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

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Report Prepared for

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Appendices

Appendix A: Certificates of Qualified Persons

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 Standards of Disclosure for Mineral Projects (NI 43-101).

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).

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 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 (t) of ore producing 17.1 million pounds (Mlb) Cu, 398,00 ounces (oz) Ag, and 2,900 oz Au grading 1.00% Cu, 16.7 grams per tonne (g/t) Ag, and 0.19 g/t Au. Recovery rates were improved in 2017 at 83% Cu, 78% Ag, and 64% Au. The mined material is transported 5 km to 3,000 tonnes per day (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 t/d of nominal throughput. The ore processing capacity was expanded to 2,000 t/d in mid-2013. The current nominal throughput capacity is 3,000 t/d and averaged approximately 2,400 t/d for the 2017 calendar year. 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

The Mineral Resource Estimates (MRE) were conducted by David Keller, PGeo, of SRK Consulting (Canada) Inc. (SRKCA) using CAE Studio3™ and Leapfrog Geo™ software. Giovanny Ortiz, Associate Resource Geologist of SRK, has reviewed the resource estimation process and results and is the Qualified Person (QP) for these sections.

SRK reviewed the geology models constructed by the Dia Bras personnel and worked with them to define the grade estimation methodology and reporting criteria for mineral resources at Bolivar. 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 ordinary kriging method. The mineral resources have been estimated and classified in conformity with generally accepted CIM guidelines.

SRK is of the opinion that the MRE's are suitable for public reporting and are a fair representation of the in situ contained metal for the Bolivar Mine.

The October 31, 2017, 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.

Table 1-1: Consolidated Bolivar Mineral Resource Estimate as of October 31, 2017 – SRK Consulting (U.S.), Inc.

Category	Tonnes (000's)	Ag (g/t)	Au (g/t)	Cu (%)	Ag (koz)	Au (koz)	Cu (t)
Indicated	13,267	22.5	0.29	1.04	9,616	124	137,537
Inferred	8,012	22.4	0.42	0.96	5,779	109	76,774

Source: SRK, 2018

(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 a single value cut-off grade (CoG) of US$29 based on metal price assumptions*, metallurgical recovery assumptions**, mining/transport costs (US$17.95/t), processing costs (US$8.33/t), and general and administrative costs (US$2.41/t).

* Metal price assumptions considered for the calculation of metal value are: US$3/lb Cu, US$18.25/oz Ag, and US$1,291/oz Au.

** Metallurgical recovery assumptions are 83% Cu, 78% Ag, and 64% Au.

1.6 Mineral Reserve Estimate

The Mineral Reserve Statement presented herein are classified according to CIM definitions and in accordance with NI 43-101. The reference point at which the Mineral Reserve is identified is where the ore is delivered to the processing plant referred to as mill feed.

The procedures and methods supporting the Bolivar 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, REDCO Mining Consultants (REDCO), using supporting data supplied by Bolivar. The reserve estimation is based on stope designs using the geology block models and stope optimization software, Mineable Shape Optimizer (MSO). The development design and schedule are based on the mine design tools in Studio 5DP™ and scheduling software Enhanced Production Scheduler (EPS™). Mineral reserves do not include material from previously mined out areas. Historical mining in the El Gallo Superior orebody and areas of El Gallo Inferior are considered mined out. Mineralized material remaining in the pillars of the historical mining areas has not been included in the reserve estimation.

The Bolivar Mineral Reserve Estimate is comprised of the Probable material in the El Gallo Inferior, Chimenea 1, Chimenea 2, Bolivar Northwest, and Bolivar West mining areas. The October 31, 2017 consolidated Mineral Reserve Statement for the Bolivar Mine is presented in Table 1-2.

Table 1-2: Consolidated Bolivar Mineral Reserve Estimate as of October 31, 2017 – SRK Consulting (U.S.), Inc.

Category	Tonnes (000's)	Ag (g/t)	Au (g/t)	Cu (%)	Contained Ag (koz)	Contained Au (koz)	Contained Cu (t)
Proven	-	-	-	-	-	-	-
Probable	7,925	18.9	0.25	0.86	4,823	63	67,925
P+P	**7,925**	**18.9**	**0.25**	**0.86**	**4,823**	**63**	**67,925**

Source: SRK, 2018

(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 unit value cut-offs 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 are: US$3/lb Cu, US$18.25/oz Ag, and US$1,291/oz Au.
 ** Metallurgical recovery assumptions are 83% Cu, 78% Ag, and 64% Au.
(3) The mining costs are based on historical actual costs.
(4) The NSR cut-off values are variable by mining method:
- The economic NSR cut-off value is:
  - US$30.80 = Room and Pillar.
  - US$33.10 = Longhole Stoping.
- The marginal NSR cut-off value is:
  - US$26.50 = Room and Pillar.
  - US$28.70 = Longhole Stoping.

(5) Mining recovery and dilution have been applied and are variable by mining area and proposed mining method.

1.7 Mining Methods

Bolivar is a producing operation. The primary mining method at Bolivar is underground room and pillar mining supplemented by a minor amount of longhole open stoping (approximately 7% overall production tonnage). Current ore production is from the El Gallo Inferior body with development activities occurring in future production areas from the Bolivar Northwest and Bolivar West orebodies.

Development waste rock is primarily stored underground in historic mine openings. Ore is hauled to the surface using one of several adits or declines accessing the orebodies and dumped onto small surface storage pads outside the portals. The ore is then loaded into rigid frame over-the-road trucks and hauled on a gravel and dirt road approximately 5 km south to the Piedras Verdes mill. Mine production at Bolivar is currently an average of 2,400 t/d with a planned annual production of 3,100 t/d. A copper concentrate is produced containing payable copper, silver, and minor amounts of gold.

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 2017 reached a total of 887,236 t, equivalent to an average of 74,000 tonnes per month (t/m), or 2,400 t/d. This is 6.7% lower when compared to material processed in 2016. During 2017, production of copper concentrate has ranged between approximately 1,530 and 2,950 t/m, equivalent to roughly a 3.1% mass pull. The monthly average concentrate copper grade has ranged between 22% to 27% and credit metals averaging 374 g/t silver and 3.22 g/t gold in 2017. Metal recovery for copper, silver, and gold monthly averaged 79.6%, 76.3% and 59.5%, 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 (TSF), 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 TSF that has been in operation since late 2011. The existing TSF has five locations to store tailings (TSF1 through TSF5). The site will develop an expansion TSF to the west of the existing facilities for future tailings.

The site is installing an additional thickener and filter presses to allow additional water recovery. Thickened tails (60% solids) are being placed currently. After the filter presses are constructed dry-stack tails will be placed after February 2018.

The main TSF will be utilized and expansion plans are ongoing until mid-2019. A new dry-stack TSF (herein referred to as "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 2025. A trade-off study should be completed to optimize the size of the New TSF to confirm it will meet the life-of-mine (LoM) requirements.

Dia Bras allocated US$1 million in 2018 and US$3 million in 2018 for additional TSF equipment and TSF expansion civil works.

The overall Project infrastructure is built out, functioning and adequate for the purpose of the planned mine and mill. The existing TSF will need to be expanded to support the continued operation of the processing plant.

1.10 Environmental Studies and Permitting

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 be adjacent to the existing TSF, and may be designed and operated as a dry stack facility in order to extend the life and capacity. Permitting associated with the TSF expansion has been completed.

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 $CaCO_3$/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.

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. As noted above, the necessary permitting for the expansion of the TSF has been completed.

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. This was conducted on the expansion of the TSF, with include the preparation of a MIA.

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$476,545). 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 3,100 t/d and a processing rate of 3,029 t/d, the Bolivar reserves support the project until July 2024.

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

Table 1-3: Capital Cost Summary

Description	Sustaining (US$000's)	LoM (US$000's)
Sustaining Capital Development	17,380	17,380
Sustaining Capital Ventilation	4,824	4,824
Sustaining Capital Equipment	30,000	30,000
Sustaining Capital Infill Drilling - Exploration	7,909	7,909
Sustaining Capital Concentrator	4,121	4,121
Sustaining Capital Tailings Dam	4,623	4,623
Sustaining Capital Closure	453	453
Total Capital	**$69,309**	**$69,309**

Source: SRK, 2018

The basis of the operating cost estimate is based on site specific data. Sierra Metals and the REDCO technical team provided SRK with cost information.

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

Table 1-4: Operating Cost Summary

Description	LoM (US$000's)	LoM (US$/t Ore)	LoM (US$/Cu lb)
Underground Mining	147,308	18.59	1.24
Process	66,174	8.35	0.56
G&A	20,336	2.57	0.17
Total Operating	**$233,818**	**$29.5**	**$1.97**

Source: SRK, 2018

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$81.1 million and a present value of US$59.7 million at a discount rate of 8%. The indicative economic results are shown in Table 1-5.

Table 1-5: Bolivar Indicative Economic Results (Dry Basis)

Description	Value	Units
Market Prices		
Copper	3.19	US$/lb
Silver	18.25	US$/oz
Gold	1,291	US$/oz
Estimate of Cash Flow (all values in US$000's)		
Concentrate Net Return		**US$/lb Cu**
Copper Sales	$377,929	$3.19
Silver Sales	$61,709	$0.52
Gold Sales	$40,503	$0.34
Total Revenue	**$480,140**	**$4.05**
Treatment, Smelting and Refining Charges	($31,477)	($0.27)
Freight	($28,535)	($0.24)
Gross Revenue	**$420,129**	**$3.55**
Royalties	($16,263)	($0.14)
Net Revenue	**$403,866**	**$3.41**
Operating Costs		
Underground Mining	($147,308)	($1.24)
Process	($66,174)	($0.56)
G&A	($20,336)	($0.17)
Total Operating Cost	**($233,818)**	**($1.97)**
Operating Margin (EBITDA)	**$170,048**	**$1.44**
LoM Sustaining Capital	($69,309)	($0.59)
Income Tax	($19,680)	($0.17)
After Tax Free Cash Flow	**$81,058**	**$0.68**
NPV @: 8%	**$59.70**	**US$ million**

Source: SRK, 2018

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.

- The drilling campaign of 2017 was focused in Bolivar W and Bolivar NW. Future exploration should reduce the drilling grid to improve the category of the resources and define the limits of the mineralization in these 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 La Increible, Step Out, Sidra and 6-900.
- 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.
    - o Areas such as Step-Out, and Increible 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 MRE 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 MRE.

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 that was implemented since 2016. 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 downhole 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 downhole deviations that may influence the exact position of mineralized intervals.
- The lack of a consistent density testing program to clearly define this characteristic for the different rock and mineralization types in the different areas of the project.
- In 2017 Dia Bras carried out the survey of the exploited areas using a better methodology that improves the quality of the information but this study did not cover all the exploited areas. For the areas not recently surveyed, SRK has used the 3 m volume buffers used in the 2016 resource estimation study. There is still uncertainty associated with this practice, but 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

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. 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 mineral reserve provides an estimated mine life of seven years at an average production of approximately 3,100 t/d ore, ending in 2024.

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

- Maintain and annually update the 3D LoM design and schedule;
- Regularly perform 3D mine surveys and use the data to regularly perform stope-by-stope planned to actual reconciliations, for both grade and tonnage mined, and to continually validate the mining recovery and dilution assumptions;
- Generate a waste handling and underground storage plan, including validating the assumptions made for swell factor for blast material and re-handled material, as well as the storage fill factor;
- Perform a haulage simulation to validate the ore and waste handling assumptions made for underground truck haulage from each of the three main mining areas (El Gallo Inferior, Bolivar

West, and Bolivar Northwest) to surface, as well as the surface truck haulage from surface dumps to the mill;

- 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;
- Perform geotechnical analysis, particularly in the new zones of Bolivar Northwest and Bolivar West;
- Perform a mining methods trade-off study to identify opportunities to increase the production rate and mining recovery through review and optimization of mine design dimensions, ore and waste handling, and other mine design criteria;
- Develop and maintain an estimate of the tonnes and grade remaining in pillars. This study will require improving confidence in the accuracy of the mined-out survey models, and development of a channel samples database for reserve estimation;
- Establish a plan for the safe extraction of pillars. This study may also include the analysis of utilizing tailings or waste material as backfill in the mine; and
- 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.

1.13.3 Recovery Methods

There is 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 moved first to thickened tailings in mid-2017 and to filtered tailings in early 2018. The site must ensure that all required detailed designs are completed and permits are in place for successful operation of the TSF4 area, TSF expansions, and 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, Permitting, and Social

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.

Dust on surface roadways between the mine and the plant location remains a significant problem, and could jeopardize Dia Bras' social license or incur regulatory compliance violations. According to Dia Bras, a new strategy to address this issue is being developed.

More recent geochemical characterization data suggest that some of the material from the underground mine may be potentially acid generating. 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 based on information provided by Dia Bras. At this time, SRK is not aware of any outstanding permits or any non-compliance at the project or nearby exploration sites.

Dia Bras plans to increase the Bolivar Mine production to 5,000 t/d, which will require additional tailings storage space. A second location adjacent to the existing TSF, has been identified and permitted to receive tailings for at least three years.

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

- The issue of surface road fugitive dust emissions should be addressed as soon as possible to avoid jeopardizing the mine's social license and incurring compliance violation from the regulatory authorities.
- 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.

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).

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:

- Giovanny Ortiz, BSc, PGeo, FAusIMM, Associate Resource Geologist, is the QP responsible for geology and mineral resources, and adjacent properties Sections 4 (except 4.4), 5.1

through 5.3, 6 through 12, 14, 23 and portions of Sections 1, 25 and 26 summarized therefrom, of this Technical Report.

- Shannon L. Rhéaume, BASc Mining and Mineral Processing, PEng, Senior Mining Engineer, is the QP responsible for mineral reserves, mining methods, market studies and contracts, capital and operating costs, economic analysis, and other relevant data and information Sections 2, 3, 15, 16 (except 16.3), 19, 21 through 24 and portions of Sections 1, 25 and 26 summarized therefrom, of this Technical Report.
- Jeff Osborn, BEng Mining, MMSAQP, Principal Mining Engineer, is the QP responsible for project infrastructure Sections 5.4, 18, and portions of Sections 1, 25 and 26 summarized therefrom, of this Technical Report.
- Mark Willow, MSc, CEM, SME-RM, Principal Environmental Scientist, is the QP responsible for environmental studies, permitting and social or community impact Sections 4.4, 20 and portions of Sections 1, 25 and 26 summarized therefrom, of this Technical Report.
- Daniel H. Sepulveda, BSc, SME-RM, Metallurgist, 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, PhD, PE, President/Practice Leader/Principal Geotechnical Engineer, is the QP responsible for geotechnical Section 16.3 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	Dates of Visit	Details of Inspection
Shannon Rhéaume	SRK Consulting (Canada) Inc.	Mining and Reserves	January 22 to 25, 2018	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 to 14, 2015	Reviewed metallurgical test work and process plant.
Giovanny Ortiz	SRK Consulting (U.S), Inc.	Geology and Resources	January 22 to 25, 2018	Reviewed geology, exploration practices, mine geology, sampling, /QA/QC, and resource estimation practices.

Source: SRK, 2018

2.4 Sources of Information

The sources of information include data and reports supplied by Sierra Metals and Dia Bras personnel as well as REDCO Mining Consultants (REDCO). Documents cited throughout the report are referenced in Section 27.

2.5 Effective Date

The effective date of this report is October 31, 2017.

2.6 Units of Measure

The metric system has been used throughout this report. Tonnes (t) are metric of 1,000 kilogram (kg), or 2,204.6 pounds (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 REDCO and Burō Hidrōlogico Consultoría, in selected project areas in support of this Technical Report.

REDCO developed the procedures and methods supporting the mineral reserve estimation in conjunction with Dia Bras mine planning personnel. REDCO performed the mineral reserve estimation for Bolivar Mine.

Burō Hidrōlogico Consultoría inspected the existing TSF 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.

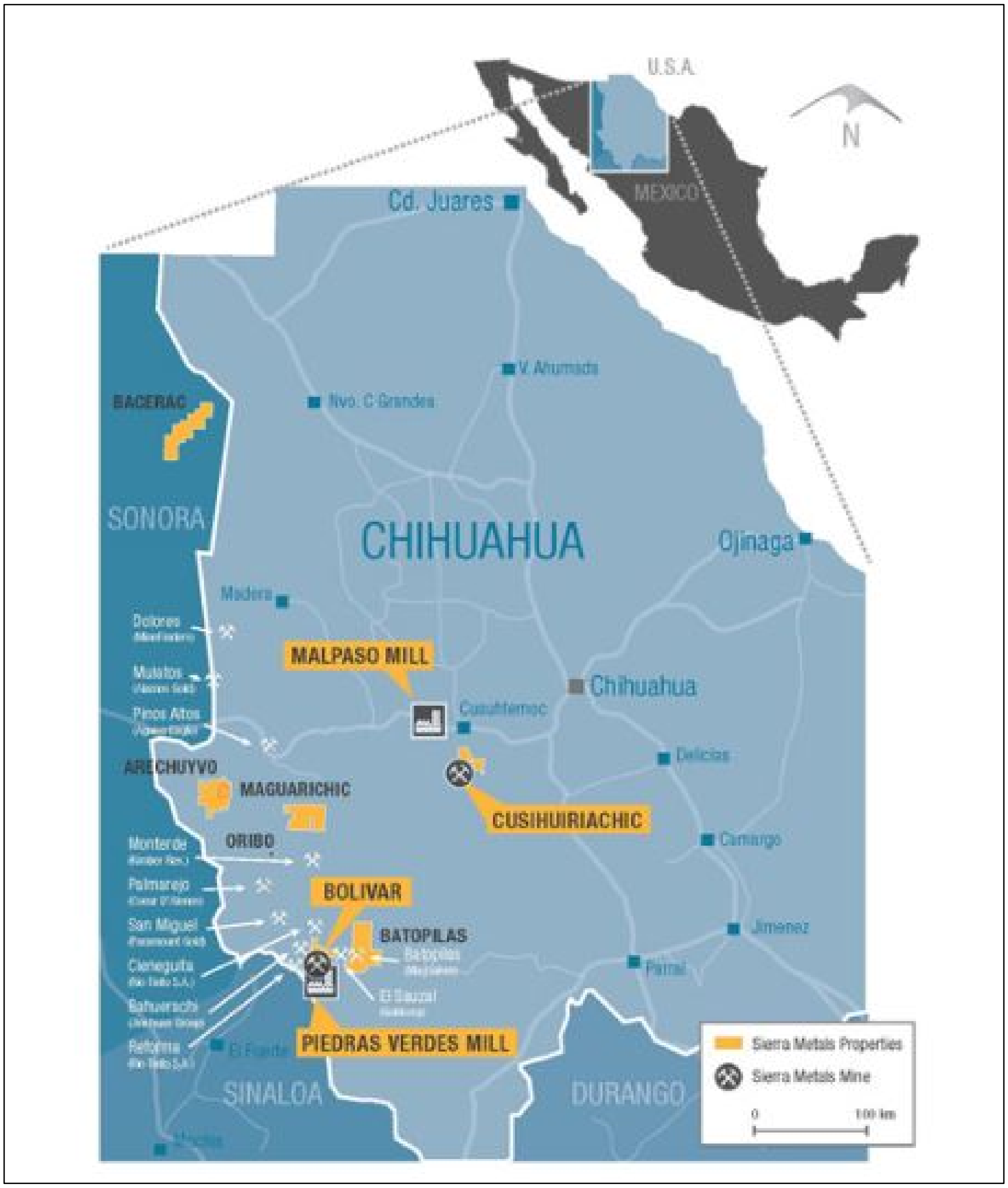
The Consultants used their experience to determine if the information from previous reports was suitable for inclusion in this technical report and adjusted information that required amending. This report includes technical information, which required subsequent calculations to derive subtotals, totals 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, 2017

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

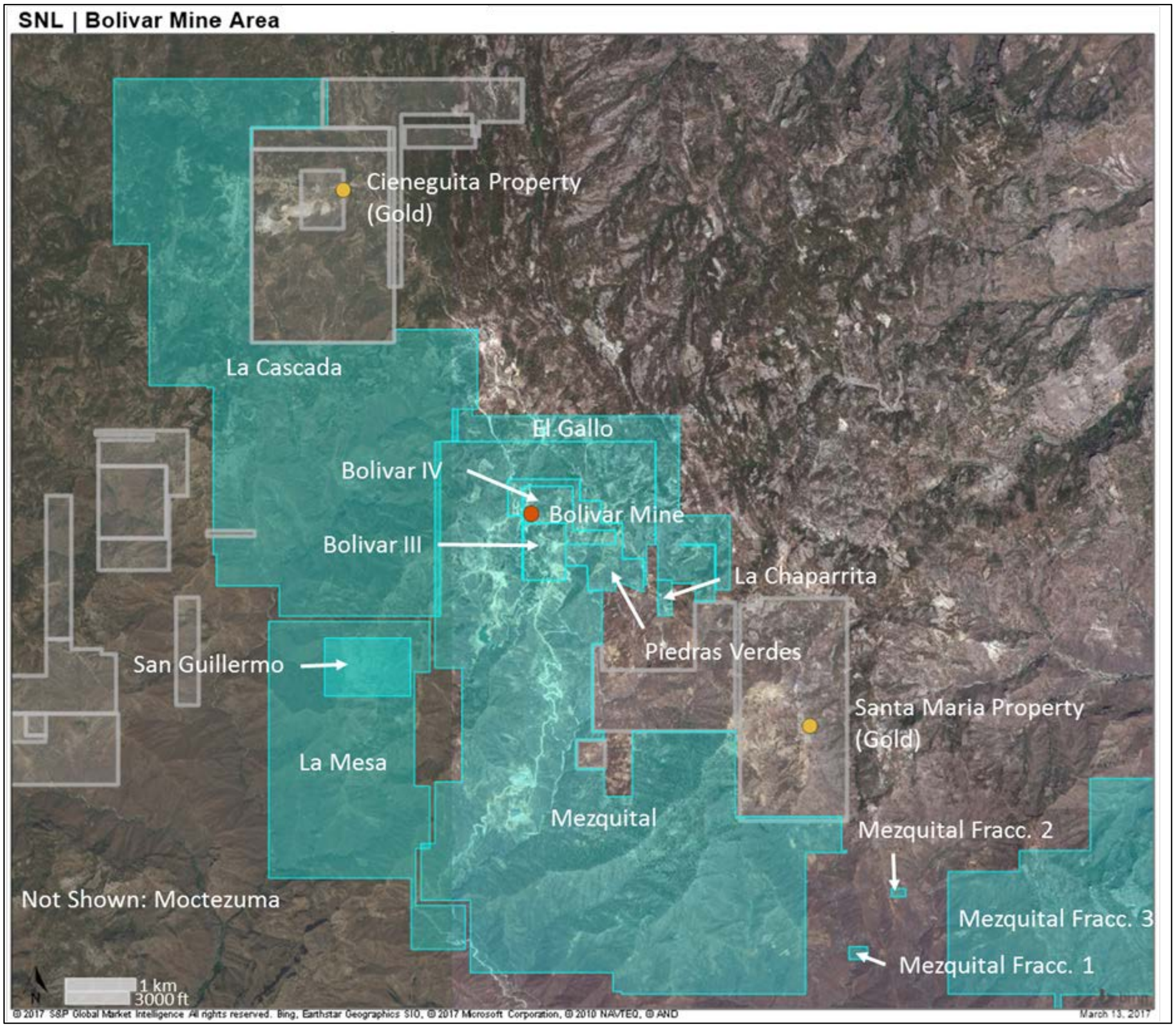
4.2 Mineral Titles

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. The concessions list 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.

Table 4-1: Concessions for the Bolivar Mine

Claim Name	Surface Area (ha)	File Number	Title Number	Expiration Date
La Cascada	1,944.33	016/32259	222720	July 13, 2037
Bolivar III	48.00	321.1/1-64	180659	September 22, 2042
Bolivar IV	50.00	321.1/1-118	195920	October 27, 2053
Piedras Verdes	92.47	016/31958	220925	October 4, 2054
Mezquital	2,475.41	016/32157	223019	October 4, 2054
Mezquital Fracc. 1	4.73	016/32157	223020	October 4, 2054
Mezquital Fracc. 2	2.43	016/32157	223021	October 4, 2054
Mezquital Fracc. 3	974.57	016/32157	223022	April 7, 2055
El Gallo	251.80	016/32514	224112	December 18, 2041
Bolivar	63.56	321.1/1-100	192324	August 12, 2052
La Chaparrita	10.00	1/1.3/00882	217751	January 11, 2055
La Mesa	718.95	016/32556	223506	January 12, 2055
Moctezuma	67.43	1/1/01432	226218	July 13, 2037
San Guillermo	96.00	099/02161	196862	In Process
Total	**6,799.69**			

Source: Gustavson, 2013



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

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); and
- 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 3, 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, and a reconnaissance of the property in January 2018, 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 permits are discussed in Section 20.

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 TSF. 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 in operations. Three filter presses have been purchased by Dia Bras. Two of the three filters will operate at any given time with the third filter on standby or under maintenance.

Thickened tails (60% solids) will be placed until 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 t 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 Moz 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 t of mineralized material were mined while the Bolivar Mine was under the control of Bencomo Family. This included:

- 195,000 t from the Fernandez trend;
- 90,000 t from the Rosario Trend; and
- 15,000 t 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 t/d, 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 t processed at 1.65% copper grade and 8.00% zinc grade;
- 2009: 89,600 t processed at 1.81% copper grade, 10.06% zinc grade, and 49.5 g/t silver; and
- 2010: 104,800 t 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 (1)	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

Source: Dia Bras, 2017

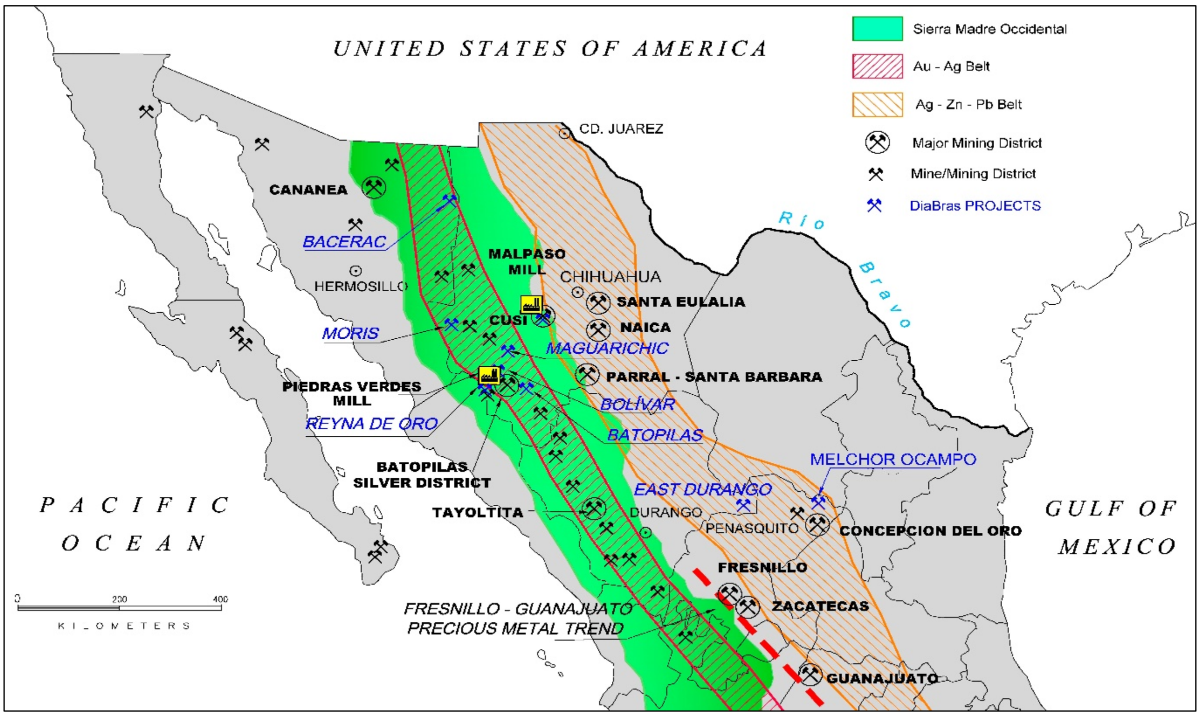
(1) Bolivar material was processed at the Mal Paso mill in 2011 until the Piedras Verdes mill was commissioned in November 2011.

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

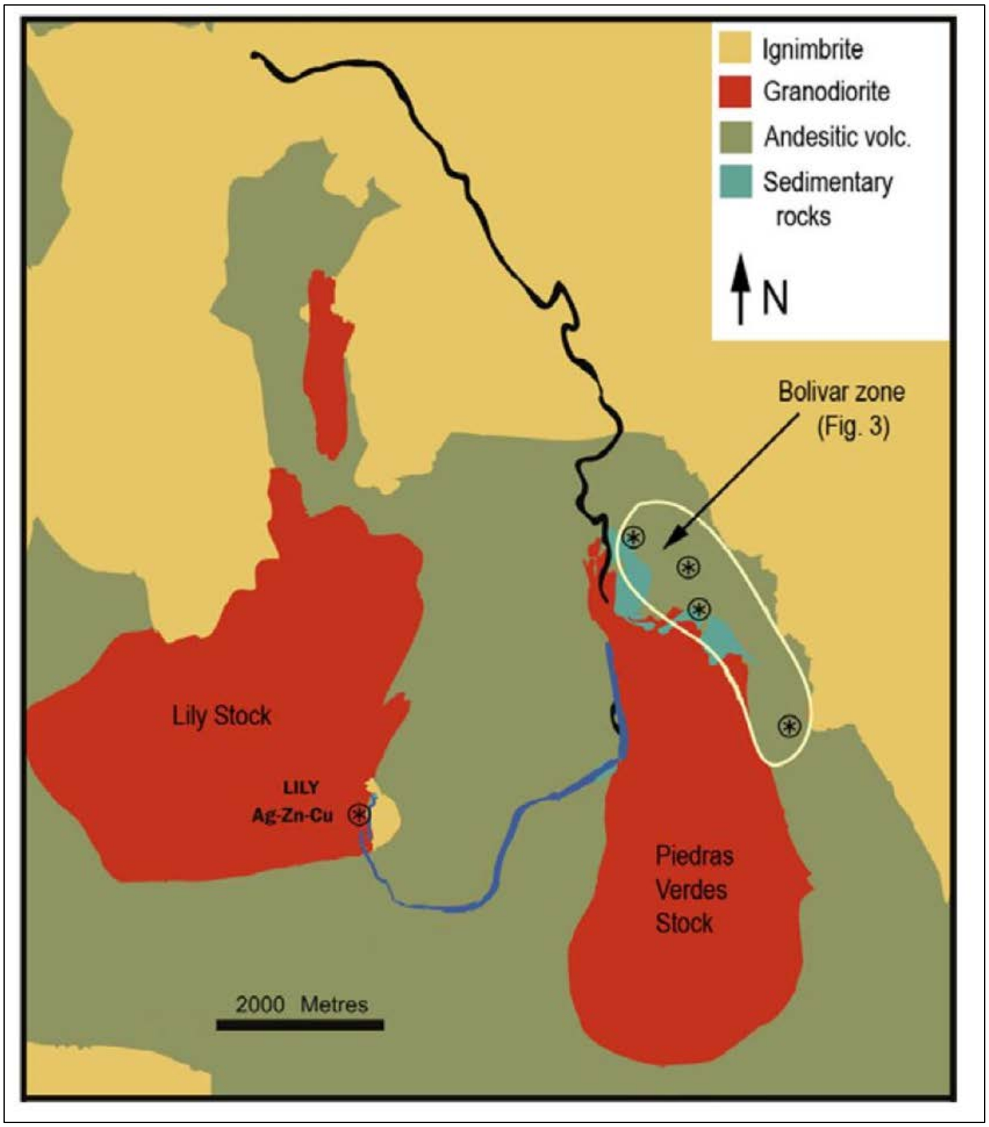
7.2 Local Geology

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).

The structural setting and the stratigraphy control de mineralization at Bolivar.



Source: Meinert, 2007

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

7.3 Property Geology

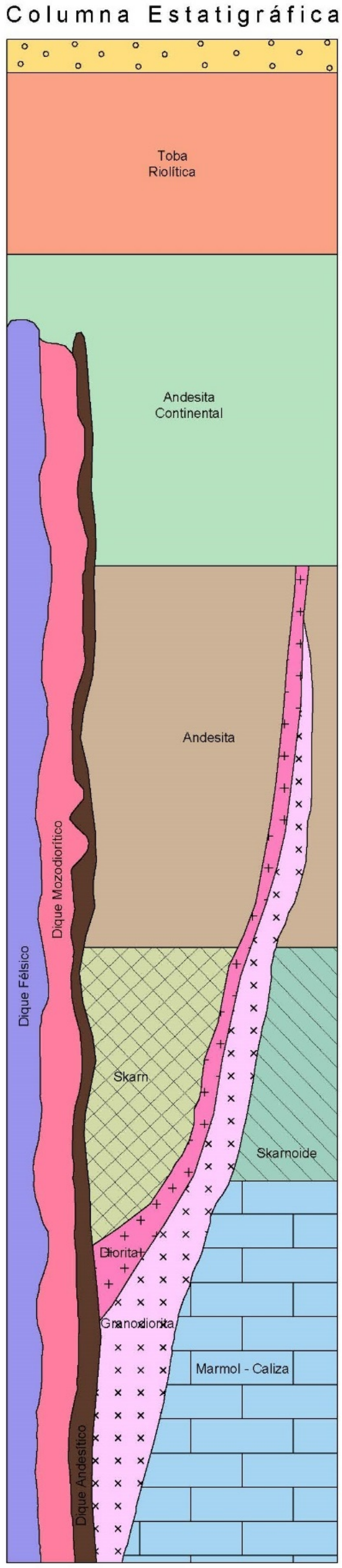
7.3.1 Skarn-hosting Sedimentary Rocks

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 40 m 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. Horizons of argillaceous dolostone (50 m thick) and argillaceous limestone (9 m thick) are above the siltstone marker layer. 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 173 m) 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

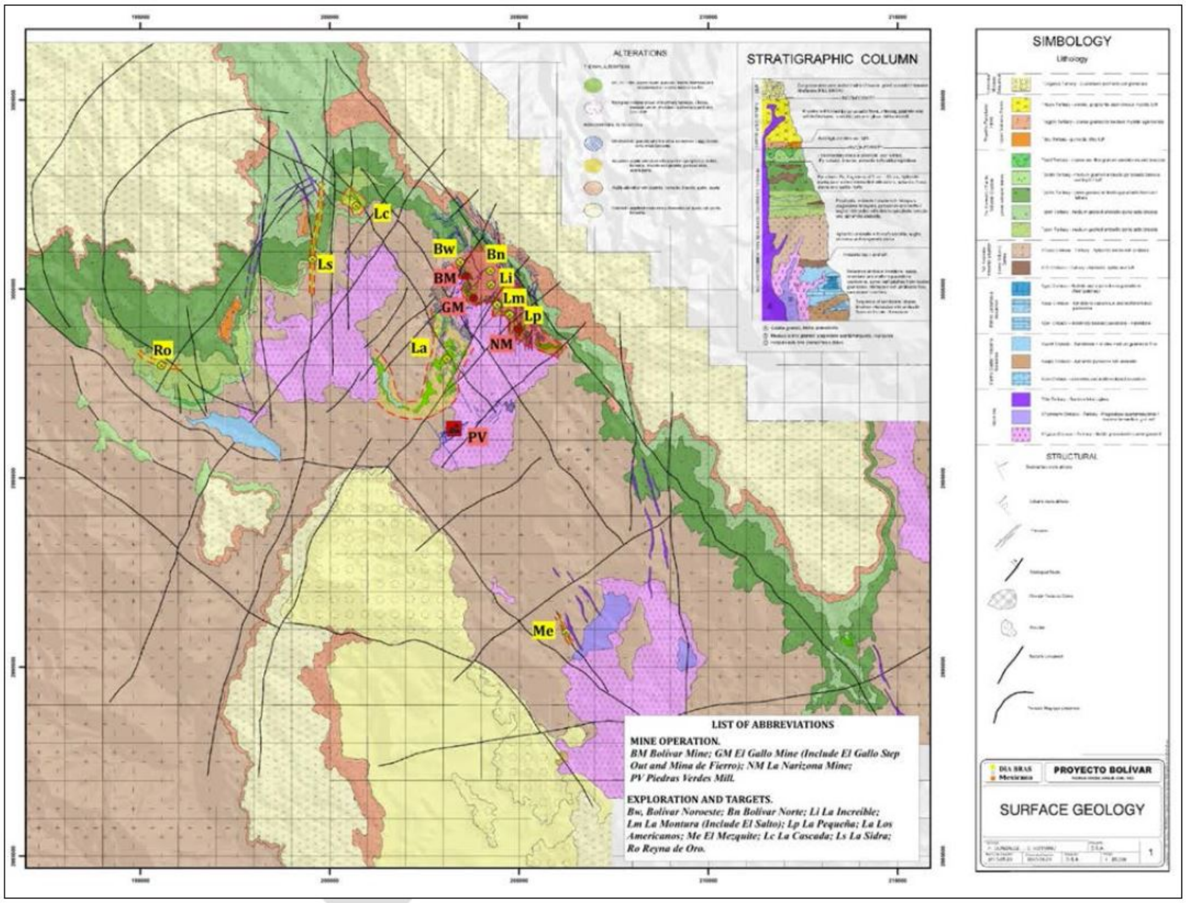
The most important igneous rocks on the property are the Piedras Verde granodiorite and related dikes and sills. All are slightly porphyritic but none are a true porphyry. The Piedras Verde granodiorite exhibits a range of textural variations and compositions. The average composition is very similar 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, 2018

Figure 7-3: Stratigraphic Column of the Bolivar Property



Source: Dia Bras

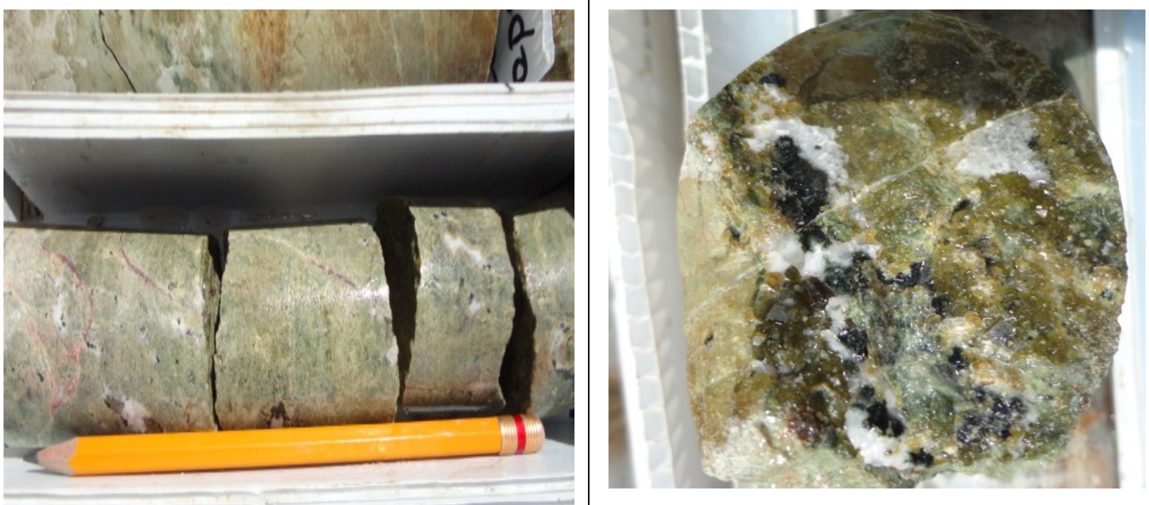
Figure 7-4: Geologic Map of the Bolivar Property

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. Figure 7-5 presents an example of a mineralized skarn with prophylitic alteration in a core sample of El Gallo area. 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 Increible.



A	B

Source: Dia Bras, 2018

Figure 7-5: Mineralized Andradite Garnet Skarn – El Gallo Area Core Sample

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 orebody discovery.
- **2006**. Dia Bras Exploration performed detailed 1:500 scale geologic mapping in the Bolivar and Bolivar South areas, including 2 m x 2 m 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 2 m panel sampling. This exploration identified two mineralized stratiform horizons in the El Gallo area, Gallo Superior and Gallo Inferior, similar to the stratiform orebody 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 2 m 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 Increible Mines, including detailed 2 m x 2 m panel sampling. Mining was mainly concentrated at the Bolivar Mine in the high-grade orebodies (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 2 m panel sampling was done at El Gallo, La Increible 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 Increible, 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.
- **2017**. Additional drilling was focused in Bolivar W, Bolivar NW. Three drillholes were completed in the El Gallo area.

9.2 Sampling Methods and Sample Quality

Sampling supporting the MRE's consists of drill core and underground channel types. SRK reviewed in general the methods and the quality assurance protocol carried out by trained geologists or geologic technicians. SRK of the opinion that the methodology and QA/QC protocol used in the drilling campaigns of 2016 and 2017 follows the best practices although some improvements can be implemented.

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 the MRE.

10 Drilling

10.1 Type and Extent

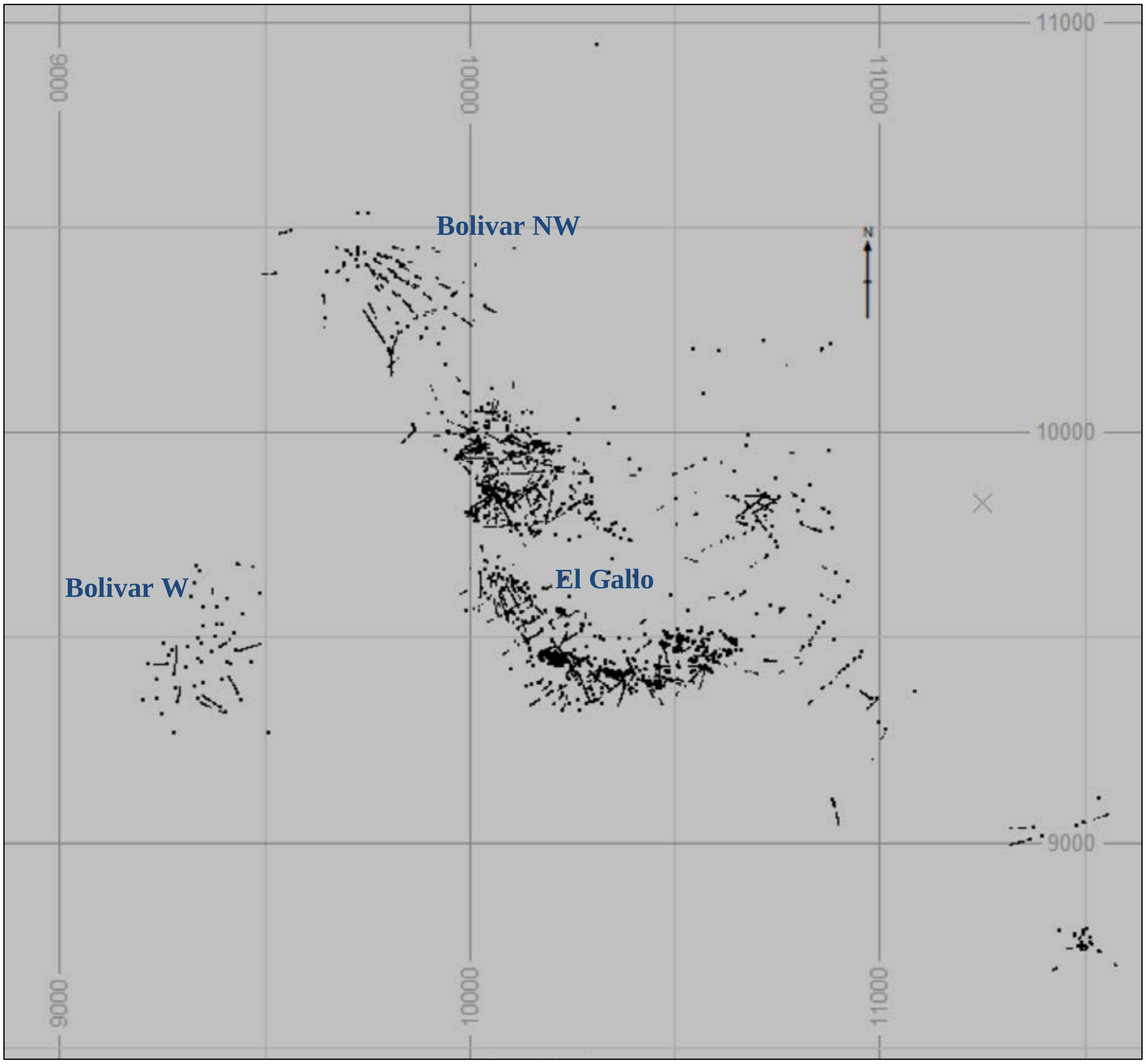
Between 1968 and 1970, Minera Frisco drilled short, diamond holes, but existing records do not provide a reliable register of the number of holes, meters drilled, or the results of drilling.

Between 2003 and 2017, Dia Bras drilled 949 HQ and NQ diameter core holes totaling to 205,548.1 m 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, Piedras Verdes, and El Gallo concessions.

Table 10-1: Summary of drilling by Dia Bras Exploration, Inc. on the Bolivar property, 2003 to 2017

Year	Drilling (m)	Number of Drillholes
2003	450.7	2
2004	16,905.4	104
2005	12,634.1	72
2006	11,727.9	68
2007	24,712.9	125
2008	22,945.6	111
2009	8,926.0	72
2010	9,404.0	66
2011	8,977.6	49
2012	14,332.6	45
2013	10,948.4	27
2014	5,948.3	30
2015	18,116.3	75
2016	17,324.5	52
2017	22,194.0	51
Total	**205,548.1**	**949**

Source: Sierra Metals, 2018



Source: SRK, 2018

Figure 10-1: Location Map of Drillhole Collars and Traces (Plan View)

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, 949 drillholes have been completed with an average length of approximately 217 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 downhole deviation surveys. A significant number of the drillholes are relatively long and their precise location is considered uncertain due to the lack of downhole surveys. Since 2016 the appropriate deviation surveys have been implemented using the equipment Deviflex (Non-magnetic electronic multishot). Prior to 2016 the practice to survey exploration drilling was not carried out consistently, 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. 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 Increible 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

Historically, samples have been crushed at Dia Bras facilities in either the Malpaso Mill or the Piedras Verdes Mill. The labs of Dia Brass carry out a chemical analysis to define the mineralized intercepts. Once the mineralized intercepts are defined, the remaining crushed material of the samples is send to ALS Chemex (ALS), an ISO-certified independent commercial laboratory. The rest of the sample preparation procedure is completed at the ALS Chemex Hermosillo, Mexico facility and final analysis is conducted at the primary laboratory in North Vancouver, BC, Canada. The crushing and splitting procedures in the Dia Bras labs should be appropriately controlled to avoid contamination of samples.

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. 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. This is a reasonable practice, but 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 Procedures

Samples supporting the 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 crushing rejects or pulps provided to ALS for analysis. 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 the MRE, Dia Bras recently conducted a thorough review of the historic sample data in the unmined areas which were analyzed 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.

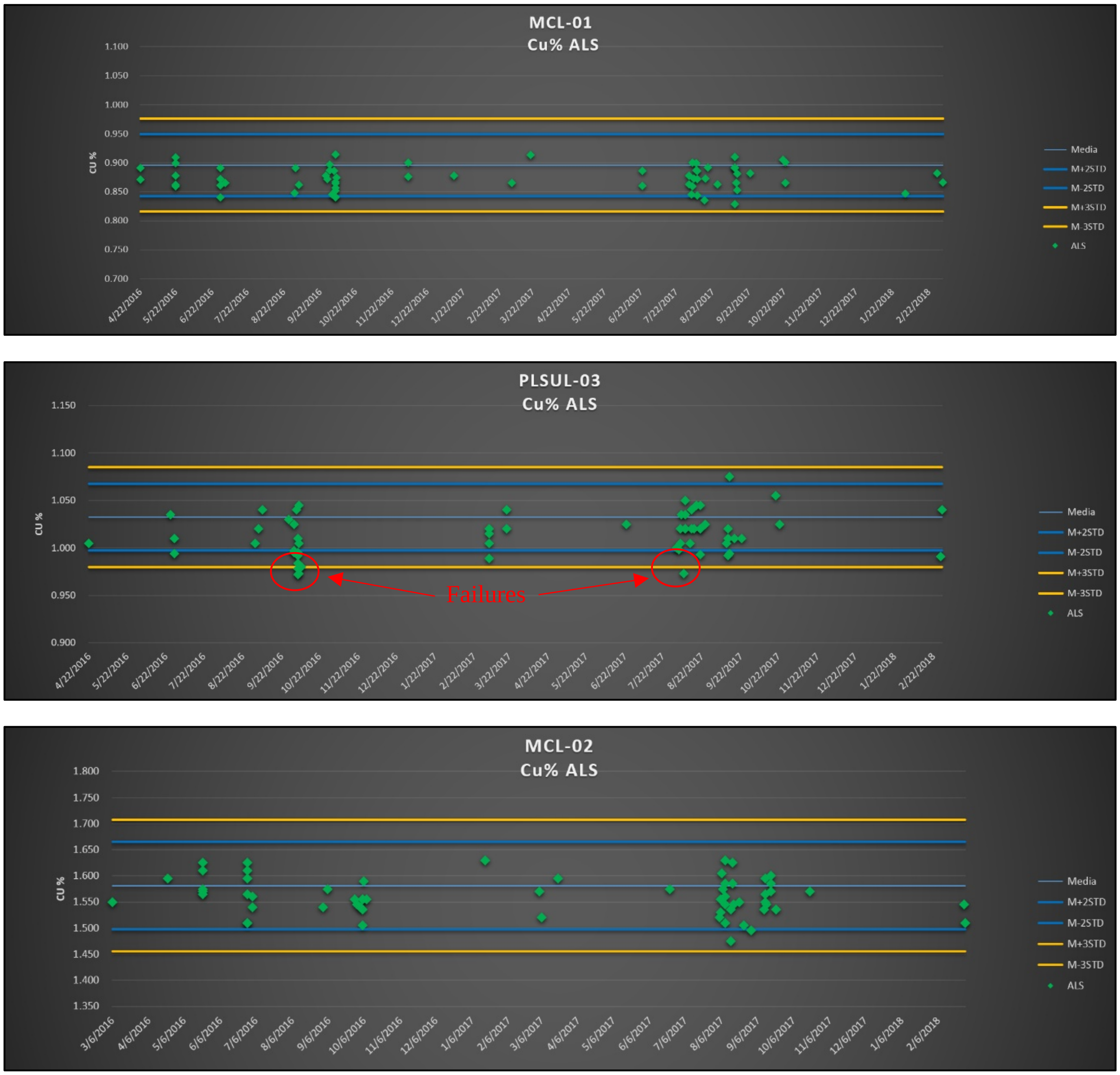
The means and between lab standard deviations (SD) are calculated from the received results of the round robin analysis, and the certified means and tolerances are provided in certificates from Smee and Associates. The certified means and expected tolerances are shown in Table 11-1.

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 (66 low-grade, 61 moderate-grade, and 61 high-grade) which were inserted into the sample stream for 99 drillholes drilled between 2012 and 2017. 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 noted some failures for the medium grade CRM-PLSUL submitted for the 2016 and 2017 QA/QC program. The performance over time for MCL-01, MCL-02 and PLSUL: Cu is shown in Figure 11-1. Dia Bras tracks and generates plots such as this for each element from each standard.

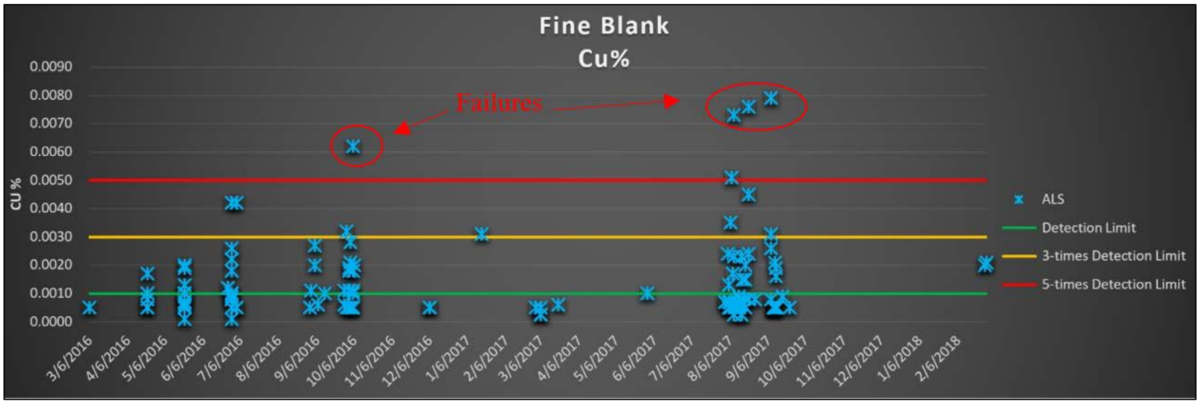


Source: Dia Bras, 2018

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

11.4.2 Blanks

Pulverized Blank material used in the QA/QC program to control the contamination in the pulverizing process of ALS consists of barren limestone selected by Bolivar geologists prepared and certified by Target Rocks. Results submitted to SRK included 123 samples which were inserted into the sample stream for 75 drillholes drilled between 2012 and 2017. The failure criteria for blanks is 5 times the detection limit of the ALS lab. SRK reviewed the performance of the blank samples submitted and noted some failures for the blanks, occurring in 5 of the 123 samples, for Cu. An example of the blank performance chart is shown in Figure 11-2. The failures indicate contamination in the pulverizing and splitting process in the lab.



Source: Dia Bras, 2018

Figure 11-2: Fine Blank Performance – Cu

Coarse blanks are not being used and the contamination in the crushing and splitting process is not being controlled.

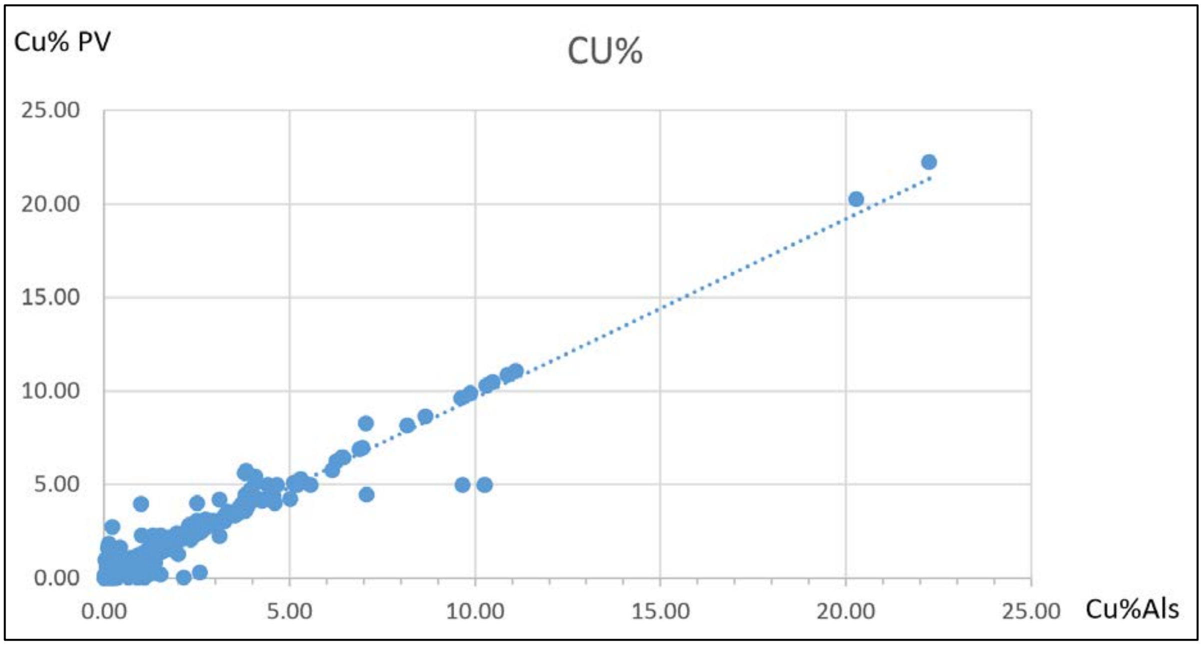
11.4.3 Duplicates

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 1,372 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 of Cu between the two. 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.

It is recommended that Dia Bras start the use of field duplicates, fine duplicates and coarse duplicates to evaluate the error in the core, crushing and pulverizing sampling processes. Although the second lab used is Piedras Verdes, it is recommended to start using a certified laboratory as a second lab control to evaluate the analytical error.



Source: Dia Bras, 2018

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 MRE. 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 5 failures of blanks due to contamination and two failures of the medium grade CRM.

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

Although some failures of blanks and CRMs were found, no actions have been taken. The procedures and processes for definition of actions upon detection of failures have been improved but there are no well-documented information about the actions taken when failures in blanks and CMS are found. The general procedure is 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. Previous technical reports deemed the level of QA/QC consistent with industry best practices, but SRK cautions, based on extensive experience, that 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 implement the use of additional controls including coarse blanks, twin samples, fine and coarse duplicates and a second lab control using a certified laboratory. It is necessary to clearly document the procedures and methods for actions taken in the event of failures.

12 Data Verification

12.1 Procedures

SRK was provided with 910 analytical certificates from ALS Minerals for the 25,979 analyses in the database. SRK reviewed and compared 120 (16.5%) of the certificates. There were no inconsistencies with the database.

In addition, SRK, 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 processing plant has been in production and metallurgical requirements for processing ore is well understood. Bolivar facilities include a metallurgical laboratory at site. Sampling and testing of samples are executed on an as-needed basis. No test work results were available at this time for the areas being mined currently. Four future areas that are being explored include:

- Gallo Inferior (zones 1-2 and 3);
- El Salto (continuation of Gallo Inferior);
- Bolivar West and North-West (new bodies that are in development); and
- La Sidra (Lead-Zn).

Only test work on the La Sidra were performed. Results indicate that this material has polymetallic characteristics with low copper content. Head grades for La Sidra were Au 2.7 g/t, Ag 7 oz/t (217.0 g/t), Pb 1.1%, Zn 2.1% and Cu 0.3%. The recoveries obtained in rougher stage treated polymetallic mineral ore were:

- Silver recoveries between 20% and 75% Ag grades up to 1470 g/t in the lead concentrate;
- Gold recoveries between 27% and 65% in the lead concentrate. Lower recoveries in the Zn concentrate;
- Lead recoveries between 50% and 70%; and
- Zinc recoveries between 20% and 50%.

La Sidra samples come from composites of diamond drilling cores ID 39901, 39903, 39905, 39906, 39911 and 39912.

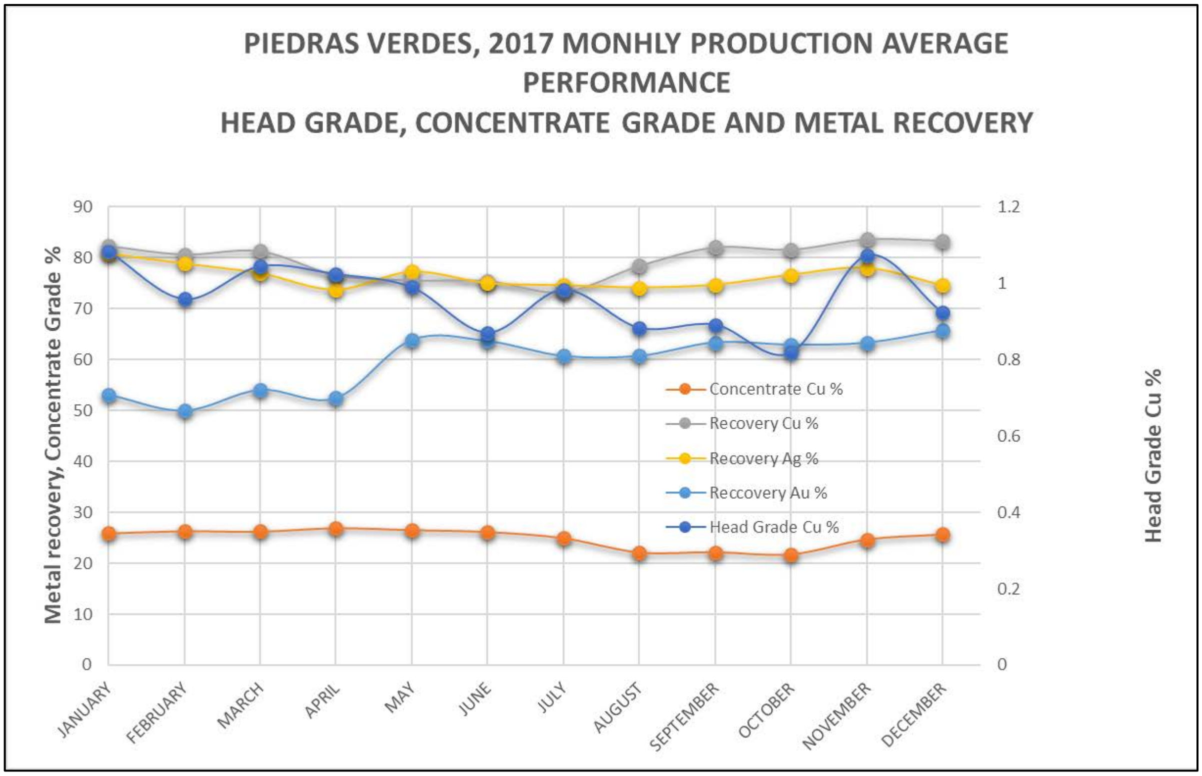
Gallo Inferior Saito as also called the zones 1-2-3, its metallurgical tests are still in progress and do not expected to be fed to the plant during 2018. At the time of writing this report, there have been no flotation tests with other future materials like Bolivar W, NW or mixtures at different ratios and skarn breccia. It is known that a mineral with a higher proportion of skarn fed to the plant, both the liberation and recovery of copper would be improved compared to mixtures with a predominance of breccia.

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 t/d of nominal throughput. The ore processing capacity was expanded to 2,000 t/d in mid-2013. The mill has been upgraded since and the current nominal throughput capacity is 3,000 t/d.

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

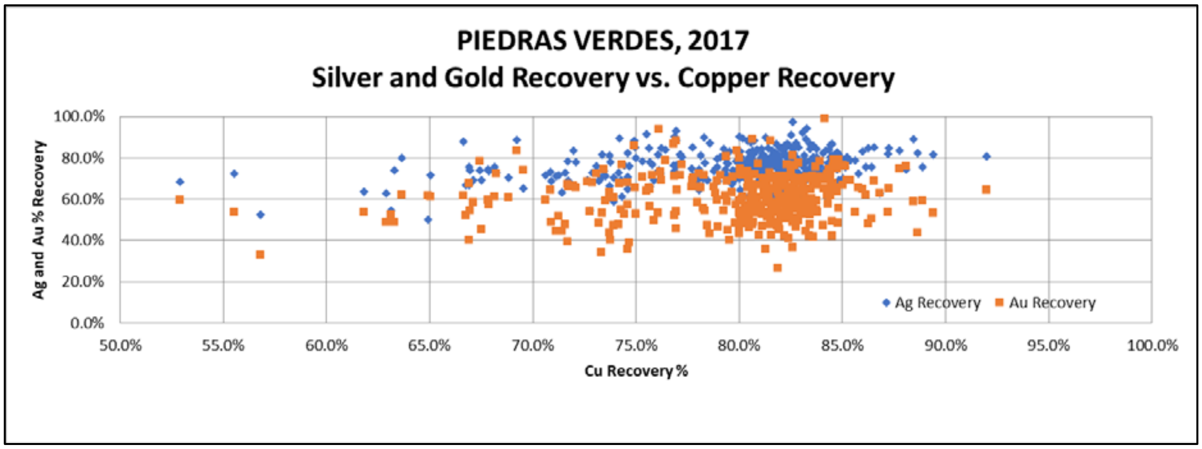
During 2017 Piedras Verdes consistently produced copper concentrate of commercial quality with copper grade ranging between 22% Cu to 27%Cu, silver content in concentrate ranging from 297 g/t to 453 g/t, and gold content in concentrate ranging from 2.6 g/t to 3.8 g/t. Metal recovery for copper, silver, and gold averaged monthly 79.6%, 76.3% and 59.5%, respectively. The increase in gold recovery that occurred in May was a result of the skarn material being fed to the plant. The skarn material has better gold recovery than the breccia.



Source: SRK

Figure 13-1: Piedras Verdes Monthly Average Performance – 2017

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 53% to 92% with a yearly average of 79%. Silver recovery ranged from 50% to 98% with a yearly average of 76.7%, and gold ranged from about 27% up to 99% with a yearly average of 61%. 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

David Keller, PGeo, of SRK (Canada) has conducted the MRE as described herein. Giovanny Ortiz, BSc Geology, FAusIMM, an associate of SRK, has reviewed the resource estimation process. SRK 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 resource database is comprised of 949 (205,548 m) diamond holes. The drilling data consists of approximately 25,980 gold, silver, copper, zinc and lead assays. Decisions whether an interval is sampled is decided by site geological staff and logging. Drilling history for the project has been documented since 2003. Drilling information from some older holes has been lost or the type of drilling is not known. These holes have been removed from the database.

The database is maintained in Microsoft® Access and was provided as Microsoft® Excel files with collar information, hole orientation, geology logging, analytical data and geotechnical data. A summary of drillhole information is provided in Table 14-1. Drilling types are provided in Table 14-2. Descriptive statistics for all drillholes are presented in 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
2017	51	22,194	11

Source: Dia Bras, 2018

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, 2018

Table 14-3: Descriptive Statistics – All Drilling

Column	Count	Min	Max	Mean	Variance	St Dev	COV
Length	37,154	0.0000	635.10	5.53	572.82	23.93	4.33
Au	37,155	0.0025	24.90	0.07	0.15	0.38	5.66
Ag	37,145	0.0000	4,720.00	8.39	1,990.49	44.61	5.32
Cu	37,155	0.0001	42.07	0.31	1.31	1.14	3.68
Pb	37,155	0.0001	8.05	0.01	0.01	0.10	7.97
Zn	37,155	0.0001	52.09	0.71	13.13	3.62	5.12

Source: SRK, 2018

14.1.2 Downhole Deviation

For 780 drillholes in the database 169 have downhole deviation measurements. Almost all drillholes drilled in 2017 have been surveyed with downhole instruments. Survey methods include Deviflex and Reflex tools. Drilling completed in 2016 averaged about 50 to 70 m between surveys. In 2017 most of the holes were surveyed at intervals as close as 1 to 2 m as checks on the deviation.

The surveys show that the initial angle of the drill setup is frequently five or more degrees off on the intended azimuth for holes drilled before 2016, and that subsequent surveys taken downhole vary significantly from the first, indicating substantial deviation. 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.

The purpose of drilling in 2016 and 2017 was 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 downhole 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. This inconsistency is resolved in newer 2016 and 2017 drilling, with downhole surveys that closely approximate the planned azimuth taken at the drill collar.

As previously observed by SRK, the average azimuth downhole deviation for these surveyed holes is highly variable, with some holes exhibiting very little deviation and others more than 15° over the course of the hole. Thus, SRK is of the opinion that downhole surveys should continue to be collected with the Deviflex equipment on a regular basis and used as a matter of course during ongoing drilling, at intervals.

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 consists of 339 samples for a total sampled length of approximately 845 m. The data base contains approximately of about 450 assay intervals for silver, copper, lead and zinc. Compared to the 2016 report there is a significant increase in assaying consistently for all four metals.

The channel sample database is kept in a series of AutoCAD® 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 as-built data provided for the levels. Due to uncertainty associated with translating this data from AutoCAD® spreadsheets in terms of precision of location in 3D, SRK is of the opinion that it is suitable only for support of Indicated and Inferred Mineral Resources. Summary statistics for channel samples are provided in Table 14-5.

Channel samples for the resources estimate are in Chimenea 1, Chimenea 2 and El Gallo Inferior domains comprising 111, 88 and 140 intervals respectively.

Table 14-5: Descriptive Statistics – Channel Samples

Column	Count	Min	Max	Mean	Variance	St. Dev	COV
Ag	426	0.005	171.57	12.94	326.90	18.08	1.40
Cu	454	0.005	12.80	1.44	3.03	1.74	1.21
Pb	427	0.003	0.91	0.04	0.00	0.07	1.85
Zn	427	0.005	5.30	0.27	0.27	0.52	1.97

Source: Dia Bras, 2018
Au not assayed for in channel sample data.

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, 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:

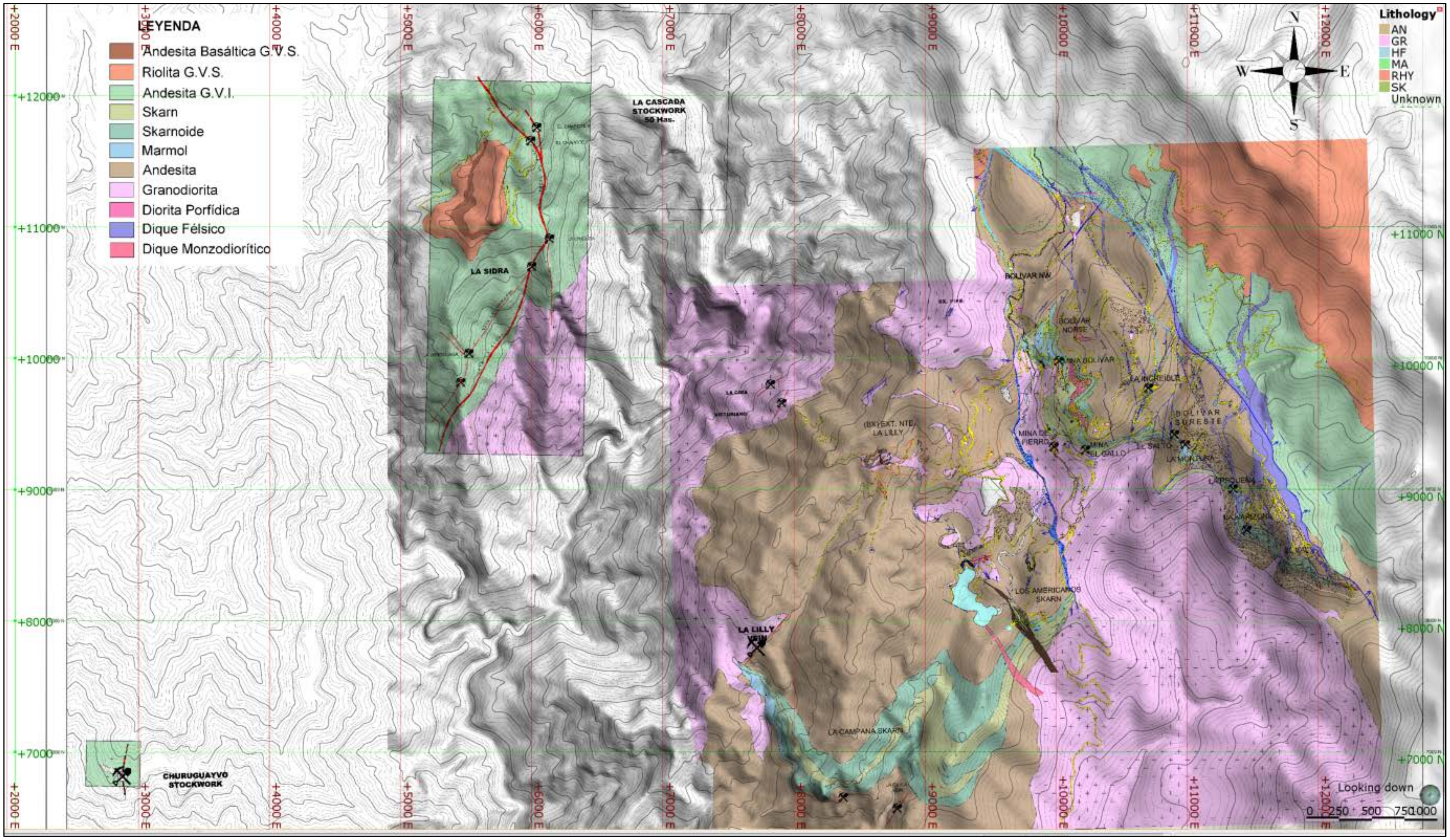
- Drillholes where the entire hole was missing assays were removed from the database used in estimation. They may have still been used to drive the geology interpretation. These are predominantly in the oldest areas of the Bolivar Mine area, or areas which are not included in the current resource estimation.
- 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 is of the opinion that this is 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.
    - 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 Geological Model

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

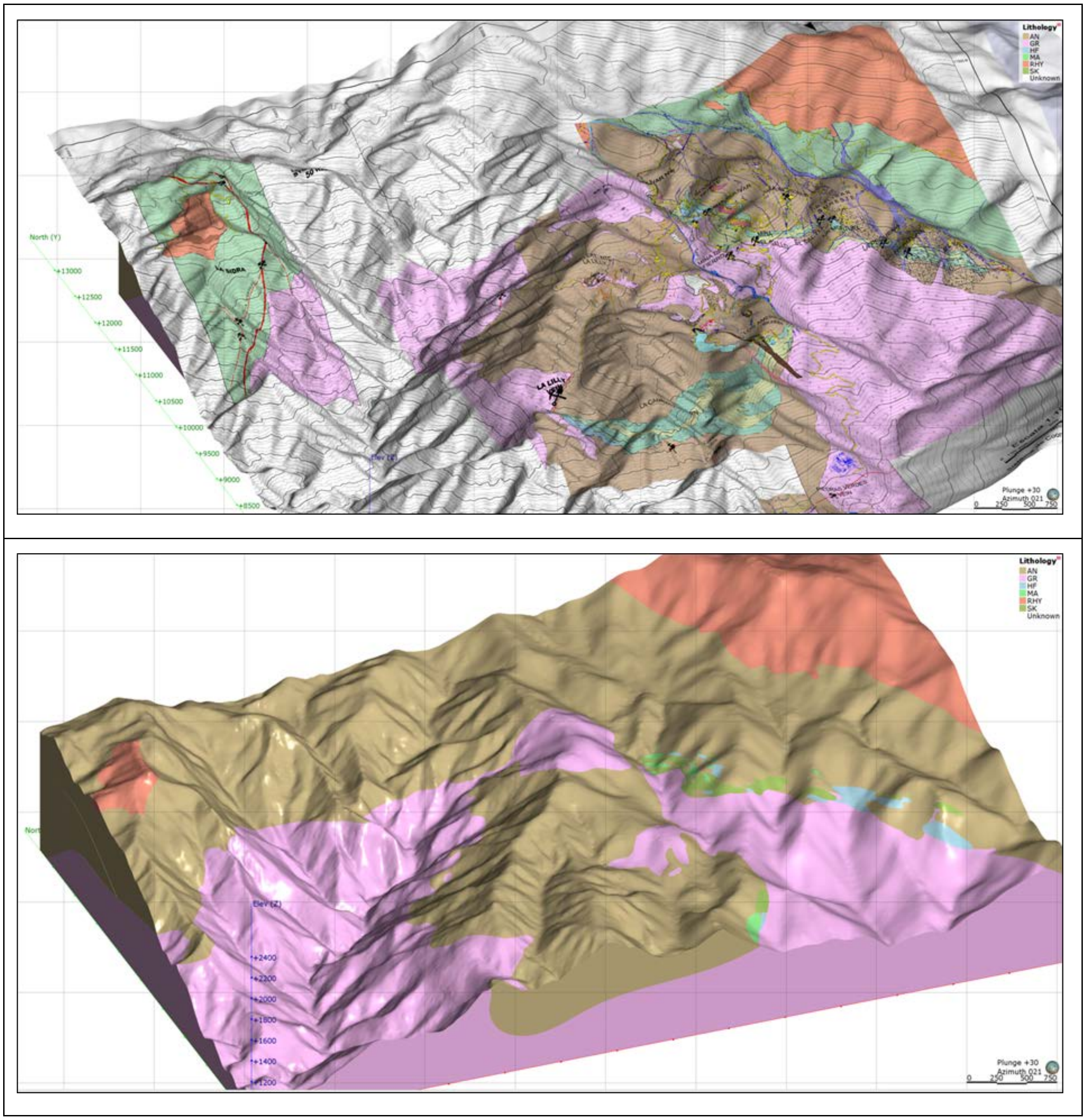
14.2.1 Project Area Regional Geology

SRK utilized surface mapping, interpreted cross sections, underground exposure data, and drilling information to generate a regional geology model, which includes major lithologies and structures in the area. This information 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 results of this work are presented in Figure 14-1 and Figure 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, which has been incorporated into the model. The geological interpretation of mineralized domains has changed significantly from the interpretation used in the 2016 report. SRK has the following comments after conducting a comparison with the previous estimate interpretations:

- Changes in orientations and trends of mineralization;
- Volumes of 14 domains have changed between 9% and 251%;
- Drilling in 2017 has increased confidence levels for the deposit particularly in the Chimeneas and Bolivar West domains; and
- Re-interpretation of Northwest domains has resulted in combining domain 8 and domain 4 with other domains.

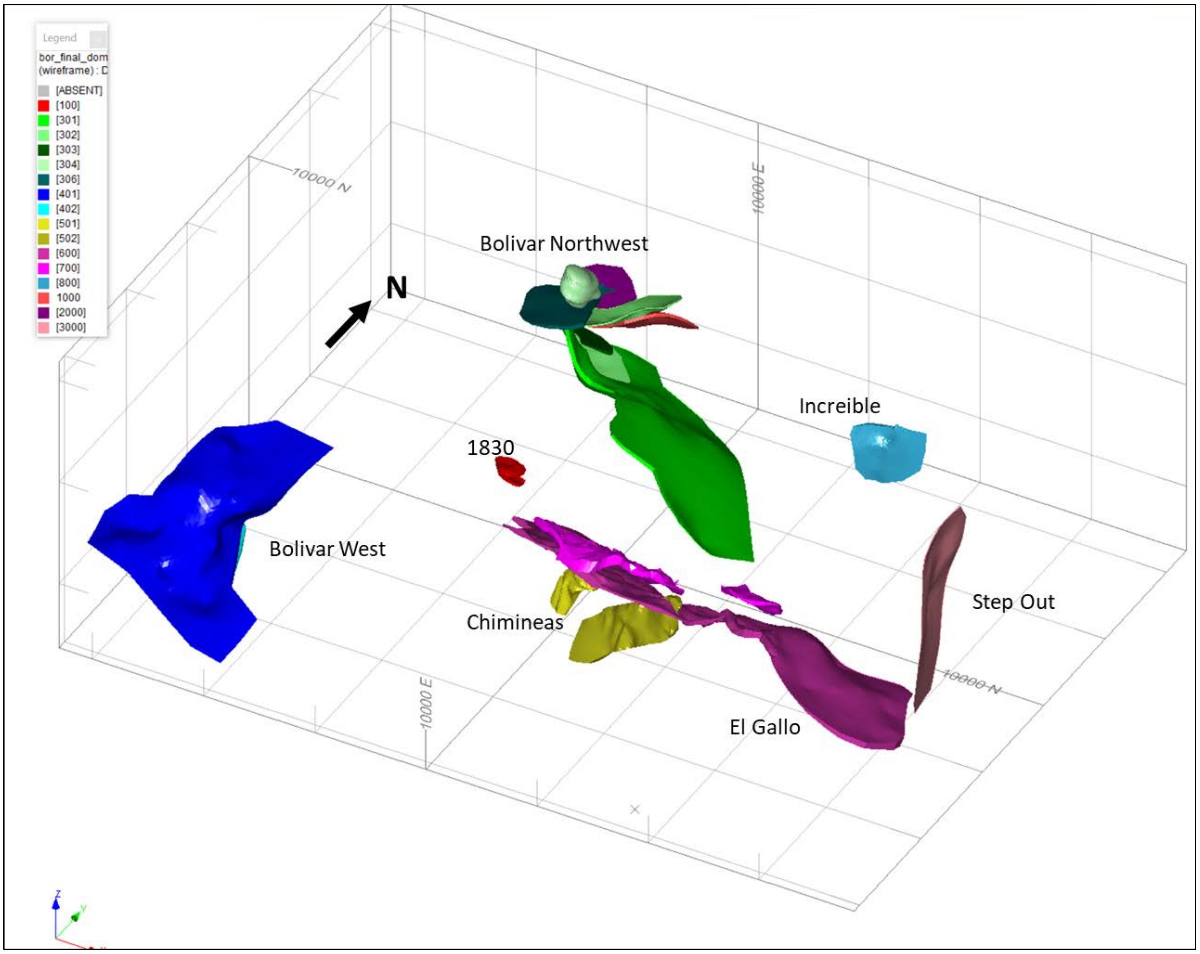
Contacts between intersecting domains have been investigated to determine the geochronology mineralization events and used to re-interpreted the domains. An example of this is the Chimeneas 1 and 2 domains which intersect the El Gallo Inferior domain. Dia Bras has found that Chimeneas mineralization postdates El Gallo mineralization and has reinterpreted the contacts, as shown in Figure 14-3. A view of the 17 mineralized domains for the project are provided in Figure 14-4 and Figure 14-5.

There are other mineralized bodies defined by Dia Bras geologists, but the level of drilling was insufficient to define the orientation or extents of the mineralization, and they were excluded from the grade estimation. The La Sidra area has been explored by Dia Bras before 2016 but is considered not to be sufficiently defined as resources for the following reasons:

- La Sidra is a different type of mineralization (epithermal veins) and is not considered to be well-understood nor sufficiently drilled to define Inferred resources.
- The metallurgical characteristics of La Sidra requires more investigation to sufficiently confirm that mineralization is can be processed by the mine.

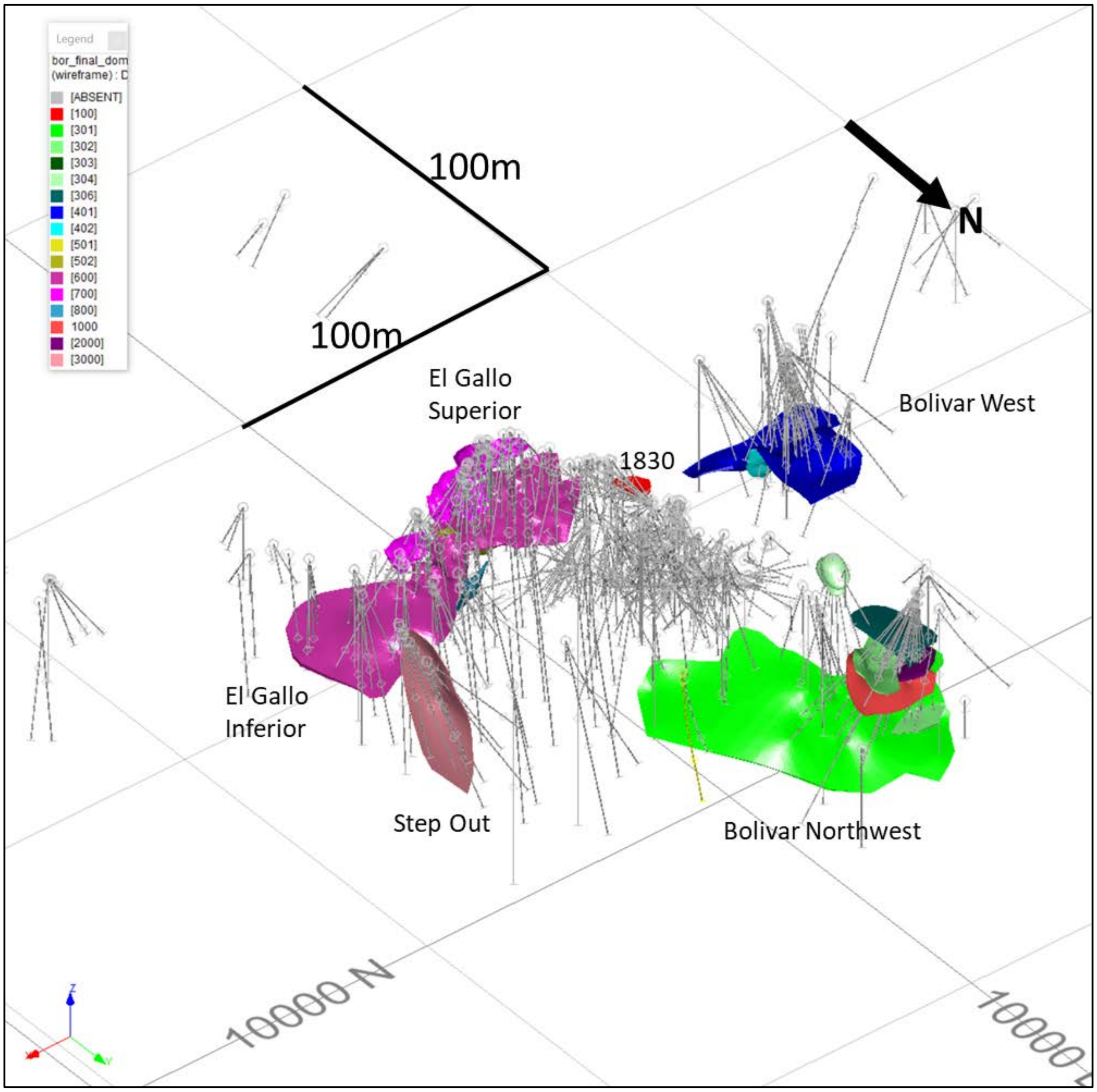
SRK considers the issues sufficient to consider the potential economics of this area as questionable with further work. Not additional drilling has been carried out in La Sidra after 2015.

Domain coding for the various mineralization domains used for Bolivar Mine is provided in Table 14-6.



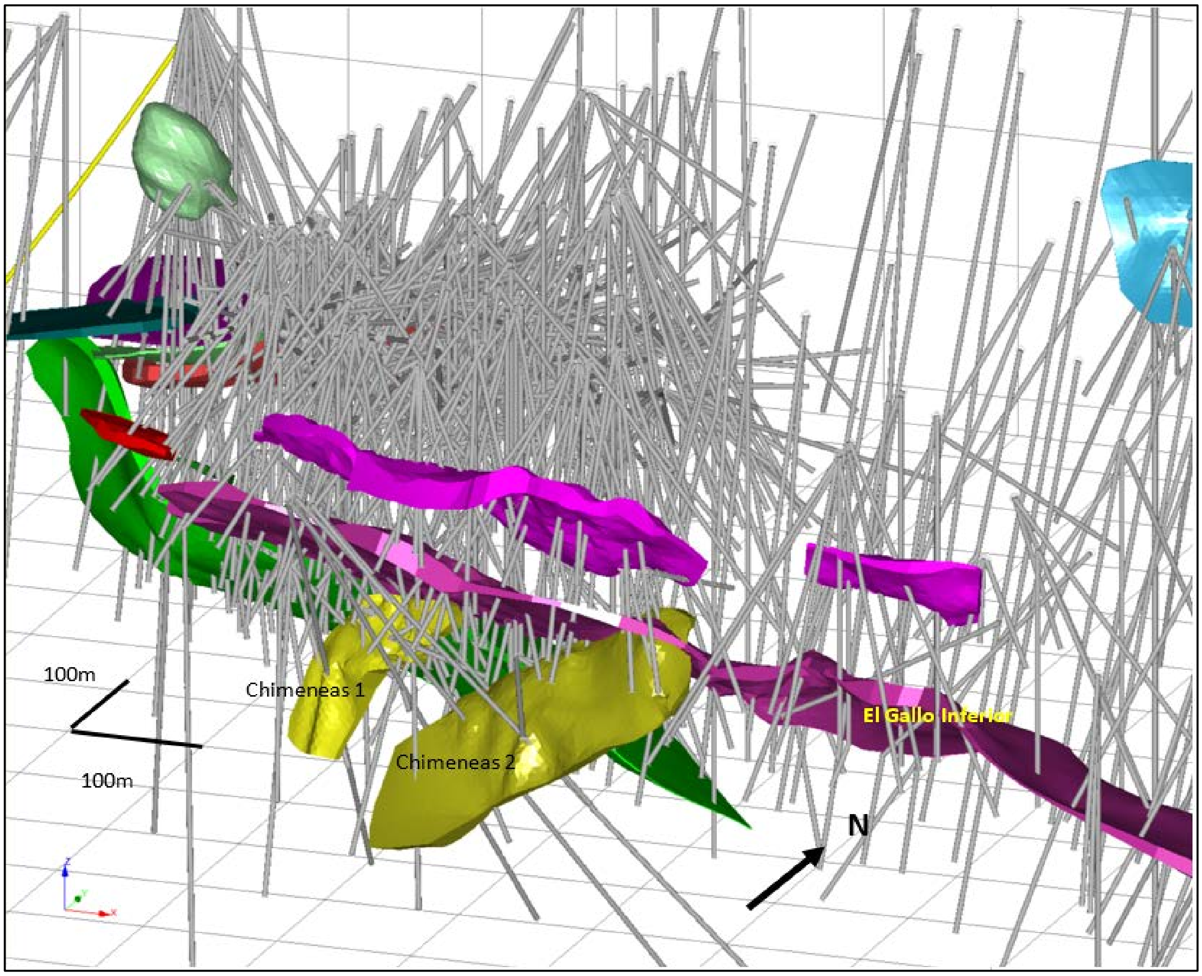
Source: SRK, 2018

Figure 14-3: Re-interpreted Mineralization Domains, Looking Northwest



Source: SRK, 2018

Figure 14-4: Perspective View of Re-Interpreted Models, Looking Southwest



Source: SRK, 2018

Figure 14-5: Perspective View Bolivar Mineralization Model and Drillholes, Looking Southwest

Table 14-6: Bolivar Resource Domains and Codes

Area	Domain	Codes
1830	100	1830
Northwest 1	301	BNW1
Northwest 2	302	BNW2
Northwest 3	303	BNW3
Northwest 5	304	BNW5
Northwest 6	305	BNW6
Northwest 7	306	BNW7
West A	401	BOWA
West B	402	BOWB
Chimera 1	501	CHI1
Chimera 2	502	CHI2
El Gallo Inferior	600	EGI
El Gallo Superior	700	EGSU
Increible	800	LINC
Northwest Zn 2	1000	NWZN2
Northwest Zn 3	2000	NWZN3
Step Out	3000	SOUT

Source: SRK, 2018

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.

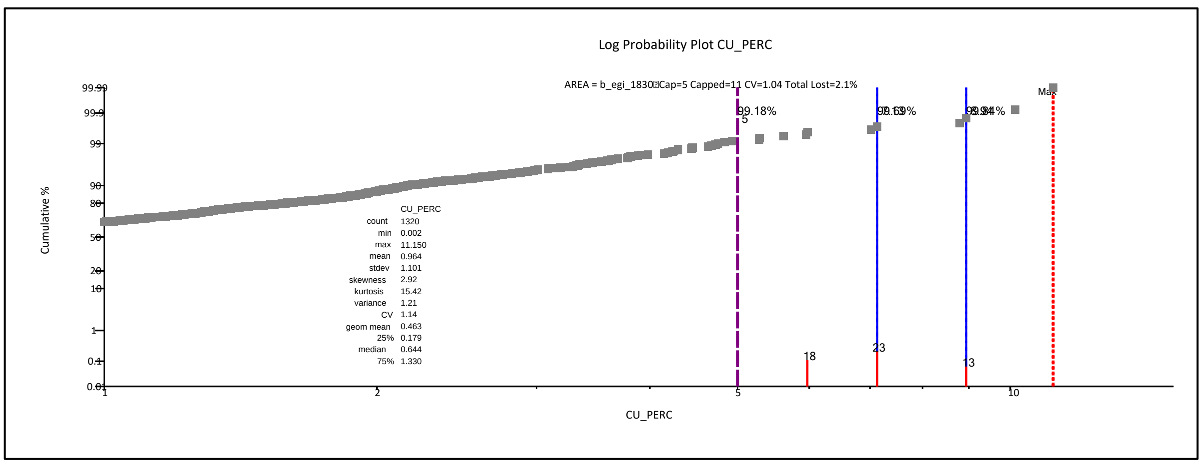
14.3.1 Outliers

To assess the potential impact of outlier samples, SRK reviewed grade distribution of the original data (not composited) 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 Inferior and 1830 area (for Cu only) are shown in Figure 14-6 and Table 14-7. The same analysis was conducted for the other areas and elements.



Source: SRK, 2018

Figure 14-6: Cu Log Probability Plot – El Gallo Inferior-1830 Areas

Table 14-7: El Gallo Inferior – 1830 Area Capping Analysis – Cu

Column	Cap	Capped Samples	Percentile	Capped (%)	Lost Total (%)	Lost CV (%)	Mean	Variance	CV
Cu%	-	-	-	-	-	-	0.964	1.21	1.14
	8.94	2	99.84%	0.20%	0.27%	2%	0.962	1.17	1.12
	7.13	4	99.69%	0.30%	0.82%	4.40%	0.956	1.09	1.09
	5	11	99.54%	0.80%	2%	9%	0.944	0.97	1.04

Source: SRK, 2018

Table 14-8 presents the capping values used for the different areas of the project.

Table 14-8: Capping Values for the Areas of Bolivar Project

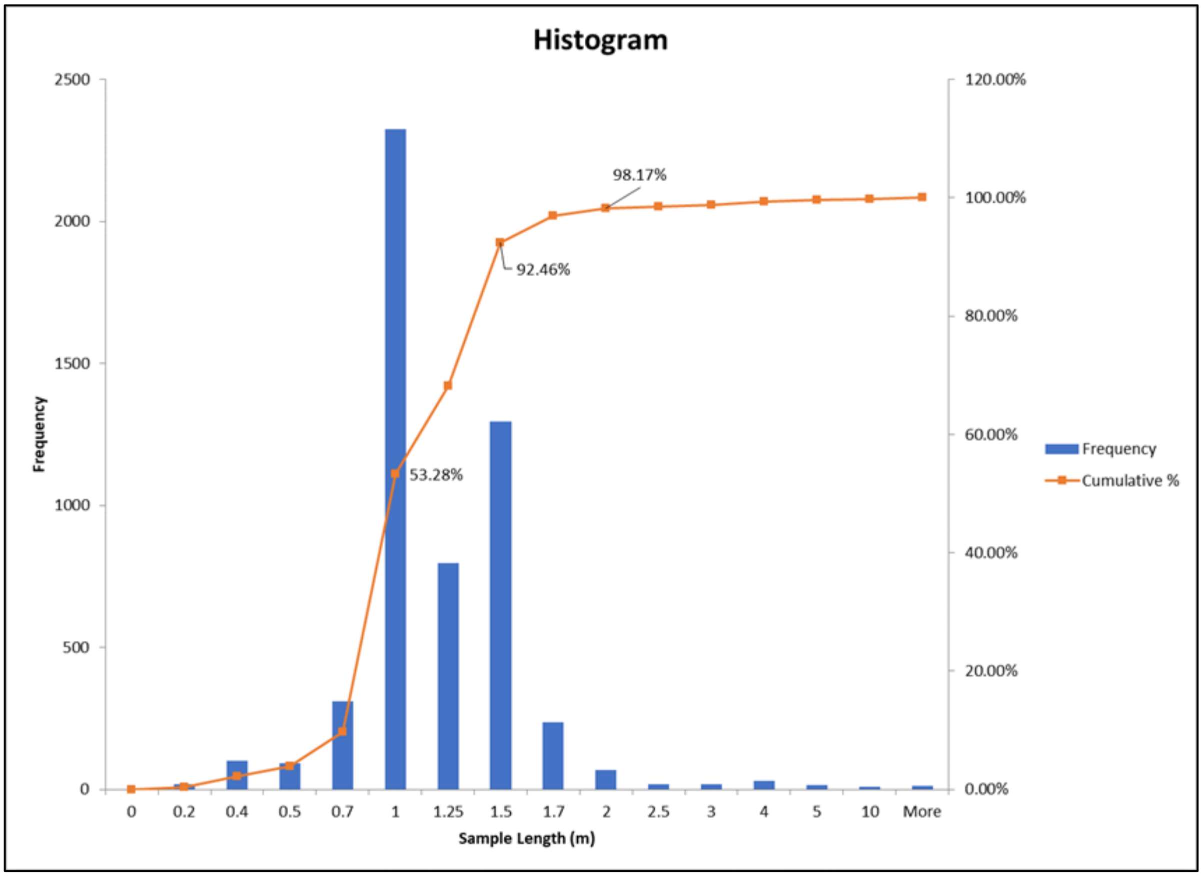
Area	Cu (%)	Zn (%)	Pb (%)	Ag (g/t)	Au (g/t)
Bolivar W	5.4	3.92	0.430	297	0.13
Chimneys	14.15	2.19	0.426	322	1.006
El Gallo Inferior/1830	5.00	4.32	0.167	130	4.04
El Gallo Superior	6.62	4.41	0.202	156	2.04
Bolivar_NW - ZN	0.786	6.60	0.080	81	2.34
Bolivar_NW_6900	3.65	5.79	0.096	209	5.00
Increible/Step Out	5.07	5.06	0.245	153	0.16

Source: SRK, 2018

14.3.2 Compositing

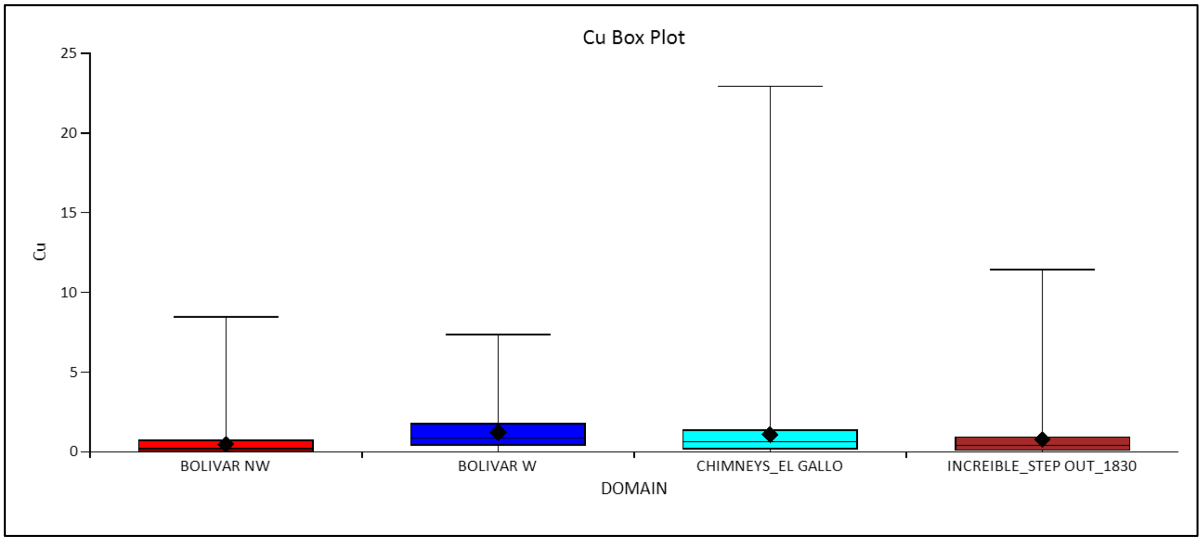
Assay sample intervals are composited to provide common support for statistical and geostatistical analysis and for estimation of resources. At intervals of 1.5 m and 2.0 m represent 92% and 98% of all sample lengths. A sample length of 2.0 m was selected as an optimal compositing interval. Although larger compositing intervals may reduce the variability of the composite a smaller composite length may allow finer definition of the bedding parallel mineralization. A histogram of drillhole sample lengths is provided in Figure 14-7. Compositing was undertaken by compositing each domain independently. Composite intervals were slightly modified so that any remainders were incorporated in the composite intervals. Based on this review, a nominal 2 m composite length is an appropriate composite size.

As capping analysis indicated no extremely high assays that would have a disproportionate influence, capping was undertaken previous to compositing. This is supported by box plots of copper values for flagged and composite data (Figure 14-8, Figure 14-9, Table 14-9, Table 14-10).



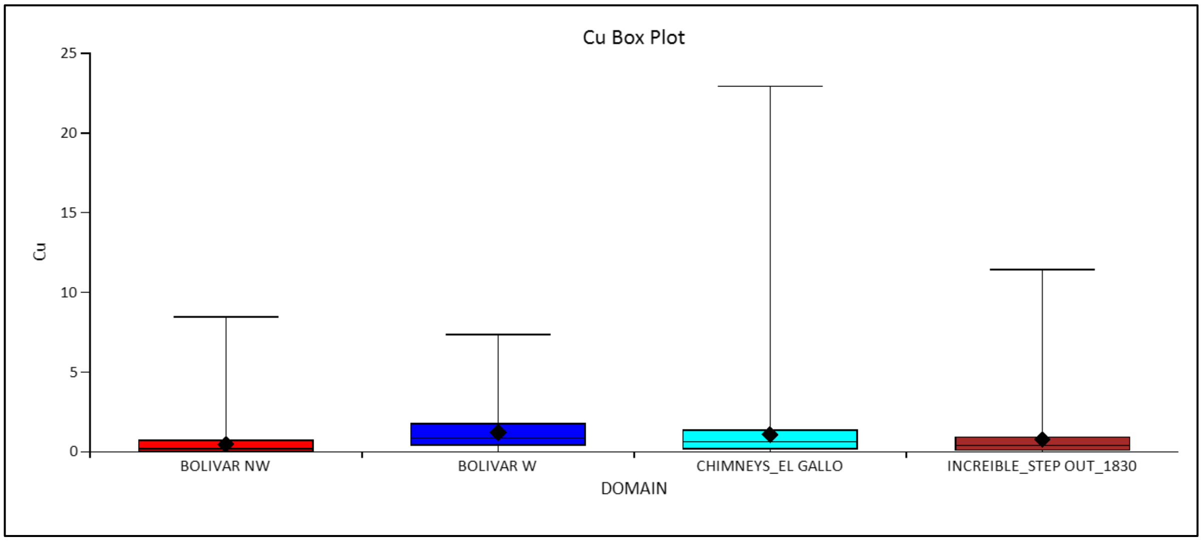
Source: SRK, 2018

Figure 14-7: Sample Length Histogram – Bolivar



Source: SRK, 2018

Figure 14-8: Box Plots for Cu Flagged Assay Intervals by Domain Group



Source: SRK, 2018

Figure 14-9: Box Plots for Cu Composited Assay Intervals by Domain Group

Table 14-9: Summary Statistics for Copper by Domain Groups Flagged Assays

Domain	Count	Weight	Min	Max	Mean	Variance	StDev	CV
Total	5,050	6,095	0	27.5	0.88	2.5	1.582	1.8
BOLIVAR NW	1,374	1,895	0	12.15	0.48	0.65	0.808	1.68
BOLIVAR W	446	558.4	0	17.7	1.207	2.16	1.469	1.22
CHIMNEYS_ELGALLO	2,785	3,194	0	27.5	1.076	3.58	1.891	1.76
INCREIBLE_STEP OUT_1830	445	447	0	11.75	0.775	2.04	1.43	1.84

Source: SRK, 2018

Table 14-10: Summary Statistics for Copper by Domain Groups Capped Assays

Domain	Count	Weight	Min	Max	Mean	Variance	StDev	CV
Total	3,084	6,095	0	22.936	0.88	1.88	1.373	1.56
BOLIVAR NW	957	1,895	0	8.472	0.48	0.49	0.7	1.46
BOLIVAR W	285	558.4	0	7.367	1.207	1.18	1.088	0.9
CHIMNEYS_EL GALLO	1,616	3,194	0	22.936	1.076	2.74	1.656	1.54
INCREIBLE_STEP OUT_1830	226	447	0.001	11.425	0.775	1.47	1.212	1.56

Source: SRK, 2018

14.4 Density

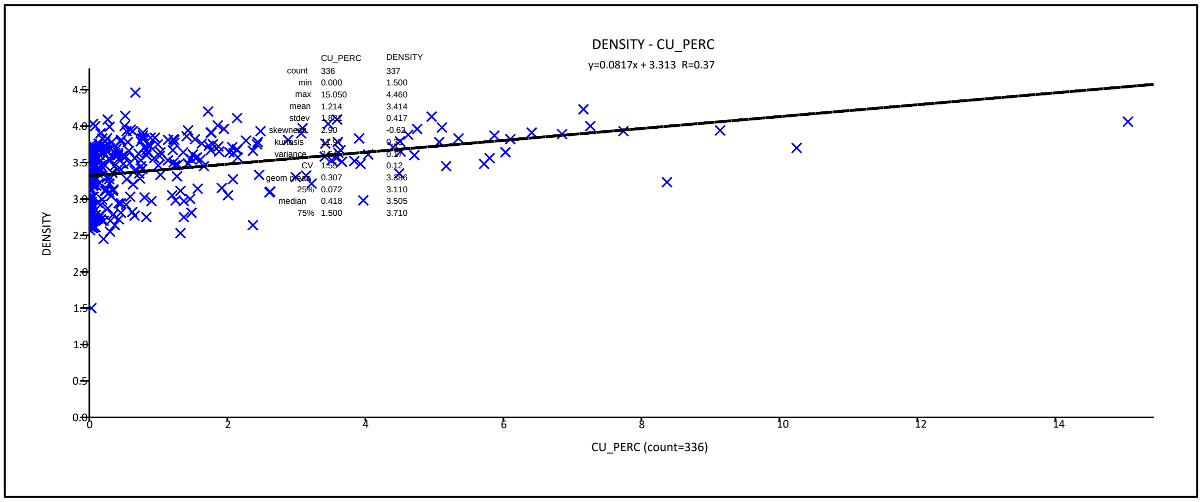
Density measurements have been taken at Bolivar from both drill core and hand samples from the underground workings.

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. 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 336 samples from these areas, with an average density of 3.414 g/cm^3. Considering only those samples where Cu >0.5%, the average density increases to 3.59 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. The actual density is likely variable, as densities measured from the drill core vary between 1.5 and 4.46 g/cm^3. Figure 14-10 shows the scatter plot of Cu% versus Density.

It is recommended to carry out a systematic density measurement program of the different rock types in the different areas of the Bolivar project, and code the bulk density accordingly.

Based on the issues discussed above, bulk density value of 3.70 g/cm^3 will be used for the estimation and reporting of resources. SRK considers this value reliable to the extent of supporting Indicated resources. Enough uncertainty exists in the usage of a single average density to characterize the variable nature of the mineralization that it would be inappropriate to consider classification of the resources as Measured.



Source: SRK, 2018

Figure 14-10: Scatter Plot Cu% vs Density (g/cm^3)

14.5 Variography

SRK used Isatis© software to model spatial continuity of copper, silver, gold, lead and zinc. Capped composites for each domain or combination of domains were used for this analysis. Channel samples were not used. Correlograms were used for this analysis. Reliable variograms were obtained from domains with larger data sets, El Gallo Inferior and La Increible domains. A combination of the two Chimenea domains provide the most reliable correlograms. Differences in variogram orientations between metals was not evident. Correlograms were weakly sensitive to minor changes in variogram axis' directions, most likely due to limited data points and undulating domain surfaces. A total of 18 variograms were modelled for the Project. A summary of variogram parameters are summarized in Table 14-11, Table 14-12 and Table 14-13. Selected example correlograms are shown in Figure 14-11, Figure 14-12 and Figure 14-13.

Table 14-11: Correlogram Parameters Chimenea 1 and 2

								Datamine™ Rotation		
Variable	**Domain**	**C_0**	**CC**	**Structure Model**	**Rx (m)**	**Ry (m)**	**Rz (m)**	**Z**	**X**	**Z**
Cu	501, 502	0.452	0.148	Spherical	15.0	15.0	9.0	20	69	-90
			0.371	Spherical	30.0	30.0	25.0	20	69	-90
			0.029	Spherical	103.0	103.0	35.0	20	69	-90
Ag	501, 502	0.189	0.011	Spherical	5.0	5.0	3.0	20	69	-90
			0.146	Spherical	25.0	20.0	14.0	20	69	-90
			0.654	Spherical	40.0	40.0	24.0	20	69	-90
Au	501, 502	0.522	0.326	Spherical	15.0	15.0	7.7	20	69	-90
			0.152	Spherical	23.0	23.0	21.0	20	69	-90
Fe	501, 502	0.339	0.579	Spherical	27.0	27.0	25.0	20	69	-90
			0.082	Spherical	115.0	115.0	55.0	20	69	-90
Pb	501, 502	0.231	0.125	Spherical	20.0	20.0	10.0	20	69	-90
			0.644	Spherical	39.0	39.0	15.0	20	69	-90
Zn	501, 502	0.157	0.706	Spherical	25.0	25.0	18.5	20	69	-90
			0.137	Spherical	55.0	55.0	22.0	20	69	-90

Source: SRK, 2018

Table 14-12: Correlogram Parameters El Gallo Inferior

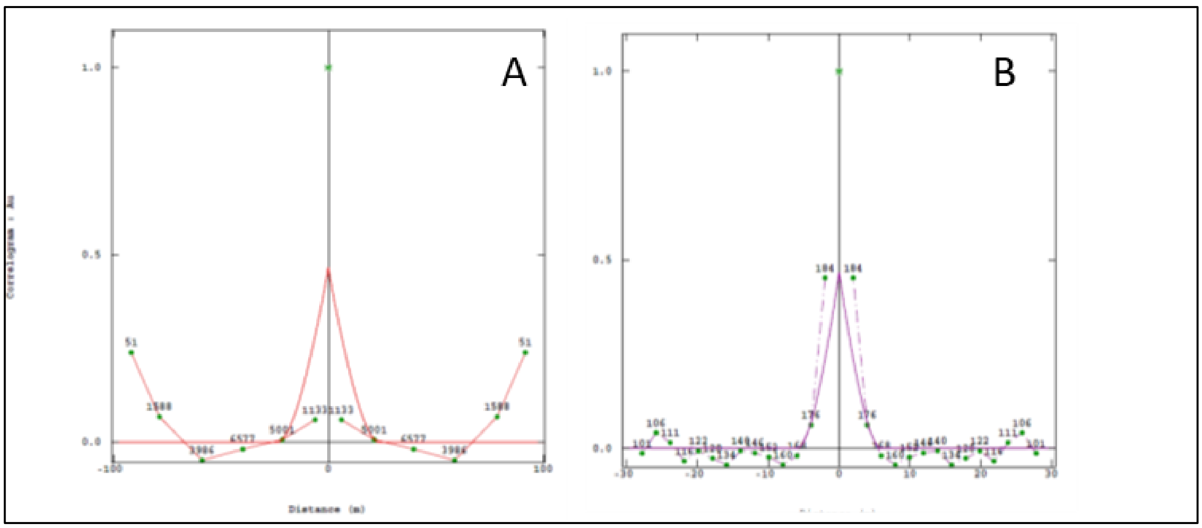
								Datamine™ Rotation		
Variable	**Domain**	**C_0**	**CC**	**Structure Model**	**Rx (m)**	**Ry (m)**	**Rz (m)**	**Z**	**X**	**Z**
Cu	600	0.095	0.492	Spherical	30.0	30.0	3.8	-152	27	-90
			0.366	Spherical	55.0	55.0	20.0	-152	27	-90
			0.050	Spherical	113.0	113.0	50.0	-152	27	-90
Ag	600	0.379	0.398	Spherical	48.0	33.0	12.0	-152	27	-90
			0.223	Spherical	57.0	93.0	19.0	-152	27	-90
Au	600	0.632	0.218	Spherical	25.0	25.0	4.0	-152	27	-90
			0.150	Spherical	81.0	81.0	6.0	-152	27	-90
Fe	600	0.157	0.253	Spherical	18.0	18.0	12.0	-152	27	-90
			0.590	Spherical	58.0	58.0	16.0	-152	27	-90
Pb	600	0.650	0.160	Spherical	20.0	20.0	7.0	-152	27	-90
			0.190	Spherical	93.0	93.0	25.0	-152	27	-90
Zn	600	0.666	0.238	Spherical	25.0	25.0	10.5	-152	27	-90
			0.096	Spherical	132.0	132.0	15.0	-152	27	-90

Source: SRK, 2018

Table 14-13: Correlogram Parameters La Increible

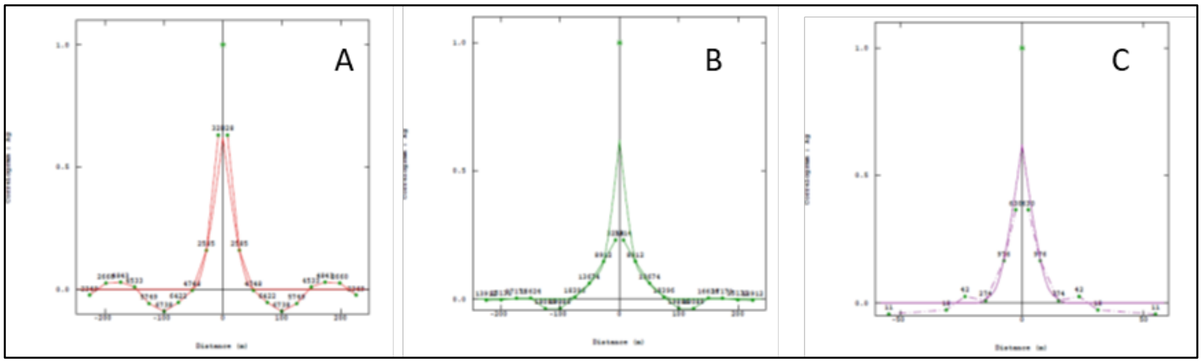
								Datamine™ Rotation		
Variable	**Domain**	**C_0**	**CC**	**Structure Model**	**Rx (m)**	**Ry (m)**	**Rz (m)**	**Z**	**X**	**Z**
Cu	800	0.434	0.355	Spherical	25.0	25.0	5.0	-26	70	-90
			0.211	Spherical	29.0	29.0	10.0	-26	70	-90
Ag	800	0.574	0.146	Spherical	8.0	8.0	3.0	-26	70	-90
			0.280	Spherical	25.0	25.0	7.5	-26	70	-90
Au	800	0.534	0.012	Spherical	5.0	5.0	2.0	-26	70	-90
			0.454	Spherical	24.0	24.0	6.0	-26	70	-90
Fe	800	0.089	0.001	Spherical	10.0	15.7	6.0	-26	70	-90
			0.910	Spherical	30.0	28.2	30.0	-26	70	-90
Pb	800	0.250	0.140	Spherical	4.0	4.0	5.0	-26	70	-90
			0.780	Spherical	10.0	10.0	8.0	-26	70	-90
			0.542	Spherical	29.0	29.0	21.0	-26	70	-90
Zn	800	0.509	0.059	Spherical	15.0	15.0	10.0	-26	70	-90
			0.432	Spherical	27.0	27.0	25.0	-26	70	-90

Source: SRK, 2018



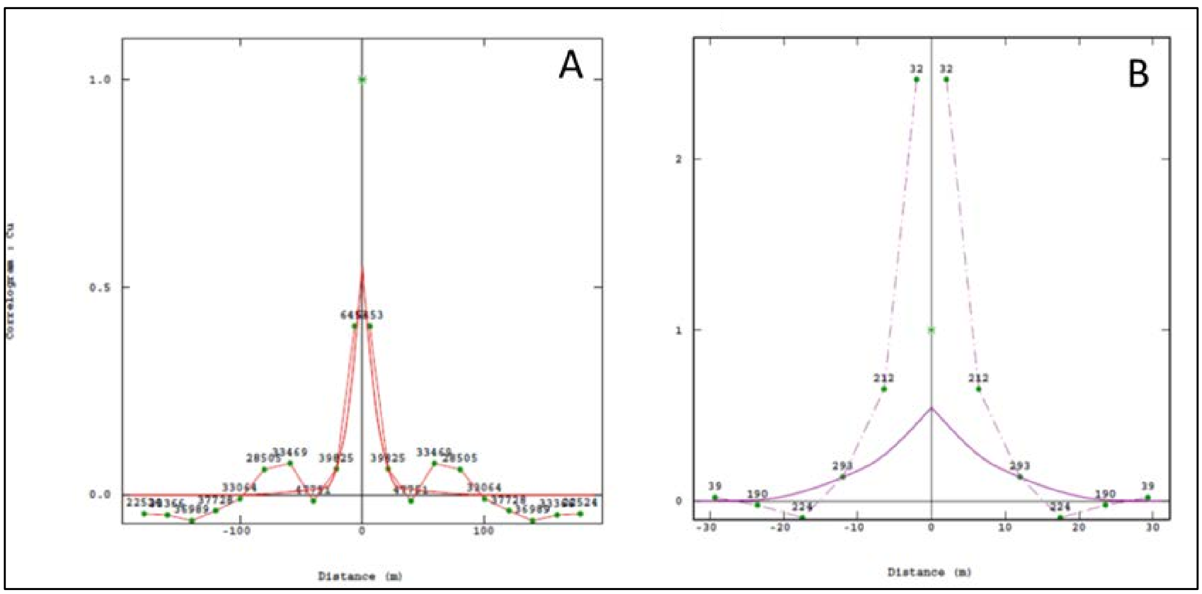
Source: SRK, 2018
A = major-semi-major axis.
B = normal axis.

Figure 14-11: Correlograms for La Increible Gold



Source: SRK, 2018
A = major axis.
B = semi normal axis.
C = normal axis

Figure 14-12: Correlograms for El Gallo Inferior Silver



Source: SRK, 2018
A = major-semi-major axis.
B = normal axis.

Figure 14-13: Correlograms for Chimenea Domains

14.6 Block Model

Block models were generated for each of the 17 domains. The block models were orientated along the mineralization azimuth trend for each domain. Each model was defined by a unique model definition.

Domain blocks were aligned parallel to the horizontal trend of mineralization. The block size for each model was 6 m x 6 m x 3 m in the X, Y and Z local coordinate directions. The block size is a compromise between variable drillhole spacing and mining selectivity blocks. Each domain model is sub-blocked to 1 m in X, Y and Z directions. The orientation of mineralization trends of each domain is summarized in Table 13-6. Model definitions are based on azimuths converted into Datamine™ Studio RM Z X Z axis rotations. Each model was based on a 200 m margin in X, Y, and Z local directions.

Table 14-14: Domain Mineralization Trends

Domain	Azimuth (°)	Dip Direction (°)	Dip (°)
100	134	44	-20
301	307	37	-40
302	352	82	-17
303	302	32	-27
304	326	56	-32
305	37	307	-27
306	57	327	-16
401	70	160	-22
402	83	173	-45
501	110	200	-69
502	107	197	-59
600	118	28	-27
700	103	13	-39
800	64	154	-70
1000	67	337	-31
2000	52	142	-21
3000	169	259	-81

Source: SRK, 2018

14.7 Estimation Methodology

The estimation strategy for the resource estimate was to estimate as closely as reasonable mineralization that is associated with bedding planes. As the Bolivar mineralization is undulating, and in some cases folded, it is important to guide the estimation along these variations. This is undertaken by using dynamic anisotropy as implemented by Datamine™ software.

The first step in the estimation process is to generate dip and dip direction vectors that can be estimated into the domain block model. SRK used the footwall and hangingwall wireframe surfaces that define the domain solid model. A Datamine™ process converts each wireframe surface triangle into a dip and dip direction vector. This vector is then estimated into the domain block model using nearest neighbor or a Datamine™ process that uses inverse distance estimation for this data. For this estimation SRK used the following a three-pass nested search:

- First Pass: 100 m spherical search, minimum number of points 3, maximum of 8;
- Second Pass: 200 m spherical search, minimum number of points 3, maximum 10; and
- Third Pass: 400 m spherical search, minimum number of points 2, maximum 20.

The dynamic anisotropy values for dip and dip-direction are used for the estimation of metals. The estimation search ellipsoid is oriented according to these values for each block estimate and should result in the estimate that reasonably follows mineralization trends.

Three domains were not estimated using dynamic anisotropy because they were very small, 1830 and Northwest 2 and 5 domains as they are relatively flat tabular solids.

Metal grades are interpolated using ordinary kriging. Each metal is interpolated in four nested passes. Variogram parameters for El Gallo Inferior, La Increible, and the two Chimenea domains are used in the estimations in these areas. For all other estimates, the variogram parameters for the Chimenea domains are assumed for each metal, with the exception that the orientation of the variogram is replaced by the mineralization trend of each domain.

Estimation search ellipse ranges are developed based on trials of estimation parameters, using a combination of variogram ranges, data spacing and in some cases adjustments to for the size or configuration of the domain. Five estimation range types have been assigned to each domain as outlined in Table 14-15. The first estimation run has an ellipsoid range of 15 m x 15 m x 5 m and is used to estimate mineralization trends at a small scale in areas with close spaced drilling. This run also limits the influence of channel samples as a combined file of capped composites and channel samples is used only with this run. The following estimation passes, 2 to 4 are estimated with capped composites from drilling data only. SRK did not find indications that silver, gold, copper, lead or zinc mineralization was significantly different between the two data types, considering the highly variable drillhole spacing over each domain. Variography, although limited in terms of numbers of data points for the domains, may indicate a high variability in grade distributions and possible continuity of grades that may be less than the average drillhole spacing. Based in these observations, the same search ellipsoid ranges have been applied to each of the six metals estimated.

Table 14-15: Summary of Estimation Parameters

						Ranges			
Variable	**Estimator**	**Domain**	**Estimation Run**	**Minimum**	**Maximum**	**SVx (m)**	**SVy (m)**	**SVz (m)**	**Maximum Composites Per Drillhole**
Cu, Au, Ag, Zn, Pb	Ordinary Kriging	100, 301-306, 1000, 2000	1	3	5	15	15	5	3
			2	3	10	25	25	5	3
			3	3	10	75	75	15	3
			4	3	10	200	200	40	3
Cu, Au, Ag, Zn, Pb	Ordinary Kriging	401, 402	1	3	5	15	15	5	3
			2	3	10	25	25	10	3
			3	3	10	38	38	38	3
			4	1	10	200	200	80	3
Cu, Au, Ag, Zn, Pb	Ordinary Kriging	501, 502	1	3	5	15	15	5	3
			2	3	10	25	25	25	3
			3	3	10	75	75	75	3
			4	3	10	200	200	200	3
Cu, Au, Ag, Zn, Pb	Ordinary Kriging	600, 700, 800	1	3	5	15	15	5	3
			2	3	10	25	25	5	3
			3	3	10	75	75	15	3
			4	3	10	200	200	40	3
Cu, Au, Ag, Zn, Pb	Ordinary Kriging	3000	1	3	5	15	15	5	3
			2	3	10	25	25	15	3
			3	3	10	75	75	45	3
			4	3	10	200	200	120	3

Source: SRK, 2018

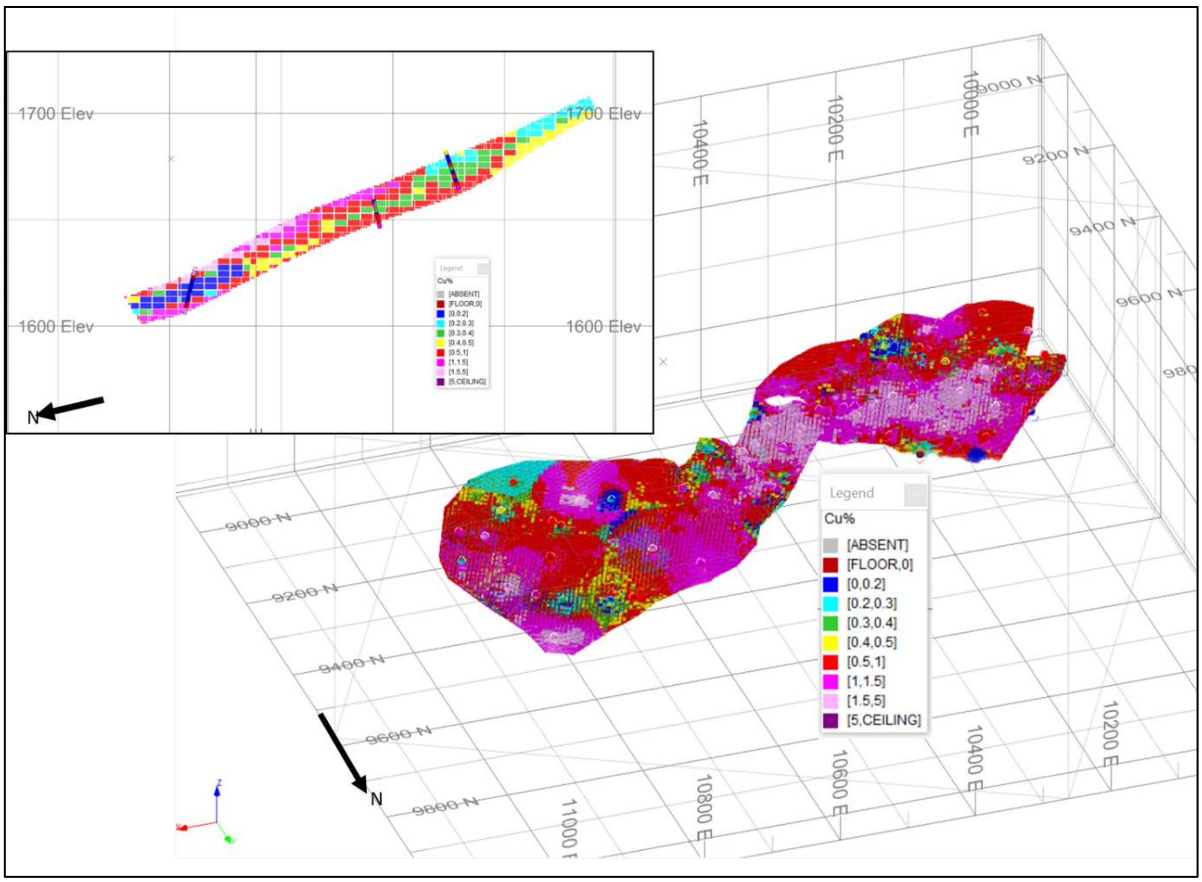
14.8 Model Validation

SRK has validated the resource estimate using visual comparison, comparing nearest neighbor estimate means with capped composite means and swath plots. In addition to the above validation tests SRK also plotted model and composite means by reblock the selected domain models at a larger block size 40 m x 40 m x 20 m. This analysis indicated reasonable results however size and extent of larger selected domain models was too small to provide a good analysis.

The optimal validation procedures for the Bolivar project is visual comparison and similarly while swath plot developed for the project are reasonable many domains are too limited in size for this analysis. SRK considers that visual comparison of composites and block models reflect the grades and the stratigraphic control of the mineralization.

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 of the Bolivar area is a reasonable and appropriate for the deposit type. An example of this the El Gallo Domain shown in Figure 14-14. This domain shows good continuity of copper grades with the block model and composites in a 3D perspective view and in Section.

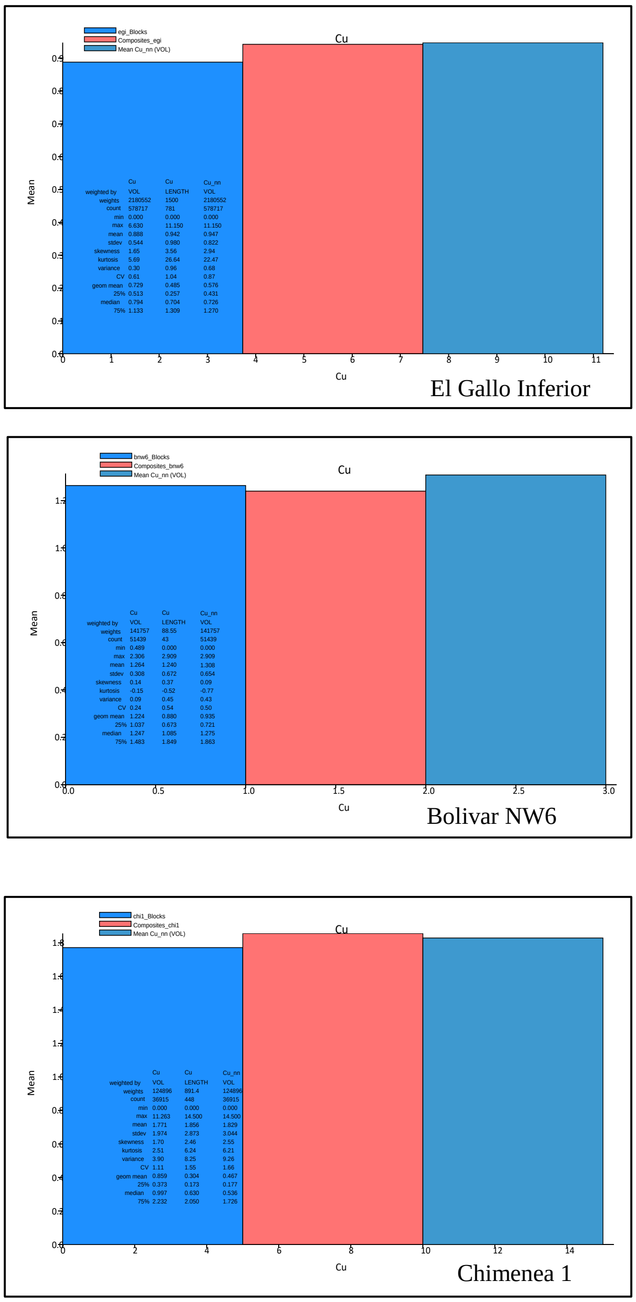


Source: SRK, 2018

Figure 14-14: Bolivar Visual Comparison, El Gallo Inferior

14.8.2 Comparative Statistics

SRK reviewed block averages, composites and the mean of nearest neighbor estimate of copper for each domain. SRK considered nearest neighbor declustering for the composites for this analysis. However, plots of declustered and un-declustered data showed enough similarity to consider just composites for this analysis. The analysis indicates a reasonable similarity between copper means for block model, composites and nearest neighbor estimates. Examples of this are presented for domains El Gallo Inferior, Bolivar Northwest 6 and Chimenea 1 in Figure 14-15. Some domains such as La Increible, Northwest 2 and 3 are have moderately higher nearest neighbor or block estimate means. However, these domains are typically small, have a limited set of drill holes or have a sharp contrast in closely spaced drilling and widely spaced drilling which adversely affects the mean comparison. Overall SRK considers the results for this analysis as a reasonable validation of domain estimates. There are no indications of systematic bias for the estimate.



Source: SRK, 2018

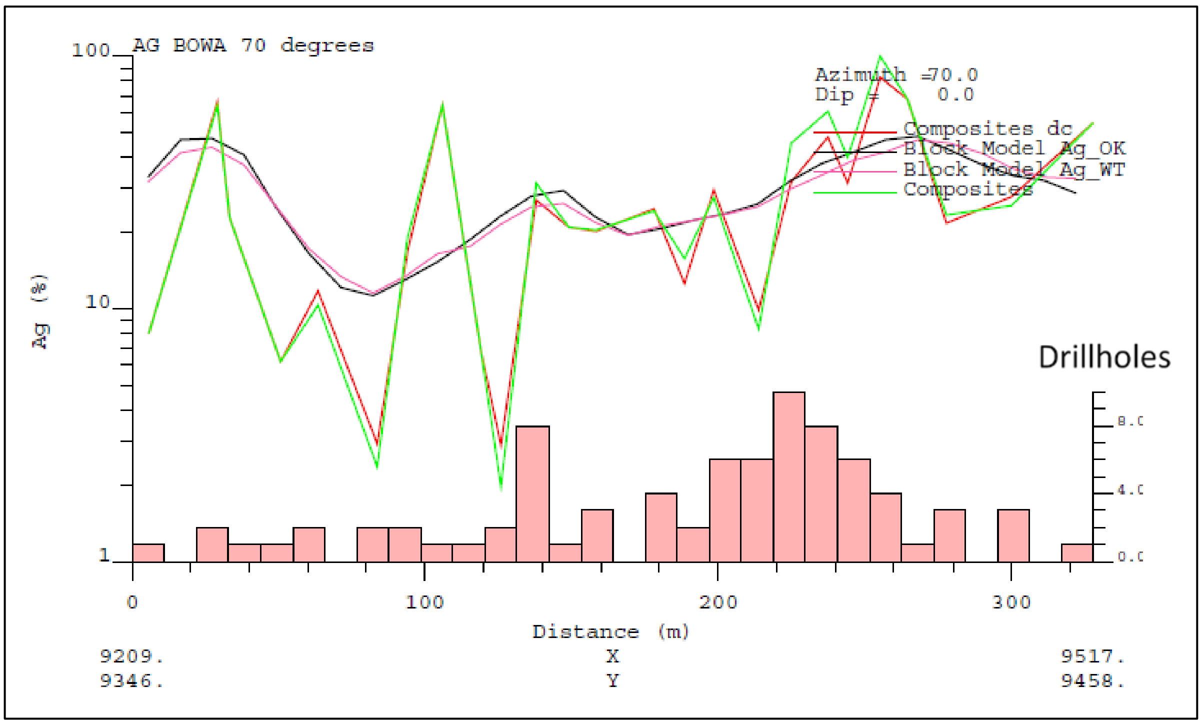
Figure 14-15: Copper Mean Plot of Domain Estimate, Composites and Nearest Neighbor Estimate

14.8.3 Swath Plots

Swath plots provide local comparison between the blocks to and the composites is made using swath plots. These plots show both the varying means of the block and composites (declustered and not declustered) along swaths. The swath plots are an indication 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. Composite trends can be more variable than estimation trends but on average they block model trends. However, the trends should be similar. Departures from this trend can occur in areas of widely spaced drilling. For the Bolivar project drilling spacing can be variable and therefor plots may more variability in the composite plots can be expected. Overall swath plots for Bolivar show a reasonable similar trend for estimated block grades and composite grades. Swath plots for Bolivar West A and B are presented in Figure 14-16 and Figure 14-17.

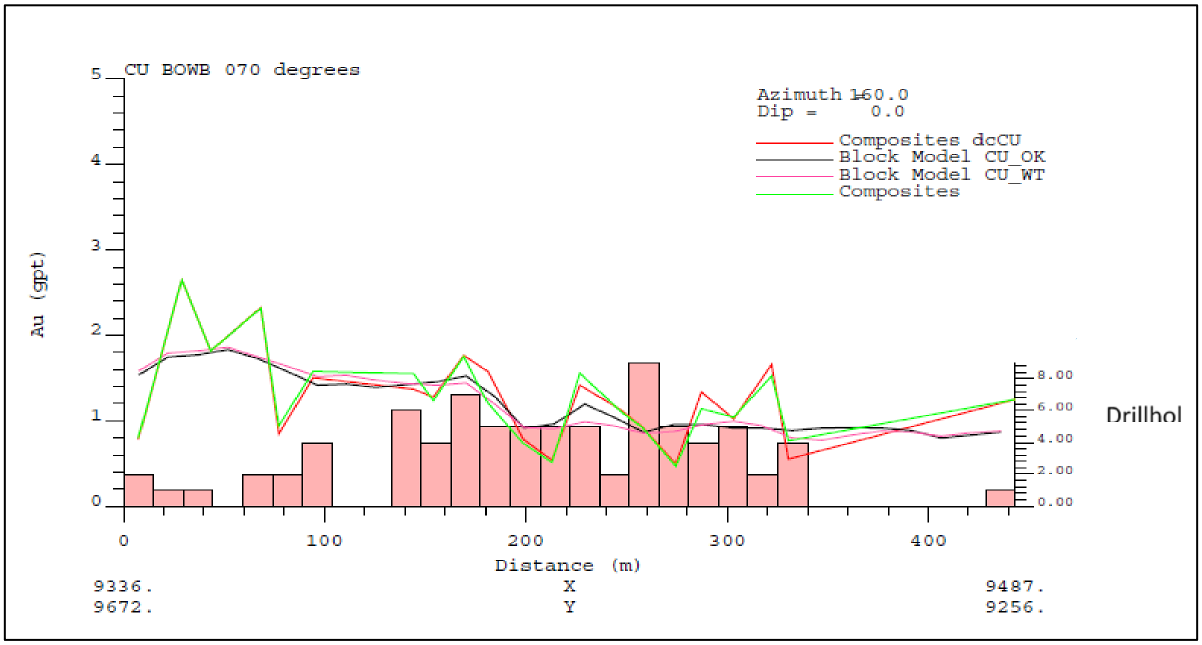
These plots are approximately parallel to the mineralization trend. Swath plots are used mainly for the large domains at Bolivar.

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, 2018

Figure 14-16: Swath Plot for Silver Bolivar West A



Source: SRK, 2018

Figure 14-17: Swath Plot for Copper, Bolivar West B

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;
- Lack of density tests of the different mineralization and rock types for all the areas;
- 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, 2014). 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.

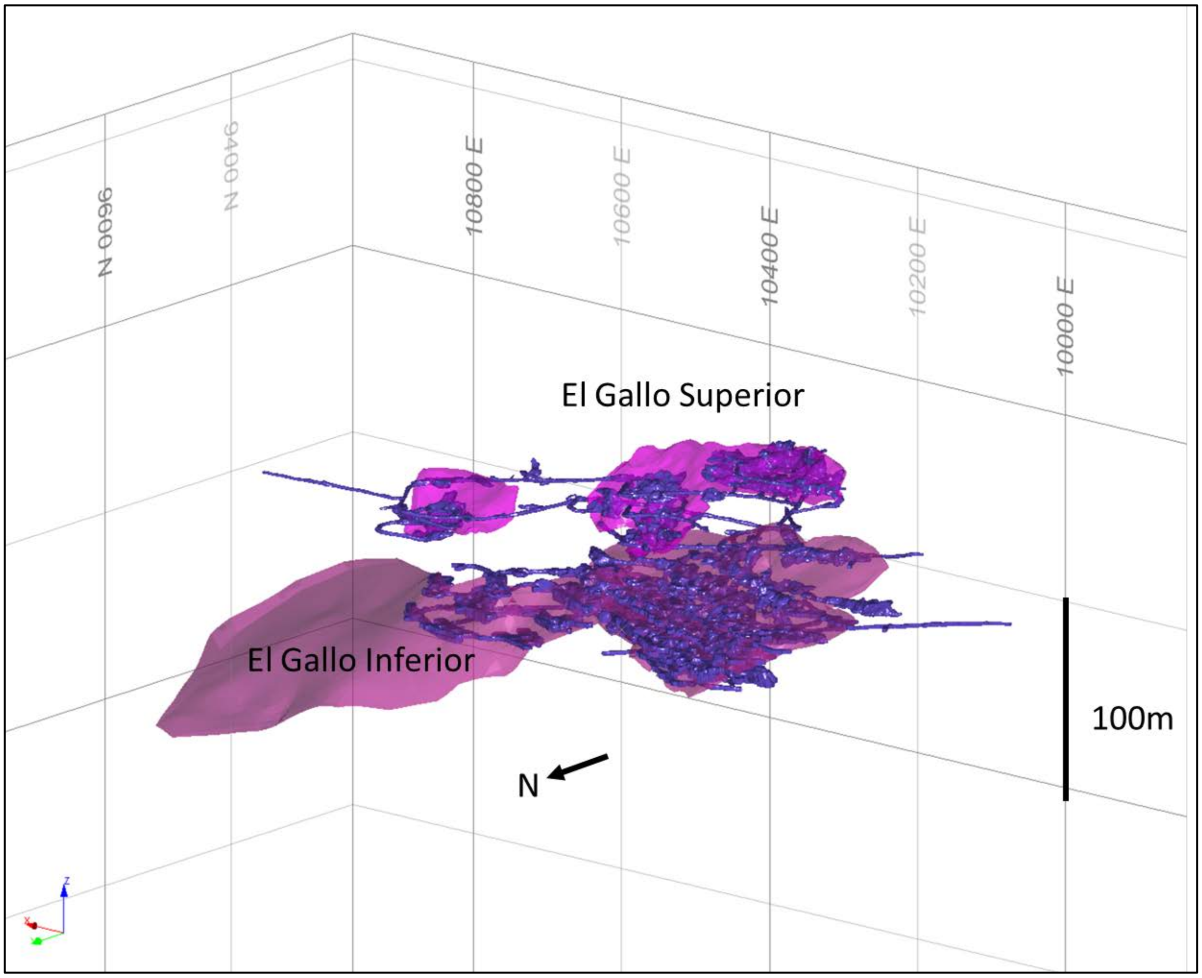
The general category for classification is as follows:

- Indicated: Blocks estimated by any of the first three estimation passes (up to 75 m) forming clusters of mineralization, nominally containing five drillholes. Areas define by fewer than three drillholes were excluded; for smaller domains the criteria was relaxed to three drillholes. Further, only areas with approximately three or more drillholes from 2016 to 2017 were classified as Indicated to address any concerns about QA/QC deficiencies in older drillholes.
- All estimated blocks not assigned to the Indicated category were assigned to the Inferred category.

14.10 Depletion for Mining

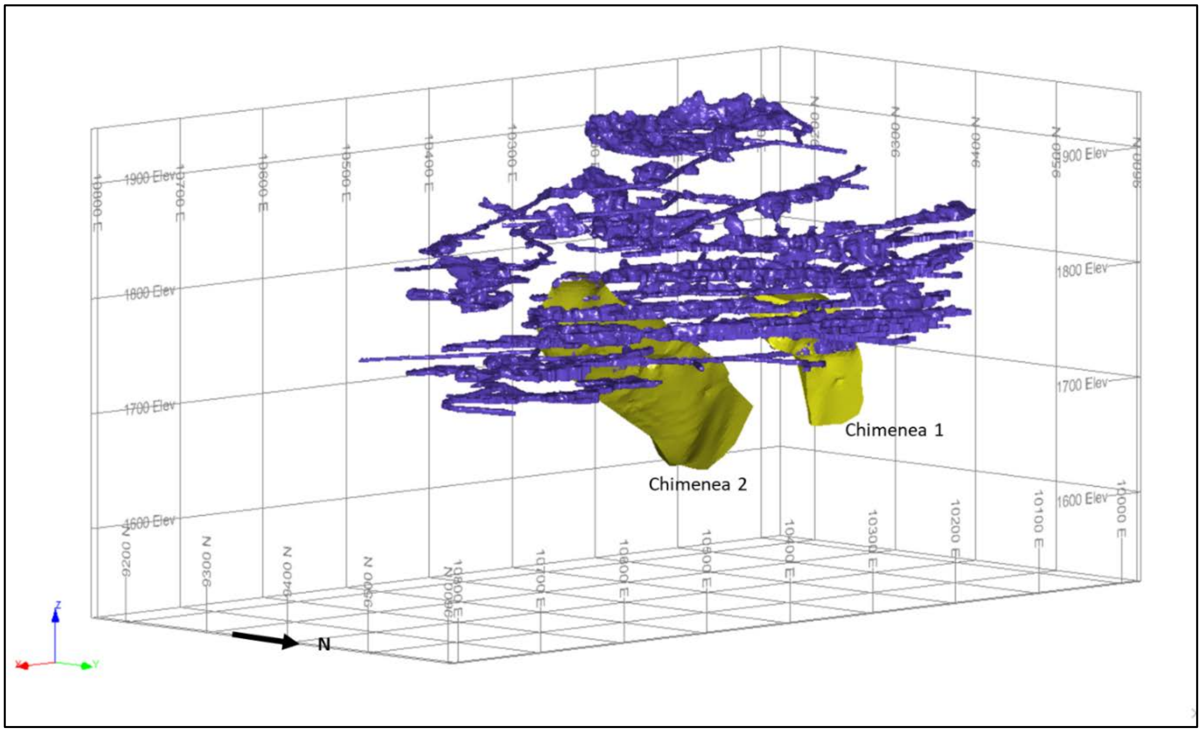
Bolivar has been actively mined since 2007. Ending in 2017, most of the production areas were surveyed using a Total Station (TOPCON GTS-305) to generate the points cloud to generate the solids of the exploited areas using AutoCAD®, MineSight™ and MeshLab software.

SRK used wireframes from a recently completed survey to deplete the El Gallo Superior, Inferior, and Chimenea 1 and 2 block models for reporting resources. This model of depleted areas provides the best coverage for these domains. The depletion model and a wireframe surface of the domains are shown in Figure 14-18 and, Figure 14-19.



Source: SRK, 2018

Figure 14-18: El Gallo Domains and Depletion Model, Looking South-Southeast



Source: SRK 2018

Figure 14-19: Chimenea Domains and Depletion Model, Looking Southwest

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 CoG 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 October 31, 2017, consolidated mineral resource statement for the Bolivar Mine area is presented in Table 14-16. 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 **Error! Reference source not found.**.

Table 14-16: Consolidated Bolivar Mineral Resource Estimate as of October 31, 2017 – SRK Consulting (U.S.), Inc.

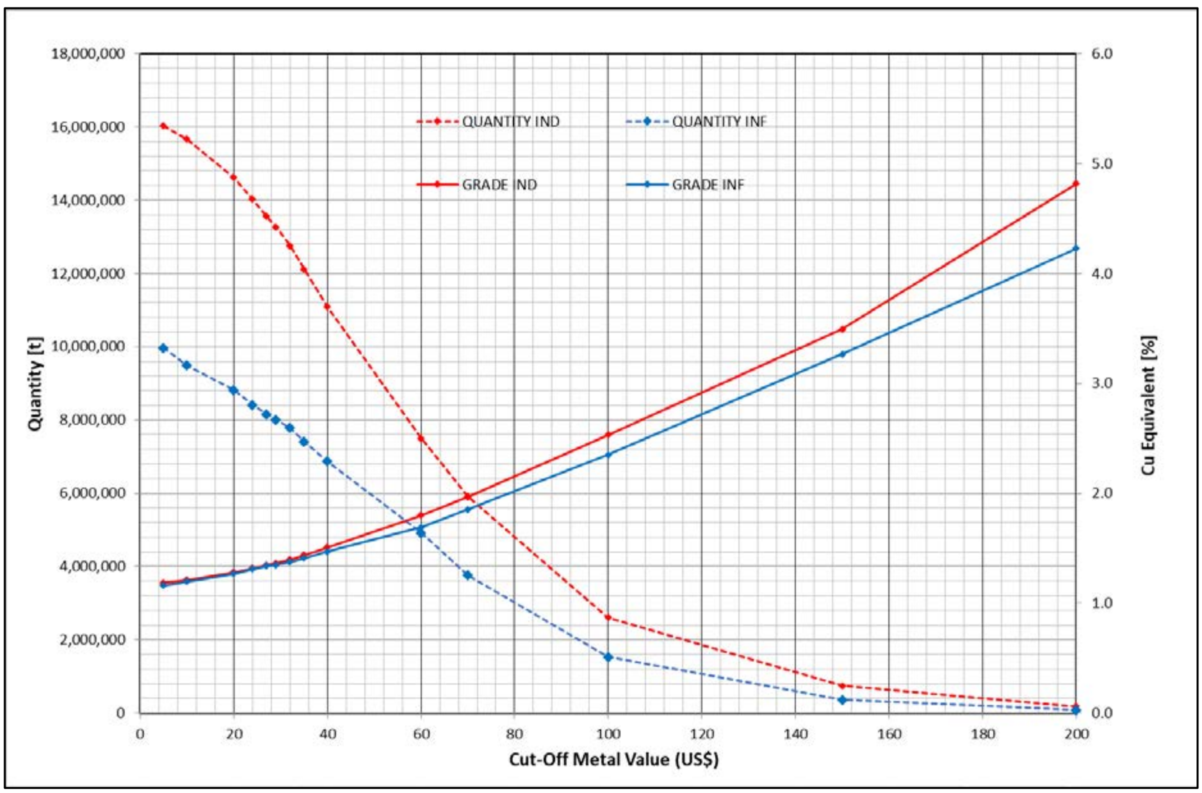
Category	Tonnes (000's)	Ag (g/t)	Au (g/t)	Cu (%)	Ag (koz)	Au (koz)	Cu (t)
Indicated	13,267	22.5	0.29	1.04	9,616	124	137,537
Inferred	8,012	22.4	0.42	0.96	5,779	109	76,774

(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 CoG's based on metal price assumptions*, metallurgical recovery assumptions**, mining/transport costs (US$17.95/t), processing costs (US$8.33/t), and general and administrative costs (US$2.41/t).
(3) The metal value CoG for the Bolivar Mine is US$29 No mineral resources are not reported for remaining pillars.

* Metal price assumptions considered for the calculation of metal value are: US$3/lb Cu, US$18.25/oz Ag, and US$1,291/oz Au.
** Metallurgical recovery assumptions are 83% Cu, 78% Ag, and 64% Au.

14.12 Mineral Resource Sensitivity

SRK generated a grade-tonnage chart to illustrate the fluctuations of tonnage and CuEq grades as a function of metal value cut-off (Figure 14-20). Table 14-17 and Table 14-18 provide tonnage and grade sensitivity for Indicated and Inferred Resources, respectively.



Source: SRK, 2018

Figure 14-20: Sensitivity Analysis Copper Grades and Tonnage Indicated and Inferred Resources

Table 14-17: Tonnage and Grade Sensitivity Indicated Resources

Cut-off (US$)	Ag (g/t)	Au (g/t)	Cu (%)	Pb (%)	Quantity (t)	Ag (oz)	Au (oz)	Cu (lb)	Pb (lb)	CuEq (%)
5	19.6	0.25	0.90	0.01	16,033,954	10,111,000	131,000	144,000	9,000	1.19
10	20.0	0.26	0.92	0.01	15,672,978	10,070,000	130,000	144,000	8,000	1.21
20	21.1	0.27	0.98	0.01	14,622,224	9,903,000	127,000	143,000	8,000	1.28
24	21.7	0.28	1.00	0.01	14,032,141	9,793,000	126,000	141,000	8,000	1.32
27	22.2	0.29	1.02	0.01	13,563,212	9,685,000	124,000	139,000	7,000	1.35
29	22.5	0.29	1.04	0.01	13,267,270	9,616,000	124,000	138,000	7,000	1.36
32	23.1	0.29	1.06	0.01	12,763,844	9,479,000	121,000	135,000	7,000	1.39
35	23.9	0.31	1.09	0.01	12,118,562	9,324,000	119,000	132,000	7,000	1.44
40	25.2	0.32	1.15	0.01	11,088,508	9,000,000	113,000	127,000	6,000	1.51
60	31.5	0.36	1.36	0.02	7,494,487	7,578,000	87,000	102,000	7,000	1.80
70	35.4	0.38	1.49	0.02	5,915,156	6,729,000	73,000	88,000	6,000	1.97
100	49.1	0.49	1.89	0.03	2,607,727	4,115,000	41,000	49,000	3,000	2.53
150	71.9	0.81	2.51	0.04	742,636	1,718,000	19,000	19,000	1,000	3.49
200	101.4	0.76	3.61	0.07	183,745	600,000	4,000	7,000	1,000	4.82

Source: SRK, 2018

Table 14-18: Tonnage and Grade Sensitivity Inferred Resources

Cut-off (US$)	Ag (g/t)	Au (g/t)	Cu (%)	Pb (%)	Quantity (t)	Ag (oz)	Au (oz)	Cu (lb)	Pb (lb)	CuEq (%)
5	19.5	0.36	0.82	0.01	9,966,061	6,240,000	115,000	82,000	4,000	1.16
10	20.1	0.37	0.85	0.01	9,490,802	6,121,000	114,000	81,000	4,000	1.20
20	21.1	0.40	0.90	0.01	8,822,243	5,987,000	112,000	79,000	3,000	1.27
24	21.8	0.41	0.93	0.01	8,410,958	5,885,000	110,000	79,000	3,000	1.31
27	22.2	0.42	0.95	0.01	8,158,836	5,813,000	110,000	78,000	3,000	1.34
29	22.4	0.42	0.96	0.01	8,011,772	5,779,000	109,000	77,000	3,000	1.35
32	22.9	0.43	0.98	0.01	7,787,782	5,725,000	108,000	76,000	3,000	1.37
35	23.7	0.44	1.00	0.01	7,408,846	5,653,000	105,000	74,000	3,000	1.41
40	24.9	0.46	1.04	0.01	6,869,260	5,492,000	102,000	72,000	3,000	1.47
60	29.5	0.54	1.19	0.01	4,924,374	4,675,000	85,000	58,000	2,000	1.69
70	33.2	0.59	1.29	0.01	3,755,104	4,006,000	72,000	49,000	2,000	1.85
100	42.0	0.69	1.67	0.01	1,532,727	2,070,000	34,000	26,000	1,000	2.35
150	59.7	0.79	2.39	0.01	366,108	703,000	9,000	9,000	0	3.27
200	69.9	0.55	3.38	0.03	80,712	182,000	1,000	3,000	0	4.23

Source: SRK, 2018

14.13 Previous Resource Estimates

A resource estimate for the Bolivar Mine was reported in September 2016 by SRK Consulting (U.S), Inc. The MRE is summarized in Table 14-19.

Table 14-19: 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

Source: SRK, 2016

Compared to the previous 2016 estimated mineral resources, Indicated tonnage has increased by 31% (3,932kt), silver and copper grades have increased by 19% (4.4 g/t Ag) and 12% (0.14% Cu, Au has slightly decreased by 5% (0.1 g/t Au), metal content increased 44% (4.176 oz Ag) for silver, 27% 33 oz Au) for Au and 40% (53,652 t) copper.

These changes can be attributed a net increase in mineralization volume and extensive drilling in high grade areas in Bolivar West and Northwest areas as well as other areas. Increases in tonnage and grade also reflect upgrading previous Inferred areas to Indicated with closely spaced drilling. Slight decrease in Au grades may be attributed to generally low grade values and high variability at these grades. Increased volumes of mineralization together with delineating more high grades mineralization has resulted in increasing contained metal significantly, particularly copper

Inferred resources tonnages has decreased by 11% (1,043 kt), silver gold and copper grades have increased by 19% (4.5% Ag), 21% (0.09 g/t Au) and 10% (0.10% Cu) respectively, metal content increased for 11% (579 oz Ag) for silver and 12% (1,056 t Cu) for copper, with a marginal increase for gold (12 oz Au).

The previous resource estimation also included a small amount of Measured resource in pillars of El Gallo which were mapped and surveyed. SRK was not provided with the updated survey information for these pillars for this study, and thus no Measured resources were stated in these areas.

14.14 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

This section summarizes the key assumptions, parameters, and methods used in the preparation of the Mineral Reserve estimate for the Bolivar Mine.

15.1 Estimation Methodology

The reserve estimation procedure used for Bolivar was to:

1. Review the geological information and resource block model for selection of applicable mining method.
2. Determine the modifying factors based on mining method, and using historical mine to mill reconciliation.
3. Determine the economic and marginal cut-off values.
4. Outline the potentially mineable areas using mineable shape optimizer (MSO).
5. Apply the modifying factors to each potentially mineable shape.
6. Evaluate if the potentially mineable shape value is greater than the cut-off value to determine if the shape is economic.
7. Refine the mineable areas through removal of shapes that are uneconomic and/or isolated from more substantial mining areas.
8. Generate the mine design including development access and infrastructure required to mine the stope shapes.
9. Generate the mine sequence and production schedule.
10. Use production and development profiles to perform cash flow modeling and application of operating and capital costs.
11. Prepare the Mineral Reserve Statement.

The reserve estimation process outlined above is consistent with industry best practice.

The reserve estimation procedure is completed for each orebody and then combined to generate the consolidated Bolivar LoM plan. The orebodies contained in the reserve estimation herein are the El Gallo Inferior, Chimenea 1, Chimenea 2, Bolivar Northwest, and Bolivar West. The mining method used in El Gallo Inferior is room and pillar (R&P). Room and pillar mining is also planned for shallow dipping ore in Bolivar West, and Bolivar Northwest. Steeper dipping orebodies in Chimenea 1, Chimenea 2, and Bolivar West are planned for extraction using longhole stoping (LHS) without backfill techniques.

15.2 Modifying Factors

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. Operation data includes historical mining methods, costs, mining recovery and dilution factors, processing recovery, and the general layout and performance of the room and pillar and longhole open stope mining methods.

The undiluted tonnes and grade of each potential mining block is based on the resource block models. 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. Reserve tonnages and grades are calculated using the following factors:

- Dilution: A factor resulting in a reduction of the overall average grade due to the mining of waste with the ore. The dilution factor depends on the mining method.
- Mining Recovery: A factor resulting in ore loss (tonnage reduction) due to the mining method and orebody/extraction geometry.

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 Dilution

Dilution is defined as the ratio of mined uneconomic material (waste) to mined economic material (ore). There are two types of dilution that are considered by Bolivar: internal, also called planned dilution; and external, also called unplanned dilution. The total planned and unplanned dilution is listed by orebody and mining method in Table 15-1. Planned and unplanned dilution are described further in this section.

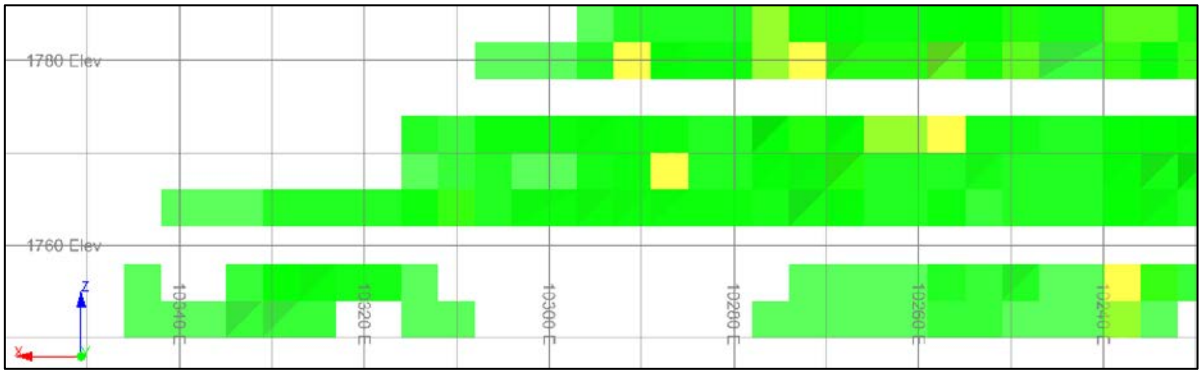
Table 15-1: Total Dilution by Orebody and Mining Method

Area	Mining Method	Dilution = Waste/Ore
El Gallo Inferior	R&P	38%
Bolivar West A	R&P	25%
Bolivar West B	LHS	24%
Bolivar NW 1	R&P	29%
Bolivar NW 2	R&P	31%
Bolivar NW 6	R&P	17%
Bolivar NW 7	R&P	43%
Bolivar NW ZN 2	R&P	70%
Chimenea 1	LHS	22%
Chimenea 2	LHS	39%

Source: REDCO, 2018
Waste = overbreak tonnes (10%) + diluted tonnes below economic cut-off
Ore = diluted tonnes above cut-off

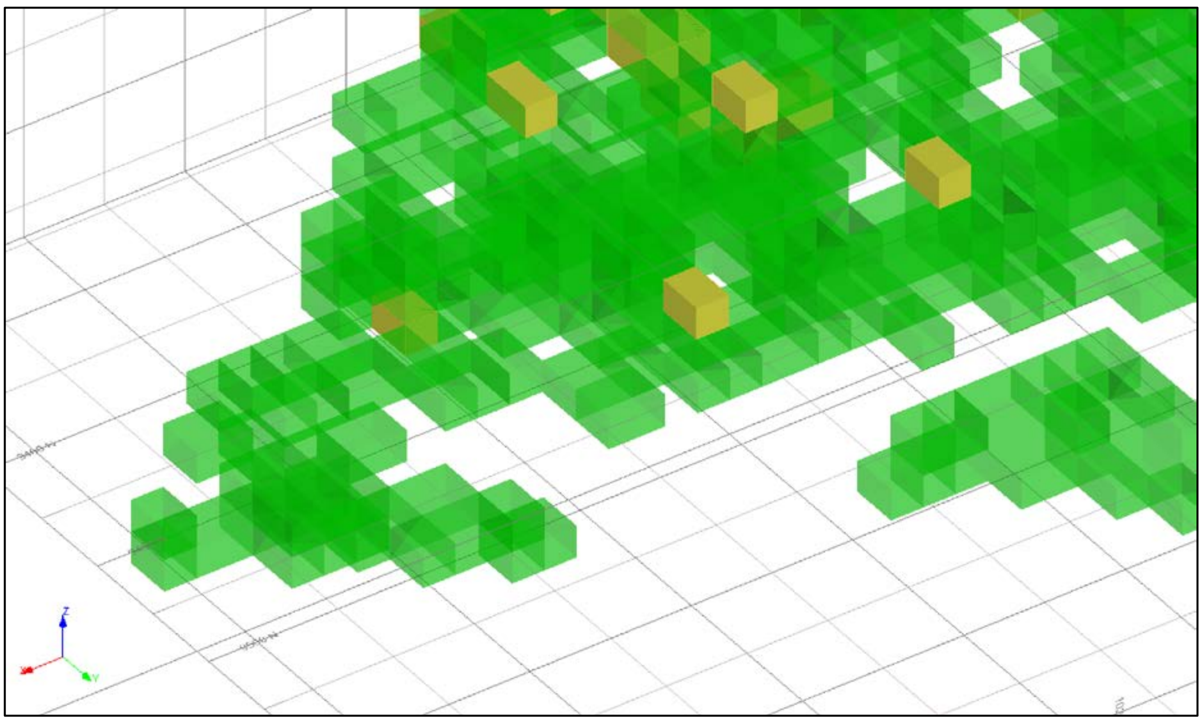
Planned Dilution

Internal or planned dilution occurs when material less than the economic cut-off value falls within a designed stope boundary (i.e., it would be drilled and blasted within the stope during mining). Examples of internal dilution in the EGI room and pillar design are depicted by the yellow blocks in Figure 15-1 and Figure 15-2.



Source: REDCO, 2018

Figure 15-1: Internal Dilution El Gallo Inferior (Section View Looking South)



Source: REDCO, 2018

Figure 15-2: Internal Dilution El Gallo Inferior (Isometric View)

Where possible, the below cut-off blocks were removed from the design. In some cased, practical mining considerations can make the inclusion of internal dilution unavoidable.

Unplanned Dilution

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 was always made for it during the mine planning process. An external dilution factor of 10% for both R&P and LHS mining at Bolivar was provided by

Dia Bras personnel and is based on historical production information. Analysis of this factor was made in previous work (SRK, 2016)) and it was determined that a 10% unplanned dilution factor is reasonable for the reserve estimation however it is recommended that Bolivar develop a reconciliation program to better understand the external dilution and mining practices that can reduce the dilution experienced.

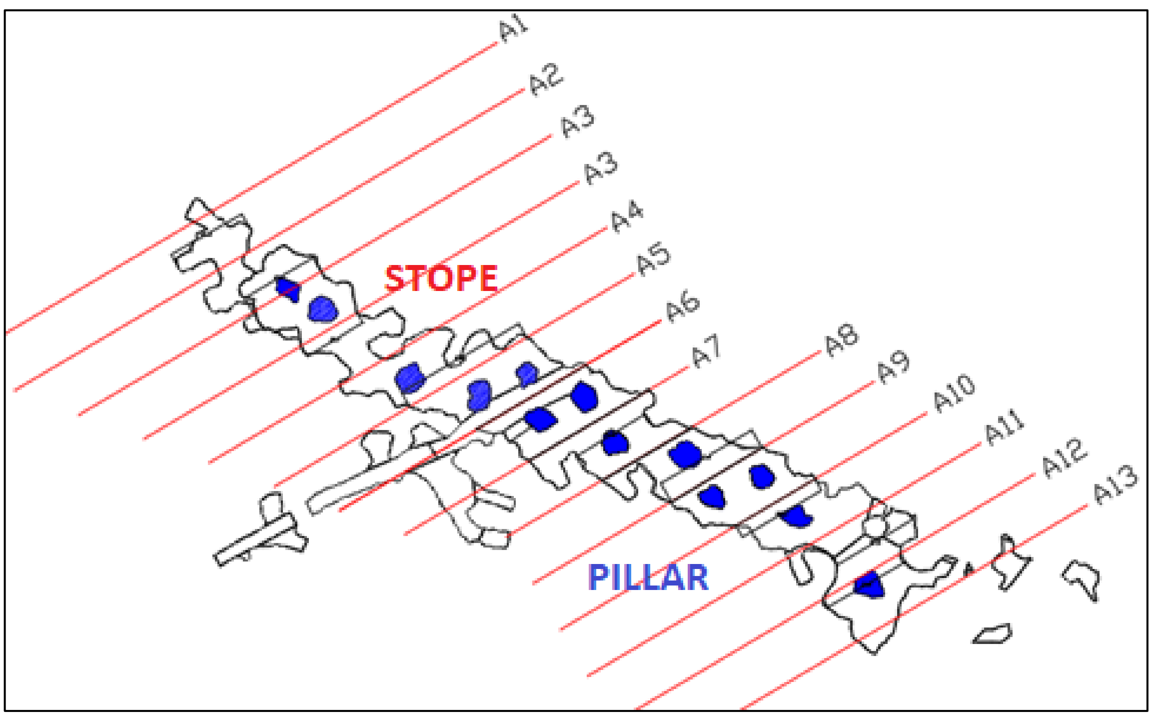
15.2.2 Mining Recovery

The principal factors of ore loss at Bolivar 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 and sill or crown pillars. These pillars have been excluded as part of the design process. Pillars account for the greatest ore loss at Bolivar.

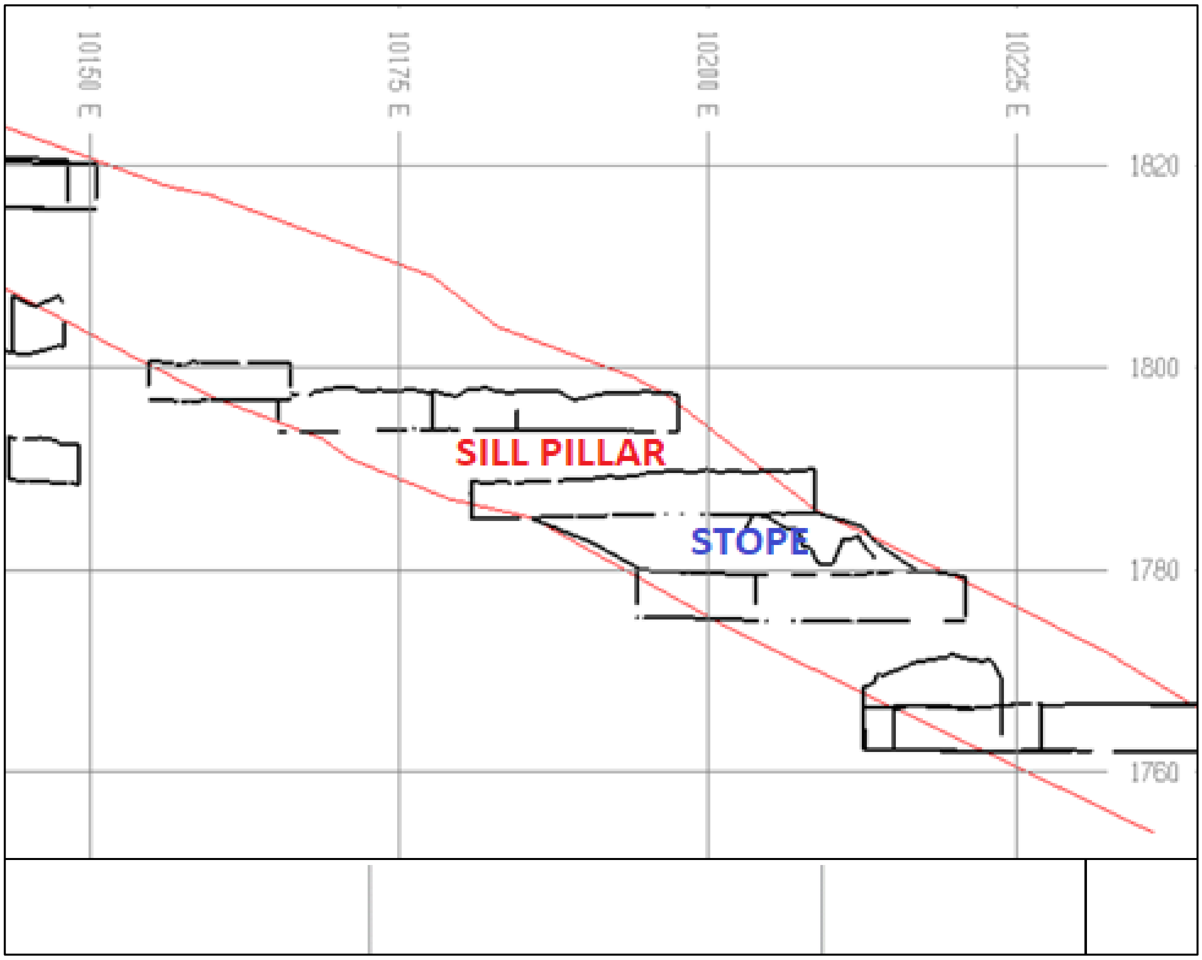
Underbreak and material loss within the stope are referred to as mineable recovery, and this has been incorporated into the reserve estimation.

An estimation of the resource recovery, or conversion of resource to reserve, was performed through analysis of the surveyed as-builts to determine the amount of material left in vertical rib pillars and horizontal sill pillars. Figure 15-3 and Figure 15-4 depict examples of the sectional analysis completed. Refer to the REDCO report for a more detailed analysis (REDCO, 2018).



Source: REDCO, 2018

Figure 15-3: Plan View Section through a Room and Pillar Survey As-built Showing Vertical Pillars (El Gallo Inferior 1170 Level)



Source: REDCO, 2018

Figure 15-4: Cross Section through a Longhole Stoping Survey As-built Showing Sill Pillars (El Gallo Inferior 1170 Level)

Overall mine recovery of the economic resource material for the room and pillar mining method ranges from 60% to 64%, and recovery in the longhole stope areas ranges from 62% to 64%.

Mineral resources in sill pillars, crown pillars, and vertical pillars are not included in the reserve estimation. These pillars 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. Dia Bras is in the initial stages of studying pillar recovery options and considers pillar recovery as an opportunity to increase future reserve estimates.

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. A net smelter return (NSR) calculation was performed on each block model block taking into account the grade, metal price, metallurgical recovery, and the payable metal. The payable metal summarized for this report includes the applicable concentrate treatment charges, refining charges, deductions, price participation, and penalty element payments.

The metal price assumptions were provided by Sierra Metals. Metallurgical recoveries used in the NSR calculation are based on operations data provided by Dia Bras for 2017.

The parameters used in the NSR calculation are summarized in Table 15-2. An NSR value was assigned to each block model block in Datamine™ software. Blocks with a resource class of Inferred or undefined have been assigned an NSR value of 0.

Table 15-2: NSR Calculation Parameters

Parameter	Unit	Value
Metal Prices		
Cu price	US$/lb Cu	3.00
Ag price	US$/oz Ag	18.25
Au price	US$/oz Au	1,291
Recovery to Concentrate		
Cu	%	83.3
Ag	%	78.3
Au	%	63.7
Concentrate Grade		
Cu	%	24
Moisture content	%	9
Smelter Payables		
Cu payable	%	96.5
Minimum Cu deduction	Min units %	1.0
Ag payable	%	90.0
Ag deduction	g/t in concentrate.	0.0
Au	%	90.0
Au deduction	g/t in concentrate	1.0
Treatment Charges/Refining Charges		
Cu concentrate treatment	US$/dmt concentrate	81.00
Cu refining charge	US$/lb payable Cu	0.081
Ag refining charge	US$/oz payable Ag	0.35
Au refining charge	US$/oz payable Au	6.00

Source: REDCO, 2018

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.

Operating costs for 2015, 2016 and January through October 2017 are summarized in Table 15-3.

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 the majority of waste mined.

Table 15-3: Operating Costs, 2015 through October 2017

Category	Units	2015	2016	2017 (January - October)
Mining Costs - Bolivar Mine	US$/t ore	10.82	8.98	10.55
Ore Transport - Mine to Piedras Verdes	US$/t ore	4.77	4.23	4.53
Processing Costs - Piedras Verdes	US$/t ore	12.05	9.46	9.85
General and Administrative Expenses	US$/t ore	3.85	2.93	2.12
Total	**US$/t ore**	**$31.49**	**$25.60**	**$27.05**

Source: REDCO, 2018

The economic and marginal cut-offs used in this report are provided in Table 15-4. Approximately 93% of reserves tonnes are planned for extraction using room and pillar mining with the remainder favorable to a modified longhole stoping method. An additional cost per tonne has been added for each mining method to account for the slot raise, sill preparation, and ground support.

Table 15-4: 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	30.70	26.50
Longhole	33.10	28.70

Source: REDCO, 2018

15.2.5 Mining Block Shapes

Potential mining blocks were constructed using Datamine™ software and its implementation of MSO and EPS (Enhanced Production Schedule). The stope blocks output from MSO were reviewed on a level-by-level basis and were manually refined so that they could be practically mined. Sill pillar levels and vertical pillars were modelled in MSO using geotechnical design criteria. The designed pillars were excluded from the Bolivar reserve estimate.

A mine design incorporating the development required to access the mining blocks and a production schedule were created. The development profile and production schedule results were used as input to evaluate the economic viability of the reserves estimated for this report.

15.3 Reserve Estimate

The Mineral Reserves are estimated in conformity with CIM Mineral Resource and Mineral Reserves Estimation Best Practices Guidelines (November 2003) and are classified according to CIM Standard Definition for Mineral Resources and Mineral Reserves (May 2014) guidelines. The Mineral Reserve Statement is reported in accordance with NI 43-101.

The reference point at which the Mineral Reserve is identified is where the ore is delivered to the processing plant referred to as mill feed.

The Bolivar Mineral Reserve Estimate is comprised of the Probable material in the El Gallo Inferior, Chimenea 1, Chimenea 2, Bolivar Northwest, and Bolivar West orebodies. The October 31, 2017 consolidated Mineral Reserve Statement for the Bolivar Mine is presented in Table 15-5. The individual detailed Mineral Reserves by area are presented in Table 15-6.

Table 15-5: Consolidated Bolivar Mineral Reserve Estimate as of October 31, 2017 – SRK Consulting (U.S.), Inc.

Category	Tonnes (000's)	Ag (g/t)	Au (g/t)	Cu (%)	Contained Ag (koz)	Contained Au (koz)	Contained Cu (t)
Proven	-	-	-	-	-	-	-
Probable	7,925	18.9	0.25	0.86	4,823	63	67,925
P+P	**7,925**	**18.9**	**0.25**	**0.86**	**4,823**	**63**	**67,925**

Source: SRK, 2018

(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 unit value cut-offs 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 metal value are: US$3/lb Cu, US$18.25/oz Ag, and US$1,291/oz Au.
** Metallurgical recovery assumptions are 83% Cu, 78% Ag, and 64% Au.

(3) The mining costs are based on historical actual costs.

(4) The NSR cut-off values are variable by mining method:
- The economic NSR cut-off value is:
  - US$30.80 = Room and Pillar; and
  - US$33.10 = Longhole Stoping.
- The marginal NSR cut-off value is:
  - US$26.50 = Room and Pillar; and
  - US$28.70 = Longhole Stoping.

(5) Mining recovery and dilution have been applied at zero grade and are variable by mining area and proposed mining method.

Table 15-6: Detailed Bolivar Mineral Reserve Estimate as of October 31, 2017 – SRK Consulting (U.S.), Inc.

Zone	Category	Tonnes (000's)	Ag (g/t)	Au (g/t)	Cu (%)	Contained Ag (koz)	Contained Au (koz)	Contained Cu (t)
El Gallo Inferior	Proven	-	-	-	-	-	-	-
	Probable	2,319	13.8	0.20	0.74%	1,028	15	17,064
	P+P	2,319	13.8	0.20	0.74%	1,028	15	17,064
Chimenea 1	Proven	-	-	-	-	-	-	-
	Probable	132	39.9	0.02	1.84%	169	0	2,420
	P+P	132	39.9	0.02	1.84%	169	0	2,420
Chimenea 2	Proven	-	-	-	-	-	-	-
	Probable	100	28.8	0.00	1.07%	92	0	1,065
	P+P	100	28.8	0.00	1.07%	92	0	1,065
Bolivar NW 1	Proven	-	-	-	-	-	-	-
	Probable	2,161	13.9	0.24	0.64%	968	17	13,789
	P+P	2,161	13.9	0.24	0.64%	968	17	13,789
Bolivar NW 2	Proven	-	-	-	-	-	-	-
	Probable	96	17.4	0.00	0.88%	54	0	841
	P+P	96	17.4	0.00	0.88%	54	0	841
Bolivar NW 6	Proven	-	-	-	-	-	-	-
	Probable	222	14.0	0.02	0.96%	100	0	2,129
	P+P	222	14.0	0.02	0.96%	100	0	2,129
Bolivar NW 7	Proven	-	-	-	-	-	-	-
	Probable	104	28.0	0.20	0.42%	94	1	440
	P+P	104	28.0	0.20	0.42%	94	1	440
Bolivar WB	Proven	-	-	-	-	-	-	-
	Probable	308	14.0	0.02	0.96%	139	0	2,959
	P+P	308	14.0	0.20	0.96%	139	0	2,959
Bolivar WA	Proven	-	-	-	-	-	-	-
	Probable	2,451	43.3	0.80	0.85%	3,415	63	20,742
	P+P	2,451	43.3	0.80	0.85%	3,415	63	20,742
Bolivar NW ZN2	Proven	-	-	-	-	-	-	-
	Probable	32	28.0	0.19	0.42%	29	0	137
	P+P	32	28.0	0.19	0.42%	29	0	137
Total	Proven	-	-	-	-	-	-	-
	Probable	7,925	18.9	0.25	0.86%	4,823	63	67,925
	P+P	7,925	18.9	0.25	0.86%	4,823	63	67,925

Source: SRK, 2018

(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 unit value cut-offs 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 metal value are: US$3/lb Cu, US$18.25/oz Ag, and US$1,291/oz Au.
 ** Metallurgical recovery assumptions are 83% Cu, 78% Ag, and 64% Au.

(3) The mining costs are based on historical actual costs.

(4) The NSR cut-off values are variable by mining method:
- The economic NSR cut-off value is:
  - US$30.80 = Room and Pillar; and
  - US$33.10 = Longhole Stoping.
- The marginal NSR cut-off value is:
  - US$26.50 = Room and Pillar; and
  - US$28.70 = Longhole Stoping.

(5) Mining recovery and dilution have been applied and are variable by mining area and proposed mining method.

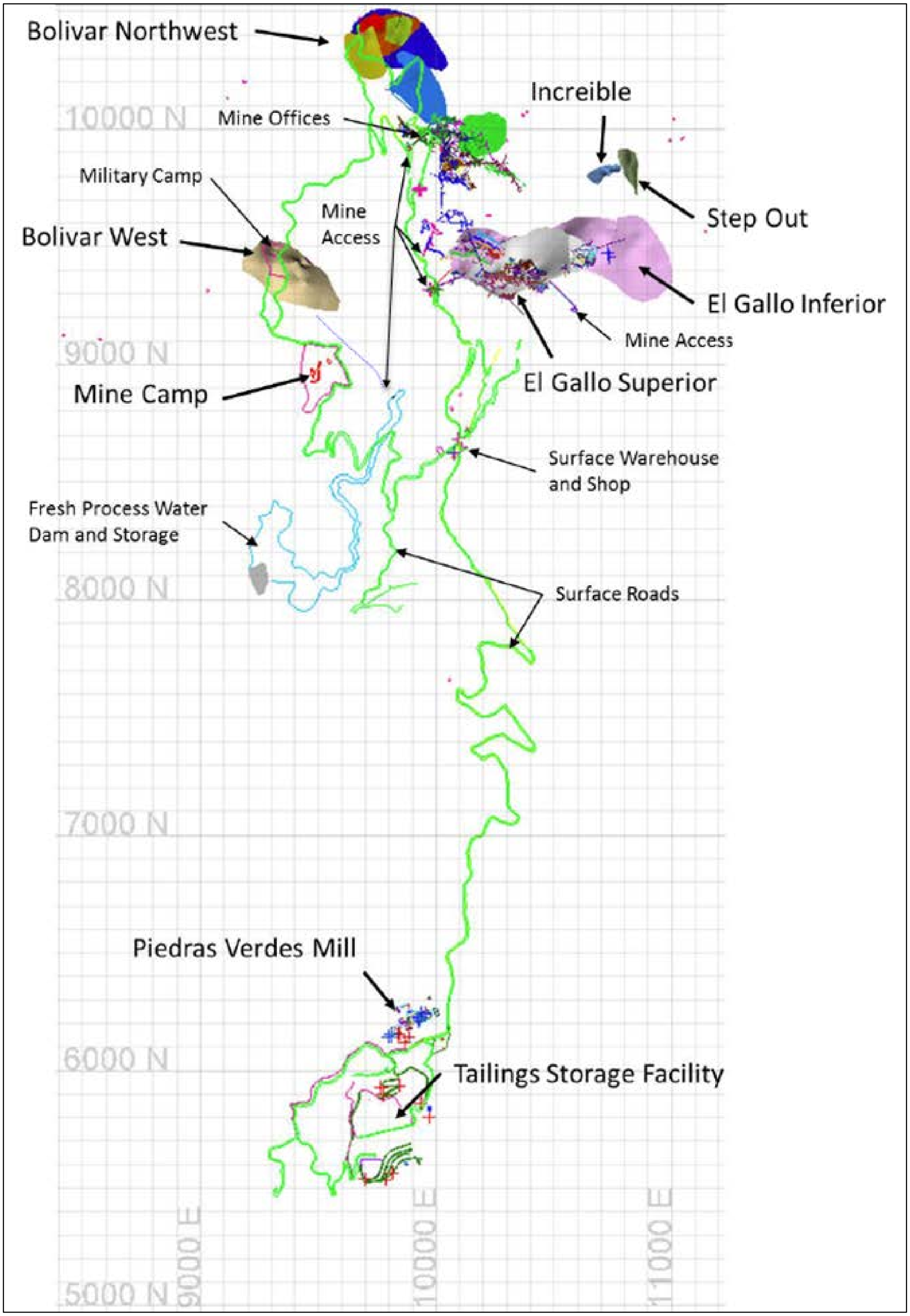
15.4 Relevant Factors

Priority must be made to development in the two new mining areas of Bolivar West and Bolivar Northwest in order to achieve the LoM production schedule associated with this reserve estimate. Initial review indicates that the development waste material from these areas can be stored underground in historical mine openings. Further analysis of the initial development waste handling and storage strategy is required. If underground storage in historical mine openings is not a viable solution, due to lack of space or operationally difficult to transfer waste material from the new mining areas to the historical mining areas, then an analysis of the surface storage locations will be required. Surface storage may also require permitting which could delay development activities in Bolivar West and Bolivar Northwest resulting in a delayed production schedule for Bolivar Mine.

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.

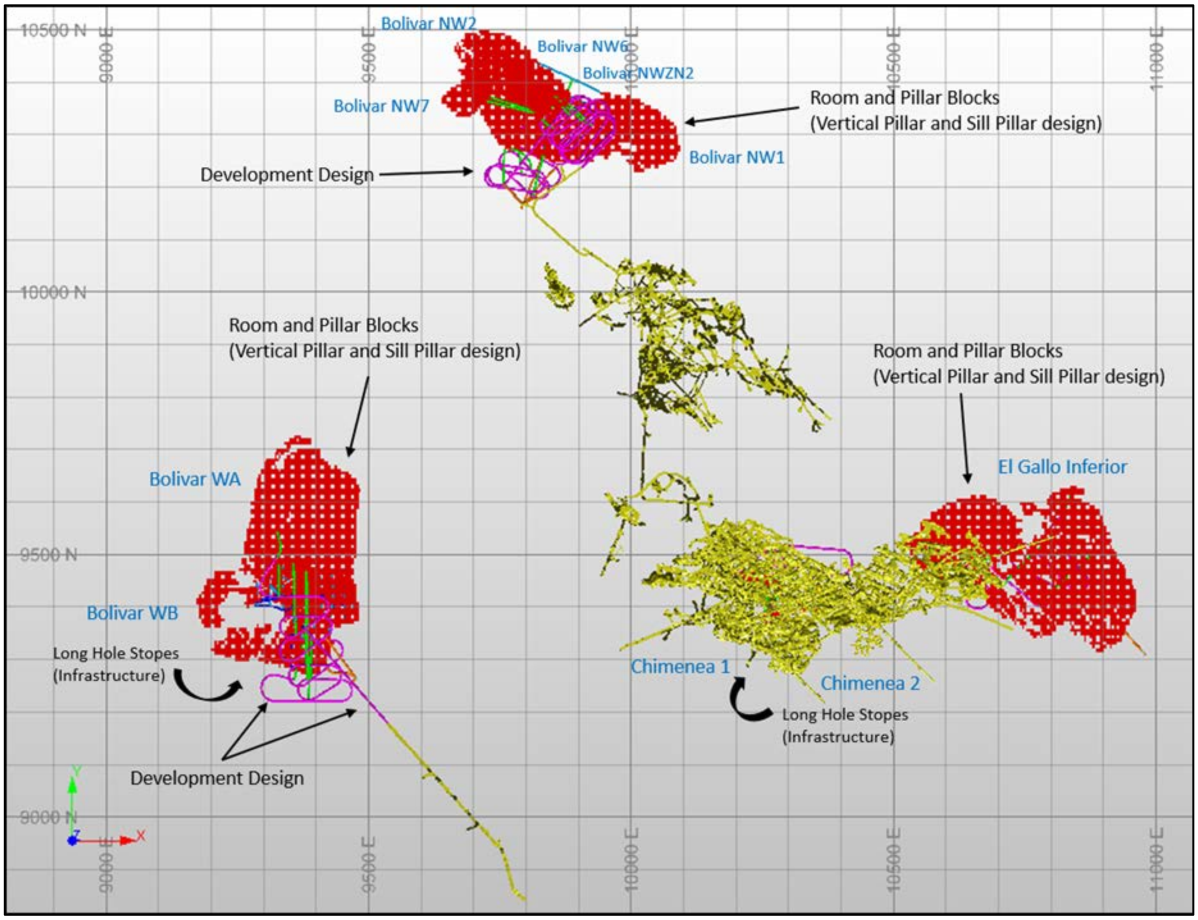
16 Mining Methods

The mineral reserve at Bolivar Mine has been estimated at 7.9 Mt primarily from room and pillar mining methods with approximately 7% production from longhole stope mining. Historical mining has occurred in the Bolivar and El Gallo Superior orebodies, which are considered mined out. Current production at Bolivar is from the El Gallo Inferior orebody. The mine reserves are comprised of 10 orebodies including: El Gallo Inferior, Chimenea 1, Chimenea 2, Bolivar West A and B, and Bolivar Northwest (NW) which is sub-divided into Bolivar NW 1, NW 2, NW 6, NW 7, and NW Z2. The orebodies are grouped geographically into three mining areas: El Gallo Inferior (EGI), Bolivar Northwest (BNW), and Bolivar West (BW). Figure 16-1 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. The mine design supporting the reserves estimate is shown in Figure 16-2.



Source: SRK, 2017

Figure 16-1: Bolivar Overview



Source: REDCO, 2018

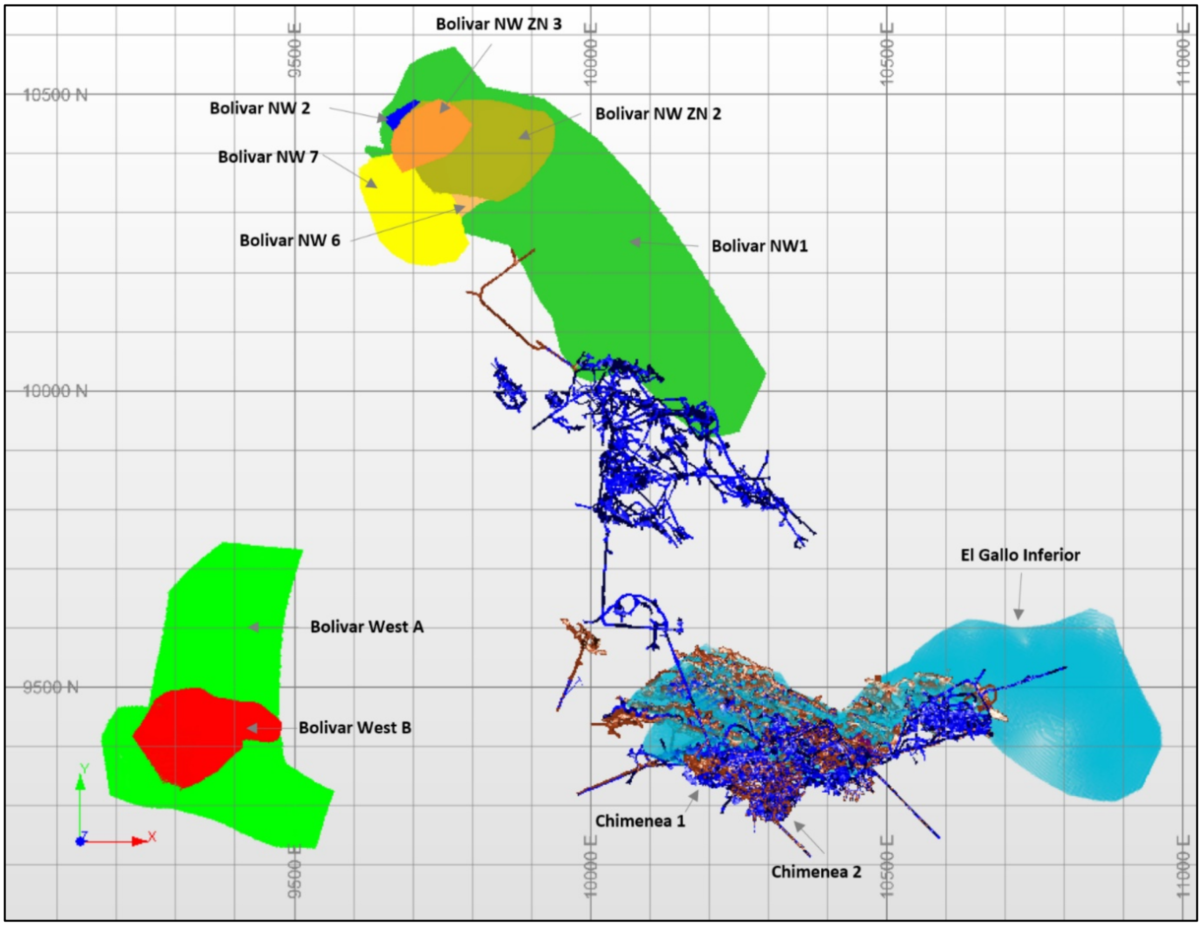
Figure 16-2: Overview of Bolivar Reserves Mine Design

The mining methodology for these mining areas is described in this section.

16.1 Current Mining Methods

Current production at Bolivar comes from the El Gallo Inferior orebody. Mining in El Gallo Inferior occurs below the El Gallo Superior orebody. 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 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 16-3 shows a plan view of the Bolivar Mine, the geology shapes, and the mined out areas.



Source: REDCO, 2018

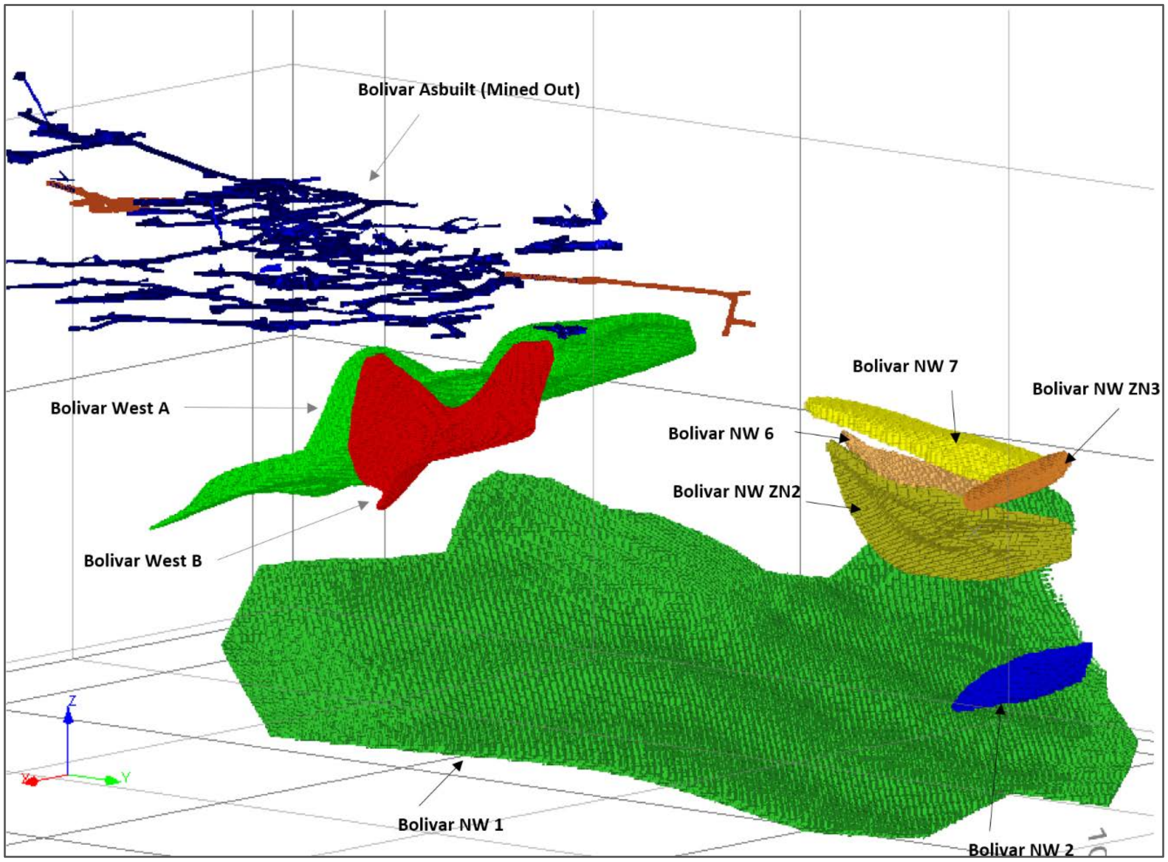
Figure 16-3: Bolivar Orebody Location Overview and Mined Out Areas

Figure 16-4 shows a rotated view of the El Gallo Inferior area and also shows the Chimenea 1 and Chimenea 2 orebodies.

Source: REDCO, 2018

Figure 16-4: Isometric View Showing El Gallo Inferior, Chimenea 1 and Chimenea 2 with Mined-out Areas

Figure 16-5 shows a rotated view, looking southwest, of Bolivar Northwest 4, 1, 2, 6, 7, and Z2 as well as as-built shapes of previous mining.



Source: REDCO, 2018

Figure 16-5: Isometric View Showing Bolivar W and Bolivar NW with Mined-out Areas

16.2 Proposed Mining Methods

The dip of the Bolivar orebodies varies with the majority as flatly dipping and suitable for the application of room and pillar (R&P) mining methods. A longhole stope (LH) mining method was applied in orebodies that are steeper with a dip greater than 60°. Typical orebody dip values are shown in Table 16-1.

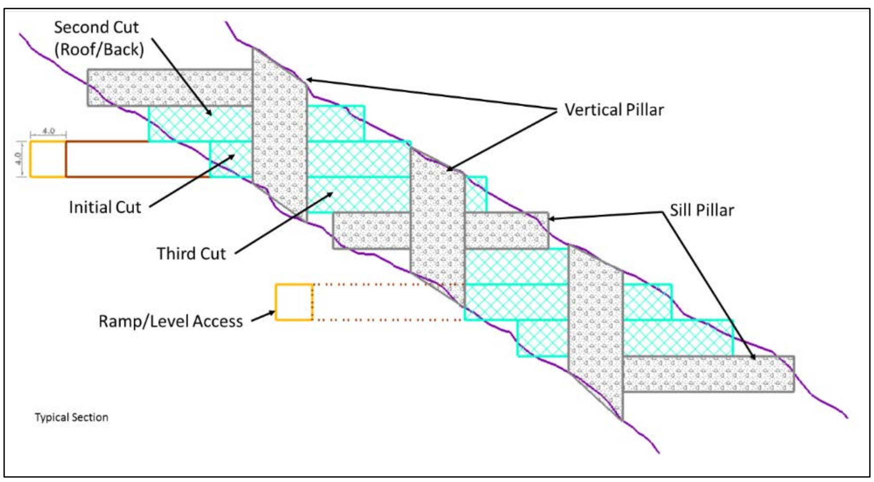
Table 16-1: Typical Orebody Dip Values

Orebody	Dip (°)	Average Dip (°)	Mining Method
El Gallo Inferior	25-35	30	R&P
Bolivar West A	29-37	34	R&P
Bolivar West B	72-76	72	LH
Bolivar NW 1	30-40	30	R&P
Bolivar NW 2	21-31	18	R&P
Bolivar NW 6	18-24	22	R&P
Bolivar NW 7	14	14	R&P
Bolivar NW ZN 2	25-35	30	R&P
Chimenea 1	60-63	62	LH
Chimenea 2	65-70	68	LH

Source: REDCO, 2018

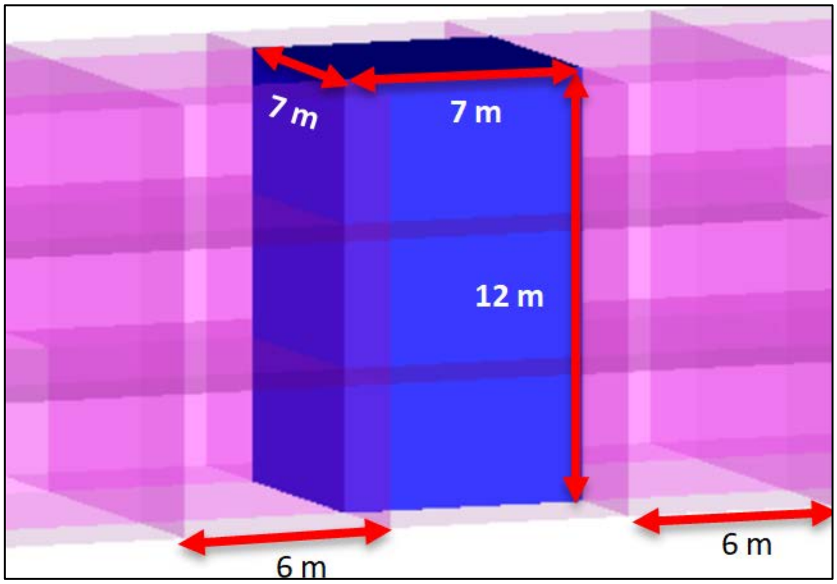
16.2.1 Room and Pillar Mining

A room and pillar design was applied in the flatly dipping orebodies in El Gallo Inferior, Bolivar West, and Bolivar Northwest. 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/back 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 16-6 shows a typical section through two room and pillar levels and Figure 16-7 depicts a schematic of a room and pillar level with dimensions.



Source: SRK, 2017

Figure 16-6: Typical Section Showing Room and Pillar Mining



Source: REDCO, 2018

Figure 16-7: Isometric View Showing Room and Pillar Mining

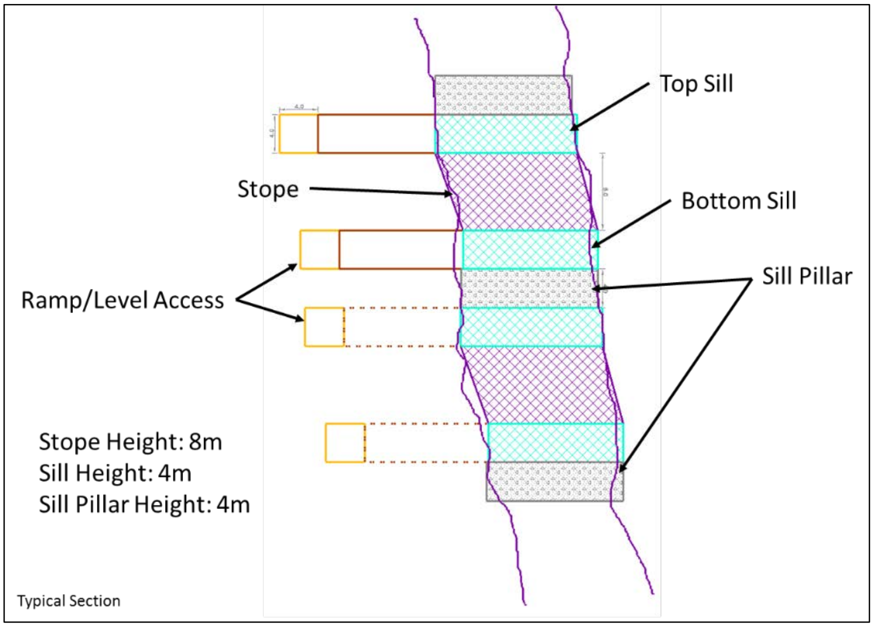
Development dimensions are 4.5 m x 4.5 m up to 4.5 m wide x 5 m high depending on the purpose, mining area and level. Ramps are designed to a 12% maximum grade for rubber tire equipment.

16.2.2 Longhole Stoping

A longhole stoping design was applied in the steeply dipping orebodies in El Gallo Inferior and Bolivar West. Chimenea 1, Chimenea 2 and Bolivar West B are suitable for mining using longhole stoping techniques. Longhole stoping can provide for higher production and better recovery of the ore. There are currently limited zones in the Bolivar area where this mining method is applicable, and mining using this method accounts for approximately 7% of the reserves stated herein. The site has some past experience using longhole techniques in the Chimenea areas.

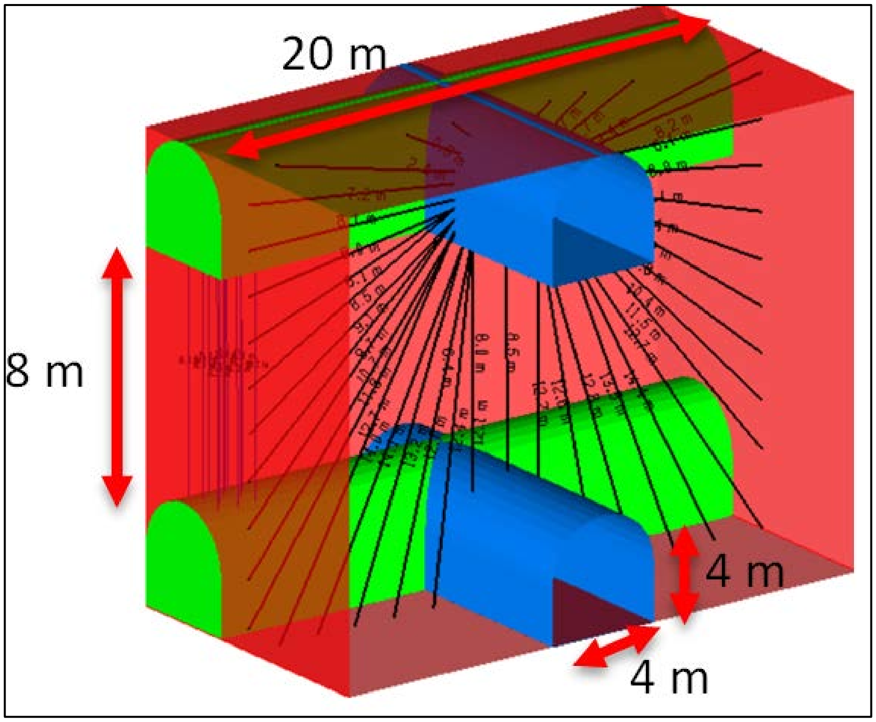
Areas where longhole mining occurs are divided into levels measuring approximately 16 m high. Each 16 m level is further divided into an initial bottom sill of 4 m and an 8 m high longhole stope which is mined an average of 20 m wide. The remaining 4 m of material is left as a sill pillar. The blastholes, 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. Development dimensions range from 4 m wide by 4 m high in ore to 4.5 m wide by 5 m high in waste. Ramps are designed to a 12% maximum grade for rubber tire equipment.

A typical longhole stope layout is shown in Figure 16-8. Vertical pillars, though not shown in this section, will need to be utilized. These pillars will be 4 m wide by 16 m high. Figure 16-9 shows a schematic view of a longhole stope with dimensions.



Source: SRK, 2017

Figure 16-8: Typical Longhole Stoping Section

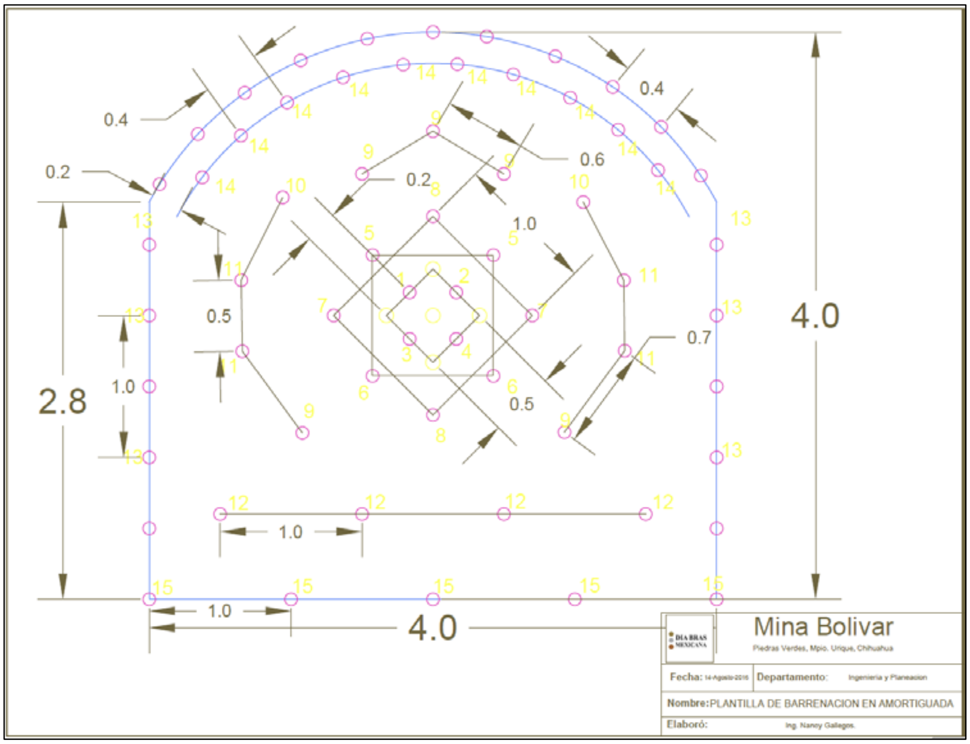


Source: REDCO, 2018

Figure 16-9: Longhole Stoping Schematic

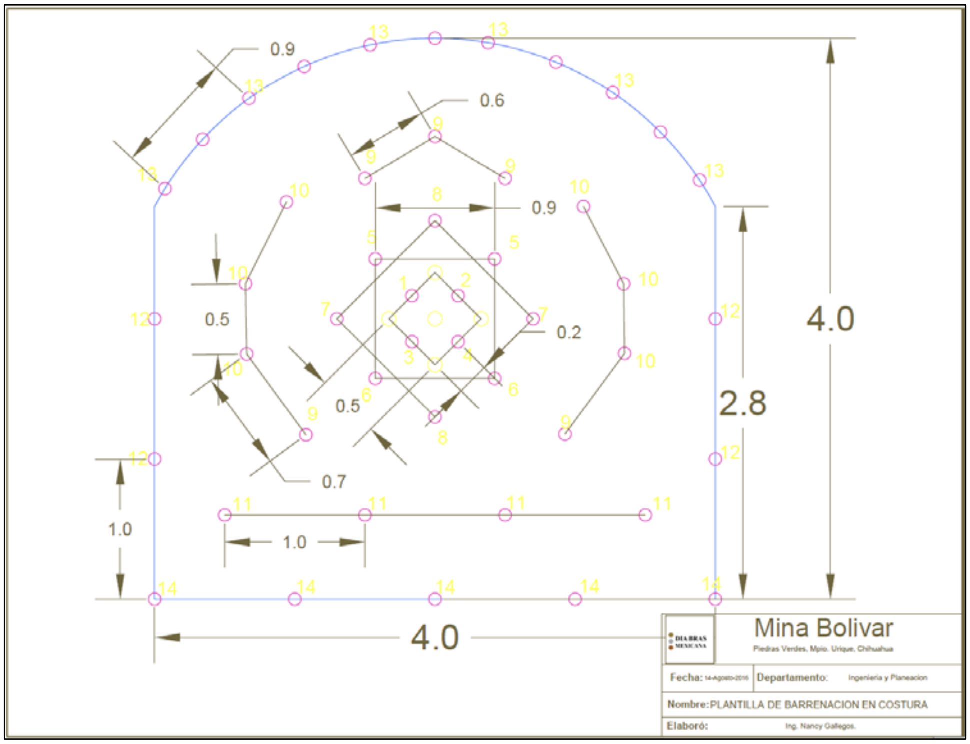
16.2.3 Drilling, Blasting, Loading and Hauling

Jackleg drills are used for lateral waste development and ramp development at Bolivar. Ramps are typically driven 4.5 m wide by 5 m high with ore accesses at 4.5 m wide by 4.5 m high. Electric-hydraulic jumbos are used for stope production, lateral development, and ramp development. Drill and blast design is carried out by the mine technical services group on site. Two layouts for typical 4 m x 4 m production blast patterns are shown in Figure 16-10 and Figure 16-11. A drill jumbo is shown drilling a production blast in El Gallo Inferior in Figure 16-12.



Source: SRK, 2017

Figure 16-10: Typical 4 m x 4 m Blast Pattern 1



Source: SRK, 2017

Figure 16-11: Typical 4 m x 4 m Blast Pattern 2

Source: SRK, 2017

Figure 16-12: Drill Jumbo Drilling a Pattern in an El Gallo Inferior Production Stope

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 slightly to 12% as the mine advances into areas outside of El Gallo Inferior. Waste rock can be placed in the stopes underground, or hauled to the surface and used as construction material.

16.2.4 Ore and Waste Handling

The ore and waste handling strategy in EGI is well established and has been applied to the future production mining areas of Bolivar W and Bolivar NW. It is recommended to perform a haulage simulation to validate the ore and waste handling assumptions made for underground truck haulage from each of the three main mining areas (EGI, Bolivar W, Bolivar NW) to surface, as well as the surface truck haulage from surface dumps to the mill. Haulage simulation will confirm that the production targets are achievable and to identify possible traffic interference and bottlenecks.

16.3 Mine Method Parameters

16.3.1 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 and El Gallo 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 RMR76 (50 to 60); and
- Back conditions: very competent RMR76 (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 to their rock mass characteristics and based on recommendations provided in the rock mechanics report by Engineers Ramos, Garcia and Nava (October 2012). Rock mass characteristics data are available only for El Gallo Inferior, Chimenea 1, and Chimenea 2 and are summarized in Table 16-2.

Table 16-2: El Gallo Inferior, Chimenea 1 and Chimenea 2 Rock ass Characteristics

Parameters	Unit	Bolivar	
		Gallo Inferior	Chimeneas 1-2
Vertical stress	MPa	9.82	
Horizontal stress	MPa	24.08	
Simple compression intact rock	MPa	170 (Rock mass) y 200 (Ore)	
Stress intact rock	MPa	17 (Rock mass) y 20 (Ore)	
UCS	MPa	120	
SRF	-	2.5	
RMR Hangingwall	-	[80-100] 100%	[80-100] 36% [60-80] 64%
RMR Ore	-	[80-100] 92.5% [60-80] 7.5%	[80-100] 44% [60-80] 56%
RMR Footwall	-	[80-100] 100%	[80-100] 31% [60-80] 69%
Q'	-	34 -28	
N	-	21-12	
Horizontal Seismic Coefficient	-	0.2	

Source: REDCO, 2018

Due to lack of geotechnical information for Bolivar W and Bolivar NW, generalized assumptions were made based on EGI and Chimenea for the rock mass properties expected.

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.

Room and Pillar Method Stability Analysis

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 R&P pillar design:

- Vertical Pillar Width: 7 m;
- Vertical Pillar Height: 12; and
- Room Span: 12 m.

To support the room and pillar design parameters, a stability analysis is carried out through the Lunder & Pakalnis methodology as shown in Table 16-3. This analysis is also used to determine whether the actual design parameters can be changed to allow a greater recovery or productivity.

Table 16-3: Lunder & Pakalnis R&P Pillar Findings

Lunder & Pakalnis - Pillar Strength	
W/H	0.58
log(W/H) + 0.75	0.52
cpav	0.24
k	1.28
Strength of Pillars (Sp)	**100.6**

Parameter	**Value**
Lithostatic Stress (MPa)	11.1
Pillar Induced Stress (MPa)	81.8
Factor of Safety (FoS)	**1.23**

Source: REDCO, 2018

The current room and pillar design reports a 1.23 FoS which indicates that the current dimensions will provide a stable operation.

Longhole Stope Method Stability Analysis

For the deposits that are being mined by LHS, a stability analysis was also carried out using the Mathews and Potvin method to determine the critical hydraulic radius of the cavity and the Lunder & Pakalnis method was used to dimension stable pillars between stopes (Table 16-4).

The Mathews method is an empirical method to dimension stopes based on a stability number, N, which defines the rock mass's ability to stand up to given ground conditions, and shape factor, S, which is the stope face hydraulic radius that accounts for the geometry of the stope surface.

To perform this the stability analysis, the following LHS stope (i.e. Chimeneas) design is evaluated:

- Stope Width: 20 m;
- Stope Height: 16; and
- Stope Length: 20 m.

Table 16-4: Mathews Bolivar Stope Findings

RMR=60 to 90	**Q'**	**A**	**B**	**C**	**N'**	**HR**	**Critical HR**	**FoS**
Crown	27	0.8	0	2	9.2	5	5.64	1.13
Hangingwall	24	0.7	0	8	26	4.4	7.75	1.75
Footwall	24	0.7	0	8	26	4.4	7.75	1.75

Source: REDCO, 2018

The critical hydraulic radius is greater than the Bolivar Mine current values, reporting a FoS of 1.13 for crown/stope roof and 1.75 for hanging and footwall.

Rib Pillar

The mine currently uses the following geotechnical pillar design between stopes:

- Pillar Width: 4 m;
- Pillar Height: 16; and
- Stope Width: 20 m

The result obtained from the Lunder and Pakalnis method are shown in Table 16-5.

Table 16-5: Lunder & Pakalnis LHS Pillar Findings

Lunder & Pakalnis - Pillar Strength	
W/H	0.25
log(W/H) + 0.75	0.15
cpav	0.000
k	0.006
Strength of Pillars (Sp)	**51.11**

Parameter	Value
Lithostatic Stress (MPa)	11.1
Pillar Induced Stress (MPa)	38.85
FoS	1.32

Source: REDCO, 2018

The current pillar between stopes reports a 1.32 FoS which indicates that the current pillar dimensions will provide a stable operation..

Sill Pillar Stability

Both methods consider sill pillars which consist of a rock mass situated above the stopes to prevent subsidence permanently or temporarily.

The Carter methodology is a used to determine the optimum thickness for the crown pillar, to ensure safety and maximum ore recovery (Table 16-6). This method is used to obtain a FoS through a relation among the critical and scaled span. If the scaled pillar span is less than critical span, the pillar is considered stable.

Table 16-6: Carter Methodology Sill Pillars Findings

Sill Pillar Design - R&P	
Q Barton	45
Density (y)	3.7
Span (S)	12
Sr (S/L)	0.4
Vein Length (L)	27
Angle	90
Sill Pillar Width (t)	4
Critical Span (Sc)	18.2
Scaled Span (Cs)	9.6
FoS (Sc/Cs)	**1.9**

Sill Pillar Design - LHS	
Q Barton	45
Density (y)	3.7
Span (S)	20
Sr (S/L)	1
Vein Length (L)	20
Angle	90
Sill Pillar Width (t)	4
Critical Span (Sc)	18.2
Scaled Span (Cs)	13.6
FoS (Sc/Cs)	**1.34**

Source: REDCO, 2018

The current sill pillar between stopes is stable, reporting a 1.9 and 1.34 FoS for R&P and LHS method respectively. Therefore, the current dimensioning ensures the stability of the operation.

16.3.2 Pillar Recovery Potential and Mining Method Alternatives

It is well understood 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. A slender vertical pillar is shown in Figure 16-13.

Source: SRK, 2017

Figure 16-13: Example Slender Pillar that Might be Recovered

It is recommended 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. Dia Bras personnel have 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. These initiatives have potential for increasing reserves and mine life in future resource and reserves updates (they are currently not included in the reserve). Recommendations are made below to initiate the study of pillar recovery.

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 as-built 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 completed a project to perform a whole mine survey using Light Detection and Ranging (LiDAR) technology in 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 as-built model and the channel samples database will allow the site to review, quantify, and prioritize pillar material for extraction.

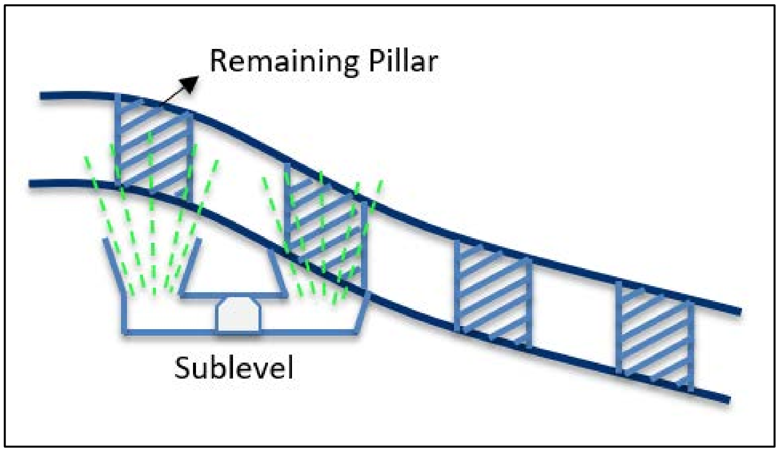
The site must then develop mine plans and safe mining practices in order to extract the pillar material. Several potential options exist for pillar extraction. SRK recommends a trade-off study to determine the feasibility of the scenarios listed below.

- 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
  - Potentially utilize rock fill to provide additional ground support for pillar recovery. May result in updated pillar dimensions for new areas;
  - 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
  - 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;
  - 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
  - A new mining method for the operation where cut-and-fill mining occurs with ground support provided by cemented paste backfill;
  - 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.

An additional pillar recovery scenario identified would not require backfill. The scenario is to develop a recovery sublevel in waste directly underneath the vertical pillars as shown in Figure 16-14. The proposed method would serve to undercut the remaining pillars with a recovery sublevel then to drill upholes into the pillars and blast to induce pillar caving. As pillars are recovered, all structural support would be removed, allowing the ground to collapse.



Source: REDCO, 2018.

Figure 16-14: Proposed Pillar Recovery Program Scheme

Further study is required to determine the feasibility of these options.

16.3.3 Hydrological

A hydrogeological review has not been undertaken by SRK. The mine is currently considered “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.

16.4 Underground Stope Optimization

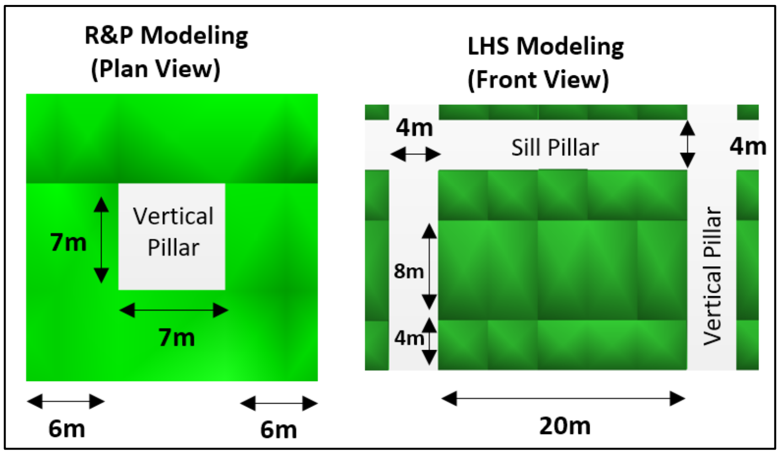
Stoping block shapes were constructed for each ore zone and mining method identified using the MSO routine provided within the suite of Datamine™ Studio 5D Planner software. MSO requires the input of several key parameters and then interrogates the resource block model against permutations of simplified mining shapes to outline a potentially economic Mineral Resource at a given cut-off value. Key parameters used for stope optimization are provided in Table 16-7.

Table 16-7: Stope Optimization Parameters for Room & Pillar and Longhole Stoping Methods

Mining Method	Room & Pillar	Longhole Stoping
Minimum Stope Length (m)	4	5
Stope Height (m)	4	Sill: 4; Stope: 8
Stope Width (m)	6	4
Pillar Width (m)	7	4
Minimum Stope Dip (°)	70	70
Maximum Stope Dip (°)	90	90
Span (m)	12	20
Marginal Cut-off (US$/t)	26.5	28.7
Economic Cut-off (US$/t)	31.6	33.8
Stope Orientation	Perpendicular to Orebody	Perpendicular to Orebody

Source: REDCO, 2018

A schematic of the stope design dimensions used in MSO are presented in Figure 16-15.

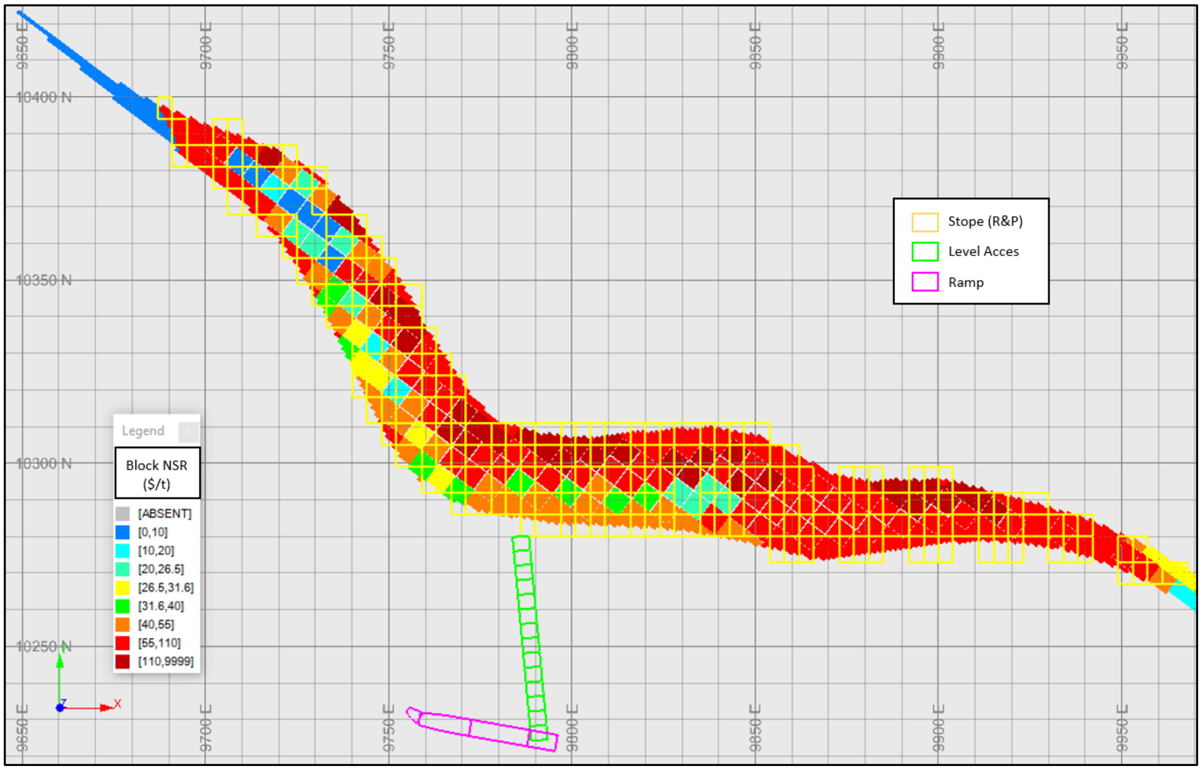


Source: REDCO, 2018

Figure 16-15: MSO Base Design for R&P and LHS

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$800/m 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 2017/2018 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.

Figure 16-16 shows a designed level section in Bolivar Northwest. 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.

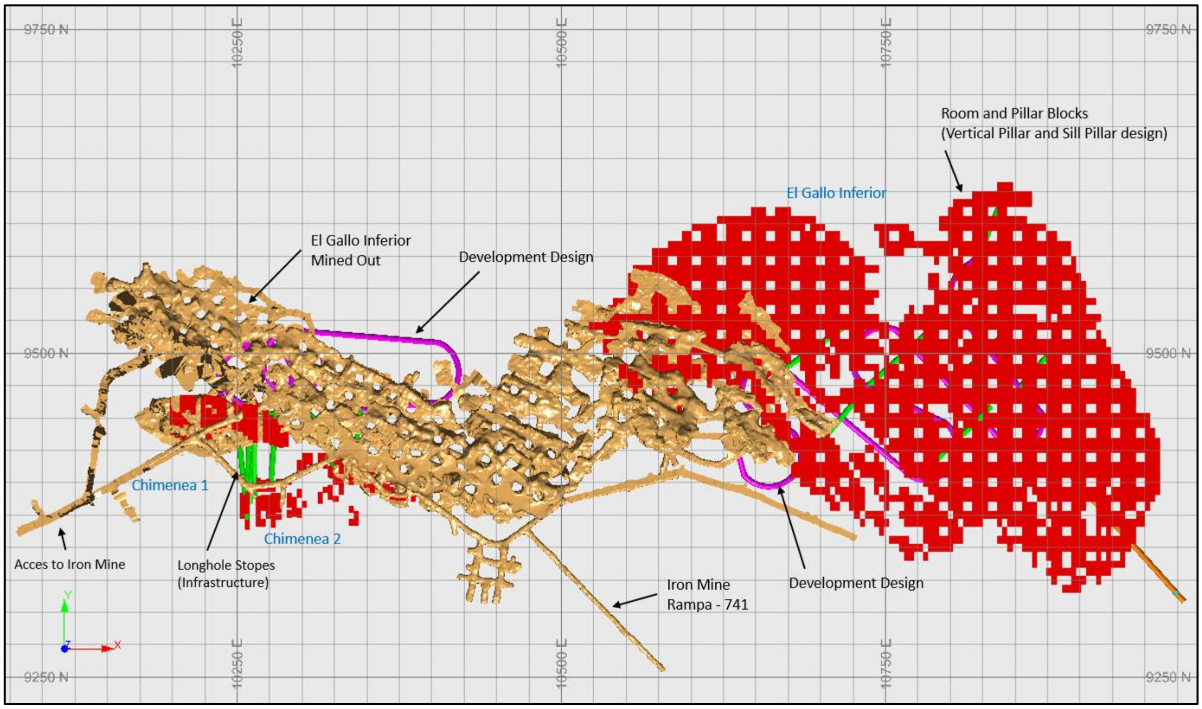


Source: REDCO, 2018

Figure 16-16: Level Design in Bolivar Northwest

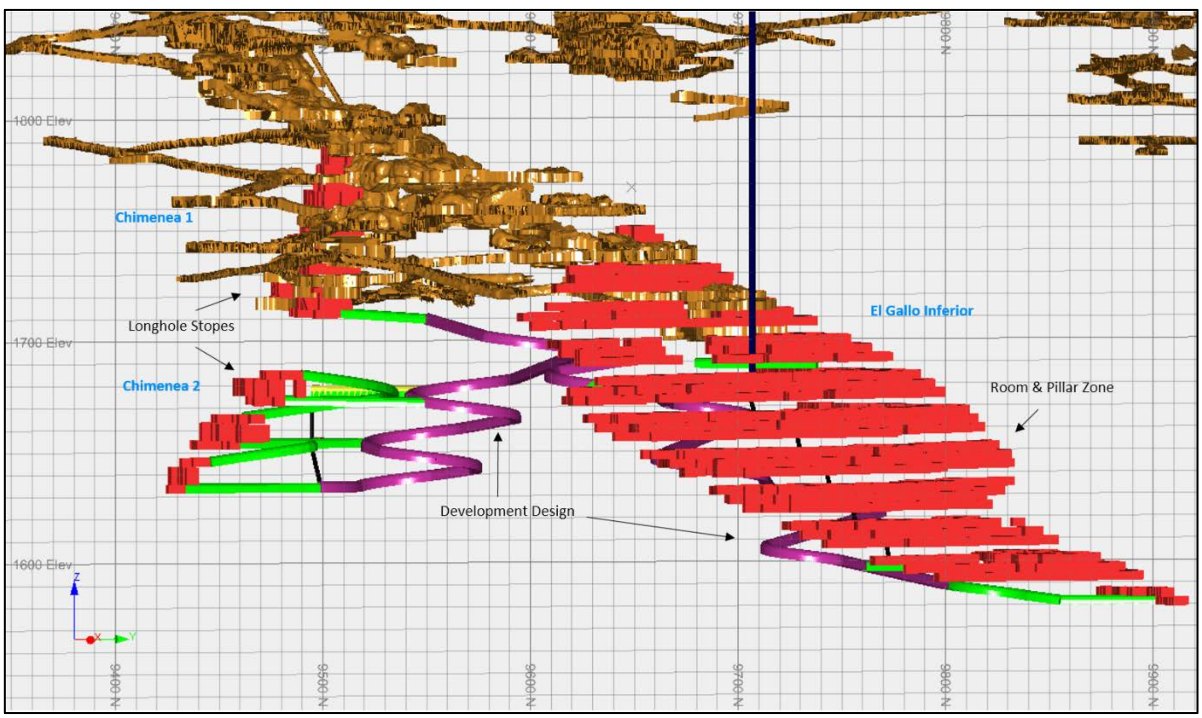
In operations, pillar placement should be optimized taking into account ore grades, room size and pillar size with field evaluation of the geotechnical conditions of the ore, waste rock, and the overall stability of the opening to ensure safe extraction.

Figure 16-17 through Figure 16-21 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 16-22, significant development is required in Bolivar Northwest to access the deeper zones of those orebodies.



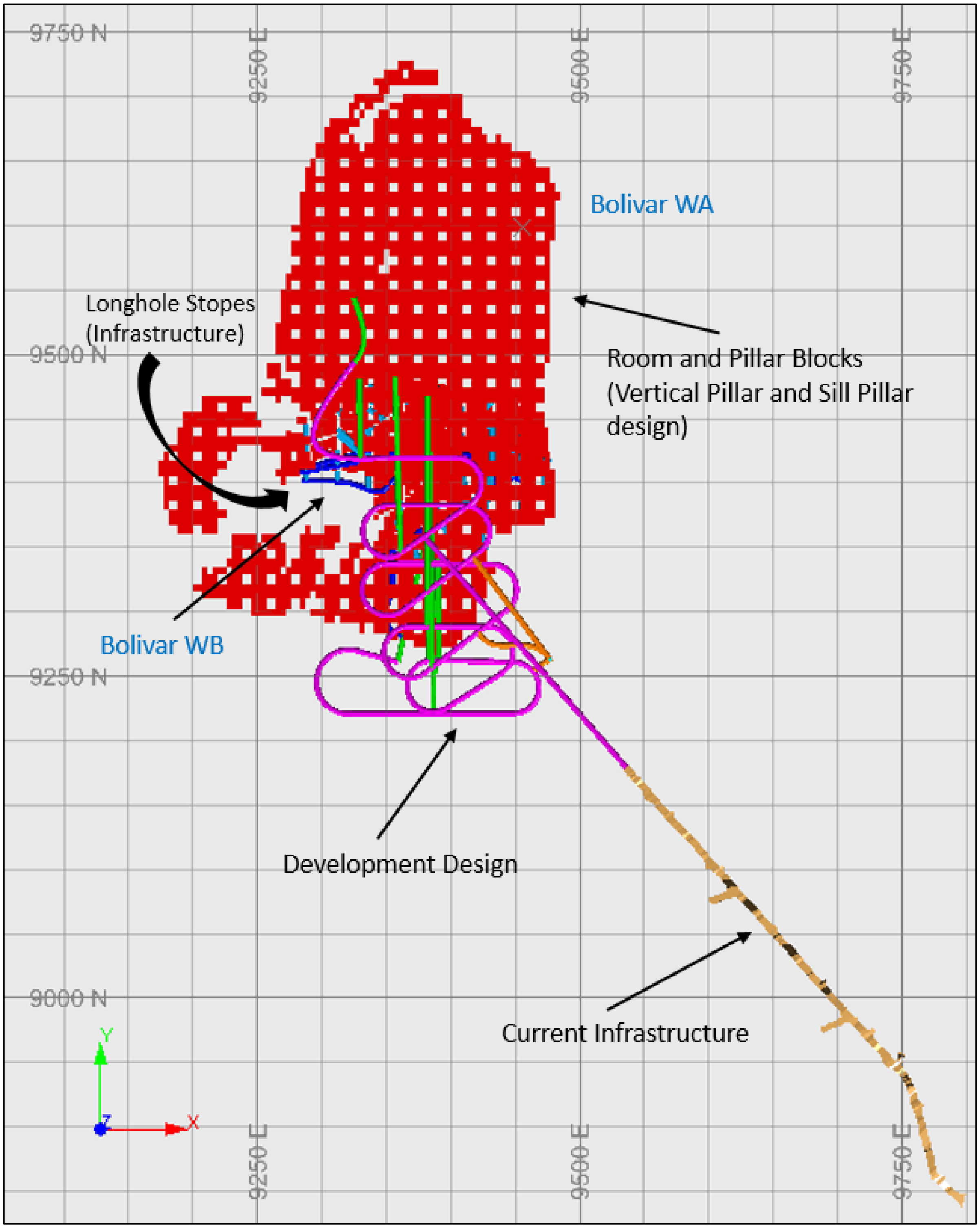
Source: REDCO, 2018

Figure 16-17: Plan View of El Gallo Inferior and Chimenea Reserve Blocks and Development - View below elevation 1780



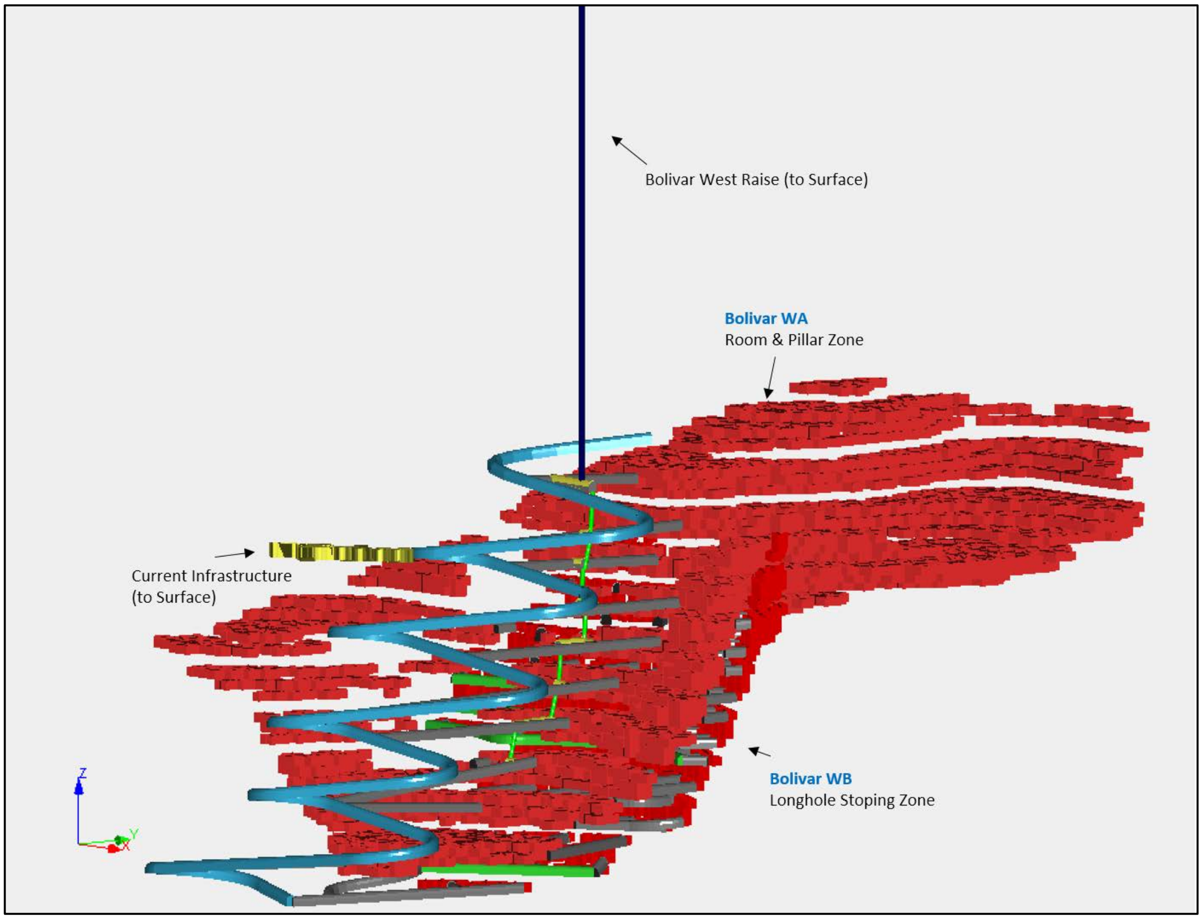
Source: REDCO, 2018

Figure 16-18: Isometric view of El Gallo Inferior and Chimenea Reserve Blocks and Development



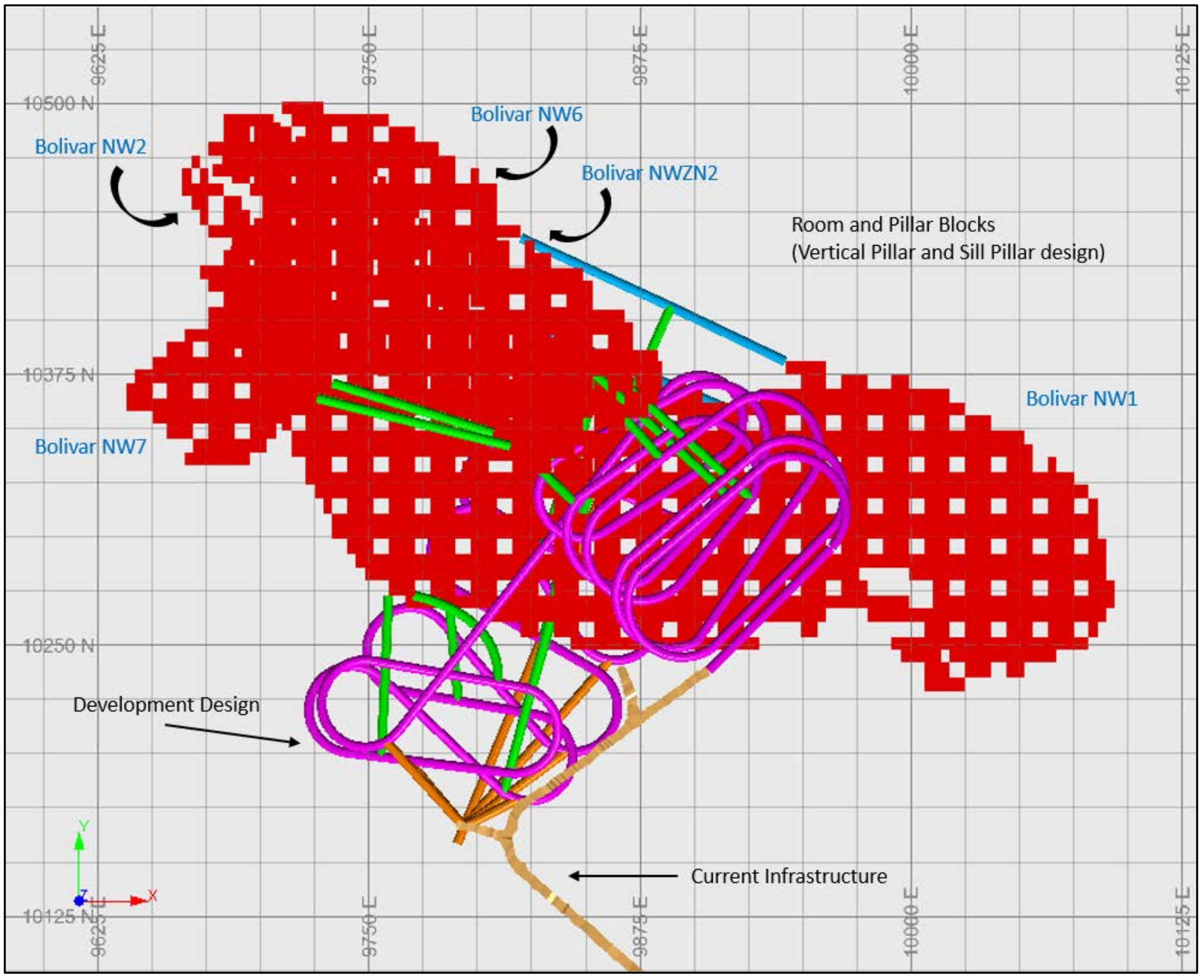
Source: REDCO, 2018

Figure 16-19: Plan View of Bolivar West Reserve Blocks and Development



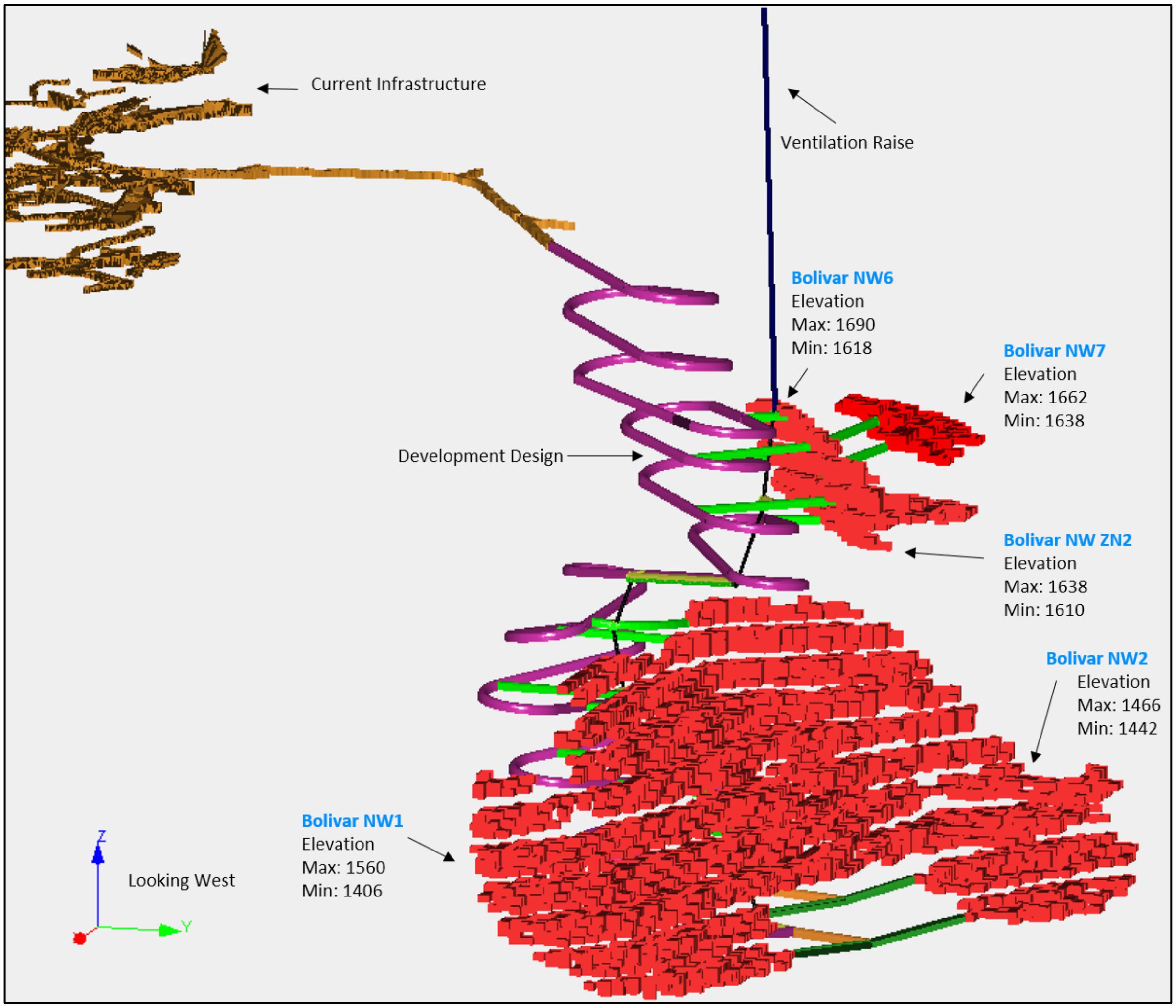
Source: REDCO, 2018

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



Source: REDCO, 2018

Figure 16-21: Plan View of Bolivar Northwest Reserve Blocks and Development



Source: REDCO, 2018

Figure 16-22: Rotated View of Bolivar Northwest Reserve Blocks and Development

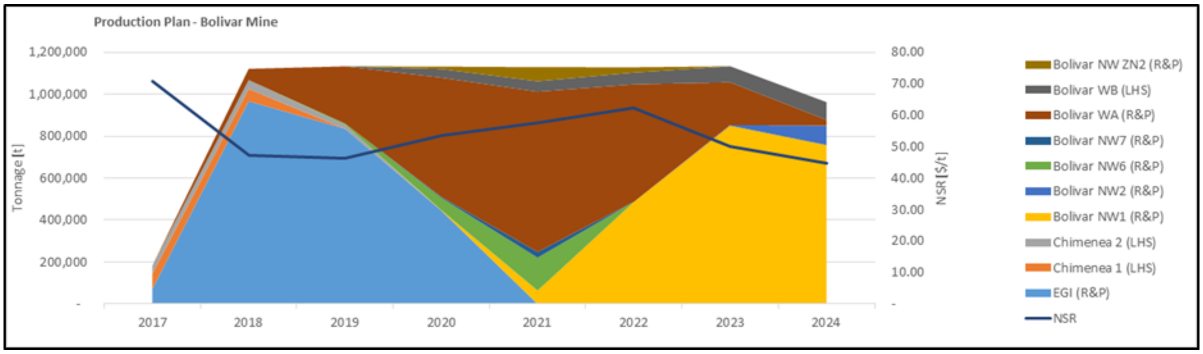
16.5 Mine Production Schedule

A LoM production schedule was generated for the Bolivar reserves and is shown in Table 16-8 and Figure 16-23. The start date of this schedule is November 2017 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 two months of production. Typical mining rates of 3,100 t/day ore and 500 t/day waste was applied. Based on historical actuals, an average rate of 8 m/d was used for development in waste and 9 m/d for development in ore.

Table 16-8: Bolivar LoM Production Plan

Item	unit	2017	2018	2019	2020	2021	2022	2023	2024	Total
EGI (R&P)	t	71,444	966,890	835,752	445,337	-	-	-	-	2,319,423
Chimenea 1 (LHS)	t	73,039	58,640	-	-	-	-	-	-	131,679
Chimenea 2 (LHS)	t	38,490	42,154	18,925	-	-	-	-	-	99,569
Bolivar NW1 (R&P)	t	-	-	-	2,164	63,933	486,512	850,454	757,959	2,161,022
Bolivar NW2 (R&P)	t	-	-	-	-	-	-	3,040	92,677	95,717
Bolivar NW6 (R&P)	t	-	-	5,873	58,431	156,732	707	-	-	221,742
Bolivar NW7 (R&P)	t	-	-	-	4,709	27,715	-	-	-	32,424
Bolivar WA (R&P)	t	-	53,804	272,955	568,939	764,073	560,650	203,531	27,463	2,451,415
Bolivar WB (LHS)	t	-	-	-	40,875	50,086	55,938	76,730	84,471	308,099
Bolivar NW ZN2 (R&P)	t	-	-	-	11,743	67,003	25,150	-	-	103,897
Ore Mined	t	182,973	1,121,488	1,133,504	1,132,198	1,129,542	1,128,958	1,133,755	962,569	7,924,987
Waste Mined	t	44,434	273,089	252,175	157,532	197,766	30,424	-	-	955,421
Total Mined	t	227,407	1,394,577	1,385,679	1,289,730	1,327,308	1,159,382	1,133,755	962,569	8,880,407
Cu (mill feed)	%	1.31	0.83	0.80	0.91	0.93	0.99	0.78	0.65	0.86
Cu (mill feed)	t	2,391	9,305	9,048	10,315	10,506	11,205	8,876	6,279	67,925
Ag (mill feed)	g/t	24.5	13.8	16.2	24.2	26.3	24.6	14.9	10.3	18.9
Ag (mill feed)	oz	144,322	498,777	591,809	880,472	953,478	891,854	542,504	320,283	4,823,499
Au (mill feed)	g/t	0.07	0.17	0.15	0.11	0.21	0.31	0.37	0.46	0.25
Au (mill feed)	oz	412	5,992	5,494	4,094	7,748	11,266	13,332	14,318	62,658
Horizontal Waste Development	m	667	4,308	3,968	2,442	3,172	492	-	-	15,049
Vertical Waste Development	m	193	413	301	266	68	-	-	-	1,241
Preparation (Ore)	m	727	3,348	3,163	3,139	3,236	3,220	3,268	3,215	23,316

Source: REDCO, 2018



Source: REDCO, 2018

Figure 16-23: Bolivar Production Plan by Orebody

16.6 Development Profile

Level accesses and on-level development, as well as primary ventilation and materials handling infrastructure, were designed in Studio 5DP™ software. The development and infrastructure designs were used to generate the development quantities. A development allowance of 20% was added to the design centerline lengths to account for the items not designed in detail. The development quantities and current advance rates were used to generate Bolivar's LoM development schedule shown in Table 16-9.

Table 16-9: Development Plan per Type of Infrastructure

Zone	Type	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total (m)
EGI Zone	Ramps (m)	241	1,234	403	-	-	-	-	-	-	1,878
	Access (m)	184	966	366	-	-	-	-	-	-	1,516
	Vent Raises (m)	173	126	34	-	-	-	-	-	-	333
	Total (m)	599	2,326	803	-	-	-	-	-	-	3,727
Bolivar NW Zone	Ramps (m)	116	635	935	1,135	967	-	-	-	-	3,788
	Access (m)	-	-	408	460	1,112	-	-	-	-	1,980
	Vent Raises (m)	-	-	215	233	68	-	-	-	-	515
	Total (m)	116	635	1,557	1,828	2,146	-	-	-	-	6,282
Bolivar W Zone	Ramps (m)	125	938	936	130	-	-	-	-	-	2,130
	Access (m)	-	535	921	716	1,093	492	-	-	-	3,757
	Vent Raises (m)	20	287	53	34	-	-	-	-	-	393
	Total (m)	145	1,760	1,909	880	1,093	492	-	-	-	6,279
Total (m)		**860**	**4,721**	**4,269**	**2,708**	**3,240**	**492**	**-**	**-**	**-**	**16,289**

Source: REDCO, 2018

16.7 Waste Storage

Currently, development waste material is hauled by scoop and placed into historical workings resulting in approximately 30% to 40% fill factor. Consideration should be made to invest in equipment to pack the waste rock into the stope to improve the fill factor and increase the amount of underground storage capacity.

Historically, approximately 90% of waste material has been stored underground in old mine workings with the remainder sent to surface for use in construction. Underground storage will continue for EGI and is planned for the new mining areas of Bolivar W and Bolivar NW once they are in production.

For the early stage of development in Bolivar NW and Bolivar W, waste material will be hauled to surface and then hauled for placement underground in EGI and other historical mined out areas. Initial review indicates that the development waste material from these areas can be stored underground in historical mine openings. Further analysis of the initial development waste handling and storage strategy is required. If underground storage in historical mine openings is not a viable solution, due to lack of space or operationally difficult to transfer waste material from the new mining areas to the historical mining areas, then an analysis of the surface storage locations will be required.

16.8 Major Mining Equipment

A list of the major underground mining equipment currently used at Bolivar Mine is included in Table 16-10. The equipment list was used as a reference point to estimate the number of equipment required to achieve the Bolivar LoM plan.

Table 16-10: Current List of Major Underground Mining Equipment at Bolivar

Mining Equipment	Capacity
Mining Trucks	
Truck Low Profile Joy 16 Td Ns.4560	16 t
Truck Low Profile ATLAS COPCP Mt-431B	30 t
New Truck Rdh Haulmaster 800-30. 30 Tons	30 t
New Truck Rdh MT420 17-1020 30 Tons	30 t
New Truck Rdh MT420 17-1021 30 Tons	30 t
Scoop Tram	
Scoop Tram Atlas Copco St-6C	6 yd^3
Scoop Tram Mti Lt 1050	6 yd^3
Scoop Tram Aramine St-14	8 yd^3
Scoop Tram Aramine St-14	8 yd^3
Scoop Tram Aramine St-14	8 yd^3
Scoop Tram Atlas Copco St-3.5 C	3.5 yd^3
Jumbo Drill	
Jumbo Electrohidraulico Atlas Copco Bomoer S1D	14 ft
Jumbo Boomer 252 Serie Cnn16Ure0029	16 ft
Jumbo MTI vein runner II	12 ft
Jumbo Frontonero Troidon 66 Xp Jmc-367	14 ft
Jumbo Bolter 88 Empernador Serie Jmc-378 ANCLADOR	15 ft
Jumbo Frontonero Troidon 66- Xp	16 ft

Source: Dia Bras, 2018

Bolivar Mine also has surface equipment to haul ore to the Piedras Verdes processing plant. This equipment consists of 18 t average capacity trucks (FMX 440 Volvo,30 t nominal capacity).

Equipment performance was calculated and validated using actual operational performance data provided by Dia Bras. The equipment performance was used to estimate the quantity of equipment required for the production and development plan of the Bolivar Mine. The maximum number of equipment required to meet the production plan is listed by mining area and totaled for Bolivar Mine in Table 16-11. The number of underground personnel required to operate the equipment is also listed for reference.

Table 16-11: Planned Underground Mining Equipment

Equipment by Mining Area	Number
Jumbo (Development) EGI Zone	1
Jumbo (Development) BNW Zone	1
Jumbo (Development) BW Zone	1
Jumbo (Production) EGI Zone	5
Jumbo (Production) BNW Zone	4
Jumbo (Production) BW Zone	4
Scoop 8 yd3 EGI Zone	3
Scoop 8 yd3 BNW Zone	2
Scoop 8 yd3 BW Zone	3
Dumper EGI Zone 30 t	6
Dumper BNW Zone 30 t	9
Dumper BW Zone 30 t	10
Volquete Truck (to Processing Plant) EGI Zone	16
Volquete Truck (to Processing Plant) BNW Zone	14
Volquete Truck (to Processing Plant) BW Zone	16

Total Equipment – Bolivar Mine	Max
Total Jumbo (Development)	4
Total Jumbo (Production)	8
Total Scoop 8yd3	8
Total Dumpers 30 t	16
Volquete Truck (to Processing Plant) EGI Zone	23
Personnel	76

Source: REDCO, 2018

The equipment will be shared for development and production activities. The equipment estimate considers a spare scoop, dumper, jumbo, and truck as contingency. This extra equipment could be used in any orebody as necessary.

An auxiliary mine equipment list was provided by site and is listed in Table 16-12 for reference.

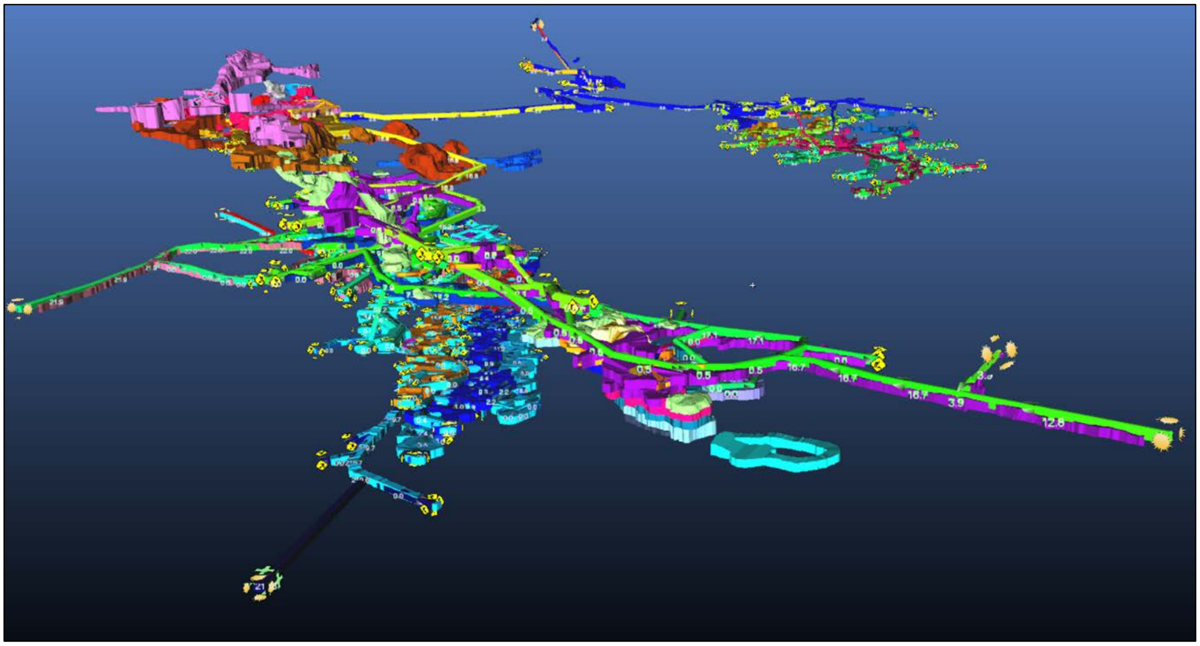
Table 16-12: Auxiliary Mining Equipment

Auxiliary Equipment
Pick-up
No Ec 40 Dodge 2014
No Ec 51 Dodge 2014
No Ec 55 Dodge 2014
No Ec 61 Dodge 2014
Nissan Pick Up (Powder Magazine)
No Ec 9 Mitsubishi 2017
No Ec 11 Mitsubishi 2017
No Ec 56 Mitsubishi 2017
No Ec 58 Mitsubishi 2017
Surface Equipment
Truck for personnel 95 No.1 (26P)
Truck for personnel 02 (50P) '76
Sterling Truck 2005 (Water tank)
Freighliner Truck 2007 (Water tank)
Motor Grader 72V16992 Caterpillar 140G
Underground repair
Scissor lifts 4927 Getman A-64
Board Long Year Stope Master
Marcotte Anfo Truck M40 Minejack

Source: Dia Bras, 2018

16.9 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 16-24.



Source: Dia Bras, 2016

Figure 16-24: 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.

A conceptual ventilation network was designed in each area. 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 LoM plan. Each zone, Bolivar West, El Gallo and Bolivar Northwest is modeled as independent system.

Table 16-13 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) was used for equipment, 55 cfm/person (0.026 m^3/sec per person) for personnel, and an assumption of 76 people working underground with a total ore and waste production of 3,500 t/day was used.

Table 16-13: Ventilation Requirements for Equipment and Personnel

Item	Count	Total Diesel Engine Horsepower (hp)	% Effective Utilization	Personnel Requirement (cfm)	Equipment Requirement (cfm)/hp	Total (cfm)	Total (m^3/sec)
Truck	16	3,680	74		100	271,216	128.0
Drill Jumbo	12	1,214	50		100	60,700	28.7
Scoop Tram	8	1,837	72		100	134,866	63.7
Personnel	76		100	55		4,180	2.0
Total						140,483	222.3

Source: REDCO, 2018

Using the production schedule, a simplified ventilation model was generated for the three main 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 (losses). It was assumed that all vehicles would be turned off when not in use for extended periods.

Total airflow required during Bolivar peak production was calculated to be 199 m^3/sec at year 2021. Maximum airflow required in the Bolivar West was calculated to be 129 m^3/sec at year 2021, for El Gallo zone a maximum requirement of 97 m^3/sec at year 2018 and for Bolivar Northwest a maximum requirement of 109 m^3/sec at year 2024. The ventilation requirements by mining area is shown in Table 16-14.

In El Gallo Inferior, Bolivar West and Bolivar Northwest, a forcing system must be employed in order to deliver fresh air directly to the room and pillar and longhole stopes and levels. The fresh air is pulled through the mine access portals by surface fans located at the top of exhaust raises located in each of the mining areas. The fresh air is delivered to the orebody access ramps and then directed to production areas using auxiliary vent fans and ducting. Air is exhausted through a series of internal ventilation raises that connect to surface through a raisebored vent raise.

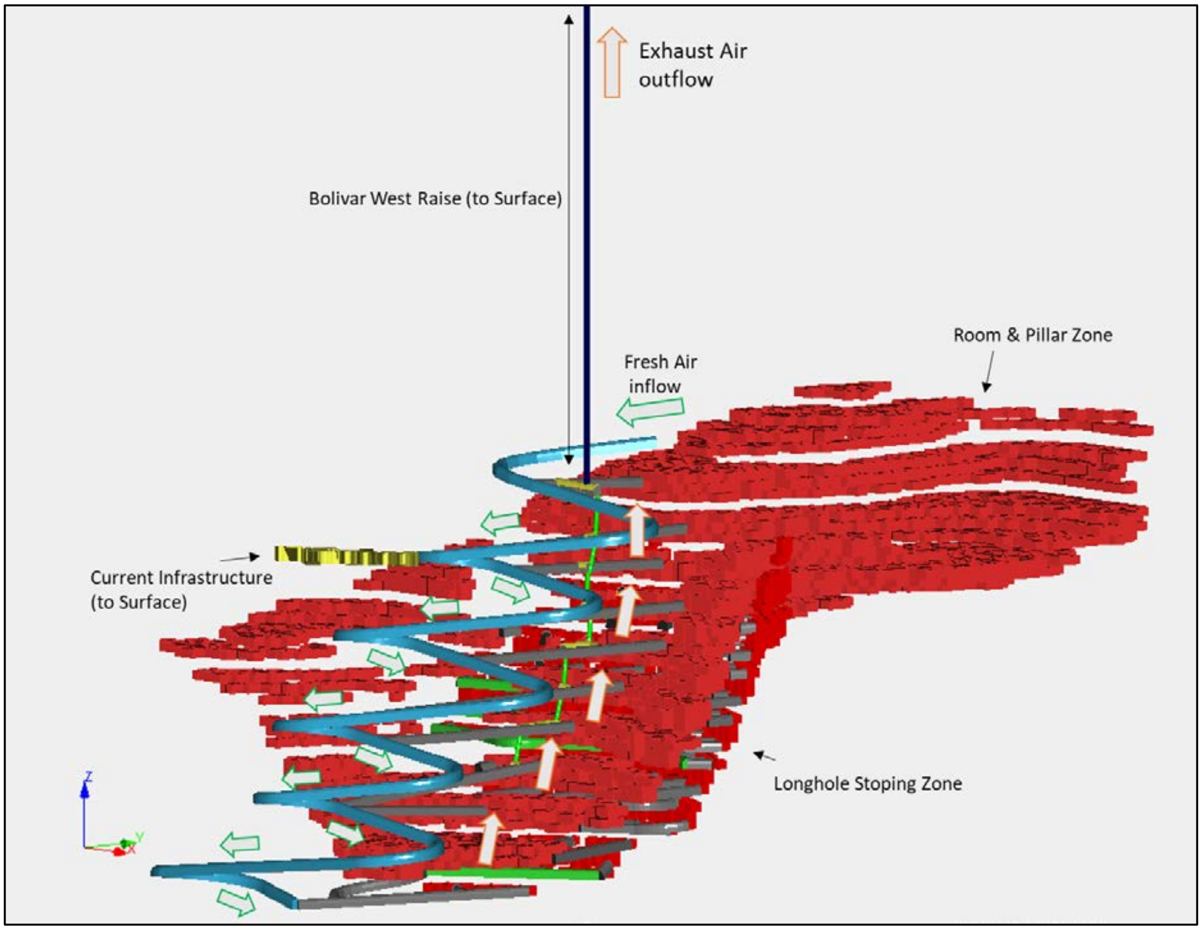
The vent system for Bolivar W, Bolivar NW, and EGI are depicted in Figure 16-25, Figure 16-26, Figure 16-27. A schematic of the overall vent system is shown in Figure 16-28.

Table 16-14: Ventilation Requirements by Mining Area

El Gallo Zone - cfm/Equipment (underground equipment)									
Equipment	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Jumbo (Development)	5,058	5,058	5,058	-	-	-	-	-	-
Jumbo (Production)	5,058	25,292	20,233	10,117	-	-	-	-	-
Scoop 8 yd3	33,717	50,575	50,575	16,858	-	-	-	-	-
Dumper 30 t	16,951	101,706	67,804	33,902	-	-	-	-	-
Personnel	4,180	3,979	3,152	1,644	-	-	-	-	-
Total + 10% Losses	**71,461**	**205,271**	**161,505**	**68,773**	**-**	**-**	**-**	**-**	**-**
Air Requirement (m^3/sec)									
Equipment	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Jumbo (Development)	2.4	2.4	2.4	-	-	-	-	-	-
Jumbo (Production)	2.4	11.9	9.6	4.8	-	-	-	-	-
Scoop 8 yd3	15.9	23.9	23.9	8.0	-	-	-	-	-
Dumper 30 t	8.0	48.0	32.0	16.0	-	-	-	-	-
Personnel	2.0	1.9	1.5	0.8	-	-	-	-	-
Total + 10% Losses	**33.7**	**96.9**	**76.3**	**32.5**	**-**	**-**	**-**	**-**	**-**
Bolivar NW - cfm/Equipment (underground equipment)									
Equipment	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Jumbo (Development)	5,058	5,058	5,058	5,058	5,058	-	-	-	-
Jumbo (Production)	-	-	5,058	5,058	10,117	15,175	20,233	20,233	-
Scoop 8 yd3	16,858	16,858	33,717	33,717	33,717	16,858	33,717	33,717	-
Dumper 30 t	16,951	16,951	16,951	33,902	84,755	101,706	152,559	152,559	-
Personnel	-	-	22	284	1,167	1,897	3,147	3,694	-
Total + 10% Losses	**42,754**	**42,754**	**66,886**	**85,822**	**148,295**	**149,200**	**230,621**	**231,223**	**-**
Air Requirement (m^3/sec)									
Equipment	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Jumbo (Development)	2.4	2.4	2.4	2.4	2.4	-	-	-	-
Jumbo (Production)	-	-	2.4	2.4	4.8	7.2	9.6	9.6	-
Scoop 8 yd3	8.0	8.0	15.9	15.9	15.9	8.0	15.9	15.9	-
Dumper 30 t	8.0	8.0	8.0	16.0	40.0	48.0	72.0	72.0	-
Personnel	-	-	0.0	0.1	0.6	0.9	1.5	1.7	-
Total + 10% Losses	**20.2**	**20.2**	**31.6**	**40.5**	**70.0**	**70.5**	**108.9**	**109.2**	**-**

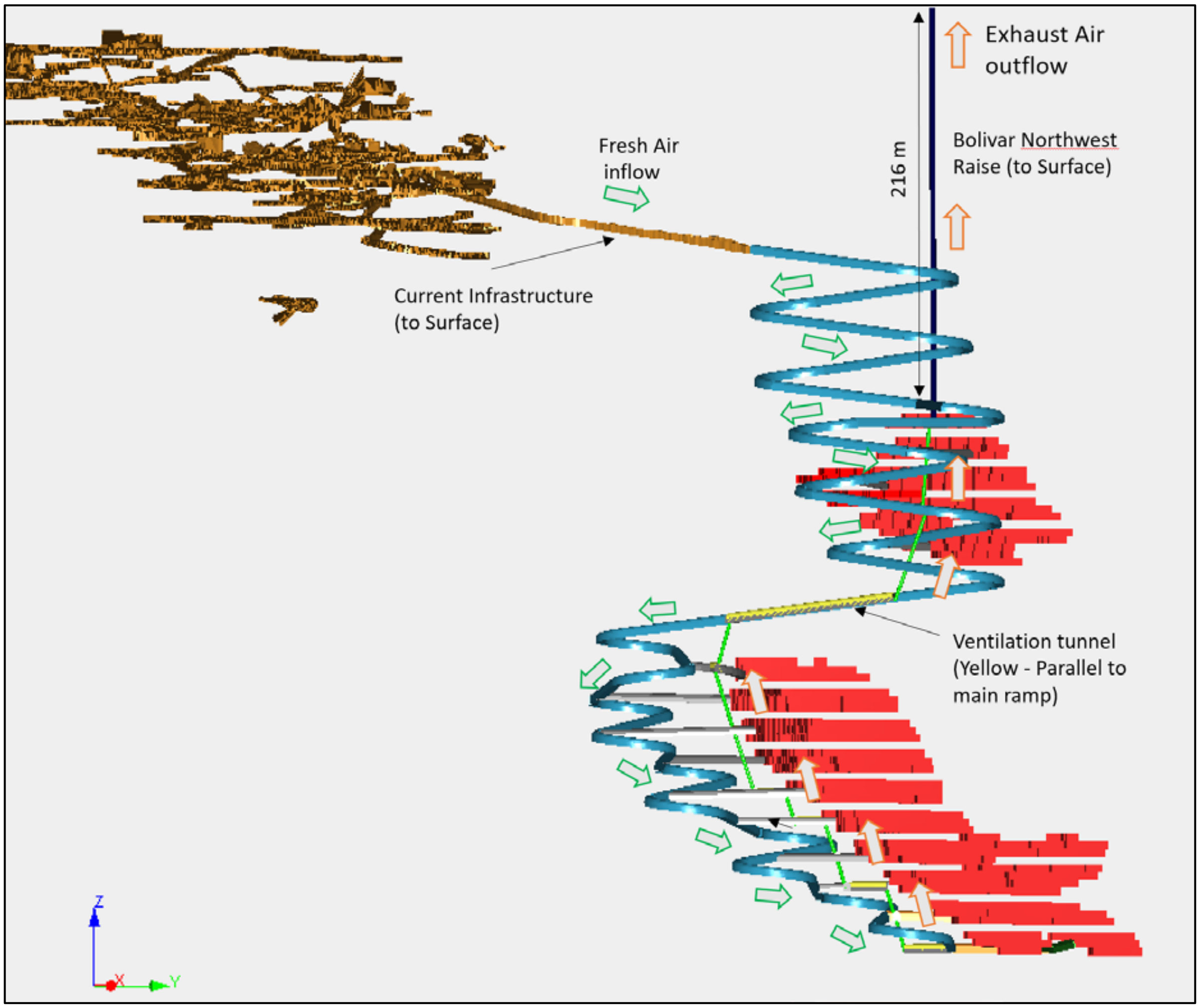
Bolivar W - cfm/Equipment (underground equipment)									
Equipment	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Jumbo (Development)	5,058	5,058	5,058	5,058	5,058	5,058	-	-	-
Jumbo (Production)	-	5,058	10,117	15,175	20,233	15,175	10,117	5,058	-
Scoop 8 yd3	16,858	33,717	33,717	33,717	50,575	33,717	16,858	16,858	-
Dumper 30 t	16,951	33,902	84,755	118,657	169,510	118,657	50,853	33,902	-
Personnel	-	201	1,007	2,251	3,013	2,283	1,033	486	-
Total + 10% Losses	**42,754**	**85,729**	**148,118**	**192,344**	**273,228**	**192,379**	**86,747**	**61,935**	**-**
Air Requirement (m^3/sec)									
Equipment	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Jumbo (Development)	2.4	2.4	2.4	2.4	2.4	2.4	-	-	-
Jumbo (Production)	-	2.4	4.8	7.2	9.6	7.2	4.8	2.4	-
Scoop 8 yd3	8.0	15.9	15.9	15.9	23.9	15.9	8.0	8.0	-
Dumper 30 t	8.0	16.0	40.0	56.0	80.0	56.0	24.0	16.0	-
Personnel	-	0.1	0.5	1.1	1.4	1.1	0.5	0.2	-
Total + 10% Losses	**20.2**	**40.5**	**69.9**	**90.8**	**129.0**	**90.8**	**41.0**	**29.2**	**-**

Source: REDCO, 2018



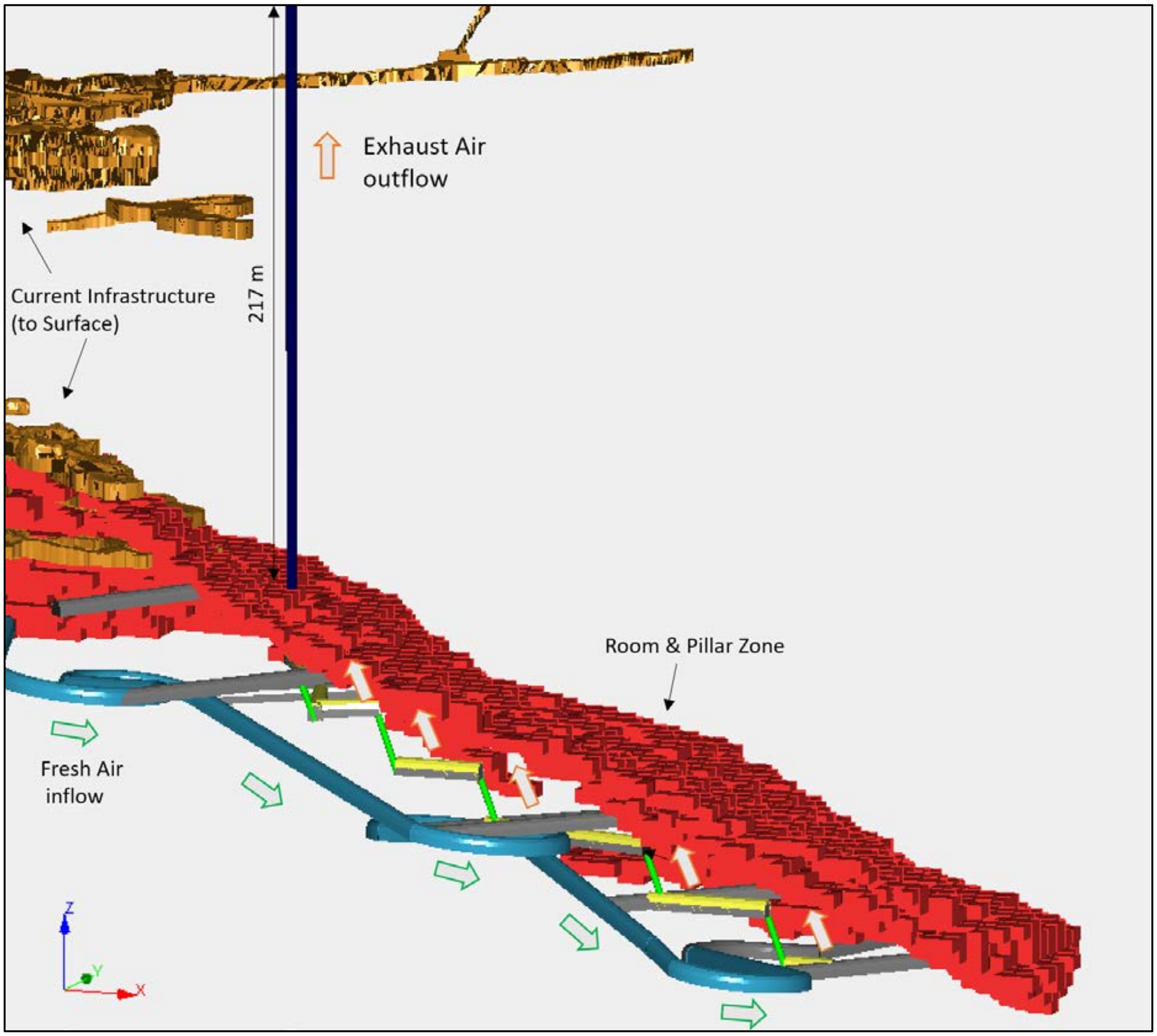
Source: REDCO, 2018

Figure 16-25: Bolivar West Ventilation Raise Location



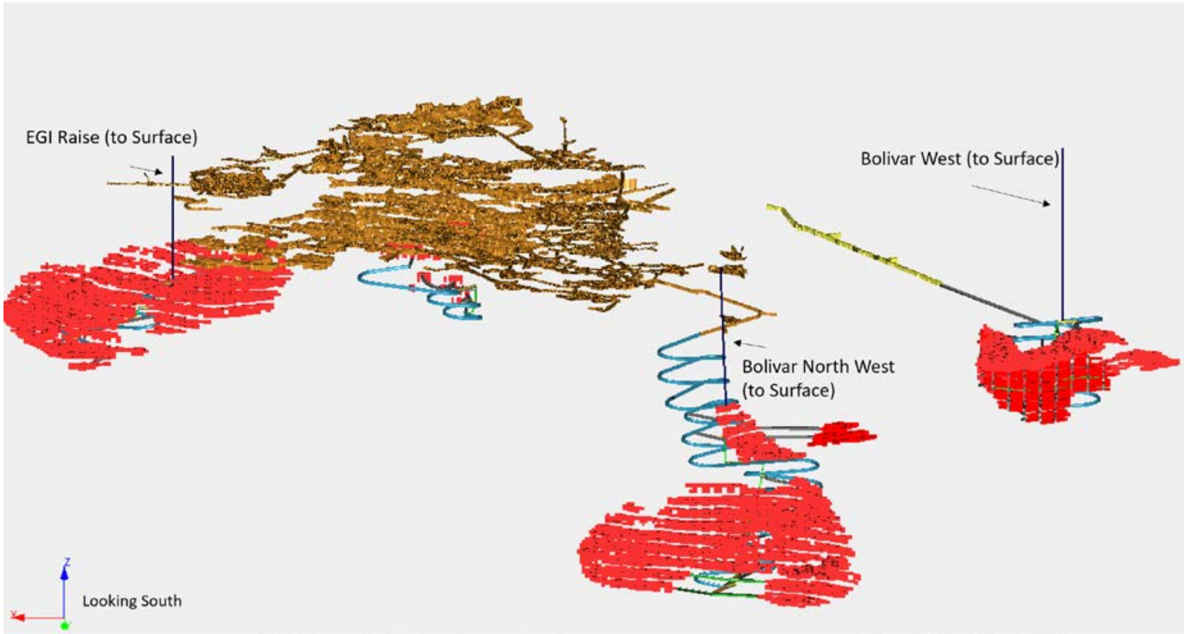
Source: REDCO, 2018

Figure 16-26: Bolivar Northwest Ventilation Raise Location



Source: REDCO, 2018

Figure 16-27: El Gallo Inferior Ventilation Raise Location



Source: REDCO, 2018

Figure 16-28: Bolivar W/Bolivar NW/El Gallo Inferior Key Ventilation Development Layout

The surface exhaust raise will be a 4m diameter raisebore. The internal orebody exhaust raises will be 3 m by 3 m drop raises. The surface fans will be located at the top of each of the main orebody exhaust raises. The surface raise airflows and pressures are shown by mining area in Table 16-16.

Table 16-15: Fan Airflow and Pressure by Mining Area

Fan	Location	Fan Airflow (cfm)	Fan Pressure (kPa)	Horse Power (Hp)
1	BNW - Top of Main Raise	235,000	0.67	450
2	BW - Top of Main Raise	175,000	0.85	350
3	EGI - Top of Main Raise	210,000	0.80	400

Source: REDCO, 2018

It is highly recommended that the site implements a whole-of-mine ventilation plan. The main objectives of the plan would be to further develop and define:

- 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

17.1 Process Description

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 with mass balance is shown in Figure 17-1.

17.1.1 Crushing Circuit

Dump trucks of approximately 20 t 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 plant is fed by a feed hopper equipped with a 20 inch x 20 inch static grizzly discharging to a jaw crusher in open circuit, with its product feeding a vibrating screen. The nominal four-inch material discharging from the jaw crusher is classified by two double deck vibrating screens. The top screen is two inches by one inch and the bottom screen is 3/4 inch by 3/8 inch. Material smaller than 3/8 inch becomes final product that is transferred to two feed silos that have 1,000 t each capacity. The vibrating screen's oversize feeds a secondary crushing stage consisting of two cone crushers. The top screen is conveyed to a Sandvik HC660 cone crusher and the bottom screen oversize is conveyed to a Metso HP-300 cone crusher. The cone crusher's discharge joins the primary crusher's discharge and feeds the vibrating screen.

17.1.2 Grinding Circuit

Fine ore from the silos feed the grinding circuit which uses two conventional 9.5 ft x 14 ft ball mills operating in parallel, each one in closed circuit with a hydrocyclone cluster. The two bill mills underwent complete overhauls during end of the 2017 year to improve mechanical availability. The hydrocyclones were changed from D26 to D20 to improve plant stability. The product size in the cyclone overflow ranges between 34% and 48% passing 75 micrometers with an average of 43.5% for the 2017 year. The hydrocyclone overflow feed the flotation circuit. The hydrocyclone underflow is returned to the ball mills for further size reduction.

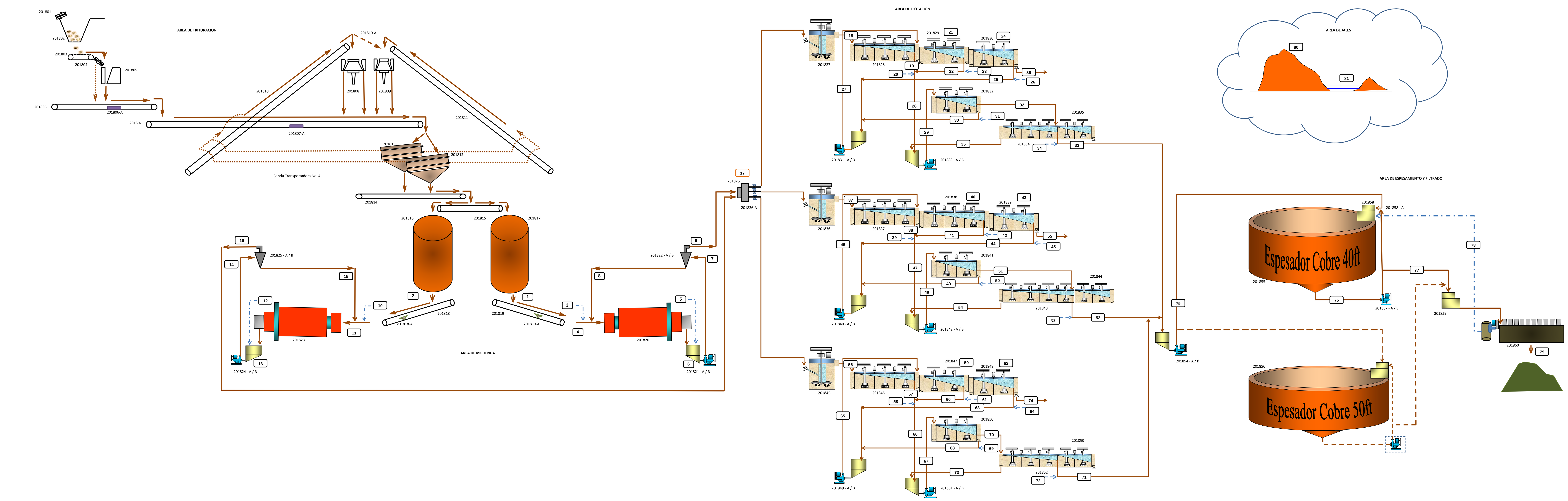
17.1.3 Flotation Circuit

The flotation circuit operates three identical parallel flotation lines. Each flotation line includes a 12 ft x 12 ft conditioning tank, three DR 300 ft^3 rougher flotation cells, where the rougher concentrate feeds the cleaning stage. The cleaning stage consists of two DR 300 ft^3 primary cleaner flotation cells, three Sub A 100-ft^3 secondary flotation cells and two Sub A 100 ft^3 tertiary cleaning flotation cells. Rougher's tails feed the rougher-scavenger stage which consists of four DR 300 ft^3 flotation cells. The final copper concentrate typically comes from the second cleaner flotation product, however if it does not meet specification, the concentrate is sent to the third cleaner. Tails from the rougher-scavenger become the plant's final tails.

17.1.4 Thickening and Filtration

The flotation concentrate is thickened in a 40 ft x 10 ft thickener before being dewatered using three vacuum filters. A 50 ft x 10 f thickener is also installed and used on an as-needed basis. Solids are thickened to greater than 40% solids by weight in the thickener underflow and filtered using a Dorr-Oliver 8 ft x 10 ft disc filter. Filtrate from the disc filter is recycled back to the thickener and the thickener overflow is recycled back to the process. A standby disc filter is also installed. The filter copper concentrate contains approximately 9% to 10% moisture.

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



ITEM	AREA DE TRITURACION
201801	PARRILLA DE RECIBO
201802	TOLVA DE GRUESOS
201803	ALIMENTADOR DE ORUGAS
201804	PARRILLA TIPO GRISLLEY
201805	QUEBRADORA DE QUIJADAS 35 X 42
201806	BANDA TRANSPORTADORA # 1
201806-A	ELECTRO IMAN CON BANDA MOVIL
201807	BANDA TRANSPORTADORA # 2
201807-A	ELECTRO IMAN CON BANDA MOVIL
201808	QUEBRADORA DE CONO, MARCA SANDVIK CH 660
201809	QUEBRADORA DE CONO, MARCA METSO HP 300
201810	BANDA TRANSPORTADORA # 3
201810-A	CHUTE DE DESVIO, PARA REGRESAR A CIRCUITO SECUNDARIO
201811	BANDA TRANSPORTADORA # 8
201812	CRIBA VIBRATORIA DESITER 12 X 16
201813	CRIBA VIBRATORIA TEREX 12 X 16
201814	BANDA TRANSPORTADORA # 4
201815	BANDA TRANSPORTADORA # 5
201816	SILO DE FINOS MOLINO # 2 CAPACITAD 1000 TON.
201817	SILO DE FINOS MOLINO # 1 CAPACIDAD 1000 TON.
ITEM	**AREA DE MOLINEDA**
201818	BANDA TRANSPORTADORA # 6
201818-A	PESO METRO EN BANDA MOVIL
201819	BANDA TRANSPORTADORA # 7
201819-A	PESO METRO EN BANDA MOVIL
201820	MOLINO DOMINION 9.5 X 14 Ft # 1
201821 A / B	BOMBAS CENTRIFUGAS HORIZONTALES 6 X 8
201822 A / B	HIDROCILCONES D - 20
201823	MOLINO DOMINION 9.5 X 14 Ft # 2
201824 A / B	BOMBAS CENTRIFUGAS HORIZONTALES 6 X 8
201825 A / B	HIDROCILCONES D - 20
201826	CAJON REPARTIDOR DE CARGA
201826 A	MUESTREADOR AUTOMATICO DE CABEZA
ITEM	**AREA DE FLOTACION CIRCUITO 1**
201827	ACONDICIONADOR DE PULPA 11 X 11
201828	BANCO PRIMARIO DE COBRE (3 CELDAS DE 300 FT3 C/U)
201829	BANCO AGOTATIVO 1 DE COBRE (2 CELDAS DE 300 FT3 C/U)
201830	BANCO AGOTATIVO 2 DE COBRE (2 CELDAS DE 300 FT3 C/U)
201831 A / B	BOMBAS CENTRIFUGAS HORIZONTALES 3 X 4
201832	BANCO PRIMERA LIMPIA DE COBRE (2 CELDAS DE 300 FT3 C/U)
201833 A / B	BOMBAS CENTRIFUGAS HORIZONTALES 3 X 4
201834	BANCO SEGUNDA LIMPIA DE COBRE (3 CELDAS DE 100 FT3 C/U)
201835	BANCO TERCERA LIMPIA DE COBRE (2 CELDAS DE 100 FT C/U)
ITEM	**AREA DE FLOTACION CIRCUITO 2**
201836	ACONDICIONADOR DE PULPA 11 X 11
201837	BANCO PRIMARIO DE COBRE (3 CELDAS DE 300 FT3 C/U)
201838	BANCO AGOTATIVO 1 DE COBRE (3 CELDAS DE 300 FT3 C/U)
201839	BANCO AGOTATIVO 2 DE COBRE (2 CELDAS DE 300 FT3 C/U)
201840 A / B	BOMBAS CENTRIFUGAS HORIZONTALES 3 X 4
201841	BANCO PRIMERA LIMPIA DE COBRE (2 CELDAS DE 300 FT3 C/U)
201842 A / B	BOMBAS CENTRIFUGAS HORIZONTALES 3 X 4
201843	BANCO SEGUNDA LIMPIA DE COBRE (4 CELDAS DE 100 FT3 C/U)
201844	BANCO TERCERA LIMPIA DE COBRE (2 CELDAS DE 100 FT C/U)
ITEM	**AREA DE FLOTACION CIRCUITO 3**
201845	ACONDICIONADOR DE PULPA 11 X 11
201846	BANCO PRIMARIO DE COBRE (3 CELDAS DE 300 FT3 C/U)
201847	BANCO AGOTATIVO 1 DE COBRE (2 CELDAS DE 300 FT3 C/U)
201848	BANCO AGOTATIVO 2 DE COBRE (2 CELDAS DE 300 FT3 C/U)
201849 A / B	BOMBAS CENTRIFUGAS HORIZONTALES 3 X 4
201850	BANCO PRIMERA LIMPIA DE COBRE (2 CELDAS DE 300 FT3 C/U)
201851 A / B	BOMBAS CENTRIFUGAS HORIZONTALES 3 X 4
201852	BANCO SEGUNDA LIMPIA DE COBRE (3 CELDAS DE 100 FT3 C/U)
201853	BANCO TERCERA LIMPIA DE COBRE (2 CELDAS DE 100 FT C/U)
201854 A / B	BOMBAS CENTRIFUGAS HORIZONTALES 3 X 4
ITEM	**AREA DE ESPESAMIENTO Y FILTRADO**
201855	ESPESADOR DE COBRE DE 40 FT
201856	ESPESADOR DE COBRE DE 50 FT
201857 A / B	BOMBAS CENTRIFUGAS HORIZONTALES 3 X 4
201858	CAJON ALIMENTADOR DE CONCENTRADO A ESPESADOR
201858 - A	CORTADOR AUTOMATICO DE CONCENTRADO
201859	CAJON ALIMENTADOR A FILTRO DE DISCO
201860	FILTRO DE DISCO DOOR OLIVER 8 X 10

CORRIENTE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
G. E. MINERAL	3.20	3.20		3.20		3.20	3.20	3.20	3.20		3.20		3.20	3.20	3.20	3.20	3.20	3.20	4.00	
G.E. PULPA	2.88	2.88		2.367		2.222	1.954	2.367	1.493		2.367		2.222	1.954	2.367	1.493	1.493	1.493	1.24	
TON / HR. MINERAL	63	63		158		158	158	95	63		158		158	158	95	63	126.00	63	2.10	
% DE SOLIDOS	95	95		84.00		80.00	71.00	84.00	48.00		84.00		80.00	71.00	84.00	48.00	48.00	48.00	26	
DILUCION	0.053	0.053		0.190		0.250	0.408	0.190	1.083		0.190		0.250	0.408	0.190	1.083	1.083	1.08	2.846	
TON / HR AGUA	7	7	12.00	30.00	28.875	39.38	64.33	18.00	68	12.00	30.00	28.875	39.38	64.33	18.00	68	136.50	68.25	5.99	6.178
TON / HR PULPA	70	70		187.50		196.88	221.83	112.50	131		187.50		196.88	221.83	112.50	131	262.50	131.25	8.093	
M^3 / HR MINERAL	20	20		49.22		49.22	49.22	29.53	19.69		49.22		49.22	49.22	29.53	19.69	39.38	19.69	0.526	
M^3 / HR AGUA	7	7	12.00	30.00	28.88	39.38	64.33	18.00	68.25	12.00	30.00	28.88	39.38	64.33	18.00	68.25	136.50	68.25	5.989	6.18
M^3 / HR PULPA	27	27		79.22		88.59	113.55	47.53	87.94		79.22		88.59	113.55	47.53	87.94	175.88	87.94	6.515	
GPM AGUA	31	31	52.84	132.10	127.15	173.38	283.27	79.26	300.53	52.84	132.10	127.15	173.38	283.27	79.26	300.53	601.06	300.53	26.371	27.20
GPM PULPA	118	118		348.83		390.11	500.00	209.30	387.22		348.83		390.11	500.00	209.30	387.22	774.44	387.22	28.69	
	TRITURACION		MOLINO 1							MOLINO 2							FINOS	FLOTACIO DE COBRE 1		

CORRIENTE	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
G. E. MINERAL	3	4.00		3	4.00		4.00	4.00	4.00	4.00		4.00	4.00		4.00	3	3.2	4.00		3
G.E. PULPA	1.45	1.16		1.45	1.13		1.25	1.25	1.25	1.24		1.17	1.16		1.18	1.41	1.49	1.24		1.45
TON / HR. MINERAL	61	2.08		59	2.08		4.19	4.19	4.19	4.19		4.19	2.08		4.19	59	63	2.10		61
% DE SOLIDOS	45	18		45	15		27	27	27	26		19	18		20	42	48.00	26		45
DILUCION	1.222	4.556		1.222	5.667		2.704	2.704	2.704	2.846		4.263	4.556		4.000	1.381	1.08	2.846		1.222
TON / HR AGUA	74.43	9.49	2.546	71.88	11.81	9.335	11.33	11.32	11.33	11.93	5.431	17.86	9.49	1.103	16.76	81.22	68.25	5.99	6.178	74.43
TON / HR PULPA	135.32	11.574		130.69	13.889		15.519	15.509	15.519	16.115		22.053	11.574		20.950	140.03	131.25	8.093		135.32
M^3 / HR MINERAL	19.030	0.521		18.379	0.521		1.048	1.047	1.048	1.048		1.048	0.521		1.048	18.379	19.69	0.526		19.030
M^3 / HR AGUA	74.43	9.491	2.55	71.88	11.806	9.34	11.329	11.322	11.329	11.925	5.43	17.863	9.491	1.10	16.760	81.22	68.25	5.989	6.18	74.43
M^3 / HR PULPA	93.46	10.012		90.26	12.326		12.376	12.369	12.376	12.973		18.910	10.012		17.808	99.60	87.94	6.515		93.46
GPM AGUA	327.73	41.791	11.21	316.52	51.984	41.11	49.883	49.854	49.883	52.512	23.92	78.655	41.791	4.86	73.800	357.63	300.53	26.371	27.20	327.73
GPM PULPA	411.53	44.08		397.45	54.28		54.50	54.46	54.50	57.12		83.27	44.08		78.41	438.56	387.22	28.69		411.53
																	FLOTACIO DE COBRE 2			

CORRIENTE	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
G. E. MINERAL	4.00		3	4.00		4.00	4.00	4.00	4.00		4.00	4.00		4.00	3	3.20	4.00		3	4.00
G.E. PULPA	1.16		1.45	1.13		1.25	1.25	1.25	1.24		1.17	1.16		1.18	1.41	1.49	1.24		1.45	1.16
TON / HR. MINERAL	2.08		59	2.08		4.19	4.19	4.19	4.19		4.19	2.08		4.19	59	63.00	2.10		61	2.08
% DE SOLIDOS	18		45	15		27	27	27	26		19	18		20	42	48.00	26		45	18
DILUCION	4.556		1.222	5.667		2.704	2.704	2.704	2.846		4.263	4.556		4.000	1.381	1.08	2.846		1.222	4.556
TON / HR AGUA	9.49	2.546	71.88	11.81	9.335	11.33	11.32	11.33	11.93	5.431	17.86	9.49	1.103	16.76	81.22	68.25	5.99	6.178	74.43	9.49
TON / HR PULPA	11.574		130.69	13.889		15.519	15.509	15.519	16.115		22.053	11.574		20.950	140.03	131.25	8.093		135.32	11.574
M^3 / HR MINERAL	0.521		18.379	0.521		1.048	1.047	1.048	1.048		1.048	0.521		1.048	18.379	19.69	0.526		19.030	0.521
M^3 / HR AGUA	9.491	2.55	71.88	11.806	9.34	11.329	11.322	11.329	11.925	5.43	17.863	9.491	1.10	16.760	81.22	68.25	5.989	6.18	74.43	9.491
M^3 / HR PULPA	10.012		90.26	12.326		12.376	12.369	12.376	12.973		18.910	10.012		17.808	99.60	87.94	6.515		93.46	10.012
GPM AGUA	41.791	11.21	316.52	51.984	41.11	49.883	49.854	49.883	52.512	23.92	78.655	41.791	4.86	73.800	357.63	300.53	26.371	27.20	327.73	41.791
GPM PULPA	44.08		397.45	54.28		54.50	54.46	54.50	57.12		83.27	44.08		78.41	438.56	387.22	28.69		411.53	44.08
																FLOTACIO DE COBRE 3				

CORRIENTE	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81
G. E. MINERAL		3	4.00		4.00	4.00	4.00	4.00		4.00	4.00		4.00	3	4.00	4.00	4.00		4.00	3.2	
G.E. PULPA		1.45	1.13		1.25	1.25	1.25	1.24		1.17	1.16		1.18	1.41	1.30	1.51	1.51		3.15	1.41	
TON / HR. MINERAL		59	2.08		4.19	4.19	4.19	4.19		4.19	2.08		4.19	59	4.19	4.19	4.19		4.19	118	
% DE SOLIDOS		45	15		27	27	27	26		19	18		20	42	31	45	45		91	42	
DILUCION		1.222	5.667		2.704	2.704	2.704	2.846		4.263	4.556		4.000	1.381	2.226	1.222	1.222		0.099	1.381	
TON / HR AGUA	2.546	71.88	11.81	9.335	11.33	11.32	11.33	11.93	5.431	17.86	9.49	1.103	16.76	81.22	9.33	5.12	5.12	8.912	0.41	162.43	25.935
TON / HR PULPA		130.69	13.889		15.519	15.509	15.519	16.115		22.053	11.574		20.950	140.03	13.516	9.311	9.311		4.604	280.06	
M^3 / HR MINERAL		18.379	0.521		1.048	1.047	1.048	1.048		1.048	0.521		1.048	18.379	1.048	1.048	1.048		1.048	36.758	
M^3 / HR AGUA	2.55	71.88	11.806	9.34	11.329	11.322	11.329	11.925	5.43	17.863	9.491	1.10	16.760	81.22	9.326	5.121	5.121	8.91	0.414	162.43	25.93
M^3 / HR PULPA		90.26	12.326		12.376	12.369	12.376	12.973		18.910	10.012		17.808	99.60	10.374	6.169	6.169		1.462	199.19	
GPM AGUA	11.21	316.52	51.984	41.11	49.883	49.854	49.883	52.512	23.92	78.655	41.791	4.86	73.800	357.63	41.066	22.550	22.550	39.24	1.825	715.26	114.20
GPM PULPA		397.45	54.28		54.50	54.46	54.50	57.12		83.27	44.08		78.41	438.56	45.68	27.16	27.16		6.44	877.11	
															ESPESAMIENTO Y FILTRADO					JALES	

EXMIN, DIA BRAS MEXICANA			
DIAGRAMA DE FLUJO POR AREAS / BALANCE METALURGICO DE MASA			
OPERACION PLANTA A 3000 TON / DIA			
ELABORO :	ING. JESUS SANDOVAL	FECHA :	23 / 01 / 2018
REVISO :		FECHA :	
APROVO :		FECHA :	
ESCALA :	SIN ESCALA	REVISION :	A
CODIGO :	E-DIA-0001		
SIMBOLOGIA :	AGUA		
	CARGA		

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17.2 Production Performance

17.2.1 Current Plant Production

Ore feed during year 2017 totaled of 887,236 t, equivalent to an average of 74,000 t/m, or 2,400 t/d. This suggests that the 3,000 t/d mill capacity is not being fully utilized.

Piedras Verdes' monthly average performance for 2017 is shown in Table 17-1

Figure 17-2 shows the daily mill feed in terms of tonnes and copper head grade. There is 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.

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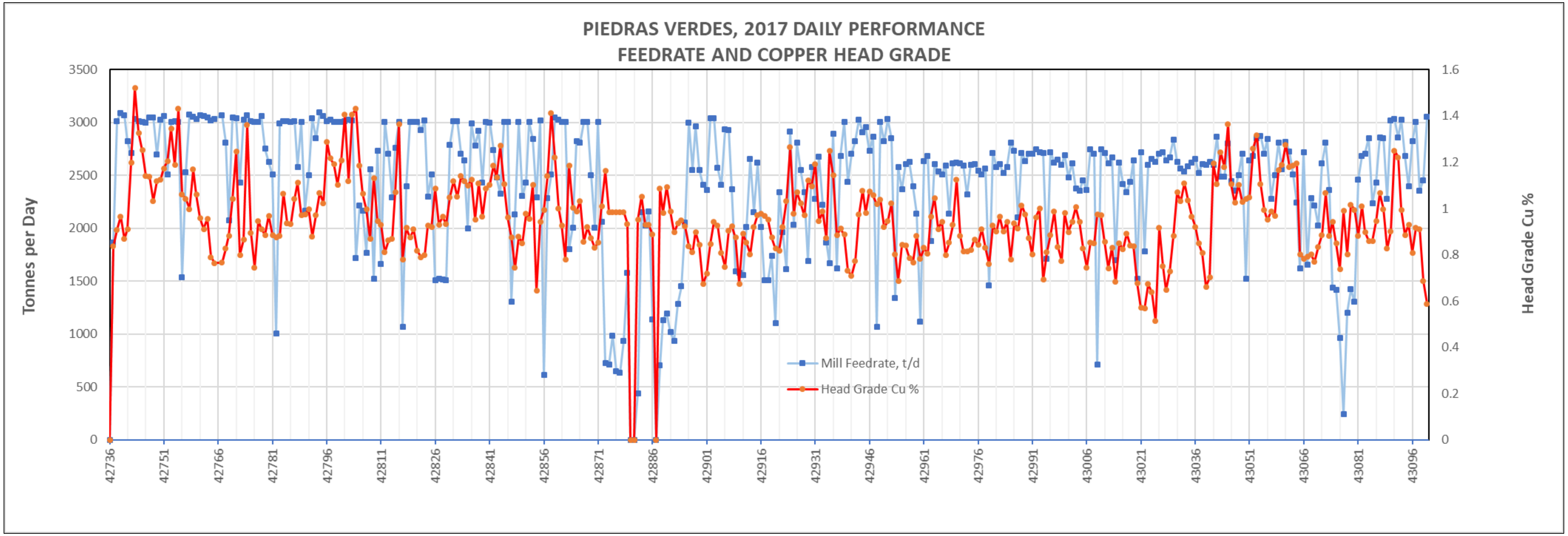
Table 17-1: Piedras Verdes Monthly Average Performance - 2017

Production 2017	Grinding	Head Grades			Production Concentrate	Concentrate Grade			Production Metal Content			Recoveries		
	(t/m)	Au (g/t)	Ag (g/t)	Cu (%)	(t/m)	Au (g/t)	Ag (g/t)	Cu (%)	Au (kg)	Ag (kg)	Cu (t)	Au (%)	Ag (%)	Cu (%)
January	85,620	0.22	15.7	1.08	2,949	3.33	368.3	25.92	9.82	1,086	764	53.17	80.88	82.37
February	77,828	0.19	14.4	0.96	2,283	3.19	387.7	26.37	7.29	885	602	50.03	78.91	80.71
March	80,526	0.21	15.7	1.04	2,604	3.48	373.6	26.27	9.07	973	684	54.10	77.00	81.35
April	75,225	0.21	15.7	1.02	2,190	3.83	397.7	26.97	8.40	871	591	52.49	73.74	76.70
May	56,628	0.17	16.1	0.99	1,594	3.75	441.9	26.59	5.98	704	424	63.89	77.30	75.66
June	61,085	0.13	15.2	0.87	1,533	3.20	453.4	26.20	4.90	695	402	63.64	75.04	75.49
July	72,070	0.14	15.0	0.98	2,081	3.04	388.2	24.96	6.32	808	520	60.74	74.64	73.34
August	75,132	0.15	14.2	0.88	2,358	2.83	334.8	22.08	6.66	790	521	60.75	74.18	78.46
September	76,137	0.14	13.5	0.89	2,516	2.62	306.0	22.15	6.59	770	557	63.40	74.73	82.09
October	76,431	0.13	11.9	0.82	2,352	2.66	297.8	21.70	6.27	700	510	62.97	76.70	81.66
November	78,674	0.19	16.0	1.07	2,722	3.39	342.8	24.71	9.23	933	673	63.33	78.04	83.68
December	71,881	0.15	16.1	0.92	2,153	3.27	402.1	25.70	7.05	866	553	65.80	74.61	83.41
Total 2017	**887,237**	**0.17**	**14.7**	**0.96**	**27,336**	**3.17**	**368.8**	**24.82**	**87.58**	**10,082**	**6,801**	**58.44%**	**76.41%**	**79.82%**

Source: Dia Bras, 2017



Source: SRK, 2017

Figure 17-2: Piedras Verdes – 2017 Daily Performance

Production of copper concentrate has ranged between approximately 1,500 and 2,900 t/m, equivalent to roughly a 3.1% mass pull. The monthly average has consistently reached commercial quality with copper at 24.9% and credit metals averaging 374 g/t silver and 3.2 g/t gold in 2016.

17.2.2 Process Plant Consumable Usage

Reagents and grinding media consumption for 2017 are summarized in Table 17-2. Reagent usage and consumption are within range of similar process plants.

Table 17-2: Reagents and grinding media consumption for 2017

Production 2017	Grinding	Reagent Consumption (kg)					Reagent Consumption (g/t)					Ball Consumption	
	t/m	X-343	S-7583	T-100	CC-1065	ZnSO4	X-343	S-7583	T-100	CC-1065	ZnSO4	kg	kg/t
January	85,620	481	0	1,371	1,504	3,515	5.62	0.00	16.01	17.56	41.05	23,086	0.27
February	77,828	450	0	1,278	1,389	3,097	5.79	0.00	16.42	17.85	39.79	19,569	0.25
March	80,526	470	0	1,364	1,593	3,294	5.84	0.00	16.94	19.78	40.90	20,614	0.26
April	75,225	451	0	1,203	1,450	2,821	5.99	0.00	15.99	19.27	37.50	19,010	0.25
May	56,628	323	0	990	945	2,288	5.71	0.00	17.49	16.69	40.40	18,800	0.33
June	61,085	385	0	1,138	1,133	2,566	6.31	0.00	18.63	18.55	42.00	16,250	0.27
July	72,070	485	0	1,272	1,185	3,049	6.73	0.00	17.66	16.45	42.30	19,100	0.27
August	75,132	0	2,028	1,223	1,353	2,863	0.00	26.99	16.28	18.00	38.10	22,450	0.30
September	76,137	0	2,098	1,294	1,414	3,015	0.00	27.56	16.99	18.57	39.60	22,290	0.29
October	76,431	0	2,170	1,268	1,294	3,157	0.00	28.39	16.59	16.93	41.30	22,960	0.30
November	78,674	0	2,107	1,376	1,259	2,750	0.00	26.78	17.49	16.00	34.95	25,150	0.32
December	71,881	0	2,208	1,389	1,199	3,089	0.00	30.72	19.32	16.68	42.98	27,070	0.38
Total 2017	**887,237**	**3,046**	**10,611**	**15,166**	**15,718**	**35,502**	**5.99**	**28.05**	**17.09**	**17.72**	**40.01**	**256,349**	**0.29**

Source: Dia Bras, 2018

17.2.3 Process Plant Operating Costs

Process Plant Operating Cost for 2017 and projected Operating cost for 2018 are summarized Table 17-3. For the 2017 production year, the total plant operating Cost were US$9.80/t. The projected operating cost for the 2018 years is US$8.35/t.

Table 17-3: Process Plant Operating Cost Summary- 2017 to 2018

Plant Cost	US$/t	2017	2018
Labor	US$/t	2.65	2.28
Reagents	US$/t	0.27	0.49
Ball Mill	US$/t	0.50	0.73
Electric Power	US$/t	1.36	1.24
Oil	US$/t	0.11	0.07
Diesel	US$/t	0.33	0.47
Tires	US$/t	0.01	0.02
Gasoline	US$/t	0.03	0.01
Water services	US$/t	0.12	0.00
Spare parts	US$/t	0.80	0.87
Food service	US$/t	0.39	0.38
External services	US$/t	1.11	0.49
Other	US$/t	2.11	1.29
Total Plant Cost	**US$/t**	**9.80**	**8.35**

Source: Dia Bras, 2018

17.2.4 Process Plant Capital Cost

Process plant capital expenditures are summarized in Table 17-4 for 2018. Planned capital expenditures for 2018 total US$3.95 million which includes US$2.8 million for modification and repairs to the facilities. Most of the identified capital expenditures are for replacement and refurbishment of existing equipment and facilities.

Table 17-4: Process Plant Capital Cost for 2018

Description	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Total Capital Costs (000's USD)	**700**	**550**	**550**	**550**	**550**	**550**	**83**	**83**	**83**	**83**	**83**	**83**	**3,950**
Mine Equipment Subtotal	**150**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**150**
2 Trucks (tailings management)	100												100
Bus personnel carriers	50												50
Tailings Dam Subtotal	**83**	**83**	**83**	**83**	**83**	**83**	**83**	**83**	**83**	**83**	**83**	**83**	**1,000**
Building	83	83	83	83	83	83	83	83	83	83	83	83	1,000
Increased Plant Capability Subtotal	**467**	**467**	**467**	**467**	**467**	**467**	**-**	**-**	**-**	**-**	**-**	**-**	**2,800**
Crushing	**100**	**100**	**100**	**100**	**100**	**100**	**-**	**-**	**-**	**-**	**-**	**-**	**600**
Cone crusher	100	100	100	100	100	100							600
Grinding	**278**	**278**	**278**	**278**	**278**	**278**	**-**	**-**	**-**	**-**	**-**	**-**	**1,670**
Centrifugal 8 x 6 pumps	12	12	12	12	12	12							70
Cyclones D-20/D-26	5	5	5	5	5	5							30
9.5' x 14' mill (used)	178	178	178	178	178	178							1,070
Installing new mill	83	83	83	83	83	83							500
Flotation	**24**	**24**	**24**	**24**	**24**	**24**	**-**	**-**	**-**	**-**	**-**	**-**	**145**
Flash cells	15	15	15	15	15	15							90
Cells instrumentation flash	3	3	3	3	3	3							20
Float level controllers	6	6	6	6	6	6							35
Thickening and Filtering	**64**	**64**	**64**	**64**	**64**	**64**							**385**
Filter concentrate	58	58	58	58	58	58							350
Thickener PLC 40FT	2	2	2	2	2	2							10
Thickener rehabilitation 50FT	4	4	4	4	4	4							25

Source: Dia Bras, 2018

17.3 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 17-5 shows the Piedras Verdes mill's major process equipment, its key characteristics, and power ratings.

Table 17-5: Piedras Verdes Mill's Major Process Equipment

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

Source: SRK, 2017

17.4 Conclusion and Recommendations

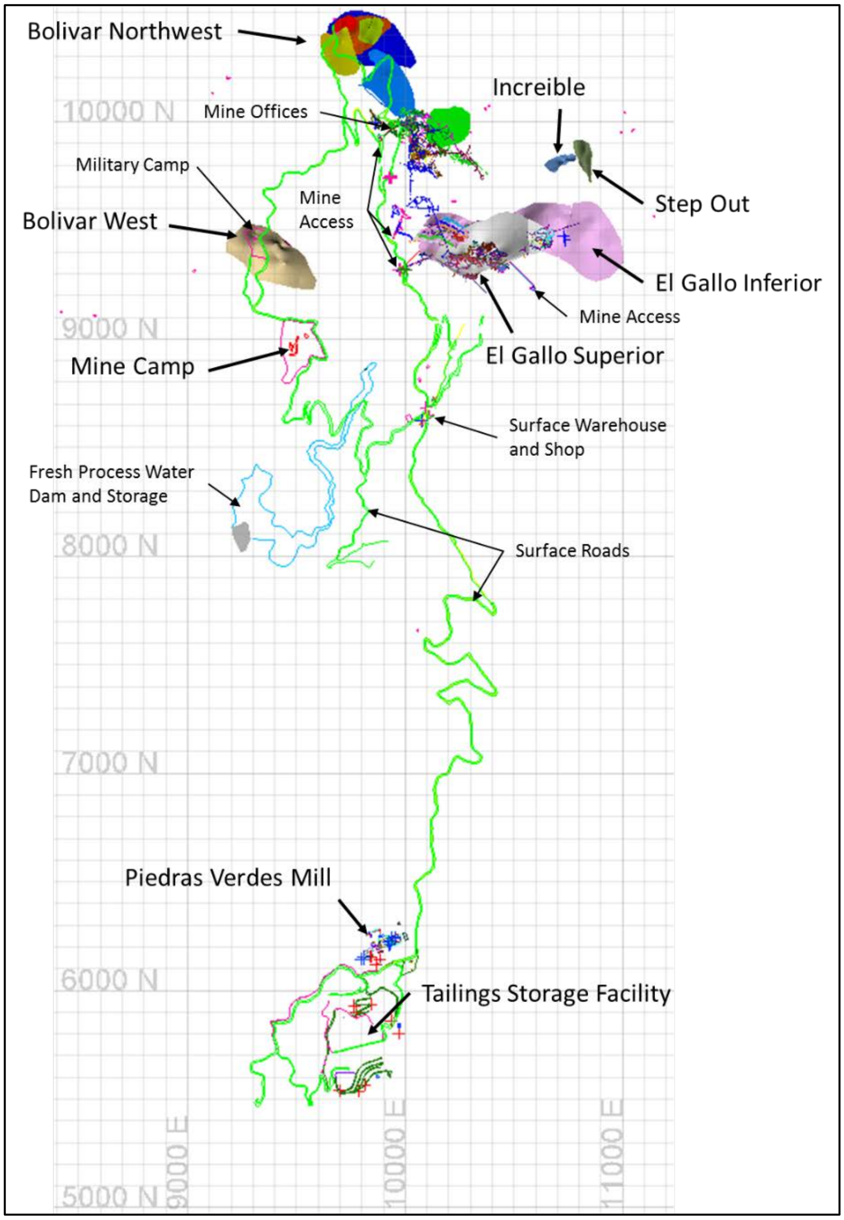
Dia Bras operates a conventional concentration plant consisting of crushing, grinding, flotation, thickening and filtration of the final concentrate. Flotation tails are disposed of in a conventional tailings facility. Ore feed during year 2017 reached a total of 887,236 t, equivalent to an average of 74,000 t/m, or 2,400 t/d. Production of copper concentrate has ranged between approximately 1,500 and 2,900 t/m, equivalent to roughly a 3.1% mass pull. The monthly average has consistently reached commercial quality with copper at 24.9% and credit metals averaging 374 g/t silver and 3.2 g/t gold in 2017. Copper concentrate grade percentage decreased by 2.1% from the previous year while silver and gold grade increased marginally.

There is 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. Complete overhaul of both ball mills occurred late in 2017 and early 2018 to improve the mechanical availability of the grinding circuit. The hydrocyclones were changed from D26 to D20 to improve plant stability. The change in hydrocyclones improved the water balance as well as classification resulting in a 3% increase in copper recovery.

18 Project Infrastructure

The Project has fully developed infrastructure including access roads, a 329-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, TSF, 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

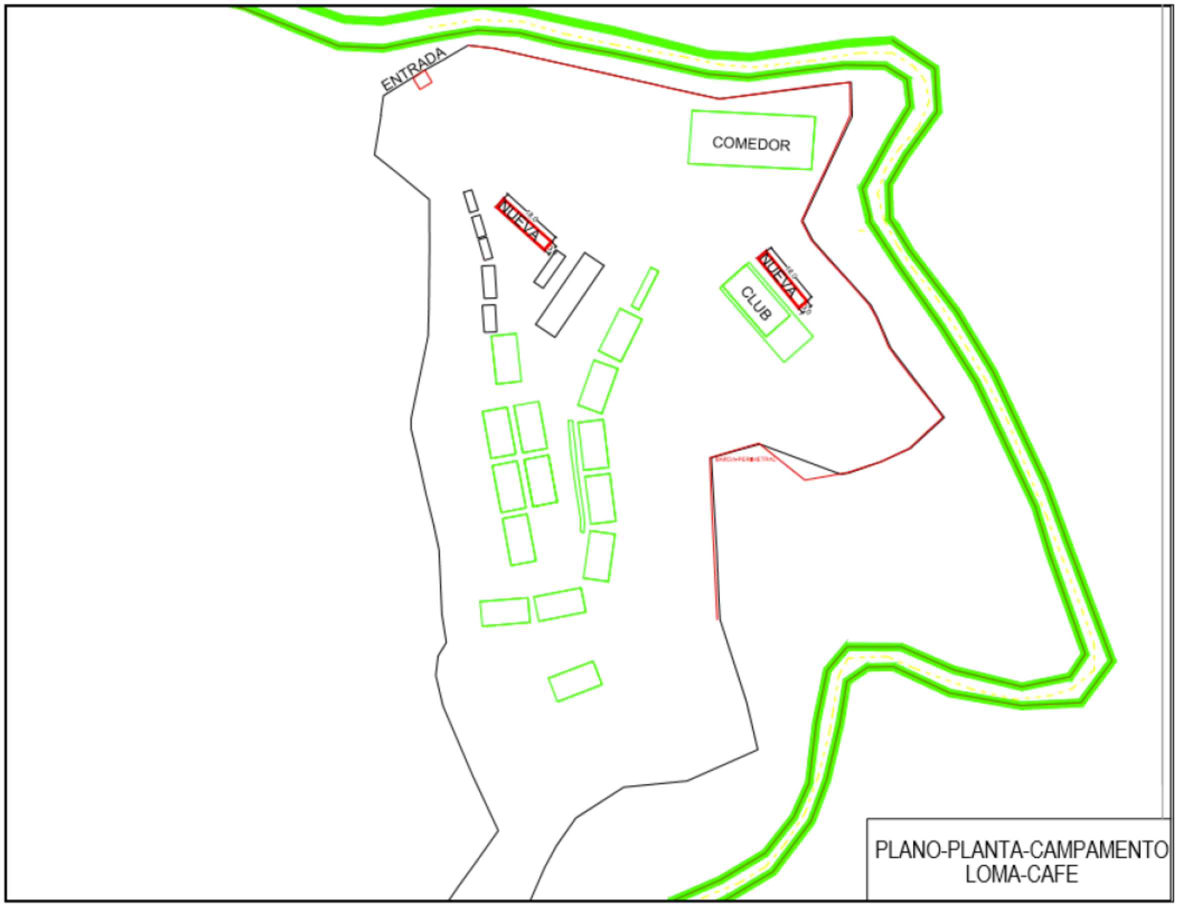
Access to the Bolivar Mine is by paved road approximately 305 km southwest from Chihuahua and then approximately 80 km by all-season gravel roads to the villages of Cieneguita and Piedras Verdes adjacent to the Project.

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 329 workers and contractors. Figure 18-2 shows photographs of the mine camp. Figure 18-3 shows the camp layout.

Source: Sierra Metals, 2018

Figure 18-2: Bolivar Camp Photographs



Source: Sierra Metals, 2018

Figure 18-3: Bolivar Camp Layout

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 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 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 orebody. 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 support 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 18-4. Explosives storage for powder and primers is located in a controlled area located remotely from site.

Source: SRK, 2017

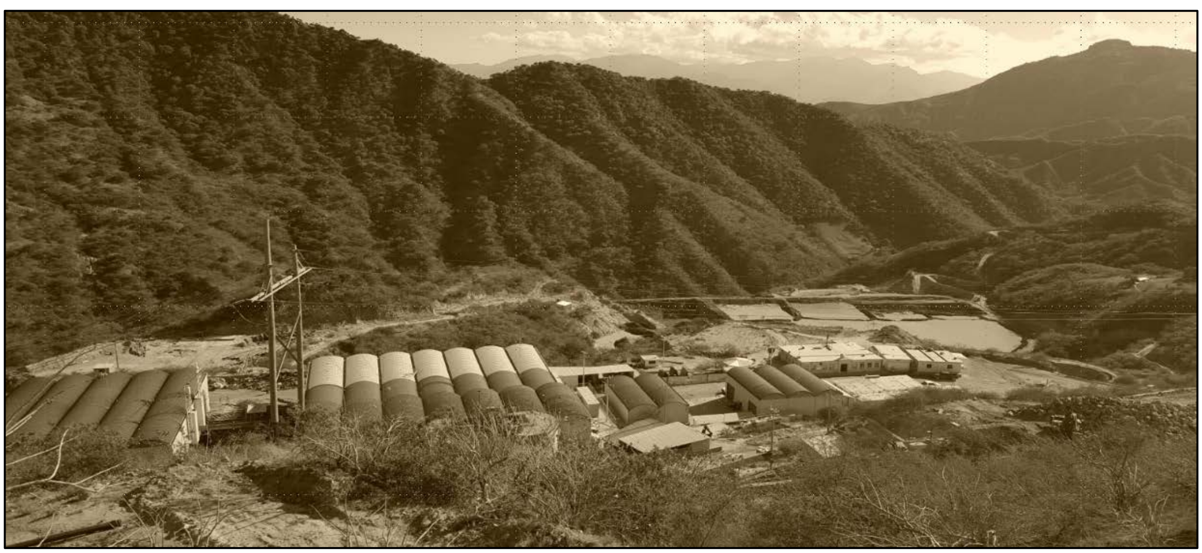
Figure 18-4: Bolivar Maintenance Shop

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 18-5 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 18-6).

Source: Google Maps, 2017

Figure 18-5: Bolivar Aerial View of the Processing Plant



Source: Dia Bras, 2017

Figure 18-6: 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, Equipos Y Gas de la Sierra from Guazapares provides the fuel in 10,000 kg tanker trucks every 15 days. The 2017 cost of propane is US$12.50/kg. The propane is stored in several tanks on the Project site. Table 18-1 summarizes the tanks with their location and capacities.

Table 18-1: Propane Tank Location and Capacities

Tank Location	Capacity	Units
Piedras Verde Plant	4,000	L
Piedras Verde Plant	5,000	L
Camp - Module I	5,000	L
Camp - Module L	135	kg
Camp - Module L	500	kg
Camp - Module N	135	kg
Camp - Module S	500	kg
Camp - Module D	1,000	kg
Laundry	135	kg
Cafeteria	5,000	kg

Source: Sierra Metals, 2018

The propane use in 2016 and 2017 us summarized in Table 18-2 . The average 2017 consumption is approximately 6,000 L/m down 8% from 2016. An additional 85,000 L was used at the camp in 2017 bringing the total 2017 use to 157,107 L.

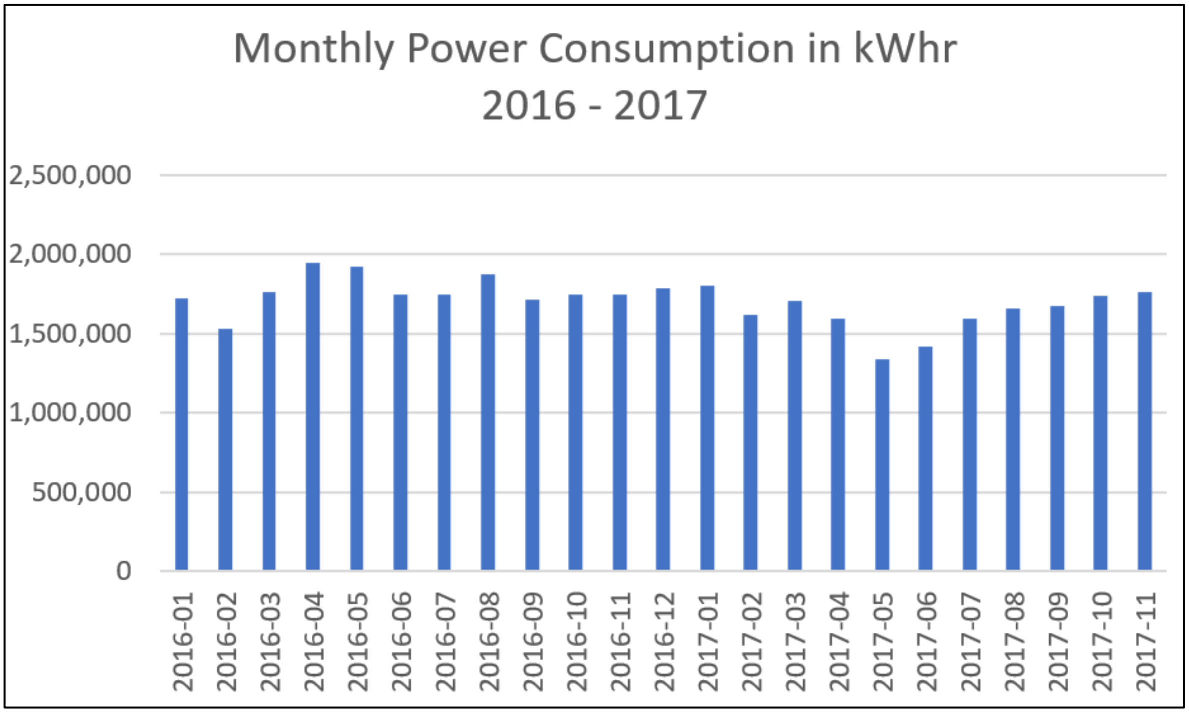
Table 18-2: Propane Consumption at the Piedras Verde Plant by Year

Month	2016 (L)	2017 (L)
January	7,945	5,347
February	7,425	6,537
March	6,589	6,612
April	5,549	5,465
May	4,325	5,543
June	4,670	6,342
July	5,412	7,265
August	6,530	7,052
September	7,560	6,023
October	6,480	5,423
November	7,750	5,512
December	7,800	4,986
Total	**78,035**	**72,107**

Source: Sierra Metals, 2018

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 connected load on site is approximately 4 MW. The system operates at a typical load of 2 MW. Backup generation is provided for the mine and processing plant with a diesel-powered generator set. The backup generator, with a capacity of 2,000 kVA is located at the processing plant location. The transmission line towers can be seen in Figure 18-6. Figure 18-7 shows the monthly power consumption for January 2016 to November 2017 as a representation of the use. The plant uses approximately 78% of the total with the mine using the remainder. Electricity has varied in unit cost averaged approximately US$0.06/kWh in 2016 and US$0.08/kWh in 2017. The monthly cost for electricity averages US$137,000.



Source: Sierra Metals, 2018

Figure 18-7: 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 approximately every three days by with a 10,000 L tanker truck by a local vendor, Nuevo Terrazas Delicias Chihuahua from Cuauhtémoc Chihuahua. The tank storage and capacity is summarized in Table 18-3. The average price per liter for diesel and gasoline was MXN$14.52/L and MXN$13.62 respectively in July 2017.

Table 18-3: Fuel Tank Storage and Capacity Summary

Location	Tank	Quantity	Type (units)
Mine Storage	Workshop Tank	10,350	Diesel (L)
	Mine Tank	9,700	Diesel (L)
	Mine Tank	5,510	Gasoline (L)
Plant Storage	Processing Tank 1	4,500	Diesel (L)
	Processing Tank 2	4,500	Diesel (L)
	Processing Tank 3	2,000	Diesel (L)

Source: Sierra Metals, 2018

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 at a rate of 40,000 to 50,000 L/d. The plant uses approximately 2,700 L/d of potable water.

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 Mm^3 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 1 Mm^3 water tank located near the reservoir. The water tank then supplies water via a pipeline to a processing plant storage tanks with a capacity of 500,000 m^3 approximately 1,800 m to the south. A photograph of the reservoir is shown in Figure 18-8.

Source: SRK, 2017

Figure 18-8: Piedras Verdes Reservoir

The site water usage for 2017 is summarized in Table 18-4. Approximately 53% of the total process water is recycled. In 2017, the process plant used approximately 1.02 m^3/t processed makeup water out of the total 2.16 m^3/t of ore processed.

Table 18-4: Title Site Water Use (2017)

Month	Fresh Water (m^3)	Recovered Water (m^3)	Consumed Water (m^3)	Tonnes Milled (t)	Water Use per Tonne Processed (m^3/t)
January	86,476	94,182	180,659	85,620	2.11
February	80,163	93,394	173,557	77,828	2.23
March	80,526	89,383	169,909	80,526	2.11
April	78,234	86,509	164,743	75,225	2.19
May	56,061	63,989	120,051	56,628	2.12
June	58,030	69,637	127,667	61,085	2.09
July	70,629	83,601	154,230	72,070	2.14
August	75,132	78,889	154,020	75,132	2.05
September	77,203	87,558	164,761	76,137	2.16
October	80,252	87,895	168,147	76,431	2.20
November	86,542	94,409	180,951	78,674	2.30
December	75,475	79,069	154,545	71,881	2.15
Total	**904,724**	**1,008,515**	**1,913,239**	**887,237**	**2.16**

Source: Sierra Metals, 2018

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

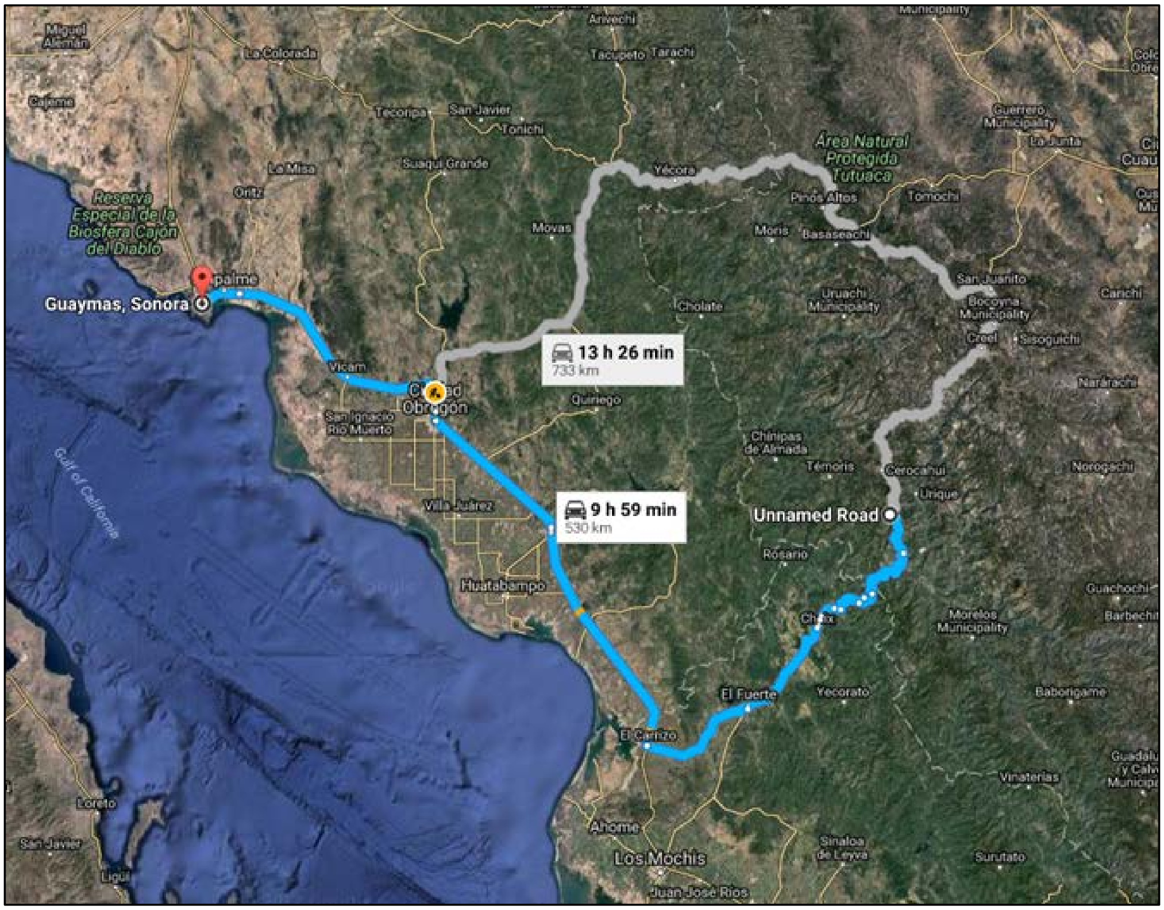
The site has a separate security force of approximately 12 people, there are typically four people on each crew. Additionally, there is a Mexican Army base located in close proximity to the Project site. The mine site guard house is located at the entrance to the Bolivar Mine. The processing site guard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

18.9 Logistics

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

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 18-9 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 18-9: 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. The septic system is pumped on a quarterly basis. Trash, as previously mentioned, is hauled to the landfill at Cieneguita.

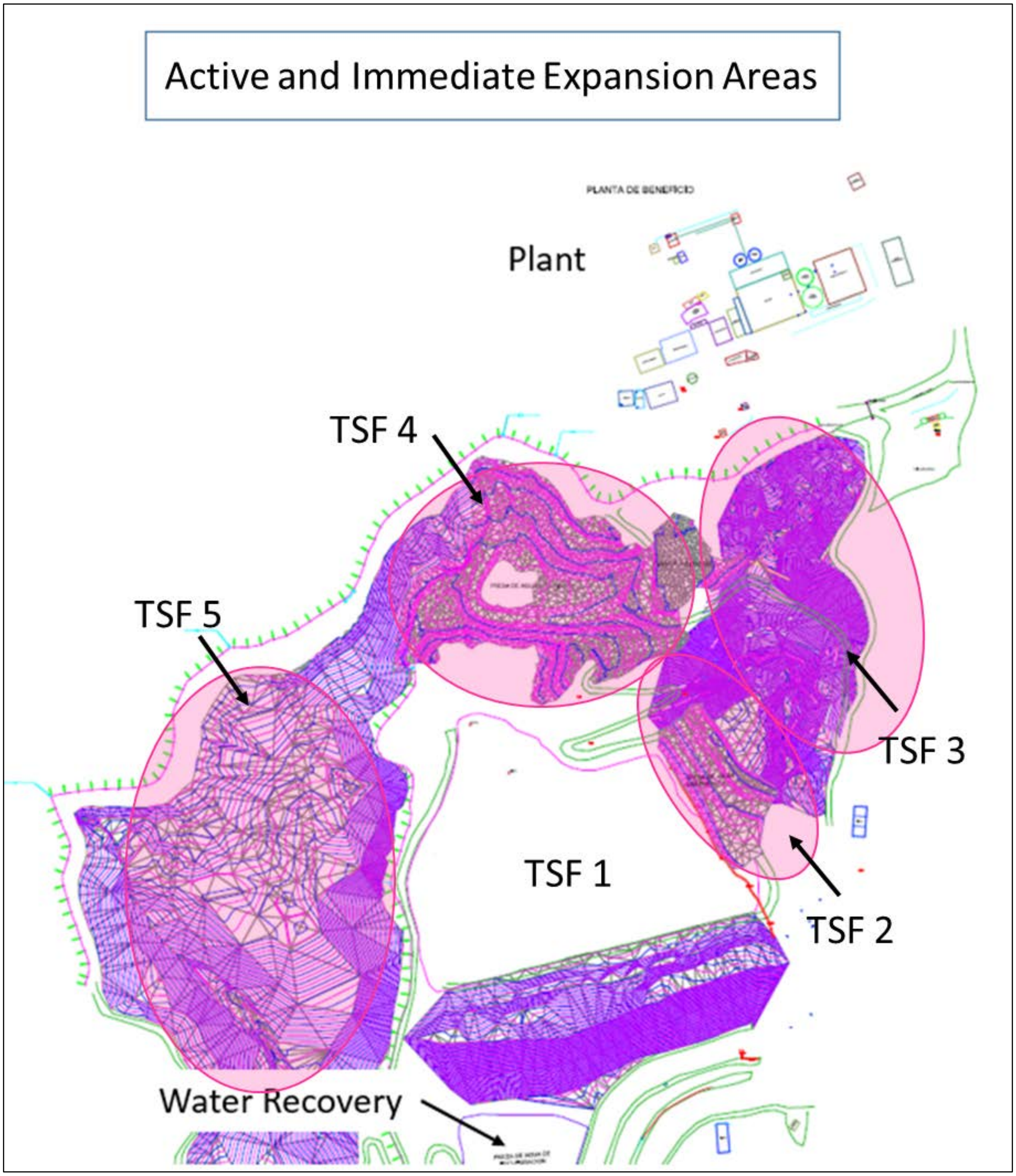
18.10.2 Waste Rock Storage

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 Storage Facility

The existing tailings storage facility (TSF) has been in operation since the Piedras Verdes mill was commissioned in late 2011. The existing TSF1 and TSF2 can be seen in Figure 18-10 along with expansion areas, TSF3 through TSF5, adjacent to the existing facility.

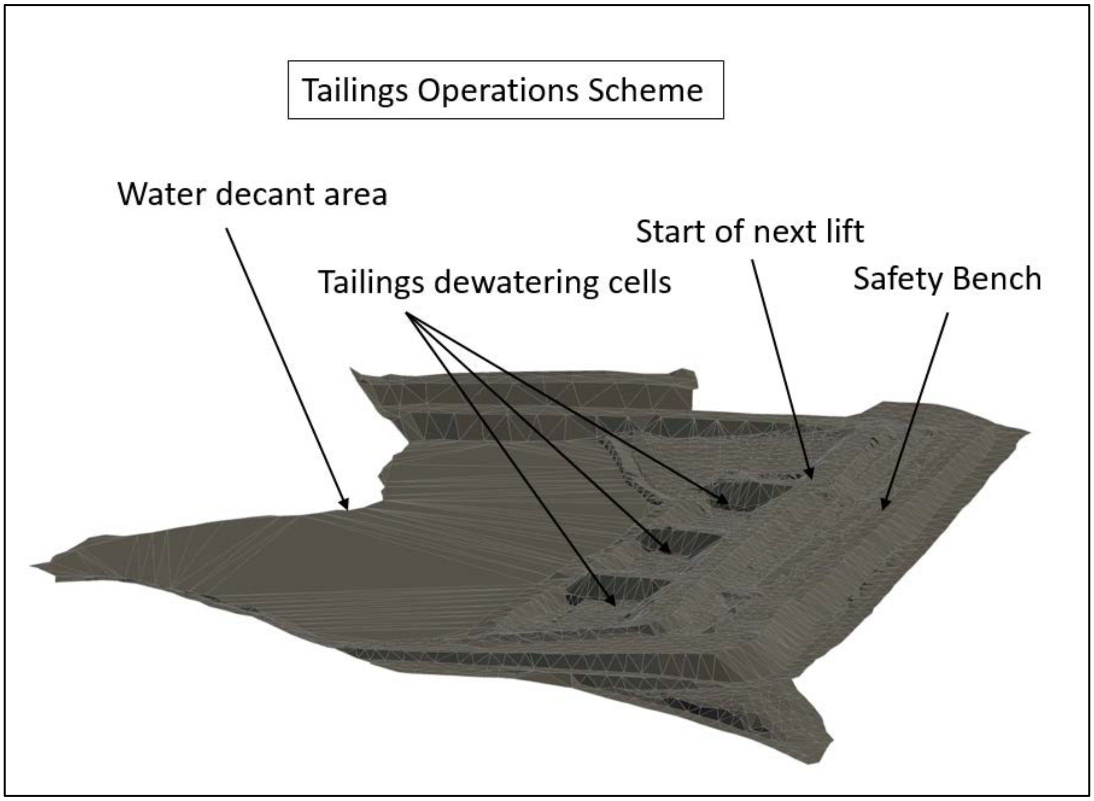


Source: Dia Bras, 2017

Figure 18-10: 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 is TSF1. The site utilized the capacity in TSF2 and TSF3 in 2017. The remaining capacity in TSF1 is as contingency capacity. The TSF4 tailings placement is at capacity and operational modifiations are ongoing to add additional capacity to the existing TSF facilities (TSF1 through TSF4). The new system is discussed in Secion 18.11.2.

In general, the existing tailings facility were 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 was 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 TSF 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 18-11 shows the dewatering cells and the general shape of the TSF operational area.



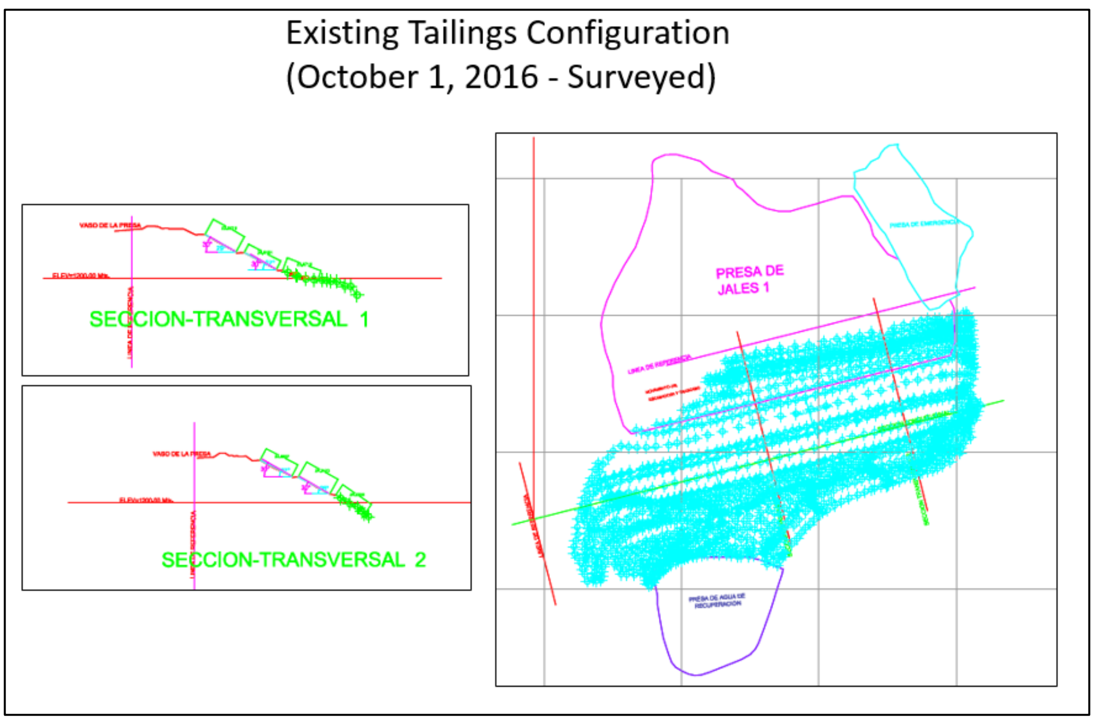
Source: Dia Bras, 2017

Figure 18-11: 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° maximum and provide 4 m 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. Additional items were identified later in 2017 that continue to be addressed. Dia Bras provided survey data showing the slope corrections and these can be seen in the photograph in Figure 18-12. The design parameters and as-built can be seen in Figure 18-13.

Source: SRK, 2017

Figure 18-12: Photograph of the Active Tailings Area



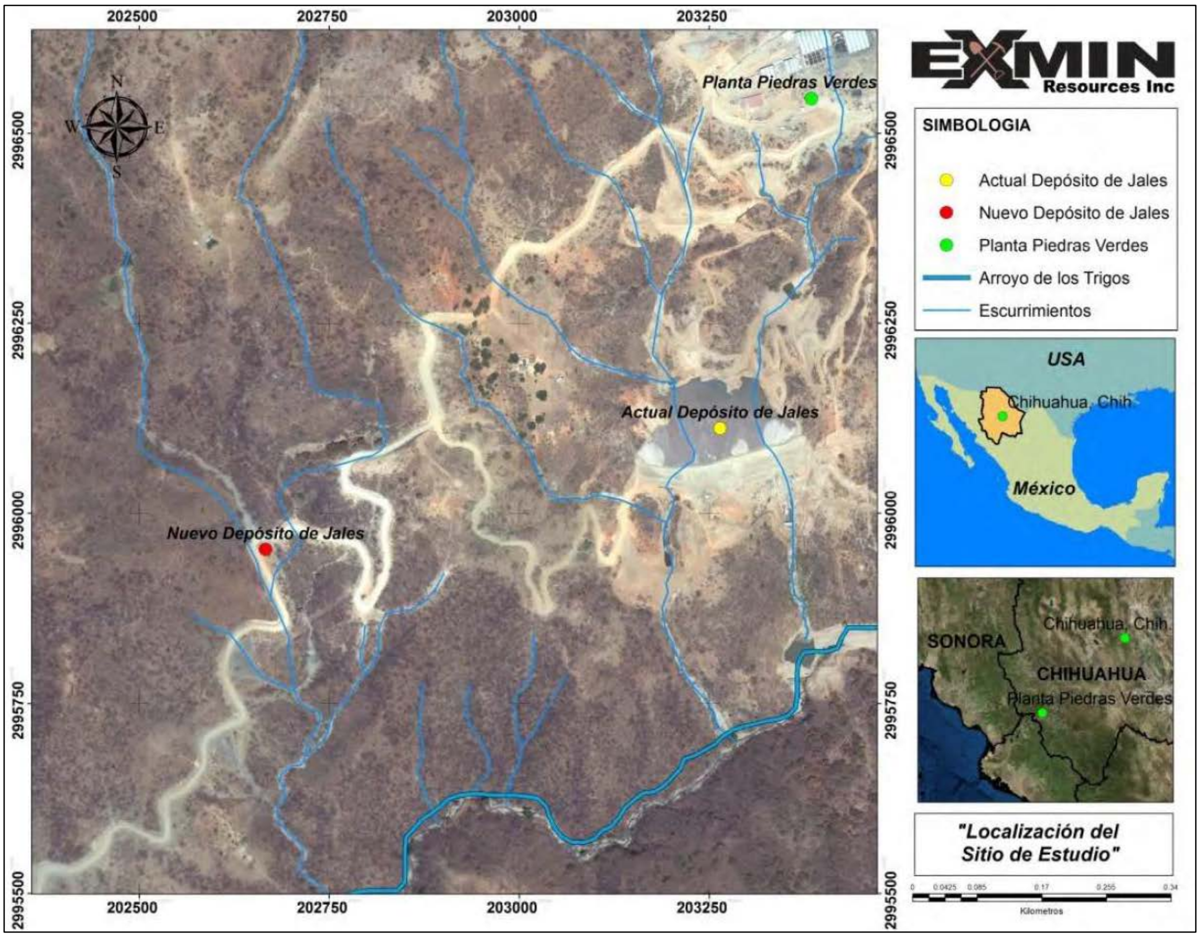
Source: Dia Bras, 2016

Figure 18-13: Existing Tailings Grade and Survey

18.11.2 Tailings 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. TSF5, also known as "Cañada 2" is in development with ongoing studies to prepare it for deposition in 2018.

Burō Hidrōlogico Consultoría, in June 2016 and further analysis in 2017, prepared an analysis of the watershed, including rainfall analysis, and completed a review of the geology in the area. Figure 18-14 shows the area under study by Burō Hidrōlogico Consultoría. The existing TSF can be seen on the right.



Source: Burō Hidrōlogico Consultoría, 2016

Figure 18-14: View of Burō Hidrōlogico Consultoría Study Area

Figure 18-15 shows the location of the TSF expansion areas, the location of a New TSF to the west, and the location of additional infrastructure.

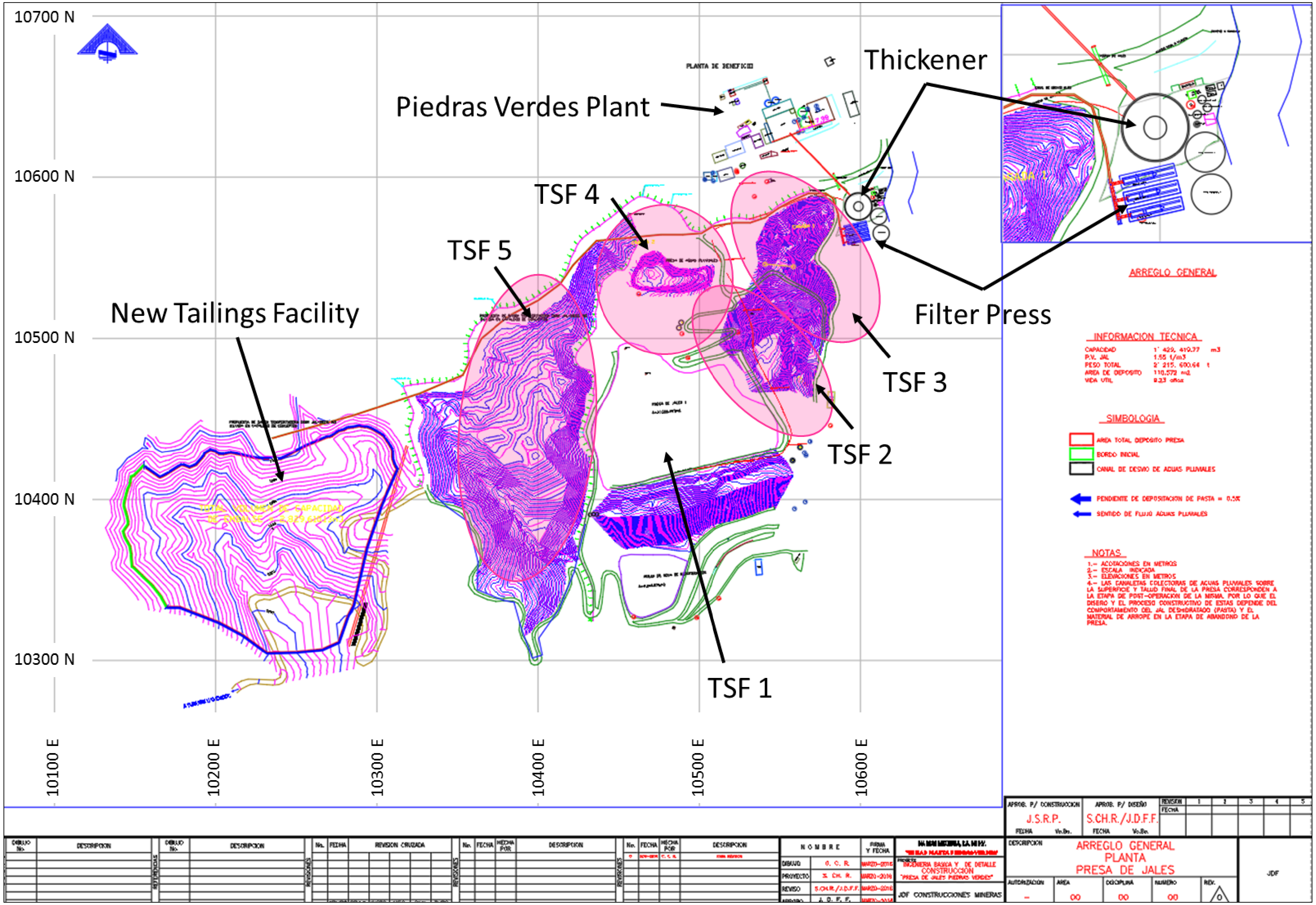


Figure 18-15: Overview of TSF Expansion Locations and Infrastructure

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. Process tailings are delivered from the plant to a thickener via pipeline. The 60% solids tailings from the thickener will be placed, via pipeline, in TSF4.

Three filter presses have been purchased by Dia Bras. Installation of these filters is planned for completion in 2018. 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 TSF4 and TSF5 via a conveyor after the conveyor is installed. The conveyor is planned for completion by February 2018. TSF4 and TSF5 will provide capacity to mid 2019.

Expansion beyond TSF5 will consist of the construction of the New TSF, as shown in Figure 18-15, located to the west of TSF5. This facility, when complete, will provide capacity to 2025. Dia Bras has calculated the 2025 total TSF capacity assuming 4,000 t/d ore production from Piedras Verdes.

In summary, tailings consisting of approximately 40% solids will be placed in conventional tailings storage facilities (TSF1-TSF3) were completed in 2017. Thickened tails (60% solids) were placed in TSF4 in 2017. Dry-stack tails will be placed after February 2018 in TSF4 and TSF5. Expansion around the main TSF, in TSF1-TSF5, 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 TSF1 through TSF5. Additional permitting will be required for the New TSF. Dia Bras allocated US$1 million in 2018 and US$3 million in 2019 for TSF expansion civil works.

SRK recommends that the site continue its project efforts to complete the installation of the remaining TSF support systems. Ongoing challenges with the existing TSF capacity will necessitate ensuring that all required detailed designs are completed and permits are in place for successful operation of the TSF4 “Cañada 2”, expansion of the existing TSF options, and 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 optimize the size of the New TSF to confirm it will meet the LoM requirements.

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 assumptions are presented in Table 19-1.

Table 19-1: Metal Prices

Commodity	Value	Unit
Au	1,291	US$/oz
Ag	18.25	US$/oz
Cu	3.19	US$/lb

Source: Sierra Metals, 2017

20 Environmental Studies, Permitting and Social or Community Impact

SRK senior environmental specialist and Qualified Person, Ms. Monica Salguero, SME-RM, conducted a site visit and inspection of the Bolivar Mine, process area, and TSFs on January 22 to 26, 2018. In addition, Ms. Salguero was supported by Mr. Mark Willow, Principal environmental scientist and QP during the review of documentation provided by the operator and preparation of the following information.

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. Sierra Metals plans to increase the production from the mine to ±5,000 t/d within the next few years.

As part of the overall review of the project, SRK was obliged to employ electronic translation software to convert many of the relevant documents and datasheets from their 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.

20.1 Environmental Studies and Liabilities

Detailed information regarding environmental studies related to the Bolivar Mine was not made specifically available for this assessment. However, summaries of some of these studies are provided in the environmental impact assessment documentation used to support the permitting efforts of the current operation and future tailings storage area.

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. The current tailings storage facilities would also constitute a reclamation liability for the operation, as well as potential soil remediation around the tailings impoundment from an overtopping of the impoundment that occurred in December 2013 due to extreme weather conditions. The contaminated areas were remediated, inspected, and released by the regulatory authorities as of June 26, 2014 (Inspection Order Number CI0031VI2014 of March 18, 2014, and the Inspection Act Number CI0031V12014, lifted on March 19, 2014).

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, and possibly even the regulatory authorities. Development of an effective mitigation plan prior to any regulator involvement is recommended.

20.2 Environmental Management

20.2.1 Tailings Disposal

Existing Tailings Storage Facility

Currently, Dia Bras is constructing a raise on TSF embankment using waste rock generated from the Bolivar West underground mining operation. This vertical expansion should allow the storage of tailings for approximately eight more months. While a stability study was supposedly prepared for this raise, SRK was not provided a copy for this review, though Dia Bras personnel noted that it did meet with regulatory approval. Since the embankment raise is occurring within an already permitted area, a new *Manifesto de Impacto Ambiental* or MIA, was not required. As a result of the overtopping incident reported in 2013 resulting from heavy rains during monsoon season, the mine has constructed stormwater diversion channels to reduce the inclusion pf non-contact stormwater into the impoundment.

Future Tailings Storage Facility

Dia Bras plans to increase the Bolivar Mine production to 5,000 t/d, which will require additional tailings storage space. A second location adjacent to the existing TSF, has been identified and permitted to receive tailings for at least three years. Any future expansions of this new facility will likely include the relocation of the adjacent federal highway in order to achieve the required capacity. The permitting of a future expansion of this second TSF will be more complicated and time consuming; as such, Dia Bras is considering installing a dry stack facility instead of a traditional tailings dam configuration. This approach would increase the capacity of the second TSF to approximately four years.

20.2.2 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.

20.2.3 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.

20.3 Mexican Environmental Regulatory Framework

20.3.1 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.

20.3.2 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 30, 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 plant site in 2018.

20.3.3 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.

Dia Bras constructed a water dam to provide for water usage in the process plant and for domestic use (camp, cooking, etc.). SRK did not receive or review the permits related to this activity.

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 drillholes. Limits on the areas of disturbance by access roads, camps, equipment areas, drill pads, portals, trenches, etc. are specified.

20.3.4 Expropriations

Expropriation of ejido and communal properties is subject to the provisions of agrarian laws. The Bolivar Project is subject to these provisions with respect to Ejido Piedras Verdes, in the Municipality of Urique, in the State of Chihuahua, Mexico.

20.3.5 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.

20.3.6 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.

20.3.7 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 in Figure 20-1.

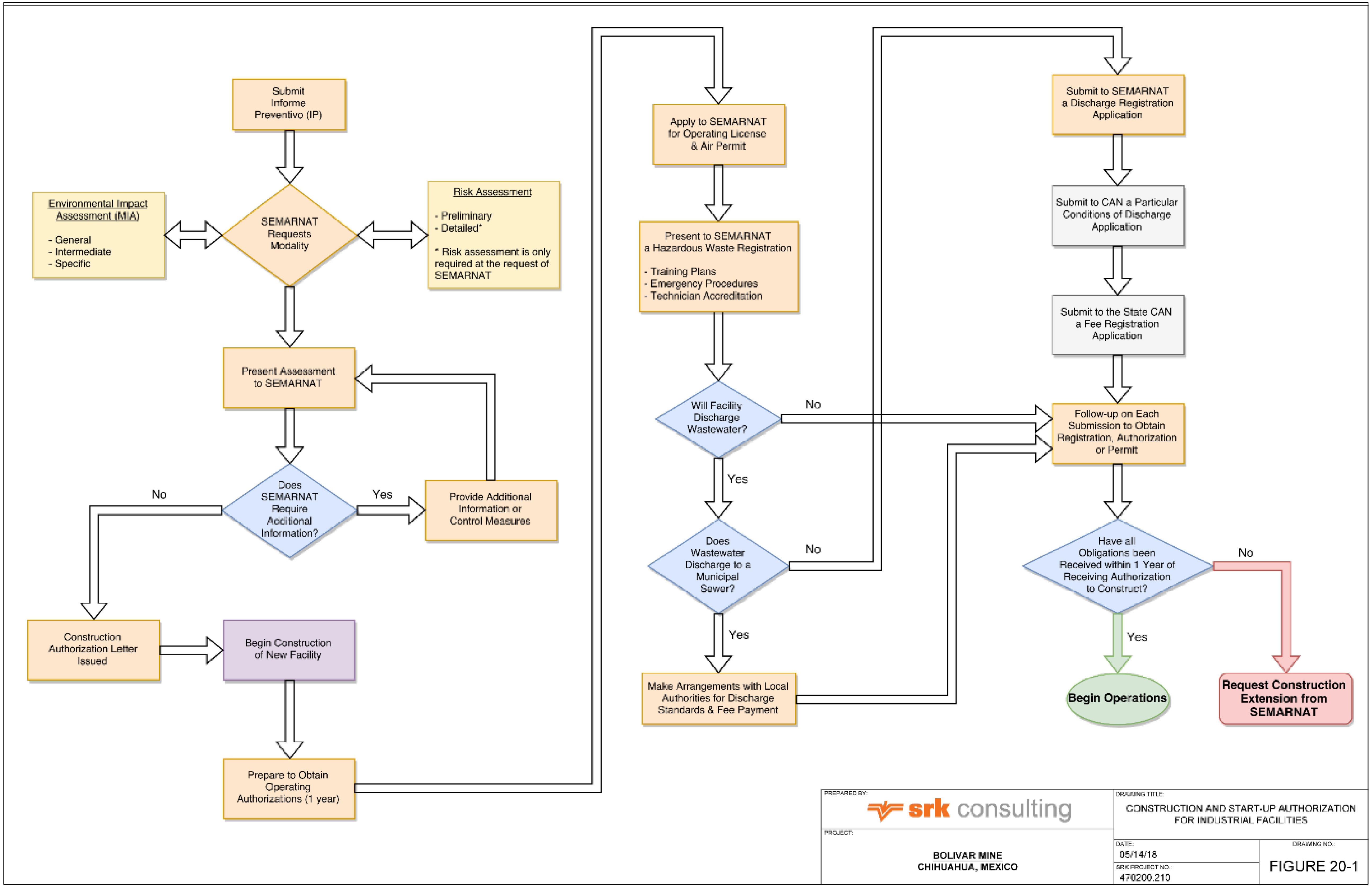


Figure 20-1: Construction and Start-up Authorization for Industrial Facilities

20.3.8 Required Permits and Status

The required permits for continued operation at the Bolivar Mine, including exploration of the site, have been obtained based on information provided by Dia Bras. These include the necessary Changes in Use of Soil (Land Use Change), Forest Permits, and MIA authorizations. 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. Dia Bras is currently preparing a study to comply with CONAGUA (National Water Commission) requirements to demonstrate that no impact is produced on adjacent arroyos (creeks).

Information regarding the exploration and mining permits in Table 20-1 and Table 20-2 was provided by Dia Bras.

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

Permit	Agency	Approval Date (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. The new mines of the Bolivar Project have MIA authorization document SG.IR.08-2015/271 from SEMARNAT dated October 2015. The plant site has a MIA, document SG.IR.08-2010/106. 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. 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.

Permit	Agency	Approval Date (or anticipated Approval Date)
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. 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.
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.

Source: Dia Bras, 2018

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

Source: Dia Bras, 2018

20.3.9 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.

20.3.10 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 m^2 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 m^2 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.

20.4 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.

Dust on surface roadways between the mine and the plant location remains a significant problem, and could jeopardize Dia Bras' social license. The operation utilizes two water trucks to maintain the roads wet; however, due to the evaporative levels in Chihuahua, this system of dust control is not particularly efficient. According to Dia Bras, a new strategy is being developed using clay/silt soil, which is currently undergoing on-site trials. SRK was informed that nearby topsoil stockpile areas are identified to use these soils as top layer for the roads and avoid major dust impacts in the area.

20.5 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).

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)	**$9,259,318**
Total (US$) (1)	**$476,545**

(1) Based on exchange rate of US$1 = MXN$19.43 (May 14, 2018)

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

This section outlines the capital and operating costs considered in this valuation. All costs presented in this section are second semester 2018 US dollars, unless stated otherwise.

The audited Bolivar project is currently in operation with reserves to support operation into 2024 at the forecast throughput and operating cost rates.

21.1 Capital Costs

The Project's technical team and REDCO 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;
- Ventilation;
- Equipment;
- Infill drilling and Exploration;
- Plant;
- TSF; and
- Closure.

Mine development is related to any underground mine development that is capitalized. The cost estimate is based site specific data from Bolivar.

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.

Equipment sustaining cost includes the capital to maintain and replace mine equipment, while plant and TSF sustaining capital accounts for the expansion of the TSF. Additional capital costs have been included in to account for Plant improvements in 2018.

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

As this is a currently operating and producing Project, SRK considered that the company already has necessary working capital in place. Additional working capital movements were not incorporated into the economic model.

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

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

Description	Sustaining (US$000's)	LoM (US$000's)
Sustaining Capital Development	$17,380	$17,380
Sustaining Capital Ventilation	$4,824	$4,824
Sustaining Capital Equipment	$30,000	$30,000
Sustaining Capital Infill Drilling - Exploration	$7,909	$7,909
Sustaining Capital Concentrator	$4,121	$4,121
Sustaining Capital Tailings Dam	$4,623	$4,623
Sustaining Capital Closure	$453	$453
Total Capital	**$69,309**	**$69,309**

Source: SRK, 2018

21.2 Operating Costs

The operating cost estimated is based on site specific data. SRK was provided with historic costs for the purposes of comparison. 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 estimated operating cost and historical information provided by the project owner.

Table 21-2: Modeled Operating Cost Summary

Description	LoM (US$000's)	LoM (US$/t ore)	LoM (US$/Cu lb)
Underground Mining	147,308	18.59	1.24
Process	66,174	8.35	0.56
G&A	20,336	2.57	0.17
Total Operating	**233,818**	**29.5**	**1.97**

Table 21-3: Bolivar Historic Operating Costs

Period (2017 Jan to Nov)	Total Cost (US$/t)
Mine	15.09
Plant	9.80
G&A	2.43
Total (2017 Jan-Nov)	**$27.32**

22 Economic Analysis

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 REDCO. This section discloses these assumptions and comments on the profitability of the reserves. The economic model was prepared under the assumption of 100% ownership. All financial data is real terms in U.S. dollars (US$), unless otherwise stated.

22.1 Assumptions External to Project

This valuation is based on metal prices provided by Sierra Metals. Sierra Metals currently has a contract for the provision of its copper concentrate; SRK reviewed the details of the existing contract. The provided metal prices are in line with current metal prices. The metal price assumption is presented in Table 22-1.

Table 22-1: Metal Prices

Commodity	Value	Unit
Au	1,291	US$/oz
Ag	18.25	US$/oz
Cu	3.19	US$/lb

Source: REDCO, 2018

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$/oz
Ag Minimum Deduction	-	g/t
Ag Payability Factor	90	%
Ag Refining Charge	0.35	US$/oz
Cu Minimum Deduction	1.0%	% points
Cu Payability Factor	96.5	%
Treatment Charge	81	US$/t concentrate
Cu Refining Charge	0.08	US$/lb

Source: Dia Bras, 2016

The project depends 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 incurs losses in the process of shipping to this. Losses are assumed to equal to 0.50% of concentrate mass. In order to calculate transportation costs, an average moisture content of 9% was assumed for the concentrate. The following are the considered the transportation costs estimated for the copper concentrate (Table 22-3).

Table 22-3: Product Sale Cost

Description	Value	Units
Transportation	101.46	US$/t concentrate (wet)

Source: REDCO, SRK, 2018

22.2 Commercial Assumptions

Bolivar is a polymetallic operation that currently produces a copper concentrate containing gold and silver that is sold under an existing contract.

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 2024, based on the reserves disclosed in this report. The depreciation also considers that the Project currently holds an amount of US$28.5 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$27.8 million has been used as an opening balance for the losses carried forward.

22.4 Production Assumptions

The LoM mine production schedule estimates that the mine will produce approximately 7.9 Mt of run-of-mine (RoM) at the following average metal grades:

- Au: 0.25 g/t;
- Ag: 18.93 g/t; and
- Cu: 0.86%.

The production scenario assumes that the start period is November 2017, 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.

Table 22-4: Mine Production Summary

Description	Value	Units
Mine Production		
Underground Ore	7,925	kt
Underground Waste	955	kt
Total Material	**8,880**	**kt**
Avg. Daily Capacity (ore)	3,029	t/d
RoM Grade		
Copper	0.86%	%
Silver	18.93	g/t
Gold	0.25	g/t
Contained Metal		
Copper	67.92	kt
Silver	4,823	koz
Gold	63	koz

Source: SRK, 2018

The RoM is fed as a single feed type to the plant. Copper concentrate is produced from the beneficiation of the ore. The LoM production of copper concentrate is presented in Table 22-5.

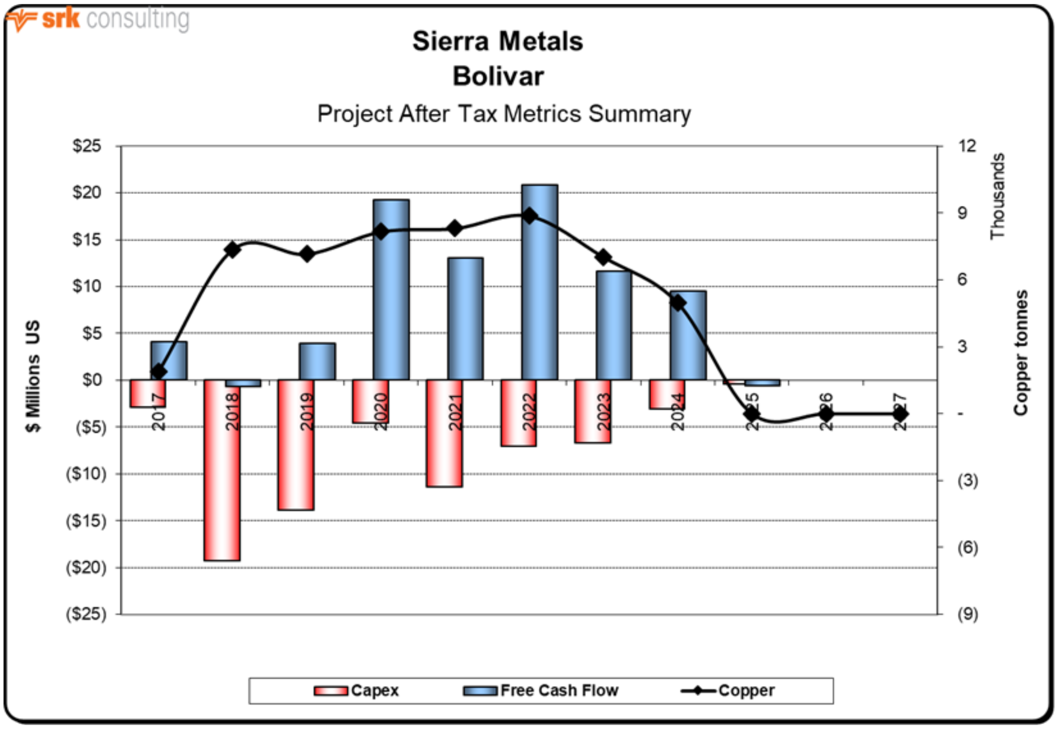
Table 22-5: Processing Summary

Description	Value	Units
RoM Ore Milled	**7,925**	kt
Daily Capacity	3,029	t/d
Copper Concentrate		
Moisture Content	9%	%
Concentrate Copper Grade	22.10%	%
Concentrate Silver Grade	458.88	g/t
Concentrate Gold Grade	4.85	g/t
Recovery		
Copper	83%	%
Silver	78%	%
Gold	64%	%
Concentrate Yield	**3.23%**	**%**

Source: SRK, 2018

22.5 Results

Results of the Bolivar analysis indicate that the Project has a potential present value of approximately US$59.7 million at an 8% discount rate. Figure 22-1 shows the project after- tax metrics.



Source: SRK, 2018

Figure 22-1: Bolivar After-Tax Metrics

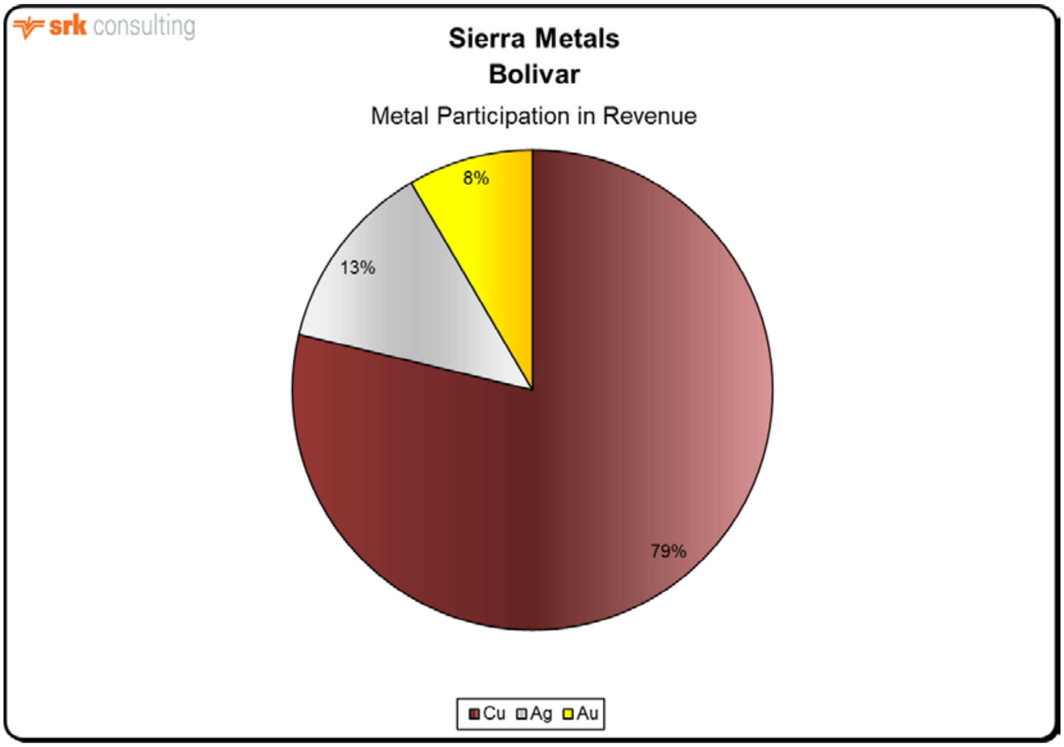
Indicative economic results are presented in Table 22-6.

Table 22-6: Bolivar Indicative Economic Results (Dry Basis)

Description	Value	Units
Market Prices		
Copper	3.19	US$/lb
Silver	18.25	US$/oz
Gold	1,291	US$/oz
Estimate of Cash Flow (all values in US$000's)		
Concentrate Net Return		**US$/lb Cu**
Copper Sales	$377,929	$3.19
Silver Sales	$61,709	$0.52
Gold Sales	$40,503	$0.34
Total Revenue	**$480,140**	**$4.05**
Treatment, Smelting and Refining Charges	($31,477)	($0.27)
Freight	($28,535)	($0.24)
Gross Revenue	**$420,129**	**$3.55**
Royalties	($16,263)	($0.14)
Net Revenue	**$403,866**	**$3.41**
Operating Costs		
Underground Mining	($147,308)	($1.24)
Process	($66,174)	($0.56)
G&A	($20,336)	($0.17)
Total Operating Cost	**($233,818)**	**($1.97)**
Operating Margin (EBITDA)	**$170,048**	**$1.44**
LoM Sustaining Capital	($69,309)	($0.59)
Income Tax	($19,680)	($0.17)
After Tax Free Cash Flow	**$81,058**	**$0.68**
NPV @: 8%	**$59.70**	**US$ million**

Source: SRK, 2018

Copper is the largest contributor to the project revenue and corresponds to approximately 79% of value. Gold and silver are considered by-products of the operation and each contribute 8% and 13%, respectively, to the mine's revenue. Figure 22-2 shows a graphical representation of each metals contribution to the Project's revenue.



Source: SRK, 2018

Figure 22-2: Metal Contribution to Revenue

Table 22-7 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 22-7: Bolivar Production Summary

Year	Calendar Year	Plant Feed (Mt)	Copper Concentrate (kt)	Free Cash Flow (US$ million)	Remaining Asset NPV – EoY (US$ million)
1	2017	0.18	8.30	4.10	58.41
2	2018	1.12	34.79	(0.66)	61.50
3	2019	1.13	34.25	3.94	62.73
4	2020	1.13	39.05	19.26	48.78
5	2021	1.13	39.77	13.01	38.81
6	2022	1.13	42.42	20.86	20.82
7	2023	1.13	33.60	11.67	9.55
8	2024	0.96	23.77	9.47	0.24
9	2025	-	-	(0.59)	(0.04)
10	2026	-	-	-	-
11	2027	-	-	-	-
Total		**7.92**	**255.93**	**81**	

Source: SRK, 2018

Table 22-8 presents the composition of the Bolivar cash costs.

Table 22-8: Bolivar Cash Cost

Cash Costs	US$000's	US$/t ore
Direct Cash Cost		
Underground Mining Cost	$147,308	$18.59
Process Cost	$66,174	$8.35
Site G&A Cost	$20,336	$2.57
Treatment Charges	$20,627	$2.60
Smelting & Refining Charges	$10,850	$1.37
Freight	$28,535	$3.60
By-Product Credits	($102,212)	($12.90)
C1 Direct Cash Costs	**$191,618**	**$24.18**
US$/t ore	**$24.18**	
US$/lb Cu	**$1.62**	
Indirect Cash Cost		
Royalties	$16,263	$2.05
Indirect Cash Costs	**$16,263**	**$2.05**
US$/t-ore	**$2.05**	
US$/Cu-lb	**$0.14**	
Capital Cash Costs		
Sustaining Capital	$69,309	$8.75
Capital Cash Costs	**$69,309**	**$8.75**
US$/t ore	**$8.75**	
US$/lb Cu	**$0.59**	
Total Cash Costs	**$277,190**	**$34.98**
US$/t ore	**$34.98**	
US$/lb Cu	**$2.34**	

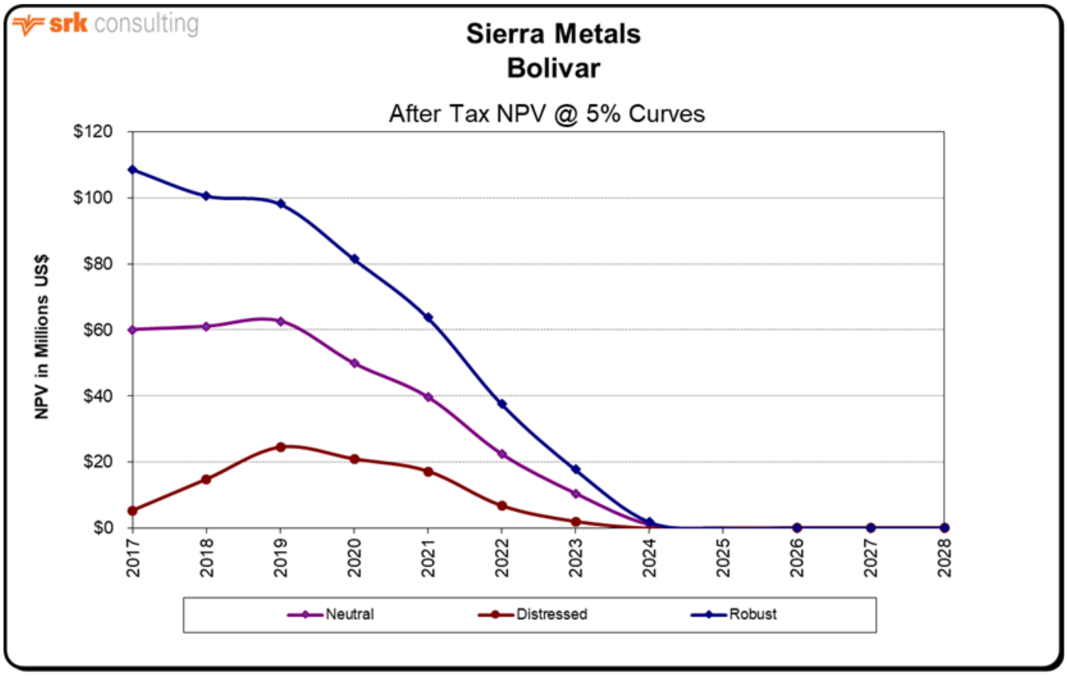
Source: SRK, 2018

22.6 Sensitivities

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

Figure 22-3 presents the after-tax net present value curves, where:

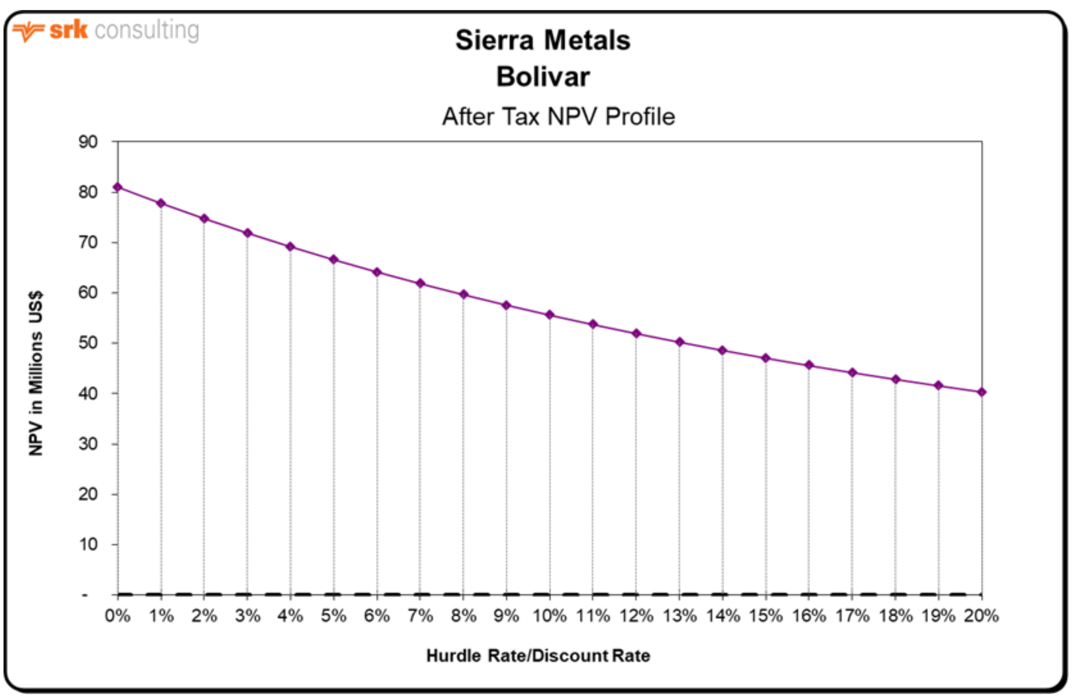
- Distressed metal prices are 20% lower than neutral prices;
- Neutral metal prices as presented in this section; and
- Robust metal prices are 20% higher than neutral prices.



Source: SRK, 2017

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

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



Source: SRK, 2018

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

A sensitivity analysis for key operating and economic parameters is shown in Figure 22-5.

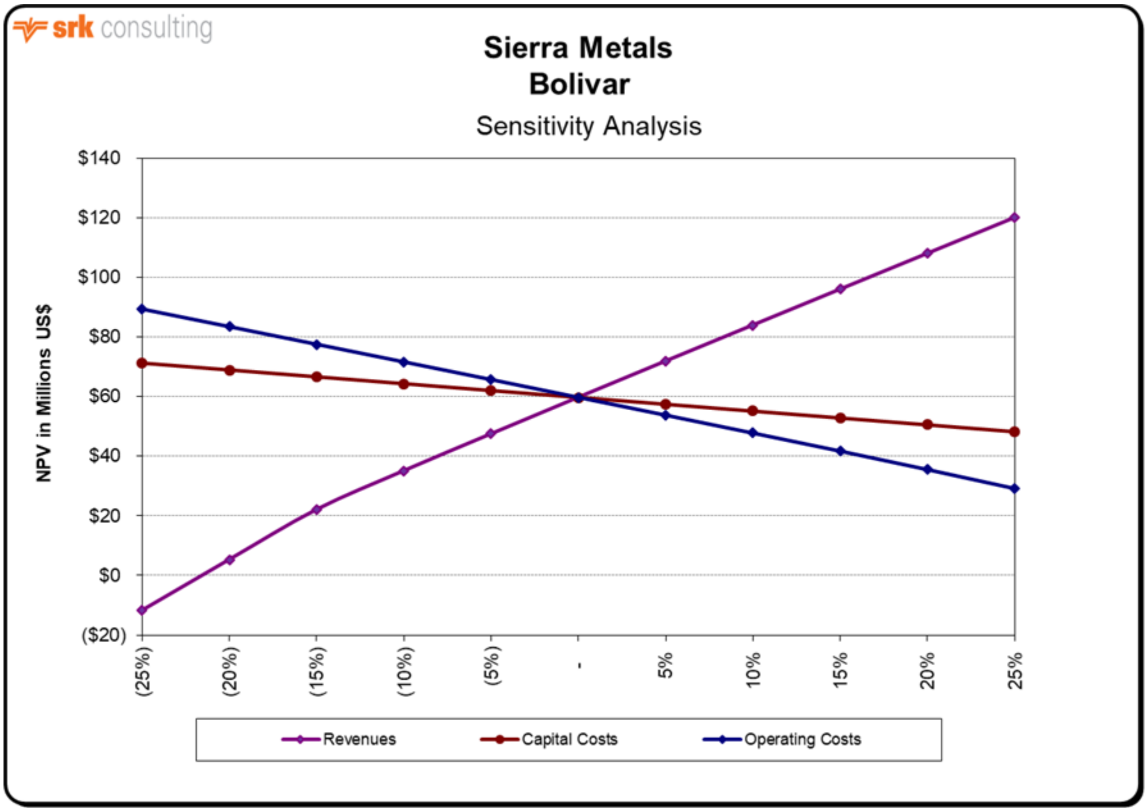


Figure 22-5: Bolivar Sensitivity Analysis

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.

- The drilling campaign of 2017 was focused in Bolivar W and Bolivar NW. Future exploration should reduce the drilling grid to improve the category of the resources and define the limits of the mineralization in these 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 Increible, Step Out, Sidra and 6-900.
- 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.
- Areas such as Step-Out, and Increible 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 MRE 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 MRE.

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 that was implemented since 2016. 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 downhole 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 downhole deviations that influence the exact position of mineralized intervals.
- The lack of a consistent density testing program to clearly define this characteristic for the different rock and mineralization types in the different areas of the project.
- In 2017 Dia Brass carried out the survey of the exploited areas that improved the quality of the information but this study did not cover all the exploited areas. For the areas not recently surveyed, SRK has used the 3 m volume buffers used in the 2016 resource estimation study. 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 production schedule associated with these reserves estimate results in mining until mid-2024 at an average production of approximately 3,100 ore t/day. The LoM production plan is comprised of material from three main mining areas: EGI, Bolivar W, and Bolivar NW using room and pillar and longhole stoping mining methods. The Bolivar W and Bolivar NW are current in initial development stages and priority to development these areas will be required to achieve the LoM production schedule.

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 2017 reached a total of 887,236 t, equivalent to an average of 74,000 t/m, or 2,400 t/d. Production of copper concentrate has consistently ranged between approximately 1,500 and 2,900 t/m, equivalent to roughly a 3.1% mass pull. The monthly average has consistently reached commercial quality with copper at 24.9% and credit metals averaging 374 g/t silver and 3.2 g/t gold in 2017.

There is 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 Environmental, Permitting and Social

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.

Dust on surface roadways between the mine and the plant location remains a significant problem, and could jeopardize Dia Bras' social license. According to Dia Bras, a new strategy to address this issue is being developed.

More recent geochemical characterization data suggest that some of the more recent material from the underground mine may be potentially acid generating. 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 based on information provided by Dia Bras. At this time, SRK is not aware of any outstanding permits or any non-compliance at the project or nearby exploration sites.

Dia Bras plans to increase the Bolivar Mine production to 5,000 t/d, which will require additional tailings storage space. A second location adjacent to the existing TSF, has been identified and permitted to receive tailings for at least three years.

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.

25.6 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 79% of value. Gold and silver are considered by-products of the operation and each contribute 8% and 13%, respectively, to the mine'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$81.1 million and a present value of US$59.7 million based on a discount rate of 8%.

Economic projections of the base case metal prices scenario indicate that the project's free cash flow will be slightly negative in 2018 and recover in 2019. This is related to the high intensity of capital expenditure projected for 2018.

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:

- Continue the implementation of a regular practice of downhole surveys for drilling using the non-magnetic Deviflex equipment.
- Continue and improve 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.
- Complement the QA/QC protocol using additional controls including coarse blanks, twin samples, fine and coarse duplicates and a second lab control using a certified laboratory to control de different phases of the preparation and chemical analysis process.
- Document the failures in the quality control protocol and the correction measurements taken.
- Stablish a consistent density testing program including the representative selection of drill core from the different rock and mineralization types for the different areas of Bolivar and La Sidra. Periodically, some samples 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 modern 3D survey method to obtain the exploited volumes for all the project to define the mined areas.
- Conduct additional drilling in Increible, 6-900 and Step Out areas. Drillhole spacing should be on the order of 75 m 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.
- Carry out additional 25 to 50 m grid infill drilling in Bolivar NW and Bolivar W to improve the resources classification to Measured and Indicated and complete some drillholes to define the limits of the mineralization in these areas.
- 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:

- Maintain and annually update the 3D LoM design and schedule;
- Regularly perform 3D mine surveys and use the data to regularly perform stope-by-stope planned to actual reconciliations, for both grade and tonnage mined, and to continually validate the mining recovery and dilution assumptions;

- Generate a waste handling and underground storage plan, including validating the assumptions made for swell factor for blast material and re-handled material, as well as the storage fill factor;
- Perform a haulage simulation to validate the ore and waste handling assumptions made for underground truck haulage from each of the three main zones to surface, as well as the surface truck haulage from surface dumps to the mill;
- 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;
- Perform geotechnical analysis, particularly in the new zones of Bolivar Northwest and Bolivar West;
- Perform a mining methods trade-off study to identify opportunities to increase the production rate and improve mining recovery through review and optimization of mine design dimensions, ore and waste handling, and other mine design criteria; and improve overall conversion of mine resources to reserves;
- Develop and maintain an estimate of the tonnes and grade remaining in pillars. This study will require improving confidence in the accuracy of the mined-out survey models, and development of a channel samples database for reserve estimation;
- Establish a plan for the safe extraction of pillars. This study may also include the analysis of utilizing tailings or waste material as backfill in the mine; and
- 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.

26.1.3 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 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 expanded TSF areas, TSF4 and 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 optimize the size of the New TSF to confirm it will meet the LoM requirements.

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:

- The issue of surface road fugitive dust emissions should be addressed as soon as possible to avoid jeopardizing the mine's social license and incurring compliance violation from the regulatory authorities.
- 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	Cost US$
Geology and Resources	Drilling	1,250,000
Mining and Reserves	Mining methods trade-off study including evaluation of ore and waste handling and haulage simulation	200,000
Mining and Reserves	Mine ventilation survey and whole-of-mine plan	75,000
Mining and Reserves	Geotechnical analysis in new mining areas Bolivar West and Bolivar Northwest	250,000
Mining and Reserves	Pillar extraction study	150,000
Environmental & Social	Fugitive Dust Control Plan (currently underway)	0
Environmental & Social	Closure cost estimate and benchmarking exercise	50,000
Environmental & Social	Tailings closure workshop and closure plan development	25,000
Total		**$2,000,000**

Source: SRK, 2018
Note: Drilling costs assume US$125/m drilling costs.

27 References

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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.

Term	Definition
Pillar	Rock left behind to help support the excavations in an underground mine.
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

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CERTIFICATE OF QUALIFIED PERSON

I, Giovanny J. Ortiz, Geologist, FAusIMM do hereby certify that:

1. I am Associate 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 October 31, 2017 (the "Technical Report")
3. I am a Professional Geoscientist with the following academic qualifications:
   - BSc (Geology) — Universidad Industrial de Santander, Bucaramanga, Colombia (1994)
   - Specialization (Management) — Universidad Autónoma de Bucaramanga, Bucaramanga, Colombia (1994)
   - Citation Applied Geostatistics — University of Alberta (2007)
4. I am a registered Geologist with the Colombian Council of Geology, Bogotá, Colombia, and a fellow (FAusIMM) in good standing of the Australasian Institute of Mining and Metallurgy (AusIMM 304612)
5. I am familiar with the NI 43-101 and certify that by reason of education, affiliation with a professional association and past relevant work experience, I fulfill the requirements to be a "Qualified Person" as defined in NI43-101. My work experience includes 21 years in South America and Central America as exploration geologist, project manager, VP Exploration, estimation of mineral resources, and working in different geological settings and deposit types.
6. I am responsible for the preparation of Sections 6-12 and 14, and portions of Sections 1, 4, 5.1-5.3, 25 and 26 summarized therefrom, of this Technical Report.
7. I visited the Bolivar Mine property on January 22, 2018 for 4 days.
8. I have no previous involvement with The Bolivar Mine.
9. I am independent of the issuer applying all of the tests in section 1.5 of NI 43-101.
10. I have read NI 43-101 and this report has been prepared in compliance with this instrument and form.
11. 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 29th Day of June, 2018

-"signed"-

____

Giovanny J. Ortiz, BSc Geology, FAusIMM

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CERTIFICATE OF QUALIFIED PERSON

I, Shannon L. Rhéaume, BASc Mining and Mineral Processing, PEng, do hereby certify that:

1. I am a Senior Consultant (Mining Engineer) of SRK Consulting (Canada) Inc., Suite 101, 1984 Regent Street South, Sudbury, Ontario, P3E 5S1, Canada.
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 October 31, 2017 (the "Technical Report").
3. I graduated with a Bachelor of Applied Science degree in Mining and Mineral Process Engineering from the University of British Columbia in 2000. I am a registered member of the Professional Engineers of Ontario (PEO). I have practiced mining engineering continuously since 2000, and have over 17 years of operational, engineering, management, and consulting experience. I have worked in underground mines including blast hole open stope and narrow vein mining, and in commodities such as gold, nickel, potash, uranium, zinc, and copper. I have engaged in the process of Mineral Resources to Mineral Reserves estimates. Upon graduation I was employed by Placer Dome as a Mine Engineer for the underground operations at Campbell Mine in Red Lake, Ontario, Canada for almost five years. Following operations, I was employed by MineRP Canada where I consulted to mine operations and eventually managed the consulting team. Since joining SRK Consulting in 2013, I have been engaged in technical engineering studies, mine design and scheduling, optimized production planning, operations improvement, and due diligence reviews.
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 January 22, 2018 for 4 days.
6. I am responsible for mineral reserves, mining methods, market studies and contracts, capital and operating costs, economic analysis and other relevant data and information in Sections 2, 3, 15, 16 (except for 16.3), 19, 21 through 24, 27, 28 and portions of Sections 1, 25 and 26 summarized therefrom.
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 29th Day of June 2018.

"Signed and Stamped"

____

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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 October 31, 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 32 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 have not visited the Bolivar Mine property.
6. I am responsible for Project Infrastructure Sections 5.4, 18 and portions of Sections 1, 25 and 26 summarized therefrom.
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 acting as QP in report titled “NI 43-101 Technical Report on Resource and Reserves, Bolivar Mine, Mexico” with an Effective Date of February 28, 2017 and a Report Date of April 6, 2017.
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 29th Day of June 2018.

“Signed and Stamped”

Jeff Osborn, BEng Mining, MMSAQP [01458QP]
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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 October 31, 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 25 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 3 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.
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 acting as QP in report titled "NI 43-101 Technical Report on Resources and Reserves, Bolivar Mine, Mexico" with an Effective Date of February 28, 2017 and a Report Date of April 6, 2017.
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 29th Day of June 2018.

"Signed and Stamped"

Daniel H. Sepulveda, B.Sc, SME-RM

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CERTIFICATE OF QUALIFIED PERSON

I, John Tinucci, PhD, PE, ISRM, do hereby certify that:

1. I am Practice Leader/Principal Consultant (Geotechnical 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 October 31, 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 37 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. My industry commodities experience includes salt, potash, coal, platinum/palladium, iron, molybdenum, gold, silver, zinc, diamonds, and copper. My mine design experience includes open pit, room and pillar, (single and multi-level), conventional drill-and-blast and mechanized cutting, longwall, steep narrow vein, cut and fill, block caving, sublevel caving and cut and fill longhole stoping and paste backfilling.
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 have not visited the Bolivar Mine property.
6. I am responsible for geotechnical Section 16.3 and portions of Sections 1, 25 and 26.
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 acting as QP on report titled "NI 43-101 Technical Report on Resources and Reserves, Bolivar Mine, Mexico" with an Effective Date of February 28, 2017 and a Report Date of April 6, 2017.
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 29th Day of June 2018.

"Signed and Stamped"

John Tinucci, PhD, PE, ISRM

Principal Consultant (Geotechnical Engineer)

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CERTIFICATE OF QUALIFIED PERSON

I, Mark Allan Willow, MSc, CEM, SME-RM do hereby certify that:

1. I am Practice Leader/Principal Environmental Scientist 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 October 31, 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 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 Environmental Studies, Permitting and Social or Community Impact Sections 4.4, 20 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 acting as QP on report titled "NI 43-101 Technical Report on Resources and Reserves, Bolivar Mine, Mexico" with an Effective Date of February 28, 2017 and a Report Date of April 6, 2017.
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 29th Day of June 2018.

"Signed and Stamped"

Mark Allan Willow, MSc, CEM, SME-RM