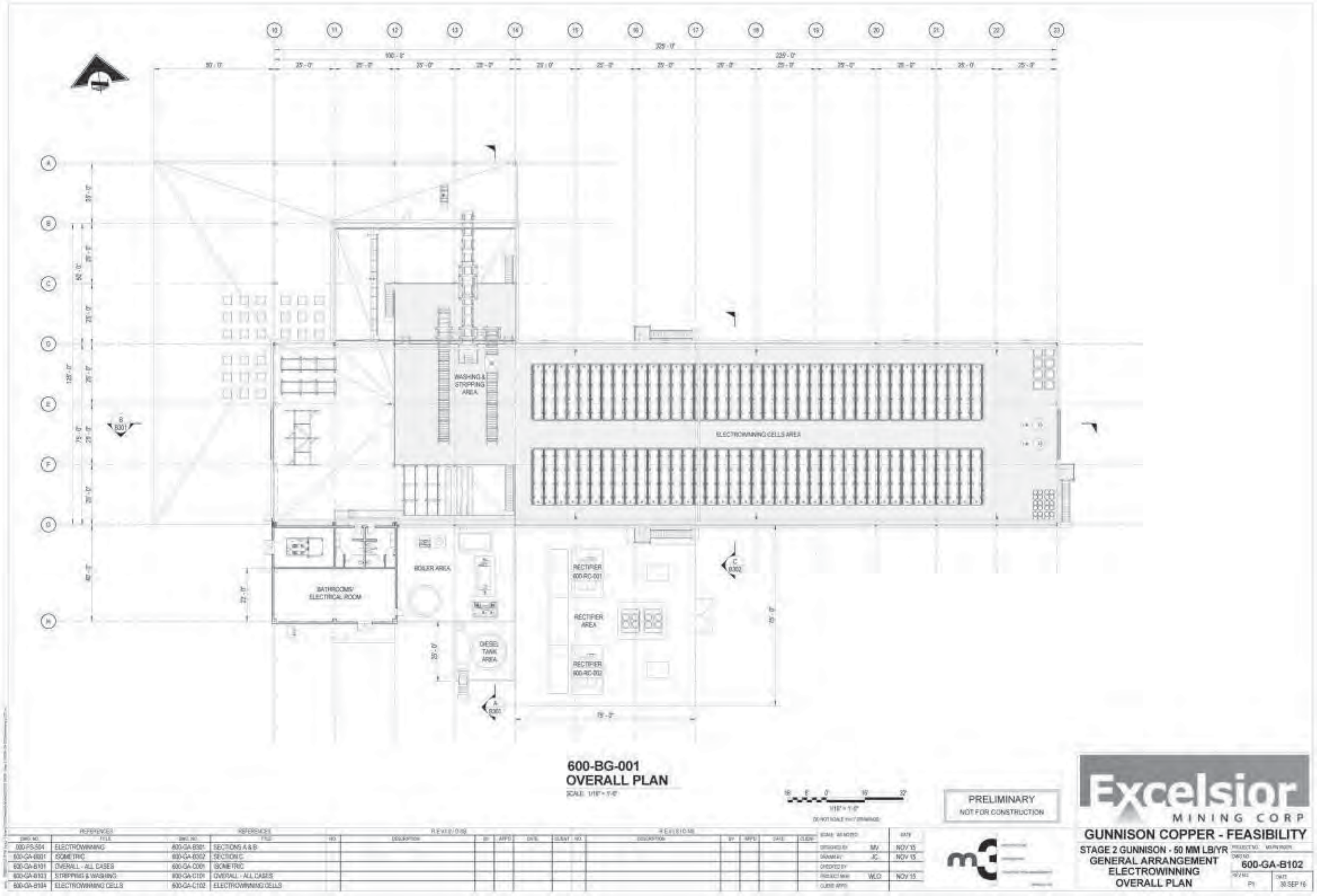

Figure 17-5: Electrowinning Overall Plan

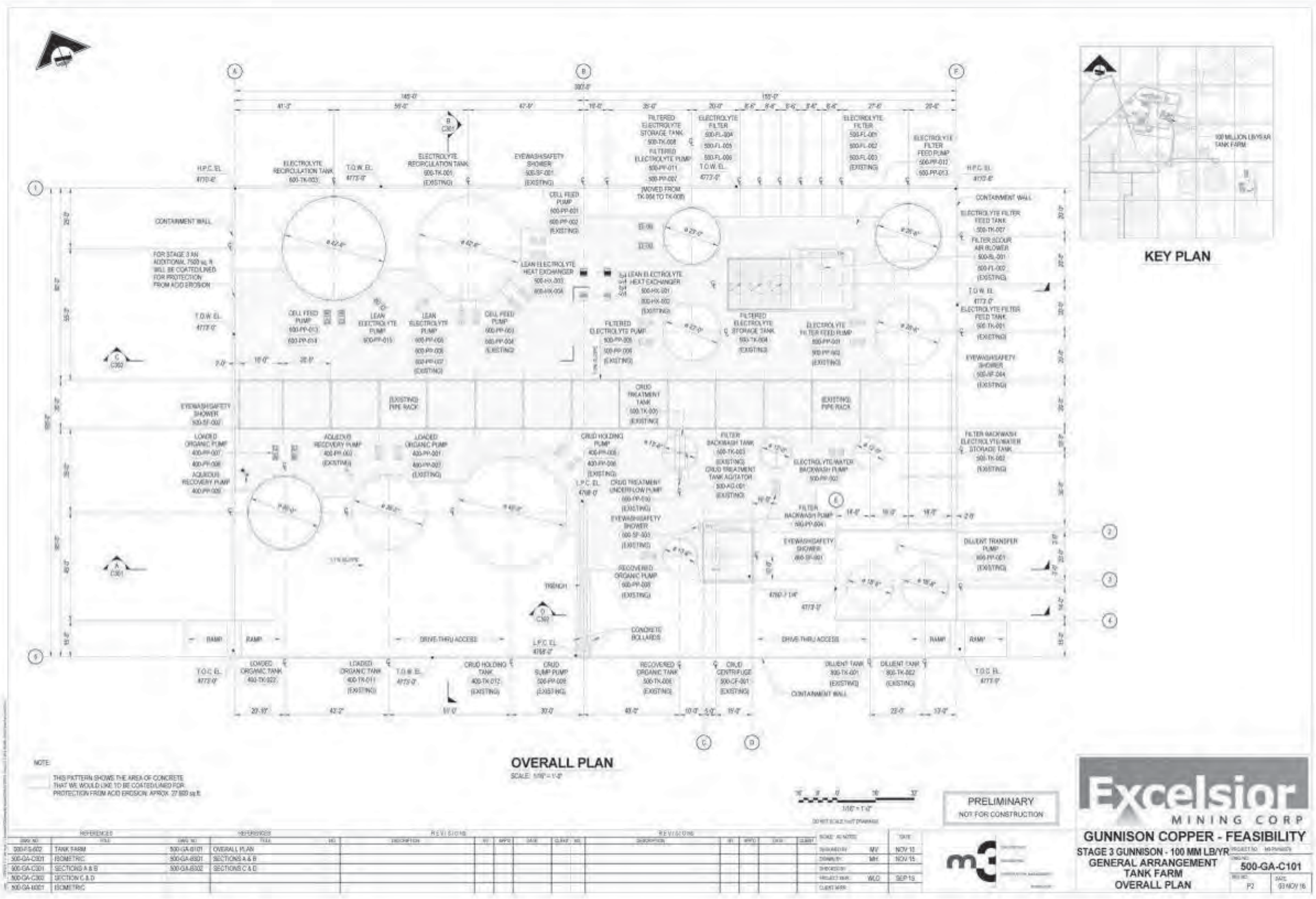

Figure 17-6: Tank Farm Overall Plan

Crud is the mixture of solids, organic liquid, and aqueous solution that accumulates at the organic/aqueous interface in the settlers or any mixture of aqueous and organic liquids that requires separation. Crud is removed by suction from the settlers and needs to be treated to separate the three phases for reuse in the process or, in the case of the solids, for disposal. Crud also comes from the mixture of aqueous, organic, and solids that accumulates in the electrolyte filters. The crud treatment system consists of the following major equipment.

- Crud Holding Tank
- Crud Treatment Tank
- Crud Centrifuge (Tricanter)
- Recovered Organic Tank

Crud from the Crud Holding Tank will be pumped to the Crud Treatment Tank, an agitated, cone-bottom tank. Amendments including clay and diatomaceous earth can be added to the Crud Treatment Tank to assist in separation of the phases. The Crud Centrifuge is a horizontal-axis centrifuge that separates the crud into its three component phases, allowing aqueous and organic liquids to be returned to the process. Solids are collected in a container for offsite disposal.

17.1.5 Rinsing

The mineralized formation becomes depleted of its leachable copper in approximately four years. The formation is then rinsed using the same injection and recovery wells that were used during leaching. Clean water from water supply wells or permeate from the water treatment plant (Sec. 17.1.6) is injected to flush out the remaining leach solution and reduce the concentrations of dissolved solids in the formation. Rinse water (rinsate) from the recovery wells is directed to the PLS pond, if it contains recoverable copper; the evaporation pond, if water treatment is not available, or the water treatment plant (WTP) after it is constructed at the Gunnison plant site in Year 7.

17.1.6 Water Treatment

The WTP is designed to provide treatment for mine-influenced water (MIW) comprising wellfield conditioning and rinse water return from the ISR wellfield, raffinate bleed, and impacted hydraulic control water (Sec. 17.2.4). The main treatment process includes high density lime neutralization, particulate filtration, conditioning, and membrane filtration for removal of dissolved solids. Treated water (permeate) from the WTP is utilized for wellfield rinsing and may also be used for reagent makeup water and other freshwater demands.

The WTP produces the following primary effluent streams.

- Treated water (permeate) delivered to the Clean Water Pond
- Brine water delivered to Evaporation Pond #1
- Metals and sulfate precipitation solids delivered in a slurry to the solids impoundments

The lime neutralization process consists of reaction of the influent flow with lime (calcium hydroxide), forming metal hydroxides and gypsum (calcium sulfate) as solids. Neutralization incorporates a significant solids recycle from the clarifier underflow for preconditioning with lime in order to maximize lime utilization and increase the size and density of precipitated solids.

Solids are separated from the treated flow through use of a clarifier following the initial reaction with lime. Clarifier underflow consisting of metal hydroxide precipitates and gypsum is pumped to a solids thickener. The clarifier overflow is conditioned and routed through a coagulation clarifier, multimedia filter, and cartridge filtration system for removal of suspended solids.

The conditioned, filtered flow is pumped through a membrane filtration system to reduce the concentrations of dissolved solids. The water that passes through the membrane (permeate) is pumped to the Clean Water Pond for reuse in formation rinsing. Approximately 80% of the WTP influent is expected to be recovered in the permeate. The reject from membrane filtration is subjected to desaturation, to remove more dissolved solids, and additional solids separation. Most of the overflow from this process is recycled back to the lime neutralization reaction tank, but a portion of the overflow ('blowdown") is sent to the evaporation pond to prevent buildup of sodium, chloride, and other dissolved solids in the process.

All of the solids from the various clarifiers, filters, and settlers report to a solids thickener. The underflow from this thickener is designed to be 10 to 20% solids and is pumped to a solids impoundment for dewatering and final solids disposal. The overflow from the solids thickener is pumped to the lime neutralization reaction tank. Water drained from the solids impoundment or pumped from the supernatant pool in the impoundment is returned to the WTP as influent.

17.1.7 Evaporation

The Gunnison Project is designed as a "zero-discharge" facility. All excess process solutions and mine-impacted waters will be sent to Evaporation Pond #1. A double-lined evaporation pond with leak collection and removal system (LCRS) is used to contain and evaporate excess water. The pond is equipped with shore-mounted, ducted-fan type mechanical evaporator units, installed around the edge of the pond in positions commonly upwind from the pond. Water is pumped at high pressure through the spray head and blown with a fan out across the pond.

The sprayers will automatically shut off when adverse wind directions and/or wind velocity exceeds a level that may result in overspray. Mechanical evaporators will be supplied solution from floating submersible pumps to allow sediments to settle on the pond bottom and minimize interference with and clogging of the sprayers. After operations have ceased, the liquids will be evaporated and the remaining solids will be covered, graded to shed surface water, and revegetated so that evapotranspiration exceeds annual precipitation infiltration.

17.1.8 Solids Dewatering

Solids produced by the WTP from neutralization, coagulation, and settling are pumped to solids impoundments for containment, dewatering, and solidification. Solids slurry is discharged into the impoundment at a slurry density of 10 to 20 percent by weight. Each impoundment is designed to include an LCRS, underdrain, and decant systems to manage clarifier underflow from the WTP, allow dewatering of the solids, and recirculate water back into the WTP. The impoundments are designed with an HDPE-lined berm in the middle separating it into two compartments for management of solids and liquids. One compartment can be "rested" and permitted to settle and densify while the underflow is directed to the other compartment. Moisture drains from the slurry as it densifies and is collected in the underdrain pipes, or forms a supernatant pool on top of the solids that is pumped to associated seepage ponds. Water is then pumped from the seepage pond and is recycled back into the WTP. Solids are expected to drain to an ultimate density of 50% by weight. All solids impoundments are expected to be closed in place by covering the dried solids with clean topsoil, grading the area to drain surface water, and revegetating the surface so that evapotranspiration losses exceed annual precipitation infiltration.

17.1.9 Sulfuric Acid Plant

Producing sulfuric acid (H_2SO_4) onsite for the leaching requirements is an optional addition to the Gunnison plant that is planned for Stage 3. Sulfuric acid generation uses molten sulfur to make sulfuric acid through the process of oxidation, which produces heat. Waste heat from the acid making process produces steam as a by-product to generate electrical power, which reduces operating costs. Facilities required for onsite acid generation include molten sulfur rail unloading and storage facilities, sulfur burning and steam generation plant, acid absorption area, steam turbine generation plant, water treatment plant, acid storage tanks, and cooling towers (see Figure 17-7).

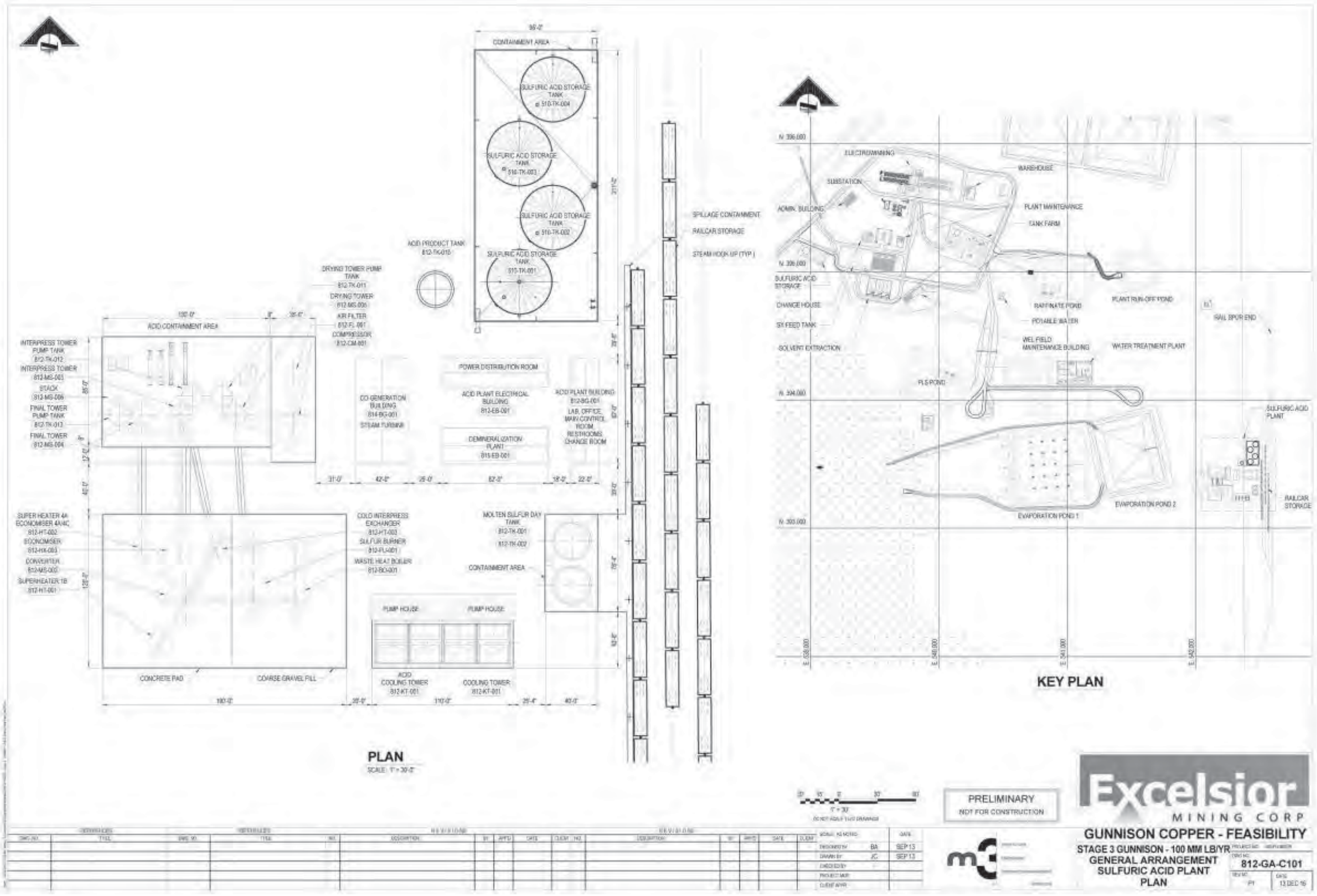

Figure 17-7: Sulfuric Acid Plant

The proposed acid plant is a double-contact double-absorption acid plant which provides the highest conversion rate and lowest emission of sulfur dioxide (SO_2), less than 500 ppm by volume. The sulfur-burning sulfuric acid plant is sized for 1,625 tons per day (100% H_2SO_4), with the product acid strength of 98.5% H_2SO_4. Allowing for 10 days down time each year for maintenance, the acid plant operates at an average of 80% capacity for the first 20 years. In seven of those years, the demand is projected to be greater than 100% of capacity.

The process to make concentrated sulfuric acid from molten sulfur is a multi-step process that generates a great deal of heat that can be used to generate electrical power. Molten sulfur is burned to produce sulfur dioxide (SO_2), which is converted to sulfur trioxide (SO_3) catalytically. SO_3 is hydrated in absorption towers to produce concentrated H_2SO_4. Burning sulfur, catalytic conversion to SO_3, and hydration to H_2SO_4 all produce considerable heat. Some of that heat is captured to make high-pressure steam for electrical power generation. Low-pressure steam is used for sulfur heating among other uses. Cooling towers are necessary to dissipate waste heat from the processes.

Molten sulfur is received at the plant in rail tank cars with a payload capacity of approximately 100 tons. The rail cars must be heated by steam to liquefy the sulfur since heat loss in the car during transit solidifies some of the sulfur. When re-heated, the molten sulfur is discharged to a receiving pit and pumped into heated storage tanks. A heated pump tank is provided at the rail unloading siding and heated storage tanks located at the nearby acid plant.

Molten sulfur is pumped from the storage tanks to the sulfur furnace where it is mixed with high pressure air to atomize the sulfur and dry combustion air to burn the sulfur. A bleed stream of sulfur is recirculated back to the sulfur storage tanks to ensure a consistent feed of sulfur to the sulfur burners. Excess air is provided at the burners to ensure complete combustion and sufficient excess oxygen in the off-gas for the conversion of SO_2 to SO_3 in the acid plant.

The combustion air for the sulfur furnace is dried to remove any moisture in the air prior to combustion to prevent corrosion in the downstream equipment. Air is drawn in from the atmosphere by the Main Blower through the Air Filter and the Drying Tower. In the drying tower, moisture is removed from the air through absorption in sulfuric acid. The main blower must be capable of providing the stoichiometric oxygen requirements of the plant with sufficient excess oxygen, typically 5.5% oxygen at the tail gas stack, and must overcome the flow resistance of the plant.

The air leaving the drying tower is delivered to the Sulfur Burner, where liquid sulfur is injected through pressure atomizing nozzles. Under design conditions, the air flow and sulfur flow are adjusted to result in a burner temperature of 1,075ºC. The combustion process in the sulfur burner produces off-gas with about 11% $SO_{2.}$ Energy is recovered from the hot SO_2 gas in the Waste Heat Boiler by raising steam.

SO_2 in the off-gas is catalytically converted to SO_3 in a four-bed converter with vanadium pentoxide as the catalyst. The reaction is exothermic and increases the temperature of the gas. The SO_2 gas temperature going to the Converter is controlled at 420ºC through a boiler gas by-pass duct. Temperature control of the gas at the inlet to the catalyst beds is critical because the SO_2 conversion occurs within a limited temperature range.

- Hot gas leaving catalyst Bed 1 is cooled in the Superheater to the required inlet temperature of catalyst Bed 2.
- Gas leaving Bed 2 is cooled in the Hot Interpass Exchanger to the required inlet temperature of Bed 3.
- Hot SO_3 gas leaving Bed 3 is cooled in the Cold Interpass Exchanger and the Economizer before reaching the Interpass Tower.
- SO_3 gas is absorbed into strong acid in the Interpass Tower.
- Cold lean SO_2 gas from the Interpass Tower is reheated in two gas heat exchangers operating in series before entering converter Bed 4.

- The weak SO_3 gas leaving Bed 4 is cooled in Superheater 1A and Economizers 4A/4C before reaching the Final Tower and from there is discharged from the Tailgas Stack.

Mass transfer from the gas phase to the acid phase takes place in the Absorption Towers. All acid towers have an acid distributor designed to spread acid uniformly over the tower cross-section packing to promote gas to liquid mass transfer, mist-eliminators on top outlet to capture entrained acid mist and spray, and a screen in the acid outlet to capture packing chips. The acid circulates in a closed loop in all towers, starting from a pump tank with an acid cooler provided in the loop. The acid circulation rate through the towers is typically between 10 to 20 times that of the acid production rate. Sufficient acid is circulated to wet the packing and to limit the temperature rise of the acid due to the heat of dilution and reaction.

- In the Drying Tower, moisture in the air transfers to the acid thereby diluting the acid.
- In the Interpass and Final Towers, the SO_3 gas transfers to the acid phase.

In cold climates, typically two grades of acid are produced, 93% H_2SO_4 in winter and 98.5% H_2SO_4 in summer. The stronger acid freezes at +5 °C while the weaker acid freezes at -34 °C. To make 98.5% acid, a split stream of acid from the Interpass Tower circulation is sent to the Final Tower, where it produces 98.5% acid, which is sent to storage. A second split stream of acid from the Interpass Tower circulation is sent to the Drying Tower to absorb moisture from the air. A corresponding stream of diluted acid at 93% is returned from the Drying Tower. To make 93% acid, a split stream of the 93% acid circulation returning from the Drying Tower is taken to storage.

Steam produced in the Waste Heat Boiler from cooling the sulfur burner is superheated and used to create electrical power in the steam turbine generator (STG). Steam production is proportional to the acid production: approximately 1.25 tons of steam per ton of acid. The Start-up/Emergency Boiler creates low-pressure steam needed to start up the sulfur burner and provide low-pressure steam when the process is down. Some low pressure steam is extracted from the STG and used in the deaerator and molten sulfur heating system during the acid-making process. Condensate from the STG system is collected and polished (treated) to be reused as waste heat boiler feed water.

Boiler feed water is received in a deaerator, where oxygen is stripped by low pressure steam. Two boiler feed water pumps are provided, one motor driven and one steam turbine driven. The boiler feed water is heated in Economizers and Interpass Heat Exchangers. The heated water then goes to the Waste Heat Boiler to maintain inventory.

The Acid Plant Cooling Tower provides cooling water for heat regulation in the acid section of the plant. The Drying Tower, Interpass Tower, Final Tower, and Product Acid Coolers are heat exchangers that operate in parallel to control process temperatures. A cooler in the main blower lubrication system also uses cooling water supplied from the Acid Plant Cooling Tower.

17.1.10 Reagents

There are several reagents required for the SX-EW process. Diluent provides a petroleum liquid base for the extractant used as the organic phase of SX. The Diluent Tank stores makeup liquid to compensate for evaporative and process loss of organic. Sulfuric acid storage tanks are provided to store approximately 14 days of the acid supply required for leaching and making the electrolyte for the EW process. Concentrated sulfuric acid is delivered by tanker trucks or produced in the acid plant (Section 17.1.9). Other reagents include extractant, the active ingredient in the organic phase that transfers copper from PLS to electrolyte; cobalt sulfate, an additive to the electrolyte to improve plating; guar, a cathode smoothing agent; and mist suppressor, a chemical added to the electrolyte to inhibit the formation of acid mist in the tankhouse.

17.2 SUPPORTING SYSTEMS

There are several systems that are necessary to support the SX-EW operation. These include systems to contain solutions, convey solutions, provide water, control the process, suppress fires, and ensure that mine-influenced solutions in the subsurface do not migrate offsite.

17.2.1 Central Piping and Power Corridor

The ISR wellfield is managed using header houses that each serve a block of injection and recovery wells. Header houses are connected to the processing plant through a central piping corridor (Figure 17-8). The corridor contains the large-diameter piping necessary to convey solutions to and from the header houses in operation at any given time. Buried lateral header pipes connect the header house to the above-ground main header piping through multiple valved connections that enable operators to direct solutions to various process ponds and tanks over the operating life of the project.

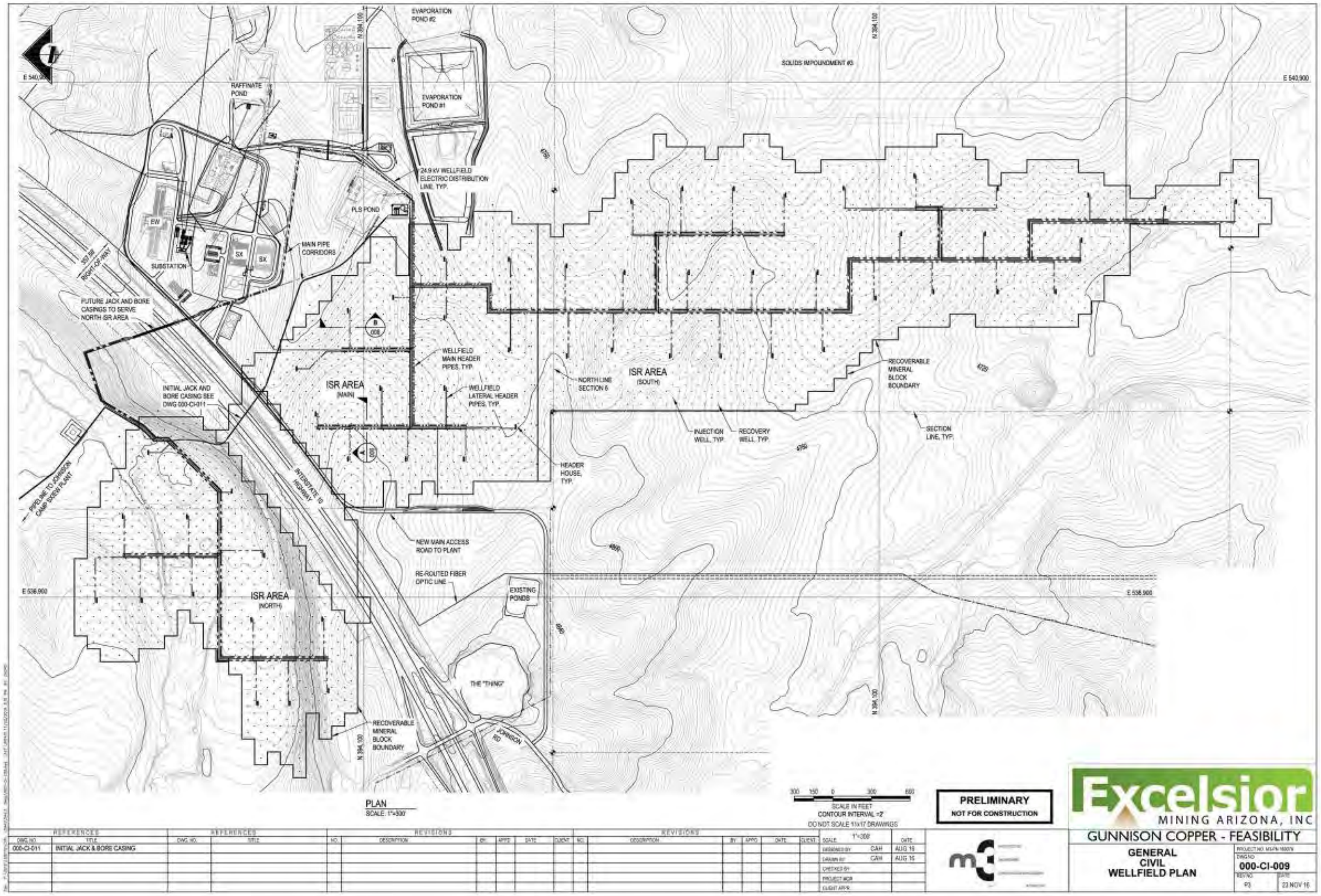

Figure 17-8: Civil Wellfield Plan

Power and communications will be delivered to the header house via buried cables from pole-mounted powerlines and fiber-optic cables in the central corridor. A pad-mounted transformer near each header house will drop the voltage to 480 volt, 3 phase current to provide power to the recovery pumps, to operate controls in the header house, and to air condition the electrical room.

17.2.2 Process Control and Monitoring

The operational data from instrumentation in the header houses is transmitted via fiber-optic cables to the control room in the EW building where it is monitored by a computerized plant control system (PCS). Communication between the PCS and the main control enclosures is by fiber-optic cable. The operator in the control room uses the PCS to monitor conditions at each well and communicates any abnormal conditions to the wellfield operators. The control room operator has the ability to turn off pumps from the control room, but restarting pumps, adjusting flow conditions, and monitoring line pressures is reserved for the wellfield operators.

The PCS is also equipped with data loggers to record information from the instruments at each well to enable the operator to examine trends, calculate local and cumulative flows, set alarm conditions, and maintain production records. The PCS provides trending, historical and alarm data for level sensors, flow meters, and any other instrumentation required in this system. Alarms are triggered when monitored parameters are out of limits set by the operator. Alarms will also be generated when there is a communications fault, equipment or instrument failure, or a process that is out of control limits.

17.2.3 Process Ponds

Process ponds are used to store and handle the various liquids and liquid-solid mixtures that are involved in the SX-EW process. PLS ponds collect copper-bearing solutions from the ISR wellfield, allow particulates to settle, and provide a source for feeding the SX plant. Raffinate ponds collect the solution from which copper has been removed (raffinate) and provide a source of acidified solution for leaching to the ISR wellfield. These ponds are managed so that they have a reserve of solutions to maintain SX-EW and ISR operations if one or the other is interrupted and surge capacity to contain the solutions if the other part of the operation is not operating. Both sets of ponds are equipped with pumps and piping to remove the stored solutions and deliver them to the necessary destination at the variable flows and adequate pressures.

Other ponds for the Gunnison Project include the Pipeline Drain Pond, Clean Water Pond, Recycled Water Pond, Evaporation Pond #1, Water Treatment Feed Pond, and solids impoundments. The Pipeline Drain Pond is situated at a low point between the Gunnison site and the JCM site that allows the contents of the pipelines between the facilities to be drained, if necessary, to perform maintenance or repair work. The Clean Water Pond is a reservoir of well water from the water supply system and water treated by the WTP for rinsing of blocks that have finished their useful leaching cycle. The Recycled Water Pond receives solutions from ISR recovery wells that contain copper below the grade suitable for feed to the SX plant. These solutions are acidified and returned to the ISR wellfield via the Raffinate Pond.

17.2.4 Hydraulic Control Wells

Hydraulic control wells are used at the margins of the ISR wellfield to ensure that groundwater impacted by the leaching process is contained within defined boundaries. Hydraulic control and observation wells are used to control the hydraulic gradient and ensure that the flow of groundwater is toward the ISR wellfield throughout its perimeter. Hydraulic control wells are positioned on the “downgradient” perimeter of the wellfield to cause a depression in the phreatic (water table) surface to “capture” any impacted groundwater. The hydraulic control wells ensure an inward hydraulic gradient i.e., groundwater movement is toward the operating wellfield. The hydraulic control wells are designed by location and extraction rate to capture PLS before it flows out of the permitted wellfield area.

Observation wells are located outside of the hydraulic control wells to demonstrate that the groundwater gradient (i.e., flow direction) is inward (i.e., toward the wellfield). Water levels are measured in pairs of observation wells, one near the hydraulic control wells and the other farther away in the direction of natural groundwater movement, to verify that the phreatic surface of the aquifer near the wells is at a lower elevation than that of the one farther away, indicating that the flow direction is toward the wellfield. If not, extraction (pumping) rates in the hydraulic control wells are increased until the flow direction is once again toward the wellfield.

Hydraulic control water pumped from these wells is directed into one of two collecting pipelines. One of the pipelines conveys hydraulic control water that is unimpacted by ISR operations to Evaporation Pond #1 (initially) or the Clean Water Pond where it can be used for wellfield rinsing. Hydraulic control water that is from wells that have been impacted by the ISR operations are conveyed to Evaporation Pond #1.

Additional hydraulic control and observation wells will be installed as necessary as the wellfield develops. Pumping rates will be increased at hydraulic control wells in response to observation wells in their vicinity that suggest the inward gradient is not being maintained. Groundwater sampling and analytical testing at observation wells will also be conducted on a regular basis to evaluate for any evidence that impacted groundwater is migrating past the hydraulic control perimeter.

18 PROJECT INFRASTRUCTURE

18.1 SITE LOCATION

The Gunnison Project is located in Cochise County, Arizona, on the southeastern flank of the Little Dragoon Mountains in the Johnson Camp Mining District. The property is about 65 miles east of Tucson, Arizona, along Interstate Highway 10 (I-10), between Benson, Arizona and Willcox, Arizona (Figure 18-1). Initial production from the Gunnison wellfield, Stage 1, will be processed in facilities at the Johnson Camp Mine (JCM) site north of the interstate. In Stage 2, processing and support facilities will be constructed south of the interstate and expanded in Stage 3. The Stage 2 and 3 process facilities are located east of the ISR well field and south of I-10 in Section 31, which is referred to as the Connie Johnson property.

18.2 ACCESS ROADS

The primary access to the site will be from I-10 via the North Johnson Road exit between Benson and Willcox, Arizona. The exit is at the location of “The Thing” attraction on the south side of I-10. Stage 1 processing facilities are located at the Johnson Camp Mine (JCM) site north of the interstate and the Gunnison Stage 2 and 3 processing facilities and initial wellfield are located south of the interstate. Eventually, the wellfield will extend to the north of the interstate, as well.

The JCM site is accessed from the North Johnson Road exit by traveling approximately ⅓ mile north. Keep right on North Johnson/Seven Dash Road for another ⅔ mile to the JCM main entrance. The Stage 1 JCM plant area is approximately 1.6 miles from the main entrance. North Johnson Road and North Seven Dash Road are unpaved (Figure 18-2).

The Gunnison site will be accessed by a new gravel road which connects to Johnson Road south of “The Thing” attraction and runs along the south line of Section 36, (T15S, R22E) to the guard house. From the guard house, the access road will follow the east line of Section 36 and then continue along the I-10 right of way east across the well field and send branches off to the east-southeast to serve the various process and ancillary areas (Figure 18-2). The access road is approximately one mile long. North Johnson Road continues south approximately four miles to the town of Dragoon from the I-10 exit.

18.3 PROCESS BUILDINGS

The Stage 1 process facilities are present at the JCM plant site. Existing mixer-settlers, tank farm, and electrowinning building will be used to process copper-bearing solutions pumped up to JCM from the Gunnison wellfield (Figure 18-3).

Stages 2 and 3 of the project include the addition of process facilities on the Gunnison side consisting of solvent extraction mixer-settlers, a tank farm, and an electrowinning building (Figure 18-4). For Stage 2, the solvent extraction settlers consist of three, covered mixer-settler tanks (Figure 17-4), and the electrowinning building (tankhouse) consists of a steel building with metal roofing and siding. The Stage 2 electrowinning cell area is on one end of the building and the automatic stripping machine and the cathode handling equipment are on the other, with a paved cathode storage area outdoors (Figure 17-5). An electrical equipment room and a control room above are located near the cathode stripping area so that personnel in the control room can observe the entire operation. Cathode handling, weighing and banding is performed at the cathode handling section. Asphalt is provided outside the cathode handling area to allow cathode storage and loading of cathodes onto flatbed trailers for shipment to market. The building is provided with ventilation fans to circulate air in the cell area. The transformer-rectifiers which provide direct electrical current for electrowinning are located outside and upwind of the building to minimize impacts from mist and vapors evolved during electrowinning.

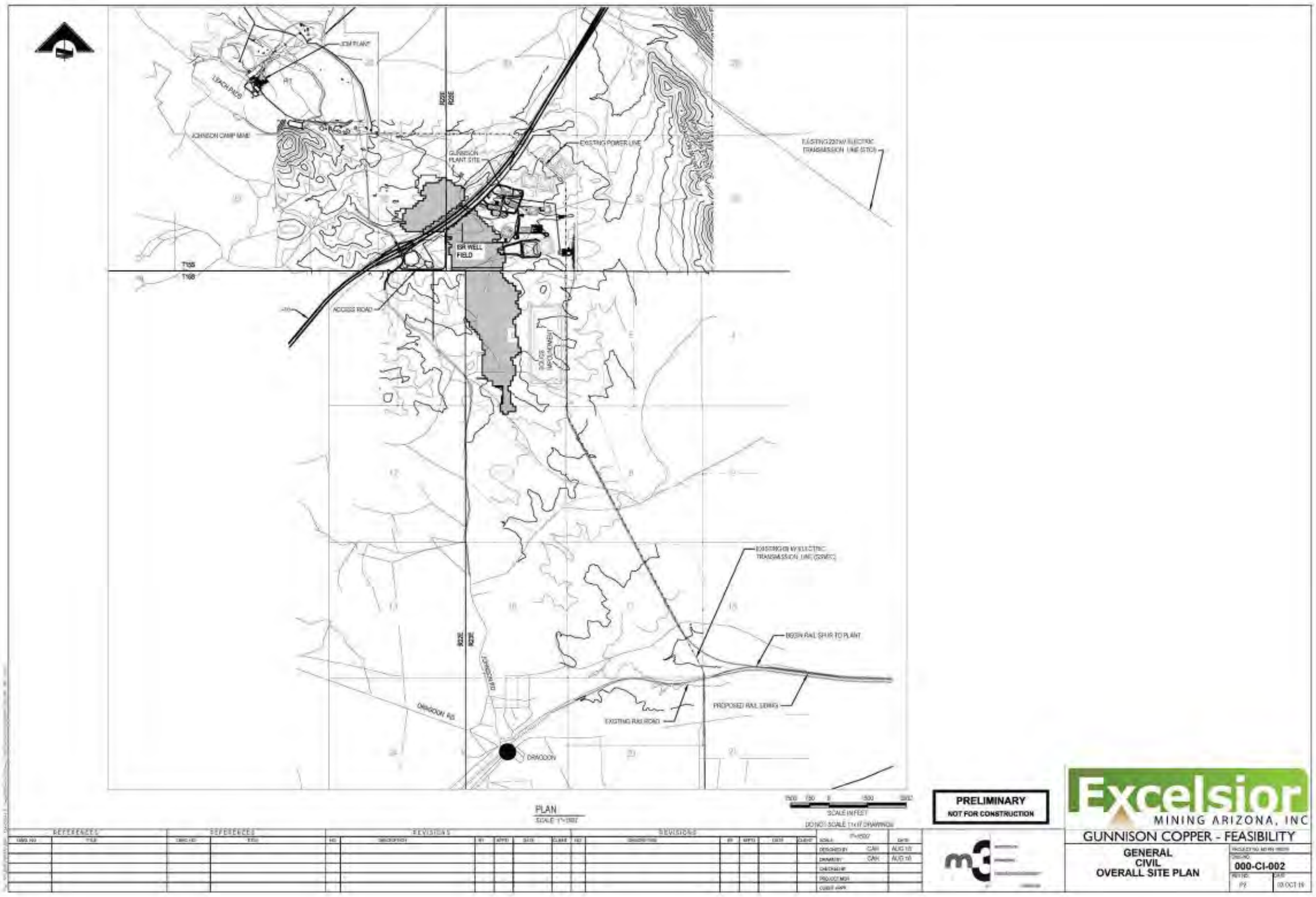

Figure 18-1: Overall Site Plan

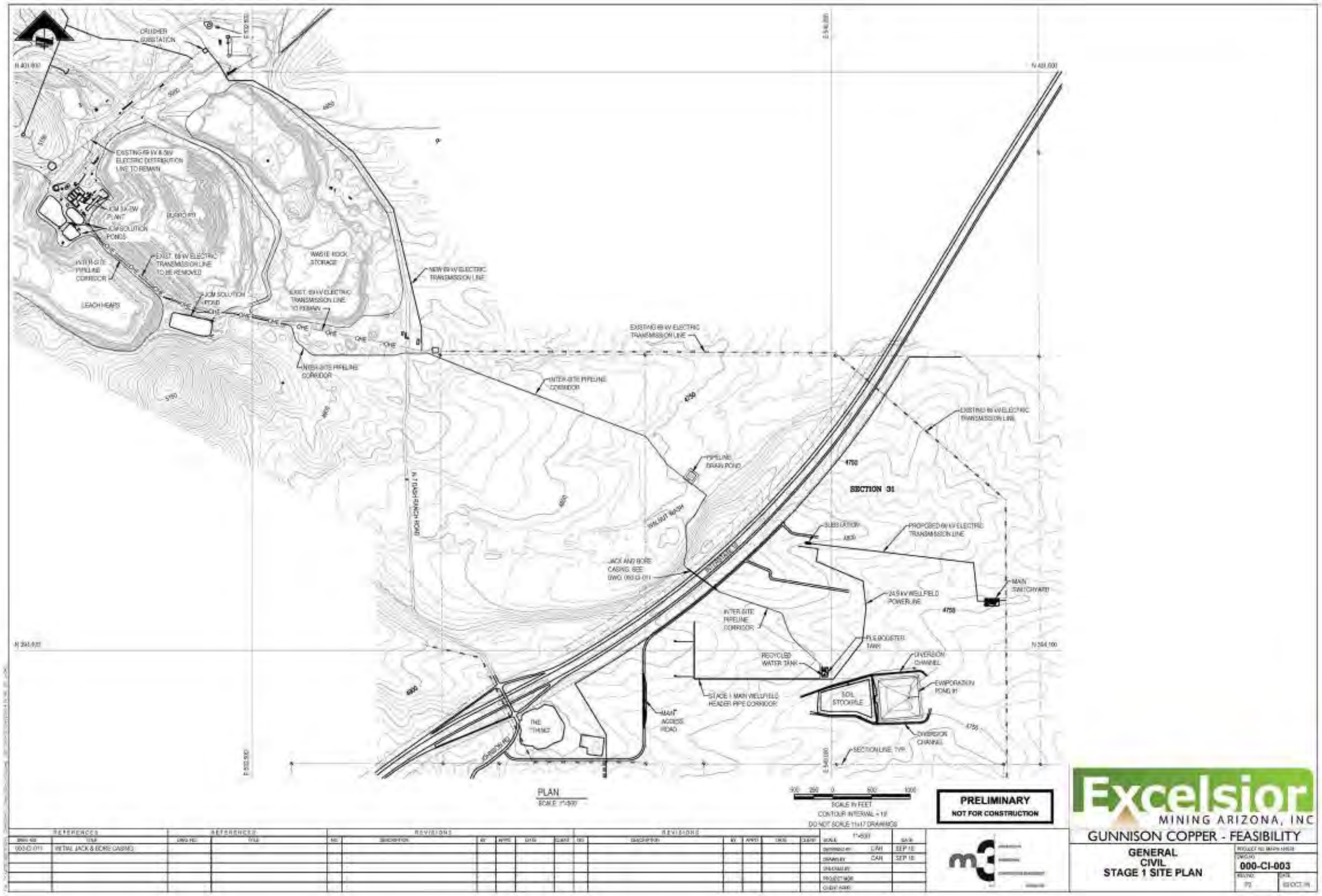

Figure 18-2: Stage 1 Facilities and Infrastructure

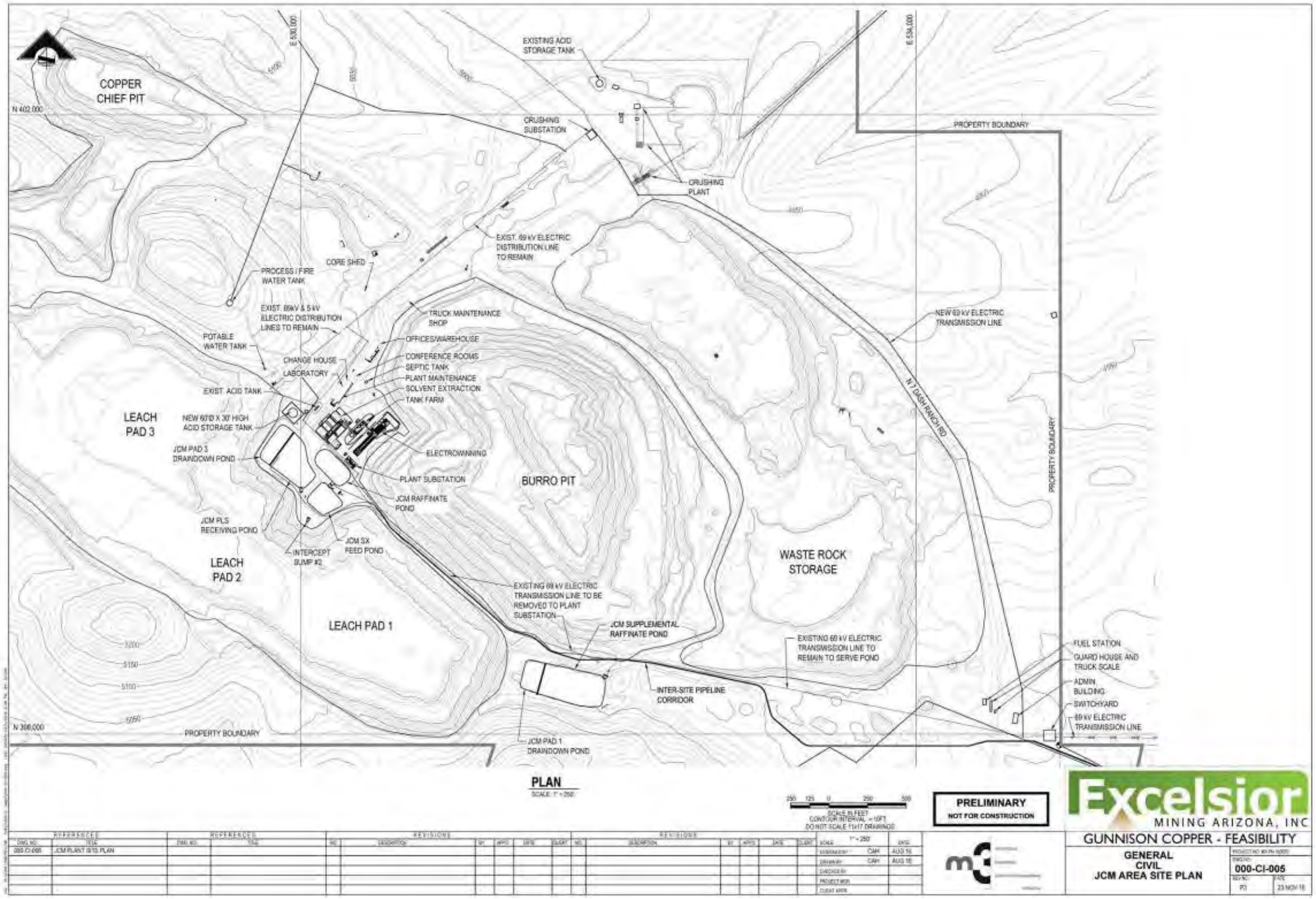

Figure 18-3: Johnson Camp Mine Facilities Arrangement

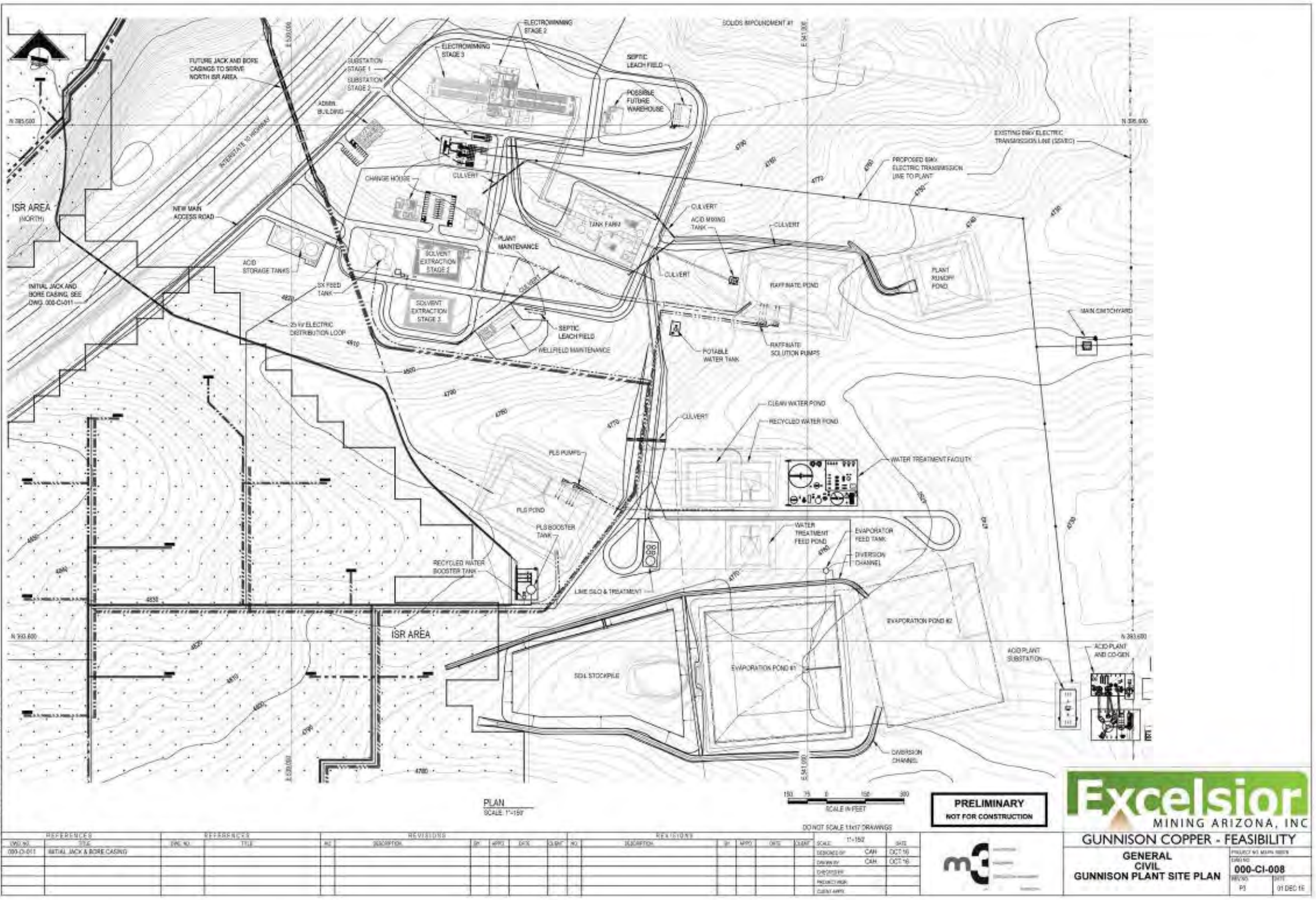

Figure 18-4: Site Plan of Stage 2 and 3 Facilities and Infrastructure

The Stage 2 tank farm is uncovered and located downhill from the mixer-settlers and the electrowinning building to facilitate gravity drainage of fluids to the tank farm. The tank farm contains tanks, pumps, filters, and heat exchangers involved in the handling of aqueous and organic solutions used in the process (Figure 17-6). The tank farm has a containment area that drains to a sump with an oil-water separator to return spilled liquid to the proper location for recycling. A drain line is also provided to drain the tank farm sump to the Raffinate Pond in case of a process upset during power outage.

For Stage 3 operation, a second train with three additional mixer-settlers is added to SX, additional tanks and electrolyte filters are added to the tank farm, and additional cells are added to the electrowinning building on the opposite side of the cathode handling area (Figure 18-4). The additional electrowinning cells will be served by a second electrowinning bridge crane, but will share the stripping machine and most of the other cathode handling infrastructure.

18.4 ANCILLARY FACILITIES

Ancillary buildings are needed to support the Gunnison Copper Project at both the JCM site and at the Gunnison site in Stages 2 and 3.

18.4.1 JCM Ancillaries

The ancillary buildings at the JCM site are existing buildings that may need minor modification to serve as intended for the Gunnison project. The administration building, guard house, weigh scale, and fuel station are located at the main gate (Figure 18-3). The former truck shop will be modified to act as a wellfield warehouse. The existing offices/warehouse building will be used as a warehouse for plant operations. The conference rooms will be used for operations and safety meetings. The change house, sample preparation area, laboratory, and plant maintenance areas will be modified as necessary to perform the same functions for operations at the JCM site.

18.4.2 Gunnison Ancillaries

Additional ancillary buildings will be constructed at the Gunnison site for Stage 2 and 3 operations (Figure 18-4). Ancillary buildings include a guard house, an administration building, change house, plant maintenance building, and wellfield maintenance building.

18.4.2.1 Guard House

The guard house is located near the main gate along the access road on the west side of the property. The guard house is a modular building which includes security office, training room, restroom, check-in area, and storage. The area also includes a scale to weight trucks entering and leaving the property.

18.4.2.2 Administration Complex

The administration complex includes the administration building, change house, and plant maintenance building, all located north of the SX facilities (Figure 18-4). The administration building is a single story pre-engineered steel building that includes offices for the administrative and supervisory personnel for the operation. The change house is a single-story, pre-engineered steel building for workers coming and going at shift change. The change house includes showers and locker rooms for men and women; meeting room; offices for safety and training personnel; exam, first aid, and nurse’s room; supply rooms; and records room. The plant maintenance building is a two-story, pre-engineered steel building for maintenance of equipment used in the SX-EW process. The first floor of the maintenance building includes working areas, tool cribs, instrument room, overhead crane, offices, and restrooms. The second story present at one end of the building includes offices and meeting rooms for planning and supervisory personnel.

18.4.2.3 Wellfield Maintenance Facilities

A wellfield maintenance building is located near the well field, northwest of the PLS Pond (Figure 18-4). The wellfield maintenance building is a single-story, pre-engineered steel building for maintenance of well field pumps, valves, and instrumentation, and analysis of samples and data collected during the installation of the wells associated with the ISR well field. This building will contain offices for wellfield maintenance supervisors, geologists, and hydrogeologists, storage space for wellfield pumps, motors, valves, controls, and instrumentation and the maintenance bays to work on them.

18.5 WATER TREATMENT PLANT

A water treatment plant is scheduled for construction in Year 7 of operation to treat water from the wellfield that has been used for rinsing the depleted mineralization. The plant is located between the Raffinate Pond and Evaporation Pond #1 (Figure 18-4) and consists of a building with tanks, reactors, filters, and ancillary equipment and an outdoor tank farm for the larger process tanks.

18.6 SULFURIC ACID PLANT

The sulfuric acid plant is scheduled for construction in Year 6 of operations. It will burn molten sulfur to make sulfuric acid for the leach operation and generate electrical power using the waste heat from the sulfur burning and acid making process. The sulfuric acid plant is located east of Evaporation Pond #1 along the railroad spur that runs along the eastern margin of the Project area (Figure 18-4). The facility includes molten sulfur day tanks, sulfur burner and waste-heat boiler, drying and adsorption tower area, cogeneration building, water treatment building, power distribution building and substation, cooling towers, office building, sulfuric acid storage area, and a rail yard for unloading molten sulfur and sulfuric acid (Figure 18-5).

18.7 PONDS AND IMPOUNDMENTS

Several lined ponds and impoundments are needed to contain liquids and solids that are not directly related to the SX-EW process. These ponds include a Water Treatment Feed Pond; Plant Runoff Pond to intercept potentially impacted surface drainage; Clean Water Pond and Recycled Water Pond that are associated with the wellfield rinsing and water treatment systems; Evaporation Pond #1 located southeast of the SX-EW area for evaporating excess solutions and reject brines from the water treatment plant; and solids impoundments to contain metal hydroxide and sulfate precipitates from the pH neutralization of wellfield rinse water (Figure 18-6).

18.8 RAIL ROAD FACILITIES

The Union Pacific main line railroad passes through the town of Dragoon, Arizona. A new rail siding will connect to the main line about 1 mile northeast of the town of Dragoon. A new rail spur will generally follow an existing power line alignment northwest to the plant site. The rail spur is about 4 miles long and terminates at the east side of the site near Evaporation Pond #1 (Figure 18-1). Sulfuric acid will be received during initial operations, replaced by molten sulfur shipments when the acid plant is constructed. The rail loading facility near the plant consists of three sidings in addition to the spur line to accommodate up to 25 cars each: one for unloading, one for empties, and one for switching. The new siding (drop-pull track) will consist of three tracks and will be of sufficient length to accommodate an 80-car unit train. It is assumed that the Union Pacific will service the property from Dragoon.

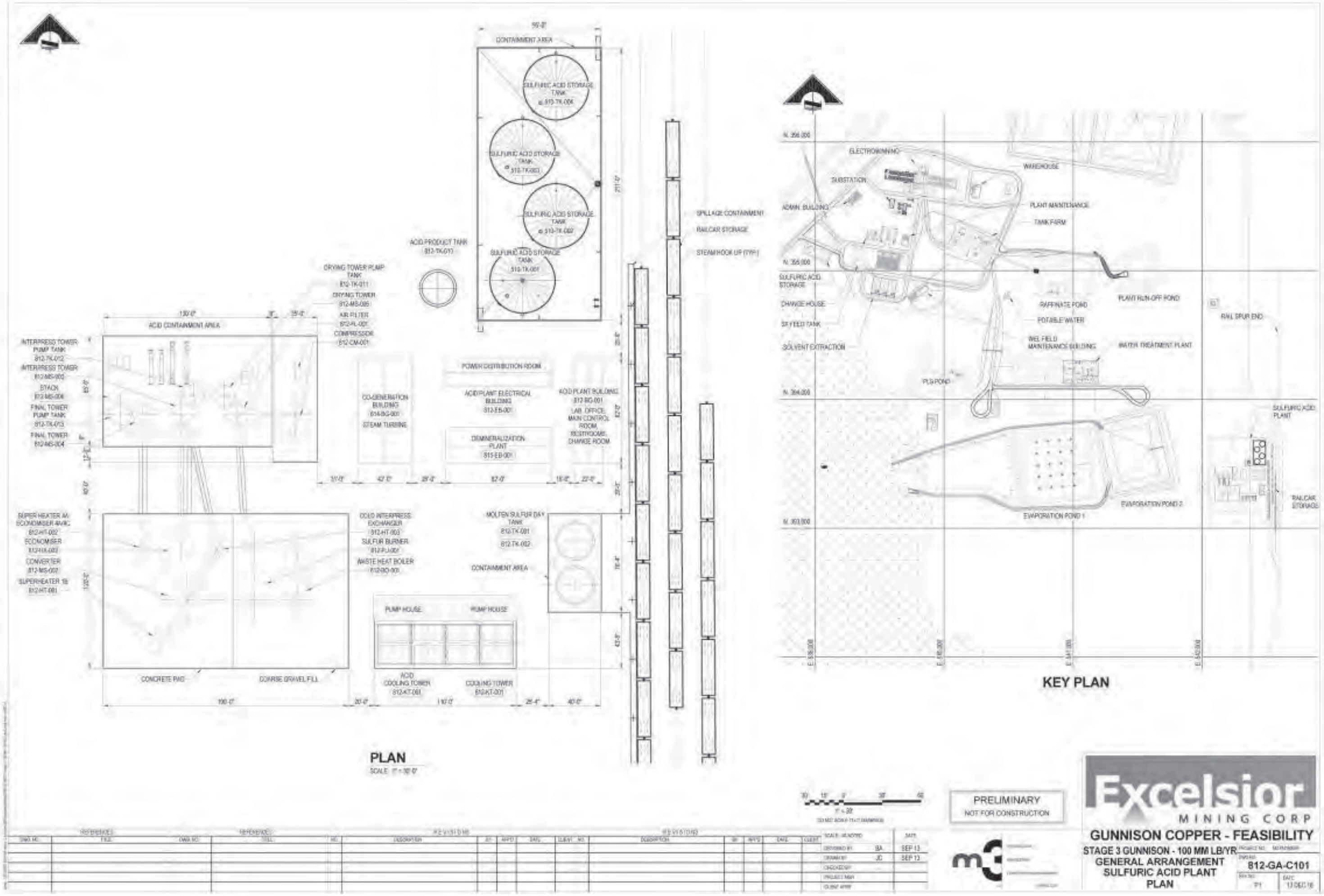

Figure 18-5: Acid Plant Cogeneration General Arrangement

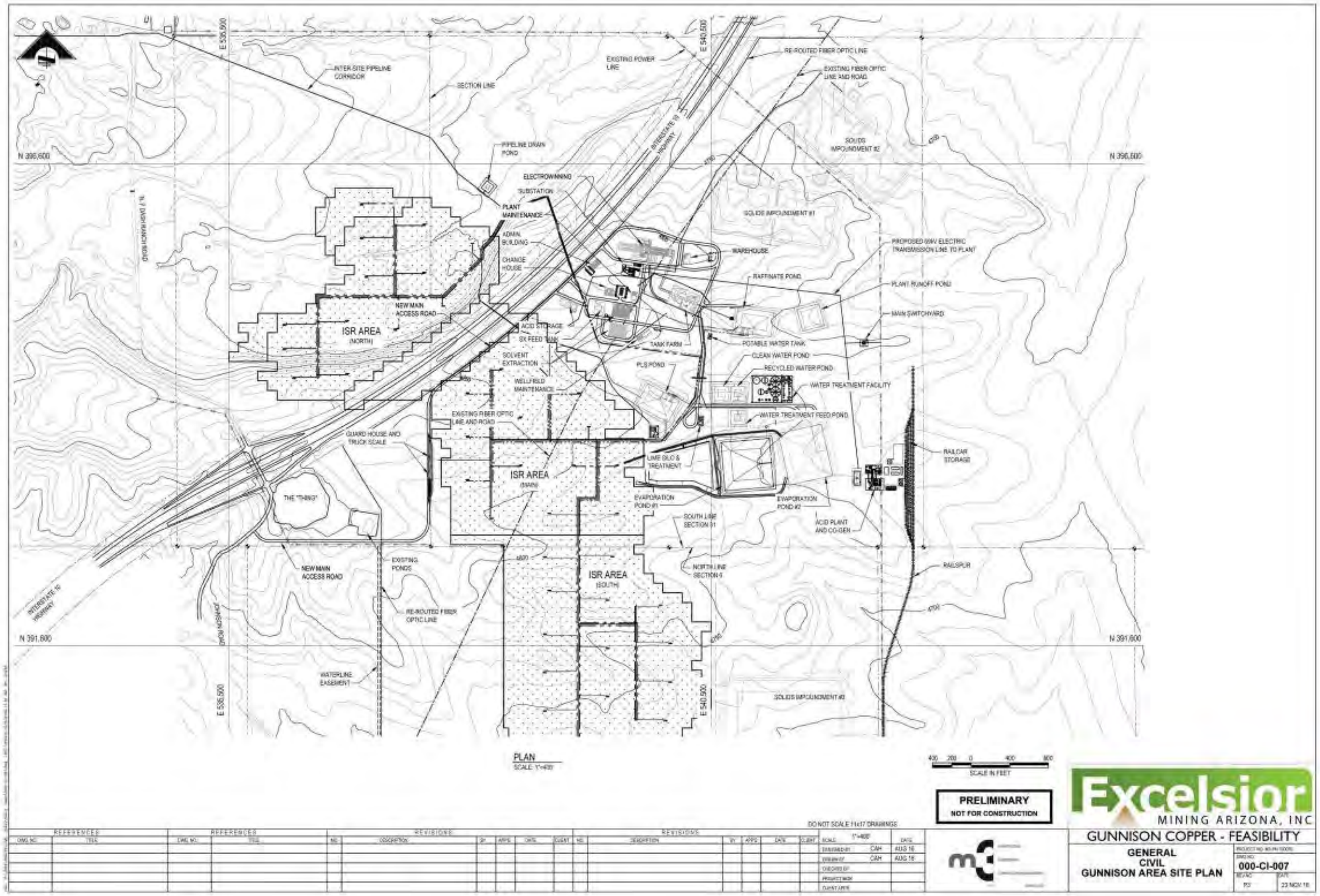

Figure 18-6: Gunnison Area Site Plan

18.9 POWER SUPPLY & DISTRIBUTION

Power for the facility will be taken from an existing 69 kV electric transmission line feeding the existing Johnson Camp mine located on the north side of I-10. The existing power line is owned by the Sulfur Springs Valley Electric Cooperative Inc. located in Willcox, Arizona. The power line approaches the plant site along the eastern boundary of Section 31. The existing 69kV line will be tapped and connected to an adjacent switchyard with metering facilities. Then a new, 0.5-mile 69kV transmission line will be constructed to connect to a temporary electrical substation for Stage 1 operations (Figure 18-2). In Stages 2 and 3, the temporary substation will be replaced by a main substation (Figure 18-4). At the main substation, power will be transformed to 24.9 kV for distribution throughout the plant and wellfield. Additional transformers will be provided in the various process areas to provide medium voltage (4160 V) and low voltage (480 V) to feed the end users.

A second main substation will be located near the sulfuric acid plant (Section 18.6 and Figure 18-4) to supply and transmit the power generated by the steam turbine from waste heat produced in the acid plant.

18.10 WATER SUPPLY & DISTRIBUTION

Fresh water is supplied from existing wells on the JCM property and pumped to an existing process/fire water storage tank (Figure 18-7). The lower portion of the storage tank is reserved for fire water. Process water for plant use is taken from the storage tank above the fire water reserve level. Potable water for the JCM site is provided by the existing Section 19 well, chlorinator building, and potable water tank.

In Stage 2, process water and fire water pipelines will be constructed from the JCM process/fire water tank to the Gunnison site. The elevation difference provides sufficient hydraulic head for process and fire water pressure demands without pumping.

Also for Stage 2, a water well will be constructed northeast of the Gunnison site for potable water supply to the Gunnison plant. A potable water tank and chlorination system will be provided for the potable water system. Potable water will be used for offices, labs, restrooms, and eye wash stations.

18.11 SANITARY WASTE DISPOSAL

Sanitary wastes from sinks, lavatories, toilets, and showers will be handled by septic systems. The septic systems will be typically dedicated to an individual building, but it is possible that adjacent buildings might share a septic tank or leach field. The septic systems will be designed and permitted in accordance with Cochise County regulations.

Sinks and drains where chemical handling operations are taking place will either drain to the tank farm sump and ultimately report to the Raffinate Pond, or be contained in dedicated piping to a chemical containment tank. Any containment tanks will be serviced by licensed hazardous materials handling contractors in accordance with federal, state, and local regulations.

18.12 WASTE MANAGEMENT

Solid wastes will be collected in approved containers, removed from site by a solid waste contractor, and disposed in accordance with federal, state, and local regulations. Excess construction materials and construction debris will be removed from site by the generating contractor.

Recyclable materials that are non-hazardous, such as scrap metal, paper, used oil, batteries, wood products, etc., will be collected in suitable containers and recycled with appropriate vendors.

Hazardous materials, such as contaminated greases, chemicals, paint, and reagents, will be collected and recycled, whenever possible, or shipped off-site for destruction, treatment, or disposal.

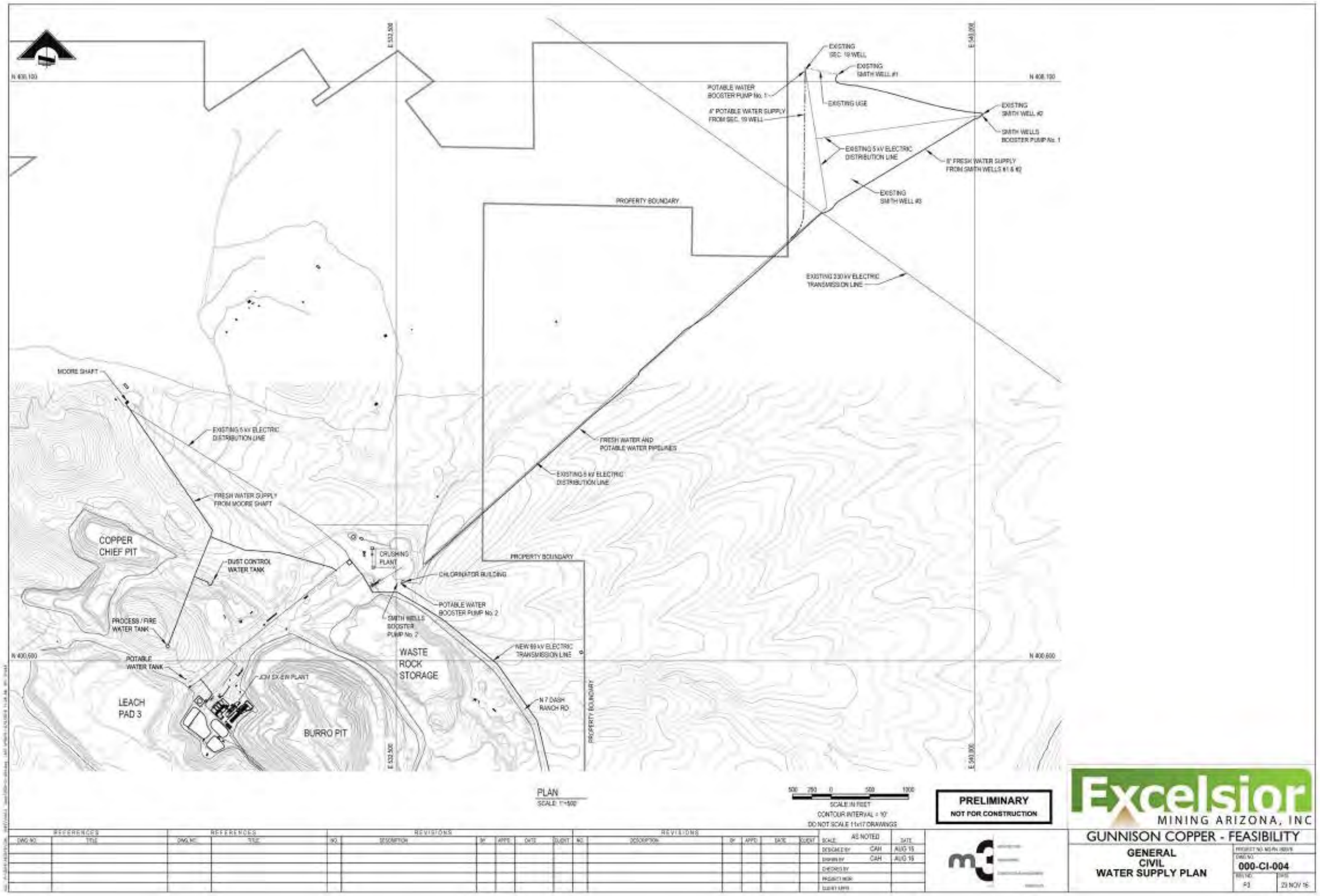

Figure 18-7: Water Supply Plan

18.13 SURFACE WATER CONTROL

Storm water run-off will be diverted around the plant facilities as much as possible. The natural gradient of the land generally slopes from the northwest to the southeast.

Stormwater, process water, or fresh water falling on or running on to potentially impacted areas of the site is considered potentially contaminated "contact" water and will be directed to containment ponds and sumps to prevent contamination of the natural drainage ways. Collected contact water will be pumped to the evaporation pond or to the recycled water pond (after it is constructed at the onset of rinsing).

18.14 TRANSPORTATION & SHIPPING

All materials coming into the JCM and Gunnison plants will be brought in by truck. Specifically, sulfuric acid will be received at the JCM site for Stage 1, and at both the JCM and Gunnison sites by truck for Stage 2 operations. Beginning in Stage 3, sulfuric acid and molten sulfur will arrive by rail and be unloaded into their respective storage tanks at the rail yard. The Gunnison site may continue to receive sulfuric acid by truck during Stage 3, if needed. Incoming materials include reagents, pebble lime, extractant, diluent, diesel, warehouse stock, well construction materials, and spare parts.

The primary product leaving the plant is cathode copper, which will be by flatbed tractor trailers. Recycled materials leaving the plant will also be by truck. Scales to weigh full and empty trucks coming into and leaving the site are provided at the main gate for highway trucks and at the rail spur for the rail cars of sulfuric acid and sulfur.

18.15 COMMUNICATIONS

The connection to telephone and internet service has not been confirmed at this time; however, telephone service is available at the Johnson Camp property one mile north and at the town of Dragoon, four miles to the south, which is located on a major intercontinental fiber optic communications line. The telecommunication system will be integrated with the onsite data network system utilizing a voice over internet protocol (VoIP) phone system. A dedicated server will be provided for setup and maintenance of the VoIP system. Handsets will plug into any network connection in the system for telecommunications. The office network will support accounting, payroll, maintenance and other servers as well as individual user computers. High bandwidth routers and switches will be used to logically segment the system and provide the ability to monitor and control traffic over the network.

A process control system network will support the screen, historian and alarm servers connected to the control room computers as well as Programmable Logic Controllers (PLC). This system will incorporate redundancy and a gateway between the office system and control system to allow business accounting systems to retrieve production data from the control system. No phone or user computer will be connected to this system.

The internal communications within the plant will utilize the same VoIP phone system, which will provide direct dial to other phones throughout the plant site. Mobile radios will also be used by operating and maintenance personnel for daily communications while outside the office.

19 MARKET STUDIES AND CONTRACTS

19.1 MARKET STUDIES

The anticipated long-term demand for copper cathode is not easily determined but for the purpose of this report, it has been assumed that markets for this product will remain steady. To date, no market study has been conducted for this Project and there are no contracts in place related to mineral sales at the time of this report. No direct marketing has been done for the copper cathode that would potentially be produced at Gunnison and therefore no off-take agreements exist. These options will be reviewed in detail when the Project proceeds to the feasibility stage. With all that being said, the copper market historically has been robust as to consumption requirements.

The Base Case study price for the FS is $2.75/lb Cu, as it was for the 2016 PFS Update. The three-year trailing average price for copper for the end of November 2016 is $2.62/lb Cu. M3 uses a blended price 60% historical three years and 40% futures price two years forward for evaluating minerals projects. The current blended price for the end of November 2016 is $2.59/lb Cu. Considering the volatility of copper prices over the last several years, in M3's opinion, the $2.75/lb Cu is a reasonable approximation of where the copper price is headed when the Project is permitted and ready for construction in 2018.

19.2 CONTRACTS

Principal activities for Excelsior are project financing, community relations and permitting, and related engineering activities that support the development of the Gunnison Copper Project. During this period, contracting activities will continue to be driven by the need to acquire specialists and professional services firms to assist Excelsior with these various activities.

A number of contracts will need to be put into place in order to complete the proposed studies. Some are already in place and others are still proposed. These include:

- Project financing,
- Community relations,
- Land use,
- Environmental studies and permitting,
- Hydrology and hydrogeology,
- Metallurgical and process engineering support,
- Detail engineering and procurement,
- Site safety and health services,
- Professional Services,
- Drilling services contractors, and
- Sulfuric acid contract.

Contractors will be pre-qualified by Excelsior on the basis of their:

- Safety record,
- Previous experience on similar projects,

- Quality of workmanship on previous projects,
- Quality/experience of on-site management,
- Local availability in region,
- Previous schedule performance,
- Financial stability, and
- Cost competitiveness.

Areas with clearly defined scopes of work will be required as unit price or lump sum contracts.

20 ENVIRONMENTAL STUDIES AND PERMITTING, CLOSURE, AND SOCIAL OR COMMUNITY IMPACT

20.1 ENVIRONMENTAL STUDIES AND PERMITTING

Federal, state, and local government environmental permits that will potentially be required before the mine becomes operational are listed in Table 20-1. The purpose of this section is to identify and discuss key environmental permits and related environmental studies that are most likely to drive the permitting schedule.

Table 20-1: Environmental Permits

Required Permits	Issuing Agency	Regulatory Program or Statute
• Underground Injection Control (UIC) Permit (Application submitted February 2016)	United States Environmental Protection Agency (USEPA)	Safe Drinking Water Act
• USEPA Identification Number (RCRA Subtitle C Site Identification Form 8700-12)	USEPA	Resource Conservation and Recovery Act (RCRA)
• APP Individual Permit (for wellfield and impoundments) (Application submitted January 2016)	ADEQ	Environmental Quality Act – APP program
• APP General Permits (for sewer system, other minor facilities)	ADEQ	Environmental Quality Act – APP program
• Air Quality Permit	ADEQ	Clean Air Act
• Drinking Water System Approval to Construct and Approval of Construction	ADEQ	Safe Drinking Water Act
• Mined Land Reclamation Permit	Arizona State Mine Inspector	ARS. § 27-901
• Intent to Clear Land	Arizona Department of Agriculture	ARS. § 3-904
• Sewage System Permit	Cochise County Department of Health and Social Services	Environmental Quality Act – APP program
• Encroachment Permit (for utility corridors under I-10)	Arizona Department of Transportation (ADOT)	AAC. R17-3-502
• Dam Safety (for regulated impoundments)	ADWR	ARS. 45-1203 & 1206
• Endangered Species Act	EPA	16 U.S.C. §§ 1531 et seq.
• National Historic Preservation Act	EPA	16 U.S.C. §§ 470 et seq.
• Section 404 Permit	US Army Corps of Engineers	Clean Water Act Section 404

The environmental and permitting process involves, among other things, preparing a mine closure and reclamation plan for the Arizona State Mine Inspector. In addition, several permits must be obtained, the most important of which are the Aquifer Protection Permit (APP) (State of Arizona), the Underground Injection Control permit (UIC) (regulated by US Environmental Protection Agency ["USEPA"]) and the air quality permit (State of Arizona). Currently, there are no known environmental liabilities for the Gunnison Project. Key permits that are expected to drive the permitting schedule include the Endangered Species Act (ESA), the National Historic Preservation Act (NHPA), the Underground Injection Control (UIC) Permit, and the Aquifer Protection Permit (APP). These are discussed in the sections below. It is anticipated that the EPA will be the lead agency for ESA and NHPA compliance for the project. EPA will also be the lead for the UIC, while Arizona Department of Environmental Quality (ADEQ) will be the lead for the APP.

Not all of the permits listed in Table 20-1 are applicable to the project. For example, the Section 404 permit is not applicable because there are no jurisdictional waters of the U.S. at the site. Two washes in the vicinity of the Project, Walnut Wash and Big Draw, do not connect to any traditional navigable waters and do not have any impoundments along their flow paths. Indistinct, faint hydrological paths may lead to the Willcox Playa, but it is questionable whether any water from the Project site actually reaches the Playa. The Army Corps of Engineers has chosen not to exercise jurisdiction outside the high-water mark of the Willcox Playa, and no CWA 404 permits have been issued in the area of the Willcox Playa. Therefore, Excelsior is proceeding on the basis that there are no jurisdictional waters at the Project.

The proposed APP-regulated impoundments will not be regulated under ADWR Dam Safety Regulations, based on their proposed designs.

20.1.1 Endangered Species Act

Section 7 of the ESA requires that, for any federal agency action, the permitting authority must evaluate the potential impact of a project to federally-listed species and their critical habitat. Elements of the ESA are applicable even on private lands absent of any other federal nexus. If a federal agency with authority over the project determines that the project may affect a listed species or designated critical habitat, consultation with the U.S. Fish and Wildlife Service (USFWS) will be required. During this consultation the USFWS is required to determine if any listed species will be harmed or harassed (collectively referred to as ‘take’) by the project and determine if adverse impact to critical habitat will occur. USFWS will also determine, during this consultation, if the proposed action is likely to jeopardize the continued existence of any listed species[3] or adversely modify critical habitat.[4] Should the USFWS make a jeopardy or adverse modification determination, they are required to identify reasonable and prudent alternatives to the proposed action that meet the purpose and need of the proposed activity. If an incidental take permit is required, the USFWS is likely to identify binding reasonable and prudent measures (RPMs) and terms and conditions (TCs) of ‘take’ to offset the impacts. Importantly, the ESA does not necessarily preclude development of projects with potential impacts to federally listed species.

Regardless of whether the project will require a federal agency action, Section 9 of the ESA will be applicable and the ‘take’ of listed species is prohibited without a permit. Should the project have no federal nexus and require a permit for ‘take’ of listed species, AMI must obtain a Section 10 permit under the ESA. The Section 10 permitting process is an applicant-driven process, is often complex, requires mitigation to offset ‘take’ of listed species, and can take

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[3] Jeopardizing the continued existence is defined as directly or indirectly affecting a species’ numbers, reproduction, or distribution in such a way as to considerably reduce the species’ ability to survive and recover in the wild.

[4] Adversely modifying critical habitat is defined as “Destruction or adverse modification means a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features.” (50 CFR Part 402)

several years to develop in coordination with the USFWS.[5] Based on the environmental analyses conducted to date[4], it is not anticipated that a Section 10 permit will be required for the development of the project.

Based on experience with other mining projects in southern Arizona and the environmental analyses conducted to date for the project (Darling, 2016), it is not anticipated that the project will result in adverse impacts to listed species or critical habitat. However, it is anticipated that insignificant impacts to a single listed species, the lesser long-nosed bat, may occur. As such, informal Section 7 consultation may be required. In this process, USFWS will analyze the project and anticipated impacts to listed species and either concur with the federal agency's conclusion that any impacts are not likely to adversely affect species, or disagree with the agency's conclusion and thus require formal Section 7 consultation. It is anticipated that the USFWS will require informal consultation only and that consultation will be completed in a timely manner and not preclude the development of the project.

20.1.2 National Historic Preservation Act

Because the project will have a federal nexus, any adverse effects to cultural properties will require consultation and mitigation in the form of data recovery and research. Should impacts to cultural resources eligible for registration on the National Register of Historic Places[6] (Historic Properties) be unavoidable, authorization to mitigate the impacts to these resources is obtained through implementation of Section 106 consultation.

The consultation is typically conducted between the federal action agencies and the State Historic Preservation Office (SHPO). The Advisory Council on Historic Preservation will also be asked if they would like to participate in the consultation but typically they decline. The National Historic Preservation Act also requires that federal action agencies consult with tribes having cultural affinity to the project area, development of an historic properties treatment plan, and development and execution of a Memorandum of Agreement (MOA). Signatories to the MOA could be the SHPO, EPA, and any other federal agencies that may be involved. Concurring parties to the agreement can include interested Native American groups and Excelsior. Concurring parties are not obligated to sign the MOA but will be given opportunity to review and comment. It is not anticipated that effects to cultural resources will preclude development of the project.

Surveys for cultural resources in the vicinity of the project were conducted by Professional Archaeological Services of Tucson (PAST, 2010 A and B) and WestLand Resources, Inc. (WestLand) (King, 2014 and Stone, 2017). These surveys have documented no cultural resource sites in the vicinity of the project. To date, no traditional cultural places have been identified in the vicinity of the project. Compliance with Section 106 of the NHPA is not anticipated to preclude the development of the project.

20.1.3 Underground Injection Control

The UIC permit will focus on the design, construction, operation, and closure of the wellfield. In the permit application submitted to USEPA on February 3, 2016, Excelsior demonstrated that the basin fill above the ore zone and the sulfide zone are not underground sources of drinking water (USDWs). Therefore, Excelsior is seeking an aquifer exemption only for the oxide ore zone. It is expected that many of the requirements of the APP and UIC permits will overlap, streamlining compliance. For example, Excelsior has proposed the same point-of-compliance wells for monitoring of the wellfield for both permits. Similarly, the same contingency plan was proposed for both permits. USEPA has no licensing timeframe requirements for UIC applications. For a variety of commercial reasons

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[5] Because Section 10 permits are discretionary decisions by the USFWS or National Marine Fishers Service, these permits generally require NEPA review and independent ESA compliance by these agencies.

[6] The official list of the Nation's historic places considered worthy of preservation.

Excelsior's initial permit applications cover the northern half of the Project. A UIC application will be submitted for the southern portion once sustained commercial production has been demonstrated. Groundwater studies conducted in support of the UIC are summarized in Section 20.1.5.

20.1.4 Aquifer Protection Permit

The APP application was submitted to ADEQ on January 13, 2016 and it was found to be administratively complete. ADEQ has conducted an initial review of the application and provided comments and requested additional information on June 17, 2016; Excelsior has responded to these comments and provided the requested information on September 1, 2016.

The Gunnison Project facilities regulated by APP are the ISR wellfield and nine impoundments that are being permitted or will be permitted: Solids Ponds 1a and 1b, 2a and 2b, and Solids Pond 3, Evaporation Ponds 1 and 2 (if needed), the Recycled Water Pond, PLS Pond, Raffinate Pond, the Plant Runoff pond, and the Pipeline Drain Pond. BADCT for the wellfield includes the following elements: (1) balanced injection and recovery volumes, (2) hydraulic control pumping to maintain hydraulic gradients toward the wellfield, (3) operational controls regarding flow volumes and injection pressures, (4) well construction according to 40 CFR Subpart D, Section 146.30, (4) rinsing for closure, and (5) wellfield plugging and abandonment. Impoundments will be designed, constructed, operated, and maintained using prescriptive BADCT (ADEQ, 2004). They will be sized to have sufficient capacity and freeboard. Process solution impoundments will have a double-liner with a leak collection and removal system (LCRS) between the liners. The licensing timeframe (LTF) for the substantive review of the APP application ranges from 186-294 business days from the date of administrative completeness, not including the time needed to prepare comment responses. For a variety of commercial reasons Excelsior's initial permit applications cover the northern half of the Project. An APP application will be submitted for the southern portion once sustained commercial production has been demonstrated. Groundwater studies conducted in support of the APP are summarized in Section 20.1.5.

20.1.5 Groundwater Characterization Studies

In support of the APP and UIC applications, extensive studies have been conducted. The sections below summarize the studies to date.

20.1.5.1 Aquifer Properties

Excelsior has conducted several drilling campaigns on the Gunnison site to characterize the hydrogeologic conditions at the site in support of the mining operations and permitting. Wells specifically designed and installed for hydrogeologic characterization were installed in 2011-2012 (6 wells) and 2014-2015 (25 wells). A suite of geophysical logs, including spinner flow meter and corehole dynamic flowmeter logs were run. Aquifer testing of 24 wells was performed and water level responses were monitored in 75 observation wells to evaluate aquifer properties (hydraulic conductivity, transmissivity, storativity), and hydraulic connections between pumping and observation wells. The 24 locations covered the range of typical hydrogeologic conditions observed at the site, and included tests in basin fill, fractured zones within various bedrock units, fault intersects, massive blocks with limited faulting, highly mineralized zones, and unmineralized zones. Tests were analyzed by standard industry methods using AQTESOLV (v4.5) software. Estimates of porosity were calculated from different data sources, including density logging, sonic logs, and an indirect method formulated by the US Geological Survey based on aquifer testing observations. The hydrogeologic investigations were used to populate and calibrate the hydrogeologic flow model (discussed below).

20.1.5.2 Fracture Gradient Testing

Excelsior conducted 29 fracture gradient tests around the wellfield in different formations to evaluate the injection pressure at which rock would fracture. The mining method for the Project relies on passing solutions through existing fractures where copper has been deposited. Creation of new fractures or propagation of existing fractures would be counterproductive to the recovery of copper. Measured fracture gradients ranged from 0.78 to 2.22 psi/ft. Excelsior will not have difficulty staying below the maximum allowed injection pressures.

20.1.5.3 Groundwater Quality

Excelsior has characterized background groundwater quality at the site in support of permitting. Analyses of samples from wells installed in the oxide zone indicate that groundwater at the Project is generally a calcium-sodium-magnesium-bicarbonate type with total dissolved solids (TDS) concentrations in the range of 210 to 420 milligrams per liter (mg/L).

During drilling operations, hydrocarbons were detected in several drill holes. Excelsior and its consultants have concluded that these compounds are likely related to an underground storage tank on an adjacent property and the result of past (non-Excelsior) drilling practices. Excelsior is not the owner or operator of the property on which that underground storage tank is located. There is no known ongoing or current source of petroleum contamination. To the extent that the source of the contamination is from an off-site source, that contamination should be addressed by the owners or operators of the property where the release occurred. See A.R.S. Secs. 49-1001(11), 1005 (imposing responsibility for remediation on owners and operators of underground storage tanks). The results of Excelsior's evaluation have been communicated to the Arizona Department of Environmental Quality (ADEQ). The ADEQ has not required Excelsior to take any action to address this issue. As a result, Excelsior does not consider that the observed contamination presents a material impact on its ability to extract the mineral resources or on the mineral reserve itself.

20.1.5.4 Groundwater Modeling

The Gunnison Project groundwater model was constructed in 2015 by Clear Creek Associates in support of the Aquifer Protection Permit (APP) and Underground Injection Control (UIC) permit applications and wellfield operations planning for the northern half of the orebody. The model uses the finite difference model code "MODFLOW-NWT" as implemented in the graphical user interface known as "Groundwater Vistas" (v.6.78; Environmental Simulations, Inc., 2011). The finite difference grid consists of 209 rows, 209 columns and 7 layers for a total of 305,767 calculation cells, 173,523 of which are active. The model domain covers an area of 87.8 square miles and encompasses the major hydrologic drainages in the vicinity of the Project.

The model was constructed using a number of extensive datasets created by Excelsior, including a detailed mapping of fracture intensity, which is key to groundwater flow in the Project area.

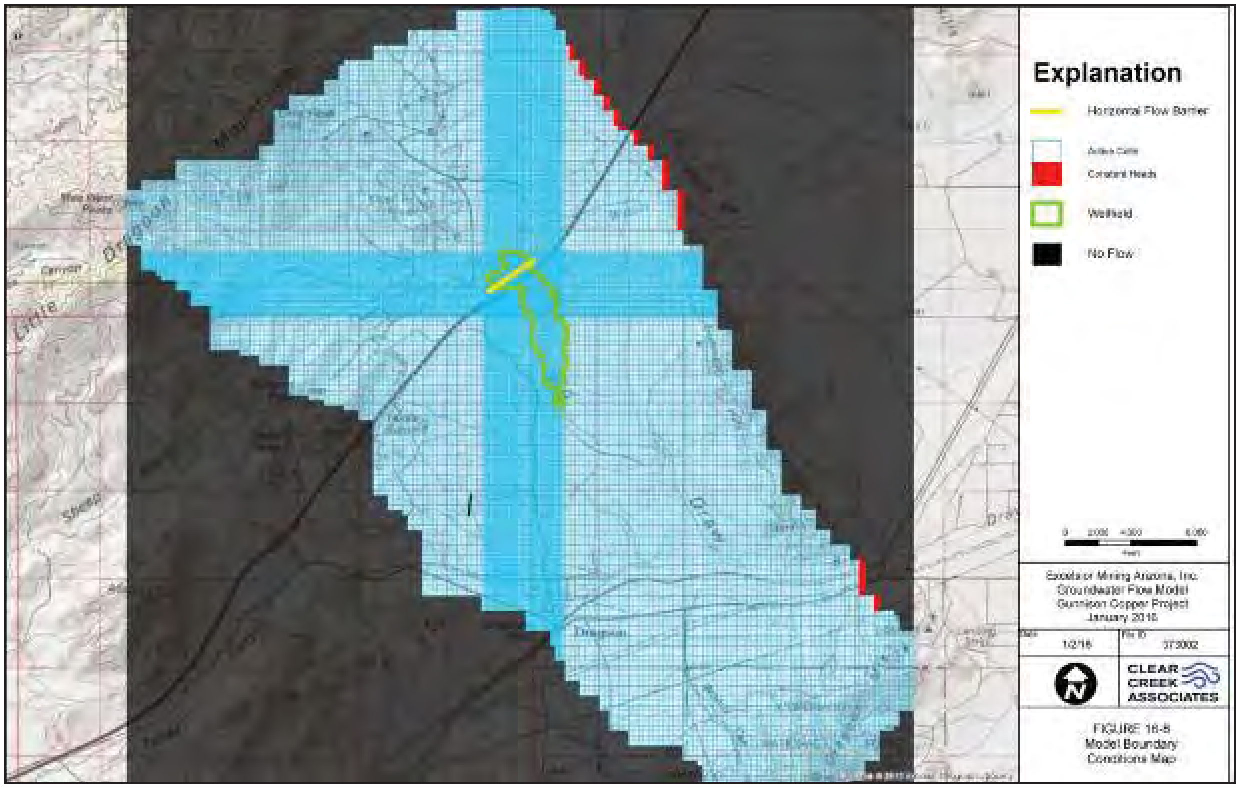

Figure 20-1: Groundwater Model Boundary Conditions

The distribution of hydraulic properties was based on a geologic block model developed by Excelsior for the ore deposit. This geologic block model was created from examination and review of numerous core samples and downhole logging techniques. Fracture intensity was assigned to block model cells in the ore deposit based on the interpretation of the downhole samples and logs. The fracture intensity was used as the primary source for model hydraulic conductivity. From numerous exploration core holes, Excelsior assigned geologic units and a level of fracturing with a range of 1 (least fractured) to 5 (most fractured) to blocks that are 100 feet by 50 feet by 25 feet thick. The block model assigned both a geologic unit designation and the fracture intensity. Aquifer tests and geophysical information provided data that allowed correlation of fracture intensity and hydraulic conductivity using a power law relationship (Figure 16-7), which was used to set hydraulic conductivity values in the model area. Model zonation of hydraulic properties was done for each combination of geologic unit and fracture intensity.

Outside of the Project block model, material property zones were assigned based on geologic units mapped by Cooper and Silver (1964); these zones were assigned hydraulic conductivity values appropriate for each geologic unit. Values of aquifer storage were assigned uniformly as specific storage at 1×10^{-5} per foot. Porosity was assigned using a similar relationship between measured porosity and fracture intensity. Porosity values ranged from approximately 1 to 3 percent in the bedrock portion of the model domain. Specific yield assigned to bedrock units were set to 0.8 times porosity. The basin fill values of specific yield were set to 0.15 for the upper basin fill, and 0.08 for the lower basin fill.

The model was run to simulate zero net pumping within the wellfield (i.e. injection = recovery); with hydraulic control pumping around the perimeter resulting in overall net pumping and a maximum drawdown of approximately 40 feet during the life of mine. Hydraulic control wells were initially positioned in the model approximately 300 feet apart, then adjusted to assure complete containment. Several wells were added in more permeable fault zones to maintain containment. Based on the results of the hydraulic control simulations, solutions in the wellfield area will be fully contained. Use of hydraulic control wells around the downgradient perimeter allows for operational flexibility, minimizes drawdown, and is conservative of the water resource.

The overall statistical match between measured water levels and model simulated levels was good, with a root mean square error (RMSE) of 4.3%. The mean error is -1.3 feet, and the absolute residual mean is 28.7 feet. These statistics mean that the model is a good representation of groundwater flow conditions in the Project area.

20.1.5.5 Geochemical Modeling

After copper recoveries decline in the mining blocks, they will be rinsed with fresh water prior to closure. In 2015, Duke HydroChem LLC (Duke) was retained to conduct a geochemical characterization of ISR process solutions and to evaluate the rinsing strategy for wellfield closure. Geochemical modeling was conducted using the REACT module of the Geochemist's Workbench software, Release 10.0.

Duke used the chemical compositions of existing JCM raffinate and PLS as a proxy for the Project solutions, with the exception of dissolved fluoride, dissolved iron, and dissolved copper concentrations, which were adjusted upward to be consistent with site-specific observations regarding fluoride in JCM wells, metallurgical testing of Project ore, and expected PLS grades.

The geochemical model indicated that the following three-step closure strategy would result in concentrations of regulated constituents below Aquifer Water Quality Standards:

- Step 1: Rinsing 3 pore volumes
- Step 2: A rest phase (100 to 200 days) until near neutral pH conditions are attained
- Step3: Rinsing at least 2 additional pore volumes

20.2 WATER AND WASTE MANAGEMENT

There will be no traditional mine wastes such as waste rock and tailings produced by this project because of the ISR mining method. "Mine wastes" produced are primarily in the form of excess solutions and chemical precipitates from the treatment of those excess solutions. Excess water will be evaporated and the solids residues generated by treatment of excess solutions will be contained in lined impoundments.

A water management plan has been designed for the project to make the most efficient use of water resources and eliminate discharges. A number of impoundments will be used to manage process solutions. During the Stage 1 of the Project (Years 1 thru 3), existing ponds at JCM will be used for 100% of PLS and raffinate storage as well as the collection of draindown from JCM Leach Pad 123. The draindown collection ponds will also catch surface runoff from storm events.

Two additional ponds will be constructed for Stage 1 operations. A pond will be constructed on the north side of I-10 (Pipeline Drain Pond) at a topographic low point between JCM and the Gunnison site to contain pipeline drainage in the event that one of the pipelines needs to be repaired. An Evaporation Pond will be constructed at the Gunnison site south of I-10 to evaporate a portion of the wellfield conditioning and hydraulic control water during Stage 1 and eventually rinse water once rinsing of the leached formations begins in Year 5 in Stage 2.

Additional ponds will be constructed on the east side of the wellfield as production increases and SX-EW facilities are constructed south of Interstate 10. These include: the Gunnison PLS pond, Gunnison Raffinate pond, Plant Runoff pond, Clean Water pond, Recycled Water pond, and Solids Impoundments, which will contain the precipitate from the Water Treatment Plant planned for construction in Year 7. The Plant Runoff Pond, Pipeline Drain Pond, and the Clean Water Pond will be constructed with a single HDPE liner and no leak detection. The PLS, Raffinate, Recycle, Evaporation, and Solids ponds will be constructed with a double liner and a leak collection and removal system between the liners in accordance with prescriptive BADCT designs for the APP.

The ISR process involves: a) delivering acidified leach solution (raffinate) to the mineralized blocks through injection wells, b) recovering pregnant leach solution (PLS) from adjacent recovery wells, c) stripping dissolved copper from PLS, d) re-acidifying the mostly barren raffinate, and e) delivering it back into the wellfield. Most of the solution is recycled in the "closed loop" of injection, recovery, solvent extraction of copper, and re-acidification. A small amount of solution is added from the process (acid addition, electrolyte filter backwashing, cathode washing, etc.). Groundwater pumped from the formation to maintain hydraulic control is added to create an excess flow of impacted water that must be managed. Excess solutions will initially be routed to evaporation ponds where mechanical evaporators will be used to assist natural solar evaporation in reducing the water volume. Formation rinsing after mineralized blocks have been depleted by injecting clean water and recovering rinse solutions (rinsate) from the wellfield will add to the excess solutions that must be managed. The rinsate will also be sent to the Evaporation Pond and evaporated.

Starting in Stage 3 of the Project, a Water Treatment Plant (WTP) will allow for the rinsate and other excess solutions to be treated and approximately 80% returned for reuse in the process and as 'clean water' for rinsing. The WTP is a high-density solids (HDS) lime neutralization system coupled with membrane filtration to produce permeate that will be pumped to the Clean Water Pond.

The solids from the WTP process will be pumped to the Solids Impoundments as a slurry containing precipitated solids. The concentrate brine and filter backwash from the WTP will be pumped to the Evaporation Pond(s). Groundwater produced from hydraulic control pumping will be conveyed to the Clean Water Pond or, if impacted by PLS, to the Evaporation Pond.

The Solids Impoundments will be double-lined ponds with a leak collection and removal system constructed in accordance with Arizona prescriptive BADCT guidance (ADEQ, 2004). The impoundments will include an overliner drainage system piped wot a drainage collection pond. The Solids Impoundments will be used to dewater the WTP solids and recover water, which will be returned to the equalization pond for the WTP. Solids are expected to settled to approximately 50%. The impoundments will be closed in place at the end of their functional life in accordance with Arizona BADCT (ADEQ, 2004).

Pond sizes are based on the chemistry of the process solutions, process flow streams, and the volume of solids that will result after evaporation or water treatment. The ponds will be constructed with excess capacity to meet the freeboard requirements of prescriptive BADCT.

20.3 CLOSURE AND RECLAMATION COSTS

All APP-regulated facilities must be closed in accordance with the stipulations of the permit at the end of operations. Closure activities described in the APP Application refer only to APP facilities. Non-APP facilities, such as buildings and infrastructure, will be reclaimed in accordance with the Mined Land Reclamation Program overseen by the Arizona State Mine Inspector's Office. This program requires the development of reclamation plans that will ensure safe and stable post-mining land use. Re-grading and resurfacing needs, if any, will be completed with good engineering practices minimizing unwanted surface disturbances. The closure and reclamation plans must include cost estimates and financial assurance for implementing the plans. Mechanisms for providing required financial assurance for the cost of implementing the reclamation plans are listed at A.R.S. § 27-973. Excelsior will prepare a reclamation plan and will submit the plan to the responsible regulatory office as required by the Mined Land Reclamation Statutes.

Prior to recovery operations, Excelsior will provide a bond to ensure future mine closure expenses will be met. The amount of the bond will be based on the closure-remediation-reclamation cost estimates using third-party contractor costs. The estimates for Stage 1 operations have been provided to ADEQ. The closure plan for the wellfield will be based on the phased installation of new production blocks while previously installed production blocks are operated and then closed following depletion of economic levels of copper in the ground. The phased process of installation, operation, and closure of production blocks will be continued throughout the permitted operation area and will minimize the area to be closed at any point in the life of the Project. Final closure of operational infrastructure including the containment ponds, tanks, and plants will commence once copper recovery has ended. Closure and reclamation costs are summarized in Table 20-2.

Table 20-2: Closure and Reclamations Costs

Item	Description	Cost ($000)
Johnson Camp Closure Costs		
JCM Supplemental Raff. and Pad 1 Draindown Pond 1 (Year 30)	Cut and bury liner, backfill, soil cover, revegetate	$222.6
JCM PLS Receiving & Pad 3 Draindown Pond (Year 30)	Cut and bury liner, backfill, soil cover, revegetate	$221.4
JCM SX Feed Pond (Year 28)	Cut and bury liner, backfill, soil cover, revegetate	$69.2
JCM Raffinate Pond (Year 28)	Cut and bury liner, backfill, soil cover, revegetate	$74.7
Leach Heap Closure (Year 12)	Regrade surface to drain, place and compact soil cover, revegetate	$1,600.0
Subtotal JCM Closure		$2,187.9
Johnson Camp Reclamation Costs		
Waste Rock Stockpile Reclamation (Year 33)	Regrade for stable slopes, add growth medium, scarify, reseed	$706.2
Building Demolition (Year 30)	Salvage equipment, demolish building, dispose scrap, break and bury concrete	$162.6
Piping and Electrical (Year 30)	Dispose HDPE pipe in landfill, cut poles at ground, salvage electric lines & poles	$60.0
Roads (Year 33)	Regrade to stabilize banks & promote drainage, scarify, revegetate	$145.0
Miscellaneous Areas (Year 30)	Salvage as appropriate, regrade, soil cover, scarify, reseed	$110.8
Hazard Fencing (Year 30)	Place protective fencing	$423.4
Subtotal JCM Reclamation		$1,608.0
Contingency (20% of all direct costs)		$759.2
EPCM & QA/QC		$1,024.9
JCM Reclamation & Closure		$5,580.0
Gunnison Closure		
Solids Pond 1 a & 1b (Year 12)	Soil cover over solids, grade to drain, revegetate	$762.7
Solids Ponds 2a & 2b (Year 15)	Soil cover over solids, grade to drain, revegetate	$762.7
PLS Pond (Year 28)	Bury liner (or remove and remediate soil if necessary), backfill, revegetate	$170.0
Raffinate Pond (Year 28)	Bury liner (or remove and remediate soil if necessary), backfill, revegetate	$165.4
Clean Water Pond (Year 30)	Bury liner, backfill, revegetate	$29.9
Recycle Water Pond (Year 30)	Bury liner (or remove and remediate soil if necessary), backfill, revegetate	$29.9
Runoff Pond (Year 30)	Bury liner, backfill, revegetate	$56.0
Solids Pond 3 (Year 33)	Soil cover over solids, grade to drain, revegetate	$2,075.4
Evaporation Pond (Year 33)	Bury liner (or remove and remediate soil if necessary), backfill, revegetate	$48.1
Wellfield Rinsing		$8,088.5
Subtotal Gunnison Closure		$12,868.9
Gunnison Reclamation		
Building Demolition	Removal of equipment, demolition, soil cover, and revegetation	$0
Header house/wellfield piping	Remove Header houses and piping, backfill and revegetate	$680.3
Subtotal Gunnison Reclamation		$680.3
Contingency (20% of all direct costs)		$2,573.8
EPCM & QA/QC		$3,474.6
Gunnison Reclamation & Closure		$18,917.3
Total JCM & Gunnison Reclamation and Closure		$24,497.3
Wellfield Abandonment Costs		$18,917
Non-Refundable Bond Fees		$8,334
Total Reclamation & Closure		$50,400

Closure of the ISR wellfield requires rinsing and neutralization of the portions of the formation that have been exposed to leaching. Clean water for rinsing will be provided by water supply wells and recycled water from the Water Treatment Plant. Extracted rinse water will be treated with greater than 80 percent returned for additional rinsing and the remainder being entrained in the Solids Impoundments or disposed of in the Evaporation Ponds. Rinsing is considered complete when the concentrations of regulated constituents are at or below acceptance criteria.

Wells that are accepted as being sufficiently rinsed will be abandoned in accordance with UIC regulations and Arizona Department of Water Resources (ADWR) guidance.

The wells will be grouted from the bottom upward using a tremie pipe to eliminate the well's ability to act as a conduit for solution migration.

APP-regulated impoundments, including the PLS, Raffinate, Recycled Water, and Evaporation Ponds will be closed in accordance with an approved closure plan and APP BADCT requirements. The solution ponds that contain liquids (PLS, raffinate, pipline draindown, etc) will be emptied and cleaned. Liners will be inspected for signs of leakage. The soils beneath prospective defects will be investigated and remediated as necessary. After clearance, the liner materials will be folded into the bottom of the pond for burial in place. Perimeter berms above the natural land surface will be pushed into the pond to cover the liner, contoured, and revegetated to shed surface runoff and minimize infiltration. The impoundments containing solids (Evaporation and Solids Impoundments) will be closed in place and covered to minimize infiltration. The edges of the liner will be folded in, covered with a low permeability cap, contoured, and revegetated to shed surface runoff and minimize infiltration.

20.4 COMMUNITY RELATIONS

Excelsior seeks to build sustainable partnerships and bring value to the communities where it operates. Excelsior's approach to community relations reinforces its core values and provides guidelines for making decisions on a variety of issues, ranging from charitable giving to resource development. To that end, Excelsior has developed a broad-based community relations and stakeholder outreach program in support of the Gunnison Project. Various levels of activity and outreach occur as a function of the development of the Project from prefeasibility and feasibility studies, through Project construction and operations, to closure and rehabilitation. Elements of this program include:

- Targeted stakeholder outreach to government, community, business, non-profit and special interest groups, and leaders at the local, county and state level.
- Development of community relation and communication tools and resources (e.g. Project website, Project e-newsletter, and presentation materials);
- Public open houses and technical briefings when appropriate.

Crucial elements of Excelsior's community relations efforts will involve ensuring consistent and ongoing communication with all stakeholders, and providing opportunities for meaningful two-way dialogue and active public involvement. Excelsior will focus on ensuring the public benefits related to the Gunnison Project, such as employment opportunities, supplier services, infrastructure development and community investment are optimized for the local community.

20.5 ECONOMIC BENEFITS

Excelsior commissioned an Economic Impact Study through Arizona State University's W. P. Carey School of Business which forecasts the increase in economic activity within Arizona during the construction phase and life of the mine. The study utilized an Arizona-specific version of the Regional Economic Models Inc. (REMI) regional forecasting model[7] to make projections about the direct benefit and multiplier effect of the Gunnison Project. The economic impact of mine development to surrounding communities and the State in General are outlined below.

- On average, during the lifetime of the Project, annualized Arizona jobs added is 819[8]. This employment creation includes 108 direct jobs created and 711 indirect "secondary" jobs, with employment increasing by 283 individuals within Cochise County.
- Employment benefits are distributed through many sectors. The largest impacts are in mining, construction, professional/technical services, and government sectors. Additional significant impacts are in real estate, retail trade, health care, and accommodation/food services among others.
- The annual average value added to Arizona's Gross State Product (GSP) during the entire Project life – pre-production, production and closure – is approximately $109 million with approximately $28 million added within Cochise County. The total addition to the GSP is $2.9 billion, with $757 million locally within Cochise County.

Economic modeling predicts the Project will have an average annual impact on state revenues of $10.9 million for a total impact of $295 million. Activity for Cochise County has been forecasted to average $3.6 million with a total impact for county revenues of $98 million. Note that the Economic Impact Study was based on the 2014 prefeasibility study and a 20-year production life. The current PFS is based on a revised resource estimate and a 24-year production life.

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[7] This study was based on a projected 20 year production phase. The current measured and indicated copper resource is planned for a 24 year production phase with similar pre- and post-production time periods.

[8] The values reported here reflect the "acid plant scenario" in which Excelsior constructs and manages an internal sulfuric acid production facility.

21 CAPITAL AND OPERATING COSTS

Capital and operating costs for the Gunnison Project were estimated on the basis of a feasibility level of design for Stage 1 of development and operation and prefeasibility level of design for Stages 2 and 3. These estimates included construction materials; construction and operating labor based on those designs; consumption of power, reagents, and consumables; budgetary quotes for major process and ancillary equipment; and estimates from other consultants for the Water Treatment Plant (WTP) and sulfuric acid plant.

21.1 CAPITAL COST

Capital cost (CAPEX) is divided into initial and sustaining capital costs. Sustaining capital costs include the ongoing year-by-year additions to wellfield development, construction of the Stage 2 and Stage 3 SX-EW plants, each adding 50 mppa of copper cathode capacity, the construction of a sulfur burning sulfuric acid and cogeneration plant, the addition of a WTP, and the addition of a railroad siding and railcar unloading facility.

The annual sustaining capital additions include drilling, piping, and cabling for wellfield and header house additions to new mining blocks, and major capital additions such as new ponds that don't fall in Year 3 for Stage 2 development or Year 6 for Stage 3 development.

Table 21-1: Summary of Capital Cost over Life of Project

Stage	Copper Production	Description	Total ($000s)
Initial Capital (Stage 1)	25 mppa	Initial Wellfield Development; JCM SX-EW improvements, Pipelines between wellfield & JCM; Gunnison Evaporation Pond; Powerline rerouting.	$46,941
Stage 2 (Year 3)	75 mppa	Gunnison 50 mppa SX-EW; 80 EW cells; New PLS, Raffinate ponds; Gunnison ancillary bldgs.;	$117,030
Stage 3 (Year 6 & 7)	125 mppa	Wellfield Expansion; Gunnison 50 mppa SX-EW; 80 EW cells; Water Treatment Plant (WTP); Clean & Recycled Water Ponds; Solids Ponds 1A & 1B; Wellfield expansion; Railroad Siding & Railcar Unloading	$147,254
Acid Plant (Years 5 & 6)		Sulfuric Acid Plant, Molten Sulfur Handling, Cogen Plant; Boiler Water Treatment (Optional)	$81,246
Sustaining Capital		All wellfield drilling costs after Stage 1	$309,961
Sustaining Capital		All wellfield infrastructure expansion after Stage 1, Solids Impoundments 2 & 3.	$86,596
Total		Initial & Sustaining Capital Cost	$789,028

A Basis of Capital Cost Estimate specification (160076-1027) was prepared by M3 (2016). It provides information regarding the sources of capital cost information, assumptions that were used in the estimation, exclusions, and project-specific conditions.

Some of the costs and quantity estimates used by M3 were provided by others.

- Veolia Water (2016) provided capital cost for equipment and construction of the Water Treatment Plant to treat water returned from rinsing operations in areas of the wellfield that have been depleted of economically recoverable copper.
- Kinley Exploration LLC (Kinley) provided cost estimates for installation and development of extraction, injection, and hydraulic control wells, as well as well abandonment costs for existing wells and core holes and production wells that have been rinsed and are out of service.

- NORAM Engineering & Constructors of Vancouver, B.C. in 2014 provided capital and operating cost for the acid plant to be constructed in Year 6 for operation in Year 7. Their original cost was based on a plant producing 1350 tons per day of concentrated sulfuric acid. This price was scaled up to a larger plant producing 1625 tons per day of sulfuric acid using the formula, R2/R1 to the power of 0.6.
- MHF Services, a railroad consulting company, estimated the capital costs to install a railroad siding off of the Union Pacific Southern Pacific railroad and rail transfer and unloading yard for deliveries of acid and/or sulfur.

21.1.1 Basis of Capital Cost

The capital cost estimates on which this feasibility study is based were prepared from a level of engineering commensurate with a +/- 15% level of accuracy. Among the components used for the capital cost estimates were the following items:

- Subsoil investigation
- Facilities Plot plan and site location maps
- Electronic Topography with a contour interval of 2 feet
- Plant, road railroad, and other site preparation drawings
- Final process flow sheets and process design criteria
- Final equipment selection and sizing
- Final general arrangement drawings
- Architectural design criteria
- Ancillary building general arrangements and elevations
- Development of final utility requirements and heat balances
- Final P&IDs and Design Criteria
- Substation design and specifications
- Final single line drawings
- Final motor list
- Material take-offs for civil, concrete, structural, piping, electrical, & instrumentation
- Original pricing for plant equipment and materials greater than 75%
- Development of estimate construction hours and labor rates by craft using sources like RS Means, Davis Bacon, and M3 internal historical data for installation and construction.
- Indirect costs based on M3 historical rates from domestic mining projects (described in Section 21.2.

Some parts of the capital cost estimates were based on third party consulting reports. These reports were prepared by:

- Kinley Exploration – Drilling & completion costs; well abandonment costs, well maintenance costs
- Veolia Water - Water Treatment Plant,

- NORAM Engineering & Constructors - Sulfuric acid plant
- MHF Consulting – Railroad siding and rail unloading yard

The estimates by Veolia, NORAM, and MHF Consulting were prepared at a prefeasibility level of detail but since they are not constructed until Year 6 at the earliest, their lower accuracy will not impact the overall feasibility study accuracy of +/- 15%. The WTP design will be evaluated again once the chemistry of rinse water is known to a better degree. The sulfuric acid plant is the only area where significant cost increases could occur based on sizing options that will be determined once the actual acid consumption is more thoroughly characterized by operational experience.

21.1.2 Initial Capital (Stage 1)

Initial capital costs for the Gunnison Project include the drilling and development of the Stage 1 wellfield, installation of a substation at the Gunnison wellfield, laying a set of 24" pipe lines for PLS and raffinate between the Gunnison wellfield and the Johnson Camp Mine (JCM), and minor improvements to the JCM plant. These improvements include the repair of an existing rectifier, and improvements to the JCM solvent extraction area and Control Room automation, additions of equipment to the JCM Tank Farm, relocation of the JCM power line, and upgrades to the JCM lab. Partitions will be placed in two of the existing JCM ponds to separate drain down from the existing JCM leach pads and process solutions from the Gunnison wellfield. An emergency generator will be installed at JCM in order to keep the leach pad recirculation pumps running in the event of a power outage. In addition, the Gunnison Evaporation Pond will be installed in Stage 1.

To develop the initial capital cost estimate, flowsheets were updated for the Stage 1 operation looking at opportunities to improve Johnson Camp's facilities. These flowsheets led to an updated equipment list, a revised three dimensional model, new general arrangement (GA) drawings, and new capital equipment quotations, and more accurate pricing for overland pipe runs. Electrical equipment and the new power line costs were built up from material take-offs while modifications to the Johnson Camp plant piping and electrical distribution were factored using allowances based on capital equipment cost.

The civil, concrete, and steelwork disciplines were estimated from GAs for improvements at the wellfield. Materials of construction were based on original quotes for piping, electrical, and instrumentation for this project and from recent M3 projects. Construction labor was adjusted for current Davis-Bacon prevailing shop wages in Arizona. M3 provided the design and cost estimate for modifications to the process ponds and evaporation pond at Johnson Camp. The accuracy range of the estimate is +15% to -15% suitable to support a Feasibility Study. Table 21-2 summarizes direct and indirect costs that make up the initial capital costs by Area.

Table 21-2: Initial Capital Costs

Area	Area Name	Cost ($000s)	Main Items
000	Plant General	516	Site Access Road; Gunnison communications
200	Wellfield Development	8,788	Contractor drilling; well abandonments; permanent drilling equipment
300	Wellfield Infrastructure	5,281	Header House installation; Wellfield piping & electrification, Tunnel beneath Interstate; Pipe Bridge across Walnut Wash
355	Solution Ponds (JCM)	3,726	Partition JCM ponds;
405	Solvent Extraction (JCM)	825	Instrumentation & Control upgrades; new control room;
505	Tank Farm (JCM)	1,368	Additional electrolyte filter; new crud centrifuge; new heat exchangers; additional contact water heater
605	Electrowinning (JCM)	2,474	Rebuild of ABB rectifier; replacement cathodes and anodes
660	Reclaim Water Systems	2,793	Gunnison Evaporation Pond; Mechanical evaporators; Power distribution
700	Main Substation (Gunnison)	984	Gunnison Substation installation;
705	Main Substation (JCM)	469	Emergency generator installation; minor upgrades
710	Transmission Line (Gunnison)	690	Metering station at existing 69 kV line; overhead line to Gunnison substation
715	Transmission Line (JCM)	325	Relocation of 69 kV line on JCM property
805	Reagents (JCM)	2,615	New sulfuric acid storage tank;
901	Security Building (Gunnison)	61	Power to portable security shack
904	Laboratory (JCM)	180	Analytical equipment upgrades to existing JCM lab
Freight		1,133	
	Total Direct Costs	**32,228**	
	Indirect Costs (excludes Area 200)	**4,421**	
	Contingency (15%)	**4,179**	
	Owners Costs	**5,468**	
	Total Stage 1 Capital Costs	**46,296**	

Note: Wellfield development drilling is carried in the Stage 1 capex but is carried in Sustaining Capital starting in Year 1.

21.1.3 Wellfield Drilling

Estimates for well drilling and completion for the Project use both contractor drilling rates and drilling costs based on owning and operating the drilling equipment in house. The Stage 1 wellfield drilling and completion costs have been estimated using contractor costs to reduce initial capital expenditures. The cost for purchasing drilling equipment has been deferred to Year 2. The initial wellfield initial capital cost covering Year -1 is estimated to be $9.4 million. This total covers 72,069 feet of drilling and completion of injection wells, recovery wells, hydraulic control wells, and monitoring wells. The estimated contractor cost, $99.35 per foot, is based on Kinley's estimate for drilling cost for wells using a contractor's drill rig at $80.00 per foot plus an amount for well supplies. These supplies include: well casing and installation materials, well pumps, drop pipes, cabling, and downhole instrumentation, sand, and cement. In Year -1, the cost for well supplies equates to 19.35/foot although each year, the cost of well supplies varies slightly depending on what is scheduled to be drilled. Over the life-of-mine, the cost of well supplies averages $20.42/foot.

For years after Year 2, Excelsior plans to self-perform drilling using its own fleet of drill rigs and support equipment. The capital cost in Year 3 for purchasing the drilling fleet and support equipment is $11.4 million. Kinley has prepared a detailed cost estimate for well drilling using labor build-ups per drill and service rig, hours and days of operation per rig, hours and costs per rig activity including drilling labor, drilling consumables (mud, drill bits, etc.), casing installation, cementing, integrity testing, hole surveying and geophysical testing, pump installation, and well abandonment costs. The cost of Owner supplied drilling averages $72.13/foot (excluding two outlier years). In Years 4 and 16, relatively little footage is drilled (a quirk of the current mine plan), so the fixed drilling crew labor costs skew the per foot costs to $177/foot and $305/foot, respectively. In practice, production drilling will be smoothed out to prevent these anomalies in drilling cost.

21.1.4 Wellfield Infrastructure

Initial wellfield infrastructure includes site roads, header houses, and central utility corridors that contain power, communications and piping infrastructure. Header houses are portable buildings from which piping and cabling to wells are distributed and instrumentation and communications is housed to control the wells and monitor flows. Header houses are connected to trunk piping by two sets of buried header pipes and to overhead electrical supply and communication backbone by buried cables. Header pipes carry raffinate, clean water, rinsate, and PLS solutions to and from the wellfield. Direct initial wellfield infrastructure costs are estimated to be $5.3 million.

Piping from the Gunnison wellfield will pass beneath Interstate 10 via one 60-inch casing that will be installed beneath the Interstate. A pond will be installed north of the Interstate so that the pipelines between JCM and the Interstate have somewhere to drain in the event that repairs to a line need to be made. South of the Interstate, pipelines can be drained into the PLS booster tank.

21.1.5 Gunnison Evaporation Pond

An Evaporation Pond will be constructed near the wellfield to receive and evaporate excess solutions generated by the ISR operation. The Evaporation Pond will be constructed with a double HDPE liner system with a LCRS system in accordance with prescriptive Arizona BADCT design requirements. Excess solutions including water pumped from hydraulic control wells, immature PLS solutions, raffinate, and reject water from the WTP will be discharged to the Evaporation Pond. Multiple mechanical evaporators will be used to enhance natural evaporation to dispose of the excess water. Direct costs for the construction of the Evaporation Pond are estimated to total $2.7 million.

21.1.6 Johnson Camp Plant Improvements

EMC intends to partition JCM PLS Ponds #1 and #3 into two segments to separate leach dump drain and runoff from Gunnison process solutions. A large, field erected PLS Booster Tank and accompanying pump station have been added at the Gunnison wellfield to collect and pump PLS PLS to the Johnson Camp ponds for processing and handling. The direct cost for these improvements is $3.7 million.

There are two existing transformer-rectifiers at the Johnson Camp Tankhouse, one for each group of EW cells. For Stage 1, the ABB transformer-rectifier will be repaired at an estimated direct cost of $928,500 for repair and reinstallation. The Macroamp transformer-rectifier replacement will be deferred until Stage 2.

In the Reagents area, a new 5,000-ton, sulfuric acid storage tank will be installed at Johnson Camp at a cost of $1.9 million. This tank will provide two weeks of undiluted sulfuric acid storage for Stage 1 wellfield production.

Other initial capital expenses include the relocation of the incoming 69 kV power line to Johnson Camp, building a substation on the Gunnison site to support the wellfield, and the addition of a crud centrifuge (tricanter) to the Tank Farm for cleaning organic and electrolyte solutions, and the addition of mobile equipment and light vehicles.

21.2 INDIRECT COSTS

Indirect capital costs were generally factored from the direct field cost. Below is a list of indirect items in the capital cost estimate:

- Indirect field mobilization is 1.5% of the direct field cost without mobile equipment.
- Temporary construction facilities is 0.5% of direct cost less mobile equipment.
- Construction power is 0.1% of direct cost less mobile equipment.
- Engineering Procurement and Construction management is 16.8% for Stages 2 and 3 of the direct cost plus the indirect cost listed above. Stage 1 EPCM was estimated to be 13.5% since Excelsior will self-perform much of the construction management.
- EPCM temporary facilities and utility setup were estimated as 0.5% of total constructed cost.
- Commissioning was estimated to cost 1% of plant equipment less mobile equipment.
- Vendor supervision is estimated as 1.5% of plant equipment costs during construction and 0.5% of plant equipment costs, each, for pre-commissioning and commissioning.
- Capital spare parts are estimated as 2.0% of plant equipment and commissioning spares are 0.5% of plant equipment.

Contingency for both wellfield development and plant improvements have been included at 20% of the total direct and indirect costs.

21.3 OWNER'S COSTS

Owner's costs include items for the initial capital cost that fall into the Owner's responsibility. Table 21-3 shows the estimated Owner's costs for the project. Because the Johnson Camp operation comes with existing offices, utilities, infrastructure and a trained supervisory labor force, many of the cost categories for Owner's costs will require minimal capital. The Owner's costs are estimated to be $5.5 million of which the largest item is the first fills three months of sulfuric acid for the wellfield ($2.0 million or 36%). Other major costs include:

- Replacing the diluent and extractant for the Johnson Camp settlers
- Sulfuric acid for electrolyte make-up
- Staffing build-up and training
- Construction insurance
- Vehicle replacements

Table 21-3: Owner's Cost

Item	Sub Section	Units	UOM	Unit Cost ($)	Total ($)
Staff Build-up	G&A	2	persons	$ 125,000	250,000
	Wellfield	2	persons	$ 85,000	170,000
	Process	2	persons	$ 85,000	170,000
Communications	Phone	12	months	$ 1,000	12,000
	Radio				0
	IT	0	lot	$ 50,000	0
Owner's Team Camp Costs	Food	0			0
	Temporary housing	0		$ -	0
	Power and water	300	days	$ 150	45,000
Temporary Sanitation	Portable toilets (daily) 180 days x 5 units	900	ea/day	$ 13.65	12,285
	Garbage Collection	12	months	$ 400	4,800
Offices	Temp on site (months)	0			0
	Off-site (months)	0		$ -	0
Admin Equipment, Office Furniture,	upgrades to existing equip.	0	lot	$ 100,000	0
Computers, Software		8	each	$ 4,000	32,000
Mine & Plant Shop Equipment	Small Tools (Admin)	1	lot	$ 100,000	100,000
Warehouse	Warehouse first fill	1	lot	$ 100,000	100,000
Reagents First Fills					
	Sulfuric Acid - Wellfield 3 months supply	16,000	ton	$ 125	2,000,000
	Sulfuric Acid - SX-EW	3,000	ton	$ 125	375,000
	Diluent	133,000	gallon	$ 2.18	289,940
	Extractant	27	m^3	$ 11,000	291,500
	Guar	1,000	gallon	$ 3.00	3,000
	Cobalt Sulfate	2,000	lb	$ 2.40	4,800
	FC 1100	1,000	lb	$ 15.00	15,000
Vehicles					
	2016 Chevrolet 2500 HD Crew LT 4wd	4	each	$ 41,500	166,000
	Used Ambulance	1	each	$ 30,000	30,000
	Cat TL1255 12,000 lb telehandler forklift	0	each	$ 190,000	0
	Cat ton forklift	1	each	$ 43,500	43,500
	Cat 420F backhoe	0	each	$ 114,000	0
	Used Cat 725 5000-gallon Water Truck	0	each	$ 250,000	0
	F250 Utility Trucks	2	each	$ 41,000	82,000
	McElroy Tracstar 630 Fusion Machine (14"-24")	1	ea	$ 205,500	205,500
Medical, Security & Safety	Medical Station Supplies	1		$ 50,000	50,000
	Safety Supplies	70		$ 150	10,500
Preproduction Employment & Training	Job Specific Training	35		$ 3,000	105,000
Owner Commissioning Team		2		$ 50,000	100,000
Construction Insurance		1	lot	$ 500,000	500,000
Software	Admin	1		$ 50,000	50,000
Corporate Services		0		$ 100,000	0
Environmental	Permitting Indirects	0		$ 50,000	0
	Compliance	0		$ 250,000	0
	Closure Bond	0		$ 500,000	0
Community Development		0		$ 50,000	0
ROW & Land Acquisition		1		$ 50,000	50,000
Addition Consultants		1		$ 100,000	100,000
Legal, Permits & Fees		1		$ 100,000	100,000
				Total	5,467,825

21.4 SUSTAINING CAPITAL COST

Sustaining capital costs include all capital expenditures that occur after production begins. Major plant expansions for Stage 2 in Year 3 and Stage 3 in Year 6 include the building of SX-EW facilities that handle 50 mppa of copper, each. Construction of the Gunnison site ancillary facilities, enlargement of the Gunnison electrical substation, construction of the Gunnison process ponds, and much of the plant infrastructure occur in Stage 2. Construction of the sulfuric acid plant in Year 6, the railroad siding and railcar unloading yard, and construction of the water treatment plant and related impoundments are captured in Stage 3.

The capital cost estimates for Stage 2 and Stage 3 have been handled similar to the Stage 1 initial capital cost estimate as discrete cost build-ups based on flowsheets, general arrangement drawings, material take-off for construction material quantities and capital equipment budgetary pricing.

In addition to the Stage 2 and Stage 3 plant constructions, there are the year-by-year capital costs associated with mostly with the expansion of the wellfield, wellfield infrastructure, and the addition of evaporation and solids ponds.

21.4.1 Year-by-Year Sustaining Capital

Annual sustaining capital costs include well construction, equipment replacement, and wellfield infrastructure development for new mining blocks. Wellfield sustaining capital costs accrue from continued well drilling and completion through Year 19 of the mine schedule. Beyond Year 19, there are wellfield equipment replacement costs that continue through Year 27. Wellfield infrastructure includes the addition of Header Houses for discrete mining blocks containing 45 to 60 wells. Each Header House plus the civil excavation, and trenching, piping and cabling to the wells represents approximately $700,000 in direct cost. In addition, there are annual incremental increases to the lateral piping that feeds the Header House headers and overhead 24.9 kV lines to each Header House. Table 21-4 summarizes the wellfield sustaining costs. Note that wellfield drilling represents 86% of the total wellfield sustaining capital costs.

Table 21-4: Wellfield Sustaining Capital Schedule (1000's)

Year	Wellfield Development ($000s)	Wellfield Infrastructure ($000s)	Ponds ($000s)	Other ($000s)	Total ($000s)	Main Items
1	2,556	925	26	0	3,507	1 Header House (HH); Lateral piping; 1 evaporator
2	2,367	2,227	0	0	4,595	1 HH; Lateral piping;
3	19,146	in Stage 2 capex			19,146	Purchase drilling fleet and support equipment
4	3,490	0	13	0	3,504	1 evaporator
5	13,221	4,894	0	0	18,116	5 HH; Lateral piping
6	11,026	in Stage 3 capex			11,026	drilling only
7	11,454	953	0	0	12,407	1 HH; Lateral piping;
8	14,001	2,337	0	0	16,338	2 HH; Lateral piping;
9	12,951	3,668	0	0	16,619	3 HH; Lateral piping;
10	8,452	1,159	3,906	0	13,517	1 HH; Lateral piping; Solids Impoundment #2A & #2B;
11	19,799	5,125	0	0	24,924	4 HH; Lateral piping;
12	7,191	1,159	0	0	8,349	1 HH; Lateral piping;
13	34,393	9,907	21,102		65,401	8 HH; Lateral piping; Solids Impoundment #3
14	7,067	0	0	0	7,067	drilling only
15	45,001	9,650	0	0	54,651	9 HH; Lateral piping
16	6,892	0	419	0	7,311	Lateral piping;
17	26,641	11,580	0	1,168	39,389	10 HH; Lateral piping; Jack & Bore Tunnel #2; Pipe bridge
18	11,751	0	0	0	11,751	drilling only
19	19,617	3,156	0	0	22,773	3 HH; Lateral piping;
20	25,673	900	0	0	26,573	1 HH; Lateral piping
21	1,433	0	0	0	1,433	well abandonments only
22	2,007	0	0	0	2,007	well abandonments only
23	1,223	0	0	0	1,223	well abandonments only
24	1,593	0	0	0	1,593	well abandonments only
25	736	0	0	0	736	well abandonments only
26	4				4	well abandonments only
27	4				4	well abandonments only
28					0	

21.4.2 Stage 2 SX/EW Plant Capital Costs

The construction of the Stage 2 SX-EW plant is scheduled to go into operation in Year 4. The plant includes three SX settlers, and a complete Tank Farm scaled for Stage 2 production, and an EW facility with 80 electrowinning cells and an Automatic Stripping Machine. The plant includes a PLS Pond, a Raffinate Pond, a Plant Run-off Pond, and a Recycled Water Pond. The Stage 2 Plant also includes a sulfuric acid storage area for acid that is trucked in, prior to making acid on site in Stage 3. Ancillary buildings include a Security Building with a truck scale, an Administration Building, a Change House, a Plant Warehouse, a Plant Maintenance Building, and a Wellfield Maintenance Building.

Stage 2 capital costs are summarized by Area in Table 21-5 below. The total cost of Stage 2 plant development is $125.1 million not including an additional $19.2 million for wellfield drilling development in Year 3, bringing to the total to $144.3 million. The 50 mppa copper production addition brings the total Gunnison Project capacity to 75 mppa.

Table 21-5: Stage 2 – 50 mppa SX-EW Plant Capital Cost

Area	Area Name	Cost ($000s)	Main Items
000	Plant General	4,453	Plantsite grading; Plant Runoff Pond; Sitewide Communications
300	Wellfield Infrastructure	5,308	3 Header Houses; Wellfield piping and electrical expansion
350	Solution Ponds (Gunnison)	7,204	PLS and Raffinate Ponds, VT Pumps, SS Piping, Electrical Distribution
400	Solvent Extraction (Gunnison)	12,634	3 settlers; 6 mix tanks and pumper-mixers; Loaded Organic Tank, SS piping; power distribution, instrumentation
500	Tank Farm (Gunnison)	8,354	Tankage; crud tricanter; electrolyte filters; heat exhangers
600	Electrowinning (Gunnison)	23,810	80 EW Cells; Production bridge crane, automated stripping machine;
605	Electrowinning (JCM)	2,031	Replacement of MacroAmp transformer-rectifier system
650	Fresh Water System	1,702	Clean Water Pond installation, potable water well and piping
655	Fire Water Systems	964	Installation of foam fire system; yard piping
660	Reclaim Water Systems	1,888	Installation of Recycled Water Pond
700	Main Substation (Gunnison)	5,622	Expansion of Gunnison Substation to power the SX-EW plant
710	Transmission Line (Gunnison)	246	Overhead line to Gunnison Plant
800	Reagents (Gunnison)	166	Diluent storage, pumping, and piping
810	Sulfuric Acid Storage (Gunnison)	4,065	Installation of 2 sulfuric acid storage tanks; piping, and containment
900	Ancillary Facilities - General	1,252	Installation of compressor, boiler, diesel feed pumps, piping and
901	Security Building (Gunnison)	90	New prefabricated security building
902	Truck Scale (Gunnison)	135	Installation of truck scale
903	Administration Bldg (Gunnison)	907	Pre-engineered metal building plus architectural, plumbing, electrical
905	Change House	1,046	Pre-engineered metal building plus architectural, plumbing, electrical
921	Plant Maintenance Bldg	666	Pre-engineered metal building plus architectural, plumbing, electrical
922	Wellfield Maintenance Bldg	1,779	Pre-engineered metal building plus architectural, plumbing, electrical
Freight		4,787	
	Total Direct Costs	**89,109**	
	Indirect Costs (excludes Area 200)	**19,113**	
	Contingency (15%)	**16,233**	
	Owners Costs	**667**	
	Total Stage 2 Capital Costs	**125,122**	
Note: Stage 2 Capex excludes $19.1 million needed for Year 3 drilling and acquisition of the drilling fleet.			

The Stage 3 Plant Expansion adds another 50 mppa in copper cathode capacity bringing the total plant capacity to 125 mppa. This expansion includes adding another 80 EW cells to the Gunnison tankhouse, three additional settlers to the SX circuit, additional tankage and electrolyte filters to the Tank Farm, and the addition of the Water Treatment Plant (WTP) and Solids Impoundments 1A & 1B. The WTP addition is discussed in detail below in Section 21.4.4. Also, the railroad siding and railcar unloading facility will be built during Stage 3. Table 21-6 summarizes the costs by Area for Stage 3 construction which comes to $150.2 million. This cost plus another $11.0 million for wellfield development brings the total for Stage 3 costs to $161.2 million.

Table 21-6: Stage 3 100 mppa Capital Costs

Area	Area Name	Cost ($000s)	Main Items
000	Plant General	17,529	Railroad siding and sulfur unloading yard; transloading platform
300	Wellfield Infrastructure	1,245	1 Header house; piping and electrical
350	Solution Ponds (Gunnison)	1,877	Additional PLS and Raffinate pumps
400	Solvent Extraction (Gunnison)	13,479	3 more settlers; 6 mix tanks, pumper-mixers, SS piping, electrical
500	Tank Farm (Gunnison)	5,627	Tankage; electrolyte filters; heat exhangers
600	Electrowinning (Gunnison)	19,604	80 EW Cells; Production bridge crane;
655	Fire Water Systems	374	Installation of foam fire system; yard piping
660	Reclaim Water Systems	4,929	Solids Impoundments #1A & #1B;
670	Water Treatment Plant	27,650	Water Treatment Plant capex
710	Transmission Line (Gunnison)	6,995	Tap off 230 kV power line and substation
800	Reagents (Gunnison)	186	Additional Diluent Tank
810	Sulfuric Acid Storage (Gunnison)	1,662	Additional Sulfuric Acid Storage Tank
811	Sulfuric Acid Rail Terminal	534	Railcar mover
812	Sulfuric Acid Plant Infrastructure	260	Sitework & Septic
900	Ancillary Facilities - General	164	Additional compressor
Freight		5,421	
	Total Direct Costs	**107,536**	
	Indirect Costs (excludes Area 200)	**23,048**	
	Contingency (15%)	**19,587**	
	Owners Costs	**0**	
	Total Stage 3 Capital Costs	**150,171**	
Note: Stage 3 Capex excludes $11.0 million needed for Year 6 drilling.			

21.4.3 Sulfuric Acid Plant

For the Base Case, a sulfuric acid plant is planned for construction in Year 6 to reduce the cost of sulfuric acid necessary to the ISR process and use the waste heat to generate electricity. In the Alternate Case, the sulfuric acid plant is omitted.

No additional engineering or estimating work has been done on the sulfuric acid since the 2014 PFS study (m3, 2014). The total installed capital cost for the sulfuric acid plant facility was estimated as $73.58 million. However, the acid demand in the current study calls for 1,625 mtpd to be produced whereas the acid plant in the plant design is for 1,350 mtpd, requiring a 20% increase in capacity. For the current study, the capital cost for the acid plant was factored higher using the following formula:

Acid Plant CAPEX @ 1625 mtpd = Acid Plant CAPEX @1350 mtpd x $(1,625/1,350)^{0.6}$

This "$(R_2/R_1)^{0.6}$" formula is a common rule-of-thumb used to scale capital costs for processing plants and equipment. This formula was used across the board for all components of the acid plant, rather than selectively for specific plant areas or equipment. The upsized sulfuric acid plant CAPEX is summarized in Table 21-7.

Table 21-7: Sulfuric Acid Capital Cost Summary

Area	Description	Capital Cost (X $000)
812	Sulfuric Acid Plant	$44,411
813	Molten Sulfur Handling	$1,799
814	Power Co-Generation Plant	$9,267
815	Boiler Water Treatment	$757
	Sub-Total Direct Cost	$56,234
	Indirect Field Cost (Mobilization)	$844
	Temporary Construction Facilities	$281
	Temporary Construction Power	$56
	Engineering, Procurement & Construction Management	$9,645
	Capital Spare Parts	$297
	Commissioning Spare Parts	$50
	Vendor Support	$297
	Contingency	$12,263
	Total Acid Plant Capital Cost	**$81,246**

The capital cost estimate for the sulfuric acid plant and associated facilities is an incremental cost to the estimate for the SX/EW facilities. Common facilities already included in the SX/EW estimate are not included in the sulfuric acid plant estimate.

21.4.4 Water Treatment Plant Addition

A water treatment plant (WTP) for the Gunnison Project is planned for construction in Year 7 to treat the water from rinsing depleted blocks of the ISR wellfield beginning in Year 8. Because of this timing the Water Treatment Plant cost was included in the Stage 3 expansion CAPEX.

A conceptual water treatment plant design was conducted by Veolia Water Technologies based on water quality and flow information provided to them from this project (Veolia, 2016). The capital cost estimate was developed assuming the project will be executed using a design-build (DB) approach. Major equipment costs to support the capital cost estimate are based on budgetary vendor quotes and Veolia's data from similar projects. Typical costs for engineering, procurement, and construction management are covered by a standard percentage of the construction cost. The non-binding estimate of probable cost, with an assumed accuracy of -15% to +30% (AACE Class 4 Estimate), is presented below for project planning and evaluation purposes only.

Budgetary Installed Capital Cost: $30,000,000

The approximate breakdown for the capital cost estimate is as follows:

Equipment Supply: $13,000,000

Construction/Installation: $14,000,000

Indirect Costs: $3,000,000

Note that indirect costs include engineering, procurement, project management, construction management, and startup/commissioning.

21.5 OPERATING COST

21.5.1 ISR Wellfield Operating Cost

Wellfield operating costs include labor, sulfuric acid, and consumables which are shown in Table 21-8 below. Initial wellfield operations involve injection of acidified raffinate from the SX-EW plant into injection wells, recovery of PLS from production wells, pumping the recovered PLS to a collection tank or pond for treatment in the Johnson Camp or Gunnison SX-EW plants, maintenance of the wells and wellfield, reconfiguring well equipment, and expanding piping, cabling, and instrumentation within the wellfield as required. Stage 1 wellfield production supports 3,800 gpm of PLS flow to Johnson Camp; Stage 2 production supports a combined PLS flow of 9,500 gpm to both plant; and Stage 3 supports up to 19,500 gpm of PLS flow.

Wellfield labor consists of operators who service the Header Houses, take samples of solutions, read instrumentation, and look after the wells. Wellfield maintenance personnel repair the wellfield piping, switch pipelines from leaching service to rinsing service, and replace faulty instrumentation. The wellfield labor grows from 17 personnel in Stage 1 to 29 personnel in Stage 2 to 33 personnel in Stage 3. Accordingly, the labor cost per lb drops from $0.033/lb Cu in Stage 1 to $0.016/lb Cu in Stage 2 to $0.012/lb Cu in Stage 3.

Electric power costs are proportional to the number of wells operating in the wellfield. While the total power cost attributed to the wellfield pumping increases with increasing production, the unit power cost remains the same; $0.027/lb Cu.

Costs shown are for example years of producing wellfield during each Stage.

When a mining block is completely leached, the wells will be reconfigured for groundwater rinsing, typically after four years of leaching operation. Rinsing will involve circulating fresh water through the mining block with periods of rest between circulations. Once rinsing has met permit conditions the wells will be abandoned, as described elsewhere.

Table 21-8: ISR Wellfield Operating Cost Breakdown

	Stage 1 (Year 3)		Stage 2 (Year 6)		Stage 3 (Year 9)	
Item	Annual cost ($000s)	Cost per lb. Cu	Annual cost ($000s)	Cost per lb. Cu	Annual cost ($000s)	Cost per lb. Cu
Wellfield Labor	818	0.032	1,180	0.016	1,542	0.012
Electrical power	706	0.028	1,997	0.027	3,403	0.027
Sulfuric Acid (Wellfield Make-up)	13,813	0.538	41,502	0.555	26,006	0.206
Maintenance	1,046	0.041	1,834	0.025	1,882	0.015
Supplies & Services	66	0.003	198	0.003	331	0.003
Total Wellfield Operating Costs	16,448	0.641	46,711	0.625	33,164	0.262

21.5.2 SX/EW Operating Cost

The operating cost for the combined SX/EW facilities averages $26.0 million per year or $0.220 per pound of copper produced for Stage 3 (Years 7 thru 20), not including G&A, water treatment costs, or evaporation ponds. Stage 1 plant operating costs average $7.3 million or $0.327 per pound. Stage 2 plant operating costs average $18.3 million per year or $0.261 per pound. Table 21-9 gives example years within Stages 1, 2, and 3 showing the breakdown of SX operating cost by operating labor, reagents, power, maintenance labor and spare parts, and operating supplies.

Table 21-9: Summary SW/EW Operating Cost

Category	Stage 1 (Year 3)		Stage 2 (Year 6)		Stage 3 (Year 9)	
	Annual cost ($000s)	Cost per lb. Cu	Annual cost ($000s)	Cost per lb. Cu	Annual cost ($000s)	Cost per lb. Cu
Operating Labor	$1,546	$0.060	$2,930	$0.039	$3,020	$0.024
Reagents	$1,027	$0.040	$3,202	$0.043	$4,316	$0.034
Electric Power	$3,154	$0.123	$8,435	$0.113	$13,450	$0.106
Maintenance Parts & Services[1]	$1,746	$0.068	$3,855	$0.052	$5,618	$0.044
Operating Supplies & Services	$201	$0.008	$513	$0.007	$802	$0.006
Total Operating Cost	**$7,674**	**$0.299**	**$18,934**	**$0.253**	**$27,207**	**$0.215**

[1] - Includes maintenance labor costs.

The labor cost for the SX/EW area is based on an average wage rate of $64,000 and 35% fringe benefits. Stage 1 starts with a staffing plan of 40 personnel for the Johnson Camp plant at an annual labor cost of $1.5 million. In Stage 2, the Gunnison SX-EW plant is placed into operation with an additional 27 plant personnel at a total annual labor cost of $4.6 million. For the Stage 3 addition to the Gunnison SX-EW plant, 4 additional cathode harvesters will be added, bringing the annual plant labor staff to 71 personnel. At full staffing the SX-EW plant will consist of 11 personnel in Operations Administration, 38 operations personnel, and 22 maintenance personnel. Table 21-10 lists the SX-EW plant operator and maintenance positions, rates, and quantity of personnel added for each Stage. The cost of labor is totaled for full production.

Table 21-10: SX-EW Operating Labor Cost Summary

Department and Position	Number Of Personnel	Annual Salary $	Benefits 35.0%	Annual Salary $	Benefits $	Total Annual Salary
Administration - Operations						
SXEW Manager	1	120,000	42,000	120,000	42,000	162,000
SXEW General Foreman	0	95,000	33,250	-	-	-
SX/EW Shift Supervisor	8	65,000	22,750	520,000	182,000	702,000
Leach Supervisor	0	65,000	22,750	-	-	-
Metallurgist	0	83,200	29,120	-	-	-
Administrative Assistant	2	32,000	11,200	64,000	22,400	86,400
SXEW Operations						
SX Operator	8	50,000	17,500	400,000	140,000	540,000
EW Operator	8	46,000	16,100	368,000	128,800	496,800
EW Helper	8	37,000	12,950	296,000	103,600	399,600
Laborer	14	33,500	11,725	469,000	164,150	633,150
SXEW Maintenance						
Maintenance Supervisors (Mech+Elec	2	80,000	28,000	160,000	56,000	216,000
Maintenance Planner	1	65,000	22,750	65,000	22,750	87,750
Shift Supervisor	0	65,000	22,750	-	-	-
SXEW Maintenance						
Mechanic/Welder	6	65,000	22,750	390,000	136,500	526,500
Mechanic Helper	6	52,000	18,200	312,000	109,200	421,200
Electrician	4	70,000	24,500	280,000	98,000	378,000
Instrument Tech	3	73,000	25,550	219,000	76,650	295,650
					-	
Total SXEW Plant	71					4,945,050

The annual cost of reagents for the SX-EW area is $4.3 million at the peak of production and includes extractant, diluent, cobalt sulfate, guar, mist suppressor (FC-1100), and sulfuric acid for electrolyte makeup. Sulfuric acid for the wellfield leaching is included in the wellfield operating cost estimate. The annual consumption of SX/EW reagents and cost for a typical year at full production is shown in Table 21-11 below.

Table 21-11: SX-EW Reagent Consumption and Costs

Cathode Copper Produced	126,432,538*	lbs. / year	
Reagent	Quantity per Year (lbs/yr)	Annual Cost	$ Cost / lb. Copper
Extractant	290,796	$1,387,967	0.110
Diluent	3,919,419	$1,959,709	0.0155
Sulfuric Acid (SX-EW plant)	27,815,229	$640,982	0..0051
Cobalt Sulfate	12,643	$50,573	0.0004
Guar	37,930	$218,097	0.0017
Mist Suppressor (FC 1100)	3,793	$59,133	0.0005
Total SX-EW Plant		$4,316,461	0.0341

*Totals for Year 9

The annual power cost for SX/EW, including the wellfield is $13.8 million at full 125 mppa plant capacity and is based on a power consumption of 1.028 kWh per lb of cathode copper produced and at a cost of power of $0.08/ kWh.

The annual cost for maintenance parts and services at peak of production is $5.6 million and is based on 5.0% of the SX/EW equipment cost.

Annual cost of operating supplies and services at peak production is $0.8 million and is approximately $0.006/lb of cathode copper produced.

21.5.3 General and Administrative Cost

Total annual general and administrative cost for the facility is $6.8 million, or $0.054 per pound of copper produced at peak production and an average of $0.33 per pound for Stage 1. The G&A labor is the largest component at $3.5 to 3.8 million per year, based on a staffing plan of 49 people total (43 people in Stage 1). Allowances were made for non-labor components of general and administrative expenses, which include office supplies, fuels, communications, small vehicle maintenance, claims assessments, legal and auditing, insurances, travel, meals and expenses, community relations, recruiting and relocation expenses, and janitorial services. The breakdown of G&A cost and labor detail is shown in Table 21-12 and Table 21-13.

Table 21-12: General and Administrative Cost Breakdown

	Year 3		Year 6		Year 9	
Cost Item	Annual Cost	Cost per lb	Annual Cost	Cost per lb	Annual Cost	Cost per lb
Processing Units Base Rate (lbs./year)	25,648,338		74,773,181		126,432,859	
Labor & Fringes	3,495,150	0.136	3,883,950	0.052	3,883,950	0.031
Accounting (excluding labor)	25,000	0.001	25,000	0.000	25,000	0.000
Safety & Environmental (excluding labor)	25,000	0.001	25,000	0.000	25,000	0.000
Human Resources (excluding labor)	25,000	0.001	25,000	0.000	25,000	0.000
Security (excluding labor)	25,000	0.001	25,000	0.000	25,000	0.000
Assay Lab (excluding labor)	300,000	0.012	300,000	0.004	300,000	0.002
Office Operating Supplies and Postage	40,000	0.002	40,000	0.001	40,000	0.000
Maintenance Supplies	193,691	0.008	400,459	0.005	400,459	0.003
Propane,Power	26,314	0.001	37,640	0.001	37,674	0.000
Communications	70,000	0.003	70,000	0.001	70,000	0.001
Small Vehicles	125,000	0.005	125,000	0.002	125,000	0.001
Claims Assessment	10,000	0.000	10,000	0.000	10,000	0.000
Legal & Audit	300,000	0.012	300,000	0.004	300,000	0.002
Consultants	150,000	0.006	150,000	0.002	150,000	0.001
Janitorial Services	50,000	0.002	50,000	0.001	50,000	0.000
Insurances	1,000,000	0.039	1,000,000	0.013	1,000,000	0.008
Subs, Dues, PR, and Donations	60,000	0.002	60,000	0.001	60,000	0.000
Travel, Lodging, and Meals	150,000	0.006	150,000	0.002	150,000	0.001
Recruiting/Relocation	125,000	0.005	125,000	0.002	125,000	0.001
Total General & Administrative Cost	6,195,155	0.242	6,802,048	0.091	6,802,083	0.054

Table 21-13: General and Administrative Labor Cost Summary

Department and Position	Number Of Personnel	Per Person		Crew		
		Annual Salary $	Benefits 35%	Annual Salary $	Benefits $	Total Annual Salary
General & Administrative						
General Manager	1	200,000	70,000	200,000	70,000	270,000
Administrative Assistant	1	34,000	11,900	34,000	11,900	45,900
			-	-	-	-
Community Affairs Manager	0	120,000	42,000	-	-	-
Com. Affairs Assistant	0	34,000	11,900	-	-	-
Admin Manager	0	120,000	42,000	-	-	-
Security Guard	12	30,000	10,500	360,000	126,000	486,000
Safety Manager	1	120,000	42,000	120,000	42,000	162,000
Safety Admin Assistant	0	34,000	11,900	-	-	-
Safety Specialist	1	65,000	22,750	65,000	22,750	87,750
HR Manager	1	120,000	42,000	120,000	42,000	162,000
HR Administrative Assistant	1	34,000	11,900	34,000	11,900	45,900
IT Technician	2	65,000	22,750	130,000	45,500	175,500
Controller	1	120,000	42,000	120,000	42,000	162,000
Senior Accountant	1	65,000	22,750	65,000	22,750	87,750
Accounts Payable	1	35,000	12,250	35,000	12,250	47,250
Cost Accounting	1	65,000	22,750	65,000	22,750	87,750
Payroll	0	35,000	12,250	-	-	-
Purchasing/Warehouse Manager	1	120,000	42,000	120,000	42,000	162,000
Purchasing Agent	1	55,000	19,250	55,000	19,250	74,250
Purchasing Assistant	1	34,000	11,900	34,000	11,900	45,900
Warehouse Supervisor	0	60,000	21,000	-	-	-
Warehouseman	4	45,000	15,750	180,000	63,000	243,000
Technical Manager	0	120,000	42,000	-	-	-
Administrative Assistant	1	34,000	11,900	34,000	11,900	45,900
Process Engineer	1	70,000	24,500	70,000	24,500	94,500
Planner	0	65,000	22,750	-	-	-
Surveyor/Technician	1	52,000	18,200	52,000	18,200	70,200
Environmental Manager	1	95,000	33,250	95,000	33,250	128,250
Environmental Engineer	1	70,000	24,500	70,000	24,500	94,500
Environmental Technician	1	52,000	18,200	52,000	18,200	70,200
Senior Geologist	1	75,000	26,250	75,000	26,250	101,250
Geologist	1	60,000	21,000	60,000	21,000	81,000
Junior Geologist	0	40,000	14,000	-	-	-
Metallurgist	2	75,000	26,250	150,000	52,500	202,500
Chief Chemist	1	85,000	29,750	85,000	29,750	114,750
Lab Technician	4	52,000	18,200	208,000	72,800	280,800
Sr. Hydrologist	1	85,000	29,750	85,000	29,750	114,750
Hydro Techs	2	52,000	18,200	104,000	36,400	140,400
Total General & Administration	49					3,883,950

21.5.4 Water Treatment Plant

An estimate of annual OPEX has also been developed based on vendor data, previous estimates for similar treatment systems and plant operating experience (Veolia, 2016). Major OPEX categories include labor, utility power, chemical reagents, process consumables, waste disposal and compliance sampling, analysis and reporting. Annual wages for operators and electrical power cost are site specific, and were provided by M3.

Line item costs for the general categories include the following:

Labor

- Maintenance technicians
- Environmental health and safety support

- Administrative support
- Engineering
- Environmental compliance support
- Utilities;
- Electrical power consumption based on estimate of online factor and connected loads

Process consumables and chemical reagents

- Lime
- Alum
- Flocculant
- Caustic (NaOH)
- Sulfuric Acid
- Hydrochloric Acid
- Filter Media
- Sodium Bisulfite
- Sodium EDTA
- Antiscalant
- Biocide

A summary of operating costs for the Water Treatment Plant is provided in Table 21-14.

Table 21-14: Water Treatment Plant Operating Cost Summary

Operating Cost	Minimum (Year 9)	Maximum (Year 21)	Life-of-Mine Costs
Labor	979	978	$18,596
Utility Power	231	699	$7,617
Chemicals	2,209	6,693	$72,894
Maintenance	127	386	$4,201
Total Operating Cost	3,546	8,757	$103,309

21.5.5 Sulfuric Acid Plant

The annual operating costs for the sulfuric acid plant, power plant, and associated facilities is $27.38 million or $46.45 per ton sulfuric acid and $0.32 per pound of copper produced. The acid plant operating costs are summarized in Table 21-15 below.

Table 21-15: Acid Plant Operating Costs

Annual Sulfuric Acid Production	589,475	tons / year	
Annual Copper Production	85,650,000	lbs. / year	
	Annual Cost (X $000)	Cost / ton Acid	Cost / lb. Copper
Labor	$1,803	$3.06	$0.02
Reagents	$24,090	$40.87	$0.28
Fuels (Propane)	$631	$1.07	$0.01
Power (Credit)	($7,032)	($11.93)	($0.08)
Maintenance	$4,486	$7.61	$0.05
Operating Supplies	$3,403	$5.77	$0.04
Total	$27,381	$46.45	$0.32

21.5.5.1 Labor

Labor cost is based on a staffing plan of 10 operators and 7 maintenance personnel. The operating crew consists of a general foreman and technician on day shift, five days per week, and a control room operator and field operator each shift seven days per week. The average annual wage rate is $73,129 plus 45% for fringe benefits. The wage rate is higher than the average in the SX/EW facility due to the limited mix of higher pay employees in the acid plant.

21.5.5.2 Reagents

Reagents needed for the sulfuric acid plant includes the sulfur required for acid production and water treatment chemicals for the cooling tower and boiler feed water systems. One ton of sulfur will produce a little over 3 tons of sulfuric acid. Based on a requirement of 589,475 tons of sulfuric acid annually, approximately 192,142 tons of sulfur will be required. The cost of sulfur used is $125.00 per ton delivered to site and is based on the average published cost for U. S. west coast sulfur and Houston sulfur over the last eleven years with freight allowed to the project site. An allowance of $30,000 per year was used for the water treatment chemicals.

21.5.5.3 Fuels (Propane)

Propane usage to fire the steam boiler at the sulfur unloading area is based on a boiler sized for 5 million BTU/hr. and a heat value for Propane of 92,500 BTU/gallon. It is assumed that the boiler would operate 16 hours per day. The cost for propane was set at $2.00 per gallon, the average of current wholesale and residential cost.

21.5.5.4 Power Credit

The power requirements to produce sulfuric acid was estimated to be 4,082 kW or $2.68 million annually at the cost of power of $0.080/ kWh. The turbine generator is expected to produce approximately 14.1 MW of power at a value of $9.89 million annually at the same cost of power. The excess power can displace purchased power for the SX/EW and leach facilities or sold back to the power company. The net power credit is $7.03 million annually. The power consumption and power produced were factored from existing in-house data on similar sulfur burning acid plants.

21.5.5.5 Maintenance

Annual maintenance cost for the sulfuric acid plant was estimated to be 4% of the installed cost of the acid plant or $3.2 million. The annual maintenance for the power plant was estimated to be $0.01 / kWh or $1.0 million. Total maintenance cost is $4.5 million annually. The maintenance cost includes an accrual for major repairs that will occur at intervals of 1.5 to 2 years.

21.5.5.6 Operating Supplies and Services

Operating supplies and services was estimated at 2.5% of the total installed cost of the acid plant and power plant or $2.03 million annually which equals $3.45/ton of acid.

Railroad services for unloading sulfur and operating the railcar unloading and storage facility is estimated to be $1.37 million annually which equals $2.33/ton of acid.

General and administration costs are included in the SX/EW costs. No additional G&A costs are required for the acid plant.

The total operating supplies and services estimate comes to $5.78/ton of acid produced.

21.6 RECLAMATION AND CLOSURE COST

In the 2014 Gunnison Copper PFS, reclamation and closure costs were accounted for in the financial model as sustaining capital costs. In the current FS, reclamation costs have been refined and are now accounted for as expenses (operating costs) with some concurrent well abandonment and JCM leach pad closure. The reclamation and closure costs used in the financial model are estimated to be $51.9 million. These costs are summarized in Table 21-16 below.

Four main components comprise the reclamation costs:

- Johnson Camp Mine, Ponds, Leach Pad & Waste Dumps
- Well Abandonment
- Gunnison Plant, Ponds, & Infrastructure
- Bond Fees

Table 21-16: Summary Reclamation and Closure Cost

Area	Reclamation & Closure Costs ($000s)
JCM Buildings, Ponds, Waste Dump & Heap	$ 5,580
Well Abandonment	$ 17,569
Gunnison Plant, Ponds	$ 18,917
Bond Fees	$ 8,334
Total	$ 50,400

In the case of the Johnson Camp Mine, M3 used the reclamation quantities developed by Bikerman (2008) in its NI 43-101 Feasibility Study for the reopening of the Johnson Camp Mine. M3 used its own labor hours and costs to develop the reclamation and closure cost for the Gunnison site.

Well abandonment is a concurrent closure activity that is captured by Kinley in its 2015 updated wellfield development cost estimate. The cost of well abandonment, $17.6 million excludes the abandonment of exploration holes that are captured in Year -1, which were capitalized as pre-production. The cost for rinsing is captured in the water treatment and comingled with wellfield operating costs although these costs could be considered reclamation and closure activities.

The Gunnison area reclamation and closure cost estimate includes closure estimates for each process and water treatment pond as well as an aggregate cost for demolition and reclamation of the Gunnison plant site. The reclamation cost includes dismantling all buildings and equipment and removing from the site. Above ground concrete will be demolished and removed from site or buried on site. Below ground concrete will remain and be covered.

Solution ponds will be drained and the top lining removed to inspect the bottom lining for leaks. If there is evidence of leaks, the bottom lining must be removed, the soil at the leak tested for contamination, and any required remediation performed before the pond can be covered. If no evidence of leaks is found, the top lining can be folded over in place and the pond covered. The ponds must be filled to form a mound to prevent storm water from collecting over the pond and migrating into the pond.

The plant site will be graded to existing contours. Roads will be left in place; however, asphalt will be removed. The plant site and solution and evaporation ponds will be hydro-seeded for plant growth.

The bond fees are non-refundable expenses for covering the cost of project bonding. The estimated amount is based on 3% annually of the amount bonded.

In the current study, the reclamation costs for the acid plant were not included in the financial model because the intention is for the acid plant to be operated as a going concern as separate business entity. The timing of reclamation of the acid plant is not likely to occur simultaneously with the reclamation and closure of the Gunnison Project.

22 ECONOMIC ANALYSIS

The financial evaluation presents the determination of the Net Present Value (NPV), payback period (time in years to recapture the *initial* capital investment), and the Internal Rate of Return (IRR) for the project. Annual cash flow projections were estimated over the life of the operation based on the estimates of capital expenditures and production cost and sales revenue. The sales revenue is based solely on the production of a copper cathode. The estimates of capital expenditures and site production costs have been developed specifically for this project and have been presented in earlier sections of this report.

22.1 WELLFIELD STATISTICS

Wellfield production is reported as soluble copper removed from the ISR operation. The annual production figures were obtained from the extraction plan as presented earlier in this report.

22.2 PLANT PRODUCTION STATISTICS

The design basis for the process plant for each stage is:

- Stage 1 – 4,860 gpm nameplate SX flow; 3,890 gpm nominal SX flow;
- Stage 2 – 14,610 gpm nameplate SX flow; 11,690 gpm nominal SX flow
- Stage 3 – 19,500 gpm nameplate SX flow; 15,600 gpm nominal SX flow
- 1.5 g/L recovered at the SX Plant.

Average annual full-rate production is projected to approximately be:

- Stage 1 – 25 million pounds
- Stage 2 – 75 million pounds
- Stage 3 - 125 million pounds

Total life of operation production is projected at approximately 2,165 million pounds of copper.

22.2.1 Copper Sales

The copper cathodes are assumed to be shipped to buyers in the US market, with sales terms negotiated with each buyer. The financial model assumptions are based on experience with copper sales from similar operations in the US.

22.3 CAPITAL EXPENDITURE

Capital expenditures for this project include the construction of the in-situ recovery (ISR) wellfield and solution extraction/electrowinning (SX/EW) plant. Initial capital items include expenditures that are necessary to bring the plant into production. The estimated initial capital for Stage 1 production is $46.9 million. Sustaining capital items includes wellfield expansion, construction of the Gunnison SX-EW plant in two stages (Stage 2 and Stage 3), several ponds for process solutions, and for storing solids from the water treatment plant, the construction of the water treatment plant, a sulfuric acid plant and a railroad siding and railcar unloading facility, and the replacement of capital equipment is estimated to be $741.8 million.

The Alternate Case was developed which does not included an acid plant to be constructed and reduces the sustaining capital cost by $81.2 million in Year 6 of operations. In the Alternate Case, the railroad siding and railcar unloading is still included.

22.3.1 Initial Capital

The financial indicators have been determined with 100% equity financing of the initial capital. Any acquisition cost or expenditures, such as property acquisition, permitting, and study costs, prior to project authorization have been treated as "sunk" cost and have not been included in the analysis.

The total initial capital carried in the financial model for new construction and pre-production wellfield development is expended over a 3-year period. The initial capital includes Owner's costs and contingency. The capital will be expended in the years before production and a small amount carried over into the first production year.

Table 22-1: Initial Capital Requirement (millions)

	Cost
Wellfield Development	$9.4
Wellfield Infrastructure	$5.3
SX-EW Plant Improvements	$11.0
Utility, Plant Infrastructure, and Ancillaries	$6.0
Indirect Costs	$5.6
Owner's Cost	$5.5
Contingency	$4.2
Initial Capital Cost	$46.9

Note: Slight differences between summation of line items and total are due to rounding.

22.3.2 Sustaining Capital

A schedule of capital cost expenditures during the production period was estimated and included in the financial analysis under the category of sustaining capital. The total life of operation sustaining capital is estimated to be $741.8 million. This capital will be expended during a 30-year period and consists of $309.7 million for wellfield development, equipment, and abandonment, wellfield infrastructure, $86.6 million for wellfield infrastructure development, $234.3 million to construct the Gunnison SX-EW plant in two stages and water/solids management ponds, $81.2 for an acid plant, $30.0 million for water treatment plant.

The Alternate Case leaves out the sulfuric acid plant, thereby reducing the sustaining capital by $81.2 million.

22.3.3 Working Capital

A 15-day delay of receipt of revenue from sales is used for accounts receivables. A delay of payment for accounts payable of 30 days is also incorporated into the financial model. In addition, working capital allowance of approximately $2.5 million for plant consumable inventory is estimated over Year -1 and Year 1. All the working capital is recaptured at the end of the mine life and the final value of these accounts is zero.

22.4 REVENUE

Annual revenue is determined by applying estimated metal prices to the annual payable metal estimated for each operating year. Sales prices have been applied to all life of operation production without escalation or hedging. The revenue is the gross value of payable metals sold before treatment charges and transportation charges. The copper prices used in the evaluation are $2.75/lb. for the life of the mine.

22.5 TOTAL OPERATING COST

The average Cash Operating Cost over the life of the operation is estimated to be $0.87 per pound of copper produced, excluding the cost of the capitalized pre-production leaching. Cash Operating Cost includes wellfield operations, process plant operations, water treatment, and general administrative cost. Table 22-2 below shows the estimated operating cost by area per pound of copper produced.

Table 22-2: Life of Operation Operating Cost – Base Case

Operating Cost	$/lb. Cu*
Wellfield	$0.30
SX-EX Plant	$0.23
Water Treatment	$0.05
General Administration	$0.08
Total Operating Cash Cost	$0.66
Royalties, Incidental Taxes (excludes Income Taxes), Reclamation, and Misc.	$0.21
Total Cash Cost	$0.87

Note: Any summation discrepancies are due to rounding.

Table 22-3: Life of Operation Operating Cost – Alternate Case

Operating Cost	$/lb. Cu*
Wellfield	$0.60
SX-EX Plant	$0.24
Water Treatment	$0.05
General Administration	$0.08
Total Operating Cash Cost	$0.97
Royalties, Incidental Taxes (excludes Income Taxes), Reclamation, and Misc.	$0.21
Total Cash Cost	$1.18

Note: Any summation discrepancies are due to rounding.

22.6 TOTAL CASH COST

Total Cash. Cost is the Total Operating Cost plus royalties, property and severance taxes, and reclamation and closure costs. The average Total Cash Cost over the life of the operation is estimated to be $0.87 per pound of copper produced for the Base Case and $1.18 for the Alternate Case, which is shown above.

22.6.1 Royalty

There are three entities that are entitled to royalties: the State of Arizona, Greenstone and Altius. The State has a sliding scale royalty between 2-8%. The royalty calculation takes into account the upper price limit based on the 60-month trailing average plus one standard deviation of the price and a lower price limit of $1.69 per pound. The sliding scale factor is estimated by dividing 6% by the difference of the annual upper price and the lower price. Then, the royalty is calculated by multiplying the sliding scale factor by the annual estimated price spread plus the minimum State royalty rate (2%).

The Greenstone royalty is paid at the rate of 3.0% of the value of copper produced, up 1% from 2015, while the Altius royalty is paid at a rate of 1.0% of the copper value produced.

Royalties for the life of the operation are estimated at $272.3 million and average $0.13 per pound of copper recovered.

22.6.2 Property and Severance Taxes

Property and severance taxes are estimated to be $90.7 million and average $0.04 per pound of copper recovered. Property taxes were estimated to be approximately $1.8 million per year during production, totaling $43.5 million for the life of the operation. Severance taxes are calculated as 2.5% of net proceeds before taxes from mining. Severance taxes are estimated to be approximately $56.4 million for the life of the operation.

22.6.3 Reclamation and Closure

Reclamation and closure costs include well abandonment costs for core holes and production wells, closure of process water impoundments, demolition of processing facilities and ancillary structures, and restoration of the land surface to pre-development conditions. The total cost for reclamation and closure is estimated to be $51.9 million and averages $0.02 per pound of copper recovered.

22.6.4 Income Taxes

Taxable income for income tax purposes is defined as metal revenues minus operating expenses, royalty, property and severance taxes, reclamation and closure expense, depreciation and depletion. The combined federal and state corporate income tax rate in Arizona is 39.53 percent and is applied to ‘taxable income’ derived from the Gunnison Project.

Income taxes are estimated by applying state and federal tax rates to taxable income. The primary adjustments to taxable income are tax depreciation and the depletion deduction. Income taxes estimated in this manner total $984.1 million for the life of the project.

22.6.5 Net Cash Flow

Net cash flow after all operating costs, capital costs and income taxes is estimated to be $ $2,356 million for the Base Case. Table 22-4 shows the project cash flow tabulation. The Alternate Case is estimated to be $1,945 million.

Base Case	Total	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
SXEW Operations																		
SX Flow Rate (gpm)	13,198	-	-	3,722	3,746	3,780	9,250	9,350	12,415	18,370	18,250	18,875	18,930	18,465	18,650	18,450	18,610	18,325
SXEW PLS (g/l)	1.50	-	-	1.004	1.573	1.551	1.428	1.851	1.373	1.561	1.567	1.527	1.513	1.548	1.522	1.542	1.533	1.564
Recovered Copper (klbs)	2,165,031	-	-	12,084	25,836	25,648	57,953	75,901	74,773	125,762	125,439	126,433	125,637	125,402	124,478	124,824	125,178	125,737
Payable Metals																		
Payable Copper (klbs)	2,165,031	-	-	12,084	25,836	25,648	57,953	75,901	74,773	125,762	125,439	126,433	125,637	125,402	124,478	124,824	125,178	125,737
Income Statement ($000)																		
Metal Prices																		
Copper ($/lb.)	2.75			2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75	2.75
Revenues																		
Copper Revenue ($ 000)	5,953,834			33,230	71,049	70,533	159,370	208,728	205,626	345,846	344,957	347,690	345,502	344,854	342,315	343,265	344,240	345,777
Sulfuric Acid ($ 000)	65,300			-	-	-	-	-	-	454	1,585	-	-	-	-	-	-	-
Total Revenues	6,019,134	-	-	33,230	71,049	70,533	159,370	208,728	205,626	346,299	346,542	347,690	345,502	344,854	342,315	343,265	344,240	345,777
Operating Cost																		
Well Field	641,274	-	-	6,790	10,105	12,711	37,012	32,326	52,203	29,986	27,373	33,023	32,472	30,322	33,325	29,744	31,933	30,418
SXEW Plant	496,735	-	-	5,395	7,706	7,674	16,453	19,100	18,934	27,121	27,079	27,207	27,105	27,075	26,956	27,000	27,046	27,145
Water Treatment Plant	112,929	-	-	-	-	-	-	-	-	-	3,954	3,546	4,367	5,391	4,885	5,664	5,338	5,327
General Administration	166,846	-	-	6,194	6,195	6,195	6,799	6,802	6,802	6,802	6,802	6,802	6,802	6,802	6,802	6,802	6,802	6,802
Total Operating Cash Cost	1,417,784	-	-	18,380	24,006	26,580	60,264	58,229	77,939	63,909	65,209	70,578	70,746	69,590	71,968	69,210	71,119	69,691
Other Expenses																		
Miscellaneous	43,301	-	-	242	517	513	1,159	1,518	1,495	2,515	2,509	2,529	2,513	2,508	2,490	2,496	2,504	2,515
Royalties	272,334	-	-	1,329	2,842	2,821	6,375	8,349	8,225	13,834	13,798	13,908	13,820	13,794	13,693	13,731	13,770	13,831
Property Tax	43,461			242	517	513	1,159	1,518	1,495	2,515	2,509	2,529	2,513	2,508	2,490	2,496	2,504	2,515
Severance Tax	56,412	-	-	178	572	534	1,207	1,839	1,555	3,463	3,450	3,397	3,367	3,369	3,265	3,351	3,339	3,363
Salvage Value	(6,210)			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Reclamation & Closure	50,400	-	147	147	213	213	213	335	335	335	335	335	335	693	4,154	963	1,019	2,052
Total Production Cost	1,877,481	-	147	20,518	28,667	31,175	70,377	71,788	91,044	86,571	87,809	93,274	93,293	92,462	98,059	92,247	94,254	93,967
Operating Income	4,141,653	-	(147)	12,713	42,382	39,358	88,993	136,940	114,582	259,728	258,733	254,416	252,208	252,392	244,256	251,018	249,987	251,810
Depreciation																		
Initial Capital	46,871			6,698	11,479	8,198	5,854	4,186	4,181	4,186	2,090	-	-	-	-	-	-	-
Sustaining Capital	741,817			501	4,860	24,371	34,817	35,078	59,142	72,124	62,271	51,657	39,763	36,009	34,258	29,820	25,884	26,679
	788,688			7,199	16,339	32,568	40,671	39,264	63,323	76,309	64,362	51,657	39,763	36,009	34,258	29,820	25,884	26,679
Net Income before Taxes	3,352,965	-	(147)	5,514	26,043	6,790	48,322	97,677	51,259	183,419	194,371	202,759	212,445	216,384	209,998	221,198	224,103	225,131
Income Taxes	995,765		-	1,023	6,073	1,335	9,645	26,227	10,124	51,964	56,278	59,526	63,485	65,080	62,706	67,077	68,168	68,483
Operating Income After Taxes	2,357,200	-	(147)	4,491	19,970	5,455	38,678	71,449	41,135	131,455	138,092	143,233	148,961	151,304	147,292	154,121	155,935	156,648
Cash Flow																		
Operating Income	4,141,653	-	(147)	12,713	42,382	39,358	88,993	136,940	114,582	259,728	258,733	254,416	252,208	252,392	244,256	251,018	249,987	251,810
Working Capital																		
AR/AP/Inventory	0	-	(1,000)	(1,355)	(1,092)	233	(882)	(2,196)	1,747	(6,934)	97	394	104	(68)	300	(266)	117	(180)
Reclamation Bond	0	-	(4,899)	-	(2,214)	-	-	(4,037)	-	-	-	-	-	(941)	-	1,389	-	-
Total Working Capital	(0)	-	(5,899)	(1,355)	(3,305)	233	(882)	(6,233)	1,747	(6,934)	97	394	104	(1,009)	300	1,124	117	(180)
Capital Expenditures																		
Initial Capital																		
Wellfield	14,643	-	13,911	732	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Process Plant	11,008	-	10,458	550	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Owners Cost	5,468	-	3,694	1,773	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Infrastructure	6,019	-	5,718	301	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Indirects	5,553	-	5,276	278	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Contingency	4,179	-	3,970	209	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sustaining Capital																		
Wellfield	309,691	-	-	2,556	2,367	19,146	3,490	13,221	11,026	11,454	14,001	12,951	8,452	19,799	7,191	34,393	7,067	45,001
Wellfield HH & Infrastructu	86,596			951	2,227	5,493	138	3,196	3,007	953	2,337	3,668	4,299	5,125	1,159	23,777	3,394	6,253
Process Plant	234,285			-	23,406	93,624	-	35,176	82,078	-	-		-	-		-	-	-
Acid Plant	81,246	-	-	-	-	-	-	16,249	64,997	-	-	-	-	-	-	-	-	-
Water Treatment Plant	30,000	-	-	-	-	-	-	-	9,000	21,000	-	-	-	-	-	-	-	-
Total Capital Expenditures	788,688	-	43,027	7,350	28,001	118,263	3,629	67,843	170,108	33,407	16,338	16,619	12,751	24,924	8,349	58,169	10,461	51,254
Cash Flow before Taxes	3,352,965	-	(49,073)	4,007	11,076	(78,672)	84,482	62,865	(53,778)	219,387	242,491	238,191	239,561	226,460	236,206	193,972	239,642	200,376
Cummulative Cash Flow before Taxes		-	(49,073)	(45,066)	(33,990)	(112,662)	(28,180)	34,684	(19,094)	200,294	442,785	680,976	920,538	1,146,997	1,383,204	1,577,176	1,816,818	2,017,194
				1.0	1.0	1.0	1.0	0.4	-	0.1	-	-	-	-	-	-	-	
Taxes																		
Income Taxes	995,765	-	-	1,023	6,073	1,335	9,645	26,227	10,124	51,964	56,278	59,526	63,485	65,080	62,706	67,077	68,168	68,483
Cash Flow after Taxes	2,357,200	-	(49,073)	2,985	5,003	(80,007)	74,837	36,637	(63,902)	167,424	186,213	178,665	176,077	161,380	173,500	126,895	171,474	131,893
Cummulative Cash Flow after Taxes		-	(49,073)	(46,088)	(41,086)	(121,093)	(46,256)	(9,619)	(73,521)	93,903	280,116	458,781	634,858	796,237	969,737	1,096,632	1,268,107	1,399,999
				1.0	1.0	1.0	1.0	1.0	1.0	0.4	-	-	-	-	-	-	-	-
Economic Indicators before Taxes																		
NPV @ 7.5%	7.5%	1,173,075																
IRR		**48.4%**																
Payback	Years	**4.5**																
Economic Indicators after Taxes																		
NPV @ 7.5%	7.5%	807,955																
IRR		**40.2%**																
Payback	Years	**6.4**																

Table 22-4: Financial Analysis – Base Case (Years -2 to 15)

Base Case	Total	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
SXEW Operations																	
SX Flow Rate (gpm)	13,198	18,376	15,236	18,383	16,381	12,950	16,260	10,620	8,584	3,960	-	-	-	-	-	-	-
SXEW PLS (g/l)	1.50	1.534	1.784	1.320	1.636	1.493	1.347	1.656	0.809	0.500	-	-	-	-	-	-	-
Recovered Copper (klbs)	2,165,031	123,629	119,198	106,406	117,549	84,787	96,102	77,143	30,447	8,686	-	-	-	-	-	-	-
Payable Metals																	
Payable Copper (klbs)	2,165,031	123,629	119,198	106,406	117,549	84,787	96,102	77,143	30,447	8,686	-	-	-	-	-	-	-
Income Statement ($000)																	
Metal Prices																	
Copper ($/lb.)	$ 2.75	$ 2.75	$ 2.75	$ 2.75	$ 2.75	$ 2.75	$ 2.75	$ 2.75	$ 2.75	$ 2.75	$ 2.75	$ -	$ -	$ -	$ -	$ -	$ -
Revenues																	
Copper Revenue ($ 000)	$ 5,953,834	$ 339,979	$ 327,796	$ 292,616	$ 323,261	$ 233,163	$ 264,280	$ 212,142	$ 83,729	$ 23,885	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Sulfuric Acid ($ 000)	$ 65,300	$ -	$ 4,542	$ -	$ 6,523	$ 6,526	$ -	$ 11,806	$ 13,530	$ 20,335	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Revenues	$ 6,019,134	$ 339,979	$ 332,338	$ 292,616	$ 329,784	$ 239,689	$ 264,280	$ 223,948	$ 97,258	$ 44,221	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Operating Cost																	
Well Field	$ 641,274	$ 31,837	$ 25,699	$ 30,678	$ 24,241	$ 23,742	$ 30,275	$ 18,565	$ 16,249	$ 9,532	$ 303	$ 180	$ 230	$ -	$ -	$ -	$ -
SXEW Plant	$ 496,735	$ 26,812	$ 26,112	$ 24,092	$ 25,702	$ 20,677	$ 22,250	$ 19,010	$ 10,856	$ 2,229	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Water Treatment Plant	$ 112,929	$ 5,301	$ 5,319	$ 5,384	$ 7,925	$ 7,932	$ 8,757	$ 7,361	$ 6,257	$ 5,251	$ 2,866	$ 2,484	$ 4,810	$ 4,810	$ -	$ -	$ -
General Administration	$ 166,846	$ 6,802	$ 6,802	$ 6,802	$ 6,802	$ 6,802	$ 6,789	$ 6,805	$ 6,789	$ 6,802	$ 1,360	$ 1,360	$ 1,360	$ 1,360	$ -	$ -	$ -
Total Operating Cash Cost	$ 1,417,784	70,751	63,933	66,956	64,670	59,154	68,070	51,741	40,151	23,815	4,529	4,024	6,401	6,171	-	-	-
Other Expenses																	
Miscellaneous	$ 43,301	$ 2,473	$ 2,384	$ 2,128	$ 2,351	$ 1,696	$ 1,922	$ 1,543	$ 609	$ 174	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Royalties	$ 272,334	$ 13,599	$ 13,112	$ 19,004	$ 24,192	$ 16,253	$ 16,965	$ 10,114	$ 4,021	$ 955	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Property Tax	$ 43,461	$ 2,473	$ 2,384	$ 2,128	$ 2,351	$ 1,696	$ 1,922	$ 1,543	$ 609	$ 174	$ 40	$ 40	$ 40	$ 40	$ -	$ -	$ -
Severance Tax	$ 56,412	$ 3,289	$ 3,285	$ 2,754	$ 3,245	$ 2,204	$ 2,386	$ 2,095	$ 677	$ 228	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Salvage Value	$ (6,210)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ (6,210)	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Reclamation & Closure	$ 50,400	$ 1,125	$ 857	$ 1,063	$ 805	$ 835	$ 1,501	$ 1,513	$ 1,750	$ 1,783	$ 6,838	$ 8,769	$ 1,839	$ 8,427	$ 1,471	$ -	$ -
Total Production Cost	$ 1,877,481	$ 93,710	$ 85,955	$ 94,033	$ 97,615	$ 81,837	$ 92,766	$ 68,549	$ 47,816	$ 20,920	$ 11,407	$ 12,833	$ 8,280	$ 14,638	$ 1,471	$ -	$ -
Operating Income	$ 4,141,653	$ 246,269	$ 246,383	$ 198,582	$ 232,169	$ 157,852	$ 171,515	$ 155,399	$ 49,442	$ 23,301	$ (11,407)	$ (12,833)	$ (8,280)	$ (14,638)	$ (1,471)	$ -	$ -
Depreciation																	
Initial Capital	$ 46,871	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sustaining Capital	$ 741,817	$ 28,026	$ 26,649	$ 27,147	$ 25,733	$ 25,618	$ 21,831	$ 15,935	$ 11,312	$ 22,332	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	$ 788,688	$ 28,026	$ 26,649	$ 27,147	$ 25,733	$ 25,618	$ 21,831	$ 15,935	$ 11,312	$ 22,332	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Net Income before Taxes	$ 3,352,965	$ 218,243	$ 219,734	$ 171,435	$ 206,436	$ 132,234	$ 149,684	$ 139,464	$ 38,130	$ 969	$ (11,407)	$ (12,833)	$ (8,280)	$ (14,638)	$ (1,471)	$ -	$ -
Income Taxes	$ 995,765	66,104	67,147	50,410	62,041	38,052	43,492	41,843	9,299	184	-	-	-	-	-	-	-
Operating Income After Taxes	$ 2,357,200	$ 152,139	$ 152,588	$ 121,026	$ 144,395	$ 94,182	$ 106,192	$ 97,621	$ 28,831	$ 784	$ (11,407)	$ (12,833)	$ (8,280)	$ (14,638)	$ (1,471)	$ -	$ -
Cash Flow																	
Operating Income	$ 4,141,653	$ 246,269	$ 246,383	$ 198,582	$ 232,169	$ 157,852	$ 171,515	$ 155,399	$ 49,442	$ 23,301	$ (11,407)	$ (12,833)	$ (8,280)	$ (14,638)	$ (1,471)	$ -	$ -
Working Capital																	
AR/AP/Inventory	$ 0	$ 325	$ (246)	$ 1,881	$ (1,715)	$ 3,249	$ (278)	$ 315	$ 4,254	$ 837	$ 2,732	$ (372)	$ -	$ -	$ -	$ -	$ -
Reclamation Bond	$ 0	$ 448	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,065	$ 2,877	$ 160	$ 2,859	$ 2,292	$ -
Total Working Capital	$ (0)	$ 774	$ (246)	$ 1,881	$ (1,715)	$ 3,249	$ (278)	$ 315	$ 4,254	$ 837	$ 2,732	$ 1,693	$ 2,877	$ 160	$ 2,859	$ 2,292	$ -
Capital Expenditures																	
Initial Capital																	
Wellfield	$ 14,643	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Process Plant	$ 11,008	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Owners Cost	$ 5,468	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Infrastructure	$ 6,019	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Indirects	$ 5,553	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Contingency	$ 4,179	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Sustaining Capital																	
Wellfield	$ 309,691	$ 6,892	$ 26,641	$ 11,751	$ 19,617	$ 25,673	$ 1,433	$ 2,007	$ 1,223	$ 1,593	$ 736	$ 4	$ 4	$ -	$ -	$ -	$ -
Wellfield HH & Infrastructu	$ 86,596	$ 3,816	$ 8,502	$ 4,246	$ 3,156	$ 900	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Process Plant	$ 234,285	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Acid Plant	$ 81,246	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Water Treatment Plant	$ 30,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Capital Expenditures	$ 788,688	$ 10,708	$ 35,143	$ 15,998	$ 22,773	$ 26,573	$ 1,433	$ 2,007	$ 1,223	$ 1,593	$ 736	$ 4	$ 4	$ -	$ -	$ -	$ -
Cash Flow before Taxes	$ 3,352,965	$ 236,334	$ 210,994	$ 184,465	$ 207,680	$ 134,528	$ 169,804	$ 153,707	$ 52,473	$ 22,545	$ (9,411)	$ (11,144)	$ (5,406)	$ (14,478)	$ 1,387	$ 2,292	$ -
Cummulative Cash Flow before Taxes		$ 2,253,528	$ 2,464,522	$ 2,648,987	$ 2,856,667	$ 2,991,196	$ 3,161,000	$ 3,314,707	$ 3,367,180	$ 3,389,725	$ 3,380,314	$ 3,369,170	$ 3,363,764	$ 3,349,286	$ 3,350,673	$ 3,352,965	$ 3,352,965
Taxes																	
Income Taxes	$ 995,765	$ 66,104	$ 67,147	$ 50,410	$ 62,041	$ 38,052	$ 43,492	$ 41,843	$ 9,299	$ 184	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Cash Flow after Taxes	$ 2,357,200	$ 170,230	$ 143,848	$ 134,056	$ 145,639	$ 96,476	$ 126,312	$ 111,864	$ 43,175	$ 22,361	$ (9,411)	$ (11,144)	$ (5,406)	$ (14,478)	$ 1,387	$ 2,292	$ -
Cummulative Cash Flow after Taxes		$ 1,570,230	$ 1,714,077	$ 1,848,133	$ 1,993,772	$ 2,090,248	$ 2,216,561	$ 2,328,424	$ 2,371,599	$ 2,393,960	$ 2,384,549	$ 2,373,405	$ 2,367,999	$ 2,353,521	$ 2,354,908	$ 2,357,200	$ 2,357,200
		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Economic Indicators before Taxes																	
NPV @ 7.5%	7.5%																
IRR																	
Payback	Years																
Economic Indicators after Taxes																	
NPV @ 7.5%	7.5%																
IRR																	
Payback	Years																

Table 22-4: Financial Analysis – Base Case (Years 16 to 31)

22.7 NPV AND IRR

The economic analysis for the Base Case before taxes indicates an Internal Rate of Return (IRR) of 57.9% and a payback period of 3.7 years. The Net Present Value ("NPV") before taxes is $1,203.9 million at a 7.5% discount rate. The economic analysis for the Base Case after taxes indicates that the project has an IRR of 45.9% with a payback period of 4.3 years. The NPV after taxes is $829.5 million at a 7.5% discount rate. Note that the payback period covers two major plant expansions that can be partially covered by operating profits. Only the initial capital cost will have to be completely financed through debt or equity.

Table 22-5 compares the financial indicators for the Base Case and the Alternate Case.

Table 22-5: Financial Indicators

	Base Case	Alternate Case
Years of Commercial Production	24	24
Total Copper Produced (million lbs)	2,165	2,165
LOM Copper Price (avg $/lb)*	$2.75	$2.75
Initial Capital Costs (million $)	$46.9	$46.9
Sustaining Capital Costs (million $)	$741.8	$660.6
Payback of Capital (pre-tax/post-tax)	4.5/6.4	4.4/4.9
Internal Rate of Return (pre-tax/post-tax)	48.4% / 40.2%	48.5% / 40.6%
Life of Mine Direct Operating Cost ($/pound Cu Recovered)	$0.65	$0.97
Life of Mine Total Production Cost ($/pound Cu Recovered)	$0.87	$1.18
Pre-tax NPV at 7.5% discount rate (million $)	$1173.1	$980.4
Post-tax NPV at 7.5% discount rate (million $)	$808.0	$693.7

**Price provided by Excelsior*

Table 22-6 compares the Base Case project financial indicators with the financial indicators when other different variables are applied. By comparing the results it can be seen that fluctuation in the copper price has the most dramatic impact on project economics. Fluctuation in the initial capital cost has the least impact on project economic indicators.

Table 22-6: After Tax Sensitivities – Base Case (with Acid Plant)

	Copper Price		
	NPV @ 7.5%	IRR%	Payback (yrs)
Base Case	$ 808.0	40.2%	6.4
20%	$ 1,115.7	51.7%	4.0
10%	$ 962.4	46.0%	4.6
-10%	$ 651.6	34.2%	6.9
-20%	$ 495.3	28.2%	7.4
	Operating Cost		
	NPV @ 7.5%	IRR%	Payback (yrs)
Base Case	$ 808.0	40.2%	6.4
20%	$ 735.6	36.7%	6.7
10%	$ 771.8	38.4%	6.6
-10%	$ 843.3	41.9%	5.3
-20%	$ 878.0	43.6%	4.9
	Initial Capital		
	NPV @ 7.5%	IRR%	Payback (yrs)
Base Case	$ 808.0	40.2%	6.4
20%	$ 802.7	38.5%	6.5
10%	$ 805.4	39.3%	6.5
-10%	$ 810.6	41.1%	6.4
-20%	$ 813.1	42.1%	6.4

Note: $ in millions

The Alternate Case economic after tax sensitivities are shown below in Table 22-7.

Table 22-7: After Tax Sensitivities – Alternate Case (no Acid Plant)

	Copper Price		
	NPV @ 7.5%	IRR %	Payback (yrs)
Base Case	$ 693.7	40.6%	4.9
20%	$ 1002.2	52.6%	4.0
10%	$ 848.0	46.7%	4.4
-10%	$ 536.3	34.1%	6.4
-20%	$ 378.4	27.3%	7.1
	Operating Cost		
	NPV @ 7.5%	IRR %	Payback (yrs)
Base Case	$ 693.7	40.6%	4.9
20%	$ 593.1	36.3%	6.3
10%	$ 643.7	38.5%	6.1
-10%	$ 742.4	42.6%	4.7
-20%	$ 791.0	44.6%	4.5
	Initial Capital		
	NPV @ 7.5%	IRR %	Payback (yrs)
Base Case	$ 693.7	40.6%	4.9
20%	$ 688.5	38.8%	5.0
10%	$ 691.1	39.6%	4.9
-10%	$ 696.3	41.6%	4.8
-20%	$ 698.8	42.7%	4.8

Note: $ in millions

23 ADJACENT PROPERTIES

The Gunnison Project lies within the porphyry copper metallogenic province of the southwestern United States. It is located in the Cochise Mining District, which is dominated by Cu-Zn skarns. With the acquisition of the Johnson Camp Mine, Excelsior now controls a majority of historical producing properties in the district. Tungsten and minor lead-silver-gold have been produced in adjacent properties in the district (Cooper and Silver, 1964). In particular, tungsten has been historically produced in the area west of the Gunnison Project in the northern half of the Texas Canyon quartz monzonite stock before and during World War I. Lead-silver was also historically produced from Paleozoic limestones in the Gunnison Hills east of the Gunnison Project in the early 1900s (Cooper and Silver, 1964). Mineralization on adjacent properties is not necessarily indicative of the mineralization on the Gunnison Project. The author has relied on reports by others (as referenced) for the information presented in this section and has been unable to verify the information.

24 OTHER RELEVANT DATA AND INFORMATION

24.1 PROJECT EXECUTION PLAN

24.1.1 Introduction

This section of the report provides the Project Execution Plan which forms the basis of the project schedule and capital cost estimate. The execution plan covers the period commencing with the preparation of the feasibility study and finishing with plant commissioning and first production.

Excelsior will advance the Gunnison Project in three plant stages, 25 MM lb/yr, 75 MM lb/yr, and 125 MM lb/yr, with each stage commencing production in Years 1, 4, and 7, respectively. Stage 1 production is presently scheduled to commence in mid-2018 by completing a number of tasks (Table 24-1). These include receiving permits to operate the mine and finally constructing the Stage 1 wellfield and infrastructure improvements to use the existing plant at the Johnson Camp Mine. The Aquifer Protection Permit and Underground Injection Control Permit applications have already been. Under the current schedule, wellfield drilling and construction will commence in late 2017.

Table 24-1: Gunnison Project Execution Plan

	2015				2016				2017				2018			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Permitting			🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩						
Complete Feasibility								🟪								
Receive Permits										🟪						
Basic Engineering											🟩					
Long Lead time Procurement										🟩	🟩					
Construct Stage 1 Facility											🟩	🟩	🟩			
Plant Commissioning													🟪			
First Commercial Production														🟪		

24.1.2 Description

The Project Execution Plan describes, at a high level, how the Project will be carried out. This plan contains an overall description of what the main work focuses are, Project organization, the estimated schedule, and where important aspects of the Project will be carried out.

The Project execution proposed incorporates an integrated strategy for engineering, procurement and construction management (EPCM). The primary objective of the execution methodology is to deliver the Project at the lowest capital cost, on schedule, and consistent with the Project standards for quality, safety, and environmental compliance.

24.1.3 Objectives

The Project execution plan has been established with the following objectives:

- To maintain the highest standard of safety so as to minimize incidents and accidents;

- To design and construct a process plant, together with the associated infrastructure, that is cost-effective, achieves performance specifications and is built to high quality standards;
- To design and operate the wellfield using proven methodologies and equipment;
- To optimize the project schedule to achieve an operating plant in the most efficient and timely manner within the various constraints placed upon the Project; and
- To comply with the requirements of the conditions for the construction and operating license approvals.

24.1.4 Plan of Approach

24.1.4.1 Philosophy

This section describes the execution plan for advancing the Gunnison Copper Project from the current Feasibility Report stage to production. The project execution plan will ensure that key project processes and procedures are in place that will:

- Develop a Project Schedule beginning with the feasibility study through Permitting, Construction and Commissioning;
- Consider significant project logistics;
- Develop and implement site communications and construction infrastructure;
- Plan for early construction mobilization;
- Develop and execute project control procedures and processes;
- Perform constructability reviews;
- Implement project accounting and cost control best practices;
- Issue a cost control plan and a control budget; and
- Oversee project accounting.

Excelsior intends to utilize an Engineering, Procurement and Construction Management (EPCM) approach utilizing multiple hard money and low unit cost prime contracts for CM, as the recommended method for executing the Project. The capital cost estimate is based on this methodology. Wellfield development pre-production work activities as well as site road construction will be performed by contractors selected through a pre-qualification and pre-tending process. Because the Project is located in an area with an abundance of qualified contractors, construction is to be performed by Arizona and Southwest US-based companies.

Some items affecting the Project are:

- Ability to start work that does not require engineering;
- Availability of construction and engineering resources;
- Experience of the qualified firms considered and their typical and proposed approach;
- An approach that utilizes the best resources available (matching contractors to the size of each contract)

The majority of mechanical and electrical equipment required for the Project will be procured within North America. Concrete and building construction materials will be sourced locally in the southern Arizona. Structural and miscellaneous steel, piping, tanks, electrical and miscellaneous process equipment will be sourced within the US, and to the extent practical, within the region.

24.1.4.2 Engineering

The detailed engineering schedule is based on interim permitting approval to be granted in early 2017 with Basic Engineering starting in Q2 of 2017, and full EPCM release in Q3 of 2017.

Engineering will be done to match the plant protocol for drawing titles, equipment numbers and area numbers. Design will produce drawings in the Imperial System of Units (English) format. Drawings and specifications will be done in English.

A site conditions specification has been completed to ensure that suppliers and contractors are aware of the site conditions. Individual equipment specifications will be done.

Engineering control will be maintained through drawing lists, specification lists, equipment lists, pipeline lists and instrument lists. Control of Engineering Requisitions for Quote (ERFQ) will be performed through an anticipated purchase orders list. Progress will be tracked through the use of the lists mentioned.

Concrete reinforcing steel drawings will be done using customary bar available in the US. Reinforcing bar will be fully detailed to allow either site or shop fabrication.

Structural steel will be detailed by M3 using TEKLA software. Mechanical steel will be dictated by M3 utilizing either Inventor or TEKLA. This will allow fabrication of steel prior to the award of steel installation contracts.

Owner review of engineering progress and design philosophy will be an ongoing process.

24.1.4.3 Procurement

Procurement of long delivery equipment and materials will be scheduled with their relevant engineering tasks. This will ensure that the applicable vendor information is incorporated into the design drawings and that the equipment will be delivered to site at the appropriate time and supports the overall project schedule.

Procurement of major process equipment will be by the EPCM contractor, acting as Agent for Excelsior through the use of owner-approved purchase order forms. This will include the equipment in the equipment list as well as the process control instrumentation in the instrument list. Some instruments will be part of vendor equipment packages. In addition, structural steel, electrical panels, electrical lighting, major cable quantities, specialty valves and special pipe will be purchased. Contractors will be responsible for the purchase of common materials only.

Equipment and bulk material Suppliers will be selected via a competitive bidding process. Similarly, construction contractors will be selected through a pre-qualification process followed by a competitive bidding process. It is envisaged that the Project will employ a combination of lump sum and unit price contracts as appropriate for the level of engineering and scope definition available at the time contract(s) are awarded.

It is intended that equipment will be sourced on a world-wide basis, assessed on the best delivered price and delivery schedule, fit-for-purpose basis.

Equipment will be purchased FOB at the point of manufacture or nearest shipping port for international shipments. A logistics contractor will be selected to coordinate all shipments of equipment and materials for the Project and arrange for ocean and overland freight to the job site.

The EPCM contractor will be responsible for the receipt of the major equipment and materials at site. The equipment and materials will be turned over to the installation contractor for storage and safe keeping until installed. Bulk piping and electrical materials and some minor equipment will be made part of the construction contracts, and as such will be supplied by the various construction contractors. It is expected that each construction contractor provide for the receipt, storage, and distribution of materials and minor equipment they purchased.

The EPCM contractor will establish a list of recommended pre-qualified vendors for each major item of equipment for approval by Excelsior. The EPCM contractor will prepare the tender documents, issue the equipment packages for the bid, prepare a technical and commercial evaluation, and issue a letter of recommendation for purchase for approval by Excelsior. Excelsior through the assistance of the EPCM contractor will conduct the commercial negotiations with the recommended vendor and advise the EPCM contractor of the negotiated terms for preparation of the purchase documents. When approved, the EPCM contractor will issue the purchase order, track the order, and expedite the engineering information and delivery of the equipment to the site.

24.1.4.4 Inspection

The EPCM contractor will be responsible to conduct QA/QC inspections for major equipment during the fabrication process to ensure the quality of manufacture and adherence to specifications. Levels of inspection for major equipment will be identified during the bidding stage, which may range from receipt and review of the manufacturer's quality control procedures to visits to the vendor's shops for inspection and witnessing of shop tests prior to shipment of the equipment. Where possible, inspectors close to the point of fabrication will be contracted to perform this service in order to minimize the travel cost for the Project. Some assistance may also be provided by the EPCM engineering design team.

24.1.4.5 Expediting

The EPCM contractor will also be responsible to expedite the receipt of vendor drawings to support the engineering effort as well as the fabrication and delivery of major equipment to the site. An expediting report will be issued at regular intervals outlining the status of each purchase order in order to alert the Project of any delays in the expected shipping date or issue of critical vendor drawings. Corrective action can then be taken to mitigate any delay.

The logistics contractor will be responsible to coordinate and expedite the equipment and material shipments from point of manufacture to site, including international shipments through customs.

24.1.4.6 Project Services

The EPCM contractor will be responsible for management and control of the various Project activities and ensure that the team has appropriate resources to accomplish Excelsior's objectives.

24.1.5 Construction

24.1.5.1 Construction Methodology

The Stage 1 construction program is scheduled to start in Q3 2017. The work includes project access road development, drilling and infrastructure for the first wellfield mining block, installation of PLS collection tankage and overland piping, tunneling beneath Interstate 10, and minor construction improvements at the Johnson Camp Mine. The entire construction period for Stage 1 is approximately 9 months.

Stage 2 and Stage 3 construction will consist of conventional disciplines to erect the Gunnison SX-EW plant. Stage 2 and Stage 3 construction work are each scheduled for approximately 12 months from mobilization to the commencement of commissioning. Earthworks associated with the well field and related facilities will commence as soon as the contractor can be mobilized to the field, after the permits have been released. This work will include completion of the surface diversions, process building foundations and process ponds.

24.1.5.2 Construction Management

Construction Management will be done as Agent for Excelsior using prime contracts for civil/concrete and structural/mechanical/electrical/piping/instrumentation. The contracting plan is based on utilizing local contractors to execute the construction work packages to minimize mobilization and travel costs. The EPCM contractor will pre-qualify local contractors and prepare tender documents to bid and select the most qualified and cost effective contractor for the various work packages. Some work packages will include the design, supply, and erection for specific facilities which are specialized in nature. The EPCM contractor will be comprised of individuals capable of coordinating the construction effort, supervising and inspecting the work, performing field engineering functions, administering contracts, supervising warehouse and material management functions, and performing cost control and schedule control functions. These activities will be under the direction of a resident construction manager and a team of engineers, and locally hired supervisors, and technicians. There would also be a commissioning team to do final checkout of the Project.

Some site services will be contracted to third party specialists, working under the direction of the resident construction manager. Construction service contracts identified at this time include the following:

- Field survey services;
- QA/QC testing services; and
- Site security (If required).

24.1.6 Contracting Plan

Contracting is an integral function in the Project's overall execution. Contracting for the Gunnison Copper Project will be done in full accord with the provisions of the Excelsior/EPCM contract.

A combination of vertical, horizontal, and design construct contracts may be employed as best suits the work to be performed, degree of engineering and scope definition available at the time of award. Concrete batch plants in Benson and/or Willcox, Arizona should adequately supply concrete to all construction contractors. There will not be a dedicated construction camp as temporary residential facilities exist in both Benson and Willcox.

The civil/concrete contract will cover all clearing, grubbing, bulk excavation, engineered fill, geomembrane lining, and all concrete forming, rebar, and placement. This approach will result in economy of scale and eliminate interfacing issues which would arise if multiple contractors were employed. The contractor will require only one major mobilization for all work.

As part of the contracting strategy, a list of proposed contract work packages has been developed to identify items of work anticipated to be assembled into a contract bid package. Depending upon how the Project is ultimately executed and the timing, several work packages may be combined to form one contract bid package. The following table represents the Proposed Contract Work Package list:

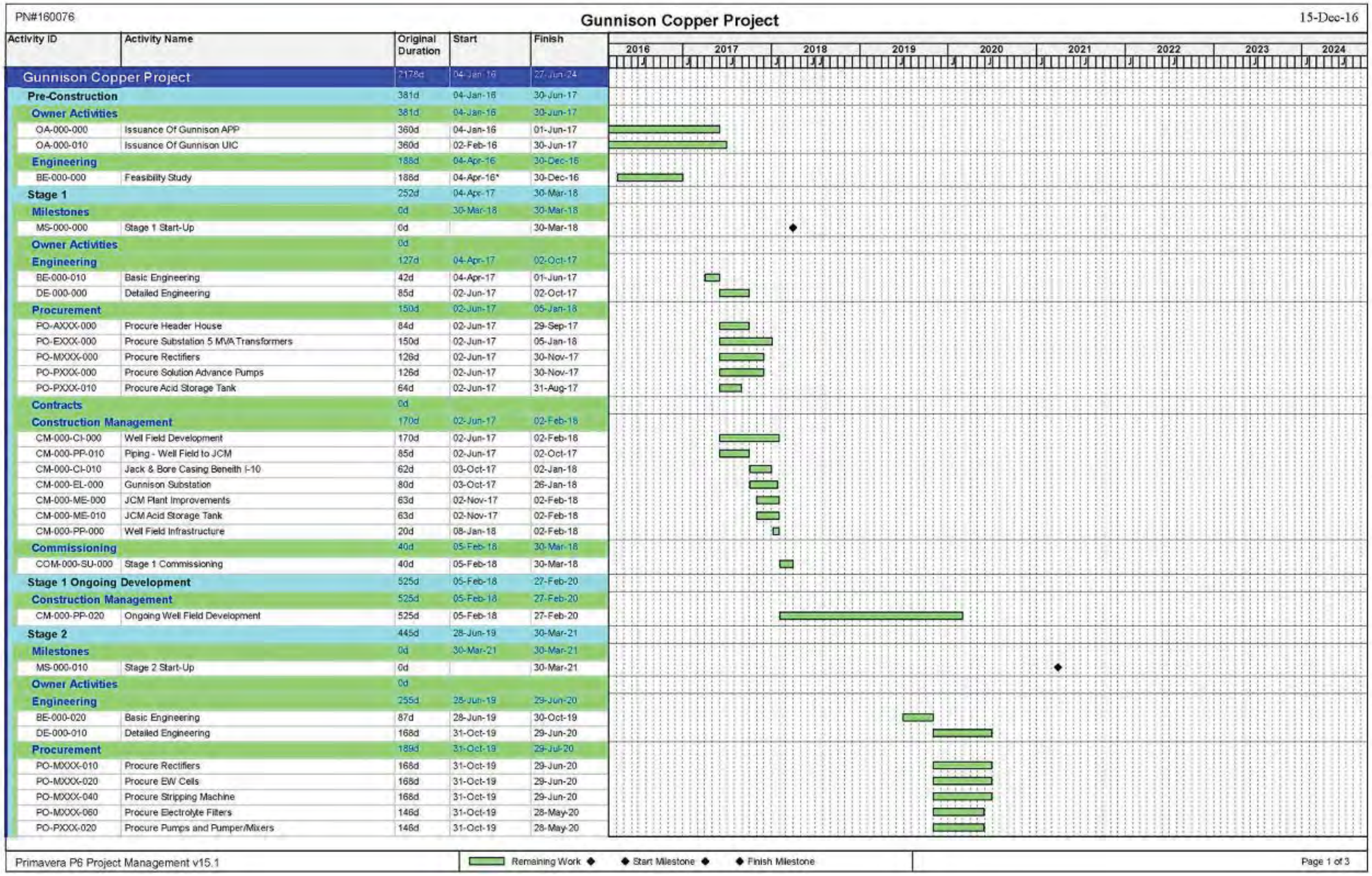
Table 24-2: Proposed Contract Work Package List for Stage 1

No.	Bid Packages:	Comments
1	Well Drilling and Completion Contract	Wellfield Development
2	Jack & Bore Contract	Run Pipe Casing beneath Interstate 10
3	69 kV & 24.9 kV Power Lines & 69 kV Gunnison Substation	
4	Gunnison Field Piping & Electrical Distribution	Includes installation of Header House
5	Overland HDPE Piping from Wellfield to JCM	
6	Field Erected Tanks at Gunnison & JCM	
7	Mechanical/Electrical Work at JCM	Repair Re-Install ABB Rectifier, Tank Farm Improvements
8	Instrumentation/Communications in Wellfield and at JCM	SX automation; new control room; HH communications with JCM plant.

24.1.7 Project Schedule

At the present time, the study has developed a sequence of effort that should be followed as well as an estimated schedule through which the Project will likely proceed. The schedule is comprised of Milestones, Feasibility Study, Permitting, Basic Engineering & Long-lead Procurement, Detail Engineering and Construction & Start Up activities. The schedule (by component) is shown at the end of this section.

The key milestone assumptions that drive the schedule are the completion of environmental permitting in Q2 of 2017 leading to a full project release in Q3 of 2017. Figure 24-1 is a Gantt Chart for construction of Stages 1 through 3 including the Water Treatment Plant in Year 7.



PN#160076

Gunnison Copper Project

15-Dec-16

Activity ID	Activity Name	Original Duration	Start	Finish
Gunnison Copper Project		2178d	04-Jan-16	27-Jun-24
Pre-Construction		381d	04-Jan-16	30-Jun-17
Owner Activities		381d	04-Jan-16	30-Jun-17
OA-000-000	Issuance Of Gunnison APP	360d	04-Jan-16	01-Jun-17
OA-000-010	Issuance Of Gunnison UIC	360d	02-Feb-16	30-Jun-17
Engineering		188d	04-Apr-16	30-Dec-16
BE-000-000	Feasibility Study	188d	04-Apr-16*	30-Dec-16
Stage 1		252d	04-Apr-17	30-Mar-18
Milestones		0d	30-Mar-18	30-Mar-18
MS-000-000	Stage 1 Start-Up	0d		30-Mar-18
Owner Activities		0d		
Engineering		127d	04-Apr-17	02-Oct-17
BE-000-010	Basic Engineering	42d	04-Apr-17	01-Jun-17
DE-000-000	Detailed Engineering	85d	02-Jun-17	02-Oct-17
Procurement		150d	02-Jun-17	05-Jan-18
PO-AXXX-000	Procure Header House	84d	02-Jun-17	29-Sep-17
PO-EXXX-000	Procure Substation 5 MVA Transformers	150d	02-Jun-17	05-Jan-18
PO-MXXX-000	Procure Rectifiers	126d	02-Jun-17	30-Nov-17
PO-PXXX-000	Procure Solution Advance Pumps	126d	02-Jun-17	30-Nov-17
PO-PXXX-010	Procure Acid Storage Tank	64d	02-Jun-17	31-Aug-17
Contracts		0d		
Construction Management		170d	02-Jun-17	02-Feb-18
CM-000-CI-000	Well Field Development	170d	02-Jun-17	02-Feb-18
CM-000-PP-010	Piping - Well Field to JCM	85d	02-Jun-17	02-Oct-17
CM-000-CI-010	Jack & Bore Casing Beneith I-10	62d	03-Oct-17	02-Jan-18
CM-000-EL-000	Gunnison Substation	80d	03-Oct-17	26-Jan-18
CM-000-ME-000	JCM Plant Improvements	63d	02-Nov-17	02-Feb-18
CM-000-ME-010	JCM Acid Storage Tank	63d	02-Nov-17	02-Feb-18
CM-000-PP-000	Well Field Infrastructure	20d	08-Jan-18	02-Feb-18
Commissioning		40d	05-Feb-18	30-Mar-18
COM-000-SU-000	Stage 1 Commissioning	40d	05-Feb-18	30-Mar-18
Stage 1 Ongoing Development		525d	05-Feb-18	27-Feb-20
Construction Management		525d	05-Feb-18	27-Feb-20
CM-000-PP-020	Ongoing Well Field Development	525d	05-Feb-18	27-Feb-20
Stage 2		445d	28-Jun-19	30-Mar-21
Milestones		0d	30-Mar-21	30-Mar-21
MS-000-010	Stage 2 Start-Up	0d		30-Mar-21
Owner Activities		0d		
Engineering		255d	28-Jun-19	29-Jun-20
BE-000-020	Basic Engineering	87d	28-Jun-19	30-Oct-19
DE-000-010	Detailed Engineering	168d	31-Oct-19	29-Jun-20
Procurement		189d	31-Oct-19	29-Jul-20
PO-MXXX-010	Procure Rectifiers	168d	31-Oct-19	29-Jun-20
PO-MXXX-020	Procure EW Cells	168d	31-Oct-19	29-Jun-20
PO-MXXX-040	Procure Stripping Machine	168d	31-Oct-19	29-Jun-20
PO-MXXX-060	Procure Electrolyte Filters	146d	31-Oct-19	28-May-20
PO-PXXX-020	Procure Pumps and Pumper/Mixers	146d	31-Oct-19	28-May-20

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Figure 24-1: Gunnison Project Summary Schedule

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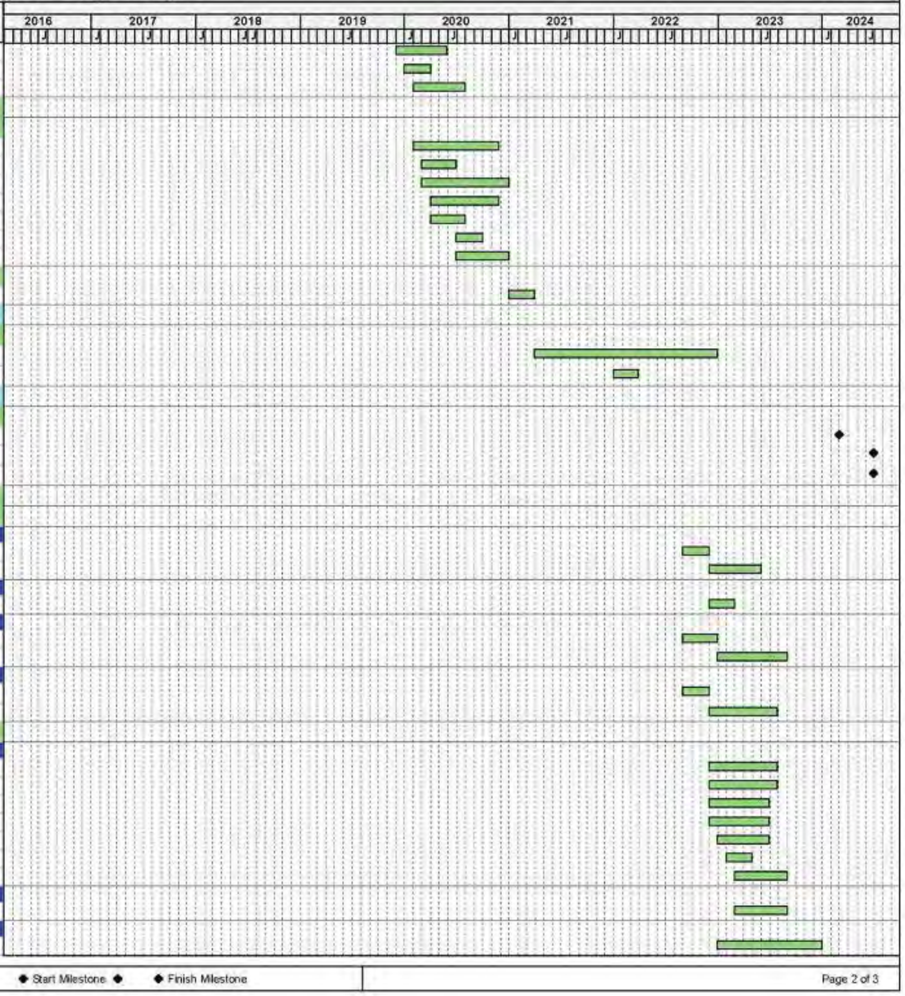
Gunnison Copper Project

15-Dec-16

Activity ID	Activity Name	Original Duration	Start	Finish
PO-MXXX-050	Procure Settlers	126d	02-Dec-19	28-May-20
PO-PXXX-030	Procure Tankage	64d	31-Dec-19	30-Mar-20
PO-MXXX-030	Procure EW Crane	127d	31-Jan-20	29-Jul-20
Contracts		0d		
Construction Management		233d	31-Jan-20	30-Dec-20
CM-000-CI-050	EW Area	211d	31-Jan-20	25-Nov-20
CM-000-CI-020	Solution Ponds	86d	28-Feb-20	29-Jun-20
CM-000-CI-030	SX Area	213d	28-Feb-20	30-Dec-20
CM-000-CI-040	Tank Farm Area	169d	31-Mar-20	25-Nov-20
CM-000-CI-060	Acid Storage Area	86d	31-Mar-20	30-Jul-20
CM-000-EL-010	Gunnison Substation Upgrade	64d	30-Jun-20	29-Sep-20
CM-000-SS-000	Ancilary Buildings	127d	30-Jun-20	30-Dec-20
Commissioning		63d	31-Dec-20	30-Mar-21
COM-000-SU-010	Stage 2 Commissioning	63d	31-Dec-20	30-Mar-21
Stage 2 Ongoing Development		442d	31-Mar-21	28-Dec-22
Construction Management		442d	31-Mar-21	28-Dec-22
CM-000-PP-030	Ongoing Well Field Development	442d	31-Mar-21	28-Dec-22
CM-000-CI-070	Construction - Evap Pond #2	60d	31-Dec-21	25-Mar-22
Stage 3		477d	31-Aug-22	27-Jun-24
Milestones		85d	28-Feb-24	27-Jun-24
MS-000-020	Stage 3 Start-Up - Plant	0d		28-Feb-24
MS-000-030	Stage 3 Start-Up - Acid Plant	0d		27-Jun-24
MS-000-30	Stage 3 Start-Up - WTP Plant	0d		27-Jun-24
Owner Activities		0d		
Engineering		253d	31-Aug-22	30-Aug-23
Plant Site		188d	31-Aug-22	30-May-23
BE-000-030	Basic Engineering	62d	31-Aug-22	29-Nov-22
DE-000-020	Detailed Engineering	126d	30-Nov-22	30-May-23
Rail Road		61d	30-Nov-22	27-Feb-23
DE-000-030	Detailed Engineering	61d	30-Nov-22	27-Feb-23
Acid Plant		253d	31-Aug-22	30-Aug-23
BE-000-040	Basic Engineering	82d	31-Aug-22	29-Dec-22
DE-000-040	Detailed Engineering	171d	30-Dec-22	30-Aug-23
Water Treatment Plant		230d	31-Aug-22	28-Jul-23
BE-000-050	Basic Engineering	62d	31-Aug-22	29-Nov-22
DE-000-050	Detailed Engineering	168d	30-Nov-22	28-Jul-23
Procurement		272d	30-Nov-22	28-Dec-23
Plant Site		191d	30-Nov-22	30-Aug-23
PO-MXXX-070	Procure Rectifiers	168d	30-Nov-22	28-Jul-23
PO-MXXX-080	Procure EW Cells	168d	30-Nov-22	28-Jul-23
PO-MXXX-090	Procure Electrolyte Filters	148d	30-Nov-22	29-Jun-23
PO-PXXX-040	Procure Pumps and Pumper/Mixers	148d	30-Nov-22	29-Jun-23
PO-MXXX-100	Procure Settlers	128d	30-Dec-22	29-Jun-23
PO-PXXX-050	Procure Tankage	63d	31-Jan-23	27-Apr-23
PO-MXXX-110	Procure EW Crane	131d	27-Feb-23	30-Aug-23
Rail Road		130d	28-Feb-23	30-Aug-23
PO-MXXX-120	Procure Rail & Switches	130d	28-Feb-23	30-Aug-23
Acid Plant		252d	30-Dec-22	28-Dec-23
PO-MXXX-130	Procure Acid Plant Equipment	252d	30-Dec-22	28-Dec-23



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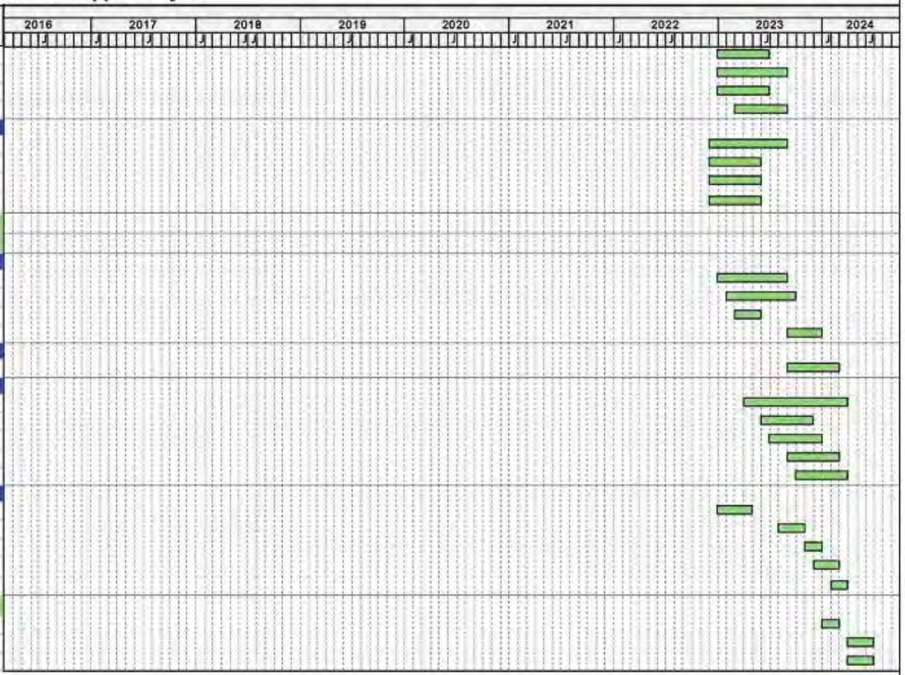
Gunnison Copper Project

15-Dec-16

Activity ID	Activity Name	Original Duration	Start	Finish
PO-MXXX-140	Procure Cooling Towers	128d	30-Dec-22	29-Jun-23
PO-MXXX-150	Procure Cogen Turbines	171d	30-Dec-22	30-Aug-23
PO-MXXX-170	Procure Scrubbers	128d	30-Dec-22	29-Jun-23
PO-MXXX-160	Procure Tankage and Jacketing For Sulfur Unloading	130d	28-Feb-23	30-Aug-23
Water Treatment Plant		191d	30-Nov-22	30-Aug-23
PO-MXXX-180	Procure Clarifiers	191d	30-Nov-22	30-Aug-23
PO-MXXX-190	Procure Filters	126d	30-Nov-22	30-May-23
PO-MXXX-200	Procure RO System	126d	30-Nov-22	30-May-23
PO-MXXX-210	Procure Lime and Soda Ash Systems	126d	30-Nov-22	30-May-23
Contracts		0d		
Construction Management		316d	30-Dec-22	28-Mar-24
Plant Site		252d	30-Dec-22	28-Dec-23
CM-000-CI-080	EW Area	171d	30-Dec-22	30-Aug-23
CM-000-CI-090	SX Area	170d	31-Jan-23	28-Sep-23
CM-000-CI-100	Tank Farm Area	65d	28-Feb-23	30-May-23
CM-000-CI-110	Acid Storage Area	81d	31-Aug-23	28-Dec-23
Rail Road		124d	31-Aug-23	28-Feb-24
CM-000-SS-010	Construct Railroad Siding & Railcar Unloading Area	124d	31-Aug-23	28-Feb-24
Acid Plant		252d	31-Mar-23	28-Mar-24
CM-000-SS-020	Acid Plant	252d	31-Mar-23	28-Mar-24
CM-000-SS-030	Molten Sulfur Handling and Storage	127d	31-May-23	29-Nov-23
CM-000-SS-050	Boiler Water Treatment and Cooling	124d	30-Jun-23	28-Dec-23
CM-000-SS-040	Cogeneration Plant	124d	31-Aug-23	28-Feb-24
CM-000-SS-060	Ancillary Facilities	125d	29-Sep-23	28-Mar-24
Water Treatment Plant		316d	30-Dec-22	28-Mar-24
CM-000-CI-120	Solution Ponds	84d	30-Dec-22	27-Apr-23
CM-000-CN-000	WTP Foundation	65d	31-Jul-23	30-Oct-23
CM-000-ME-020	Install WTP Equipment	39d	31-Oct-23	28-Dec-23
CM-000-PP-040	WTP Piping	62d	30-Nov-23	28-Feb-24
CM-000-EL-020	WTP Power	42d	31-Jan-24	28-Mar-24
Commissioning		128d	29-Dec-23	27-Jun-24
COM-000-SU-10	Stage 3 Commissioning - Plant	43d	29-Dec-23	28-Feb-24
COM-000-SU-20	Stage 3 Commissioning - Acid Plant	64d	29-Mar-24	27-Jun-24
COM-000-SU-30	Stage 3 Commissioning - WTP Plant	64d	29-Mar-24	27-Jun-24



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24.1.8 Commissioning Plan

The Commissioning Plan will also be project specific and is characterized as the transition of the constructed facilities from a status of “mechanically” or “substantially” complete to operational as defined by the subsystem list that will be developed for the Project. The commissioning group will systemically verify the functionality of plant equipment, piping, electrical power and controls. This test and check phase will be conducted by discrete facility subsystems. The tested subsystems will be combined until the plant is fully functional. Start-up, also a commissioning group responsibility, will progressively move the functional facilities to operational status and performance.

In addition to these activities, the commissioning portion of the work will also include coordination of facilities operations training, maintenance training and turnover of all compiled commissioning documentation in an agreed form.

24.1.9 Health and Safety Plan

The Health and Safety Plan (HASP) will be established for the construction of the Gunnison Copper Project and any other authorized work at the Project site. The HASP covers all contractor personnel working on the Project and any other authorized work for the Project.

The HASP specifies regulatory compliance requirements, training, certifications and medical requirements necessary to complete the project for all personnel and contractors involved in the Project. Along with the Operations Procedures, the HASP is to be followed by all Contractor personnel working at the site.

24.1.10 Project Organization

Figure 24-2 shows a typical organization chart for construction of the Gunnison Copper Project. Because Stage 1 construction is relatively small, some of the functions from field engineering, procurement and expediting and construction management can be doubled up. For Stages 2 and 3, the scale of construction will require more personnel on the CM team.

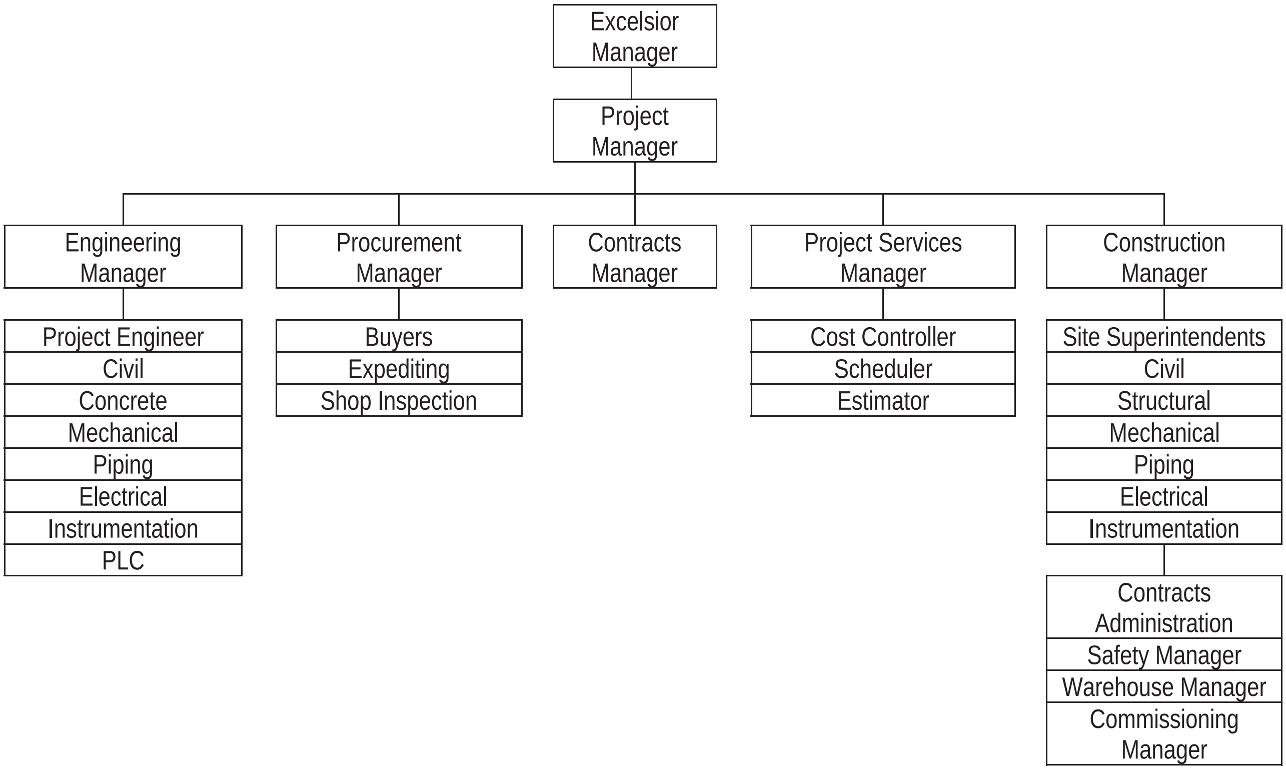

Figure 24-2: Project Organization Block Diagram

25 INTERPRETATION AND CONCLUSIONS

The Gunnison Copper Project is an oxidized copper deposit in southeastern Arizona, USA that is amenable to in situ recovery (ISR) technology for the leaching copper from oxidized mineralization below the water table and conventional solvent extraction and electrowinning (SX-EW) technology for making a saleable copper product. The mineral resource estimate in measured and indicated categories is estimated at 873 million short tons with total copper (TCu) grade of 0.29 percent at a cut-off TCu grade of 0.05%. MDA estimates probable mineral reserves at 782 million short tons at a TCu grade of 0.29 percent after applying engineering and operational design parameters.

25.1 CONCLUSIONS

A production schedule has been developed using input from independent consultants and existing Project data. The production schedule anticipates recovery of 48 percent of the estimated contained copper in the reserves for production of 2,165 million pounds of cathode copper in a mine life of 24 years. Production from an ISR well field results in pregnant leach solution from which saleable cathode copper can be produced by a conventional SX-EW process. M3 designed an appropriately-sized SX-EW copper recovery plant for construction on the Gunnison Project and provided capital cost estimates for its construction.

Excelsior plans to develop the full copper production capacity of 125 million pounds per annum (mppa) in three stages. Stage 1 capacity is planned for 25 mppa using the existing SX-EW plant that was acquired in 2015 at the Johnson Camp Mine (JCM). The JCM plant presently has the capacity to produce the desired 25 mppa and needs only minor modifications and upgrades to achieve the production goals. Stage 2 capacity is planned to be 75 mppa, which will require construction of a 50 mppa SX-EW plant that will be sited on the Gunnison property. Stage 3 capacity is planned to increase to 125 mppa through at 50 mppa addition to the Gunnison plant. The current schedule predicts Stage 2 operations beginning in Year 4 of operation and Stage 3 operations beginning in Year 7. Each stage of development is supported by a detailed capital cost estimate at the prefeasibility level.

M3 completed an economic analysis for this Feasibility Study using industry standard criteria for studies at this level. The results of this study indicate that ISR development of the Gunnison Copper Project offers the potential for positive economics based upon the information available at this time. Project economics are based on beginning production at approximately 25 mppa in Stage 1 with the JCM plant and Gunnison wellfield infrastructure, increasing production to approximately 75 mppa in Year 4 with the construction of the Stage 2 Gunnison plant, and increasing production to 125 MM mppa in Year 7 with construction of the Stage 3 Gunnison plant additions. Stage 3 includes construction of the sulfur-burning acid plant, cogeneration facilities, and rail spur for the delivery of molten sulfur, which are part of the base case.

The base-case economic analysis indicates an after-tax Net Present Value (NPV) of $807 million at a 7.5 percent discount rate with a projected Internal Rate of Return (IRR) at 40.1 percent. The base case includes a sulfuric acid plant constructed in Year 6 to supply the acid for ISR copper extraction. If the sulfuric acid plant and cogeneration facilities are not constructed and sulfuric acid continues to be supplied by truck or rail, the NPV at a 7.5 percent discount rate is $691 million with projected IRR of 40.5 percent. Payback is projected to occur in approximately 6.5 years with the acid plant and 4.9 years without it. However, Stage 1 production would payout in 2.8 years if Stage 2 is delayed.

The economics are based on a base case of $2.75/lb long-term copper price, and a design copper production rate of 25, 75, and 125 mppa, as described above, with production declining in the final 4 years of mine life. Direct operating costs are estimated at $0.65/lb of copper in the acid plant case and $0.97/lb of copper in the alternate case using purchased acid. Initial capital costs are estimated at $46.9 million. Sustaining capital costs of $742 million are projected in the acid plant case and $661 million in the alternate case using purchased acid, of which approximately $310 million is attributable to ISR well construction.

25.2 PROJECT RISKS

Certain risks and opportunities are associated with the Project, as is typical for mine development projects. These risks may include environmental permitting, title issues, taxation, public/political opposition, or legal impediments to operating this type of mining/processing operation at this location. The following Project-specific risks have been identified along with the measures that Excelsior envisages to mitigate the risk.

1. **Copper recovery.** The ISR process for recovering copper from oxidized mineralization in fractured bedrock has been tested at on core in a variety of bench scale tests. However, it has not been tested in the ground as a pilot test or as limited-scale production at the Gunnison site. Metallurgical testing has established that mineralization is amenable to copper leaching and recovery. Laboratory testing results have been used to approximate results of ISR in bedrock, they may not reflect eventual performance. Potential deviations include:

    - Recovery rates (kinetics) that are slower than predicted
    - Hydrological conditions and hydrogeochemical reactions at depth resulting in reduced copper recoveries
    - Short-circuiting of leaching solutions along major fractures resulting in reduced “sweep efficiency”
    - Reduced acid strength due to neutralization by gangue (non-copper) minerals
    - Low fracture density and width resulting in poor contact of leach solution with copper oxides

    Mitigation. Many of these risks can be addressed by developing operational strategies during both the development and Stage 1 operation of the wellfield. This will include producing detailed local geological/structural and hydrological models while the wellfield is being emplaced to further aid in placement of final well locations. Operational strategies will involve predetermining flowrates and acid strengths based on these models for initiating the wellfield in order to maximize quick breakthrough and economic PLS grades. The average copper recovery estimate of 48 percent of total copper has been reduced from metallurgical testing maximums to address these uncertainties.

2. **Reagent consumption/cost.** This Project relies on large volumes of sulfuric acid to accomplish the mobilization of copper from the subsurface and to produce a saleable product. In addition the project requires substantial quantities of lime (CaO) to neutralize excess solutions during water treatment. Increases in the price of reagents with respect to the price of copper would have a negative impact on the economics of the Project.

    Mitigation. The Project has two options for obtaining sulfuric acid: purchasing liquid acid and making acid from molten sulfur. Since sulfuric acid is used extensively in the production of copper worldwide, a significant increase in the price of sulfuric acid or sulfur would likely be accompanied by an increase the price of copper, partially compensating for higher reagent costs, mitigating the impact. Lime and/or limestone can be produced locally in Cochise County if the quantities are sufficient to make the economics worthwhile. Lhoist (formerly Chemical Lime) owns a lime plant in Cochise County near Douglas, AZ that, according to a company official, could be put back into production should the demand increase, meaning one or two significant new projects.

3. **Well design and spacing.** The well design consists of a borehole cased through the alluvial material into the mineralized bedrock with an open borehole through the productive portion of the mineralized material. Problems may arise in the construction of these wells due to caving that would increase drilling costs that are part of initial and sustaining capital costs. Borehole instability could require perforated casing to keep the borehole open, potentially resulting in a larger borehole and additional costs for the materials, labor, and

drilling. The current well design is part of the ADEQ Aquifer Protection Permit and the EPA's Underground Injection Control permit so changes to the borehole design could require amending these two permits.

Borehole spacing is presently on 100-foot centers with a 50-foot offset resulting in 71 feet between an injection well and its nearest recovery wells. Drilling costs per pound of copper produced would increase, if this spacing proves to be too wide.

Mitigation. The proposed well design can be tested in during Stage 1 production to evaluate the adequacy of construction method and borehole stability to minimize potential problems during implementation and reduce uncertainty concerning well field construction costs. Aquifer testing in the preproduction stage should provide additional data with which to evaluate the optimum borehole spacing.

4. **Gypsum formation/rinsing.** Mineralized areas with significant carbonate content may reach saturation and cause precipitation of calcium sulfate (gypsum) in the formation. Precipitates forming in fractures could reduce flow rates in the formation, retarding the leaching of copper oxides with a consequent reduction in the rate of copper recovery. Gypsum precipitates in the formation might also reduce the rinsing rate, causing an increase in water treatment costs.

   Mitigation. The box tests or fracture simulation tests clearly indicated that the precipitation of gypsum did not alter flow rates however, noting the possible impact in flow reduction and rinsing volume requirements should provide greater confidence in the copper recovery and rinsing projections. Leaching schedules have already been lengthened, pumping rates and porosity reduced through time in this prefeasibility study to compensate for uncertainties associated with these types of issues.

5. **Permitting difficulties.** Permitting for mining projects in the western US and Arizona in particular has been an arduous and unpredictable task in the recent past. Public opposition can be mobilized from outside of the local community by groups that tend to obstruct mining projects. Permitting the sulfuric acid plant may be more difficult in the future due to its air quality implications when compared to the well field/plant issues that are already mitigated somewhat by the presence of SX-EW operations in the immediate vicinity.

   Mitigation. Permitting difficulties can be mitigated by developing support within the local community, identifying and fixing potential areas of contention before they arise, getting support from community leaders in advance of applying for permits. Another measure is developing realistic permitting schedules that incorporate time to deal with challenges which also helps minimize deleterious consequences.

25.3 PROJECT OPPORTUNITIES

Several opportunities have be identified which could enhance the viability and economic attractiveness of the Project. Many of these opportunities may be realized by removal of risk and uncertainty that are present at the prefeasibility level.

1. **Copper recoveries.** The anticipated copper recovery of 48 percent of total copper is an estimate based on the best interpretation of existing test work. This copper recovery could be exceeded in practice. Recovery increases could improve the rate of recovery as well as increase total copper recovered. Improvements in the rate of recovery would mean lower flows from the wellfield for the same level of copper production, lowering operational costs, or that the increased grade could result in higher copper production (revenue) for the same operating cost. Improvements in total copper recovered have the obvious benefit of increasing total revenue during the life of the mine.

2. **Increased copper price.** The current financial analysis is based on a copper price of \$2.75 per pound. Over the last year, the copper price has ranged from \$2.00 to \$2.20 for most of the year but is currently approximately \$2.65 per pound, which is close to the three year trailing average. Global demand increases

for copper have the potential to drive copper prices higher, thereby increasing the economic (revenue) outlook for the Project.

3. **Additional resources.** Section 14 reports 187.2 million tons of inferred mineral resources at an average grade of 0.17% total copper. It is uncertain if further exploration will result in this mineralization being delineated as an indicated or measured mineral resource. However, if these inferred mineral resources can be converted to the measured or indicated categories they have the potential to increase the mineral reserve and improve the economic outlook of the Project.

4. **Well Field Optimization.** No effort has been made to optimize well spacing for the Project. The spacing between wells determines the number of wells required to leach the Gunnison oxide deposit. Operator experience over the life of operation also has the potential to increase individual well flow rates that would result in increased well spacing distances reducing the number of required wells to leach the entire wellfield.

26 RECOMMENDATIONS

Based on the results of this Feasibility Study, it is recommended that Excelsior proceed with the Project through basic and detailed engineering, once financing is secured. The engineering for the project is fairly complete. The drilling, mineral resource estimation, wellfield mine planning, wellfield drilling and infrastructure development and the staged SX-EW plant have all been adequately defined. Until the initial wellfield is drilled and solution is pumped for processing, there is not much left to investigate. The following sections discuss areas for potential investigationWellfield Recommendations

26.1 PROCESS RECOMMENDATIONS

The Stage 1 SX-EW plant is a fully functional plant that has been operated and is presently in care and maintenance. Additional engineering has been done to bring the plant up to a modern automated SX-EW, especially in the solvent extraction area. The Tank Farm has had some equipment additions to help with temperature management of solutions, treatment of crud, and filtration of electrolyte. The Tankhouse has had very little in the way of improvements over its current state.

The solution transfer systems that bring solutions to the plant and return them to the wellfield for leaching operations has been substantially improved over the 2016 PFS Update. The Jack & Bore tunnel that will run beneath Interstate 10 has now been designed at a feasibility level. The next levels of engineering, basic and detailed engineering, will look at the wellfield infrastructure, the PLS Booster Station details, and the piping corridor between JCM and the Gunnison side of the property.

Plant design and engineering may be necessary to keep up with changes in permitting considerations, production goals, or in response to findings of proposed metallurgical testing. Details of the piping, controls, and containment for the wellfield collection and distribution system need to be worked out.

26.2 WATER TREATMENT

For the 2016 FS, Veolia Water took another look at the process solution chemistry and water balance to develop a new block flow diagram, equipment list, a list of consumables, a power requirement and capital and operating costs. Additional work on the water treatment process is not an immediate concern because construction of the WTP is not expected until formation rinsing is fully implemented. At that point, the composition and character of WTP influent can be used as the basis for a design and sizing of the water treatment process. The present level of water treatment design is sufficient to establish that water treatment processes are available to achieve the goal of recycling rinse water and that the processes are economically viable.

Estimates of the composition of water to be treated are sufficient to continue evaluation of treatment processes. Evaluation of water treatment technologies and strategies is recommended during the feasibility study. Water treatment technology for mine-influenced water is advancing at a rapid pace. Small improvements in water treatment costs and reductions in volumes of waste liquids and solids produced can have a significant economic impact with respect to the large volumes of rinse water that will need to be treated.

26.3 PERMITTING

There are three main permits that must be acquired for the Stage 1 Gunnison ISR operation: 1) the Arizona Aquifer Protection Permit (APP) issued by the Arizona Department of Environmental Quality (ADEQ), 2) a Class III Underground Injection Control (UIC) permit issued by the United States Environmental Protection Agency (USEPA) and 3) an amendment to the Johnson Camp Mine APP. Applications for these permits have been submitted to the respective agencies. Comments from the agencies have been received for the Gunnison APP and Gunnison UIC permits and responses have returned by Excelsior. The JCM APP amendment has been submitted to ADEQ and is awaiting comments. There will be ongoing work responding to agency requests for additional information, meetings with agency personnel, and modifications to the project in response to agency requests.

26.4 SULFURIC ACID PLANT

The design work for the Gunnison sulfuric acid plant was made by NORAM in 2013-14 for the Gunnison PFS. This work was scaled up from 1350 tons per day to 1625 tons per day for the 2016 PFS Update. No work was changed for the 2016 FS so the design and costing for the sulfuric acid plant and cogen facilities is still effectively at a PFS level. As discussed previously, this lower accuracy for the sulfuric acid plant capital cost will not affect the overall feasibility study accuracy of +/- 15%. At some point, the sulfuric acid plant will have to be revisited for more accurate cost estimating and to advance permitting for it.

The sulfuric acid plant currently comes on line in Year 7 of the mine life so there is ample time to see what the actual sulfuric acid demand is before a construction decision is made. Both the Base Case (with acid plant) and Alternative Case (no acid plant) provide robust economics so the decision drivers will be the long-term sulfuric acid cost and the refined acid consumption of the wellfield. Once more is known about these two factors, Excelsior can revisit the engineering and costing for the sulfuric acid plant.

26.5 BUDGET FOR ADDITIONAL WORKS

Excelsior has proposed a list and budget for additional work that will support the feasibility study. Table 26-1 below defines the scope of the technical activities.

Table 26-1: Feasibility Budget for the Gunnison Copper Project

Detail	Cost US$
Permitting Work	
Gunnison APP	$150,000
Gunnison UIC	$150,000
JCM APP Amendment	$100,000
Other Permits	$50,000
Subtotal Permitting Work	$450,000
Sulfuric Acid Plant	
Sulfuric Acid Plant proper (NORAM or other)	$350,000
Sulfuric Acid Storage	$50,000
Cogeneration Facilities	$50,000
Molten Sulfur Storage	$50,000
Railcar sulfur/sulfuric acid unloading	$50,000
Subtotal Sulfuric Acid Plant	$500,000
Total	950,000

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APPENDIX A – CERTIFICATES OF QUALIFIED PERSONS

CERTIFICATE of QUALIFIED PERSON

I, Richard K. Zimmerman, R.G., do hereby certify that:

1. I am currently employed as Environmental Geologist by:

   M3 Engineering & Technology Corporation
   2051 W. Sunset Road, Ste. 101
   Tucson, Arizona 85704
   U.S.A.

2. I am a graduate of Carleton College and received a Bachelor of Arts degree in Geology in 1976. I am also a graduate of the University of Michigan and received a Master of Science degree in Geology 1980.

3. I am a:

   - Registered Professional Geology in the State of Arizona (No. 24064)
   - Registered Member in good standing of the Society for Mining, Metallurgy and Exploration, Inc. (No. 3612900RM)

4. I have practiced geology, mineral exploration, environmental remediation, and project management for 35 years. I have worked for mining and exploration companies for 8 years, engineering consulting firms for 22 years, and for M3 Engineering and Technology Corporation for 5 years.

5. I have read the definition of "qualified person" set out in National Instrument 43-101 ("NI 43-101") and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfill the requirements to be a "qualified person" for the purposes of NI 43-101.

6. I am responsible for Sections 1, 2, 3, 4, 5, 18, 19, 23, 24, 25, 26, 27 of the technical report titled "Gunnison Copper Project, NI 43-101 Technical Report, Feasibility Study" ("Technical Report") dated effective December 17, 2016.

7. I have had prior involvement with the property that is the subject of this Technical Report. The prior involvement was as an independent consultant to Excelsior for previous studies concerning the design, engineering, and cost estimation of processing plant.

8. I have visited the site on several occasions, most recently on February 10, 2016.

9. As of the date of this certificate, to the best of my knowledge, information and belief, the Technical Report contains all scientific and technical information required to be disclosed to make the report not misleading.

10. I am independent of the issuer applying all of the tests in section 1.5 of National Instrument 43-101.

11. I have read National Instrument 43-101 and Form 43-101F1, and the Technical Report has been prepared in compliance with that instrument and form.

Signed and dated this 16th day of January, 2017.

SME
Society for
Mining, Metallurgy
& Exploration

Richard K. Zimmerman
SME Registered Member No 3612900
Signature
Date Signed 1/16/2017
Expiration date 12/31/2017

Richard K Zimmerman

Richard K Zimmerman, M.Sc., R.G., SME-RM No. 3612900RM

MINE DEVELOPMENT ASSOCIATES
MINE ENGINEERING SERVICES

CERTIFICATE OF QUALIFIED PERSON

I, Michael M. Gustin, C.P.G., do hereby certify that:

1. I am currently employed as Senior Geologist by Mine Development Associates, Inc., 210 South Rock Blvd., Reno, Nevada 89502.
2. I graduated with a Bachelor of Science degree in Geology from Northeastern University in 1979 and a Doctor of Philosophy degree in Economic Geology from the University of Arizona in 1990.
3. I am a Licensed Professional Geologist in the state of Utah (#5541396-2250), a Licensed Geologist in the state of Washington (#2297), a Registered Member of the Society of Mining Engineers (#4037854RM), and a Certified Professional Geologist of the American Institute of Professional Geologists (#CPG- 11462).
4. I have worked as a geologist in the mining industry for more than 30 years. I have previously explored, drilled, evaluated, and modelled oxide copper deposits similar to Gunnison in Arizona and elsewhere.
5. I have read the definition of "qualified person" set out in National Instrument 43-101 ("NI 43-101"). I certify that by reason of my education, affiliation with certified professional associations, and past relevant work experience, I fulfill the requirements to be a "qualified person" for the purposes of NI 43- 101.
6. I am responsible for Sections 6 through 12 and 14 of the technical report titled "Gunnison Copper Project, NI 43-101 Technical Report Feasibility Study" ("Technical Report") dated effective December 17, 2016.
7. Other than my work with Excelsior Mining Corp related to this Technical Report and the prior technical report, I have had no prior involvement with the Gunnison Copper project that is the subject of this Technical Report.
8. I visited the Gunnison project site on January 16, 2015.
9. As of the Effective Date of this Technical Report, to the best of my knowledge, information, and belief, the portions of the Technical Report for which I am responsible contain all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.
10. I am independent of the issuer applying all of the tests in Section 1.5 of National Instrument 43-101.
11. I have read National Instrument 43-101 and Form 43-101F1, and the Technical Report has been prepared in compliance with that instrument and form.

Signed and dated this 13th day of January, 2017.

11462
MICHAEL M. GUSTIN

Signature of Qualified Person

Michael M. Gustin
Print name of Qualified Person

775-856-5700

210 South Rock Blvd.
Reno, Nevada 89502
FAX: 775-856-6053

CERTIFICATE of QUALIFIED PERSON

I, Ronald J. Roman do hereby certify that:

1. I am currently employed as an Engineer and Project Manager by:

   Leach, Inc.
   4741 N Placita del Sol
   Tucson, AZ 85749

2. I am a graduate of the Colorado School of Mines

3. I am a:

   - Registered Professional Engineer in the State of Arizona (#25799)

4. I have practiced engineering and project management at Leach, Inc. and have consulted on copper leaching projects at White Pine Copper, Michigan; Johnson Camp Mine, Arizona; Silver Bell Mine, Arizona; King-King Project, Philippines; Buenuavista (Cananea), Mexico; La Caridad, Mexico; Cajone, Peru; and Toquapala, Peru.

5. I have read the definition of "qualified person" set out in National instrument 43-101 ("NI 43-101") and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfill the requirements to be a "qualified person" for the purposes of NI 43-101.

6. I am responsible for Section 13 of the technical report titled "Gunnison Copper Project, NI 43-101 Technical Report, Feasibility Study" ("Technical Report) dated effective December 17, 2016.

7. I was responsible for the Section 13 of the technical report titled "Gunnison Copper Project, NI 43-101 Technical Report, Prefeasibility Study Update" dated effective January 28, 2016, prepared for Excelsior Mining Corp.

8. I was QP for Metallurgy for Section 13 for "Gunnison Copper Project, NI 43-101 Technical Report, Prefeasibility Study" Dated effective January 13, 2014.

9. I visited the Gunnison Site on September 13, 2013.

10. As of the date of this certificate, to the best of my knowledge, information and belief, the Technical Report contains all scientific and technical information required to be disclosed to make the report not misleading.

11. I am independent of the issuer applying all of the tests in Section 1.5 of National Instrument 43-101.

12. I have read National Instrument 43-101 and Form 43-101F1, and the Technical Report has been prepared in compliance with that instrument and form.

Signed and dated this 12 day of January, 2017.

Registered Professional Engineer (Metallurgical)
CERTIFICATE NO. 25799
RONALD J. ROMAN
Date Signed 1/12/17
ARIZONA U.S.A.

Signature of Qualified Person

Ronald J. Roman
Print name of Qualified Person

MINE DEVELOPMENT ASSOCIATES
MINE ENGINEERING SERVICES

CERTIFICATE OF QUALIFIED PERSON

I, Neil Prenn, MMSA-QPM, do hereby certify that:

1. I am currently employed as Senior Geologist by Mine Development Associates, Inc., 210 South Rock Blvd., Reno, Nevada 89502.
2. I am a graduate of the Colorado School of Mines in 1967 with an Engineer of Mines degree.
3. I am a Registered Professional Engineer in the State of Nevada, and a registered Qualified Person with the Mining and Metallurgical Associates of America (MMSA).
4. I have worked as a Mining Engineer for more than 45 years, providing mine designs, reserve estimates and economic analyses for dozens of base- and precious-metals deposits and industrial minerals deposits in the United States and various countries of the world.
5. I have read the definition of "qualified person" set out in National Instrument 43-101 ("NI 43-101"). I certify that by reason of my education, affiliation with certified professional associations, and past relevant work experience, I fulfill the requirements to be a "qualified person" for the purposes of NI 43- 101.
6. I am responsible for Sections 15 of the technical report titled "Gunnison Copper Project, NI 43-101 Technical Report Feasibility Study" ("Technical Report") dated effective December 17, 2016.
7. Other than my work with Excelsior Mining Corp related to this Technical Report and the prior technical reports I have had no prior involvement with the Gunnison Copper project that is the subject of this Technical Report.
8. I have visited the Gunnison Project Site, and inspected core from drilling on the Gunnison project during the period of August 24-25, 2015
9. As of the Effective Date of this Technical Report, to the best of my knowledge, information, and belief, the portions of the Technical Report for which I am responsible contain all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.
10. I am independent of the issuer applying all of the tests in Section 1.5 of National Instrument 43-101.
11. I have read National Instrument 43-101 and Form 43-101F1, and the Technical Report has been prepared in compliance with that instrument and form.

Signed and dated this 13th day of January, 2017.

NEIL B. PRENN
MINING

Signature of Qualified Person

Neil Prenn
Print name of Qualified Person

775-856-5700

210 South Rock Blvd.
Reno, Nevada 89502
FAX: 775-856-6053

CERTIFICATE of QUALIFIED PERSON

I, R. Douglas Bartlett, do hereby certify that:

1. I am currently employed as a Hydrogeologist by:

   Clear Creek Associates
   6155 E. Indian School Rd., Suite 200
   Scottsdale, Arizona, 85251

2. I am a graduate of Colorado State University

3. I am a:

   - Registered Geologist in the States of Arizona, California, Oregon, Washington, Alaska, and Pennsylvania

4. I have practiced geology and hydrogeology since 1977 at: Dames & Moore in Denver and Phoenix; Anaconda Minerals in Denver, Colorado; and Clear Creek Associates in Scottsdale, Arizona. My expertise includes mining-related hydrogeologic investigations and groundwater modeling.

5. I have read the definition of “qualified person” set out in National instrument 43-101 (“NI 43-101”) and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfill the requirements to be a “qualified person” for the purposes of NI 43-101.

6. I am responsible for Sections 16 and 20 of the technical report titled “Gunnison Copper Project, NI 43-101 Technical Report Feasibility Study” (“Technical Report”) dated effective December 17, 2016.

7. I was responsible for the Sections 16, and 20 of the technical report titled “Gunnison Copper Project, NI 43-101 Technical Report, Prefeasibility Study Update” dated effective January 28, 2016, prepared for Excelsior Mining Corp.

8. I have not had prior involvement with the property that is the subject of the Technical Report except as set out in paragraph 7.

9. I visited the Gunnison Site on July 1, 2015.

10. As of the date of this certificate, to the best of my knowledge, information and belief, the Technical Report contains all scientific and technical information required to be disclosed to make the report not misleading.

11. I am independent of the issuer applying all of the tests in Section 1.5 of National Instrument 43-101.

12. I have read National Instrument 43-101 and Form 43-101F1, and the Technical Report has been prepared in compliance with that instrument and form.

Signed and dated this 13 day of January, 2017

____
Signature of Qualified Person

R. Douglas Bartlett
Print name of Qualified Person

25059
R. DOUGLAS BARTLETT
Date Signed 01-13-2017
Expires March 31, 2017

CERTIFICATE of QUALIFIED PERSON

I, Thomas L. Drielick, P.E., do hereby certify that:

1. I am currently employed as Sr. Vice President by:

   M3 Engineering & Technology Corporation
   2051 W. Sunset Rd., Suite 101
   Tucson, Arizona 85704
   U.S.A.

2. I am a graduate of Michigan Technological University and received a Bachelor of Science degree in Metallurgical Engineering in 1970. I am also a graduate of Southern Illinois University and received an M.B.A. degree in 1973.

3. I am a:
   - Registered Professional Engineer in the State of Arizona (No. 22958)
   - Registered Professional Engineer in the State of Michigan (No. 6201055633)
   - Member in good standing of the Society for Mining, Metallurgy and Exploration, Inc. (No. 850920)
   - Member in good standing of AACE (Association for the Advancement of Cost Engineering) International, Inc. (No. 05031)

4. I have practiced metallurgical and mineral processing engineering and project management for 46 years. I have worked for mining and exploration companies for 18 years and for M3 Engineering & Technology Corporation for 28 years.

5. I have read the definition of “qualified person” set out in National Instrument 43-101 (“NI 43-101”) and certify that by reason of my education, affiliation with a professional association (as defined in NI 43-101) and past relevant work experience, I fulfill the requirements to be a “qualified person” for the purposes of NI 43-101.

6. I am responsible for the preparation of Sections 17 “Recovery Methods”, 21 “Capital and Operating Costs”, and 22 “Economic Analysis” of the technical report titled “Gunnison Copper Project NI 43-101 Feasibility Study” (the "Technical Report") dated effective December 17, 2016, prepared for Excelsior Mining Corp.

7. I had involvement in the property through the preparation of technical reports on the property for Excelsior Mining Corporation.

8. I visited the Johnson Camp Mine and plant site in August 29, 2012 but did not visit the Gunnison Project site.

9. As of the effective date of the Technical Report, to the best of my knowledge, information and belief, the Technical Report contains all scientific and technical information required to be disclosed to make the report not misleading.

10. I am independent of the issuer applying all of the tests in Section 1.5 of National Instrument 43-101.

11. I have read National Instrument 43-101 and Form 43-101F1, and the Technical Report has been prepared in compliance with that instrument and form.

Signed and dated this 13th day of January, 2017.

Signature of Qualified Person

Registered Professional Engineer
CERTIFICATE NO
22958
THOMAS L
DRIELICK
Date Signed 1-13-17
ARIZONA U.S.A.

Thomas L. Drielick
Print name of Qualified Person

APPENDIX B – MINERAL CLAIM DETAIL

Patented Mining Claims (Johnson Camp)

Parcel 1

Arizona, Blue Grass, Puzzle, Enough, and Carlton patented lode mining claims, Mineral Survey No. 4340

Parcel 2

Afterthought, Burro, Burro No. 3, Coronado, Coronado No. 2, and Mason No. 1 patented lode mining claims, Mineral Survey No. 4571

Parcel 3

St. George patented lode mining claim, Mineral Survey No. 1966

Parcel 4

Mayflower (aka May Flower) patented lode mining claim, Mineral Survey No. 2764

Parcel 5

Acorn, A-Number One, A-Number Two, Chicago, Cochise, Copper Thread, Johnson, Little Johnnie, Rough Rider, Tenderfoot, and United Fraction patented lode mining claims, Mineral Survey No. 4314

Parcel 6

Blue Lead, North Star, Little Bush, Copper Chief, Southern Cross, Blue Lead Extension, Dwarf, and Esmeralda patented lode mining claims, Mineral Survey No. 3242 Anaconda, Last Chance, Delta, and Sara patented lode mining claims, Mineral Survey No. 1525

Parcel 8

Southern patented lode mining claim, Lot 45, Mineral Survey No. 327

Parcel 9

Mi-an-te-no-mah patented lode mining claim, Lot 48, Mineral Survey No. 330

Parcel 10

Peabody patented lode mining claim, Lot 39, Mineral Survey No. 286

Parcel 11

Donna Anna patented lode mining claim, Lot 40, Mineral Survey No. 287

Parcel 12

Highland Mary patented lode mining claim, Lot 37, Mineral Survey No. 284

Parcel 13

Copper King patented lode mining claim Lot 38, Mineral Survey No. 285 382681 v2

Parcel 14

Golden Shield patented lode mining claim, Lot 43, Mineral Survey No. 325

Parcel 15

Republic patented lode mining claim, Lot 42, Mineral Survey No. 324

Parcel 16

Chicora patented lode mining claim, Lot 44, Mineral Survey No. 326

Parcel 17

Tycoon patented lode mining claim, Lot 47, Mineral Survey No. 329

Parcel 18

Mammoth patented lode mining claim, Lot 49, Mineral Survey No. 331

Parcel 19

Clondike, Blue Jacket, Keystone, Blue Bell, Copper Bell, Dewey, True Blue, and Ross patented lode mining claims, Mineral Survey No. 1717

Parcel 20

382681 v2 Hillside, Pittsburg, and Teaser patented lode mining claims, Mineral Survey No. 3306

Parcel 21

San Jacinto patented lode mining claim, Lot 46, Mineral Survey No. 328

BLM Claims

CLAIM NAME AND NUMBER	BLM Serial # (AMC #)	TOWNSHIP, RANGE, SECTION*	Maintenance Costs	Area
		Mr Twn Rng Sec		
ALPHA #1	21945	14 0160S 0220E 025	$155.00	Gunnison
ALPHA #2	21946	14 0160S 0220E 025	$155.00	Gunnison
ALPHA #3	21947	14 0160S 0220E 025	$155.00	Gunnison
ALPHA #4	21948	14 0160S 0220E 025	$155.00	Gunnison
ALPHA #5A	351064	14 0160S 0220E 025	$155.00	Gunnison
ALPHA #6	21950	14 0160S 0220E 024	$155.00	Gunnison
ALPHA #7	21951	14 0160S 0220E 024	$155.00	Gunnison
ALPHA #8	21952	14 0160S 0220E 024	$155.00	Gunnison
ALPHA #9	21953	14 0160S 0220E 024	$155.00	Gunnison
ALPHA #10	21954	14 0160S 0220E 024	$155.00	Gunnison
ALPHA #11	21955	14 0160S 0220E 024	$155.00	Gunnison
ALPHA #12	21956	14 0160S 0220E 024	$155.00	Gunnison
ALPHA #13	21957	14 0160S 0220E 024	$155.00	Gunnison
ALPHA #15	21959	14 0160S 0220E 024	$155.00	Gunnison
ALPHA #16	21960	14 0160S 0220E 024	$155.00	Gunnison
ALPHA #17	21961	14 0160S 0220E 024	$155.00	Gunnison
ALPHA #18	21962	14 0160S 0220E 024	$155.00	Gunnison
ALPHA #19	21963	14 0160S 0220E 024	$155.00	Gunnison
ALPHA #20	21964	14 0160S 0220E 024	$155.00	Gunnison
ALPHA #22	21966	14 0160S 0220E 026	$155.00	Gunnison
ALPHA #23	21967	14 0160S 0220E 026	$155.00	Gunnison
ALPHA #24	21968	14 0160S 0220E 023	$155.00	Gunnison
ALPHA #25	21969	14 0160S 0220E 023	$155.00	Gunnison
ALPHA #26	21970	14 0160S 0220E 023	$155.00	Gunnison
ALPHA #31	21975	14 0160S 0220E 023	$155.00	Gunnison
ALPHA #32	21976	14 0160S 0220E 023	$155.00	Gunnison
ALPHA #33	21977	14 0160S 0220E 023	$155.00	Gunnison
ALPHA 34 A	324360	14 0160S 0220E 023	$155.00	Gunnison
ALPHA #36	21980	14 0160S 0220E 025	$155.00	Gunnison
ALPHA #37	21981	14 0160S 0220E 025	$155.00	Gunnison
ALPHA #38	21982	14 0160S 0220E 025	$155.00	Gunnison
ALPHA #39	21983	14 0160S 0220E 025	$155.00	Gunnison
ALPHA #40	21984	14 0160S 0220E 025	$155.00	Gunnison
ALPHA #45	21989	14 0160S 0220E 025	$155.00	Gunnison
ALPHA #46	21990	14 0160S 0220E 025	$155.00	Gunnison
ALPHA #49	21991	14 0160S 0220E 025	$155.00	Gunnison
ALPHA #50	21992	14 0160S 0220E 025	$155.00	Gunnison

ALPHA #51	21993	14 0160S 0220E 025	$155.00	Gunnison
ALPHA 52 A	324361	14 0160S 0220E 026	$155.00	Gunnison
ALPHA 118	326439	14 0160S 0220E 001	$155.00	Gunnison
ALPHA 119	326440	14 0160S 0220E 001	$155.00	Gunnison
ALPHA 120	326441	14 0160S 0220E 001	$155.00	Gunnison
ALPHA 121	326442	14 0160S 0220E 001	$155.00	Gunnison
ALPHA 122	326443	14 0160S 0220E 001	$155.00	Gunnison
ALPHA 123	326444	14 0160S 0220E 001	$155.00	Gunnison
ALPHA 124	326445	14 0160S 0220E 001	$155.00	Gunnison
ALPHA 125	326446	14 0160S 0220E 011	$155.00	Gunnison
ALPHA 126	326447	14 0160S 0220E 011	$155.00	Gunnison
ALPHA 127	326448	14 0160S 0220E 011	$155.00	Gunnison
ALPHA 128	326449	14 0160S 0220E 013	$155.00	Gunnison
ALPHA 129	326450	14 0160S 0220E 013	$155.00	Gunnison
ALPHA 130	326451	14 0160S 0220E 013	$155.00	Gunnison
ALPHA 131	326452	14 0160S 0220E 013	$155.00	Gunnison
ALPHA 27	340653	14 0160S 0220E 023	$155.00	Gunnison
ALPHA 28	340654	14 0160S 0220E 023	$155.00	Gunnison
ALPHA 29	340655	14 0160S 0220E 023	$155.00	Gunnison
ALPHA 30	340656	14 0160S 0220E 023	$155.00	Gunnison
ALPHA 35	340657	14 0160S 0220E 023	$155.00	Gunnison
ALPHA 41	340658	14 0160S 0220E 023	$155.00	Gunnison
ALPHA 42	340659	14 0160S 0220E 023	$155.00	Gunnison
ALPHA 43	340660	14 0160S 0220E 023	$155.00	Gunnison
ALPHA 44	340661	14 0160S 0220E 023	$155.00	Gunnison
ALPHA 56	340662	14 0160S 0220E 023	$155.00	Gunnison
ALPHA 57	340663	14 0160S 0220E 023	$155.00	Gunnison
ALPHA 58	340664	14 0160S 0220E 023	$155.00	Gunnison
ALPHA 59	340665	14 0160S 0220E 023	$155.00	Gunnison
ALPHA 60	340666	14 0160S 0220E 023	$155.00	Gunnison
TALLSHIP 5-A	341334	14 0160S 0220E 013	$155.00	Gunnison
TALLSHIP 7-A	341335	14 0160S 0220E 013	$155.00	Gunnison
TALLSHIP 8-A	341336	14 0160S 0220E 013	$155.00	Gunnison
TALLSHIP 9-A	341337	14 0160S 0220E 012	$155.00	Gunnison
TALLSHIP 10-A	341338	14 0160S 0220E 012	$155.00	Gunnison
TALLSHIP B-1	341339	14 0160S 0220E 012	$155.00	Gunnison
TALLSHIP B-2	341340	14 0160S 0220E 012	$155.00	Gunnison
TALLSHIP B-3	341341	14 0160S 0220E 012	$155.00	Gunnison
TALLSHIP B-4	341342	14 0160S 0220E 012	$155.00	Gunnison
TALLSHIP B-5	341343	14 0160S 0220E 012	$155.00	Gunnison
TALLSHIP B-6	341344	14 0160S 0220E 013	$155.00	Gunnison
TALLSHIP B-7	341345	14 0160S 0220E 013	$155.00	Gunnison
TALLSHIP B-8	351062	14 0160S 0220E 013	$155.00	Gunnison
TALLSHIP B-9	351063	14 0160S 0220E 013	$155.00	Gunnison
TALLSHIP B10	341968	14 0160S 0220E 013	$155.00	Gunnison

TALLSHIP #C-1	73414	14 0160S 0220E 013	$155.00	Gunnison
TALLSHIP #C-2	73415	14 0160S 0220E 024	$155.00	Gunnison
TALLSHIP #C-3	73416	14 0160S 0220E 013	$155.00	Gunnison
TALLSHIP #C-4	73417	14 0160S 0220E 024	$155.00	Gunnison
TALLSHIP #C-5	73418	14 0160S 0220E 013	$155.00	Gunnison
TALLSHIP #C-6	73419	14 0160S 0220E 024	$155.00	Gunnison
TALLSHIP #C-7	73420	14 0160S 0220E 013	$155.00	Gunnison
PROSPECT 1	341969	14 0150S 0220E 035	$155.00	Gunnison
PROSPECT 2	341970	14 0150S 0220E 035	$155.00	Gunnison
PROSPECT 3	341971	14 0150S 0220E 035	$155.00	Gunnison
PROSPECT 4	341972	14 0150S 0220E 035	$155.00	Gunnison
PROSPECT 5	341973	14 0150S 0220E 035	$155.00	Gunnison
PROSPECT 6	341974	14 0150S 0220E 035	$155.00	Gunnison
PROSPECT 7A	341975	14 0150S 0220E 035	$155.00	Gunnison
PROSPECT 8A	341976	14 0150S 0220E 035	$155.00	Gunnison
PROSPECT 9	341977	14 0150S 0220E 035	$155.00	Gunnison
TEX 1	341978	14 0150S 0230E 031	$155.00	Gunnison
TEX 2	341979	14 0160S 0220E 001	$155.00	Gunnison
TEX 3	341980	14 0150S 0230E 031	$155.00	Gunnison
TEX 4	341981	14 0160S 0230E 006	$155.00	Gunnison
TEX 5	341982	14 0150S 0230E 031	$155.00	Gunnison
TEX 6	341983	14 0160S 0230E 006	$155.00	Gunnison
TEX 7	341984	14 0150S 0230E 031	$155.00	Gunnison
TEX 8	341985	14 0160S 0230E 006	$155.00	Gunnison
TEX 9	341986	14 0150S 0230E 031	$155.00	Gunnison
TEX 10	341987	14 0160S 0230E 006	$155.00	Gunnison
TEX 11	341346	14 0150S 0230E 031	$155.00	Gunnison
TEX 12	341988	14 0160S 0230E 006	$155.00	Gunnison
TEX 13	341347	14 0160S 0230E 006	$155.00	Gunnison
TEX 14	341989	14 0160S 0230E 005	$155.00	Gunnison
TEX 15	341990	14 0160S 0220E 001	$155.00	Gunnison
TEX 16	341348	14 0160S 0220E 001	$155.00	Gunnison
TEX 17	341991	14 0160S 0230E 006	$155.00	Gunnison
TEX 18	341349	14 0160S 0230E 006	$155.00	Gunnison
TEX 19	341992	14 0160S 0230E 006	$155.00	Gunnison
TEX 20	341993	14 0160S 0230E 006	$155.00	Gunnison
TEX 21	341994	14 0160S 0230E 006	$155.00	Gunnison
TEX 22	341995	14 0160S 0230E 006	$155.00	Gunnison
TEX 23	341996	14 0160S 0230E 006	$155.00	Gunnison
TEX 24	341997	14 0160S 0230E 006	$155.00	Gunnison
TEX 25	341998	14 0160S 0230E 006	$155.00	Gunnison
TEX 26	341999	14 0160S 0230E 006	$155.00	Gunnison
TEX 27	342000	14 0160S 0230E 005	$155.00	Gunnison
TEX 28	342001	14 0160S 0230E 005	$155.00	Gunnison
TEX 29	341350	14 0160S 0230E 006	$155.00	Gunnison

TEX 30	341351	14 0150S 0230E 031	$155.00	Gunnison
ADDIE R	403667	14 0150S 0220E 023	$155.00	Johnson Camp
ALAMOSA	403668	14 0150S 0220E 023	$155.00	Johnson Camp
BEE R2	403669	14 0150S 0220E 024	$155.00	Johnson Camp
BEE R1	403670	14 0150S 0220E 024	$155.00	Johnson Camp
BEE R3	403671	14 0150S 0220E 024	$155.00	Johnson Camp
BEE R4	403672	14 0150S 0220E 024	$155.00	Johnson Camp
BEE R5	403673	14 0150S 0220E 024	$155.00	Johnson Camp
BEE R11	403674	14 0150S 0220E 024	$155.00	Johnson Camp
BEE R12	403675	14 0150S 0220E 024	$155.00	Johnson Camp
BONANZA	403676	14 0150S 0220E 022	$155.00	Johnson Camp
BUMBLE BEE	403677	14 0150S 0220E 023	$155.00	Johnson Camp
BURRO L	403678	14 0150S 0220E 035	$155.00	Johnson Camp
BURRO 4	403679	14 0150S 0220E 035	$155.00	Johnson Camp
BURRO 5	403680	14 0150S 0220E 035	$155.00	Johnson Camp
BURRO 6	403681	14 0150S 0220E 035	$155.00	Johnson Camp
BURRO 7	403682	14 0150S 0220E 035	$155.00	Johnson Camp
BURRO 8	403683	14 0150S 0220E 035	$155.00	Johnson Camp
BURRO NO 9	403684	14 0150S 0220E 035	$155.00	Johnson Camp
BURRO 19	403685	14 0150S 0220E 027	$155.00	Johnson Camp
CALUMET	403686	14 0150S 0220E 036	$155.00	Johnson Camp
CHARLES	403687	14 0150S 0220E 036	$155.00	Johnson Camp
CHELSIE FRACTION	403688	14 0150S 0220E 022	$155.00	Johnson Camp
COLORADO	403689	14 0150S 0220E 022	$155.00	Johnson Camp
DEFENDER	403690	14 0150S 0220E 022	$155.00	Johnson Camp
DORA	403691	14 0150S 0220E 036	$155.00	Johnson Camp
E-5 FRACTION	403692	14 0150S 0220E 013	$155.00	Johnson Camp
ECHO NO 1	403693	14 0150S 0220E 024	$155.00	Johnson Camp
ECHO R2	403694	14 0150S 0220E 024	$155.00	Johnson Camp
ECHO R3	403695	14 0150S 0220E 024	$155.00	Johnson Camp
ELEPHANT	403696	14 0150S 0220E 023	$155.00	Johnson Camp
ELLA	403697	14 0150S 0220E 036	$155.00	Johnson Camp
ELLENOR	403698	14 0150S 0220E 027	$155.00	Johnson Camp
ERICKA	403699	14 0150S 0220E 036	$155.00	Johnson Camp
ERNEST	403700	14 0150S 0220E 036	$155.00	Johnson Camp
EULA BELLE	403701	14 0150S 0220E 027	$155.00	Johnson Camp
GLADYS R	403702	14 0150S 0220E 036	$155.00	Johnson Camp
GUSTAVE	403703	14 0150S 0220E 036	$155.00	Johnson Camp
HAGERMAN	403704	14 0150S 0220E 036	$155.00	Johnson Camp
IMOGENE	403705	14 0150S 0220E 027	$155.00	Johnson Camp
INA	403706	14 0150S 0220E 036	$155.00	Johnson Camp
INDICATOR	403707	14 0150S 0220E 022	$155.00	Johnson Camp
KATIE	403708	14 0150S 0220E 022	$155.00	Johnson Camp

KENTUCKY	403709	14 0150S 0220E 023	$155.00	Johnson Camp
LAST CHANCE	403710	14 0150S 0220E 027	$155.00	Johnson Camp
LAURA J	403711	14 0150S 0220E 024	$155.00	Johnson Camp
LIME NO 1	403712	14 0150S 0220E 022	$155.00	Johnson Camp
LIME NO 2	403713	14 0150S 0220E 022	$155.00	Johnson Camp
LIME NO 3	403714	14 0150S 0220E 022	$155.00	Johnson Camp
LIME NO 4	403715	14 0150S 0220E 022	$155.00	Johnson Camp
LINDA SUE	403716	14 0150S 0220E 027	$155.00	Johnson Camp
LOUIE	403717	14 0150S 0220E 036	$155.00	Johnson Camp
MARY	403718	14 0150S 0220E 036	$155.00	Johnson Camp
MARY EILENE	403719	14 0150S 0220E 027	$155.00	Johnson Camp
MASON	403720	14 0150S 0220E 027	$155.00	Johnson Camp
MESCAL NO 5	403721	14 0150S 0220E 027	$155.00	Johnson Camp
MILLINGTON	403722	14 0150S 0220E 023	$155.00	Johnson Camp
MIRIAM	403723	14 0150S 0220E 022	$155.00	Johnson Camp
MOORE #1	403724	14 0150S 0220E 022	$155.00	Johnson Camp
MOORE #2	403725	14 0150S 0220E 022	$155.00	Johnson Camp
MOORE #3	403726	14 0150S 0220E 022	$155.00	Johnson Camp
NELDA LANE	403727	14 0150S 0220E 027	$155.00	Johnson Camp
PORTLAND	403728	14 0150S 0220E 023	$155.00	Johnson Camp
PRIMROSE	403729	14 0150S 0220E 023	$155.00	Johnson Camp
PRIMROSE BEE	403730	14 0150S 0220E 023	$155.00	Johnson Camp
PUZZLE NO 2	403731	14 0150S 0220E 022	$155.00	Johnson Camp
S-10	403732	14 0150S 0220E 023	$155.00	Johnson Camp
S-12	403733	14 0150S 0220E 023	$155.00	Johnson Camp
S-14	403734	14 0150S 0220E 023	$155.00	Johnson Camp
S-16	403735	14 0150S 0220E 023	$155.00	Johnson Camp
S-18	403736	14 0150S 0220E 023	$155.00	Johnson Camp
S-26	403737	14 0150S 0220E 024	$155.00	Johnson Camp
S-28	403738	14 0150S 0220E 024	$155.00	Johnson Camp
S-30	403739	14 0150S 0220E 024	$155.00	Johnson Camp
S-32	403740	14 0150S 0220E 024	$155.00	Johnson Camp
S-34	403741	14 0150S 0220E 024	$155.00	Johnson Camp
SHARIE LYNN	403742	14 0150S 0220E 027	$155.00	Johnson Camp
SHIRLEY LOUISE	403743	14 0150S 0220E 027	$155.00	Johnson Camp
ULTIMO	403744	14 0150S 0220E 036	$155.00	Johnson Camp
WOLFRIME	403745	14 0150S 0220E 036	$155.00	Johnson Camp
BRENDA KAYE	405106	14 0150S 0220E 027	$155.00	Johnson Camp
BURRO A	405107	14 0150S 0220E 026	$155.00	Johnson Camp
BURRO B	405108	14 0150S 0220E 027	$155.00	Johnson Camp
BURRO 17	405121	14 0150S 0220E 027	$155.00	Johnson Camp
BURRO 18	405122	14 0150S 0220E 027	$155.00	Johnson Camp
BURRO 20	405123	14 0150S 0220E 027	$155.00	Johnson Camp

CHARLENE	405124	14 0150S 0220E 027	$155.00	Johnson Camp
FRANCINE	405126	14 0150S 0220E 027	$155.00	Johnson Camp
JANE RAE	405127	14 0150S 0220E 027	$155.00	Johnson Camp
BURRO C	408182	14 0150S 0220E 026	$155.00	Johnson Camp
BURRO D	408183	14 0150S 0220E 026	$155.00	Johnson Camp
BURRO E	408184	14 0150S 0220E 026	$155.00	Johnson Camp
BURRO G	408185	14 0150S 0220E 026	$155.00	Johnson Camp
BURRO H	408186	14 0150S 0220E 026	$155.00	Johnson Camp
BURRO I	408187	14 0150S 0220E 026	$155.00	Johnson Camp
BURRO 11	408188	14 0150S 0220E 026	$155.00	Johnson Camp
BURRO 12	408189	14 0150S 0220E 026	$155.00	Johnson Camp
BURRO 13	408190	14 0150S 0220E 026	$155.00	Johnson Camp
BURRO 14	408191	14 0150S 0220E 026	$155.00	Johnson Camp
BURRO 15	408192	14 0150S 0220E 026	$155.00	Johnson Camp
BURRO 16	408193	14 0150S 0220E 026	$155.00	Johnson Camp
CORNADO NO 1	408194	14 0150S 0220E 026	$155.00	Johnson Camp
ROSIE R	408195	14 0150S 0220E 026	$155.00	Johnson Camp
J SULLY #6	408909	14 0150S 0220E 036	$155.00	Johnson Camp
J SULLY #8	408911	14 0150S 0220E 036	$155.00	Johnson Camp
J SULLY #11	408914	14 0150S 0220E 036	$155.00	Johnson Camp
J SULLY #12	408915	14 0150S 0220E 036	$155.00	Johnson Camp
J SULLY #13	408916	14 0150S 0220E 036	$155.00	Johnson Camp
J SULLY #14	408917	14 0150S 0220E 036	$155.00	Johnson Camp
J SULLY #15	408918	14 0150S 0220E 036	$155.00	Johnson Camp
SULLY #16	408919	14 0150S 0220E 036	$155.00	Johnson Camp
ASHLEY	416211	14 0150S 0220E 024	$155.00	Johnson Camp
J-TRAVASSOS	416212	14 0150S 0220E 024	$155.00	Johnson Camp
N-TRAVASSOS	416213	14 0150S 0220E 024	$155.00	Johnson Camp
SUMMERTIME	416214	14 0150S 0220E 023	$155.00	Johnson Camp
SUNSET	416215	14 0150S 0220E 023	$155.00	Johnson Camp
T-ACKEN	416216	14 0150S 0220E 024	$155.00	Johnson Camp
WILDFIRE	416217	14 0150S 0220E 023	$155.00	Johnson Camp

*some claims may extend into adjacent Townships, Ranges or Sections

	ANNUAL COST	TOTAL # OF CLAIMS
TOAL GUNNISON CLAIMS	$19,840.00	128
TOTAL JOHNSON CAMP CLAIMS	$18,135.00	117
GRAND TOTAL EXHIBIT A	$37,975.00	245

State Permits

Permit Number	1st Year	2nd Year	3rd Year	4th Year	5th Year
08- 118677 Sec. 7	Rent: $911.46 App. Fee: $500 Exp: $4,557.30 Paid in advance	Rent: none App. Fee:$500 Exp:$ 4,557.30 Due: 1-8-17	Rent: $455.73 App. Fee: $500 Exp: $9,114.60 Due: 1-8-18	Rent: $455.73 App. Fee: $500 Exp: $9,114.60 Due: 1-8-19	Rent: $455.73 App. Fee: $500 Exp: $9,114.60 Due: 1-8-20
08- 118685 Sec.18	Rent: $558.48 App. Fee: $500 Exp: $2,792.40 Paid in advance	Rent: none App. Fee:$500 Exp: $2,792.40 Due: 02-05-17	Rent: $279.01 App. Fee: $500 Exp: $5,588.80 Due: 02-05-18	Rent: $279.01 App. Fee: $500 Exp: $5,588.80 Due: 02-05-19	Rent: $279.01 App. Fee: $500 Exp: $5,588.80 Due: 02-05-20
08- 118687 Sec.5	Rent: $638.78 App. Fee: $500 Exp: $3,193.90 Paid in advance	Rent: none App. Fee:$500 Exp:$3,193.90 Due: 02-05-17	Rent: $319.39 App. Fee: $500 Exp: $6,387.80 Due: 02-05-18	Rent: $319.39 App. Fee: $500 Exp: $6,387.80 Due: 02-05-19	Rent: $319.39 App. Fee: $500 Exp: $6,387.80 Due: 02-05-20
08- 118686 Sec.25	Rent: $80.00 App. Fee: $500 Exp: $400.00 Paid in advance	Rent: none App. Fee:$500 Exp:$400.00 Due: 02-05-17	Rent: $40.00 App. Fee: $500 Exp: $800.00 Due: 02-05-18	Rent: $40.00 App. Fee: $500 Exp: $800.00 Due: 02-05-19	Rent: $40.00 App. Fee: $500 Exp: $800.00 Due: 02-05-20
08- 118966 Sec.29	Rent: $1,280.00 App. Fee: $500 Exp: $6,400.00 Paid in advance	Rent: none App. Fee:$500 Exp:$6,400.00 Paid: 6-23-17	Rent: $640.00 App. Fee: $500 Exp:$12,800.00 Paid: 6-23-18	Rent: $640.00 App. Fee: $500 Exp:$12,800.00 Paid: 6-23-19	Rent: $640.00 App. Fee: $500 Exp:$12,800.00 Paid: 6-23-20
08- 118965	Rent: $1,280.00 App. Fee: $500	Rent: none	Rent: $640.00 App. Fee: $500	Rent: $640.00 App. Fee: $500	Rent: $640.00 App. Fee: $500
Sec.8	Exp: $6,400.00 Paid in advance	App. Fee:$500 Exp:$6,400.00 Paid: 6-23-17	Exp:$12,800.00 Paid: 6-23-18	Exp:$12,800.00 Paid: 6-23-19	Exp:$12,800.00 Paid: 6-23-20
08- 118964 Sec.17	Rent: $1,280.00 App. Fee: $500 Exp: $6,400.00 Paid in advance	Rent: none App. Fee:$500 Exp:$6,400.00 Paid: 6-23-17	Rent: $640.00 App. Fee: $500 Exp:$12,800.00 Paid: 6-23-18	Rent: $640.00 App. Fee: $500 Exp:$12,800.00 Paid: 6-23-19	Rent: $640.00 App. Fee: $500 Exp:$12,800.00 Paid: 6-23-20
08- 118963 Sec.32	Rent: $1,280.00 App. Fee: $500 Exp: $6,400.00 Paid in advance	Rent: none App. Fee:$500 Exp:$6,400.00 Paid: 6-23-17	Rent: $640.00 App. Fee: $500 Exp:$12,800.00 Paid: 6-23-18	Rent: $640.00 App. Fee: $500 Exp:$12,800.00 Paid: 6-23-19	Rent: $640.00 App. Fee: $500 Exp:$12,800.00 Paid: 6-23-20

State Mineral Lease

Permit Number 11-53946 Sec. 36 Rent: $11,964.75 Minimum Royalty: $6,381.20 Due: June 16th each year

Lease expires 6-15-2034

Connie Johnson Deed

All mines and minerals in and under Section 31, Township 15 South, Range 23 East, Gila and Salt River Base and Meridian, containing *615.52* acres, more or less; together with the power to take all usual, necessary or convenient means for working, getting, laying up, dressing, making merchantable, and taking away the said mines and minerals, and also for the above purposes, or for any other purposes whatsoever, to make and repair tunnels and sewers, and to lay and repair pipes for conveying water to and from any manufactory or other building as reserved in that certain Warranty Deed from Hetty Wilson Johnson (formerly Hetty G. Wilson) and Conner Johnson, her husband, to Tom Adams and Lizzie E, Adams, husband and wife, dated May 19, 1943, and recorded at Book 136 Deeds of Real Estate, pages 123, 124 in the Office of the Cochise County, Arizona Recorder.

Fee Simple Land

The mineral rights and other interests in the following parcels located in Cochise County, Arizona, as more specifically described in Exhibit A to the Option:

Parcel A: The mineral estate only in approximately 39.06 acres of land in Section 19, T. 16 S., R. 23 E. and Sections 24 and 25, T. 16 S., R 22 E.

Parcel D: The property in approximately 14.24 acres of land in Section 19, T. 16 S., R. 23 E. and Section 25, T. 16 S., R 22 E.

Parcel E: The property in approximately 4.28 acres of land in Section 19, T. 16 S., R. 23 E.

Parcel F: The property in approximately 15.29 acres of land in Section 25, T. 16 S., R. 22 E. (save and excluding a 15 foot easement along the northern boundary of Parcels D and E)

Johnson Camp Fee Lands

The following parcels of fee land are all situated in Township 15 South, Range 22 East, G&SRB&M, Cochise County, Arizona

Parce1 1

Section 26: Lots 8, 9, 10, and 11 EXCEPT all coal and other minerals as reserved in the patent from the United States of America, containing 139.00 acres, more or less.

Parcel 2

Section 26: Those portions of the King and Wolfrime Queen patented lode mining claims lying within the Southeast Quarter (SE1/4) as shown on Mineral Survey No. 1800, U.S. Patent No. 40087, recorded in the records of Cochise County at Book 26, Deeds of Mines, Page 251, containing 1.00 acres, more or less.

Parcel 3

Section 24: Lot 16

Section 25: Lots 11, 13, 14, 16, 17, 18, 20, and 21 382681 v2 EXCEPT any portion of Section 25 lying in the Southeast Quarter of the Northwest Quarter and the Northeast Quarter of the Southwest Quarter of Section 25, Township 15 South, Range 22 East, G&SRB&M, conveyed by Special Warranty Deed dated January 26, 1987 from Cyprus Mines Corporation, Grantor, to David A. Rae, Grantee, recorded in the Cochise County records as Document No. 870102364.

EXCEPT a right-of-way for ditches and canals constructed by the authority of the United States as reserved in the patent from the United States of America.

Containing 53.444 acres, more or less.

Parcel 4

Section 23: Lots 11, 12, 13, 15, and 16

Section 24: Lots 11, 12, and 13 EXCEPT any portion lying within the South Half of the Southeast Quarter of the Northwest Quarter (S1/2SE1/4NW1/4) and the East Half of the Southwest Quarter (E1/2SW1/4) of Section 24, Township 15 South, Range 22 East, G&SRB&M conveyed by Special Warranty Deed dated January 26, 1987 from Cyprus Mines Corporation, Grantor, to David A. Rae, Grantee, recorded in the Cochise County records as Document No. 870102364.

Section 25: Lot 12 EXCEPT any portion lying within the Southeast: Quarter of the Northwest Quarter (SE1/4NW1/4) and the Northeast Quarter of the Southwest Quarter (NE1/4SW1/4) of Section 25, Township 15 South, Range 22 East, G&SRB&M, conveyed by Special Warranty Deed dated January 26, 1987 from Cyprus Mines Corporation, Grantor, to David A. Rae, Grantee, recorded in the Cochise County records as Document No. 870102364.

Section 26: Lots 4, 14, 15, 16, 17, 18, and 19; Southwest Quarter of the Northwest Quarter (SW1/4NW1/4) EXCEPT a right-of-way for ditches and canals constructed by the authority of the United States as reserved in the patent from the United States of America. Containing 307.47 acres, more or less.

Section 25: Lot 15 consisting of 37.53 acres, more or less; and Lot 16 consisting of 38.26 acres, more or less; and Lot 19 consisting of 40 acres, more or less, subject to ownership of those portions of unpatented claims Gladys R and Erika that lie North of the Southern boundary of Lot 19; and

Those portions of Lots 20 and 21 that lie East of the survey line dated April 23, 1989 completed by H.W. Smith, Registered Land Surveyor; and Those portions of the Cochise Lode Claim and the United Fraction Lode Claim that lie East of the survey line dated April 23, 1989 completed by H.W. Smith, Registered Land Surveyor; and That portion of the Highland Mary Lode Claim lying East of the survey line dated April 23, 1989 completed by 382681 v2 H.W. Smith, Registered Land Surveyor. All described lands, in sum, containing 116.267 acres, more or less.