# NI 43-101 Technical Report on Resources and Reserves Bolivar Mine Mexico

**Effective Date: February 28, 2017**
**Report Date: April 6, 2017**

**Report Prepared for**

## Sierra Metals, Inc.


79 Wellington Street West, Suite 2100
P.O. Box 157
Toronto, Ontario, M5K 1H1
Canada


**Report Prepared by**


SRK Consulting (U.S.), Inc.
1125 Seventeenth Street, Suite 600
Denver, CO 80202


SRK Project Number: 470200-160

**Signed by Qualified Persons:**


Matthew Hastings, MSc Geology, MAusIMM (CP), Senior Consultant (Resource Geology)
Jon Larson, BS Mining Engineering, MBA, PE, MMSAQP, Principal Consultant (Mining Engineer)
Jeff Osborn, BEng Mining, MMSAQP, Principal Consultant (Mining Engineer)
Daniel H. Sepulveda, B.Sc., Metallurgist, SME-RM
John Tinucci, PhD, PE, President/Practice Leader/Principal Consultant (Geotechnical Engineer)
Mark Willow, MSc, CEM, SME-RM, Principal Environmental Scientist


**Reviewed by:**


Joanna Poeck, BEng Mining, SME-RM, MMSAQP, Senior Consultant (Mining Engineer)
Bart A. Stryhas, PhD, CPG, Principal Resource Geologist

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# 1 Summary

The purpose of this Technical Report (Technical Report) is to present an update on Resources and Reserves for Sierra Metals, Inc. (Sierra Metals or the Company) by SRK Consulting (U.S.), Inc. (SRK) on the Bolivar Mine, Mexico (Bolivar or the Project). Bolivar is an operating mine that has been in commercial production since late 2011. This report was prepared in accordance with National Instrument 43-101 (NI 43-101).

## 1.1 Property Description and Ownership

The Bolivar property is owned by Sierra Metals, formerly known as Dia Bras Exploration, Inc., through subsidiary companies Dia Bras Mexicana S.A. de C.V. and EXMIN S.A. de C.V. (collectively Dia Bras). The property consists of 14 mineral concessions (approximately 6,800 ha) in the northern Mexican state of Chihuahua. The property is located in the Piedras Verdes mining district, 400 km south by road from the city of Chihuahua (population 4.8 million as of 2010) and roughly 10 km southwest of the town of Urique (population 1,102 as of 2010). The property includes the Bolivar Mine, a historic Cu-Zn skarn deposit that has been actively mined by Dia Bras since November 2011, as well as a processing plant, which is situated approximately 5.1 km by road from the mine.

## 1.2 Geology and Mineralization

The Bolivar deposit is a Cu-Zn skarn and is one of many precious and base metal deposits of the Sierra Madre belt, which trends north-northwest across the states of Chihuahua, Durango and Sonora in northwestern Mexico (Meinert, 2007). The deposit is located within the Guerrero composite terrane, which makes up the bulk of western Mexico and is one of the largest accreted terranes in the North American Cordillera. The Guerrero terrane, proposed to have accreted to the margin of nuclear Mexico in the Late Cretaceous, consists of submarine and lesser subaerial volcanic and sedimentary sequences ranging from Upper Jurassic to middle Upper Cretaceous in age. These sequences rest unconformably on deformed and partially metamorphosed early Mesozoic oceanic sequences.

The Piedras Verdes district is made up of Cretaceous andesitic to basaltic flows and tuffs intercalated with greywacke, limestone, and shale beds. Cu-Zn skarn mineralization is located in carbonate rocks adjacent to the Piedras Verde granodiorite. Mineralization exhibits strong stratigraphic control and two stratigraphic horizons host the bulk of the mineralization: an upper calcic horizon, which predominantly hosts Zn-rich mineralization, and a lower dolomitic horizon, which predominantly hosts Cu-rich mineralization. In both cases, the highest grades are developed where structures and associated breccia zones cross these favorable horizons near skarn-marble contacts.

## 1.3 Status of Exploration, Development and Operations

The Bolivar Mine is currently an operational project. In 2016, Bolivar processed 950,000 tonnes of ore producing 17.1 million lb Cu, 398,00 oz Ag, and 2,900 oz Au grading 1.00% Cu, 16.7 g/t Ag, and 0.19 g/t Au. Recovery rates were at 82% Cu, 78% Ag, and 51% Au. The mined material is transported 5 km to 3,000 t/d Piedras Verdes Mill.

## 1.4 Mineral Processing and Metallurgical Testing

Various development and test mining has occurred at the Bolivar mine under Dia Bras ownership since 2005. Prior to late 2011, no processing facilities were available on site, and the ore was trucked to Cusi's Malpaso mill located 270 km by road. Bolivar's Piedras Verdes processing facilities started operating in October 2011 at 1,000 tonnes per day of nominal throughput. The ore processing capacity was expanded to 2,000 tonnes per day in mid-2013. The current nominal throughput capacity is 3,000 tonnes per day. Bolivar facilities include a metallurgical laboratory at site. Sampling and testing of samples are executed on an as-needed basis.

## 1.5 Mineral Resource Estimate

Mineral Resource Estimations have been conducted by Matthew Hastings of SRK Consulting (U.S.) Inc., a Qualified Person under National Instrument 43-101 – Standards of Disclosure for Mineral Projects, using Maptek Vulcan™ and Leapfrog Geo™ software.

SRK has worked with Dia Bras personnel to develop the geology models, grade estimations, and reporting criteria for mineral resources at Bolivar. Geology models were developed by Dia Bras and were modified and reviewed by SRK. In all, there are seventeen individual mineralized bodies identified through drilling and mine development. These were used as hard boundaries for the purposes of the estimation. Although the majority of the estimated resource is supported by drilling, limited channel samples support the estimation near the mined portions of the deposit. The block models were created by SRK, and have been estimated using a combination of inverse distance and ordinary kriging methods. The mineral resources have been estimated and classified in conformity with generally accepted CIM "Estimation of Mineral Resource and Mineral Reserves Best Practices" guidelines.

SRK is of the opinion that the Mineral Resource estimations are suitable for public reporting and are a fair representation of the in-situ contained metal for the Bolivar Mine.

The September 30, 2016, consolidated Mineral Resource statement for the Bolivar Mine area is presented in Table 1-1. These resources are stated in undeveloped areas of the deposits as well as within remaining surveyed pillars in the existing mined out areas. The pillar resources are reported using a lower COG to reflect the fact that they have been exposed through previous mining.

**Table 1-1: Consolidated Bolivar Mineral Resource Estimate as of September 30, 2016 – SRK Consulting (U.S.), Inc.**

| Category | Tonnes (000's) | Ag (g/t) | Au (g/t) | Cu (%) | Ag (koz) | Au (koz) | Cu (t) |
|---|---|---|---|---|---|---|---|
| Indicated | 9,335 | 18.1 | 0.30 | 0.90 | 5,440 | 91 | 83,885 |
| Inferred | 9,055 | 17.9 | 0.33 | 0.86 | 5,200 | 97 | 77,830 |

(1) Mineral resources are reported inclusive of ore reserves. Mineral resources are not ore reserves and do not have demonstrated economic viability. All figures rounded to reflect the relative accuracy of the estimates. Copper, gold, and silver, assays were capped where appropriate.
(2) Mineral resources are reported at variable metal value cut-off grades based on metal price assumptions*, metallurgical recovery assumptions**, mining/transport costs (US$13.59/t), processing costs (US$10.00/t), and general and administrative costs (US$3.40/t).
(3) The metal value cut-off grade for the unmined portions of the Bolivar Mine is US$27 and is US$20 for the remaining vertical pillars in the mined areas. The mineral resources within the remaining vertical pillars comprise less than 1% of the Indicated Mineral Resources. No mineral resources are reported for the remaining crown or sill pillars.
* Metal price assumptions considered for the calculation of metal value are: Copper (Cu): US$/lb 2.43, Silver (Ag): US$/oz 18.30, and Gold (Au): US$/oz 1,283.00.
** Metallurgical recovery assumptions are 81% Cu, 77% Ag, and 49% Au.
*The resources were estimated by SRK. Matthew Hastings, M.Sc., PGeo, MAusIMM #314693 of SRK, a Qualified Person, performed the resource calculations for Bolivar.*

## 1.6 Mineral Reserve Estimate

Bolivar is a currently operating underground mine with production history under Dia Bras ownership of more than five years. A copper concentrate is produced containing payable copper, silver and minor amounts of payable gold. Various underground development activities, test mining, and smaller scale milling has taken place under Dia Bras ownership since the early to 2000s.

The procedures and methods supporting the mineral reserve estimation have been developed by SRK in conjunction with Dia Bras mine planning personnel. The reserve estimations presented herein have been conducted by independent consultants using supporting data generated by the site. In general each mining area is evaluated using reasonable mining block shapes based on the mining method applicable to the zone. Mineral Reserves estimated by the independent consultants are categorized in a manner consistent with industry best practice. Data and information supporting the mining recovery, mining dilution, metallurgical recoveries, consensus commodity pricing, and treatment and refining charges have been provided by Dia Bras and reviewed by SRK. These factors are used to calculate a Net Smelter Return (NSR) for the blocks in the models. Historic and expected direct and indirect mining, processing and general and administrative costs were provided by Dia Bras. To be considered economic, the NSR value of the mining block must be greater than the economic cutoff. Blocks below the economic cutoff but above the marginal cutoff are, in some cases, included in the reserve where they are in between or immediately adjacent to an economic block and it is reasonable to expect that no significant additional development would be required to extract the marginal block. Isolated blocks, defined as blocks with no defined access or blocks that do not pay for the required development, have been excluded. Only material classified as Measured and Indicated Resources contribute to the grade values in a mining block. Material inside the mine design and not classified as Measured or Indicated is assumed to have 0 grade. Mined out areas were provided by Dia Bras personnel, and represent development and production up to September 30, 2016.

Mineral Reserve Estimations have been conducted by Jon Larson of SRK Consulting (U.S.) Inc., a Qualified Person under National Instrument 43-101 – Standards of Disclosure for Mineral Projects, using Maptek Vulcan™ and Minemax iGantt software. The consolidated mineral reserve statement for the Bolivar Mine is presented in Table 1-2.

**Table 1-2: Consolidated Bolivar Mineral Reserve Estimate as of September 30, 2016 – SRK Consulting (U.S.), Inc.**

| Category | Tonnes (000's) | Ag (g/t) | Au (g/t) | Cu (%) | Ag (koz) | Au (koz) | Cu (t) |
|---|---|---|---|---|---|---|---|
| Proven | - | - | - | - | - | - | - |
| Probable | 4,327 | 17.5 | 0.31 | 0.85 | 2,441 | 44 | 36,586 |
| P+P | 4,327 | 17.5 | 0.31 | 0.85 | 2,441 | 44 | 36,586 |

(1) All figures rounded to reflect the relative accuracy of the estimates. Totals may not sum due to rounding.
(2) Ore reserves are reported at NSR cut-offs (CoG) based on metal price assumptions*, metallurgical recovery assumptions**, mining costs, processing costs, general and administrative (G&A) costs, and treatment and refining charges.
* Metal price assumptions considered for the calculation of NSR are: Copper (Cu): US$/lb 2.43, Silver (Ag): US$/oz 18.30, and Gold (Au): US$/oz 1,283.00.
** Metallurgical recovery assumptions are 81% Cu, 77% Ag, and 49% Au.
(3) The NSR CoG is variable by mining method:
- US$30.50 = Room and Pillar; and
- US$32.50 = Longhole Stoping.

(4) Ore reserves have been stated on the basis of a mine design, mine plan, and cash-flow model:
- Mining recovery applied is 85%.
- Mining dilution (internal and external), applied with a zero grade, ranges from 12% to 36% and averages 16%.

Source: SRK, 2017

The reserves estimated herein are contained in El Gallo Inferior, and zones called Chimenea 1, Chimenea 2, Bolivar West, and Bolivar Northwest. The El Gallo Superior and Bolivar areas are considered mined out, though mineralized material remains in pillars. Any remaining pillar tonnes have not been included in the reserves at this time. The production schedule associated with this reserves estimate results in mining until July 2021 at an average production of approximately 2,500 ore t/day.

## 1.7 Mining Methods

Ore production at Bolivar is primarily by means of underground room and pillar mining. Ore is processed at the Piedras Verdes mill located south of the mine. Mining has occurred in several mostly shallow dipping zones in the immediate Bolivar area including Bolivar, El Gallo Superior, El Gallo Superior Magnetita, and El Gallo Inferior.

Areas where room and pillar mining occurs are divided into levels measuring approximately 16 m high. Each 16 m level is further divided into sublevels of approximately 4 m. A ramp is driven and access to the middle sublevel is established in the footwall, and the initial cut in ore is developed at this middle sublevel. The roof is then drilled, blasted and mucked. The third cut is mined down to the lower sublevel floor. Ramps in ore are established whenever possible to minimize the mining of waste. The remaining 4 m of material is left as a sill pillar.

Chimenea 1, Chimenea 2 and the steeply dipping areas of Bolivar West are suitable for mining using longhole stoping techniques. Longhole stoping can provide for higher production and better recovery of the ore than the room and pillar method. However, there are currently limited zones in the Bolivar area where this mining method is applicable, and mining using this method accounts for approximately 8% of the reserves stated herein. The site has some past experience using longhole techniques in the Chimenea areas.

Current production is from the El Gallo Inferior body. January through September 2016 ore production reported by the mine averaged 2,440 t/day, and ore delivered to Piedras Verdes was 2,460 t/day. Ore is hauled to the surface using one of several adits or declines accessing the orebodies and dumped onto small pads outside the portals. The ore is then loaded into rigid frame over-the-road trucks, typically 18 tonne capacity, and hauled on a gravel and dirt road approximately 5.1 km south to the Piedras Verdes mill.

## 1.8 Recovery Methods

Dia Bras operates a conventional concentration plant consisting of crushing, grinding, flotation, thickening and filtration of the final concentrate. Flotation tails are disposed of in a conventional tailings facility. Ore feed during year 2016 reached a total of 950,398 tonnes, equivalent to an average of 79,200 tonnes per month, or 2,600 tonnes per day. During 2016, production of copper concentrate has consistently ranged between approximately 2,000 and 2,700 tonnes per month, equivalent to roughly a 2.9% mass pull. The monthly average concentrate production has consistently reached commercial quality with copper grade at 27% and credit metals averaging 369 g/t silver and 2.19 g/t gold in 2016. Metal recovery for copper, silver, and gold averaged 81.8%, 78.1% and 52.1%, respectively.

## 1.9 Project Infrastructure

The Project has fully developed infrastructure including access roads, a man-camp capable of supporting 385 persons that includes a cafeteria, laundry facilities, maintenance facilities for the underground and surface mobile equipment, electrical shop, guard house, fuel storage, laboratories, warehousing, storage yards, administrative offices, plant offices, truck scales, explosives storage, processing plant and associated facilities, tailings storage facility, and water storage reservoir and water tanks.

The site has fully developed and functioning electric power from the Mexican power grid, backup diesel generators and heating from site propane tanks.

The Project has developed waste handling and storage facilities. The site has minimal waste rock requirements but does have a small permitted area to dispose of waste rock. The tailings management plan at the Bolivar mine includes placement of tails in a number of locations in and around the Tailings Storage Facility (TSF) that has been in operation since late 2011. The current TSF has five locations to store tailings (TSF1-5). The site will develop an expansion TSF to the west of the existing facilities for future tailings.

Tailings consisting of approximately 40% solids will be placed in conventional tailings storage facilities until June 2017. The site is installing an additional thickener and filter presses to allow additional water recovery. Thickened tails (60% solids) will be placed from June 2017 to February 2018. After the filter presses are constructed dry-stack tails will be placed after February 2018.

The main TSF will be utilized until mid-2019. A new dry-stack TSF (New TSF) to be located just to the west of the existing facility will be utilized after mid-2019 and has an expected life through 2023.

SRK notes that Dia Bras has allocated US$6.1 million in 2017 for the thickener, filter presses, and TSF expansion civil works.

The overall Project infrastructure is built out and functioning and adequate for the purpose of the planned mine and mill. SRK notes that the current tailings facility will need to be expanded to support the continued operation of the processing plant.

## 1.10 Environmental Studies and Permitting

SRK's environmental QP did not conduct a site visit of the Bolivar Mine. As such, the following information is predicated on a review of limited data and documentation provided by the site and direct communications with legal representatives for the operator.

The current tailings disposal facility has capacity until mid-2019. Dia Bras intends to build additional tailings capacity concurrent with mine operations. The expansion will require additional permitting effort.

Geochemical characterization results for 2014 and 2015, provided to SRK, indicate low metals leaching potential and either uncertain or non-acid generating potential. The 2016 ABA results (NP = 52.5 kg CaCO3/ton; AP = 141 kg CaCO3/ton), however, suggest that some of the more recent material may be potentially acid generating: NP/AP = 0.372. Additional investigation of the current materials being deposited into the tailings impoundment may be warranted; however, given the dryness of the Chihuahuan Desert, this may not necessarily be a material issue for the project.

The required permits for continued operation at the Bolivar Mine, including exploration of the site, have been obtained. SRK has not conducted an investigation as to the current status of all the required permits. At this time, SRK is not aware of any outstanding permits or any non-compliance at the project or nearby exploration sites.

In 2009, SEMARNAT agreed that an environmental impact assessment for the Bolivar Mine was not necessary since the area has been under exploration and exploitation since 1979, but that Dia Bras was still subject to the applicable environmental regulations. However, in the event that modifications to the existing operation were proposed, SEMARNAT would need to be consulted to determine the appropriate procedures for authorization.

In 2015, an authorization for the Unique Environmental License (Licencia Ambiental Unica [LAU]) was granted by SEMARNAT to EXMIN in order to carry out mineral processing and other metallurgical activities (beneficiation) at the Bolivar mill site. The document establishes the environmental obligations to be met by the company.

In 2014, the enforcement branch of SEMARNAT, PROFEPA, conducted an inspection of several streams and arroyos near the EXMIN property (Bolivar Mine). SRK understands from the documentation provided that tailings from the beneficiation plant had spilled into these drainages during heavy rains in 2013. According to EXMIN, the cleanup was performed over a period of several months, and any residual testing showed that the materials in the streams met with Mexican norms. No further action appears to have been ordered.

In February 2017, Treviño Asociados Consultores presented to Dia Bras, S.A. de C.V. a work breakdown of the anticipated tasks for closure and reclamation of the Bolivar Mine. The closure costs were estimated to be MX$9,259,318 (~US$453,888). SRK's scope of work did not include an assessment of the veracity of this closure cost estimate, but, based on projects of similar nature and size within Mexico, the estimate appears low in comparison.

## 1.11 Capital and Operating Costs

Using an average mining rate of 2,985 t/d and a processing rate of 2,450 t/d, the Bolivar reserves support the project until July 2021.

The yearly capital expenditure by area is summarized in Table 1-3.

**Table 1-3: Capital Cost Summary (US$)**

| Description | Total ($000s) | 2016 ($000s) | 2017 ($000s) | 2018 ($000s) | 2019 ($000s) | 2020 ($000s) | 2021 ($000s) | 2022 ($000s) |
|---|---|---|---|---|---|---|---|---|
| Mine Development | 10,221 | 193 | 1,989 | 4,440 | 2,602 | 983 | 14 | 0 |
| Ventilation | 2,659 | 0 | 308 | 1,278 | 1,073 | 0 | 0 | 0 |
| Equipment Sustaining | 14,699 | 0 | 5,515 | 5,732 | 3,254 | 173 | 25 | 0 |
| Geological Exploration | 11,442 | 0 | 3,223 | 2,444 | 1,680 | 2,005 | 2,090 | 0 |
| Plant Sustaining | 866 | 0 | 866 | 0 | 0 | 0 | 0 | 0 |
| TSF Sustaining | 6,376 | 0 | 5,276 | 514 | 586 | 0 | 0 | 0 |
| Closure | 453 | 0 | 0 | 0 | 0 | 0 | 0 | 453 |
| **Total Capital** | **$46,715** | **$193** | **$17,177** | **$14,407** | **$9,195** | **$3,161** | **$2,129** | **$453** |

Source: SRK, 2017

The basis of the operating cost estimate is a first principles approach based on site specific data. Dia Bras' technical team provided SRK with historic costs on a monthly basis, which was used to derive future costs.

Table 1-4 and Table 1-5 show a summary of total operating costs and unit operating costs.

**Table 1-4: Operating Cost Summary (US$)**

| Area | Total ($000s) | 2016 ($000s) | 2017 ($000s) | 2018 ($000s) | 2019 ($000s) | 2020 ($000s) | 2021 ($000s) |
|---|---|---|---|---|---|---|---|
| Mine | 58,812 | 3,101 | 12,435 | 12,684 | 13,246 | 13,146 | 4,200 |
| Plant | 43,277 | 2,282 | 9,151 | 9,334 | 9,747 | 9,674 | 3,090 |
| G&A | 14,729 | 777 | 3,114 | 3,177 | 3,317 | 3,292 | 1,052 |
| **Total** | **$116,817** | **$6,159** | **$24,700** | **$25,194** | **$26,311** | **$26,112** | **$8,342** |

Source: SRK, 2017

**Table 1-5: Unit Operating Cost Summary (US$)**

| Area | LoM ($000s) | Average ($/t) |
|---|---|---|
| Mine | 58,812 | 13.59 |
| Plant | 43,277 | 10.00 |
| G&A | 14,729 | 3.40 |
| **Total** | **$116,817** | **$26.99** |

Source: SRK, 2017

## 1.12 Economic Analysis

The reserves stated in this report support a profitable operation under the cost and market assumptions discussed in this report and indicate a free cash flow of US$10.4 million and a present value of US$7.1 million based on a discount rate of 8%.

Economic projections of the base case metal prices scenario indicate that the project's cumulative free cash flow will be negative in 2017 and 2018 and recover in 2019. The project's present value will be negative between 2017 and 2019 and recover in 2020. This is related to two factors. The first is the high intensity of capital expenditure projected for these two years, and the second is a small dip in the copper production for 2018. The breakeven copper price for Bolivar is US$2.25/lb; SRK notes the current spot price is approximately US$2.65/lb and a price of US$2.43 was used in this economic analysis.

The current scenario presents Dia Bras with two years of relatively significant capital financing requirements considering the estimated reserves. SRK recommends that the company should conduct the studies described herein to:

- Evaluate a pillar recovery program;
- Revise the mining method; and
- Utilize tailings as backfill.

The potential improvements may allow the operation to revise its production schedule, revise the capital expenditure schedule, and allow prioritization of further geological study and exploration to identify resources and reserves that will support a more favorable LoM plan.

# 1.13 Conclusions and Recommendations

## 1.13.1 Geology and Mineral Resources

SRK has the following conclusions regarding the exploration efforts and potential for the Bolivar and La Sidra areas.

- Several areas within the Bolivar Mine would benefit from additional drilling, as the current spacing is insufficient to adequately define the continuity of mineralization for prospective mining. Areas that would benefit from additional drilling to improve confidence in the estimation include Bolivar NW, Bolivar W, and Increíble/Step Out.
- Other areas such as extensions of El Gallo Inferior and the Chimeneas orebodies are close to existing mining operations and would benefit from additional drilling to expand known resources.
    - SRK notes that areas such as Bolivar W, Step-Out, and Increíble would all benefit from better positioning of drill stations, as some of the drilling orientations in the current database are getting very near to the same strike and dip as the mineralized bodies themselves.

SRK is of the opinion that the Mineral Resource Estimate has been conducted in a manner consistent with industry best practices and that the data and information supporting the stated Mineral Resources is sufficient for declaration of Indicated and Inferred classifications of resources. SRK has not classified any of the resources in the Measured category due to certain deficiencies regarding the data supporting the Mineral Resource Estimate.

These deficiencies include:

- The lack of a historic QA/QC program, which has only been supported by a recent resampling and modern QA/QC program for a limited number of holes. Measured resources generally are supported by high resolution drilling or sampling data that feature consistently implemented and monitored QA/QC.

- The lack of consistently-implemented down-hole surveys in the historic drilling. Observations from the survey data which has been done to date show potential for significant deviations from planned orientations as well as local down-hole deviations that may influence the exact position of mineralized intervals.
- The lack of industry-standard asbuilt data delineating mined out areas. SRK utilized multiple data types to define the mined areas, and notes that none of them include well-defined 3D solids with measurable volumes. SRK has constructed 3-D solids by combining AutoCAD level plan survey lines, points, and as built triangulations and generated distance buffers (3 m) to obtain volumes in areas that have been mined. There is still uncertainty associated with this practice, but SRK notes that this is likely balanced by the conservative nature of distance buffer approach, which may actually flag some material that is to be mined in the near term as having been previously mined.

### 1.13.2 Mining and Reserves

Recent production data was used as a primary source of information to validate or derive, as necessary, the relevant modifying factors used to convert Mineral Resources into Mineral Reserves. SRK is of the opinion that the Mineral Reserve Estimate has been conducted in a manner consistent with industry best practices and that the data and information supporting the stated mineral reserves is sufficient for declaration of Probable classifications of reserves.

The production schedule associated with this reserves estimate results in mining until July 2021 at an average production of approximately 2,500 ore t/day. The tailings storage facility will need to be expanded. Dia Bras is planning to install an additional thickener and filter presses and move to a dry stack method of tailings handling and storage. As a result the overall tailings handling system will evolve over the next twelve months. Dia Bras has budgeted capital for these activities and is working with a number of external contractors to complete the various phases of the overall management plan. Delays in these projects could impact the overall mine plan by delaying the processing of ore at Piedras Verdes beyond 2017.

SRK has the following recommendations regarding mining and reserves at Bolivar:

- The planning of infill drilling and mine planning should emphasize the conversion of resources into reserves inventory especially for the mid- and long-range planning horizons;
- Use updated 3D mine survey data and improved processes to:
  - Regularly perform stope-by-stope planned to actual reconciliations, for both grade and tonnage mined, to continually validate the mining recovery and dilution assumptions; and
  - Develop an estimate of the tonnes and grade remaining in pillars;
- Initiate a mining methods trade-off study to plan for the safe extraction of pillars and identify possible improvements to the mining methods used. This study should also include the analysis of utilizing tailings as backfill in the mine;
- Develop and annually update a 3D life-of-mine (LoM) design and schedule; and
- Develop and implement a whole-of-mine ventilation plan in order to implement and maintain a forced ventilation system over the life of the mine.

### 1.13.3 Recovery Methods

SRK notes a high level of month-to-month variability for both tonnes and head grade input to processing. Better integration between geology, mine planning and processing can significantly reduce this variability. Additional work is also needed in the processing facilities to stabilize the operation. Improvements include the implementation of a preventive maintenance program and training programs to improve operators' skill, with the ultimate objective of improving metal recovery and lower operating cost, while maintaining or improving concentrate quality.

### 1.13.4 Tailings Management

As part of the overall tailings management plan, Bolivar is moving to filtered tailings. Expansion in the immediate area of the currently operating facility will occur as the site moves first to thickened tailings in mid-2017 and to filtered tailings in early 2018. SRK recommends that the site continue its project efforts to complete the installation of the thickener, filter presses, and conveyor. The site must ensure that all required detailed designs are completed and permits are in place for successful operation of the New TSF located to the west of the existing facility. An analysis of utilizing tailings as backfill in the mine should be carried out, and a trade-off study should be completed to determine if the size of the New TSF can be reduced.

### 1.13.5 Environmental and Permitting

SRK has the following recommendations regarding environment, permitting, and social or community impact at Bolivar:

- SRK recommends that Dia Bras contract an independent review of the closure cost estimate, with an emphasis on benchmarking against other projects in northern Mexico. This will require a site investigation and the preparation of a more comprehensive and detailed closure and reclamation plan before a closure specialist evaluates the overall closure approach and costs.
- Based on the 2016 geochemical characterization data, a more robust and comprehensive testing program for the tailings should be undertaken with an emphasis on closure of the existing facilities in such a manner as to not pose a risk to local groundwater resources.

# 2 Introduction

## 2.1 Terms of Reference and Purpose of the Report

The purpose of this Technical Report (Technical Report) is to present an update on Resources and Reserves for Sierra Metals, Inc. (Sierra Metals or the Company) by SRK Consulting (U.S.), Inc. (SRK) on the Bolivar Mine, Mexico (Bolivar or the Project). Bolivar is an operating mine that has been in commercial production since late 2011. This report was prepared in accordance with National Instrument 43-101 (NI 43-101).

The quality of information, conclusions, and estimates contained herein is consistent with the level of effort involved in SRK's services, based on: i) information available at the time of preparation, ii) data supplied by outside sources, and iii) the assumptions, conditions, and qualifications set forth in this report. This report is intended for use by Sierra Metals subject to the terms and conditions of its contract with SRK and relevant securities legislation. The contract permits Sierra Metals to file this report as a Technical Report with Canadian securities regulatory authorities pursuant to NI 43-101, Standards of Disclosure for Mineral Projects. Except for the purposes legislated under provincial securities law, any other uses of this report by any third party is at that party's sole risk. The responsibility for this disclosure remains with Sierra Metals. The user of this document should ensure that this is the most recent Technical Report for the property as it is not valid if a new Technical Report has been issued.

This report provides Mineral Resource and Mineral Reserve estimates, and a classification of resources and reserves prepared in accordance with the Canadian Institute of Mining, Metallurgy and Petroleum Standards on Mineral Resources and Reserves: Definitions and Guidelines, May 10, 2014 (CIM, 2014).

## 2.2 Qualifications of Consultants (SRK)

The Consultants preparing this technical report are specialists in the fields of geology, exploration, Mineral Resource and Mineral Reserve estimation and classification, underground mining, geotechnical, environmental, permitting, metallurgical testing, mineral processing, processing design, capital and operating cost estimation, and mineral economics.

None of the Consultants or any associates employed in the preparation of this report has any beneficial interest in Sierra Metals or its subsidiaries. The Consultants are not insiders, associates, or affiliates of Sierra Metals or its subsidiaries. The results of this Technical Report are not dependent upon any prior agreements concerning the conclusions to be reached, nor are there any undisclosed understandings concerning any future business dealings between Sierra Metals and the Consultants. The Consultants are being paid a fee for their work in accordance with normal professional consulting practice.

The following individuals, by virtue of their education, experience and professional association, are considered Qualified Persons (QP) as defined in the NI 43-101 standard, for this report, and are members in good standing of appropriate professional institutions. QP certificates of authors are provided in Appendix A. The QP's are responsible for specific sections as follows:

- Jon Larson, Principal Consultant (Mining Engineer) is the QP responsible for Reserves, Mining Methods, Market Studies and Contracts, Capital and Operating Costs, Economic Analysis, Adjacent Properties, and Other Relevant Data and Information – Sections 2, 3, 15, 16.1, 16.3-16.8, 18.11, 19, 21-24, and portions of Sections 1, 25 and 26 summarized therefrom, of this Technical Report.
- Matthew Hastings, Senior Consultant (Resource Geology) is the QP responsible for the Geology and Resource - Sections 4, 5.1-5.3, 6-12, and 14, and portions of Sections 1, 25 and 26 summarized therefrom, of this Technical Report.
- Jeff Osborn, Principal Consultant (Mining Engineer) is the QP responsible for Project Infrastructure - Sections 5.4, 18.1-18.10, and portions of Sections 1, 25 and 26 summarized therefrom, of this Technical Report.
- Mark Willow, Principal Environmental Scientist is the QP responsible for Environmental Studies, Permitting and Social or Community Impact - Section 20 and portions of Sections 1, 25 and 26 summarized therefrom, of this Technical Report.
- Daniel Sepulveda, Associate Consultant (Metallurgy) is the QP responsible for Mineral Processing and Metallurgical Testing and Recovery Methods - Sections 13, 17 and portions of Sections 1, 25 and 26 summarized therefrom, of this Technical Report.
- John Tinucci, President/Practice Leader/Principal Consultant (Geotechnical Engineer) is the QP responsible for Mining Methods - Section 16.2, and portions of Sections 1, 25 and 26 summarized therefrom, of this Technical Report.

## 2.3 Details of Inspection

**Table 2-1: Site Visit Participants**

| Personnel | Company | Expertise | Date(s) of Visit | Details of Inspection |
|---|---|---|---|---|
| Jon Larson | SRK Consulting (U.S.) Inc. | Mining and Reserves | October 18-19, 2016 | Tour of mine, mill, and surface facilities. Reviewed planning practices and mining methods. |
| Daniel Sepulveda | SRK Consulting (U.S.) Inc. | Metallurgy and Process | March 12-14, 2015 | Reviewed metallurgical test work and process plant. |
| Matthew Hastings | SRK Consulting (U.S) Inc. | Geology and Resources | March 12-14, 2015 | Reviewed geology, exploration practices, mine geology, sampling/QAQC, and resource estimation practices. |

## 2.4 Sources of Information

The sources of information include data and reports supplied by Sierra Metals and Dia Bras personnel as well as documents cited throughout the report and referenced in Section 27.

## 2.5 Effective Date

The effective date of this report is December 31, 2016. Mined out areas are as of September 30, 2016.

## 2.6 Units of Measure

The metric system has been used throughout this report. Tonnes (t) are metric of 1,000 kg, or 2,204.6 lb. All currency is in U.S. dollars (US$) unless otherwise stated.

# 3 Reliance on Other Experts

The Consultant’s opinion contained herein is based on information provided to the Consultants by Sierra Metals and Dia Bras throughout the course of the investigations. SRK has relied upon the work of other consultants, most notably Burō Hidrōlogico Consultoría, in selected project areas in support of this Technical Report.

Burō Hidrōlogico Consultoría inspected the existing tailings storage facility in 2016. Additionally, in June 2016, Burō Hidrōlogico Consultoría prepared an analysis of the watershed, including rainfall analysis, and completed a review of the geology in the area.

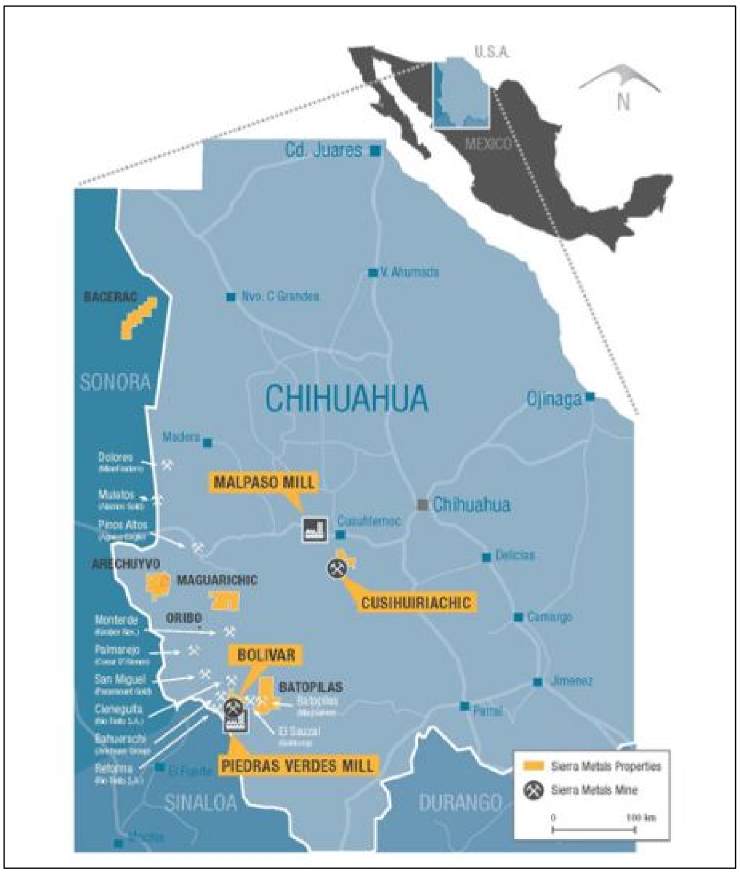
The Consultants used their experience to determine if the information from previous reports was suitable for inclusion in this technical report and adjusted information that required amending. This report includes technical information, which required subsequent calculations to derive subtotals, totals and weighted averages. Such calculations inherently involve a degree of rounding and consequently introduce a margin of error. Where these occur, the Consultants do not consider them to be material.

SRK has relied upon Sierra Metals for disclosure of accurate and factual information regarding the surface land ownership or agreements as well as the mineral titles and their validity. These items have not been independently reviewed by SRK and SRK did not seek an independent legal opinion of these items.

# 4 Property Description and Location

## 4.1 Property Location

The Bolivar property is located in Chihuahua, Mexico (Figure 4-1), in the municipality of Urique. The property is situated in the rugged, mountainous terrain of the Sierra Madre Occidental, approximately 250 km southwest of the city of Chihuahua and approximately 1,250 km northwest of Mexico City. The geographic center of the property is 27°05'N Latitude and 107°59'W Longitude. It is roughly bounded to the northeast by the Copper Canyon mine (50 km from the Bolivar mine), to the south by the El Fuerte river (18 km), to the north by the village of Piedras Verdes (5 km), and to the northwest by the town of Cieneguita (12.5 km).

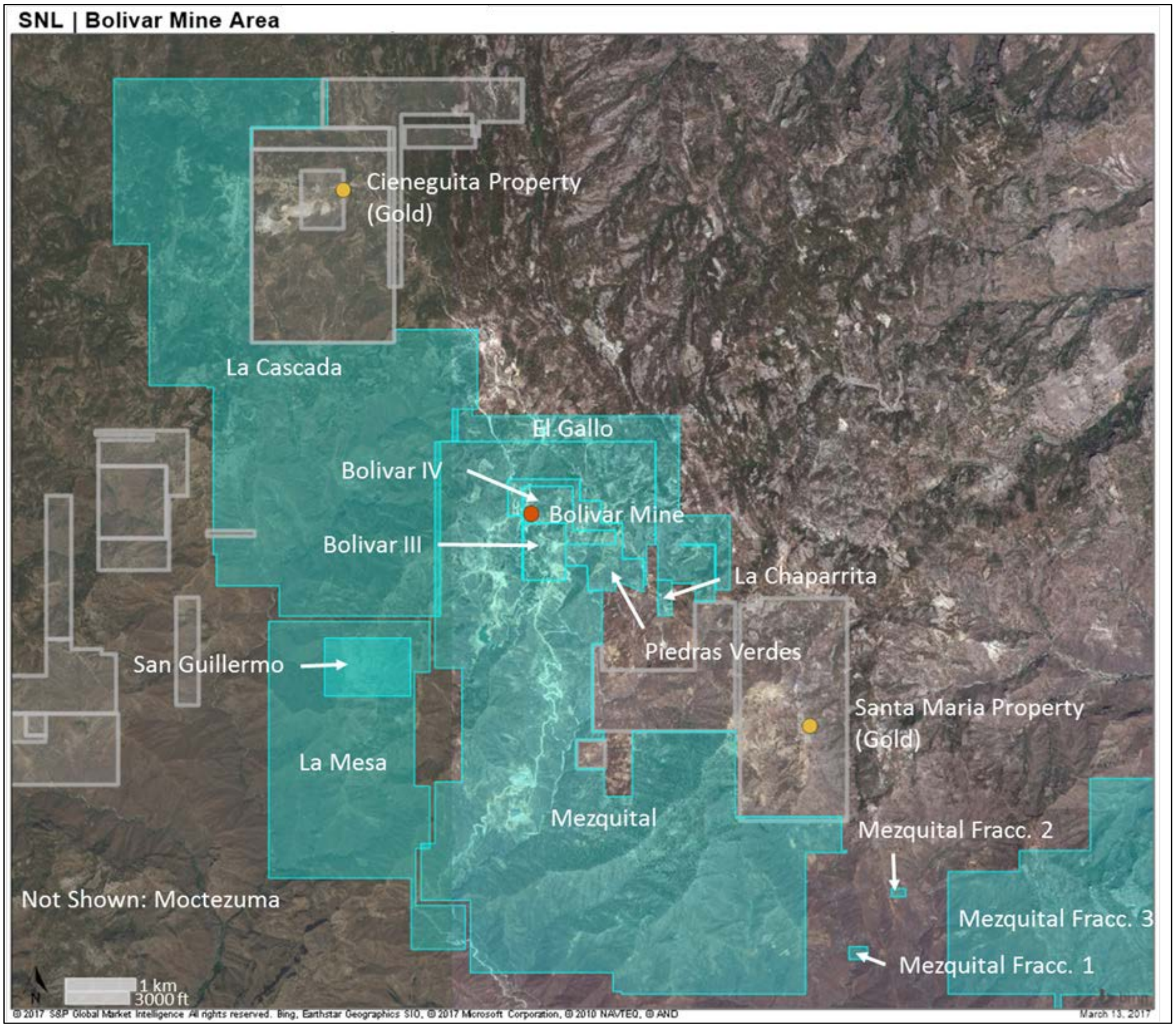



Source: Dia Bras

**Figure 4-1: Map Showing the Location of the Bolivar Property in Chihuahua, Mexico**

## 4.2 Mineral Titles

Dia Bras wholly holds mineral concession titles allowing exploration and mining within 14 concessions (6,799.69 ha) that make up the project area. Locations of the concessions are shown in cyan in Figure 4-2. Other area concessions are shown in gray. A list of the concessions is provided in Table 4-1. Production from the Bolivar Mine is not subject to any royalties; however, the concessions are subject to a federal tax that varies by concession.




Source: SNL FINANCIAL LC, 2017

**Figure 4-2: Land Tenure Map showing Bolivar Concessions**

Figure 4-3 shows the concessions in the immediate Bolivar mine area with the Bolivar West, Bolivar Northwest and La Sidra zones identified.


Source: SNL FINANCIAL LC, 2017

**Figure 4-3: Map of the Bolivar Property**

**Table 4-1: Concessions for the Bolivar Mine**

| Claim Name | Surface Area (Ha) | File Number | Title Number | Expiration Date | Claim Name | Surface Area (ha) | File Number |
|---|---|---|---|---|---|---|---|
| La Cascada | 1,944.33 | 016/32259 | 222720 | 2054-08-26 | La Cascada | 1,944.33 | 016/32259 |
| Bolivar III | 48.00 | 321.1/1-64 | 180659 | 2037-07-13 | Bolivar III | 48.00 | 321.1/1-64 |
| Bolivar IV | 50.00 | 321.1/1-118 | 195920 | 2042-09-22 | Bolivar IV | 50.00 | 321.1/ 1-118 |
| Piedras Verdes | 92.47 | 016/31958 | 220925 | 2053-10-27 | Piedras Verdes | 92.47 | 016/31958 |
| Mezquital | 2,475.41 | 016/32157 | 223019 | 2054-10-04 | Mezquital | 2,475.41 | 016/32157 |
| Mezquital Fracc. 1 | 4.73 | 016/32157 | 223020 | 2054-10-04 | Mezquital Fracc. 1 | 4.73 | 016/32157 |
| Mezquital Fracc. 2 | 2.43 | 016/32157 | 223021 | 2054-10-04 | Mezquital Fracc. 2 | 2.43 | 016/32157 |
| Mezquital Fracc. 3 | 974.57 | 016/32157 | 223022 | 2054-10-04 | Mezquital Fracc. 3 | 974.57 | 016/32157 |
| El Gallo | 251.80 | 016/32514 | 224112 | 2055-04-07 | El Gallo | 251.80 | 016/32514 |
| Bolivar | 63.56 | 321.1/1-100 | 192324 | 2041-12-18 | Bolivar | 63.56 | 321.1/1-100 |
| La Chaparrita | 10.00 | 1/1.3/00882 | 217751 | 2052-08-12 | La Chaparrita | 10.00 | 1/1.3/00882 |
| La Mesa | 718.95 | 016/32556 | 223506 | 2055-01-11 | La Mesa | 718.95 | 016/32556 |
| Moctezuma | 67.43 | 1/1/01432 | 226218 | 2055-01-12 | Moctezuma | 67.43 | 1/1/01432 |
| San Guillermo | 96.00 | 099/02161 | 196862 | In Process | San Guillermo | 96.00 | 099/02161 |
| **Total** | **6,799.69** | | | | **Total** | **6,799.69** | |

Source: Gustavson, 2013

### 4.2.1 Nature and Extent of Issuer’s Interest

Dia Bras holds an agreement for surface rights (exploration and mining) with the Piedras Verdes Ejido, the village roughly 12 km from the property. Production from the Bolivar Mine is not subject to any royalties; however, the concessions are subject to a federal tax that varies by concession.

## 4.3 Royalties, Agreements and Encumbrances

### 4.3.1 Purchase Agreements

The concessions listed in Table 4-1 are described in more detail as follows:

- La Cascada: In August 2004, Dia Bras entered into an Option to Purchase Agreement with Polo y Ron Minerales, S.A. de C.V. to acquire the La Cascada claim for US$10,000.
- Bolivar III and Bolivar IV: In 2004, Dia Bras purchased 50% of all the rights of Bolívar III and IV from Minera Senda de Plata, SA de CV. On October 2, 2007 the remaining 50% was purchased from Mr. Javier Octavio Bencomo Munoz and his wife Carmen Beatriz Chavez Marquez.
- Piedras Verdes: In December 2007, Dia Bras entered into an Option to Purchase Agreement with Mr. Raul Tarín Melendez and Mrs. María Francisca Carrasco Valdez to purchase the Piedras Verdes concession for US$10,000.
- Mezquital, Mezquital Fracción 1 through 3, and El Gallo: On November 2005, Dia Bras entered into an Option to Purchase Agreement with Polo y Ron Minerales, S.A. de C.V. to acquire the Mezquital, Mezquital Fracción 1, Mezquital Fracción 2, Mezquital Fracción 3, and El Gallo concessions for US$5,000.

- Bolivar: In January 2008, Dia Bras entered into a purchase agreement with Marina Fernandez regarding the Bolívar property for US$85,000 paid between 2008 and 2009.
- La Chaparrita: In January 29, 2008, Dia Bras entered into an Option to Purchase Agreement with Mr. Jesús Fernández Loya on behalf of Minera Senda de Plata S.A. de C.V. to purchase the La Chaparrita concession for US$85,000.
- La Mesa: In January 2005, Dia Bras staked the La Mesa claim, at Dirección General de Minas, México.
- Moctezuma: In November 2010, Dia Bras entered into an Option to Purchase Agreement with Mr. Juan Orduño García, Mr. Jesús Manuel Chávez González, and Mr. Armando Solano Montes purchase the Moctezuma concession. The terms of the agreement included a total cash payment of MX$3,500,000 (Mexican Pesos).
- San Guillermo: In October 2011, Dia Bras entered into a purchase agreement with Minera Potosi Silver, a sister company of Minera Piedras Verdes del Norte, S.A. de C.V., for the San Guillermo concession for MX$464,000.

### 4.3.2 Legal Contingencies

In October 2009, Polo y Ron Minerals, S.A. de C.V. (P&R) sued Sierra Metals and Dia Bras Mexicana S.A. de C.V. P&R and claimed damages for the cancelation of an option agreement regarding the San Jose properties in Chihuahua, Mexico (the “San Jose Properties”). The San Jose Properties are not located in any areas where Dia Bras currently operates, nor are these properties included in any resource estimates of Sierra Metals. Sierra Metals believes that it has complied with all of its obligations pertaining to the Option Agreement. In October 2011, the 8th Civil Court of the Judicial District of Morelos in Chihuahua issued a resolution that absolved Sierra Metals from the claims brought against it by P&R on the basis that P&R did not provide evidence to support any of its claims. P&R appealed this resolution to the State Court, which overruled the previous resolution and ordered the Company to:

- Transfer to P&R 17 mining concessions from the Company’s Bolivar project, including the mining concessions where both mine operations and mineral reserves are located; and
- Pay US$423 to P&R.

Sierra Metals was not appropriately notified of this resolution. In February 2013, a Federal Court in the State of Chihuahua granted Sierra Metals a temporary suspension of the adverse resolution issued by the State Court of Chihuahua, Mexico. In July 2014, a Federal Court in the State of Chihuahua ordered that Sierra Metals was entitled to receive proper notice of the adverse resolution previously issued by the State Court of Chihuahua. This allows Sierra Metals to proceed with its appeal (writ of “amparo”) of the State Court’s previous resolution. The adverse resolution has been temporarily suspended since March 2013, which suspension will remain in place pending the writ of amparo. The amparo is being heard in Federal Court and will challenge the State Court’s ruling. The Federal Court’s verdict in the amparo will be final and not appealable. The Company continues to vigorously defend its position by applying the proper legal resources necessary to defend its position. On February 12, 2016, the

Second Federal Collegiate Court of Civil and Labor Matters, of the Seventeenth circuit in the State of Chihuahua, ("the Federal Court") issued a new judgment ruling that the State Court lacked jurisdiction to rule on issues concerning mining titles, and that no previous rulings by the State Court against the Sierra Metals shall stand. They ordered the cancellation of the previous adverse resolution by the state Court. The Company will continue to vigorously defend this claim. Sierra Metals continues to believe that the original claim is without merit.

In 2009, a personal action was filed in Mexico against DBM by an individual, Ambrosio Bencomo Muñoz as administrator of the intestate succession of Ambrosio Bencomo Casavantes y Jesus Jose Bencomo Muñoz, claiming the annulment and revocation of the purchase agreement of two mining concessions, Bolívar III and IV between Minera Senda de Plata S.A. de C.V. and Ambrosio Bencomo Casavantes, and with this, the nullity of purchase agreement between DBM and Minera Senda de Plata S.A. de C.V. In June 2011, the Sixth Civil Court of Chihuahua, Mexico, ruled that the claim was unfounded and dismissed the case, the plaintiff appealed to the State Court. On November 3rd, 2014, the Sixth Civil Court of Chihuahua ruled against the plaintiff, noting that the legal route by which the plaintiff presented his claim was not admissible. On February 17, 2017 the State Court issued a ruling dismissing the arguments of the plaintiff and stating that, at the time that the suit was filed, the plaintiff's right to file was already expired. Sierra Metals will continue to vigorously defend this action and is confident that the claim is of no merit.

## 4.4 Environmental Liabilities and Permitting

### 4.4.1 Environmental Liabilities

Based on communications with representatives from Dia Bras, it does not appear that there are currently any known environmental issues that could materially impact the extraction and beneficiation of mineral resources or reserves. From previous assessments (Gustavson, 2013), lesser known environmental liabilities include unreclaimed exploration disturbances (i.e., roads, drill pads, etc.) and small residual waste rock piles from historical mining operations. As observed by SRK personnel during the site visit, dust emissions generated as a result of ore haulage traffic from the mine to mill could become an issue in the future, but has not yet become an issue for SEMARNAT.

### 4.4.2 Required Permits and Status

Required permits and the status of those permits are discussed in Section 20.4.

## 4.5 Other Significant Factors and Risks

There are no other factors or risks that affect access, title or right or ability to perform work on the property other than those stated in the above sections which SRK would expect to have a material impact on the resource and reserves statement.

# 5 Accessibility, Climate, Local Resources, Infrastructure and Physiography

## 5.1 Topography, Elevation and Vegetation

The Bolivar property is located in the rugged topography of the Sierra Madre Occidental mountain range. Elevation varies from 600 to 2,100 m above sea level.

Vegetative cover in the region consists of oak and eucalyptus trees at low elevations and pine trees at higher elevations. The land surrounding the mine is used to raise cattle. Wildlife in the area includes various species of insects, lizards, snakes, birds, and small mammals.

## 5.2 Accessibility and Transportation to the Property

From the city of Chihuahua, the Bolivar property can be accessed via travel along paved (325 km) and unpaved roads (70 to 80 km) to the Piedras Verdes or Cieneguita villages, located 2 km and 7 km north of the Bolivar mine, respectively. Transportation from the villages to the mineral concessions is via private and company vehicles.

## 5.3 Climate and Length of Operating Season

Climate in the project area is semi-arid, with a mean annual temperature of 25°C and 758 mm of annual precipitation on average. The region experiences a rainy season from June to October, when monthly precipitation ranges from 83 to 188 mm; the rest of the year is relatively dry (approximately 26 mm of monthly precipitation). In the past, the Bolivar mine has operated year-round and operations were not limited by climatic variations.

## 5.4 Infrastructure Availability and Sources

### 5.4.1 Power

Electricity is currently sourced from Mexico's main grid system. Backup generators are also located at the Bolivar mine site.

### 5.4.2 Water

Industrial water is sourced from the Piedras Verdes dam, a reservoir that is owned and operated by Dia Bras. The reservoir drains to the El Fuerte River, 2 km south of the Bolivar mine. Water from the dam is sufficient to meet mine and mill operations and exploration needs. Potable water is available from local sources.

### 5.4.3 Mining Personnel

Two villages, Piedras Verdes and Cieneguita, are located within 10 km of the mineral concessions. The combined population of these two villages is approximately 1,500 people, many of the mine employees live in these villages.

### 5.4.4 Potential Tailings Storage Areas

The site has an existing tailings storage facility. The tailings management plan at the Bolivar mine includes placement of tailings in a number of locations. The site is also installing infrastructure to recover additional process water and reduce the water content of the final tailings. A thickener, with a diameter of 36.6 m, is under construction and is planned to be in operation in June 2017. Three filter presses have been purchased by Dia Bras. Installation of these filters is planned for completion in September 2017. Two of the three filters will operate at any given time with the third filter on standby or under maintenance.

Tailings consisting of approximately 40% solids will be placed in conventional tailings storage facilities until June 2017. Thickened tails (60% solids) will be placed from June 2017 to February 2018. Dry-stack tails will be placed after February 2018. Expansion around the main TSF will be utilized until mid-2019 when dry stack tailings will be placed in a New TSF to be located just to the west of the existing facility.

### 5.4.5 Potential Waste Rock Disposal Areas

The site has existing permitted waste rock disposal areas.

### 5.4.6 Potential Processing Plant Sites

The site has an existing mineral processing site that has been in use since its commissioning in 2011.

# 6 History

## 6.1 Prior Ownership and Ownership Changes

Ownership history of the mineral concessions at Bolivar are shown in Table 6-1, modified from a 2013 technical report completed by Gustavson Associates in Lakewood, Colorado USA. No earlier records of ownership are known to exist.

**Table 6-1: Ownership History and Acquisition Dates for Claims at the Bolivar Property**

| Claim Name | Previous Owner | Date Acquired |
|---|---|---|
| La Cascada | Polo y Ron Minerales, S.A. de C.V. | August 10, 2004 |
| Bolivar III | Javier Bencomo Munoz | September 14, 2004 |
| Bolivar IV | Javier Bencomo Munoz | September 14, 2004 |
| Piedras Verdes | Raul Tarin Melendez | December 11, 2007 |
| Mezquital | Polo y Ron Minerales, S.A. de C.V. | November 11, 2005 |
| Mezquital Fracc. 1 | Polo y Ron Minerales, S.A. de C.V. | November 11, 2005 |
| Mezquital Fracc. 2 | Polo y Ron Minerales, S.A. de C.V. | November 11, 2005 |
| Mezquital Fracc. 3 | Polo y Ron Minerales, S.A. de C.V. | November 11, 2005 |
| El Gallo | Polo y Ron Minerales, S.A. de C.V. | November 11, 2005 |
| Bolivar | Minera Senda de Plata, S.A. de C.V. | January 29, 2008 |
| La Chaparrita | Minera Senda de Plata, S.A. de C.V. | January 29, 2008 |
| La Mesa | Direccion General de Minas | January 12, 2005 |
| Moctezuma | Juan Orduno Garcia/Jesus Chavez Gonzalez / Armando Solano Montes | November 5, 2010 |
| San Guillermo | Minera Piedras Verdes del Norte, S.A. de C.V. | October 4, 2011 |

Source: Gustavson, 2013

## 6.2 Exploration and Development Results of Previous Owners

Minera Frisco conducted a mapping and exploratory drilling program from 1968 to 1970 targeting porphyry copper mineralization in the Piedras Verdes district. In 1992, the Consejo de Recursos Minerales (Mexican Geological Service) completed a single visit for Minera Senda de Plata. No documentation for these historical exploration activities has been identified.

## 6.3 Historic Mineral Resource and Reserve Estimates

A qualified person has not done sufficient work to classify the historical estimate as a current resource estimate or mineral reserve estimate and the issuer is not treating the historical estimate as a current resource estimate.

## 6.4 Historic Production

Historic mining and exploration for polymetallic deposits in the Sierra Madres has been carried out sporadically since the Spanish colonial period. In 1632, a native silver vein was discovered at La Nevada near Batopilas. Thereafter, sporadic mining of silver deposits continued for almost one hundred years. A second phase of mining started with the Carmen Mine near the end of 18th Century, but was halted due to the Mexican War of Independence from 1810 to 1821. A third phase of mining in the region occurred from 1862 to 1914, but was again halted due to the Mexican Revolution in 1910.

The Urique District is characterized by gold-rich fissure veins hosted by andesitic rocks. Since 1915, there have been sporadic attempts to develop mineral deposits in the area. Small scale mining of polymetallic deposits in this district started before 1910 by gambusinos (artisanal miners). Production records from 1929 are reported as 2,891 tonnes of ore containing 2,686 kg of copper (Cu), 7,990 kg of lead (Pb), 1,061 kg of silver (Ag) and 44 kg of gold (Au), indicating an average grade of 0.09% Cu, 0.28% Pb, 367 g/t Ag and 15.22 g/t Au. Since 1915, some 300 million ounces of silver, are reported to have been produced from the Batopilas District. Other mining activities in the area include the Cieneguita de los Trejo gold deposit located at the outskirts of the village of Cieneguita, which is situated about 1.5 km northwest of the northwestern corner of the El Cumbre Mineral License. In the 1990s, Glamis Gold Ltd. (Glamis) developed an open pit mine and produced gold by heap leaching method. The old leach pads are visible from the Bolivar property.

From 1980 to 2000, some 300,000 tonnes of mineralized material were mined while the Bolivar Mine was under the control of Bencomo Family. This included:

- 195,000 tonnes from the Fernandez trend;
- 90,000 tonnes from the Rosario Trend; and
- 15,000 tonnes from the Pozo del Agua Area.

Detailed production records for this period are not available, but are reported to be in the order of 50 tonnes per day, and the average grade of the mineralized material is reported to be in the range from 5% to 6% Cu and 25% to 30% Zn. Production records from 2000 to 2007 were not available to SRK. According to Sierra Metals, then known as Dia Bras Exploration Inc., production from 2008 to 2010 was as follows

- 2008: 126,500 tonnes processed at 1.65% copper grade and 8.00% zinc grade
- 2009: 89,600 tonnes processed at 1.81% copper grade, 10.06% zinc grade, and 49.5 g/t silver
- 2010: 104,800 tonnes processed at 1.45% copper grade, 8.59% zinc, and 31.6 g/t silver

Commercial production was declared in November 2011. Table 6-2 lists the 2011 to 2016 production as reported by Sierra Metals.

**Table 6-2: 2011 to 2016 Bolivar Production**

| Year | Plant | Tonnes Processed (dry) | Au (g/t) | Ag (g/t) | Cu (%) |
|---|---|---|---|---|---|
| 2011 | Mal Paso* | 88,247 | | 46.62 | 1.32 |
| 2012 | Piedras Verdes | 312,952 | | 24.58 | 1.17 |
| 2013 | Piedras Verdes | 507,865 | 0.05 | 21.16 | 1.25 |
| 2014 | Piedras Verdes | 666,414 | 0.29 | 22.23 | 1.20 |
| 2015 | Piedras Verdes | 830,447 | 0.25 | 20.57 | 1.15 |
| 2016 | Piedras Verdes | 950,398 | 0.19 | 16.72 | 1.00 |

* Bolivar material was processed at the Mal Paso mill in 2011 until the Piedras Verdes mill was commissioned in November 2011.
Source: Dia Bras, 2017

# 7 Geological Setting and Mineralization

## 7.1 Regional Geology

The Bolivar property is located within the Guerrero composite terrane, which makes up the bulk of western Mexico and is one of the largest accreted terranes in the North American Cordillera. The terrane is proposed to have accreted to the margin of Mexico in the Late Cretaceous, and consists of submarine and lesser subaerial volcanic and sedimentary sequences ranging from Upper Jurassic to middle Upper Cretaceous in age. These sequences rest unconformably on deformed and partially metamorphosed early Mesozoic oceanic sequences.

The Bolivar deposit is one of many precious and base metal occurrences in the Sierra Madre precious metals belt, which trends north-northwest across the states of Chihuahua, Durango, and Sonora (Figure 7-1).

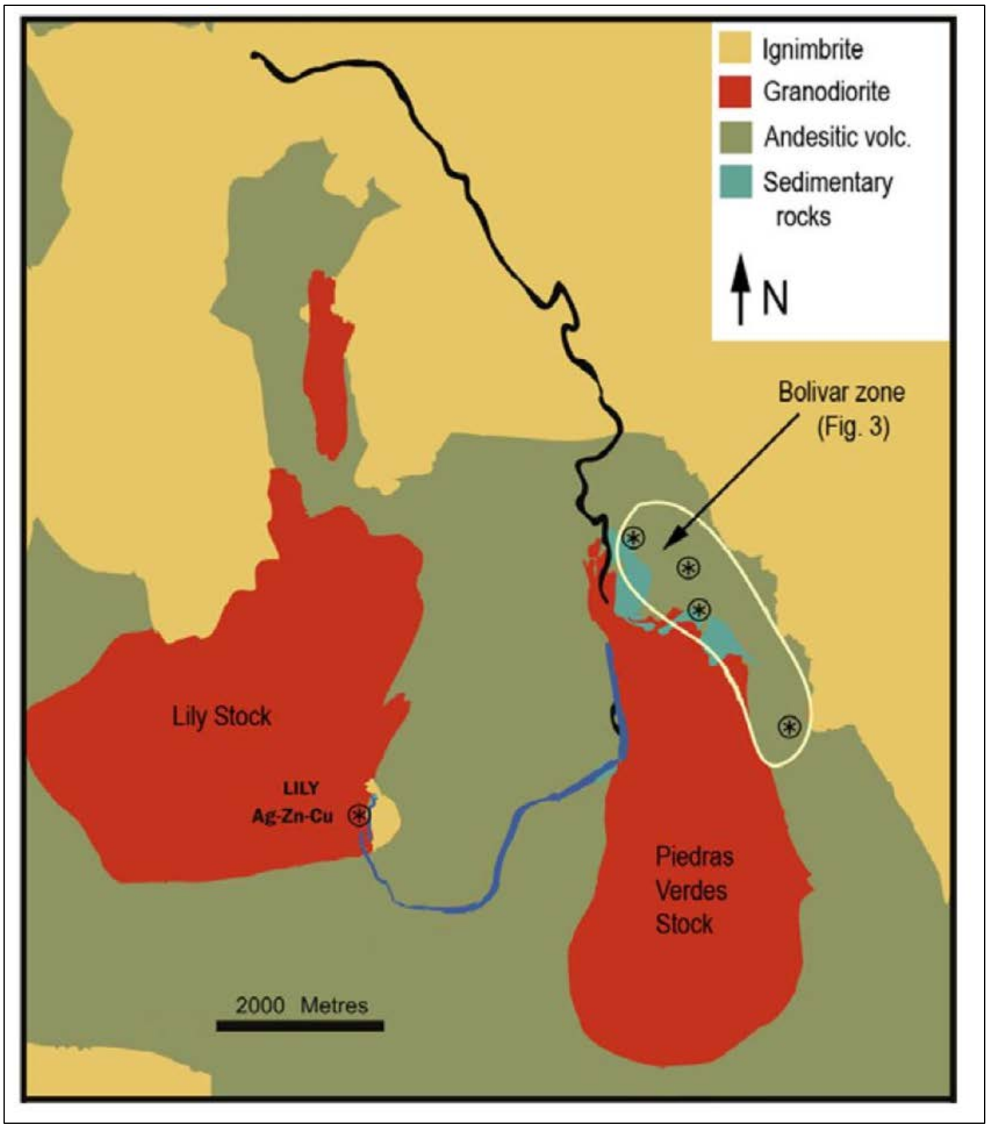

Source: Dia Bras, 2012

**Figure 7-1: Regional Geology Map showing the Locations of Various Mines in the Sierra Madre Occidental Precious Metals Belt**

## 7.2 Local Geology

The Piedras Verdes district shown in Figure 7-2 consists of Cretaceous andesitic to basaltic flows and tuffs intercalated with greywacke, limestone, and shale beds commonly referred to as the Lower Volcanic Series (LVS). This volcanic-sedimentary package has been intruded by a number of Upper Cretaceous to Lower Cenozoic age intermediate to felsic composition plutonic bodies that range from 85 to 28.3 Ma. The LVS and intermediate to felsic intrusive bodies have in turn been overlain by a widespread cap of rhyolitic and dacitic ignimbrites and tuffs referred to as the Upper Volcanic Series (UVS), that were deposited between 30 to 26 Ma; the UVS is one of the largest continuous ignimbrite provinces in the world. All known mineralization in this region formed during the time interval between the deposition of the LVS and the deposition of the UVS (Meinert, 2007).

At the Bolivar property, the volcanic rocks strike northwest and dip gently to moderately to the northeast. Assuming these volcanics are younger than the granodiorite, the stock must also be tilted to the northeast (Meinert, 2007). A number of outcrops exhibit tight, northeast trending folds. Three major sets of faults have been recognized at the local scale, these include: a north-northwest trending set which dip steeply northeast or southwest, an east-southeast trending set, and a north-trending set. None of the faults on the property are described as having offsets greater than 200 m (Meinert, 2007).




Source: Meinert, 2007

**Figure 7-2: Local Geology Map showing the Location of the Bolivar Property**

## 7.3 Property Geology

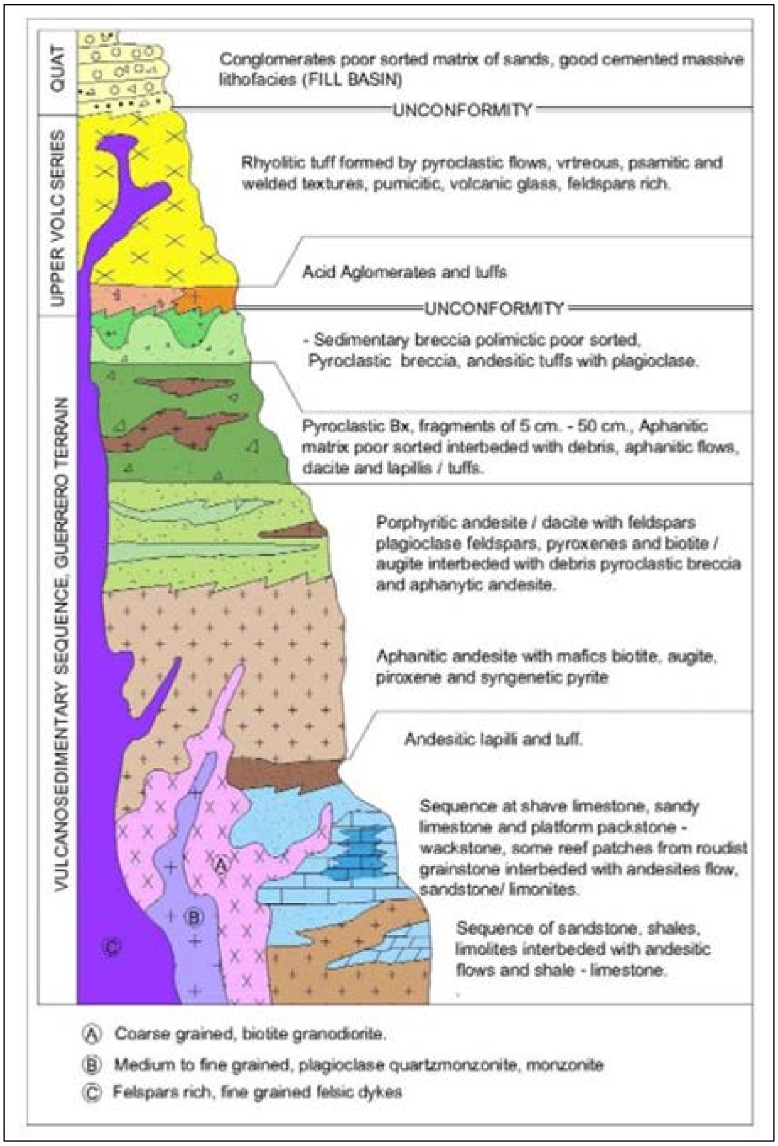
### 7.3.1 Skarn-hosting Sedimentary Rocks

Skarn alteration and mineralization at the Bolivar property is hosted primarily in a package of sedimentary rocks that occur as a layer or lens within the LVS (Reynolds, 2008). All sedimentary units have undergone low grade metamorphism. The lowermost sedimentary horizon observed is a dolostone which ranges from 24 m to 40m in thickness. The lower part of the dolostone horizon is interlayered with siltstone. To the south, progressively less of the sedimentary sequence is cut out by granodioritic intrusive rocks and the dolostone is observed to be underlain by a siltstone horizon. The lower siltstone unconformably overlies the LVS. The dolostone is overlain by a discrete layer of siltstone. The average thickness of this siltstone unit is 12 to 30 m. Above the siltstone marker layer are horizons of argillaceous dolostone (50 m thick) and argillaceous limestone (9 m thick). The uppermost sedimentary horizon is a limestone with local chert and argillaceous laminations. The vertical thickness of this horizon varies considerably in cross-section (108 to 173m) and this variation is attributed to paleo-topographic relief. The upper contact of the limestone is an unconformity with the LVS. Figure 7-3 presents the stratigraphy of the property and Figure 7-4 is the geologic map.

### 7.3.2 Intrusive Rocks

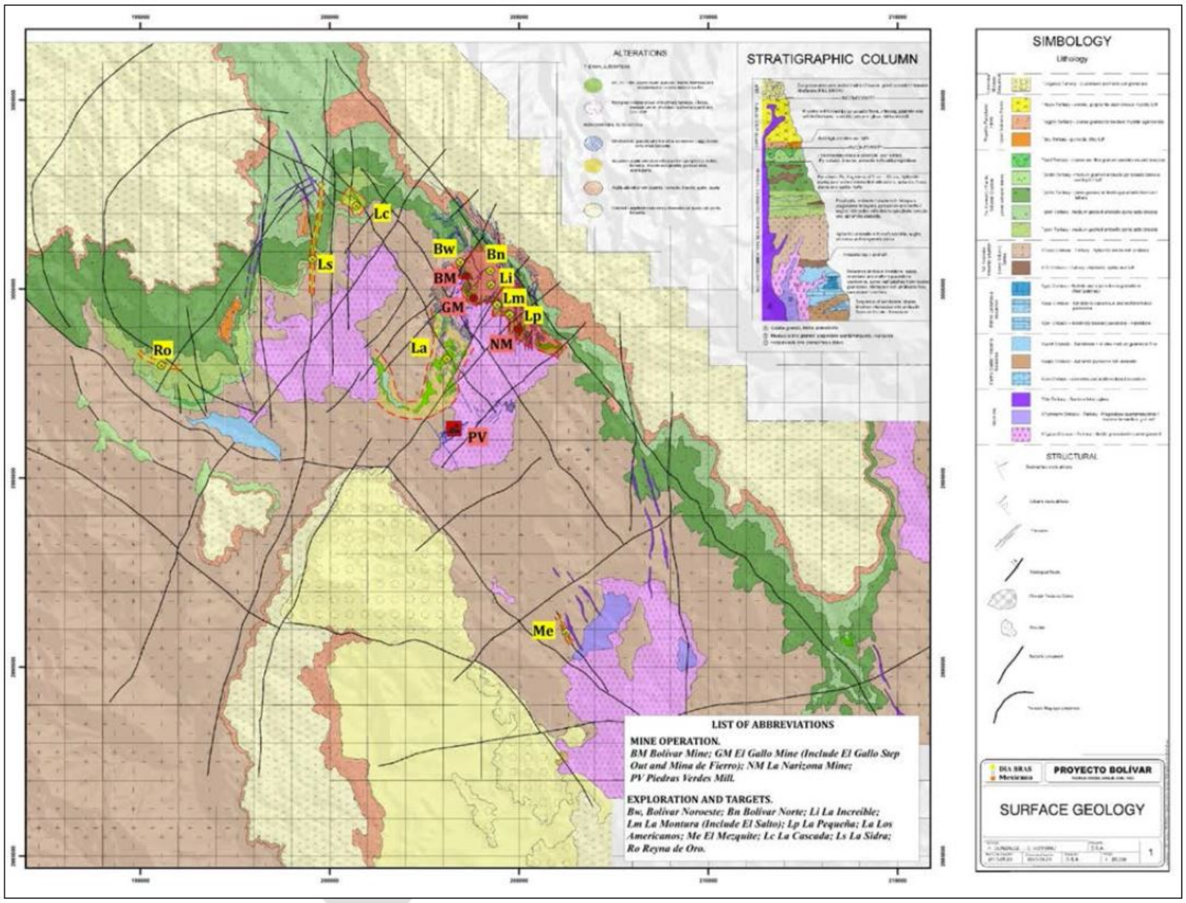
The most important igneous rocks on the property are the Piedras Verde granodiorite and related dikes and sills. All are slightly porphyritic but none are a true porphyry. The Piedras Verde granodiorite exhibits a range of textural variations and compositions. The average composition is very similar to plutons related to Cu skarns (Meinert, 2007). There is no indication of an Au association.

The dikes locally cut the granodiorite, have planar, chilled contacts, and are generally finely crystalline. Both their texture and crosscutting relations suggest that the dikes are younger and shallower than the granodiorite. Both granodiorite and andesite dikes have alteration and locally skarn, along their contacts. In addition endoskarn affects both the granodiorite and in rare cases, the andesite dikes. Thus, these rocks are older than or at best coeval with alteration/mineralization. The presence of skarn veins cutting an andesite dike is clear evidence that at least some skarn is later than at least some of the andesite dikes. A closer association of granodiorite with skarn alteration and mineralization is suggested by local K-silicate veining of the granodiorite and the zonation of skarn relative to this contact.




Source: Dia Bras

**Figure 7-3: Stratigraphic Column of the Bolivar Property**




Source: Dia Bras

**Figure 7-4: Geologic Map of the Bolivar Property**

## 7.4 Significant Mineralized Zones

Mineralization at the Bolivar property is hosted by skarn alteration in carbonate rocks adjacent to the Piedras Verde granodiorite (Meinert, 2007). Orientations of the skarn vary dramatically, although the majority are gently-dipping. Thicknesses vary from 2 m to over 20 m. Skarn mineralization is strongly zoned, with proximal Cu-rich garnet skarn in the South Bolivar area, close to igneous contacts, and more distal Zn-rich garnet+pyroxene skarn in the northern Bolivar and southern skarn zones near El Val. The presence of chalcopyrite+bornite dominant skarn (lacking sphalerite) in the South Bolivar area, along with K-silicate veins in the adjacent granodiorite suggests that this zone is close to a center of hydrothermal fluid activity. In contrast, the main Bolivar mine is characterized by Zn>Cu and more distal skarn mineralogy such as pyroxene>garnet and pale green and brown garnets.

Alteration is zoned relative to fluid flow channels. From proximal to distal, the observed sequence is: red-brown garnet to brown garnet with chalcopyrite ± bornite ± magnetite to green garnet ± pyroxene with chalcopyrite + sphalerite to massive sulfide (sphalerite ± chalcopyrite ± galena) to marble with stylolites and other fluid escape structures.

Mineralization exhibits strong stratigraphic control and two stratigraphic horizons host the majority: an upper calcic horizon, which predominantly hosts Zn-rich mineralization, and a lower dolomitic horizon, which predominantly hosts Cu-rich mineralization. In both cases, the highest grade are developed where fault or vein structures and associated breccia zones cross these favorable horizons near skarn-marble contacts. Meinert (2007) suggested that hydrothermal fluids moved up along the Piedras Verdes Granodiorite contact, forming skarn and periodically undergoing phase separation that caused brecciation. Zones of breccia follow faults like the Rosario, Fernandez, and Breccia Linda trends as well as nearly vertical breccia pipes such as La Increíble.

# 8 Deposit Type

## 8.1 Mineral Deposit

The Bolivar deposit is classified as a high-grade Cu-Zn skarn and exhibits many characteristics common to this deposit type (Meinert, 2007). The term skarn refers to coarse-grained calcium or magnesian silicate alteration formed at relatively high temperatures by the replacement of the original rock, which is often carbonate-rich. The majority of the world's economic skarn deposits formed by infiltration of magmatic-hydrothermal fluids, resulting in alteration that overprints the genetically related intrusion as well as the adjacent sedimentary country rocks (Ray and Webster, 1991). While alteration commonly develops close to the related intrusion, fluids may also migrate considerable distances along structures, lithologic contacts, or bedding planes. Based on the alteration assemblages present, skarn deposits are generally described as either calcic (garnet, clinopyroxene, and wollastonite) or magnesian (olivine, phlogopite, serpentine, spinel, magnesium-rich clinopyroxene). Both the alteration and the mineralization in skarn deposits are considered to be magmatic-hydrothermal in origin.

## 8.2 Geological Model

The geological model descried above, for the Bolivar deposit is well-understood and has been verified through multiple expert opinions as well as a history of mining. SRK is of the opinion that the model is appropriate and will serve Dia Bras going forward.

# 9 Exploration

## 9.1 Relevant Exploration Work

The following information has been modified and updated from a 2009 technical report prepared by SGS Geostat.

**Exploration Conducted by Dia Bras Exploration, 2003-2012:**

- **2003 to 2005**. During this period, Dia Bras carried out an exploration program of geological mapping, outcrop sampling, topographic survey, 1:250 and 1:500 scale, including detailed 2 m x 2 m panel sampling perpendicular to the mineralized structures. Dia Bras completed semi-regional prospecting, reconnaissance and representative sampling in to the Bolivar District at the La Montura and Narizona prospects. Pilot mining started at the Bolivar Mine. Development drifting conducted led to the Brecha Linda ore body discovery.
- **2006**. Dia Bras Exploration performed detailed 1:500 scale geologic mapping in the Bolivar and Bolivar South areas, including 2 m x 2m panel sampling. Dia Bras Exploration did some prospecting in other mineralized area to the south, including El Gallo. This work was accompanied by a rock panel geochemical survey. The results of the El Gallo prospecting supported the drilling program.
- **2007**. Detailed underground, 1:250 scale geological mapping was complete on the El Gallo and La Narizona areas, including detailed 2 m x 2m panel sampling. This exploration identified two mineralized stratiform horizons in the El Gallo area, Gallo Superior and Gallo Inferior, similar to the stratiform ore body at La Narizona. Preliminary geologic mapping to support the drilling was completed on three other mineralized areas to the south, La Montura, La Pequeña and El Val.
- **2008**. Detailed 1:500 scale surface geology mapping was done at the Bolivar North zone, including representative chips sampling, yielding a geochemical anomaly consistent with the NW structural trend. Mining was mainly concentrated in the Titanic, Selena and San Francisco areas on and under level 6 (Rosario), Guadalupe, Rebeca and San Angel, which were high grade, individual orebodies, geologically related to the calcareous upper stratigraphic favorable horizon.
- **2009**. Detailed 1:250 scale geologic mapping was done at San Francisco and Los Americanos North, including detailed 2 m x 2m panel sampling. Regional 1:25,000 scale geology and detailed stream sediment sampling was done over the entire Bolivar Property, yielding the new targets of Los Americanos – Lilly Skarn (Cu-Zn), La Cascada - Sidra (Au) and El Mezquite (Au). Underground 1:250 scale detailed mapping was done at San Francisco and La Increíble Mines, including detailed 2 m x 2m panel sampling. Mining was mainly concentrated at the Bolivar Mine in the high grade ore bodies (Rosario, La Foto, Fernandez, Rosario Magnetita, and San Angel areas). Dia Bras Exploration announced the construction of the new Piedras Verdes Mill with capacity of 1,000 t/d.
- **2010**. 1:1000 geologic mapping was done at La Cascada – La Sidra areas, including chips channel sampling; and a TITAN IP Geophysical Survey (done by the contractor QUANTEC). A drilling program was completed, indicating low grade gold. Regional 1:25,000 scale geologic mapping was completed over the entire Bolivar Property, including lithology units, regional faulting and dikes, and alteration, confirming the previous geochemical anomalies

on Los Americanos – Lilly Skarn (Cu-Zn), La Cascada - Sidra (Au) and El Mezquite (Au) targets. Underground 1:250 scale detailed mapping, including detailed 2 m x 2m panel sampling was done at El Gallo, La Increíble and La Narizona Mines. Mining was mainly concentrated then at Narizona, El Gallo, and Rosario areas, while Dia Bras continued with the construction of new Piedras Verdes Mill.

- **2011**. New geological interpretations indicated the continuity of El Gallo trends to southeast toward La Montura, and northeast toward La Increíble, discovering the El Salto and El Gallo step out areas respectively. Underground development and production drifting allowed detailed, 1:250 scale mapping at Bolivar, El Gallo, and La Narizona Mines. Mining of 360 t/d was terminated during late October and the new Piedras Verdes Mill started with commercial production of 1,000 t/d operation, mainly from El Gallo mine.
- **2012**. Underground development and production drifting and detailed 1: 250 scale mapping was done at Bolivar, El Gallo, and La Narizona Mines. Production of 1,000 t/d processing at Piedras Verdes Mill began by receiving ore principally from the upper stratigraphic horizon from El Gallo Mine. Exploration on the El Gallo step out and El Salto areas continued using a drilling contractor. Preliminary drilling started at La Montura and La Pequeña areas, located in between El Gallo and Narizona mines.
- **2013 to 2016**. New geological interpretations were completed at Bolivar for the Bolivar W and Bolivar NW areas. Ongoing underground production and development in El Gallo Superior (EGS) and El Gallo Inferior (EGI), with new development of the Chimeneas areas. Interpretation and drilling of the La Sidra vein to the west of the main Bolivar mine area. The La Sidra vein yielded results from exploration drilling of mineralized intervals ranging from 0.3 to 2.1 m, with grades ranging from 0.01 to 9.1 g/t Au and 0.01 to 1,850 g/t Ag.

## 9.2 Sampling Methods and Sample Quality

Sampling supporting the Mineral Resource estimation consists of drill core and underground channel types. SRK has not reviewed the methods or quality assurance protocol for the sampling but understands that the work has been done by trained geologists or geologic technicians.

## 9.3 Significant Results and Interpretation

The exploration results at Bolivar and in the nearby area are used to develop detailed exploration plans and to support Mineral Resource estimation.

# 10 Drilling

## 10.1 Type and Extent

Between 1968 and 1970, Minera Frisco drilled short, diamond holes, but existing records do not provide a reliable register of the number of holes, meters drilled, or the results of drilling.

Between 2003 and 2012, Dia Bras drilled 691 HQ and NQ diameter core holes totaling to 122,835 meters as listed in Table 10-1 and shown in Figure 10-1. The objective of drilling completed during this period was to explore for mapped and projected polymetallic sulfide mineralization in calc-silicate rocks with moderate east-northeast dips. These efforts identified Cu-rich skarn mineralization within the Bolivar III, Bolivar IV, Piedres Verdes, and El Gallo concessions.

**Table 10-1: Summary of drilling by Dia Bras Exploration, Inc. on the Bolivar property, 2003-2012**

| Area | Number of Drillholes | Total Meters Drilled |
|---|---|---|
| Bolivar Alta Ley | 117 | 21,787.42 |
| Bolivar Noroeste | 21 | 3,422.83 |
| Bolivar Norte | 12 | 3,262.10 |
| Bolivar Sur | 42 | 10,583.75 |
| Brecha Linda | 10 | 948.00 |
| Brecha Linda Este | 2 | 336 |
| El Gallo | 84 | 20,152.17 |
| El Salto | 11 | 20,152.17 |
| El Val | 8 | 3,777.00 |
| Fernadez | 8 | 666.30 |
| Fernandez | 19 | 2,467.10 |
| Guadalupe | 57 | 7,682.55 |
| La Bota | 7 | 544.30 |
| La Herradura | 6 | 819.00 |
| La Increíble | 29 | 9,418.14 |
| La Montura | 11 | 2,588.80 |
| La Narizona | 28 | 5,115.50 |
| La Pequeña | 7 | 2,344.05 |
| Manto Gordo | 2 | 73.30 |
| Mina N01 CE 868E | 3 | 182.20 |
| Mina N01 CE 898N | 8 | 748.85 |
| Mina N01 R 9860S | 15 | 1,068.70 |
| Nivel 1 | 4 | 402.00 |
| Nivel 6 | 1 | 141.00 |
| Rebeca | 15 | 1764.00 |
| Rosario | 18 | 1,553.10 |
| San Angel | 37 | 4,808.90 |
| San Francisco | 34 | 4,548.00 |
| Selena | 30 | 2,966.60 |
| Selena 2 | 1 | 90 |
| Titanic | 16 | 1,460.70 |
| Titanic 2 | 28 | 3,167.00 |
| **Total** | **691** | **122,834.91** |

Source: Gustavson, 2013

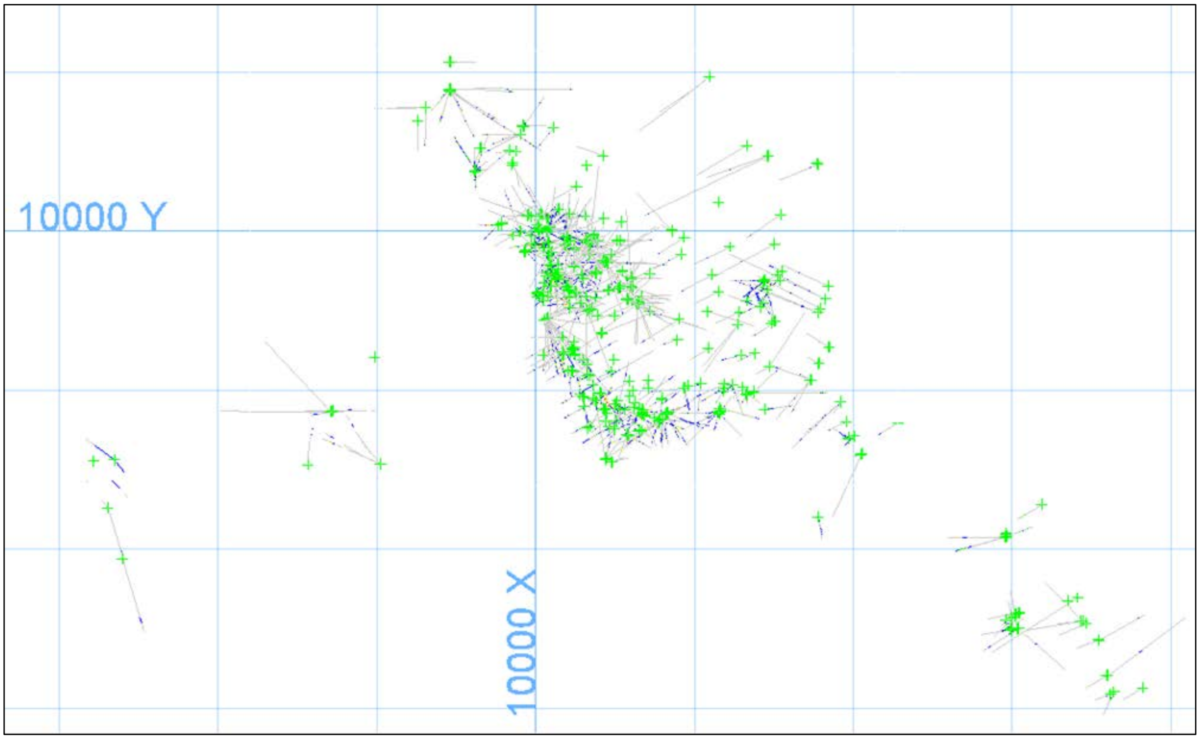



**Figure 10-1: Location Map of Drillhole Collars**

## 10.2 Procedures

The Bolivar Mine uses a local coordinate grid which is based on meters from a central control point. Nearby exploration is registered in a standard UTM coordinate grid, and thus it is necessary to consider the exploration data completely separate from the mine data.

The primary drilling method at Bolivar has been diamond core. To date, 769 drillholes have been completed with an average length of approximately 190 m. The drillholes have been drilled predominantly from surface and to a lesser degree, underground in a wide variety of orientations. In the vicinity of the mining operations, the average drillhole spacing ranges between 25 and 50 m. In the deeper or less explored areas, the average drillhole spacing ranges between 75 and 150 m. Overall, the majority of the drilling completed by Dia Bras has been relatively closely spaced and appears to have been directed at resource definition. Only a small percentage of the drillholes have down-hole deviation surveys. A significant number of the drillholes are relatively long and their precise location is considered uncertain due to the lack of down-hole surveys. It is not current practice to survey exploration drilling, which poses a significant risk as to the confidence that can be had in the location of the results and interpretation of recent exploration efforts. The current drilling intersects the mineralization at a wide range of orientations and therefore drill intercept lengths do not necessarily reflect the true thickness of mineralization.

The drilling has been conducted with Dia Bras-owned drills and outside contractors. All drill core has been logged by Dia Bras staff geologists. Sample intervals are determined by the geologist and the core is then cut in half (hydraulic splitter) and bagged by Dia Bras technicians. SRK is of the opinion that the core processing area and logging facilities are all appropriately organized and consistent with industry best practices.

## 10.3 Interpretation and Relevant Results

The drilling results are used to guide ongoing exploration efforts and to support the resource estimation. SRK notes that the majority of the individual deposits are drilling as perpendicular to the deposit as possible, but that some areas such as the Step Out and Increíble deposits feature drilling that is very close to parallel the trend of mineralization. This has been accounted for in the mineral resource classification, and SRK strongly recommends drilling these areas from different positions to improve the angle of intersection between the drilling and true thickness of mineralization.

# 11 Sample Preparation, Analysis and Security

## 11.1 Security Measures

After logging and splitting, all exploration drilling samples are laid out in order and recorded into a digital database prior to shipping. Samples are placed into larger plastic bags, and these bags are marked with the hole ID and sample numbers, then sealed with a security seal. All samples are kept behind gated access-controlled areas on the Bolivar mine site, then transported by Dia Bras personnel to a shipping facilitator. Hard copies and electronic forms are kept for all sample transactions, detailing shipping, receipt, and types of analyses to be conducted.

## 11.2 Sample Preparation for Analysis

All analyses for new exploration drilling or resource expansion are currently performed by ALS Chemex (ALS), an ISO-certified independent commercial laboratory. Sample preparation is completed at the ALS Chemex Hermosillo, Mexico facility and final analysis is conducted at the primary laboratory in North Vancouver, BC, Canada. Historically, samples have been prepared at Dia Bras facilities in either the Malpaso Mill or the Piedras Verdes Mill. This practice was discontinued at the end of 2014.

## 11.3 Sample Analysis

The analytical history of Bolivar sampling is complex, and includes various sources of analyses from the nearby Malpaso Mill Lab or Piedras Verdes Mill Lab and ALS. Previous reports have noted inconsistencies between the internal and external laboratories in terms of analytical precision and accuracy, with the Malpaso Mill historically featuring relatively poor results from submitted QA/QC samples. SRK notes that a significant effort has been made over the past two years to improve the equipment and methodology for Dia Bras' internal laboratory. The results of the current QA/QC program indicate that performance has drastically improved and now meets industry standards. The QA/QC program includes check samples between the Piedras Verdes lab and ALS which show reasonable duplicate performance. In addition, certified reference materials (CRM) analyzed by Piedras Verdes over the previous year show excellent performance.

The current program is that all samples are analyzed internally initially at the PV Lab, and that selected intervals with identified mineralization are re-submitted to ALS. This ensures that intervals identified to have material mineralization by the PV lab are sent for analysis at ALS, and that sample intervals with little chance of being mineralized are not. This is done to reduce analytical costs. The duplicates are selected from coarse rejects from the initial preparation. The ALS results are incorporated into the database as the final analytical result for the duplicated intervals. SRK notes that this is a reasonable practice, but that a study should be conducted to formally document and establish the validity of the internal assays. Results from 2016 suggest that the Piedras Verdes mill may now be suitable as a primary lab, as long as monitoring of the performance continues.

## 11.4 Quality Assurance/Quality Control (QA/QC) Procedures

Samples supporting the Mineral Resource estimation (MRE) were analyzed, almost exclusively, by the ALS Minerals laboratory (ALS) in Vancouver, BC. Canada. However, the preparation of samples has been completed at other facilities and historically conducted by the nearby Piedras Verdes mill, with pulps provided to ALS for analysis. SRK notes that inconsistencies in the preparation methodology and the size-fraction of the received pulp have been noted over the history of the Project, but that the results of recent duplicate comparisons show reasonable agreement between samples prepared entirely by ALS or by the Piedras Verdes lab.

One purpose of a QA/QC program is to submit samples with known or expected values, in the sequence of normal analyses, to "test" the internal or third party laboratory's accuracy. These samples with known values are blind to the laboratory, so analyses that are not within expected tolerances represent failure criteria which are flagged upon receipt and action is taken to rectify with the lab the potential source of the failure and take corrective action.

Prior to 2013, the drill sampling QA/QC program only featured duplicate sampling which evaluates analytical precision. This program was not consistent with industry best practices and was modified to current industry standards. From 2013 to late 2015, a very basic QA/QC program included continued submission of duplicate samples to ALS Chemex as well as insertion of Certified Reference Material (CRM). This program was not properly monitored and the results were not tracked in detail. The current QA/QC procedures (established late 2015) include: insertion of CRMs, blanks, and duplicates, at rates consistent with industry best practices. The results are monitored and tracked by Dia Bras personnel. The results of the QA/QC show reasonable performance for the laboratory and SRK is of the opinion that the current analytical methods and QA/QC are up to industry standards and will serve Bolivar well going forward.

In order to provide additional support to the data used for Mineral Resource estimation, Dia Bras recently conducted a thorough review of the historic sample data in the unmined areas which were analysed without modern QA/QC. They selected 315 (~307 m) samples from several areas and submitted these intervals for reanalysis with appropriate QA/QC measures to ALS. This serves to validate some historic drilling (dating back to 2012), specifically in areas that are critical to the Mineral Resource statement, as well as test the historic performance of the Piedras Verdes Mill against the new ALS results.

### 11.4.1 Certified Reference Materials

Dia Bras currently inserts CRM into the sample stream at a rate of about 1:20 samples, although the insertion rate is adjusted locally to account for particular observations in the core. Three CRM have been procured and certified via round robin analysis for the current exploration programs. These CRM have been homogenized and packaged by Target Rocks Peru (S.A.) and the round robin conducted by Smee & Associates Consulting Ltd., a consultancy specializing in provision of CRM to clients in the mining industry.

Each CRM undergoes a rigorous process of homogenization and analysis using aqua regia digestion and AA or ICP finish, from a random selection of 10 packets of blended pulverized material. None of the CRM are certified for Au, a minor contributor to the mineral resources at Bolivar. The six laboratories participating in the round robin for the Target Rocks CRM are:

- ALS Minerals, Lima;
- Inspectorate, Lima;
- Acme, Santiago;
- Certimin, Lima;

- SGS, Lima; and
- LAS, Peru.

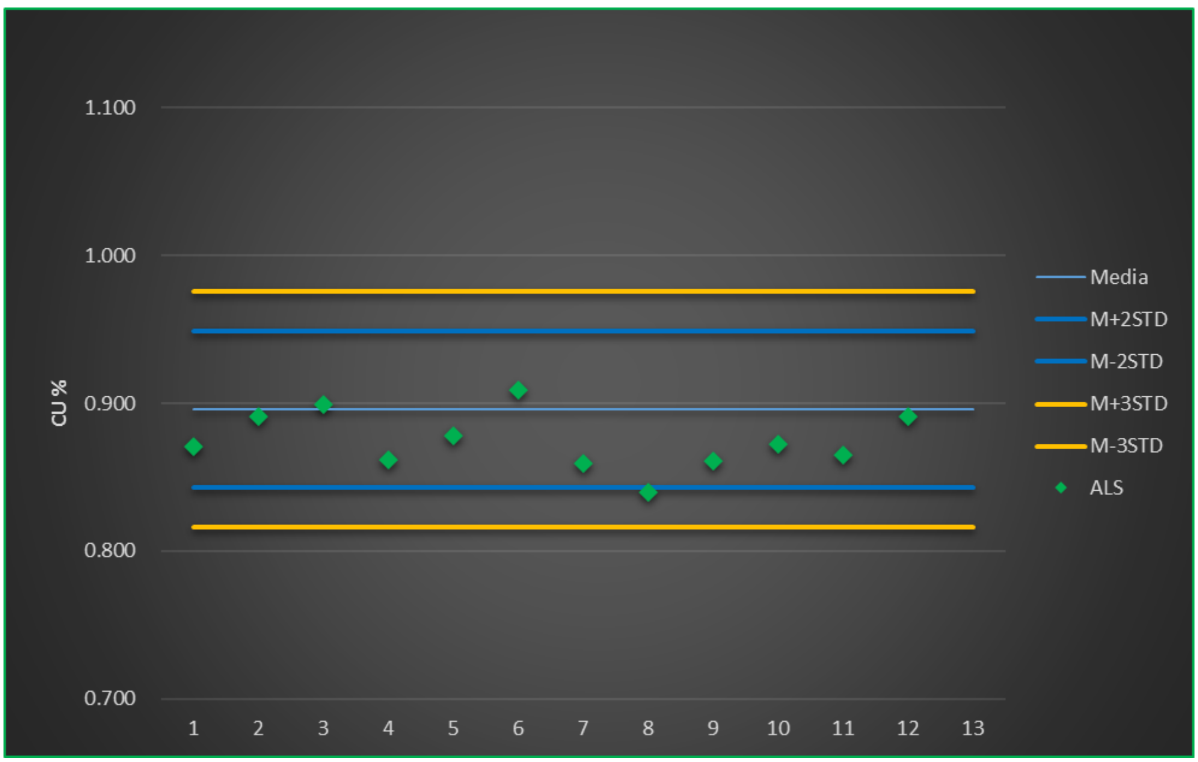
The means and between lab standard deviations (SD) are calculated from the received results of the round robin analysis, and the certified means and tolerances are provided in certificates from Smee and Associates. The certified means and expected tolerances are shown in Table 11-1.

**Table 11-1: CRM Expected Means and Tolerances**

| CRM | Certified Mean | | | | Two Standard Deviations (between lab) | | | |
|---|---|---|---|---|---|---|---|---|
| Element | Ag (g/t) | Pb (%) | Cu (%) | Zn (%) | Ag (g/t) | Pb (%) | Cu (%) | Zn (%) |
| MCL-01 | 26.4 | 0.326 | 0.896 | 0.988 | 1.90 | 0.03 | 0.05 | 0.07 |
| MCL-02 | 40.8 | 0.653 | 1.581 | 2.49 | 3.4 | 0.05 | 0.084 | 0.09 |
| Mat. PLSUL N° 03 | 192.00 | 3.094 | 1.033 | 3.15 | 4.00 | 0.084 | 0.036 | 0.13 |

Source: Dia Bras, 2016

QA/QC data provided to SRK includes 71 CRM (29 low-grade, 23 moderate-grade, and 19 high-grade) which were inserted into the sample stream for 42 drillholes drilled between 2012 and 2016. The performance of the CRM is evaluated over time using a simple plot of the expected mean vs. the reported analysis, and a +/-3 SD failure criteria. This is consistent with industry best practices, and SRK notes no failures for any of the CRMs submitted for the 2016 drilling or the resampling program. An example of the CRM performance for MCL-01: Cu is shown in Figure 11-1. Dia Bras tracks and generates plots such as this for each element from each standard. SRK has noted zero failures for all of the CRM provided, across each of the elements certified.

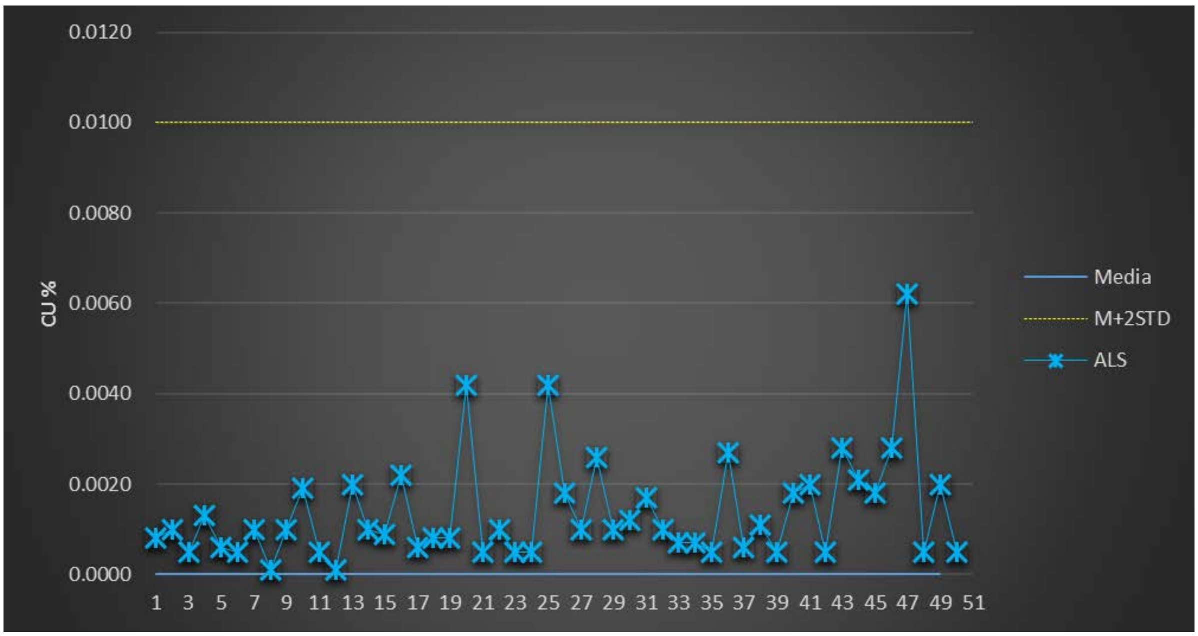



Source: Dia Bras, 2016

**Figure 11-1: CRM Performance for MCL-01 – Cu**

### 11.4.2 Blanks

Blank material used in the QA/QC program consists of barren limestone selected by Bolivar geologists. Results submitted to SRK included 50 samples which were inserted into the sample stream for 27 drillholes drilled between 2012 and 2016. The failure criteria for blanks is roughly +2SD of the mean of the blanks. SRK reviewed the performance of the blank samples submitted and noted very limited failures for the blanks, occurring in 4 of the 50 samples, and only for Zn. An example of a successful blank performance chart is shown in Figure 11-2.




Source: Dia Bras, 2016

**Figure 11-2: Blank Performance – Cu**

### 11.4.3 Duplicates

Prior to 2013, the drill sampling QA/QC featured duplicate sampling only. The 2005 report by Roscoe Postle Associates notes that Dia Bras geologists collected field duplicate samples from split drill core after every tenth sample and submitted the samples to Chemex, in lieu of a standard QA/QC program.

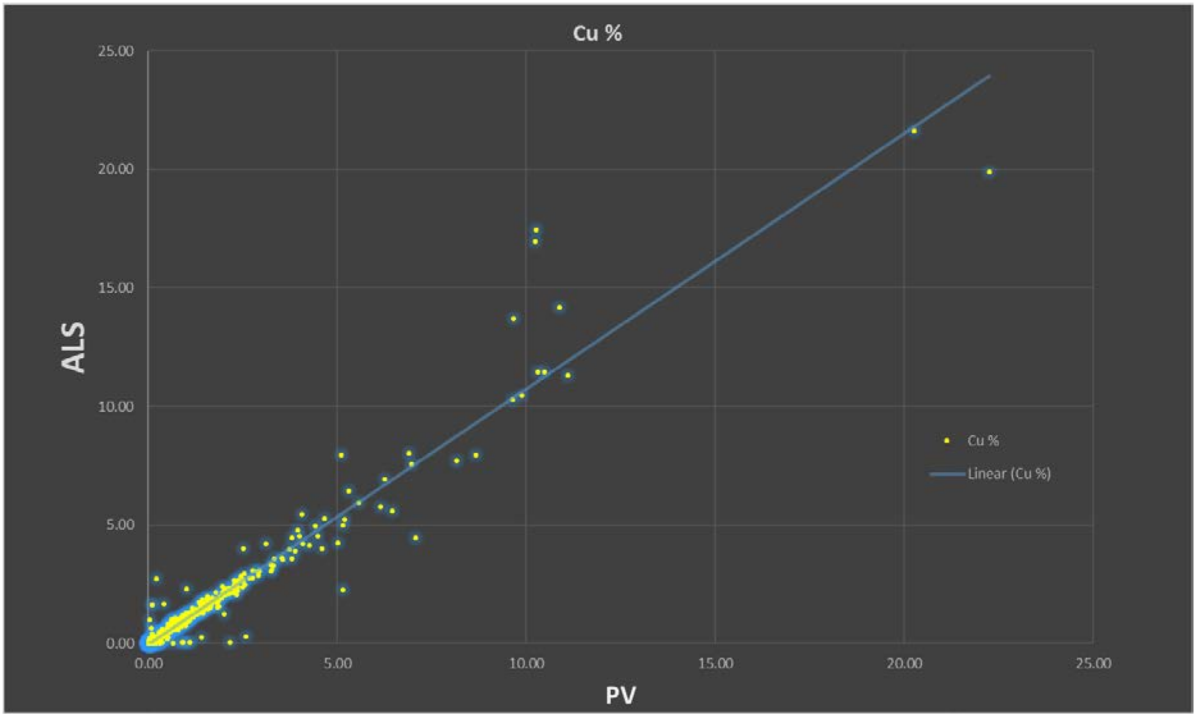
Currently, all duplicate samples are initially analyzed by Dia Bras' internal Piedras Verdes lab, and selected mineralized intervals are then re-submitted to ALS; these duplicates are selected from coarse rejects from the internal laboratory preparation. For 2016, this represents 942 samples which have been analyzed at both laboratories for 2016.

The performance of duplicate splits submitted to both the PV lab and ALS show excellent agreement of the mean values between the two, as summarized in Table 11-2. As shown in Figure 11-3, the ALS values agree very well with the PV values across the range of analyses, with ALS actually exhibiting a very slight bias at the very high grade ranges compared to PV. SRK noted the same for Zn and Ag.

**Table 11-2: Inter-lab Duplicate Performance of Mean Values**

| Lab | Cu (%) | Zn (%) | Fe (%) | Pb (%) | Au (g/t) | Ag (g/t) |
|---|---|---|---|---|---|---|
| PV | 0.75 | 0.16 | 5.03 | 0.02 | 0.09 | 13.47 |
| ALS | 0.75 | 0.16 | 5.03 | 0.02 | 0.09 | 13.49 |

Note: from 942 coarse rejects submitted to both ALS and PV labs.
Source: Dia Bras, 2016




Source: Dia Bras, 2016

**Figure 11-3: Duplicate Scatter Plot - Cu**

On the basis of individual duplication, the coarse reject splits perform poorly, with approximately 30% of the Cu samples differing by a factor of more than 30% from the other. The split is essentially equal in terms of samples that are 30% high or 30% low, reflecting no consistent laboratory bias. The majority of these discrepancies occur at the lower grade ranges, which are unlikely to materially affect the mineral resource estimation. These discrepancies are fairly common for the type of sample split utilized and the highly variable nature of the skarn mineralization.

### 11.4.4 Results

The results of the 2016 QA/QC show excellent performance of CRM and blanks, with no evidence of meaningful bias or contamination. SRK notes that these results have been provided by Dia Bras.

SRK is of the opinion that the results from the duplicate analysis suggest that the results from the PV lab compared to the ALS lab show excellent overall comparisons, and despite a relatively high percent difference on a sample by sample basis, that any bias between the two labs is negligible in terms of resource estimation.

### 11.4.5 Actions

No actions have been taken on the basis of the results of the QA/QC, given the lack of failures. SRK notes that the procedures and processes for definition of actions upon detection of failures are not well-documented, but have been described as follows:

- Upon receipt of laboratory analytical reports QA/QC samples are copied and merged into a master spreadsheet which displays them on a graph, as well as designating whether they are a failure per the above criteria.
- In the event of a failure, the database technicians communicate internally with geologists to ensure that the correct sample was submitted.
- If this is the case, the laboratory is notified and the batch is re-analyzed and re-reported. If no failures are noted, these analyses are transferred into the QA/QC sheets and the final drilling database is updated with the non-QA/QC samples.

## 11.5 Opinion on Adequacy

Dia Bras has completed a very limited QA/QC program consisting of field duplicate sampling during the first few years of its exploration drilling programs. SRK notes that previous technical reports deemed the level of QA/QC consistent with industry best practices and cautions that, based on SRK's extensive experience, this is not the case.

SRK is of the opinion that, given the recent QA/QC results and comparison to the PV mill, as well as the fact that Bolivar is a producing mine with a robust production history, that the quality of the analytical data is sufficient to report mineral resources in the Indicated and Inferred categories. SRK strongly advises Dia Bras to continue to support ongoing QA/QC monitoring and document the procedures and methods for actions to be taken in the event of failures.

# 12 Data Verification

## 12.1 Procedures

SRK was provided with 441 analytical certificates from ALS Minerals for the 23,000 analyses in the database. SRK reviewed and compared 89 (20%) of the certificates containing 9% of the assays. SRK notes that there were only four certificates that contained information that was inconsistent with the database, and that these appear to have been reanalyzed and replaced in the database based on similar values between the electronic database and the assay certificate values.

In addition Gustavson and RPA have conducted other means of data validation in previous reports and found the data to be sufficient in terms of accuracy for use at those times.

## 12.2 Limitations

SRK did not review 100% of the analyses from the analytical certificates as a part of this report. In addition, SRK reviewed analyses from certificates that are likely to have been reanalyzed either as a part of the recent resampling program or over the normal course of the previous 6 years of work.

## 12.3 Opinion on Data Adequacy

SRK is of the opinion that the data provided is adequate for estimation of Mineral Resources and classification in the Indicated and Inferred categories.

# 13 Mineral Processing and Metallurgical Testing

## 13.1 Testing and Procedures

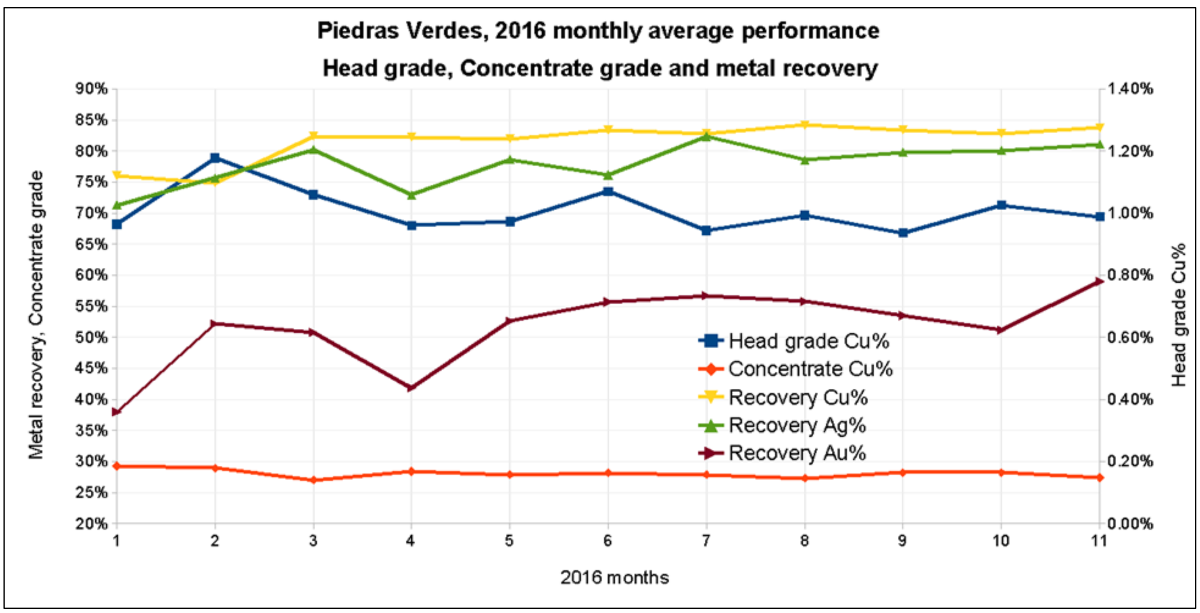
Bolivar facilities include a metallurgical laboratory at site. Sampling and testing of samples are executed on an as-needed basis. No testwork results were available at this time for the areas being mined currently or for the new prospects being explored.

## 13.2 Recovery Estimate Assumptions

Various development and test mining has occurred at the Bolivar mine under Dia Bras ownership since 2005. Prior to late 2011, no processing facilities were available on site, and the ore was trucked to the Cusi Mine's Malpaso mill located 270 km by road. Bolivar's Piedras Verdes processing facilities started operating in October 2011 at 1,000 tonnes per day of nominal throughput. The ore processing capacity was expanded to 2,000 tonnes per day in mid-2013. The mill has been upgraded since and the current nominal throughput capacity is 3,000 tonnes per day.

Piedras Verdes' monthly average metallurgical performance for the last twelve month is shown in Figure 13-1.

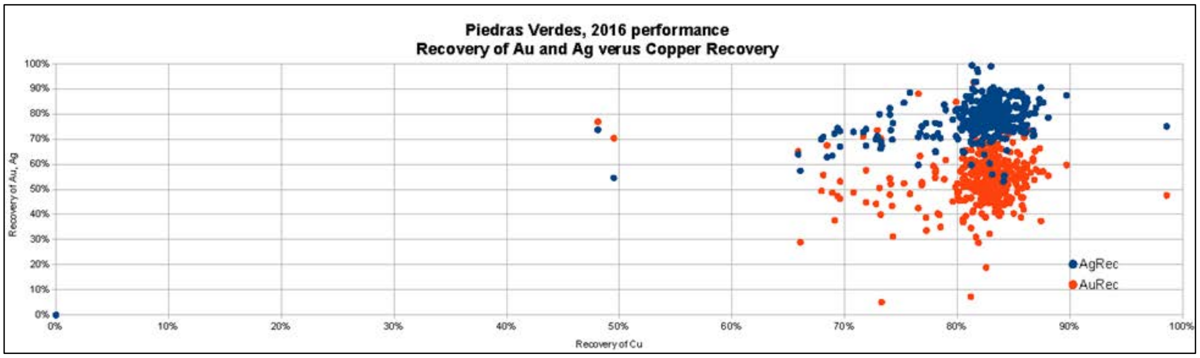
During 2016 Piedras Verdes consistently produced copper concentrate of commercial quality with copper grade ranging between 27 %Cu to 29 %Cu, silver content in concentrate ranging from 369 g/t to 538 g/t, and gold content in concentrate ranging from 2.2 g/t to 4/5 g/t. Metal recovery for copper, silver, and gold averaged 81.8%, 78.1% and 52.1%, respectively.




Source: SRK

**Figure 13-1: Piedras Verdes Monthly Average Performance - 2016**

An analysis of the recovery relationship between copper and credit metals is shown in Figure 13-2. Silver and gold's recovery shows a general positive correlation with copper; nevertheless, all metals show large variations in recovery. Copper recovery ranged from approximately 50% to 98% with the vast majority of results in the 65% to 88% range. Silver recovery ranged from 50% to 100%, and gold ranged from about 5% up to 90% with a higher concentration of results around 55%. SRK recommends that Piedras Verdes analyze ways to stabilize the recovery operations with the purpose of achieving consistent metallurgical performance.




Source: SRK

**Figure 13-2: Recovery Relationship of Cu vs. Ag and Au**

# 14 Mineral Resource Estimate

Matthew Hastings, M.Sc., C.P. AusIMM, has conducted the mineral resource estimation (MRE) as described herein. Mr. Hastings has relied on the commentary and expertise of Dia Bras and Sierra Metals personnel over the course of the study.

## 14.1 Drillhole and Channel Sample Database

Information supporting the MRE is derived from databases of drilling information as well as underground channel sample information.

### 14.1.1 Drilling Database

The drilling database contains 878 drillholes totaling to 176,600 meters. Within this dataset, there are only 692 holes with assay data from 22,981 intervals with a total length of 25,638 m. Decisions regarding whether an interval is sampled is made by site geology personnel on the basis of geologic logging. The drilling history (Table 14-1) of Bolivar has been documented since 2003, and features a number of different types of drilling (Table 14-2) and various periods of activity. Drilling information for some older holes has been lost, or the type of drilling is unknown, and these holes have been removed from the database.

The database is maintained in Microsoft Access and provided to SRK in Microsoft Excel format tables, with collar information, hole orientation information, geology logging, analytical data, and geotechnical data (Table 14-3).

**Table 14-1: Bolivar Drilling History**

| Year | Count | Meters | % of Total |
|---|---|---|---|
| 2003 | 1 | 202 | 0 |
| 2004 | 100 | 16,026 | 9 |
| 2005 | 74 | 13,129 | 7 |
| 2006 | 67 | 10,720 | 6 |
| 2007 | 123 | 25,095 | 14 |
| 2008 | 117 | 24,006 | 14 |
| 2009 | 69 | 8,521 | 5 |
| 2010 | 67 | 9,155 | 5 |
| 2011 | 49 | 9,307 | 5 |
| 2012 | 45 | 14,161 | 8 |
| 2013 | 27 | 11,402 | 6 |
| 2014 | 29 | 5,646 | 3 |
| 2015 | 76 | 18,446 | 10 |
| 2016 | 34 | 10,789 | 6 |

Source: Dia Bras, 2016

**Table 14-2: Drilling Types**

| Hole Type | Count | Meters |
|---|---|---|
| Unknown | 45 | 7,639 |
| NQ | 143 | 28,327 |
| BTW | 23 | 1,818 |
| HQ_NQ | 349 | 102,193 |
| HQ | 6 | 2,298 |
| BQ | 313 | 34,472 |

Source: Dia Bras, 2016

**Table 14-3: Descriptive Statistics – All Drilling**

| Column | Count | Min | Max | Mean | Variance | St Dev | CV |
|---|---|---|---|---|---|---|---|
| Length | 25,564 | 0.002 | 800.55 | 5.94 | 756.60 | 27.51 | 4.63 |
| Au | 19,610 | 0.003 | 14.60 | 0.11 | 0.19 | 0.43 | 4.08 |
| Ag | 20,999 | 0.001 | 4,720.00 | 12.83 | 3,504.00 | 59.19 | 4.61 |
| Cu | 20,762 | 0.001 | 42.07 | 0.48 | 2.10 | 1.45 | 3.03 |
| Pb | 19,825 | 0.001 | 8.05 | 0.02 | 0.01 | 0.12 | 6.16 |
| Zn | 20,998 | 0.001 | 52.09 | 1.12 | 20.02 | 4.47 | 4.01 |

Source: Dia Bras, 2016

### 14.1.2 Downhole Deviation

Only 41 of the 692 drillholes have downhole deviation measurements. This has only been in practice for a selection of holes since the 2013 drilling campaign. Survey methods include gyro, Deviflex, and Reflex tooling. For these holes, the purpose of the survey is to assess deviation and determine whether it is a factor for the accuracy of drilling information. In general, this has been done on 20 to 50 m intervals for the majority of holes, with much closer spacing on surveys for a selection of newer 2016 holes. In all cases, the surveys show that the initial angle of the drill setup is frequently five or more degrees off on the intended azimuth, and that subsequent surveys taken down-hole vary significantly from the first indicating substantial deviation (Table 14-4). The survey deviations are not consistent within the measurement data and the results indicate that un-surveyed drillholes could be materially off of the planned azimuth which is recorded into the database. SRK notes that this is resolved in newer 2016 drilling, with downhole surveys that closely approximate the planned azimuth taken at the drill collar.

The average azimuth downhole deviation for these 41 surveyed holes is highly variable, with some holes exhibiting very little deviation and others more than 15 degrees over the course of the hole. Thus, SRK is of the opinion that downhole surveys should be collected on a more regular basis and used as a matter of course during ongoing drilling, at intervals of no more than 50 m. The uncertainty associated with the position of the majority of the drilling is a major contributor to the classification of the resource.

**Table 14-4: Example of drilling deviations**

| Hole Name | Depth | Azimuth | Dip | Type |
|---|---|---|---|---|
| DB15B491 | 0 | 75 | -55 | Reflex |
| DB15B491 | 50 | 49.6 | -55.3 | Reflex |
| DB15B491 | 100 | 49.8 | -55.5 | Reflex |
| DB15B491 | 150 | 49.9 | -55.9 | Reflex |
| DB15B491 | 250 | 50.6 | -55.8 | Reflex |
| DB15B494 | 0 | 75 | -80 | Reflex |
| DB15B494 | 50 | 66.3 | -80.5 | Reflex |
| DB15B494 | 100 | 63.9 | -80.2 | Reflex |
| DB15B494 | 150 | 66.3 | -80.4 | Reflex |
| DB15B494 | 200 | 66.2 | -80 | Reflex |
| DB15B494 | 250 | 67.1 | -80.5 | Reflex |
| DB15B494 | 290 | 67.1 | -80.4 | Reflex |
| DB15B495 | 0 | 75 | -60 | Reflex |
| DB15B495 | 50 | 59.4 | -59.4 | Reflex |
| DB15B495 | 100 | 59.6 | -59.3 | Reflex |
| DB15B495 | 150 | 59.6 | -59.3 | Reflex |
| DB15B495 | 200 | 58.8 | -59 | Reflex |
| DB15B495 | 240 | 58.8 | -59.1 | Reflex |

Source: Dia Bras, 2016

### 14.1.3 Channel Sample Database

The channel sample database is kept in a series of AutoCAD (CAD) files, either within embedded tables or as graphic information in the file itself. SRK was provided these AutoCAD files and extracted the information from the files to create an Excel database of points and values for the elements analyzed. Coordinates for the points are taken from the approximate X,Y coordinate positions of the CAD files and the Z elevation is derived from the matching 3D asbuilt data provided for the levels. SRK located 1,278 channel samples using this method, and notes that only 881 of these have analyses for Cu or other metals. It is presumed that the others were also analyzed, but that these values have been lost.

SRK notes that not all elements were analyzed consistently within the channel samples, with Cu being the overwhelming majority, and comparably fewer samples analyzed for Pb, Zn, Ag, and Au. The simple descriptive statistics for the El Gallo Superior (EGS) channel samples are shown in Table 14-5.

**Table 14-5: Descriptive Statistics – EGS Channel Samples**

| Column | Count | Min | Max | Mean | Variance | St Dev | CV |
|---|---|---|---|---|---|---|---|
| Ag | 23 | 1.3 | 68.1 | 20.07 | 428.10 | 20.69 | 1.03 |
| Cu | 881 | 0.001 | 20.4 | 1.29 | 2.12 | 1.46 | 1.13 |
| Pb | 139 | 0.001 | 1.36 | 0.03 | 0.01 | 0.12 | 3.55 |
| Zn | 881 | 0.001 | 25.68 | 1.07 | 9.05 | 3.01 | 2.8 |

Note: Au not assayed for in channel sample data.
Source: Dia Bras, 2016

At this time, the channel sample data only applies to the EGS orebody, and has only been used to estimate mineral resources into the pillars from this area. Due to uncertainty associated with translating this data from AutoCAD spreadsheets in terms of precision of location in 3D, SRK judges it to be suitable only for support of Indicated and Inferred Mineral Resources.

### 14.1.4 Missing and Unsampled Intervals

The handling of missing and unsampled intervals for the Bolivar data is critical to the estimation. There are many cases where samples are not present in the database for significant thicknesses, or the entire drillholes. In most cases, this is because the geologist logging the drillhole did not note mineralization or material of interest and did not deem the interval worth sampling. However, SRK notes that there were other factors that may have contributed to intervals not having assay results. Some assays have been lost or deemed of too low confidence by Dia Bras to include in the MRE. Others are partial analyses, meaning that Cu was analyzed, but not Au. For example, there are about 1,000 less Au analyses in total than Cu, which is a function of the analytical capability of the Piedras Verdes lab prior to installation of a fire assay circuit. All modern assays feature the complete elemental suite, and SRK is of the opinion that these incomplete, historic assays are not likely to materially affect the mineral resources in areas yet to be mined.

In a select few obvious cases, SRK advised Dia Bras (prior to this work) that they should sample those intervals that clearly should cross the mineralized body based on other nearby drilling or sampling. Dia Bras did this, and submitted modern QA/QC along with the selection of samples to effectively “infill” most of these areas.

In general, SRK handled the missing or unsampled intervals as follows:

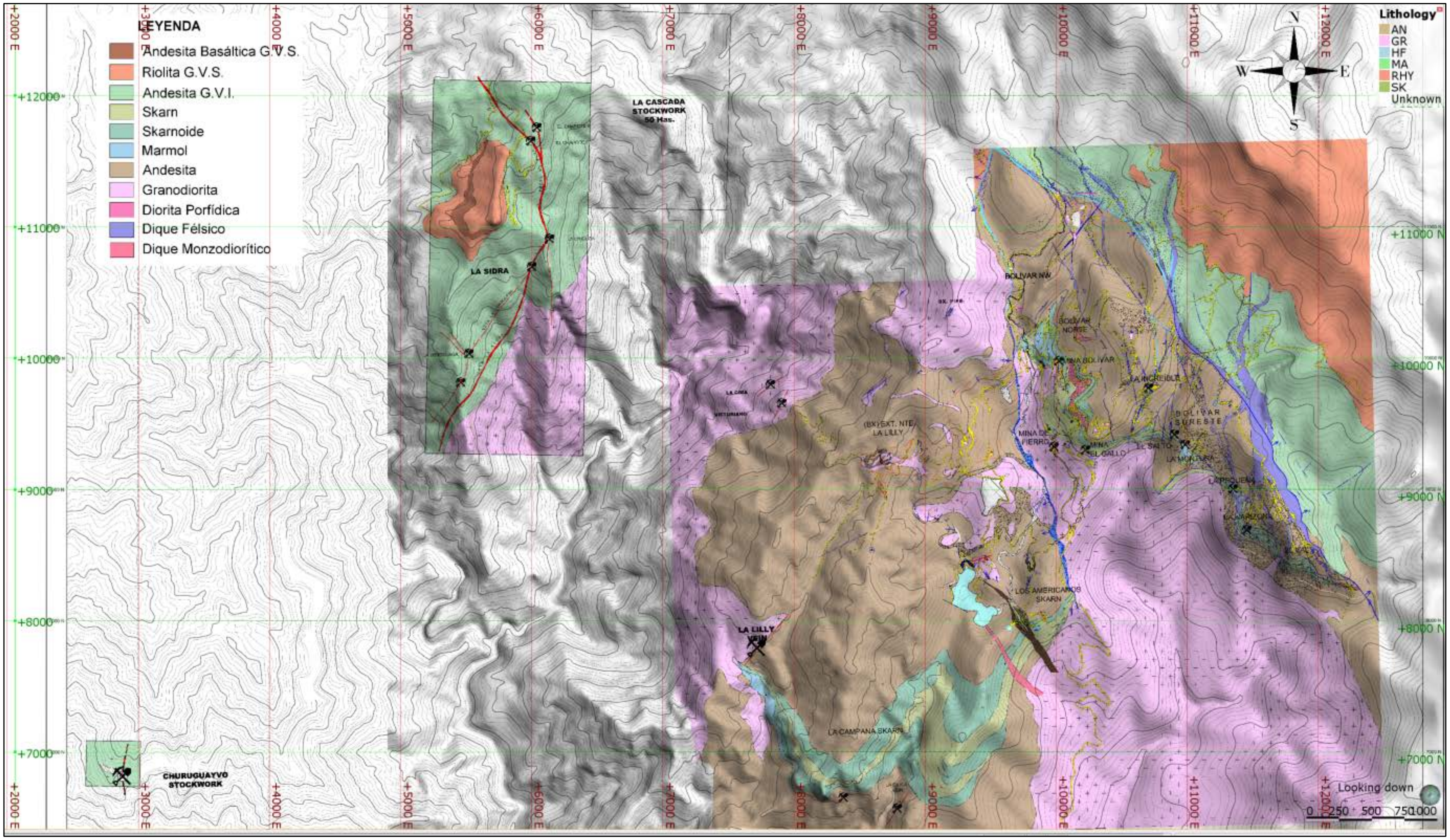
- Drillholes where the entire hole was missing assays were removed from the database used in estimation. They may have still been used to drive the geology interpretation. These are predominantly in the oldest areas of the Bolivar mine area, or areas which are not included in the current resource estimation.
- If a drillhole had at least one sample interval, any remaining unsampled intervals are assigned a value of 0.001 (g/t or %).
- If a sample has analyses for Cu, but missing other elements, these are also given a value of 0.001 (g/t or %).
    - SRK judges this to be conservative but notes that it accounts for the variations in data density, in which one cannot assign the same level of confidence to an area using 25 samples for Cu, for example, with only five samples for Au.
    - SRK notes that this effect is minimal and only affects some of the older drilling that is in the upper and mined out areas of the deposits.

## 14.2 Geologic Model

Geology and mineralization models were constructed in 3D to serve as limits and guides for interpolation of grades during the mineral resource estimation.

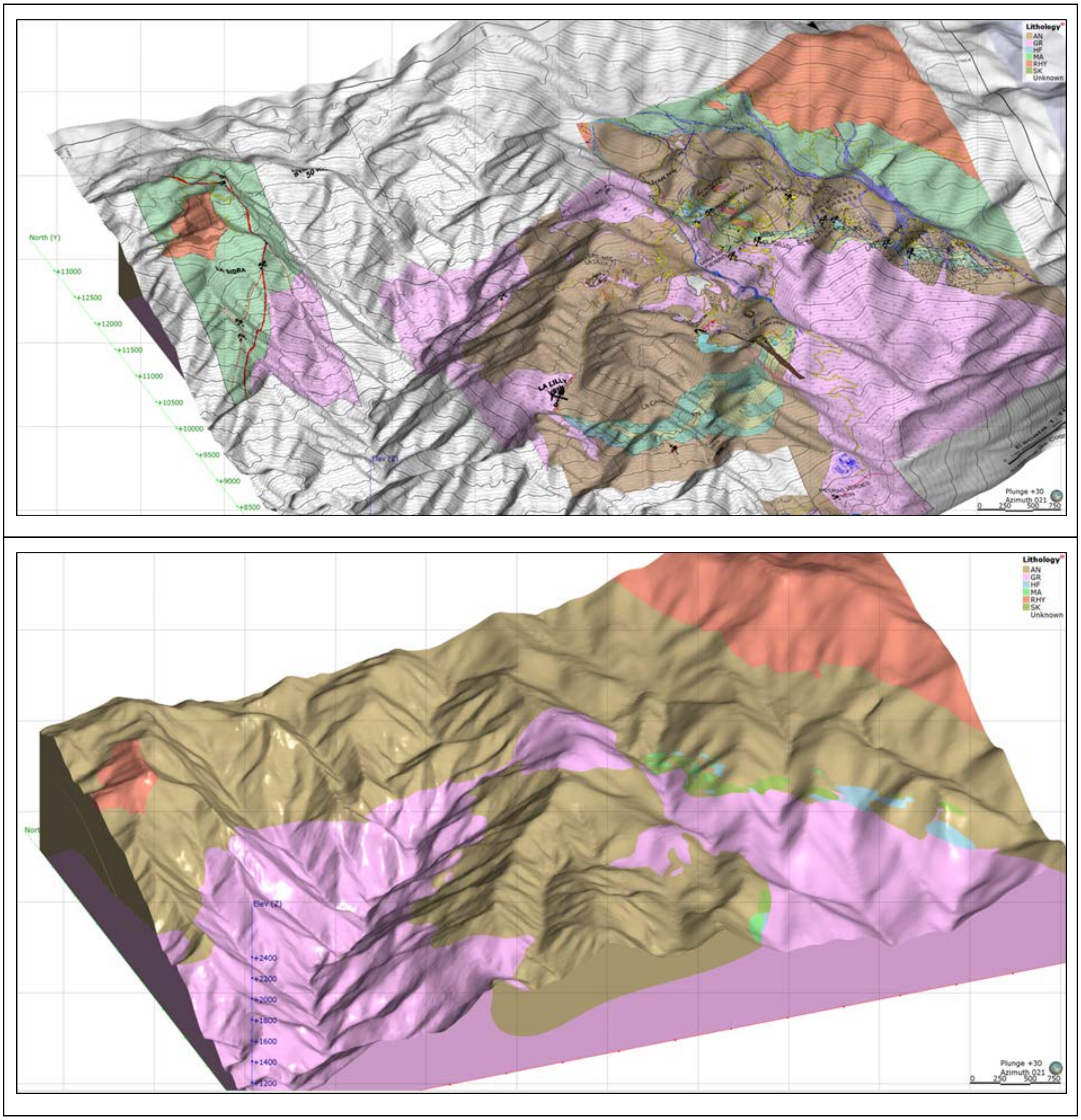
### 14.2.1 Project Area Regional Geology

SRK utilized surface mapping, interpreted cross sections, underground exposure data, and drilling information to generate a model of the regional geology. This includes the major lithologies and structures in the area. This was used primarily to flag the block model with rock types that were used to assign bulk densities, estimate rock quality, or estimate geochemical qualities for waste/ore. The support and results of this work are presented in Figures 4-1 and 14-2.




Source: SRK, 2016

**Figure 14-1: Plan View of Bolivar Area Geology Map**

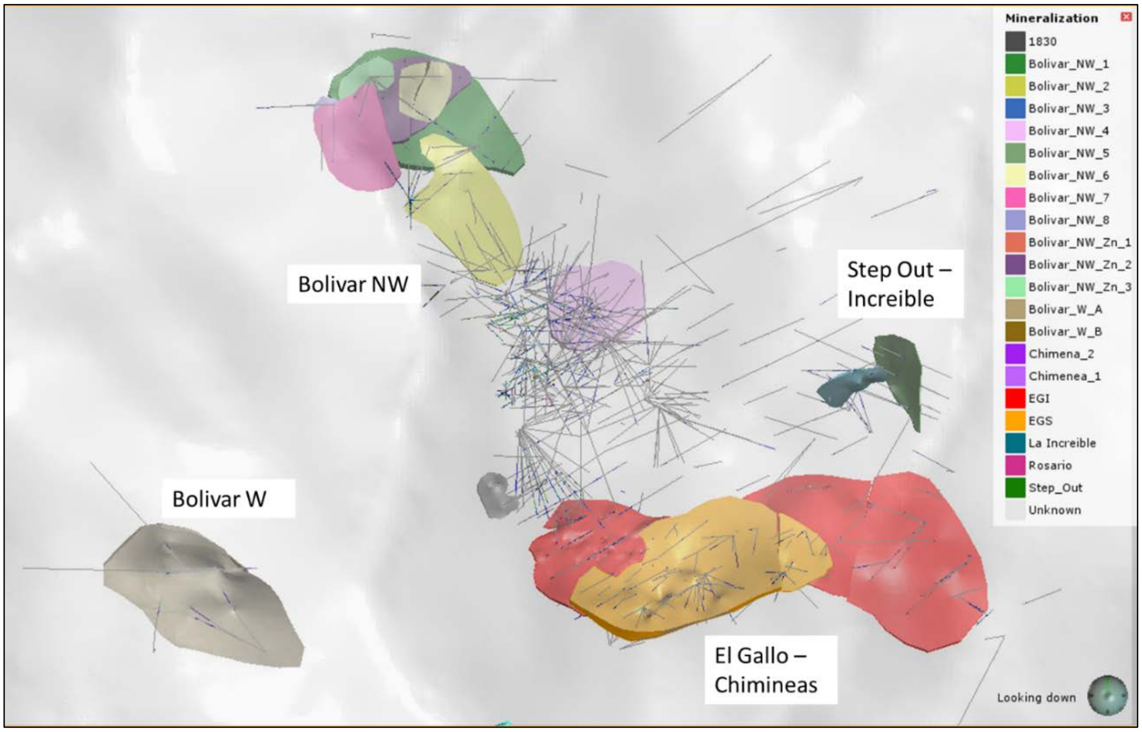



Source: SRK, 2016

**Figure 14-2: Perspective View of Mapped vs. Modeled Geology**

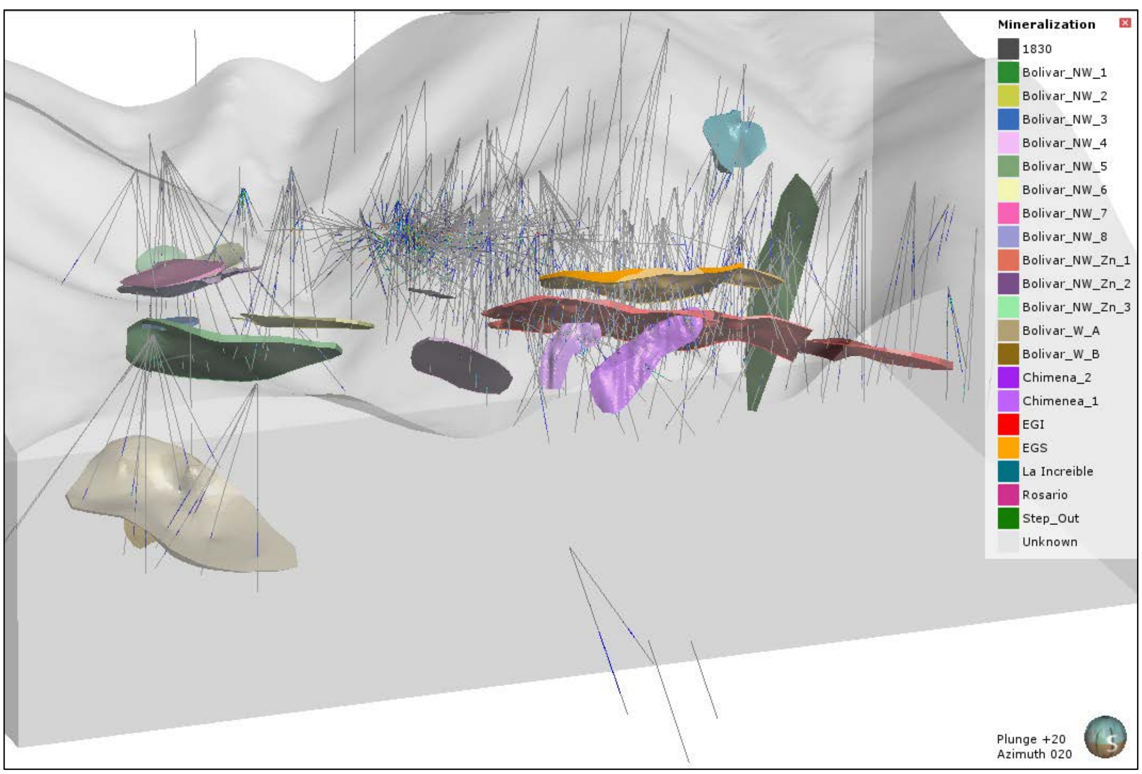
## 14.2.2 Bolivar Area Mineralization

The model for the mineralized bodies in the Bolivar area was initially constructed by Dia Bras geologists using Leapfrog Geo software to implicitly model skarn contacts and volumes from the drilling information. SRK reviewed and revised the model as needed, collaborating with Dia Bras to ensure that it is representative of the mineralization for the area. Three high angle normal faults are known to locally offset the mineralized orebodies where they cross, and have been incorporated into the model. A layout of the mineralized bodies is shown in Figure 14-3 and Figure 14-4.




Source: SRK, 2016

**Figure 14-3: Plan View of Bolivar Mineralization Model**




Source: SRK, 2016

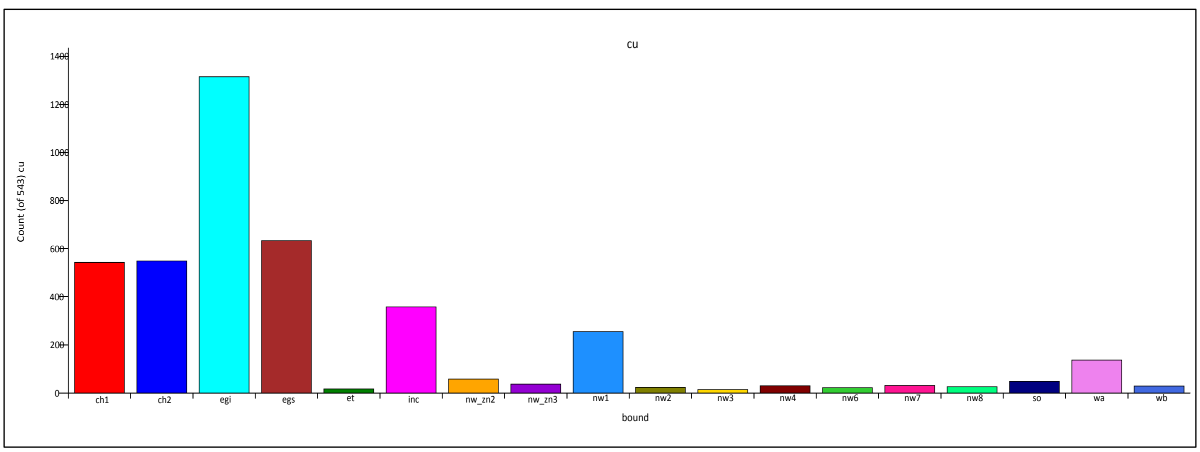
**Figure 14-4: Orthogonal View of Bolivar Mineralization Model**

In all, 18 mineralized bodies were modeled as resource domains for the Bolivar area, as shown in Table 14-6. SRK notes that there are other mineralized bodies defined by Dia Bras geologists, but that the level of drilling was insufficient to define the orientation or extents of the mineralization, and they were excluded from the grade estimation. The individual domain codes are used to describe these areas throughout this report, as well as in statistical and comparison tables as follows. After modeling of these domains, SRK evaluated the sample density and statistical grade distribution for the four commodities of interest (Ag, Au, Cu, Pb, and Zn). As shown in Figure 14-5, the majority of samples are in the El Gallo area (Superior and Inferior) as well as the Chimeneas areas. Descriptive statistics for the grades by domain are summarized in Table 14-7.

**Table 14-6: Bolivar Resource Domains and Codes**

| Area | Code |
|---|---|
| Chimenea 1 | CH1 |
| Chimenea 2 | CH2 |
| El Gallo Inferior | EGI |
| El Gallo Superior | EGS |
| 1830 | ET |
| Increíble | INC |
| Northwest Zinc 2 | NW_ZN2 |
| Northwest Zinc 3 | NW_ZN3 |
| Northwest 1 | NW1 |
| Northwest2 | NW2 |
| Northwest 3 | NW3 |
| Northwest 4 | NW4 |
| Northwest 6 | NW6 |
| Northwest 7 | NW7 |
| Northwest 8 | NW8 |
| Step Out | SO |
| West A | WA |
| West B | WB |

Source: SRK, 2016




Source: SRK, 2016

**Figure 14-5: Counts of Cu Samples by Resource Domain**

### Table 14-7: Descriptive Drilling Statistics by Resource Domain – Bolivar Area

| Column | Domain | Count | Min | Max | Mean | Variance | St Dev | CV | 25% | 50% | 75% | 99% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Au (g/t) | ALL | 4,125 | 0.001 | 11.85 | 0.17 | 0.40 | 0.63 | 3.62 | 0.00 | 0.02 | 0.09 | 2.48 |
| | CH1 | 543 | 0.001 | 0.70 | 0.02 | 0.00 | 0.04 | 2.27 | 0.00 | 0.00 | 0.02 | 0.12 |
| | CH2 | 549 | 0.001 | 2.27 | 0.03 | 0.03 | 0.17 | 5.17 | 0.00 | 0.00 | 0.02 | 0.61 |
| | EGI | 1,315 | 0.001 | 11.85 | 0.27 | 0.49 | 0.70 | 2.65 | 0.01 | 0.06 | 0.24 | 3.16 |
| | EGS | 633 | 0.001 | 10.35 | 0.15 | 0.61 | 0.78 | 5.16 | 0.00 | 0.02 | 0.07 | 2.03 |
| | ET | 17 | 0.001 | 2.06 | 0.77 | 0.51 | 0.71 | 0.93 | 0.03 | 0.83 | 1.12 | 2.01 |
| | INC | 358 | 0.003 | 4.60 | 0.03 | 0.06 | 0.25 | 9.26 | 0.00 | 0.01 | 0.01 | 0.16 |
| | NW_ZN2 | 58 | 0.003 | 5.17 | 0.35 | 0.51 | 0.71 | 2.05 | 0.03 | 0.13 | 0.38 | 2.74 |
| | NW_ZN3 | 37 | 0.003 | 1.24 | 0.14 | 0.08 | 0.28 | 2.09 | 0.01 | 0.02 | 0.09 | 1.20 |
| | NW1 | 255 | 0.001 | 10.00 | 0.52 | 0.87 | 0.94 | 1.80 | 0.08 | 0.24 | 0.56 | 5.45 |
| | NW2 | 23 | 0.003 | 1.28 | 0.15 | 0.06 | 0.24 | 1.57 | 0.01 | 0.05 | 0.18 | 0.99 |
| | NW3 | 14 | 0.033 | 2.80 | 0.53 | 0.60 | 0.78 | 1.47 | 0.09 | 0.23 | 0.45 | 2.61 |
| | NW4 | 30 | 0.003 | 4.62 | 0.37 | 0.96 | 0.98 | 2.66 | 0.01 | 0.10 | 0.16 | 3.82 |
| | NW6 | 22 | 0.001 | 8.64 | 0.86 | 3.94 | 1.99 | 2.30 | 0.02 | 0.31 | 0.66 | 7.36 |
| | NW7 | 31 | 0.041 | 4.71 | 0.86 | 1.12 | 1.06 | 1.23 | 0.19 | 0.32 | 1.02 | 4.36 |
| | NW8 | 26 | 0.012 | 3.18 | 0.40 | 0.49 | 0.70 | 1.77 | 0.09 | 0.19 | 0.33 | 3.10 |
| | SO | 48 | 0.001 | 0.12 | 0.02 | 0.00 | 0.03 | 1.84 | 0.00 | 0.00 | 0.01 | 0.12 |
| | WA | 137 | 0.001 | 1.74 | 0.01 | 0.01 | 0.09 | 7.69 | 0.00 | 0.00 | 0.00 | 0.13 |
| | WB | 29 | 0.001 | 0.10 | 0.00 | 0.00 | 0.02 | 4.12 | 0.00 | 0.00 | 0.00 | 0.07 |
| | | | | | | | | | | | | |
| **Column** | **Domain** | **Count** | **Min** | **Max** | **Mean** | **Variance** | **St Dev** | **CV** | **25%** | **50%** | **75%** | **99%** |
| Ag (g/t) | ALL | 4,125 | 0.000 | 4720.00 | 23.20 | 9417.00 | 97.04 | 4.18 | 1.70 | 7.00 | 22.00 | 247.97 |
| | CH1 | 543 | 0.000 | 582.00 | 38.14 | 5440.00 | 73.76 | 1.93 | 1.86 | 6.40 | 38.04 | 365.45 |
| | CH2 | 549 | 0.000 | 4720.00 | 32.15 | 53876.00 | 232.11 | 7.22 | 1.20 | 5.53 | 15.97 | 422.64 |
| | EGI | 1,315 | 0.000 | 235.00 | 15.29 | 443.80 | 21.07 | 1.38 | 2.60 | 9.00 | 20.00 | 95.91 |
| | EGS | 633 | 0.000 | 1850.00 | 21.96 | 5146.00 | 71.74 | 3.27 | 0.00 | 6.39 | 27.90 | 131.87 |
| | ET | 17 | 0.000 | 158.00 | 62.29 | 2231.00 | 47.24 | 0.76 | 20.89 | 54.13 | 85.26 | 153.13 |
| | INC | 358 | 0.100 | 580.00 | 18.23 | 1804.00 | 42.47 | 2.33 | 1.70 | 5.70 | 16.90 | 150.10 |
| | NW_ZN2 | 58 | 0.100 | 291.00 | 28.13 | 2108.00 | 45.92 | 1.63 | 3.12 | 10.72 | 29.00 | 183.73 |
| | NW_ZN3 | 37 | 0.100 | 59.70 | 7.18 | 183.10 | 13.53 | 1.89 | 0.50 | 1.34 | 5.49 | 56.57 |
| | NW1 | 255 | 0.000 | 90.00 | 9.20 | 135.20 | 11.63 | 1.26 | 2.00 | 4.75 | 12.00 | 49.60 |
| | NW2 | 23 | 0.700 | 95.00 | 26.57 | 644.00 | 25.38 | 0.96 | 4.97 | 20.21 | 31.92 | 89.94 |
| | NW3 | 14 | 3.700 | 76.00 | 27.75 | 459.50 | 21.44 | 0.77 | 9.25 | 24.00 | 32.68 | 73.38 |
| | NW4 | 30 | 1.000 | 119.00 | 20.97 | 690.60 | 26.28 | 1.25 | 5.13 | 9.26 | 18.35 | 107.18 |
| | NW6 | 22 | 0.000 | 374.00 | 86.24 | 9940.00 | 99.70 | 1.16 | 2.05 | 47.86 | 131.04 | 344.52 |
| | NW7 | 31 | 1.000 | 54.00 | 14.23 | 165.10 | 12.85 | 0.90 | 4.23 | 10.89 | 16.55 | 51.84 |
| | NW8 | 26 | 0.800 | 142.00 | 17.24 | 809.10 | 28.44 | 1.65 | 4.09 | 5.95 | 15.22 | 117.15 |
| | SO | 48 | 0.000 | 68.00 | 9.75 | 240.50 | 15.51 | 1.59 | 0.50 | 3.43 | 9.37 | 60.21 |
| | WA | 137 | 0.000 | 669.00 | 37.76 | 8320.00 | 91.22 | 2.42 | 2.00 | 13.00 | 31.00 | 540.13 |
| | WB | 29 | 0.000 | 43.00 | 10.26 | 153.00 | 12.37 | 1.21 | 0.69 | 4.77 | 14.70 | 40.85 |

Table 14-7 (continued)

| Column | Domain | Count | Min | Max | Mean | Variance | St Dev | CV | 25% | 50% | 75% | 99% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cu (%) | ALL | 4,125 | 0.000 | 27.50 | 0.95 | 2.81 | 1.68 | 1.77 | 0.07 | 0.44 | 1.17 | 7.58 |
| | CH1 | 543 | 0.000 | 27.50 | 1.68 | 11.58 | 3.40 | 2.02 | 0.09 | 0.38 | 1.56 | 17.35 |
| | CH2 | 549 | 0.000 | 19.90 | 0.75 | 1.21 | 1.10 | 1.46 | 0.09 | 0.42 | 1.01 | 4.54 |
| | EGI | 1,315 | 0.000 | 8.94 | 0.86 | 1.00 | 1.00 | 1.16 | 0.14 | 0.59 | 1.21 | 4.48 |
| | EGS | 633 | 0.000 | 12.70 | 0.87 | 1.94 | 1.39 | 1.59 | 0.00 | 0.22 | 1.24 | 5.89 |
| | ET | 17 | 0.000 | 7.13 | 2.37 | 3.35 | 1.83 | 0.77 | 0.93 | 2.17 | 2.92 | 6.78 |
| | INC | 358 | 0.000 | 11.75 | 0.77 | 2.06 | 1.43 | 1.87 | 0.07 | 0.27 | 0.78 | 7.18 |
| | NW_ZN2 | 58 | 0.001 | 3.29 | 0.37 | 0.38 | 0.62 | 1.67 | 0.01 | 0.06 | 0.42 | 2.57 |
| | NW_ZN3 | 37 | 0.001 | 0.74 | 0.07 | 0.03 | 0.16 | 2.43 | 0.00 | 0.01 | 0.02 | 0.71 |
| | NW1 | 255 | 0.000 | 5.78 | 0.76 | 0.54 | 0.73 | 0.97 | 0.25 | 0.56 | 1.12 | 3.06 |
| | NW2 | 23 | 0.037 | 2.97 | 1.08 | 0.70 | 0.84 | 0.77 | 0.41 | 0.75 | 1.48 | 2.94 |
| | NW3 | 14 | 0.187 | 6.44 | 1.70 | 3.12 | 1.77 | 1.04 | 0.33 | 1.15 | 1.81 | 6.11 |
| | NW4 | 30 | 0.035 | 2.73 | 0.70 | 0.34 | 0.58 | 0.82 | 0.32 | 0.59 | 0.93 | 2.46 |
| | NW6 | 22 | 0.000 | 3.14 | 1.19 | 0.98 | 0.99 | 0.83 | 0.18 | 0.99 | 1.95 | 3.09 |
| | NW7 | 31 | 0.083 | 3.18 | 0.88 | 0.36 | 0.60 | 0.68 | 0.47 | 0.85 | 1.00 | 2.88 |
| | NW8 | 26 | 0.052 | 3.38 | 0.85 | 0.47 | 0.68 | 0.80 | 0.39 | 0.76 | 0.96 | 2.99 |
| | SO | 48 | 0.000 | 5.75 | 0.42 | 1.36 | 1.17 | 2.77 | 0.01 | 0.02 | 0.16 | 5.67 |
| | WA | 137 | 0.000 | 8.93 | 1.14 | 1.77 | 1.33 | 1.17 | 0.22 | 0.64 | 1.70 | 5.05 |
| | WB | 29 | 0.000 | 7.60 | 0.92 | 1.91 | 1.38 | 1.51 | 0.05 | 0.40 | 1.17 | 6.00 |

| Column | Domain | Count | Min | Max | Mean | Variance | St Dev | CV | 25% | 50% | 75% | 99% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pb (%) | ALL | 4,125 | 0.000 | 3.93 | 0.02 | 0.01 | 0.08 | 4.01 | 0.00 | 0.00 | 0.01 | 0.28 |
| | CH1 | 543 | 0.000 | 1.98 | 0.04 | 0.01 | 0.10 | 2.52 | 0.00 | 0.01 | 0.04 | 0.36 |
| | CH2 | 549 | 0.000 | 3.02 | 0.03 | 0.01 | 0.08 | 2.97 | 0.00 | 0.01 | 0.02 | 0.29 |
| | EGI | 1,315 | 0.000 | 0.54 | 0.01 | 0.00 | 0.04 | 3.74 | 0.00 | 0.00 | 0.00 | 0.17 |
| | EGS | 633 | 0.000 | 0.61 | 0.01 | 0.00 | 0.03 | 2.69 | 0.00 | 0.00 | 0.01 | 0.09 |
| | ET | 17 | 0.000 | 0.05 | 0.01 | 0.00 | 0.01 | 1.18 | 0.00 | 0.01 | 0.01 | 0.04 |
| | INC | 358 | 0.000 | 0.53 | 0.04 | 0.00 | 0.06 | 1.60 | 0.00 | 0.01 | 0.04 | 0.27 |
| | NW_ZN2 | 58 | 0.001 | 3.93 | 0.06 | 0.16 | 0.40 | 6.73 | 0.00 | 0.01 | 0.02 | 0.48 |
| | NW_ZN3 | 37 | 0.000 | 0.04 | 0.01 | 0.00 | 0.01 | 1.20 | 0.00 | 0.00 | 0.01 | 0.03 |
| | NW1 | 255 | 0.000 | 0.05 | 0.00 | 0.00 | 0.01 | 2.27 | 0.00 | 0.00 | 0.00 | 0.03 |
| | NW2 | 23 | 0.000 | 0.13 | 0.01 | 0.00 | 0.02 | 2.85 | 0.00 | 0.00 | 0.01 | 0.09 |
| | NW3 | 14 | 0.001 | 0.01 | 0.00 | 0.00 | 0.00 | 0.71 | 0.00 | 0.00 | 0.01 | 0.01 |
| | NW4 | 30 | 0.000 | 0.03 | 0.01 | 0.00 | 0.01 | 1.26 | 0.00 | 0.00 | 0.01 | 0.03 |
| | NW6 | 22 | 0.000 | 0.03 | 0.00 | 0.00 | 0.01 | 1.62 | 0.00 | 0.00 | 0.00 | 0.03 |
| | NW7 | 31 | 0.000 | 0.01 | 0.00 | 0.00 | 0.00 | 0.96 | 0.00 | 0.00 | 0.00 | 0.01 |
| | NW8 | 26 | 0.000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.79 | 0.00 | 0.00 | 0.00 | 0.00 |
| | SO | 48 | 0.000 | 0.09 | 0.02 | 0.00 | 0.02 | 1.16 | 0.00 | 0.01 | 0.03 | 0.08 |
| | WA | 137 | 0.000 | 0.89 | 0.04 | 0.01 | 0.11 | 2.98 | 0.00 | 0.01 | 0.01 | 0.56 |
| | WB | 29 | 0.000 | 0.27 | 0.02 | 0.00 | 0.06 | 2.35 | 0.00 | 0.00 | 0.01 | 0.24 |

Table 14-7 (continued)

| Column | Domain | Count | Min | Max | Mean | Variance | St Dev | CV | 25% | 50% | 75% | 99% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Zn (%) | ALL | 4,125 | 0.000 | 47.19 | 0.34 | 3.07 | 1.75 | 5.10 | 0.01 | 0.03 | 0.14 | 5.56 |
| | CH1 | 543 | 0.000 | 8.81 | 0.22 | 0.40 | 0.63 | 2.87 | 0.01 | 0.03 | 0.14 | 2.53 |
| | CH2 | 549 | 0.000 | 3.94 | 0.07 | 0.04 | 0.20 | 2.68 | 0.01 | 0.02 | 0.06 | 0.83 |
| | EGI | 1,315 | 0.000 | 25.10 | 0.18 | 1.04 | 1.02 | 5.53 | 0.01 | 0.03 | 0.10 | 3.14 |
| | EGS | 633 | 0.000 | 18.50 | 0.28 | 1.64 | 1.28 | 4.51 | 0.00 | 0.02 | 0.07 | 6.47 |
| | ET | 17 | 0.000 | 0.60 | 0.16 | 0.03 | 0.17 | 1.06 | 0.03 | 0.08 | 0.27 | 0.56 |
| | INC | 358 | 0.004 | 30.00 | 0.58 | 4.07 | 2.02 | 3.48 | 0.03 | 0.16 | 0.45 | 4.75 |
| | NW_ZN2 | 58 | 0.011 | 10.55 | 1.89 | 5.97 | 2.44 | 1.29 | 0.20 | 0.81 | 2.76 | 9.59 |
| | NW_ZN3 | 37 | 0.004 | 5.72 | 1.03 | 1.19 | 1.09 | 1.06 | 0.09 | 0.91 | 1.38 | 4.78 |
| | NW1 | 255 | 0.000 | 6.75 | 0.23 | 0.67 | 0.82 | 3.65 | 0.01 | 0.02 | 0.06 | 5.31 |
| | NW2 | 23 | 0.003 | 0.42 | 0.05 | 0.01 | 0.08 | 1.69 | 0.01 | 0.02 | 0.04 | 0.34 |
| | NW3 | 14 | 0.029 | 1.19 | 0.27 | 0.13 | 0.36 | 1.32 | 0.04 | 0.09 | 0.24 | 1.13 |
| | NW4 | 30 | 0.004 | 2.21 | 0.19 | 0.11 | 0.33 | 1.71 | 0.03 | 0.07 | 0.10 | 1.13 |
| | NW6 | 22 | 0.000 | 1.64 | 0.21 | 0.15 | 0.39 | 1.89 | 0.01 | 0.07 | 0.16 | 1.46 |
| | NW7 | 31 | 0.002 | 0.09 | 0.01 | 0.00 | 0.02 | 1.60 | 0.00 | 0.01 | 0.01 | 0.08 |
| | NW8 | 26 | 0.005 | 2.78 | 0.17 | 0.33 | 0.58 | 3.37 | 0.01 | 0.02 | 0.03 | 2.22 |
| | SO | 48 | 0.000 | 47.19 | 6.37 | 131.20 | 11.45 | 1.80 | 0.67 | 1.58 | 3.84 | 45.98 |
| | WA | 137 | 0.000 | 17.80 | 0.57 | 1.61 | 1.27 | 2.22 | 0.03 | 0.18 | 0.61 | 4.73 |
| | WB | 29 | 0.000 | 3.34 | 0.72 | 0.83 | 0.91 | 1.27 | 0.01 | 0.40 | 0.95 | 3.13 |

Note: Statistics weighted by length, do not include channel samples for EGS.
Source: SRK, 2016

# 14.3 Assay Capping and Compositing

SRK evaluated capping of outlier populations and compositing of variable-length data to minimize variance prior to the estimation as well as obtain a more reasonable approximation of grades during the resource estimation.

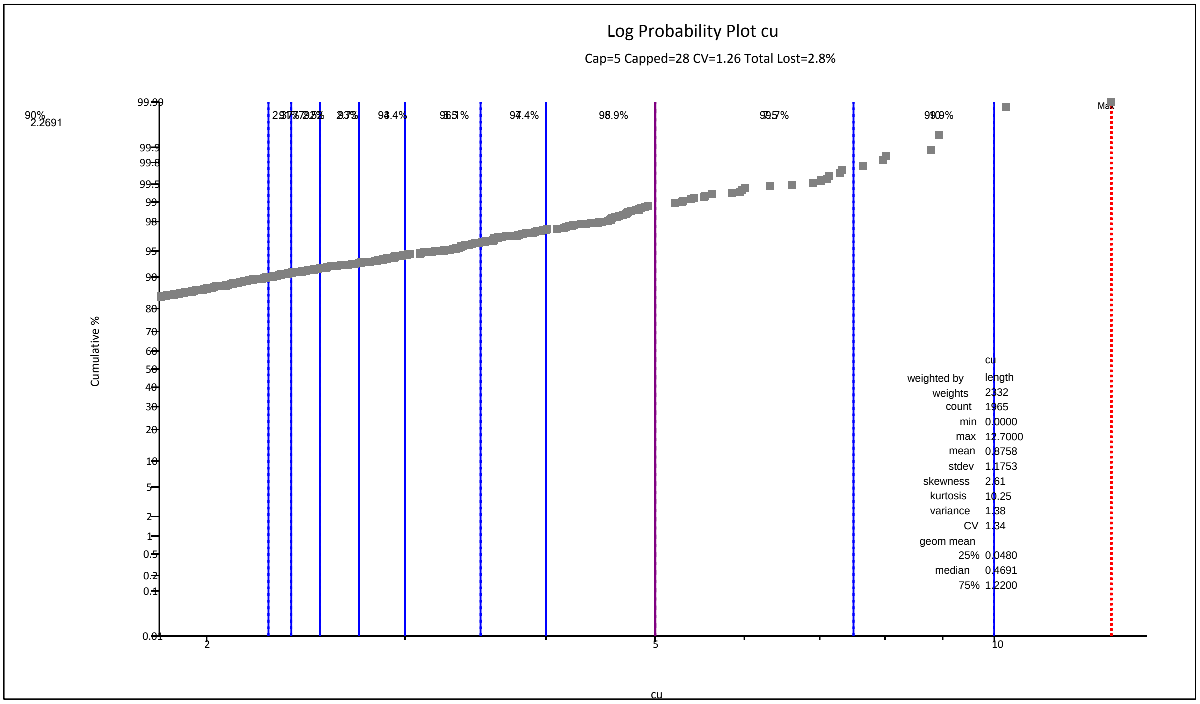
## 14.3.1 Outliers

To assess the potential impact of outlier samples, SRK reviewed grade distribution within mineralized areas consisting of grouped domains, to determine the impact of these samples on the estimates within the general resource areas.

**Bolivar**

For the Bolivar mineralized bodies, SRK evaluated areas of combined domains based on a particular type of mineralization, noting consistencies in form and source of mineralization for each. SRK reviewed the histograms and log probability plots of the data populations from each area to determine outlier samples as those exhibiting a grade that is not consistent with the greater population or would disproportionately influence the estimation. In some cases, the populations were so low grade or consistent that outlier capping was not deemed necessary, although this generally occurred only for Pb or Zn.

Examples of the capping analysis for the El Gallo area (for Cu only) are shown in Figure 14-6 and Table 14-8. The same analysis was conducted for the other areas and elements, and is presented in Appendix B.




Source: SRK, 2016

**Figure 14-6: Cu Log Probability Plot – El Gallo Area**

**Table 14-8: El Gallo Capping Analysis – Cu**

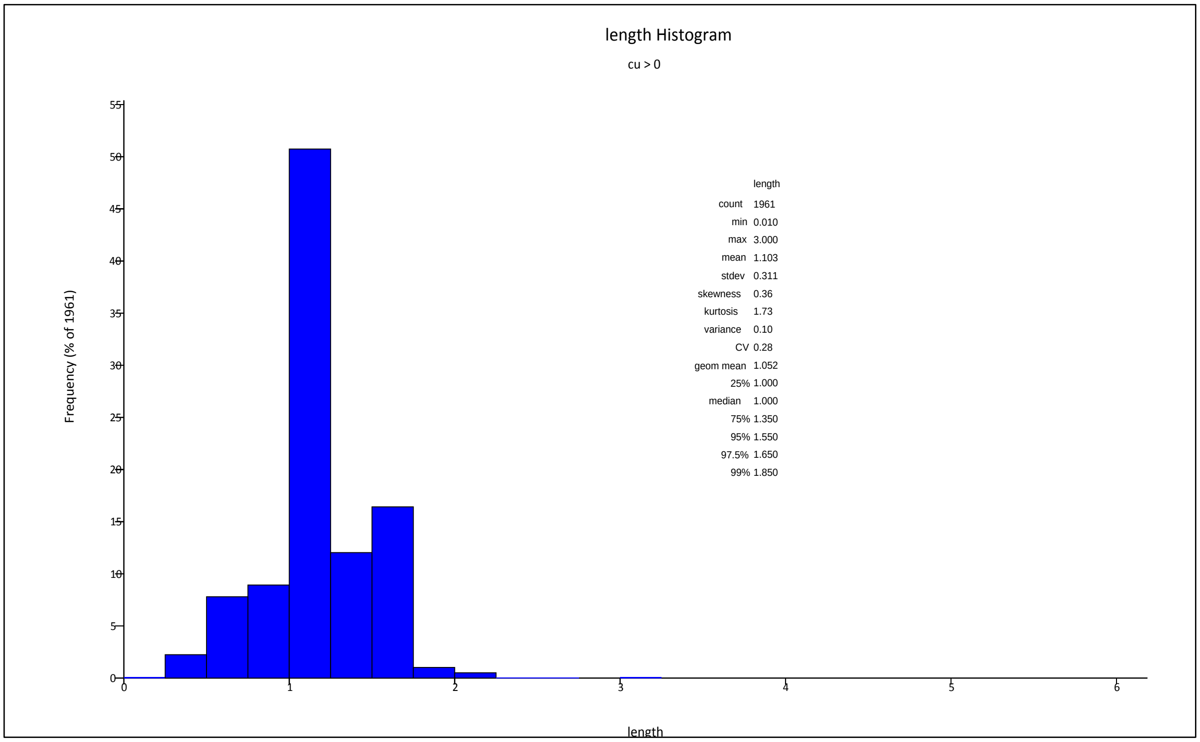
| Column | Cap | Capped Samples | Percentile | Capped % | Lost % | CV % | Mean | Variance | CV |
|---|---|---|---|---|---|---|---|---|---|
| Cu (%) | 10 | 2 | 99.90% | 0.10 | 0.15 | 0.29 | 0.88 | 1.37 | 1.34 |
| | 7.5 | 7 | 99.70% | 0.40 | 0.60 | 1.70 | 0.87 | 1.32 | 1.32 |
| | 5 | 28 | 98.90% | 1.10 | 2.80 | 6.30 | 0.86 | 1.16 | 1.26 |
| | 4 | 62 | 97.40% | 2.60 | 5.10 | 10 | 0.84 | 1.02 | 1.21 |
| | 3.5 | 90 | 96.10% | 4.60 | 7 | 13 | 0.82 | 0.93 | 1.17 |
| | 3 | 127 | 95% | 6.50 | 9.80 | 16 | 0.80 | 0.81 | 1.13 |
| | 2.73 | 156 | 93% | 7.90 | 12 | 18 | 0.78 | 0.74 | 1.10 |
| | 2.52 | 178 | 92% | 9.10 | 14 | 20 | 0.76 | 0.68 | 1.08 |
| | 2.3777 | 201 | 91% | 10.20 | 15 | 21 | 0.75 | 0.64 | 1.06 |
| | 2.2691 | 224 | 90% | 11.40 | 16 | 22 | 0.74 | 0.61 | 1.05 |
| | cu > 5 | | | | | | 6.70 | 2.28 | 0.23 |
| | cu <= 5 | | | | | | 0.81 | 0.97 | 1.22 |

Source: SRK, 2016

## 14.3.2 Compositing

SRK reviewed the sample lengths for all the samples in the database and noted them to be relatively consistent in terms of distribution for the Bolivar deposits. Histograms of the sample lengths for each area are shown in Figure 14-7. Based on this review, SRK notes that a nominal 3 m composite length is an appropriate composite size, especially when considered in the context of minimum mining widths which will range from 3 to 6m depending on the area and deposit type.

Capping was conducted prior to compositing of samples. Short composites were retained, and accounted for in the length-weighting of the statistics as well as the estimation. The channel sample data used in the EGS area has not been composited or capped, as the Cu grades were rather consistent and the contributions for Ag and Au were minimal. The results of the compositing for both the Bolivar areas are presented in Table 14-9, Table 14-10, Table 14-11, Table 14-12, and Table 14-13.




Source: SRK, 2016

**Figure 14-7: Sample Length Histogram – Bolivar**

**Table 14-9: Composite Statistics – El Gallo Area**

| Column | Domain | Count | Min | Max | Mean | Variance | St Dev | CV |
|---|---|---|---|---|---|---|---|---|
| Au | ALL | 886 | 0.00 | 4.42 | 0.20 | 0.16 | 0.40 | 1.98 |
| | 1830 | 6 | 0.01 | 1.44 | 0.77 | 0.31 | 0.55 | 0.72 |
| | EGI | 536 | 0.00 | 2.69 | 0.24 | 0.15 | 0.38 | 1.56 |
| | EGS* | 345 | 0.00 | 4.42 | 0.13 | 0.18 | 0.42 | 3.27 |
| Ag | ALL | 886 | 0.00 | 100.00 | 16.21 | 317.20 | 17.81 | 1.10 |
| | 1830 | 6 | 4.49 | 94.45 | 56.02 | 1,220.00 | 34.93 | 0.62 |
| | EGI | 536 | 0.00 | 100.00 | 14.28 | 191.90 | 13.85 | 0.97 |
| | EGS* | 367 | 0.00 | 100.00 | 18.72 | 466.80 | 21.61 | 1.15 |
| Cu | ALL | 886 | 0.00 | 4.79 | 0.85 | 0.81 | 0.90 | 1.06 |
| | 1830 | 6 | 0.66 | 4.68 | 2.22 | 1.30 | 1.14 | 0.51 |
| | EGI | 536 | 0.00 | 4.24 | 0.82 | 0.56 | 0.75 | 0.91 |
| | EGS* | 1,225 | 0.00 | 20.40 | 1.14 | 1.84 | 1.36 | 1.19 |
| Pb | ALL | 886 | 0.00 | 0.34 | 0.01 | 0.00 | 0.02 | 2.52 |
| | 1830 | 6 | 0.00 | 0.02 | 0.01 | 0.00 | 0.00 | 0.59 |
| | EGI | 536 | 0.00 | 0.34 | 0.01 | 0.00 | 0.03 | 2.93 |
| | EGS* | 1,225 | 0.00 | 25.68 | 0.71 | 6.23 | 2.50 | 3.50 |
| Zn | ALL | 886 | 0.00 | 5.00 | 0.18 | 0.31 | 0.56 | 3.14 |
| | 1830 | 6 | 0.04 | 0.33 | 0.16 | 0.01 | 0.11 | 0.69 |
| | EGI | 536 | 0.00 | 4.45 | 0.15 | 0.19 | 0.44 | 3.00 |
| | EGS* | 483 | 0.00 | 5.00 | 0.18 | 0.40 | 0.63 | 3.45 |

*EGS includes uncomposited channel sample data.
Source: SRK, 2016

**Table 14-10: Composite Statistics – Bolivar Northwest Area**

| Column | Domain | Count | Min | Max | Mean | Variance | St Dev | CV |
|---|---|---|---|---|---|---|---|---|
| Au | ALL | 211 | 0.00 | 3.13 | 0.45 | 0.35 | 0.59 | 1.30 |
| | NW_ZN2 | 26 | 0.00 | 2.70 | 0.34 | 0.30 | 0.55 | 1.60 |
| | NW_ZN3 | 17 | 0.00 | 0.51 | 0.14 | 0.03 | 0.16 | 1.19 |
| | NW1 | 96 | 0.00 | 2.36 | 0.50 | 0.29 | 0.54 | 1.08 |
| | NW2 | 15 | 0.00 | 0.54 | 0.13 | 0.02 | 0.15 | 1.14 |
| | NW3 | 6 | 0.06 | 1.78 | 0.52 | 0.42 | 0.65 | 1.25 |
| | NW4 | 12 | 0.01 | 2.34 | 0.37 | 0.52 | 0.72 | 1.94 |
| | NW6 | 11 | 0.16 | 2.72 | 0.65 | 0.65 | 0.80 | 1.23 |
| | NW7 | 16 | 0.16 | 3.13 | 0.86 | 0.71 | 0.84 | 0.98 |
| | NW8 | 12 | 0.04 | 3.06 | 0.40 | 0.50 | 0.70 | 1.78 |
| Ag | ALL | 211 | 0.00 | 166.35 | 17.12 | 493.70 | 22.22 | 1.30 |
| | NW_ZN2 | 26 | 0.16 | 113.52 | 26.96 | 913.50 | 30.22 | 1.12 |
| | NW_ZN3 | 17 | 0.18 | 30.37 | 7.18 | 84.53 | 9.19 | 1.28 |
| | NW1 | 96 | 0.00 | 34.80 | 9.20 | 78.01 | 8.83 | 0.96 |
| | NW2 | 15 | 0.00 | 59.69 | 22.95 | 294.60 | 17.16 | 0.75 |
| | NW3 | 6 | 4.60 | 57.01 | 27.31 | 309.70 | 17.60 | 0.64 |
| | NW4 | 12 | 3.24 | 72.16 | 20.97 | 390.80 | 19.77 | 0.94 |
| | NW6 | 11 | 24.08 | 166.35 | 73.50 | 1,218.00 | 34.90 | 0.47 |
| | NW7 | 16 | 1.73 | 54.00 | 14.23 | 99.70 | 9.99 | 0.70 |
| | NW8 | 12 | 2.54 | 69.28 | 17.24 | 467.10 | 21.61 | 1.25 |
| Cu | ALL | 211 | 0.00 | 2.78 | 0.71 | 0.31 | 0.56 | 0.79 |
| | NW_ZN2 | 26 | 0.00 | 2.14 | 0.37 | 0.31 | 0.56 | 1.52 |
| | NW_ZN3 | 17 | 0.00 | 0.28 | 0.07 | 0.01 | 0.09 | 1.41 |
| | NW1 | 96 | 0.00 | 2.31 | 0.75 | 0.25 | 0.50 | 0.67 |
| | NW2 | 15 | 0.00 | 1.59 | 0.93 | 0.32 | 0.57 | 0.61 |
| | NW3 | 6 | 0.29 | 2.78 | 1.34 | 0.73 | 0.85 | 0.64 |
| | NW4 | 12 | 0.18 | 1.63 | 0.71 | 0.16 | 0.40 | 0.56 |
| | NW6 | 11 | 0.26 | 1.86 | 1.17 | 0.35 | 0.59 | 0.50 |
| | NW7 | 16 | 0.39 | 2.36 | 0.87 | 0.18 | 0.43 | 0.49 |
| | NW8 | 12 | 0.12 | 1.54 | 0.84 | 0.20 | 0.45 | 0.53 |
| Pb | ALL | 211 | 0.00 | 0.27 | 0.01 | 0.00 | 0.02 | 3.41 |
| | NW_ZN2 | 26 | 0.00 | 0.27 | 0.03 | 0.00 | 0.06 | 1.95 |
| | NW_ZN3 | 17 | 0.00 | 0.02 | 0.01 | 0.00 | 0.01 | 0.74 |
| | NW1 | 96 | 0.00 | 0.03 | 0.00 | 0.00 | 0.00 | 1.76 |
| | NW2 | 15 | 0.00 | 0.06 | 0.01 | 0.00 | 0.01 | 1.97 |
| | NW3 | 6 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.27 |
| | NW4 | 12 | 0.00 | 0.02 | 0.01 | 0.00 | 0.00 | 0.85 |
| | NW6 | 11 | 0.00 | 0.02 | 0.00 | 0.00 | 0.01 | 1.17 |
| | NW7 | 16 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.84 |
| | NW8 | 12 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.68 |
| Zn | ALL | 211 | 0.00 | 4.56 | 0.44 | 0.77 | 0.88 | 1.99 |
| | NW_ZN2 | 26 | 0.02 | 4.56 | 1.68 | 2.14 | 1.46 | 0.87 |
| | NW_ZN3 | 17 | 0.12 | 2.32 | 1.02 | 0.34 | 0.59 | 0.57 |
| | NW1 | 96 | 0.00 | 3.40 | 0.22 | 0.38 | 0.62 | 2.83 |
| | NW2 | 15 | 0.00 | 0.22 | 0.04 | 0.00 | 0.05 | 1.33 |
| | NW3 | 6 | 0.04 | 0.65 | 0.28 | 0.08 | 0.28 | 1.03 |
| | NW4 | 12 | 0.03 | 0.64 | 0.19 | 0.04 | 0.19 | 0.99 |
| | NW6 | 11 | 0.01 | 1.26 | 0.21 | 0.09 | 0.30 | 1.43 |
| | NW7 | 16 | 0.00 | 0.09 | 0.01 | 0.00 | 0.02 | 1.49 |
| | NW8 | 12 | 0.01 | 1.47 | 0.17 | 0.18 | 0.42 | 2.49 |

Source: SRK, 2016

**Table 14-11: Composite Statistics – Chimeneas Area**

| Column | Domain | Count | Min | Max | Mean | Variance | St Dev | CV |
|---|---|---|---|---|---|---|---|---|
| Au | ALL | 452 | 0.00 | 1.22 | 0.02 | 0.01 | 0.07 | 3.40 |
| | CH1 | 232 | 0.00 | 0.22 | 0.02 | 0.00 | 0.02 | 1.63 |
| | CH2 | 220 | 0.00 | 1.22 | 0.03 | 0.01 | 0.10 | 3.54 |
| Ag | ALL | 452 | 0.00 | 298.40 | 27.67 | 2,383.00 | 48.81 | 1.76 |
| | CH1 | 232 | 0.00 | 285.10 | 36.10 | 3,355.00 | 57.92 | 1.60 |
| | CH2 | 220 | 0.00 | 298.40 | 18.86 | 1,223.00 | 34.97 | 1.85 |
| Cu | ALL | 452 | 0.00 | 15.86 | 1.17 | 3.98 | 1.99 | 1.71 |
| | CH1 | 232 | 0.00 | 15.86 | 1.59 | 7.03 | 2.65 | 1.67 |
| | CH2 | 220 | 0.00 | 4.16 | 0.73 | 0.41 | 0.64 | 0.88 |
| Pb | ALL | 452 | 0.00 | 0.76 | 0.03 | 0.00 | 0.07 | 1.92 |
| | CH1 | 232 | 0.00 | 0.76 | 0.04 | 0.01 | 0.08 | 1.91 |
| | CH2 | 220 | 0.00 | 0.34 | 0.03 | 0.00 | 0.05 | 1.76 |
| Zn | ALL | 452 | 0.00 | 2.00 | 0.13 | 0.07 | 0.27 | 2.06 |
| | CH1 | 232 | 0.00 | 2.00 | 0.19 | 0.12 | 0.35 | 1.87 |
| | CH2 | 220 | 0.00 | 0.57 | 0.07 | 0.01 | 0.11 | 1.50 |

Source: SRK, 2016

**Table 14-12: Composite Statistics – Bolivar West**

| Column | Domain | Count | Min | Max | Mean | Variance | St Dev | CV |
|---|---|---|---|---|---|---|---|---|
| Au | ALL | 8 | 0.03 | 0.45 | 0.09 | 0.02 | 0.13 | 1.50 |
| | WA | 7 | 0.03 | 0.45 | 0.09 | 0.02 | 0.14 | 1.54 |
| | WB | 1 | 0.07 | 0.07 | 0.07 | 0.00 | 0.00 | 0.00 |
| Ag | ALL | 69 | 0.53 | 188.40 | 28.86 | 1,206.00 | 34.72 | 1.20 |
| | WA | 57 | 0.53 | 188.40 | 31.85 | 1,360.00 | 36.88 | 1.16 |
| | WB | 12 | 0.69 | 28.85 | 12.67 | 85.28 | 9.24 | 0.73 |
| Cu | ALL | 69 | 0.06 | 3.44 | 1.11 | 0.68 | 0.83 | 0.74 |
| | WA | 57 | 0.06 | 3.44 | 1.12 | 0.72 | 0.85 | 0.76 |
| | WB | 12 | 0.06 | 2.70 | 1.07 | 0.50 | 0.71 | 0.66 |
| Pb | ALL | 69 | 0.00 | 0.30 | 0.04 | 0.00 | 0.07 | 1.90 |
| | WA | 57 | 0.00 | 0.30 | 0.04 | 0.00 | 0.07 | 1.91 |
| | WB | 12 | 0.00 | 0.19 | 0.03 | 0.00 | 0.06 | 1.88 |
| Zn | ALL | 69 | 0.00 | 6.17 | 0.62 | 0.70 | 0.84 | 1.34 |
| | WA | 57 | 0.00 | 6.17 | 0.57 | 0.74 | 0.86 | 1.50 |
| | WB | 12 | 0.01 | 2.01 | 0.89 | 0.45 | 0.68 | 0.76 |

Source: SRK, 2016

**Table 14-13: Composite Statistics – Increíble Area**

| Column | Domain | Count | Min | Max | Mean | Variance | St Dev | CV |
|---|---|---|---|---|---|---|---|---|
| Au | ALL | 168 | 0.00 | 1.57 | 0.02 | 0.02 | 0.13 | 5.86 |
| | INC | 129 | 0.00 | 1.57 | 0.03 | 0.02 | 0.14 | 5.62 |
| | SO | 39 | 0.00 | 0.09 | 0.01 | 0.00 | 0.02 | 2.29 |
| Ag | ALL | 168 | 0.00 | 77.89 | 12.60 | 259.50 | 16.11 | 1.28 |
| | INC | 129 | 0.00 | 77.89 | 14.72 | 281.90 | 16.79 | 1.14 |
| | SO | 39 | 0.00 | 64.79 | 4.95 | 107.40 | 10.36 | 2.09 |
| Cu | ALL | 168 | 0.00 | 3.95 | 0.57 | 0.56 | 0.75 | 1.32 |
| | INC | 129 | 0.00 | 3.55 | 0.67 | 0.54 | 0.74 | 1.10 |
| | SO | 39 | 0.00 | 3.95 | 0.20 | 0.48 | 0.69 | 3.44 |
| Pb | ALL | 168 | 0.00 | 0.36 | 0.03 | 0.00 | 0.04 | 1.54 |
| | INC | 129 | 0.00 | 0.36 | 0.03 | 0.00 | 0.05 | 1.40 |
| | SO | 39 | 0.00 | 0.07 | 0.01 | 0.00 | 0.01 | 1.58 |
| Zn | ALL | 168 | 0.00 | 9.99 | 0.74 | 2.28 | 1.51 | 2.04 |
| | INC | 129 | 0.00 | 6.74 | 0.48 | 0.72 | 0.85 | 1.78 |
| | SO | 39 | 0.00 | 9.99 | 1.70 | 6.89 | 2.63 | 1.55 |

Source: SRK, 2016

## 14.4 Density

Density measurements have been taken at Bolivar from both drill core and hand samples from the underground workings.

In the case of both, density has been assessed via the standard immersion method, measuring the mass of the sample in air and then water, and taking the difference between the two. SRK notes that this method is reasonable. In addition, Bolivar has data from ongoing production supporting an average density of material through the plant that generally fluctuates around 3.7 g/cm$^3$.

The samples from drill core do not feature corresponding lithologies or mineralized bodies that allow for correlation, but SRK has plotted them in the context of the geologic model. Unfortunately, the majority have been taken from areas in the older Bolivar mine areas, which are not modeled for the purposes of this updated MRE. There are 343 samples from these areas, with an average density of 3.44 g/cm$^3$. Considering only those samples where Cu >0.5%, the average density increases to 3.64 g/cm$^3$. Given this general agreement with the average 3.7 g/cm$^3$ density determined by the plant, SRK finds it reasonable to assume that the mineralized areas in Bolivar share this density. SRK notes that the actual density is likely variable, as densities from the drill core vary between 1.5 and 4.5 g/cm$^3$.

For other lithologies in the area, SRK does not have corresponding density measurements provided by Dia Bras. For the other areas, SRK has assigned densities based on published density measurements as well as SRK internal data for corresponding rock types from similar projects. The density assigned to the various lithologies and mineralization types is summarized in Table 14-14.

SRK notes that the absence of density data for the surrounding areas are significant considerations in the lack of a Measured classification for the Bolivar Mineral Resources.

**Table 14-14: Densities by Lithology**

| Lithology | Density (g/cm$^3$) |
|---|---|
| Granodiorite | 2.68 |
| Andesite | 2.57 |
| Hornfels | 2.80 |
| Marble | 2.72 |
| Skarn | 3.26 |
| Mineralized Skarn | 3.70 |
| Rhyolite | 2.20 |
| Vein | 2.70 |

Source: SRK, 2016

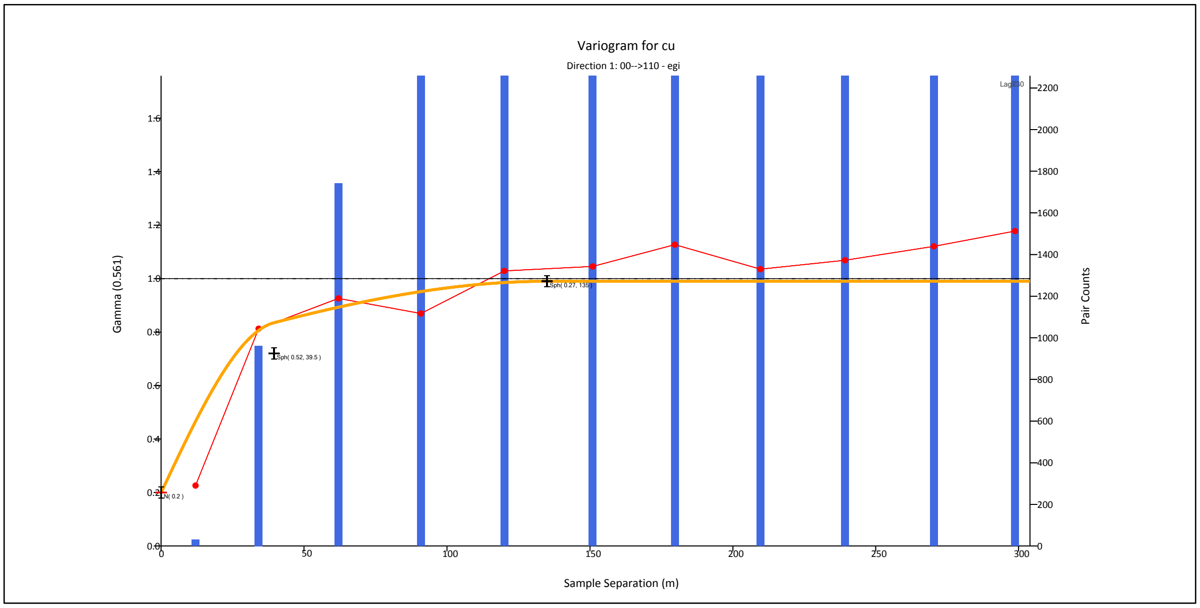
## 14.5 Variogram Analysis and Modeling

Using the capped and composited data, SRK reviewed the sample continuity within the El Gallo orebodies as well as the La Sidra vein. Other orebodies did not feature sufficient samples or continuity to generate reasonable variograms for modeling continuity. In addition, many of the mineralized areas feature high variances (even after capping and compositing) which made modeling of the variograms very difficult or impossible.

### 14.5.1 El Gallo Inferior (Bolivar Areas)

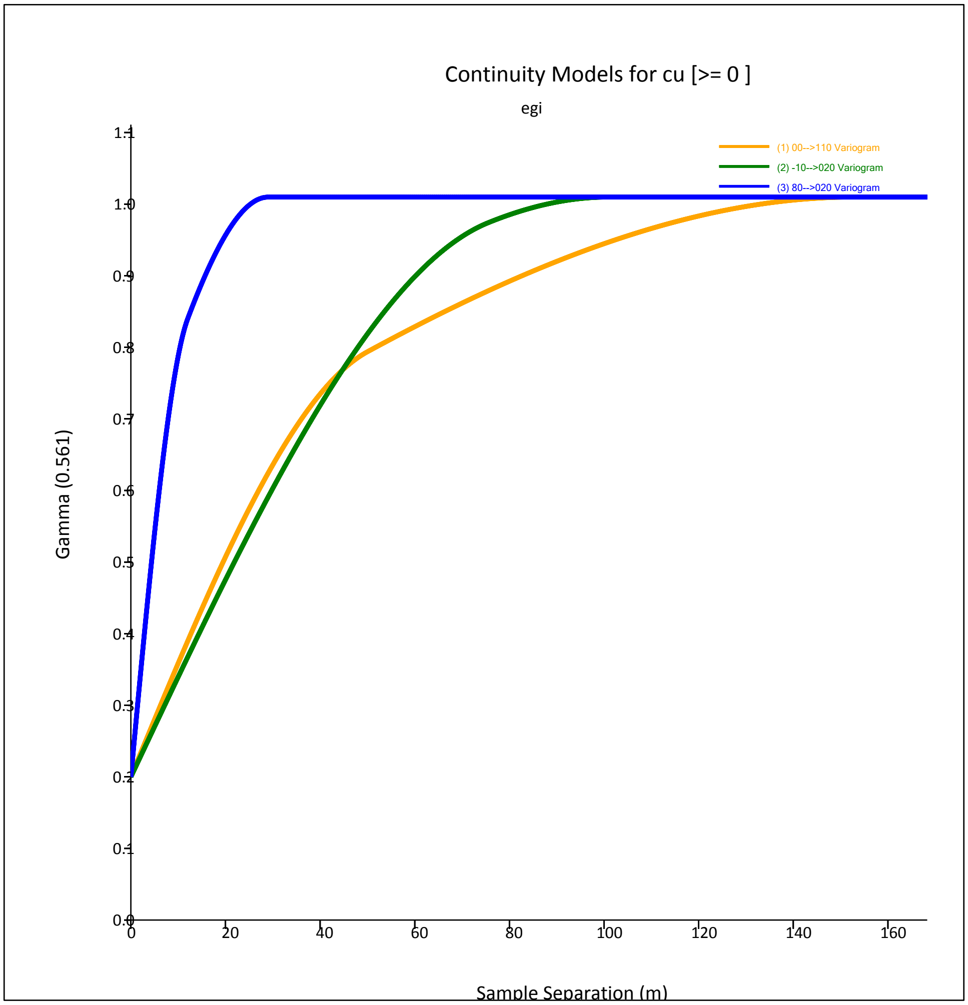
First, SRK modeled multiple directional variograms in 10° increments to generate continuity models within horizontal, along strike, and dip plane continuities for Cu, Au, and Ag in the El Gallo Inferior (EGI) area and Au and Ag in the La Sidra area. Counts of modeled variogram points below the sill for each variogram are used to flag the highest continuities in each direction by calculating a ratio of these points below the sill to the total number of points in the range of the variogram. After a direction of continuity in each plane is modeled, a variogram for the down-hole samples is modeled to determine the nugget effect to be used on modeling the other variograms. Finally, the directional variograms are calculated and modeled, yielding three variograms with a consistent continuity model. In the case of EGI, this model results in a flattened ellipsoid oriented roughly in the orientation of the orebody. The continuity model is shown in Figure 14-9. The same methodology was applied for both Au and Ag, and Pb and Zn were not modeled, as continuities are assumed to be related to the Cu mineralization.

Ranges for the Cu variograms are between about 150 m in the major orientation (along strike) to less than 20 m in the minor orientation (hanging wall to footwall). Given that EGI is the only area within the Bolivar area with sufficient sample density to produce reasonable variograms, SRK elected to use ordinary kriging for this area only, but relied on the continuity models calculated for this representative orebody to provide reasonable ranges of interpolation for the other Bolivar mineralized areas.



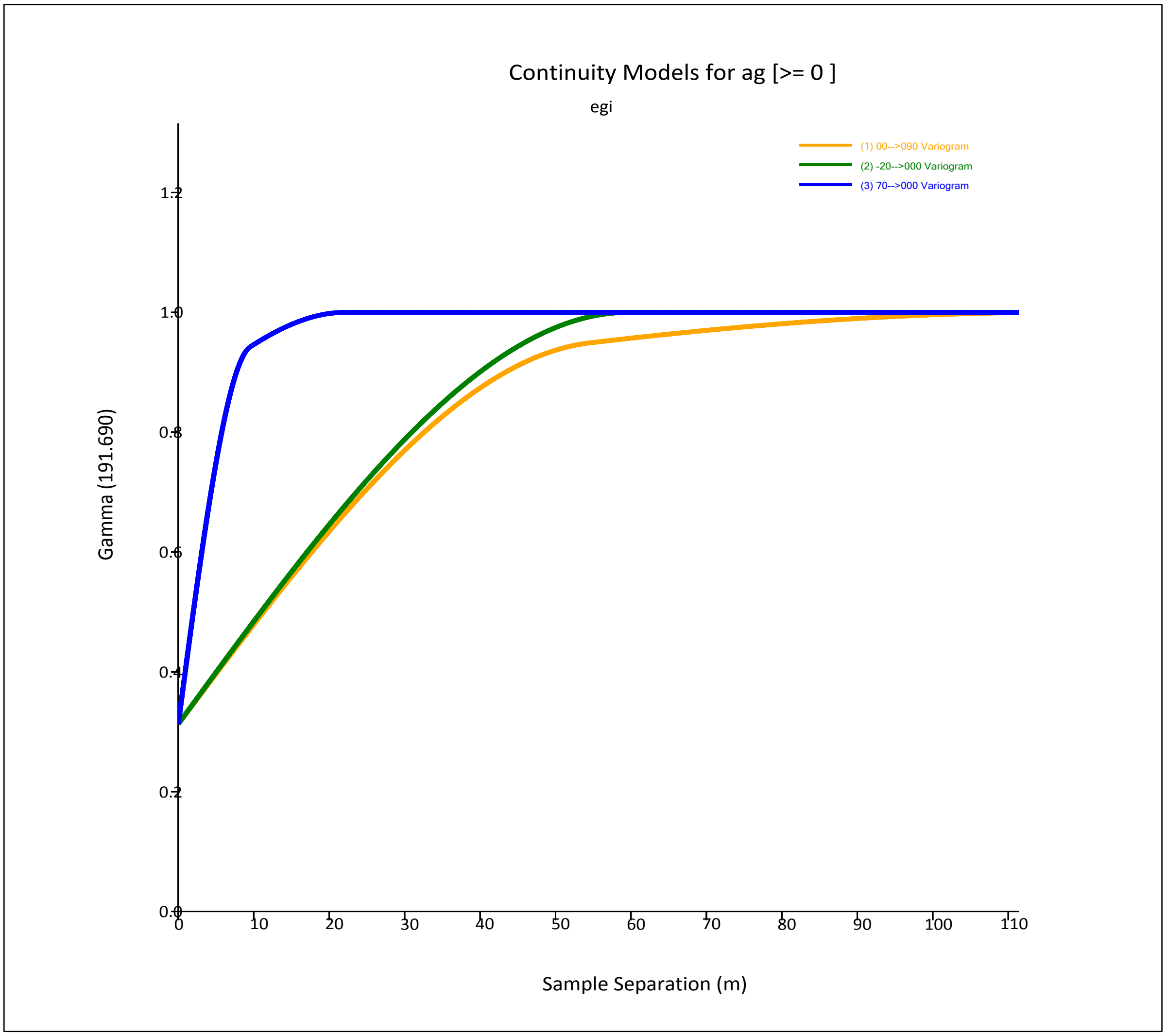

Source: SRK, 2016

**Figure 14-8: EGI Directional Variogram Model – Cu 110° Azimuth**



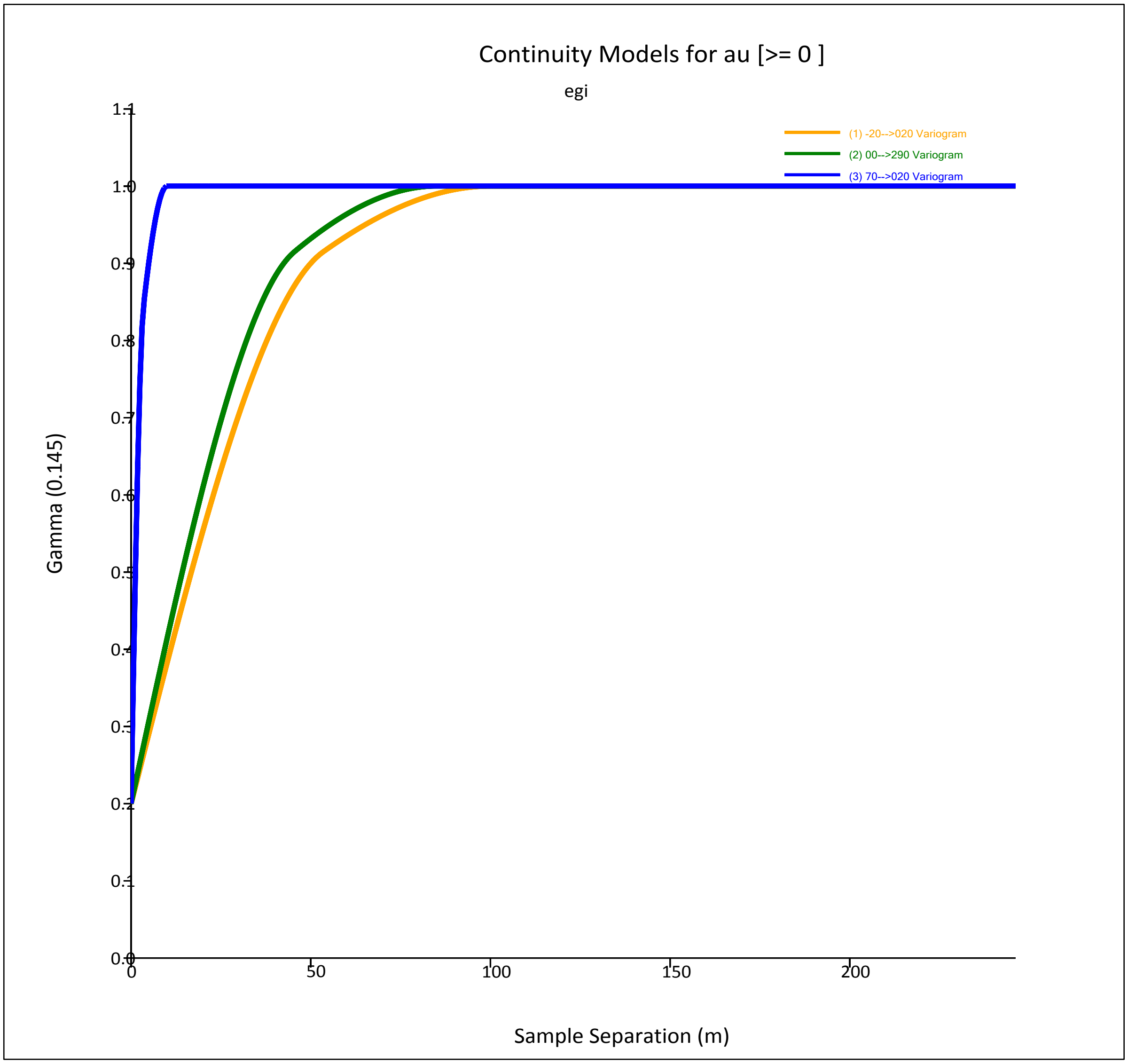

Source: SRK, 2016
Note: Directional variogram models superimposed onto a single graph.

**Figure 14-9: EGI Complete Variogram Models - Cu**




Source: SRK, 2016
Note: Directional variogram models superimposed onto a single graph.

**Figure 14-10: EGI Complete Variogram Models – Ag**




Source: SRK, 2016
Note: Directional variogram models superimposed onto a single graph.

**Figure 14-11: EGI Complete Variogram Models – Au**

The results of the variogram analysis are used as inputs for the ordinary kriging algorithm used in the EGI grade estimation. Again, the parameters for Cu have been utilized for the estimation of Pb and Zn as well, as the mineralization is spatially related and modeling of Pb and Zn variograms was not critical due to the limited importance of these elements to the economics of the project. The variogram models and kriging parameters for Cu, Au, and Ag were used in the estimation for EGI in Vulcan™ 3D Mining software, and are summarized in Table 14-15.

**Table 14-15: EGI Variogram Models**

| Column | Nugget | Str 1 Sill | Orientation | Bearing | Dip | Str 1 Range (m) | | Str 2 Sill | Str 2 Range (m) | |
|---|---|---|---|---|---|---|---|---|---|---|
| Cu (%) | 0.2 | 0.49 | Major | 110 | 0 | X | 50 | 0.4 | X | 153 |
| | | | Semi-Major | 20 | -20 | Y | 75.5 | | Y | 101 |
| | | | Minor | 20 | 80 | Z | 12 | | Z | 29 |
| Ag (g/t) | 0.31 | 0.54 | Major | 90 | 0 | X | 55 | 0.15 | X | 100 |
| | | | Semi-Major | 0 | -20 | Y | 60 | | Y | 60 |
| | | | Minor | 0 | 70 | Z | 10 | | Z | 20 |
| Au (g/t) | 0.2 | 0.49 | Major | 290 | 0 | X | 54 | 0.31 | X | 100 |
| | | | Semi-Major | 20 | -20 | Y | 45 | | Y | 85 |
| | | | Minor | 20 | 70 | Z | 5 | | Z | 10 |

Source: SRK, 2016

# 14.6 Block Model

SRK constructed two block models for the Bolivar areas in Vulcan™ 3D Mining software. Sub-blocking was used to better define geologic contacts and eliminate the need for partial percent calculations in larger blocks. Blocks have been sub-blocked and flagged by lithologies and mineralized bodies, as well as topography and for mined out volumes.

SRK built a separate block model for the EGS area to focus on reporting the resource from the pillars in that area. This model is constructed of generally smaller block sizes to account for the presence of the closely-spaced channel sample data, as well as the dimensions of the pillars.

A summary of the block models' designs are shown in Table 14-16 and Table 14-17.

**Table 14-16: Bolivar (EGI) Block Model Parameters**

| Bolivar | X | Y | Z |
|---|---|---|---|
| Origin | 9100 | 9200 | 1330 |
| Extents | 11140 | 10568 | 2194 |
| Block Min (m) | 1 | 1 | 1 |
| Block Max (m) | 24 | 24 | 12 |

Note: Sub-blocks are limited to a maximum of 6 m x 6 m x 6 m within the mineralized bodies.
Source: SRK, 2016

**Table 14-17: EGS Pillars Block Model Parameters**

| EGS Pillars | X | Y | Z |
|---|---|---|---|
| Origin | 10120 | 9270 | 1742 |
| Extents | 10678 | 9588 | 1946 |
| Block Min (m) | 1 | 1 | 1 |
| Block Max (m) | 3 | 3 | 3 |

Source: SRK, 2016

# 14.7 Estimation Methodology

SRK used the capped and composited data within the individual mineralized domains to interpolate grades for Ag, Au, Cu, Pb, and Zn into the block models. The individual mineralization domains listed above in Section 14.2.2were used as hard boundaries, with the samples within each domain being used to only estimate blocks within the same. With the exception of the EGI orebody, an inverse distance squared (ID2) method was used to interpolate grade. EGI used an ordinary kriging (OK) method based on the variograms modeled in that area.

A three-pass nested search was utilized for each area, with dimensions of the search ellipsoid increasing in each pass. Search ranges for the ellipsoids are generally based on the EGI variogram ranges, and SRK notes that a nominal 75 m range in the second pass is consistent with approximately 50% of the maximum variogram range. The initial shorter range estimation pass is designed to estimate blocks that may be considered as higher confidence resources if the quality of the supporting data and information could be improved. The search ellipsoid was oriented parallel to the strike and dip of the mineralization, and had a flattened shape to approximate the tabular nature of mineralization.

In cases where the orientation or thicknesses of the mineralized areas are variable, such as EGI, directional search anisotropy has been used in the estimate to vary the orientation of the search ellipsoid as a function of the orientation of hangingwall and footwall surfaces bounding mineralization. Each block utilizes the distance of that block between the bounding surfaces, and varies the thickness of the ellipsoid and its orientation as a weighted average of the orientation of the surfaces closest to the block. The vertical thickness of the ellipsoid is defined by the estimation parameters as a percentage of the total thickness between the two surfaces at any given point. This allows the estimation to be informed by the variable geometry of the mineralization solids, which is reasonable and consistent with observations from the existing mining operations as well as common knowledge for this type of mineralization

The effect is most pronounced in deposits where the location of the hanging wall or footwall is known to control the distribution of grade, with higher grades locally being associated with a specific upper or lower contact in the mineralized body. Rather than truncating these grades by using a single ellipsoid (or even several) this method effectively “unfolds” these contacts, allowing grades to be interpolated along them.

Exceptions to the general estimation methodology are as follows:

- An additional, first estimation pass was utilized in EGS, using only the channel samples to estimate blocks within an approximate 5 m radius. This was done to better estimate the grade in the pillar areas where the channel samples exist. Channel samples were not composited. Rather, a nominal 2 m length is assigned based on information from the CAD drawings. They also were left uncapped since analysis of the channels did not show that capping was required for the Cu assays, and Au and Ag were generally not analyzed for the channel sample data.
- Single ellipsoid orientations are adequate for the Bolivar Northwest (BNW) area, as the mineralized bodies are relatively consistent in thickness and orientation.

The estimations were refined over an iterative process of evaluating the results, validating them, and modifying parameters to obtain a model that accurately represents the mineralization and is statistically valid when compared to the input data supporting the estimation. The specific details for the estimation parameters for each area are summarized in Table 14-18 through Table 14-24.

### Table 14-18: Estimation Parameters - EGI

| EGI | Ordinary Kriging | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Pass | Bearing (Z) | Plunge (Y)* | Dip (X)* | Major | Semi-Major | Minor** | Min | Max | Max/DH |
| 1 | NA | NA | NA | 25 | 25 | 20% | 3 | 10 | 2 |
| 2 | | | | 75 | 75 | 20% | 3 | 10 | 2 |
| 3 | | | | 200 | 200 | 40% | 3 | 10 | 2 |

* Controlled by DA/unfolding using fault block-specific hangingwall and footwall surfaces.
* Minor axis relative to the total distance btw hangingwall and footwall.
Source: SRK, 2016

### Table 14-19: Estimation Parameters – EGS

| EGS | ID2 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Pass | Bearing (Z) | Plunge (Y)* | Dip (X)* | Major | Semi-Major | Minor** | Min | Max | Max/DH |
| Local | 0 | -32 | 0 | 5 | 5 | 2.5 | 1 | 10 | NA |
| 1 | NA | NA | NA | 25 | 25 | 20% | 3 | 10 | 2 |
| 2 | | | | 75 | 75 | 20% | 3 | 10 | 2 |
| 3 | | | | 200 | 200 | 40% | 3 | 10 | 2 |

* Controlled by DA/unfolding using fault block-specific hangingwall and footwall surfaces.
* Minor axis relative to the total distance btw hangingwall and footwall.
Source: SRK, 2016

### Table 14-20: Estimation Parameters – Bolivar NW

| BNW | ID2 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Area | Pass | Bearing (Z) | Plunge (Y) | Dip (X) | Major | Semi-Major | Minor | Min | Max | Max/DH |
| NW1 | 1 | 350 | -34 | -15 | 25 | 25 | 5 | 3 | 10 | 2 |
| | 2 | | | | 75 | 75 | 10 | 3 | 10 | 2 |
| | 3 | | | | 200 | 200 | 20 | 3 | 10 | 2 |
| NW2 | 1 | 338 | -16 | -20 | 25 | 25 | 5 | 3 | 10 | 2 |
| | 2 | | | | 75 | 75 | 10 | 3 | 10 | 2 |
| | 3 | | | | 200 | 200 | 20 | 3 | 10 | 2 |
| NW3 | 1 | 90 | 0 | 0 | 25 | 25 | 5 | 3 | 10 | 2 |
| | 2 | | | | 75 | 75 | 10 | 3 | 10 | 2 |
| | 3 | | | | 200 | 200 | 20 | 3 | 10 | 2 |
| NW4 | 1 | 45 | -41 | 5 | 25 | 25 | 5 | 3 | 10 | 2 |
| | 2 | | | | 75 | 75 | 10 | 3 | 10 | 2 |
| | 3 | | | | 200 | 200 | 20 | 3 | 10 | 2 |
| NW6 | 1 | 20 | 7 | 15 | 25 | 25 | 5 | 3 | 10 | 2 |
| | 2 | | | | 75 | 75 | 10 | 3 | 10 | 2 |
| | 3 | | | | 200 | 200 | 20 | 3 | 10 | 2 |
| NW7 | 1 | 160 | 14 | -10 | 25 | 25 | 5 | 3 | 10 | 2 |
| | 2 | | | | 75 | 75 | 10 | 3 | 10 | 2 |
| | 3 | | | | 200 | 200 | 20 | 3 | 10 | 2 |
| NW8 | 1 | 312 | -15 | -30 | 25 | 25 | 5 | 3 | 10 | 2 |
| | 2 | | | | 75 | 75 | 10 | 3 | 10 | 2 |
| | 3 | | | | 200 | 200 | 20 | 3 | 10 | 2 |
| NW_ZN2 | 1 | 356 | -25 | 5 | 25 | 25 | 5 | 3 | 10 | 2 |
| | 2 | | | | 75 | 75 | 10 | 3 | 10 | 2 |
| | 3 | | | | 200 | 200 | 20 | 3 | 10 | 2 |
| NW_ZN3 | 1 | 43 | 9 | -15 | 25 | 25 | 5 | 3 | 10 | 2 |
| | 2 | | | | 75 | 75 | 10 | 3 | 10 | 2 |
| | 3 | | | | 200 | 200 | 20 | 3 | 10 | 2 |

Source: SRK, 2016

### Table 14-21: Estimation Parameters - CHIM

| CHIM | ID2 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Pass | Bearing (Z) | Plunge (Y) | Dip (X) | Major | Semi-Major | Minor | Min | Max | Max/DH |
| 1 | 0 | 0 | 0 | 25 | 25 | 25 | 5 | 10 | 2 |
| 2 | | | | 75 | 75 | 50 | 3 | 10 | 2 |
| 3 | | | | 200 | 200 | 200 | 3 | 10 | 2 |

Source: SRK, 2016

**Table 14-22: Estimation Parameters - BW**

| BW | ID2 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Pass | Bearing (Z) | Plunge (Y)* | Dip (X)* | Major | Semi-Major | Minor** | Min | Max | Max/DH |
| 1 | NA | NA | NA | 25 | 25 | 40% | 3 | 10 | 2 |
| 2 | | | | 75 | 75 | 40% | 3 | 10 | 2 |
| 3 | | | | 200 | 200 | 40% | 1 | 10 | NA |

* Controlled by DA/unfolding using fault block-specific hangingwall and footwall surfaces.
* Minor axis relative to the total distance btw hangingwall and footwall.
Source: SRK, 2016

**Table 14-23: Estimation Parameters - INC**

| INC | ID2 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Area | Pass | Bearing (Z) | Plunge (Y) | Dip (X) | Major | Semi-Major | Minor | Min | Max | Max/DH |
| INC | 1 | 214 | -53 | 50 | 25 | 25 | 5 | 3 | 10 | 2 |
| | 2 | | | | 75 | 75 | 10 | 3 | 10 | 2 |
| | 3 | | | | 200 | 200 | 15 | 1 | 10 | NA |
| SO | 1 | 0 | 0 | 0 | 25 | 25 | 25 | 3 | 10 | 2 |
| | 2 | | | | 75 | 75 | 50 | 3 | 10 | 2 |
| | 3 | | | | 200 | 200 | 200 | 1 | 10 | NA |

Source: SRK, 2016

**Table 14-24: Estimation Parameters - 1830**

| 1830 | ID2 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Area | Pass | Bearing (Z) | Plunge (Y) | Dip (X) | Major | Semi-Major | Minor | Min | Max | Max/DH |
| 1830 | 1 | 45 | -22 | 0 | 25 | 25 | 5 | 3 | 10 | 2 |
| | 2 | | | | 75 | 75 | 10 | 3 | 10 | 2 |
| | 3 | | | | 200 | 200 | 15 | 1 | 10 | NA |

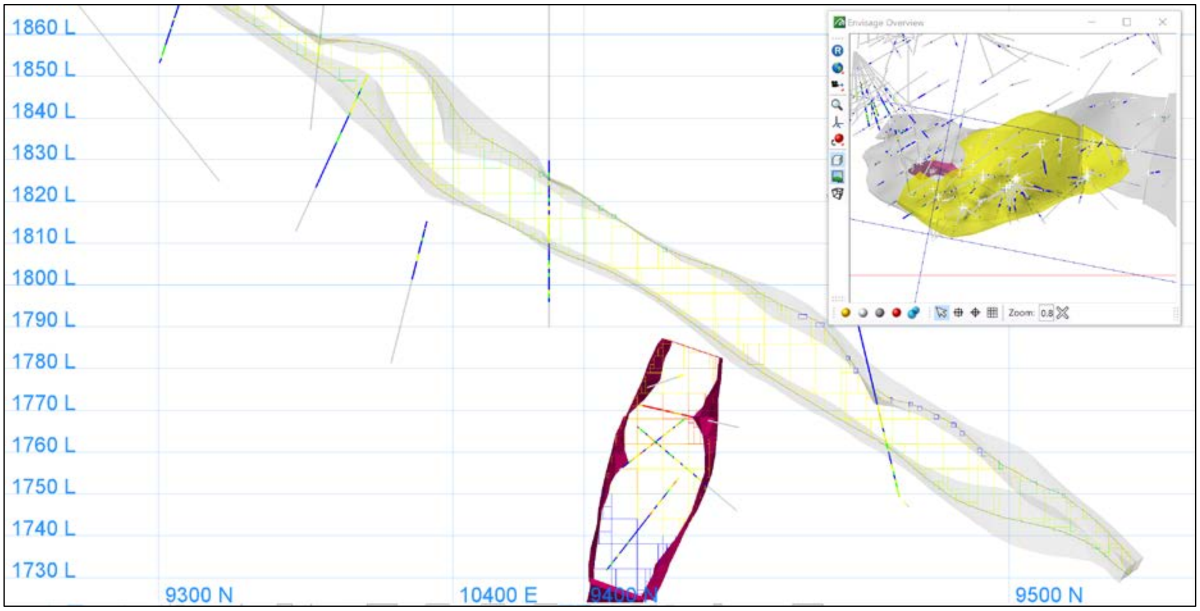
Source: SRK, 2016

## 14.8 Model Validation

SRK validated the resulting block models and estimations using three primary means; visual comparison, statistical comparison, and swath plots.

### 14.8.1 Visual Comparison

A visual comparison of the blocks to the composite grades for the various elements was conducted to review the distribution of grade and assess geologic reasonableness of the model. This comparison was conducted both in section and level plan maps. SRK is of the opinion that the visual comparison for both the Bolivar and La Sidra areas is reasonable and appropriate for the deposit types. Examples of this comparison are shown in Figure 14-12.

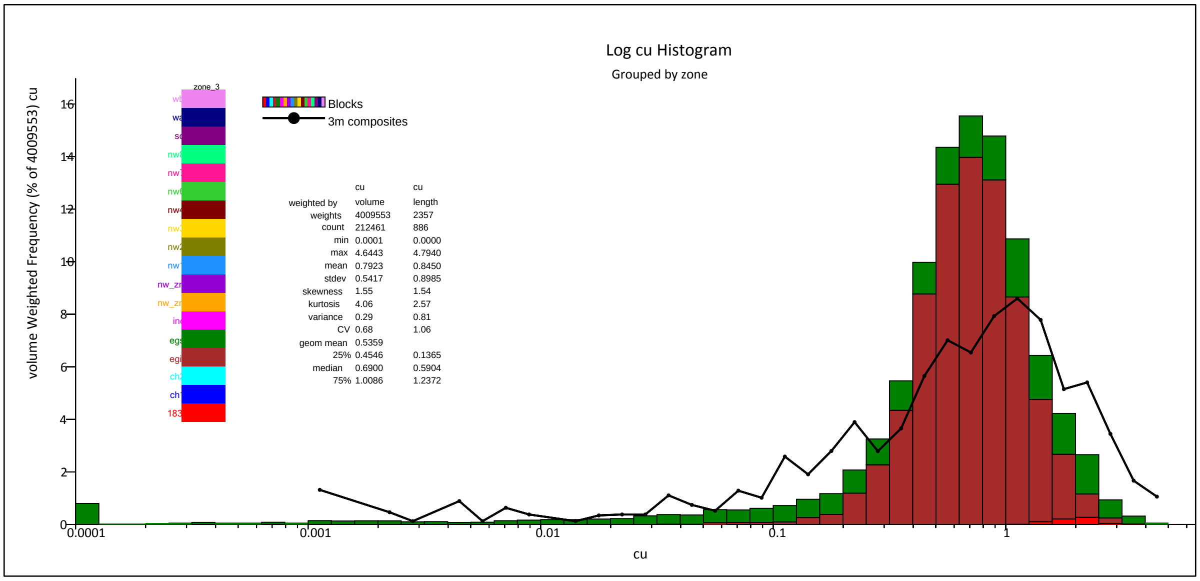



Source: SRK

**Figure 14-12: Bolivar Visual Comparison**

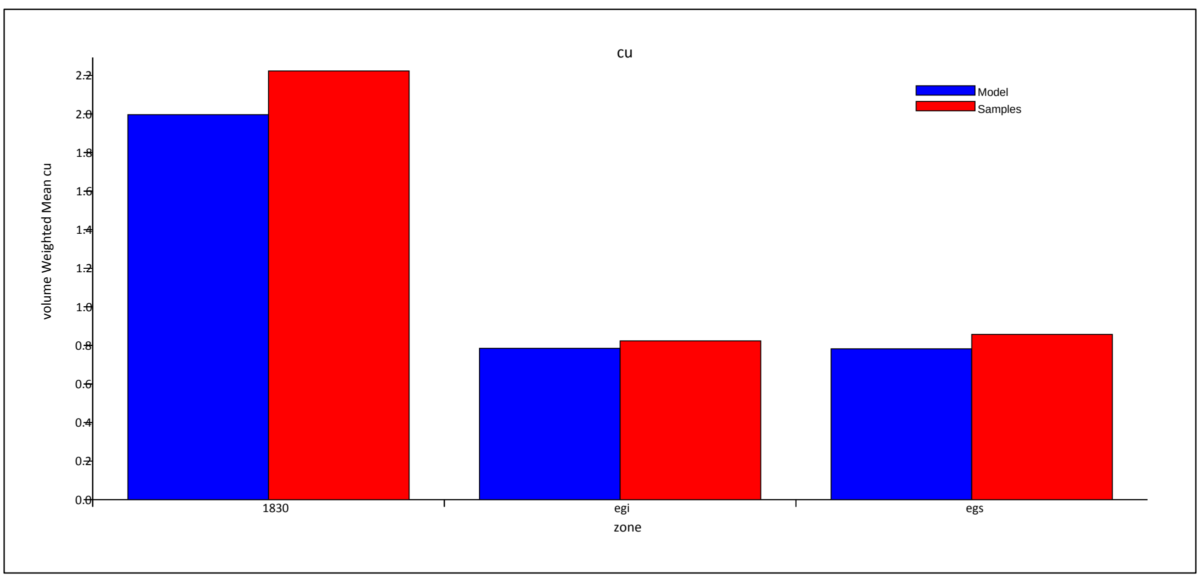
## 14.8.2 Comparative Statistics

SRK reviewed a comparison of the statistics of the composites to the estimation to assess the potential for any bias in the estimation as well as the degree of smoothing in the estimate. A series of statistical comparisons were conducted including reviews of the histograms for each metal, mean analysis between the blocks and composites, and the relationship between the estimation passes and the amount of data used for each. This was done for all five metals estimated into the blocks, for each area. Examples of this analysis for the EGI orebody are shown in Figure 14-13 and Figure 14-14. The analyses completed for each area show that in all cases that the blocks approximate the grade distribution of the composites. In addition, the mean analysis shows a reasonable agreement between the overall composite and block means for each area, with the estimate representing a reasonable declustered mean of the composites, and not exhibiting any consistent bias that would result in over or under-estimation.




Source: SRK, 2016

**Figure 14-13: Cu Histogram for El Gallo Area**



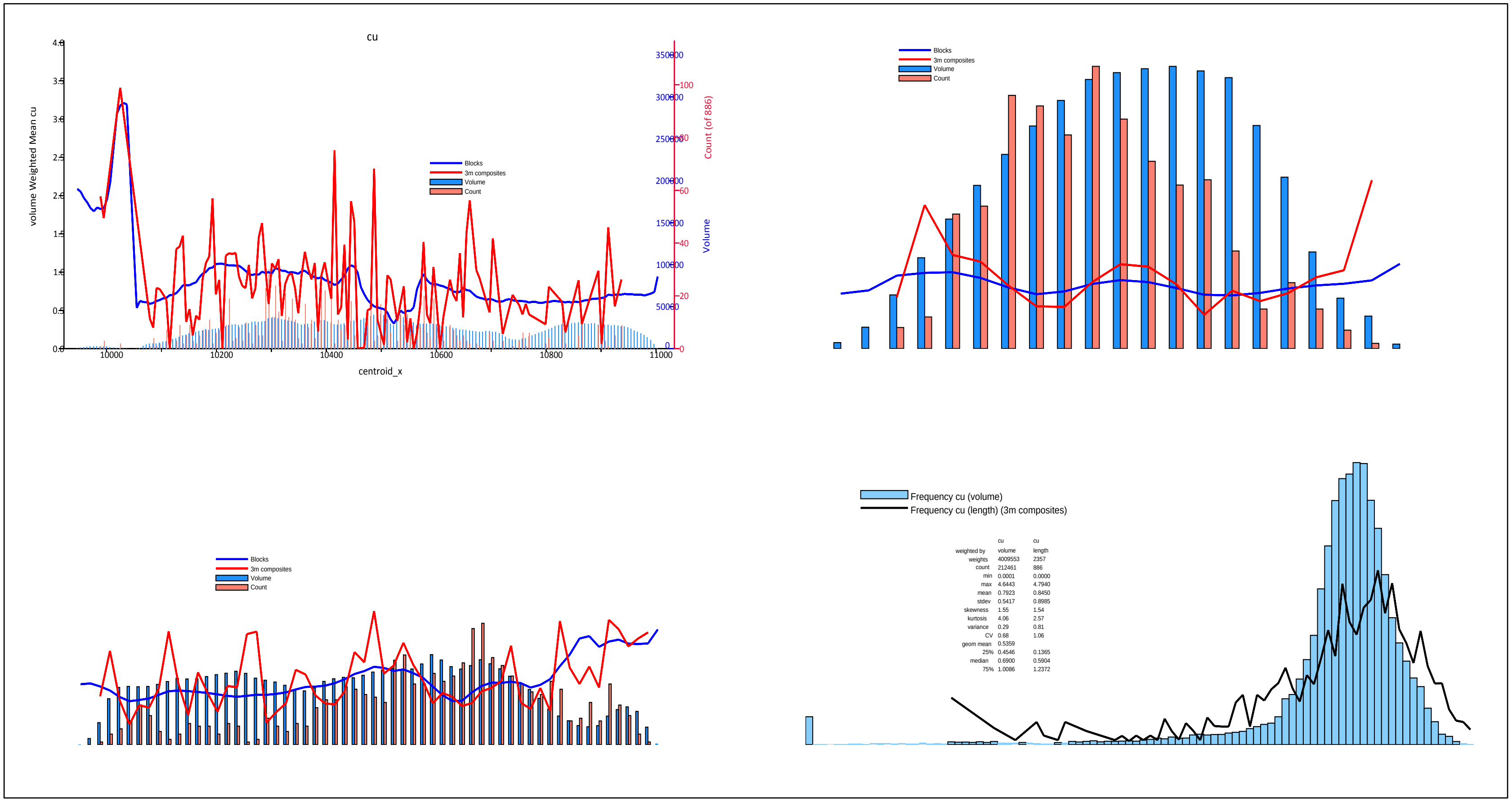

Source: SRK, 2016

**Figure 14-14: Mean Analysis by Zone**

### 14.8.3 Swath Plots

A more local comparison between the blocks to and the composites is made using swath plots. These show both the varying means of the block and composites (declustered) along swaths or slices through the model, as well as the amount of data supporting the estimate in each swath. The swath plots show that there are no significant local biases in the estimation that cannot be explained by composites along strike or dip that are influencing the estimation in areas where the drill spacing is very wide. As expected, the relative numbers of samples is low in these areas, which coincidentally also feature fewer estimated blocks. Although the estimation could be restricted by distance in this area, SRK has left it as-is to capture potential for further resource definition with drilling. The blocks in these areas are generally classified as Inferred. The swath plots generally show similar grade trends between the sample data and the estimated blocks, and it is clear that where the data is sufficiently dense that the estimate is performing well. An example of the swath plots for the El Gallo Area is shown in Figure 14-15. The swath plots for all of the elements and areas are presented in Appendix C.

SRK is of the opinion that the swath plots illustrate the reasonableness of the estimation for each area and support the validity of the estimate.




Source: SRK, 2016

**Figure 14-15: Swath Plots – El Gallo Area Cu**

## 14.9 Resource Classification

Mineral resource classification is a subjective concept, and industry best practices suggest that resource classification should consider both the confidence in the geological continuity of the mineralized structures, the quality and quantity of exploration data supporting the estimates and the geostatistical confidence in the tonnage and grade estimates. Appropriate classification criteria should aim at integrating all of these concepts to delineate regular areas of similar resource classification.

SRK is satisfied that the geological modeling honors the current geological information and knowledge. The location of the samples and the assay data are sufficiently reliable to support resource estimation. The sampling information was acquired primarily by core drilling.

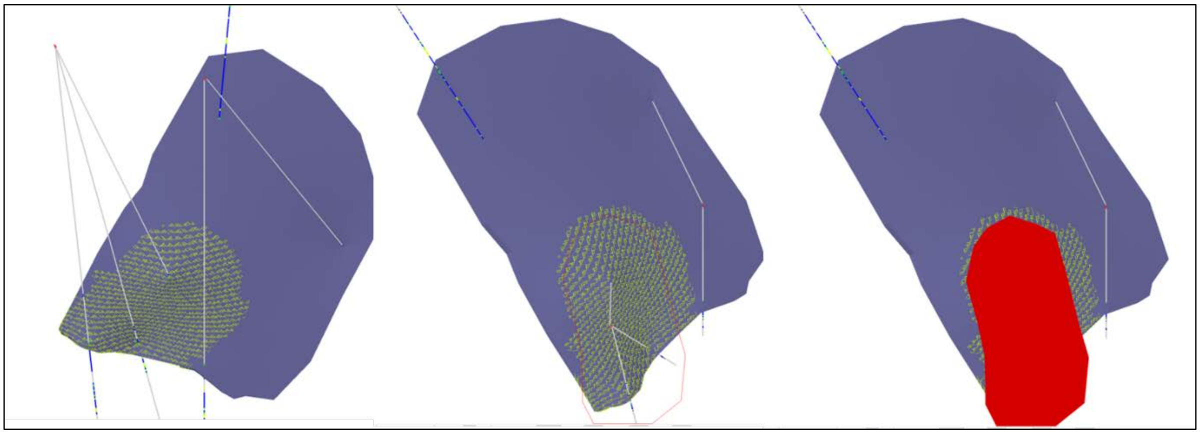
Significant factors affecting the classification include:

- Lack of historic and consistent QA/QC program;
- Lack of downhole surveys for most drillholes and measured deviations from planned and actual azimuths;
- Spacing of drilling compared to observed geologic continuity;
- Geostatistical factors suggesting ranges of reasonable influence between sampling; and
- Bolivar is a producing mine with a successful operating history dating more than 10 years.

In order to classify mineralization as an Indicated Mineral Resource, “the nature, quality, quantity and distribution of data” must be “such as to allow confident interpretation of the geological framework and to reasonably assume the continuity” (CIM Definition Standards on Mineral Resources and Mineral Reserves, December 2005). SRK has based this classification both on the continuity observed in well-drilled areas of the Project, as well as geologic continuity observed from underground exposures of the mineralization. The classification is generally based on the block estimation passes, using the amount of data and ranges of interpolation from the nested passes to flag blocks, which are then considered to guide a manually digitized polygon to assign the final classification and eliminate local inconsistencies in the block-by-block classification of the estimation pass. An example of the classification results is shown in Figure 14-16.

The general category for classification is as follows:

- Indicated: Blocks estimated by samples located at an average distance of 75 m, utilizing at least two drillholes and generally located in areas supported by multiple holes which included modern analyses and QA/QC; and
- All estimated blocks not assigned to the Indicated category were assigned to the Inferred category.



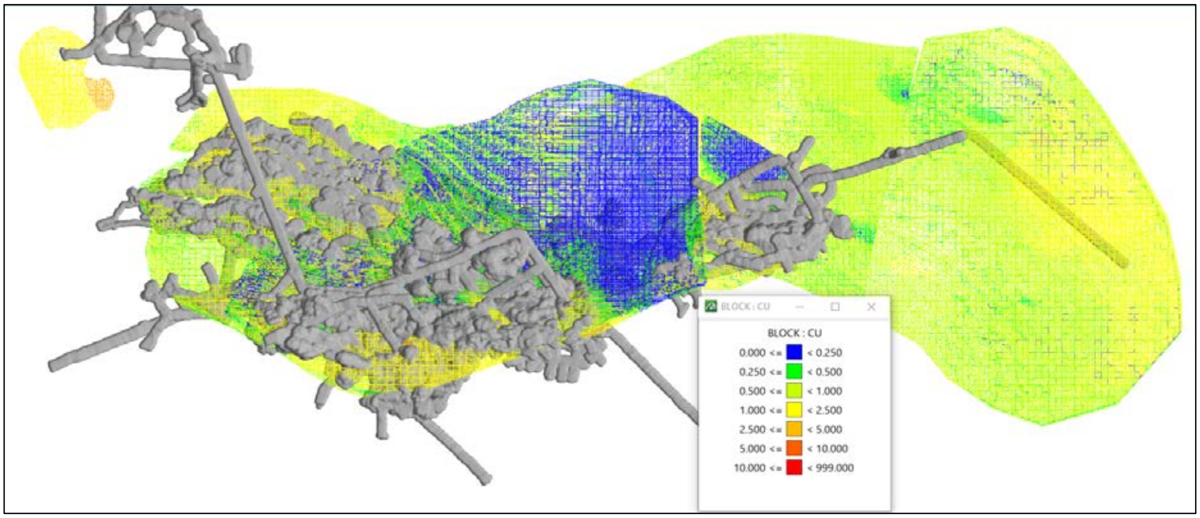
Note: In the far left image, blocks are displayed which have been estimated in either the first or second estimation pass, using more than 2 drill holes with an average distance of less than 75m. The central image shows a polygon which has been drawn in the plane of the mineralized body to generally encompass the blocks, but is modified to reduce the jagged irregular nature of the blocks on the fringes. The image on the right shows the closed volume extrapolated from the polygon, which has been used to flag the final classification.
Source: SRK, 2016

**Figure 14-16: Example of Indicated Classification Methodology – Bolivar NW**

## 14.10 Depletion for Mining

Bolivar has been actively mined since 2007. The production areas have not been surveyed using modern survey methods via 3D cavity monitoring systems (CMS). The asbuilt mined areas provided to SRK include multiple AutoCAD and PDF files which show a combination of survey points for stoped areas, polylines for the various cuts of the stopes, and wireframes which roughly delineate development and production areas. SRK was not provided with detailed mined volumes that could be used to flag blocks as mined in the block model. In order to provide a reasonable assessment of the mined areas in the allotted time frame for this study, SRK used the combined types of data provided to generate a 3m distance buffer of the mined areas and generate volumes that could be used in flagging the blocks as mined. SRK notes that this method of defining the mined areas is likely conservative in areas of active mining, but also accounts for the local uncertainty associated with the multiple data types and lack of complete detailed 3D surveys.

SRK notes that the mined areas are only located in the vicinities of El Gallo Inferior, El Gallo Superior, and Chimeneas. A plan view of the 3m buffer around the mined areas is shown in Figure 14-17.




Source: SRK, 2016

**Figure 14-17: Plan View of Mined Areas Buffer**

## 14.11 Mineral Resource Statement

CIM Definition Standards for Mineral Resources and Mineral Reserves (December 2005) defines a mineral resource as:

*"A concentration or occurrence of diamonds, natural solid inorganic material, or natural solid fossilized organic material including base and precious metals, coal, and industrial minerals in or on the Earth's crust in such form and quantity and of such a grade or quality that it has reasonable prospects for economic extraction. The location, quantity, grade, geological characteristics and continuity of a Mineral Resource are known, estimated or interpreted from specific geological evidence and knowledge".*

The "reasonable prospects for economic extraction" requirement generally implies that the quantity and grade estimates meet certain economic thresholds and that the Mineral Resources are reported at an appropriate cut-off grade taking into account extraction scenarios and processing recoveries. To assess this at Bolivar, SRK has calculated an economic value for each block in terms of US dollars ($) based on the grade of contained metal in the block, multiplied by the assumed recovery for each metal, multiplied by pricing established by Sierra Metals for each commodity. Costs for mining and processing are taken from data provided by Dia Bras for their current underground mining operation.

The September 30, 2016, consolidated mineral resource statement for the Bolivar Mine area is presented in Table 14-25. These resources have been stated in undeveloped areas of the deposits as well as within surveyed pillar shapes in the existing mined out areas, using a lower COG to reflect the fact that they have been exposed through previous mining. A detailed break-down of the mineral resources by mineralized area is presented in Table 14-26.

**Table 14-25: Consolidated Bolivar Mineral Resource Estimate as of September 30, 2016– SRK Consulting (U.S.), Inc.**

| Category | Tonnes (000's) | Ag (g/t) | Au (g/t) | Cu (%) | Ag (koz) | Au (koz) | Cu (t) |
|---|---|---|---|---|---|---|---|
| Indicated | 9,335 | 18.1 | 0.30 | 0.90 | 5,440 | 91 | 83,885 |
| Inferred | 9,055 | 17.9 | 0.33 | 0.86 | 5,200 | 97 | 77,830 |

(1) Mineral resources are reported inclusive of ore reserves. Mineral resources are not ore reserves and do not have demonstrated economic viability. All figures rounded to reflect the relative accuracy of the estimates. Copper, gold, and silver assays were capped where appropriate.

(2) Mineral resources are reported at variable metal value cut-off grades based on metal price assumptions*, metallurgical recovery assumptions, mining/transport costs (US$13.59/t), processing costs (US$10.00/t), and general and administrative costs (US$3.40/t).

(3) The metal value cut-off grade for the unmined portions of the Bolivar Mine is US$27 and is US$20 for the remaining vertical pillars in the mined areas. The mineral resources within the remaining vertical pillars comprise less than 1% of the Indicated Mineral Resources. No mineral resources are reported for the remaining crown or sill pillars.

* Metal price assumptions considered for the calculation of metal value are: Copper (Cu): US$/lb 2.43, Silver (Ag): US$/oz 18.30, and Gold (Au): US$/oz 1,283.00.

** Metallurgical recovery assumptions are 81% Cu, 77% Ag, and 49% Au.

*The resources were estimated by SRK. Matthew Hastings, M.Sc., PGeo, MAusIMM #314693 of SRK, a Qualified Person, performed the resource calculations for Bolivar.*

**Table 14-26: Detailed Bolivar Mineral Resources as of September 30, 2016– SRK Consulting (U.S.), Inc.**

| Area | Category | Tonnes (000's) | Ag (g/t) | Au (g/t) | Cu (%) | Ag (Koz) | Au (Koz) | Cu (t) |
|---|---|---|---|---|---|---|---|---|
| Chimeneas 1 | Indicated | 142 | 51.5 | 0.02 | 2.21 | 234.3 | 0.1 | 3,128 |
| Chimeneas 2 | | 262 | 22.6 | 0.04 | 0.97 | 190.2 | 0.3 | 2,543 |
| El Gallo Inf. | | 4,746 | 14.9 | 0.26 | 0.86 | 2,269.1 | 39.7 | 40,818 |
| El Gallo Inf. Pillars | | 26 | 22.6 | 0.22 | 1.05 | 19.0 | 0.2 | 275 |
| El Gallo Superior Pillars | | 99 | 25.7 | 0.15 | 1.43 | 81.8 | 0.5 | 1,421 |
| Bolivar NW Zn2 | | 226 | 35.1 | 0.28 | 0.61 | 255.7 | 2.0 | 1,381 |
| Bolivar NW 1 | | 1,578 | 10.5 | 0.64 | 0.87 | 532.8 | 32.5 | 13,732 |
| Bolivar NW 2 | | 95 | 25.1 | 0.22 | 0.92 | 76.7 | 0.7 | 874 |
| Bolivar NW 4 | | 460 | 19.6 | 0.47 | 0.71 | 289.5 | 7.0 | 3,269 |
| Bolivar NW 6 | | 166 | 69.4 | 0.76 | 1.05 | 371.1 | 4.1 | 1,747 |
| Bolivar NW 7 | | 194 | 14.2 | 0.60 | 0.88 | 88.9 | 3.7 | 1,709 |
| Bolivar W A | | 1,175 | 26.0 | - | 0.93 | 981.1 | - | 10,932 |
| Bolivar W B | | 163 | 9.5 | - | 1.26 | 50.0 | - | 2,057 |
| 1830 | Inferred | 98 | 53.6 | 0.78 | 2.02 | 169.2 | 2.5 | 1,984 |
| Chimeneas 1 | | 39 | 6.1 | - | 0.98 | 7.6 | - | 385 |
| Chimeneas 2 | | 202 | 18.0 | - | 0.86 | 117.1 | - | 1,738 |
| El Gallo Inf. | | 1,845 | 10.7 | 0.23 | 0.79 | 635.1 | 13.6 | 14,572 |
| Increíble | | 417 | 17.9 | 0.03 | 0.86 | 239.4 | 0.4 | 3,587 |
| Bolivar NW Zn2 | | 155 | 44.6 | 0.93 | 0.62 | 221.5 | 4.6 | 958 |
| Bolivar NW 1 | | 2,586 | 7.4 | 0.49 | 0.72 | 613.5 | 40.7 | 18,618 |
| Bolivar NW 2 | | 383 | 17.1 | 0.04 | 0.69 | 210.6 | 0.5 | 2,642 |
| Bolivar NW 3 | | 115 | 30.6 | 0.58 | 1.44 | 113.5 | 2.1 | 1,660 |
| Bolivar NW 4 | | 373 | 20.2 | 0.44 | 0.71 | 242.7 | 5.3 | 2,651 |
| Bolivar NW 6 | | 139 | 75.8 | 0.56 | 1.31 | 338.4 | 2.5 | 1,819 |
| Bolivar NW 7 | | 524 | 12.3 | 0.88 | 0.82 | 207.4 | 14.8 | 4,298 |
| Bolivar NW 8 | | 518 | 16.2 | 0.60 | 0.82 | 270.0 | 10.0 | 4,246 |
| Step Out | | 32 | 20.3 | 0.05 | 1.19 | 20.6 | 0.1 | 376 |
| Bolivar W A | | 1,470 | 36.4 | - | 1.12 | 1,721.3 | - | 16,464 |
| Bolivar W B | | 159 | 14.0 | - | 1.15 | 71.9 | - | 1,832 |

(1) Mineral resources are reported inclusive of ore reserves. Mineral resources are not ore reserves and do not have demonstrated economic viability. All figures rounded to reflect the relative accuracy of the estimates. Copper, gold, and silver assays were capped where appropriate.

(2) Mineral resources are reported at variable metal value cut-off grades based on metal price assumptions*, metallurgical recovery assumptions**, mining/transport costs (US$13.59/t), processing costs (US$10.00/t), and general and administrative costs (US$3.40/t).

(3) The metal value cut-off grade for the unmined portions of the Bolivar Mine is US$27 and is US$20 for the remaining vertical pillars in the mined areas. The mineral resources within the remaining vertical pillars comprise less than 1% of the Indicated Mineral Resources. No mineral resources are reported for the remaining crown or sill pillars.

* Metal price assumptions considered for the calculation of metal value are: Copper (Cu): US$/lb 2.43, Silver (Ag): US$/oz 18.30, and Gold (Au): US$/oz 1,283.00.

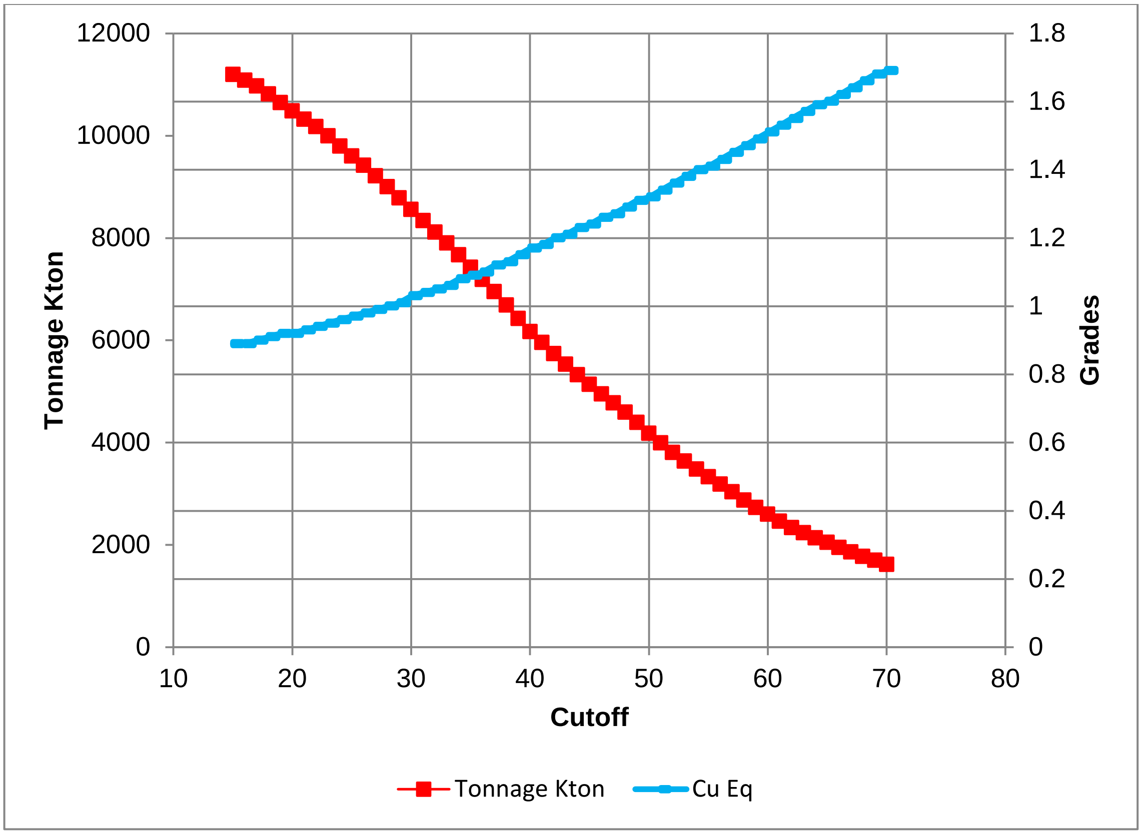
** Metallurgical recovery assumptions are 81% Cu, 77% Ag, and 49% Au.

*The resources were estimated by SRK. Matthew Hastings, M.Sc., PGeo, MAusIMM #314693 of SRK, a Qualified Person, performed the resource calculations for Bolivar.*

## 14.12 Mineral Resource Sensitivity

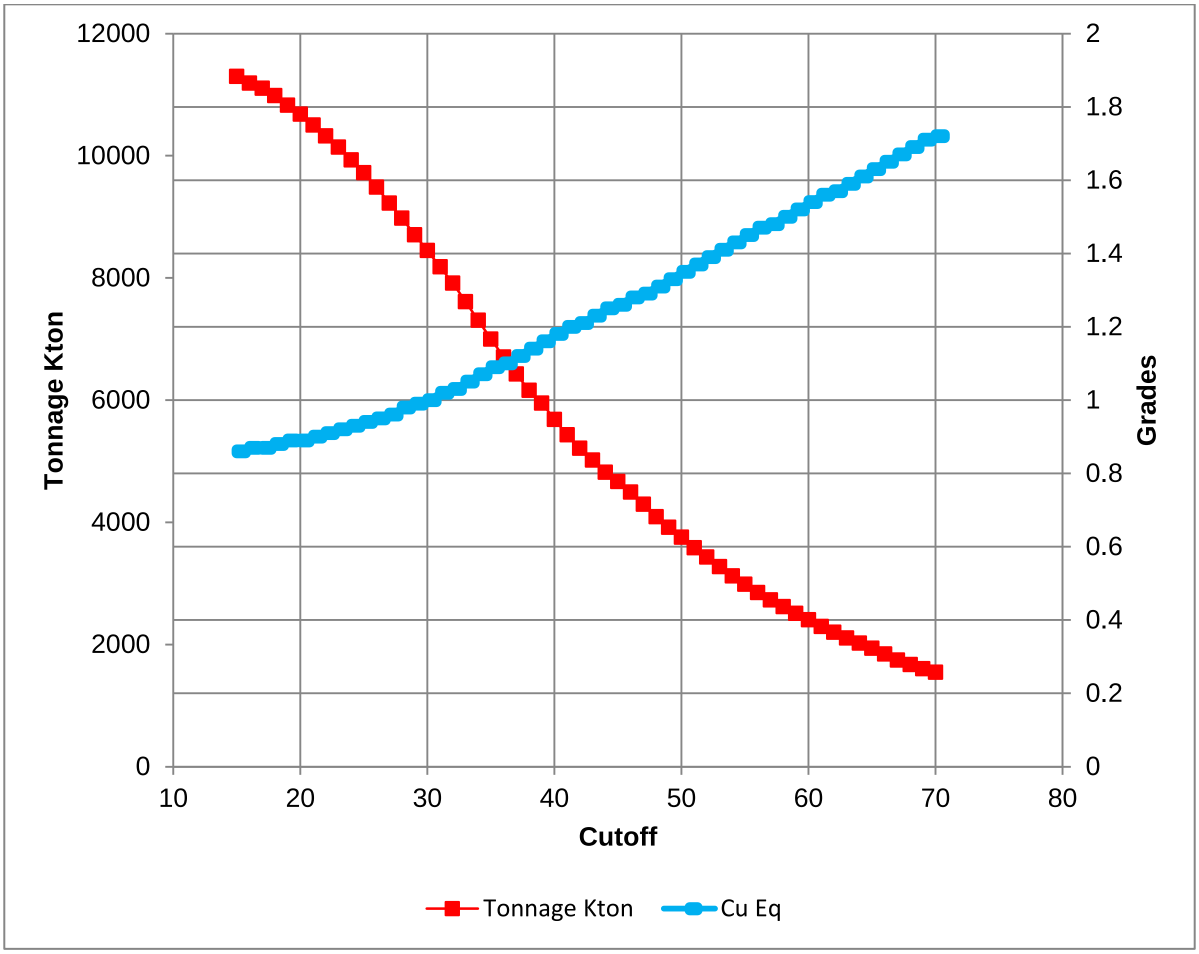
SRK has generated grade-tonnage charts which illustrate the fluctuations of tonnage and copper equivalent (CuEq) grade as a function of the metal value cut-off. Equivalencies are calculated by dividing the MetVal by the unit value of 1% recovered Cu (US$43.43). These charts are shown in Figure 14-18 and Figure 14-19.

SRK notes that the project is relatively sensitive to the cut-off, in both Indicated and Inferred mineralization.




Note: Excludes pillars and is reported from unmined areas only.

**Figure 14-18: Grade Tonnage Chart – Bolivar Indicated Mineralization**




Note: Excludes pillars and is reported from unmined areas only.

**Figure 14-19: Grade Tonnage Chart – Bolivar Inferred Mineralization**

## 14.13 Relevant Factors

There are no other factors pertinent to the mineral resource statement other than those stated in the above sections which SRK would expect to have a material impact on the statement.

# 15 Mineral Reserve Estimate

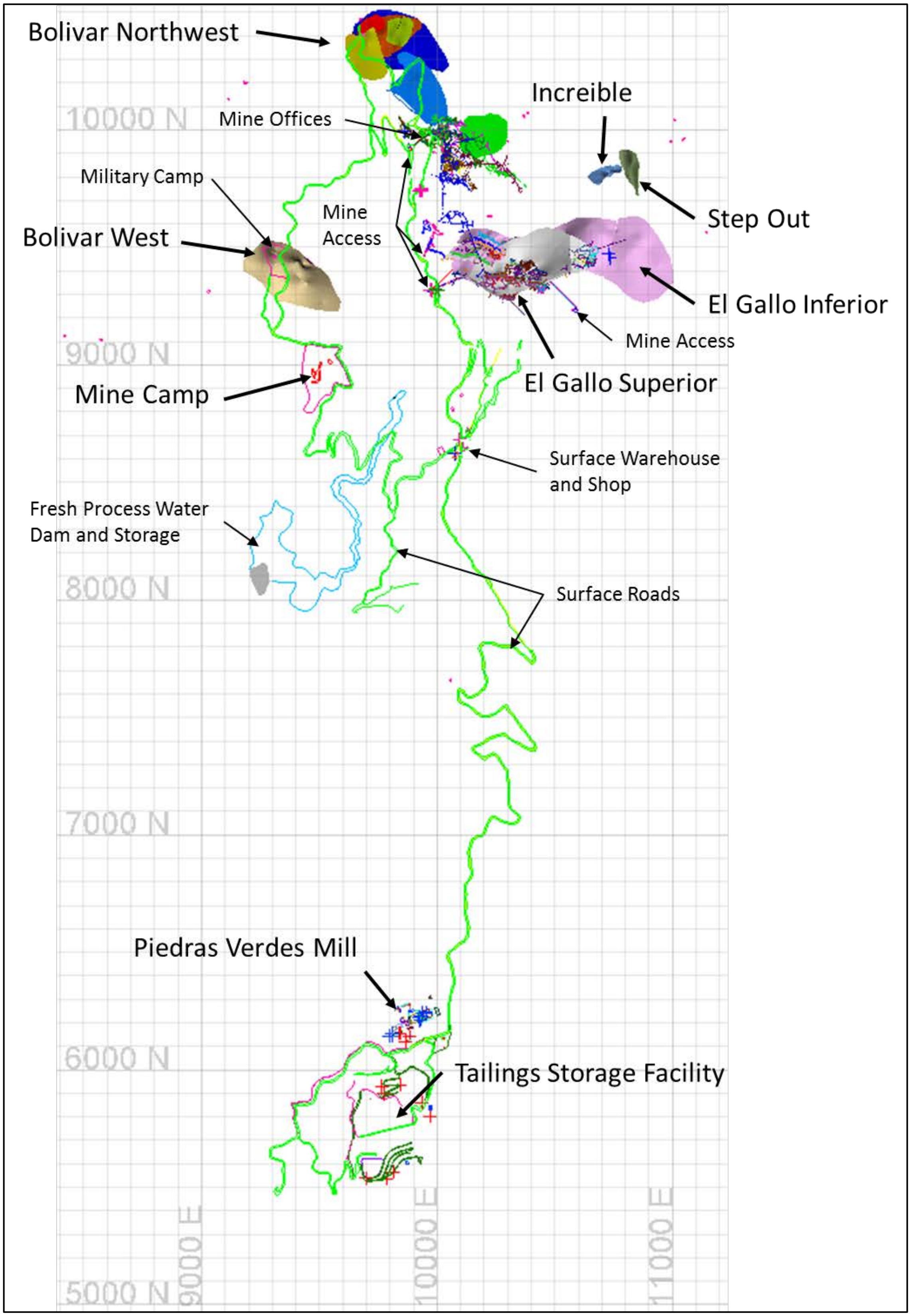
## 15.1 Introduction

Bolivar is a producing operation with ore production primarily by means of underground room and pillar mining. Commercial production was declared by Sierra Metals in November 2011. The initial production decision was not based on a feasibility study of Mineral Reserves demonstrating economic viability. There is an increased uncertainty and economic and technical risks of failure associated with this production decision.

Bolivar ore is processed at the Piedras Verdes mill. The mill is located south of the mine and was commissioned in 2011. Various underground development activities, test mining, and smaller scale milling has taken place under Dia Bras ownership since the early to 2000s. Underground mining has occurred in several zones in the immediate Bolivar area including Bolivar, El Gallo Superior, and El Gallo Superior Magnetita.

Current production is from the El Gallo Inferior body. January through September 2016 ore production reported by the mine averaged 2,440 t/day, and ore delivered to Piedras Verdes was 2,460 t/day. Ore is hauled to the surface using one of several adits or declines accessing the orebodies and dumped onto small pads outside the portals. The ore is then loaded into rigid frame over-the-road trucks, typically 18 tonne capacity, and hauled on a gravel and dirt road approximately 5.1 km south to the Piedras Verdes mill. A copper concentrate is produced containing payable copper, silver and minor amounts of payable gold.

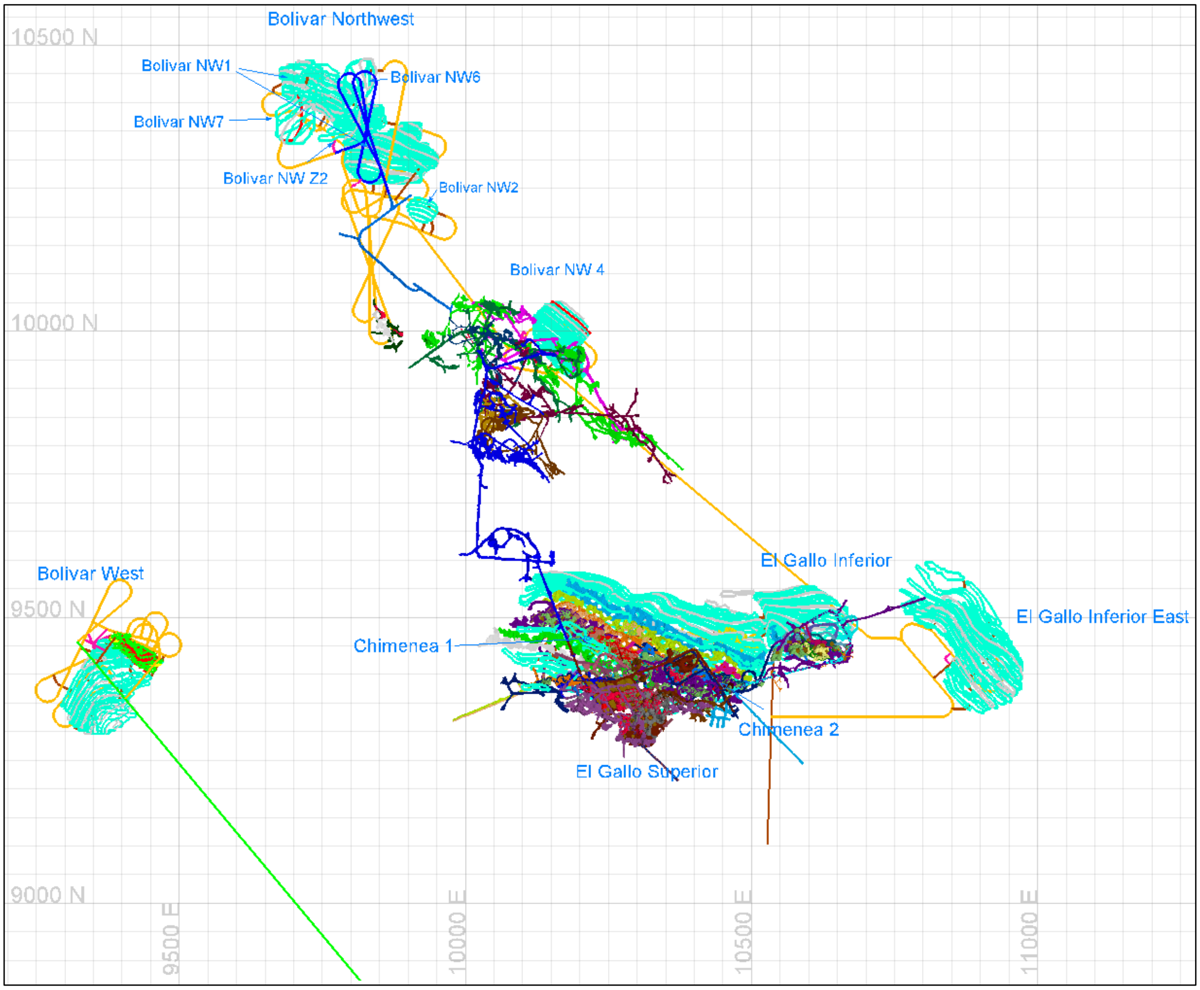
The reserves estimated herein are contained in El Gallo Inferior, and zones called Chimenea 1, Chimenea 2, Bolivar West, and Bolivar Northwest. The El Gallo Superior and Bolivar areas are considered mined out, though mineralized material remains in pillars. Any remaining pillar tonnes have not been included in the reserves at this time. Figure 15-1 shows an overview of the Bolivar area including the mineralized zones, underground access, mine camp, Piedras Verdes processing facility, and other key surface infrastructure and features.




Source: SRK, 2017

**Figure 15-1: Bolivar Overview**

Figure 15-2 shows an overview of the mining areas, asbuilts, and mine design supporting the reserves estimate.




Source: SRK, 2017

**Figure 15-2: Bolivar Mining Areas**

## 15.2 Conversion Assumptions, Parameters and Methods

Indicated Mineral Resources were converted to Probable Mineral Reserves by applying the appropriate modifying factors, as described herein, to potential mining block shapes created during the mine design process. No Measured Resources are estimated and, as a result, no Proven Reserves are stated.

The production history of the operation forms the basis for the modifying factors used to convert resources to reserves. Data made available to SRK includes historical costs, mining recovery and dilution factors, processing recovery, and the general layout and performance of the room and pillar mining method at the mine.

The undiluted tonnes and grade of each potential mining block is based on the resource block model estimated by SRK as described in Section 14 of this report. All Mineral Reserve tonnages are expressed as "dry" tonnes (i.e., no moisture) and are based on the density values stored in the block model. While some mining blocks may consist entirely of Indicated Mineral Resources, other mining blocks may include Inferred Mineral Resources and unclassified material. Where Inferred and unclassified material has been included in a mining block, such material has been assigned a grade of zero. Unplanned dilution, as defined in Section 15.2.2, has also been applied with a grade of zero.

Reserve tonnes and grade are calculated using the following factors:

- Mining Recovery: a factor resulting in ore loss (tonnage reduction) due to the mining method applied and the ore body geometry; and
- Dilution: a factor resulting in a reduction of the overall average grade due to the mining of waste with the ore.

The generalized formula for calculating the reserve tonnage in each mining block is:

$$T_{reserve} = T_{mining\ block} * \text{Mining Recovery\%} * (1+\text{Dilution\%}_{unplanned})$$

The generalized formula for calculating the reserve grade is:

$$G_{reserve} = \text{Resource Grade}_{mining\ block} / (1+\text{Dilution\%}_{unplanned})$$

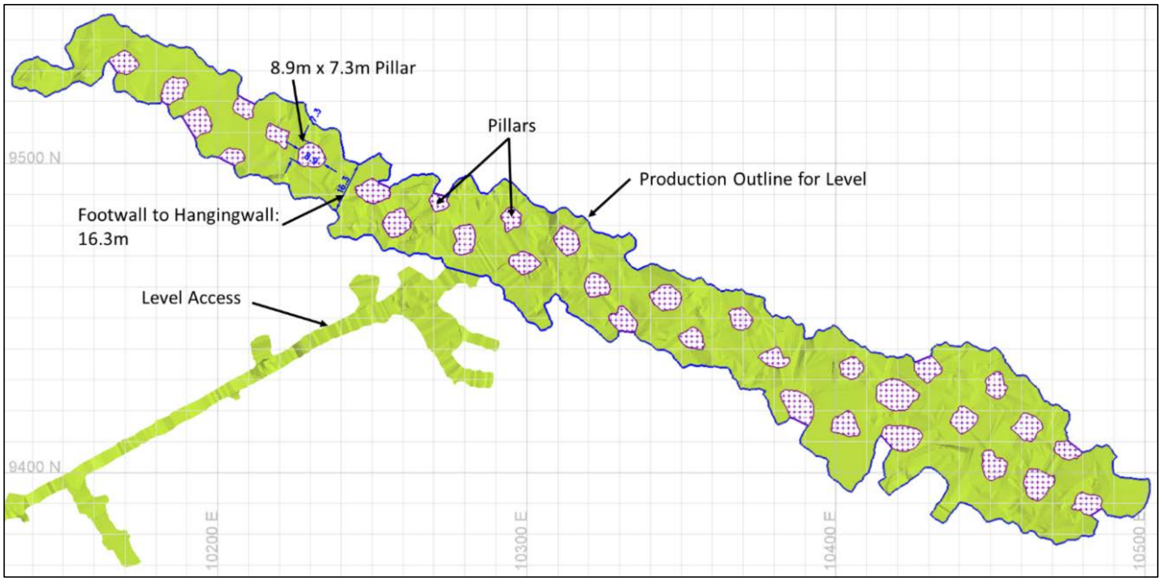
### 15.2.1 Mining Recovery

A mining recovery factor of 85% for room and pillar mining at Bolivar was provided by Dia Bras personnel and is based on historical production information. Detailed stope-by-stope production information corresponding to 3D asbuilt data was not provided to SRK. While underground survey data is collected and mine asbuilts are updated, a cavity monitoring system (CMS) is not in use at the site. As a result, it can be difficult to obtain an accurate model of the mined out areas, particularly in the roof of the stopes. Dia Bras is planning to complete a three-dimensional (3D) survey update for the mine. SRK supports this effort and recommends that the site should regularly perform stope-by-stope planned to actual reconciliations, for both grade and tonnage mined, to continually validate the mining recovery assumptions. The results of such analysis will become more important as new areas in Bolivar West and Bolivar Northwest are mined.

Ore loss can be the result of:

- Underbreak – the mineralized material is not blasted loose and remains in the stope walls;
- Mineralized material loss within stope – the blasted mineralized material is left in the stope due to poor access for the loader, buried by falls of waste rock from walls, left on the floor, or material blasted but does not fall from flatter lying walls; and
- Mineralized material left in pillars – in the case of Bolivar, the ore loss due to leaving vertical pillars behind has been accounted for using the mining recovery factor. Sill or crown pillars have been excluded as part of the design process. Pillars account for the greatest ore loss at Bolivar.

To evaluate the reasonableness of the recovery factor provided by the mine, SRK analyzed the asbuilts from levels in El Gallo Inferior. Two example levels are shown below. Figure 15-3 shows a plan view of the asbuilt on Nivel (Level) 312 with a floor elevation of approximately 1775. The blue outline represents the production outline of the level, and the pillars are shown in purple. The area of the blue outline on this level is 11,068 $m^2$. The total area of the pillars is 1739 $m^2$. Assuming the entire area within the production outline was ore, the recovery on this level was 84%.

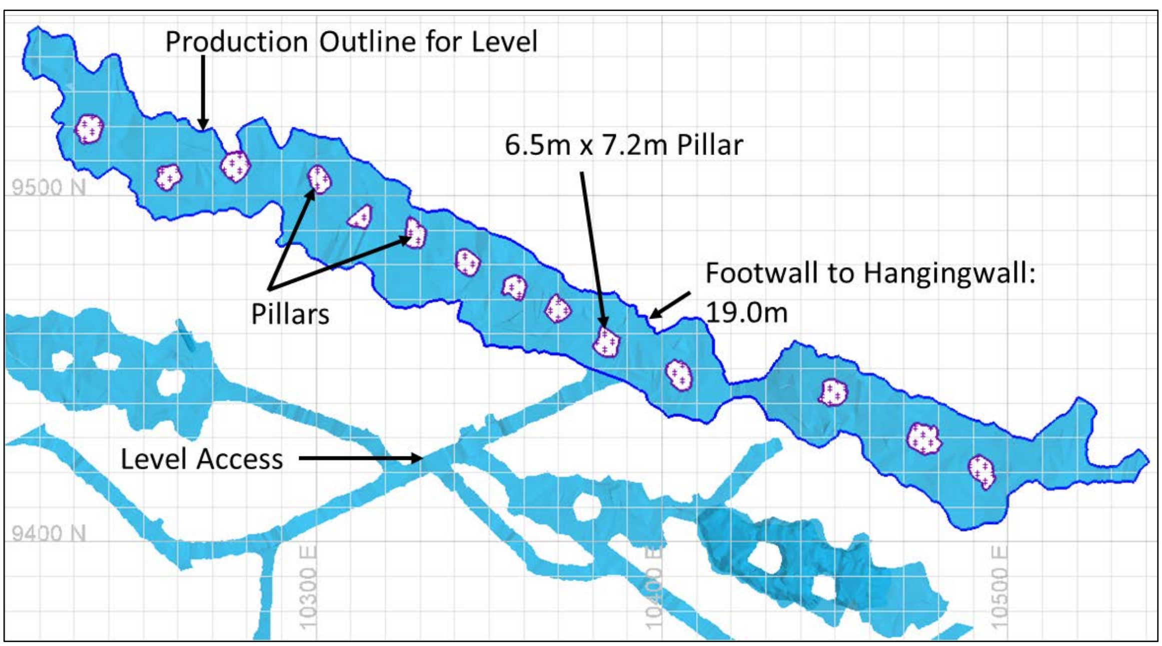



Source: SRK, 2017

**Figure 15-3: El Gallo Level 312 Asbuilt with Pillars**

Figure 15-4 shows the asbuilt on Level 601 with a floor elevation of approximately 1760. The area within the production outline of the level is 7840 $m^2$, and the area left in pillars is 629 $m^2$. The recovery in this section of Level 601 is 92%.

Considering additional allowances for the dip of the orebody, underbreak and other material loss, which can range from 0% under tightly controlled blasting and mucking cycles to 10% or more in less ideal conditions, SRK views 85% as a reasonable recovery factor.




Source: SRK, 2017

**Figure 15-4: El Gallo Level 601 Asbuilt with Pillars**

Certain ore bodies in Bolivar West, and Chimenea 1 and Chimenea 2 are more steeply dipping and are conducive to the application of a longhole mining technique. The site has some experience with longhole mining, but did not provide historical production information to SRK. The recovery applied to the steeply dipping ore in Bolivar West, Chimenea 1 and Chimenea 2, which accounts for approximately 8% of the total reserve, is based on typical recovery factors for longhole mining and takes into account vertical pillars required for ground control.

Table 15-1 lists the mining recovery factors applied to each ore body based on the mining method.

**Table 15-1: Mining Recovery Factors**

| Mining Method | Recovery | Ore Body |
|---|---|---|
| Room & Pillar | 85% | El Gallo Inferior, Bolivar West, Bolivar Northwest |
| Longhole Stopes | 85% | Chimenea 1, Chimenea 2, Bolivar West |
| Longhole Sill (Top and Bottom) | 85% | Chimenea 1, Chimenea 2, Bolivar West |
| Room & Pillar | 85% | El Gallo Inferior, Bolivar West, Bolivar Northwest |

Source: SRK, 2017

As described above, mineral resources in sill pillars, crown pillars, and vertical pillars are not included in the reserves. These pillars may contain value, but they are left in place to ensure the geotechnical stability of the stopes. Mining operations are often able to recover some portion of pillars after primary mining is complete in an area or at the end of the mine life when pillars are no longer required, and Dia Bras is working on plans for pillar recovery. SRK notes that the program is in the initial stages, and considers pillar recovery as an opportunity to increase future reserve estimates.

### 15.2.2 Dilution

Dilution is defined as the ratio of waste to mineralized material. There are two types of dilution that would be expected in the mine: internal, also called planned dilution; and external, also called unplanned dilution.

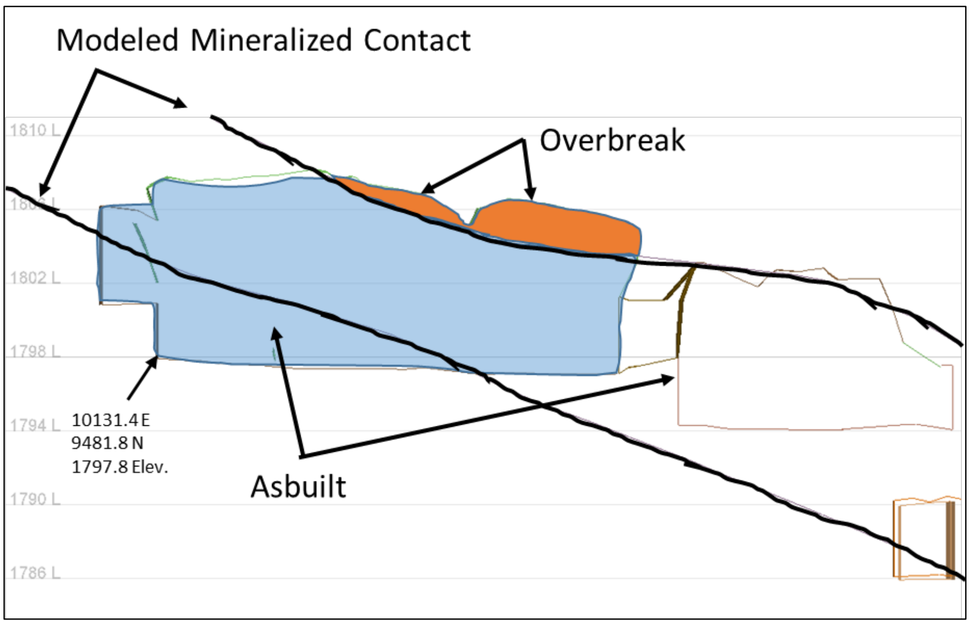
- Internal or planned dilution occurs when material less than a cut-off grade falls within a designed stope boundary (i.e., it would be drilled and blasted within the stope during mining).

  Internal dilution is incorporated into the design when calculating the material contained within the designed stope. If the average grade of the stope falls too low when this material is incorporated into the stope, the stope should be redesigned to exclude more of this low-grade material. Judgment must be exercised during the stope design process to minimize dilution from this source, but practical mining considerations usually make the inclusion of internal dilution unavoidable. Internal dilution is straightforward to quantity in a mine plan using software to calculate tonnes and grade above and below the Net Smelter Return (NSR) cut-off within the designed stope blocks.

- External or unplanned dilution is derived from low- or zero-grade material outside the stope design boundaries. This dilution is the result of over-break arising from poor drilling and blasting techniques, adverse geological structures, and failure within zones of weak rock. External dilution is expected even under the best of circumstances, and an allowance is always made for it during the mine planning process.

A dilution factor of 10% for room and pillar mining at Bolivar was provided by Dia Bras personnel and is based on historical production information. SRK was unable to review previous mine designs and predicted grade models for specific mining areas. As is the case for the recovery factor used, SRK recommends that the site implement a program to reconcile stope-by-stope tonnage and grade in order to compare the mine design planned values and production results. This will allow the validation and calibration of the dilution factor.

To evaluate the validity of this parameter, SRK performed a sectional based analysis on mine asbuilt information. Figure 15-5 shows an example of a section through the stope asbuilt on Level 552 (floor elevation of approximately 1,798 m) with the modeled mineralized zone contact and suspected overbreak highlighted for clarity. The orientation of the section is N37E.




Source: SRK, 2017

**Figure 15-5: Vertical Section through Level 552, NW-6 Asbuilt**

The area of the blue designed cut is 243 $m^2$, and the area of the overbreak is 22 $m^2$. In this case, the unplanned dilution is approximately 9%. Considering the analysis described above and factors used at other operations, it is SRK's opinion that 10% unplanned dilution factor is reasonable. As previously described, the recommended reconciliation program and updated 3D mine survey may allow the site to develop and refine mining practices that can reduce the dilution experienced at the mine.

The total dilution (planned + unplanned) subdivided by mining area for the reserves estimate contained herein is listed Table 15-2. Total dilution ranges from 13% to 36% and averages 16%. The primary factors impacting the total dilution is the width and dip of the mineralized zone, the distribution of grade within the mineralization, and the planned mining method.

**Table 15-2: Dilution Factors**

| Zone | Total Dilution (%) |
|---|---|
| El Gallo Inferior | 16 |
| El Gallo Inferior East | 19 |
| Chimenea 1 | 17 |
| Chimenea 2 | 13 |
| Bolivar West | 15 |
| Bolivar NW 1 | 14 |
| Bolivar NW 2 | 36 |
| Bolivar NW Z2 | 18 |
| Bolivar NW 4 | 19 |
| Bolivar NW 6 | 22 |
| Bolivar NW 7 | 15 |

Source: SRK, 2017

### 15.2.3 Net Smelter Return

The mineral deposits at Bolivar are polymetallic with copper, silver and gold metals contributing to the total value of mineralized material. Because the value of the mineralization is not based on one commodity, the reserves estimate contained herein utilizes a Net Smelter Return (NSR) approach. NSR is defined as the proceeds from the sale of mineral products after deducting off-site processing and distribution costs and is typically expressed on a dollar per tonne basis. An NSR approach is commonly used in the mining industry for polymetallic deposits and is considered best practice.

The metal price assumptions have been derived from January 2017 BMO Capital Markets Street Consensus Commodity prices, and in SRK's opinion are reasonable for the statement of mineral resources and ore reserves. Metallurgical recoveries used in the NSR calculation are based on data provided by Dia Bras for 2016 (January through September).

Dia Bras currently holds a contract for the sale of its concentrate. The contract documents were reviewed by SRK, and the terms are reasonable and in line with the terms at similar operations. SRK reviewed concentrate shipment and concentrate assay test results for 2015 and 2016 and notes the following:

- The average grade of copper in the concentrate, as reported in the concentrate shipment log, was 26% in 2016. The Piedras Verdes reports show an average copper grade in concentrate of 28%; and
- Bismuth in concentrate can result in a penalty element charge up to US$10 per tonne of concentrate but typically ranges from US$3 to US$5 per tonne of concentrate. The concentrate shipping cost is included in the operation's G&A costs and are not included in the NSR calculation.

The parameters used in the NSR calculation are summarized in Table 15-3. An NSR value was assigned to each block model block in Vulcan software. Blocks with a resource class of inferred or undefined have been assigned an NSR value of 0.

**Table 15-3: NSR Calculation Parameters**

| Parameter | Unit | Value |
|---|---|---|
| **Metal Prices** | | |
| Cu price | US$ / lb Cu | 2.43 |
| Ag price | US$ / oz Ag | 18.30 |
| Au price | US$ / oz Au | 1,283 |
| **Recovery to Concentrate** | | |
| Cu | % | 81.1 |
| Ag | % | 76.8 |
| Au | % | 48.7 |
| **Concentrate Grade** | | |
| Cu | % | 26 |
| Moisture content | % | 9 |
| **Smelter Payables** | | |
| Cu payable | % | 96.5 |
| Minimum Cu deduction | Min units % | 1.0 |
| Ag payable | % | 90.0 |
| Ag deduction | g/t in conc. | 0.0 |
| Au | % | 90.0 |
| Au deduction | g/t in conc. | 1.0 |
| **Treatment Charges/Refining Charges** | | |
| Cu conc. treatment | US$/dmt conc. | 94.00 |
| Cu refining charge | US$/lb payable Cu | 0.094 |
| Ag refining charge | US$/oz payable Ag | 0.35 |
| Au refining charge | US$/oz payable Au | 6.00 |

Source: SRK, 2017

For a block with a mill feed grade of 0.94% copper, 21.2 g/t silver, and 0.17 g/t gold, the following factors for each element can be used to estimate the NSR value per tonne:

NSR (US$/t) = US$37.76 x Cu (%) + US$0.38 x Ag (g/t) + US$12.05 x Au (g/t) = 45.62 (US$/t)

### 15.2.4 Cut-off Evaluation

The NSR value of each potential mining block was calculated and evaluated against economic and marginal cut-off values. The economic cut-off varies by mining method and includes direct and indirect mining costs, processing costs, concentrate shipping, and general and administrative costs. Mining blocks with an average NSR value above the economic cut-off, that have defined access, and that are not isolated (i.e., mining blocks that do not pay for the development to those blocks) are classified as economic and included in the reserves. In some cases, marginal blocks, defined as blocks below the economic cut-off but above the cost of direct mining and processing, are included in the reserve if they are in between or immediately adjacent to economic blocks and it is reasonable to expect that no significant additional development would be required to extract the marginal block. Mining blocks not meeting the criteria described above are classified as waste.

SRK reviewed operating costs for 2014, 2015 and January through August 2016. These costs are summarized in Table 15-4. Dia Bras capitalizes its waste development, which has averaged approximately 10% of the material mined annually. Access to sublevels in the El Gallo Inferior room and pillar stopes is typically driven in ore, and ramp development and main haulage accounts for a majority of waste mined. SRK recommends regular review of the classification of capital development and expensed waste as mine production moves into different zones and additional preparation work on sublevels may be required.

**Table 15-4: Operating Costs, 2014 through August 2016**

| Category | Units | 2014 | 2015 | 2016 (January - August) |
|---|---|---|---|---|
| Mining Costs - Bolivar Mine | US$/t ore | 13.23 | 10.82 | 9.28 |
| Ore Transport - Mine to Piedras Verdes | US$/t ore | 5.07 | 4.77 | 4.31 |
| Processing Costs - Piedras Verdes | US$/t ore | 14.61 | 12.05 | 10.00 |
| Concentrate Shipping | US$/t ore | 4.15 | 3.45 | 2.42 |
| General and Administrative Expenses | US$/t ore | 5.46 | 3.85 | 3.40 |
| **Total** | **US$/t ore** | **$42.52** | **$34.95** | **$29.42** |

Source: SRK, 2017

The economic and marginal cut-offs used in this report are provided in Table 15-5. More than 92% of reserves tonnes are planned for extraction using room and pillar mining. Chimenea 1, Chimenea 2, and an area in Bolivar West is favorable to a modified longhole stoping method. An additional cost per tonne has been added to account for the slot raise, sill preparation and ground support.

**Table 15-5: Economic and Marginal Cut-offs by Mining Method**

| Mining Method | Economic Cut-off (US$/t ore) | Marginal Cut-off (US$/t ore) |
|---|---|---|
| Room and Pillar | 30.50 | 24.50 |
| Longhole | 32.50 | 26.50 |

Source: SRK, 2017

### 15.2.5 Mining Block Shapes

The mining method used in El Gallo Inferior is Room and Pillar. Room and Pillar mining is also planned for shallow dipping ore in Bolivar West, and Bolivar Northwest. Steeper dipping ore bodies in Chimenea 1, Chimenea 2 and Bolivar West are planned for extraction using longhole stoping techniques. Potential mining blocks were constructed using Maptek Vulcan software and its implementation of Stope Shape Optimizer produced by Alford Mining Systems. Additional information on the optimization parameters can be found in Section 16.3. The stope blocks output from Stope Shape Optimizer were reviewed on a level-by-level basis and were manually refined so that they could be practically mined. Sill pillar levels were identified and flagged for exclusion from the reserves. As previously described, SRK considers the recovery of portions of vertical and sill pillars as a potential to increase future reserves, but quantifying, planning and implementing a pillar recovery program requires further study in order to be able to estimate a reserve for this material.

A mine design incorporating the development required to access the mining blocks and a production schedule were created as described in Section 16. The production schedule results were input into a Technical Economic Model, described in Section 22, to verify the economic viability of the reserves estimated for this report.

## 15.3 Reserve Estimate

**Mineral Reserves were classified using the 2014 CIM Definition Standards. The QP for the estimate is Jon Larson, P.E., MMSA QP of SRK Consulting (U.S.), Inc. The consolidated mineral reserve statement for the Bolivar Mine area is presented in Table 15-6: Consolidated Bolivar Mineral Reserve Estimate as of September 30, 2016 – SRK Consulting (U.S.), Inc.**

| Category | Tonnes (000's) | Ag (g/t) | Au (g/t) | Cu (%) | Ag (koz) | Au (koz) | Cu (t) |
|---|---|---|---|---|---|---|---|
| Proven | - | - | - | - | - | - | - |
| Probable | 4,327 | 17.5 | 0.31 | 0.85 | 2,441 | 44 | 36,586 |
| P+P | 4,327 | 17.5 | 0.31 | 0.85 | 2,441 | 44 | 36,586 |

(1) All figures rounded to reflect the relative accuracy of the estimates. Totals may not sum due to rounding.
(2) Ore reserves are reported at NSR cut-offs (CoG) based on metal price assumptions*, metallurgical recovery assumptions**, mining costs, processing costs, general and administrative (G&A) costs, and treatment and refining charges.
* Metal price assumptions considered for the calculation of NSR are: Copper (Cu): US$/lb 2.43, Silver (Ag): US$/oz 18.30, and Gold (Au): US$/oz 1,283.00.
** Metallurgical recovery assumptions are 81% Cu, 77% Ag, and 49% Au.
(3) The NSR CoG is variable by mining method:
- US$30.50 = Room and Pillar; and
- US$32.50 = Longhole Stoping.

(4) Ore reserves have been stated on the basis of a mine design, mine plan, and cash-flow model:
- Mining recovery applied is 85%.
- Mining dilution (internal and external), applied with a zero grade, ranges from 12% to 36% and averages 16%.

Source: SRK, 2017

Table 15-7. A detailed break-down of the mineral reserves by area in presented in Table 15-7. The reserves estimated herein are as of September 30, 2016. All values are estimated mill feed and include mining dilution and recovery.

**Table 15-6: Consolidated Bolivar Mineral Reserve Estimate as of September 30, 2016 – SRK Consulting (U.S.), Inc.**

| Category | Tonnes (000's) | Ag (g/t) | Au (g/t) | Cu (%) | Ag (koz) | Au (koz) | Cu (t) |
|---|---|---|---|---|---|---|---|
| Proven | - | - | - | - | - | - | - |
| Probable | 4,327 | 17.5 | 0.31 | 0.85 | 2,441 | 44 | 36,586 |
| P+P | 4,327 | 17.5 | 0.31 | 0.85 | 2,441 | 44 | 36,586 |

(5) All figures rounded to reflect the relative accuracy of the estimates. Totals may not sum due to rounding.
(6) Ore reserves are reported at NSR cut-offs (CoG) based on metal price assumptions*, metallurgical recovery assumptions**, mining costs, processing costs, general and administrative (G&A) costs, and treatment and refining charges.
* Metal price assumptions considered for the calculation of NSR are: Copper (Cu): US$/lb 2.43, Silver (Ag): US$/oz 18.30, and Gold (Au): US$/oz 1,283.00.
** Metallurgical recovery assumptions are 81% Cu, 77% Ag, and 49% Au.
(7) The NSR CoG is variable by mining method:
- US$30.50 = Room and Pillar; and
- US$32.50 = Longhole Stoping.

(8) Ore reserves have been stated on the basis of a mine design, mine plan, and cash-flow model:
- Mining recovery applied is 85%.
- Mining dilution (internal and external), applied with a zero grade, ranges from 12% to 36% and averages 16%.

Source: SRK, 2017

**Table 15-7: Detailed Bolivar Mineral Reserve Estimate as of September 30, 2016 – SRK Consulting (U.S.), Inc.**

| Zone | Category | Tonnes (000's) | Ag (g/t) | Au (g/t) | Cu (%) | Ag (koz) | Au (koz) | Cu (t) |
|---|---|---|---|---|---|---|---|---|
| El Gallo Inferior | Proven | - | - | - | - | - | - | - |
| | Probable | 2,051 | 14.2 | 0.24 | 0.82 | 938 | 16 | 16,787 |
| | P+P | 2,051 | 14.2 | 0.24 | 0.82 | 938 | 16 | 16,787 |
| Chimenea 1 | Proven | - | - | - | - | - | - | - |
| | Probable | 86 | 49.3 | 0.02 | 2.01 | 136 | 0 | 1,724 |
| | P+P | 86 | 49.3 | 0.02 | 2.01 | 136 | 0 | 1,724 |
| Chimenea 2 | Proven | - | - | - | - | - | - | - |
| | Probable | 87 | 20.6 | 0.02 | 0.85 | 57 | 0 | 735 |
| | P+P | 87 | 20.6 | 0.02 | 0.85 | 57 | 0 | 735 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Bolivar NW 1 | Proven | - | - | - | - | - | - | - |
| | Probable | 875 | 10.2 | 0.62 | 0.82 | 288 | 18 | 7,187 |
| | P+P | 875 | 10.2 | 0.62 | 0.82 | 288 | 18 | 7,187 |
| Bolivar NW 2 | Proven | - | - | - | - | - | - | - |
| | Probable | 34 | 19.6 | 0.19 | 0.82 | 22 | 0 | 281 |
| | P+P | 34 | 19.6 | 0.19 | 0.82 | 22 | 0 | 281 |
| Bolivar NW 4 | Proven | - | - | - | - | - | - | - |
| | Probable | 281 | 19.5 | 0.52 | 0.66 | 176 | 5 | 1,849 |
| | P+P | 281 | 19.5 | 0.52 | 0.66 | 176 | 5 | 1,849 |
| Bolivar NW 6 | Proven | - | - | - | - | - | - | - |
| | Probable | 138 | 55.6 | 0.62 | 0.83 | 247 | 3 | 1,146 |
| | P+P | 138 | 55.6 | 0.62 | 0.83 | 247 | 3 | 1,146 |
| Bolivar NW 7 | Proven | - | - | - | - | - | - | - |
| | Probable | 120 | 12.0 | 0.50 | 0.75 | 46 | 2 | 896 |
| | P+P | 120 | 12.0 | 0.50 | 0.75 | 46 | 2 | 896 |
| Bolivar NW Z2 | Proven | - | - | - | - | - | - | - |
| | Probable | 66 | 36.5 | 0.28 | 0.78 | 78 | 1 | 520 |
| | P+P | 66 | 36.5 | 0.28 | 0.78 | 78 | 1 | 520 |
| Bolivar West | Proven | - | - | - | - | - | - | - |
| | Probable | 590 | 23.9 | - | 0.93 | 453 | - | 5,461 |
| | P+P | 590 | 23.9 | - | 0.93 | 453 | - | 5,461 |
| **Total** | **Proven** | **-** | **-** | **-** | **-** | **-** | **-** | **-** |
| | **Probable** | **4,327** | **17.5** | **0.31** | **0.85** | **2,441** | **44** | **36,586** |
| | **P+P** | **4,327** | **17.5** | **0.31** | **0.85** | **2,441** | **44** | **36,586** |

(1) All figures rounded to reflect the relative accuracy of the estimates. Totals may not sum due to rounding.
(2) Ore reserves are reported at NSR cut-offs (CoG) based on metal price assumptions*, metallurgical recovery assumptions**, mining costs, processing costs, general and administrative (G&A) costs, and treatment and refining charges.
* Metal price assumptions considered for the calculation of NSR are: Copper (Cu): US$/lb 2.43, Silver (Ag): US$/oz 18.30, and Gold (Au): US$/oz 1,283.00.
** Metallurgical recovery assumptions are 81% Cu, 77% Ag, and 49% Au.
(3) The NSR CoG is variable by mining method:
- US$30.50 = Room and Pillar; and
- US$32.50 = Longhole Stoping.

(4) Ore reserves have been stated on the basis of a mine design, mine plan, and cash-flow model:
- Mining recovery applied is 85%.
- Mining dilution (internal and external), applied with a zero grade, ranges from 12% to 36% and averages 16%.

Source: SRK, 2017

## 15.4 Relevant Factors

The production schedule associated with this reserves estimate results in mining until July 2021 at approximately 2,500 ore t/day. The tailings storage facility will need to be expanded. Dia Bras is managing the TSF expansion as described in detail in Section 18.11. Dia Bras is planning to install an additional thickener and filter presses and move to a dry stack method of tailings handling and storage. The overall tailings handling system will evolve over the next twelve months. Dia Bras has budgeted capital for these activities and is working with a number of external contractors to complete the various phases of the overall management plan. Delays in these projects could impact the overall mine plan by delaying the processing of ore at Piedras Verdes beyond 2017.

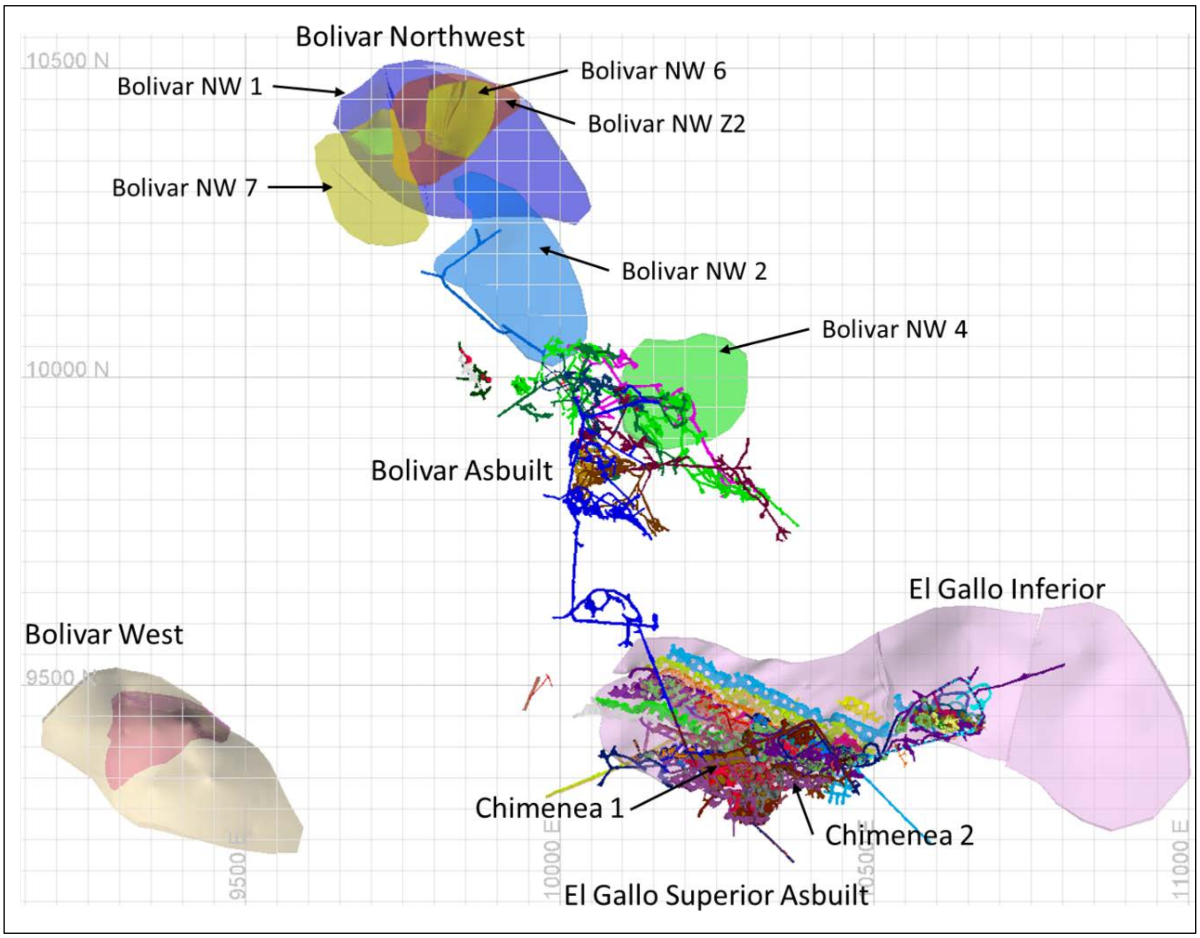
SRK knows of no other existing environmental, permitting, legal, socio-economic, marketing, political or other factors that might materially affect the mineral reserve estimate contained herein.

# 16 Mining Methods

## 16.1 Current or Proposed Mining Methods

Current production at Bolivar comes from the El Gallo Inferior ore body. Mining in El Gallo Inferior occurs below the El Gallo Superior ore body. Ore is hauled to the surface using one of several adits or declines accessing the orebodies and dumped onto small pads outside the portals. The ore is then loaded into rigid frame over-the-road trucks, typically 18 tonne capacity, and hauled on a gravel and dirt road approximately 5.1 km south to the Piedras Verdes mill. Future production will include ore from El Gallo Inferior, Chimenea 1, Chimenea 2, Bolivar West, and Bolivar Northwest (NW). Bolivar NW reserves are further broken down into Bolivar NW 1, NW 2, NW 4, NW 6, NW 7, and NW Z2.

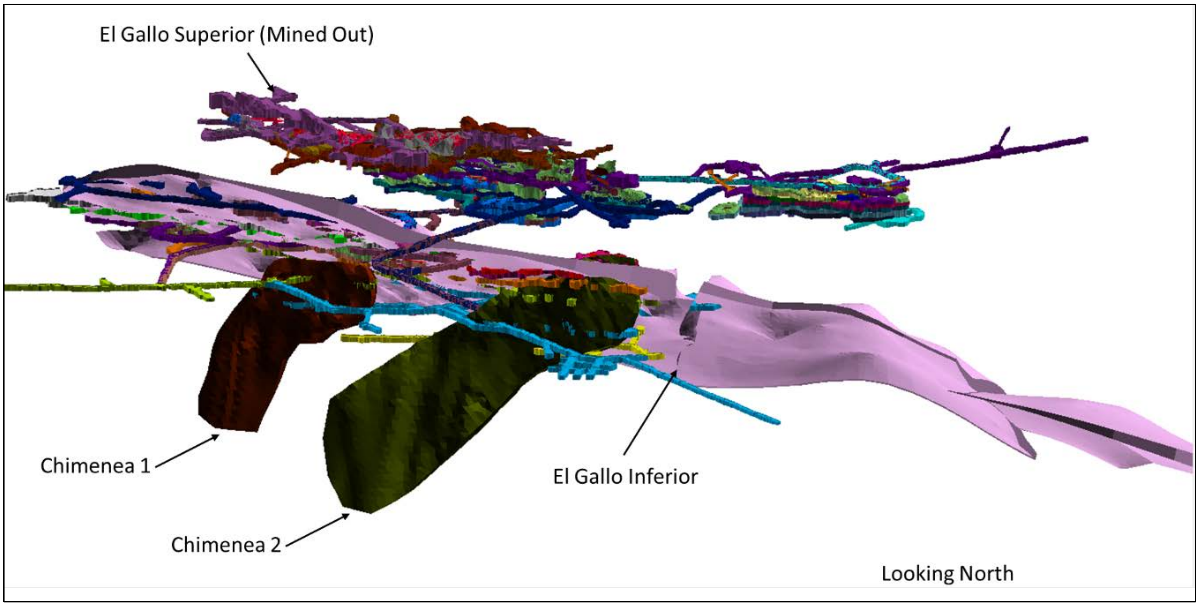
Figure 16-1 shows a plan view of the Bolivar mine, the geology shapes, and the mined out areas.




Source: SRK, 2017

**Figure 16-1: Bolivar Ore Body Location Overview and Mined Out Areas**

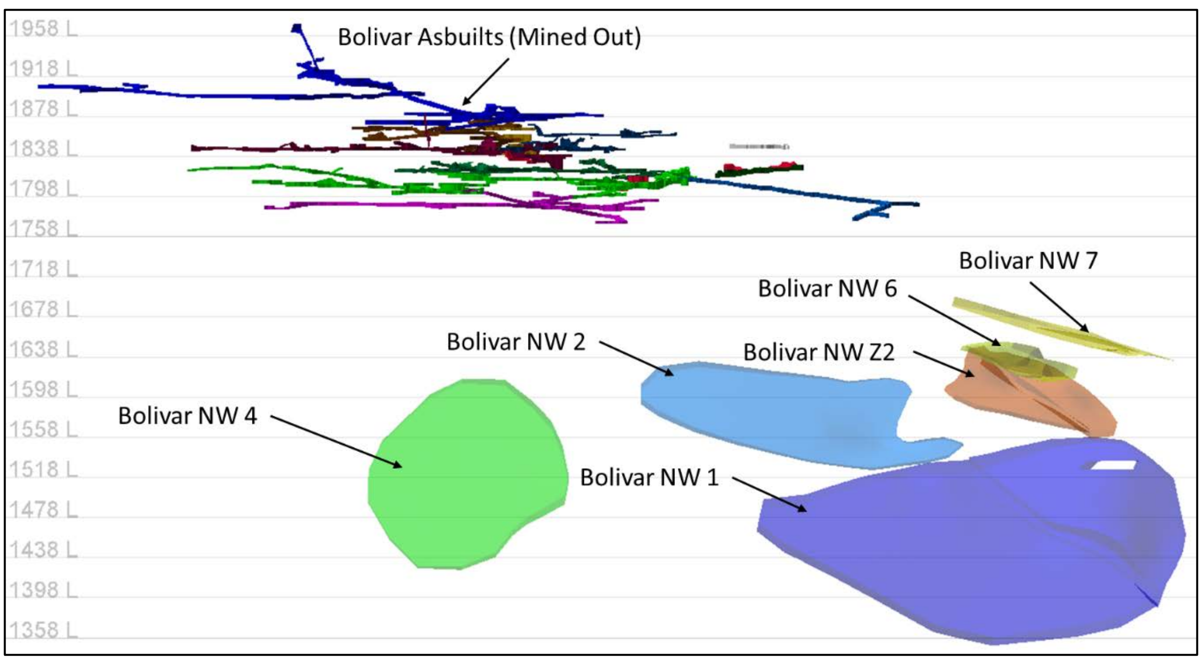
Figure 16-2 shows a rotated view of the El Gallo Inferior area and also shows the Chimenea 1 and Chimenea 2 ore bodies.




Source: SRK, 2017

**Figure 16-2: Rotated View Showing El Gallo Inferior, Chimenea 1 and Chimenea 2 Ore Bodies with Mined-out Areas**

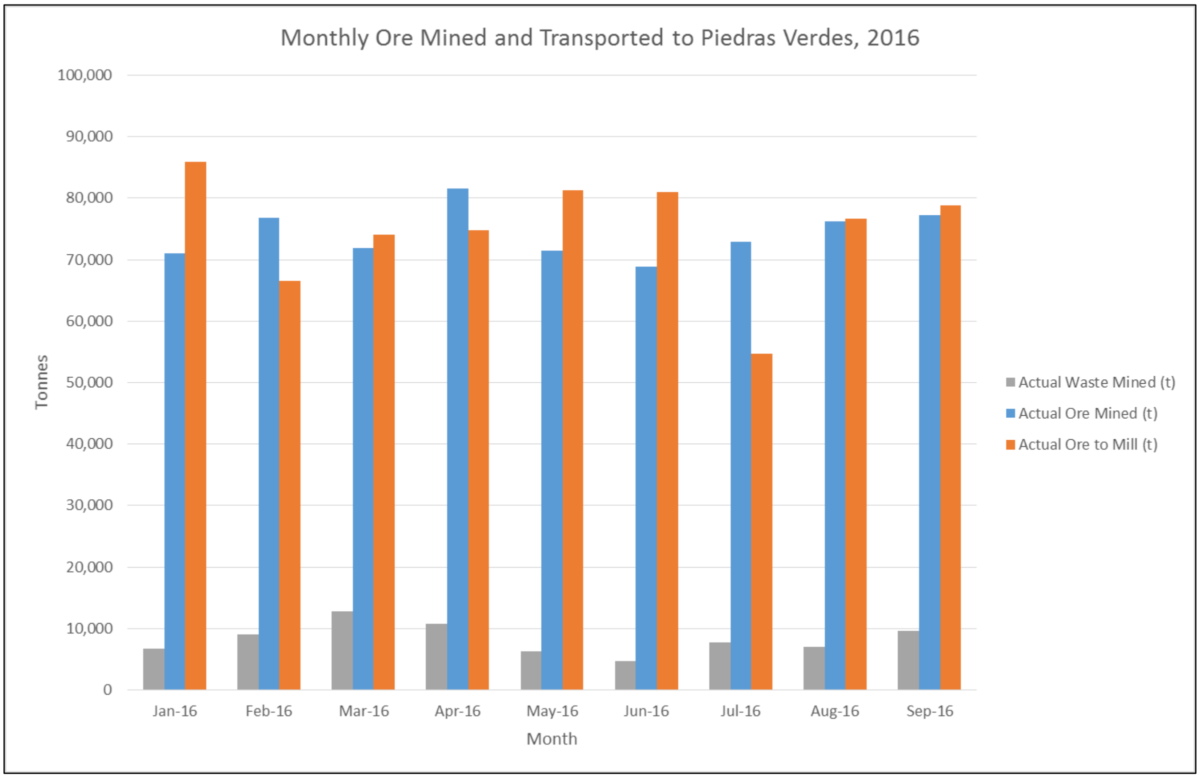
Figure 16-3 shows a rotated view, looking southwest, of Bolivar Northwest 4, 1, 2, 6, 7, and Z2 as well as asbuilt shapes of previous mining.




Source: SRK, 2017

**Figure 16-3: Rotated View Showing Bolivar NW Zones**

Ore production for January through September 2016, as reported by the mine, was just over 668,000 total tonnes. Waste mining totaled 74,500 tonnes, and for the same period, 673,600 tonnes were reported as transported to the Piedras Verdes mill. Figure 16-4 shows January through September 2016 waste and ore production as well as the tonnes transported to Piedras Verdes by month.




Source: SRK, 2017

**Figure 16-4: Mined and Transported Ore, 2016**

During SRK's visit to site in October 2016, it was reported that approximately 67,000 tonnes of broken ore was in the mine in stopes ready to be mucked out or in small underground stockpiles. A small amount of ore is stockpiled near the primary crusher at the mill site. Other broken ore is temporarily placed outside portal locations prior to being hauled to the mill. No other long term or low grade ore stockpiles are in use.

Table 16-1 shows a comparison of planned tonnes and grade vs. production as reported by the mill (dry tonnes). Considering the information contained in Figure 16-4 and Table 16-1, SRK notes the following:

- Monthly ore production from the mine is between 70,000 and 80,000 t/month and averaged 74,200 t/month. Waste mining averaged 8,275 t/month.
- Ore processed for the period was approximately 10% below target. Head grades for copper, the primary value driver for the operation, were approximately 4.5% below plan. The planned mill feed grades do not vary by month. Monthly estimates of planned grades may allow the operation to better prepare for variations in ore including the potential for blending from different levels or areas of the mine.

- The operation's ability to maintain short term stockpiles of ore in the mine, at the portal locations, and at the mill helps mitigate temporary disruptions in the mining, ore transport and milling operations.
- In the three months where tonnes processed by the mill was less than 70,000 t/month, Cu grades were 14.5% higher than the average grades of the other months. It is not clear whether these are anomalies or were expected/planned due to zones of higher grade ore encountered in the mine.

**Table 16-1: Planned vs. Reported Production, Piedras Verdes Mill, 2016**

| | Planned | | | | Reported Mill Processed | | | |
|---|---|---|---|---|---|---|---|---|
| **Month** | **Tonnes (dry t)** | **Cu (%)** | **Ag (g/t)** | **Au (g/t)** | **Tonnes (dry t)** | **Cu (%)** | **Ag (g/t)** | **Au (g/t)** |
| January | 89,571 | 1.05 | 22.0 | 0.30 | 82,965 | 0.96 | 18.9 | 0.29 |
| February | 83,600 | 1.05 | 22.0 | 0.30 | 67,076 | 1.18 | 18.1 | 0.22 |
| March | 88,611 | 1.05 | 22.0 | 0.30 | 68,845 | 1.06 | 18.0 | 0.28 |
| April | 85,556 | 1.05 | 22.0 | 0.30 | 83,061 | 0.96 | 20.5 | 0.28 |
| May | 88,611 | 1.05 | 22.0 | 0.30 | 84,979 | 0.97 | 17.5 | 0.18 |
| June | 85,556 | 1.05 | 22.0 | 0.30 | 68,212 | 1.07 | 17.3 | 0.14 |
| July | 88,611 | 1.05 | 22.0 | 0.30 | 82,812 | 0.94 | 15.7 | 0.13 |
| August | 88,611 | 1.05 | 22.0 | 0.30 | 84,302 | 0.99 | 14.4 | 0.12 |
| September | 85,556 | 1.05 | 22.0 | 0.30 | 83,146 | 0.94 | 14.2 | 0.14 |
| **Total** | **784,283** | **1.05** | **22.0** | **0.30** | **705,398** | **1.00** | **17.1** | **0.20** |

Source: SRK, 2017

Table 16-2 shows the average daily mine production for 2014, 2015 and 2016 (January through September).

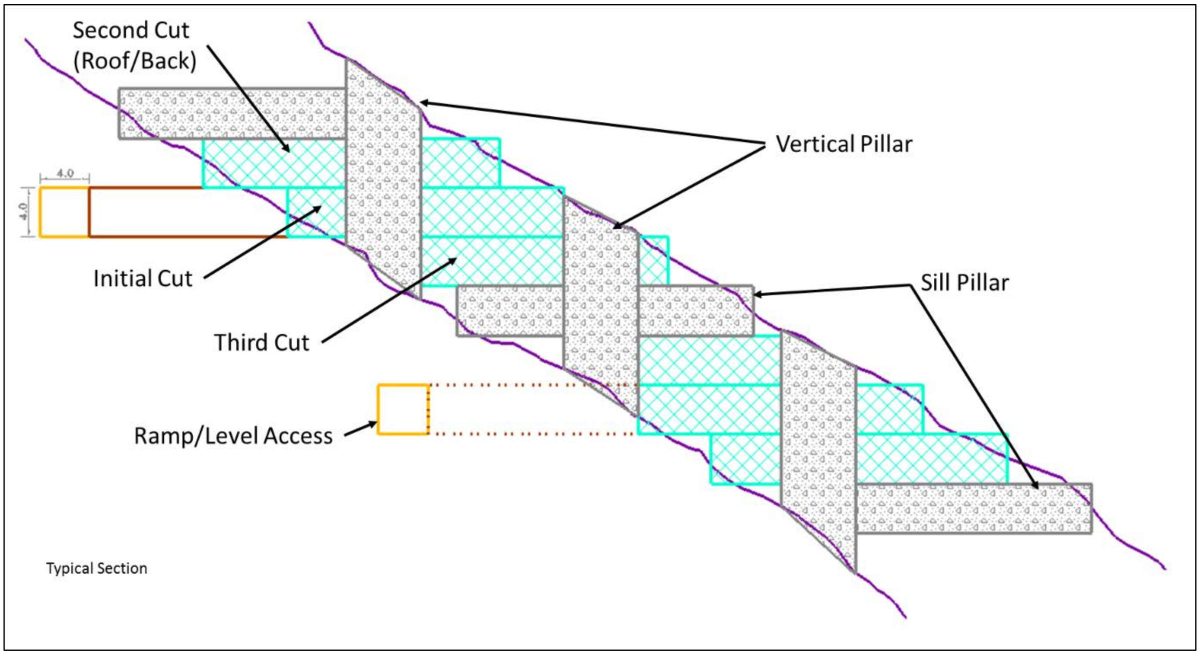
**Table 16-2: Reported Mine and Mill Production**

| **Category** | **2014** | **2015** | **2016 (January to September)** |
|---|---|---|---|
| Ore Mined (t/day) | 1,644 | 2,253 | 2,438 |
| Waste Mined (t/day) | 175 | 281 | 272 |
| Total Mined (t/day) | 1,818 | 2,534 | 2,710 |
| Total Development (m/day) | 9.4 | 14.2 | 14.4 |

Source: SRK, 2017

### 16.1.1 Room and Pillar Mining

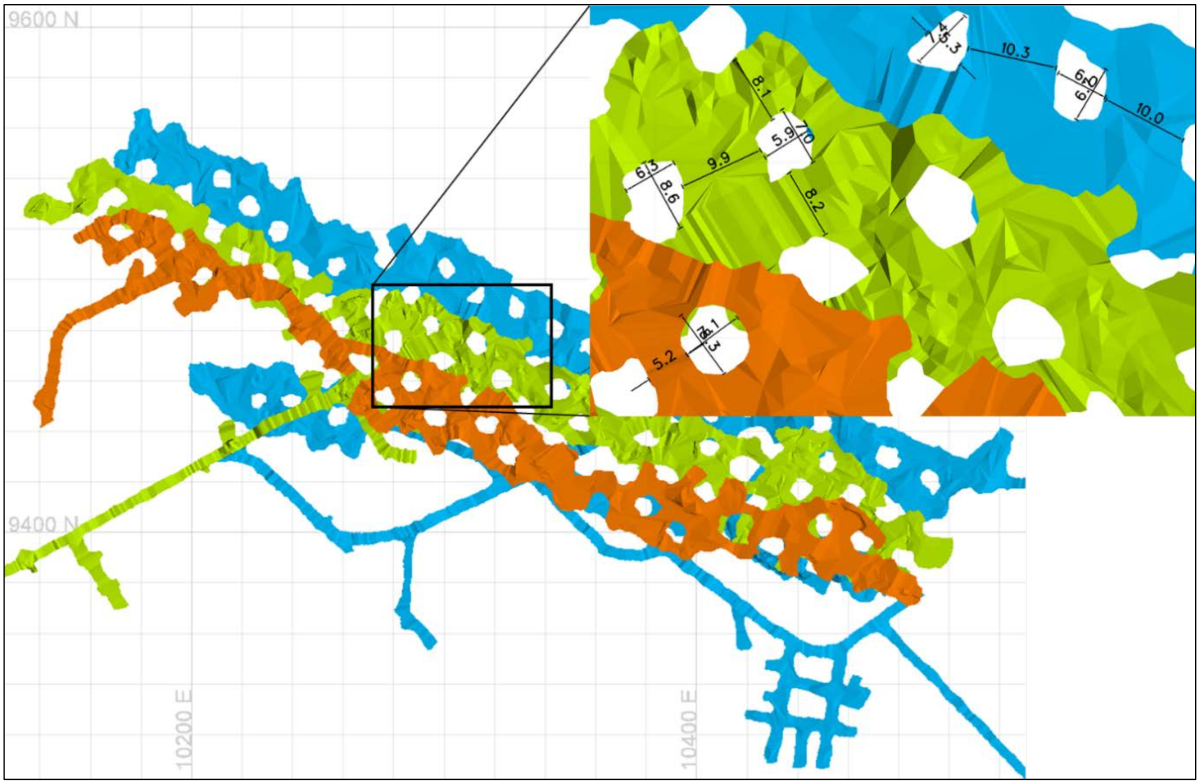
Areas where room and pillar mining occurs are divided into levels measuring approximately 16 m high. Each 16 m level is further divided into sublevels of approximately 4 m. A ramp is driven and access to the middle sublevel is established in the footwall, and the initial cut in ore is developed at this middle sublevel. The roof is then drilled, blasted and mucked. The third cut is mined down to the lower sublevel floor. Ramps are established in ore whenever possible to minimize the mining of waste. The remaining 4 m of material is left as a sill pillar. Figure 16-5 shows a typical section through two room and pillar levels.




Source: SRK, 2017

**Figure 16-5: Typical Section Showing Room and Pillar Mining**

Figure 16-6 shows a plan view of three existing sublevels in El Gallo Inferior illustrating the pillar size and span. The blue, green and orange levels have floor elevations of approximately 1,760 m, 1,775 m and 1,787 m, respectively. The inset image is labeled with distances in meters. Pillar dimensions on this level range from approximately 5.9 to 8.6 m with spans from 5.2 to 10.3 m.

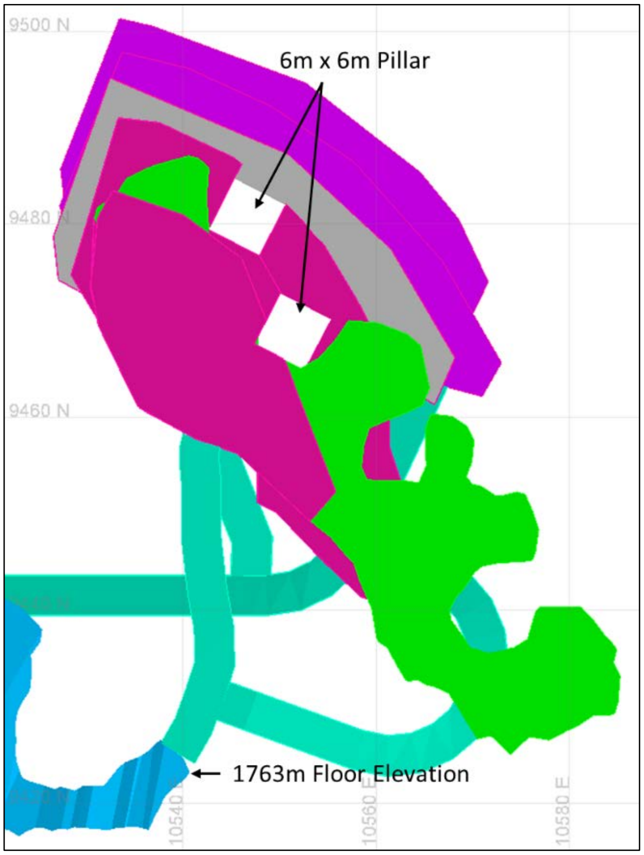



Source: SRK, 2017

**Figure 16-6: El Gallo Inferior Levels with Pillar Sizes and Span**

SRK notes that pillars are designed on a regular pattern. An opportunity exists to do a detailed design on a level-by-level basis in order to optimize pillar placement. Working with site personnel, a review of a mining area in El Gallo Inferior on level (rebaje) 762 was performed. Figure 16-7 and Figure 16-8 show overviews of the area. Variation in colors signify groupings of cuts. Figure 16-9 through Figure 16-13 show a detailed design of this area with Figure 16-9 through Figure 16-13 showing profiles at the sublevel spacing from the top to the bottom of the designed area.

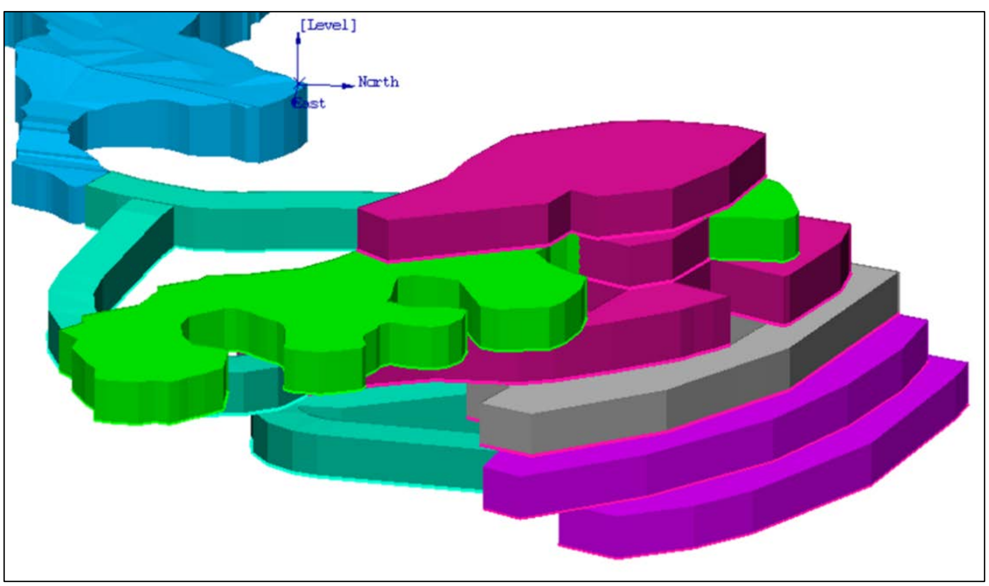
The existing mined out material is shown in green; the mining on this sublevel defines the pillar placement. Care should be taken to review the sublevels above and below to help optimize the pillar placement taking into account ore grades, room size and pillar size. Two pillars are established in the design. Field evaluation of the geotechnical conditions of the ore, waste rock, and the overall stability of the openings is required to ensure safe extraction.




Source: SRK, 2017

**Figure 16-7: Plan View of Rebaje 762 in El Gallo Inferior**

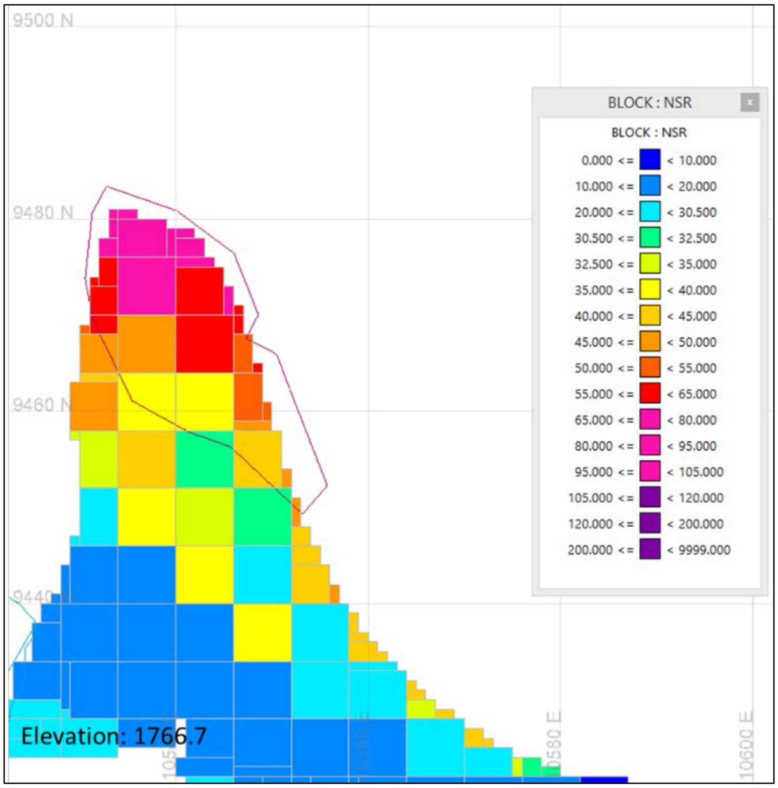
Figure 16-8 shows an isometric view of the area.




Source: SRK, 2017

**Figure 16-8: Isometric View of Rebaje 762**

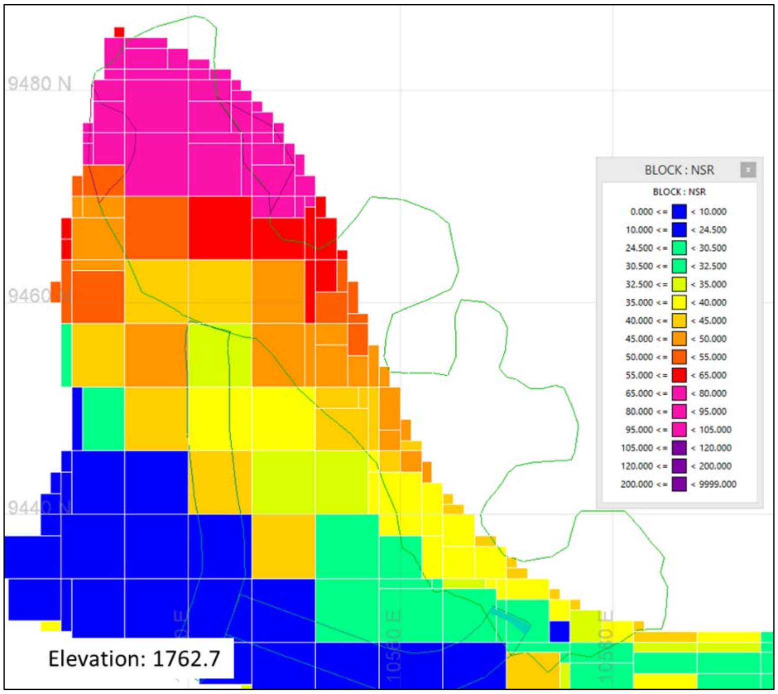
Figure 16-9 shows the upper most sublevel in this design. A section through the block model is shown colored by NSR values. The block model blocks range in size from 1 m x 1 m to 6 m x 6 m. Also shown is as an outline of the mining block on the level. The size and shape of the potential mining block on this level is in part determined by the active mining on the level below shown in Figure 16-10.




Source: SRK, 2017

**Figure 16-9: Profile View at 1766.7 m Elevation**

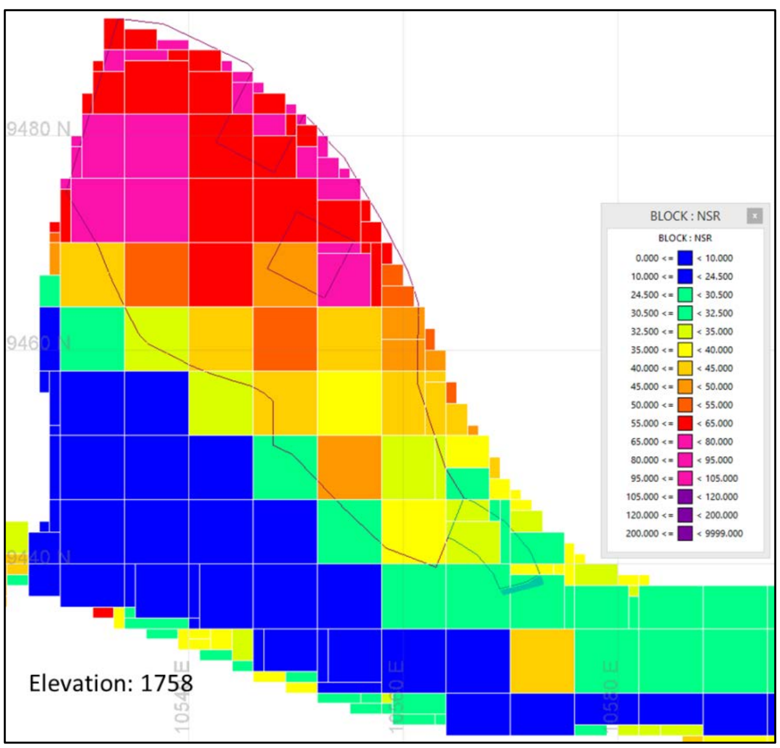
Figure 16-10 shows the existing asbuilt. SRK notes that mining has occurred outside of what the geology and resource models show as ore. As described in Section 14 of this report, maintaining a channel sample database using industry best practices will provide more detailed information for incorporation into the geology and resource models and ensure ore is incorporated into the plan or waste is not mined as ore.




Source: SRK, 2017

**Figure 16-10: Profile View at 1762.7 m Elevation**

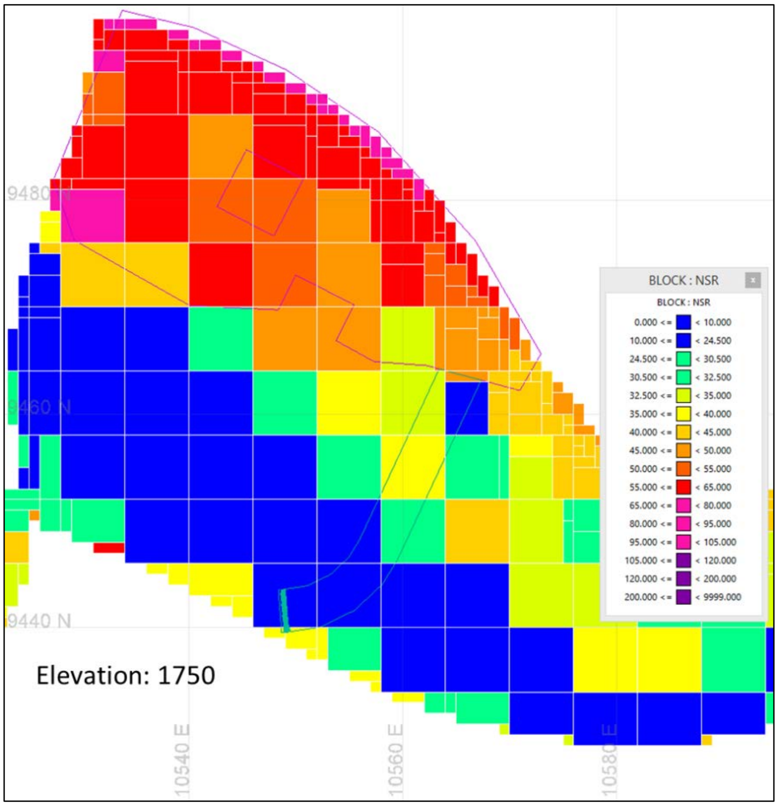
Figure 16-11 shows the mining block, pillars and block model profile at the 1758 elevation.




Source: SRK, 2017

**Figure 16-11: Profile View at 1758 m Elevation**

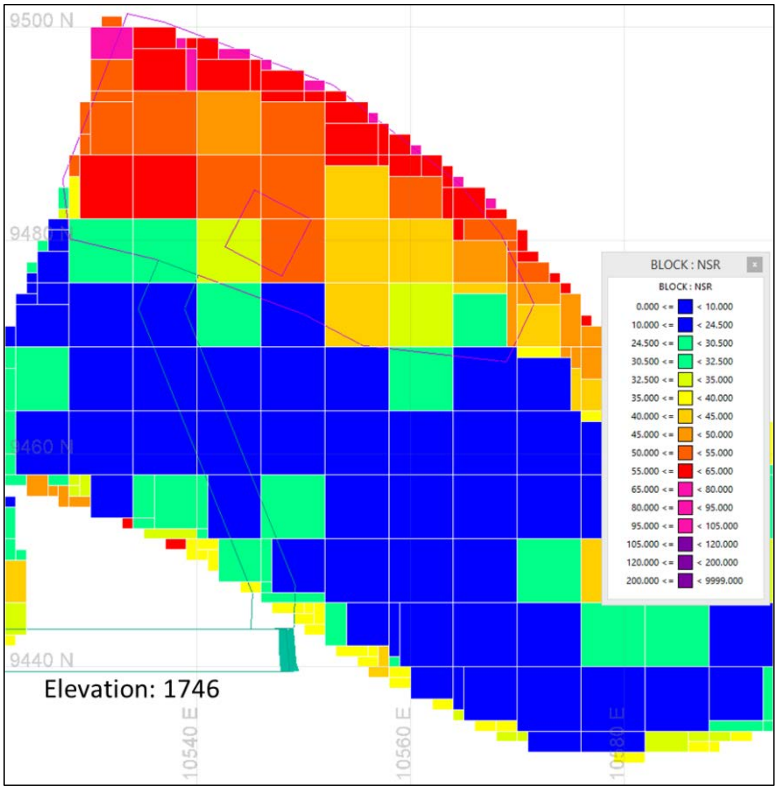
Figure 16-12 shows the mining block, pillars and block model profile at the 1750 elevation. The 1754 level is omitted as it is expected to be a sill pillar.




Source: SRK, 2017

**Figure 16-12: Profile View at 1750 m Elevation**

Figure 16-13 shows the mining block, pillars and block model profile at the 1746 elevation.

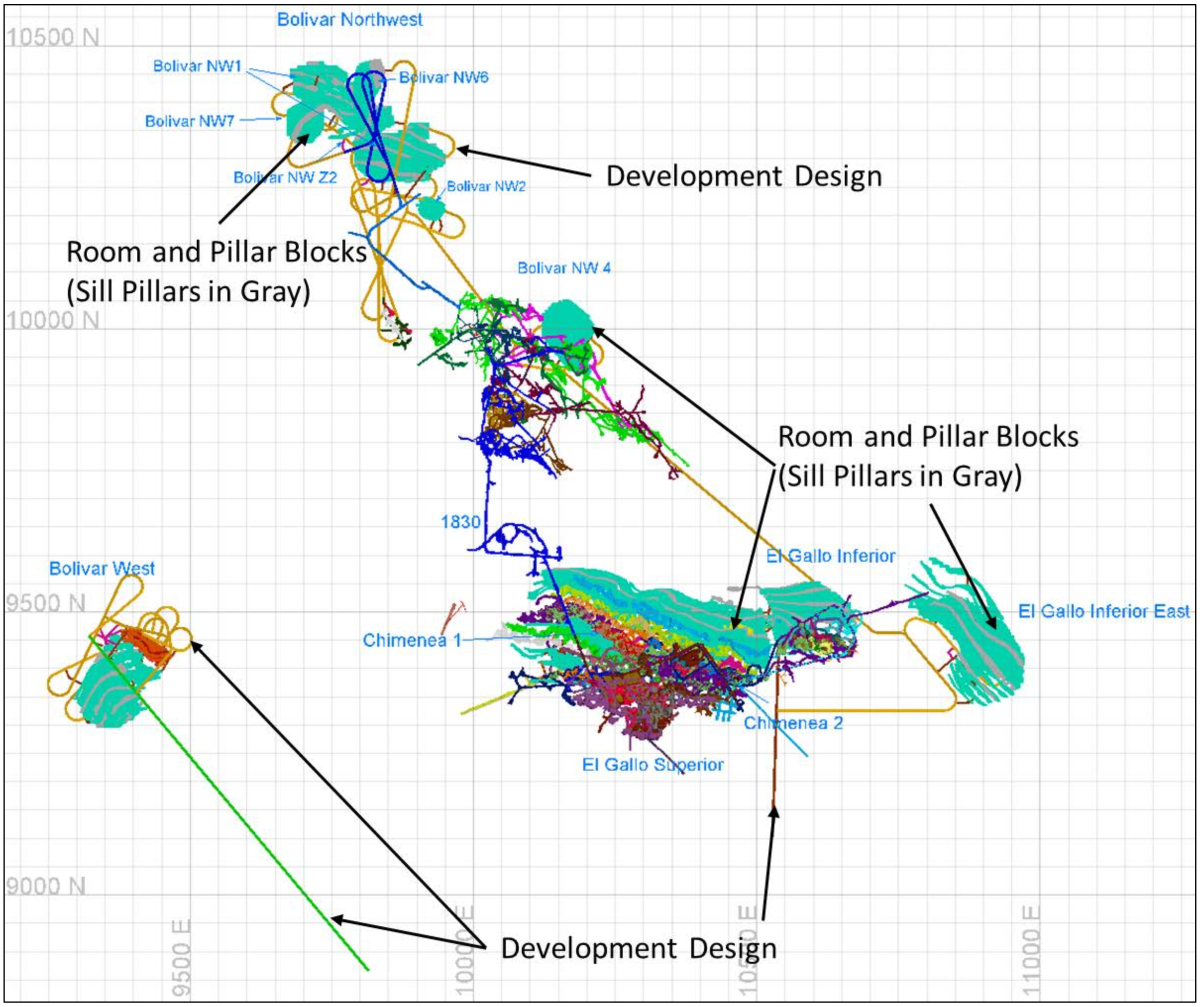



Source: SRK, 2017

**Figure 16-13: Profile View at 1746 m Elevation**

SRK recommends that the design and the mining in this area should be used as a test for strategic placement of pillars and optimization of the room and pillar size.

A room and pillar design was applied to El Gallo Inferior, Bolivar West and Bolivar Northwest. The El Gallo Inferior design includes a pod to the east of the main area as illustrated in Figure 16-14. Development dimensions are 4 m x 4 m up to 5 m wide x 5 m high depending on the purpose, mining area and level. Ramps are designed to a 12% maximum grade for rubber tire equipment.

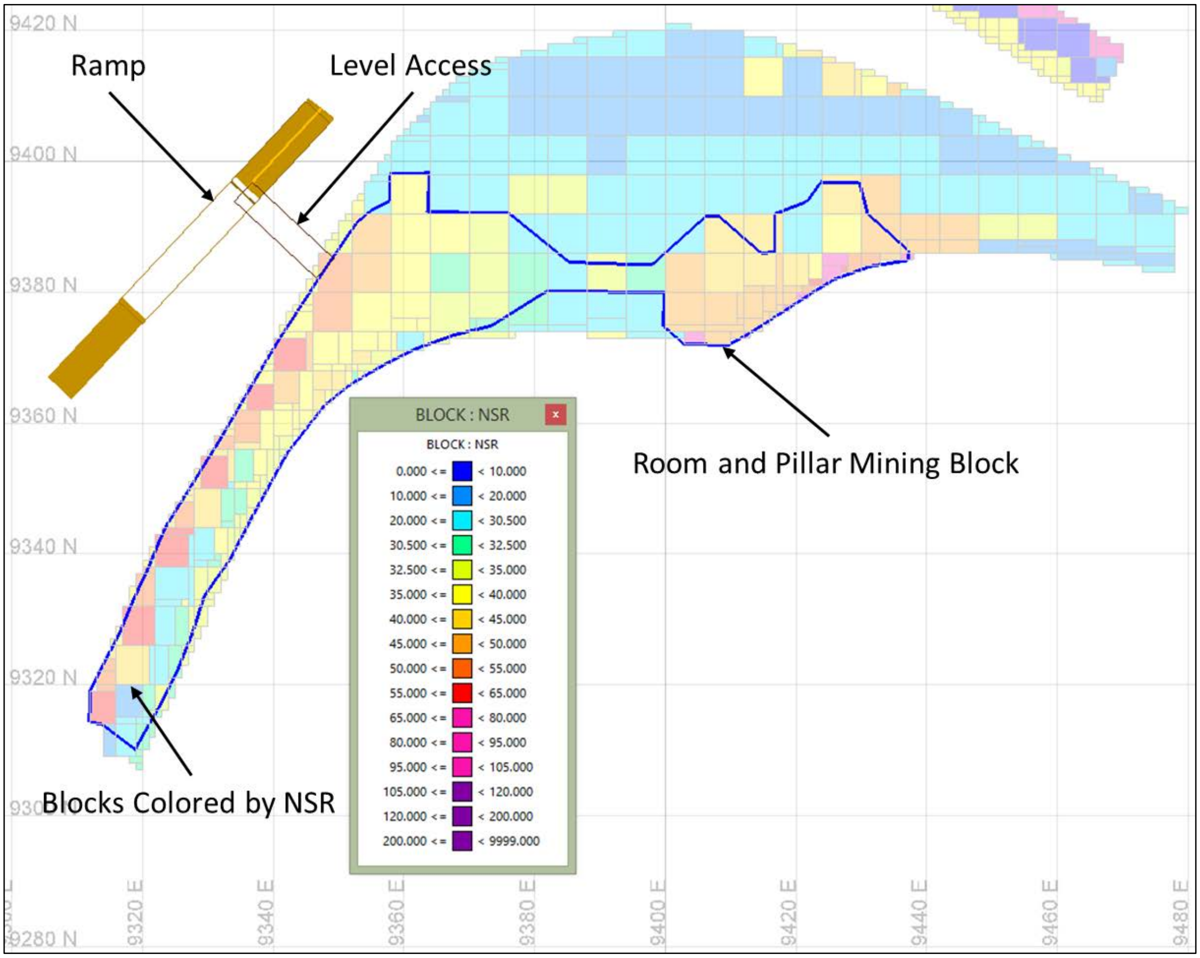



Source: SRK, 2017

**Figure 16-14: Overview of Mine Design for Reserves**

As described in Section15, the output from the stope optimization process was analyzed on a level-by-level basis. Polygons were drawn on level sections with levels spaced 4 m apart. Using the stope optimizer blocks as a guide, practical mining constraints such as a minimum mining width of 4 m, a minimum waste pillar width of 5 m, and reasonable access to the sublevel and mining block were considered in the design of the reserve block. Each 16 m level was divided into 4 m sublevels. Three of the sublevels will be mined with the fourth typically left as a sill pillar.

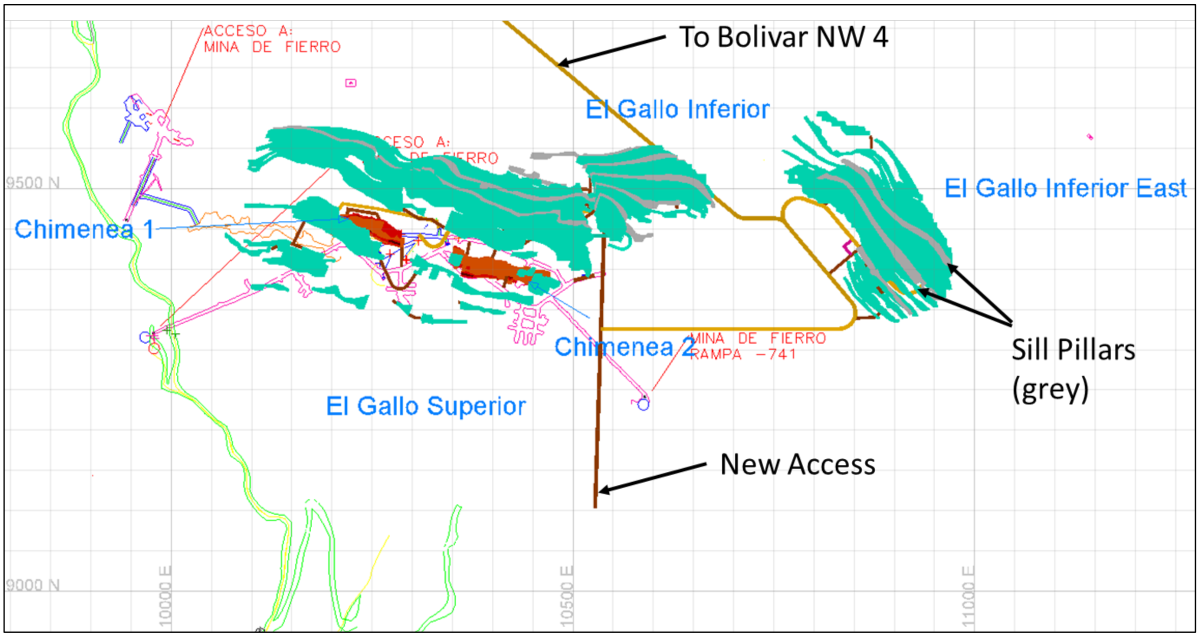
Figure 16-15 shows a level section in Bolivar Northwest on the 1514 floor elevation. The ramp is designed in the footwall, and access to the level is via a crosscut. This example shows where mining through lower grade material can provide access to other minable blocks. Use of sampling and ore control practices will allow the proper determination to be made whether or not to send the low grade material to the mill.




Source: SRK, 2017

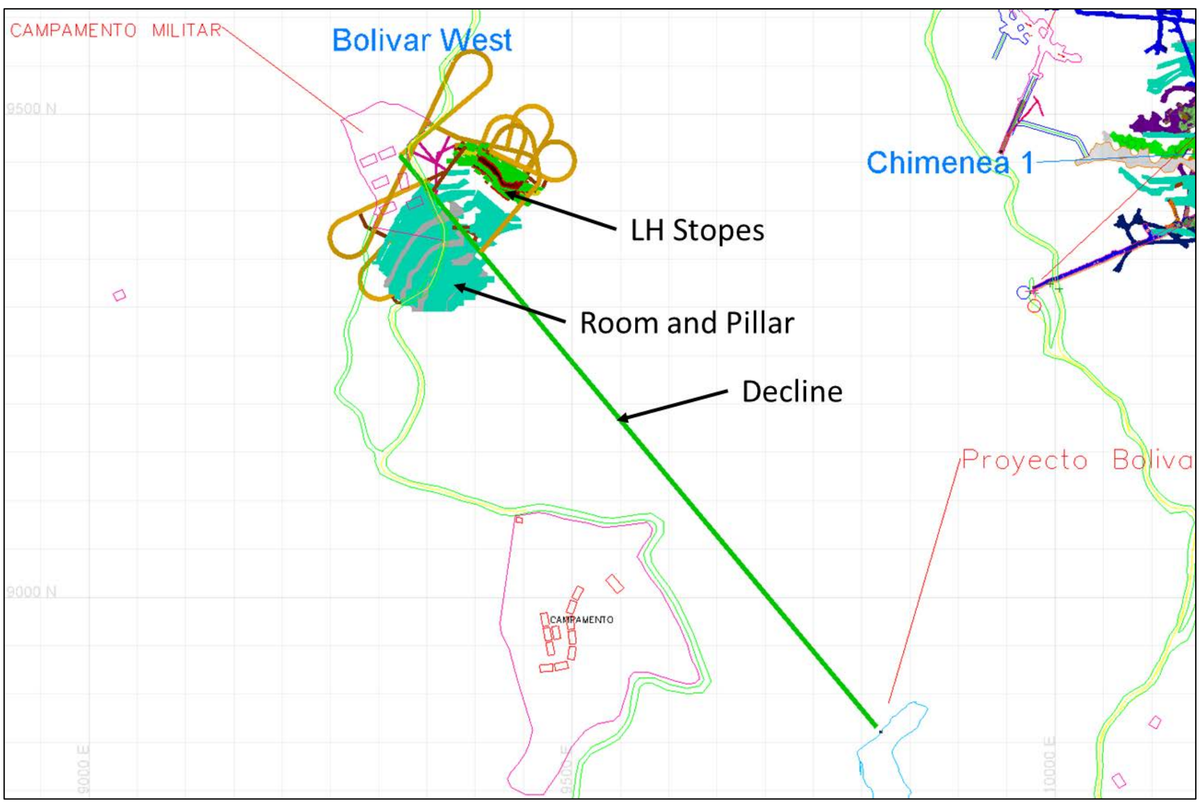
**Figure 16-15: Level Design in Bolivar West**

Figure 16-16 through Figure 16-19 show all of the mining areas with the development required to access the areas. Labels are provided to identify key features. As shown in Figure 16-20, significant development is required in Bolivar Northwest to access the deeper zones of those ore bodies.



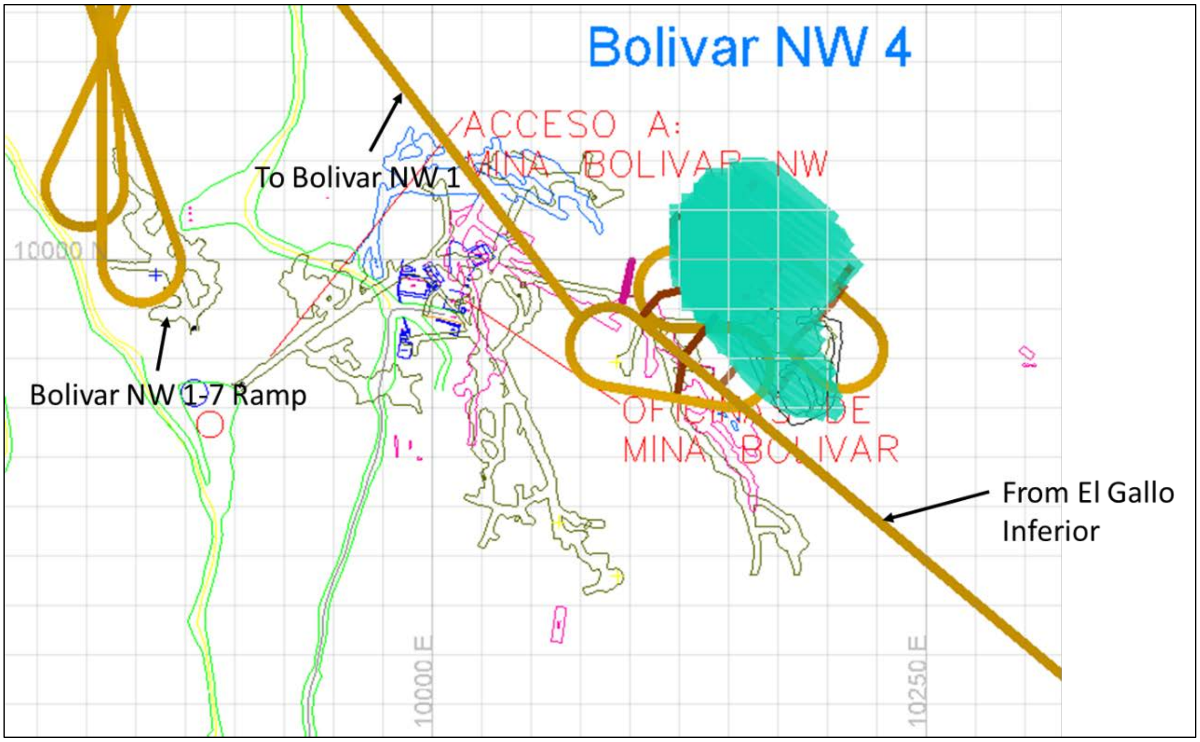

Source: SRK, 2017

**Figure 16-16: Plan View of El Gallo Inferior and Chimenea Reserve Blocks and Development**



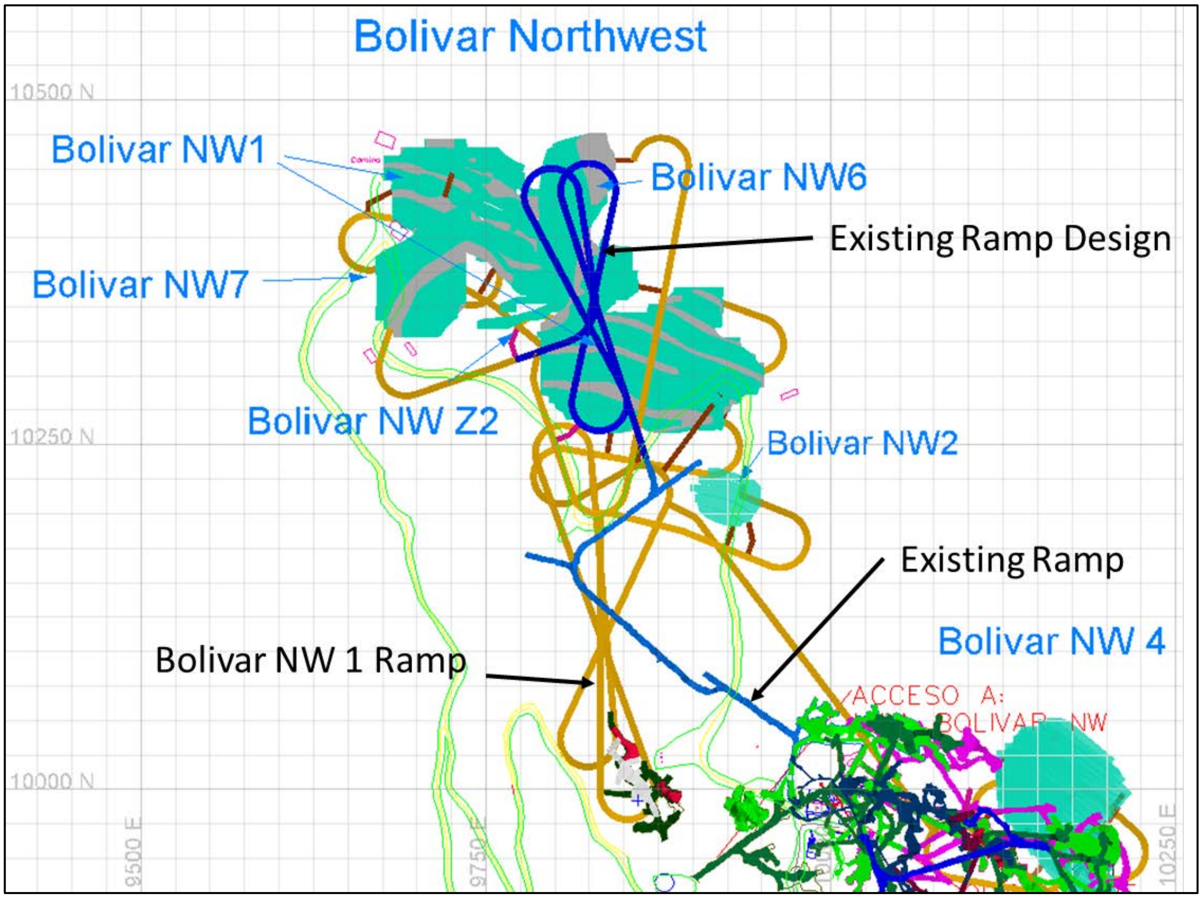

Source: SRK, 2017

**Figure 16-17: Plan View of Bolivar West Reserve Blocks and Development**



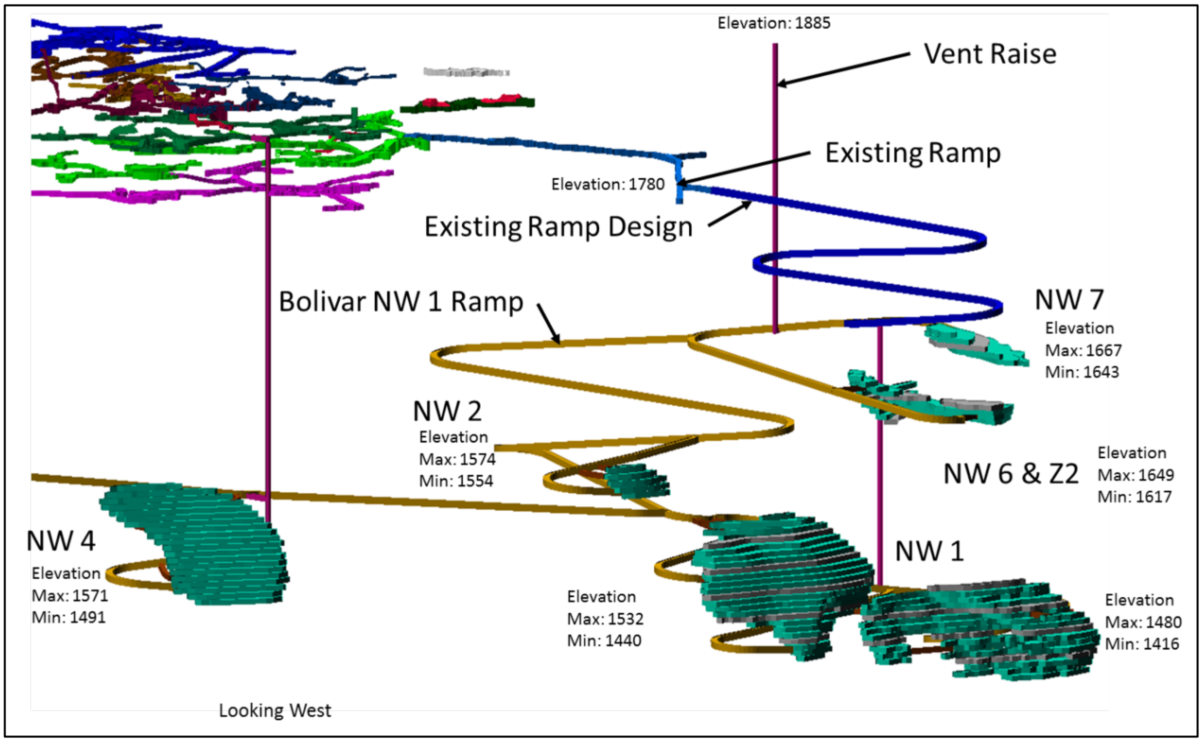

Source: SRK, 2017

**Figure 16-18: Plan View of Bolivar NW4 Reserve Blocks and Development**




Source: SRK, 2017

**Figure 16-19: Plan View of Bolivar NW1, Z2, 6 and 7 Reserve Blocks and Development**




Source: SRK, 2017

**Figure 16-20: Rotated View of Bolivar NW Reserve Blocks and Development**

The dip of the ore bodies varies, and some areas are suitable for the application of longhole stoping techniques. Typical ore body dip values are shown in Table 16-3.

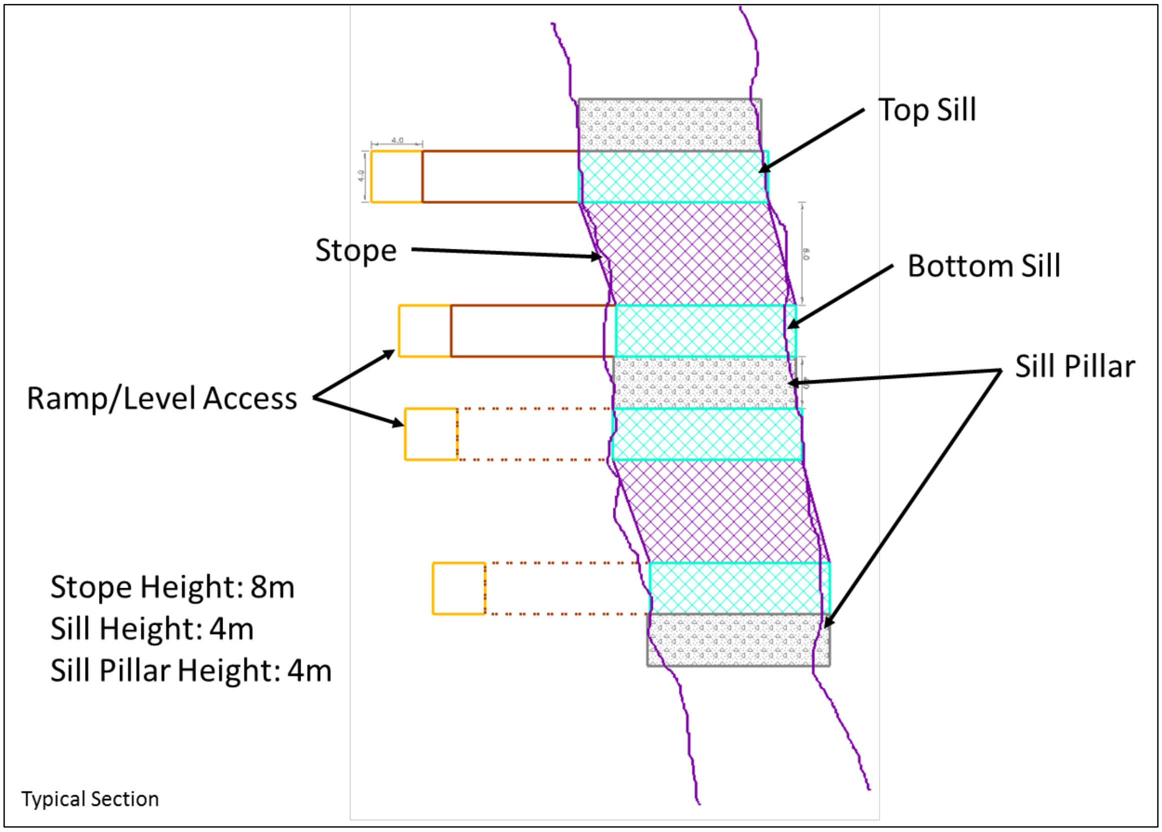
**Table 16-3: Typical Ore Body Dip Values**

| Ore Body | Typical Dip (Degrees) |
|---|---|
| El Gallo Inferior | 30 |
| Bolivar NW 1 | 35 |
| Bolivar NW 2 | 25 |
| Bolivar NW Z2 | 18 |
| Bolivar NW 4 | 40 |
| Bolivar NW 6 | 21 |
| Bolivar NW 7 | 15 |
| Bolivar W (Room and Pillar) | 34 |
| Bolivar W (Longhole) | 75 |
| Chimenea 1 | 73 |
| Chimenea 2 | 73 |

Source: SRK, 2017

## 16.1.2 Longhole Stoping

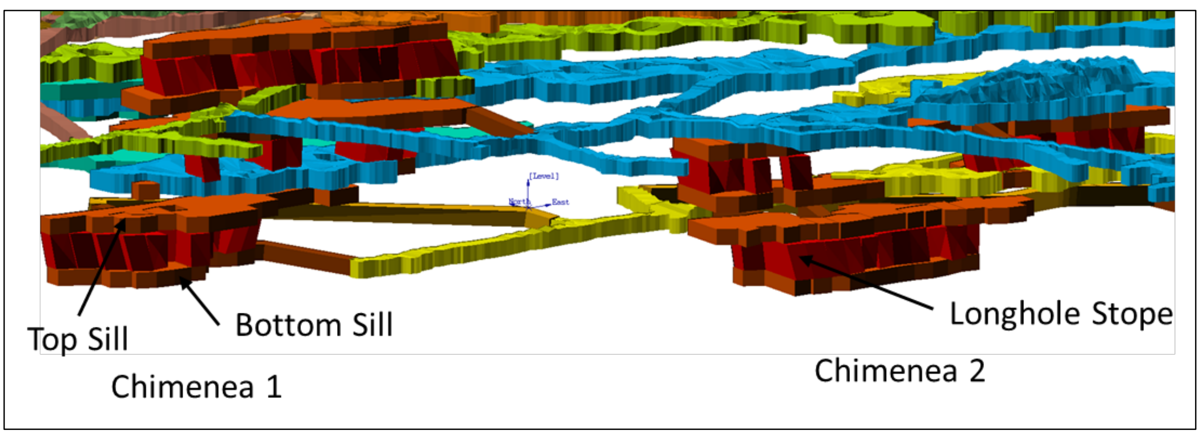
Chimenea 1, Chimenea 2 and the steeply dipping areas of Bolivar West are suitable for mining using longhole stoping techniques. Longhole stoping can provide for higher production and better recovery of the ore. However, there are currently limited zones in the Bolivar area where this mining method is applicable, and mining using this method accounts for approximately 8% of the reserves stated herein. The site has some past experience using longhole techniques in the Chimenea areas. A typical layout shown in Figure 16-21. Vertical pillars, though not shown in this section, will need to be utilized. These pillars will be 7 m x 7 m with a 12 m span.




Source: SRK, 2017

**Figure 16-21: Typical Longhole Stoping Section**

Figure 16-22 shows the design for Chimenea 1 and Chimenea 2, looking northeast, and the proximity to existing development and El Gallo Inferior.

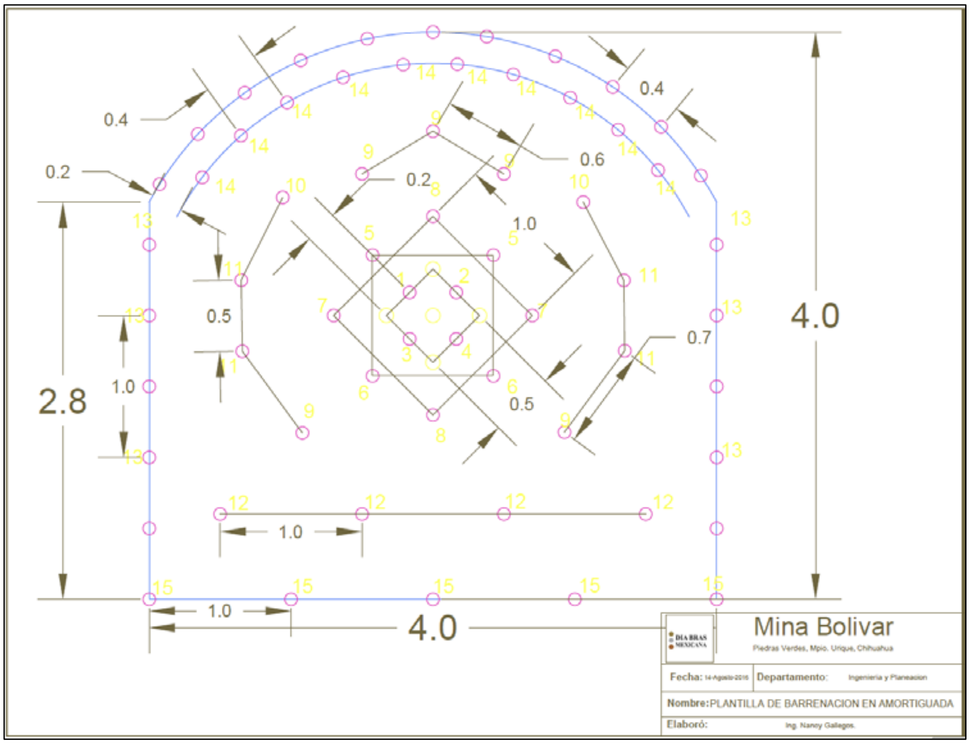



Source: SRK, 2017

**Figure 16-22: Isometric View of Chimenea 1 and Chimenea 2, Looking NE**

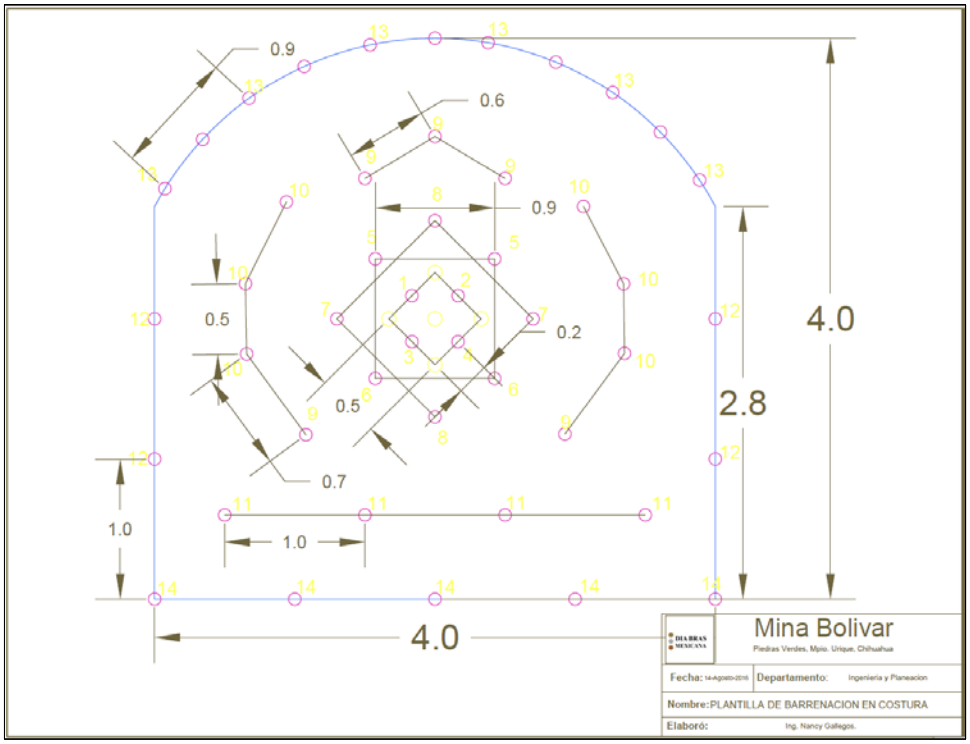
### 16.1.3 Drilling, Blasting, Loading and Hauling

Jackleg drills are used for lateral development and ramp development at Bolivar. Electric-hydraulic jumbos are used for production, lateral development and ramp development. Drill and blast design is carried out by the mine technical services group on site. Two pattern layouts for typical 4m x 4m blast patterns are shown in Figure 16-23 and Figure 16-24. SRK notes that drill and blast is an area of emphasis in the mine planning process. A drill jumbo is shown drilling a production blast in El Gallo Inferior in Figure 16-25.




Source: SRK, 2017

**Figure 16-23: Typical 4 m x 4 m Blast Pattern 1**




Source: SRK, 2017

**Figure 16-24: Typical 4 m x 4 m Blast Pattern 2**

Source: SRK, 2017

**Figure 16-25: Drill Jumbo Drilling a Pattern in an El Gallo Inferior Production Stope**

The blastholes, typically 2.5 inch in diameter, are loaded with ANFO or Emulsion as defined by the specific blast design, and initiated with non-electric detonators.

After blasting, the face is mucked by scoops, and material is loaded into trucks and hauled to the ramp portal on surface. Historically, approximately 10% of total production is waste. This percentage will increase to 18% as the mine advances into areas outside of El Gallo Inferior. Waste rock can be placed in the stopes underground, hauled to the surface and used as construction material; e.g. pads at the portal, or hauled to surface waste dumps.

### 16.1.4 Pillar Recovery Potential and Mining Method Alternatives

Dia Bras personnel has indicated their intention to develop methods for the safe extraction of pillars as well as optimizing or modifying the current room and pillar mining method to improve the overall operation. SRK considers these initiatives as having potential for increasing reserves and mine life in future resource and reserves updates. Pillar recovery is not considered in the reserves stated in this document. SRK makes the following recommendations.

There is uncertainty in the tonnage and grade of material remaining in pillars. There are two primary causes for this uncertainty. First, while mined out areas are surveyed on a regular basis, some of the mined out volume models are not updated with the latest information or are not in the correct position. This is especially true in El Gallo Superior where there is a low degree of confidence in the accuracy of the asbuilt models. The second cause of uncertainty is in the grade of the material left in pillars. Channel samples have been collected, but much of the information is stored in 2D AutoCad drawings and are not in a usable form for reserve estimation purposes.

Dia Bras is initiating a project to perform a whole mine survey using Light Detection and Ranging (LiDAR) technology. It is expected that an updated mine survey will be available early in the second quarter of 2017. The site is also planning to evaluate their existing channel samples database and, where necessary, collect new samples in order to increase the confidence in the grade estimation of the pillar material.

Improving the mine asbuilt model and the channel samples database will allow the site to review, quantify, and prioritize pillar material for extraction.

The site must then develop mine plans and safe mining practices in order to extract the pillar material. Several potential options exist for pillar extraction. SRK recommends a trade-off study to determine the feasibility of the scenarios listed below.

- Scenario 1: Pillar Recovery with no backfill
    - Focus on recovering pillars without additional support generated by backfilling mined out areas.
    - Requirements:
        - Site visit and geotechnical characterization of existing Pillars;
        - Pillar rating assessment;
        - Numerical modelling to characterize pillar stress conditions;
        - Pillar extraction sequence and impact on stability of other pillars; and
        - Assessment of pillar extraction.

- Scenario 2: Post Pillar cut-and-fill with rock fill
  - o Potentially utilize rock fill to provide additional ground support for pillar recovery. May result in updated pillar dimensions for new areas.
  - o Requirements:
    - All under Scenario 1; and
    - Empirical pillar design criteria;
    - Pillar design by mining levels including access (an update to the long term mine layout);
    - Numerical simulation to assess impact of rock fill on pillar stability;
    - Pillar optimization: grid location and orientation; and
    - Numerical simulation of optimized pillars with rock fill.
- Scenario 3: Post pillar cut-and-fill with compacted tailings
  - o Will result in confirmation or updates to pillar dimension recommendations, a back fill specification for the compacted tailings, and an updated mine layout and sequence.
  - o Requirements:
    - All under Scenario 1; and
    - Compacted tailings specifications;
    - Numerical simulation optimized pillars with tailing; and
    - Mine sequence evaluation
- Scenario 4: Pillar-less cut-and-fill mining with cemented paste fill
  - o A new mining method for the operation where cut-and-fill mining occurs with ground support provided by cemented paste backfill.
  - o Requirements:
    - All under Scenario 1; and
    - Paste specifications;
    - Numerical modelling of support;
    - Trade-off for method implementation ; and
    - Mine planning including new required infrastructure.

The mine does not produce enough waste rock to backfill all areas previously mined and recover the remaining pillars. The ability to utilize existing and future tailings as backfill may be an attractive option for both the handling of mine tailings and obtaining fill material for pillar recovery. Further study is required, however, to determine the feasibility of these options.

## 16.2 Parameters Relevant to Mine or Pit Designs and Plans

### 16.2.1 Geotechnical

Skarn deposits are generally formed by infiltration of magmatic-hydrothermal fluids, resulting in alteration that overprints the genetically related intrusion and adjacent sedimentary country rocks. While alteration commonly develops close to the related intrusion, fluids may migrate considerable distances along structures, lithologic contacts, or bedding planes. These alteration structures typically form planes or zones of weakness in the underground workings.

Based on the alteration assemblages present, skarn deposits are generally described as either calcic (gartnet, clinopyroxene, and wollastinite) or magnesian (olivine, phlogopite, serpentine, spinel, magnesium-rich clinopyroxene). Both the alteration and the mineralization in skarn deposits are magmatic-hydrothermal in origin. These affects can lead to wide variations in the rock mass strengths.

The geotechnical characteristics at El Gallo Superior (Superior) and El Gallo Inferior (Inferior) generally consists of the following conditions:

- General mineralized shape: Tabular;
- Ore thickness: thick (20 to 30 m, but up to 70 m);
- Ore plunge: intermediate (30° to 40°);
- Overburden depths: shallow (25 to 260 m);
- Rock Quality Designation (61±10);
- Uniaxial compressive strength (127 MPa);
- Joint spacing (60 to 100 mm);
- Joint Conditions (Hard joint walls and slightly rough);
- Ore rock mass conditions: competent $RMR_{76}$ (50 to 60); and
- Back conditions: very competent $RMR_{76}$(65 to 75).

Currently, the El Gallo Superior and Inferior deposits are being mined using a room and pillar method. The areas are mined in accordance with recommendations provided in the rock mechanics report by Engineers Ramos, Garcia and Nava (October 2012). The report proposed that roof bolts and mesh be added to open faces.

The report also suggests that the pillar size should be greater than 7 m wide by 8 m long. The safety factor calculated for these size pillars assumes the room to be 10 m wide. The dip of the deposit (i.e., average of 33°) combined with a variable ore thickness makes mining on dip difficult and results in the need for variable pillar dimensions since pillar stability is a function of pillar width compared to its height. This led to the recommendation that horizontal room and pillar mining method be employed between levels with off-ore decline and access ramps. Sublevels for a given level are ramped on-ore to the next sublevel. This room and pillar mining method is a well-established method that allows flexibility in both production sequencing and ground support.

The mine currently uses the following geotechnical mine design parameters:

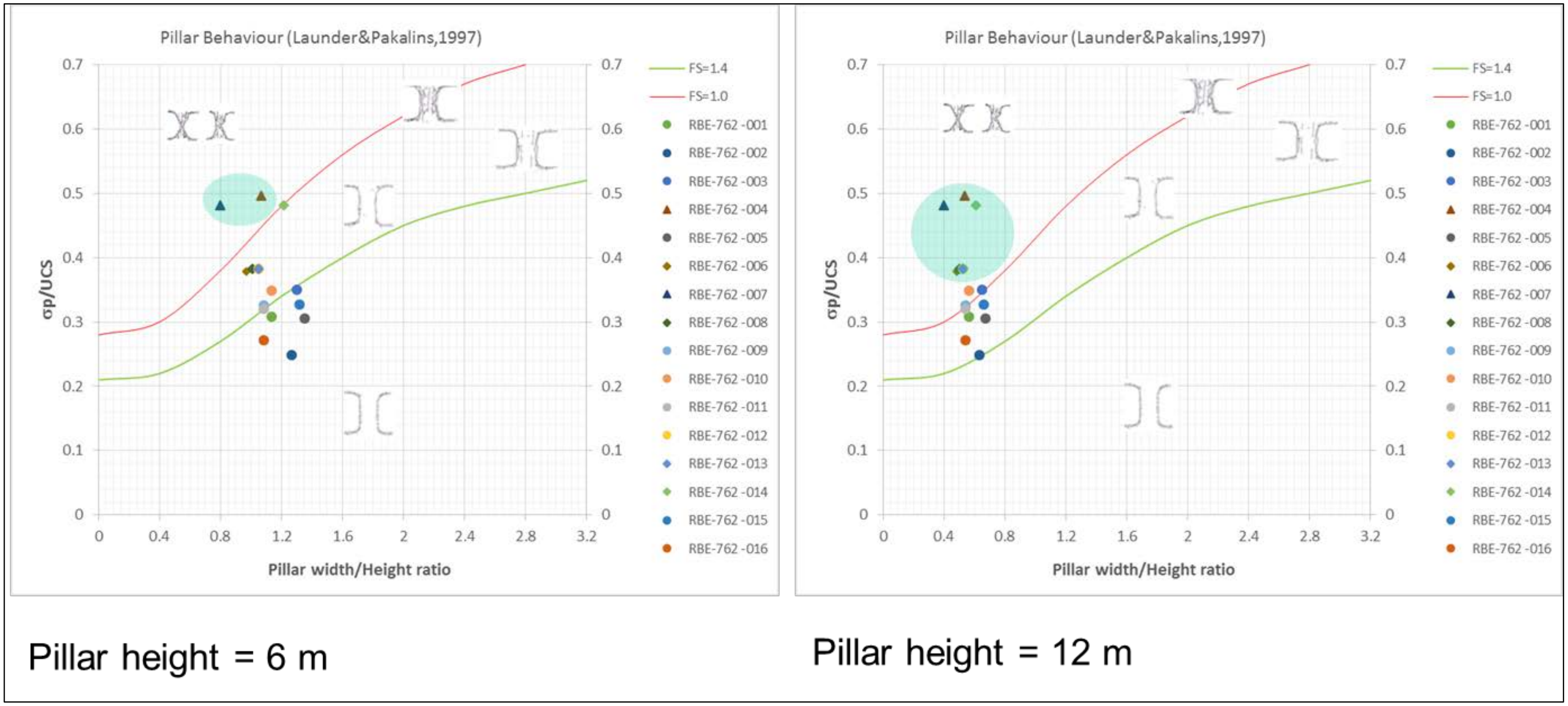
- Stope width: 11 to 13 m;
- Pillar Width: 7 m; and
- Room Height: 6, 12 and 18 m.

SRK has reviewed pillar performance with these parameters by comparing to the Lunder & Pakalnis, 1997 stability charts. Figure 16-26 shows an example of the pillar stability charts applied at Bolivar. The dot points represent individual pillar widths to high ratios versus the ratio between average pillar stress to the UCS rock strength. The majority of the pillars represented in the figure are predicted to be stable.

SRK notes that the Lunder & Pakalnis charts represent case histories for multi-pillar arrays while at Bolivar there is typically a single row of pillars along strike of the orebody suggesting that the Bolivar pillars would be even more stable than predicted by the stability charts. SRK considers that there is a good opportunity to increase the span between pillars by recovering some pillars and optimizing pillar design by reducing the dimensions. A pillar size reduction has not been included in the reserve estimate. However, SRK considers this adjustment to be an upside potential in reserve recovery provided test areas confirm that pillars remain stable.

Similarly, there is an upside potential to recover 20% to 40% of existing pillars in historically mined areas, depending on ground conditions and room span geometries. There may also be an upside opportunity to adjust the mining method to use cemented backfill in the new areas to avoid leaving pillars all together.

SRK notes that pillar recovery operations are the most dangerous of all mining activities because of the potential for sudden rockfall and adjacent pillar collapse when removing the pillars. The strategic use of artificial active or passive ground support (e.g., bolting, timber sets, grout cans, tight backfilling, etc.) can reduce the rock fall risk. SRK recommends that if pillars are to be recovered that the engineering plan be thoroughly reviewed from a ground stability perspective. A formal stability analysis needs to be completed prior to any pillar recovery operations. Figure 16-27 shows an example of slender pillar that might be recovered because the pillar is not heavily loaded and the roof spans are short in this area of the mine.




Source: SRK, 2017

**Figure 16-26: Example of Pillar Stability Chart, Level 762**

Source: SRK, 2017

**Figure 16-27: Example Slender Pillar that Might be Recovered**

### 16.2.2 Hydrological

A hydrogeological review has not been undertaken by SRK. The mine is currently dry and has been historically dry with periodic water inflows into the portals due to seasonal rains. Currently, the mine does not require any large scale dewatering.

## 16.3 Underground Stope Optimization

Potential mining blocks shapes were constructed using Maptek Vulcan's implementation of Alford Mining System's Stope Shape Optimizer (Stope Optimizer). The mining method applicable to all areas in El Gallo Inferior, Bolivar Northwest and shallow dipping areas of Bolivar West is room and pillar. Longhole stoping is planned for Chimenea 1, Chimenea 2 and steeply dipping area of Bolivar West.

### 16.3.1 Depletion

Dia Bras personnel provided the mined out areas that were modeled as of September 30, 2016. SRK is aware that not all mined out areas are modeled, and there is some uncertainty, as described in previous sections, in the accuracy of the existing asbuilt information. SRK collected the available information, used a modeling technique to generate a 3 m distance buffer of the mined areas, and generated volumes that could be used in flagging the blocks as mined.

### 16.3.2 Optimization Parameters and Process

NSR values were calculated using the parameters described in Section 15.2 for material classified as Measured or Indicated. All other blocks are assumed to be waste with NSR and grade values of zero.

Stope optimization was used to construct initial minable shapes. Key parameters used for stope optimization are provided in Table 16-4.

**Table 16-4: Stope Optimization Parameters (Angelita, Elissa, Escondida, Esperanza, and Zulma)**

| | | |
|---|---:|---:|
| Mining Method | Room and Pillar | Longhole |
| Minimum Stope Length (m) | 4 | 5 |
| Minimum Waste Pillar Width (m) | 5 | 5 |
| Stope Height (m) | 4 | Sill: 4, Stope: 8 |
| Stope Width (m) | 5 | 5 |
| Cut-off (NSR) | 30.50 | 32.50 |
| Stope Orientation | Perpendicular to Orebody | Perpendicular to Orebody |

Source: SRK, 2017

Tonnes and grade for each stope shape were further processed in spreadsheets to apply the mining recovery, external dilution (at 0 grade), and to calculate an NSR for the diluted and recovered material. Blocks were classified as economic, marginal or waste based on the NSR value of the mining block and cut-off for the area. The blocks meeting the reserve criteria were visually inspected and isolated blocks were identified and removed from the reserves. An average development cost of US$705/meter was used to evaluate how much development a particular block could support. This dollar amount was the average contractor and Dia Bras development mining cost used for the 2017 site budget. Marginal blocks immediately adjacent to economic blocks were considered and included in the reserves if it was reasonable to expect that no significant additional development would be required to exploit the marginal block.

## 16.4 Mine Production Schedule

Bolivar is an operating mine with a production history spanning more than five years. Site personnel produce an annual plan broken down by month. Additional years are planned at quarterly and annual resolution for a period of four additional years. SRK has reviewed the 2017 through 2021 plans and notes the following:

- Operations and production personnel are supported by a geology and engineering groups;
- The geology and engineering groups work in close collaboration;
- Historical knowledge of the site is leveraged in the planning process; and

- As is typical, sampling is performed in areas ahead of planned mining. However, the results are generally not used to update the resource model used for long range planning. As a result, there is a disconnect between the short range site plan and the LOM reserves plans. The short range site plan typically includes additional material not included in the LOM reserves.

SRK recommends that the planning of infill drilling, channel sampling, and mine planning should emphasize converting resources into reserves inventory and efforts should be undertaken to minimize the differences of the short term site plans and the LOM reserves plans.

To verify the economic viability of the reserves estimated for this report, SRK created a production plan incorporating only reserves material as described in this report and the development required to access the mining blocks. Development access to ore was designed to be 4m wide by 4m high, while ramp development in new areas was design at 5 m wide by 5 m high. An additional allowance length of 20% was added in the waste development to account for turnouts, laydowns, and ventilation development that will be required but was not designed in detail on each level. The resulting production plan is shown in Table 16-5 with ore quantities broken down by zone. The start date of this schedule is October 2016 as this is the month immediately following the cut-off date of the mine-out data used in this report. The first period of the schedule represents three months of production. A typical ore mining rate of 400 t/day to 1,000 t/day per active stope was used. Mining rates for ore and waste as well as the rate of development (meters) used in the schedule are reasonable given the production history at the mine.

**Table 16-5: SRK Production Plan**

| Item | Unit | Months 1-3 | Year 1 | Year2 | Year 3 | Year 4 | Year 5 | Total |
|---|---|---|---|---|---|---|---|---|
| Ore Mined | t | 228,159 | 915,009 | 933,307 | 974,662 | 967,298 | 309,012 | 4,327,449 |
| Waste Mined | t | 15,787 | 171,220 | 431,839 | 238,053 | 85,792 | 1,140 | 943,831 |
| Total Mined | t | 243,947 | 1,086,229 | 1,365,146 | 1,212,715 | 1,053,090 | 310,152 | 5,271,279 |
| Cu (mill feed) | % | 0.954 | 0.927 | 0.814 | 0.863 | 0.767 | 0.806 | 0.845 |
| Cu (mill feed) | t | 2,177 | 8,484 | 7,597 | 8,414 | 7,422 | 2,492 | 36,586 |
| Ag (mill feed) | g/t | 16.7 | 18.5 | 19.6 | 22.2 | 12.1 | 11.5 | 17.5 |
| Ag (mill feed) | oz | 122,322 | 545,008 | 587,115 | 695,045 | 377,292 | 114,629 | 2,441,411 |
| Au (mill feed) | g/t | 0.285 | 0.233 | 0.231 | 0.203 | 0.517 | 0.551 | 0.315 |
| Au (mill feed) | oz | 2,093 | 6,851 | 6,930 | 6,360 | 16,090 | 5,477 | 43,800 |
| El Gallo Inferior Ore | t | 228,159 | 819,911 | 356,216 | - | - | - | 1,404,286 |
| El Gallo Inferior Ore (E)[1] | t | - | - | 137,366 | 220,032 | 255,281 | 33,943 | 646,622 |
| Chimenea 1 Ore | t | - | 63,864 | 21,952 | - | - | - | 85,816 |
| Chimenea 2 Ore | t | - | 31,235 | 41,858 | 13,701 | - | - | 86,794 |
| Bolivar NW 7 Ore | t | - | - | 119,512 | - | - | - | 119,512 |
| Bolivar NW 6 Ore | t | - | - | 75,449 | 62,620 | - | - | 138,070 |
| Bolivar NW Z2 Ore | t | - | - | 34,627 | 31,706 | - | - | 66,333 |
| Bolivar NW 4 Ore | t | - | - | - | 103,531 | 177,272 | - | 280,803 |
| Bolivar NW 1 Ore | t | - | - | - | 65,643 | 534,612 | 275,069 | 875,324 |
| Bolivar NW 2 Ore | t | - | - | - | 34,285 | - | - | 34,285 |
| Bolivar W Ore (LH) | t | - | - | 121,846 | 55,487 | - | - | 177,333 |
| Bolivar W Ore (R&P) | t | - | - | 24,480 | 387,657 | 134 | - | 412,271 |
| Ore Mined | t/day | 2,453 | 2,500 | 2,550 | 2,663 | 2,636 | 1,451 | |
| Waste Mined | t/day | 170 | 468 | 1,180 | 650 | 234 | 5 | |
| Total Mined | t/day | 2,623 | 2,968 | 3,730 | 3,313 | 2,869 | 1,456 | |
| Waste Development | m/day | 3.5 | 7.3 | 16.8 | 10.1 | 3.8 | 0.1 | |
| Ore + Waste Dev. | m/day | 3.5 | 11.0 | 21.5 | 11.1 | 3.8 | 0.1 | |

[1]El Gallo Inferior, East Zone
Source: SRK, 2017

It is SRK's opinion that the analysis of this representative production schedule, which incorporates the development plan, the capital and operating costs described in Section 21, provides a reasonable test of the economic viability of the reserves.

## 16.5 Major Mining Equipment

A list of the major mining equipment used underground is included in Table 16-6. The equipment appears to be of sufficient quantity and appropriate size for the operation. SRK notes that good maintenance practices, proper ventilation, and properly timed equipment overhaul or replacement will be important as the mine progress deeper and further from the surface access.

**Table 16-6: Major Underground Mining Equipment**

| Type | Make | Model | Capacity |
|---|---|---|---|
| Truck, Low Profile | JARVIS CLARK | JDT-413 | 12 t |
| Truck, Low Profile | JARVIS CLARK | JDT-413 | 12 t |
| Truck, Low Profile (Under Repair) | JARVIS CLARK | | Under Repair |
| Truck, Low Profile | MTI | DTI804 | 18 t |
| Truck, Low Profile | MTI | DTI804 | 18 t |
| Truck, Low Profile | MTI | DTI804 | 18 t |
| Truck, Low Profile | JOY GLOBAL | 16TM | 16 t |
| Truck, Low Profile | MTI | DTI804 | 18 t |
| Truck, Low Profile | ATLAS COPCO | MT-431B | 30 t |
| Drill Jumbo | ATLAS COPCO | BOOMER 235 | 12 foot |
| Drill Jumbo | MTI | VEIN RUNNER2 | 12 foot |
| Drill Jumbo | ATLAS COPCO | BOOMER S1D | 14 foot |
| Drill Jumbo | GETMAN 200 | H226 | 12 foot |
| Drill Jumbo | ATLAS COPCO | | 16 foot |
| Drill Jumbo | BOART LONGYEAR | STOPEMASTER XHD | |
| Scoop Tram | SANDVIK | EJC-180 | 5 yds |
| Scoop Tram | ATLAS COPCO | ST-6C | 6 yds |
| Scoop Tram | ATLAS COPCO | ST-6C | 6 yds |
| Scoop Tram | MTI | LT-1050 | 6 yds |
| Scoop Tram | ATLAS COPCO | ST-14 | 8 yds |
| Scoop Tram | ATLAS COPCO | ST-3.5C | 3.5 yds |
| Scoop Tram | ATLAS COPCO | ST-3.5C | 3.5 yds |

Source: SRK, 2017

Dia Bras provided SRK with a list of planned equipment to meet the production requirements over the next three years as mining in Bolivar West and Bolivar Northwest proceeds.

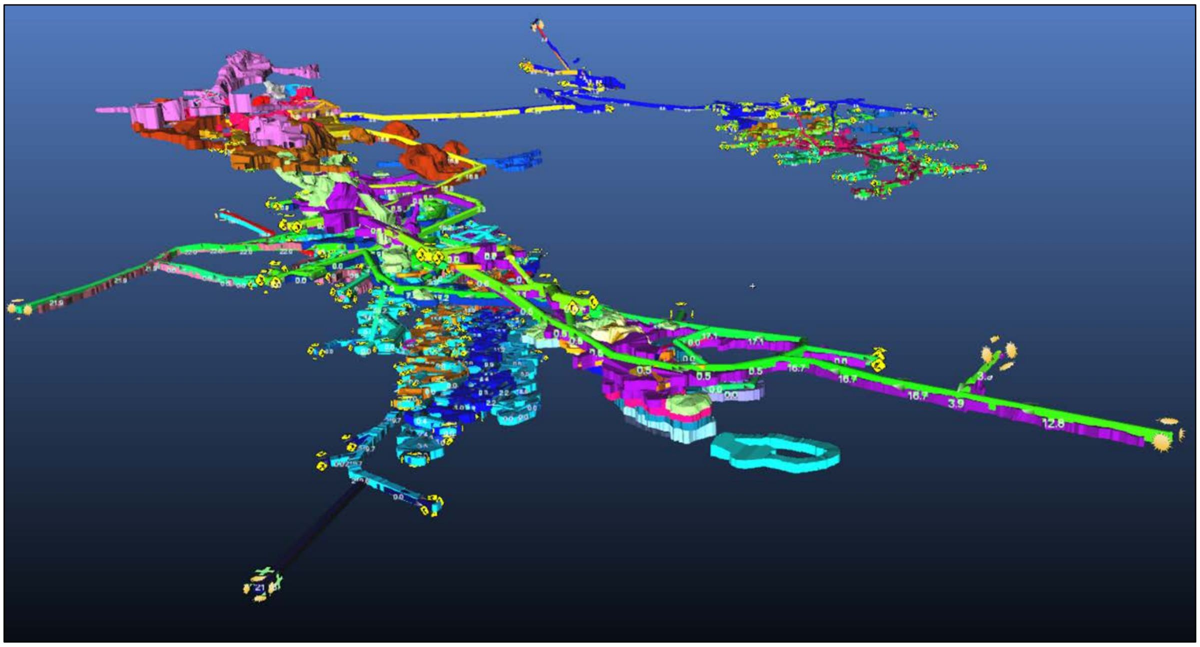
**Table 16-7: Planned Underground Mining Equipment**

| Type | Make | Number Planned | Purpose |
|---|---|---|---|
| Drill Jumbo, Boomer 282 | Atlas Copco | 4 | Two planned for Bolivar West, two for Bolivar NW |
| Scoop Tram, ST-14 | Atlas Copco | 4 | Two planned for Bolivar West, two for Bolivar NW |
| Truck, 18 t | MACK | 6 | Three planned for Bolivar West, Three for Bolivar NW |

Source: SRK, 2017

## 16.6 Ventilation

The Bolivar mine currently relies on natural ventilation, and as a result airflow through the mine varies in quantity and direction as the atmospheric conditions on the surface change. Bolivar personnel have modeled the workings and airflow for the mine in Ventsim as illustrated in Figure 16-28.



Source: Dia Bras, 2016

**Figure 16-28: Dia Bras Ventilation Model for Existing Workings**

As the mine progresses into Bolivar West, Bolivar Northwest, and further east in El Gallo Inferior, a forced ventilation system will be required.

Airflow requirements for a forced system were calculated based on the total equipment and personnel expected to be working in each of the zones over the life of mine plan. Bolivar West is not connected to the rest of the mine, but El Gallo Inferior and Bolivar Northwest are and were modeled as a connected system.

Table 16-8 shows the mine equipment used in determining the mine total airflow under the current operating scenario. Airflow requirement assumptions of 100 cfm/bhp (0.06 $m^3$/s per kW) for equipment, 55 cfm/person (0.026 $m^3$/s per person) for personnel, and an assumption of 60 people working underground with a total ore and waste production of 2,710 t/day was used.

**Table 16-8: Ventilation Requirements for Equipment and Personnel**

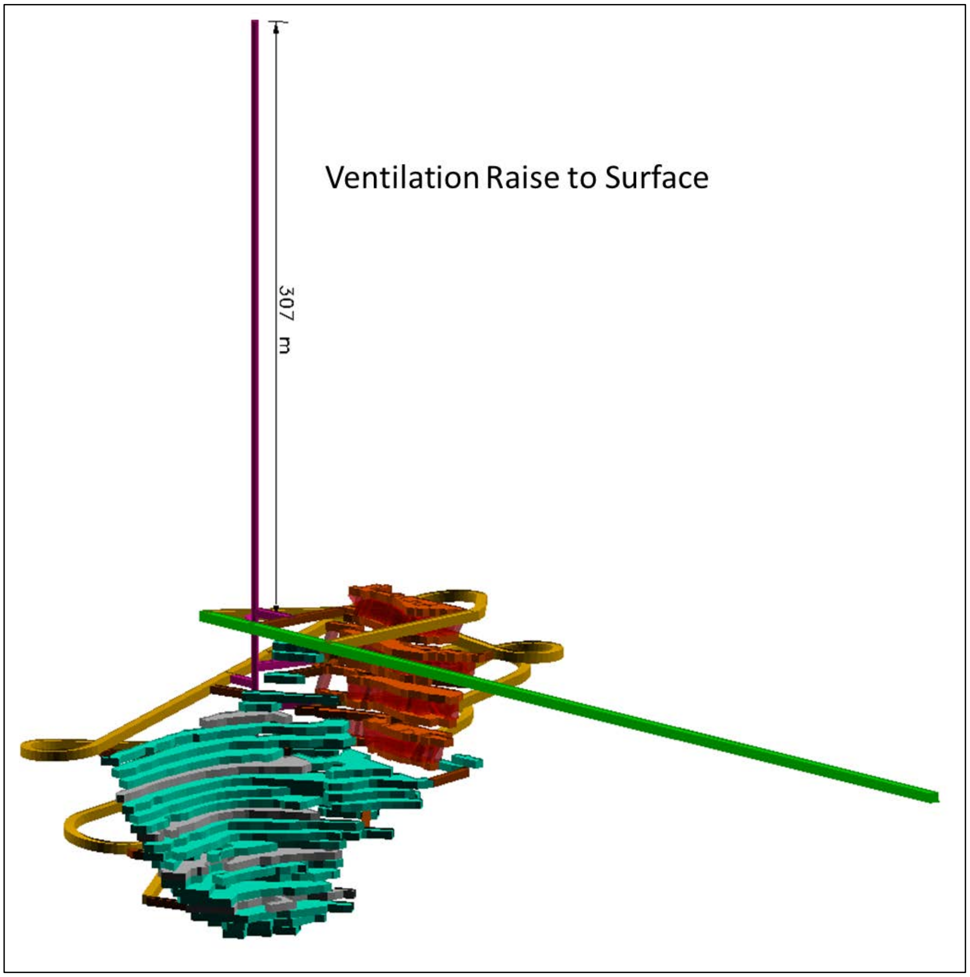
| Item | Count | Total Diesel Engine Horsepower (hp) | % Effective Utilization | Personnel Requirement (cfm) | Equipment Requirement (cfm)/hp | Total (cfm)[1] | Total ($m^3$/s) |
|---|---|---|---|---|---|---|---|
| Truck | 8 | 1840 | 50 | | 100 | 92,000 | 43.42 |
| Drill Jumbo | 6 | 607 | 15 | | 100 | 9,105 | 4.30 |
| Scoop Tram | 7 | 1639 | 45 | | 100 | 73,755 | 34.81 |
| Personnel | 60 | | 100 | 55 | | 3,300 | 1.56 |
| **Total** | | | | | | 178,160 | 84.08 |

[1] Total requirement at current production of 2,710 t/day
Source: SRK, 2017

Using the production schedule, SRK generated a ventilation model for the state reserve mining areas. The maximum airflow through the mine was calculated by summing the airflow requirements of the equipment and personnel working in each zone at peak production. An additional 10% was then added for contingency. It was assumed that all vehicles will be turned off when not in use for extended periods.

Total airflow required in Bolivar West at peak production was calculated to be 87.31 $m^3$/s. Maximum airflow required in the Bolivar NW 1, 2, Z2, 6 and 7 was calculated to be 68.90 $m^3$/s. Bolivar NW 4 and El Gallo Inferior east was calculated to be 33.52 $m^3$/s and 34.26 $m^3$/s respectively. Maximum airflow through the Bolivar NW and El Gallo Inferior system peaks at just over 94.39 $m^3$/s for a few months in the production schedule.

In Bolivar West, a forcing system delivers fresh air directly to the room and pillar and longhole stopes and levels. The airflow enters through the surface raise and is delivered to a mid-level where it splits to the two main working sections. The air exhausts through the main ramp to surface. Levels are connected as required with ventilation raises. The fan pressure is closely linked to the raise diameters in the mine. The surface raise diameter of 4 m and an internal raise diameter of 3 m is specified in order to reduce the pressure in the raises (which can be used as secondary egress) as well as accommodate a smaller, less costly fan. A fan located at the top of the ventilation raise shown in Figure 16-29 moving 91.1 $m^3$/s with a fan pressure of 0.73 kilopascals (kPa) is appropriate for Bolivar West.




Source: SRK, 2017

**Figure 16-29: Bolivar West Ventilation Raise Location with Depth to First Ventilation Drift**

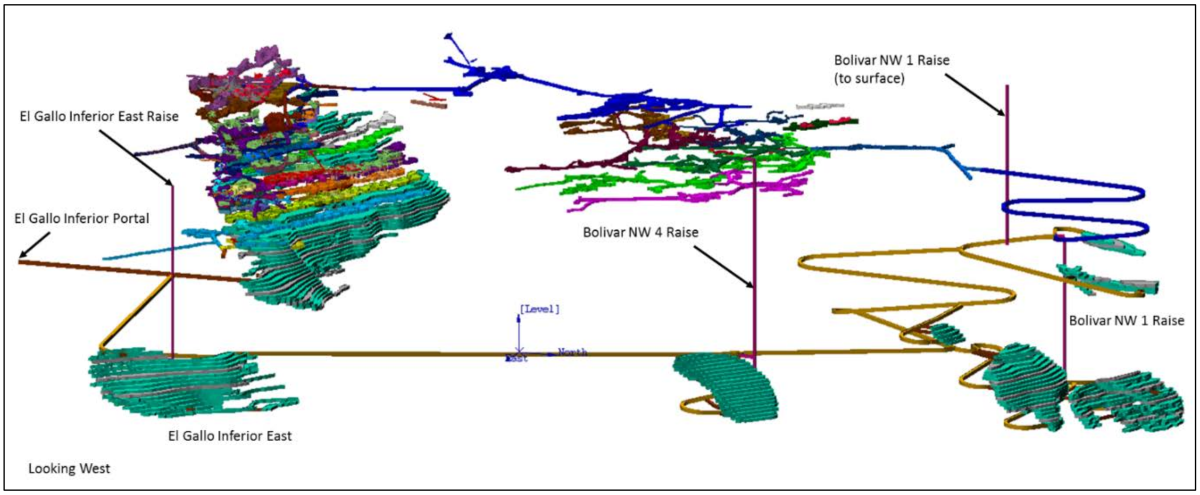
Four fans are specified to be installed in the Bolivar Northwest and El Gallo Inferior (East) system. One is located at the top of a 4 m diameter raise in Bolivar NW 1, and one is located at the top of a 4 m diameter raise in El Gallo Inferior East. The other two fans are located in Bolivar NW 4 and Bolivar NW 1. The forcing system induces fresh air flow down the raises in Bolivar NW 1 and El Gallo Inferior. Air exhausts out of the Bolivar NW 4 raise and El Gallo Inferior portal. Table 16-9 shows the information for the four new fans.

**Table 16-9: Fan Airflow and Pressure for Bolivar Northwest and El Gallo Inferior (East)**

| Fan | Location | Fan Airflow ($m^3/s$) | Fan Pressure (kPa) |
|---|---:|---:|---:|
| 1 | BNW 1 – Top of Main Raise | 64.01 | 1.000 |
| 2 | BNW4 | 40.00 | 0.288 |
| 3 | El Gallo Portal | 85.32 | 0.652 |
| 4 | El Gallo Inf. – Top of Main Raise | 126.76 | 0.600 |

Source: SRK, 2017

Figure 16-30 shows the key ventilation development required for the Bolivar Northwest and El Gallo Inferior system.




Source: SRK

**Figure 16-30: Bolivar NW/El Gallo Inferior Key Ventilation Development Layout**

SRK recommends that the site implement a whole-of-mine ventilation plan. The main objectives of the plan would be to:

- Develop a whole-of-mine ventilation strategy that will ultimately achieve best practice;
- Provide additional data for the detailed design and construction of the forced ventilation system;
- Identify areas of the mine that may need to be sealed in order for the ventilation system to function as designed;
- Identify auxiliary ventilation requirements; and
- Train personnel in the operation of the system as well as how the mine plan and operational practices can impact the performance of the system.

# 17 Recovery Methods

Dia Bras operates a conventional concentration plant consisting of crushing, grinding, flotation, thickening and filtration of the final concentrate. Flotation tails are disposed of in a conventional tailings facility. A block diagram is shown in Figure 17-1.

Dump trucks of approximately 20 tonnes capacity deliver the ore from the mine to the primary crusher area. Trucks can dump directly to the primary crusher or, alternatively, in one of multiple stockpiles. A front-end loader reclaims ore from the stockpiles and feeds the jaw crusher.

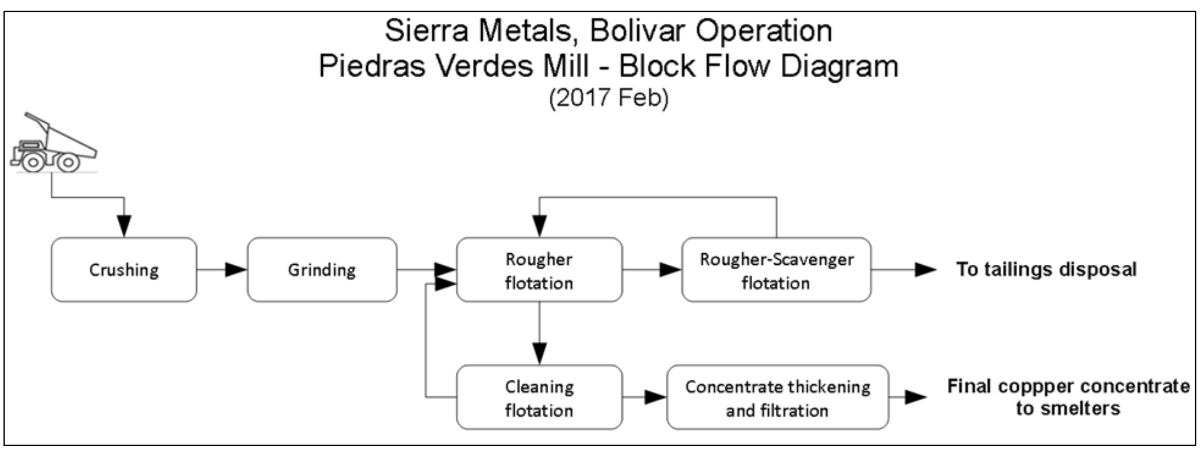
The crushing circuit has been expanded recently. In its current configuration, the crushing plant consists of a jaw crusher in open circuit, with its product feeding a vibrating screen. Material passing the vibrating screen opening becomes final product that is transferred to the feed silos. The vibrating screen's oversize feeds a secondary crushing stage consisting of two cone crushers. The cone crusher's discharge joins the primary crusher's discharge and feeds the vibrating screen.

The grinding stage uses two conventional ball mills operating in parallel, each one in closed circuit with a hydrocyclone battery. Ore is fed to the ball mills from two silos using conveyor belts. The hydrocyclone overflow feed the flotation circuit.

The flotation circuit operates three identical parallel flotation lines. Each flotation line includes a rougher stage where the rougher concentrate feeds the cleaning stage, and the rougher's tails feed the rougher-scavenger stage. The cleaning circuit consists of three consecutive cleaning stages, tailings from each cleaning stage along with the rougher-scavenger's concentrate are recirculated to the feed of the rougher stage. Tails from the rougher-scavenger become the plant's final tails.

The flotation concentrate is thickened before being dewatered using three vacuum filters.

Final flotation tails are pumped to the tailings storage facility where they are classified using hydrocyclones. Process water is reclaimed from the tailings water pond and reused in the process plant.




Source: SRK, 2017

**Figure 17-1: Piedras Verdes Mill – Block Flow Diagram**

Piedras Verdes' monthly average performance for 2016 is shown in Table 17-1.

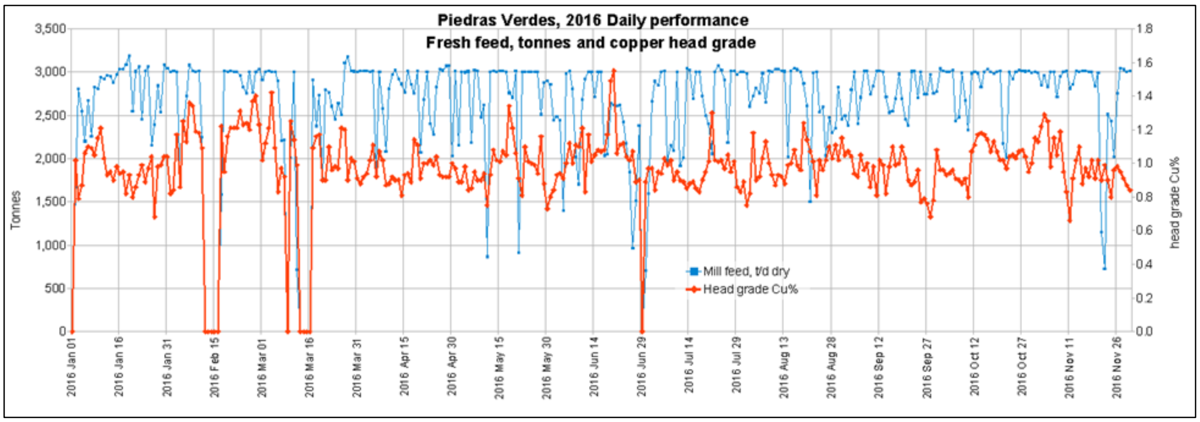
### Table 17-1: Piedras Verdes Monthly Average Performance - 2016

| Month | Mill feed, t/month dry | Concentrate t/d dry | Head grade Cu% | Head grade Ag g/t | Head grade Au g/t | Concentrate Cu% | Concentrate Ag g/t | Concentrate Au g/t | Recovery Cu% | Recovery Ag% | Recovery Au% |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 82,965 | 2,080 | 0.96% | 18.9 | 0.28 | 29.3% | 538 | 4.31 | 76.1% | 71.3% | 38.0% |
| 2 | 67,076 | 2,046 | 1.18% | 18.1 | 0.22 | 28.9% | 448 | 3.81 | 74.9% | 75.7% | 52.2% |
| 3 | 68,845 | 2,229 | 1.06% | 18.0 | 0.28 | 27.0% | 446 | 4.47 | 82.4% | 80.3% | 50.8% |
| 4 | 83,061 | 2,314 | 0.96% | 20.5 | 0.28 | 28.4% | 536 | 4.24 | 82.2% | 72.9% | 41.8% |
| 5 | 84,979 | 2,435 | 0.97% | 17.5 | 0.18 | 27.8% | 481 | 3.23 | 82.0% | 78.7% | 52.6% |
| 6 | 68,212 | 2,163 | 1.07% | 17.3 | 0.14 | 28.2% | 417 | 2.52 | 83.4% | 76.2% | 55.7% |
| 7 | 82,812 | 2,324 | 0.94% | 15.7 | 0.13 | 27.9% | 462 | 2.63 | 82.8% | 82.4% | 56.7% |
| 8 | 84,302 | 2,587 | 0.99% | 14.4 | 0.12 | 27.3% | 369 | 2.19 | 84.2% | 78.6% | 55.8% |
| 9 | 83,146 | 2,303 | 0.94% | 14.2 | 0.14 | 28.2% | 408 | 2.75 | 83.4% | 79.8% | 53.5% |
| 10 | 88,993 | 2,681 | 1.03% | 16.2 | 0.21 | 28.2% | 432 | 3.62 | 82.9% | 80.1% | 51.2% |
| 11 | 82,540 | 2,495 | 0.99% | 16.3 | 0.17 | 27.4% | 438 | 3.23 | 83.8% | 81.1% | 59.0% |
| 12 | 73,467 | 2,096 | 0.94% | 13.8 | 0.16 | 27.4% | 386 | 3.41 | 83.0% | 80.0% | 59.0% |
| **Total** | **950,398** | **27,753** | **1.00%** | **16.7** | **0.19** | **28.0%** | **446** | **3.35** | **81.8%** | **78.1%** | **52.1%** |
| **Min.** | **67,076** | **2,046** | **0.94%** | **13.8** | **0.12** | **27.0%** | **369** | **2.19** | **74.9%** | **71.3%** | **38.0%** |
| **Max.** | **88,993** | **2,681** | **1.18%** | **20.5** | **0.28** | **29.3%** | **538** | **4.47** | **84.2%** | **82.4%** | **59.0%** |

Source: Dia Bras, 2017

Ore feed during year 2016 reached a total of 950,398 tonnes, equivalent to an average of 79,200 tonnes per month, or 2,600 tonnes per day. This suggests that the 3,000 t/d mill capacity is not being fully utilized.

Figure 17-2 shows the daily mill feed in terms of tonnes and copper head grade. SRK notes a high level of variability for both tonnes and head grade. Better integration between geology, mine planning and processing can significantly reduce the variability. Additional work is also needed in the processing facilities to stabilize the operation. Improvements include the implementation of a preventive maintenance program and training programs to improve operators' skill, with the ultimate objective of improving metal recovery and lower operating cost, while maintaining or improving concentrate quality.




Source: SRK, 2017

**Figure 17-2: Piedras Verdes – 2016 Daily Performance**

Production of copper concentrate has consistently ranged between approximately 2,000 and 2,700 tonnes per month, equivalent to roughly a 2.9% mass pull. The monthly average has consistently reached commercial quality with copper at 27% and credit metals averaging 369 g/t silver and 2.19 g/t gold in 2016.

## 17.1 Plant Design and Equipment Characteristics

Bolivar uses a conventional copper concentrator plant. The operation is completely manual with no automation or online monitoring being used in the processing circuit. The grinding product, or flotation feed particle size distribution is approximately $P_{80}$=250 μm. Table 17.2 shows the Piedras Verdes mill's major process equipment, its key characteristics, and power ratings.

**Table 17-2: Piedras Verdes Major Process Equipment**

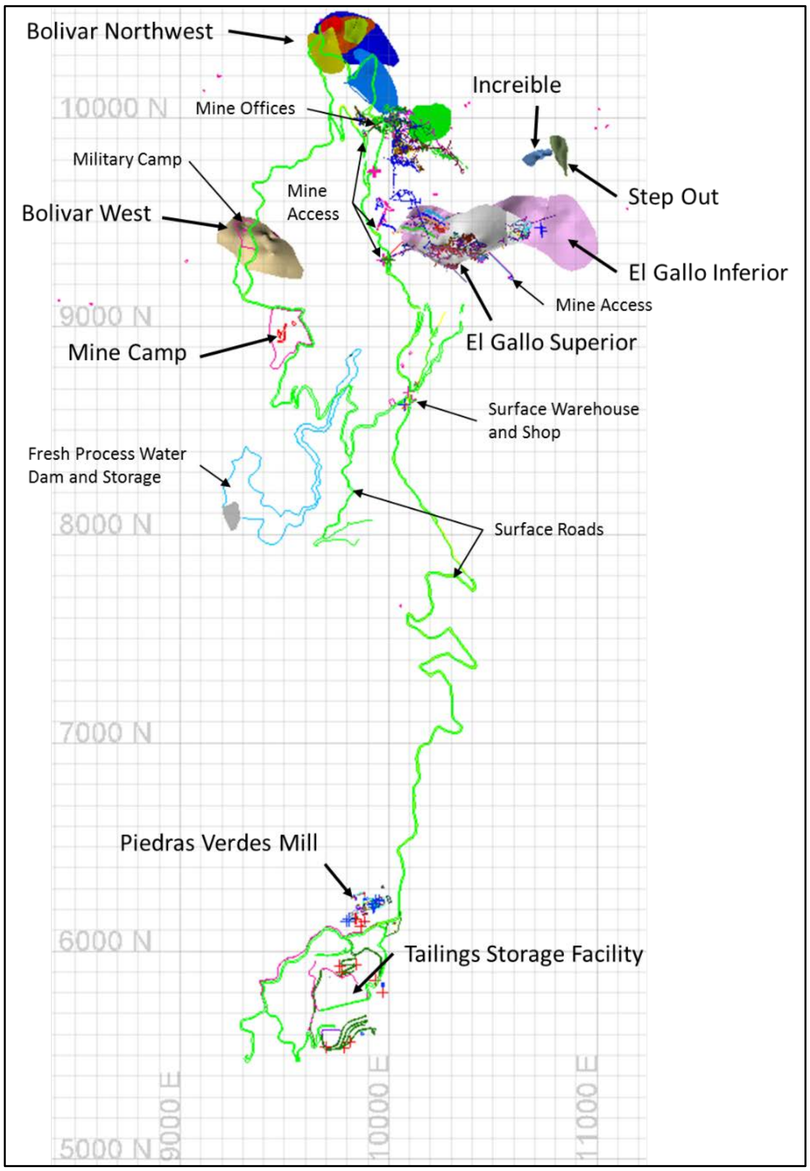
| Area | Equipment | Quantity | Manufacturer, Model | Motor (KW) |
|---|---|---|---|---|
| Crushing | Apron feeder | 1 | Metso AF5-60MN-16.4 | 22 |
| Crushing | Jaw crusher | 1 | Stedman | 93 |
| Crushing | Cone crusher | 1 | Sandvik H6800 | 336 |
| Crushing | Cone crusher | 1 | Metso HP-300 | 224 |
| Crushing | Vibrating screen | 1 | Terex Simplicity 6 ft x 16 ft | 15 |
| Crushing | Vibrating screen | 1 | Deister 6 ft x 1 ft’ | 20 |
| Grinding | Ball mill | 1 | Dominion 9 ft-6 inch x 14 ft | 447 |
| Grinding | Ball mill | 1 | Dominion 9 ft-6 inch x 14 ft | 447 |
| Flotation | Conditioning tank | 1 | 12 ft x 12 ft | 37 |
| Flotation | Rougher cell | 3 x 3 | DR 300, 300 $ft^3$ | 22 |
| Flotation | Rougher-scavenger cell | 3 x 4 | DR 300, 300 $ft^3$ | 22 |
| Flotation | Cleaning first | 3 x 2 | DR 300, 300 $ft^3$ | 22 |
| Flotation | Cleaning second | 3 x 3 | Sub-A 100 $ft^3$ | 11 |
| Flotation | Cleaning third | 3 x 2 | Sub-A 100 $ft^3$ | 11 |
| Thickening | Thickener | 1 | 50 ft | 15 |
| Thickening | Thickener | 1 | 40 ft | 15 |
| Filtration | Disc filter | 1 | Dorr Oliver 8 ft x 10 discs | na |
| Filtration | Disc filter | 1 | FLSmidth 8 ft X 10 Disc | 7.5 |
| Filtration | Drum filter | 1 | Eimco | na |

Source: SRK, 2017

# 18 Project Infrastructure

The Project has fully developed infrastructure including access roads, a 385 person man-camp that includes a cafeteria, laundry facilities, maintenance facilities for the underground and surface mobile equipment, electrical shop, guard house, fuel storage, laboratories, warehousing, storage yards, administrative offices, plant offices, truck scales, explosives storage, processing plant and associated facilities, tailings storage facility, and water storage reservoir and water tanks. The site has electric power from the Mexican power grid, backup diesel generators, and heating from site propane tanks. The Project is fully functional and built out for the currently producing mine and mill.

Figure 18-1 shows the general facilities location for the Project.




Source: SRK, 2017

**Figure 18-1: Bolivar General Facilities Location**

## 18.1 Access and Local Communities

Access to the Bolivar Mine is by paved road approximately 305 km southwest from Chihuahua and then approximately 80 km by all-season gravel roads to the villages of Cieneguita and Piedras Verdes adjacent to the Project.

The Project is located near several small communities namely Cieneguita Lluvia de Oro (population ~1,000), Pierdras Verdas (population ~500), and San José del Pinal. The Project is approximately 5 km southeast of the small Ejido community of Piedras Verdes with the offices and camp known as Loma Café located about 2 km to the southwest of Piedras Verdes. The community of Piedras Verdes supports the mine by providing potable water, trash collection and disposal in the nearby Cieneguita landfill, and transportation for construction materials including sand and gravel. The water is supplied by two local springs.

The camp supports the 385 workers and contractors. The majority of the project staff live outside the local area in regional cities of Delicias, Parral, Chihuahua, Durango, San Luis Potosi, Creel, Torreon, and Sonora, and Mexico City. The company provides transportation in busses and vans from transfer locations in the City of Chihuahua, approximately seven hours northeast of the project and from the community of Choix, Sinaloa approximately five hours to southwest. Crew changes occur on Tuesday and Wednesday each week. Personnel living in the region work six days with one day off, usually on Sunday. Personnel living outside the region work 14 days followed by seven days off. Personnel are work one of two shifts per day, 7:00AM to 7:00PM or 7:00PM to 7:00AM.

The camp is located 2.7 km from the Bolivar Mine, and at 8.4 km from the Piedras Verdes processing plant site. The company provides transportation from the camp to the mine or mill in four busses.

## 18.2 Service Roads

The site has developed and functioning gravel service roads that access the mine portals, water storage reservoir, camp, and process facilities. The roads between the mine and processing plant are used daily by the fleet of contract trucks that move the ore from the mine ore pads to the processing plant.

## 18.3 Mine Operations and Support Facilities

The mine is accessed through various portals as described in Section 16. The mine operation is supported by the newer mine camp with rooms, change house facilities, and cafeteria. The mine office is located at the portal to the Bolivar mine. There are two mine related surface maintenance facilities. The first is a mine maintenance facility at the portal of the Bolivar mine. An additional facility is located near the portal accessing the El Gallo Inferior ore body. A third additional facility to service surface equipment and to provide storage is located at the mill area. The mine infrastructure includes a compressed air system, located at the main portal to the Bolivar Mine, with compressors and receiving tanks that supports the underground operations. Refuge chambers are located in various sections of the underground mine. There are small functional shops underground to support minor equipment repairs and servicing. A medical building is located at the portal to the Bolivar mine. A photograph of the mine maintenance shop is provided in Figure 18-2. Explosives storage for powder and primers is located in a controlled area located remotely from site.

Source: SRK, 2017

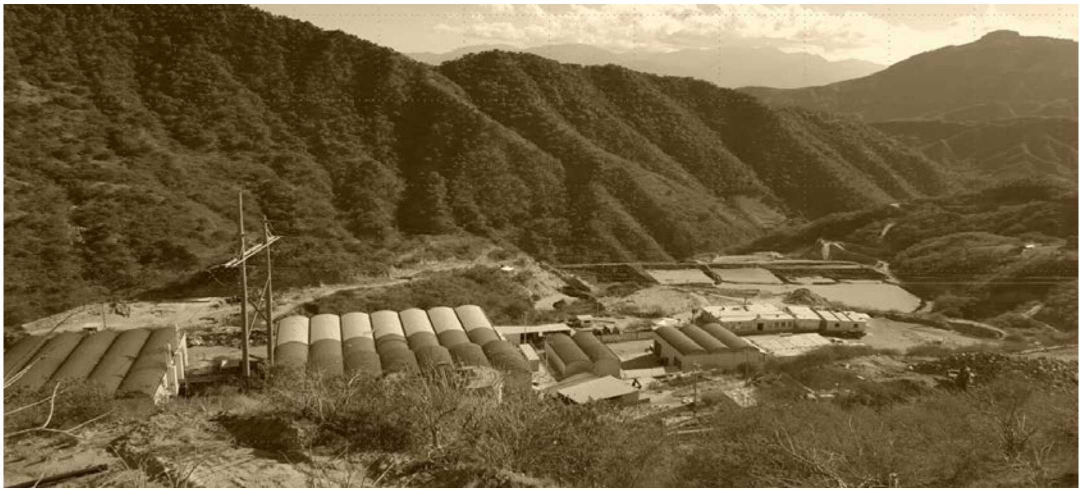
**Figure 18-2: Bolivar General Facilities Location**

## 18.4 Process Support Facilities

The processing area has a security shack, administrative offices, truck scales, electrical shop, maintenance shop, fuel storage, smaller camp and cafeteria, and the processing facilities as described in Section 17. Figure 18-3 shows an aerial view of the site. A photograph from the hill above the processing plant shows the location of the tailings storage area toward the right center of the picture (Figure 18-4).

Source: Google Maps, 2017

**Figure 18-3: Bolivar Aerial View of the Processing Plant**



Source: Dia Bras, 2017

**Figure 18-4: Project Processing Plant (looking south)**

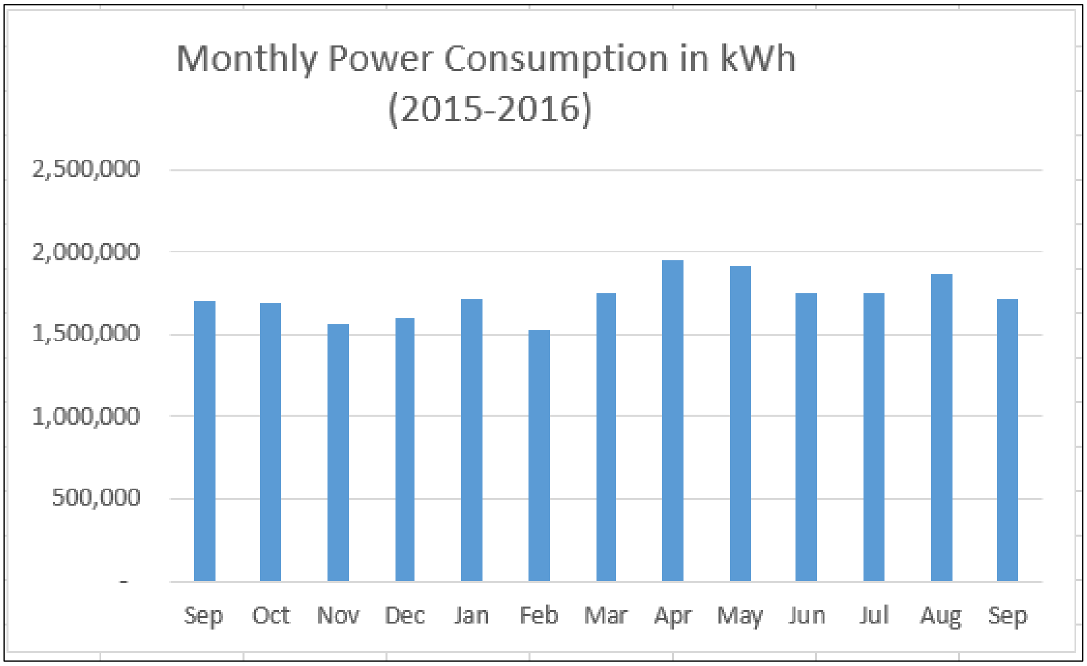
## 18.5 Energy

### 18.5.1 Propane

The site uses propane for general heating and heating of water in the camp. A local supplier from Cuauhtémoc, Chihuahua provides the fuel. In 2016, the consumption was 10,000 liters per month.

### 18.5.2 Power Supply and Distribution

Power to the site is supplied by high voltage power supplied through the Comisión Federal de la Electricidad (CFE), the state-owned utility through a 33kV power line. The Project has a substation that feeds the mine and processing plant through a secondary distribution line. The system operates at a typical load of 2.5 MW. Backup generation is provided for the mine and processing plant with diesel powered generator sets. The backup generators are located at the processing plant location. The transmission line towers can be seen in Figure 18-4. Figure 18-5 shows the monthly power consumption for September 2015 to September 2016 as a representation of the use.




Source: Dia Bras, 2017

**Figure 18-5: Monthly Power Consumption**

### 18.5.3 Fuel Storage

The site has diesel storage tanks on site that supply fuel for the mine underground and surface equipment as well as the backup generators. The fuel is restocked by vendors.

## 18.6 Water Supply

### 18.6.1 Potable Water

Potable water for use at the camp is supplied by the community of Piedras Verde from local springs through the local water utility piping.

### 18.6.2 Process Water

The supply water for the processing plant is supplied from a nearby Pierdras Verdes dam, owned by Dia Bras. The reservoir has a capacity of 1.5 million m3 and can meet the plant makeup water requirement of approximately 123,000 $m^3$/month (based on 2015 usage) or 92,200 $m^3$/month for nine months of 2016. The water is pumped from a pump house at the reservoir to an interim water tank located near the reservoir. The water tank then supplies water via a pipeline to the processing plant storage tanks approximately 1,800 m to the south. A photograph of the reservoir is shown in Figure 18-6.

Source: SRK, 2017

**Figure 18-6: Piedras Verdes Reservoir**

## 18.7 Site Communications

The site is equipped with a satellite communications system, including telephone and internet that allows communications between the plant and office facilities. A radio system is also in use. The mine has hard line telephone service.

## 18.8 Site Security

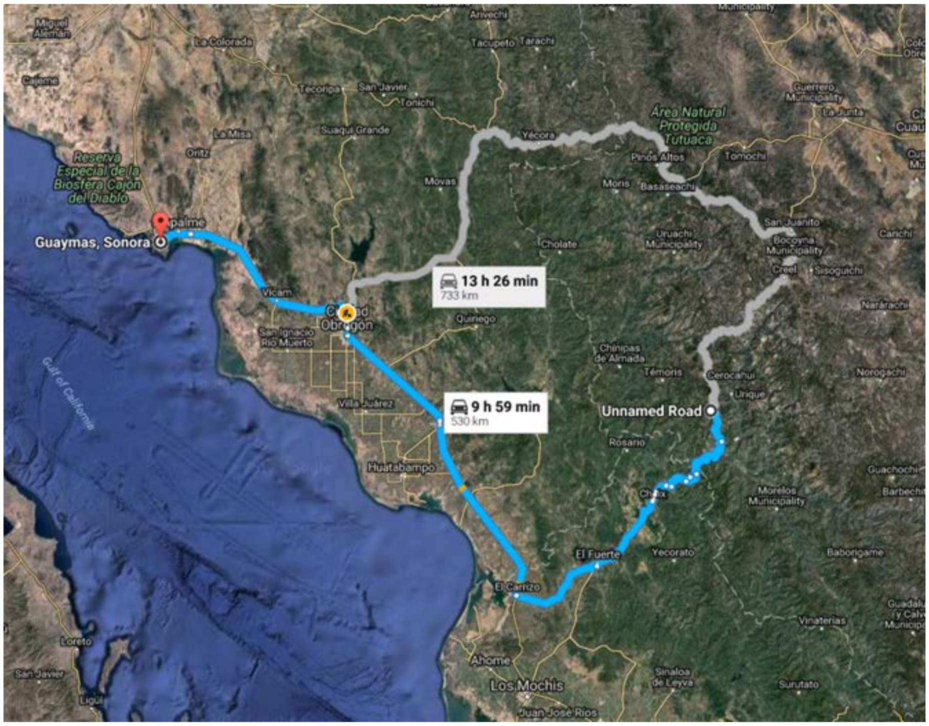
The site has a separate security force of approximately 12 people, there are typically four people on each crew. Additionally, there is a Mexican Army base located in close proximity to the Project site. The mine site guard house is located at the entrance to the Bolivar Mine. The processing site guard house is located near the scales at the processing plant.

## 18.9 Logistics

The copper concentrates are loaded in 18 ton trucks and shipped by road to the port at Guaymas. The concentrate is sold FOB port. The Project produced 30,555 tonnes of concentrate in 2015 (approximately 2,500 tonnes/month). During the first nine months of 2016, concentrate totaled 22,652 tonnes. The 2016 average per month is approximately 2,500 tonnes/month.

The copper concentrate is sampled and placed in a shipping truck, weighed and then covered by a tarpaulin and then shipped 530km, approximately 10 hours one way, through Bahuichivo to the port of Guaymas. Figure 18-7 shows the trucking routes to Guaymus.

All other materials required for the Project are shipped to the site via the road system by truck.




Source: Google Maps, 2017

**Figure 18-7: Copper Concentrate Trucking Routes**

# 18.10 Waste Handling and Management

## 18.10.1 Waste Management

The site has septic systems to handle wastewater and sewage. Trash, as previously mentioned, is hauled to the landfill at Cieneguita.

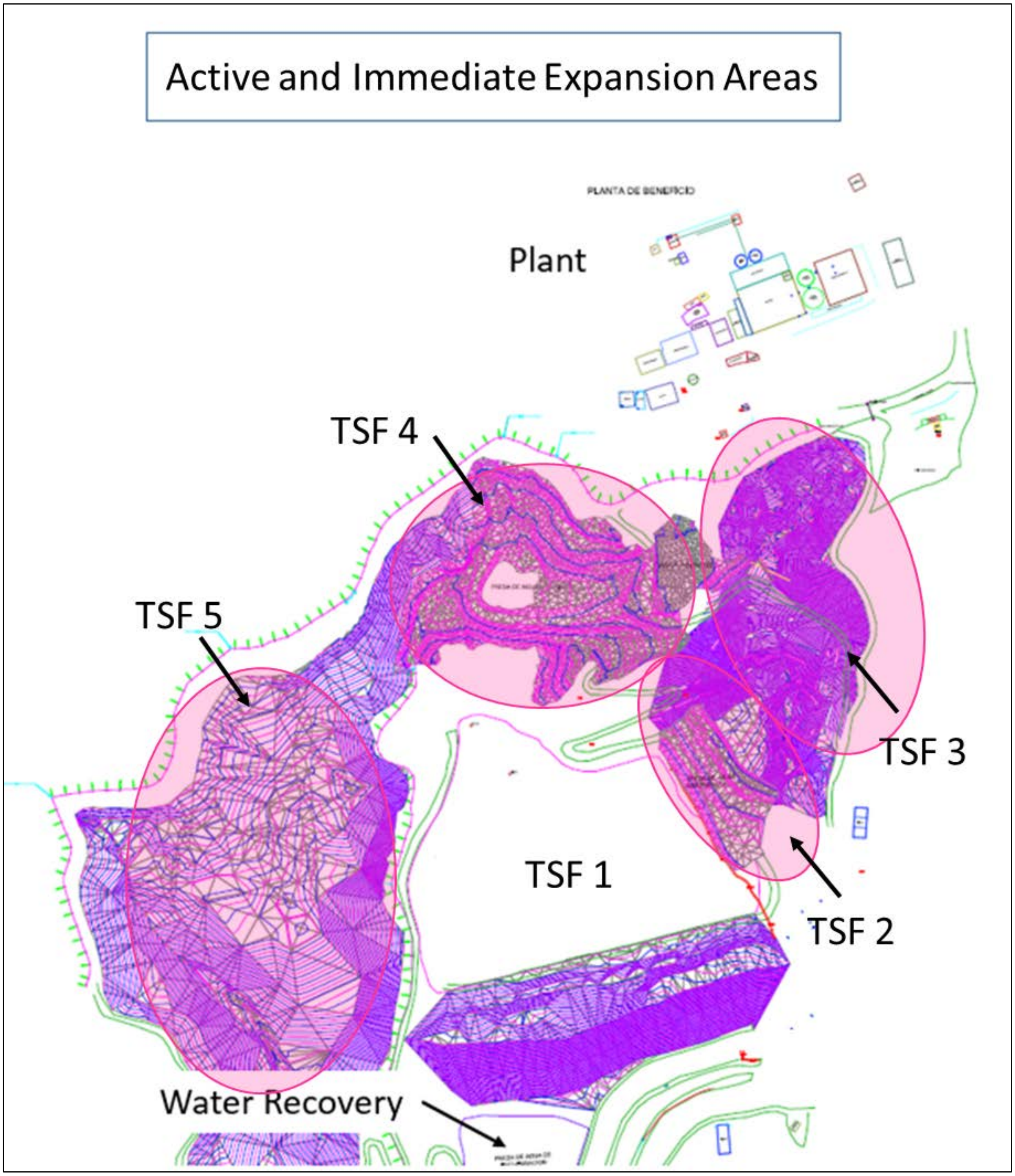
## 18.10.2 Waste Rock Storage

The site has minimal waste rock storage needs as the majority of the underground waste is stored underground. What little waste that comes to the surface is placed in the permitted storage areas.

# 18.11 Tailings Management

## 18.11.1 Existing Tailings Facility

The existing tailings facility has been in operation since the Piedras Verdes mill was commissioned in late 2011. The existing tailings facility location (TSF 1 and TSF 2) can be seen in Figure 18-8 and Figure 18-13 along with expansion areas, TSF 3-5, adjacent to the existing facility.

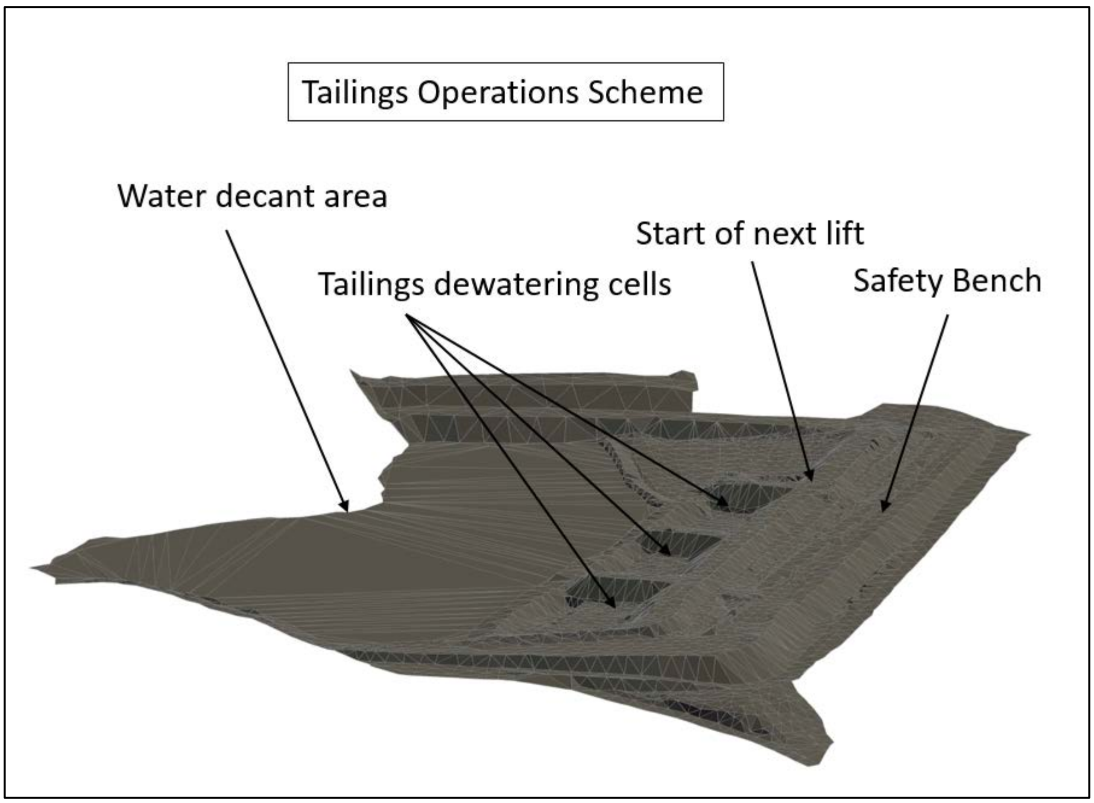



Source: Dia Bras, 2017

**Figure 18-8: Active Tailing Area Location**

The tailings management plan at the Bolivar mine includes placement of tailings in a number of locations. The principal storage facility, Tailings Area 1 (TSF1) in Figure 18-8, is the largest of the facilities operated to date. It has a remaining capacity of 862,000 tonnes, or one lift. Tailings are currently not being placed in TSF1. The site is utilizing capacity in Tailings Storage Area 2 (TSF2). The remaining capacity in TSF1 as contingency capacity. The capacity of this TSF2, with no additional expansion, is approximately 78,000 tonnes and will be reached in April 2017. At that point tailings will be placed in TSF 3, which has a capacity of 463,850 tonnes. TSF 3 has approximately six months of capacity and will support production through September/October 2017. TSF 4 will be ready to accept tailings in June 2017 and will be used after TSF 3 reaches capacity. The TSF 4 tailings placement will be modified with new equipment. The new system is discussed in Secion 18.11.2.

In general, the existing tailings facility and TSF2 and TSF3 will be operated by moving the tailings from the processing plant via pipelines to holding cells on the tailings area near the leading edge of the embankment. Water is drained to the back of the facility (closest to the plant). The multiple cells allow the tailings to drain while new tailings are placed in the next cell. Once drained, the higher density material is moved to the front of the embankment to build the next lift embankment with mobile equipment (excavator and dozer). The construction method is known as “upstream construction.” The sequence repeats from the front of the embankment across the tailings storage facility until the next lift is prepared to raise the TSF to the next level. A sump exists at the bottom of the tailing facility that captures any seep or runoff water and is returned for use at the processing plant. Figure 18-9 shows the dewatering cells and the general shape of the TSF operational area.



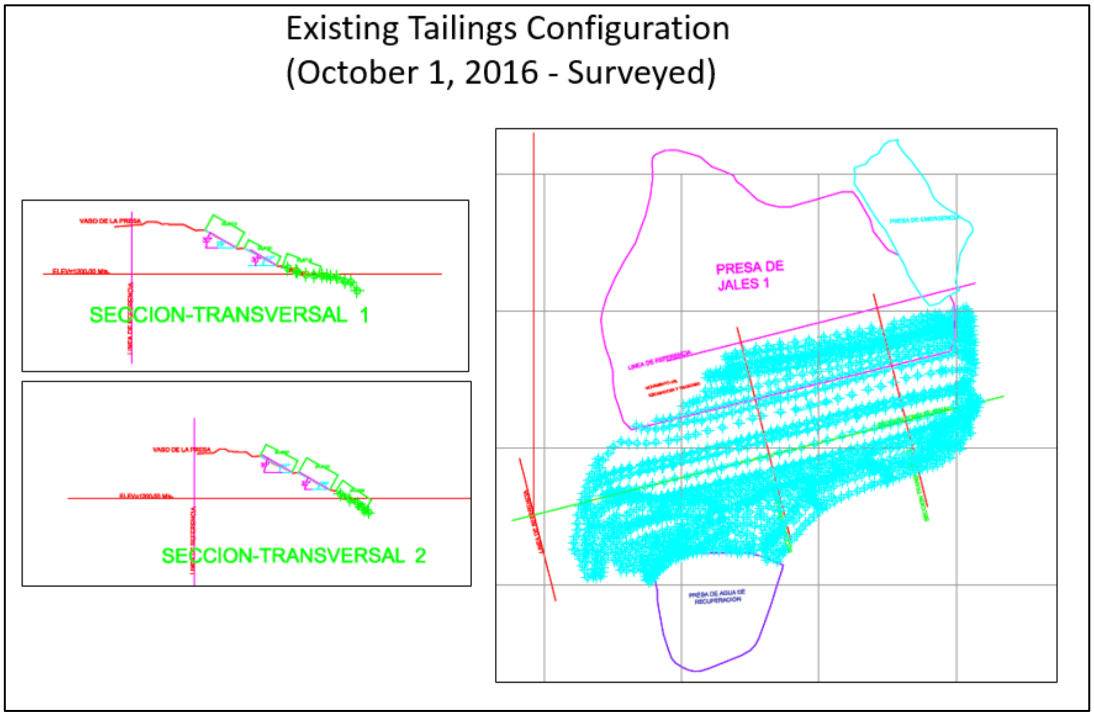

Source: Dia Bras, 2017

**Figure 18-9: Active Tailing Operation**

The existing permitted facility had been inspected by Burō Hidrōlogico Consultoría in 2016 and recommendations were made to modify the slopes to 30 degrees maximum and provide 4 meter benches. SRK has summarized the findings in this section and it does not take any design responsibility since SRK is not the “Engineer on Record” for the design or inspection. Additional work suggested was to maintain a drainage channel to keep water off the edges of the TSF, clean up and reestablish the edges of the TSF on solid rock, address erosion, and add cover over a pipe under an access road. These items have been addressed. Dia Bras provided survey data showing the slope corrections and these can be seen in the photograph in Figure 18-10. The design parameters and as-built can be seen in Figure 18-11.

Source: SRK, 2017

**Figure 18-10: Photograph of the Active Tailings Area**



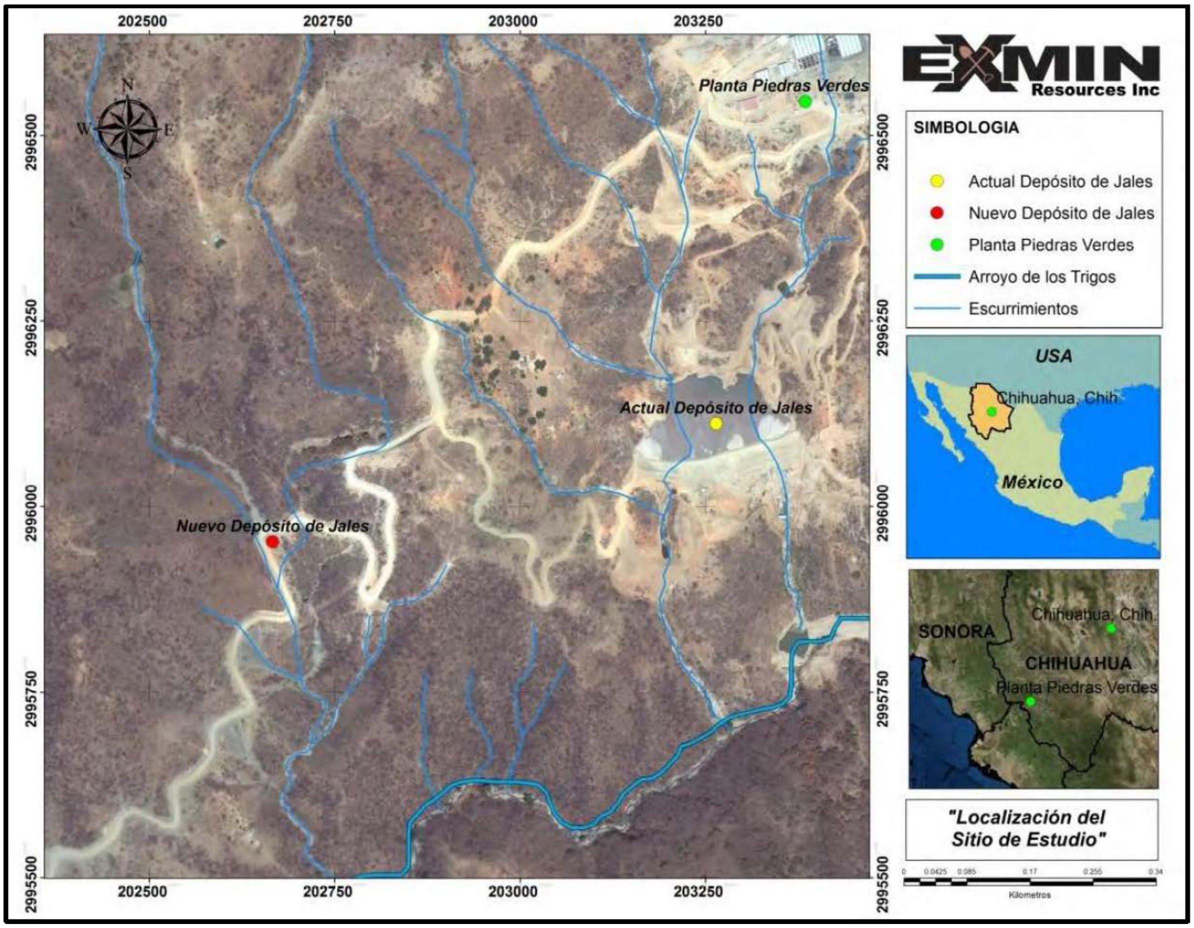

Source: Dia Bras, 2016

**Figure 18-11: Existing Tailings Grade and Survey**

## 18.11.2Tailings Facility Expansion

Dia Bras has contracted with Burō Hidrōlogico Consultoría and JDF Construction Mineras SA de CV (JDF) for the geotechnical evaluation, design, costing and construction of a TSF expansion program that allows the processing of ore beyond the reserves stated in this report. The current status and planned sequence of expansion is described in this section.

Burō Hidrōlogico Consultoría, in June 2016, prepared an analysis of the watershed, including rainfall analysis, and completed a review of the geology in the area. Figure 18-12 shows the area under study by Burō Hidrōlogico Consultoría. The existing TSF can be seen on the right.




Source: Burō Hidrōlogico Consultoría, 2016

**Figure 18-12: View of Burō Hidrōlogico Consultoría Study Area**

Figure 18-13 shows the location of the TSF expansion areas, the location of a New TSF to the west, and the location of additional infrastructure.

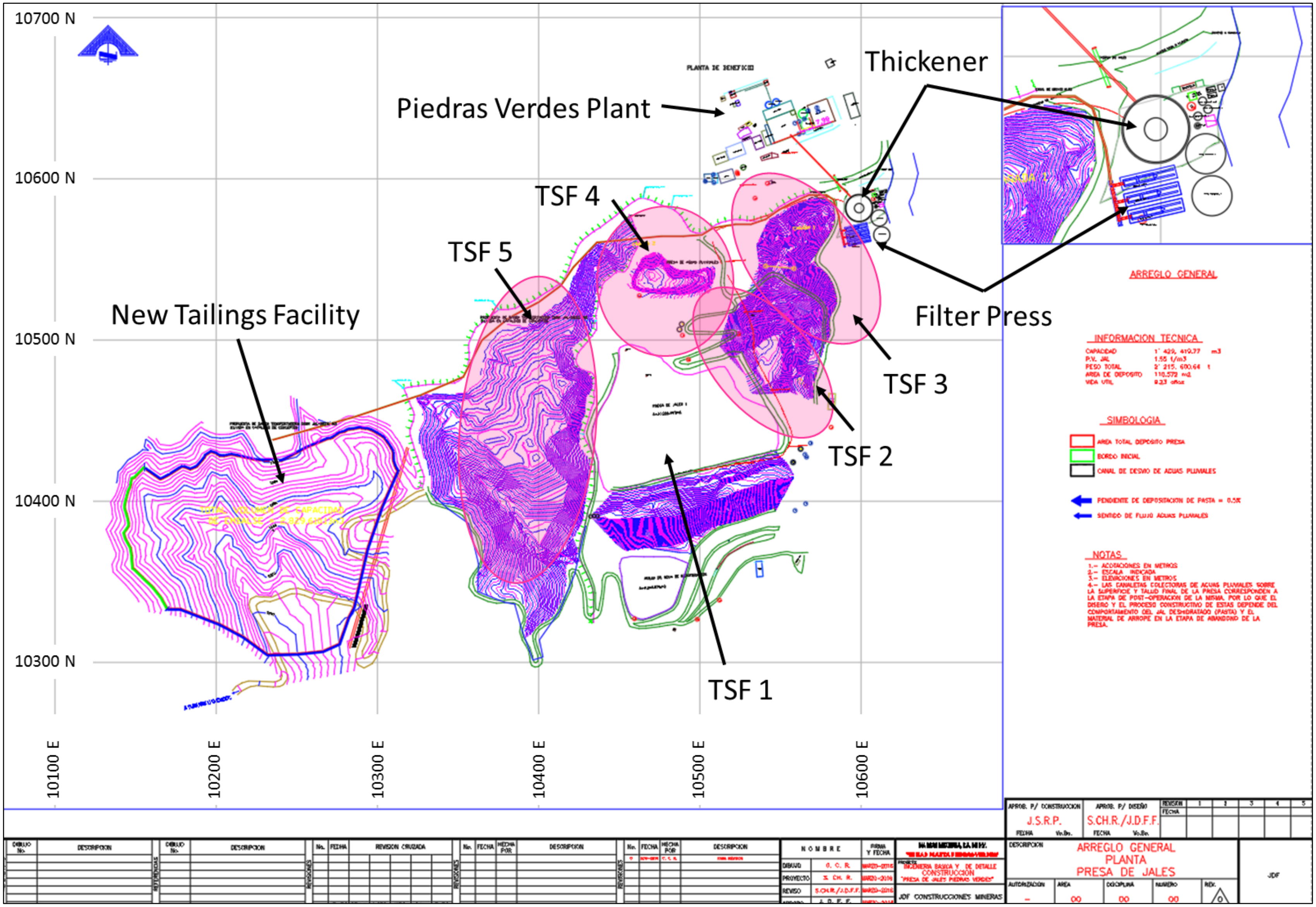



**Figure 18-13: Overview of TSF Expansion Locations and Infrastructure**

As part of the overall management plan, the site is also installing infrastructure to recover additional process water and reduce the water content of the final tailings. Current tailings are approxmiately 40% solids.

A thickener, with a diameter of 36.6 m, is under construction and is planned to be in operation in June 2017. Process tailings will be delivered from the plant to the new thickener via pipeline. The 60% solids tailings from the thickener will be placed, via pipeline, in TSF 4.

Three filter presses have been purchased by Dia Bras. Installation of these filters is planned for completion in September 2017. Two of the three filters will operate at any given time with the third filter on standby or under maintenance. Following the installation and commissioning of the thickener and filter presses, the final tailings from the Bolivar mine will consist of 85% solids. This dry-stack material will be placed in the remainder of TSF 4 and TSF 5 via a conveyor after the conveyor is installed. The conveyor is planned for completion by February 2018. TSF 4 and TSF 5 will provide capacity to mid 2019.

Expansion beyond TSF 5 will consist of the construction of the New Tailings Facility (New TSF) shown in Figure 18-13 located to the west of TSF 5. This facility, when complete, will provide capacity to July 2023. SRK notes that Dia Bras has calculated the July 2023 total TSF capacity assuming 4,000 ore tonnes per day production from Piedras Verdes.

In summary, tailings consisting of approximately 40% solids will be placed in conventional tailings storage facilities (TSF 1-TSF 3) until June 2017. Thickened tails (60% solids) will be placed from June 2017 to February 2018 in TSF 4. Dry-stack tails will be placed after February 2018 in TSF 4 TSF 5. Expansion around the main TSF, inTSF 1-TSF 5, will be utilized until mid 2019 when dry stack tailings will be placed in the New TSF to located just to the west of the existing facility.

All permits are in place for TSF 1 through TSF 5. Additional permitting will be required for the New TSF. SRK notes that Dia Bras has allocated US$6.1 million in 2017 for the thickener, filter presses, and TSF expansion civil works.

SRK recommends that the site continue its project efforts to complete the installation of the thickener, filter presses, and conveyor. The site must ensure that all required detailed designs are completed and permits are in place for successful operation of the New TSF located to the west of the existing facility. An analysis of utilizing tailings as backfill in the mine should be carried out, and a trade-off study should be completed to determine if the size of the New TSF can be reduced.

# 19 Market Studies and Contracts

Bolivar is an underground mining operation producing commercial quality copper concentrate containing payable amounts of copper, silver and gold. Dia Bras currently holds a contract for the sale of its concentrate. The contract was reviewed by SRK and its terms were included in the technical economic model. The terms appear reasonable and in line with similar operations SRK is familiar with.

The metals produced from the Bolivar concentrate are traded on various metals exchanges. Metal prices were provided by Sierra Metals and have been derived from January 2017 BMO Capital Markets Street Consensus Commodity prices. In SRK's opinion the prices used are reasonable for the statement of mineral resources and ore reserves. The metal price assumption are presented in Table 19-1.

**Table 19-1: Metal Prices**

| Commodity | Value | Unit |
|---|---|---|
| Au | 1,283 | $/oz |
| Ag | 18.30 | $/oz |
| Cu | 2.43 | $/lb |

Source: Sierra Metals, 2017

# 20 Environmental Studies, Permitting and Social or Community Impact

## 20.1 Environmental Studies and Background Information

SRK's environmental specialist did not conduct a site visit of the Bolivar Mine. As such, the following information is predicated on a review of available documentation and direct communications with the operator.

The Bolivar Mine consists of a 2,400 t/d underground Cu, Ag and Au mining operation. The mined material is transported 5 km to the 3,000 t/d Piedras Verdes Mill. The mine is located within 14 contiguous mineral concessions covering a total of 6,800 ha. The Bolivar Mine, Piedras Verdes Milling operation and the 14 concessions (the Project) are owned by Sierra Metals through its ownership of the various operating entities. Until December 2012, Sierra Metals was formerly named DIA BRAS Exploration Inc.

Limited data and documents were available for the project. Those that were provided for review have not been officially or completely translated, and SRK was obliged to employ electronic translation software to convert many of them from the native Spanish, thus limiting the efficiency of the review. In addition, several of the documents were conceptual or only available in draft form and may not accurately reflect the final design conditions of the facility.

## 20.2 Environmental Studies and Liabilities

Detailed information regarding environmental studies related to the Bolivar Mine was not made specifically available for this assessment. Based on communications with representatives from Dia Bras, it does not appear that there are currently any known environmental issues that could materially impact the extraction and beneficiation of mineral resources or reserves.

From previous assessments (Gustavson, 2013), known environmental liabilities include unreclaimed exploration disturbances (i.e., roads, drill pads, etc.) and small residual waste rock piles from historical mining operations.

As observed by SRK personnel during the site visit, dust emissions generated as a result of ore haulage traffic from the mine to mill could become an issue with several adjacent landowners in the future. Development of a mitigation plan prior to any regulator involvement is recommended.

## 20.3 Environmental Management

### 20.3.1 Tailings Disposal

The current tailings disposal facility has capacity until mid-2019. Dia Bras intends to build additional tailings capacity concurrent with mine operations. The expansion will require additional permitting effort.

### 20.3.2 Geochemistry

Geochemical characterization of the Bolivar Mine tailings has been conducted annually by a qualified third-party laboratory in Mexico as part of the monitoring and reporting requirements of NOM-141-SEMARNAT-2003. The testing includes leach testing for metals and acid-base accounting (ABA).

Acid-base accounting (ABA) testing is a static test procedure designed to measure the long-term potential for waste rock and/or tailings to generate acid.

Net-neutralization potential (NNP) consists of two measurements: (1) neutralization potential (NP) and (2) the acid-generating potential (AP). NNP is defined as the difference between these two measurements (NNP = NP – AP). The NP/AP ratio is also used to describe the acid-producing potential of mine waste. ABA classifications for mine-waste samples are based on both NNP and NP/AP and are divided into three categories including acid-generating, uncertain, and non-acid generating.

According to the Nevada Division of Environmental Protection report on Waste Rock, Overburden, and Ore dated February 2014, if the ratio is less than 1.2:1, the material is considered potentially acid generating (PAG). If the ratio is greater than 1.2, no additional testing is required.

The testing results for 2014 and 2015, provided to SRK, indicate low metals leaching potential and either uncertain or non-acid generating potential. The 2016 ABA results (NP = 52.5 kg $CaCO_3$/ton; AP = 141 kg $CaCO_3$/ton), however, suggest that some of the more recent material may be potentially acid generating: NP/AP = 0.372. Additional investigation of the current materials being deposited into the tailings impoundment may be warranted; however, given the dryness of the Chihuahuan Desert, this may not necessarily be a material issue for the project.

### 20.3.3 Emission and Waste Management

In 2015, an authorization for the Unique Environmental License (*Licencia Ambiental Unica* [LAU]) was granted by SEMARNAT to EXMIN in order to carry out mineral processing and other metallurgical activities (beneficiation) at the Bolivar mill site.

The document establishes the environmental obligations to be met by the company. It establishes that EXMIN operations must adhere to the authorizations provided by the LAU in the matter of atmospheric emissions and generation/management of hazardous wastes.

Several key conditions of the LAU include:

- EXMIN must submit its Annual Operating Card (Cédula de Operacion Anual) between March 1st and June 30th of each year;
- Discharges of wastewater to natural water reservoirs or sewers, without CONAGUA approval, is prohibited;
- The operation shall develop and maintain a contingency plan (not provided to SRK);
- For point sources of atmospheric emissions (end of pipe), all emission sampling ports shall be installed and maintained in good conditions;
- Emissions must meet the Maximum Permissible Limits (Limites Maximos Permisibles [MPL]) established by the NOM-085-SEMARNAT-2011 and NOM-043-SEMARNAT-1193;
- Emissions of Volatile Organic Compounds (VOCs) should be kept to a minimum, since there is no any normative regulating emissions at this time; and
- Records of the operation and maintenance of equipment that generates emissions shall be maintained.

# 20.4 Mexican Environmental Regulatory Framework

## 20.4.1 Mining Law and Regulations

Mining in Mexico is regulated through the Mining Law, approved on June 26, 1992 and amended by decree on December 24, 1996, Article 27 of the Mexican Constitution.

Article 6 of the Mining Law states that mining exploration; exploitation and beneficiation are public utilities and have preference over any other use or utilization of the land, subject to compliance with laws and regulations.

Article 19 specifies the right to obtain easements, the right to use the water flowing from the mine for both industrial and domestic use, and the right to obtain a preferential right for a concession of the mine waters.

Articles 27, 37 and 39 rule that exploration; exploitation and beneficiation activities must comply with environment laws and regulations and should incorporate technical standards in matters such as mine safety, ecological balance and environmental protection.

The Mining Law Regulation of February 15, 1999 repealed the previous regulation of March 29, 1993. Article 62 of the regulation requires mining projects to comply with the General Environmental Law, its regulations, and all applicable norms.

## 20.4.2 General Environmental Laws and Regulations

Mexico's environmental protection system is based on the General Environmental Law known as *Ley General del Equilibrio Ecológico y la Protección al Ambiente* - LGEEPA (General Law of Ecological Equilibrium and the Protection of the Environment), approved on January 28, 1988 and updated December 13, 1996.

The Mexican federal authority over the environment is the *Secretaría de Medio Ambiente y Recursos Naturales* - SEMARNAT (Secretariat of the Environment and Natural Resources). SEMARNAT, formerly known as SEDESOL, was formed in 1994, as the *Secretaría de Medio Ambiente Recursos Naturales y Pesca* (Secretariat of the Environment and Natural Resources and Fisheries). On November 30th, 2000, the Federal Public Administration Law was amended giving rise to SEMARNAT. The change in name corresponded to the movement of the fisheries subsector to the *Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación* - SAGARPA (Secretariat of Agriculture, Livestock, Rural Development, Fisheries and Food), through which an increased emphasis was given to environmental protection and sustainable development.

SEMARNAT is organized into a number of sub-secretariats and the following main divisions:

- INE – Instituto Nacional de Ecología (National Institute of Ecology), an entity responsible for planning, research and development, conservation of national protection areas and approval of environmental standards and regulations.
- PROFEPA - Procuraduría Federal de Protección al Ambiente (Federal Attorney General for the Protection of the Environment) responsible for law enforcement, public participation and environmental education.
- CONAGUA – Comisión Nacional del Agua (National Water Commission), responsible for assessing fees related to water use and discharges.
- Mexican Institute of Water Technology.

- CONANP – Comisión Nacional de Areas Naturales Protegidas (National Commission of Natural Protected Areas).

The federal delegation or state agencies of SEMARNAT are known as *Consejo Estatal de Ecología* – COEDE (State Council of Ecology).

PROFEPA is the federal entity in charge of carrying out environmental inspections and negotiating compliance agreements. Voluntary environmental audits, coordinated through PROFEPA, are encouraged under the LGEEPA.

Under LGEEPA, a number of regulations and standards related to environmental impact assessment, air and water pollution, solid and hazardous waste management and noise have been issued. LGEEPA specifies compliance by the states and municipalities, and outlines the corresponding duties.

Applicable regulations under LGEEPA include:

- Regulation to LGEEPA on the Matter of Environmental Impact Evaluations, May 30, 2000;
- Regulation to LGEEPA on the Matter of Prevention and Control of Atmospheric Contamination, November 25, 1988;
- Regulation to LGEEPA on the Matter of Environmental Audits, November 29, 2000;
- Regulation to LGEEPA on Natural Protected Areas, November 20, 2000;
- Regulation to LGEEPA on Protection of the Environment Due to Noise Contamination, December 6, 1982; and
- Regulation to LGEEPA on the Matter of Hazardous Waste, November 25, 1988.

Mine tailings are listed in the Regulation to LGEEPA on the Matter of Hazardous Waste. Norms include:

- Norma Official Mexicana (NOM)-CRP-001-ECOL, 1993, which establishes the characteristics of hazardous wastes, lists the wastes, and provides threshold limits for determining its toxicity to the environment;
- NOM-CRP-002-ECOL, 1993 establishes the test procedure for determining if a waste is hazardous;
- On September 13, 2004, SEMARNAT published the final binding version of its new standard on mine tailings and mine tailings dams, NOM-141-SEMARNAT-2003. The new rule has been renamed since the draft version was published in order to better reflect the scope of the new regulation. This NOM sets out the procedure for characterizing tailings, as well as the specifications and criteria for characterizing, preparing, building, operating, and closing a mine tailings dam. This very long (over 50 pages) and detailed standard sets out the new criteria for characterizing tailings as hazardous or non-hazardous, including new test methods. A series of technical annexes address everything from waste classification to construction of the dams. The rule is applicable to all generators of non-radioactive tailings and to all dams constructed after this NOM goes into effect; and
- Existing tailings dams will have to comply with the new standards on post-closure. The NOM formally went into effect 60 days after its publication date.

**PROFEPA "Clean Industry"**

The *Procuraduría Federal de Protección al Ambiente* (the enforcement portion of Mexico's Environmental Agency, referred to as PROFEPA), administers a voluntary environmental audit program and certifies businesses with a "Clean Industry" designation if they successfully complete the audit process. The voluntary audit program was established by legislative mandate in 1996 with a directive for businesses to be certified once they meet a list of requirements including the implementation of international best practices, applicable engineering and preventative corrective measures.

In the Environmental Audit, firms contract third-party, PROFEPA-accredited auditors, considered experts in fields such as risk management and water quality, to conduct the audit process. During this audit, called "Industrial Verification," auditors determine if facilities are in compliance with applicable environmental laws and regulations. If a site passes, it receives designation as a "Clean Industry" and is able to utilize the Clean Industry logo as a message to consumers and the community that it fulfills its legal responsibilities. If a site does not pass, the government can close part, or all of a facility if it deems it necessary. However, PROFEPA wishes to avoid such extreme actions and instead prefers to work with the business to create an "Action Plan" to correct problem areas.

The Action Plan is established between the government and the business based on suggestions of the auditor from the Industrial Verification. It creates a time frame and specific actions a site needs to take in order to be in compliance and solve existing or potential problems. An agreement is then signed by both parties to complete the process. When a facility successfully completes the Action Plan, it is then eligible to receive the Clean Industry designation.

PROFEPA believes this program fosters a better relationship between regulators and industry, provides a green label for businesses to promote themselves and reduces insurance premiums for certified facilities. The most important aspect, however, is the assurance of legal compliance through the use of the Action Plan, a guarantee that ISO 14001 and other Environmental Management Systems cannot make.

According to Dia Bras, the company has initiated the PROFEPA "Clean Industry" application process for the Bolivar mill site. The site is currently preparing for the third-party, external audit, and anticipated obtaining the certification in 2017.

**SIGA**

Many companies in Mexico adopt the corporate policy, *Sistema Integral de Gestión Ambiental* (SIGA) (Integral System of Environmental Management), for the protection of the environmental and prevention of adverse environmental impacts. SIGA emphasizes a commitment to environmental protection along with sustainable development, as well as a commitment to strict adherence to environmental legislation and regulation and a process of continuous review and improvement of company policies and programs. The companies continue to improve their commitments to environmental stewardship through the use of the latest technologies that are proven, available, and economically viable.

SRK is not aware if the Bolivar Mine participates in the SIGA program at this time, but recommends that they do so.

Other environmental/social industry programs that the mine could participate in include:

- Seeking accreditation under the voluntary self-management program for health and safety with the Mexican Department of Labor and Social Welfare (PASST); and
- Strive to receive the Social Responsible Company (ESR) Distinctive, which is awarded by the Mexican Center of Philanthropy.

### 20.4.3 Other Laws and Regulations

**Water Resources**

Water resources are regulated under the National Water Law, December 1, 1992 and its regulation, January 12, 1994 (amended by decree, December 4, 1997). In Mexico, ecological criteria for water quality is set forth in the Regulation by which the Ecological Criteria for Water Quality are Established, CE-CCA-001/89, dated December 2, 1989. These criteria are used to classify bodies of water for suitable uses including drinking water supply, recreational activities, agricultural irrigation, livestock use, aquaculture use and for the development and preservation of aquatic life. The quality standards listed in the regulation indicate the maximum acceptable concentrations of chemical parameters and are used to establish wastewater effluent limits. Ecological water quality standards defined for water used for drinking water, protection of aquatic life, agricultural irrigation and irrigation water and livestock watering are listed.

Discharge limits have been established for particular industrial sources, although limits specific to mining projects have not been developed. NOM-001-ECOL-1996, January 6, 1997, establishes maximum permissible limits of contaminants in wastewater discharges to surface water and national “goods” (waters under the jurisdiction of the CONAGUA).

Daily and monthly effluent limits are listed for discharges to rivers used for agricultural irrigation, urban public use and for protection of aquatic life; for discharges to natural and artificial reservoirs used for agricultural irrigation and urban public use; for discharges to coastal waters used for recreation, fishing, navigation and other uses and to estuaries; and discharges to soils and to wetlands. Effluent limitations for discharges to rivers used for agricultural irrigation, for protection of aquatic life and for discharges to reservoirs used for agricultural irrigation have also been established.

**Ecological Resources**

In 2000, the National Commission of Natural Protected Areas (CONANP) (formerly CONABIO, the National Commission for Knowledge and Use of Biodiversity) was created as a decentralized entity of SEMARNAT. As of November 2001, 127 land and marine Natural Protected Areas had been proclaimed, including biosphere reserves, national parks, national monuments, flora and fauna reserves, and natural resource reserves.

Ecological resources are protected under the *Ley General de Vida Silvestre* (General Wildlife Law). (NOM)-059-ECOL-2000 specifies protection of native flora and fauna of Mexico. It also includes conservation policy, measures and actions, and a generalized methodology to determine the risk category of a species.

Other laws and regulations include:

- Forest Law, December 22, 1992, amended November 31, 2001, and the Forest Law Regulation, September 25, 1998;
- Fisheries Law, June 25, 1992, and the Fisheries Law Regulations, September 29, 1999; and
- Federal Ocean Law, January 8, 1986.

**Regulations Specific to Mining Projects**

All aspects related to Mine Safety and Occupational Health are regulated in Mexico by NOM-023-STPS-2003 issued by the Secretariat of Labor. Appendix D of this regulation refers specifically to ventilation for underground mines, such as Bolivar Mine, and establishes all the requirement underground mines should comply with, which are subject of regular inspections.

New tailings dams are subject to the requirements of NOM-141-SEMARNAT-2003, Standard that Establishes the Requirements for the Design, Construction and Operation of Mine Tailings Dams. Under this regulation, studies of hydrogeology, hydrology, geology and climate must be completed for sites considered for new tailings impoundments. If tailings are classified as hazardous under NOM-CRP-001-ECOL/93, the amount of seepage from the impoundment must be controlled if the facility has the potential to affect groundwater. Environmental monitoring of groundwater and tailings pond water quality and revegetation requirements is specified in the regulations.

NOM-120-ECOL-1997, November 19, 1998 specifies environmental protection measures for mining explorations activities in temperate and dry climate zones that would affect xerophytic brushwood (matorral xerofilo), tropical (caducifolio) forests, or conifer or oak (encinos) forests. The regulation applies to “direct” exploration projects defined as drilling, trenching, and underground excavations. A permit from SEMARNAT is required prior to initiating activities and SEMARNAT must be notified when the activities have been completed. Development and implementation of a Supervision Program for environmental protection and consultation with CONAGUA is required if aquifers may be affected. Environmental protection measures are specified in the regulations, including materials management, road construction, reclamation of disturbance and closure of drill holes. Limits on the areas of disturbance by access roads, camps, equipment areas, drill pads, portals, trenches, etc. are specified.

### 20.4.4 Expropriations

Expropriation of ejido and communal properties is subject to the provisions of agrarian laws.

### 20.4.5 NAFTA

Canada, the United States and Mexico participate in the North American Free Trade Agreement (NAFTA). NAFTA addresses the issue of environmental protection, but each country is responsible for establishing its own environmental rules and regulations. However, the three countries must comply with the treaties between themselves; and the countries must not reduce their environmental standards as a means of attracting trade.

### 20.4.6 International Policy and Guidelines

International policies and/or guidelines that may be relevant to the Bolivar Mine include:

- International Finance Corporation (Performance Standards) – social and environmental management planning; and

- World Bank Guidelines (Operational Policies and Environmental Guidelines).

These items were not specifically identified and included in SRK's environmental scope of work; however, given that Sierra Metals is a Canadian entity, general corporate policy tends to be in compliance with IFC, World Bank and Equator Principles.

SRK recommends that a more comprehensive audit of the Bolivar Mine be conducted with respect to these guidelines and performance standards.

### 20.4.7 The Permitting Process

Environmental permits are required from various federal and state agencies. The general process for obtaining authorization to construct a new industrial facility is shown below (Figure 20-1).

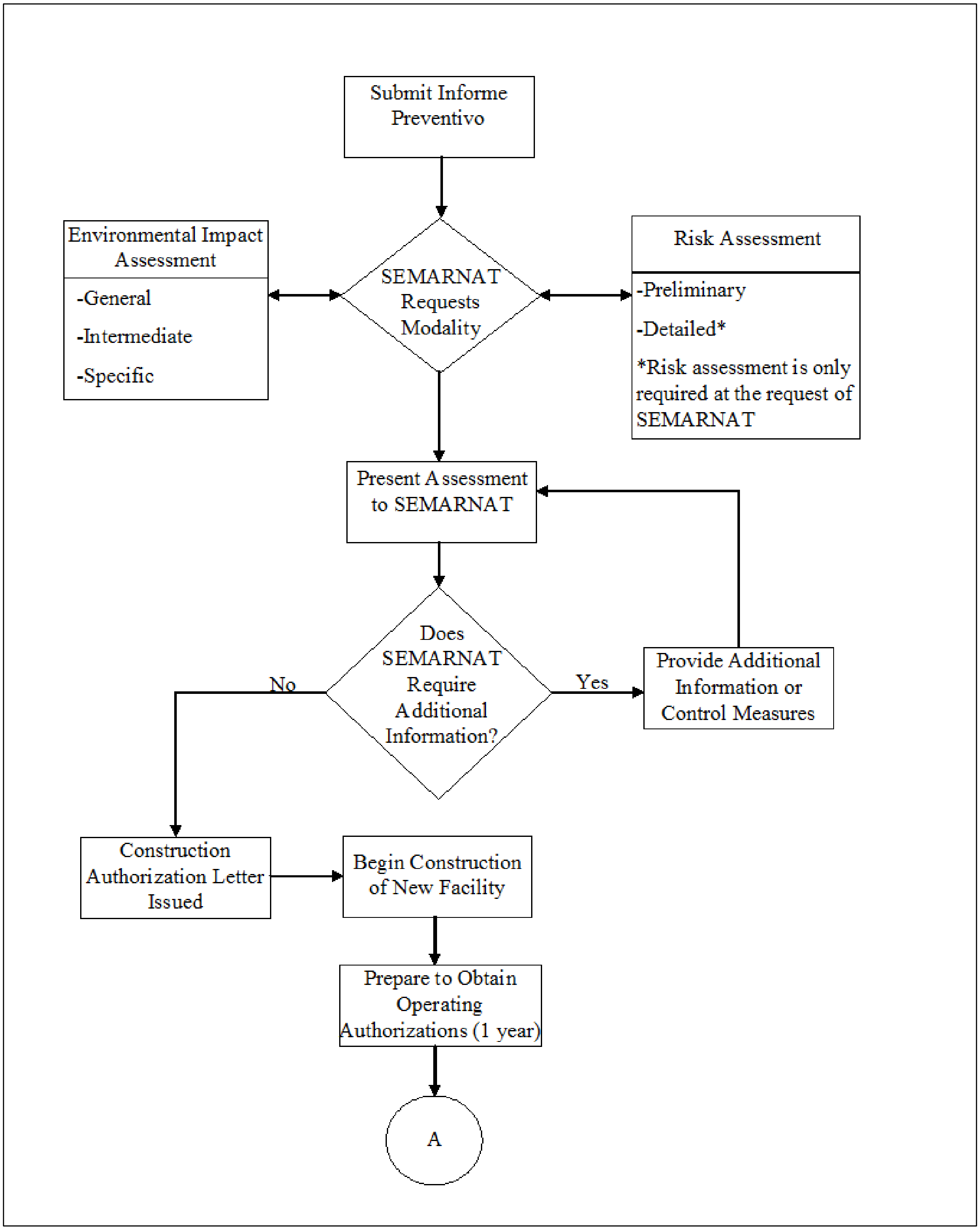



**Figure 20-1: Construction and Start-up Authorization for Industrial Facilities**

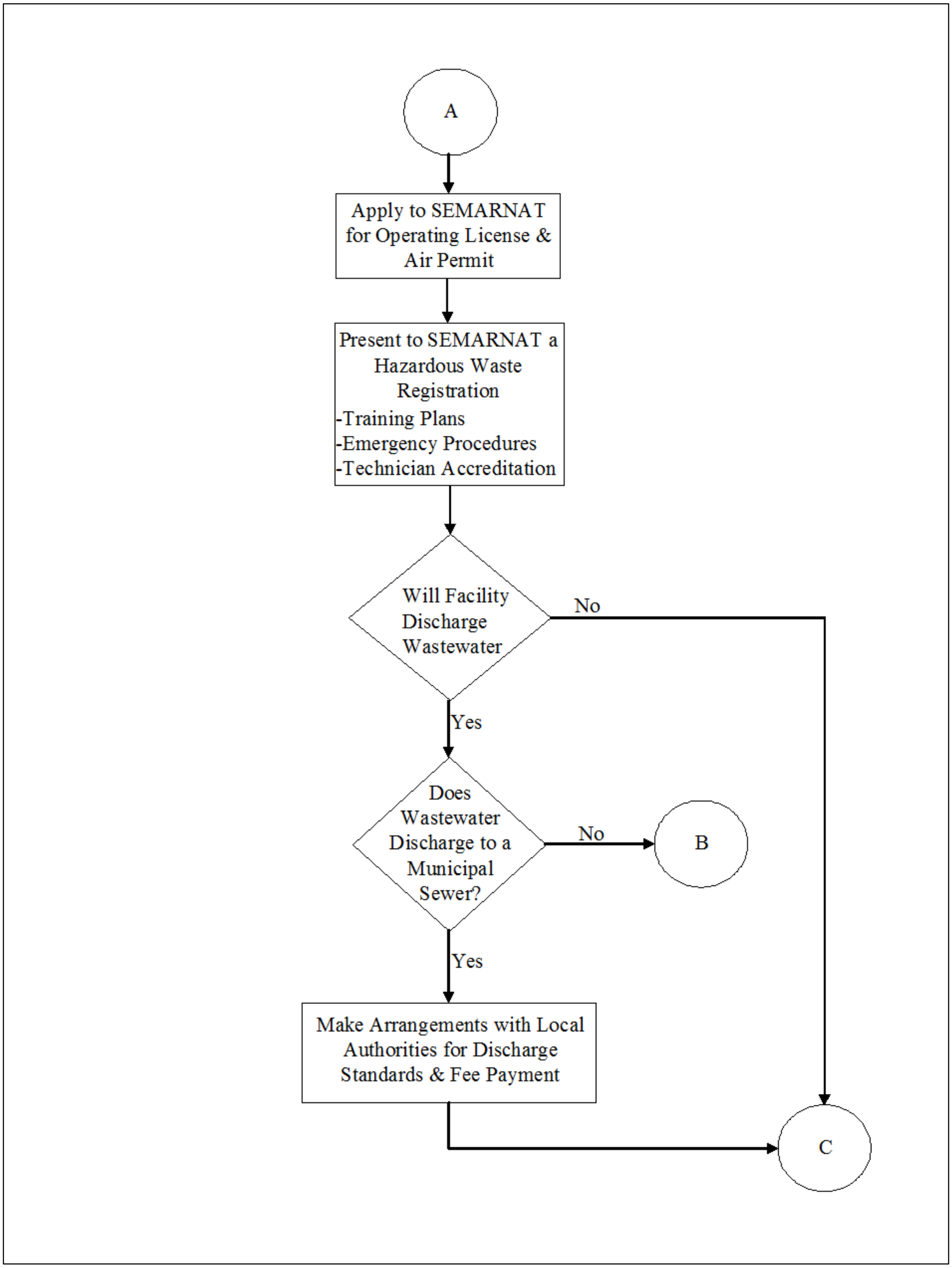



**Figure 20-1 (continued): Construction and Start-up Authorization for Industrial Facilities**

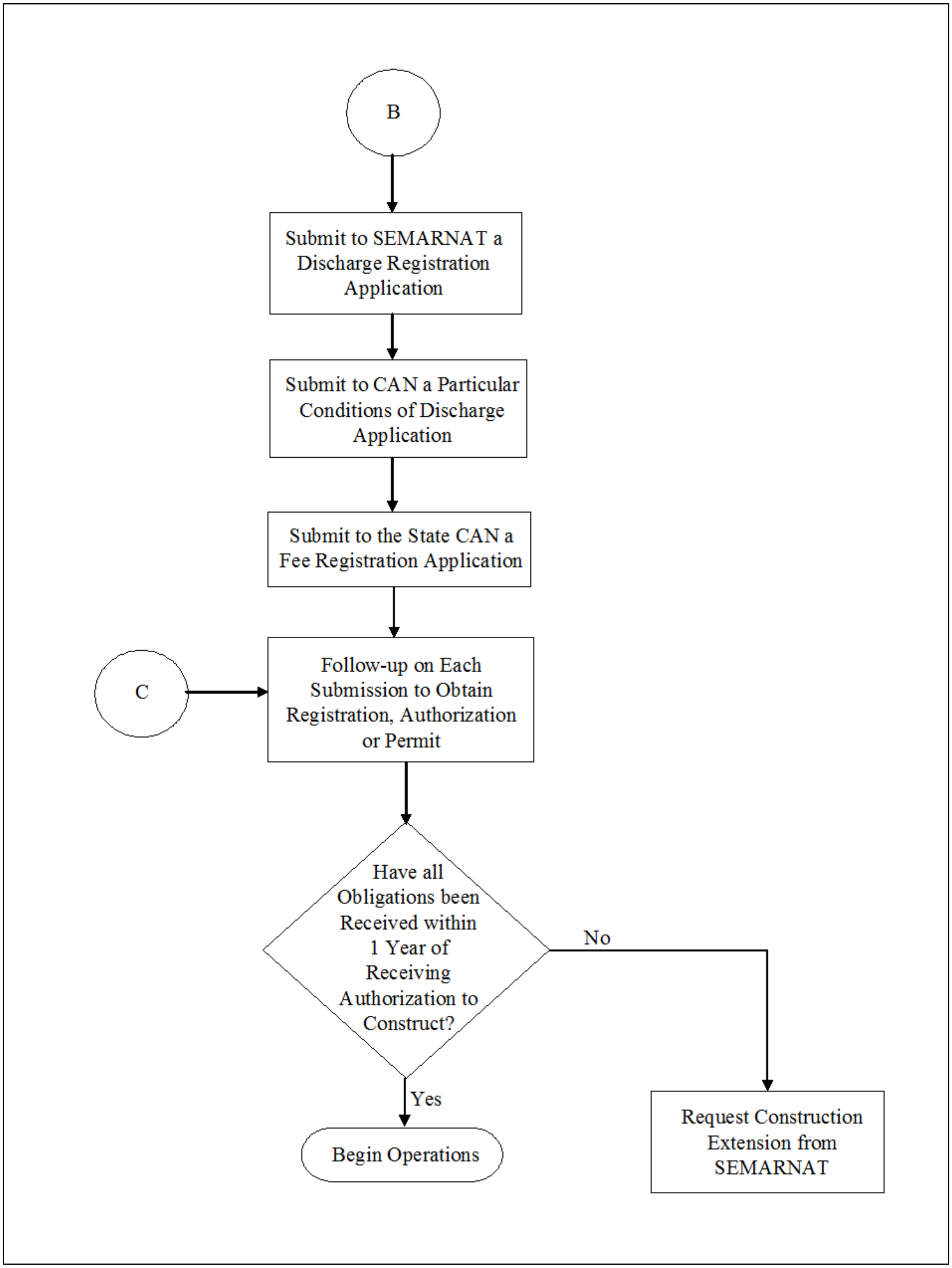



**Figure 20-1 (continued): Construction and Start-up Authorization for Industrial Facilities**

### 20.4.8 Required Permits and Status

The required permits for continued operation at the Bolivar Mine, including exploration of the site, have been obtained. SRK has not conducted an investigation as to the current status of all the required permits. At this time, SRK is not aware of any outstanding permits or any non-compliance at the project or nearby exploration sites. The following information regarding the exploration and mining permits was provided by Dia Bras.

**Table 20-1: Permit and Authorization Requirements for the Bolivar Mine**

| Permit | Agency | Approval Date<br>(or anticipated Approval Date) |
|---|---|---|
| Mining Law Concession | President via the Minister of Commerce and Industrial and the General Directorate of Mines Promotion - *Mexican Secretaría de Economía* | See Table 20-2 |
| *Manifestación de Impacto Ambiental* (MIA) - Environmental Impact Statement | *Secretaría de Medio Ambiente y Recursos Naturales* (SEMARNAT) - Secretariat of the Environment and Natural Resources | The operating mines of the Bolivar project are exempt from having to apply for the MIA according to the document SG.IR.08-2009 / 191 from SEMARNAT dated May 2009 that recognizes the exception since Dia Bras proved that the mining concessions predated the 1988 law. Any other concession will need a MIA or prove pre-existence.<br>The new mines of the Bolivar Project have MIA authorization document SG.IR.08-2015 / 271 from SEMARNAT dated October, 2015.<br>The plant site has a MIA, document SG.IR.08-2010 / 106.<br>The MIA for the power line and substation is the document number SG.IR.08-2013 /004. |
| *Análisis de Riesgo* - Risk Analysis Report | *Dirección Estatal de Proteccion Civil Chihuahua* (with assistance from external consultant) | A risk analysis focusing on the security on the use of explosives, was conducted and approved in D.O. 901/2015.<br>Additional studies have recently been completed, but not yet submitted to SEMARNAT. |
| Operating License (and Air Quality Permit) | SEMARNAT | The Bolivar mine area has no atmospheric emissions. The Bolivar plant area has a *Licencia Unica Ambiental* (unique environmental license) dated October 14, 2015, and approved under SG. CA.08-2015/075. |
| *Cambio de Uso de Suelo* - Land Use Change Permit | SEMARNAT | The operating concessions in the Bolivar Project are exempt from having to apply for the *Cambio de Uso de Suelo*, according to the document SG.IR.08-2009 / 191 from SEMARNAT dated May 2009, since Dia Bras proved that the mining concessions existed prior to the 1988 law. For the proposed mines, Dia Bras has presented the studies and solicitation, and is expecting a resolution in the next few weeks. |
| Concession Title for Underground Water Extraction | *Comisión Nacional del Agua* (CONAGUA) - National Water Commission) | Mine dewatering is regulated under the Mining Law and no permit is required to extract mine water. |
| Authorization for Utilization of National Surface Water | CONAGUA | For decades, new water appropriations in the area have been under moratorium; which was recently lifted by CONAGUA. Dia Bras has applied for new water appropriations and is expecting a response in April 2017. |
| Wastewater Discharge Permit | CONAGUA | For the Bolivar mine offices, there is a title permit BOO.906.01-1341 dated June 21, 2015.<br>For the Bolivar plant, there are documents No B00.E.22.4.-420 and No B00.906.01-1340 dated June 21, 2015. |
| Hazardous Waste Registration | SEMARNAT | The last update to this registration is dated September 18, 2015. The site reviews annually to determine if additional updates are necessary. |
| Explosives Use Permit | *Secretaría de la Defensa Nacional (SEDENA)* | Permit Number 4042. This permit is reviewed and updated annually, with the last one issued on December 1, 2016. |

| Permit | Agency | Approval Date (or anticipated Approval Date) |
|---|---|---|
| Archeological release letter | *Instituto Nacional de Antropologia y Historia* (INAH) | Updated in November 2013. No sites of interest for the INAH |
| Contract for Land Use | Local Ejido | The original contract was updated January 28, 2015. |

**Table 20-2: Bolivar Project Concessions**

| Holding Company | Name | Type | Area | File No. | Title No. | Enrolled | Expiry |
|---|---|---|---:|---:|---:|---:|---:|
| Dia Bras Mexicana (DBM) | *La Cascada* | Exploration | 1,944.33 | 016/32259 | 222720 | 8/27/2004 | 8/26/2054 |
| Javier Bencomo Muñoz 50%, DBM 50% | *Bolivar III* | Exploitation | 48.00 | 321.1/1-64 | 180659 | 7/14/1987 | 7/13/2037 |
| Javier Bencomo Muñoz 50%, DBM 50% | *Bolivar IV* | Exploitation | 50.00 | 321.1/1-118 | 195920 | 9/23/1992 | 9/22/2042 |
| Dia Bras Mexicana | *Piedras Verdes* | Exploration | 92.4698 | 016/31958 | 220925 | 10/28/2003 | 10/27/2053 |
| Dia Bras Mexicana | *Mezquital* | Exploration | 2,475.41 | 016/32157 | 223019 | 10/5/2004 | 10/4/2054 |
| Dia Bras Mexicana | *Mezquital Fracc. 1* | Exploration | 4.73 | 016/32157 | 223020 | 10/5/2004 | 04/10/2054 |
| Dia Bras Mexicana | *Mezquital Fracc. 2* | Exploration | 2.4338 | 016/32157 | 223021 | 10/5/2004 | 10/4/2054 |
| Dia Bras Mexicana | *Mezquital Fracc. 3* | Exploration | 974.5713 | 016/32157 | 223022 | 10/5/2004 | 10/4/2054 |
| Dia Bras Mexicana | *El Gallo* | Exploration | 251.7977 | 016/32514 | 224112 | 4/8/2005 | 4/7/2055 |
| Dia Bras Mexicana | *Bolivar* | Exploitation | 63.5633 | 321.1/1-100 | 192324 | 12/19/1991 | 12/18/2041 |
| Dia Bras Mexicana | *La Chaparrita* | Exploitation | 10.00 | 1/1.3/00882 | 217751 | 8/13/2002 | 8/12/2052 |
| Dia Bras Mexicana | *La Mesa* | Exploration | 718.95 | 016/32556 | 223506 | 1/12/2005 | 1/11/2055 |
| EXMIN, S.A. DE C.V. | *Moctezuma* | Exploitation | 67.4364 | 1/1/01432 | 226218 | 01/12/2005 | 01/12/2055 |
| EXMIN, S.A. DE C.V. | *San Guillermo* | Exploration | 96.0000 | 099/02161 | 196862 | 13/08/1993 | 12/08/2043 |

### 20.4.9 MIA and CUS Authorizations

In 2009, SEMARNAT agreed that a MIA for the Bolivar Mine was not necessary since the area has been under exploration and exploitation since 1979, but that DIA BRAS was still subject to the applicable environmental regulations according to article 29 of the LGEEPA. However, in the event that modifications to the existing operation were proposed, SEMARNAT would need to be consulted to determine the appropriate procedures for authorization.

In a resolution between SEMARNAT Chihuahua (Brenda Ríos Prieto) and DIA BRAS MEXICANA (Arturo Valles Chávez) dated October 2015, the agency conditionally authorizes the Bolivar Mine consisting of opening five (5) shafts for underground mines, 11 boreholes, waste dumps, material stock yard, tailings dam, and infrastructure construction (roads, substation, dining room, electricity distribution line, two (2) powder kegs and temporary waste store; based on the information presented in the Environmental Impact Manifestation (*Manifestacion de Impacto Ambiental* (MIA)) submitted in August 2015.

The area covered by the Land Use Change (*Cambio de Uso de Suelo* (CUS)) is 9.7570 Hectares (24.11 acres) and the total construction area is 11.448 Hectares (28.28 acres).

The resolution has a validity of 15 years and can be renewed through an advance request to SEMARNAT, accompanied by a verification issued by PROFEPA.

### 20.4.10 PROFEPA Inspection

In 2014, the enforcement branch of SEMARNAT, PROFEPA, conducted an inspection of several streams and arroyos near the EXMIN property (Bolivar Mine). SRK understands from the documentation provided that tailings from the beneficiation plant had spilled into these drainages during heavy rains on December 20 and 21, 2013. The affected streams included:

- Arroyo Los Alisos (also known as Arroyo Agua Caliente or Arroyo Tubares). The affected area covers 12.9 km above the river bed by 2.5 m wide. In total, an area of 32,250 m2 was affected with tailings deposited on the stream bed; and
- Rio Fuerte (also known as Rio Urique, Rio Batopilas). Arroyo Los Alisos joins with this river, tailings were found in an area of 1,750 m2 over the river bed.

Follow-up correspondence references a proposed remediation plan submitted by Arturo Valles Chávez, legal representative of EXMIN, to SEMARNAT. SRK was not provided a copy of this plan for review. However, according to EXMIN, the cleanup was performed over a period of several months, and any residual testing showed that the materials in the streams met with Mexican Norms. No further action appears to have been ordered by PROFEPA or SEMARNAT.

## 20.5 Social Management Planning and Community Relations

As part of the project review by SEMARNAT, the MIA document was made available to the public for review and comment prior to the issuance of the conditional authorization. SRK is not aware of any other public consultation or stakeholder engagement activities on the part of Dia Bras.

## 20.6 Closure and Reclamation Plan

Current regulations in México require that a preliminary closure program be included in the MIA and a definite program be developed and submitted to the authorities during the operation of the mine (generally accepted as three years into the operation). These closure plans tend to be conceptual and typically lack much of the detail necessary to develop an accurate closure cost estimate. However, Dia Bras has attempted to prescribe the necessary closure activities for the operation.

In February 2017, Treviño Asociados Consultores presented to Dia Bras, S.A. de C.V. a work breakdown of the anticipated tasks for closure and reclamation of the Bolivar Mine.

**Table 20-3: Bolivar Mine Cost of Reclamation and Closure of the Mine**

| Closure Activity | Cost Estimate MXN$ |
|---|---|
| Waste Rock Piles (regrading, soil preparation, revegetation) (2 ha) | $105,430 |
| Exploration Drill Pads (remove contaminated soils, soil preparation, revegetation, erosion control) (4Ha) | $48,300 |
| Roads (Border reconstruction, ditches, revegetation) (8 ha) | $96,600 |
| Building Demolition (camps, plant, mill – dismantle, remove, soil remediation, soil preparation, revegetation) | $7,653,250 |
| Tailings Impoundment (regrading, soil cover and preparation, revegetation) (6ha) | $316,020 |
| Power Line Corridor (soil preparation, revegetation) (12 ha) | $62,218 |
| Power Line Removal (850 poles; 12.64 km cable) | $977,500 |
| **Total (MXN)** | **$9,259,318** |
| Total (USD)* | US$453,888 |

*Based on exchange rate of USD$1 = MXN$20.4 (22Feb2017)

SRK's scope of work did not include an assessment of the veracity of this closure cost estimate, but, based on projects of similar nature and size within Mexico, the estimate appears low in comparison. SRK recommends that Dia Bras conduct an outside review of this estimate, with an emphasis on benchmarking against other projects in northern Mexico.

While Mexico requires the preparation of a reclamation and closure plan, as well as a commitment on the part of the operator to implement the plan, no financial surety (bonding) has thus far been required of mining companies. Environmental damages, if not remediated by the owner/operator, can give rise to civil, administrative and criminal liability, depending on the action or omission carried out. PROFEPA is responsible for the enforcement and recovery for those damages, or any other person or group of people with an interest in the matter. Also, recent reforms introduced class actions as a means to demand environmental responsibility from damage to natural resources.

# 21 Capital and Operating Costs

As part of the verification process to certify the reserves presented in this report, SRK conducted an economic valuation of the Bolivar Project including only reserve material. This section outlines the capital and operating costs considered in this valuation. All costs presented in this section are second semester 2016 US dollars, unless stated otherwise.

## 21.1 Capital Costs

Using an average mining rate of 2,985 and a processing rate of 2,450 t/d, the Bolivar reserves support the project until July 2021.

Considering this life of mine, the Project's technical team prepared an estimate of capital required to sustain the mining and processing operations. This capital estimate is broken down into the following main areas.

- Mine Development;
- Vent Raises;
- Equipment Sustaining;
- Geological Exploration;
- Plant;
- Tailings Storage Facility (TSF); and
- Closure.

Mine development is related to any underground mine development that is capitalized. The Project's average development cost is based on actual numbers for the first three quarters of 2016 and projected numbers for the remainder months of this year. The cost considered is US$705/m, and is supported by the 2016 cost numbers below.

- A cost if US$617.53/m for 3,801 meters developed by the company; and
- A cost of US$918.93/m for 1,562 meters developed by a contracted third party.

This average cost combined with the amount of development meters modeled in the production schedule prepared by SRK compose the basis for the estimated LoM development cost.

A meter estimate of ventilation raises that will be required to maintain production in the underground mining areas was created based on the ventilation requirements in Section 16. The estimated unit cost for the vent raise is US$2,000/m.

Equipment sustaining cost includes the capital to maintain and replace mine equipment, while plant and TSF sustaining capital accounts for the expansion of the tailings storage facility.

Exploration capital will be used in the exploration of future mining opportunities within the company's mining and exploration concessions.

In addition to the capital requirements presented above, the evaluation also includes an estimate of working capital requirements based on the following terms:

- 5 days delay of 90% of payment and 30 days delay of 10% of payment of product sales;
- 30 days delay in payables, excluding labor; and
- 60 days inventory of items associated with mining, processing and product transportation.

As this is a currently operating/producing Project, SRK considered that the company already has necessary working capital in place, estimated at US$459,000.

The yearly capital expenditure by area is summarized in Table 21-1.

**Table 21-1: Capital Cost Summary (US$)**

| Description | Total ($000s) | 2016 ($000s) | 2017 ($000s) | 2018 ($000s) | 2019 ($000s) | 2020 ($000s) | 2021 ($000s) | 2022 ($000s) |
|---|---|---|---|---|---|---|---|---|
| Mine Development | 10,221 | 193 | 1,989 | 4,440 | 2,602 | 983 | 14 | 0 |
| Ventilation | 2,659 | 0 | 308 | 1,278 | 1,073 | 0 | 0 | 0 |
| Equipment Sustaining | 14,699 | 0 | 5,515 | 5,732 | 3,254 | 173 | 25 | 0 |
| Geological Exploration | 11,442 | 0 | 3,223 | 2,444 | 1,680 | 2,005 | 2,090 | 0 |
| Plant | 866 | 0 | 866 | 0 | 0 | 0 | 0 | 0 |
| TSF Sustaining | 6,376 | 0 | 5,276 | 514 | 586 | 0 | 0 | 0 |
| Closure | 453 | 0 | 0 | 0 | 0 | 0 | 0 | 453 |
| **Total Capital** | **$46,715** | **$193** | **$17,177** | **$14,407** | **$9,195** | **$3,161** | **$2,129** | **$453** |

Source: SRK, 2017

SRK notes that sustaining capital estimates for the existing plant equipment has been included in the operating costs. The Plant Sustaining and TSF Sustaining in Table 21-1 is for the TSF program described in Section 18.11.2.

## 21.2 Operating Costs

The basis of the operating cost estimate is a first principles approach based on site specific data. Dia Bras' technical team provided SRK with historic costs on a monthly basis, which were used to derive future costs. The costs were broken down into three main areas, as follows:

- Mining;
- Processing; and
- G&A.

Table 21-2 and Table 21-3 show a summary of total operating costs and unit operating costs.

**Table 21-2: Operating Cost Summary (US$)**

| Area | Total ($000s) | 2016 ($000s) | 2017 ($000s) | 2018 ($000s) | 2019 ($000s) | 2020 ($000s) | 2021 ($000s) |
|---|---|---|---|---|---|---|---|
| Mine | 58,812 | 3,101 | 12,435 | 12,684 | 13,246 | 13,146 | 4,200 |
| Plant | 43,277 | 2,282 | 9,151 | 9,334 | 9,747 | 9,674 | 3,090 |
| G&A | 14,729 | 777 | 3,114 | 3,177 | 3,317 | 3,292 | 1,052 |
| **Total** | **$116,817** | **$6,159** | **$24,700** | **$25,194** | **$26,311** | **$26,112** | **$8,342** |

Source: SRK, 2017

**Table 21-3: Unit Operating Cost Summary (US$)**

| Area | LoM ($000s) | Average ($/t) |
|---|---|---|
| Mine | 58,812 | 13.59 |
| Plant | 43,277 | 10.00 |
| G&A | 14,729 | 3.40 |
| **Total** | **$116,817** | **$26.99** |

Source: SRK, 2017

The mining cost was developed from the following eight individual functions that comprise the mining operation. Table 21-4 presents each function and its associated unit cost.

**Table 21-4: Mining Operation Cost by Functions**

| Area | Cost (US$/t) |
|---|---:|
| Labor | 2.17 |
| Bonus | 0.06 |
| Settlements | 0.05 |
| Explosives | 1.15 |
| Diesel | 0.84 |
| Power | 0.33 |
| Drilling Consumables | 0.25 |
| Lubricants | 0.38 |
| Tires | 0.20 |
| Gasoline | 0.03 |
| Spare Parts | 1.10 |
| Employee Restaurant | 0.50 |
| External Services | 0.47 |
| Hauling out of Mine | 4.31 |
| Other | 1.75 |
| **Total** | **$13.59** |

Source: Dia Bras, 2016

The processing cost was developed from the following seven individual functions that compose the processing operation; Table 21-5 presents each function and its associated unit cost.

**Table 21-5: Processing Operation Cost by Functions**

| Area | Cost (US$/t) |
|---|---:|
| Labor | 2.16 |
| Bonus | 0.06 |
| Settlements | 0.04 |
| Reagents | 0.21 |
| Grinding Media | 0.42 |
| Power | 0.99 |
| Lubricants | 0.07 |
| Diesel | 0.12 |
| Tires | 0.03 |
| Gasoline | 0.02 |
| Spare Parts | 0.84 |
| Employee restaurant | 0.39 |
| External Services | 2.18 |
| Other | 2.49 |
| **Total** | **$10.00** |

Source: Dia Bras, 2016

The G&A cost estimate is approximately US$3.40/t, based on the historic costs from 2016.

# 22 Economic Analysis

Sierra Metals is a producing issuer as defined by Section 1.1 of NI 43-101, and Bolivar is an operating mine with a significant production history. A technical economic model was prepared by SRK to evaluate the Project. This model is based on production assumptions and the market conditions, cost estimates, sales deductions and costs and royalties and taxes provided by Sierra Metals and Dia Bras' technical team and reviewed by SRK. This section discloses these assumptions and comments on the profitability of the reserves. The economic model was prepared under the assumption of 100% equity. All financial data is real terms using second half 2016 dollars. Currency is in real term U.S. dollars (US$), unless otherwise stated.

## 22.1 Assumptions External to Project

This valuation is based on metal prices provided by Sierra Metals and reviewed by SRK. Sierra Metals currently has a contract for the provision of its copper concentrate; SRK reviewed the details of the existing contract. The provided price curve has good adherence with recent and historic prices and general consensus of market forecasters. The metal price assumption is presented in Table 22-1.

**Table 22-1: Metal Prices**

| Commodity | Value | Unit |
|---|---|---|
| Au | 1,283 | US$/oz |
| Ag | 18.30 | US$/oz |
| Cu | 2.43 | US$/lb |

Source: Sierra Metals, 2017

The existing concentrate sales contract defines net smelter return terms for the copper concentrate, these terms are summarized and presented in Table 22-2.

**Table 22-2: Bolivar Net Smelter Return Terms**

| Item | Value | Unit |
|---|---|---|
| Au Minimum Deduction | 1.00 | g/t |
| Au Payability Factor | 90 | % |
| Au Refining Charge | 6.00 | US$/oz |
| Minimum Grade to Qualify for Payment | 30.00 | g/t |
| Ag Payability Factor | 90 | % |
| Ag Refining Charge | 0.35 | US$/oz |
| Cu Minimum Deduction | 1.0% | % points |
| Cu Payability Factor | 97 | % |
| Treatment Charge | 94 | US$/t-conc. |
| Cu Refining Charge | 0.094 | US$/lb |

Source: Dia Bras, 2016

The projects depend on logistics solutions that are considered external to the project, the products are transported from the various sites by truck to local smelters. The product also incurs impurity penalties, and the estimated charges used for the model contained herein are based on historic figures. In order to calculate transportation costs, an average moisture content of 8% was assumed for the concentrate. The following are the considered the transportation costs and impurities penalties estimated for the copper concentrate (Table 22-3).

**Table 22-3: Product Sale Cost**

| Description | Value | Units |
|---|---|---|
| Transportation | 76.22 | US$/t-conc. |
| Transportation Surcharge (2016)* | 35.42 | US$/t-conc. |
| Impurities Penalties | 5.00 | US$/t-conc. |

* Transportation surcharge expired at the end of 2016.
Source: Dia Bras, 2016

## 22.2 Commercial Assumptions

Bolivar is a polymetallic operation that currently produces a copper concentrate that is sold under an existing contract. This valuation was prepared using concentrate sales proceeds and revenue generated by the Bolivar operation alone. Specific price assumptions were calculated from the aforementioned price curve and through the application of appropriate discounts and premiums based on the physical characteristics and qualities of each product. The product types from Bolivar is a copper concentrate also containing gold and silver.

## 22.3 Taxes Depreciation and Royalties

The analysis of the Bolivar Project includes a total of 30% of income taxes over taxable income. Losses carried forward are used when possible.

A depreciation schedule was calculated by SRK, assuming that the Project is able to depreciate all of its assets by the end of the mine life, which occurs in 2021, based on the reserves disclosed in this report. The depreciation also considers that the Project currently holds an amount of US$5.8 million of installed assets that are yet to be depreciated.

The Project includes payment of three types of governmental royalties, the first is called an ordinary mining right, which is considered to be a payment of approximately US$220,000 on a yearly basis. An extraordinary mining right is directly associated to the Project's precious metals gross revenue and is 0.5% of such stream. The third is called a special mining tax and is 7.5% of the gross operating margin. The project also includes profit sharing with its employees. These costs are built into the modeled operating costs.

An existing loss carried forward of US$16.8 million has been used as an opening balance for the losses carried forward. An inflation index of 2.5% was used to inflate losses carried forward on a yearly basis.

## 22.4 Production Assumptions

The life of mine (LoM) mine production schedule estimates that the mine will produce approximately 4.3 Mt of run of mine (RoM) at the following average metal grades:

- Au: 0.31 g/t;
- Ag: 17.5 g/t; and
- Cu: 0.85%.

The production scenario assumes that the start period is October 2016, and the details of the life of mine RoM production are presented in Table 22-4. Note that only Probable reserve material is included in this economic analysis. Site personnel generate an alternate mine plan which includes 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.

**Table 22-4: Mine Production Summary**

| Description | Value | Units |
|---|---|---|
| Development Waste | 14,115 | m |
| Sill Waste | 377 | m |
| Vent Raises | 1,329 | m |
| Mined Waste | 944 | kt |
| Mined Ore | 4,327 | kt |
| Daily Mining Rate | 2,985 | t/d |
| Gold Grade, Mined | 0.31 | g/t |
| Silver Grade, Mined | 17.5 | g/t |
| Copper Grade | 0.85 | % |
| Contained Gold, Mined | 43.8 | koz |
| Contained Silver, Mined | 2,441 | koz |
| Contained Copper, Mined | 80,660 | klb |

Source: SRK, 2017

The RoM is fed as a single feed type to the plant, which is summarized in Table 22-5.

**Table 22-5: Plant Feed Summary**

| Description | Value | Units |
|---|---|---|
| RoM Processed | 4,327 | kt |
| Average Processing Rate | 2,450 | t/d |
| Milled Ore Gold Grade | 0.31 | g/t |
| Milled Ore Silver Grade | 17.5 | g/t |
| Milled Ore Copper Grade | 0.85 | % |
| Milled Ore Gold Content | 43.8 | koz |
| Milled Ore Silver Content | 2,441 | koz |
| Milled Ore Copper Content | 80,660 | klb |

Source: SRK, 2017

Copper concentrate is produced from the beneficiation of the ore. The life of mine production of copper concentrate is presented in Table 22-6.

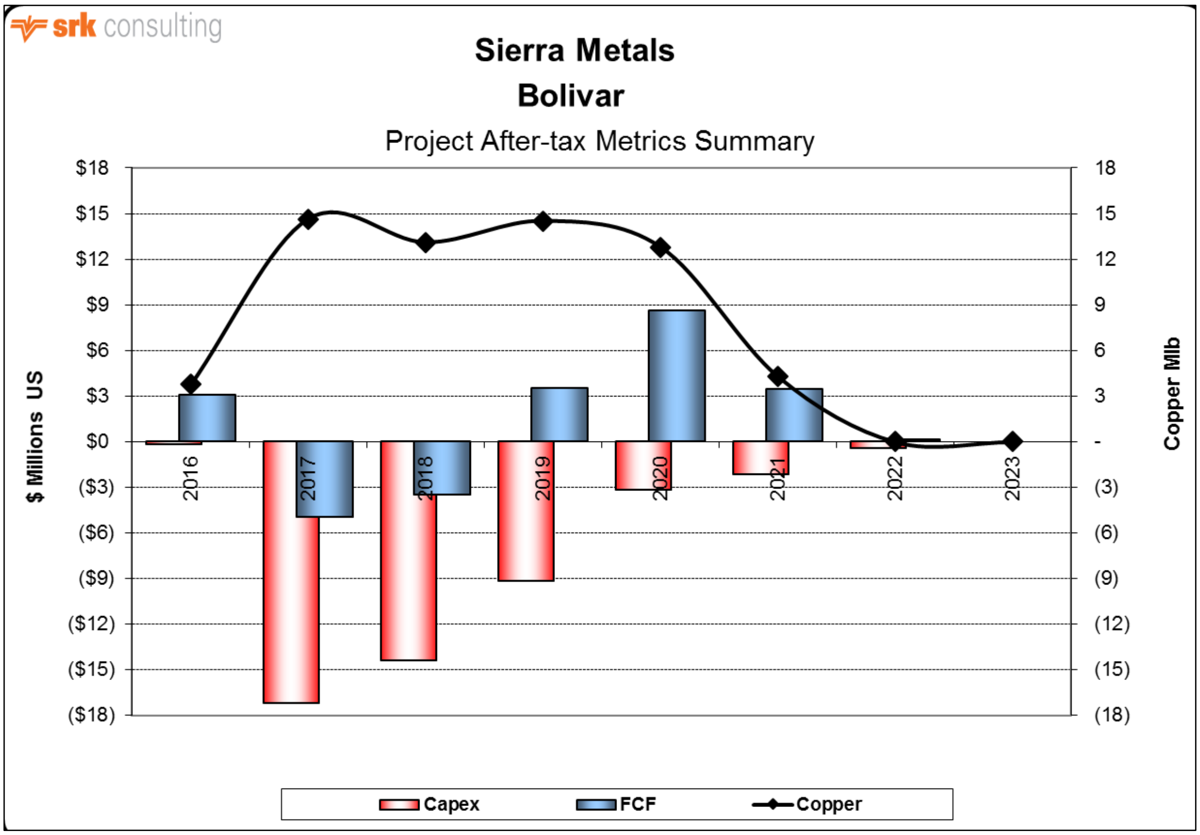
**Table 22-6: Copper Concentrate Production Summary**

| Item | Value | Unit |
|---|---|---|
| Copper Concentrate | | |
| Concentrate Gold Grade | 6.26 | g/t |
| Concentrate Silver Grade | 550 | g/t |
| Concentrate Copper Grade | 28.0% | % |
| Recovery | | |
| Gold | 48.7% | % |
| Silver | 76.8% | % |
| Copper | 81.1% | % |
| Concentrate Yield | **106.0** | kt (dry) |

Source: SRK, 2017

## 22.5 Results

Results of the Bolivar analysis indicate that the Project has a potential present value of approximately US$7.1 million, based on an 8% discount rate. Figure 22-1 shows the project after-tax metrics.




Source: SRK, 2017

**Figure 22-1: Bolivar After-Tax Metrics**

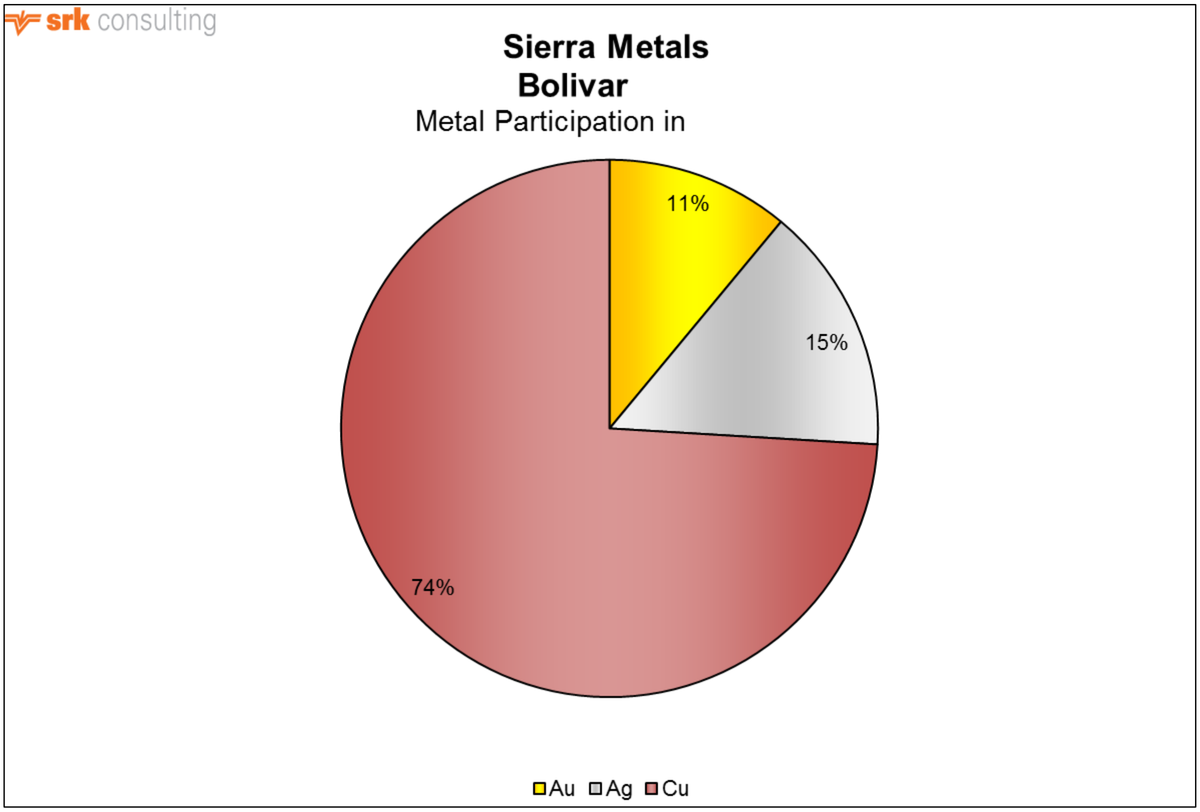
Indicative economic results are presented in Table 22-7.

**Table 22-7: Bolivar Indicative Economic Results (Dry Basis)**

| Description | Value | Units |
|---|---|---|
| **Market Prices** | | |
| Gold | 1,283 | US$/oz |
| Silver | 18.30 | US$/oz |
| Copper | 2.43 | US$/lb |
| **Estimate of Cash Flow** | **US($000s)** | **US$/lb-Cu** |
| **Concentrate Net Return** | | |
| Gold Sales | $22,829 | $0.36 |
| Silver Sales | $30,881 | $0.49 |
| Copper Sales | $153,283 | $2.43 |
| **Total Revenue** | **$206,994** | **$3.28** |
| Treatment Charges | ($9,961) | **($0.16)** |
| Smelting and Refining Charges | ($6,627) | ($0.11) |
| Freight, Impurities & Third Parties | ($9,598) | ($0.15) |
| **Gross Revenue** | **$180,808** | |
| Mining Rights | ($6,274) | ($0.10) |
| **Net Revenue** | **$174,534** | |
| **Operating Costs** | | |
| Underground Mining | ($58,812) | ($0.93) |
| Process | ($43,277) | ($0.69) |
| G&A | ($14,729) | ($0.23) |
| **Total Operating** | **($116,817)** | **($1.85)** |
| **Operating Margin (EBITDA)** | **$57,717** | |
| Initial Capital | $0 | |
| LoM Sustaining Capital | ($46,715) | |
| Working Capital | $459 | |
| Income Tax | ($1,085) | |
| **After Tax Free Cash Flow** | **$10,376** | |
| **NPV @: 8%** | **$7,074** | |

Source: SRK, 2017

Copper is the largest contributor to the project revenue and corresponds to approximately 74% of value. Gold and silver are considered by-products of the operation and each contribute 11% and 15%, respectively, to the mine's revenue. Figure 22-2 shows a graphical representation of each metals contribution to the Project's revenue.




Source: SRK, 2017

**Figure 22-2: Metal Contribution to Revenue**

Table 22-8 shows annual production and revenue forecasts for the life of the project. All production forecasts, material grades, plant recoveries and other productivity measures were developed by SRK and Dia Bras.

**Table 22-8: Bolivar Production Summary**

| Period | RoM (Mt) | Plant Feed (Mt) | Copper Conc. (kt) | Free Cash Flow (US$ millions) | Discounted Cash Flow (US$ millions) |
|---|---|---|---|---|---|
| 1 | 228 | 228 | 6.3 | 3.07 | 3.07 |
| 2 | 915 | 915 | 24.6 | (4.94) | (4.58) |
| 3 | 933 | 933 | 22.0 | (3.47) | (2.97) |
| 4 | 975 | 975 | 24.4 | 3.49 | 2.77 |
| 5 | 967 | 967 | 21.5 | 8.61 | 6.33 |
| 6 | 309 | 309 | 7.2 | 3.44 | 2.34 |
| 7 | 0 | 0 | 0.0 | 0.17 | 0.10 |
| **Total** | **4,327** | **4,327** | **106.0** | **10.38** | **7.07** |

Source: SRK, 2017

Table 22-9 presents the composition of the Bolivar cash costs.

**Table 22-9: Bolivar Cash Cost**

| Cash Costs | US$000's | US$/lb-Cu |
|---|---|---|
| **Direct Cash Cost** | | |
| Underground Mining Cost | $58,812 | $0.93 |
| Process Cost | $43,277 | $0.69 |
| Site G&A Cost | $14,729 | $0.23 |
| Treatment Charges | $9,961 | $0.16 |
| Smelting & Refining Charges | $6,627 | $0.11 |
| Impurities Penalties | $576 | $0.01 |
| Third Party Participation | $0 | $0.00 |
| Freight | $9,022 | $0.14 |
| By-Product Credits | ($53,711) | ($0.85) |
| **Direct Cash Costs** | **$89,293** | **$1.42** |
| **US$/lb-Cu** | **$1.42** | **$1.42** |
| **Indirect Cash Cost** | | |
| Royalties | **$6,274** | **$0.10** |
| **Indirect Cash Costs** | **$6,274** | **$0.10** |
| **US$/lb-Cu** | **$0.10** | **$0.10** |
| **Capital Cash Costs** | | |
| Mine Development | $10,221 | $0.16 |
| Vent Raises | $2,659 | $0.04 |
| Equipment Sustaining | $14,699 | $0.23 |
| Geological Exploration | $11,442 | $0.18 |
| Plant Sustaining | $866 | $0.01 |
| TSF Sustaining | $6,376 | $0.10 |
| **Capital Cash Costs** | **$46,262** | **$0.73** |
| **US$/Equivalent lb-Cu** | **$0.73** | **$0.73** |
| **Total Cash Costs** | **$141,828** | **$2.25** |
| **US$/Equivalent lb-Cu** | **$2.25** | **$2.25** |

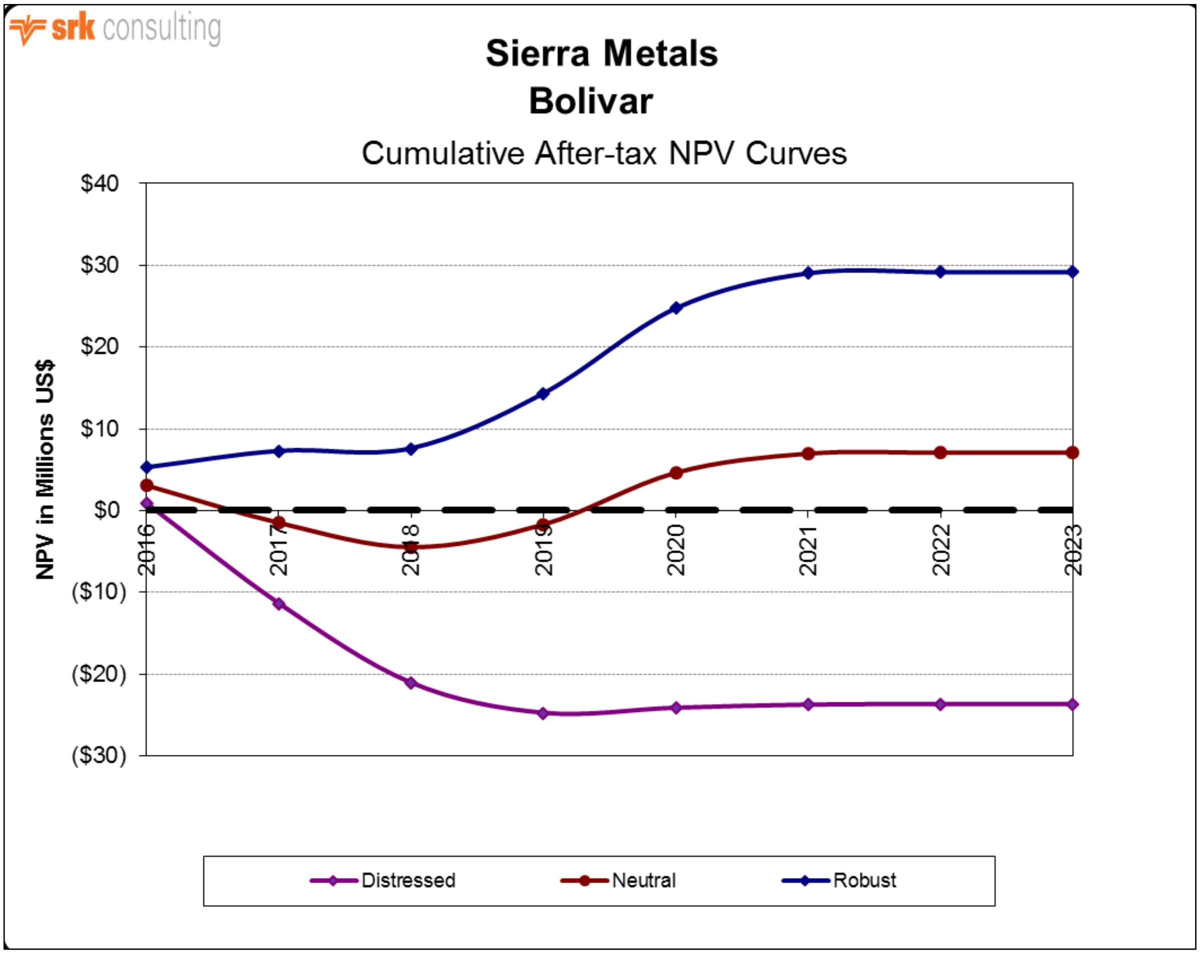
Source: SRK, 2017

## 22.6 Sensitivities

Sensitivity analysis on discount rates and different metal prices scenarios were completed.

Figure 22-3 presents the behavior of the accumulated after-tax net present value, where:

- Distressed metal prices are 20% lower than neutral prices;
- Neutral metal prices as presented in this section; and
- Robust metal prices are 20% higher than neutral prices.

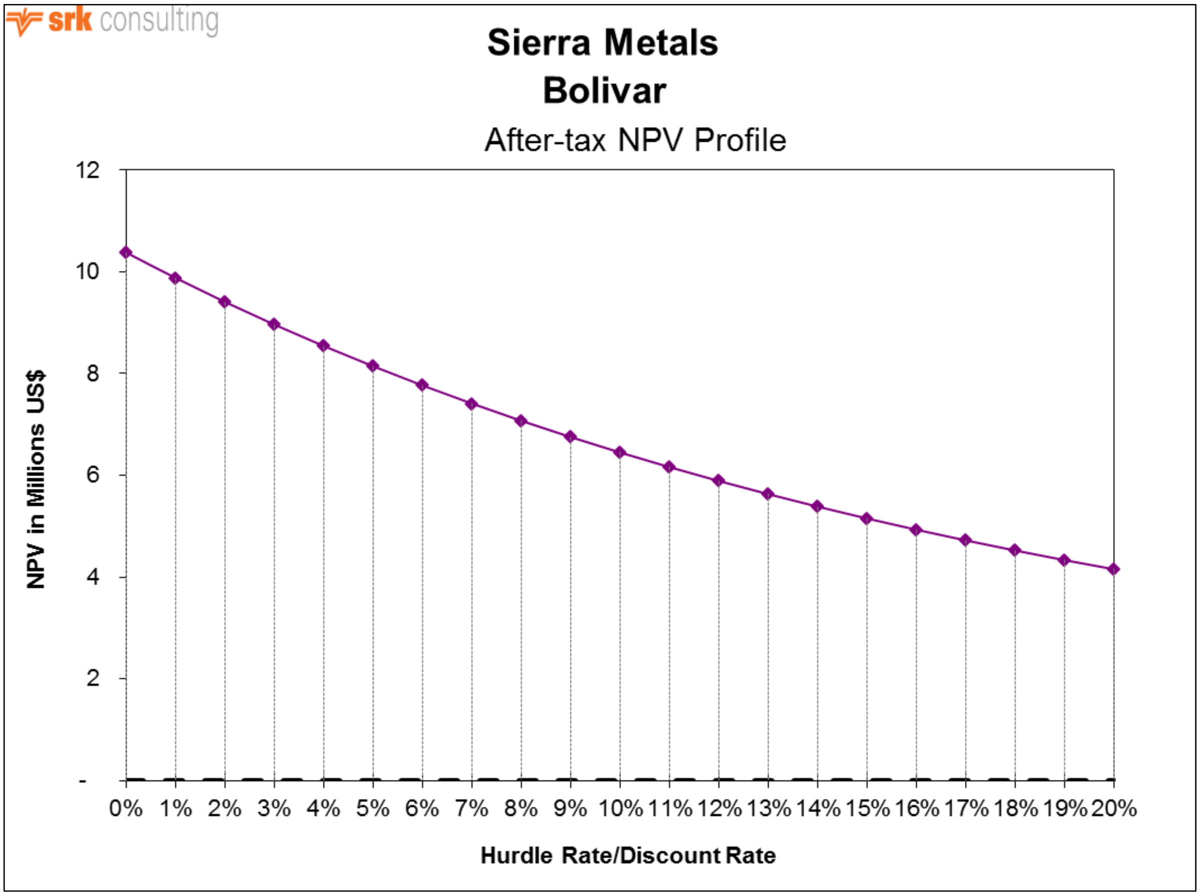



Source: SRK, 2017

**Figure 22-3: Bolivar After-Tax Cumulative NPV Price Sensitivity**

Figure 22-3 indicates that the project's present value will be negative between 2017 and 2019 and recover in 2020. It also shows that the mine would not support a reduction of 20% on metal prices, the breakeven copper price is effectively US$2.25/lb.

Figure 22-4 presents the sensitivity of the after-tax net present values to the hurdle rate.




Source: SRK, 2017

**Figure 22-4: Bolivar After-Tax NPV Hurdle Rate Sensitivity**

A sensitivity analysis for key operating and economic parameters is shown in Table 22-10.

**Table 22-10: Bolivar NPV Sensitivity (US$000's)**

| NPV @ 5% | -25% | -20% | -15% | -10% | -5% | 0% | 5% | 10% | 15% | 20% | 25% |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Recovery | (32,000) | (24,000) | (16,000) | (8,000) | 0 | 7,000 | 13,000 | 18,000 | 24,000 | 29,000 | 35,000 |
| Capital Costs | 15,000 | 14,000 | 12,000 | 10,000 | 9,000 | 7,000 | 5,000 | 4,000 | 2,000 | 0 | (2,000) |
| Operating Costs | 23,000 | 20,000 | 16,000 | 13,000 | 10,000 | 7,000 | 3,000 | (1,000) | (5,000) | (10,000) | (14,000) |

Source: SRK, 2017

# 23 Adjacent Properties

SRK is not aware of any adjacent properties to the Bolivar mine as defined under NI 43-101.

# 24 Other Relevant Data and Information

SRK knows of no other relevant data at this time.

# 25 Interpretation and Conclusions

## 25.1 Exploration

SRK has the following conclusions regarding the exploration efforts and potential for the Bolivar and La Sidra areas.

- Several areas within Bolivar would benefit from additional drilling, as the current spacing is insufficient to adequately define the continuity of mineralization for prospective mining. Areas that would benefit from additional drilling to improve confidence in the estimation include Bolivar NW, Bolivar W, and Increíble/Step Out.
- Other areas such as extensions of El Gallo Inferior and the Chimeneas orebodies are close to existing mining operations and would benefit from additional drilling to expand known resources.
    - SRK notes that areas such as Bolivar W, Step-Out, and Increíble would all benefit from better positioning of drill stations, as some of the drilling orientation in the current model is getting very near to the same strike and dip as the mineralized bodies themselves.

## 25.2 Mineral Resource Estimate

SRK is of the opinion that the Mineral Resource Estimate has been conducted in a manner consistent with industry best practices and that the data and information supporting the stated mineral resources is sufficient for declaration of Indicated and Inferred classifications of resources. SRK has not classified any of the resources in the Measured category due to some uncertainties regarding the data supporting the Mineral Resource Estimate.

These deficiencies include:

- The lack of a historic QA/QC program, which has only been supported by a recent resampling and modern QA/QC program for a limited number of holes. This will be required in order to achieve Measured resources which generally are supported by high resolution drilling or sampling data that feature consistently implemented and monitored QA/QC.
- The lack of consistently-implemented down-hole surveys in the historic drilling. Observations from the survey data which has been done to date show significant deviations from planned orientations as well as local down-hole deviations that influence the exact position of mineralized intervals.
- The lack of industry-standard asbuilt data delineating mined areas. SRK has elected to combine the multiple data types that define the mined areas, and notes that none of them include well-defined 3D solids with measurable volumes. Rather, SRK has taken the combined CAD lines, points, and triangulations and generated distance buffers (3 m) to obtain volumes in areas that have been mined. There is still uncertainty associated with this practice, but SRK believes that this is likely balanced by the conservative nature of distance buffer approach, which may actually flag some material that is to be mined in the near term as having been previously mined.

## 25.3 Mineral Reserve Estimate

SRK is of the opinion that the Mineral Reserve Estimate has been conducted in a manner consistent with industry best practices and that the data and information supporting the stated mineral reserves is sufficient for declaration of Probable classifications of reserves.

The Bolivar mine is a producing operation. Recent production data was used as a primary source of information to validate or derive, as necessary, the relevant modifying factors used to convert Mineral Resources into Mineral Reserves. The initial production decision was not based on a feasibility study of Mineral Reserves demonstrating economic viability. There is an increased uncertainty and economic and technical risks of failure associated with this production decision.

The production schedule associated with this reserves estimate results in mining until July 2019 at an average production of approximately 2,500 ore t/day. The tailings storage facility will need to be expanded. Dia Bras is managing the TSF expansion as described in detail in Section 18.11. Dia Bras is planning to install an additional thickener and filter presses and move to a dry stack method of tailings handling and storage. As a result the overall tailings handling system will evolve over the next twelve months. Dia Bras has budgeted capital for these activities and is working with a number of external contractors to complete the various phases of the overall management plan. Delays in these projects could impact the overall mine plan by delaying the processing of ore at Piedras Verdes beyond 2017.

## 25.4 Metallurgy and Processing

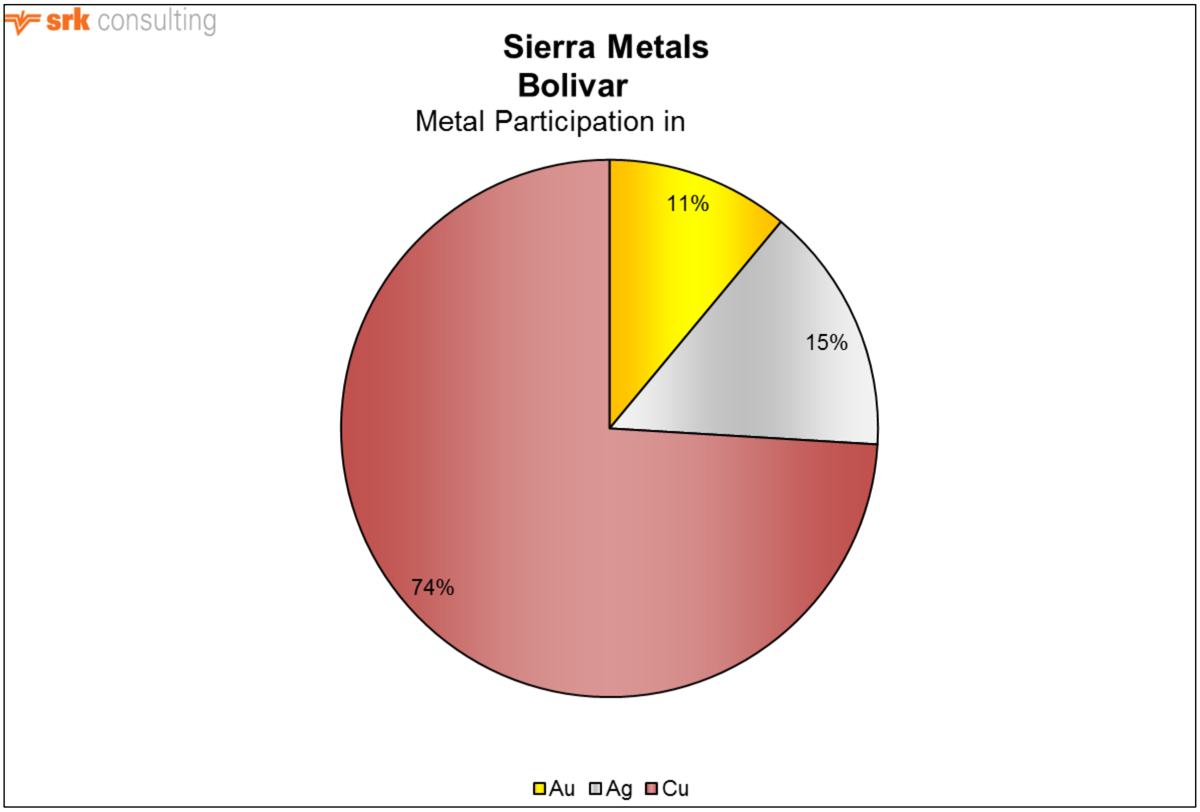
Dia Bras operates a conventional concentration plant consisting of crushing, grinding, flotation, thickening and filtration of the final concentrate. Flotation tails are disposed of in a conventional tailings facility. Ore feed during year 2016 reached a total of 950,398 tonnes, equivalent to an average of 79,200 tonnes per month, or 2,600 tonnes per day. Production of copper concentrate has consistently ranged between approximately 2,000 and 2,700 tonnes per month, equivalent to roughly a 2.9% mass pull. The monthly average has consistently reached commercial quality with copper at 27% and credit metals averaging 369 g/t silver and 2.19 g/t gold in 2016.

SRK notes a high level of month-to-month variability for both tonnes and head grade. Better integration between geology, mine planning and processing can significantly reduce the variability. Additional work is also needed in the processing facilities to stabilize the operation. Improvements include the implementation of a preventive maintenance program and training programs to improve operators' skill, with the ultimate objective of improving metal recovery and lower operating cost, while maintaining or improving concentrate quality.

## 25.5 Projected Economic Outcomes

Bolivar is a polymetallic mine that produces and sells copper concentrate. Copper is the largest contributor to the project revenue and corresponds to approximately 74% of value. Gold and silver are considered by-products of the operation and each contribute 11% and 15%, respectively, to the mine's revenue. Figure 25-1 shows a graphical representation of each metals contribution to the Project's revenue.

The reserves stated in this report support a profitable operation under the cost and market assumptions discussed in this report and indicate a free cash flow of US$10.4 million and a present value of US$7.1 million based on a discount rate of 8%.




Source: SRK, 2016

**Figure 25-1: Metal Contribution to Revenue**

Economic projections of the base case metal prices scenario indicate that the project's cumulative free cash flow will be negative in 2017 and 2018 and recover in 2019. The project's present value will be negative between 2017 and 2019 and recover in 2020. This is related to two factors. The first is the high intensity of capital expenditure projected for these two years, and the second is a small dip in the copper production for 2018. The breakeven copper price for Bolivar is US$2.25/lb; SRK notes the current spot price is approximately US$2.65/lb.

The current scenario presents Dia Bras with two years of relatively significant capital financing requirements considering the estimated reserves. SRK recommends that the company should conduct the studies described herein to:

- Evaluate a pillar recovery program;
- Revise the mining method; and
- Utilize tailings as backfill.

The potential improvements may allow the operation to revise its production schedule, revise the capital expenditure schedule, and allow prioritization of further geological study and exploration to identify resources and reserves that will support a more favorable LoM plan.

# 26 Recommendations

## 26.1 Recommended Work Programs and Costs

### 26.1.1 Geology

SRK recommends the following for work programs at Bolivar and La Sidra:

- Institute a regular practice of downhole surveys for drilling, at intervals between 25 and 50 m as appropriate.
- Continue the current QA/QC program, and monitor progress of the program over time to identify trends in the preparation and analytical phases of sample analysis.
- Collect a representative selection of drill core from the mineralized areas of Bolivar and La Sidra for density testing. These should be submitted to a third party independent laboratory such as ALS Minerals for testing using ASTM standards. The samples should be returned to the site for parallel testing using the current methods employed by Dia Bras and reviewed to ensure that the performance is reasonable.
- Use a consistent 3D survey method to better define mined areas. Procedures and tools exist to survey mined areas safely, and provide accurate information regarding stoped or developed areas.
- Generate a complete and verifiable database of channel samples, formatted similar to the drillhole database which is consistent with industry best practices and mining software packages, to improve the quality and accuracy of the estimation in areas where mining is ongoing.
- Conduct additional drilling in the Bolivar NW, Bolivar W, Increíble, and Step Out areas. Drill hole spacing should be on the order of 75m for delineation drilling and would preferentially be infilled to 25 m for pre-production.
    - This will require establishment of underground drill stations in certain areas to achieve the type of spacing and precision needed to have high confidence in the positions and orientations of the mineralized bodies.
- Conduct additional drilling in the La Sidra area. Spacing should be on the order of 50 m for delineation drilling and would preferentially move to 25 m for infill drilling around areas of known higher grade mineralization.

### 26.1.2 Mining and Reserves

SRK has the following recommendations regarding mining and reserves at Bolivar:

- The planning of infill drilling and mine planning should emphasize the conversion of resources into reserves inventory especially for the mid and long-range planning horizons;
- Use updated 3D mine survey data and improved processes to:
    - Regularly perform stope-by-stope planned to actual reconciliations, for both grade and tonnage mined, to continually validate the mining recovery and dilution assumptions; and
    - Develop an estimate of the tonnes and grade remaining in pillars.

- Initiate a mining methods trade-off study to plan for the safe extraction of pillars and identify possible improvements to the mining methods used. This study should also include the analysis of utilizing tailings as backfill in the mine.
- Develop and annually update a 3D life-of-mine (LoM) design and schedule.
- Develop and implement a whole-of-mine ventilation plan in order to implement and maintain a forced ventilation system over the life of the mine.
- An expansion of the existing tailings storage facility will need to occur. Dia Bras is managing the TSF expansion as described in detail in Section 18.11. Dia Bras is planning to install an additional thickener and filter presses and move to a dry stack method of tailings handling and storage. As a result the overall tailings handling system will evolve over the next twelve months. Dia Bras has budgeted capital for these activities and is working with a number of external contractors to complete the various phases of the overall management plan. Delays in these projects could impact the overall mine plan by delaying the processing of ore at Piedras Verdes beyond 2017.

### 26.1.3 Tailings Management

SRK has the following recommendations regarding mining and reserves at Bolivar:

- As part of the overall tailings management plan, Bolivar is moving to filtered tailings. Expansion in the immediate area of the currently operating facility will occur as the site moves first to thickened tailings in mid-2017 and to filtered tailings in early 2018. SRK recommends that the site continue its project efforts to complete the installation of the thickener, filter presses, and conveyor. The site must ensure that all required detailed designs are completed and permits are in place for successful operation of the New TSF located to the west of the existing facility. An analysis of utilizing tailings as backfill in the mine should be carried out, and a trade-off study should be completed to determine if the size of the New TSF can be reduced.

### 26.1.4 Environmental, Permitting and Social or Community Impact

SRK has the following recommendations regarding environment, permitting, and social or community impact at Bolivar:

- SRK recommends that Dia Bras contract an independent, outside review of the closure cost estimate, with an emphasis on benchmarking against other projects in northern Mexico. This may require and site investigation and the preparation of a more comprehensive and detailed closure and reclamation plan before a closure specialist evaluates the overall closure approach and costs.
- Based on the 2016 geochemical characterization data, a more robust and comprehensive program for the tailings should be undertaken with an emphasis on closure of the existing facilities in such a manner as to not pose a risk to local groundwater resources.

### 26.1.5 Costs

Table 26-1 lists the estimated cost for the recommended work described in Section 26.

**Table 26-1: Summary of Costs for Recommended Work**

| Category | Work | Units | Cost US$ |
|---|---|---|---|
| Geology and Resources | Updated 3D Mine Survey | 1 | 50,000 |
| Mining and Reserves | Mining Methods Trade-off Study and Utilization of Tailings as Backfill | 1 | 115,000 |
| Mining and Reserves | Mine Ventilation Plan – Ventilation Survey and Study | 1 | 75,000 |
| **Total** | | | **$240,000** |

Note: Drilling costs assume US$100/m drilling costs.
Source: SRK

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# 28 Glossary

The Mineral Resources and Mineral Reserves have been classified according to CIM (CIM, 2014). Accordingly, the Resources have been classified as Measured, Indicated or Inferred, the Reserves have been classified as Proven, and Probable based on the Measured and Indicated Resources as defined below.

## 28.1 Mineral Resources

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.

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 **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.

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. It may be converted to a Proven Mineral Reserve or to a Probable Mineral Reserve.

## 28.2 Mineral Reserves

A **Mineral Reserve** is the economically mineable part of a Measured and/or Indicated Mineral Resource. It includes diluting materials and allowances for losses, which may occur when the material is mined or extracted and is defined by studies at Pre-Feasibility or Feasibility level as appropriate that include application of Modifying Factors. Such studies demonstrate that, at the time of reporting, extraction could reasonably be justified.

The reference point at which Mineral Reserves are defined, usually the point where the ore is delivered to the processing plant, must be stated. It is important that, in all situations where the reference point is different, such as for a saleable product, a clarifying statement is included to ensure that the reader is fully informed as to what is being reported. The public disclosure of a Mineral Reserve must be demonstrated by a Pre-Feasibility Study or Feasibility Study.

A **Probable Mineral Reserve** is the economically mineable part of an Indicated, and in some circumstances, a Measured Mineral Resource. The confidence in the Modifying Factors applying to a Probable Mineral Reserve is lower than that applying to a Proven Mineral Reserve.

A **Proven Mineral Reserve** is the economically mineable part of a Measured Mineral Resource. A Proven Mineral Reserve implies a high degree of confidence in the Modifying Factors.

## 28.3 Definition of Terms

The following general mining terms may be used in this report.

**Table 28-1: Definition of Terms**

| Term | Definition |
|---|---|
| Assay | The chemical analysis of mineral samples to determine the metal content. |
| Capital Expenditure | All other expenditures not classified as operating costs. |
| Composite | Combining more than one sample result to give an average result over a larger distance. |
| Concentrate | A metal-rich product resulting from a mineral enrichment process such as gravity concentration or flotation, in which most of the desired mineral has been separated from the waste material in the ore. |
| Crushing | Initial process of reducing ore particle size to render it more amenable for further processing. |
| Cut-off Grade (CoG) | The grade of mineralized rock, which determines as to whether or not it is economic to recover its gold content by further concentration. |
| Dilution | Waste, which is unavoidably mined with ore. |
| Dip | Angle of inclination of a geological feature/rock from the horizontal. |
| Fault | The surface of a fracture along which movement has occurred. |
| Footwall | The underlying side of an orebody or stope. |
| Gangue | Non-valuable components of the ore. |
| Grade | The measure of concentration of gold within mineralized rock. |
| Hangingwall | The overlying side of an orebody or slope. |
| Haulage | A horizontal underground excavation which is used to transport mined ore. |
| Hydrocyclone | A process whereby material is graded according to size by exploiting centrifugal forces of particulate materials. |
| Igneous | Primary crystalline rock formed by the solidification of magma. |
| Kriging | An interpolation method of assigning values from samples to blocks that minimizes the estimation error. |
| Level | Horizontal tunnel the primary purpose is the transportation of personnel and materials. |
| Lithological | Geological description pertaining to different rock types. |
| LoM Plans | Life-of-Mine plans. |
| LRP | Long Range Plan. |
| Material Properties | Mine properties. |
| Milling | A general term used to describe the process in which the ore is crushed and ground and subjected to physical or chemical treatment to extract the valuable metals to a concentrate or finished product. |
| Mineral/Mining Lease | A lease area for which mineral rights are held. |
| Mining Assets | The Material Properties and Significant Exploration Properties. |
| Ongoing Capital | Capital estimates of a routine nature, which is necessary for sustaining operations. |
| Ore Reserve | See Mineral Reserve. |
| Pillar | Rock left behind to help support the excavations in an underground mine. |

| Term | Definition |
|---|---|
| RoM | Run-of-Mine. |
| Sedimentary | Pertaining to rocks formed by the accumulation of sediments, formed by the erosion of other rocks. |
| Shaft | An opening cut downwards from the surface for transporting personnel, equipment, supplies, ore and waste. |
| Sill | A thin, tabular, horizontal to sub-horizontal body of igneous rock formed by the injection of magma into planar zones of weakness. |
| Smelting | A high temperature pyrometallurgical operation conducted in a furnace, in which the valuable metal is collected to a molten matte or doré phase and separated from the gangue components that accumulate in a less dense molten slag phase. |
| Stope | Underground void created by mining. |
| Stratigraphy | The study of stratified rocks in terms of time and space. |
| Strike | Direction of line formed by the intersection of strata surfaces with the horizontal plane, always perpendicular to the dip direction. |
| Sulfide | A sulfur bearing mineral. |
| Tailings | Finely ground waste rock from which valuable minerals or metals have been extracted. |
| Thickening | The process of concentrating solid particles in suspension. |
| Total Expenditure | All expenditures including those of an operating and capital nature. |
| Variogram | A statistical representation of the characteristics (usually grade). |

## 28.4 Abbreviations

The following abbreviations may be used in this report.

**Table 28-2: Abbreviations**

| Abbreviation | Unit or Term |
|---|---|
| AA | atomic absorption |
| Ag | silver |
| Au | gold |
| AuEq | gold equivalent grade |
| bhp | brake horsepower |
| °C | degrees Centigrade |
| CoG | cut-off grade |
| cm | centimeter |
| $cm^2$ | square centimeter |
| $cm^3$ | cubic centimeter |
| cfm | cubic feet per minute |
| ° | degree (degrees) |
| dia. | diameter |
| EIS | Environmental Impact Statement |
| EMP | Environmental Management Plan |
| g | gram |
| gal | gallon |
| g/L | gram per liter |
| g-mol | gram-mole |
| gpm | gallons per minute |
| g/t | grams per tonne |
| ha | hectares |
| HDPE | Height Density Polyethylene |
| hp | horsepower |
| ICP | induced couple plasma |
| ID2 | inverse-distance squared |
| ID3 | inverse-distance cubed |
| kg | kilograms |
| km | kilometer |
| $km^2$ | square kilometer |
| koz | thousand troy ounce |
| kt | thousand tonnes |
| kt/d | thousand tonnes per day |
| kt/y | thousand tonnes per year |
| kV | kilovolt |
| kW | kilowatt |
| kWh | kilowatt-hour |
| kWh/t | kilowatt-hour per metric tonne |
| L | liter |
| L/sec | liters per second |
| L/sec/m | liters per second per meter |
| lb | pound |
| m | meter |
| $m^2$ | square meter |
| $m^3$ | cubic meter |
| masl | meters above sea level |
| mg/L | milligrams/liter |
| mm | millimeter |
| $mm^2$ | square millimeter |
| $mm^3$ | cubic millimeter |
| Moz | million troy ounces |
| Mt | million tonnes |
| MW | million watts |

| Abbreviation | Unit or Term |
|---|---|
| m.y. | million years |
| NI 43-101 | Canadian National Instrument 43-101 |
| OSC | Ontario Securities Commission |
| oz | troy ounce |
| % | percent |
| ppb | parts per billion |
| ppm | parts per million |
| QA/QC | Quality Assurance/Quality Control |
| RC | rotary circulation drilling |
| RoM | Run-of-Mine |
| RQD | Rock Quality Description |
| SEC | U.S. Securities & Exchange Commission |
| sec | second |
| t | tonne (metric ton) (2,204.6 pounds) |
| t/h | tonnes per hour |
| t/d | tonnes per day |
| t/y | tonnes per year |
| TSF | tailings storage facility |
| µm | micron or microns |
| V | volts |
| W | watt |
| XRD | x-ray diffraction |
| y | year |

# Appendices

# Appendix A: Certificates of Qualified Persons

SRK Consulting (U.S.), Inc.
Suite 600
1125 Seventeenth Street
Denver, CO 80202

**T: 303.985.1333**
**F: 303.985.9947**

denver@srk.com
www.srk.com

## CERTIFICATE OF QUALIFIED PERSON

I, Matthew Hastings, MSc Geology, MAusIMM (CP) do hereby certify that:

1. I am Senior Consultant Resource Geologist of SRK Consulting (U.S.), Inc., 1125 Seventeenth Street, Suite 600, Denver, CO, USA, 80202.
2. This certificate applies to the technical report titled "NI 43-101 Technical Report on Resources and Reserves, Bolivar Mine, Mexico" with an Effective Date of February 28, 2017 (the "Technical Report").
3. I graduated with a degree in B.S.-Geology from University of Georgia in 2005. In addition, I have obtained a M.S.-Geology from University of Nevada-Reno in 2007. I am a CP of the MAusIMM and Certified Professional Geology, PGL-1343. I have worked as a Geologist for a total of 10 years since my graduation from university. My relevant experience includes working in exploration and mineral resource definition for precious metals, base metals, iron ore, and rare earth element deposits worldwide.
4. 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.
5. I visited the Bolivar Mine property on March 12, 2015 for three days.
6. I am responsible for the preparation of Sections 4, 5.1-5.3, 6-12 and 14, and portions of Sections 1, 25 and 26 summarized therefrom, of this Technical Report.
7. I am independent of the issuer applying all of the tests in section 1.5 of NI 43-101.
8. I have had prior involvement with the property that is the subject of the Technical Report. The nature of my prior involvement is from internal Sierra Metals technical reviews completed in 2015 and 2016 prior to issuance of the technical report.
9. I have read NI 43-101 and Form 43-101F1 and the sections of the Technical Report I am responsible for have been prepared in compliance with that instrument and form.
10. As of the aforementioned Effective Date, to the best of my knowledge, information and belief, the sections of the Technical Report I am responsible for contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Dated this 6th Day of April, 2017.

*"Signed and Sealed"*

________________________________

Matthew Hastings, MSc Geology, MAusIMM (CP)

SRK Consulting (U.S.), Inc.
Suite 600
1125 Seventeenth Street
Denver, CO 80202

T: 303.985.1333
F: 303.985.9947

denver@srk.com
www.srk.com

**CERTIFICATE OF QUALIFIED PERSON**

I, Jon Larson, BSc, MBA, MMSA-QP do hereby certify that:

1. I am Principal Consultant of SRK Consulting (U.S.), Inc., 1125 Seventeenth Street, Suite 600, Denver, CO, USA, 80202.
2. This certificate applies to the technical report titled "NI 43-101 Technical Report on Resources and Reserves, Bolivar Mine, Mexico" with an Effective Date of February 28, 2017 (the "Technical Report").
3. I graduated with a degree in Mining Engineering from South Dakota School of Mines and Technology in 1999. In addition, I am a QP member of the Mining & Metallurgical Society of America. I have worked as a Mining Engineer for a total of 17 years since my graduation from university. My relevant experience includes underground and open pit mine design, mine scheduling, and mine optimization.
4. 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.
5. I visited the Bolivar Mine property on October 18, 2016 for two days.
6. I am responsible for the preparation of Reserves, Mining Methods, Market Studies and Contracts, Capital and Operating Costs, Economic Analysis, Adjacent Properties, and Other Relevant Data and Information – Sections 2, 3, 15, 16.1, 16.3-16.8, 18.11, 19, 21-24, and portions of Sections 1, 25 and 26 summarized therefrom, of this Technical Report.
7. I am independent of the issuer applying all of the tests in section 1.5 of NI 43-101.
8. I have not had prior involvement with the property that is the subject of the Technical Report.
9. I have read NI 43-101 and Form 43-101F1 and the sections of the Technical Report I am responsible for have been prepared in compliance with that instrument and form.
10. As of the aforementioned Effective Date, to the best of my knowledge, information and belief, the sections of the Technical Report I am responsible for contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Dated this 6th Day of April, 2017.

*"Signed and Sealed"*

______________________________

Jon Larson, BSc, MBA, MMSA-QP

SRK Consulting (U.S.), Inc.
Suite 600
1125 Seventeenth Street
Denver, CO 80202

**T: 303.985.1333**
**F: 303.985.9947**

denver@srk.com
www.srk.com

## CERTIFICATE OF QUALIFIED PERSON

I, Jeff Osborn, BEng Mining, MMSAQP do hereby certify that:

1. I am a Principal Consultant (Mining Engineer) of SRK Consulting (U.S.), Inc., 1125 Seventeenth, Suite 600, Denver, CO, USA, 80202.
2. This certificate applies to the technical report titled “NI 43-101 Technical Report on Resources and Reserves, Bolivar Mine, Mexico” with an Effective Date of February 28, 2017 (the “Technical Report”).
3. I graduated with a Bachelor of Science Mining Engineering degree from the Colorado School of Mines in 1986. I am a Qualified Professional (QP) Member of the Mining and Metallurgical Society of America. I have worked as a Mining Engineer for a total of 29 years since my graduation from university. My relevant experience includes responsibilities in operations, maintenance, engineering, management, and construction activities.
4. 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.
5. I did not visit the Bolivar Mine property.
6. I am responsible for the preparation of Project Infrastructure - Sections 5.4, 18.1-18.10, and portions of Sections 1, 25 and 26 summarized therefrom, of this Technical Report.
7. I am independent of the issuer applying all of the tests in section 1.5 of NI 43-101.
8. I have had prior involvement with the property that is the subject of the Technical Report. The nature of my prior involvement was in the preparation of a due diligence report on the property in 2013 for a third party..
9. I have read NI 43-101 and Form 43-101F1 and the sections of the Technical Report I am responsible for have been prepared in compliance with that instrument and form.
10. As of the aforementioned Effective Date, to the best of my knowledge, information and belief, the sections of the Technical Report I am responsible for contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Dated this 6th Day of April, 2017.

*“Signed and Sealed”*

______________________________

Jeff Osborn, BEng Mining, MMSAQP [01458QP]
Principal Consultant (Mining Engineer)

SRK Consulting (U.S.), Inc.
Suite 600
1125 Seventeenth Street
Denver, CO 80202

**T: 303.985.1333**
**F: 303.985.9947**

denver@srk.com
www.srk.com

## CERTIFICATE OF QUALIFIED PERSON

I, Daniel H. Sepulveda, B.Sc, SME-RM, do hereby certify that:

1. I am Associate Consultant (Metallurgy) of SRK Consulting (U.S.), Inc., 1125 Seventeenth Street, Suite 600, Denver, CO, USA, 80202.
2. This certificate applies to the technical report titled “NI 43-101 Technical Report on Resources and Reserves, Bolivar Mine, Mexico” with an Effective Date of February 28, 2017 (the “Technical Report”).
3. I graduated with a degree in Extractive Metallurgy from University of Chile in 1992. I am a registered member of the Society of Mining, Metallurgy, and Exploration, Inc. (SME), member No 4206787RM. I have worked as a Metallurgist for a total of 23 years since my graduation from university. My relevant experience includes: employee of several mining companies, engineering & construction companies, and as a consulting engineer.
4. 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.
5. I visited the Bolivar Mine property on March 12, 2015 for 2 days.
6. I am responsible for Mineral Processing and Metallurgical Testing and Recovery Methods - Sections 13, 17 and portions of Sections 1, 25 and 26 summarized therefrom, of this Technical Report.
7. I am independent of the issuer applying all of the tests in section 1.5 of NI 43-101.
8. I have not had prior involvement with the property that is the subject of the Technical Report.
9. I have read NI 43-101 and Form 43-101F1 and the sections of the Technical Report I am responsible for have been prepared in compliance with that instrument and form.
10. As of the aforementioned Effective Date, to the best of my knowledge, information and belief, the sections of the Technical Report I am responsible for contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Dated this 6th Day of April, 2017.

*“Signed and Sealed”*

Daniel H. Sepulveda, B.Sc, SME-RM

SRK Consulting (U.S.), Inc.
Suite 600
1125 Seventeenth Street
Denver, CO 80202

**T: 303.985.1333**
**F: 303.985.9947**

denver@srk.com
www.srk.com

**CERTIFICATE OF QUALIFIED PERSON**

I, John Tinucci, Ph.D., P.E., ISRM, do hereby certify that:

1. I am a Principal Geotechnical Mining Engineer of SRK Consulting (U.S.), Inc., 1125 Seventeenth Street, Suite 600, Denver, CO, USA, 80202.
2. This certificate applies to the technical report titled “NI 43-101 Technical Report on Resources and Reserves, Bolivar Mine, Mexico” with an Effective Date of February 28, 2017 (the “Technical Report”).
3. I graduated with a degree in B.S. in Civil Engineering from Colorado State University, in 1980. In addition, I have obtained a M.S. in Geotechnical Engineering from University of California, Berkeley, in 1983 and I have obtained a Ph.D. in Geotechnical Engineering, Rock Mechanics from the University of California, Berkeley in 1985. I am member of the American Rock Mechanics Association, a member of the International Society of Rock Mechanics, a member of the ASCE GeoInstitute, and a Registered Member of the Society for Mining, Metallurgy & Exploration. I have worked as a Mining and Geotechnical Engineer for a total of 31 years since my graduation from university. My relevant experience includes 34 years of professional experience. I have 15 years managerial experience leading project teams, managing P&L operations for 120 staff, and directed own company of 8 staff for 8 years. I have technical experience in mine design, prefeasibility studies, feasibility studies, geomechanical assessments, rock mass characterization, project management, numerical analyses, underground mine stability, subsidence, tunneling, ground support, slope design and stabilization, excavation remediation, induced seismicity and dynamic ground motion.
4. 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.
5. I did not visit the Bolivar Mine property.
6. I am responsible for the preparation of Mining Methods - Section 16.2, and portions of Sections 1, 25 and 26 summarized therefrom, of this Technical Report.
7. I am independent of the issuer applying all of the tests in section 1.5 of NI 43-101.
8. I have not had prior involvement with the property that is the subject of the Technical Report.
9. I have read NI 43-101 and Form 43-101F1 and the sections of the Technical Report I am responsible for have been prepared in compliance with that instrument and form.
10. As of the aforementioned Effective Date, to the best of my knowledge, information and belief, the sections of the Technical Report I am responsible for contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Dated this 6th Day of April, 2017.

*“Signed and Sealed”*

John Tinucci, Ph.D., P.E.

SRK Consulting (U.S.), Inc.
5250 Neil Road, Suite 300
Reno, Nevada 89502

T: (775) 828-6800
F: (775) 828-6820

reno@srk.com
www.srk.com

## CERTIFICATE OF QUALIFIED PERSON

I, Mark Allan Willow, SME-RM do hereby certify that:

1. I am Practice Leader of SRK Consulting (U.S.), Inc., 5250 Neil Road, Reno, Nevada 89502.
2. This certificate applies to the technical report titled "NI 43-101 Technical Report on Resources and Reserves, Bolivar Mine, Mexico" with an Effective Date of April 6, 2017 (the "Technical Report").
3. I graduated with Bachelor's degree in Fisheries and Wildlife Management from the University of Missouri in 1987 and a Master's degree in Environmental Science and Engineering from the Colorado School of Mines in 1995. I have worked as Biologist/Environmental Scientist for a total of 22 years since my graduation from university. My relevant experience includes environmental due diligence/competent persons evaluations of developmental phase and operational phase mines through the world, including small gold mining projects in Panama, Senegal, Peru, Ecuador, Philippines, and Colombia; open pit and underground coal mines in Russia; several large copper and iron mines and processing facilities in Mexico and Brazil; bauxite operations in Jamaica; and a coal mine/coking operation in China. My Project Manager experience includes several site characterization and mine closure projects. I work closely with the U.S. Forest Service and U.S. Bureau of Land Management on permitting and mine closure projects to develop uniquely successful and cost effective closure alternatives for the abandoned mining operations. Finally, I draw upon this diverse background for knowledge and experience as a human health and ecological risk assessor with respect to potential environmental impacts associated with operating and closing mining properties, and have experienced in the development of Preliminary Remediation Goals and hazard/risk calculations for site remedial action plans under CERCLA activities according to current U.S. EPA risk assessment guidance.
4. I am a Certified Environmental Manager (CEM) in the State of Nevada (#1832) in accordance with Nevada Administrative Code NAC 459.970 through 459.9729. Before any person consults for a fee in matters concerning: the management of hazardous waste; the investigation of a release or potential release of a hazardous substance; the sampling of any media to determine the release of a hazardous substance; the response to a release or cleanup of a hazardous substance; or the remediation soil or water contaminated with a hazardous substance, they must be certified by the Nevada Division of Environmental Protection, Bureau of Corrective Action;
5. I am a Registered Member (No. 4104492) of the Society for Mining, Metallurgy & Exploration Inc. (SME).
6. 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.
7. I did not visit the Bolivar Mine property.
8. I am responsible for the preparation of Environmental Studies, Permitting and Social or Community Impact - Section 20 and portions of Sections 1, 25 and 26 summarized therefrom, of this Technical Report.
9. I am independent of the issuer applying all of the tests in section 1.5 of NI 43-101.
10. I have not had prior involvement with the property that is the subject of the Technical Report.
11. I have read NI 43-101 and Form 43-101F1 and the sections of the Technical Report I am responsible for have been prepared in compliance with that instrument and form.

12. As of the aforementioned Effective Date, to the best of my knowledge, information and belief, the sections of the Technical Report I am responsible for contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Dated this 4 Day of April, 2017.

Mark A. Willow, M.Sc., CEM, SME-RM

SME
Society for
Mining, Metallurgy
& Exploration

Mark A. Willow
SME Registered Member No. 4104492

Signature____________________

Date Signed____________________

Expiration date 12/31/2018

# Appendix B: Capping Analyses

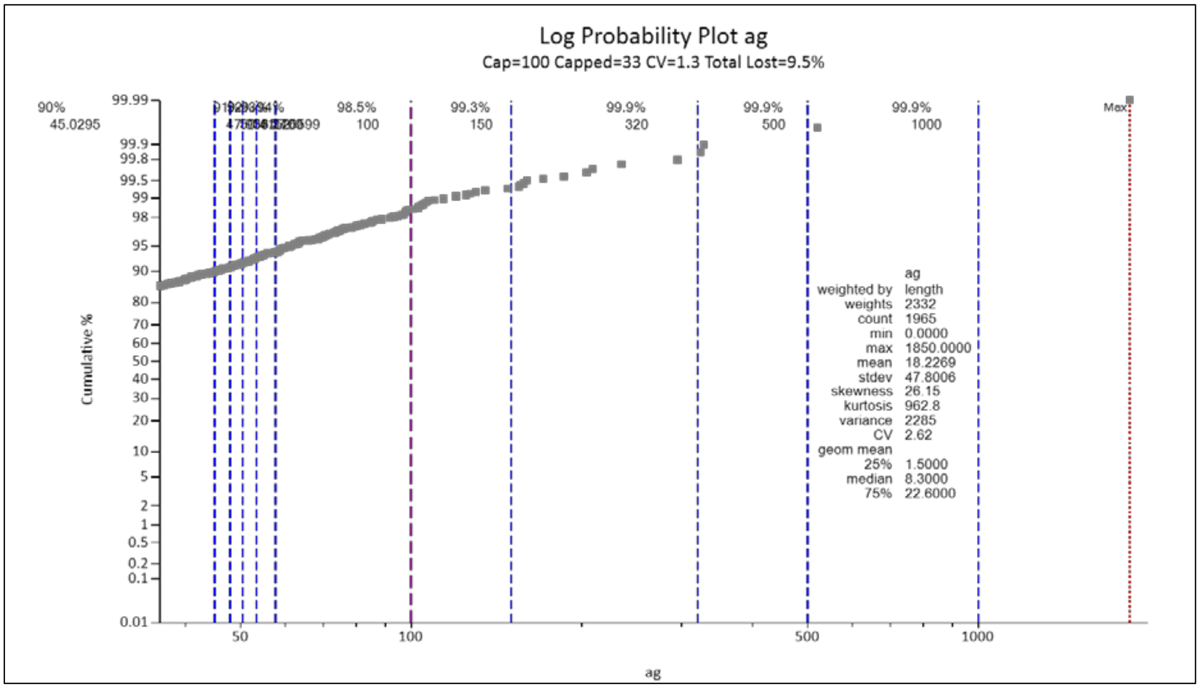



**Figure 1: Ag Log Probability Plot – El Gallo Area**

| Column | Cap | Capped | Percentile | Capped% | Lost | CV% | Mean | Variance | CV |
|---|---|---|---|---|---|---|---|---|---|
| ag | | | | | | | 18.2269 | 2285 | 2.62 |
| ag | 1000 | 1 | 99.90% | 0.10% | 2.10% | 24% | 17.8624 | 1254 | 1.98 |
| ag | 500 | 2 | 99.90% | 0.10% | 3.40% | 34% | 17.6365 | 926.4 | 1.73 |
| ag | 320 | 4 | 99.90% | 0.20% | 4.30% | 39% | 17.4493 | 779.7 | 1.6 |
| ag | 150 | 14 | 99.30% | 0.70% | 7.10% | 47% | 16.8882 | 552.8 | 1.39 |
| ag | 100 | 33 | 95% | 1.70% | 9.50% | 51% | 16.4137 | 452.3 | 1.3 |
| ag | 57.6599 | 137 | 94% | 7% | 17% | 56% | 15.1011 | 297.4 | 1.14 |
| ag | 53.3709 | 157 | 93% | 8% | 18% | 57% | 14.8272 | 275.1 | 1.12 |
| ag | 50.4152 | 178 | 92% | 9.10% | 20% | 58% | 14.6026 | 258.3 | 1.1 |
| ag | 47.936 | 200 | 91% | 10.20% | 21% | 59% | 14.3918 | 243.6 | 1.08 |
| ag | 45.0295 | 224 | 90% | 11.40% | 22% | 59% | 14.1162 | 225.8 | 1.06 |
| ag | ag > 100 | | | | | | 216.6679 | 87105 | 1.36 |
| ag | ag <= 100 | | | | | | 15.0941 | 346.9 | 1.23 |

**Table 1: El Gallo Capping Analysis – Ag**

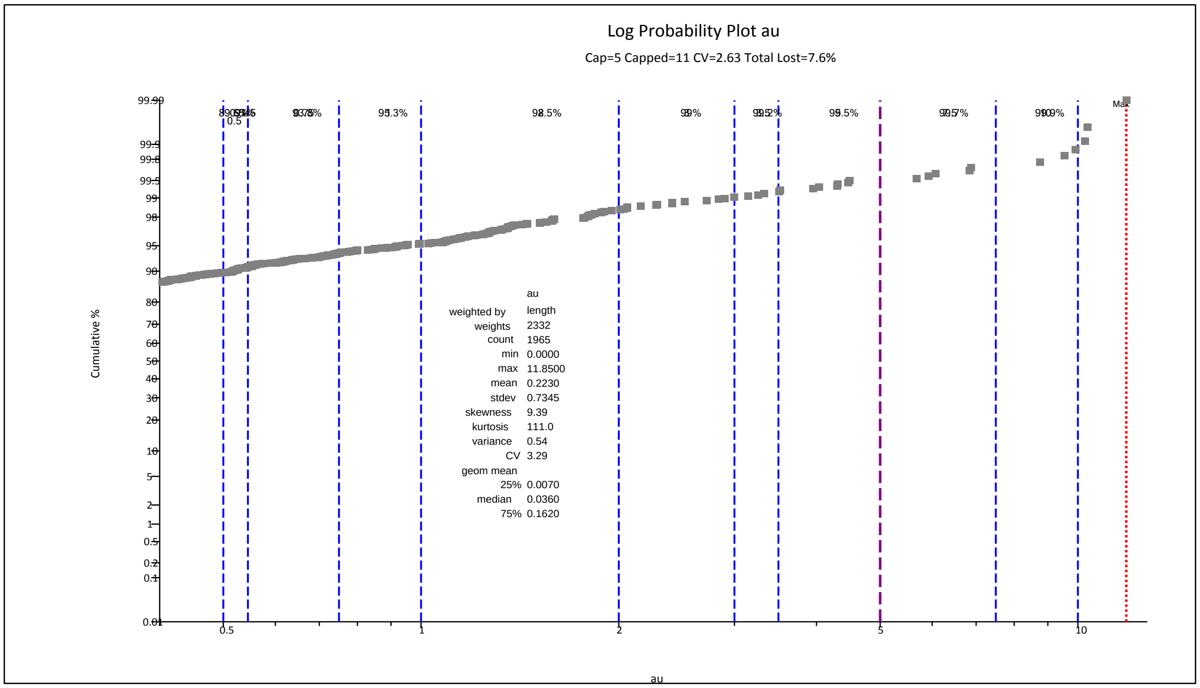



**Figure 2: Au Log Probability Plot – El Gallo Area**

| Column | Cap | Capped | Percentile | Capped% | Lost | CV% | Mean | Variance | CV |
|---|---|---|---|---|---|---|---|---|---|
| au | | | | | | | 0.223 | 0.54 | 3.29 |
| au | 10 | 3 | 99.90% | 0.20% | 0.50% | 1.60% | 0.222 | 0.52 | 3.24 |
| au | 7.5 | 6 | 99.70% | 0.30% | 3.20% | 9.60% | 0.2158 | 0.41 | 2.98 |
| au | 5 | 11 | 99.50% | 0.60% | 7.60% | 20% | 0.2058 | 0.29 | 2.63 |
| au | 3.5 | 19 | 99.20% | 1% | 12% | 28% | 0.1964 | 0.22 | 2.38 |
| au | 3 | 22 | 99% | 1.10% | 14% | 31% | 0.1918 | 0.19 | 2.28 |
| au | 2 | 36 | 98.50% | 1.80% | 20% | 38% | 0.1796 | 0.13 | 2.04 |
| au | 1 | 102 | 95.30% | 5.20% | 32% | 49% | 0.1521 | 0.07 | 1.69 |
| au | 0.75 | 135 | 93.80% | 6.90% | 38% | 53% | 0.1386 | 0.05 | 1.56 |
| au | 0.545 | 195 | 91% | 9.90% | 45% | 57% | 0.1233 | 0.03 | 1.42 |
| au | 0.5 | 224 | 90% | 11.40% | 47% | 58% | 0.119 | 0.03 | 1.39 |
| au | au > 5 | | | | | | 8.4106 | 4.4 | 0.25 |
| au | au <= 5 | | | | | | 0.1814 | 0.18 | 2.32 |

**Table 2: El Gallo Capping Analysis – Au**

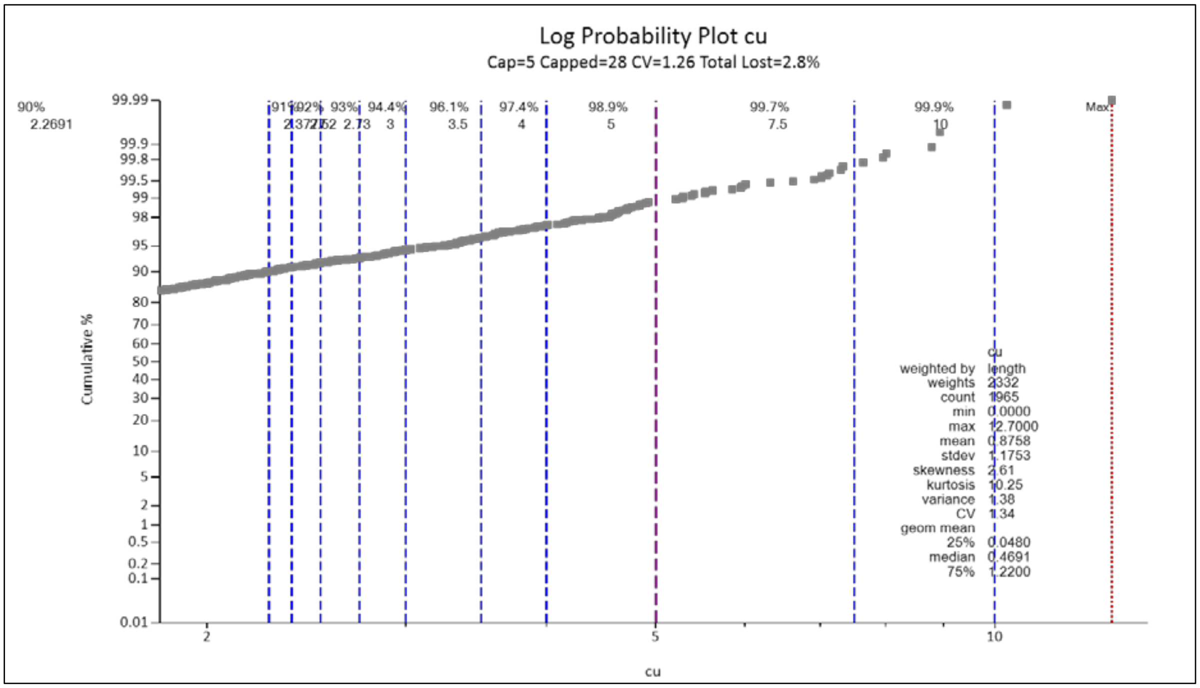



**Figure 3: Cu Log Probability Plot – El Gallo Area**

| Column | Cap | Capped | Percentile | Capped% | Lost | CV% | Mean | Variance | CV |
|---|---|---|---|---|---|---|---|---|---|
| cu | | | | | | | 0.88 | 1.38 | 1.34 |
| cu | 10 | 2 | 99.90% | 0.10% | 0.15% | 0.29% | 0.88 | 1.37 | 1.34 |
| cu | 7.5 | 7 | 99.70% | 0.40% | 0.60% | 1.70% | 0.87 | 1.32 | 1.32 |
| cu | 5 | 28 | 98.90% | 1.10% | 2.80% | 6.30% | 0.86 | 1.16 | 1.26 |
| cu | 4 | 62 | 97.40% | 2.60% | 5.10% | 10% | 0.84 | 1.02 | 1.21 |
| cu | 3.5 | 90 | 96.10% | 4.60% | 7% | 13% | 0.82 | 0.93 | 1.17 |
| cu | 3 | 127 | 95% | 6.50% | 9.80% | 16% | 0.80 | 0.81 | 1.13 |
| cu | 2.73 | 156 | 93% | 7.90% | 12% | 18% | 0.78 | 0.74 | 1.10 |
| cu | 2.52 | 178 | 92% | 9.10% | 14% | 20% | 0.76 | 0.68 | 1.08 |
| cu | 2.3777 | 201 | 91% | 10.20% | 15% | 21% | 0.75 | 0.64 | 1.06 |
| cu | 2.2691 | 224 | 90% | 11.40% | 16% | 22% | 0.74 | 0.61 | 1.05 |
| cu | cu > 5 | | | | | | 6.70 | 2.28 | 0.23 |
| cu | cu <= 5 | | | | | | 0.81 | 0.97 | 1.22 |

**Table 3: El Gallo Capping Analysis – Cu**

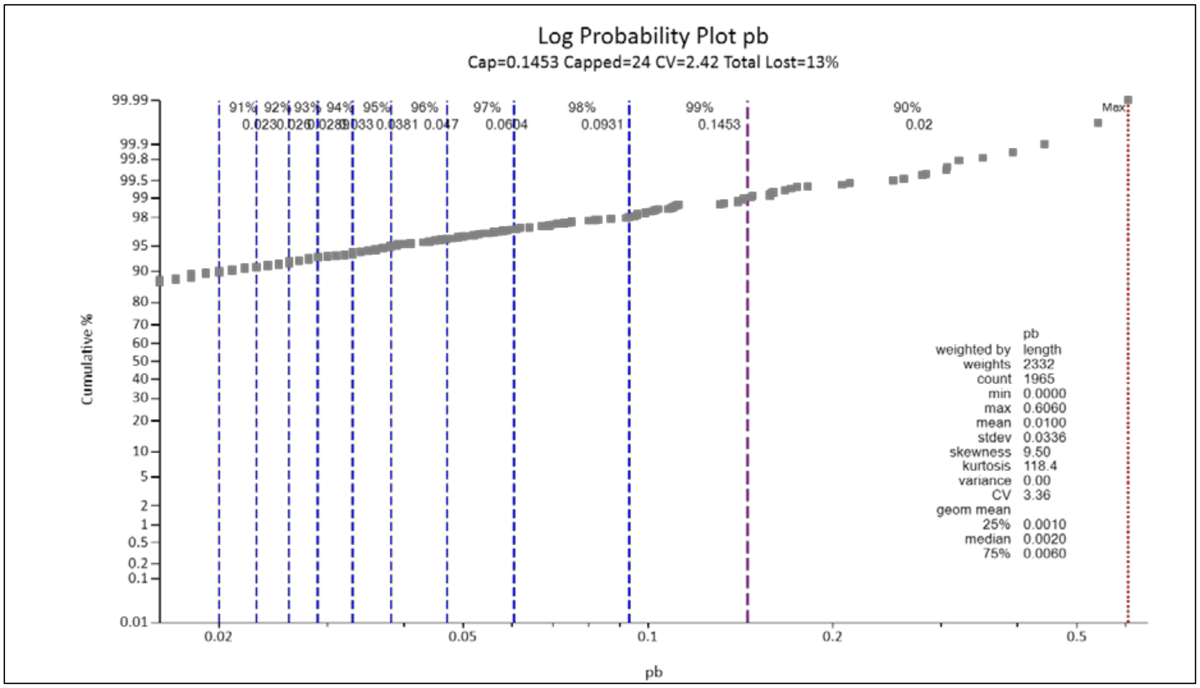



**Figure 4: Pb Log Probability Plot – El Gallo Area**

| Column | Cap | Capped | Percentile | Capped% | Lost | CV% | Mean | Variance | CV |
|---|---|---|---|---|---|---|---|---|---|
| pb | | | | | | | 0.01 | 0 | 3.36 |
| pb | 0.1453 | 24 | 99% | 1.20% | 13% | 28% | 0.0087 | 0 | 2.42 |
| pb | 0.0931 | 47 | 98% | 2.40% | 20% | 37% | 0.008 | 0 | 2.11 |
| pb | 0.0604 | 70 | 97% | 3.60% | 29% | 45% | 0.0072 | 0 | 1.84 |
| pb | 0.047 | 92 | 96% | 4.70% | 33% | 49% | 0.0067 | 0 | 1.7 |
| pb | 0.0381 | 113 | 95% | 5.80% | 37% | 52% | 0.0063 | 0 | 1.6 |
| pb | 0.033 | 135 | 94% | 6.90% | 40% | 55% | 0.006 | 0 | 1.53 |
| pb | 0.0289 | 157 | 93% | 8% | 43% | 56% | 0.0057 | 0 | 1.46 |
| pb | 0.026 | 171 | 92% | 8.70% | 45% | 58% | 0.0055 | 0 | 1.42 |
| pb | 0.023 | 195 | 91% | 9.90% | 48% | 60% | 0.0053 | 0 | 1.36 |
| pb | 0.02 | 220 | 90% | 11.20% | 51% | 61% | 0.005 | 0 | 1.3 |
| pb | pb > 0.02 | | | | | | 0.0705 | 0.01 | 1.2 |
| pb | pb <= 0.02 | | | | | | 0.0033 | 0 | 1.31 |

**Table 4: El Gallo Capping Analysis – Pb**

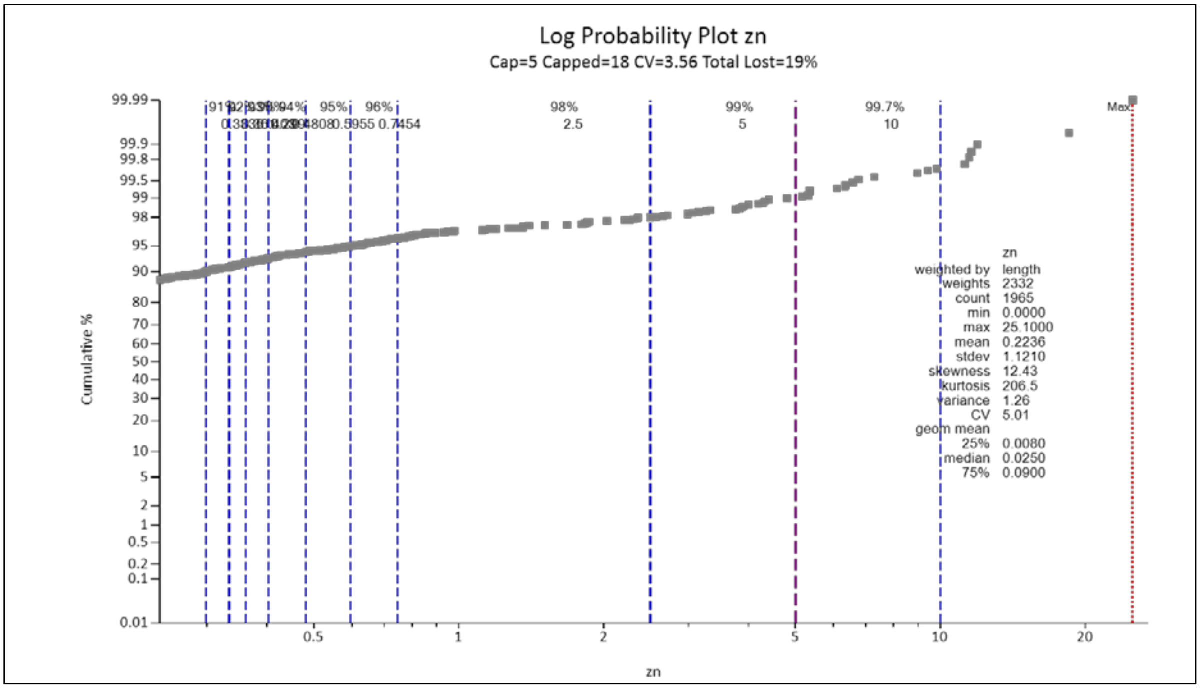



**Figure 5: Zn Log Probability Plot – El Gallo Area**

| Column | Cap | Capped | Percentile | Capped% | Lost | CV% | Mean | Variance | CV |
|---|---|---|---|---|---|---|---|---|---|
| zn | | | | | | | 0.2236 | 1.26 | 5.01 |
| zn | 10 | 6 | 99.70% | 0.30% | 6.70% | 15% | 0.2081 | 0.78 | 4.25 |
| zn | 5 | 18 | 99% | 0.90% | 19% | 29% | 0.1816 | 0.42 | 3.56 |
| zn | 2.5 | 37 | 97% | 1.90% | 33% | 44% | 0.145 | 0.17 | 2.8 |
| zn | 0.7454 | 81 | 96% | 4.10% | 53% | 64% | 0.0981 | 0.03 | 1.81 |
| zn | 0.5955 | 102 | 95% | 5.20% | 57% | 66% | 0.0913 | 0.02 | 1.68 |
| zn | 0.4808 | 124 | 94% | 6.30% | 59% | 69% | 0.0849 | 0.02 | 1.57 |
| zn | 0.403 | 144 | 93% | 7.30% | 62% | 70% | 0.0799 | 0.01 | 1.49 |
| zn | 0.361 | 166 | 92% | 8.40% | 63% | 71% | 0.0767 | 0.01 | 1.44 |
| zn | 0.3336 | 190 | 91% | 9.70% | 64% | 72% | 0.0744 | 0.01 | 1.41 |
| zn | 0.299 | 211 | 90% | 10.70% | 66% | 73% | 0.0711 | 0.01 | 1.36 |
| zn | zn > 5 | | | | | | 9.2154 | 27.24 | 0.57 |
| zn | zn <= 5 | | | | | | 0.1331 | 0.18 | 3.23 |

**Table 5: El Gallo Capping Analysis – Zn**

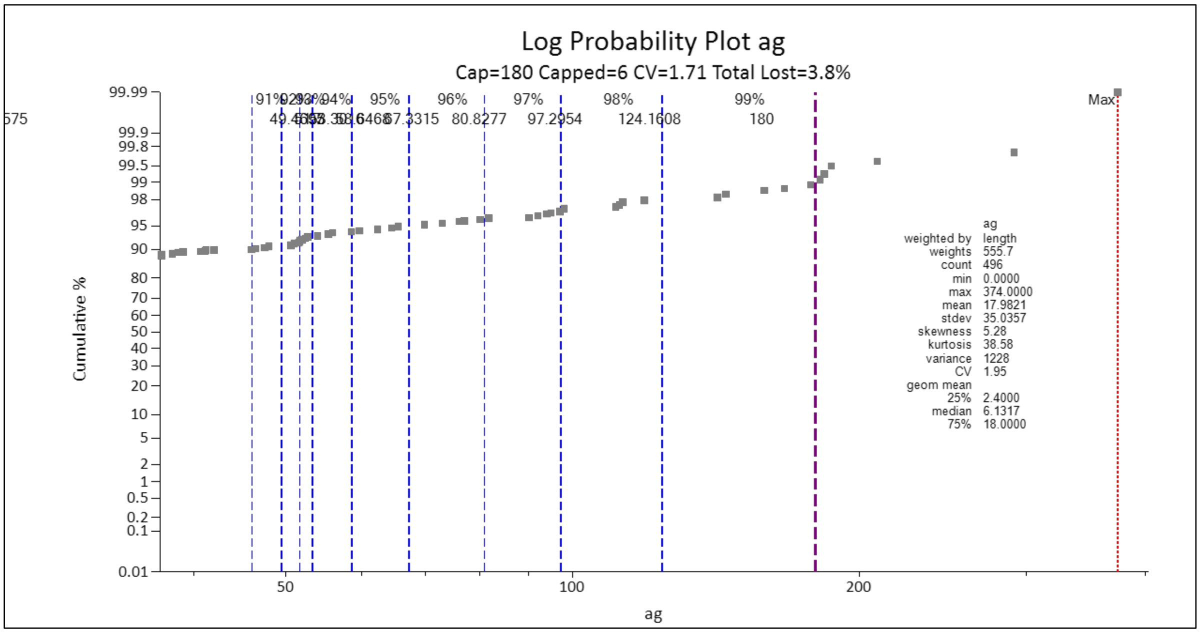



**Figure 6: Ag Log Probability Plot – Bolivar NW Area**

| Column | Cap | Capped | Percentile | Capped% | Lost | CV% | Mean | Variance | CV |
|---|---|---|---|---|---|---|---|---|---|
| ag | | | | | | | 17.9821 | 1228 | 1.95 |
| ag | 180 | 6 | 99% | 1.20% | 3.80% | 12% | 17.2528 | 870.6 | 1.71 |
| ag | 124.1608 | 11 | 98% | 2.20% | 9.30% | 21% | 16.3252 | 624.3 | 1.53 |
| ag | 97.2954 | 16 | 97% | 3.20% | 13% | 27% | 15.648 | 497 | 1.42 |
| ag | 80.8277 | 22 | 96% | 4.40% | 17% | 31% | 15.0326 | 406.5 | 1.34 |
| ag | 67.3315 | 27 | 95% | 5.40% | 20% | 35% | 14.4088 | 332.6 | 1.27 |
| ag | 58.6468 | 31 | 94% | 6.30% | 23% | 38% | 13.9233 | 285.2 | 1.21 |
| ag | 53.3016 | 36 | 93% | 7.30% | 25% | 40% | 13.5773 | 256 | 1.18 |
| ag | 51.7 | 39 | 92% | 7.90% | 26% | 40% | 13.4587 | 246.7 | 1.17 |
| ag | 49.4695 | 45 | 91% | 9.10% | 27% | 41% | 13.2612 | 232 | 1.15 |
| ag | 46.0575 | 50 | 90% | 10.10% | 29% | 43% | 12.9374 | 209.5 | 1.12 |
| ag | | | | | | | 87.8452 | 2648 | 0.59 |
| ag | | | | | | | 17.1437 | 1156 | 1.98 |

**Table 6: Bolivar NW Capping Analysis – Ag**

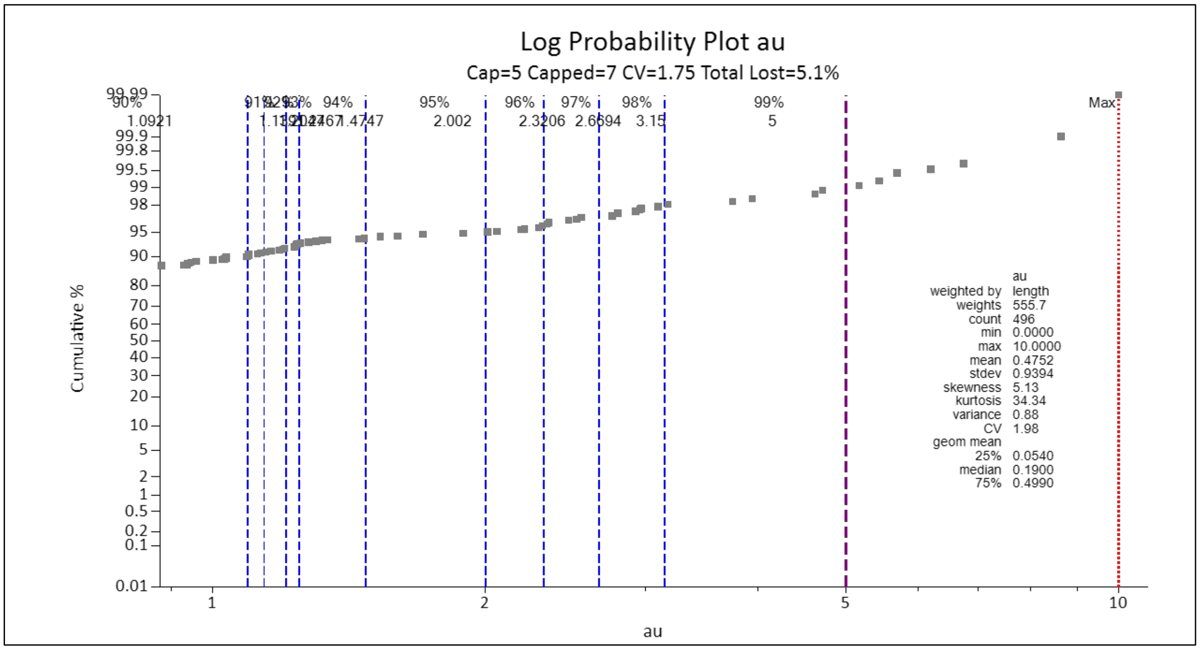



**Figure 7: Au Log Probability Plot – Bolivar NW Area**

| Column | Cap | Capped | Percentile | Capped% | Lost | CV% | Mean | Variance | CV |
|---|---|---|---|---|---|---|---|---|---|
| au | | | | | | | 0.4752 | 0.88 | 1.98 |
| au | 5 | 7 | 99% | 1.40% | 5.10% | 12% | 0.4551 | 0.63 | 1.75 |
| au | 3.15 | 12 | 98% | 2.40% | 12% | 23% | 0.4249 | 0.42 | 1.52 |
| au | 2.6694 | 18 | 97% | 3.60% | 15% | 27% | 0.4125 | 0.36 | 1.45 |
| au | 2.3206 | 23 | 96% | 4.60% | 18% | 30% | 0.4006 | 0.31 | 1.38 |
| au | 2.002 | 29 | 95% | 5.80% | 21% | 34% | 0.3855 | 0.25 | 1.31 |
| au | 1.4747 | 33 | 94% | 6.70% | 27% | 41% | 0.3566 | 0.18 | 1.17 |
| au | 1.2467 | 40 | 93% | 8.10% | 31% | 44% | 0.3419 | 0.15 | 1.12 |
| au | 1.2047 | 44 | 92% | 8.90% | 31% | 44% | 0.3386 | 0.14 | 1.1 |
| au | 1.1391 | 49 | 91% | 9.90% | 33% | 45% | 0.3329 | 0.13 | 1.08 |
| au | 1.0921 | 54 | 90% | 10.90% | 34% | 46% | 0.3285 | 0.12 | 1.07 |
| au | | | | | | | 2.7145 | 13.54 | 1.36 |
| au | | | | | | | 0.4495 | 0.71 | 1.87 |

**Table 7: Bolivar NW Capping Analysis – Au**

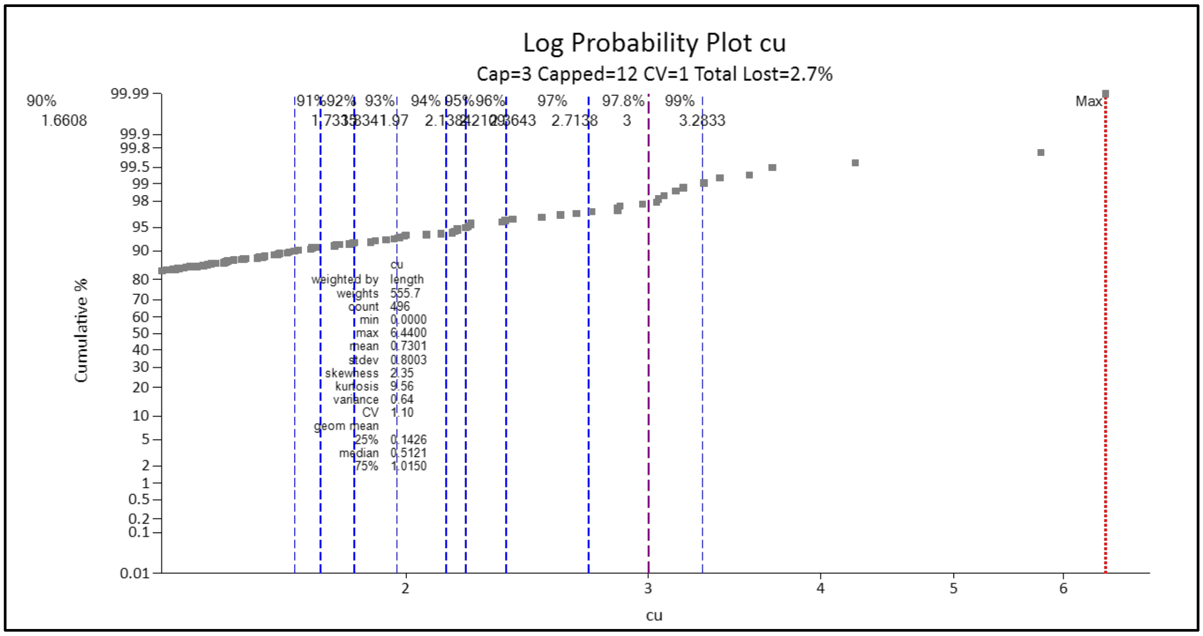



**Figure 8: Cu log probability plot – Bolivar NW area**

| Column | Cap | Capped | Percentile | Capped% | Lost | CV% | Mean | Variance | CV |
|---|---|---|---|---|---|---|---|---|---|
| cu | | | | | | | 0.7301 | 0.64 | 1.1 |
| cu | 3.2833 | 7 | 99% | 1.40% | 2% | 7% | 0.7161 | 0.53 | 1.02 |
| cu | 3 | 12 | 98% | 2.40% | 2.70% | 8.30% | 0.7117 | 0.51 | 1 |
| cu | 2.7138 | 17 | 97% | 3.40% | 3.80% | 10% | 0.7041 | 0.48 | 0.98 |
| cu | 2.3643 | 21 | 96% | 4.20% | 5.60% | 13% | 0.6915 | 0.43 | 0.95 |
| cu | 2.2109 | 26 | 95% | 5.20% | 6.50% | 15% | 0.6847 | 0.41 | 0.94 |
| cu | 2.1384 | 31 | 94% | 6.30% | 7.10% | 15% | 0.6806 | 0.4 | 0.93 |
| cu | 1.97 | 37 | 93% | 7.50% | 8.60% | 17% | 0.6698 | 0.37 | 0.91 |
| cu | 1.8341 | 42 | 92% | 8.50% | 10% | 19% | 0.6594 | 0.34 | 0.89 |
| cu | 1.7335 | 48 | 91% | 9.70% | 11% | 20% | 0.6507 | 0.32 | 0.87 |
| cu | 1.6608 | 52 | 90% | 10.50% | 12% | 21% | 0.6437 | 0.31 | 0.86 |
| cu | | | | | | | 0.3737 | 0.39 | 1.67 |
| cu | | | | | | | 0.7342 | 0.64 | 1.09 |
| | | | | | | | | | |

**Table 8: Bolivar NW Capping Analysis – Cu**

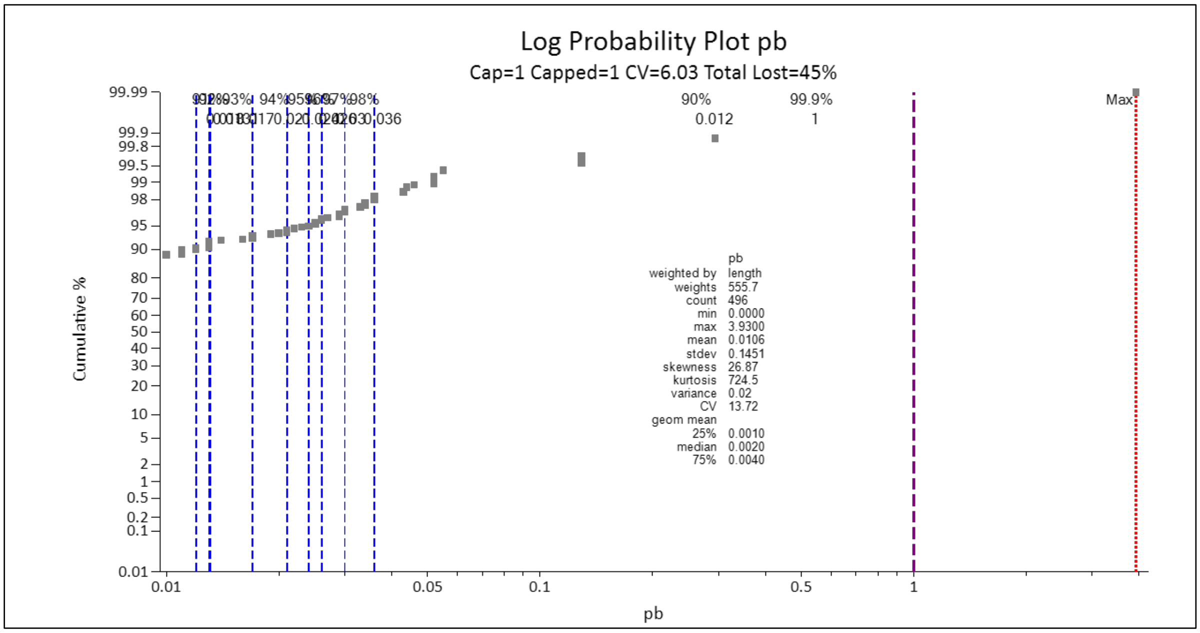



**Figure 9: Pb Log Probability Plot – Bolivar NW Area**

| Column | Cap | Capped | Percentile | Capped% | Lost | CV% | Mean | Variance | CV |
|---|---|---|---|---|---|---|---|---|---|
| pb | | | | | | | 0.0106 | 0.02 | 13.72 |
| pb | 1 | 1 | 99% | 0.20% | 45% | 56% | 0.0066 | 0 | 6.03 |
| pb | 0.036 | 10 | 98% | 2% | 67% | 88% | 0.0044 | 0 | 1.69 |
| pb | 0.03 | 15 | 97% | 3% | 69% | 88% | 0.0043 | 0 | 1.61 |
| pb | 0.026 | 20 | 96% | 4% | 70% | 89% | 0.0041 | 0 | 1.54 |
| pb | 0.024 | 25 | 95% | 5% | 70% | 89% | 0.004 | 0 | 1.5 |
| pb | 0.021 | 28 | 94% | 5.60% | 72% | 90% | 0.0039 | 0 | 1.42 |
| pb | 0.017 | 33 | 93% | 6.70% | 74% | 90% | 0.0036 | 0 | 1.31 |
| pb | 0.0131 | 38 | 92% | 7.70% | 76% | 91% | 0.0033 | 0 | 1.19 |
| pb | 0.013 | 38 | 91% | 7.70% | 76% | 91% | 0.0033 | 0 | 1.18 |
| pb | 0.012 | 46 | 90% | 9.30% | 77% | 92% | 0.0032 | 0 | 1.15 |
| pb | | | | | | | 3.93 | 0 | 0 |
| pb | | | | | | | 0.0053 | 0 | 3.04 |
| | | | | | | | | | |

**Table 9: Bolivar NW Capping Analysis – Pb**

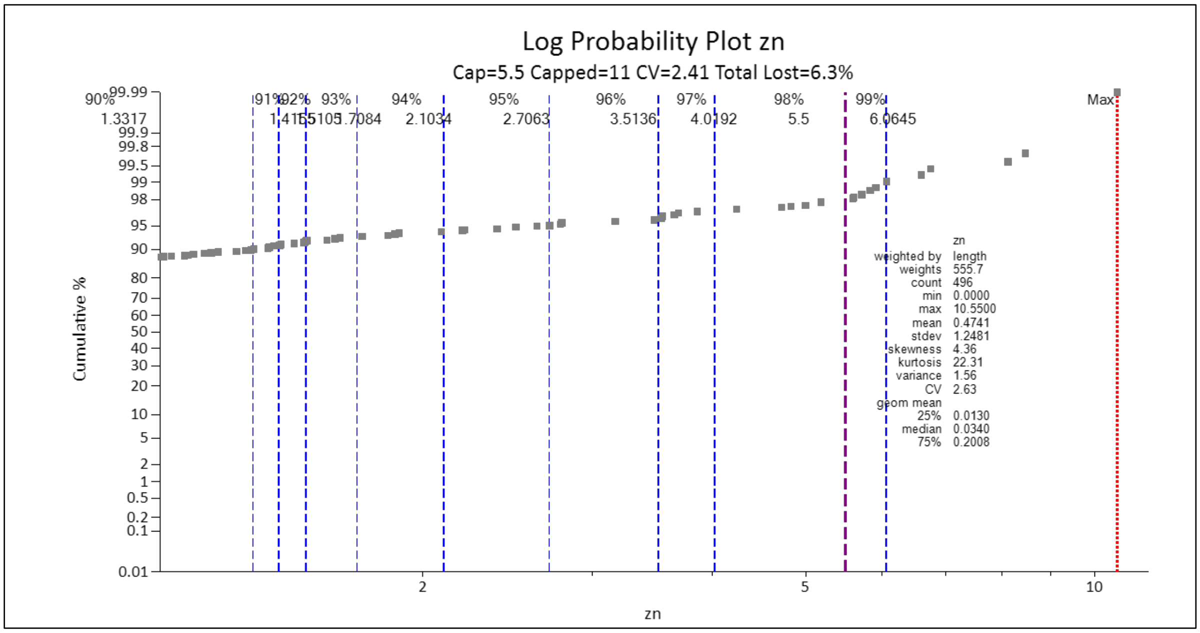



**Figure 10: Zn Log Probability Plot – Bolivar NW Area**

| Column | Cap | Capped | Percentile | Capped% | Lost | CV% | Mean | Variance | CV |
|---|---|---|---|---|---|---|---|---|---|
| zn | | | | | | | 0.4741 | 1.56 | 2.63 |
| zn | 6.0645 | 6 | 99% | 1.20% | 4.30% | 6.40% | 0.4526 | 1.24 | 2.46 |
| zn | 5.5 | 11 | 98% | 2.20% | 6.30% | 8.30% | 0.4432 | 1.14 | 2.41 |
| zn | 4.0192 | 16 | 97% | 3.20% | 15% | 16% | 0.4038 | 0.81 | 2.22 |
| zn | 3.5136 | 21 | 96% | 4.20% | 19% | 18% | 0.3868 | 0.69 | 2.15 |
| zn | 2.7063 | 26 | 95% | 5.20% | 26% | 24% | 0.3506 | 0.49 | 2 |
| zn | 2.1034 | 31 | 94% | 6.30% | 34% | 29% | 0.3172 | 0.35 | 1.88 |
| zn | 1.7084 | 36 | 93% | 7.30% | 39% | 32% | 0.2914 | 0.27 | 1.79 |
| zn | 1.5105 | 40 | 92% | 8.10% | 42% | 34% | 0.2764 | 0.23 | 1.74 |
| zn | 1.4155 | 45 | 91% | 9.10% | 44% | 35% | 0.2682 | 0.21 | 1.72 |
| zn | 1.3317 | 49 | 90% | 9.90% | 46% | 36% | 0.2601 | 0.19 | 1.7 |
| zn | | | | | | | 4.2446 | 4.8 | 0.52 |
| zn | | | | | | | 0.1813 | 0.12 | 1.95 |

**Table 10: Bolivar NW Capping Analysis – Zn**

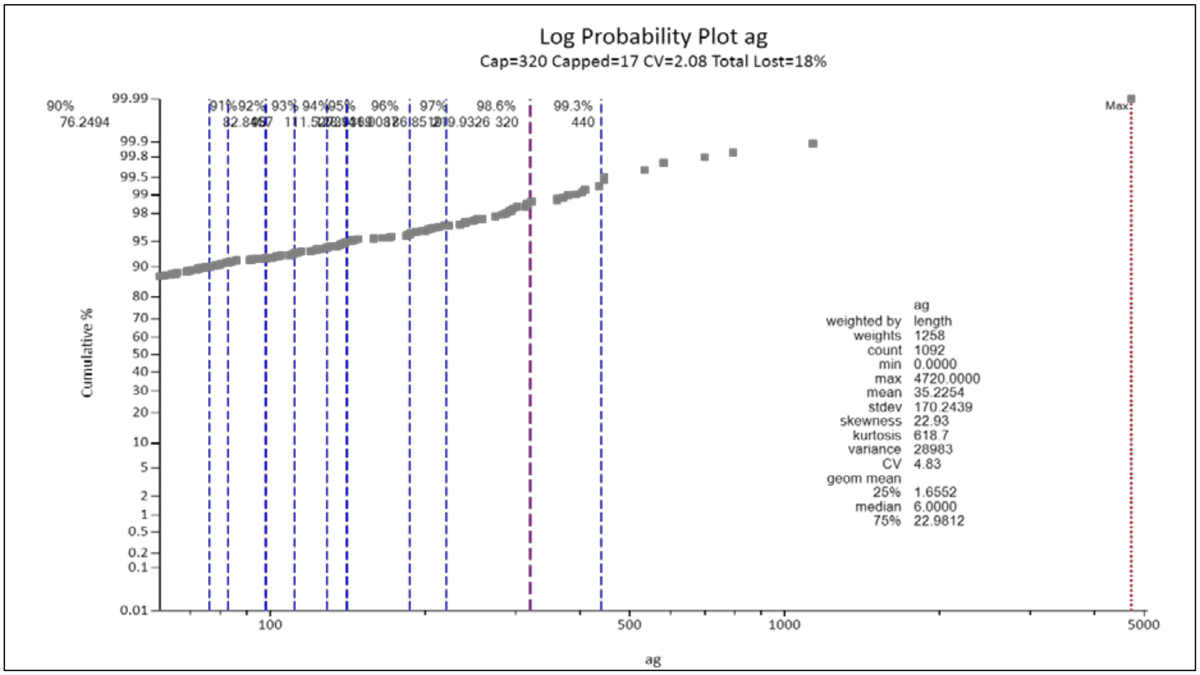



**Figure 11: Ag Log Probability Plot – Chimineas Area**

| Column | Cap | Capped | Percentile | Capped% | Lost | CV% | Count | Total | CV |
|---|---|---|---|---|---|---|---|---|---|
| ag | | | | | | | 1092 | 44315 | 4.83 |
| ag | 440 | 8 | 99.30% | 0.70% | 14% | 54% | 1092 | 37309 | 2.23 |
| ag | 320 | 17 | 98.60% | 1.60% | 18% | 57% | 1092 | 35683 | 2.08 |
| ag | 219.9326 | 37 | 97% | 3.40% | 24% | 61% | 1092 | 32836 | 1.88 |
| ag | 186.8519 | 50 | 96% | 4.60% | 28% | 63% | 1092 | 31395 | 1.79 |
| ag | 141.0087 | 62 | 95% | 5.70% | 34% | 66% | 1092 | 28801 | 1.64 |
| ag | 128.9369 | 74 | 94% | 6.80% | 36% | 67% | 1092 | 27946 | 1.6 |
| ag | 111.5273 | 87 | 93% | 8% | 39% | 68% | 1092 | 26530 | 1.53 |
| ag | 98 | 99 | 92% | 9.10% | 42% | 70% | 1092 | 25242 | 1.47 |
| ag | 82.8457 | 113 | 91% | 10.30% | 46% | 71% | 1092 | 23636 | 1.4 |
| ag | 76.2494 | 123 | 90% | 11.30% | 48% | 72% | 1092 | 22848 | 1.36 |
| ag | | | | | | | 17 | 14247 | 1.46 |
| ag | | | | | | | 1075 | 30067 | 1.98 |

**Table 11: Chimineas Capping Analysis – Ag**

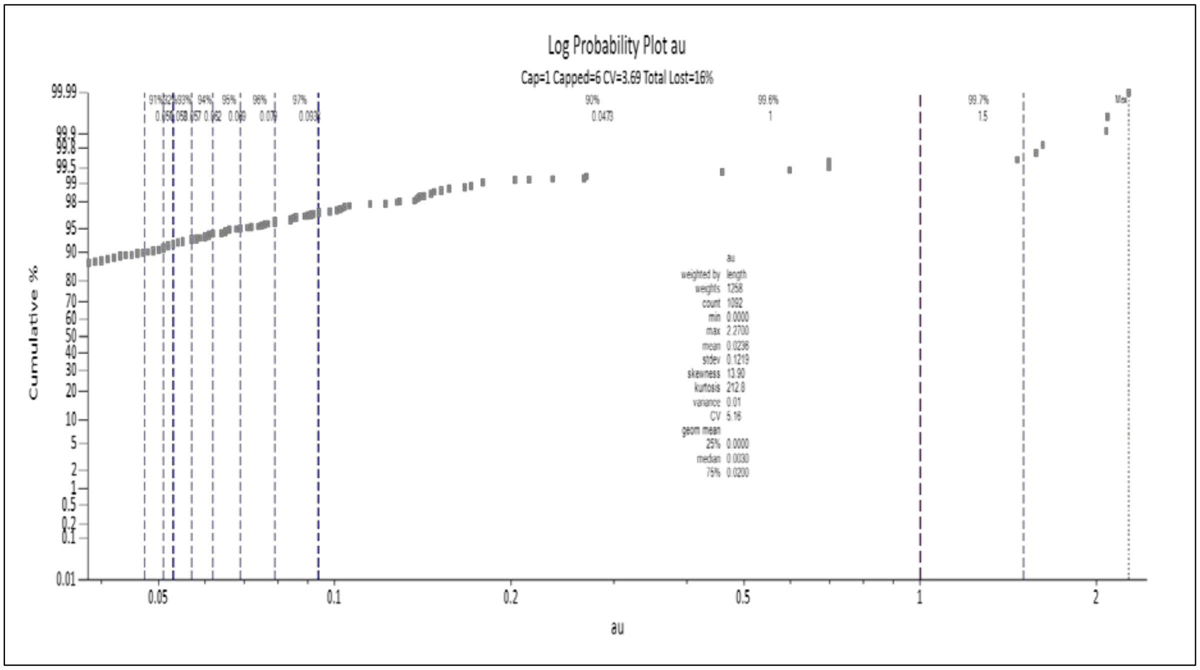



**Figure 12: Au Log Probability Plot – Chimineas Area**

| Column | Cap | Capped | Percentile | Capped% | Lost | CV% | Mean | Variance | CV |
|---|---|---|---|---|---|---|---|---|---|
| au | | | | | | | 0.0236 | 0.01 | 5.16 |
| au | 1.5 | 5 | 99.70% | 0.50% | 6.80% | 12% | 0.0223 | 0.01 | 4.56 |
| au | 1 | 6 | 99.60% | 0.50% | 16% | 29% | 0.0204 | 0.01 | 3.69 |
| au | 0.75 | 6 | 99.60% | 0.50% | 21% | 37% | 0.0195 | 0 | 3.26 |
| au | 0.2641 | 12 | 99.20% | 1.10% | 35% | 59% | 0.0164 | 0 | 2.1 |
| au | 0.1417 | 24 | 98.40% | 2.20% | 41% | 65% | 0.0152 | 0 | 1.81 |
| au | 0.1025 | 38 | 97.40% | 3.50% | 45% | 68% | 0.0144 | 0 | 1.67 |
| au | 0.079 | 54 | 95.80% | 4.90% | 48% | 69% | 0.0136 | 0 | 1.58 |
| au | 0.066 | 70 | 94.80% | 6.40% | 51% | 71% | 0.013 | 0 | 1.52 |
| au | 0.057 | 91 | 92.90% | 8.30% | 53% | 72% | 0.0124 | 0 | 1.47 |
| au | 0.0475 | 125 | 90% | 11.40% | 56% | 73% | 0.0116 | 0 | 1.41 |
| au | | | | | | | 1.8268 | 0.1 | 0.17 |
| au | | | | | | | 0.0166 | 0 | 2.67 |

**Table 12: Chimineas Capping Analysis – Au**

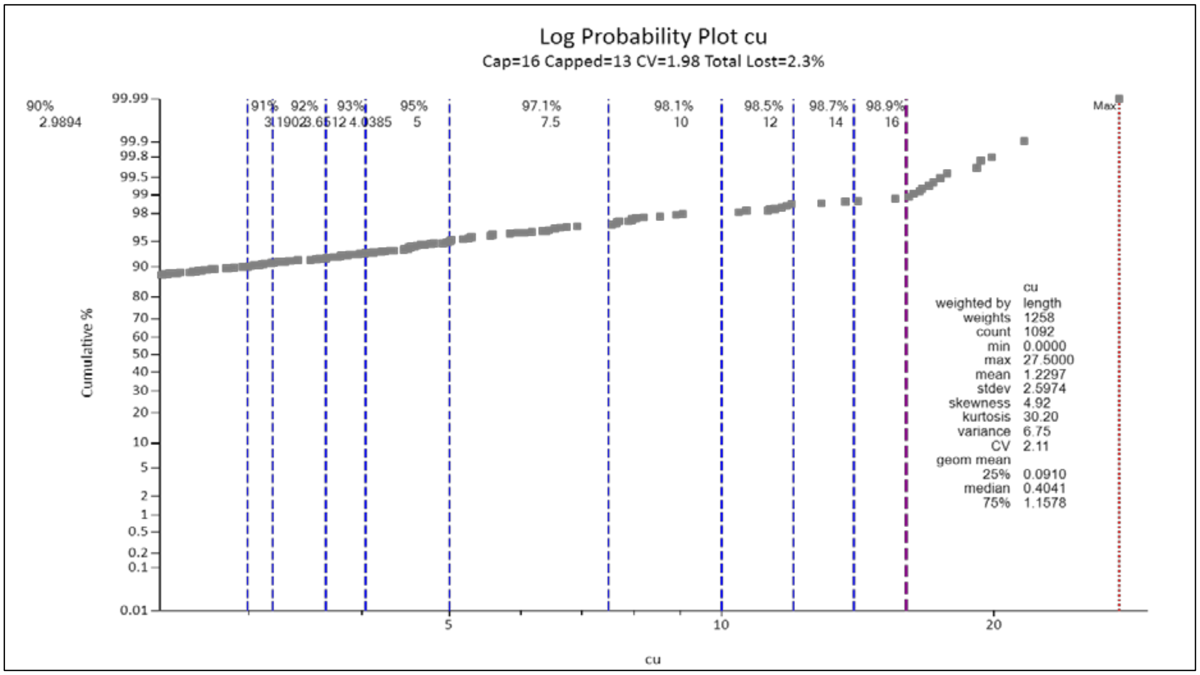



**Figure 13: Cu Log Probability Plot – Chimineas Area**

| Column | Cap | Capped | Percentile | Capped% | Lost | CV% | Count | Total | CV |
|---|---|---|---|---|---|---|---|---|---|
| cu | | | | | | | 1092 | 1547 | 2.11 |
| cu | 16 | 13 | 98.90% | 1.20% | 2.30% | 6.20% | 1092 | 1508 | 1.98 |
| cu | 14 | 15 | 98.70% | 1.40% | 4.20% | 10% | 1092 | 1477 | 1.9 |
| cu | 12 | 17 | 98.50% | 1.60% | 6.40% | 14% | 1092 | 1442 | 1.81 |
| cu | 10 | 26 | 98.10% | 2.40% | 9.50% | 19% | 1092 | 1397 | 1.71 |
| cu | 7.5 | 39 | 97.10% | 3.60% | 14% | 26% | 1092 | 1326 | 1.57 |
| cu | 5 | 61 | 94% | 5.60% | 22% | 34% | 1092 | 1209 | 1.39 |
| cu | 4.0385 | 89 | 93% | 8.20% | 27% | 39% | 1092 | 1137 | 1.3 |
| cu | 3.6512 | 101 | 92% | 9.20% | 30% | 41% | 1092 | 1100 | 1.25 |
| cu | 3.1902 | 115 | 91% | 10.50% | 33% | 43% | 1092 | 1051 | 1.2 |
| cu | 2.9894 | 127 | 90% | 11.60% | 35% | 45% | 1092 | 1027 | 1.17 |
| cu | | | | | | | 13 | 273.7 | 0.17 |
| cu | | | | | | | 1079 | 1273 | 1.72 |

**Table 13: Chimineas Capping Analysis – Cu**

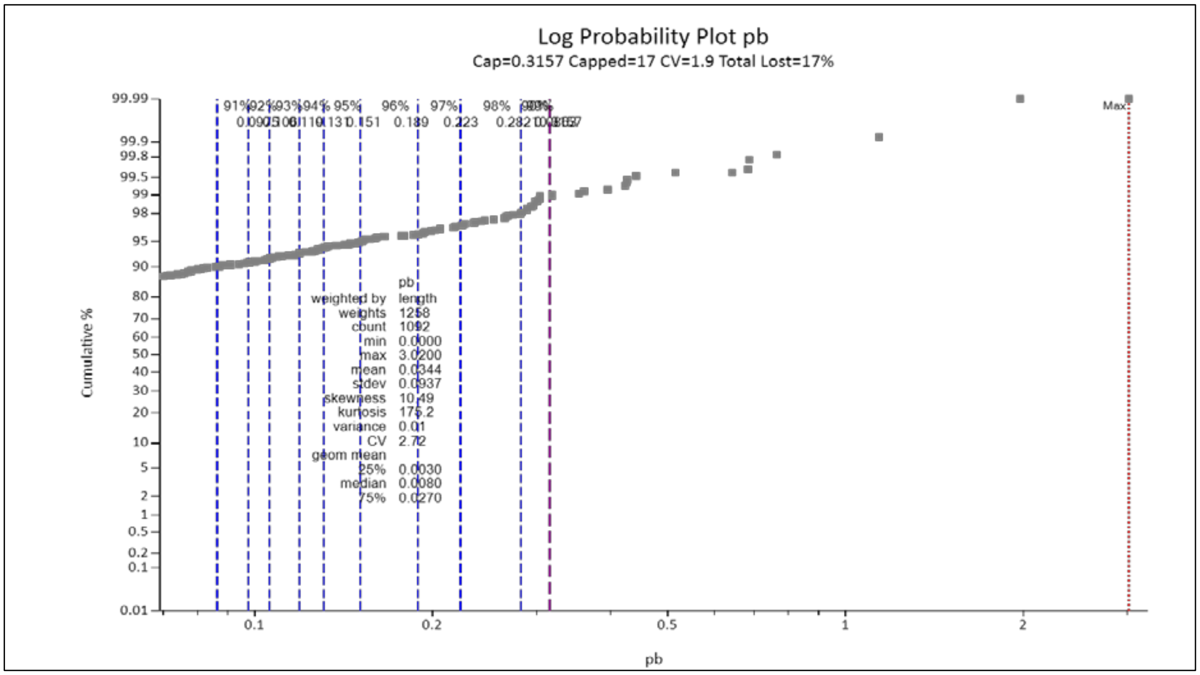



**Figure 14: Pb Log Probability Plot – Chimineas Area**

| Column | Cap | Capped | Percentile | Capped% | Lost | CV% | Count | Total | CV |
|---|---|---|---|---|---|---|---|---|---|
| pb | | | | | | | 1092 | 43.29 | 2.72 |
| pb | 0.3157 | 17 | 99% | 1.60% | 17% | 30% | 1092 | 38.73 | 1.9 |
| pb | 0.2821 | 27 | 98% | 2.50% | 18% | 32% | 1092 | 38.13 | 1.86 |
| pb | 0.223 | 40 | 97% | 3.70% | 23% | 36% | 1092 | 36.26 | 1.74 |
| pb | 0.189 | 50 | 96% | 4.60% | 26% | 39% | 1092 | 34.78 | 1.66 |
| pb | 0.151 | 64 | 95% | 5.90% | 31% | 43% | 1092 | 32.69 | 1.56 |
| pb | 0.131 | 75 | 94% | 6.90% | 34% | 45% | 1092 | 31.3 | 1.49 |
| pb | 0.119 | 87 | 93% | 8% | 36% | 47% | 1092 | 30.3 | 1.45 |
| pb | 0.106 | 101 | 92% | 9.20% | 39% | 49% | 1092 | 29.06 | 1.4 |
| pb | 0.0975 | 112 | 91% | 10.30% | 41% | 50% | 1092 | 28.14 | 1.36 |
| pb | 0.0863 | 123 | 90% | 11.30% | 44% | 52% | 1092 | 26.8 | 1.31 |
| pb | | | | | | | 15 | 8.466 | 0.68 |
| pb | | | | | | | 1077 | 34.82 | 1.84 |

**Table 14: Chimineas Capping Analysis – Pb**

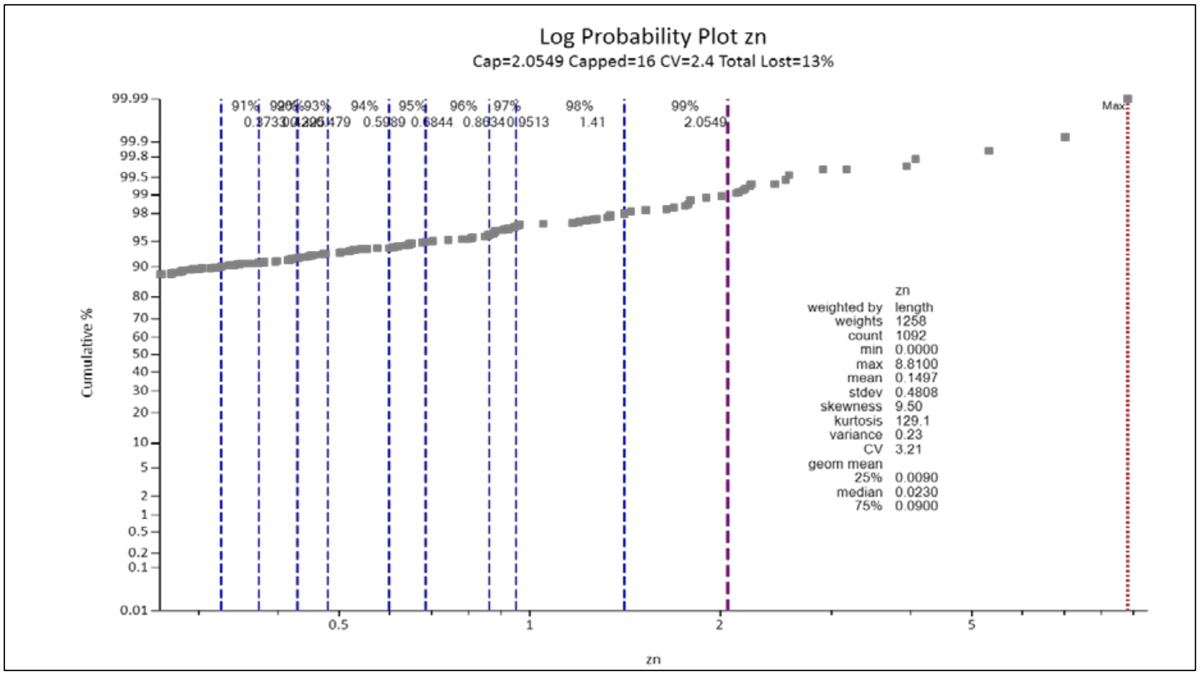



**Figure 15: Zn Log Probability Plot – Chimineas Area**

| Column | Cap | Capped | Percentile | Capped% | Lost | CV% | Count | Total | CV |
|---|---|---|---|---|---|---|---|---|---|
| zn | | | | | | | 1092 | 188.4 | 3.21 |
| zn | 2.0549 | 16 | 99% | 1.50% | 13% | 25% | 1092 | 168.2 | 2.4 |
| zn | 1.41 | 25 | 98% | 2.30% | 20% | 32% | 1092 | 156 | 2.17 |
| zn | 0.9513 | 40 | 97% | 3.70% | 28% | 40% | 1092 | 140.9 | 1.94 |
| zn | 0.8634 | 52 | 96% | 4.80% | 30% | 41% | 1092 | 137 | 1.89 |
| zn | 0.6844 | 64 | 95% | 5.90% | 36% | 45% | 1092 | 126.6 | 1.75 |
| zn | 0.5989 | 76 | 94% | 7% | 39% | 48% | 1092 | 120.6 | 1.68 |
| zn | 0.479 | 86 | 93% | 7.90% | 44% | 51% | 1092 | 110.9 | 1.57 |
| zn | 0.429 | 96 | 92% | 8.80% | 47% | 53% | 1092 | 106.2 | 1.52 |
| zn | 0.3733 | 107 | 91% | 9.80% | 50% | 55% | 1092 | 100.2 | 1.45 |
| zn | 0.325 | 117 | 90% | 10.70% | 53% | 57% | 1092 | 94.44 | 1.39 |
| zn | | | | | | | 16 | 46.99 | 0.58 |
| zn | | | | | | | 1076 | 141.4 | 2.24 |

**Table 15: Chimineas Capping Analysis – Zn**

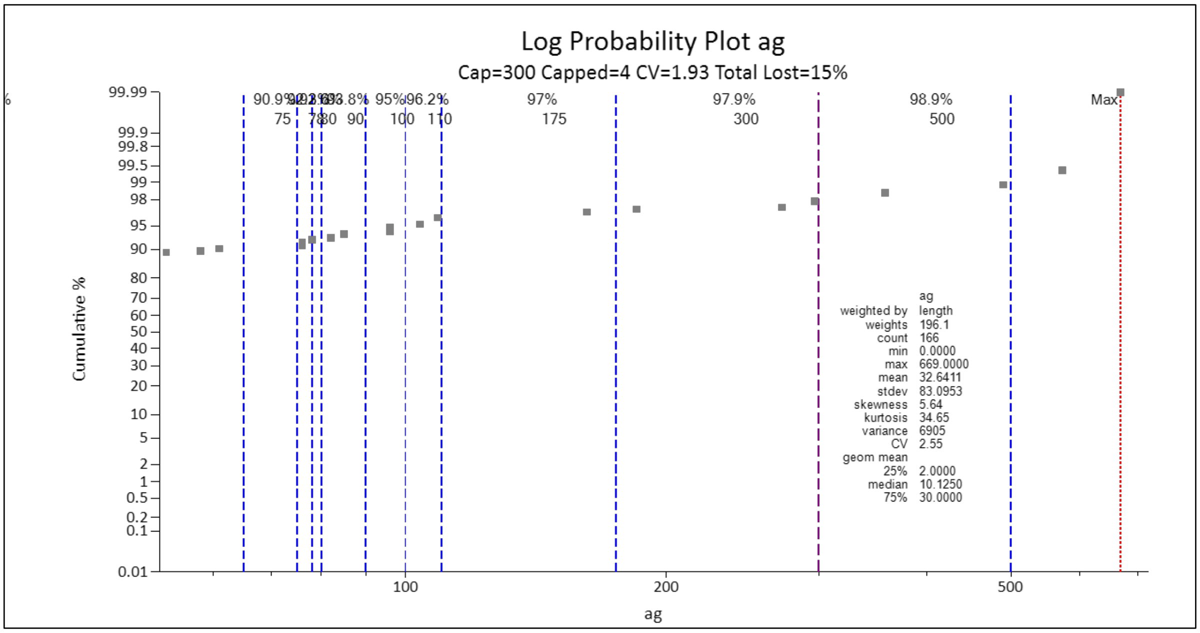



**Figure 16: Ag Log Probability Plot – Bolivar W Area**

| Column | Cap | Capped | Percentile | Capped% | Lost | CV% | Count | Mean | Total | CV |
|---|---|---|---|---|---|---|---|---|---|---|
| ag | | | | | | | 166 | 32.6411 | 6401 | 2.55 |
| ag | 500 | 2 | 98.90% | 1.20% | 4.10% | 7.80% | 166 | 31.2347 | 6125 | 2.35 |
| ag | 300 | 4 | 97.90% | 2.40% | 15% | 24% | 166 | 27.842 | 5460 | 1.93 |
| ag | 175 | 7 | 97% | 4.20% | 28% | 39% | 166 | 24.3086 | 4767 | 1.54 |
| ag | 110 | 8 | 96.20% | 4.80% | 36% | 48% | 166 | 21.9221 | 4299 | 1.32 |
| ag | 100 | 10 | 95% | 6% | 38% | 50% | 166 | 21.4402 | 4204 | 1.28 |
| ag | 90 | 12 | 93.80% | 7.20% | 40% | 51% | 166 | 20.8451 | 4088 | 1.24 |
| ag | 80 | 14 | 92.60% | 8.40% | 42% | 53% | 166 | 20.1525 | 3952 | 1.19 |
| ag | 78 | 14 | 92% | 8.40% | 42% | 53% | 166 | 19.9991 | 3922 | 1.18 |
| ag | 75 | 17 | 90.90% | 10.20% | 43% | 54% | 166 | 19.7359 | 3870 | 1.17 |
| ag | 65 | 17 | 90.40% | 10.20% | 46% | 57% | 166 | 18.7568 | 3678 | 1.11 |
| ag | | | | | | | 4 | 526.7711 | 2186 | 0.26 |
| ag | | | | | | | 162 | 21.9579 | 4215 | 1.65 |

**Table 16: Bolivar W Capping Analysis – Ag**

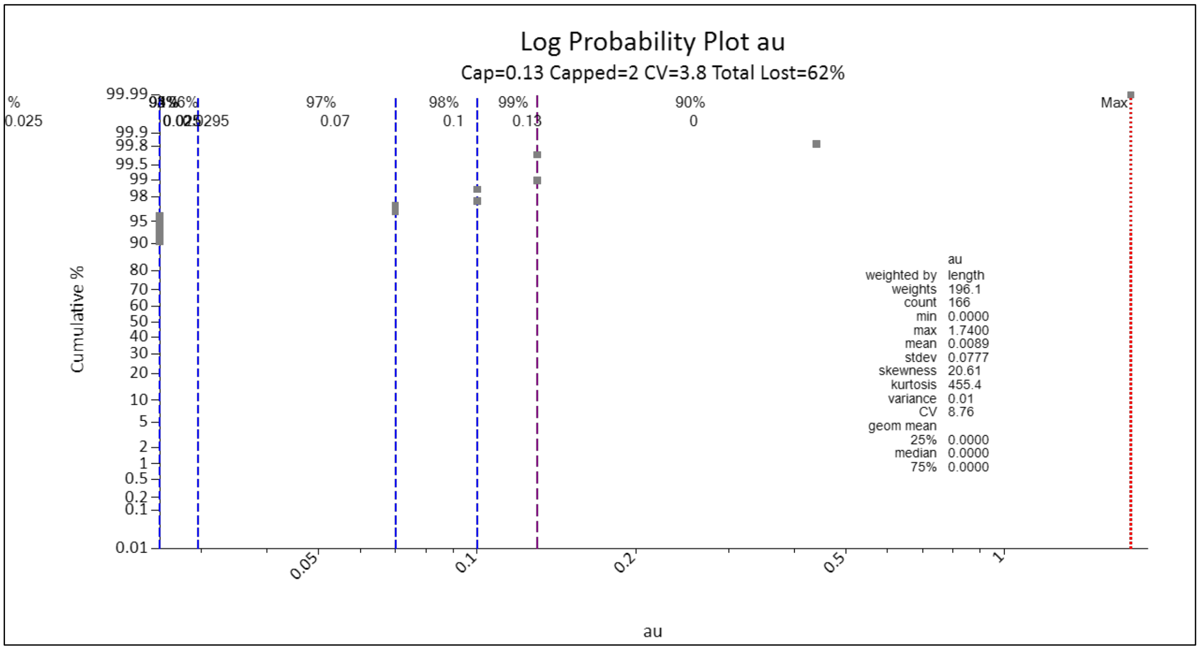



**Figure 17: Au Log Probability Plot – Bolivar W Area**

| Column | Cap | Capped | Percentile | Capped% | Lost | CV% | Count | Mean | Total | CV |
|---|---|---|---|---|---|---|---|---|---|---|
| au | | | | | | | 166 | 0.0089 | 1.741 | 8.76 |
| au | 0.13 | 2 | 99% | 1.20% | 62% | 57% | 166 | 0.0056 | 1.1 | 3.8 |
| au | 0.1 | 4 | 98% | 2.40% | 66% | 58% | 166 | 0.0052 | 1.013 | 3.65 |
| au | 0.07 | 6 | 97% | 3.60% | 71% | 61% | 166 | 0.0043 | 0.847 | 3.42 |
| au | 0.0295 | 8 | 96% | 4.80% | 82% | 65% | 166 | 0.0027 | 0.525 | 3.03 |
| au | 0.025 | 8 | 95% | 4.80% | 83% | 66% | 166 | 0.0025 | 0.489 | 3.02 |
| au | 0.025 | 8 | 94% | 4.80% | 83% | 66% | 166 | 0.0025 | 0.489 | 3.02 |
| au | 0.025 | 8 | 93% | 4.80% | 83% | 66% | 166 | 0.0025 | 0.489 | 3.02 |
| au | 0.025 | 8 | 92% | 4.80% | 83% | 66% | 166 | 0.0025 | 0.489 | 3.02 |
| au | 0.025 | 8 | 91% | 4.80% | 83% | 66% | 166 | 0.0025 | 0.489 | 3.02 |
| au | 0 | 21 | 90% | 12.70% | 100% | NaN% | 166 | 0 | 0 | NaN |
| au | | | | | | | 2 | 0 | 0 | NaN |
| au | | | | | | | 164 | 0.009 | 1.741 | 8.71 |

**Table 17: Bolivar W Capping Analysis – Au**

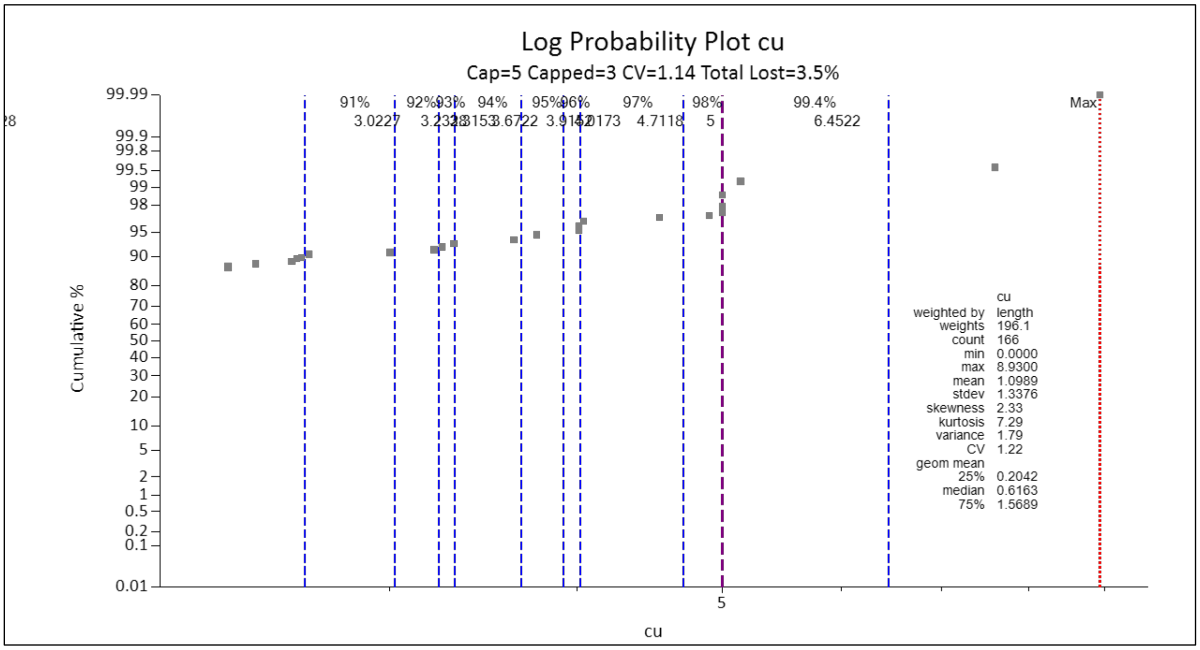



**Figure 18: Cu Log Probability Plot – Bolivar W Area**

| Column | Cap | Capped | Percentile | Capped% | Lost | CV% | Count | Mean | Total | CV |
|---|---|---|---|---|---|---|---|---|---|---|
| cu | | | | | | | 166 | 1.0989 | 215.5 | 1.22 |
| cu | 6.4522 | 2 | 99.40% | 1.20% | 1.90% | 4.20% | 166 | 1.0841 | 212.6 | 1.17 |
| cu | 5 | 3 | 98% | 1.80% | 3.50% | 6.60% | 166 | 1.0718 | 210.2 | 1.14 |
| cu | 4.7118 | 7 | 97% | 4.20% | 4.50% | 8% | 166 | 1.0631 | 208.5 | 1.12 |
| cu | 4.0173 | 9 | 96% | 5.40% | 7.40% | 11% | 166 | 1.0392 | 203.8 | 1.08 |
| cu | 3.9152 | 11 | 95% | 6.60% | 7.90% | 12% | 166 | 1.0338 | 202.7 | 1.07 |
| cu | 3.6722 | 12 | 94% | 7.20% | 9.40% | 14% | 166 | 1.02 | 200 | 1.05 |
| cu | 3.3153 | 13 | 93% | 7.80% | 12% | 16% | 166 | 0.9952 | 195.2 | 1.02 |
| cu | 3.2328 | 15 | 92% | 9% | 12% | 17% | 166 | 0.9888 | 193.9 | 1.01 |
| cu | 3.0227 | 16 | 91% | 9.60% | 14% | 19% | 166 | 0.9699 | 190.2 | 0.99 |
| cu | 2.6328 | 18 | 90% | 10.80% | 18% | 22% | 166 | 0.9326 | 182.9 | 0.94 |
| cu | | | | | | | 3 | 7.0055 | 18.56 | 0.29 |
| cu | | | | | | | 163 | 1.018 | 196.9 | 1.12 |

**Table 18: Bolivar W Capping Analysis – Cu**

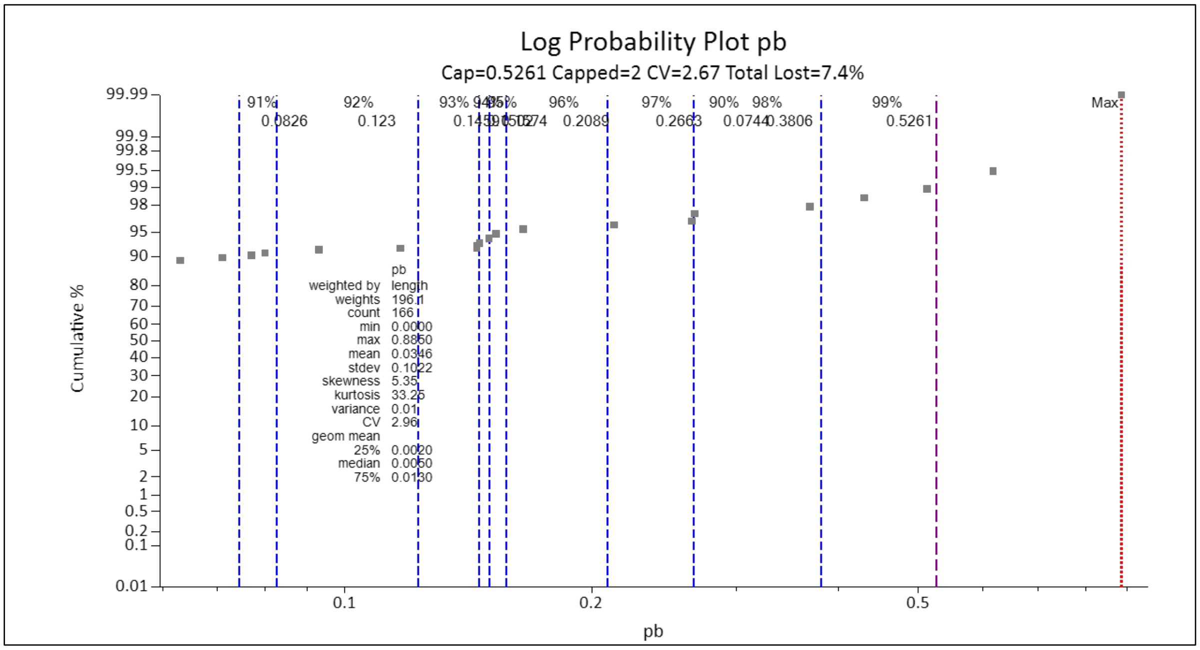



**Figure 19: Pb Log Probability Plot – Bolivar WArea**

| Column | Cap | Capped | Percentile | Capped% | Lost | CV% | Count | Mean | Total | CV |
|---|---|---|---|---|---|---|---|---|---|---|
| pb | | | | | | | 166 | 0.0346 | 6.781 | 2.96 |
| pb | 0.5261 | 2 | 99% | 1.20% | 7.40% | 9.60% | 166 | 0.0322 | 6.322 | 2.67 |
| pb | 0.3806 | 4 | 98% | 2.40% | 15% | 17% | 166 | 0.0298 | 5.845 | 2.46 |
| pb | 0.2663 | 6 | 97% | 3.60% | 25% | 24% | 166 | 0.0268 | 5.246 | 2.24 |
| pb | 0.2089 | 8 | 96% | 4.80% | 31% | 29% | 166 | 0.0245 | 4.798 | 2.09 |
| pb | 0.1574 | 9 | 95% | 5.40% | 38% | 34% | 166 | 0.0221 | 4.331 | 1.95 |
| pb | 0.1502 | 10 | 94% | 6% | 39% | 35% | 166 | 0.0217 | 4.252 | 1.92 |
| pb | 0.1459 | 12 | 93% | 7.20% | 40% | 35% | 166 | 0.0214 | 4.194 | 1.91 |
| pb | 0.123 | 14 | 92% | 8.40% | 45% | 39% | 166 | 0.0195 | 3.832 | 1.8 |
| pb | 0.0826 | 16 | 91% | 9.60% | 55% | 46% | 166 | 0.0161 | 3.155 | 1.59 |
| pb | 0.0744 | 18 | 90% | 10.80% | 58% | 48% | 166 | 0.0153 | 2.999 | 1.54 |
| pb | | | | | | | 4 | 0.1389 | 0.389 | 0.81 |
| pb | | | | | | | 162 | 0.0331 | 6.392 | 3.07 |

**Table 19: Bolivar W Capping Analysis – Pb**

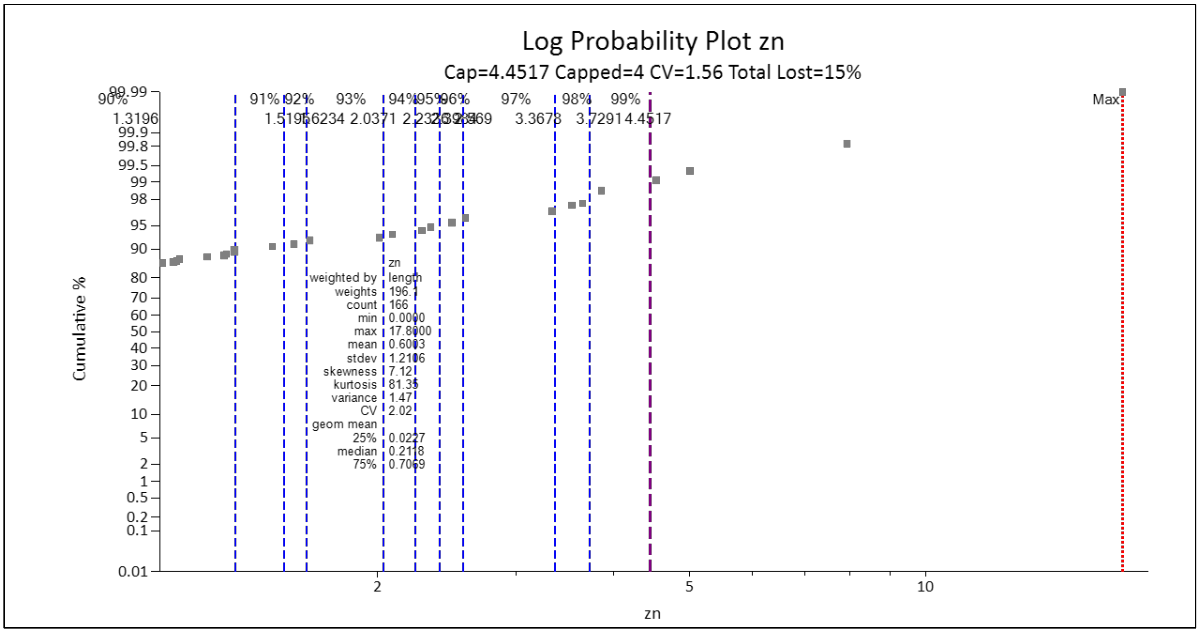



**Figure 20: Zn Log Probability Plot – Bolivar W Area**

| Column | Cap | Capped | Percentile | Capped% | Lost | CV% | Count | Mean | Total | CV |
|---|---|---|---|---|---|---|---|---|---|---|
| zn | | | | | | | 166 | 0.6003 | 117.7 | 2.02 |
| zn | 4.4517 | 4 | 99% | 2.40% | 15% | 22% | 166 | 0.5585 | 109.5 | 1.56 |
| zn | 3.7291 | 5 | 98% | 3% | 18% | 25% | 166 | 0.547 | 107.3 | 1.51 |
| zn | 3.3678 | 7 | 97% | 4.20% | 20% | 27% | 166 | 0.5371 | 105.3 | 1.47 |
| zn | 2.569 | 9 | 96% | 5.40% | 25% | 33% | 166 | 0.5064 | 99.3 | 1.35 |
| zn | 2.3984 | 10 | 95% | 6% | 27% | 34% | 166 | 0.4979 | 97.65 | 1.33 |
| zn | 2.2336 | 12 | 94% | 7.20% | 28% | 36% | 166 | 0.4883 | 95.76 | 1.3 |
| zn | 2.0371 | 13 | 93% | 7.80% | 30% | 38% | 166 | 0.4751 | 93.16 | 1.26 |
| zn | 1.6234 | 15 | 92% | 9% | 35% | 42% | 166 | 0.4428 | 86.83 | 1.17 |
| zn | 1.5195 | 16 | 91% | 9.60% | 37% | 43% | 166 | 0.4335 | 85 | 1.15 |
| zn | 1.3196 | 17 | 90% | 10.20% | 40% | 45% | 166 | 0.4138 | 81.14 | 1.1 |
| zn | | | | | | | 4 | 7.3823 | 20.67 | 0.67 |
| zn | | | | | | | 162 | 0.5021 | 97.05 | 1.48 |

**Table 20: Bolivar W Capping Analysis – Zn**

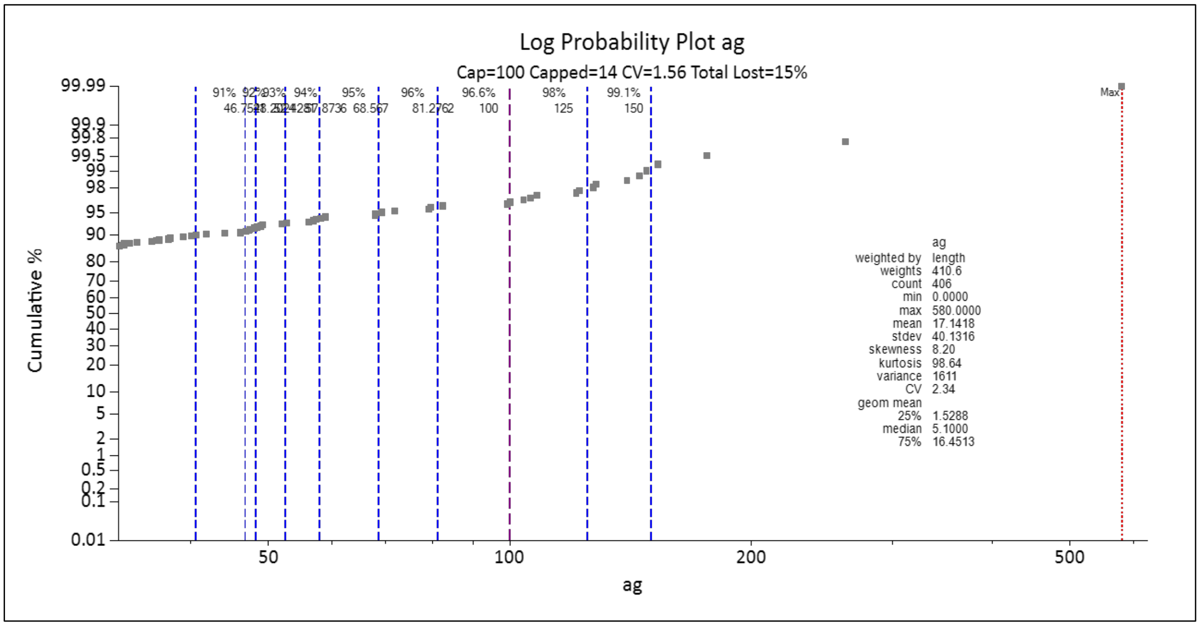



**Figure 21: Ag Log Probability Plot – Increíble Area**

| Column | Cap | Capped | Percentile | Capped% | Lost | CV% | Count | Mean | Variance | CV |
|---|---|---|---|---|---|---|---|---|---|---|
| ag | | | | | | | 406 | 17.1418 | 1611 | 2.34 |
| ag | 150 | 4 | 99% | 1.00% | 8% | 26% | 406 | 15.751 | 754.3 | 1.74 |
| ag | 125 | 9 | 98% | 2.20% | 11% | 29% | 406 | 15.3539 | 658.2 | 1.67 |
| ag | 100 | 14 | 97% | 3.40% | 15% | 33% | 406 | 14.6573 | 523.3 | 1.56 |
| ag | 81.2762 | 17 | 96% | 4.20% | 19% | 38% | 406 | 13.9266 | 411.5 | 1.46 |
| ag | 68.567 | 21 | 95% | 5.20% | 22% | 41% | 406 | 13.3381 | 339.4 | 1.38 |
| ag | 57.8736 | 25 | 94% | 6.20% | 26% | 44% | 406 | 12.7304 | 278.3 | 1.31 |
| ag | 52.4281 | 29 | 93% | 7.10% | 28% | 46% | 406 | 12.3615 | 246.8 | 1.27 |
| ag | 48.2024 | 33 | 92% | 8.10% | 30% | 47% | 406 | 12.0456 | 222.7 | 1.24 |
| ag | 46.7521 | 37 | 91% | 9.10% | 31% | 48% | 406 | 11.9203 | 213.8 | 1.23 |
| ag | 40.5975 | 41 | 90% | 10.10% | 34% | 50% | 406 | 11.325 | 175.6 | 1.17 |
| ag | | | | | | | 14 | 172.8571 | 15338 | 0.72 |
| ag | | | | | | | 392 | 11.6443 | 274.9 | 1.42 |

**Table 21: Increíble Capping Analysis – Ag**

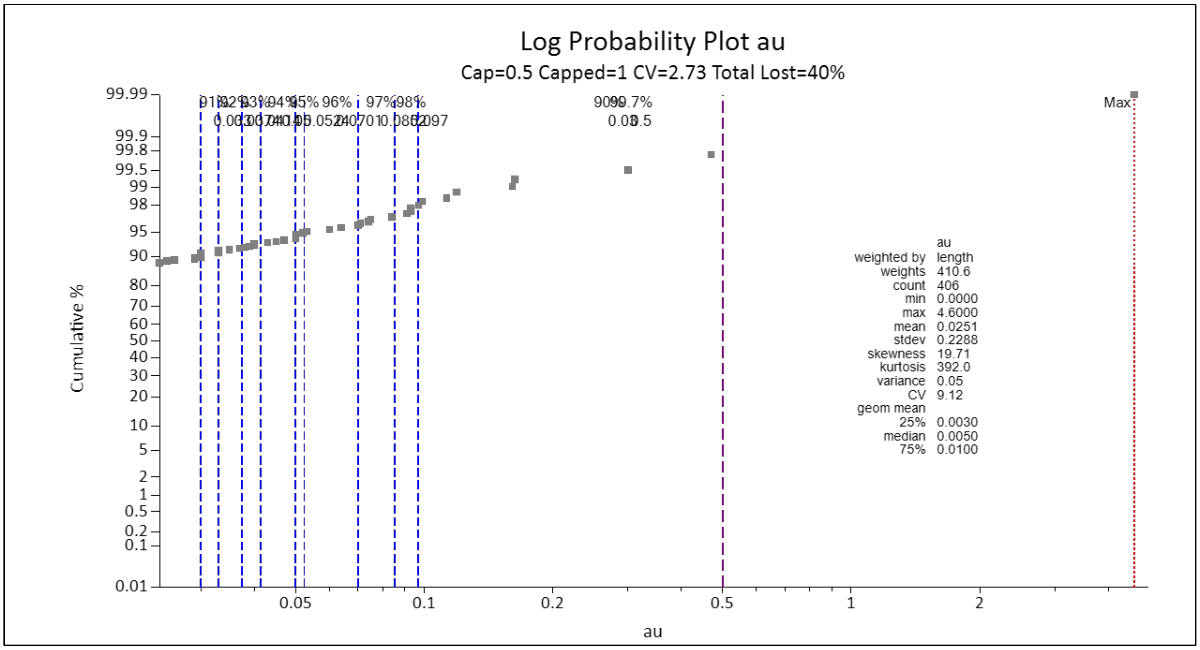



**Figure 22: Au Log Probability Plot – Increíble Area**

| Column | Cap | Capped | Percentile | Capped% | Lost | CV% | Count | Mean | Variance | CV |
|---|---|---|---|---|---|---|---|---|---|---|
| au | | | | | | | 406 | 0.0251 | 0.05 | 9.12 |
| au | 0.5 | 1 | 99.70% | 0.20% | 40% | 70% | 406 | 0.0151 | 0 | 2.73 |
| au | 0.097 | 8 | 98% | 2% | 52% | 83% | 406 | 0.0123 | 0 | 1.58 |
| au | 0.0852 | 12 | 97% | 3% | 53% | 83% | 406 | 0.012 | 0 | 1.51 |
| au | 0.0701 | 16 | 96% | 3.90% | 55% | 85% | 406 | 0.0115 | 0 | 1.41 |
| au | 0.0524 | 20 | 95% | 4.90% | 58% | 86% | 406 | 0.0106 | 0 | 1.25 |
| au | 0.05 | 21 | 94% | 5.20% | 58% | 87% | 406 | 0.0105 | 0 | 1.23 |
| au | 0.0414 | 28 | 93% | 6.90% | 61% | 88% | 406 | 0.0099 | 0 | 1.13 |
| au | 0.0374 | 32 | 92% | 7.90% | 62% | 88% | 406 | 0.0096 | 0 | 1.08 |
| au | 0.033 | 34 | 91% | 8.40% | 63% | 89% | 406 | 0.0093 | 0 | 1.02 |
| au | 0.03 | 37 | 90% | 9.10% | 64% | 89% | 406 | 0.009 | 0 | 0.98 |
| au | | | | | | | 1 | 4.6 | 0 | 0 |
| au | | | | | | | 405 | 0.0139 | 0 | 2.42 |

**Table 22: Increíble Capping Analysis – Au**

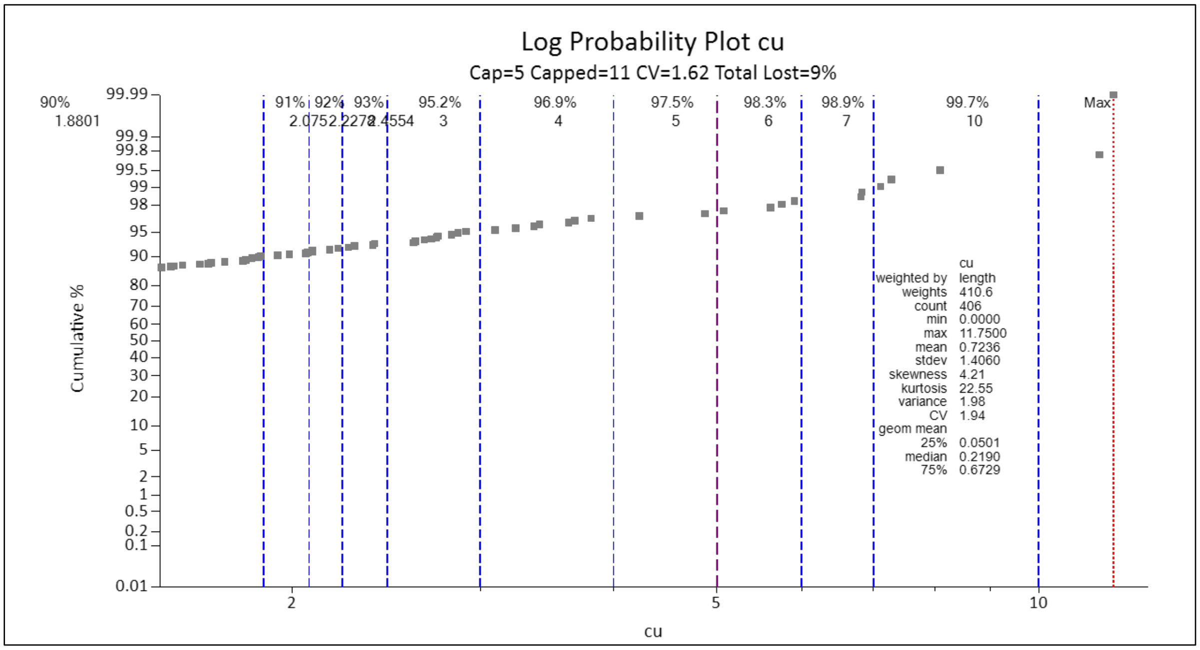



**Figure 23: Cu Log Probability Plot – Increíble Area**

| Column | Cap | Capped | Percentile | Capped% | Lost | CV% | Count | Mean | Variance | CV |
|---|---|---|---|---|---|---|---|---|---|---|
| cu | | | | | | | 406 | 0.7236 | 1.98 | 1.94 |
| cu | 10 | 2 | 99.70% | 0.50% | 1.10% | 3% | 406 | 0.716 | 1.82 | 1.89 |
| cu | 7 | 5 | 98.90% | 1.20% | 3.60% | 8.30% | 406 | 0.6977 | 1.54 | 1.78 |
| cu | 6 | 7 | 98.30% | 1.70% | 5.90% | 12% | 406 | 0.6815 | 1.36 | 1.71 |
| cu | 5 | 11 | 97.50% | 2.70% | 9% | 17% | 406 | 0.6588 | 1.14 | 1.62 |
| cu | 4 | 13 | 96.90% | 3.20% | 13% | 22% | 406 | 0.6292 | 0.91 | 1.52 |
| cu | 3 | 20 | 94% | 4.90% | 19% | 28% | 406 | 0.5895 | 0.68 | 1.4 |
| cu | 2.4554 | 29 | 93% | 7.10% | 23% | 32% | 406 | 0.5567 | 0.54 | 1.32 |
| cu | 2.2278 | 33 | 92% | 8.10% | 26% | 34% | 406 | 0.5396 | 0.48 | 1.29 |
| cu | 2.075 | 37 | 91% | 9.10% | 27% | 35% | 406 | 0.5266 | 0.44 | 1.26 |
| cu | 1.8801 | 41 | 90% | 10.10% | 30% | 37% | 406 | 0.5076 | 0.38 | 1.22 |
| cu | | | | | | | 11 | 7.4105 | 4.97 | 0.3 |
| cu | | | | | | | 395 | 0.5387 | 0.63 | 1.48 |

**Table 23: Increíble Capping Analysis – Cu**

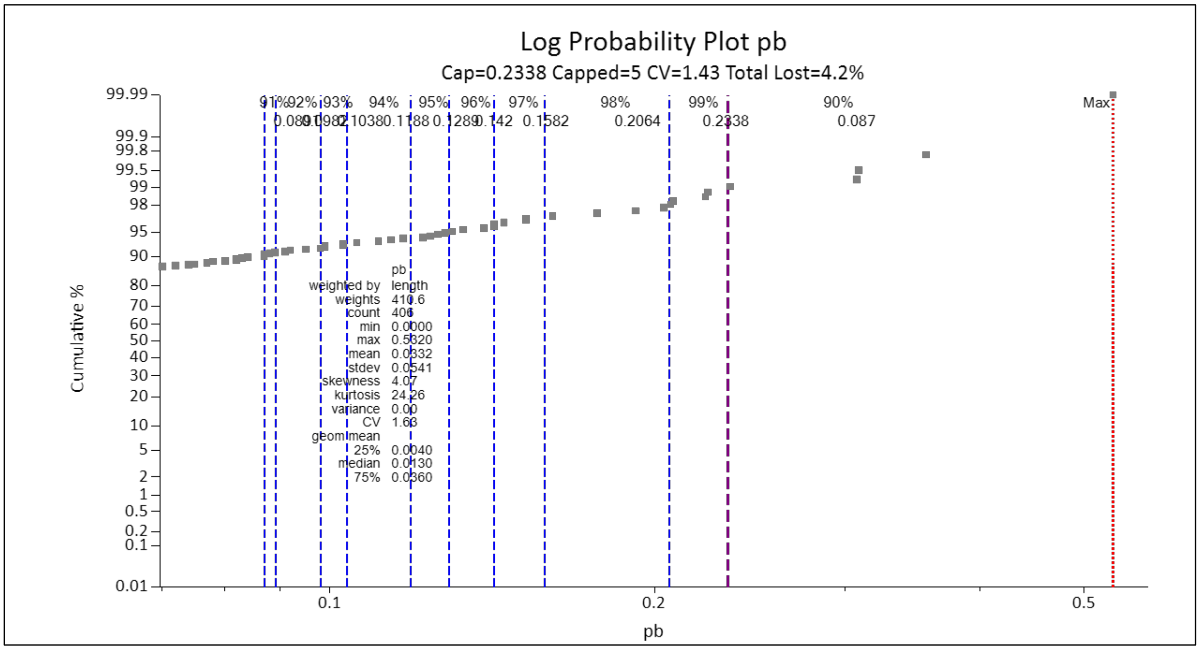



**Figure 24: Pb Log Probability Plot – Increíble Area**

| Column | Cap | Capped | Percentile | Capped% | Lost | CV% | Count | Mean | Variance | CV |
|---|---|---|---|---|---|---|---|---|---|---|
| pb | | | | | | | 406 | 0.0332 | 0 | 1.63 |
| pb | 0.2338 | 5 | 99% | 1.20% | 4.20% | 12% | 406 | 0.0318 | 0 | 1.43 |
| pb | 0.2064 | 9 | 98% | 2.20% | 5.50% | 14% | 406 | 0.0314 | 0 | 1.4 |
| pb | 0.1582 | 13 | 97% | 3.20% | 9.50% | 20% | 406 | 0.0301 | 0 | 1.3 |
| pb | 0.142 | 16 | 96% | 3.90% | 11% | 22% | 406 | 0.0295 | 0 | 1.27 |
| pb | 0.1289 | 21 | 95% | 5.20% | 13% | 24% | 406 | 0.0289 | 0 | 1.23 |
| pb | 0.1188 | 25 | 94% | 6.20% | 15% | 26% | 406 | 0.0283 | 0 | 1.2 |
| pb | 0.1038 | 29 | 93% | 7.10% | 18% | 29% | 406 | 0.0273 | 0 | 1.15 |
| pb | 0.0982 | 33 | 92% | 8.10% | 19% | 31% | 406 | 0.0269 | 0 | 1.13 |
| pb | 0.0891 | 37 | 91% | 9.10% | 21% | 33% | 406 | 0.0261 | 0 | 1.1 |
| pb | 0.087 | 39 | 90% | 9.60% | 22% | 33% | 406 | 0.0259 | 0 | 1.09 |
| pb | | | | | | | 5 | 0.3482 | 0.01 | 0.32 |
| pb | | | | | | | 401 | 0.0293 | 0 | 1.36 |

**Table 24: Increíble Capping Analysis – Pb**

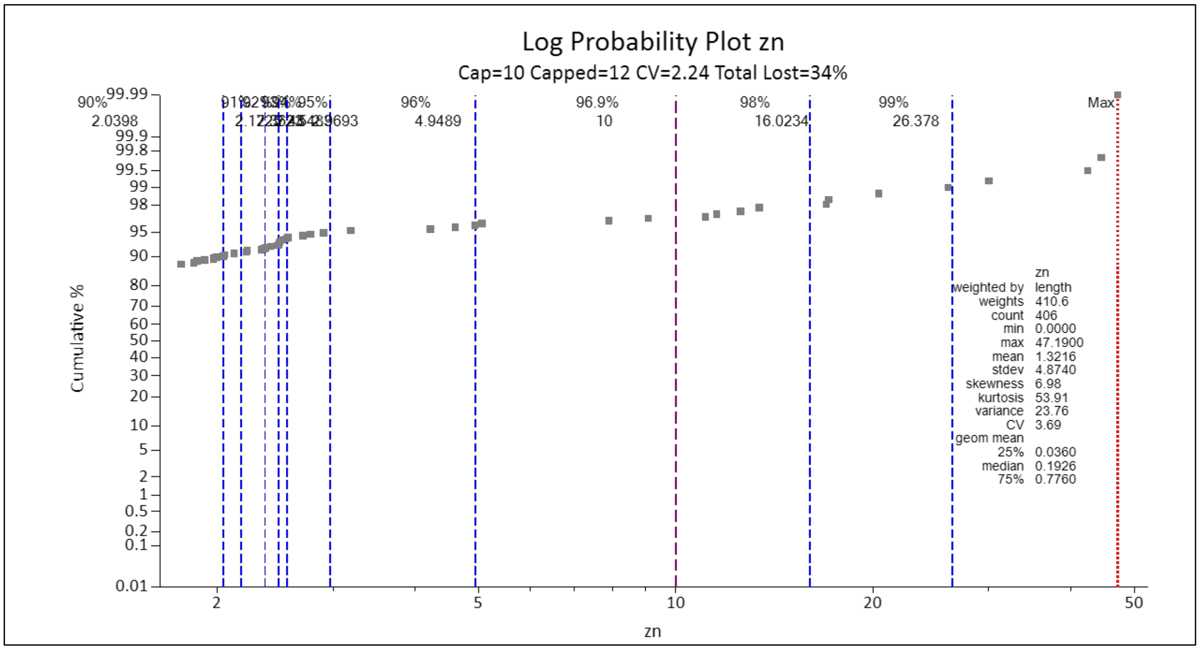


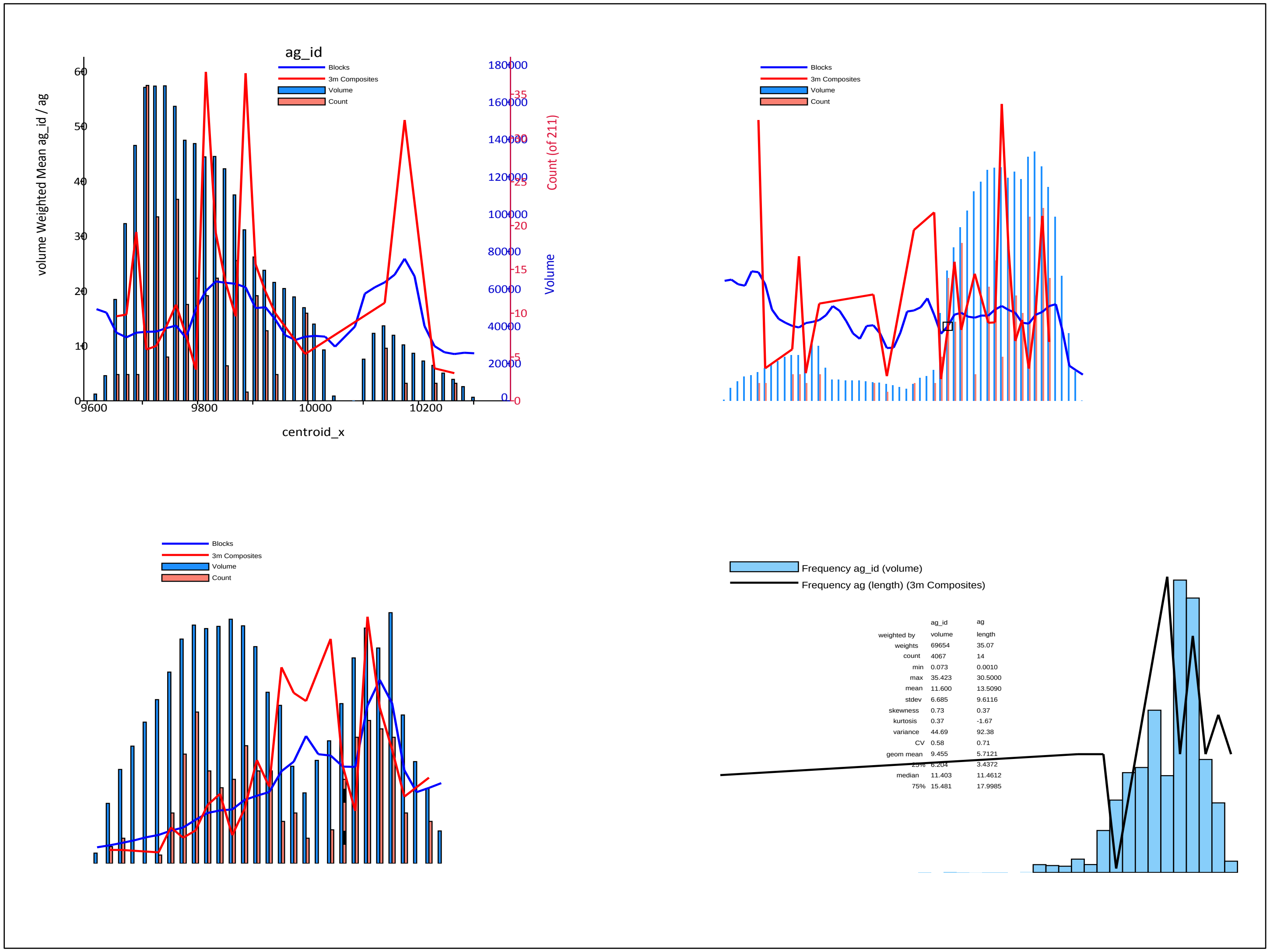

**Figure 25: Zn Log Probability Plot – Increíble Area**

| Column | Cap | Capped | Percentile | Capped% | Lost | CV% | Count | Mean | Variance | CV |
|---|---|---|---|---|---|---|---|---|---|---|
| zn | | | | | | | 406 | 1.3216 | 23.76 | 3.69 |
| zn | 26.378 | 4 | 99% | 1% | 12% | 15% | 406 | 1.1696 | 13.4 | 3.13 |
| zn | 16.0234 | 8 | 98% | 2% | 23% | 28% | 406 | 1.0169 | 7.39 | 2.67 |
| zn | 10 | 12 | 97% | 3% | 34% | 39% | 406 | 0.8618 | 3.72 | 2.24 |
| zn | 4.9489 | 15 | 96% | 3.70% | 48% | 54% | 406 | 0.6804 | 1.31 | 1.68 |
| zn | 2.9693 | 19 | 95% | 4.70% | 55% | 61% | 406 | 0.5882 | 0.7 | 1.42 |
| zn | 2.5483 | 23 | 94% | 5.70% | 56% | 63% | 406 | 0.565 | 0.6 | 1.37 |
| zn | 2.48 | 26 | 93% | 6.40% | 57% | 63% | 406 | 0.5606 | 0.58 | 1.36 |
| zn | 2.3623 | 31 | 92% | 7.60% | 57% | 64% | 406 | 0.5515 | 0.55 | 1.34 |
| zn | 2.1725 | 35 | 91% | 8.60% | 58% | 64% | 406 | 0.535 | 0.49 | 1.31 |
| zn | 2.0398 | 39 | 90% | 9.60% | 59% | 65% | 406 | 0.5224 | 0.45 | 1.29 |
| zn | | | | | | | 12 | 24.3527 | 177.6 | 0.55 |
| zn | | | | | | | 394 | 0.5594 | 0.98 | 1.77 |

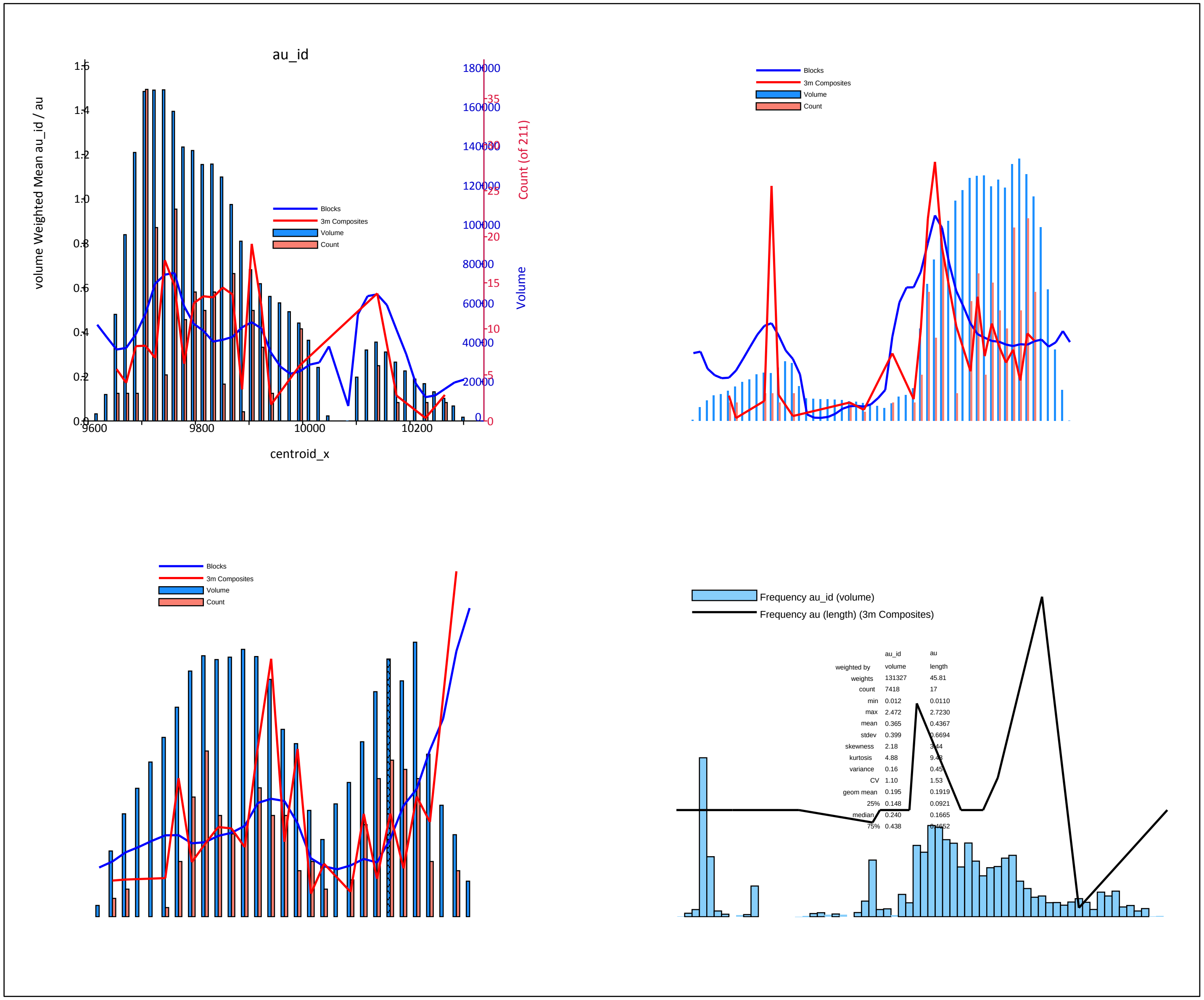
**Table 25: Increíble Capping Analysis – Zn**

# Appendix C: Swath Plots

## Figure 1: Swath Plots – Bolivar NW Ag



## Figure 2: Swatch Plots – Bolivar NW Au



## Figure 3: Swath Plots – Bolivar NW Cu

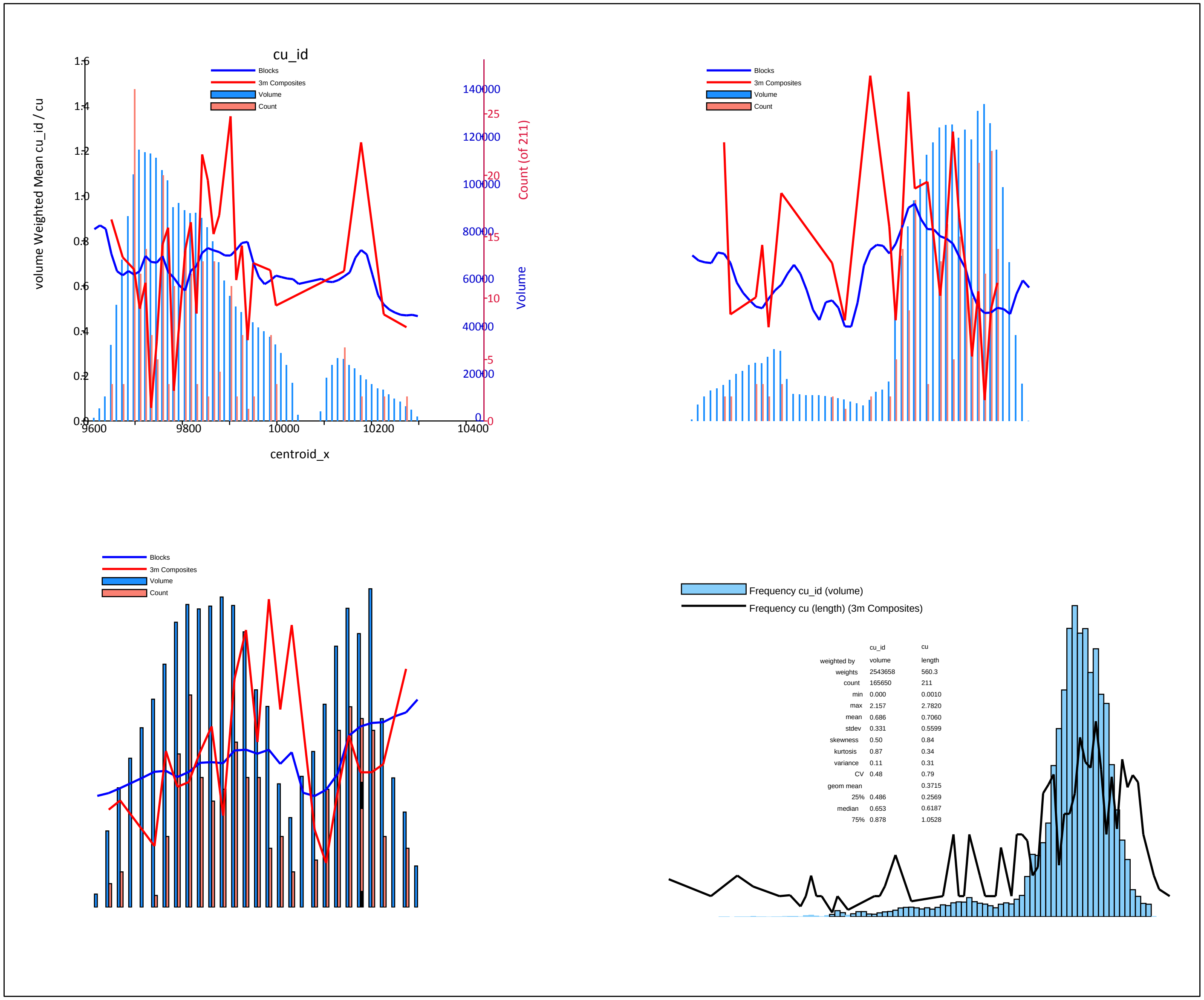
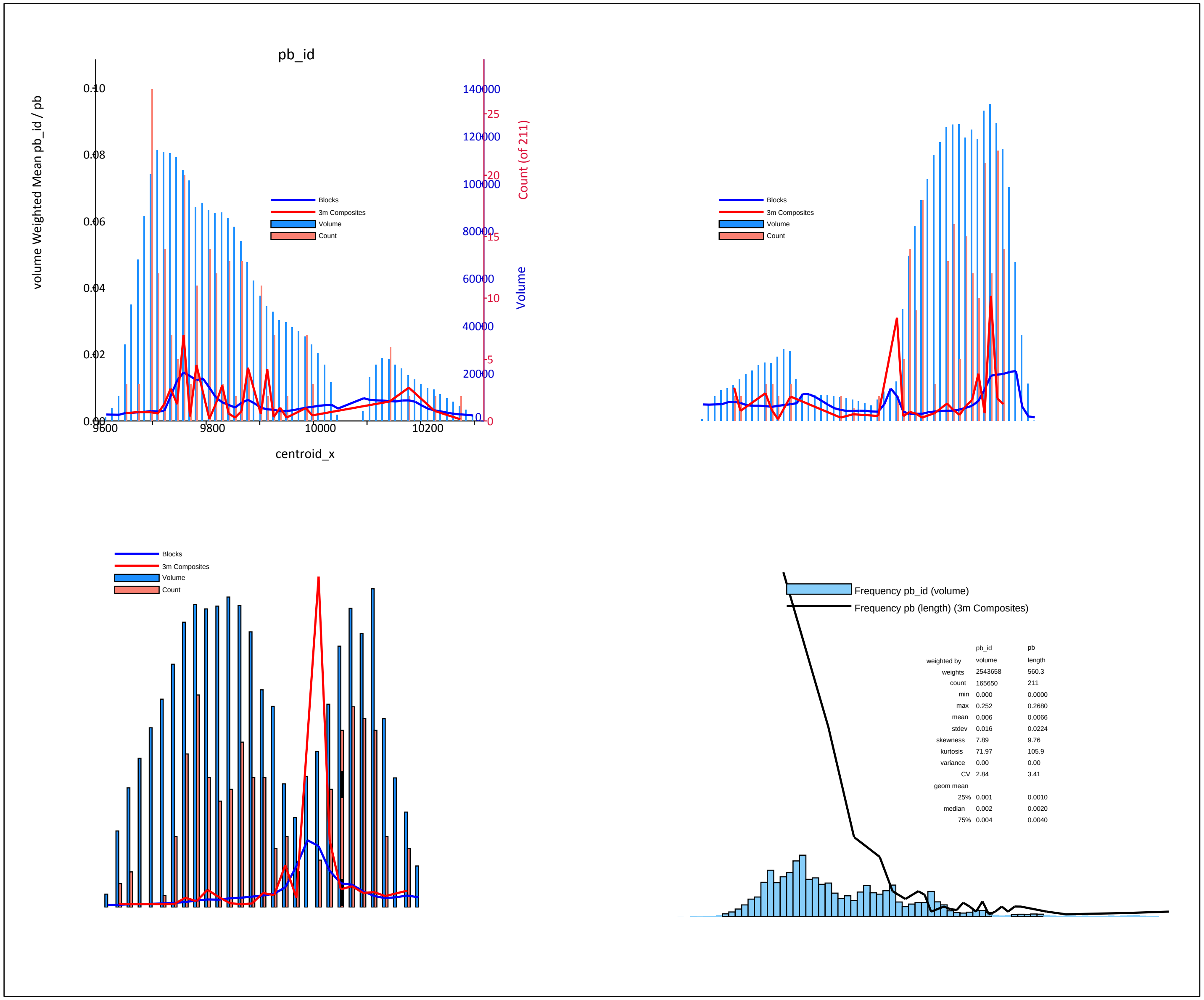
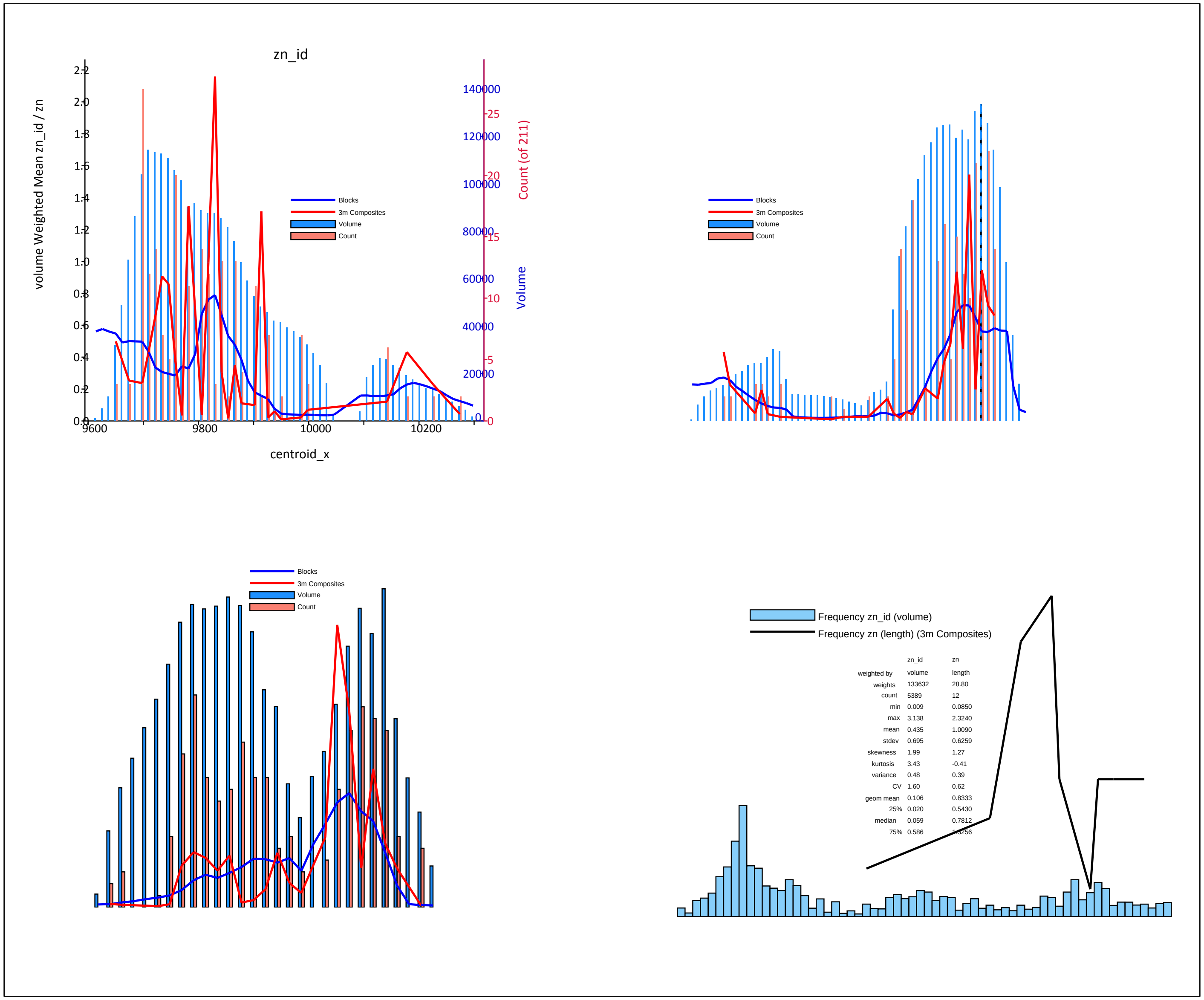


**Figure 4: Swath Plots – Bolivar Pb**



## Figure 5: Swath Plots – Bolivar Zn



## Figure 6: Swath Plots – Bolivar W Ag

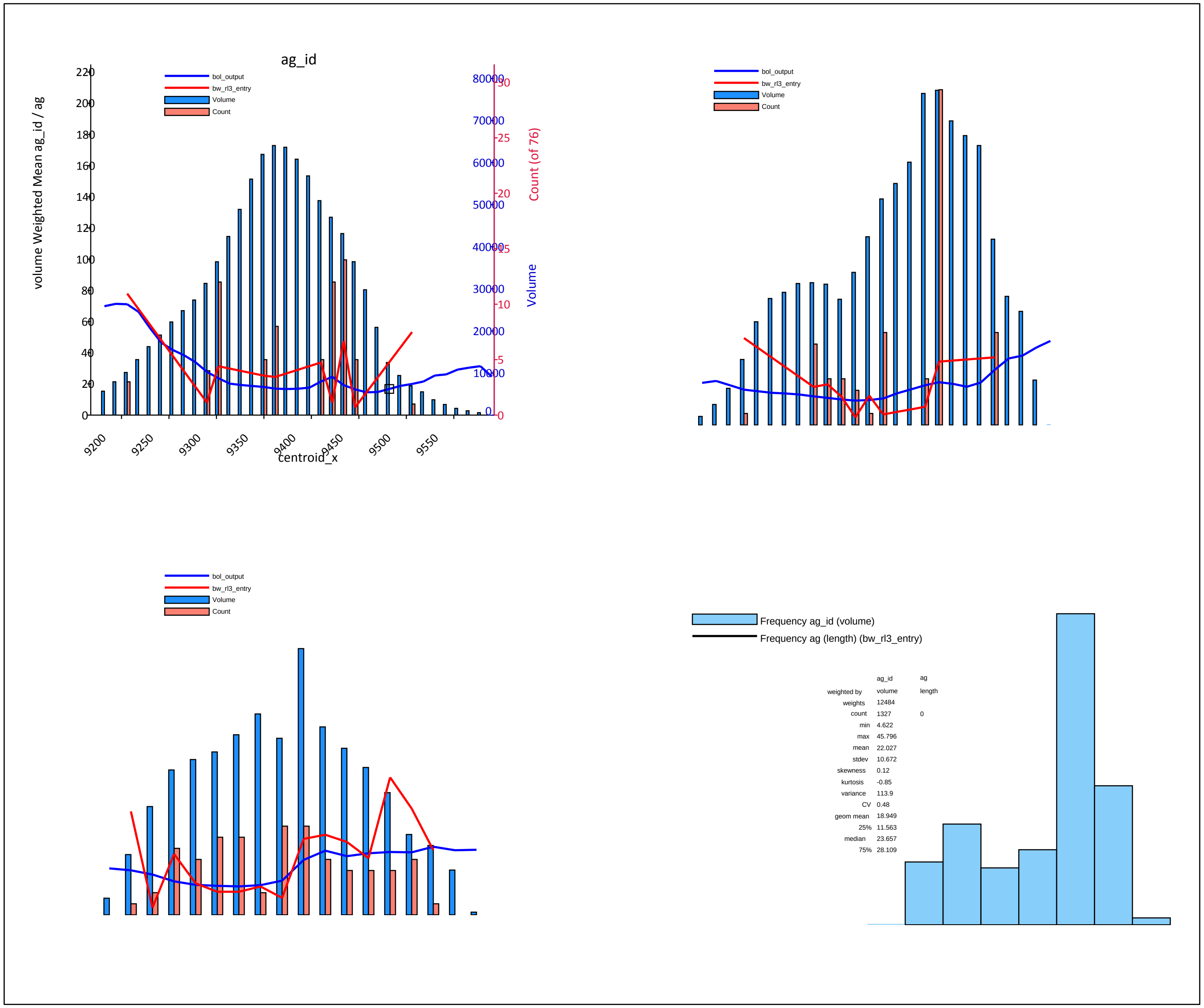
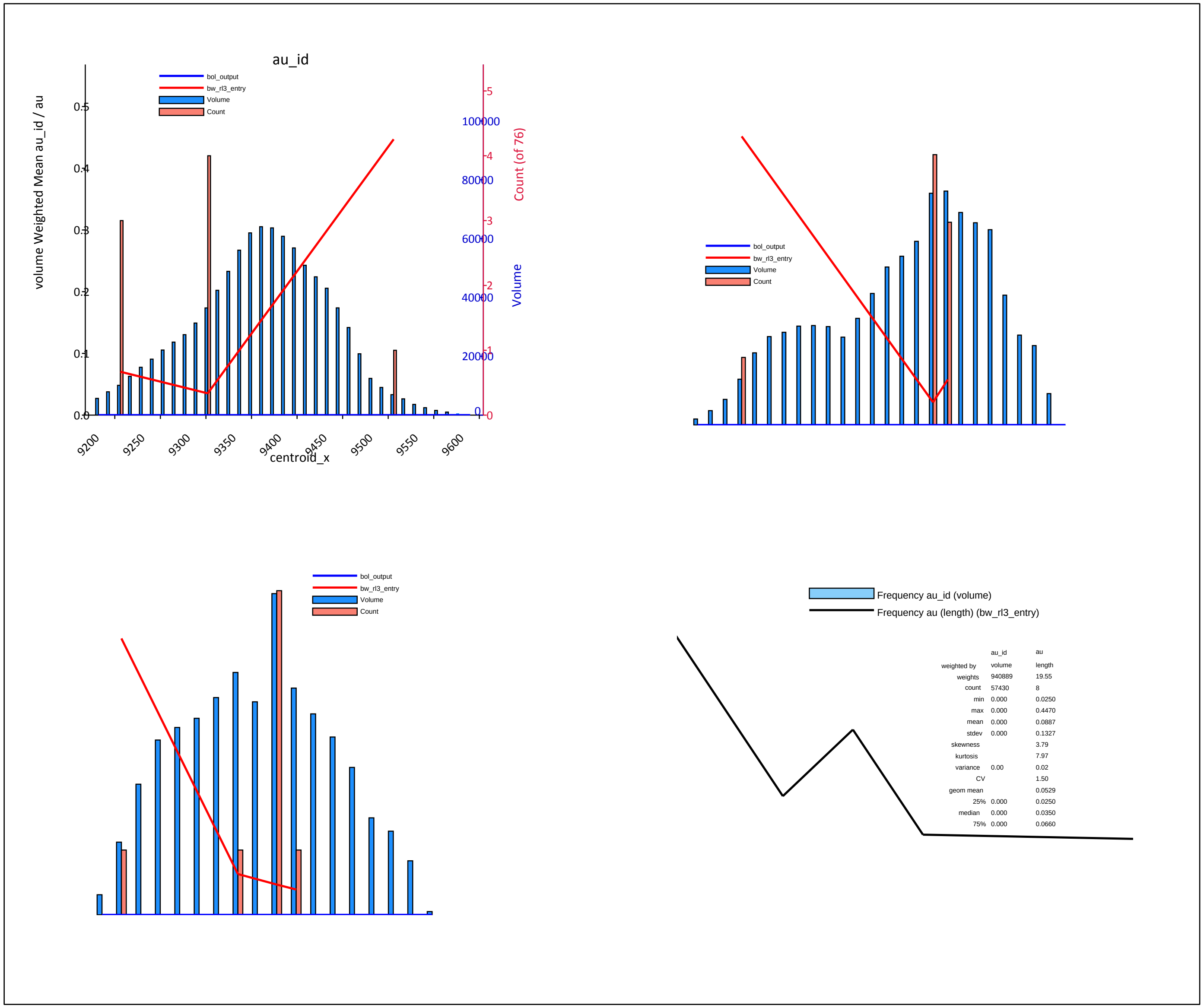
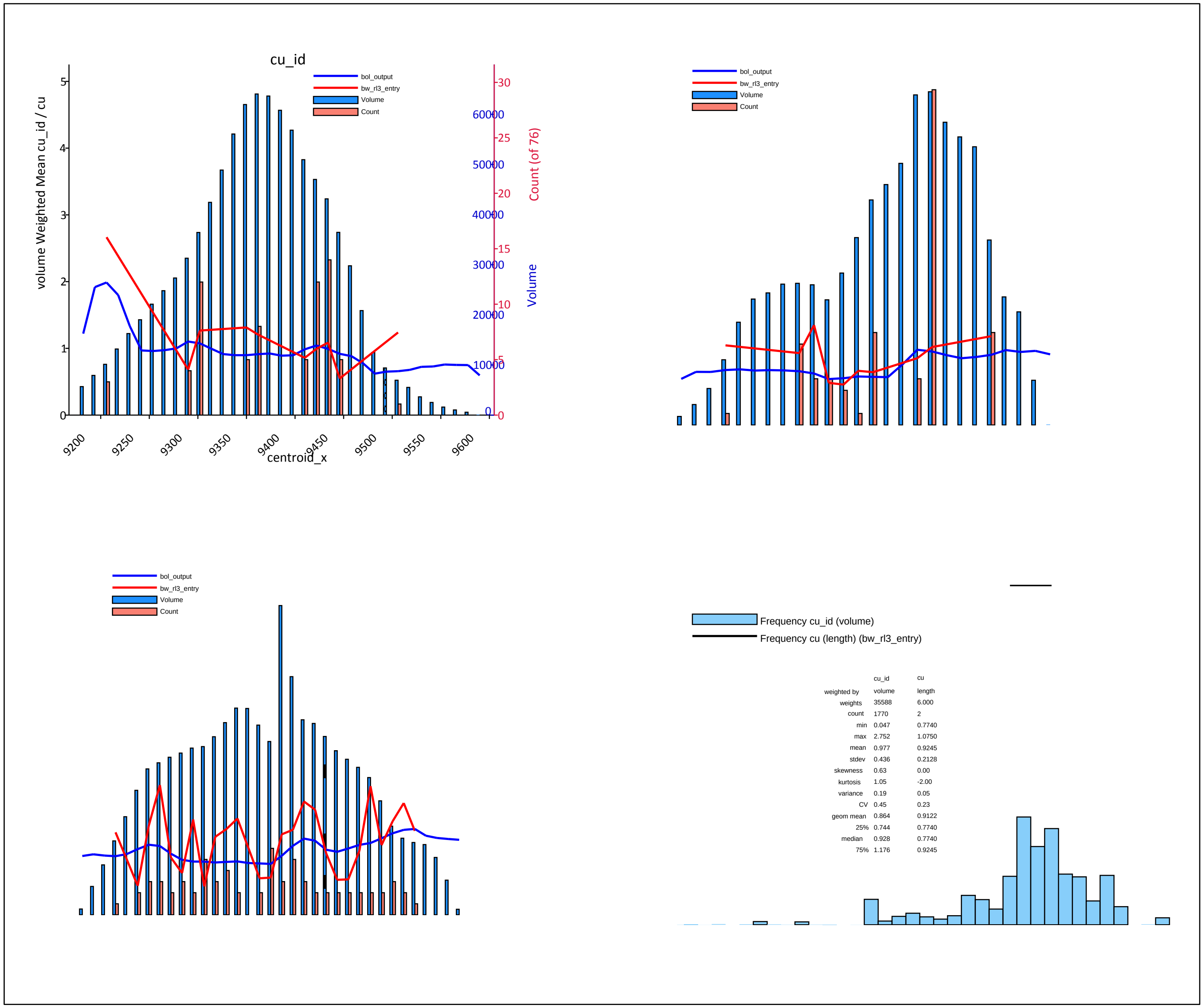


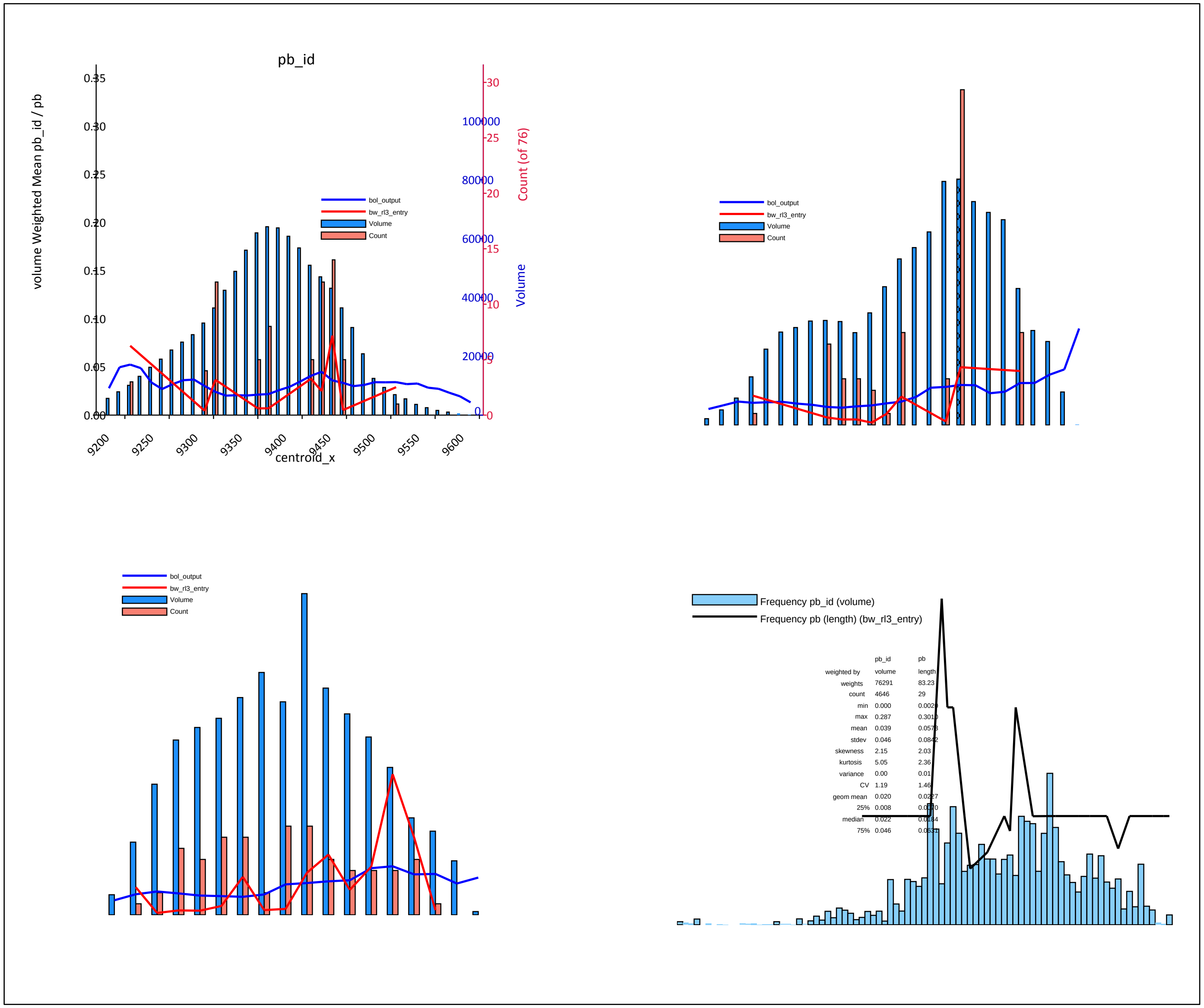
**Figure 7: Swath Plots – Bolivar W Au**



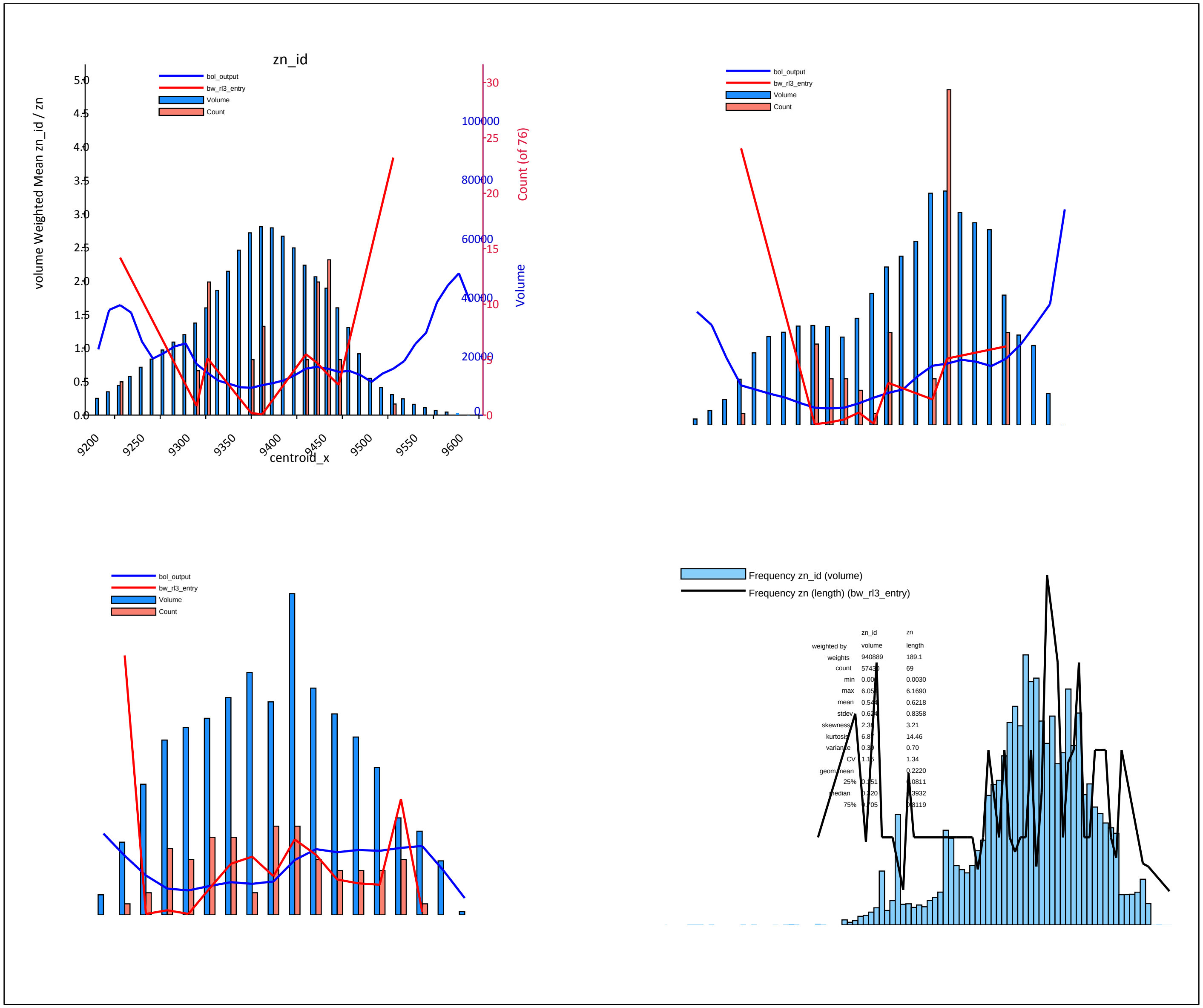
## Figure 8: Swath Plots – Bolivar W Cu



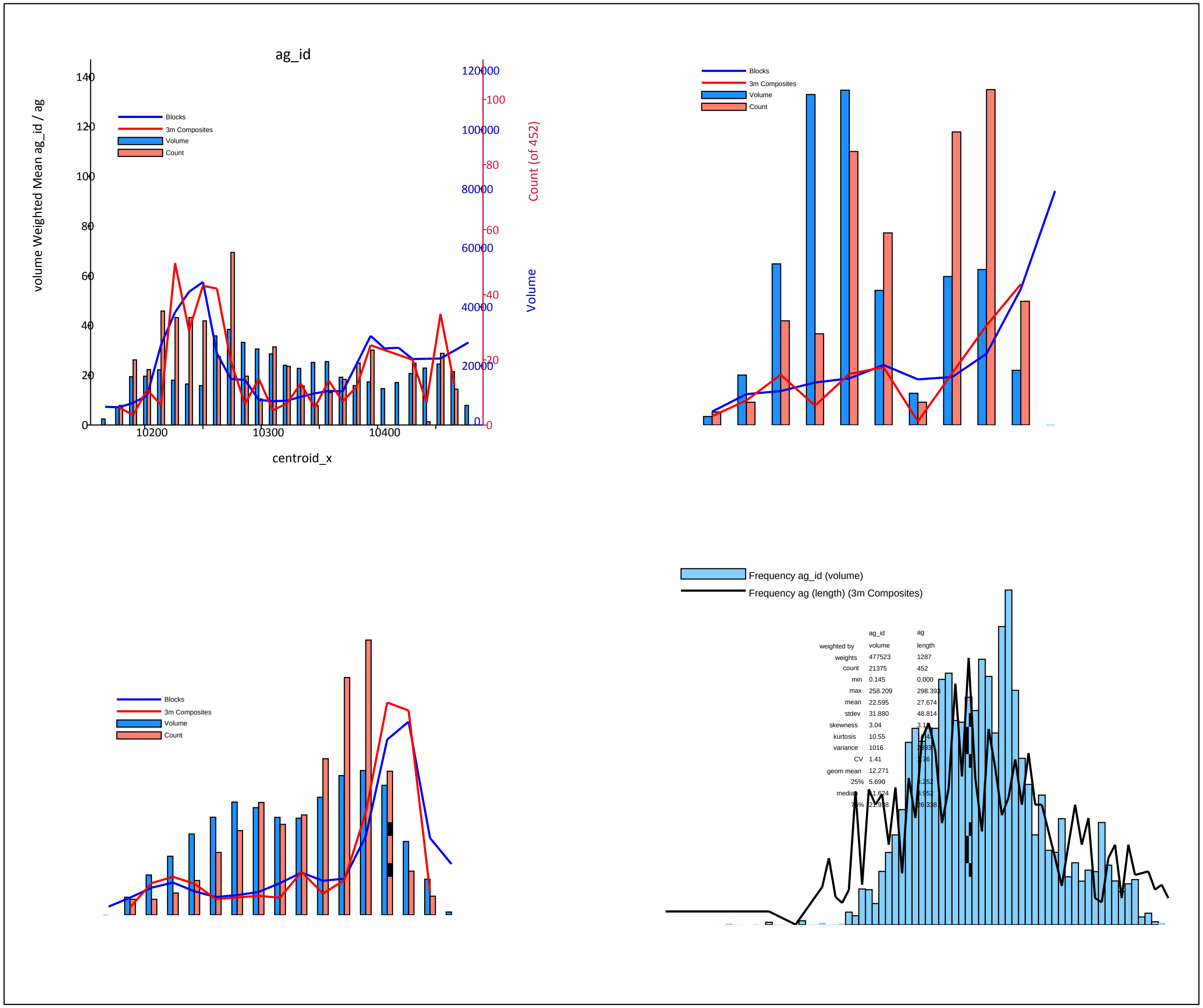
## Figure 9: Swath Plots – Bolivar W Pb



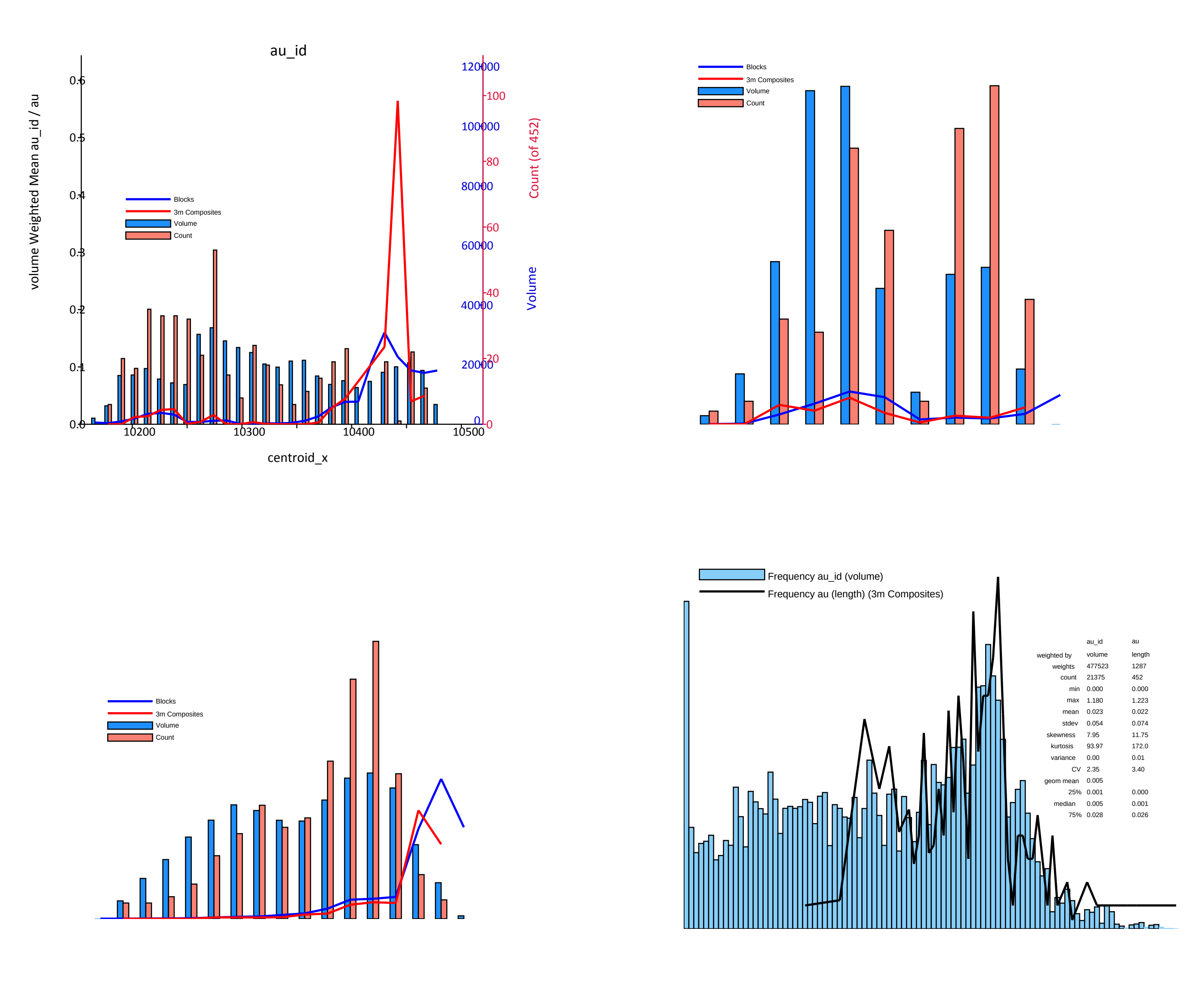
## Figure 10: Swath Plots – Bolivar W Zn



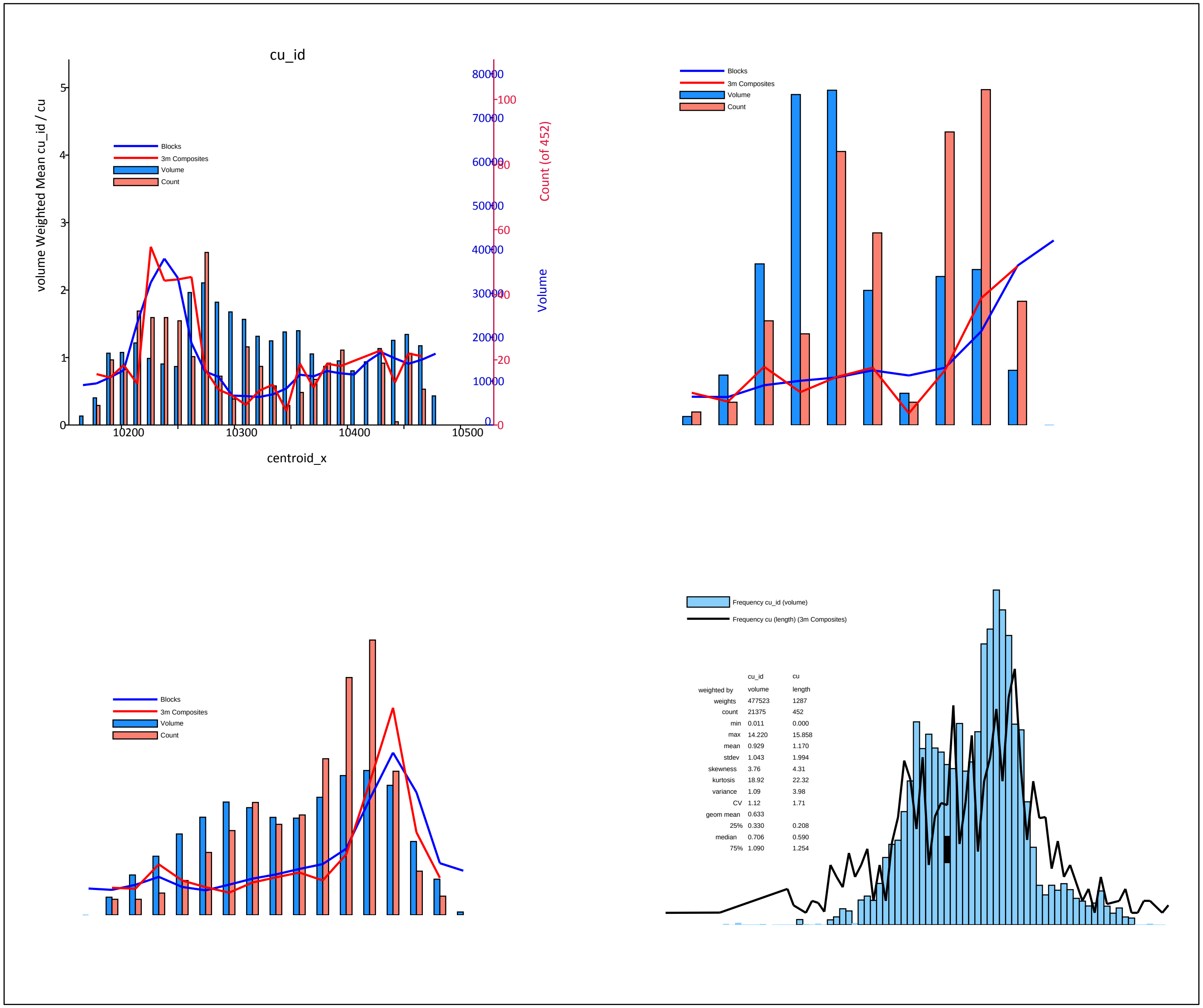
## Figure 11: Swath Plots – Chimineas Ag



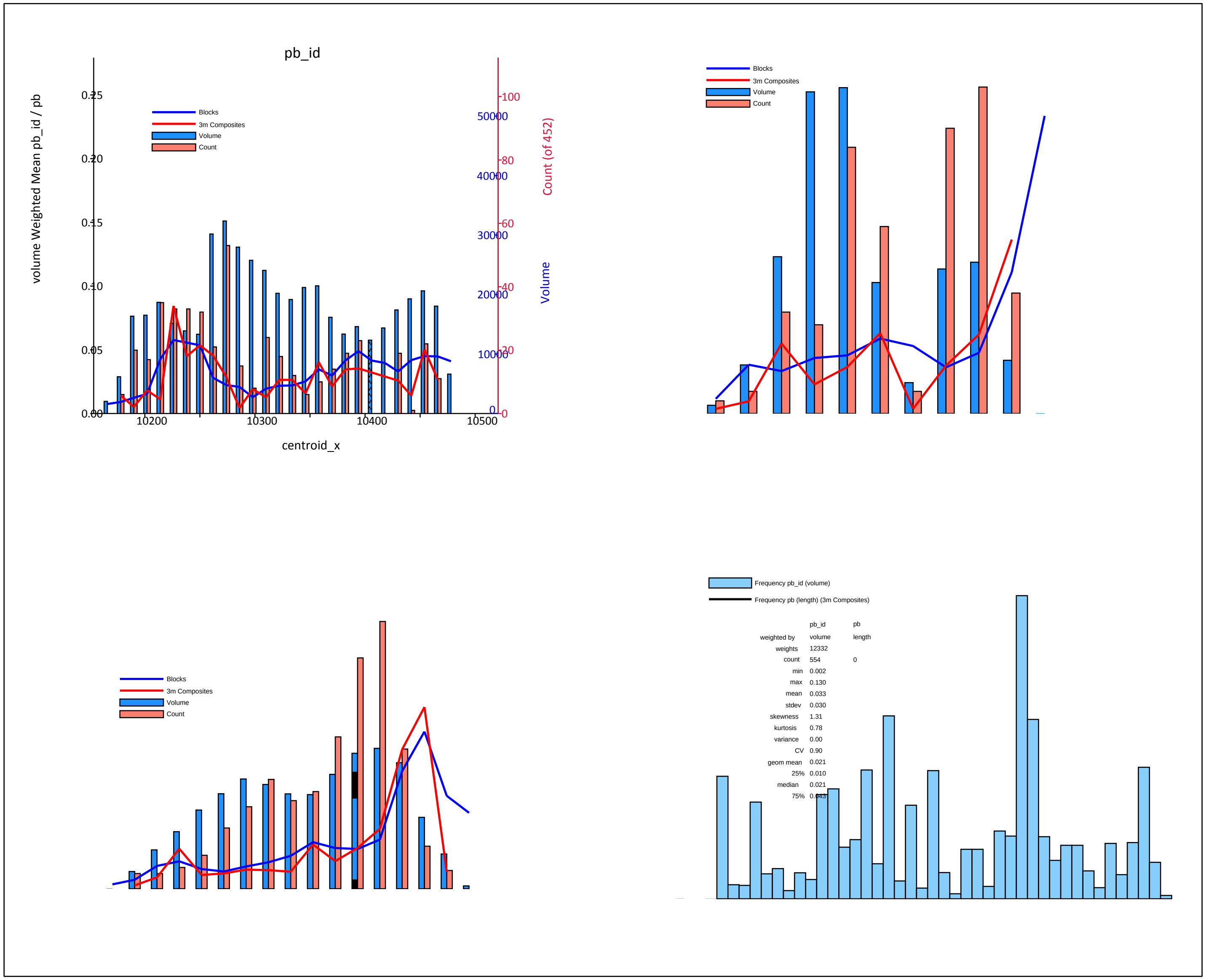
## Figure 12: Swath Plots – Chimineas Au



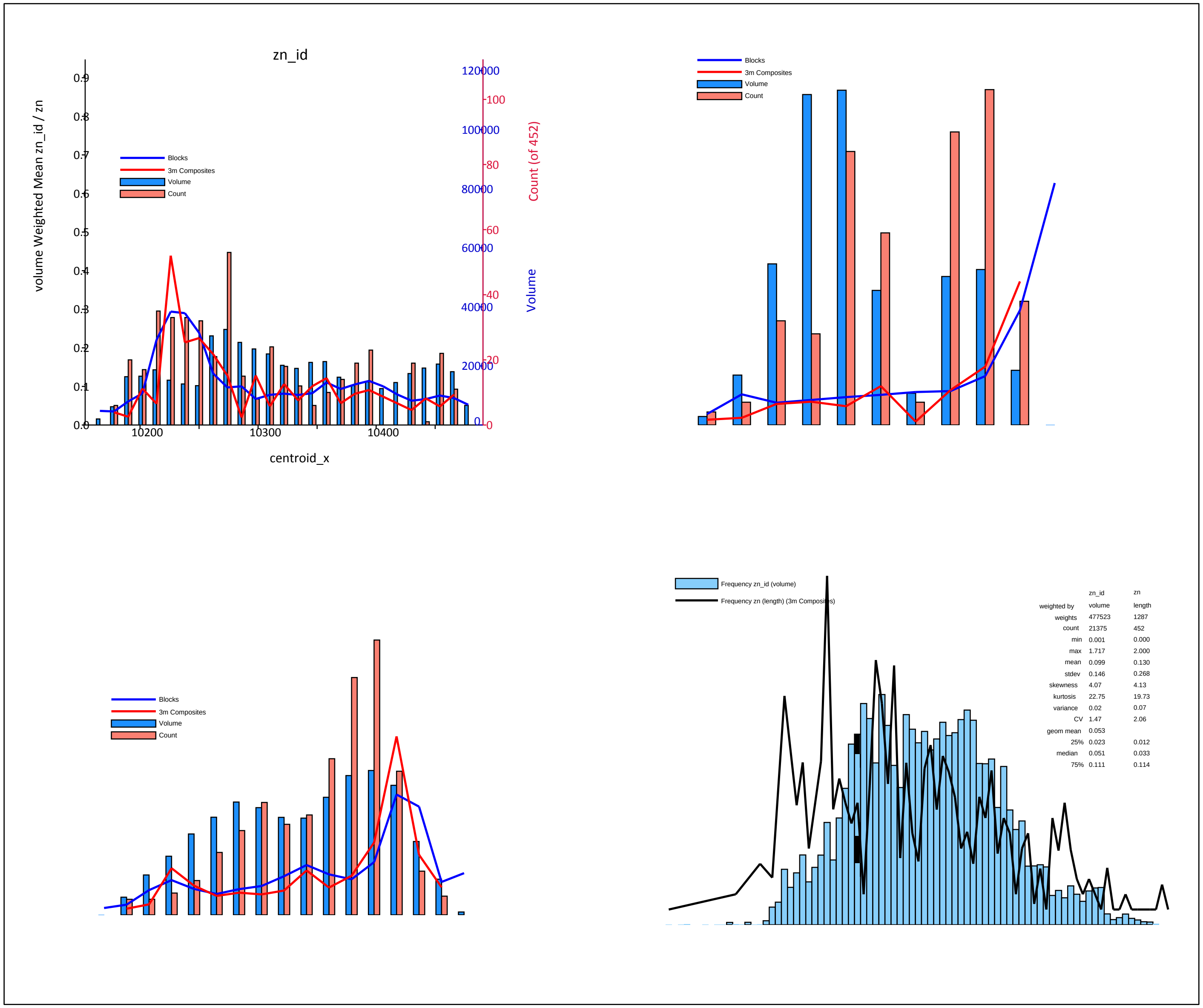
## Figure 13: Swath Plots – Chinimeas Cu



## Figure 14: Swath Plots – Chimineas Pb



## Figure 15: Swath Plots – Chimineas Zn



## Figure 16: Swath Plots – El Gallo Ag

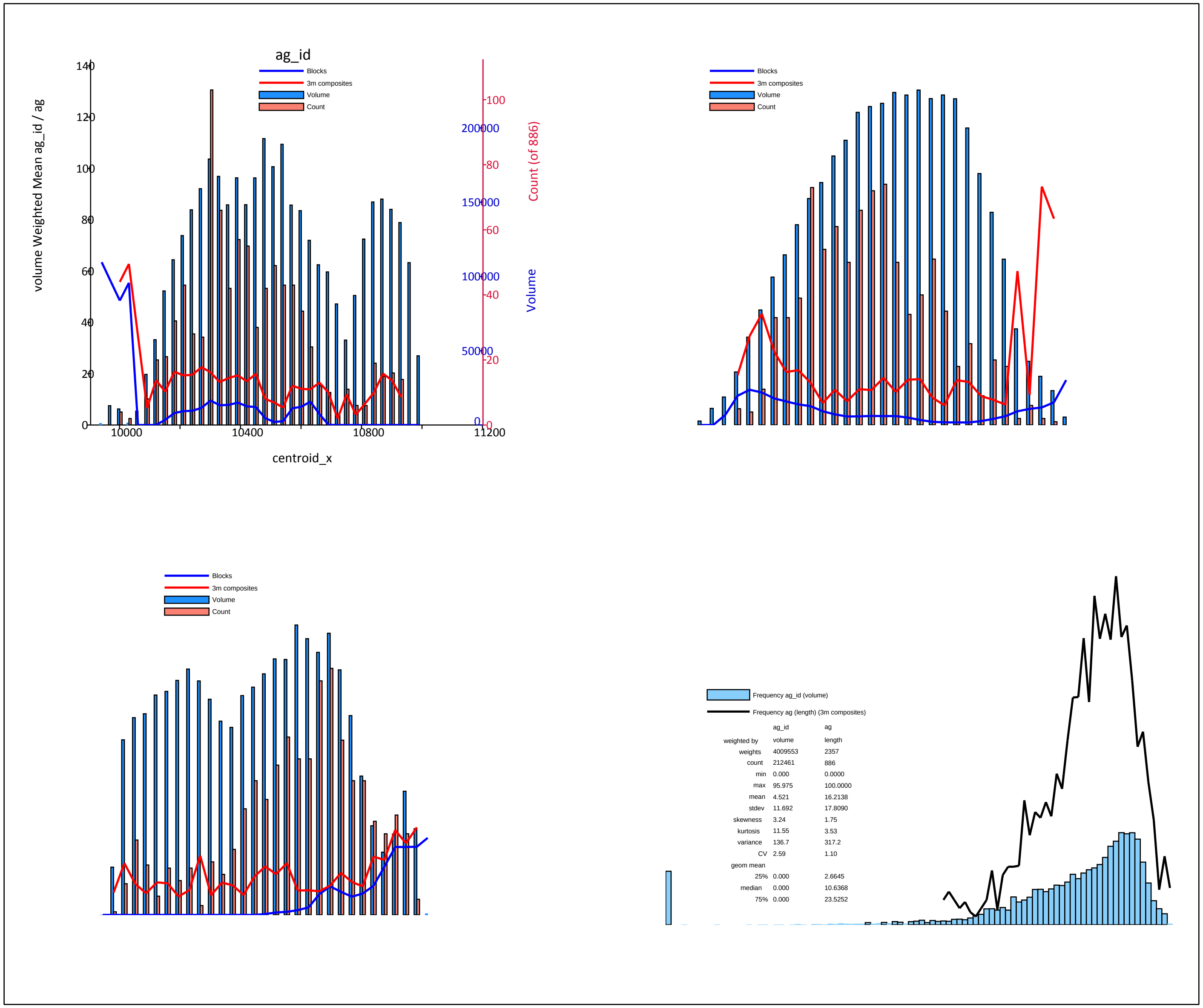
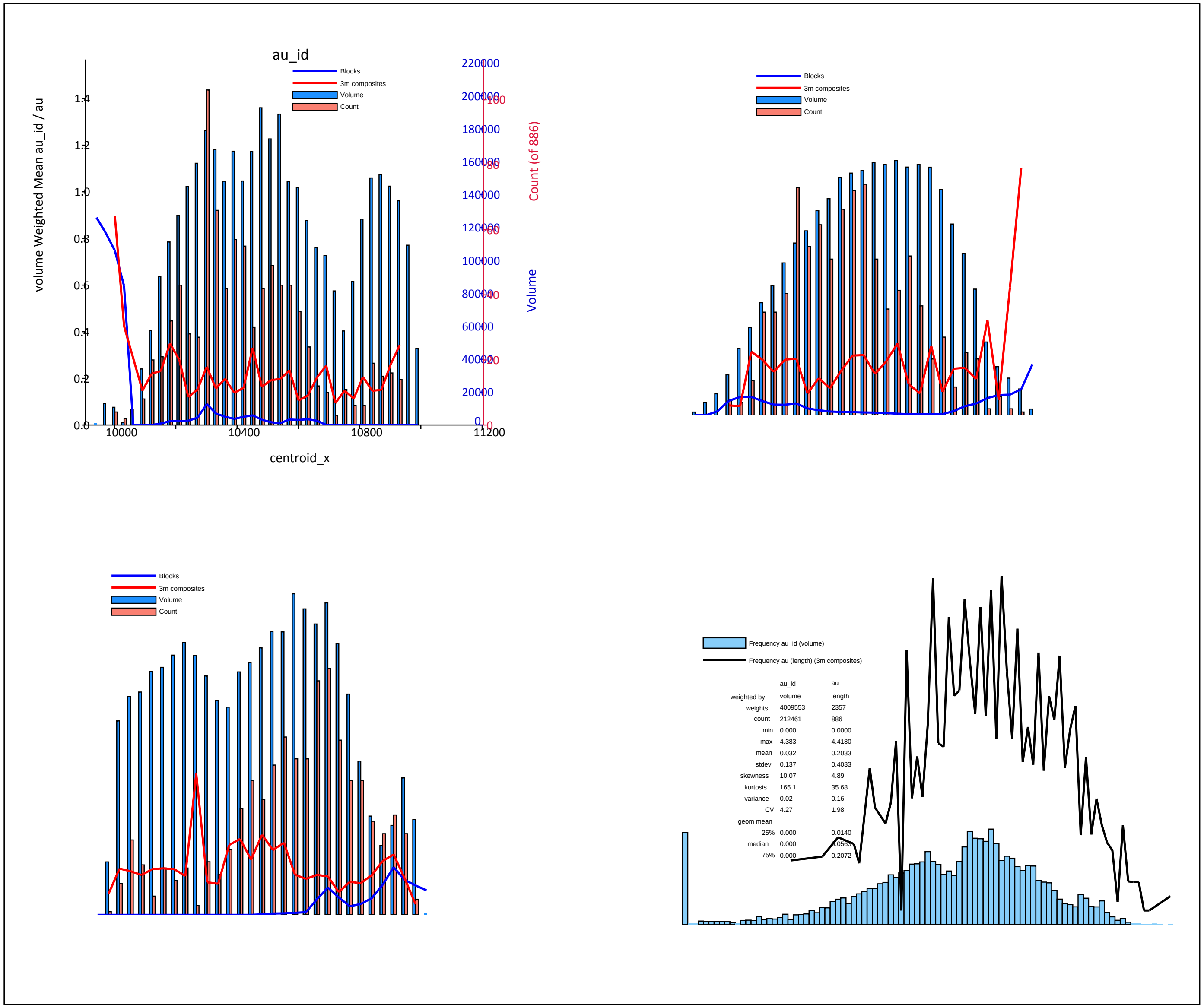
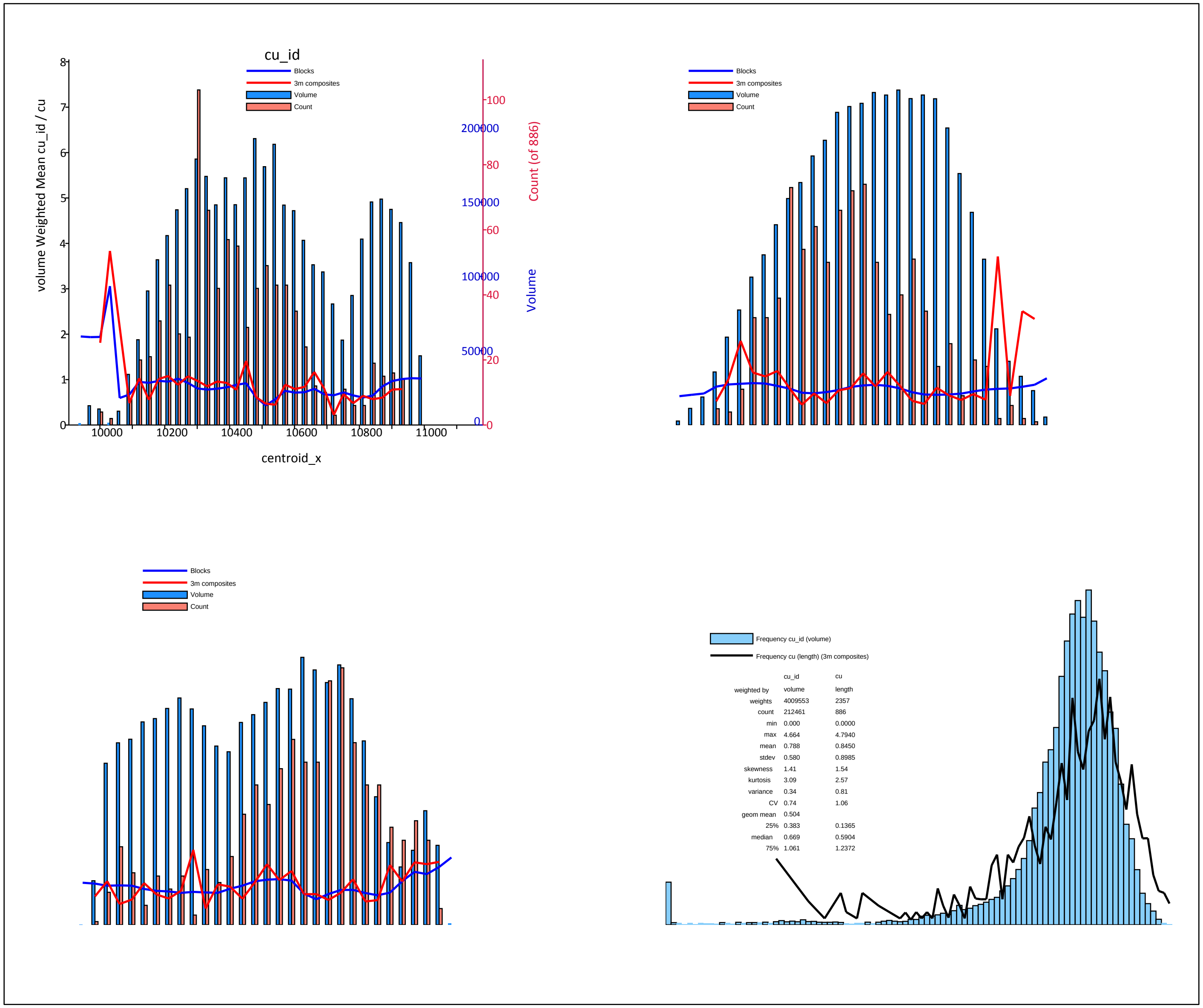


**Figure 17: Swath Plots – El Gallo Au**



## Figure 18: Swath Plots – El Gallo Cu



## Figure 19: Swath Plots – El Gallo Pb

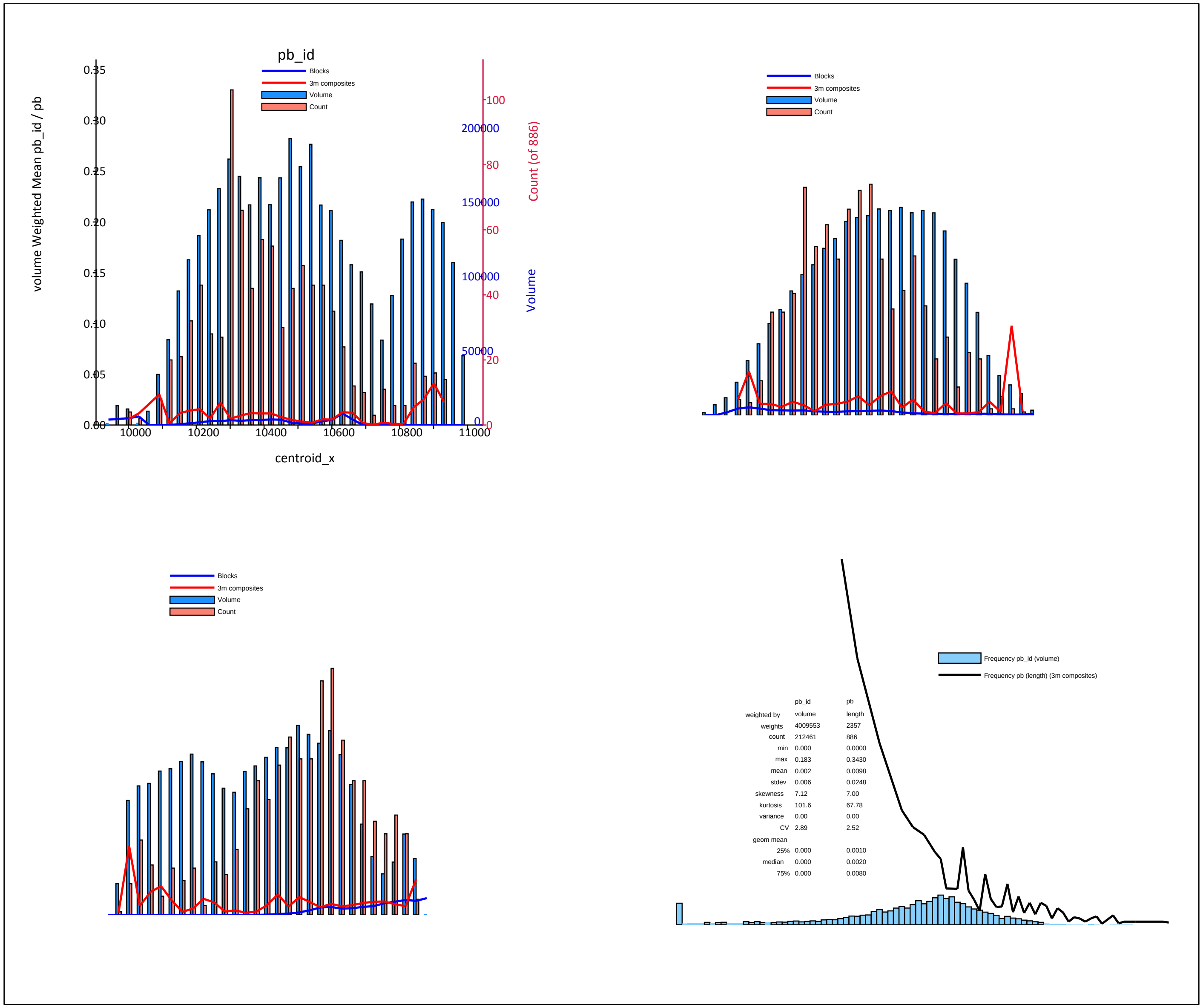
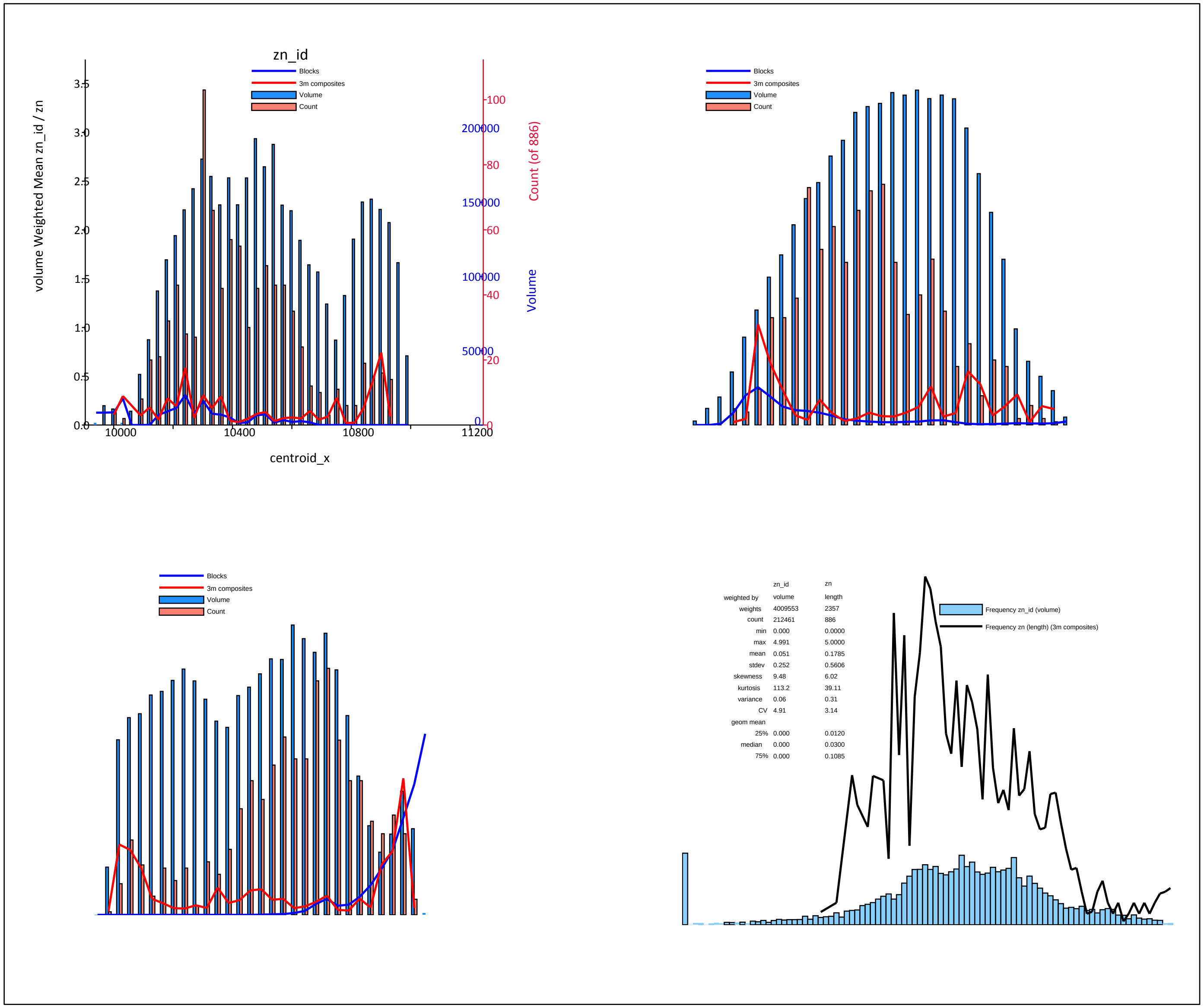
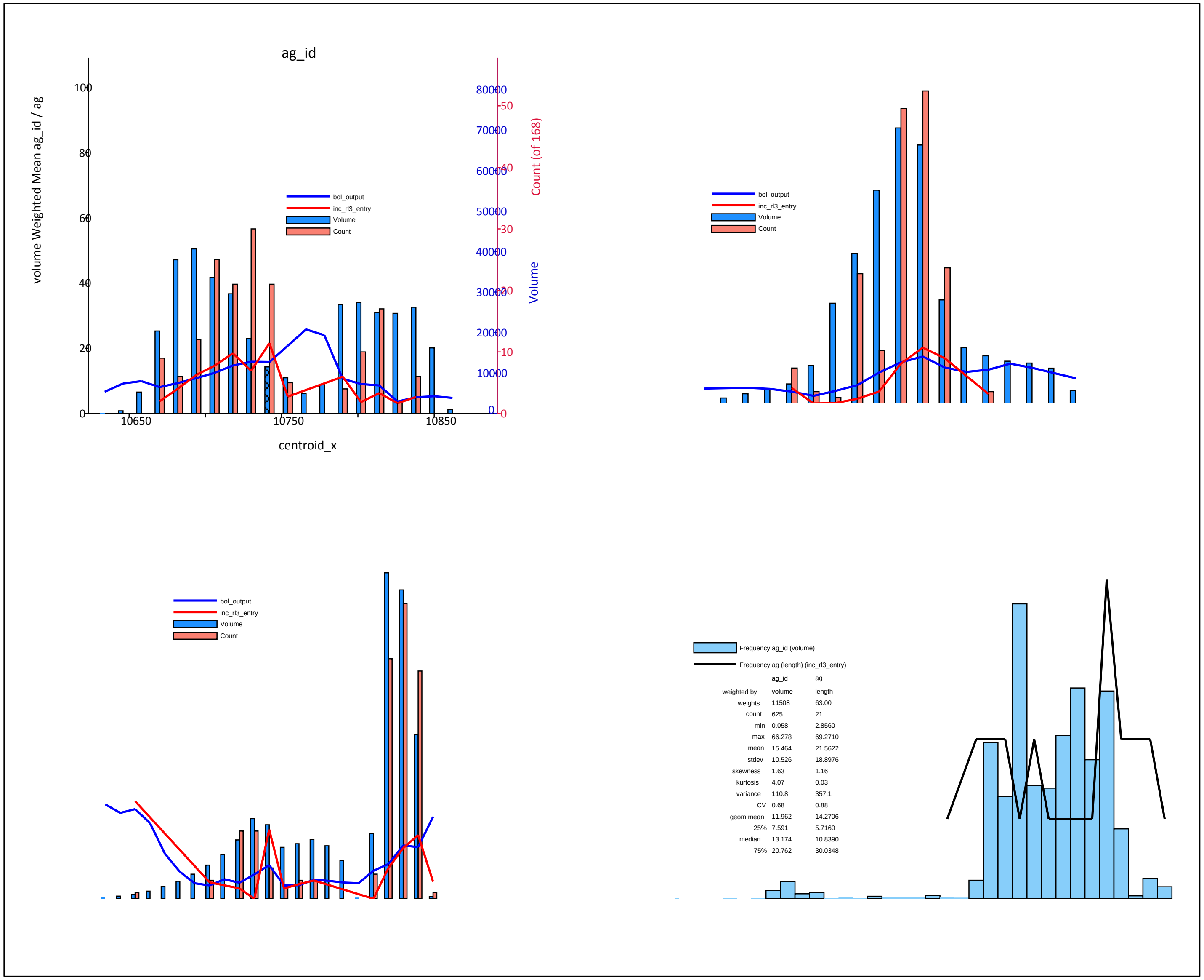


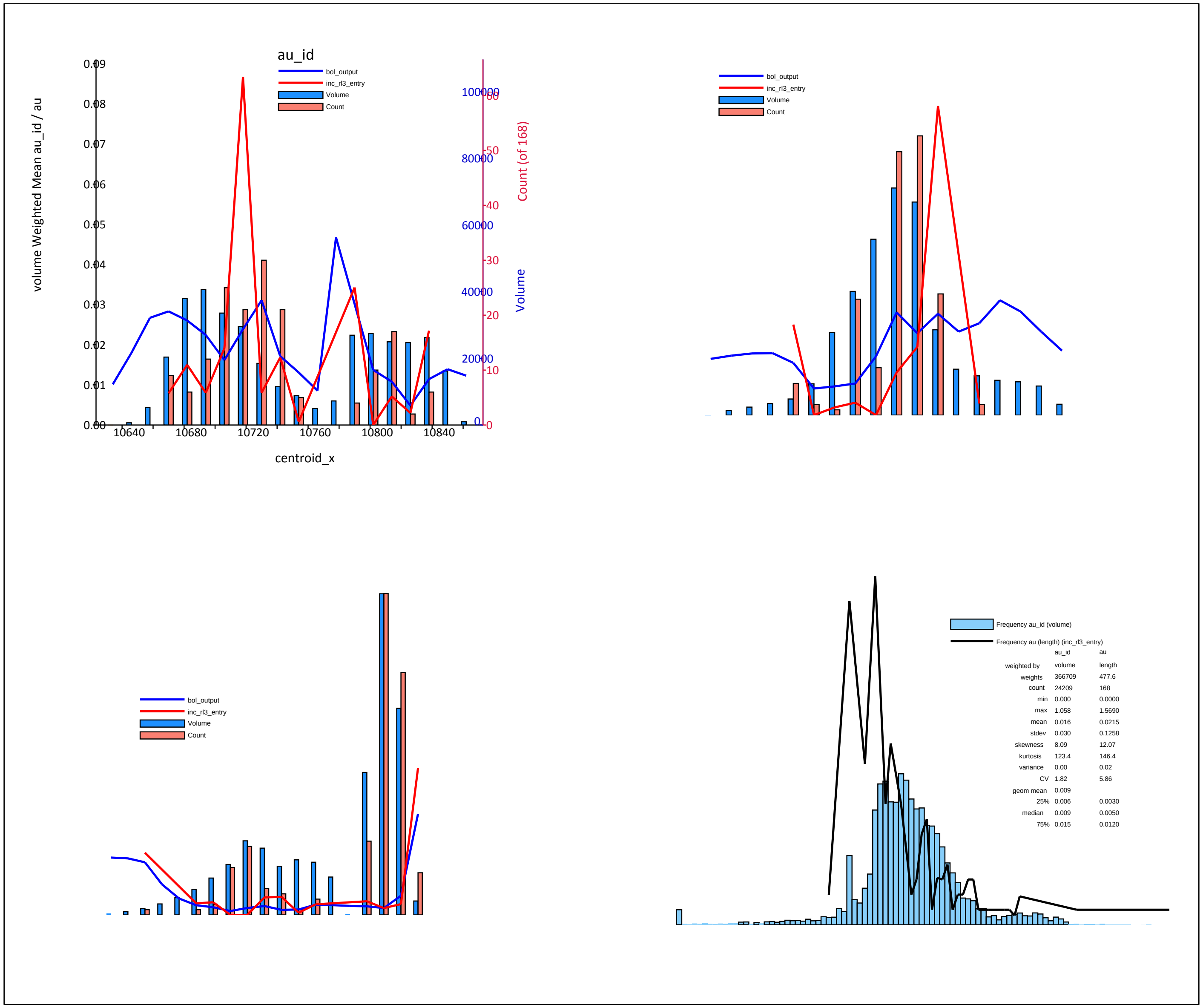
**Figure 20: Swath Plots – El Gallo Zn**



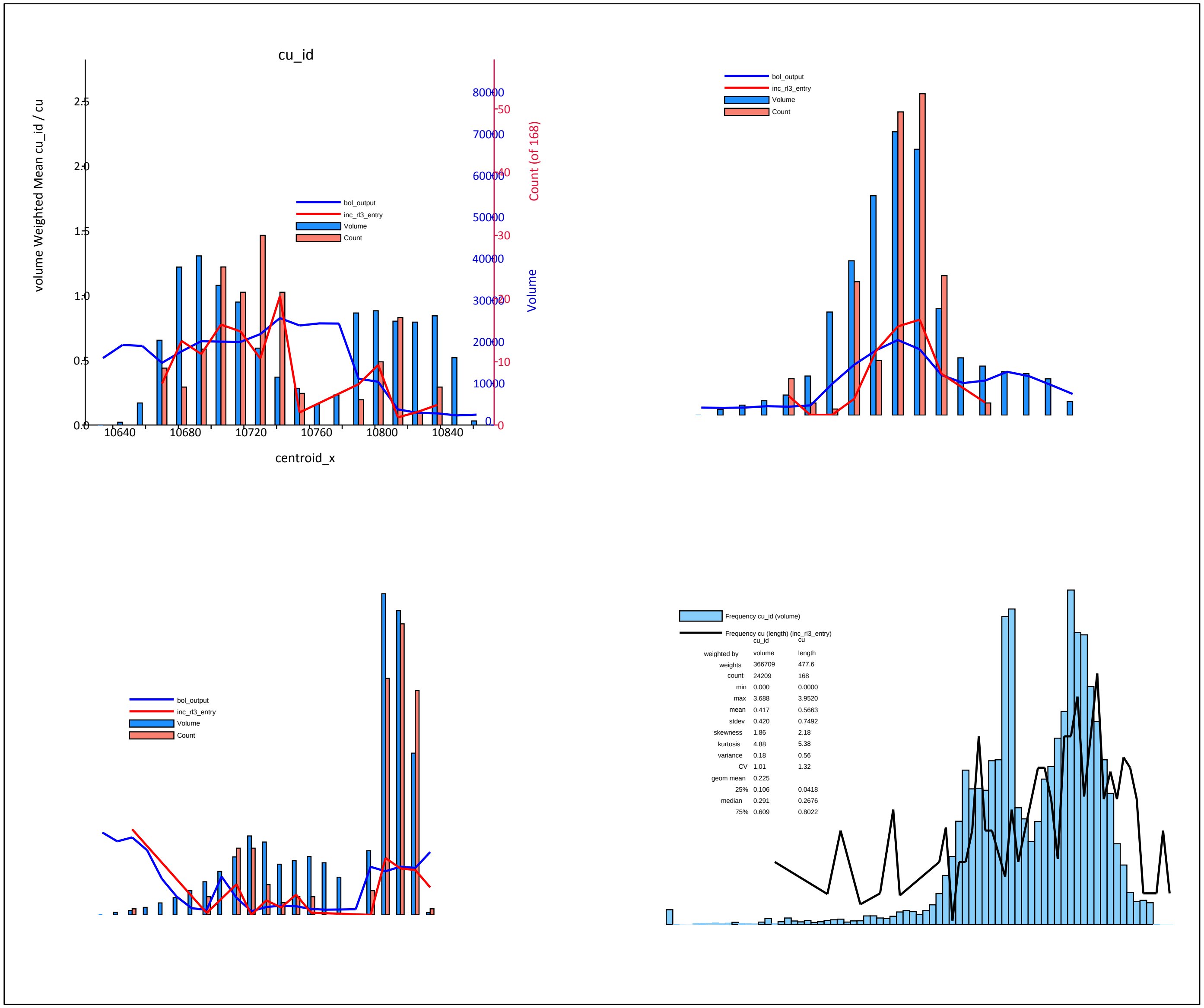
## Figure 21: Swath Plots – Increíble Ag



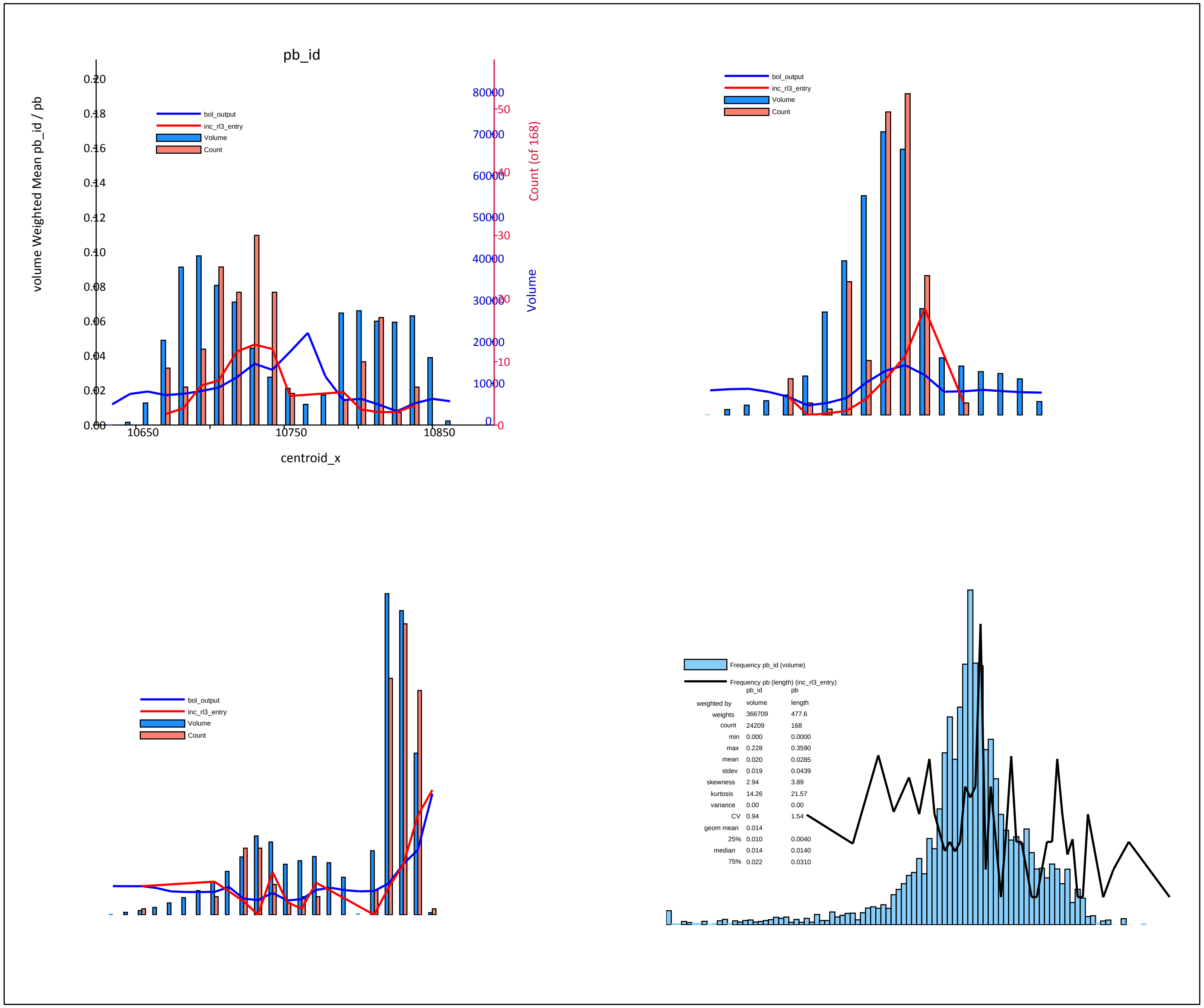
## Figure 22: Swath Plots – Increíble Au



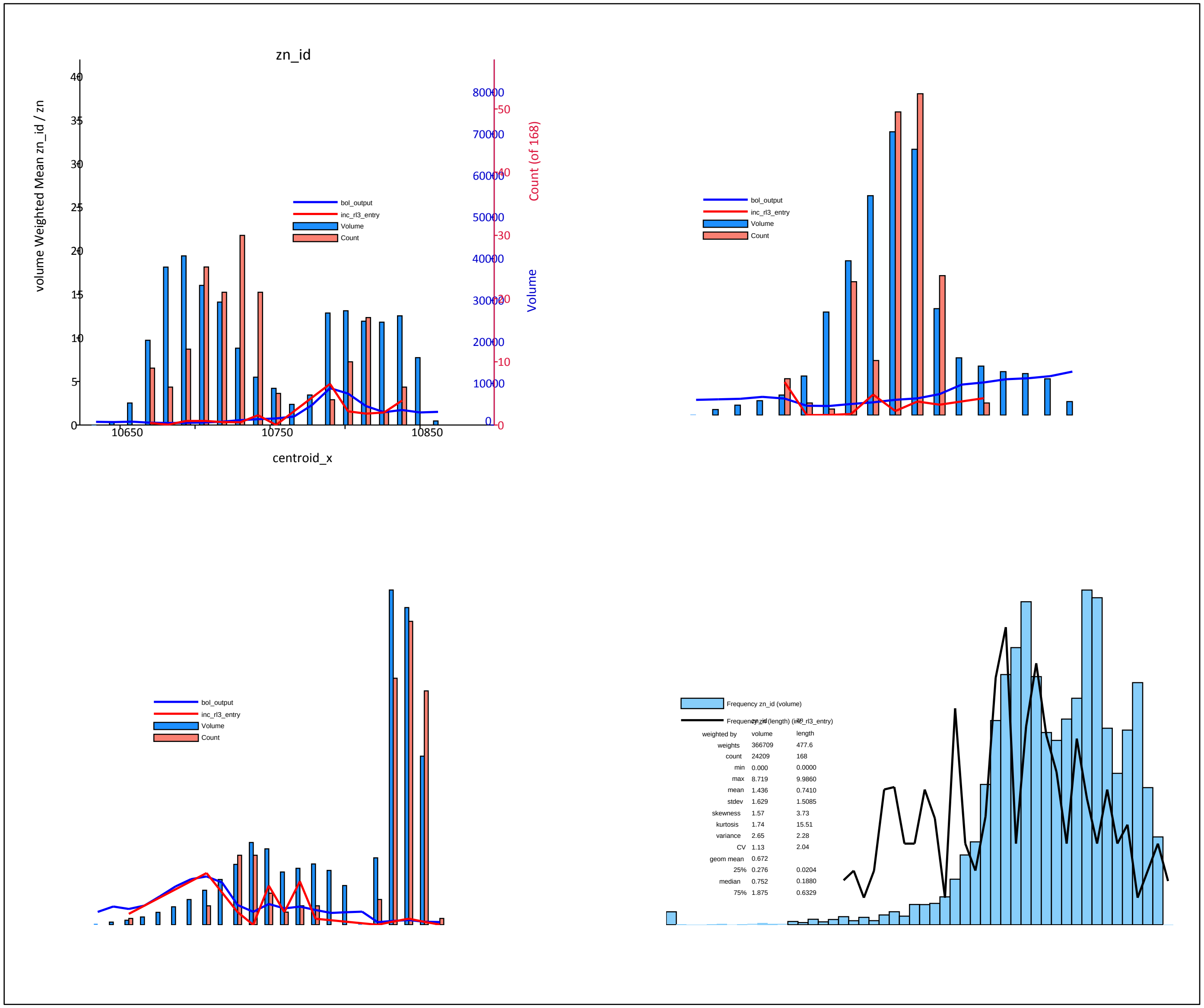
## Figure 23: Swath Plot – Increíble Cu



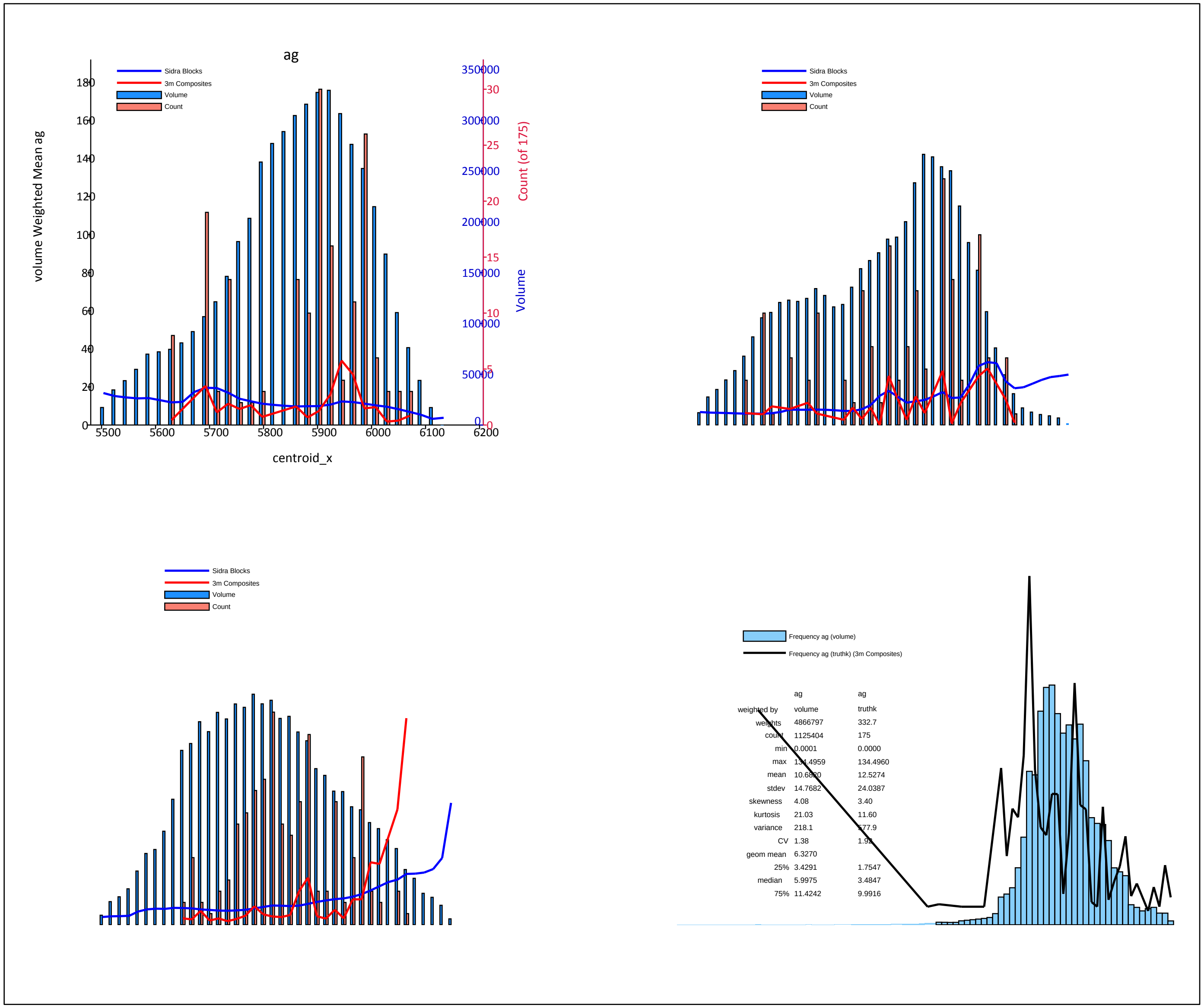
## Figure 24: Swath Plots – Increíble Pb



## Figure 25: Swath Plots – Increíble Zn



## Figure 26: Swath Plots – La Sidra Ag



## Figure 27: Swath Plots – La Sidra Au