NI 43-101 Preliminary Economic Assessment (PEA) for the Yauricocha Mine, Peru

Effective Date: July 31, 2017
Report Date: August 8, 2018

Report Prepared for

Sierra Metals, Inc.

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Date and signature Page

This Technical Report is dated August 8, 2018, with an effective date of July 31, 2017.

Name	**Professional Designation**	**Signature**	**Date Signed (dd/mm/yy)**
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1 Executive summary

Sierra Metals Inc., (Sierra) formerly known as Día Bras Exploration Inc., engaged various specialist groups to evaluate how, on a conceptual level, mining, mineral processing, and tailings management could be adapted at the Yauricocha mine and Chumpe plant to achieve a sustainable and staged increase in mine production and mill throughput.

Sierra's Yauricocha Mine and Chumpe plant (combined to form the Property))in the Junín region of Peru has been producing and processing polymetallic mineral for more than 50 years, production from the mine is processed at the company's Chumpe Plant.

Mineralisation at the Property is genetically and spatially related to the Yauricocha stock; 6 skarn bodies host mineral resources around the margins of the stock. Near surface mineral is exhausted but significant mineral resources are reported at depth, over 13Mt of measured and indicated resources and a further 6.5Mt of inferred resources were reported in the SRK resource - Effective date - July 31st, 2017 (Table 1-1).

Table 1-1: Summary of resource reported by SRK, November 19, 2017

Catergory	Tonnes(kt)	Ag (g/t)	Au (g/t)	Cu (%)	Pb (%)	Zn (%)	Density
Measured	3,094	69.97	0.79	1.72	1.23	3.20	3.74
Indicated	10,111	59.91	0.60	1.46	0.83	2.67	3.80
Measured + Indicated	13,205	62.26	0.65	1.52	0.92	2.79	3.79
Inferred	6,632	43.05	0.55	1.19	0.47	2.16	3.71

(1) Mineral Resources that are not mineral reserves do not have demonstrated economic viability. All figures are rounded to reflect the relative accuracy of the estimates. Gold, silver, copper lead and zinc assays were capped where appropriate.
(2) Mineral Resources are reported at cut-off values based on metal price assumptions*, variable metallurgical recovery assumptions (variable metallurgical recoveries** as a function of grade and relative metal distribution in individual concentrates), generalized mining/processing costs***).
* Metal price assumptions considered for the calculation of unit values are: Gold (US$1,255/oz), Silver (US$17.80/oz), Copper (US$2.60/lb), Lead (US$1.01/lb), and Zinc (US$1.25/lb).
** Metallurgical recovery assumptions for the Yauricocha Mine are variable and dependent on mineralization style and orebody type.*** The cut-off value for the Yauricocha Mine are variable and dependent on mining method and process/recovery costs, which vary between US$41/t and US$48/t. These values include static processing US$7.40/t and G&A US$3.90/t costs.
(3) SRK and Sociedad Minera Corona (SMCSA) utilized either Ordinary Kriging (OK) or Inverse Distance Weighting (IDW) to interpolate grade in all resource areas.

The geometry and grade of mineralisation at Yauricocha lends itself to sub-level caving mining and accounted for more than 98% of total current mineral production (3,000 tpd). Mineral and waste is hoisted to the 720 level and is carried by electric locomotive to the Chumpe plant for processing. Yauricocha has three hoisting shafts with a combined capacity of 4,500 tpd at the current waste to mineral ratio of 0.5:1.

Sierra commissioned Redco to evaluate, on a conceptual level, how production at Yauricocha could be increased. Redco determined that with the introduction of mineralised bodies that are part of the resource, production could be increased to 5,500 tpd using the same sublevel caving mining method configuration. Production increases will require a significant amount of advanced development and expansion of infrastructure. The existing hoisting system does not have the capacity to maintain current production and accommodate additional waste associated with the advanced development.

Sierra is constructing a fourth shaft with a hoisting capacity of 5,900 tpd. When this shaft is completed (expected mid-2020), the combined hoisting capacity will be 10,400 tpd. Advanced development ahead of increased production will increase the waste to mineral ratio.

As part of their evaluation, Redco assumed that:

- *Established operating costs of US$ 55.95/t would be used in the mine plan*
- *Operating costs per tonne would reduce to US$ 40.00/t when production rates reached 5,500 tpd.*
- *Factors that could negatively impact production as the mine extends to depth are increased dewatering challenges and increased potential for mud-rush.*
- *Redco determined that:*
- *With the completion of the Yauricocha shaft, production rates could be increased*
- *Conceptual economic analysis indicates that 5,500 tpd mineral production is the optimal mine output, which represents a production increase of 66% on current output*
- *Based on the current resource and proposed 5,500 tpd optimal mine output, the Life of Mine (LoM) is 9 years*
- *Throughout the LoM 125 km of waste development and 29 km of development in mineral will be required*
- *The processing capacity of the Chumpe plant will need expanding from 3,000 tpd if it is to process increased mine output*
- *Tailings capacity will need expanding to handle tails from the Chumpe Plant.*
- *LoM capital requirements (Mine, Plant, Closure) to realise the proposed mine plan (5,500 tpd) are estimated at US$ 238 M.*
- *Risks to the proposed mine plan are limited as Yauricocha is an established operation with proven mining methodology, mineral processing and metallurgical recovery, however, some risks are highlighted:*
- *The proposed mine plan is dependent on permitting, timings of permit approval process are not considered in the proposed mine plan*
- *The proposed mine plan considers hoisting of material beyond the capacity of the current hoisting system during 2018 and 2019*
- *Subsidence related to sub-level caving is recorded around the Central and Mascota shafts. These shafts are critical for the ingress and egress of material, if continued subsidence impacts the hoisting capacity of these shafts the proposed mine plan would be significantly impacted. Contingency planning in case of a failed shaft is not considered in the proposed mine plan*
- *The proposed mine plan considers inferred resources which are low confidence and are not suitable for the application of economic factors. Further drilling will improve confidence in these resources and better determine their potential economic viability*
- *Dewatering and ventilation demands will increase with depth and properly engineered solutions are needed if the mine plan is to be implemented*
- *Mud-rush is a known issue at Yauricocha and potential for mud-rush is likely to increase at depth. Mitigating this risk is essential to the proposed mine plan*
- *The Chumpe processing plant will need to be expanded to handle increased throughput*
- *Tailings storage capacity will need to be expanded to handle increased waste from the processing plant.*

Economic Analysis

Mineral resources that are not mineral reserves do not have demonstrated economic viability. The economic analysis includes inferred mineral resources. This PEA is preliminary in nature and there is no certainty that the PEA will be realized.

The PEA calculates (Table 1-2) a Base Case after – tax Net Present Value (NPV) of US$ 393 M with an after-tax Return of Investment (ROI) of US$ 486 M using a discount rate of 8%. The total life of mine capital cost of the project is estimated to total US$ 238 M. The payback period for the Life of Mine (LoM) capital is estimated at 4.1 years. Operating costs of the LoM total US$ 593 M, equating to an operating cost of US$ 43.86 per tonne milled. Based on this economic analysis, the proposed mine plan should be investigated further and better refined.

Table 1-2: Plan considered in the PEA

PEA Highlights Base Case of US$ 1,323/oz Gold, US$ 18.68/oz Silver, US$ 0.98/lb Lead, US$ 1.19/lb Zinc, US$ 3.15/lb Copper	Unit	Value
Net Present Value (After Tax 8% Discount Rate)	US$ M	393
Return on Investment (ROI)	US$ M	486
Mill Feed	Tonnes (Mt)	13.5
Peak Mine Production Rate	tpd	5,500
LOM Project Operating Period	yr	9
Total Capital Costs	US$ M	238
Net After – Tax Cashflow	US$ M	532
Total Operating Unit Cost	US$/t	43.86
LOM Gold Production (Payable)	oz	17,621
LOM Silver Production (Payable)	oz	11,408,281
LOM Lead Production (Payable)	t	87,881
LOM Zinc Production (Payable)	t	281,746
LOM Copper Production (Payable)	t	102,821

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2 Introduction

Sierra Metals Inc. (Sierra), formerly known as Día Bras Exploration Inc., engaged various specialist groups to evaluate how, on a conceptual level, mining, mineral processing, and tailings management could be adapted at the Yauricocha mine and Chumpe Plant (combined to form the Property) to achieve a sustainable and staged increase in mine production and mill throughput.

This technical report is a Preliminary Economic Assessment (PEA) designed to give an indication of the potential economic viability of operating the Property at increased mine output, from 3,000 tpd currently to 3,600 tpd by Q1 2019 and 5,500 tpd in 2021. Engineering to support increased processing capacity at Chumpe considered processing up to 5,500 tpd.

This report is based on measured, indicated and inferred resources reported on November 10th, 2017 by SRK, Effective Date as of July 31st, 2017.

The reader is cautioned that PEA's are indicative and not definitive and that the resources used in the mine plan include inferred resources that are too speculative to be used in an economic analysis, except as allowed for by Canadian Securities Administrator's National 43-101 (43-101) in PEA studies. Mineral resources that are not mineral reserves do not have demonstrated economic viability. There is no certainty that inferred resources can be converted to indicated or measured resources or mineral reserves and, as such, there is no certainty that the results of this PEA will be realised.

This report is a compilation of information prepared by various specialist groups as detailed in Table 2-1:

Table 2-1 Source of information used to compile this report

Group	Concept	Report
SRK Consulting (U.S), Inc.	Resource Estimation	SRK, 2017
Redco Mining Consultants	Increase mine output to 5,500 tpd	Redco, 2018
Sierra Metals (SM)	Chumpe Processing Plant - Memoria Descriptiva – Extension to 5,500 tpd	Sierra, 2018
Anddes Consulting (AC)	Expansion of tailings storage capacity	Anddes, 2018
Tierra Group	Memorandum Tecnico	TG, 2018

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The Qualified Persons responsible for the various sections of the reports are listed in Table 2-2.

Table 2-2: Qualified Persons and the Sections they are Responsible for

Name	Responsible for Section
Enrique Rubio	Sections 15, 16, 21 and 22
Matthew Hastings	Sections 2 through 12 (except subsections 4.3 and 5.5), 14, and portions of Sections 1, 25 and 26 summarized therefrom
Augusto Chung	Sections 1, 2, 3, 13, 17, 18, 19, 20, 23, 24, 25, 26 and 27

3 Reliance on other experts

See Table 2-1 above.

4 Property, description and location

Sections 4.1, 4.2 and 4.3 of this Report have been excerpted from previous NI 43-101 Technical Reports on the Yauricocha Mine, prepared by SRK (Consulting U.S., Inc), dated July 31, 2017, and by Gustavson Associates dated May 11, 2015, and are shown in italics. Standardizations have been made to suit the format of this report; any changes to the text have been indicated by the use of [brackets].

4.1 Property Location

The Yauricocha Mine is located in the Alis district, Yauyos province, department of Lima approximately 12 km west of the Continental Divide and 60 km south of the Pachacayo railway station. The active mining area within the mineral concessions is located at coordinates 421,500 m east by 8,638,300 m north on UTM Zone 18L on the South American 1969 Datum, or latitude and longitude of 12.3105 ^{o} S and 75.7219 ^{o} W. It is geographically in the high zone of the eastern Andean Cordillera, very close to the divide and within one of the major sources of the River Cañete, which discharges into the Pacific Ocean. The mine is at an average altitude of 4,600 masl. Figure 4-1 shows the project location.

Figure 4-1: Yauricocha Location Map

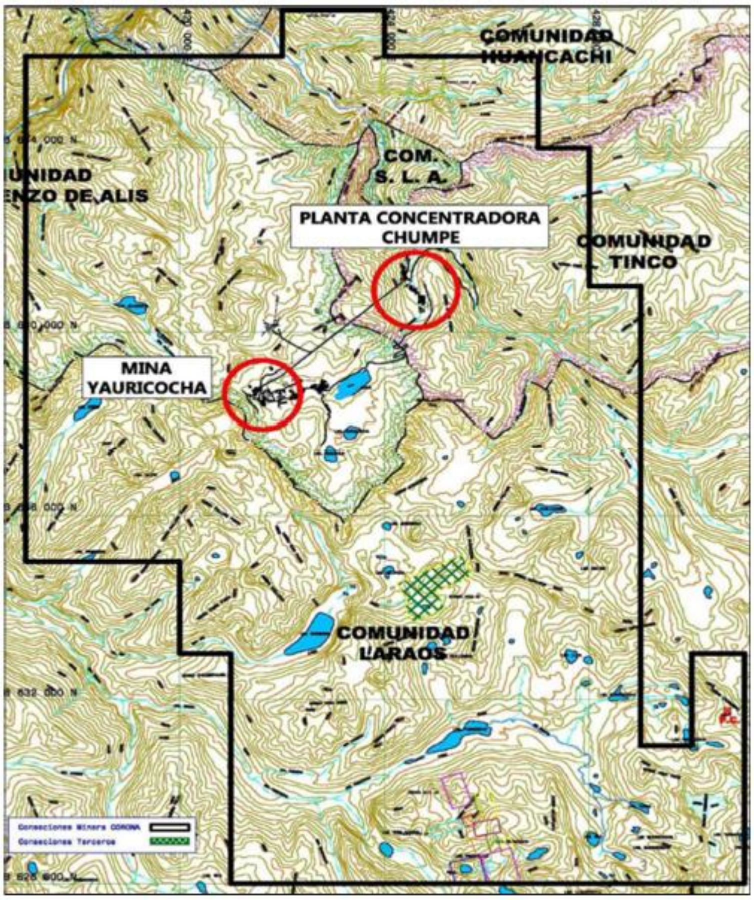
4.2 Mineral Titles

The mining concession Acumulación Yauricocha (Figure 4-2) was transferred from Empresa Minera del Centro del Peru, the Peruvian state-owned mining entity, to SMCSA in 2002 (Empresa Minera, 2002) for the sum of US$ 4.01 M, plus an agreement to invest US$3,000,000.00 to project development or to the community, *which has been completed. The Accumulation Yauricocha includes the mineral rights on 18,685 ha. It includes areas in the communities of San Lorenzo de Alis, Laraos, Tinco, Huancachi, and Tomas. Día Bras [Exploration] purchased 82% of Minera Corona in May 2011. On December 5, 2012, Día Bras Exploration changed its name to Sierra Metals Inc. According to information provided by Día Bras, the mineral concessions are not subject to an expiration date and remain in effect as long as these two conditions are met:*

- *Renewal payment is made to the Peruvian federal government in the amount of US$3 per hectare (ha) in an annual basis; and*
- *Annual minimum production amount of US$100/yr/ha.*

No non-governmental royalty is associated with the Yauricocha mineral concession.

Included within the above area is a processing site concession with an area of 148.5 ha with a permitted capacity of 2,500 dry t/d. This has been authorized by Resolution No. 279- 2010-MEMDGM/V on July 14, 2010.



Source: Sierra Metals, 2015

Figure 4-2: Yauricocha Mineral Title Map

4.2.1 Nature and Extent of Issuer's Interest

As part of the mineral concessions transfer with Empresa Minera del Centro del Peru in 2002 (see Section 4.2), SMCSA acquired approximately 677 ha of land and associated surface rights. A portion of the San Lorenzo Alis community is located within the 677 ha.

In 2007, SMCSA entered into an additional agreement with the San Lorenzo Alis community (Villaran, 2009). Under this agreement, SMCSA owns the surface rights and may conduct mining operations in the subject 677 ha through August 2, 2037, or until mine closure, whichever comes first. In exchange, SMCSA is obligated to pay the San Lorenzo Alis community an annual fee. This fee is paid by SMCSA every two years beginning on January 1, 2009, and surface rights remain in good standing. However, in February 2013 an addendum was signed which establishes that the payments must be made every year. This right of usufruct (beneficial use) has been registered before the Public Registry of Lima, Office of Cañete (Public Registry of Lima et al, 2013).

The Company has in place several land surface agreements by means of which the title holders of the land surfaces within the area of the Acumulación Yauricocha mining concession, grants the Company the right to use the superficial surface and execute mining activities. The agreements entered by the Company in this regard, are the following:

4.2.1.1 Lease Agreement: Huacuypacha

The Company has entered into a lease agreement with Mr. Abdon Vilchez Melo, regarding the surface land within the real property named Huacuypacha, located in Tinco, district of Alis, province of Yauyos, Department of Lima. This land is not registered in the Public Registry. By means of this agreement, the Company acquired the right to use said land, including access to water boreholes.

This agreement has been renewed in four opportunities. The term of the agreement expires on December 31, 2021.

4.2.1.2 Lease Agreement: Queka and Cachi-Cachi

The Company has entered into a lease agreement with the Family Varillas, in relation to land containing 56 ha located in district of Alis, province of Yauyos, Department of Lima. This land is not registered in the Public Registry. By means of this agreement, the landowner granted the use of the referred land in favor of the Company for a total payment of S/.31,500. In addition to the payment obligation, the Company has assumed the obligation to take care of all the environmental liabilities that its activities could generate.

This agreement has been amended in two opportunities. The term of the agreement expired on March 7, 2012. However, the company has signed a new agreement extending the term of the lease until March 7, 2022 in exchange for a one-time payment of S/.210,000.

4.3 Royalties, Agreements and Encumbrances

4.3.1 Debt

For the purchase of SMCSA, Día Bras Peru S.A.C. borrowed US$ 150 million in an agreement with Banco de Credito de Peru on May 24, 2011. All current obligations of debt service have been met and this Technical Report supports the cash flows and reporting requirements that are necessary to SRK Consulting (U.S.), Inc. NI 43-101 Technical Report on Resources and Reserves – Yauricocha Mine Page 24 MH/MLM Yauricocha_NI43-101_Updated-TR_470200-190_Rev11_MLM.docx November 2017 continue meeting these obligations. [The balance on the US$ 150 million loan as of September 30, 2017 is US$ 42.0 million].*

In October 2013, SMCSA has signed a new loan agreement with Banco de Credito de Peru for US$60 million. This loan has a period of 5 years and is to support expansion and infrastructure costs. [The balance on the US$ 60 million loan as of September 30, 2017 is US$ 7.8 million].

4.3.2 Royalties and Special Taxes

In 2011, the Peruvian Congress passed a new Mining Law effective in 2012. Under this law, a Special Tax and Royalty is introduced which applies to the operating margin of producing mining companies. The margin rates for a given interval of Earnings Before Interest and Tax (EBIT) are shown in Table 4-1. The total royalty is the summation of the special mining tax and the mining royalty.

Table 4-1: Royalty and Special Tax Scale

EBIT Margin	Special Mining Tax Margin Rate	Mining Royalty Margin Raw
0.00% - 5.00%	0.00%	0.00%
5.00% - 10.00%	2.00%	1.005
10.00% – 15.00%	2.40%	1.75%
15.00% - 20.00%	2.80%	2.50%
20.00% - 25.00%	3.20%	3.25%
25.00% - 30.00%	3.60%	4.00%
30.00% - 35.00%	4.00%	4.75%
35.00% - 40.00%	4.40%	5.50%
40.00% - 45.00%	4.80%	6.25%
45.00% - 50.00%	5.20%	7.00%
50.00% - 55.00%	5.60%	7.75%
55.00% - 60.00%	6.00%	8.50%
60.00% - 65.00%	6.40%	9.25%
65.00% - 70.00%	6.80%	10.00%
70.00% - 75.00%	7.20%	10.75%
75.00% - 80.00%	7.60%	11.50%
80.00% - 85.00%	8.00%	12.00%
85.00% - 90.00%	8.40%	

Source: Gustavson, 2015

4.4 Environmental Liabilities and Permitting

The mine is located on the property of the San Lorenzo de Alis and Laraos communities and in the buffer zone of the Nor Yauyos-Cochas landscape reserve. It was established by the Supreme Decree N° 033-2001-AG (06/03/2001) which has a Master Plan 2006-2011 by the National Institute of Natural Resources Natural Protected Area Office (INRENA, Instituto Nacional de Recursos Naturales, IANP, Intendencia de Áreas Naturales Protegidas).

SMCSA has managed its operations in Acumulación Yauricocha based on:

- *The Environmental Adjustment and Management Plan (PAMA, Plan de Adecuación y Manejo Ambiental) presented by CENTROMIN (approved by Directorial resolution N° 015-97-EM/DGM, 01/03/1997);*
- *The modification of the implementation nine projects of the PAMA of the Yauricocha Production Unit presented by CENTROMIN, (approved by Directorial resolution N° 159-2002-EM-DGAA, 05/23/2002);*
- *The implementation of the PAMA “Yauricocha" Administrative Economic Unit by SMCSA (approved by Directorial resolution N° 031-2007-MINEM-DGM, 02/08/2007);*

- *The Mine Closure Plan (PCM) at feasibility level of the Yauricocha Mining Unit, presented by SMCSA (approved by Directorial resolution N° 258-2009-MINEM-AAM, 08/24/2009);*
- *Authorization to operate the Mill N° 4 (8'x10') and the amendment of the "Yauricocha Chumpe" Benefit Concession to the expanded capacity of 2,500 TMD, presented by SMCSA (approved by Resolution N° 279-2010-MINEM-DGM-V, 07/14/2010);*
- *The Yauricocha Mining Unit Mine Closure Plan Update, presented by SMCSA (approved by Directorial resolution N° 495-2013-MINEM-AAM, 12/17/2013);*
- *Supporting technical reports to the PAMA (ITS, Informe Técnico Sustentatorio) "Expanding the capacity of the Processing Plant Chumpe of the Accumulated Yauricocha Unit from 2,500 to 3,000 TMD" (approved by Directorial resolution N° 242-2015-MINEM-DGAAM, 06/09/2015);*
- *Supporting technical report to the PAMA (ITS) "Technological improvement of the domestic waste water treatment system" (approved by Directorial resolution N° 486-2015-MINEMDGAAM, 11/12/2015); and*
- *Approval of the amendment of the Closure Plan of the Yauricocha Mining Unit (approved by Directorial resolution N° 002-2016-MINEM-DGAAM, 01/08/2016).*

The supporting technical reports are prepared in compliance with the Supreme Decree N° 054-2013-PCM (article Art. 4) and R.M. N° 120-2014-MEM/DM, and refers to the modification of mining components, or extensions and upgrades in the mining unit, in exploration and exploitation projects when the environmental impacts are insignificant.

Environmental liabilities and permitting are discussed in further detail in Section 20. A list of approved environmental and closure permits is included in Section 20.1 Required Permits and Status.

4.5 Other Significant Factors and Risks

SRK is not aware of any additional significant factors or risks that affect access, title, right, or ability to perform work on the property.

5 Accessibility, climate, local resources, infrastructure and physiography

Sections 5.1, 5.2, 5.3 and 5.4 of this Report have been excerpted from a previous NI 43-101 Technical Report on the Yauricocha Mine, prepared by SRK (Consulting U.S., Inc), dated July 31, 2017 and Gustavson Associates, dated May 11, 2015 and are shown in italics. Standardizations have been made to suit the format of this report; any changes to the text have been indicated by the use of [brackets].

5.1 Topography, Elevation and Vegetation

The topography of the Yauricocha mining district is abrupt, typical alpine terrain. Pliocene erosion is clearly recognizable in the undulating, open fields to the northeast of the Continental Divide while to the southeast the terrain is cut by deep valleys and canyons. The extent of this erosion is evidenced by mountain peaks with an average elevation of 5,000 masl.

To the southeast of the Continental Divide, the high valleys are related to the Chacra Uplift. Below 3,400 m elevation, this grand period of uplift is clearly illustrated by deep canyons that in some cases are thousands of metres deep. Valleys above 4,000 masl clearly demonstrate the effects of Pliocene glaciations, with well-developed lateral and terminal moraines, U-shaped valleys, hanging valleys and glacial lakes.

Vegetation in the Yauricocha area is principally tropical alpine-rain tundra. The flora is varied with species of grasses, bushes, and some trees. The biological diversity is typical of Andean alpine communities.

5.2 Accessibility and Transportation to the Property

The principal access to the Mine is the main Lima – Huancayo – Yauricocha highway. The highway is paved (asphalt) for the first 420 km, along the Lima – Huancayo – Chupaca interval. From Chupaca to the Mine the road is unpaved. Another important access route is along the southern Pan-American Highway from Lima through Cañete to Yauricocha, through the valley of the Rio Cañete, for a distance of 370 km. The road is paved (asphalt) from Lima to Pacarán, and from Pacarán to the mine it is unpaved.

5.3 Climate and Length of Operating Season

The climate in the region is cool, with two well-demarcated seasons with daytime temperatures above 20ºC; the nights are cool with temperatures below 10ºC. Operations are carried out year round. The wet season extends from November to April, and during April and May there is broad vegetative cover. The dry season covers the remainder of the year.

During the wet season, snow and hail feed the glaciers, which subsequently feed streams that descend the mountainsides and feed the lakes below.

The climate factors do not affect the length of the operating season, and the mine operates continuously year-round.

5.4 Sufficiency of Surface Rights

Overall, the property position including mineral concessions and surface rights are expected to be sufficient for foreseeable mine activities. The project infrastructure is located within the area where Sierra Metals has surface rights. The Cachi-Cachi mine is located within the area of mineral rights, but outside of the area of surface rights. Cachi-Cachi is an underground mine, and surface access to Cachi-Cachi is located within the area of surface rights.

Of the 20 km length of the property along strike, approximately 4 km have been developed near the center of the property.

5.5 *Infrastructure Availability and Sources*

5.5.1 Power

Power is provided through the existing power system, Sistema Interconectado Nacional (SINAC) to the Oroya Substation. A three phase, 60 hertz, 69 kV power line owned and operated by Statkraft (SN Power Peru S.A.) through its subsidiary, Electroandes S.A. delivers electricity from the Oroya Substation to the Property substation at Chumpe. Power is transformed to 69 KV line voltage and approximately 9 MVA is supplied to the mine and 3.75 MVA is supplied to the processing plant.

5.5.2 Water

Water is sourced from Ococha Lagoon, Cachi-Cachi underground mine, and recycled/overflow water from the TSF depending on end use.

5.5.3 Mining Personnel

The largest substantial community is Huancayo located approximately 100 km to the east-northeast. Huancayo and the surrounding communities have a combined population of approximately 340,000 people. Huancayo is the capital of the Junin Region of Peru.

The employees live on-site at four camps and a hotel with capability to house approximately 2,000 people. The camps include the supervisory camp, the mill camp, and the mining camp that also houses mining contractors. There are approximately 1,700 people (500 employees/1,200 contractors) currently working on the site.

5.5.4 Tailings Storage Areas

The Project site has an existing TSF that has recently been expanded to a capacity of approximately 2.5 Mt. Sierra Metals have evaluated nine alternatives to increase the tailings storage capacity which will allow storage of the tailings material based on the 5,500 tpd p production rate.

5.5.5 Waste Disposal Areas

The Project site has existing permitted waste disposal areas as well as systems to handle miscellaneous wastes.

5.5.6 Processing Plant Sites

The site has an existing mineral processing site that has been in use for a number of years.

6 History

Section 6 of this Report has been excerpted from previous NI 43-101 Technical Report on the Yauricocha Mine, prepared by SRK (Consulting U.S., Inc), dated July 31, 2017 and Gustavson Associates, dated May 11, 2015 and is shown in italics. Standardizations have been made to suit the format of this report; any changes to the text have been indicated by the use of [brackets].

References to reserves in this chapter are historic and do not imply the economic viability of the resources considered in this PEA. The PEA includes inferred mineral resources that are considered too speculative geologically to have the economic considerations applied to them that would enable them to be categorized as mineral reserves.

6.1 Prior Ownership and Ownership Changes

The silver of Yauricocha was initially documented by Alexander von Humboldt in the early 1800s. In 1905, the Valladares family filed the claims of what is today the Yauricocha Mine. The Valladares family mined high grade silver ore for 22 years and in 1927, Cerro de Pasco Corporation acquired the Yauricocha claims. In 1948, Cerro de Pasco commenced mining operations at Yauricocha until the Peruvian Military Government nationalized Cerro de Pasco Corporation and Yauricocha became a production unit of State-owned Centromin Peru S.A. for 30 years. In 2002, the Yauricocha unit was privatized and purchased by SMCSA. Día Bras (Sierra Metals) acquired 82% of the total equity of SMCSA in May 2011.

Sierra Metals retains a 100% controlling ownership status in the Yauricocha Mine, through their subsidiary SMCSA. An unnamed private interest holds 18.16% equity ownership in Yauricocha, with Sierra Metals holding the remaining 81.84%.

6.2 Exploration and Development Results of Previous Owners

Prior to the 1970s detailed production records are unavailable. Since 1973, Company records indicate that Yauricocha has produced 13.6 Mt of mineralized material containing 63 Moz of silver as well as 378 kt of lead, 117 kt of copper and nearly 618 kt of zinc. Since 1979, Yauricocha has averaged 413,000 t of production per year. The historical estimates presented below predate CIM and NI 43-101 reporting standards and therefore cannot be relied upon. These estimates were not used as a basis for the current resource and/or reserve estimates, as the material has already been mined and processed. Table 6-1 summarizes exploration and mining statistics under SMCSA ownership. Mineral inventory is derived from Company reports to Peruvian regulatory Authorities and are not CIM compliant. Mine production is derived from actual mine production records.

Table 6-1: Prior Exploration and Development Results

Year	Exploration (m)	Development and Infill (m)	Exploration and Development (m)	Drilling (DM) by company (m)	Drilling (DDH) by contractor (m)	Mine Production (t)	Mineral Inventory (t)(1)
2002	2,726	1,160	3,886	1,887		124,377	344,630
2003	3,307	1,648	4,955	3,415		212,677	571,520
2004	1,778	2,245	4,023	2,970		233,486	1,001,350
2005	2,004	2,030	4,034	3,160	8,043	373,546	702,524
2006	788	1,998	2,786	2,999	10,195	487,909	6,371,845
2007	826	1,640	2,466	4,751	6,196	546,652	4,773,198
2008	796	1,584	2,380	5,379	13,445	690,222	4,720,606
2009	872	1,040	1,912	4,955	13,579	802,737	4,974,593
2010	454	632	1,086	4,615	3,527	837,389	5,379,526
2011	684	927	1,611	5,195	9,071	816,289	4,943,770
2012	921	609	1,530	11,532	31,257	872,869	5,246,000
2013	1730	839	2,569	10,653	16,781	840,711	6,394,000
2014	680	331	1,011	9,357	30,455	890,910	

(1) Beginning of year balances. Mineral Inventory included Proven and Probable Reserves and Indicated Resources as reported to the Peruvian Exchange and is not CIM compliant. These numbers are for historic information purposes only.
Source: Gustavson, 2015

6.3 Historic Mineral Resource and Reserve Estimates

The historic publicly reported Mineral Resources and Reserve estimates are shown in Table 6-2. A qualified person has not done sufficient work to classify the historical estimates as a current resource and the issuer is not treating the historical estimate as a current resource estimate.

Table 6-2: Historic Mineral Resources and Reserves – Yauricocha Mine

Mineral Resources and Reserves	Tonnage (t)	Silver		Copper		Zinc		Lead		Gold	
		Grade (g/t)	Contained (Oz)	Grade (%)	Contained (t)	Grade (%)	Contained (t)	Grade (%)	Contained (t)	Grade (g/t)	Contained (Oz)
December 31, 2016											
Total Reserves & Resources	11,616,20	57	21,301,000	1.19	138,096	2.43	282,148	0.83	96,022	0.63	234,000
Total Reserves	0	60.35	6,397,290	0.88	29,029	2.92	96,124	1.07	35,422	0.61	65,050
Total Resources Exclusive of Reserves	3,296,930	55.7	14,903,710	1.3	109,067	2.2	186,024	0.7	60,600	0.63	168,950
Total Measured & Indicated Exclusive of	8,319,270	61.1	8,986,710	1.29	59,074	2.54	116,328	0.85	38,826	0.71	104,950
Reserves	4,574,370	49	5,917,000	1.33	49,993	1.86	69,696	0.58	21,774	0.53	64,000
Total Inferred	3,744,900										
Jun 30, 2016											
Total Reserves & Resources	11,616,30	57	21,301,000	1.19	138,096	2.43	282,148	0.83	96,022	0.63	234,191
Total Reserves	0	61.1	7,442,000	0.84	31,625	2.92	110,650	1.15	43,495	0.62	75,940
Total Resources Exclusive of Reserves	3,787,000	55.1	13,859,000	1.36	106,471	2.19	171,498	0.67	52,527	0.63	158,251
Total Measured & Indicated Exclusive of	7,829,300	60.5	7,942,000	1.38	56,478	2.49	101,802	0.75	30,753	0.72	93,952
Reserves	4,084,400	49.1	5,917,000	1.33	49,993	1.86	69,696	0.58	21,774	0.53	64,299
Total Inferred	3,744,900										
December 31, 2016											
Total Reserves & Resources	13,734,43	82.513	36,438,000	1.316	180,629	2.722	373,375	1.081	149,042	1.129	496,932
Total Reserves	0	75.54	13,059,000	0.791	42,777	2.346	125,970	1.413	75,758	0.92	159,188
Total Resources Exclusive of Reserves	5,377,000	NA	23,379,000	NA	137,851	NA	247,404	NA	73,284	NA	NA
Total Measured & Indicated Exclusive of	NA	NA	8,042,000	NA	NA	NA	81,889	NA	NA	NA	NA
Reserves	NA	221.55	15,337,131	7.687	83,805	7.687	165,516	2.309	NA	3.038	210,408
Total Inferred	2,153,530	3									
January 1, 2013											
Total Reserves & Resources	6,509,000	121.13	25,350,000	0.989	64,378	3.334	216,998	2.526	164,427	0.975	203,966
Total Reserves	6,394,000	6	19,500,000	0.7	44,588	2.53	161,569	2.09	133,946	0.8	164,982
Total Resources Exclusive of Reserves	115,000	94.8	5,850,000	17.20	19,790	48.19	55,429	26.506	30,481	10.54	38,984
Total Measured & Indicated Exclusive of	NA	1582.2	3,000,000	9	18,234	9	46,448	NA	11,431	4	21,736
Reserves	370,000	2	2,850,000	NA	1,556	NA	8,981	5.15	19,051	NA	17,248
Inferred		NA		0.42		2.43				1.45	
		239.9									
September 6, 2012											
Total Reserves & Resources	5,957,270	101.30	19,403,000	0.682	40,000	2.121	126,000	2.437	145,000	0.974	186,000
Total Reserves	4,162,940	3	16,021,000	0.7	29,000	2.57	107,000	2.81	117,000	0.92	123,000
Total Resources Exclusive of Reserves	1,794,330	119.7	3,382,000	0.64	11,000	1.08	19,000	1.57	28,000	1.1	63,000

Mineral Resources and Reserves	**Tonnage (t)**	**Silver**		**Copper**		**Zinc**		**Lead**		**Gold**	
		Grade (g/t)	**Contained (Oz)**	**Grade (%)**	**Contained (t)**	**Grade (%)**	**Contained (t)**	**Grade (%)**	**Contained (t)**	**Grade (g/t)**	**Contained (Oz)**
Total Measured & Indicated Exclusive of Reserves	1,794,330	58.62 58.62	3,382,000	0.64	11,000	1.08	19,000	1.57	28,000	1.1	63,000
December 31, 2011 Total Reserves & Resources Total Reserves Total Resources Exclusive of Reserves Total Measured & Indicated Exclusive of Reserves	 5,022,250 1,140,030 3,882,220 3,882,220	 120.09 2 117 121 121	 19,391,000 4,288,000 15,103,000 15,103,000	 0.806 0.93 0.77 0.77	 41,000 11,000 30,000 30,000	 2.702 2.98 2.62 2.62	 136,000 34,000 102,000 102,000	 2.927 2.34 3.1 3.1	 147,000 27,000 120,000 120,000	 0.707 0.56 0.75 0.75	 115,000 21,000 94,000 94,000
December 31, 2008 Total Reserves & Resources Total Reserves	 5,028,773 5,028,773	 152.91 3 152.91 3	 24,723,000 24,723,000	 0.83 0.83	 42,000 42,000	 2.82 2.82	 142,000 142,000	 3.41 3.41	 171,000 171,000	 NA NA	 NA NA
April 29, 2002 Total Reserves & Resources Total Reserves	 360,000 360,000	 155.5 155.5	 1,800,000 1,800,000	 0.52 0.52	 1,900 1,900	 7 7	 25,000 25,000	 3.54 3.54	 13,000 13,000	 NA NA	 NA NA

Source: SNL,2017

6.4 Historic Production

Historic production is listed in Table 6-3, and is based on Yauricocha Mine production reports.

Table 6-3: Historic Yauricocha Production

Fiscal Year	Data Source	Data Ended	Ore Processed (t)	Ag (Oz)	Cu (t)	Zn (t)	Pb (t)
2001	Reported Actual	12/31/2001	235,000	1,124,086	530	15,136	8,402
2002	Reported Actual	12/31/2002	124,000	592,538	356	7,736	4,965
2003	Reported Actual	12/31/2003	213,000	898,066	803	11,389	6,540
2004	Reported Actual	13/31/2001	356,800	643,000	1,046	14,952	996
2005	Reported Actual	12/31/2005	374,642	868,000	2,491	22,657	6,883
2006	SNL Standarized Estimate	12/31/2006	269,333	915,717	3,902	20,620	7,070
2007	Reported Actual	12/31/2007	NA	NA	5,330	NA	NA
2008	Reported Actual	12/31/2008	NA	1,832,550	5,456	20,466	11,560
2009	Reported Actual	12/31/2009	790,743	NA	NA	NA	NA
2010	Reported Actual	12/31/2010	837,839	NA	NA	NA	NA
2011	Reported Actual	12/31/2011	816,289	1,230,000	3,348	9,946	8,723
2012	Reported Actual	12/31/2012	872,869	2,143,971	4,110	22,628	15,966
2013	Reported Actual	12/31/2013	837,496	1,866,769	2,955	23,050	16,808
2014	Reported Actual	12/31/2014	890,910	2,121,565	3,491	24,610	21,189
2015	Reported Actual	12/31/2015	829,805	1,791,056	2,525	19,086	17,885
2016	Reported Actual	12/31/2016	897,169	1,841,000	2,849	24,859	16,529

Source: SNL, 2017

Production figures are based on reported actuals as documented by SNL. These are generally taken from public documentation provided by the company.

7 Geological setting and Mineralization

Sections 7.1, 7.2 and 7.3 of this Report have been excerpted from previous NI 43-101 Technical Report on the Yauricocha Mine, prepared by SRK (Consulting U.S., Inc), dated July 31, 2017 and Gustavson Associates, dated May 11, 2015 and are shown in italics. Standardizations have been made to suit the format of this report; any changes to the text have been indicated by the use of [brackets].

7.1 Regional Geology

Most of the stratigraphy, structure, magmatism, volcanism and mineralization in Peru are spatially and genetically-related to the tectonic evolution of the Andean Cordillera that is situated along a major convergent subduction zone where a segment of the oceanic crust, the Nazca Plate, slips beneath the overriding South American continental plate. The Andean Cordillera has a metamorphic rock basement of Proterozoic age on which Hercynian Paleozoic sedimentary rocks accumulated and were, in turn, deformed by plutonism and volcanism to Upper Paleozoic time. Beginning in the Late Triassic time, following Atlantic Ocean rifting, two periods of subduction along the western margins of South America resulted in the formation of the present Andes: the Mariana-type subduction from the Late Triassic to Late Cretaceous and Andean-style subduction from the Late Cretaceous to the present. Late Triassic to late Cretaceous Mariana-type subduction resulted in an environment of extension and crustal attenuation producing an oceanic trench, island arcs, and back arc basin from west to east. The back arc basin reportedly has two basinal components, the Western Basin and Eastern Basin, which are separated by the Cusco – Puno high, probably part of the Maranon Arch. The basins are largely comprised of marine clastic and minor carbonate lithologies of the Yura and Mara Groups overlain by carbonates of the Ferrobamba Formation. The western back-arc basin, called the 'Arequipa Basin', is the present Western Andean Cordillera of Peru; the site of a Holocene magmatic belt that spans the Andes and was emplaced from Late Oligocene to 25 Ma.

The Western Andean Cordillera is recognized for its world class base- and precious-metal deposits, many of which have been intermittently mined since Incan time. Most of the metal deposits in Peru are spatially and genetically associated with metal-rich hydrothermal fluids generated along magmatic belts that were emplaced along convergent plate tectonic lineaments. Furthermore, many of these primary base-metal deposits have undergone significant supergene enrichment due to uplift and weathering over the last 30 Ma.

Radiometric studies have correlated the igneous host rocks and attendant hydrothermal alteration for some of the largest and richest porphyry copper deposits in the world along the Western Andean Cordillera from 6° to 32° south, including the Chalcobamba – Tintaya iron-gold-copper skarn and porphyry belt (30 to 35 Ma) in the main magmatic arc, southward through the Santa Lucia district (25 to 30 Ma) and into Chile. The Andahuaylas-Yauri Porphyry Copper Belt, a well-known 300 km long porphyry copper belt related to middle Eocene to early Oligocene calc-alkaline plutonism, is situated along the north-eastern edge of the Western Andean Cordillera.

7.2 Local Geology

The local geology of the Yauricocha mine has been well understood by SMCSA personnel for a number of years, and is summarized as follows. Figure 7-1 and Figure 7-2 show the local surface geology of the Yauricocha area.

Goyllarisquizga Formation

The oldest rocks exposed in the area are the lower Cretaceous Goyllarisquizga arenites. This formation is approximately 300 m thick and comprises thick gray and white arenites, locally banded with carbonaceous lutites as well as small mantos of low-quality coal beds and clay. In the vicinity of Chaucha, these arenites have near their base interbedded, red lutite. The arenites crop out in the cores of the anticlines southwest of Yauricocha, as beds dispersed along the Chacras uplift, and isolated outcrops in the Éxito zone.

Jumasha Formation

The mid-Cretaceous Jumasha Formation consists of massive gray limestone, averages 700 m thick, and concordantly overlies the Goyllarisquizga Formation. Intercalations of carbonaceous lutites occur at its base near the contact with the arenites. These layers are succeeded by discontinuous lenses of maroon and grey limestone, occasionally with horizons of lutite and chert about 6 m thick. Also present are pseudo-breccias of probable sedimentary origin and a basaltic sill.

Celendín Formation

The Celendín Formation concordantly overlies the Jumasha Formation and contains finely stratified silicic lutites with intercalations of recrystallized limestone of Santoniana age as well as the France Chert. The average thickness in the Yauricocha area is 400 m.

Casapalca Red Beds

The Casapalca red beds lay concordantly on the Celendín Formation with a gradational contact. It has been assigned an age between upper Cretaceous and lower Tertiary, but because of the absence of fossils its age cannot be precisely determined. It is composed primarily of calcareous red lutites, pure limestones, and reddish arenaceous limestone. Lava flows and tuffaceous beds have been occasionally reported.

Intrusions

Major intrusive activity occurred during the Miocene period. Radiometric K-Ar ages derived from biotite samples taken in the Yauricocha and Éxito areas yield an average age of 6.9 Ma. The intrusives cut the sediments at a steep angle and exhibit sharp contacts, as well as a tendency to follow the regional strike and dip of the structure. The intrusions vary in size from bodies of several hundred square metres to large masses that cover several square kilometers. Small intrusive compositions vary from granodiorite to quartz monzonite at margins and are typically porphyritic with phenocrysts of plagioclase, orthoclase, biotite, hornblende and quartz. The plagioclases vary from orthoclase to andesine.

Metamorphism

All of the intrusions have produced metamorphic aureoles in the surrounding rocks. The extent, type, and grade of metamorphism vary greatly with the type of rock intruded. The rocks have been altered to quartzites, hornfelsed lutites, and recrystallized limestones. Locally, the intrusions have produced narrow zones of skarn of variable width. These skarn zones contain epidote, zoisite, tremolite, wollastonite, phlogopite, garnet, chlorite and diopside.

Structure

The Andean Cordillera uplift has dominated the structural evolution of the Yauricocha area through episodes of folding, fracturing, and brecciation associated with the local structure having a general NW-SE strike principally expressed as follows:

Folds

Various folds make up the principal structures of the Yauricocha area. The Purísima Concepcíon anticline and the France Chert syncline occur in the Mina Central area, while the Cachi-Cachi anticline and Huamanrripa al Norte syncline and the Quimpara syncline occur immediately to the south of Lake Pumacocha, north of Mina San Valentíne.

The Purísima Concepcíon anticline, located southwest of the Yauricocha Mine in the Mina Central area, is well defined by a tightly folded basaltic sill 17 m thick. The axial trace trends approximately N50W with a gentle SE plunge of 20°. In the axis of this anticline and towards Flanco East, the basaltic sill contains occurrences of disseminated gold in horizontal, silicic breccias.

The France Chert syncline is a tight fold, also in the Mina Central area, but located northeast of the mine. Its axial trace changes trend from N35W in the south to N65W in the north and has a SE40 plunge. The Yauricocha mineral deposit is found in the west flank of this fold and in banded limestones without subsidiary folding.

In the Mina Central area, the NW strike of the folded sediments was rotated about 30° clockwise horizontally. This distortion can be attributed to a basement shear fault that strikes NE-SW. The axial trace of the Cachi-Cachi-Prometida anticline strikes approximately N80W to N70W and its flanks dip to the north (Prometida) and south (Cachi-Cachi) with a plunge to the east. Mineralization in the vicinity of the major North Intrusive located 2 km north of Mina Central is associated with this fold.

The Quimpara syncline, located 1 km south of the discharge stream of Pumacocha Lake, has an axial trace that strikes N45W. Its east flank is in contact with the intrusive at an angle dipping 70° to 75°W. Its west flank dips about 80°E conformably with beds of dark gray limestone that are recrystallized in the vicinity of the contact. Garnets, magnetite and copper oxides occur in the same contact.

Fractures

Diverse systems of fractures were developed during episodes of strong deformation.

Folding occurred before and/or contemporaneous with intrusive emplacement. Primary fractures developed during folding along with longitudinal faults parallel to the regional strike of the stratigraphy. These faults combined to form the Yauricocha Fault along the Jumasha limestone- Celendín lutite contact. The Yauricocha Fault extends a great distance from the SE of the Ipillo mine continuing to the north behind Huamanrripa hill, parallel to and along Silacocha Lake.

After the intrusions were emplaced, the strike of the folds NW of the mine was rotated by strong horizontal forces some 30°. As a result of this rotation, three sets of shears and joints were developed: NW-SE, NE-SW and E-W with dips of 50-80° NE or SW first, then 60-85° SE or NW, and finally N or S with nearly vertical dips. This set of fractures forms fault blocks that cut the dominant lithologies of the area and join with the

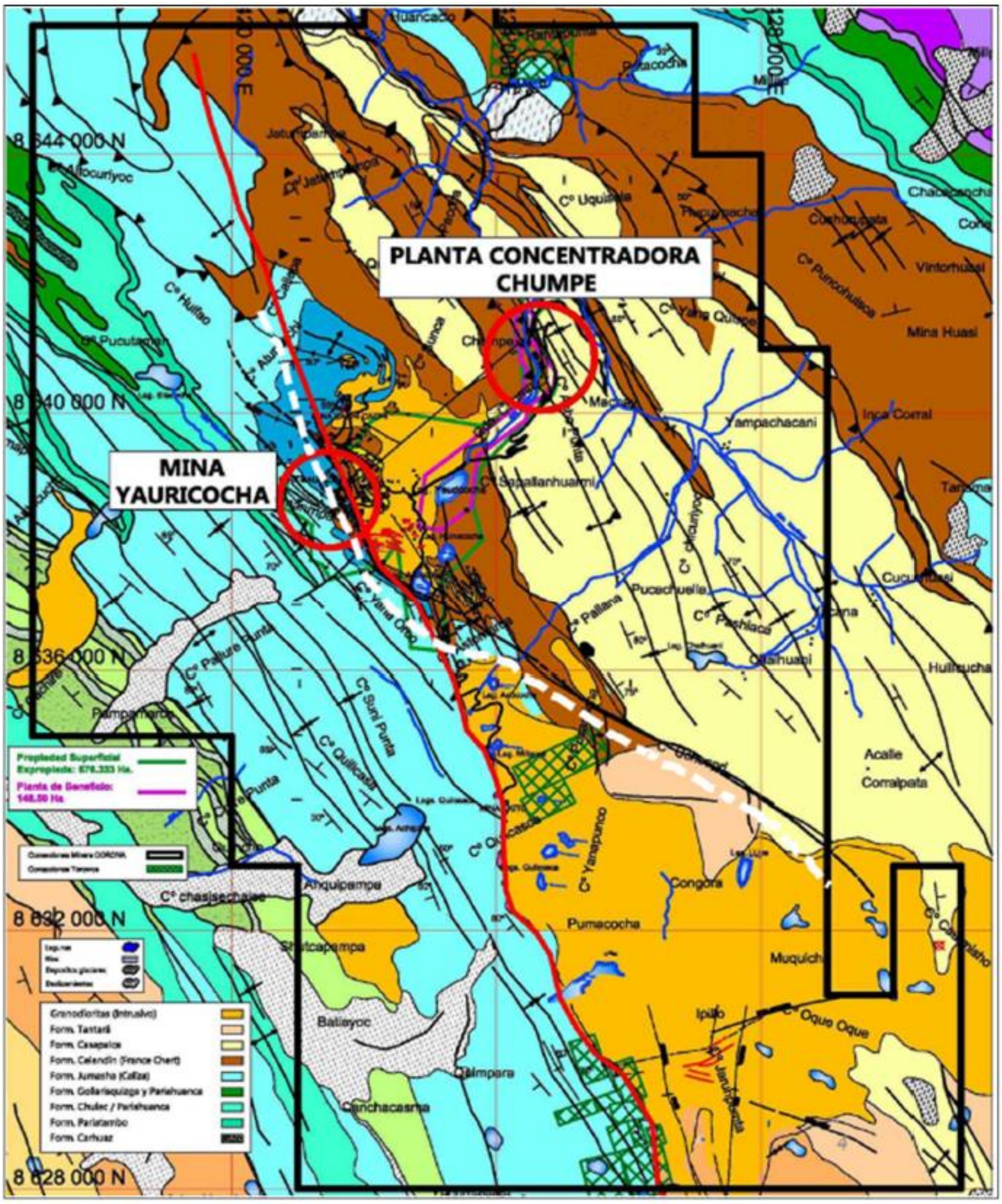
Yauricocha Fault. The Yauricocha Fault is the most significant fault in the mining district and is a strong control on mineralization.

Contacts

The contacts of the Jumasha limestone-Celendín lutite, the Jumasha limestone-intrusions, and Celendín lutite-intrusions had major influence on the development of folds, fractures and ascension of mineralizing fluids.

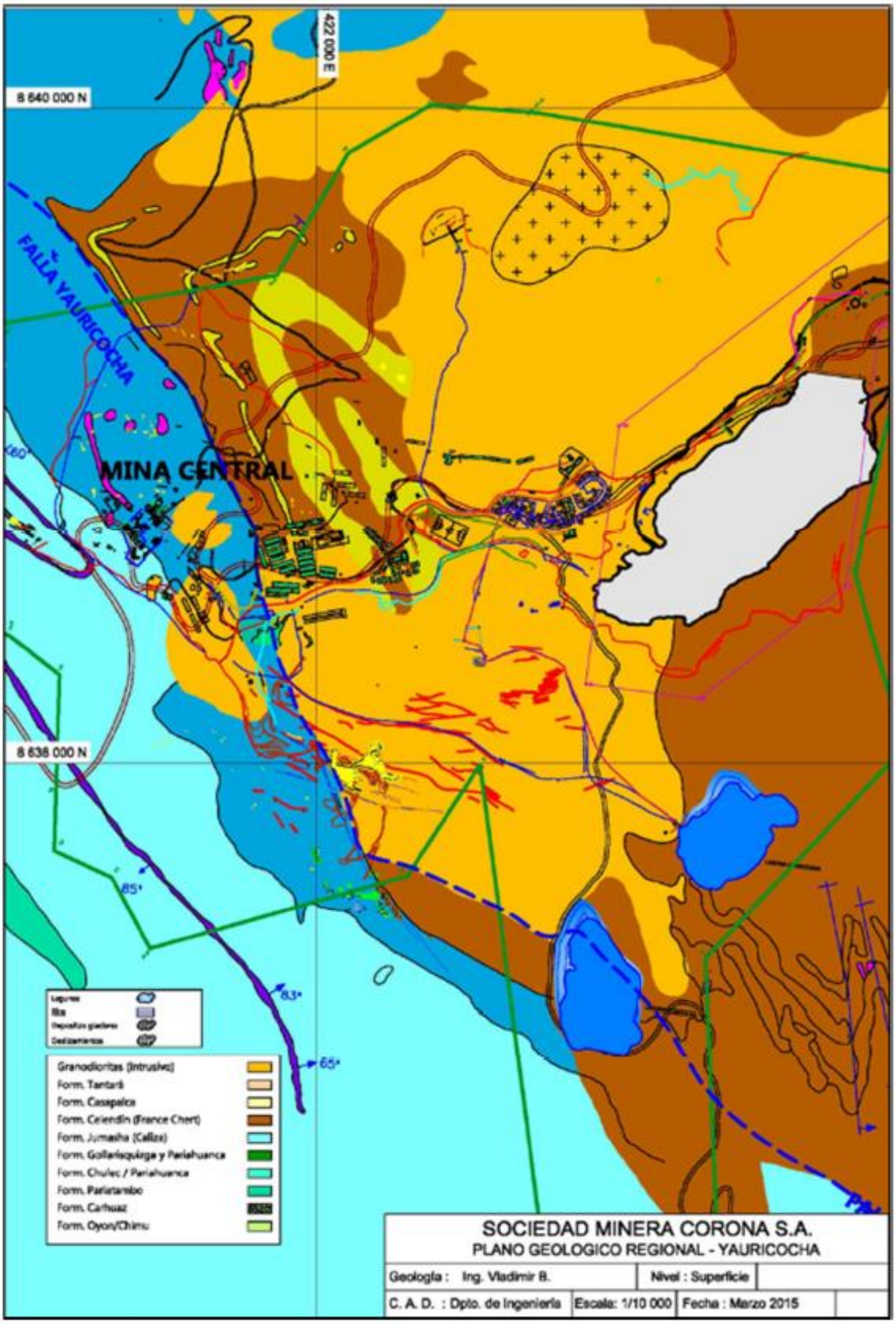
Breccias

The breccias that occur in the Yauricocha area typically follow structural lineaments and occur predominantly in the limestones associated with contacts and intersections of fractures. They form tabular and chimney-like bodies. Tectonic breccias, forming near intrusions or contacts, constitute some of the principal receptive structures for mineralization.



Source: Sierra Metals, 2015

Figure 7-1: Local Geology Map



Source: Sierra Metals, 2015

Figure 7-2: Geological Map of Yauricocha Mine Area

7.3 Significant Mineralized Zones

Mineralization at the Yauricocha Mine is represented by variably oxidized portions of a multiple-phase polymetallic system with at least two stages of mineralization, demonstrated by sulfide veins cutting brecciated polymetallic sulfide mineralized bodies. The mineralized bodies and quartz-sulfide veins appear to be intimately related and form a very important structural/mineralogical assemblage in the Yauricocha mineral deposit. Comments herein made regarding the characteristics of the Yauricocha district apply directly to the Yauricocha Mine.

All parts of the property with historic exploration or current production activity are in the current area of operations. This area is nearly centred within the concession boundary and there is both space and potential to expand the resources and the operation both directions along the strike of the Yauricocha Fault. Minera Corona has developed local classifications describing milling and metallurgical characteristics of mineralization at Yauricocha: polymetallic, oxide, and copper. Polymetallic mineralization is represented by Lead-Zinc sulfides, often with significant Silver values, oxide refers to mineralization that predominantly comprises oxidized sulfides and resulting supergene oxides, hydroxides and/or carbonates (often with anomalous Gold), and the copper classification is represented by high values of Cu with little attendant Lead-Zinc.

8 Deposit types

Section 8.1 of this Report has been excerpted from previous NI 43-101 Technical Report on the Yauricocha Mine, prepared by SRK (Consulting U.S., Inc), dated July 31, 2017 and Gustavson Associates, dated May 11, 2015 and is shown in italics. Standardizations have been made to suit the format of this report; any changes to the text have been indicated by the use of [brackets].

8.1 Mineral Deposit

Mineralization in the Yauricocha district is spatially and genetically related to the Yauricocha stock, a composite intrusive body of granodioritic to quartz monzonitic composition that has been radiometrically dated at late Miocene (approximately 7.5 million years old) (Giletti and Day, 1968). The stock intrudes tightly folded beds of the late Cretaceous Jumasha and Celendín Formations and the overlying Casapalca Formation (latest Cretaceous and Paleocene?). Mineralized bodies are dominantly high-temperature polymetallic sulfide bodies that replaced limestone. Metal-bearing solutions of the Yauricocha magmatic-hydrothermal system were highly reactive and intensely attacked the carbonate wall rock of the Jumasha and Celendín Formations, producing the channels in which sulfides were deposited. Base and precious metals were largely precipitated within several hundred metres of the stock (Lacy, 1949; Thompson, 1960). Skarn is developed adjacent to the stock but does not host appreciable amounts of economic mineralization (Alverez and Noble, 1988). Mineralization typically exhibits both vertical and radial zoning and there is a pronounced district zoning, with an inner core of enargite (the principal copper mineral) giving way outward to an enargite-chalcopyrite-bornite zone, which in turn is succeeded to the west by zones characterized by sphalerite, galena and silver (Lacy, 1949; Thompson, 1960).

The mineralized zones at Yauricocha are partially to completely oxidized and extend from the surface to below level 1220. Supergene enrichment is closely related to oxidation distribution. Supergene covellite, chalcocite and digenite are found where the sulfide minerals are in contact with oxidized areas.

Mineralization at Yauricocha very closely resembles that typified by polymetallic Ag-Au deposits, which comprise quartz-sulfide-carbonate fissure vein equivalents of quartz-sulfide and carbonate-base metal deposits. These deposits are best developed in Central and South America, where they have been mined since Inca times as important Ag sources. Quartz and pyrite of the quartz-sulfide Au +/- Cu mineralization suite typically occur early in the paragenetic sequence; carbonate-hosted mineralization and some polymetallic Ag-Au veins evolved at a later stage. Predominant controls on mineralization are structural, where dilatational structures, voids resulting from wall rock dissolution, and/or rheologic dissimilarities at contacts between units serve as enhanced fluid pathways for mineralizing solutions.

8.2 Geological Model

The geological model used for the Yauricocha deposit has been developed and verified through extensive exploration and mining activities during more than 50 years of mining. SRK is of the opinion that the geological model is appropriate and will continue to serve the company going forward.

9 Exploration

Section 9 of this Report has been excerpted from previous NI 43-101 Technical Report on the Yauricocha Mine, prepared by SRK (Consulting U.S., Inc), dated July 31, 2017 and Gustavson Associates, dated May 11, 2015 and is shown in italics. Standardizations have been made to suit the format of this report; any changes to the text have been indicated by the use of [brackets].

The Yauricocha mining district contains multiple polymetallic deposits represented by skarn and replacement bodies and intrusion-hosted veins related to Miocene-era magmatism. Mineralization is strongly structurally-controlled with the dominant features being the Yauricocha Fault and the contact between the Jumasha limestones and the Celendín Formation (especially the France Chert). Exploration is being conducted to expand the mineralized zones currently being exploited as well as on prospects in the vicinity of the operations.

Exploration in or close to the mining operations is of higher priority since it is performed under existing governmental and community permits. Any exploration success can be quickly incorporated into defined resources and reserves and thus the business plan.

Further and more detailed descriptions of these exploration targets and the results obtained from exploration efforts are described in the 2015 Gustavson technical report.

9.1 Relevant Exploration Work

Exploration in the district has been ongoing and generative methods have been successful in delineating a number of targets (described above) for future drilling or exploration development. This work has included detailed geological mapping of the areas, surface rock chip sampling, and limited trench/channel sampling.

The most recent near-mine exploration work has been focused on drilling of the newly-discovered Esperanza mineralized zone. This zone was discovered through drilling on suspected extensions of the Mascota and Cuye mineralized zones, but has evolved into its own discrete area.

9.2 Sampling Methods and Sample Quality

Sampling of exploration targets generally features rock chip or hand samples taken by geologists from surface outcrops using rock hammers and chisels. These samples are point samples and should be considered indicative of mineralization rather than representative of any volume or tonnage.

In cases where channel or trench samples are collected, these are done so using pickaxes, shovels, chisels, hammers, and other hand tools, and are likely more representative of the mineralization as they are taken across the strike of mineralization observed at surface.

Regardless, the results of exploration related-sampling in this context are used as guides for future drilling programs, rather than resource estimation.

9.3 Significant Results and Interpretation

Significant results from the exploration efforts have defined a series of areas that may be prospective for future drilling or sampling, including the following: Yauricocha Sur, *San Juan & San Antonio, Exito NE, Kilkaska, Ipillo, Falla Yauricocha, Cerros Uchcapri, Leonpitacana, and Carhuanisho, Yauricocha Este, Yauricocha Oeste, and Tintircullpa Yauricocha. Priority is given to near-mine opportunities, such as the intersection of the Cachi-Cachi structural trend and the Yauricocha fault, which continues to yield mineralized orebodies such as the newly-discovered Esperanza area.*

10 Drilling

Section 10 of this Report has been excerpted from previous NI 43-101 Technical Report on the Yauricocha Mine, prepared by SRK (Consulting U.S., Inc), dated July 31, 2017 and Gustavson Associates, dated May 11, 2015 and is shown in italics Standardizations have been made to suit the format of this report; any changes to the text have been indicated by the use of [brackets].

10.1 Type and Extent

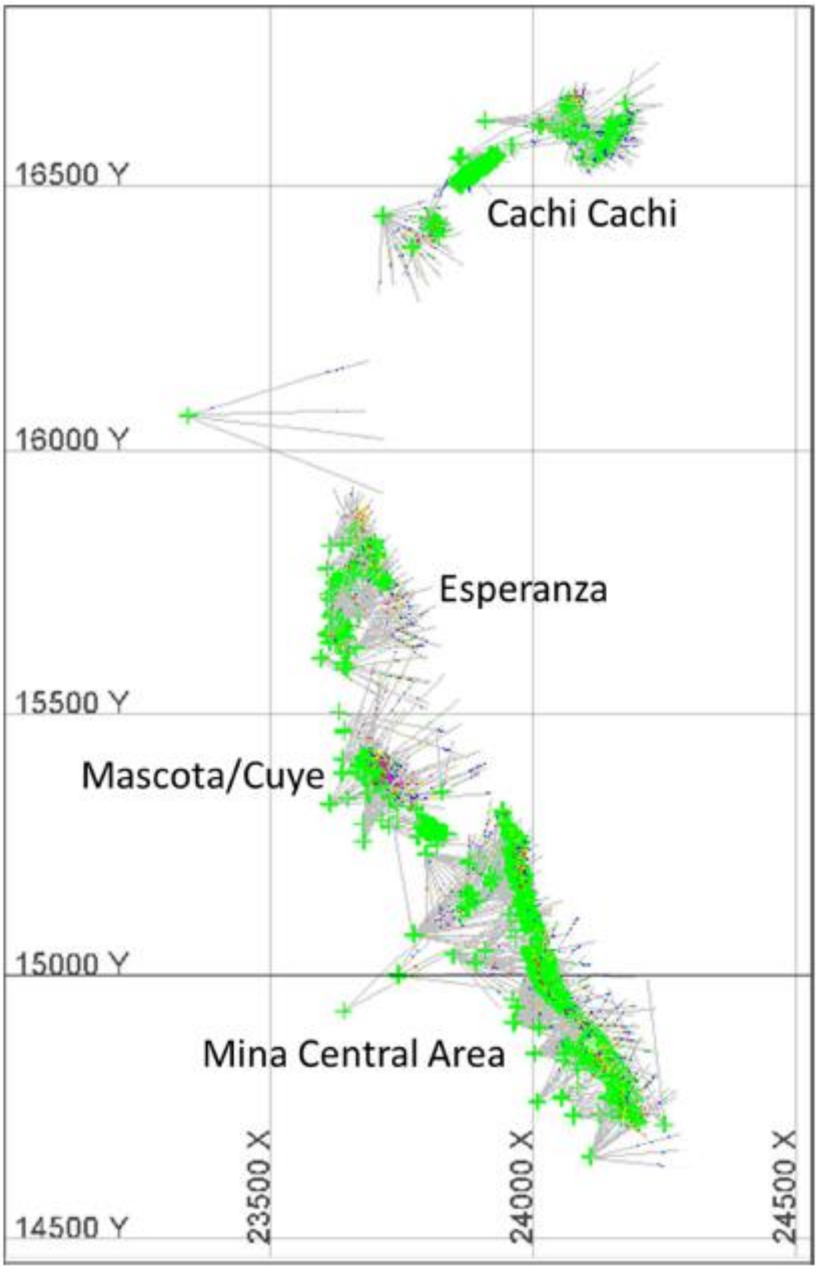
SMCSA's Geology Department owns and operates three small hydraulic drills, the reach of which varies between 80 m and 150 m with a core diameter of 3.5 cm. A fourth air drill has a reach of 60 m and the core diameter is 2.25 cm. Additionally, the department owns two jackleg drills fitted with an extension bar reaching up to 25 m. These machines are utilized to delineate mineralization at closely-spaced intervals for grade control, but are generally not included for resource estimation purposes. The company also utilizes or has previously utilized the services of drilling contractors (MDH, SMCSA, REDRILSA) for deeper drillholes reaching up to 900 m in length. Core diameters are generally HQ and NQ, although selected infill drilling within the mine is drilled using a TT-46 (46mm) diameter. Exploration (establishing continuity of mineralization) and development (reserve and production definition) drilling conducted by Corona from 2002 to 2017 is detailed in Table 10-1.

Table 10-1: Yauricocha Exploration and Development Drilling

Year	Exploration and Development (m)	Diamond Drilling by Company (m)	Diamond Drilling by Contractor (m)
2002	3,886	1,887	
2003	4,955	3,415	
2004	4,023	2,970	
2005	4,034	3,160	8,043
2006	2,786	2,999	10,195
2007	2,466	4,751	6,196
2008	2,380	5,379	13,445
2009	1,912	4,955	13,579
2010	1,086	4,615	3,527
2011	1,611	5,195	9,071
2012	1,530	11,532	31,257
2013	2,569	10,653	16,781
2014	1,011	9,357	30,455
2015	342	9,735	25,758
2016	6,260	9,145	39,981
2017(1)	4,036	4,049	28,236

(1) Information updated as of July 31, 2017
Source: Sierra Metals, 2017

In addition to the drilling at Yauricocha, extensive channel sampling of the mineralized bodies is completed for grade control and development purposes. Channel sampling is conducted on perpendicular lines crossing the various mineralized bodies. Spacing between samples is variable but generally is 2 to 4 m. Material is collected on tarps across the channel sampling intervals and transferred to bags marked with the relevant interval. These data points are utilized in Mineral Resource estimation as well. The general distribution of drilling and channel samples is shown in Figure 10-1.



Source: SRK, 2017

Figure 10-1: Extent of Drilling and Sampling

10.2 Procedures

10.2.1 Drilling

Modern drill collar locations are surveyed underground by the mine survey team by total station. Where these types of surveys have been completed, collar locations are assumed to be accurate to less than 0.1 m. Historic drilling was not surveyed to the same level of detail, potentially decreasing the accuracy of the collar positions in space compared to modern holes. This effect would potentially decrease the accuracy of the geological model and resource estimation in these areas, but SRK notes that the majority of areas supported by this historic drilling has already been mined.

While drill holes are currently surveyed down-hole for all new exploration drilling, this has not always been the case. Historic drill holes as well as selected more recent holes *that were not deemed to be long enough or otherwise designated non-critical for surveying were not surveyed down hole and the collar azimuth and dip serve as the only point of reference for the hole. SRK notes that all new holes now have down-hole surveys, and that most of these are in areas which are incorporated in the current update to the Mineral Resource estimation. While the nominal spacing of the survey has been 50 m, a number of the newer holes have been surveyed every 5 m to discern any potential risk of deviation affecting the accuracy of the interpretation.*

A study of the deviation for the holes which have currently been surveyed showed that the average deviations (of more than 3,500 measurements) down-hole are only -0.06° bearing and 0.09° inclination. This would indicate that the lack of down-hole survey information is not necessarily a risk at Yauricocha, although SRK recommends continuing the practice of surveys and nominal intervals of 25 to 50 m to ensure quality of information.

SRK visited the core logging and sampling facilities at the mine site in early 2015 as well as mid-2017, and notes that the logging facility is clean and sufficiently equipped. Logging is conducted on paper and transferred to Excel® worksheets. Details recorded include geotechnical information such as recovery and RQD, geologic information (lithology, alteration, mineralization, etc.), sampling information, as well as other parameters, which may not get incorporated in to the digital database. Samples are selected by the geologist and placed in numbered plastic bags, along with a bar-coded sample ticket for tracking. Bags are tied tightly to prevent contamination during handling and transport.

Drill recovery is generally over 97%, and there appears to be no relationship between grade distribution and recovery.

Drill holes are split by hydraulic or manual methods where core is broken or poorly indurated, and is sawn by rotary diamond saw blade where the core is competent. In both scenarios, care is taken to ensure that the sample is collected in a consistent and representative manner. SRK notes that sampling is only conducted in segments of core that are noted as having obvious mineralization during logging. This results in a number of occurrences where the first sample in a drill hole may be a very high grade one, or that there may be multiple high-grade samples with un-sampled intervals in between. These intervals have been considered as un-mineralized based on the assumptions made for the sampling or lack thereof and are flagged with a lowest-limit-of-detection value.

10.2.2 Channel Sampling

Channel samples are collected underground by geology staff. Samples are collected via hammer and chisel, with rock chips collected on a tarp for each sample, and transferred to sample bags. Typical sample intervals are 1 m along the ribs of crosscuts within stopes for the large mineralized zones or 2 m across the back of the stopes for the small mineralized zones. Ideal weights are between 2.5 and 3 kg. The samples are placed in a plastic bag labelled with a permanent marker on the outside. A sample ticket displaying the number and bar code is inserted in the bag. The bags are tied to prevent outside contamination during their handling and transportation to the assay lab.

SRK notes that samples are not weighed to ensure representativeness, but geologists are involved in the channel sampling efforts to direct samplers to collect samples, which visually are representative of the mineralization.

10.3 Interpretation and Relevant Results

Drilling and sampling results are interpreted by Minera Corona site geologists and reviewed in cross sections and plan/level maps. The relevant results are those featuring significant intervals of geologic or economic interest, which are follow up on by continued drilling or exploration development. SRK notes that other sampling types are described in the documentation at Yauricocha, such as point samples, muck samples, and others. These are taken for specialized purposes and are not used in the resource estimation.

11 Sample preparation, analyses and security

Section 11 of this Report has been excerpted from previous NI 43-101 Technical Report on the Yauricocha Mine, prepared by SRK (Consulting U.S., Inc), dated July 31, 2017 and Gustavson Associates, dated May 11, 2015 and is shown in italics. Standardizations have been made to suit the format of this report; any changes to the text have been indicated by the use of [brackets].

11.1 Security Measures

Core and channel sample material is stored at the mine site in a secure building, and the boxes are well labelled and organized. The entire mine site is access-controlled. Samples submitted to third-party laboratories are transported by mine staff to the preparation laboratory in Lima.

Channel samples are processed at SMCSA's Chumpe laboratory located in the Concentrator Plant under the supervision of company personnel.

The on-site laboratory currently is not independently certified. Channel sample locations are surveyed in the underground by mine survey staff. Sample start and end point locations are assumed to be accurate to centimetre accuracy.

11.2 Sample Preparation for Analysis

Samples are generally prepared by a primary and secondary laboratory:

- *Primary: Chumpe Laboratory –Yauricocha Mine Site; Non-ISO Certified*
- *Secondary: ALS Minerals – Lima; ISO 9001:2008 Certified*

The Chumpe laboratory prepares the majority of samples, except in cases where checks on the method of preparation are desired and ALS conducts sample prep on duplicate check assays.

11.2.1 Chumpe Laboratory

The majority of historic core samples, and effectively all channel samples have been prepared and analyzed by the Chumpe laboratory. Detailed procedures have been documented by SMCSA and are summarized below.

Sample Reception

Channel samples and selected mine infill drilling are collected in the field by the geology staff and transported by Yauricocha personnel from the Yauricocha Mine or Klepetko Adit and are received at the reception counter at the Chumpe laboratory entrance. A log entry is made to record the number of samples being received. These samples are generally between 1.5 and 3.0 kg; are damp and received in plastic bags.

Preparation

Equipment used in sample preparation includes:

- *1 – Primary Jaw Crusher, Make – Denver, Jaw capacity – 5" x 6", Output – 70%, passing ¼ ";*

- *1 – Secondary Jaw Crusher, Make – FIMA, Jaw capacity – 5" x 6", Output – 80%, passing No. 10 mesh;*
- *1 – Pneumatic Pulverizer, Make – Tmandina;*
- *2 – Sample Dryers, with temperature regulator;*
- *1 – ½" Stainless steel splitter, Make – Jones;*
- *Five compressed air nozzles;*
- *Stainless steel trays, 225 x 135 x 65 mm;*
- *Stainless steel trays, 300 x 240 x 60 mm;*
- *Plastic or impermeable cloth; and*
- *2" brushes.*

Preparation Procedure

- *Prior to beginning sample preparation, workers verify that:*
- *The equipment is clean and free from contamination;*
- *The crushers and pulverizers are functioning correctly; and*
- *The numbering of the sample bags that all bags are unique and identifiable.*
- *The procedure at Chumpe to reduce the sample to a pulp of 150 gm, at 85% passing 200 mesh is:*
- *Transfer the sample to the appropriate tray, depending on the volume of the sample, noting the tray number on the sample ticket;*
- *Insert a blank sample (silica or quartz) in each batch;*
- *Place in the Sample Dryer at a temperature of 115ºC;*
- *Code the sample envelopes with the information from the sampling ticket noting the sample code, the tray number, date and the quantity of samples requested on the sample ticket;*
- *Once dry, remove and place the tray on the work table to cool;*
- *Pass 100% of the sample through the Primary Jaw Crusher when particle sizes exceed 1 inch, the resulting product is 70% passing ¼ inch;*
- *Pass the sample through the secondary crusher, the resulting product 80% passing -10 mesh;*
- *Clean all equipment after crushing of each sample using compressed air;*
- *Weigh the -10 mesh coarse material and record;*
- *Dump the complete sample into the Jones Splitter and split/homogenize to obtain an approximate 150 g split. Clean the splitter after each sample with compressed air;*
- *Put the 150g sample in numbered envelopes in the tray for the corresponding sample sequence;*
- *Pulverize sample using the cleaned ring pulverizer until achieving a size fraction of 85% - 200 mesh. Clean the ring apparatus after each sample with the compressed air hose;*
- *Transfer the pulverized sample to the impermeable sample mat, homogenize and pour into the respective coded envelope; and*
- *Clean all materials and the work area thoroughly.*

11.2.2 ALS Minerals

For core samples, bagged split samples are transported by the internal transport service from the core logging facility. Samples are transported by truck to Lima for submission to the ALS Minerals laboratory in Lima. ALS records samples received and weights for comparison to the Yauricocha geologist's records for sampling.

Samples prepared at ALS Minerals exclusively include the 2016 to present exploration diamond drilling and all exploration diamond drillholes supporting the Esperanza mineralization (including 2015). ALS Minerals was selected as the laboratory for analysis of the Esperanza samples, in particular, to mitigate any potential concerns arising from the use of a site laboratory. SRK has not visited the ALS Minerals lab in Lima, but notes that ALS Minerals-Lima is an ISO-Certified preparation and analysis facilities and adheres to the most stringent standards in the industry.

The PREP-31 method of sample preparation was used for all samples processed through ALS Minerals. This includes jaw crushing to 70% less than 2 mm, with a riffle split of 250 g, then pulverized using ring pulverizers to >85% passing 75 µm. Samples are tracked in barcoded envelopes throughout the process using internal software tracking and control measures. ALS is an industry leader in sample preparation and analysis, and uses equipment that meets or exceeds industry standards.

11.3 Sample Analysis

Samples are generally analyzed by a primary and secondary laboratory:

- *Primary: Chumpe Laboratory –Yauricocha Mine Site; Non-ISO Certified; and*
- *Secondary: ALS Minerals – Lima; ISO 9001:2008 Certified;*
    - *Note: ALS is primary for all diamond exploration drilling samples.*

The Chumpe Laboratory provides all analyses used in the drilling/sampling database supporting the Mineral Resource estimation, whereas the ALS Laboratory is used exclusively as an independent check on the Chumpe laboratory for these samples. ALS is used exclusively for all diamond drilling supporting exploration.

11.3.1 Chumpe Laboratory

Core and channel samples from the mine are assayed utilizing two procedures. Silver, lead, zinc, and copper are assayed by atomic absorption (AA) on an aqua-regia digest. Gold is assayed by fire assay (FA) with an AA finish. Lower limits of detection are shown in

Table 11-1, and are higher than those for ALS Minerals as Chumpe does not run the same multi-element analysis.

Table 11-1: Chumpe LLOD's

Element	LLOD	Unit
Ag	0.2	Ppm
Au	0.01	Ppm
Cu	0.02	%
Pb	0.02	%
Zn	0.02	%

Source: Sierra Metals, 2016

11.3.2 ALS Minerals Laboratory

The core samples analyzed at ALS are analyzed for a suite of 35 elements using inductively coupled plasma atomic emission spectroscopy (ICP-AES) on an aqua-regia digest, generally used to discern trace levels of multiple elements. Samples are also analyzed using an AA method on an aqua-regia digest for accuracy at ore-grade ranges. Au is analyzed using FA (gravimetric finish) with an AA finish.

Lower limits of detection for the critical elements are shown in Table 11-2.

Table 11-2: ALS Minerals LLOD's

Element	LLOD	Unit
Ag	0.2	Ppm
Au	0.01	Ppm
Cu	0.02	%
Pb	0.02	%
Zn	0.02	%

Source: Sierra Metals, 2016

11.4 Quality Assurance/Quality Control Procedures

Prior to 2012, Minera Corona did not utilize the services of an independent lab for data verification. The company used an internal QA/QC procedure at its assay lab (Chumpe) located in the Concentration Plant. Historically, the results have compared well with the metal contained in concentrates and further work on a formal external QA/QC procedure had not been pursued. Beginning in 2012, Minera Corona began to use external check assays as part of the validation system for the Chumpe lab data stream.

The current procedure includes certified standards, blanks, pulp duplicates, and sample preparation size review. These are processed at approximately one per 20 samples. External labs receive approximately one sample for each 15 processed internally. Gustavson did not have the opportunity to fully observe the laboratory operation; however, Gustavson has examined QA/QC records of certified standards for 2011 through 2014.

The results of the historic QA/QC show that the Chumpe laboratory generally performed well with respect to the standard blanks and duplicates submitted from the exploration department, but SRK notes that this has not been the case over the entire project history, with the Chumpe lab consistently missing targets for certain types of QA/QC. This resulted in a limited program of pulverized duplicate samples for every sample interval being submitted to ALS Minerals in Lima as a check on the Chumpe lab, where the results showed a consistent bias. The Chumpe lab appeared to under-report Ag compared to ALS duplicates, although other metals appeared to be relatively consistent. For this reason, the mine abandoned the use of the Chumpe lab for the new exploration drilling, with all samples being sent to ALS Mineral in Lima.

Currently, Minera Corona uses a very aggressive program of QA/QC for new exploration areas to mitigate uncertainty in analytical results. A subsequent and more detailed review of the QA/QC applied to new exploration efforts focused on Esperanza is discussed in Sections 11.4.1 through 11.4.3.

11.4.1 Standards

SMCSA currently inserts standards or certified reference materials (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. Five standards have been generated by SMCSA and certified via round robin analysis for the current exploration programs. These standards have been procured from Yauricocha material, and homogenized and analyzed by Target Rocks Peru S.A., a commercial laboratory 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. The six laboratories participating in the round robin for the Yauricocha CRM are:

- *ALS Minerals, Lima;*
- *Inspectorate, Lima;*
- *Acme, Santiago;*
- *Certimin, Lima;*
- *SGS, Lima; and*
- *LAS, Peru.*

The mean 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 Target Rocks. The certified means and expected tolerances are shown in Table 11-3.

Table 11-3: 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 (%)
MAT-04	29.10	0.70	0.16	0.28	2.10	0.03	0.01	0.01
MAT-05	128.20	2.37	0.58	2.50	7.70	0.06	0.02	0.12
MAT-06	469.00	7.75	2.53	7.98	13.00	0.20	0.12	0.23
MCL-02	40.80	0.65	1.58	2.49	3.40	0.05	0.08	0.09
PLSUL-03	192.00	3.09	1.03	3.15	4.00	0.08	0.04	0.13
PLSUL-04	6.70	0.09	0.24	0.23	0.50	0.01	0.01	0.01
PLSUL-05	13.60	NA	0.49	0.47	1.00	NA	0.03	0.02
PLSUL-06	30.30	1.94	0.21	1.60	2.90	0.04	0.01	0.11
PLSUL-07	79.20	5.94	0.45	4.67	4.50	0.27	0.02	0.20
PLSUL-08	248.00	12.46	0.98	12.54	14.00	0.39	0.04	0.55

Source: Sierra Metals, 2017

SRK notes that the CRM are adequate for QA/QC monitoring, with the exception of Au, which is not certified for any CRM. Given that Au is generally a minor and lower grade component to the Mineral Resources at Yauricocha, SRK regards this as a minor risk, and notes that ALS Minerals conducts its own internal QA/QC checking Au performance as a backstop to their analyses. In total, Corona has submitted 177 CRM to ALS Minerals in 2015-2017 for new drilling with an average insertion rate of about 5%. An additional 46 CRM were submitted to the Chumpe lab during the same period for the same number of samples, at a rate of about 3%. These two sets of CRM were reviewed independently by SRK.

Performance: ALS Minerals

SRK generally uses a nominal +/-3 SD criteria for evaluating failures of the CRM. The SD used is the between lab SD, as provided in the certificates from Target Rocks. SRK notes that failure rates for the CRM as provided are very high for an operating mine. SRK notes that many failures are occurring within a certain CRM, and that this likely represents an issue with the CRM itself rather than the laboratory. SRK has previously also observed sample switching between standards, and that his has historically been an issue. SRK strongly recommends a study to determine the source of these failures in the QAQC and address the problem during the sampling and QAQC insertion phase or at the laboratory. The tabulated results of this QA/QC are shown in Table 11-4.

Table 11-4: CRM Performance Summary – ALS Minerals

STD	Total	Low 3SD	High 3SD	Failure % Low	Failure % High
Ag					
MAT-04	18	1	0	5.56%	0.00%
MAT-05	7	0	0	0.00%	0.00%
MAT-06	9	6	0	66.67%	0.00%
MCL-02	15	0	0	0.00%	0.00%
PLSUL-03	22	10	0	45.45%	0.00%
PLSUL-04	17	0	1	0.00%	5.88%
PLSUL-05	6	0	0	0.00%	0.00%
PLSUL-06	39	0	0	0.00%	0.00%
PLSUL-07	38	0	3	0.00%	7.89%
PLSUL-08	6	0	0	0.00%	0.00%
All AG	177	17	4	9.60%	2.26%
Pb					
MAT-04	18	1	1	5.56%	5.56%
MAT-05	7	3	0	42.86%	0.00%
MAT-06	9	2	1	22.22%	11.11%
MCL-02	15	0	0	0.00%	0.00%
PLSUL-03	22	9	0	40.91%	0.00%
PLSUL-04	17	0	0	0.00%	0.00%
PLSUL-06	39	3	2	7.69%	5.13%
PLSUL-07	38	5	0	13.16%	0.00%
PLSUL-08	6	0	1	0.00%	16.67%
All Pb	171	23	5	13.45%	2.92%
Cu					
MAT-04	18	0	1	0.00%	5.56%
MAT-05	7	0	1	0.00%	14.29%
MAT-06	9	0	0	0.00%	0.00%
MCL-02	15	0	0	0.00%	0.00%
PLSUL-03	22	1	0	4.55%	0.00%
PLSUL-04	17	0	1	0.00%	5.88%
PLSUL-05	6	0	0	0.00%	0.00%
PLSUL-06	39	0	2	0.00%	5.13%
PLSUL-07	38	0	14	0.00%	36.84%
PLSUL-08	6	0	0	0.00%	0.00%
All Cu	177	1	19	0.56%	10.73%
Zn					
MAT-04	18	0	7	0.00%	38.89%
MAT-05	7	0	0	0.00%	0.00%
MAT-06	9	2	0	22.22%	0.00%
MCL-02	15	0	4	0.00%	26.67%
PLSUL-03	22	0	0	0.00%	0.00%
PLSUL-04	17	0	12	0.00%	70.59%
PLSUL-05	6	0	1	0.00%	16.67%
PLSUL-06	39	0	0	0.00%	0.00%
PLSUL-07	38	0	3	0.00%	7.89%
PLSUL-08	6	0	0	0.00%	0.00%
All Zn	177	2	27	1.13%	15.25%

Performance: Chumpe Laboratory

The incidence of failure for the CRM submitted to the Chumpe laboratory in 2015-2016 is also very high, with failure rates of 40.3% low and 4.5% high for all CRM and all metals. The performance of these CRM at the Chumpe Laboratory is summarized in Table 11-5. Most notable is the consistent and significant under-reporting of Ag and over-reporting of Zn analyses compared to the expected mean for multiple CRM, across *multiple grade ranges. SRK notes that the performance between laboratories will be discussed further in Section 11.4.3.*

Table 11-5: CRM Performance Summary – Chumpe Laboratory

STD	Total	Low 3SD	High 3SD	Failure % Low	Failure % High
Ag					
MAT-04	16	6	0	37.50%	0.00%
MAT-05	11	0	0	0.00%	0.00%
MAT-06	17	17	0	100.00%	0.00%
MCL-02	14	0	0	0.00%	0.00%
PLSUL-03	33	33	0	100.00%	0.00%
PLSUL-04	24	24	0	100.00%	5.88%
PLSUL-05	19	0	15	0.00%	78.95%
PLSUL-06	84	6	4	7.14%	4.76%
PLSUL-07	81	19	2	23.46%	2.47%
PLSUL-08	23	0	1	0.00%	4.35%
All AG	322	105	22	32.61%	6.83%
Pb					
MAT-04	16	0	1	0.005	6.25%
MAT-05	11	2	0	18.18%	0.00%
MAT-06	17	0	2	0.00%	11.76%
MCL-02	14	0	0	0.00%	0.00%
PLSUL-03	33	2	0	6.06%	0.00%
PLSUL-04	24	0	9	0.00%	37.50%
PLSUL-06	84	3	10	3.57%	11.90%
PLSUL-07	81	0	3	0.00%	3.70%
PLSUL-08	23	0	6	0.00%	26.09%
All Pb	303	7	31	2.31%	10.23%
Cu					
MAT-04	16	6	0	37.5%	0.00%
MAT-05	11	7	0	63.64%	0.00%
MAT-06	17	0	0	0.00%	0.00%
MCL-02	14	1	0	7.14%	0.00%
PLSUL-03	33	32	0	96.97%	0.00%
PLSUL-04	24	9	0	37.50%	0.00%
PLSUL-05	19	0	0	0.00%	0.00%
PLSUL-06	84	1	5	1.19%	5.95%
PLSUL-07	81	1	17	1.23%	20.99%
PLSUL-08	23	0	0	0.00%	0.00%
All Cu	322	57	22	17.70%	6.83%
Zn					
MAT-04	16	5	0	31.25%	0.00%
MAT-05	11	0	4	0.00%	36.36%
MAT-06	17	0	0	0.00%	0.00%
MCL-02	14	1	7	7.14%	50.00%
PLSUL-03	33	0	0	0.00%	0.00%
PLSUL-04	24	3	3	12.50%	12.50%
PLSUL-05	19	5	1	26.32%	5.26%
PLSUL-06	84	1	12	1.19%	14.29%
PLSUL-07	81	2	53	2.47%	65.43%
PLSUL-08	23	0	13	0.00%	56.52%
All Zn	322	17	93	5.28%	28.88%

11.4.2 Blanks

SMCSA currently inserts unmineralized quartz sand blanks into the sample stream at a rate of 1:20 samples or adjusted as necessary to ensure smearing of grade is not occurring immediately after higher grade intervals. Blanks are generally about 0.5 kg of silica sand, bagged and submitted in the sample stream along with the normal core samples. The results of the blank analysis (Table 11-6) show that, using a failure criteria of 5X the LLOD, that there are systemic failures for the ALS samples and considerably less for the Chumpe samples. This is owed primarily to the very low limit of detection for the ALS samples compared to the Chumpe samples, such that a 5X LLOD failure criteria is elevated in the Chumpe samples compared to the ALS samples. LLOD's for the two laboratories are presented in Table 11-7.

Table 11-6: Blank Failures

Lab	Count	Failures				
		Ag	Pb	Cu	Zn	Au
ALS	100	7	19	14	27	0
Chumpe	264	5	1	5	15	4

Source: Sierra Metal, 2017

Failures assessed on a 5X LLOD basis

Table 11-7: Lower Limits of Detection for Yauricocha Laboratories

Element	LLOD	Unit
ALS		
Ag	0.2	Ppm
Au	0.005	Ppm
Cu	0.001	%
Pb	0.001	%
Zn	0.001	%
Chumpe		
Ag	3.11	Ppm
Au	0.03	Ppm
Cu	0.01	%
Pb	0.01	%
Zn	0.01	%

11.4.3 Duplicates (Check Samples)

SRK was not provided with duplicate sample data for the 2017 drilling.

True duplicate samples such as the other half of split core or a crushed/pulverized sample resubmitted to the same laboratory are common practice for normal QA/QC programs, but become less critical once development and mining continues. These samples are designed to check the primary assay laboratory's ability to repeat sample values or check the nugget effect of the deposit very early on, but the inherent variability of the deposit is typically known and a part of the ongoing mining at the production stage.

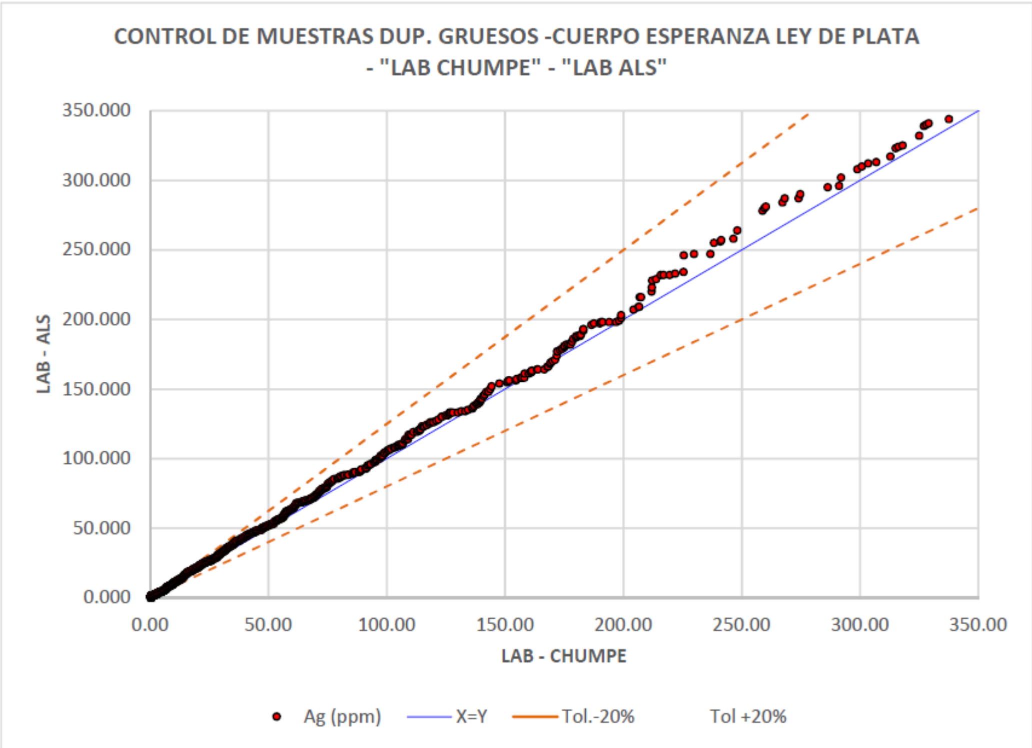
While SMCSA does not submit true duplicate samples for these intra-lab repeatability checks, they do submit approximately 1:20 check samples between labs for the same intervals. SMCSA uses three types of check samples in the QA/QC program. These include twin (core) duplicates, coarse duplicates (crushed), and pulp duplicates *(pulverized) to assess repeatability at the different phases of preparation between the site lab and third party ALS lab.*

Consistent bias is observed (Figure 11-1 and Figure 11-2) for certain elements (Ag and Zn) between the ALS and Chumpe labs, with Chumpe generally under-reporting compared to ALS, particularly at higher grades. The Cu and Pb values are consistent between labs, although the consistency does break down at higher grades. SRK is of the opinion that, for samples around the average deposit grade, the consistency between labs is reasonable, and given that the Chumpe lab is the lab used to populate the database supporting the Mineral Resource estimation, that the risk associated with analytical reporting errors is likely that the grades are being conservatively reported at the higher limits. The means for the different check assay groups are summarized in Table 11-8.

Table 11-8: Check Duplicate Statistics

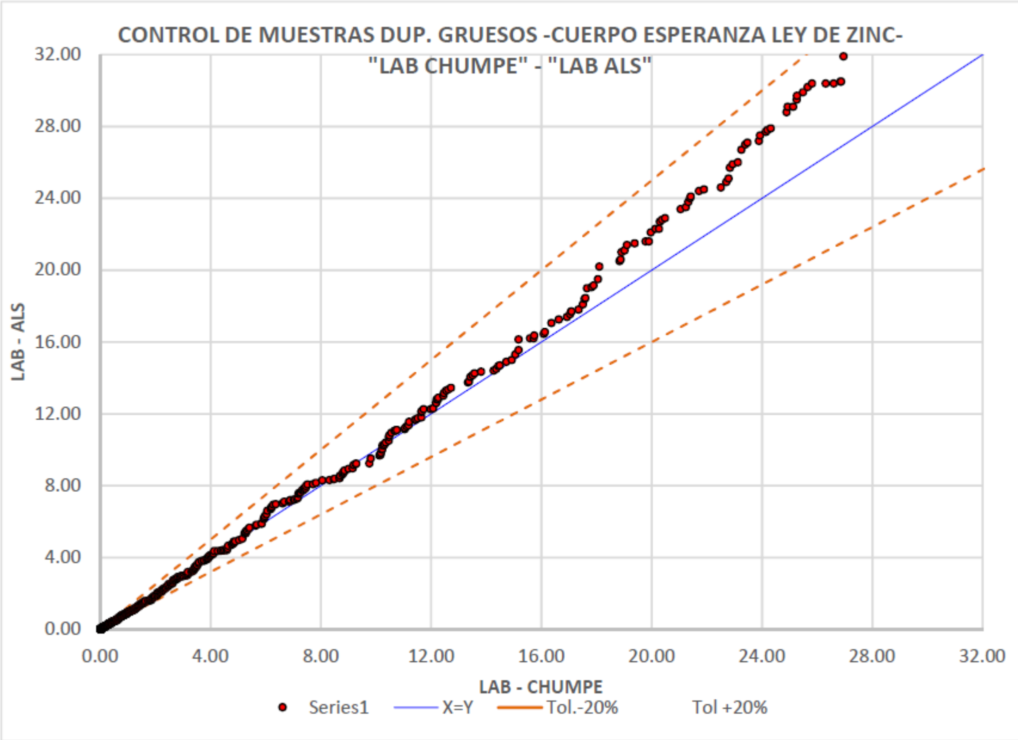
Samples		Ag (g/t)		Pb (%)		Cu (%)		Zn (%)		Au (g/t)	
Type	Count	Chumpe	ALS	Chumpe	ALS	Chumpe	ALS	Chumpe	ALS	Chumpe	ALS
Coarse	1,264	54.56	55.97	1.31	1.27	1.36	1.33	2.92	3.11	0.41	0.45
Fine	376	59.57	64.48	0.99	1.00	1.65	1.63	2.54	2.83	0.39	0.43
Twin	92	143.37	131.98	2.75	2.49	3.32	2.87	5.86	6.31	0.600	0.76

Source: SRK, 2016



Source: Sierra Metals, 2016

Figure 11-1: Coarse Duplicate Ag Analyses



Source: Sierra Metals, 2016

Figure 11-2: Coarse Duplicate Zn Analyses

11.4.4 Actions

SRK notes that the actions taken by the exploration team at Yauricocha is documented in the QA/QC procedures for the mine. In the event that a failure is noted, the laboratory is contracted, and the source of the failure is investigated. There is no formal documentation for procedures involving re-runs of batches at this time, but SRK understands that this is the process. SRK notes that the QA/QC reports are not amended to reflect the new passing QA/QC and batch, and only reflect the initial failure and batch to track laboratory performance rather than the performance of reruns.

SRK is of the opinion that these actions are not consistent with industry best practice, which generally features a program of reanalysis upon failure of a CRM in a batch of samples. Subsequent to this are incorporation of the revised samples into both the database and QA/QC analysis. SRK notes that this program is implemented at other Sierra Metals sites, but is not well documented at Yauricocha.

11.4.5 Results

The results of the QA/QC program described above show relatively high incidence of failures across the board for all types of QA/QC, with the CRM and the obvious bias between check duplicates being the most concerning. SRK notes that the CRM failures are potentially due to ongoing sample mix-ups, but that this inherently represents a failure in the process that must be reviewed. SRK evaluated the CRM performance using more lenient tolerances than the CRM themselves recommend (+/-3SD vs +/-2SD) as the recommended certified performance ranges result in extreme failure rates.

If the SD and performance criteria for the CRM as calculated by Target Rocks is deemed reasonable, and it is determined that the laboratories should be able to meet *the performance criteria, then this is a more serious matter. The laboratories are not capable of analyzing to the precision needed for these CRM, and the laboratory practices should be reviewed. Uncertainty in the accuracy and precision of the analyses would be introduced through this process, requiring some action in terms of the classification of the Mineral Resources.*

SRK is aware that the bias of the Chumpe laboratory compared to ALS has been noted and that changes in procedures and hardware are still being implemented at Chumpe to better approximate the preparation and analysis methodology employed by ALS.

11.5 Opinion on Adequacy

SRK is of the opinion that the database is supported by adequate QA/QC to have reasonable confidence to estimate Mineral Resources. SRK notes that the failures in the QA/QC should be addressed as soon as possible through review of the original CRM/blanks and their performance limits, as well as reasons for consistent bias observed between the site Chumpe lab and ALS Minerals. SRK notes that these biases are conservative given that Chumpe is the source for the historic drilling database and current channel samples, and that the nature of the bias is not such that the entire resource would be under or over-stated. SRK did not observe any consistent performance issues over time (2015-2017) at either lab, but rather noted isolated and apparently random failures for the CRM and blanks in particular. As noted, many of these can be attributed to sample mixing during QA/QC submittal or potential issues with the CRM, both problems in and of themselves. SRK continues to recommend that more attention is given to sampling and QA/QC in the future to continue to mitigate potential uncertainty in the analyses supporting the Mineral Resource. SRK also notes that any bias from the Chumpe analyses will likely be conservative due to the significant under reporting of Ag for Chumpe compared to ALS.

Although the performance and monitoring of the QA/QC samples is not consistent with industry best practices, SRK notes that the lack of precision in certain analyses (Ag, Zn, Pb, Cu) is less critical due to the nature of the mineralization and mining criteria at Yauricocha. Precision issues between 0.1 to 0.2% in the base metals is likely not sufficient to cause material issues in deciding whether material is mined or not, and these decisions are generally made with ongoing development samples and grade control entirely unsupported by detailed QA/QC. Thus, much of the risk associated with the analyses has already be borne by the active mining of multiple areas at Yauricocha, and mitigated by ongoing profitable production. SRK is of the opinion that while these issues should be addressed going forward; they represent little risk to the statement of Mineral Resources at this time.

12 Data verification

Section 12 of this Report has been excerpted from previous NI 43-101 Technical Report on the Yauricocha Mine, prepared by SRK (Consulting U.S., Inc), dated July 31, 2017 and is shown in italics. Standardizations have been made to suit the format of this report; any changes to the text have been indicated by the use of [brackets].

Other independent consultants such as Gustavson and Associates has verified the data supporting Mineral Resource estimation at Yauricocha since 2012. SRK notes that the data verification process is made difficult due to the lack of a compiled and well-ordered database for the overall mine area.

12.1 Procedures

For data prior to 2016, Gustavson reviewed the drill hole and underground channel samples databases for the Yauricocha project and compared the assay database with a separately maintained database of assay data which is described as 'laboratory data'. Chumpe lab does not provide a separately maintained database, nor are there assay certificates with which to compare the database.

For the current database, SRK has reviewed individual analytical certificates from ALS Minerals and compared a random selection of 20 of these back to the database. No errors were noted in the values from the sheets to the digital database. SRK notes that this represented about 7% of the total assays.

12.2 Limitations

SRK has not reviewed 100% of the analyses at Yauricocha against certified, independent assay certificates.

12.3 Opinion on Data Adequacy

SRK has relied upon the verification conducted by others previously and has conducted independent verification of assays to analytical certificates from ALS Minerals for the recent project history. SRK also notes that much of the risk associated with potential database contamination or transposition is borne-out through daily production in the currently operating underground mine.

SRK does recommend the installation of a dedicated database management platform that will compile and validate the database used in Mineral Resource estimation against the actual certificates received from Chumpe, as well as make QA/QC management and database export more flexible and reliable.

13 Mineral processing and metallurgical testing

Section 13 of this Report have been excerpted from previous NI 43-101 Technical Report on the Yauricocha Mine, prepared by SRK (Consulting U.S., Inc), dated July 31, 2017 and is shown in italics. Standardizations have been made to suit the format of this report; any changes to the text have been indicated by the use of [brackets].

13.1 Testing and Procedures

Yauricocha's facilities include a metallurgical laboratory at site. Sampling and testing of samples are executed on a as needed basis. Information available from site shows that Yauricocha has been testing various samples from the mineralized zones as follows:

- *Samples from Mina Central – Cuerpo Esperanza: a polymetallic Ag-Cu-Pb-Zn material that at laboratory scale achieved comparable results to those achieved in the industrial scale plant. Three products resulted from the tests: copper concentrate, lead concentrate, and zinc concentrate. Silver is preferably deported to copper and lead concentrates. No deleterious elements were reported in the flotation concentrates.*
- *Samples from a polymetallic material: test results are comparable to those of the industrial scale plant. Three products resulted from the tests: copper concentrate, lead concentrate, and zinc concentrate. Silver is preferably deported to copper and lead concentrates. Yauricocha continues testing alternative flotation conditions and reagents to reduce arsenic and antimony presence in copper concentrate and lead concentrate.*
- *Samples from Mina Mario (Pb-Zn): successfully produce a good quality lead sulphide concentrate, and found difficulties in achieving commercial quality zinc grades.*
- *Samples from Cuerpo Contacto Occidental: correspond to an oxide Ag-Pb material that successfully achieved good quality lead sulfide concentrate and lead oxide concentrate.*
- *Approximately 70% of the silver was deported to concentrates, with approximately 47% of the total being deported to lead oxide concentrate.*
- *Samples from an oxide copper mineral: this sample achieved poor metallurgical performance that laboratory personnel attributed to high presence of copper carbonates. Additional tests are planned for these samples.*
- *Samples from Esperanza Norte: a copper bearing material that achieved reasonable copper recovery and concentrate grade but with high presence of arsenic. The laboratory personnel's recommendation is to blend this material in the mill feed.*
- *Samples from copper sulfide minerals: achieved high recovery and concentrate grade but with significant arsenic presence in the copper concentrate. The laboratory personnel's recommendation is to batch processing this material in the plant.*

13.2 Recovery Estimate Assumptions

Final concentrates in

Table 13-1 for the 2017 January to September period show typical commercial concentrate grades. In the polymetallic circuit, the fresh feed assaying 0.63% Cu yielded a concentrate assaying 27.18% Cu at a recovery of 66.2% Cu. Deportment of Zn and Pb to copper concentrate translated in grade of 7.35% Zn and 2.55% Pb respectively which may trigger penalties from buyers. Silver recovery to copper concentrate reached 23% equivalent to 31 ounces/ton Ag in concentrate.

In terms of lead sulfide concentrate from the polymetallic circuit, 87.4% of the lead metal in fresh feed assaying 1.58% Pb was deported to a sulfide concentrate grading 57.41% Pb. Deportment of Cu and Zn to lead concentrate reached 8.8% and 3.3% respectively. The large fraction of silver in the polymetallic circuit was deported to the lead concentrate; it reached 43.7% recovery for the period in question.

Lead sulfide concentrate produced from the oxide circuit was 109 t which represents only a minor fraction of the overall lead concentrate production and it achieved a grade of 33.89% Pb which is below commercial levels, with copper and zinc grades at 5.49% and 16.31% respectively. Similarly, lead oxide concentrate represents a minor fraction of the overall lead concentrate production at 233 t and a grade of 52.15% Pb. Both lead concentrates produced in the oxide circuit are blended with the lead sulfide concentrate produced in the polymetallic circuit in the final lead concentrate thickener. The combined concentrate resulted in approximately 17,867 t grading 57.21% Pb, 2.3% Cu, 5.42% Zn, 1.76 g/t Au, and 37.8 oz/t Ag.

The zinc concentrate recovered 89.5% of the zinc metal or equivalent to a grade of 51.38% Zn in concentrate. Lead and copper recovery to the zinc concentrate translated in grades of 0.88% and 1.33%, respectively. Silver deportment to the zinc concentrate reached 11.0% or 3.4 ounces/ton.

Gold deportment is spread among all concentrate product and consequently it is unlikely that achieves payable levels. Yauricocha may want to look at opportunities to concentrate gold into a single product to reach payable levels, or alternatively attempt gravity concentration in the grinding stage and/or the final flotation tails.

Table 13-1: Yauricocha metallurgical Performance, January to September 2017

Processing Circuit	Stream	Tonnes	Concentrate Grade					Recovery (%)				
			Au (g/t)	Ag (oz/t)	Pb (%)	Cu (%)	Zn (%)	Au	Ag	Pb	Cu	Zn
Polymetallic	Fresh Ore	726,254	0.55	2.1	1.6	0.6	3.9	100.0	100.0	100.0	100.0	100.0
	Cu Concentrate	11,198	2.97	31.0	2.6	27.2	7.3	8.4	23.0	2.5	66.2	2.9
	Pb Concentrate	17,525	1.77	37.6	57.4	2.3	5.4	7.8	43.7	87.4	8.8	3.3
	Zn Concentrate	49,222	0.43	3.4	0.9	1.3	51.4	5.3	11.0	3.8	14.3	89.5
Oxide	Fresh Ore	6,669	0.20	6.1	4.5	0.2	5.8	100.0	100.0	100.0	100.0	100.0
	Pb Concentrate	109	2.16	67.9	33.9	5.5	16.3	17.9	18.1	12.3	53.5	4.6
	Pb Oxide Concentrate	233	0.65	37.6	53.1	0.9	3.3	14.1	26.1	46.7	38.4	2.1
	Fresh Ore	21,715	0.30	1.4	1.3	5.3	3.8	100.0	100.0	100.0	100.0	100.0
	Cu Oxide Concentrate	2,872	0.83	3.4	3.0	21.8	4.8	36.9	32.4	30.0	53.8	17.0
	Fresh Ore	2,632	0.34	2.2	0.9	1.4	2.2	100.0	100.0	100.0	100.0	100.0
	Cu Concentrate	148	0.89	17.8	9.2	19.9	20.6	14.9	45.7	56.2	79.2	53.5

Source: SRK, 2017

The as-sold final concentrate grades available for the 2017 January to August period (Table 13-2) show that only copper concentrate presents deleterious elements in high enough concentration to potentially trigger penalties from the buyer. Arsenic in copper concentrate ranged from approximately 1% up to 3.7% and fluorine ranged from approximately 100 ppm to 800 ppm. Arsenic is also present in the lead concentrate and zinc concentrate, but in levels that are unlikely to trigger penalty payments.

Table 13-2: Concentrate Sales – 2017 January to August

Product	Invoice Date	Buyer	West Tonnes	Dry Tonnes	Ag oz/ton	Au oz/t	Cu (%)	As (%)	Sb (%)	Bi (%)	Pb (%)	Zn (%)	F (ppm)	Mn (%)	Fe (%)
Cu con	2017 Jan	Glencore Peru SAC	1,184	1,061	45.2	0.098	24.7	2.2	0.21	0.13	2.6	8.0	102		
Cu con	2017 Feb	Trafigura Peru SAC	1,457	1,256	19.4	0.056	25.6	1.1	0.13	0.07	2.2	6.7	873		
Cu con	2017 Feb	Glencore Peru SAC	821	724	37.7	0.081	25.7	2.0	0.22	0.12	3.0	8.5	353		
Cu con	2017 Mar	Trafigura Peru SAC	591	518	28.9	0.072	27.3	2.2	0.15	0.10	2.4	5.9	309		
Cu con	2017 Mar	Glencore Peru SAC	917	807	36.3	0.090	27.7	2.2	0.26	0.10	2.8	6.0	268		
Cu con	2017 Apr	Trafigura Peru SAC	574	507	27.8	0.080	26.9	2.9	0.20	0.06	2.4	6.4	413		
Cu con	2017 Apr	Glencore Peru SAC	1,007	877	18.9	0.049	24.5	2.0	0.15	0.06	2.8	5.9	300		
Cu con	2017 May	Glencore Peru SAC	1,650	1,485	31.3	0.055	24.0	3.4	0.28	0.11	4.4	9.4	284		
Cu con	2017 Jun	Glencore Peru SAC	1,726	1,545	32.1	0.054	23.6	3.7	0.23	0.14	4.4	11.4	183		
Cu con	2017 Jul	Glencore Peru SAC	1,462	1,306	27.7	0.082	26.1	3.5	0.25	0.15	3.1	8.1	244		
Cu con	2017 Aug	Trafigura Peru SAC	209	187	22.0	0.080	28.0	1.8	0.22	0.12	2.0	5.0	300		
Cu con	2017 Aug	Glencore Peru SAC	2,064	1,827	16.7	0.107	25.5	2.6	0.10	0.14	3.0	7.9	285		
Pb con	2017 May	Glencore Peru SAC	2,356	2,161	43.4	0.075		0.3		0.17	54.6				
Pb con	2017 Feb	Glencore Peru SAC	2,613	2,408	39.1	0.044		0.3		0.19	57.0				
Pb con	2017 Mar	Glencore Peru SAC	2,298	2,098	36.3	0.038		0.4		0.15	53.9				
Pb con	2017 Apr	Glencore Peru SAC	2,757	2,529	34.1	0.033		0.5		0.13	55.0				
Pb con	2017 May	Glencore Peru SAC	2,804	2,584	38.9	0.032		0.7		0.22	57.2				
Pb con	2017 Jun	Glencore Peru SAC	2,074	1,909	37.7	0.037		0.7		0.22	57.2				
Pb con	2017 Jul	Glencore Peru SAC	1,849	1,717	34.2	0.062		0.3		0.29	60.0				
Pb con	2017 Aug	Glencore Peru SAC	1,597	1,493	30.5	0.085		0.7		0.28	54.2				
Zn con	2017 Jan	Trafigura Peru SAC	1,297	1,202	4.0			0.1				53.8		0.4	6.8
Zn con	2017 Jan	Trafigura Peru SAC	3,805	3,501	3.8			0.1				51.7		0.3	8.1
Zn con	2017 Feb	Trafigura Peru SAC	1,540	1,423	3.3			0.1				53.3		0.3	7.7
Zn con	2017 Feb	Trafigura Peru SAC	3,442	3,157	3.8			0.1				50.9		0.3	8.6
Zn con	2017 Feb	Trafigura Peru SAC	3,306	3,031	3.7			0.1				50.7		0.4	8.8
Zn con	2017 Mar	Trafigura Peru SAC	1,344	1,223	3.8			0.1				50.1		0.4	8.6
Zn con	2017 Mar	Trafigura Peru SAC	1,901	1,729	3.6			0.1				50.3		0.4	8.9
Zn con	2017 Apr	Trafigura Peru SAC	1,460	1,335	3.6			0.2				50.0		0.4	8.9
Zn con	2017 Apr	Trafigura Peru SAC	2,787	2,547	3.8			0.2				50.3		0.5	8.6
Zn con	2017 Apr	Trafigura Peru SAC	999	914	3.7			0.2				50.6		0.4	8.7
Zn con	2017 Apr	Trafigura Peru SAC	804	729	3.7			0.1				50.6		0.4	8.6
Zn con	2017	Trafigura	6,393	5,848	3.3			0.2				52.5		0.3	7.8

Product	Invoice Date	Buyer	West Tonnes	Dry Tonnes	Ag oz/ton	Au oz/t	Cu (%)	As (%)	Sb (%)	Bi (%)	Pb (%)	Zn (%)	F (ppm)	Mn (%)	Fe (%)
	May	Peru SAC													
Zn con	2017 Jun	Trafigura Peru SAC	4,416	4,024	3.4			0.2				52.0		0.4	7.8
Zn con	2017 Jun	Trafigura Peru SAC	1,682	1,537	3.3			0.2				52.2		0.4	7.8
Zn con	2017 Jul	Trafigura Peru SAC	7,202	6,521	3.0			0.1				50.8		0.3	8.5
Zn con	2017 Aug	Trafigura Peru SAC	6,633	6,024	3.0			0.1				50.0		0.3	8.0

Source: SRK, 2017

14 Mineral resource estimates

Section 14 of this Report has been excerpted from previous NI 43-101 Technical Report on the Yauricocha Mine, prepared by SRK (Consulting U.S., Inc), dated July 31, 2017 and is shown in italics. Standardizations have been made to suit the format of this report; any changes to the text have been indicated by the use of [brackets].

Mineral Resource Estimations have been conducted or reviewed by the following Qualified Person(s), using various industry-standard mining software:

- *Matthew Hastings, Principal Resource Geologist of SRK Consulting (U.S.) Inc.; Maptek Vulcan™.*

Estimations for the Angelita, Karlita, Celia, Escondida, and Privatizadora areas were conducted by Minera Corona personnel. SRK reviewed these estimations and found them to be consistent with industry best practice.

14.1 Drill hole/Channel Database

SRK received 11 separate databases in digital Excel format. SRK notes that Minera Corona maintains their own databases in individual spreadsheets by orebody and time period, which are in turn separated by channel sample and diamond drill hole. The compilation of these files is time-consuming and error-prone. For this reason, SRK has relied on these as individual databases for each area. SRK notes that there are likely overlaps in drilling between the multiple areas, but has considered each area to be its own standalone dataset for the purposes of analysis and estimation.

SRK is of the opinion that one of the largest and most critical deficiencies at Yauricocha is the lack of a well-maintained database in a format that compiles the entirety of the information to be used in the resource estimation. A database in this type of format would ideally be able to be sorted based on year, type of drilling/sampling, analytical lab, etc., and would permit flexibility and speed in manipulation of data and filtering it for use in Mineral Resource estimation.

14.2 Geological Model

The geological model was developed by SMCSA geologists, primarily using ARANZ Leapfrog® Geo software. Three dimensional models were derived from both drilling and channel samples, as well as incorporating mapping from mine levels and structural observations. Significant expansion and infill drilling between the end of 2015 and the effective date of the resource (July 31, 2017) has resulted in net increases in many areas of the Yauricocha deposit. Combined with these are the facts that the modelling has now been exclusively done by SMCSA geologists, resulting in a more complete and thorough model.

In many cases, the modelling has been simplified from previous years. One example of this is modelling all of the Mina Central sulfides as a single body (Figure 14-1), rather than four discrete areas. The limits of this orebody have been expanded significantly with additional drilling. The precision of these models has also improved dramatically in terms of sampling positions relative to the wireframes, notably in the tightly spaced sampling areas. In other cases where the Leapfrog® modelling has been used, the geologists have modelled more complex parts of the orebodies that were not previously *modelled or reported. These include copper-rich areas within Mascota, Esperanza, and others.*

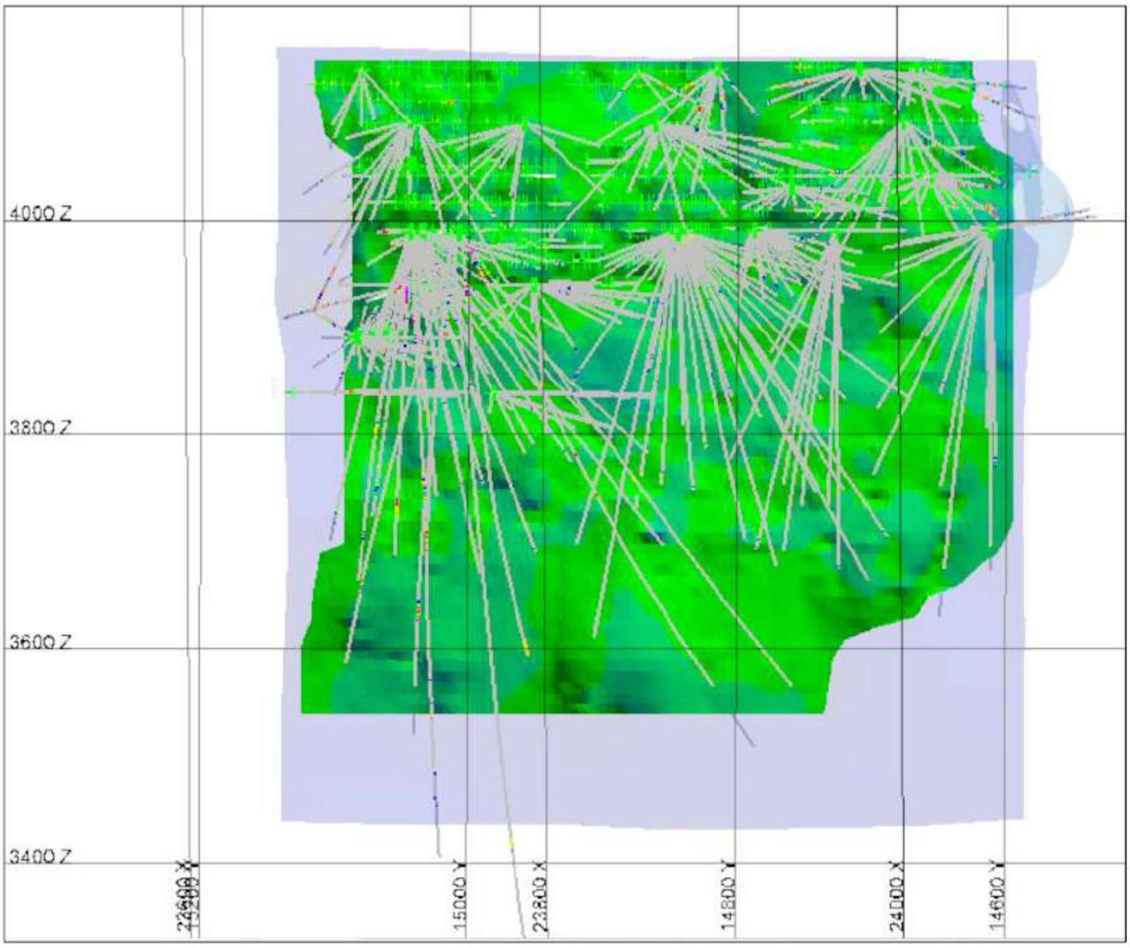
Mineralization at Yauricocha encompasses two main styles, differentiated by scale, continuity, and exploration and development style.

- *Cuerpos Massivos (large bodies) are bodies formed along major structures of significant (several hundreds of metres) of vertical extent, consistent geometry, and significant strike length. These bodies constitute the majority of tonnage mined in the operation, are easily intersected by targeted drilling, and are mined by bulk mining methods.*
- *Cuerpos Chicos (small bodies) are smaller mineralized bodies of high grades. They are often skarn bodies, are less continuous and less regular in form than the Cuerpos Massivos, and are difficult to intersect except with carefully targeted drilling. They are typically mined by overhand cut and fill or similar high-selectivity mining methods. The mine has historically drifted into these zones and delineated them using localized channel sample data. Recently, additional effort has been made to use targeted drilling to explore the extents of these bodies. Cuerpos Chicos in the Cachi-Cachi area are referred to by the area designation "Cachi-Cachi" and Cuerpos Chicos occurring in the vicinity of Mina Central are collectively referred to as the "Cuerpos Pequenos".*

14.2.1 Mina Central

The geological model for Mina Central has been constructed by SMCSA site geologists. This model is based on implicit modelling of drilling and channel sampling, and encompasses the Antacaca, Catas, Rosaura, and Antacaca Sur areas, which are broken on geographic and infrastructure boundaries rather than any mineralogic or geologic boundaries. The model is effectively continuous through all areas. The mineralization is domained using a steeply dipping, NW trending, tabular manto wireframe constructed in Leapfrog®. Both channel sampling and drilling have been used to develop this model. SRK reviewed the wireframes collaboratively with Corona personnel and noted that it appears to be a reasonable representation of the polymetallic sulfide mineralization as logged and sampled in this area. The orebody has been expanded from the previous 2015 model based on revised interpretation and expanded drilling. An example of this model in the context of the previous model is shown in Figure 14-1.

In addition to the expanded extents of the Mina Central area, SMCSA geologists have modelled selected oxide zones in the Antacaca Sur area based on drilling and development data. This is considered a separate domain from the main Mina Central area for the purposes of data analysis and estimation.



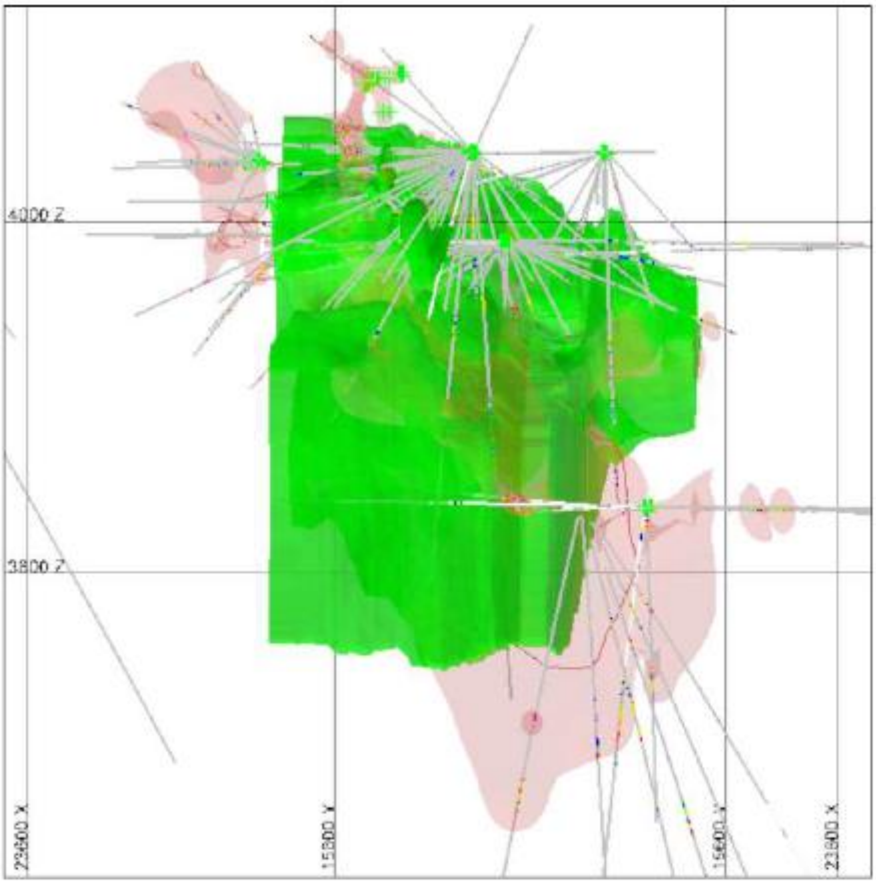
Long section looking NE. Green is 2015 models and blue is current.
Source: SRK, 2017

Figure 14-1: Example of Mina Central Model

14.2.2 Esperanza

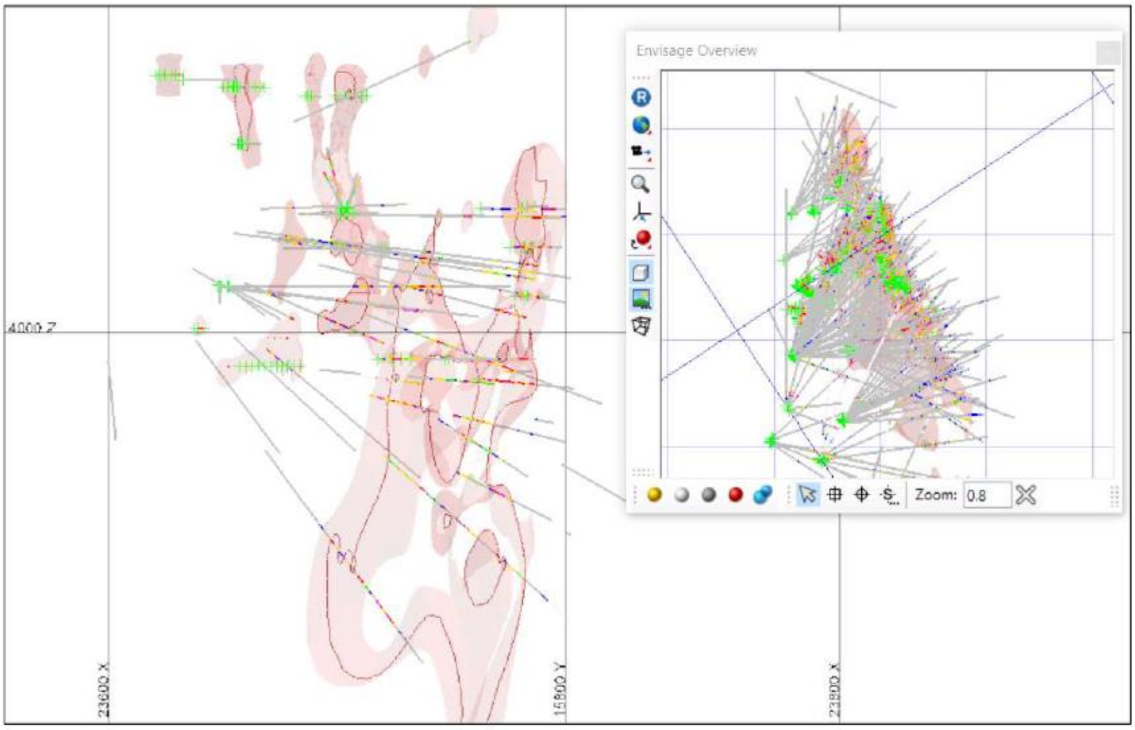
The geology model for Esperanza has been constructed by SMCSA site geologists. This model is based on very detailed drilling program as well as cross sectional and level mapping in order to capture the inherent complexity of this area. The model is implicitly modelled from a series of 6 different areas identified within Esperanza based on mineralogy or textures. These include 2 breccia zones, 1 copper zone, Esperanza North, Esperanza Distal, and a lower grade pyrite-rich area. At this time, there is insufficient evidence to discretize these areas for the purposes of resource estimation, and they have been grouped together as one large complex orebody with the exception of the pyrite area (unestimated). Additional drilling and development may change this in the future, but SRK and SMCSA geologists agree that the textural and mineralogy differences observed underground may be inherent to the style of mineralization. The model represents what appears to be a single primary feeder structures within Esperanza, which appears to coalesce at depth and split into many "finger-like" smaller structures in the upper levels. This assumption from 2015 was proven to some degree with additional drilling and development. Although general continuity along strike and down-dip is quite good, SRK notes that the mineralization varies dramatically in orientation and thickness, locally over short distances. SMCSA has instigated a dense drilling grid to 15 m spacing in areas where this complexity is noted, and will continue this practice as needed to better model the orebody as it develops and access for drilling becomes available.

Examples of the Esperanza model in the context of the previous model are shown in Figure 14-2 and Figure 14-3.



Long section looking NE. Green is 2015 models and red is current.
Source: SRK, 2017

Figure 14-2: Example of the Esperanza Model



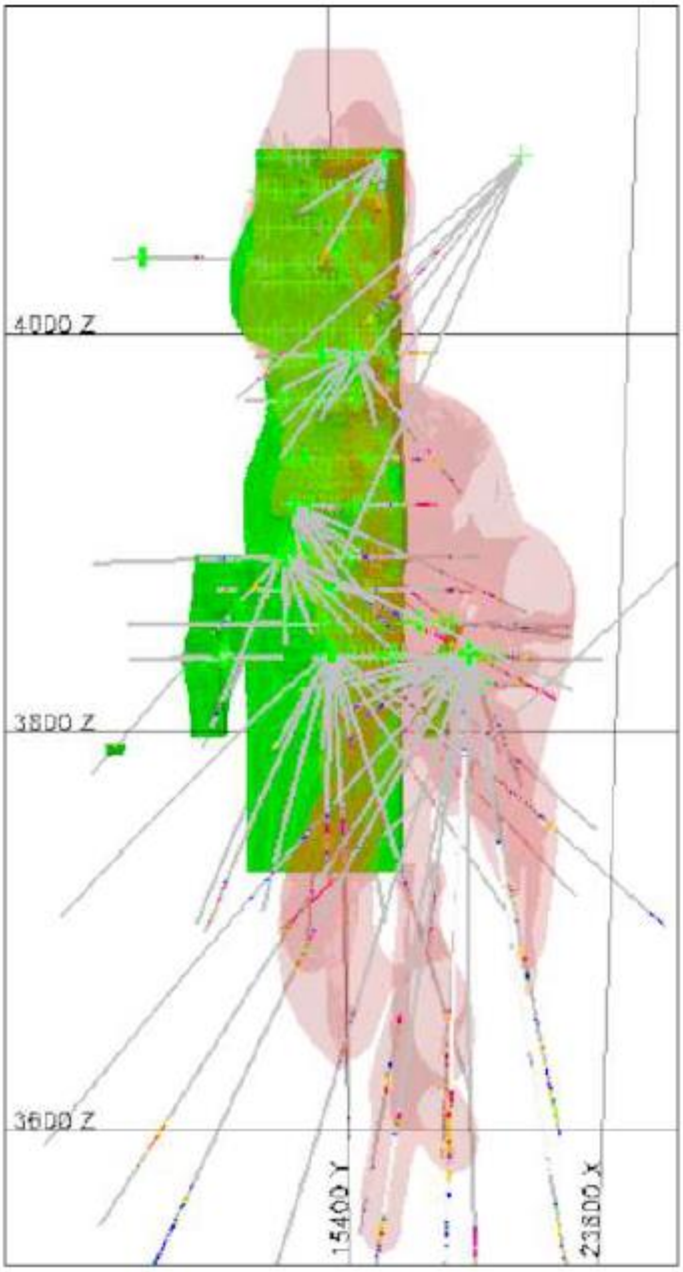
Looking NW. +/- 10 m width.

Figure 14-3: Cross section of Esperanza Model

14.2.3 Mascota

The geological model for Mascota has been constructed by SMCSA site geologists using implicit modelling in Leapfrog® Geo software. The model is based on the grouped lithologies from drilling and sampling in the Mascota mine area. SRK notes that the previous 2015 model produced by Gustavson only accounts for areas known to feature Pb-oxide mineralization, although the orebody was known to contain significant zones of oxide Cu as well as higher grade polymetallic sulfide mineralization at depth. Many of these areas have been added through the efforts of the site personnel in additional drilling/development and interpretation of the complex relationships between areas. As SRK noted in the 2016 report, these additional areas offered potential upside to the Mascota orebody, which has been realized to some degree in 2017. Significant expansions to the orebody are noted in the geologic modelling, including the copper-rich areas as well as the massive sulfide zones being explored at depth. These areas have been identified as Ag/Pb oxides, low-grade Ag/Pb oxides, Cu oxides, and polymetallic sulfides. They are considered as discrete by the Corona geologists and have been domained separately for the purposes of estimation.

An example of this model in the context of the previous model is shown in Figure 14-4.

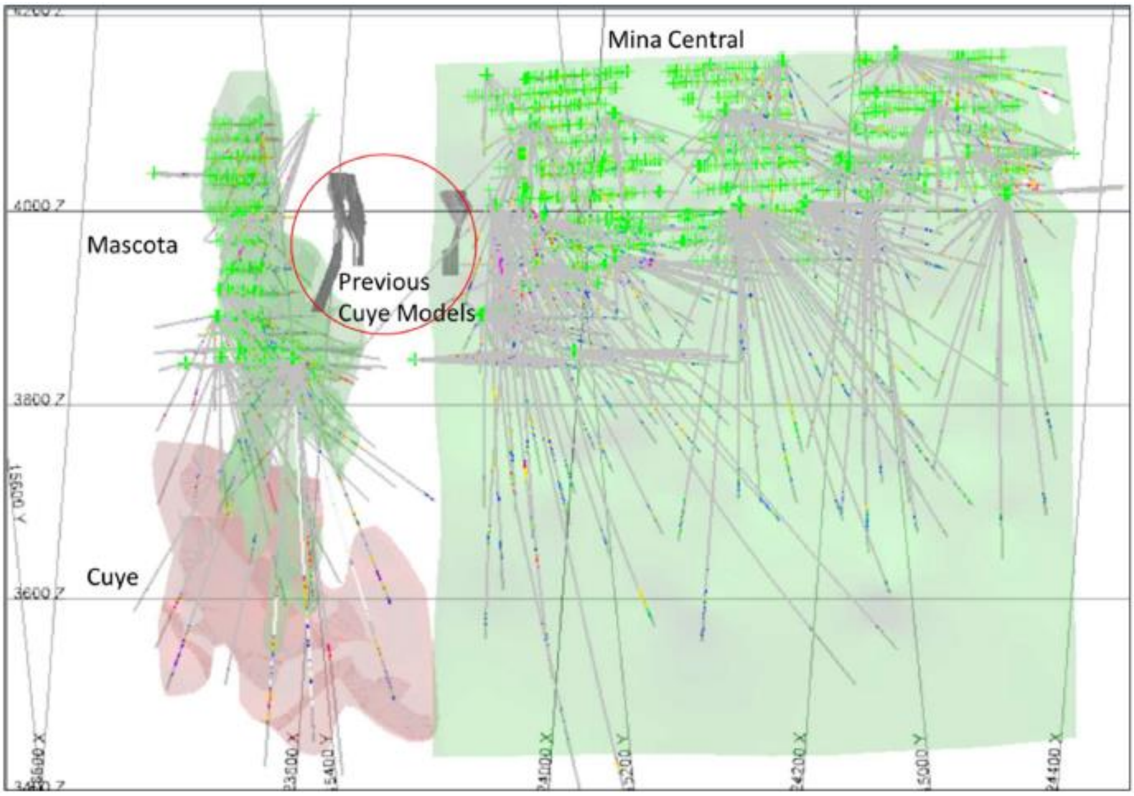


Long section looking NE. Green is 2015 models and red is current.
Source: SRK, 2017

Figure 14-4: Example of Mascota Model

14.2.4 Cuye

The Cuye orebody has previously been reported as a series of smaller bodies situated between the Mina Central and Mascota areas. These smaller orebodies have effectively been mined in the period between EOY 2015 and the current resource statement. In 2016-2017, a number of drill holes encountered considerable thicknesses of mineralization at depth below the previous Cuye orebodies. Unlike the smaller bodies, the new intersections are thicker and more continuous, if lower grade. Also, they potentially allude to an extension of the Mina Central mineralization to the north, the size and morphology of the Cuye area has completely changed from previous reports, and fits more closely with a tabular steeply dipping orebody along the trend of the Mina Central and Esperanza areas. At present, Cuye has only be sampled by relatively *widely-spaced drilling. It, like Esperanza, also features some pyrite-rich zones which have been modelled separately within the greater Cuye orebody. These areas have been excluded from the estimation as they are considered waste for the mine. An example of the Cuye orebody, compared with the previous model, is shown in Figure 14-5.*

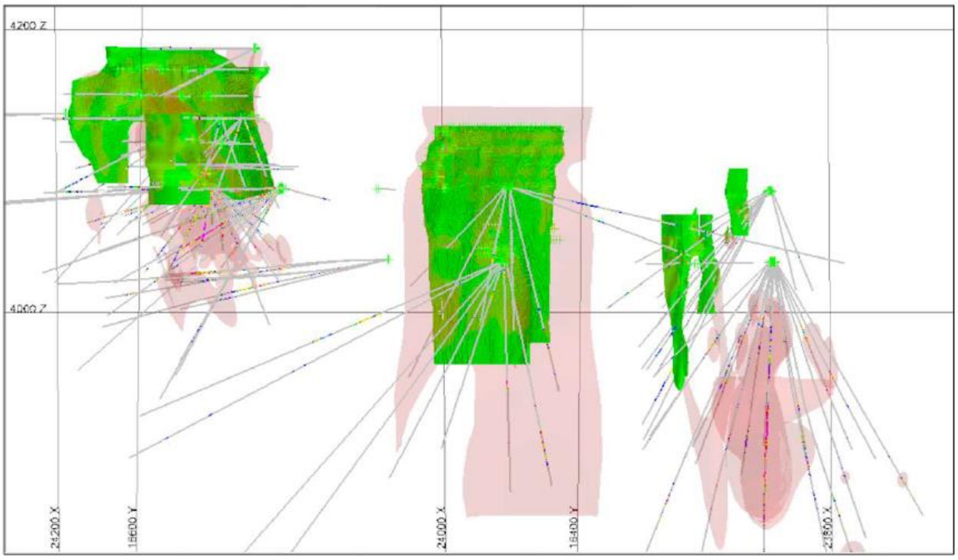


Long section looking NE. Green is current Mascota and Mina Central and red is current Cuye. Grey are previous Cuye models that have been depleted.
Source: SRK, 2017

Figure 14-5: Cuye Model (2017) in Context with Other Areas

14.2.5 Cachi-Cachi

The geological model for Cachi-Cachi has been constructed by SMCSA site geologists. This model is based on cross sectional and level mapping, and encompasses the massive orebodies Karlita, Angelita, Elissa, Escondida, Privatizadora, and Zulma, which are discrete mineralized bodies with unique morphologies and mineralization. The mineralization is domained using a variety of geometries and orientations, which are generally steeply dipping. Models are wireframes implicitly modelled in Leapfrog®. Both channel sampling and drilling have been used to develop these models. SRK reviewed the wireframes collaboratively with Corona personnel and noted that it appears to be a reasonable representation of the polymetallic sulfide mineralization as logged and sampled in this area. An example of these models is shown in Figure 14-6. Cachi-Cachi includes one new area in Privatizadora as well as significant expansions of other areas through additional drilling and/or reinterpretation.



Long section looking SE. Green is 2015 models and red is current.
Source: SRK, 2017

Figure 14-6: Example of Cachi-Cachi Models

14.2.6 Geology Model as Resource Domains

SRK considered the geology models to be hard boundaries in general with respect to the resource estimation methods. However, for the purposes of exploratory data analysis, SRK grouped selected areas based on their geography or mineralogical relationships to ensure that the populations of data were sufficient to make informed decisions regarding compositing, capping, and variography.

For exploratory data analysis, SRK began with reviewing the sample distributions and mean grades for data within each major mineralization area. These results are presented in Table 14-1 below. Based on the review of each area as a whole, SRK elected to use each geologic domain (or subdomain) as either a hard or soft boundary depending on the observations and recommendations of the site geology team. The individual domains were grouped based on a combination of factors including proximity, relative data populations, and mineralization style. The means for the domains are shown below in Table 14-1. The nomenclature and coding for the domains are summarized in

Table 14-2.

Table 14-1: Mean Grades by Area

Area	Samples Count	Ag Mean	Au Mean	Cu Mean	Pb Mean	Zn Mean
Angelita	1,919	13.97	0.30	0.48	0.26	5.35
Butz	239	34.80	0.32	0.27	1.88	5.86
CSM	186	156.80	0.33	0.26	8.25	12.49
Cuye	254	62.90	0.93	2.09	0.35	2.54
Elissa	845	112.53	0.30	0.13	2.32	10.64
Escondida (1)	728	97.59	0.46	0.41	2.17	4.38
Esperanza (2)	2,593	90.59	0.59	2.43	2.12	5.06
Gallitos	371	107.58	0.29	0.71	5.94	11.32
Karlita	1,062	88.42	0.65	0.68	1.68	5.77
Mascota	7,554	162.20	1.19	1.73	4.98	2.84
Mina Central (3)	14,535	61.04	0.66	0.92	1.01	3.20

(1) Includes Zulma
(2) Includes all Esperanza domains.
(3) Includes Contacto Oriental, Contacto Occidental, Butz, Oxidos Antacaca Sur
Source: SRK, 2017

Table 14-2: Summary of Resource Domains in Geological Models

Area	Domain	Boundary
Mina Central	Mina Central	Hard
	Antacaca Sur Oxidos	Hard
Esperanza	Esperanza	Soft
	Esperanza Breccia 1	Soft
	Esperanza Breccia 2	Soft
	Esperanza Cobre	Soft
	Esperanza Norte	Soft
	Esperanza Distal	Soft
	Esperanza Pirita	Not Estimated
Mascota	Mascota Oxide Pb Ag	Hard
	Mascota Oxide Not Economic	Hard
	Mascota Oxide Cu	Hard
	Mascota Polymetallic North	Hard
	Mascota Polymetallic East	Hard
	Mascota Polymetallic East 2	Hard
	Mascota Polymetallic South	Hard
Cuye	Cuye	Hard
	Cuye Pirita	Not Estimated
Cuerpos Pequenos	Gallito	Hard
	Oriental	Hard
	Occidental	Hard
	Occidental Oxide	Hard
	Butz	Hard
Cachi-Cachi	Angelica	Hard
	Karlita	Hard
	Elissa	Hard
	Celia	Hard
	Escondida	Hard
	Privatizadora	Hard
	Zulma	Hard

Source: SRK, 2017

14.3 Assay Capping and Compositing

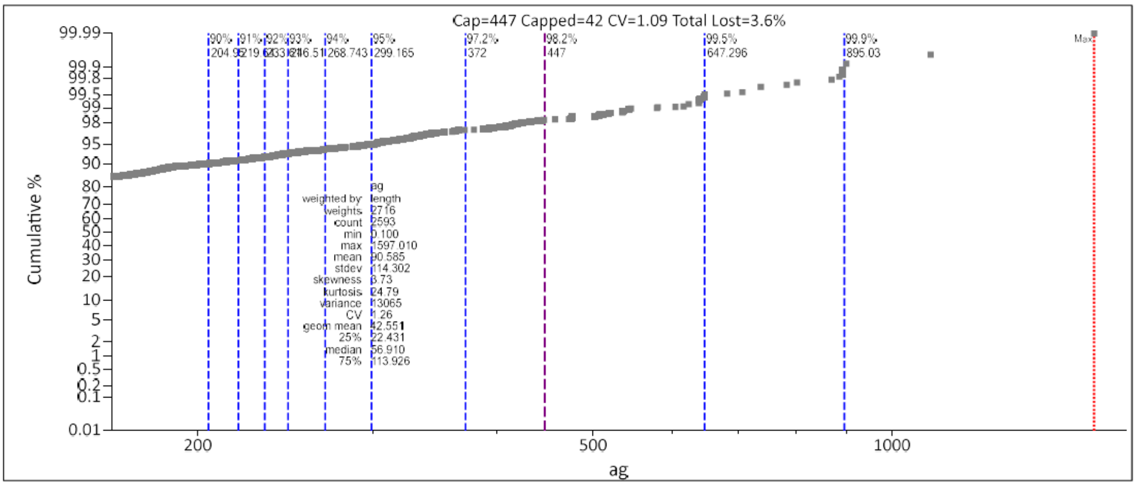
SRK conducted capping and compositing for the databases supporting estimations at Mina Central, Esperanza, Elissa, Mascota, and various Cuerpos Pequenos. Minera Corona conducted capping for the data in the areas that they estimated. SRK reviewed the results of their capping analysis and notes that they are consistent with the methods and results that SRK used.

14.3.1 Outliers

SRK reviewed the outliers for the raw sample data in each area or domain using a combination of histograms, log probability plots, and descriptive statistics. Outliers are evaluated from the raw, uncomposited data, flagged by the 3D geologic model. An example of the log probability plot reviewed for Ag is shown in Figure 14-7. An example of a corresponding capping analysis for Ag in Esperanza is shown in Table 14-3. This capping analysis reviewed the impact of the cap on a number of factors in the database, including total reduction in contained metal, percentage of samples capped, and reduction to the CV. In the cases of the Mascota polymetallic sulfide domain, Cuye, CSM, and Butz, SRK capped at a nominal 98th percentile as the paucity of data made analysis through log probability or histograms less meaningful. Capping limits assigned for each area estimated by SRK are shown in

Table 14-4.

In some cases, SRK applied limits to the area of influence for certain elements during various passes of the estimation. This was accomplished using high yield limit restrictions in Vulcan™ during the estimation. Decisions regarding how to apply this restriction to the estimation was made after reviewing the validations of the individual models and noting potential for over-stating grade due to a combination of factors including grade continuity, sample spacing, orebody morphology and more. In cases where this was used, the objective was to iteratively apply these limits at varying grades and distances to improve the validation.



Source: SRK, 2017

Figure 14-7: Log Probability Plot for Capping Analysis – Esperanza Ag

Table 14-3: Example Capping Analysis – Esperanza Ag

Cap Ag (g/t)	Capped	Percentile	Capped	Lost Ag	CV%	Max	Mean	Variance	CV
NA	0	100%	0	0	0	1,597.01	90.59	13,065	1.26
895.03	3	99.90%	0.10%	0.38%	2.90%	895.03	90.20	12,213	1.23
647.30	13	99.50%	0.50%	1.30%	6.60%	647.30	89.35	11,088	1.18
447.00	42	98.20%	1.60%	3.60%	14%	447.00	86.91	8,924	1.09
372.00	73	97.20%	2.80%	5.40%	18%	372.00	85.15	7,796	1.04
299.17	134	95%	5.20%	8.40%	23%	299.17	82.48	6,466	0.97
268.74	162	94%	6.20%	10%	25%	268.74	80.79	5,783	0.94
246.51	186	93%	7.20%	12%	27%	246.51	79.33	5,268	0.91
233.61	212	92%	8.20%	13%	29%	233.61	78.36	4,954	0.90
219.64	240	91%	9.30%	14%	30%	219.64	77.17	4,601	0.88
204.95	266	90%	10.30%	16%	32%	204.95	75.78	4,224	0.86
Ag> 447						1,597.01	652.42	43,472	0.32
Ag<=447						446.02	80.36	6,682	1.02

Red notes capping limit selected.

Source: SRK, 2017

Table 14-4: Capping Limits for Resource Areas

Area	Capping Limit				
	Ag (g/t)	Au (g/t)	Cu (%)	Pb (%)	Zn (%)
Angelita	100	1.41	2.32	3.80	18.70
Elissa	405	1.37	1.12	10.45	33.50
Escondida	1,008	2.78	6.60	19.20	24.86
Esperanza	447	3.70	15.00	14.00	30.00
Gallito	397	1.14	6.30	22.30	31.40
Karlita	590	5.35	6.50	14.00	25.00
Mina Central	944	12.00	14.70	25.30	45.00
MascotaPbAg	1,500	11.80	10.00	50.00	30.00
Mascto CuOX	450	6.30	22.50	10.00	25.20
MascotaNoEc	500	5.30	12.75	19.00	28.60
Mascota Sulf	365	3.00	5.00	20.00	40.00
Cuye	400	3.80	8.20	3.30	29.70
CSM	745	1.36	1.36	20.00	25.00
Butz	250	1.10	1.50	11.00	17.00

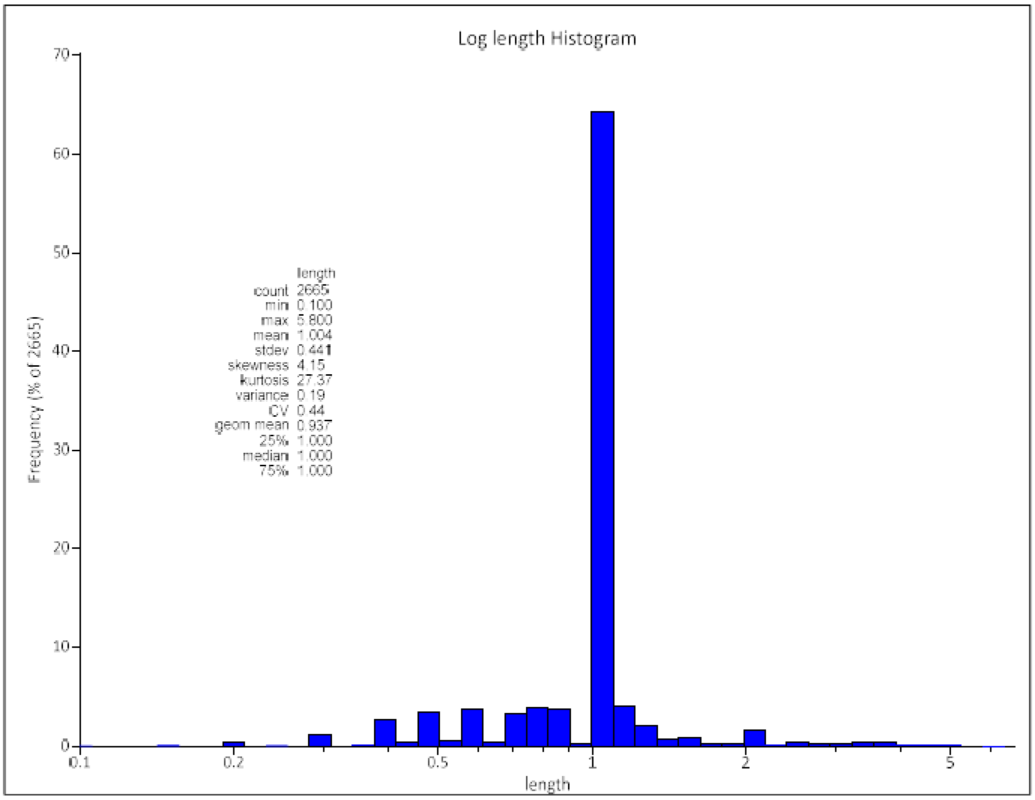
Source: SRK, 2017

14.3.2 Compositing

SRK composited the capped sample data within the geologic wireframes using standard run lengths. These composite lengths vary between various areas, but the analysis is the same to ensure that the composites are representative of the SMU and minimize variance at the scale of the estimation. The compositing analysis generally features a review of the variable sample lengths in a histogram (Table 10-1) as well as review of the sample lengths vs. grade scatter plots (Source: SRK, 2017

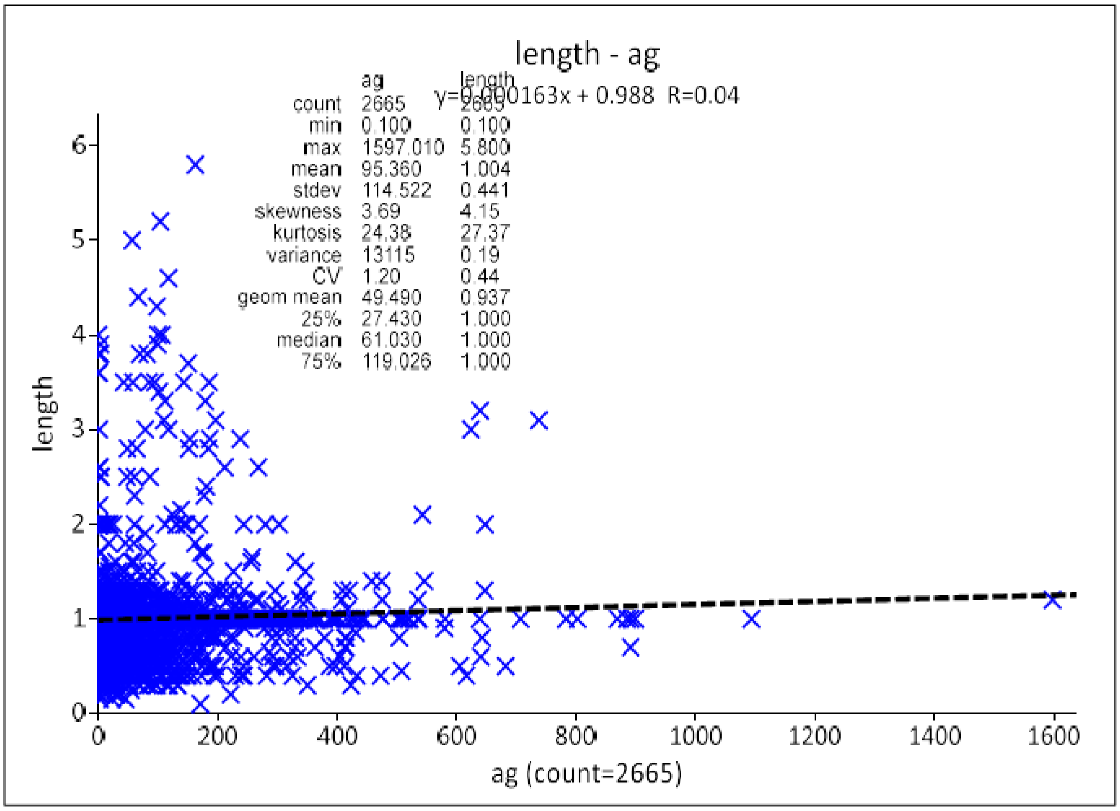
Figure 14-8 *and Source: SRK, 2017*

Figure 14-9*) to ensure that there are not material populations of high grade samples above the nominal composite length. Composite lengths for each area are summarized in Table 14-5.*



Source: SRK, 2017

Figure 14-8: Sample Length Histogram – Mina Central



Source: SRK, 2017

Figure 14-9: Length vs. Ag Plot – Esperanza

Table 14-5: Composite Lengths by Domain/Area

Area	Composite Length (m)
Angelita	2
Elissa	3
Escondida	2
Esperanza	2
Gallito	3
Karlita	2
Mina Central	2
Mascota PbAg	2
Mascota CuOX	2
Mascota NoEc	2
Mascota Sulf	2
Cuye	2
CSM	3
Butz	3

Source: Sierra Metals, 2017

14.4 Density

Density determinations are based on bulk density measurements taken from representative core samples or grab samples in each area. The mine personnel have assigned these bulk densities in each area and provided these to SRK (Table 14-6). SRK was not provided with the individual measurements for the densities, but notes that these densities are apparently in agreement with the tonnages and densities reported by the Chumpe mill.

Table 14-6: Density Assignments by Area

Area	Density (g/cm3)
Masivo Mina Central	
Modelo Esperanza	4.12
Esperanza Cobre	4.53
Esperanza Brecha	2.88
Esperanza Distal	4.04
Esperanza Norte	3.73
Catas	3.68
Antacaca	3.82
Antacaca Sur	3.64
Rosaura	3.64
Oxides Antacaca Sur	3.16
Mascota Polymetallic	3.46
Mascota Oxides Ag Pb	3.16
Mascota Oxides NE	3.16
Mascota Oxides Cu	3.55
Masivos Mina Cachi- Cachi	
Escondida	3.63
Elissa	3.40
Karlita	3.88
Angelita	3.51
Celia	3.63
Privatizadora	3.63
Modelo Escondida A1	3.63
Modelo Escondida Oxides Ag Pb	3.16
Zulma	3.58
Cuerpos Pequenos Central	
Butz	4.21
CSM	3.66
Contacto Occidental	3.63
Cuye	3.54
Contacto Oriental	3.42
Gallito	3.65

Source: Sierra Metals, 2017

14.5 Variogram Analysis and Modelling

SRK conducted detailed variogram analysis to assess orientations and ranges of continuity within the orebodies. Directional variograms were calculated for the primary mineralization areas of Mina Central and Mascota, as the quantities of data and orientations of the orebodies are well-understood. Directional variograms defining an ellipsoid resulted in 3D continuity models for each element. In all cases, appropriate nugget effects were determined from downhole variograms (Source: SRK, 2017

Figure 14-10*) then utilized in the directional variograms (Source: SRK, 2017*

Figure 14-11 *through Source: SRK, 2017*

Figure 14-13*). A linear model of coregionalization was maintained for each continuity model, and the three variograms were plotted on a single graph to define the shape of the ellipsoid (Source: SRK, 2017*

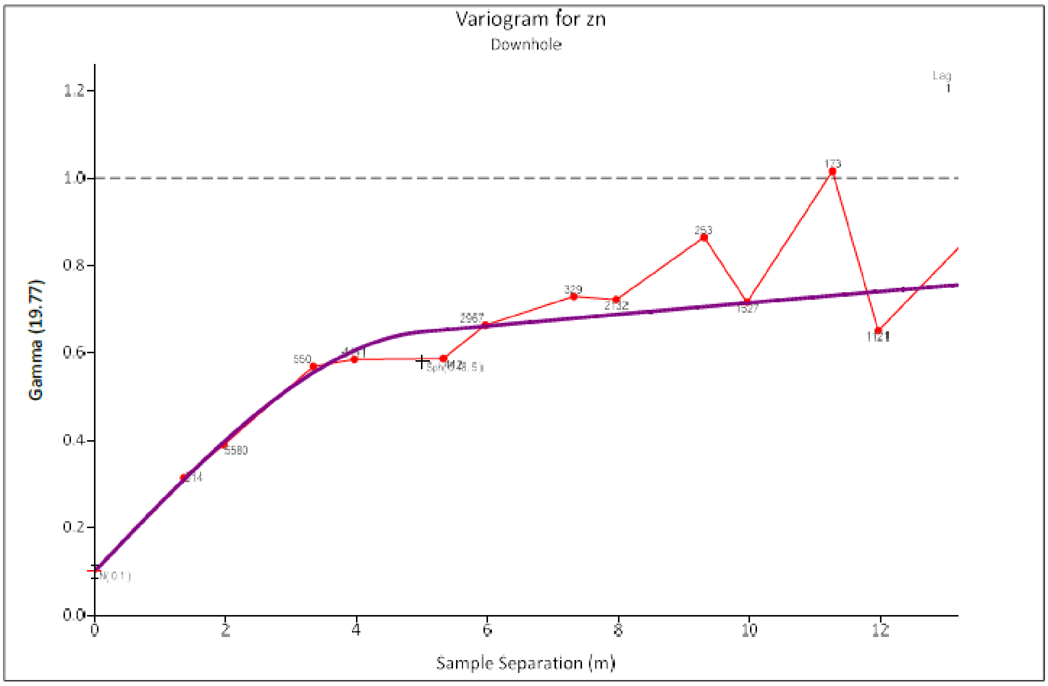
Figure 14-14*). The ellipsoids were reviewed against the data distribution to ensure reasonableness and consistency. The continuity parameters derived from the directional variography in each area and for each metal are used in the ordinary kriging estimation (*

Table 14-7*).*

For Esperanza, omni-directional variograms (Source: SRK, 2017

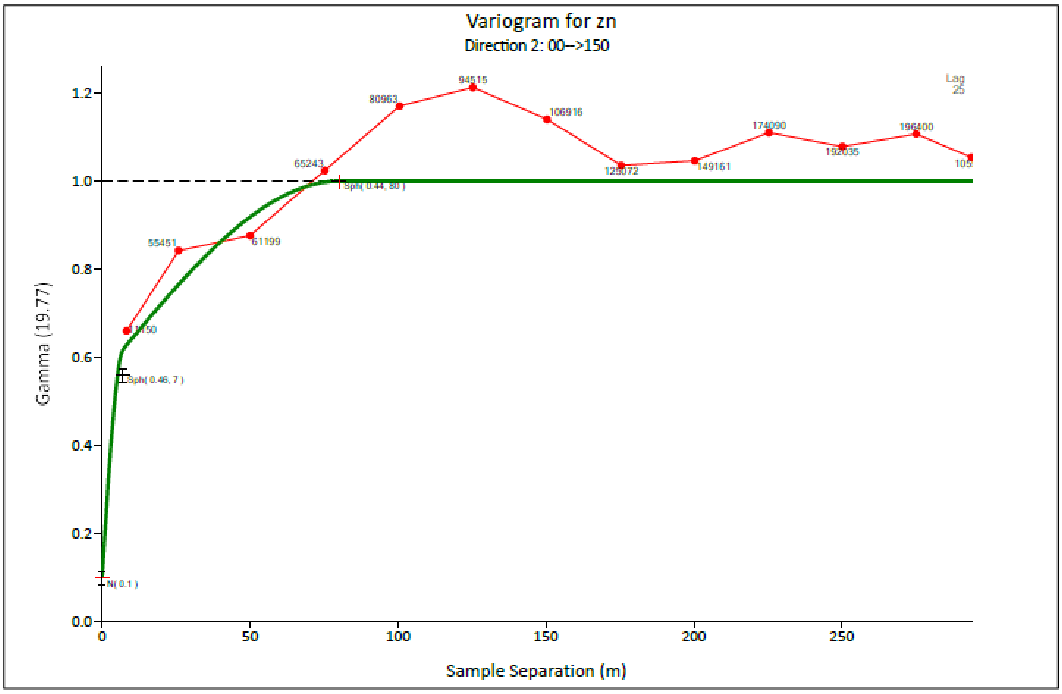
Figure 14-15*) were used as the anastomosing and variable nature of the deposit made directional variograms particularly unstable. For this area, SRK used a general flattened ellipsoid for the interpolation which was based on the orientation of the orebody. In the case of Mascota, ellipsoids generally approximate a sub-vertical "cigar" shape which is consistent with the general morphology of the orebody, although the complexity of the mineralization in Mascota is reflected in various differences in structures within the variograms calculated along these directions.*

SRK notes that certain areas (such as the Cuerpos Pequenos) where well-structured variography was difficult to obtain due to lack of well-spaced sampling were estimated using kriging parameters based on variography from nearby and more robust datasets. For example, the Occidental, Oriental, and CSM orebodies utilized variography from nearby Mina Central.



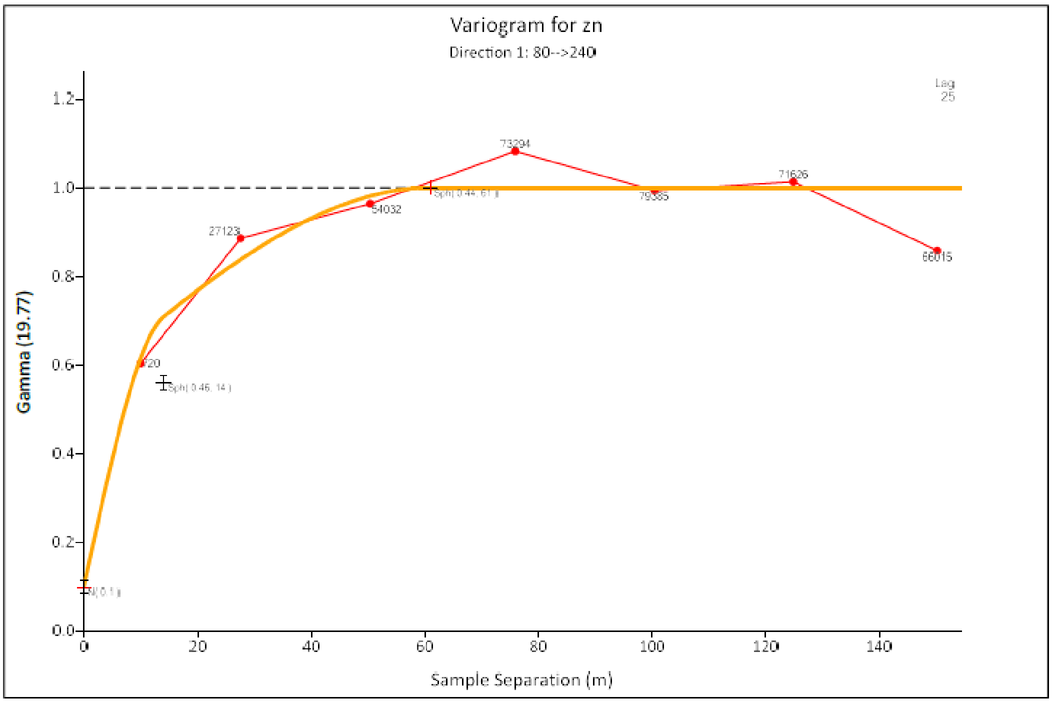
Source: SRK, 2017

Figure 14-10: Downhole Variogram – Mina Central Zn



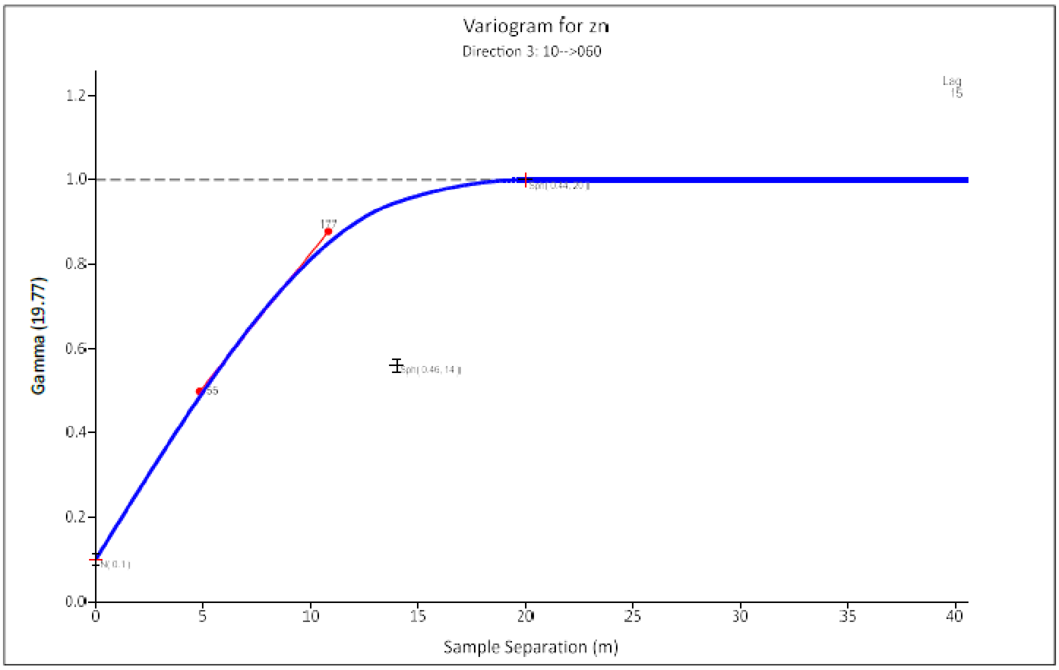
Source: SRK, 2017

Figure 14-11: Directional Variogram – Mina Central Zn Major



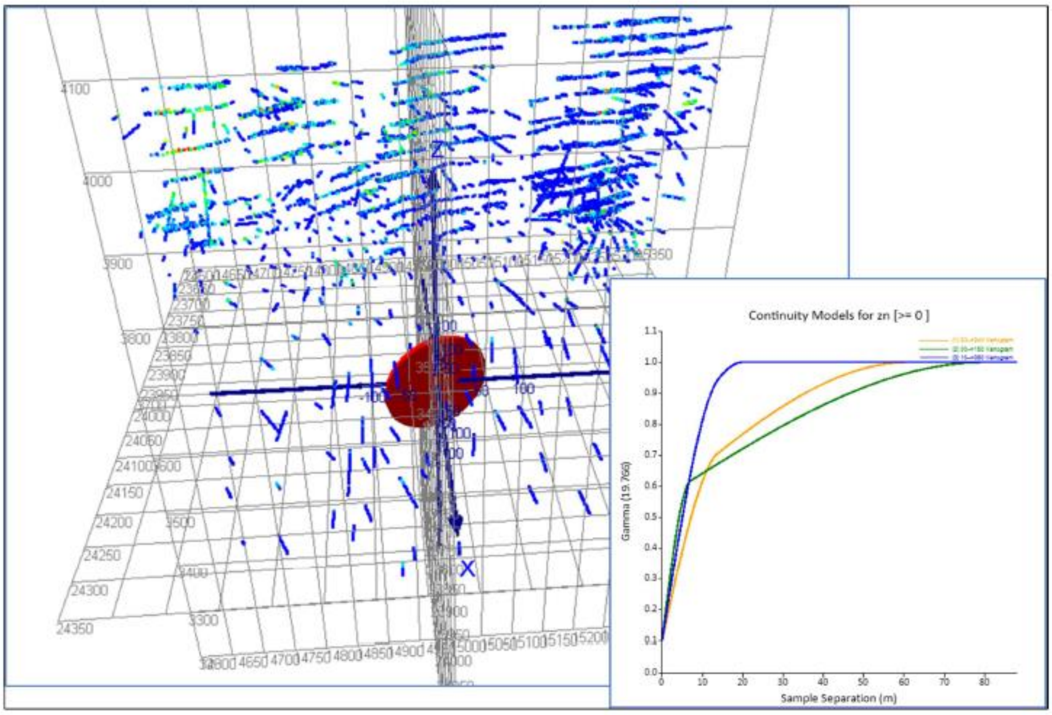
Source: SRK, 2017

Figure 14-12: Direction Variogram – Mina Central Zn Semi-Major



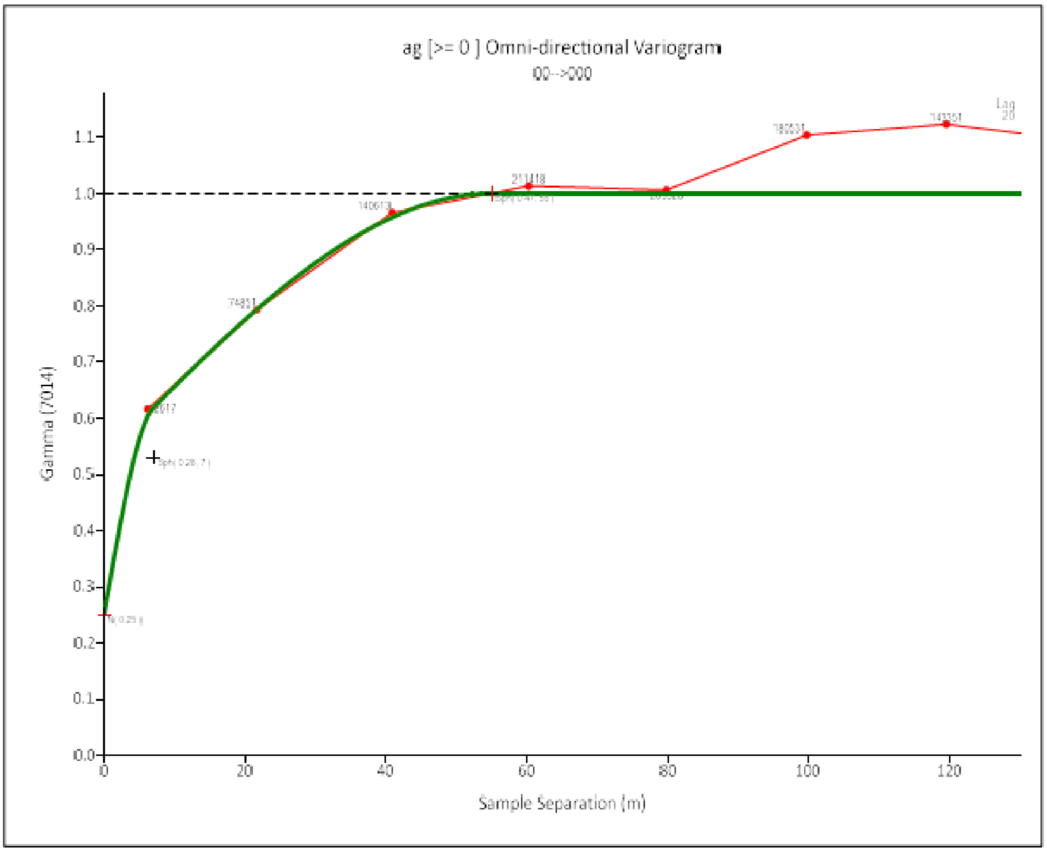
Source: SRK, 2017

Figure 14-13: Directional Variogram – Mina Central Zn Minor



Source: SRK, 2017

Figure 14-14: Continuity Model and Ellipsoid – Mina Central Zn



Source: SRK, 2017

Figure 14-15: Omni-directional Variogram – Esperanza Ag

Table 14-7: Variogram Models by Area

Domain	Variable	Nugget	Orientation	Dip	Dip Direction	Str 1 Sill	Str 1 Range(m)		Str 2 Sill	Str 2 Range(m)	
Mina Central (CSM, Butz, Oriental, Occidental)	Ag	0.3	Major	80	240	0.33	X	7	0.37	X	35
			Semi-Major	0	150		Y	3		Y	24
			Minor	10	60		Z	4		Z	8
	Au	0.2	Major	80	240	0.42	X	10	0.38	X	37
			Semi-Major	0	150		Y	16		Y	81
			Minor	10	60		Z	5		Z	6
	Cu	0.2	Major	80	240	0.60	X	18	0.21	X	34
			Semi-Major	0	150		Y	5		Y	18
			Minor	10	60		Z	4		Z	8
	Pb	0.2	Major	80	240	0.17	X	26	0.63	X	60
			Semi-Major	0	150		Y	6		Y	40
			Minor	10	60		Z	4		Z	15
	Zn	0.1	Major	80	240	0.46	X	14	0.44	X	61
			Semi-Major	0	150		Y	7		Y	80
			Minor	10	60		Z	14		Z	20
Esperanza Polymetallic	Ag	0.25	Major	0	0	0.28	X	7	0.47	X	55
			Semi-Major	0	0		Y	7		Y	55
			Minor	0	0		Z	7		Z	55
	Au	0.32	Major	0	0	0.41	X	12	0.11	X	25
			Semi-Major	0	0		Y	12		Y	25
			Minor	0	0		Z	12		Z	25
	Cu	0.15	Major	0	0	0.22	X	4	0.54	X	45
			Semi-Major	0	0		Y	4		Y	45
			Minor	0	0		Z	4		Z	45
	Pb	0.16	Major	0	0	0.43	X	12	0.52	X	46
			Semi-Major	0	0		Y	12		Y	46
			Minor	0	0		Z	12		Z	46
	Zn	0.21	Major	0	0	0.42	X	10	0.37	X	65
			Semi-Major	0	0		Y	10		Y	65

Domain	Variable	Nugget	Orientation	Dip	Dip Direction	Str 1 Sill	Str 1 Range(m)		Str 2 Sill	Str 2 Range(m)	
			Minor	0	0		Z	10		Z	65
Mascota Oxides PbAg	Ag	0.15	Major	90	0	0.52	X	20	0.37	X	35
			Semi-Major	0	320		Y	10		Y	24
			Minor	0	230		Z	5		Z	8
	Au	0.4	Major	90	0	0.37	X	8	0.38	X	37
			Semi-Major	0	320		Y	6		Y	81
			Minor	0	230		Z	9		Z	6
	Cu	0.2	Major	90	0	0.31	X	36	0.21	X	34
			Semi-Major	0	320		Y	7		Y	18
			Minor	0	230		Z	10		Z	8
	Pb	0.2	Major	90	0	0.23	X	29	0.63	X	60
			Semi-Major	0	320		Y	9		Y	40
			Minor	0	230		Z	7		Z	15
	Zn	0.1	Major	90	0	0.37	X	39	0.44	X	61
			Semi-Major	0	320		Y	7		Y	80
			Minor	0	230		Z	5		Z	20
Mascota Oxides Cu	Ag	0.15	Major	90	0	0.59	X	25	0.26	X	53
			Semi-Major	0	320		Y	13		Y	30
			Minor	0	230		Z	5		Z	11
	Au	0.45	Major	90	0	0.36	X	13	0.58	X	62
			Semi-Major	0	320		Y	27		Y	30
			Minor	0	230		Z	8		Z	15
	Cu	0.17	Major	90	0	0.48	X	24	0.43	X	51
			Semi-Major	0	320		Y	9		Y	22
			Minor	0	230		Z	12		Z	15
	Pb	0.1	Major	90	0	0.52	X	20	0.86	X	86
			Semi-Major	0	320		Y	7		Y	21
			Minor	0	230		Z	5		Z	17
	Zn	0.1	Major	90	0	0.65	X	10	0.51	X	83
			Semi-Major	0	320		Y	10		Y	31
			Minor	0	230		Z	17		Z	24
Mascota Oxides Non-Economic	Ag	0.2	Major	90	0	0.59	X	16	0.21	X	28
			Semi-Major	0	320		Y	5		Y	21
			Minor	0	230		Z	2		Z	5
	Au	0.2	Major	90	0	0.40	X	8	0.44	X	62
			Semi-Major	0	320		Y	6		Y	30
			Minor	0	230		Z	9		Z	15
	Cu	0.2	Major	90	0	0.70	X	17	0.35	X	37
			Semi-Major	0	320		Y	35		Y	40
			Minor	0	230		Z	2		Z	10
	Pb	0.1	Major	90	0	0.88	X	35	0.51	X	51
			Semi-Major	0	320		Y	9		Y	37
			Minor	0	230		Z	5		Z	9
	Zn	0.1	Major	90	0	0.28	X	24	0.36	X	41
			Semi-Major	0	320		Y	23		Y	31
			Minor	0	230		Z	13		Z	18
Elissa	Ag	0.56	Major	0	0	0.13	X	24	0.31	X	50
			Semi-Major	0	0		Y	24		Y	50
			Minor	0	0		Z	24		Z	50
	Au	0.24	Major	0	0	0.45	X	12	0.31	X	35
			Semi-Major	0	0		Y	12		Y	35
			Minor	0	0		Z	12		Z	35
	Cu	0.41	Major	0	0	0.13	X	1111	0.47	X	60
			Semi-Major	0	0		Y	11		Y	60
			Minor	0	0		Z			Z	60
	Pb	0.5	Major	0	0	0.26	X	11	0.24	X	60
			Semi-Major	0	0		Y	11		Y	60
			Minor	0	0		Z	11		Z	60
	Zn	0.46	Major	0	0	0.17	X	10	0.38	X	38
			Semi-Major	0	0		Y	10		Y	38
			Minor	0	0		Z	10		Z	38
Angelita	Ag	0.385	Major	90	50	0.61	X	30	NA	X	
			Semi-Major	0	140		Y	28		Y	
			Minor	0	50		Z	10		Z	
	Au	0.406	Major	90	50	0.59	X	26	NA	X	
			Semi-Major	0	140		Y	24		Y	
			Minor	0	50		Z	8		Z	
	Cu	0.37	Major	90	50	0.63	X	24	NA	X	

Domain	Variable	Nugget	Orientation	Dip	Dip Direction	Str 1 Sill	Str 1 Range(m)		Str 2 Sill	Str 2 Range(m)	
			Semi-Major	0	140		Y	22		Y	
			Minor	0	50		Z	10		Z	
	Pb	0.114	Major	90	50	0.89	X	27	NA	X	
			Semi-Major	0	140		Y	26		Y	
			Minor	0	50		Z	10		Z	
	Zn	0.383	Major	90	50	0.62	X	24	NA	X	
			Semi-Major	0	140		Y	24		Y	
			Minor	0	50		Z	10		Z	
Escondida	Ag	0.342	Major	90	50	0.66	X	13	NA	X	
			Semi-Major	0	140		Y	15		Y	
			Minor	0	50		Z	8		Z	
	Au	0.491	Major	90	20	0.59	X	15	NA	X	
			Semi-Major	0	110		Y	16		Y	
			Minor	0	20		Z	8		Z	
	Cu	0.072	Major	90	30	0.63	X	12	NA	X	
			Semi-Major	0	120		Y	12		Y	
			Minor	0	30		Z	3		Z	
	Pb	0.315	Major	90	40	0.89	X	12	NA	X	
			Semi-Major	0	130		Y	12		Y	
			Minor	0	40		Z	3		Z	
	Zn	0.324	Major	90	10	0.62	X	12	NA	X	
			Semi-Major	0	100		Y	12		Y	
			Minor	0	10		Z	4		Z	

(1) Includes all areas of Esperanza
Source: SRK, 2017

14.6 Block Model

Block models were created by SRK in Maptek Vulcan™ format or, in the case of the Cachi-Cachi models by SMCSA in Datamine Studio RM™ format. Sub-blocking was utilized to approximate geologic contacts. SRK produced a single block model for the Mina Central Area, flagged using codes for each area or discrete orebody. Individual models were created for Elissa, CSM, Butz, Angelita, Celia, Escondida, Karlita, Privatizadora, and Zulma.

Blocks were flagged by mineralization vs. waste, area, and domain. Blocks were coded appropriately with corresponding densities.

Coding and domains for the block models are summarized in Table 14-8. Details for the block models are summarized in Table 14-9.

Table 14-8: Domain and Area Codes for Block Models

Area	Area Code	Domain	Domain
Mina Central	1	1	Mina Central
		2	Antacaca Sur Oxidos
Esperanza	2	3	Esperanza
		4	Esperanza Breccia 1
		5	Esperanza Breccia 2
		6	Esperanza Cobre
		7	Esperanza Norte
		8	Esperanza Distal
		9	Esperanza Pirita
Mascota	3	10	Mascota Oxide PbAg
		11	MascotaOxide NotEconomic
		12	MascotaOxide Cu
		13	Mascota Polymetallic North
		14	Mascota Polymetallic East
		15	Mascota Polymetallic East 2
		16	Mascota Polymetallic South
Cuye	4	17	Cuye

		18	Cuye Pirita
Cuerpos Pequenos	5	19	Gallito
	6	20	Oriental
		21	Occidental
		22	Occidental Oxide
	7	23	Butz
Cachi-Cachi	8	24	Angelica
		25	Karlita
		26	Celia
		27	Escondida
		28	Privatizadora
		29	Zulma

Source: SRK, 2017

Table 14-9: Block Model Parameters

Area	Orientation	Origin (Local m)	Extent (Local m)	Block Size (Min m)	Block Size (Max m) Mineralization	Block Size (Max m) Waste	Vulcan Rotation (º)
Mina Central Area (1)	X	23,390	24,842	1.00	4	12	0
	Y	15,800	16,148	1.00	4	12	0
	Z	3,400	4,204	1.00	4	12	150
Elissa	X	23,850	24,006	0.50	4	12	0
	Y	16,452	16,512	0.50	4	12	0
	Z	3,850	4,150	0.50	4	12	50
CSM	X	23,670	23,790	0.50	4	12	0
	Y	14,890	15,010	0.50	4	12	0
	Z	3,774	4,050	0.50	4	12	150
Butz	X	23,866	23,938	1.00	4	12	0
	Y	15,203	15,383	1.00	4	12	0
	Z	38,690	38,810	1.00	4	12	29
Angelita	X	24,076	24,216	1.33	4	4	0
	Y	16,525	16,657	1.33	4	4	0
	Z	4,030	4,222	1.33	4	4	0
Celia	X	24,074	24,154	1.33	4	4	0
	Y	16,579	16,631	1.33	4	4	0
	Z	4,060	4,176	1.33	4	4	0
Escondida	X	23,750	23,842	1.33	4	4	0
	Y	16,370	16,458	1.33	4	4	0
	Z	3,830	4,074	1.33	4	4	0
Karlita	X	24,010	24,102	1.33	4	4	0
	Y	16,584	16,688	1.33	4	4	0
	Z	3,980	4,172	1.33	4	4	0
Privatizadora	X	23,750	23,822	1.33	4	4	0
	Y	16,324	16,396	1.33	4	4	0
	Z	3,890	3,956	1.33	4	4	0
Zulma	X	23,777	23,790	1.00	2	2	0
	Y	16,387	16,411	1.00	2	2	0
	Z	4,056	4,077	0.02	2	2	0

Source: SRK, 2017

(1) *Includes Catas, Antacaca, Rosaura, Antacaca Sur, Esperanza, Mascota, Cuye, Gallitos, Oriental, Occidental Areas.*

14.7 Estimation Methodology

SRK and SMCSA utilized either Ordinary Kriging (OK) or Inverse Distance Weighting (IDW) to interpolate grade in all resource areas. The decision on the estimation type to use was based on the confidence of the geologist in the ability of the variography to reflect the continuity of grade within the orebody as well as the need for some measure of declustering based on data spacing. In some cases where orebodies could not be related to those with reasonable variograms, an inverse distance method was utilized with a power of 2 or 3. The estimation type and sample selection criteria was chosen to achieve a reasonably reliable local estimation of grade that does not bias the global resource estimation. SRK generally utilized the geology models as hard boundaries in the estimation and estimated blocks within these boundaries using the capped composites in the same boundaries. Ranges for interpolation were derived from omni-directional variogram analysis or continuity assumptions from site geologists based on underground mining observations. All estimations utilized both channel and drilling samples, with the exception of Cuye, which only features drilling. SRK utilized three nested estimation passes for each area. SRK weighted the estimations by either length of the composites or the horizontal thickness of the composites as appropriate, depending on the orientation of the orebody and the relationship to the drilling angles. Relevant details for specific areas are summarized below, and the complete estimation parameters are summarized in

Table 14-10: Estimation Parameters

Area	Interpolation	Pass	Bearing (Z)	Plunge (Y)	Dip (X)	Major	Semi-Major	Minor	Min Comp	Max Comp	Max/DH	Max/Oct
Mina Central Sulfides (1)	OK, ID3	1	VAR	VAR	VAR	25	25	VAR	5	15	2	2
		2	VAR	VAR	VAR	50	50	VAR	3	15	2	2
		3	VAR	VAR	VAR	100	100	VAR	1	15	-	2
Mina Central Oxides (Antacaca Sur Only)	ID3	1	150	0	-85	25	25	5	5	15	2	-
		2	150	0	-85	50	50	10	3	15	2	-
		3	150	0	-85	100	100	20	1	15	-	-
Esperanza Polymetallic (1)	OK, ID3	1	155	0	-80	25	25	5	5	15	2	2
		2	155	0	-80	50	50	10	3	15	2	2
		3	155	0	-80	100	100	20	1	15	-	2
Esperanza Pyrite	ID3	1	155	0	-80	25	25	5	5	15	2	2
		2	155	0	-80	50	50	10	3	15	2	2
		3	155	0	-80	100	10	20	1	15	-	2
Mascota Pb Ag Oxides	OK, ID3	1	140	-90	-90	25	12.5	5	5	15	2	2
		2	140	-90	-90	50	25	10	3	15	2	2
		3	140	-90	-90	100	50	20	1	15	-	2
Mascota Cu Oxides	OK, ID3	1	140	-90	-90	25	12.5	5	5	15	2	2
		2	140	-90	-90	50	25	10	3	15	2	2
		3	140	-90	-90	100	50	20	1	15	-	2
Mascota Non-Econ Oxides	OK, ID3	1	140	-90	-90	25	12.5	5	5	15	2	2
		2	140	-90	-90	50	25	10	3	15	2	2
		3	140	-90	-90	100	50	20	1	15	-	2
Mascota Sulfides	OK, ID3	1	VAR	VAR	VAR	25	12.5	5	5	15	2	2
		2	VAR	VAR	VAR	50	25	10	3	15	2	2
		3	VAR	VAR	VAR	100	50	20	1	15	-	2
Cuye	OK, ID3	1	VAR	VAR	VAR	25	25	VAR	5	15	2	2
		2	VAR	VAR	VAR	50	50	VAR	3	15	2	2
		3	VAR	VAR	VAR	100	100	VAR	1	15	-	2
Gallitos	OK, ID3	1	140	-90	-90	25	25	5	5	15	2	2
		2	140	-90	-90	50	50	10	3	15	2	2
		3	140	-90	-90	100	100	20	1	15	-	2
CSM	OK, ID3	1	60	-80	0	25	25	5	5	15	2	2
		2	60	-80	0	50	50	10	3	15	2	2
		3	60	-80	0	100	100	20	1	15	-	2
Butz	OK, ID3	1	120	0	80	25	25	5	5	15	2	2
		2	120	0	80	50	50	10	3	15	2	2
		3	120	0	80	100	100	20	1	15	-	2
Angelica	OK, ID2	1	50	0	0	28	26	10	VAR	VAR	VAR	VAR
		2	50	0	0	56	52	20	VAR	VAR	VAR	VAR
		3	50	0	0	84	78	30	VAR	VAR	VAR	VAR
Karlita	OK, ID2	1	0	0	0	20	20	10	VAR	VAR	VAR	VAR

Area	Interpolation	Pass	Bearing (Z)	Plunge (Y)	Dip (X)	Major	Semi-Major	Minor	Min Comp	Max Comp	Max/DH	Max/Oct
		2	0	0	0	40	40	20	VAR	VAR	VAR	VAR
		3	0	0	0	60	60	30	VAR	VAR	VAR	VAR
Celia	OK, ID2	1	-142	0	-90	11	7	4	VAR	VAR	VAR	VAR
		2	-142	0	-90	22	14	8	VAR	VAR	VAR	VAR
		3	-142	0	-90	33	21	16	VAR	VAR	VAR	VAR
Escondida	OK, ID2	1	20	0	0	13	12	5	VAR	VAR	VAR	VAR
		2	20	0	0	26	24	10	VAR	VAR	VAR	VAR
		3	20	0	0	39	36	15	VAR	VAR	VAR	VAR
Privatizadora	OK, ID2	1	-37	-39	12	16	16	8	VAR	VAR	VAR	VAR
		2	-37	-39	12	32	32	16	VAR	VAR	VAR	VAR
		3	-37	-39	12	64	64	32	VAR	VAR	VAR	VAR
Zulma	OK, ID2	1	20	0	0	13	12	5	VAR	VAR	VAR	VAR
		2	20	0	0	26	24	10	VAR	VAR	VAR	VAR
		3	20	0	0	38	36	15	VAR	VAR	VAR	VAR

Source: SRK, 2017

.

Table 14-10: Estimation Parameters

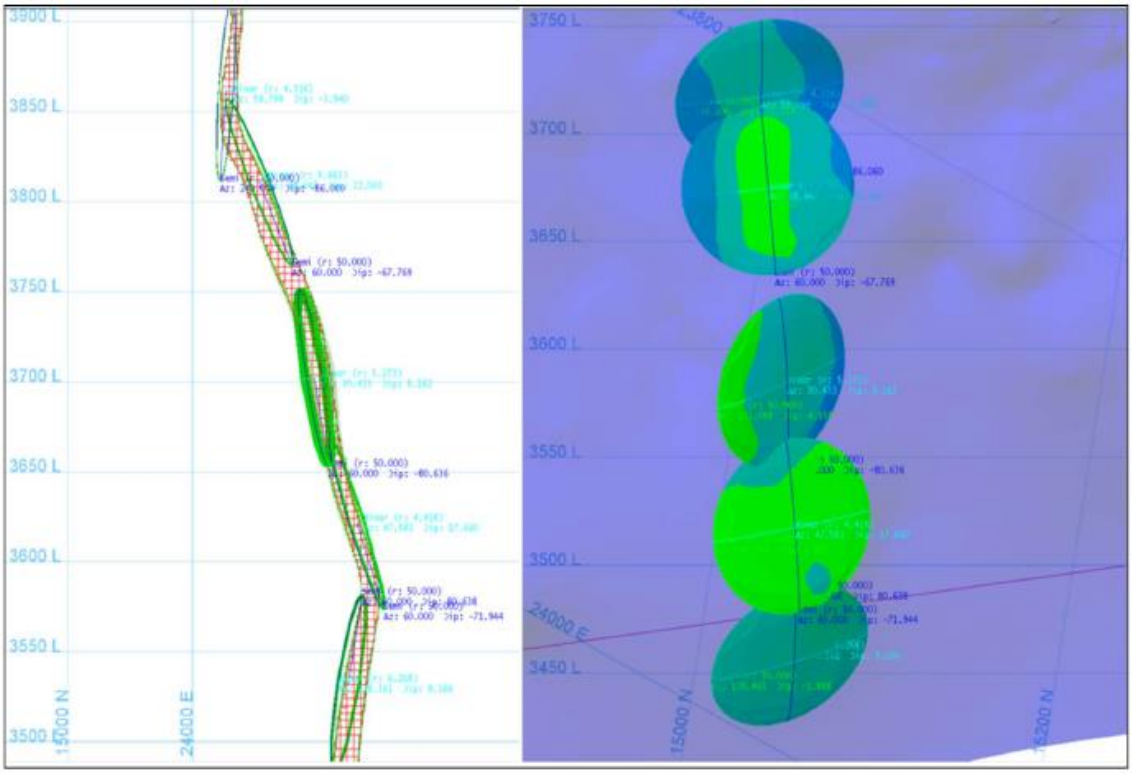
Area	Interpolation	Pass	Bearing (Z)	Plunge (Y)	Dip (X)	Major	Semi-Major	Minor	Min Comp	Max Comp	Max/DH	Max/Oct
Mina Central Sulfides (1)	OK, ID3	1	VAR	VAR	VAR	25	25	VAR	5	15	2	2
		2	VAR	VAR	VAR	50	50	VAR	3	15	2	2
		3	VAR	VAR	VAR	100	100	VAR	1	15	-	2
Mina Central Oxides (Antacaca Sur Only)	ID3	1	150	0	-85	25	25	5	5	15	2	-
		2	150	0	-85	50	50	10	3	15	2	-
		3	150	0	-85	100	100	20	1	15	-	-
Esperanza Polymetallic (1)	OK, ID3	1	155	0	-80	25	25	5	5	15	2	2
		2	155	0	-80	50	50	10	3	15	2	2
		3	155	0	-80	100	100	20	1	15	-	2
Esperanza Pyrite	ID3	1	155	0	-80	25	25	5	5	15	2	2
		2	155	0	-80	50	50	10	3	15	2	2
		3	155	0	-80	100	10	20	1	15	-	2
Mascota Pb Ag Oxides	OK, ID3	1	140	-90	-90	25	12.5	5	5	15	2	2
		2	140	-90	-90	50	25	10	3	15	2	2
		3	140	-90	-90	100	50	20	1	15	-	2
Mascota Cu Oxides	OK, ID3	1	140	-90	-90	25	12.5	5	5	15	2	2
		2	140	-90	-90	50	25	10	3	15	2	2
		3	140	-90	-90	100	50	20	1	15	-	2
Mascota Non-Econ Oxides	OK, ID3	1	140	-90	-90	25	12.5	5	5	15	2	2
		2	140	-90	-90	50	25	10	3	15	2	2
		3	140	-90	-90	100	50	20	1	15	-	2
Mascota Sulfides	OK, ID3	1	VAR	VAR	VAR	25	12.5	5	5	15	2	2
		2	VAR	VAR	VAR	50	25	10	3	15	2	2
		3	VAR	VAR	VAR	100	50	20	1	15	-	2
Cuye	OK, ID3	1	VAR	VAR	VAR	25	25	VAR	5	15	2	2
		2	VAR	VAR	VAR	50	50	VAR	3	15	2	2
		3	VAR	VAR	VAR	100	100	VAR	1	15	-	2
Gallitos	OK, ID3	1	140	-90	-90	25	25	5	5	15	2	2
		2	140	-90	-90	50	50	10	3	15	2	2
		3	140	-90	-90	100	100	20	1	15	-	2
CSM	OK, ID3	1	60	-80	0	25	25	5	5	15	2	2
		2	60	-80	0	50	50	10	3	15	2	2
		3	60	-80	0	100	100	20	1	15	-	2
Butz	OK, ID3	1	120	0	80	25	25	5	5	15	2	2
		2	120	0	80	50	50	10	3	15	2	2
		3	120	0	80	100	100	20	1	15	-	2
Angelica	OK, ID2	1	50	0	0	28	26	10	VAR	VAR	VAR	VAR
		2	50	0	0	56	52	20	VAR	VAR	VAR	VAR
		3	50	0	0	84	78	30	VAR	VAR	VAR	VAR
Karlita	OK, ID2	1	0	0	0	20	20	10	VAR	VAR	VAR	VAR

Area	Interpolation	Pass	Bearing (Z)	Plunge (Y)	Dip (X)	Major	Semi-Major	Minor	Min Comp	Max Comp	Max/DH	Max/Oct
		2	0	0	0	40	40	20	VAR	VAR	VAR	VAR
		3	0	0	0	60	60	30	VAR	VAR	VAR	VAR
Celia	OK, ID2	1	-142	0	-90	11	7	4	VAR	VAR	VAR	VAR
		2	-142	0	-90	22	14	8	VAR	VAR	VAR	VAR
		3	-142	0	-90	33	21	16	VAR	VAR	VAR	VAR
Escondida	OK, ID2	1	20	0	0	13	12	5	VAR	VAR	VAR	VAR
		2	20	0	0	26	24	10	VAR	VAR	VAR	VAR
		3	20	0	0	39	36	15	VAR	VAR	VAR	VAR
Privatizadora	OK, ID2	1	-37	-39	12	16	16	8	VAR	VAR	VAR	VAR
		2	-37	-39	12	32	32	16	VAR	VAR	VAR	VAR
		3	-37	-39	12	64	64	32	VAR	VAR	VAR	VAR
Zulma	OK, ID2	1	20	0	0	13	12	5	VAR	VAR	VAR	VAR
		2	20	0	0	26	24	10	VAR	VAR	VAR	VAR
		3	20	0	0	38	36	15	VAR	VAR	VAR	VAR

Source: SRK, 2017

Mina Central

For Mina Central, the orientation of the search ellipsoid is varied as a function of the hangingwall and footwall surfaces of the orebody using varying local anisotropy (VLA). In this case, VLA is applied using estimation of the average orientation of triangle faces from a hangingwall and footwall surface (defined using the geology model) as well as the distance between these surfaces. These values are estimated into the block model as bearing, dip, and plunge as well as thickness (minor). These define the orientation and thickness of the flattened ellipsoid as shown in in Figure 14-16. Octant restrictions were also utilized to ensure that data for the estimation is taken from a spatially-representative area to mitigate the potential impact of making an estimate entirely based on highly-clustered channel sample data.



Source: SRK, 2017

Figure 14-16: Example of LLVA for Mina Central Area

Esperanza

SRK estimated Esperanza using a sub-vertical flattened search ellipsoid, with orientations and dimensions based on the morphology of the orebody. Ranges for the ellipsoids were based on the variograms obtained through omni-directional variogram analysis of the Ag, Zn, and Cu capped and composited values, which exhibited the least variance. Although Esperanza features a variety of mineralogical textures and grade populations based on logging, there is currently not sufficient evidence for site geologists to discretize these areas as hard boundaries for the purposes of resource estimation.

Mascota

Mascota was estimated with semi-vertical cigar-shaped ellipsoids. Each domain within the larger body was estimated separately due to genetic or mineralogical features that site geologic personnel suggest as unique. SRK has visited a number of areas within the Mascota orebody and agrees with this assessment. An identical ellipsoid was utilized for each oxide area based on the general distribution of the Mascota orebody, and the ellipsoids varied for the sulfide areas depending on orientation.

Cachi-Cachi (Excl. Elissa)

SMCSA geologists estimated six areas in Cachi-Cachi using a combination of OK and IDW methods. A successive three-pass estimation was used, with successively less stringent requirements on samples. Isotropic search ellipsoids were utilized for each area, a reasonable approach given the highly variable orientations and thicknesses in Cachi-Cachi. They also utilized highly variable sample selection criteria by metal and pass, based on results observed during validation and observations from the mine areas. SRK notes that this method of sample selection varies from that employed by SRK on the models generated independently.

The detailed sample selection criteria for Cachi-Cachi is summarized in

Table 14-11.

Table 14-11: Sample Selection Criteria for Cachi-Cachi

Area	Parameter	Pass 1 #Comp.	Pass 2 #Comp.	Pass 3 #Comp.	Max / DH
Angelita					
Ag	Min	3	3	2	2
Ag	Max	8	8	6	
Pb	Min	1	1	1	2
Pb	Max	6	5	4	
Cu	Min	2	1	1	2
Cu	Max	6	6	6	
Zn	Min	14	14	14	1
Zn	Max	25	25	24	
Au	Min	3	3	3	NA
Au	Max	16	16	16	
Karlita					
Ag	Min	18	12	2	NA
Ag	Max	24	20	12	
Pb	Min	10	8	2	NA
Pb	Max	24	18	12	
Cu	Min	2	2	2	NA
Cu	Max	6	6	6	
Zn	Min	4	4	2	3
Zn	Max	16	16	12	
Au	Min	8	8	3	NA
Au	Max	16	16	16	
Celia					
Ag	Min	3	3	2	NA
Ag	Max	24	24	6	
Pb	Min	2	2	2	NA
Pb	Max	6	6	12	
Cu	Min	6	6	2	1
Cu	Max	18	16	12	
Zn	Min	6	3	3	2
Zn	Max	16	16	16	
Au	Min	3	2	2	NA
Au	Max	16	16	16	
Escondida/Zulma					
Ag	Min	4	4	3	2
Ag	Max	16	16	16	
Pb	Min	6	6	3	2
Pb	Max	16	16	16	
Cu	Min	2	2	3	NA
Cu	Max	6	6	6	
Zn	Min	3	3	3	NA
Zn	Max	16	16	16	
Au	Min	3	3	3	1
Au	Max	20	20	16	
Privatizadora					
Ag	Min	5	5	3	NA
Ag	Max	10	10	10	
Pb	Min	3	3	3	NA
Pb	Max	7	7	8	
Cu	Min	3	3	3	NA
Cu	Max	10	10	8	
Zn	Min	3	3	3	NA
Zn	Max	10	10	8	
Au	Min	1	1	2	NA
Au	Max	8	8	8	

Source: Sierra Metals, 2017

Elissa

SRK estimated the Elissa orebody using a flattened ellipsoid, oriented sub-vertically consistent with the geology model. A single orientation was used. Elissa features a significant amount of channel samples compared to drilling that are used to estimate the Mineral Resources, and as a result there exists a possibility for the estimation to be biased towards the clustered channel samples. To mitigate this risk, SRK used octant restrictions to ensure that data would be selected in a spatially representative manner so that the channel sample grades would not be extrapolated significant distances without support from the drilling.

Cuye

SRK estimated Cuye using IDW only, as the sample spacing is relatively wide for this area compared to others, and the orebody is currently not as well-understood as others. Classification of the Mineral Resource for Cuye reflect this as well. SRK did use VLA for the interpolation, based on well-defined hangingwall and footwall surfaces from drilling.

Cuerpos Pequenos

SRK estimated the orebodies comprising the Cuerpos Pequenos areas using a variety of ellipsoid shapes and dimensions, which generally approximate the orientation of the individual orebodies. SRK notes that the orebodies themselves can locally be highly variable in their orientation and thickness.

14.8 Model Validation

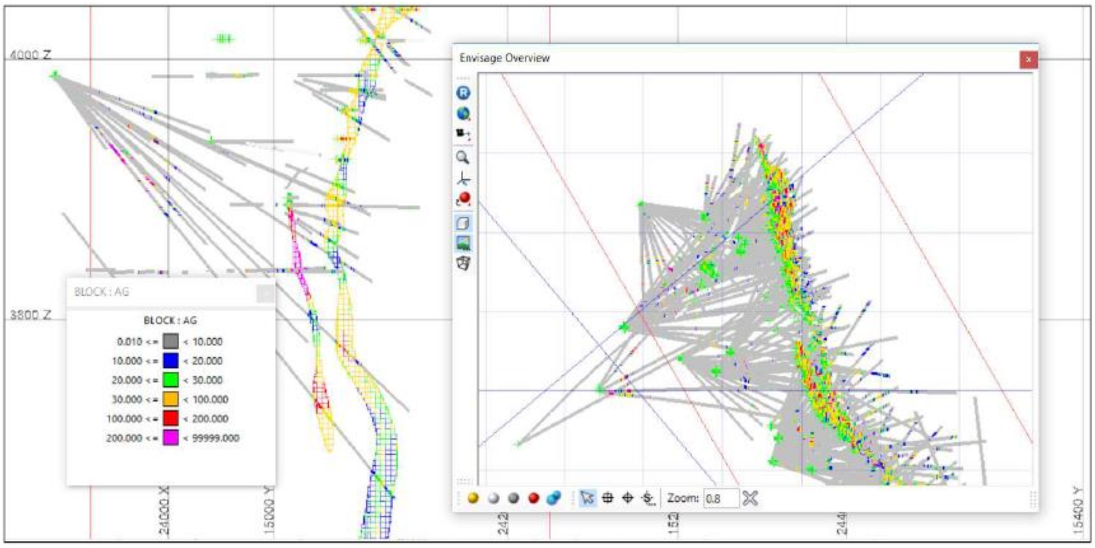
All models have been validated using a minimum of visual and statistical measures to assess the probability of conditional bias in the estimation. In the case of Esperanza, swath plots were also generated to validate the estimation. SRK is of the opinion that the validation of the models is sufficient for relying upon them as Mineral Resources, but notes that the ultimate validation of the models is in the fact that the mine continuously produces material from the areas modelled and projected by the resource estimations. SRK notes that reconciliation of the production to the resource models is not a consistent part of the current validation methods, but is under consideration by Sierra Metals for future models.

14.8.1 Visual Comparison

Both SRK and SMCSA have conducted visual comparisons of the composite grades to the block grades in each model. In general, block grade distributions match well in level and cross section views through the various orebodies. Some of these examples are shown in Source: SRK, 2017

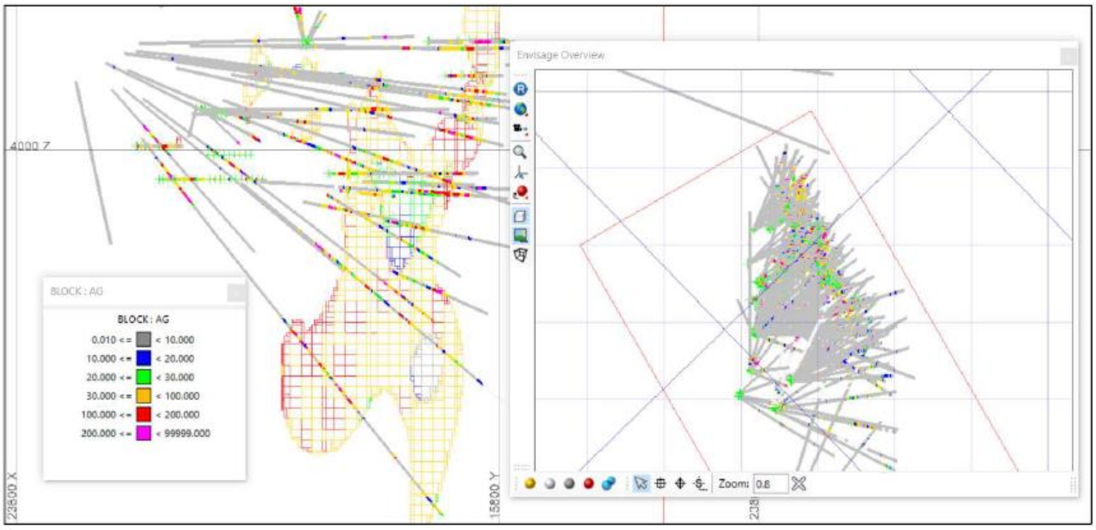
Figure 14-17 *through Source: SRK, 2017*

Figure 14-19*.*



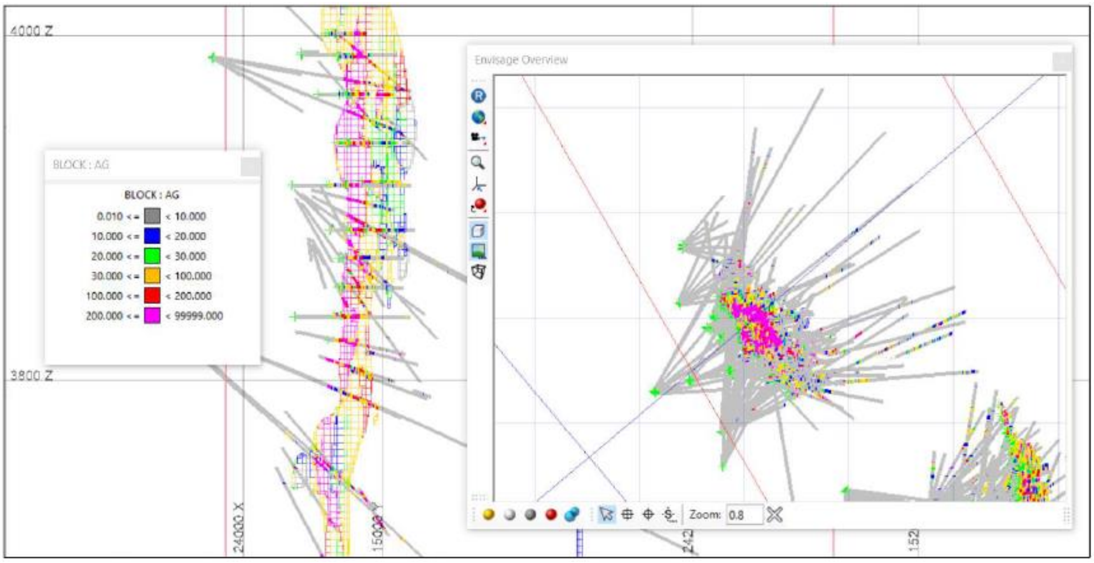
Source: SRK, 2017

Figure 14-17: Visual Block to Composite Comparison – Mina Central



Source: SRK, 2017

Figure 14-18: Visual Block to Composite Comparison – Esperanza



Source: SRK, 2017

Figure 14-19: Visual Block to Composite Comparison – Mascota

14.8.2 Comparative Statistics

SRK compared the estimated block grades to the composite grades utilized in the estimation, for the same zones and volumes to ensure that both are representative. SRK generally weighted the statistics by composite length or declustering weight for the composites, and by volume for the blocks. The comparisons for each area are shown in Table 14-12 through Table 14-22. The tabulated results show that, in almost all cases, the blocks feature a lower or similar mean to the composite grades. Where blocks locally exceed the composite grades, SRK notes that these appear to be limited occurrences, and generally the potentially over-estimated areas are in areas which have been mined previously. SRK is of the opinion that these results show that there is reasonable agreement between the models and the supporting data, with low risk for global over-estimation.

In select cases where the channel samples gave a bias due to clustering in high or low grade areas, SRK used a cell declustering method to more appropriately weight the composites for these statistical comparisons. Cells for the declustering were based on the widest drill spacing in a given area, and were evaluated on cell size vs. mean plots. In most cases, this mitigates the apparent bias between higher grade composites and lower grade blocks, as the clustered and higher grade channel sample data may affect comparably fewer blocks despite their impact on the naïve means in the composites statistics. Conversely SRK noted other areas where channel samples in development may have been in an area known to be low grade for one element (ex. Cu in Elissa) but the wider-spaced drilling encounters higher grades of Cu and affects comparably more locks. This is the opposite effect to clustered high grades but should be equally reflected in the statistical comparison.

Table 14-12: Mina Central Statistical Comparison

Data	Column	Count	Max	Mean	%Diff
Blocks	Agok	240,280	463.00	30.51	-24%
Composites (Declus)	Agok	7,788	944.00	40.18	
Blocks	Pbok	240,280	14.50	0.32	-38%
Composites (Declus)	Pbok	7,788	21.75	0.51	
Blocks	Cuok	240,280	12.60	0.77	-5%
Composites (Declus)	Cuok	7,788	14.70	0.81	
Blocks	Znok	240,280	33.71	1.494	-27%
Composites (Declus)	Znok	7,788	36.88	2.04	
Blocks	Auok	240,280	8.05	0.48	-11%
Composites (Declus)	Auok	7,788	12.00	0.54	

Source: SRK, 2017

Table 14-13: Esperanza Statistical Comparison

Data	Column	Count	Max	Mean	%Diff
Blocks	Agok	63,431	439.90	80.03	-9%
Composites (Declus)	Agok	1,633	450.00	87.92	
Blocks	Pbok	63,431	11.81	1.41	-21%
Composites (Declus)	Pbok	1,633	14.00	1.80	
Blocks	Cuok	63,431	10.67	2.13	-3%
Composites (Declus)	Cuok	1,633	15.00	2.20	
Blocks	Znok	63,431	24.29	3.55	-18%
Composites (Declus)	Znok	1,633	30.00	4.32	
Blocks	Auok	63,431	2.87	0.54	-6%
Composites (Declus)	Auok	1,633	3.70	0.57	

Source: SRK, 2017

Table 14-14: Cuye Statistical Comparison

Data	Column	Count	Max	Mean	%Diff
Blocks	Agid	46,865	380.10	56.75	-4%
Composites	Agid	121	380.10	58.81	
Blocks	Pbid	46,865	2.49	0.29	-7%
Composites	Pbid	121	2.79	0.31	
Blocks	Cuid	46,865	6.85	1.90	-5%
Composites	Cuid	121	7.14	1.99	
Blocks	Znid	46,865	29.10	2.36	-3%
Composites	Znid	121	29.10	2.43	
Blocks	Auid	46,865	3.08	0.60	-15%
Composites	Auid	121	3.80	0.71	

Source: SRK, 2017

Table 14-15: Mascota Pb, Ag Ox Statistical Comparison

Data	Column	Count	Max	Mean	%Diff
Blocks	Agok	21,692	1,277.00	333.30	-7%
Composites	Agok	1,612	1,500.00	357.20	
Blocks	Pbok	21,692	41.56	11.84	-2%
Composites	Pbok	1,612	50.00	12.09	
Blocks	Cuok	21,692	5.59	0.47	2%
Composites	Cuok	1,612	10.00	0.46	
Blocks	Znok	21,692	17.91	0.68	5%
Composites	Znok	1,612	26.33	0.65	
Blocks	Auok	21,692	10.34	2.51	1%
Composites	Auok	1,612	11.80	2.48	

Source: SRK, 2017

Table 14-16: Mascota Cu Ox Statistical Comparison

Data	Column	Count	Max	Mean	%Diff
Blocks	Agok	16,644	410.10	40.14	-7%
Composites	Agok	808	450.00	42.94	
Blocks	Pbok	16,644	8.47	0.85	3%
Composites	Pbok	808	10.00	0.82	
Blocks	Cuok	16,644	21.84	6.80	-4%
Composites	Cuok	808	22.50	7.05	
Blocks	Znok	16,644	23.49	4.74	-3%
Composites	Znok	808	25.20	4.90	
Blocks	Auok	16,644	2.89	0.21	-13%
Composites	Auok	808	6.30	0.24	

Source: SRK, 2017

Table 14-17: Mascota Pb, Ag Low-Grade Statistical Comparison

Data	Column	Count	Max	Mean	%Diff
Blocks	Agok	39,296	314.70	41.93	-18%
Composites	Agok	2,232	500.00	51.25	
Blocks	Pbok	39,296	12.46	1.02	-14%
Composites	Pbok	2,232	19.00	1.20	
Blocks	Cuok	39,296	9.89	0.76	1%
Composites	Cuok	2,232	12.75	0.76	
Blocks	Znok	39,296	28.21	3.37	14%
Composites	Znok	2,232	28.60	2.96	
Blocks	Auok	39,296	4.36	0.36	-13%
Composites	Auok	2,232	5.30	0.42	

Source: SRK, 2017

Table 14-18: Mascota Polymetallic Sulfide Statistical Comparison

Data	Column	Count	Max	Mean	%Diff
Blocks	Agok	10,770	333.80	115.60	1%
Composites	Agok	185	475.00	114.60	
Blocks	Pbok	10,770	14.59	1.66	-21%
Composites	Pbok	185	17.50	2.09	
Blocks	Cuok	10,770	5.08	0.87	-8%
Composites	Cuok	185	7.43	0.94	
Blocks	Znok	10,770	32.36	7.83	-24%
Composites	Znok	185	36.00	10.26	
Blocks	Auok	10,770	2.57	0.67	-10%
Composites	Auok	185	3.30	0.75	

Source: SRK, 2017

Table 14-19: Elissa Statistical Comparison

Data	Column	Count	Max	Mean	%Diff
Blocks	Agok	24,646	309.00	97.06	-14%
Composites (Declus)	Agok	826	40.00	113.38	
Blocks	Pbok	24,646	7.79	2.20	-1%
Composites (Declus)	Pbok	826	10.45	2.21	
Blocks	Cuok	24,646	1.01	0.18	-17%
Composites (Declus)	Cuok	826	1.12	0.22	
Blocks	Znok	24,646	28.92	8.16	-16%
Composites (Declus)	Znok	826	33.50	9.69	
Blocks	Auok	24,646	1.38	0.29	-11%
Composites (Declus)	Auok	826	1.37	0.32	

Source: SRK, 2017

Table 14-20: CSM Statistical Comparison

Data	Column	Count	Max	Mean	%Diff
Blocks	Agok	19,649	672.80	174.2	19%
Composites	Agok	192	745.00	146.1	
Blocks	Pbok	19,649	18.88	7.813	0%
Composites	Pbok	192	20.00	7.787	
Blocks	Cuok	19,649	1.24	0.254	2%
Composites	Cuok	192	1.36	0.248	
Blocks	Znok	19,649	25.07	11.05	-6%
Composites	Znok	192	25.00	11.71	
Blocks	Auok	19,649	1.19	0.282	-8%
Composites	Auok	192	1.36	0.307	

Source: SRK, 2017

Table 14-21: Gallito Statistical Comparison

Data	Column	Count	Max	Mean	%Diff
Blocks	Agok	3,727	292.30	110.30	6%
Composites	Agok	260	400.00	104.30	
Blocks	Pbok	3,727	19.99	5.43	-6%
Composites	Pbok	260	22.30	5.78	
Blocks	Cuok	3,727	5.95	0.65	1%
Composites	Cuok	260	6.30	0.65	
Blocks	Znok	3,727	26.87	11.03	-4%
Composites	Znok	260	31.40	11.46	
Blocks	Auok	3,727	0.84	0.30	6%
Composites	Auok	260	1.14	0.29	

Source: SRK, 2017

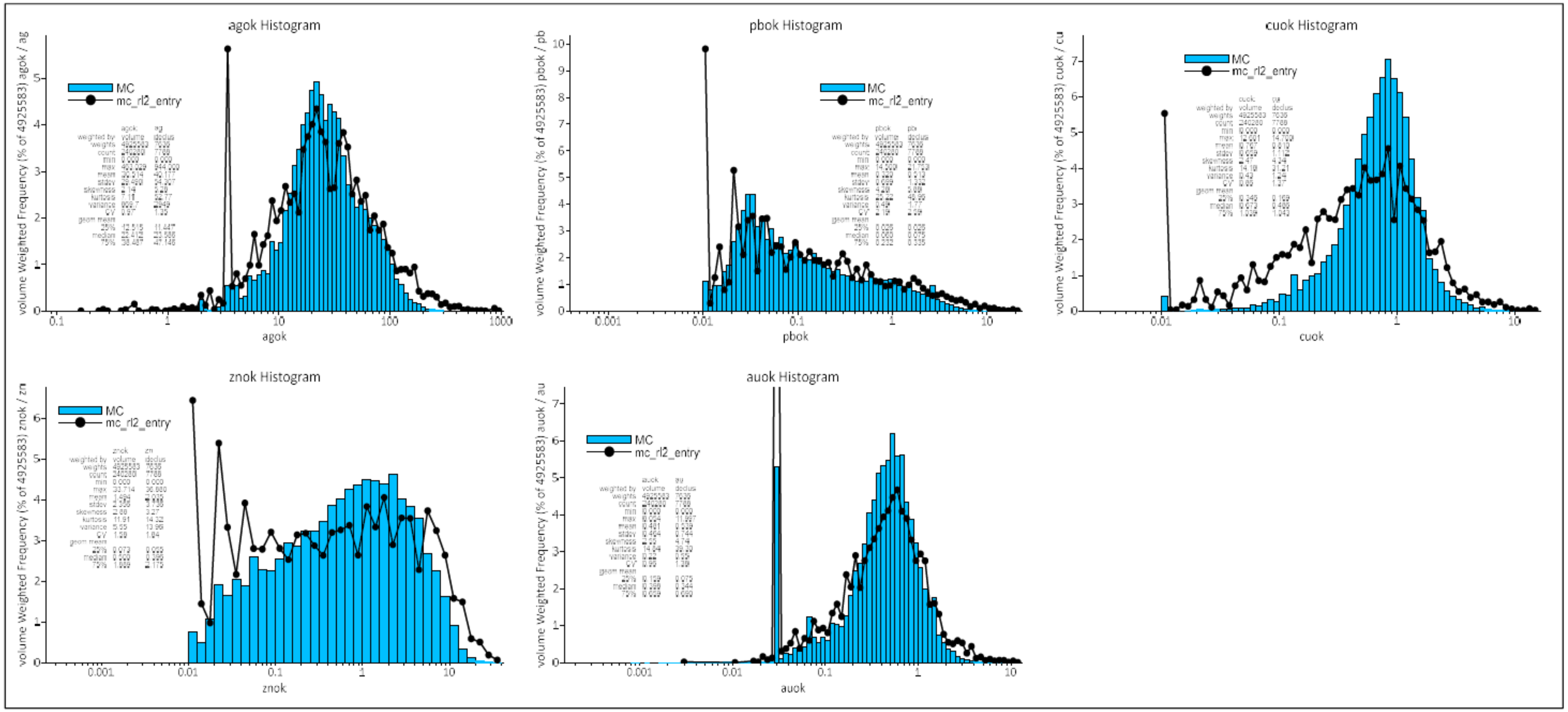
Table 14-22: Butz Statistical Comparison

Data	Column	Count	Max	Mean	%Diff
Blocks	Agok	1,920	208.60	30.80	1%
Composites	Agok	199	250.00	30.44	
Blocks	Pbok	1,920	9.70	1.83	6%
Composites	Pbok	199	11.00	1.72	
Blocks	Cuok	1,920	0.74	0.20	3%
Composites	Cuok	199	0.95	0.20	
Blocks	Znok	1,920	14.06	4.97	-13%
Composites	Znok	199	16.35	5.68	
Blocks	Auok	1,920	0.94	0.30	0%
Composites	Auok	199	1.10	0.30	

Source: SRK, 2017

14.8.3 Histogram Comparison

SRK reviewed and compared the histograms for the composites and blocks in each area. The purpose of this comparison is to provide insight to the distribution of the grade for the estimation compared to that of the composites, rather than just a simple mean. Each element was evaluated (generally on a log histogram) for each orebody. In all cases, SRK noted that the histograms of the blocks generally compared well with the histograms of the composites. Certain orebodies with few samples featured histograms which made comparison less meaningful due to the lack of data. An example from the Mina Central area is shown in Figure 14-20.



Source: SRK, 2017

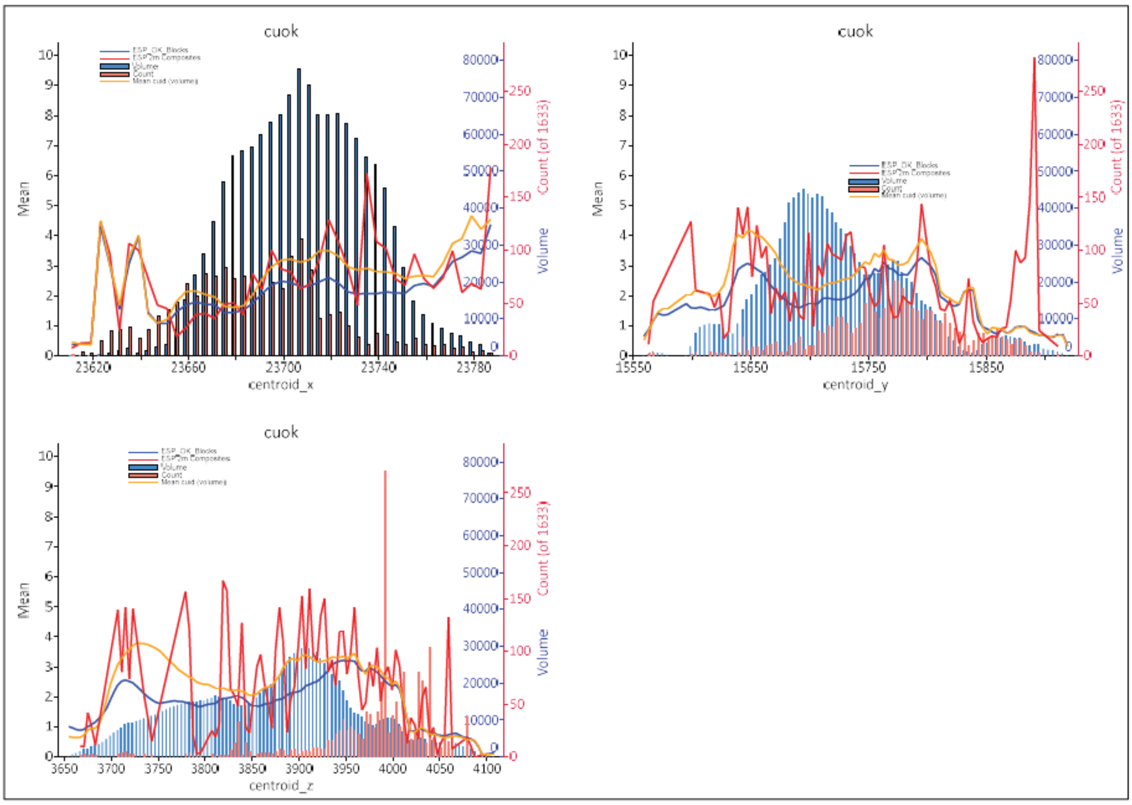
Figure 14-20 Example of Comparison Histograms for Mina Central

14.8.4 Swath Plots

For some orebodies, SRK has compiled swath plots to validate the estimation. A swath plot is a graphical display of the grade distribution derived from a series of bands (8m width in this case), or swaths, generated in the X, Y, and Z orientations through the deposit. Grade variations from the block model are compared using the swath plot to the distribution derived from the composites or other estimation methods. An example swath plot from Esperanza for Cu is shown in Source: SRK, 2017

Figure 14-21*, illustrating the comparison between the OK estimation used for reporting to the original composite grades and an IDW estimation. SRK notes that, in general the estimated grades represent a smoothed approximation of the composite grades, and are generally lower grade than the IDW estimation. The primary reason for the difference between the two estimations is that the OK estimate used the high yield limit restrictions as discussed in 14.3.1 above, whereas the IDW estimate did not.*

SRK did not produce these plots for every orebody, as narrow and tabular orientations do not necessarily allow for the swath plots as a reasonable comparison. For those orebodies with broader and less tabular morphology, this comparison is more reasonable.



Source: SRK, 2017

Figure 14-21: Esperanza Swath Plots (Cu)

14.9 Resource Classification

SRK is satisfied that the geological modelling honours the current geological information and knowledge. The location of the samples and the assay data are sufficiently reliable to support resource evaluation. The sampling information was acquired primarily by core drilling or limited channel sampling.

Estimated blocks were classified according to:

- *Confidence in interpretation of the mineralized zones;*
- *Number of data (holes or channel samples) used to estimate a block; and*
- *Average distance to the composites used to estimate a block.*

In order to classify mineralization as a Measured or 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 of gold mineralization." (CIM Definition Standards on Mineral Resources and Mineral Reserves, December 2005). SRK utilized the following general criteria for classification of the Mineral Resource:

- *Measured: Blocks estimated with an average distance of 25 m by at least three drillholes.*
- *Indicated: Blocks estimated with an average distance of 50 m by at least two drillholes.*
- *Inferred: All estimated block grades not assigned to the Measured or Indicated categories were assigned to the Inferred category.*

In the case of the Cuerpos Pequenos orebodies, a more restrictive classification scheme was utilized that better reflects the confidence of these smaller and more erratic orebodies.

- *Measured: Blocks estimated with an average distance of 10 m by at least three drillholes.*
- *Indicated: Blocks estimated with an average distance of 25 m by at least two drillholes.*
- *Inferred: All estimated block grades not assigned to the Measured or Indicated categories were assigned to the Inferred category.*

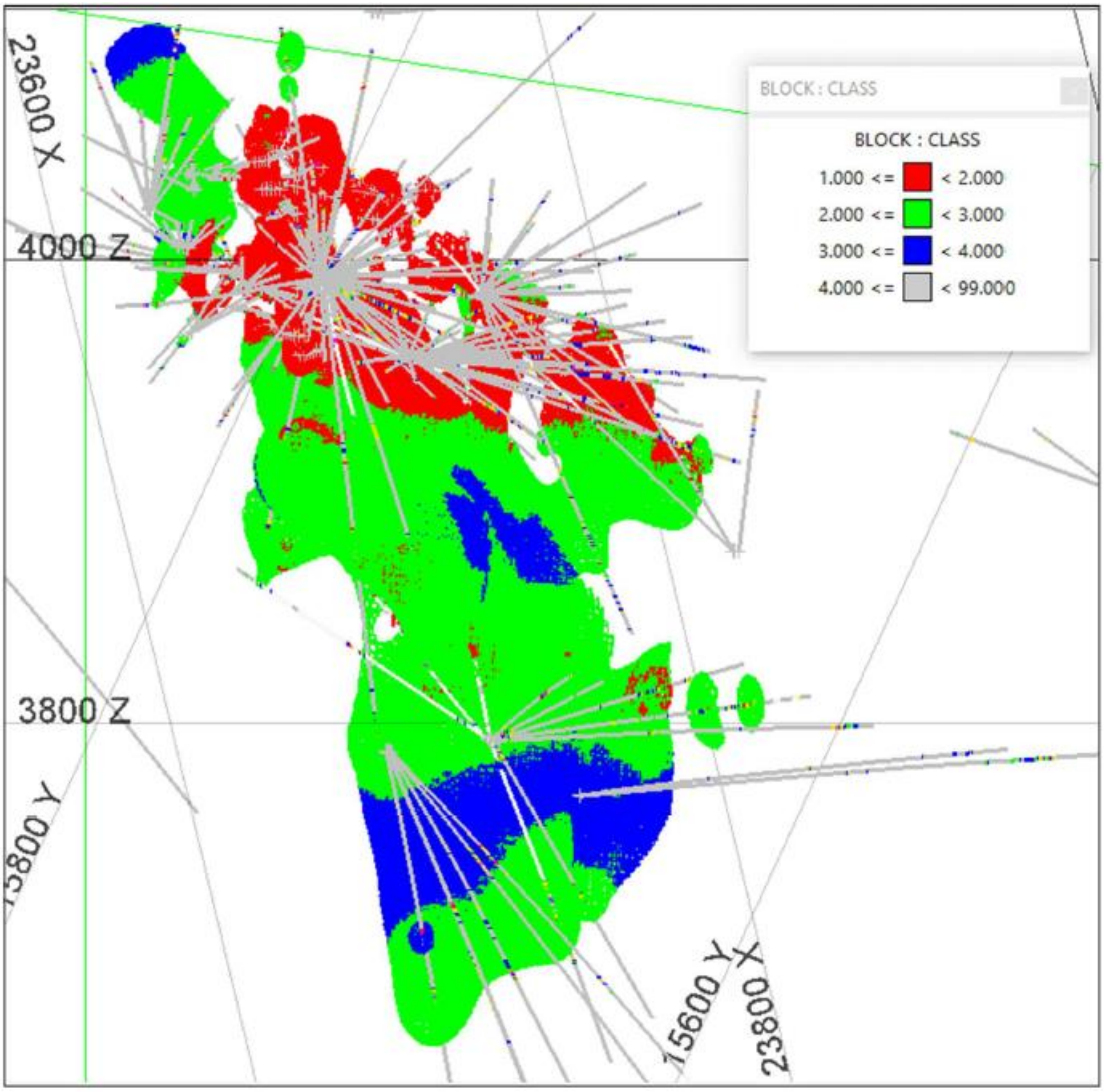
Examples of this scripted classification scheme are shown in Source: SRK, 2017

Figure 14-22 *and Source:* SRK, 2017

Figure 14-23*. SRK notes that this scripted method is not perfect, and locally results in some classification artefacts along the margins of wide-spaced drilling or in areas where data spacing varies significantly. SRK notes that this is likely something that can be improved upon as additional drilling (currently underway) infills some of these areas.*

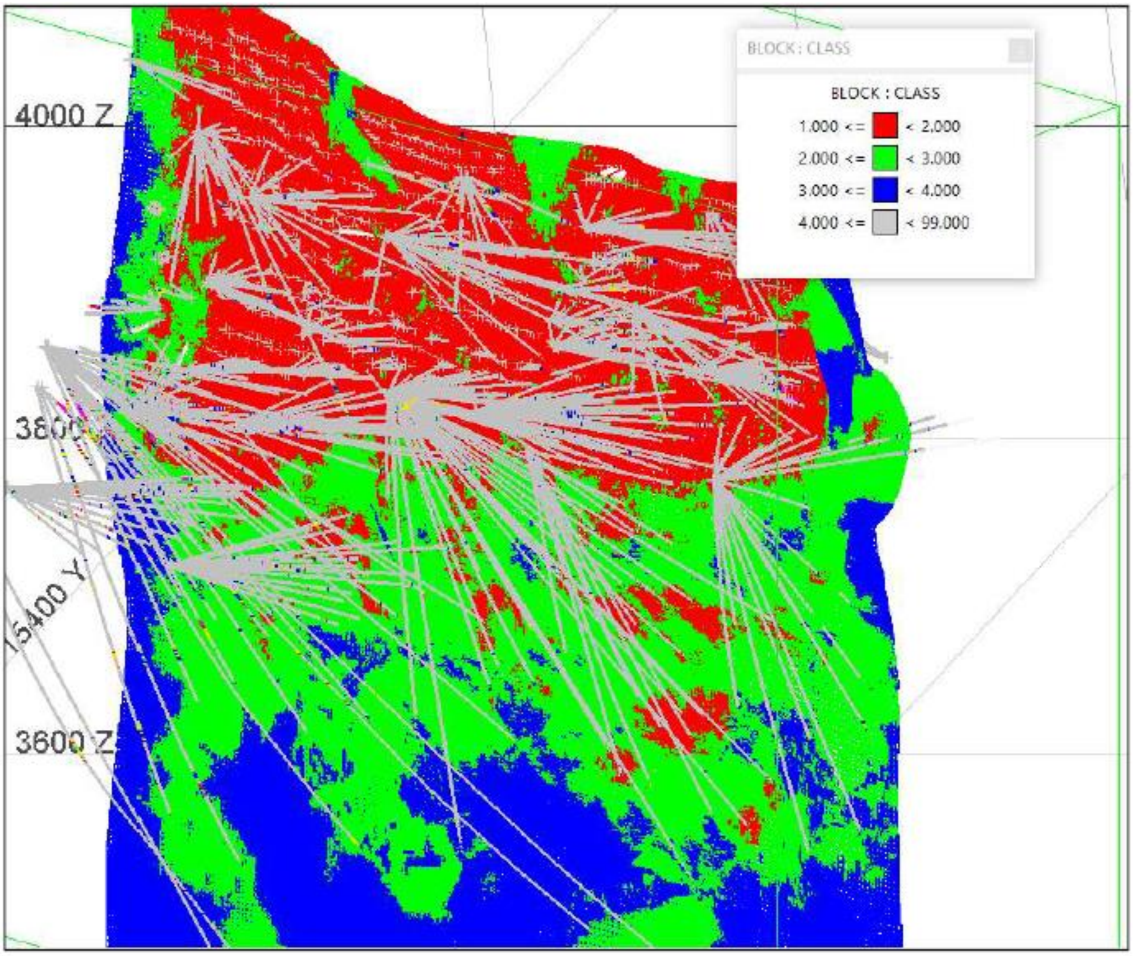
In selected cases, the blocks were reviewed on long section utilizing the above criteria. Subsequently, they were flagged using a more generalized polygon that approximated the distribution of the classes on the block by block classification, without permitting local minor changes (such as a few blocks of Inferred in the middle of a large volume of Indicated) from impacting the reporting of resources or the impending mine design. An example of this manual classification methodology is shown in Source: SRK, 2017

Figure 14-24.



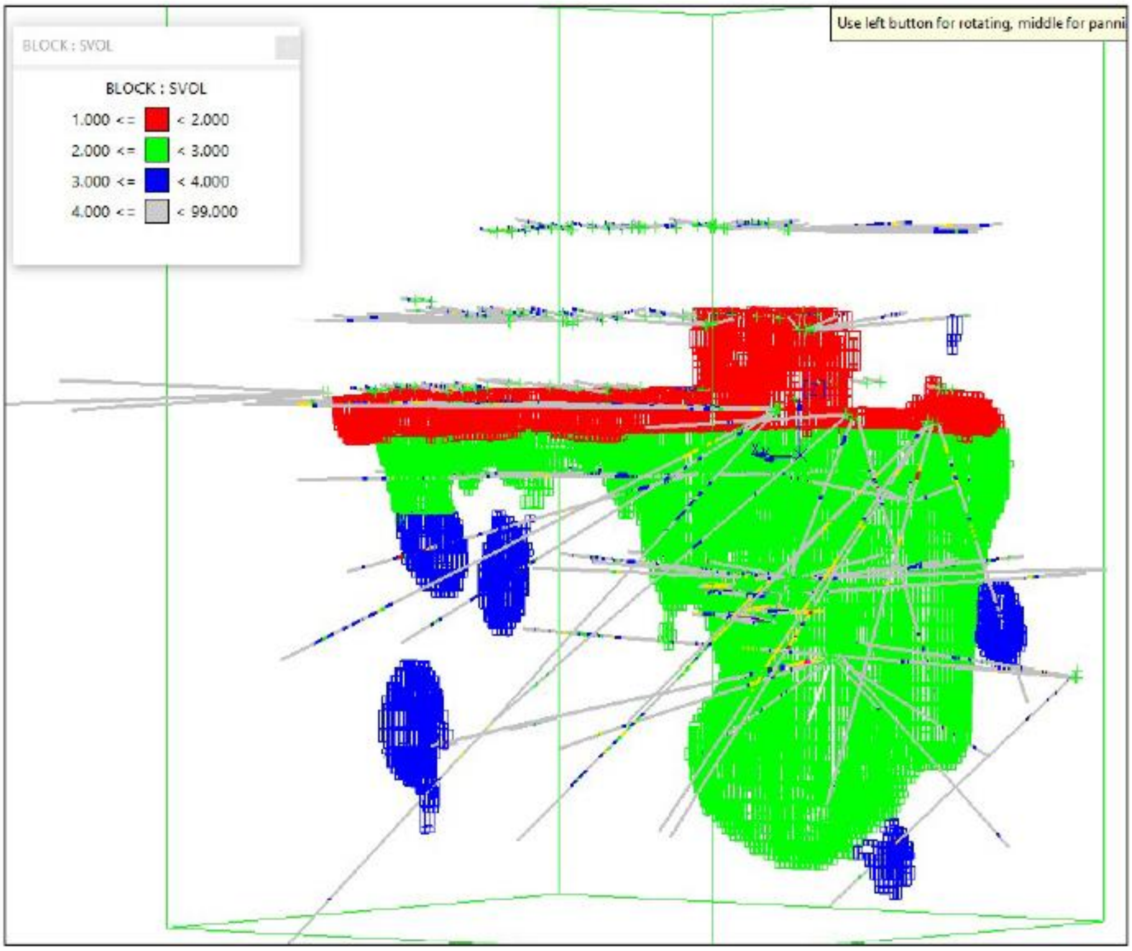
Source: SRK, 2017

Figure 14-22: Example of Scripted Classification for Esperanza



Source: SRK, 2017

Figure 14-23: Example of Scripted Classification for Mina Central



Source: SRK, 2017

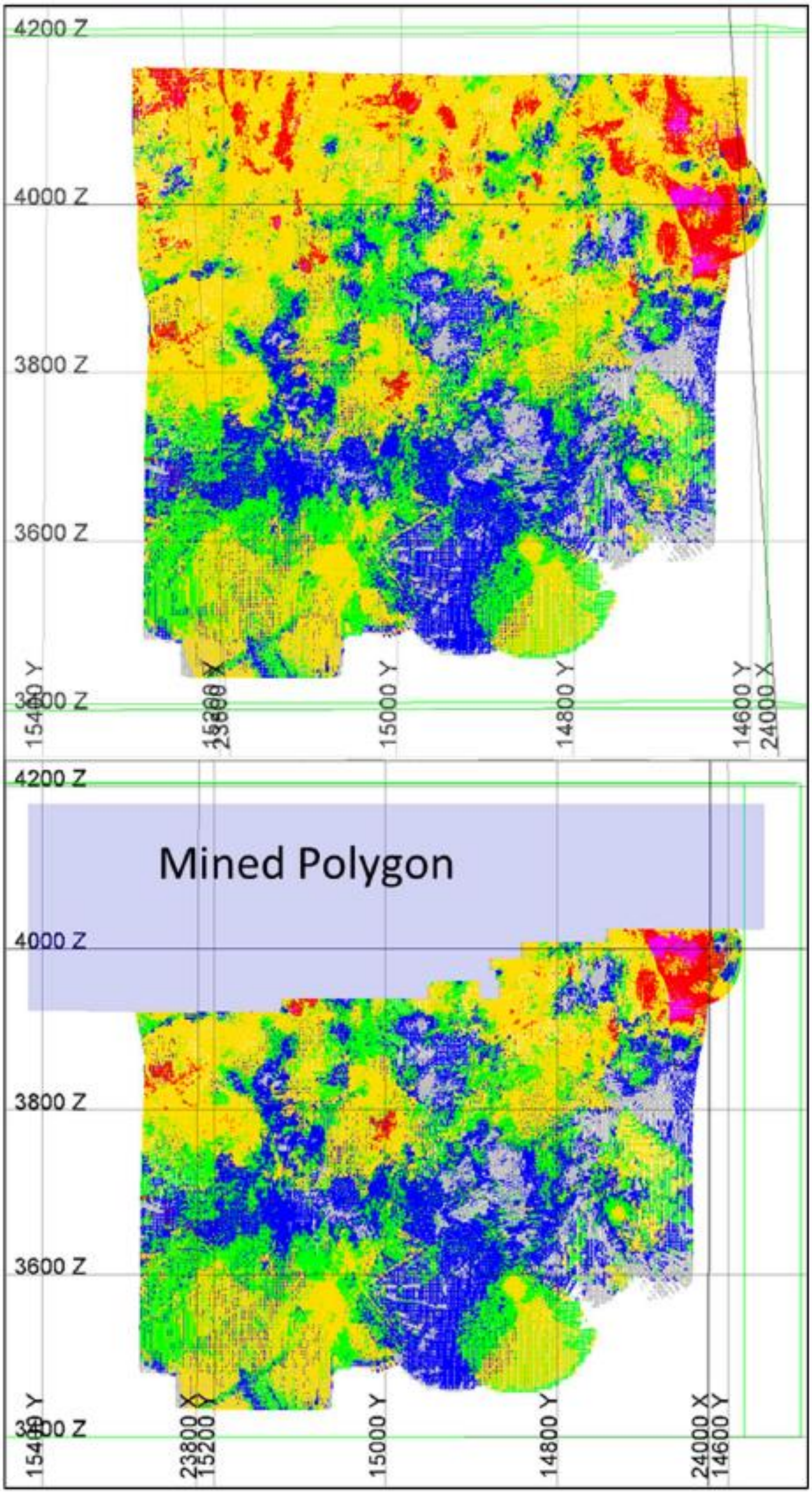
Figure 14-24: Example of Manual Classification at Angelita

14.10 Depletion

SRK depleted the block models using provided digitized polygons projected on long sections and cross sections from SMCSA. SRK notes that this is a conservative approach, given that it effectively ignores pillars or other areas which are known to have not been completely mined. However, SRK agrees with this approach and notes that extensive surveying of previously mined areas would need to be done in order to reasonably incorporate the remaining material above these levels. The polygons provided by the site engineering and geology groups were extruded into a solid 3D wireframe in the plane of the polygon. All material within each extruded polygon was flagged with a mined variable in the block model, with 1 representing completely mined, and 0 representing completely available.

An example of this is shown in Source: SRK, 2017

Figure 14-25 *for the Mina Central area.*



Source: SRK, 2017

Figure 14-25: Example of Mining Depletion in Block Models – Mina Central

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. SRK is of the opinion that the costs provided by Minera Corona represent the approximate direct marginal mining and processing cost for various mining methods. To satisfy the criteria of reasonable prospect for economic extraction, SRK has calculated unit values for the blocks in the models based on the grades estimated, metal price assumptions, and metallurgical recovery factors. SRK has done this for both the Gustavson and SRK models. SRK has not edited or amended the Gustavson block models in any way, except to calculate the unit values, assign updated densities, and deplete for previous production as described above.

The metal price assumptions have been derived from July 31, 2017 BMO Capital Markets Street Consensus Commodity prices, and are reasonable for the statement of Mineral Resources and ore reserves. These prices are generally higher than the previous technical report filed in 2016 and reflect the relative increase in commodities prices since this report. These prices are summarized in Table 14-23.

Table 14-23: Unit Value Price Assumptions

Year	Gold (US$/oz)	Silver (US$/oz)	Copper (US$/lb)	Lead (US$/lb)	Zin (US$/lb)
July 31,2017	1,255.00	17.80	2.60	1.01	1.25
July 19,2016	1,251.00	16.766	2.28	0.86	0.94

Source: Sierra Metals, 2017

The metallurgical recovery factors are based on actual to-date 2017 metallurgical recoveries for the various processes and concentrates produced by the Yauricocha mine. SRK has considered that the orebodies stated in Mineral Resources fall into one of three general categories in terms of process route: polymetallic sulfide, lead oxide, and copper sulfide. The overwhelming majority of the orebodies are considered as polymetallic sulfide, with very limited production from Pb Oxide areas, and effectively no consistent production from Cu-oxide areas. Compared to the 2016 report, one major difference is the decision to abandon a Cu sulfide-only process stream as this material is typically processed with the polymetallic sulfides. The summary of the recovery discounts applied during the unit value calculation is shown in

Table 14-24. SRK notes that the recoveries stated for the unit value calculations do not consider payability or penalties in the concentrates, as these are variable and may depend on contracts to be negotiated.

Table 14-24: Metallurgical Recovery Assumptions

Date	Process Recovery	Ag (%)	Au (%)	Cu (%)	Pb (%)	Zn (%)
2017	Polymetallic	67	16	65	85	89
	Pb Oxide	51	54	0	66	0
	Cu Oxide	28	0	39	0	0
206	Polymetallic	77	18	76	88	94
	Pb Oxide	53	24	0	66	0
	Cu Sulfide	66	35	90	0	0

Source: Sierra Metals, 2016

The general unit value calculation can then be summarized as the estimated grade of each metal, multiplied by the price (US$/g or US$/%), multiplied by the process recovery. This yields a dollar value of the block per tonne, which can be utilized to report resources above the break-even variable costs for mining, processing, and G&A. SMCSA has provided these costs to SRK, noting that they are generalized given the flexibility of the mining methods within each area or individual orebody. For example, several orebodies feature a majority of a specific mining method, but will locally utilize others on necessity, or require adjusted pumping capacity or ground conditions, which may locally move this cost up or down. SRK considers the application of a single unit value cut-off to each orebody as reasonable. The unit value sub-marginal costs provided by Corona are summarized in Table 14-25.

Table 14-25: Unit Value Cut-off by Mining Method and Area (US$/t)

Description	Break-Even Cost 2016	Break-Even Cost 2017
Sub-level Caving: Conventional	40	Not Used
Sub-level Caving: Mechanized, No Water	38	41
Sub-level Caving: Mechanized, Low Water	40	41
Cut and Fill: Overhead Conventional	51	42
Cut and Fill: Overhead Mechanized	43	48
Cut and Fill: Overhead Mechanized w/ Pillars	44	Not Used

Source: Sierra Metals, 2017
Includes static costs for the plant of US$7.40/t and G&A of US$3.90/t. Mining costs are variable between US$29.20/t – 37.00/t

The July 31, 2017, consolidated Mineral Resource statement for the Yauricocha Mine is presented in

Table 14-26. The individual detailed Mineral Resource tables by area are presented in Table 14-27.

Table 14-26: Consolidated Yauricocha Mine Mineral Resource Statement as of July 31, 2017 – SRK Consulting (U.S.), Inc. (1) (2) (3)

Class	Tonnes (kt)	Metal (US$)	Ag (g/t)	Au (g/t)	Cu (%)	Pb (%)	Zn (%)	Density
Measured	3,094	177.61	69.97	0.79	1.72	1.23	3.20	3.74
Indicated	10,111	158.39	59.91	0.60	1.46	0.83	2.67	3.80
Measured + Indicated	**13,205**	**162.89**	**62.26**	**0.65**	**1.52**	**0.92**	**2.79**	**3.79**
Inferred	6,632	125.98	43.05	0.55	1.19	0.47	2.16	3.71

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

(2) Mineral Resources are reported at unit value CoG's based on metal price assumptions, variable metallurgical recovery assumptions (variable metallurgical recoveries** as a function of grade and relative metal distribution in individual concentrates), generalized mining/processing costs.*
**Metal price assumptions considered for the calculation of unit values are: Gold (US$1,255/oz), Silver (US$ 17.80/oz), Copper (US$ 2.60/lb), Lead (US$ 1,01/lb), and Zinc (US$1.25/lb)*
*** Metallurgical recovery assumptions for the Yauricocha Mine are variable and dependent on mineralization style and orebody type.*

(3) The unit value CoG's for the Yauricocha Mine are variable and dependent on mining method and process/recovery costs which vary between US$ 41.00/t and US$48.00/t.

Table 14-27: Individual Mineral Resource Statement for Yauricocha Mine Areas as of July 31, 2017 – SRK Consulting (U.S.), Inc. (1) (2) (3)

	CoG	41	Grades					Contained Metal				
	Classification	Tonnes (kt)	Ag (g/t)	Au (g/t)	Cu (%)	Pb (%)	Zn (%)	Ag (koz)	Au (koz)	Cu (t)	Pb (t)	Zn (t)
Catas and Antacaca	Measured	913	32.16	0.94	0.91	0.16	1.98	944.36	27.56	8,296.47	1,473.77	18,121.07
	Indicated	3,359	30.07	0.57	1.05	0.13	1.46	3,247.26	61.83	35,339.57	4,306.35	48,981.51
	Meas.+Ind.	4,272	30.52	0.65	1.02	0.14	1.57	4,191.62	89.39	43,636.03	5,780.12	67,102.59
	Inferred	3,104	24.66	0.57	0.92	0.25	1.28	2,460.91	56.89	28,556.93	7,607.24	39,834.88

	CoG	41	Grades					Contained Metal				
	Classification	Tonnes (kt)	Ag (g/t)	Au (g/t)	Cu (%)	Pb (%)	Zn (%)	Ag (koz)	Au (koz)	Cu (t)	Pb (t)	Zn (t)
Rosaura and Antacaca Sur	Measured	585	69.05	0.84	0.76	1.24	2.33	1,298.93	15.85	4,459.10	7,233.51	13,616.79
	Indicated	1,254	48.76	0.74	0.84	0.47	1.34	1,966.07	29.87	10,475.40	5,841.25	16,762.59
	Meas.+Ind.	1,839	55.22	0.77	0.81	0.71	1.65	3,265.00	45.72	14,934.50	13,074.77	30,379.38
	Inferred	596	31.47	0.48	1.07	0.14	1.86	603.35	9.14	6,380.05	815.85	11,118.28

	CoG	41	Grades					Contained Metal				
	Classification	Tonnes (kt)	Ag (g/t)	Au (g/t)	Cu (%)	Pb (%)	Zn (%)	Ag (koz)	Au (koz)	Cu (t)	Pb (t)	Zn (t)
Oxides Antacaca Sur	Measured	72	185.61	1.52	0.34	3.26	0.66	426.76	3.50	242.27	2,327.91	469.53
	Indicated	161	142.34	1.50	0.40	1.84	0.91	737.48	7.77	652.49	2,959.93	1,471.82
	Meas.+Ind.	233	155.64	1.51	0.38	2.27	0.83	1,164.24	11.27	894.76	5,287.84	1,941.35
	Inferred	18	86.39	1.62	0.28	1.25	0.92	50.18	0.94	50.56	225.58	166.60

Esperanza (all zones)	CoG	41	Grades					Contained Metal				
	Classification	Tonnes (kt)	Ag (g/t)	Au (g/t)	Cu (%)	Pb (%)	Zn (%)	Ag (koz)	Au (koz)	Cu (t)	Pb (t)	Zn (t)
	Measured	790	85.82	0.64	3.16	1.27	3.09	2,181.06	16.36	24,943.71	10,073.95	24,450.03
	Indicated	3,656	78.01	0.54	2.04	1.38	3.45	9,169.85	63.79	74,644.30	50,417.26	126,098.16
	Meas.+Ind.	4,447	79.40	0.56	2.24	1.36	3.39	11,350.91	80.14	99,588.01	60,491.20	150,548.19
	Inferred	1,108	64.68	0.47	1.40	0.89	2.46	2,303.25	16.89	15,471.22	9,885.46	27,215.70

Mascota (all zones)	CoG	41	Grades					Contained Metal				
	Classification	Tonnes (kt)	Ag (g/t)	Au (g/t)	Cu (%)	Pb (%)	Zn (%)	Ag (koz)	Au (koz)	Cu (t)	Pb (t)	Zn (t)
	Measured	327	112.32	0.82	4.01	3.15	4.88	1,181.17	8.64	13,126.68	10,073.95	24,450.03
	Indicated	471	118.67	0.68	2.08	2.20	6.08	1,798.47	10.24	9,828.29	10,378.95	28,644.39
	Meas.+Ind.	798	116.07	0.74	2.87	2.59	5.59	2,979.64	18.88	22,954.97	20,682.51	44,612.89
	Inferred	63	125.55	0.72	0.52	2.31	10.19	253.32	1.45	327.27	1,448.11	6,395.60

Cuye	CoG	41	Grades					Contained Metal				
	Classification	Tonnes (kt)	Ag (g/t)	Au (g/t)	Cu (%)	Pb (%)	Zn (%)	Ag (koz)	Au (koz)	Cu (t)	Pb (t)	Zn (t)
	Indicated	623	76.24	0.73	2.21	0.42	2.12	1,527.74	14.67	13,792.33	2,636.89	13,217.39
	Inferred	1,423	54.30	0.60	1.94	0.25	2.70	2,485.18	27.48	27,623.89	3,620.82	38,429.28

Gallito	CoG	41	Grades					Contained Metal				
	Classification	Tonnes (kt)	Ag (g/t)	Au (g/t)	Cu (%)	Pb (%)	Zn (%)	Ag (koz)	Au (koz)	Cu (t)	Pb (t)	Zn (t)
	Measured	14	112.77	0.28	0.69	6.47	11.44	49.56	0.12	94.52	884.01	1,563.37
	Indicated	22	117.25	0.30	1.63	4.22	9.77	84.22	0.22	364.26	942.03	2,181.97
	Meas.+Ind.	36	115.55	0.29	1.27	5.07	10.40	133.78	0.34	458.78	1,826.04	3,745.34
	Inferred	2	116.73	0.35	0.43	5.04	7.85	8.16	0.02	9.26	109.65	170.73

Oriental	CoG	41	Grades					Contained Metal				
	Classification	Tonnes (kt)	Ag (g/t)	Au (g/t)	Cu (%)	Pb (%)	Zn (%)	Ag (koz)	Au (koz)	Cu (t)	Pb (t)	Zn (t)
	Measured	6	192.54	0.78	1.00	4.54	17.71	39.37	0.16	63.56	288.58	1,126.24
	Indicated	10	199.92	0.25	1.33	1.25	6.33	66.92	0.08	138.40	130.39	659.00
	Meas.+Ind.	17	197.12	0.45	1.20	2.50	10.65	106.28	0.24	201.96	418.96	1,785.23
	Inferred	27	89.94	0.10	0.26	0.53	7.53	77.18	0.09	69.79	140.40	2,009.78

Occidental + Oxide	CoG	41	Grades					Contained Metal				
	Classification	Tonnes (kt)	Ag (g/t)	Au (g/t)	Cu (%)	Pb (%)	Zn (%)	Ag (koz)	Au (koz)	Cu (t)	Pb (t)	Zn (t)
	Indicated	18	116.47	1.03	0.19	2.29	8.82	67.32	0.60	34.55	412.23	1,585.40
	Inferred	23	98.55	1.09	0.11	2.03	6.59	73.85	0.82	26.59	474.22	1,536.48

	CoG	41	Grades					Contained Metal				
	Classification	**Tonnes (kt)**	**Ag (g/t)**	**Au (g/t)**	**Cu (%)**	**Pb (%)**	**Zn (%)**	**Ag (koz)**	**Au (koz)**	**Cu (t)**	**Pb (t)**	**Zn (t)**
CSM	Measured	5	91.55	0.33	0.25	7.72	12.21	16.15	0.06	13.81	423.89	670.06
	Indicated	16	156.31	0.35	0.32	8.91	12.26	80.94	0.18	52.13	1,434.50	1,974.07
	Meas.+Ind.	22	139.86	0.35	0.31	8.61	12.24	97.10	0.24	65.94	1,858.39	2,644.13
	Inferred	24	181.76	0.29	0.23	7.13	11.47	142.99	0.23	55.08	1,743.51	2,805.73

	CoG	41	Grades					Contained Metal				
	Classification	**Tonnes (kt)**	**Ag (g/t)**	**Au (g/t)**	**Cu (%)**	**Pb (%)**	**Zn (%)**	**Ag (koz)**	**Au (koz)**	**Cu (t)**	**Pb (t)**	**Zn (t)**
Elissa	Measured	45	87.82	0.29	0.08	1.92	8.04	127.07	0.41	36.54	865.76	3,620.48
	Indicated	55	124.43	0.36	0.26	2.42	8.56	219.87	0.63	145.15	1,330.60	4,702.72
	Meas.+Ind.	100	107.95	0.32	0.18	2.20	8.33	346.94	1.04	181.69	2,196.36	8,323.20
	Inferred	54	83.15	0.26	0.34	2.03	4.21	145.52	0.46	183.85	1,103.09	2,294.01

	CoG	41	Grades					Contained Metal				
	Classification	**Tonnes (kt)**	**Ag (g/t)**	**Au (g/t)**	**Cu (%)**	**Pb (%)**	**Zn (%)**	**Ag (koz)**	**Au (koz)**	**Cu (t)**	**Pb (t)**	**Zn (t)**
Angelita	Measured	87	6.91	0.24	0.44	0.18	5.81	19.24	0.68	385.08	154.06	5,035.75
	Indicated	241	11.56	0.29	0.50	0.22	5.49	89.71	2.23	1,214.86	538.00	13,243.97
	Meas.+Ind.	328	10.33	0.28	0.49	0.21	5.57	108.95	2.91	1,599.94	692.06	18,279.72
	Inferred	22	18.73	0.33	0.86	0.35	4.79	13.01	0.23	185.74	74.97	1,034.15

	CoG	41	Grades					Contained Metal				
	Classification	**Tonnes (kt)**	**Ag (g/t)**	**Au (g/t)**	**Cu (%)**	**Pb (%)**	**Zn (%)**	**Ag (koz)**	**Au (koz)**	**Cu (t)**	**Pb (t)**	**Zn (t)**
Escondida + Zulma	Measured	49	115.29	0.64	0.27	3.75	7.11	182.46	1.01	132.59	1,844.89	3,501.24
	Indicated	38	82.21	0.55	0.19	3.57	5.03	99.42	0.67	69.95	1,344.04	1,891.53
	Meas.+Ind.	87	100.96	0.60	0.23	3.67	6.21	281.88	1.68	202.55	3,188.94	5,392.77
	Inferred	155	107.35	0.45	0.17	2.23	5.98	535.79	2.24	265.91	3,458.91	9,283.49

	CoG	41	Grades					Contained Metal				
	Classification	**Tonnes (kt)**	**Ag (g/t)**	**Au (g/t)**	**Cu (%)**	**Pb (%)**	**Zn (%)**	**Ag (koz)**	**Au (koz)**	**Cu (t)**	**Pb (t)**	**Zn (t)**
Celia	Measured	40	14.95	0.31	0.49	0.21	3.79	19.07	0.40	192.85	84.62	1,501.59
	Indicated	20	11.47	0.29	0.51	0.12	2.68	7.45	0.19	102.17	23.95	541.58
	Meas.+Ind.	60	13.78	0.30	0.49	0.18	3.41	26.52	0.58	295.02	108.57	2,043.17
	Inferred	1	10.06	0.36	0.50	0.14	2.34	0.37	0.01	5.71	1.64	26.81

	CoG	41	Grades					Contained Metal				
	Classification	**Tonnes (kt)**	**Ag (g/t)**	**Au (g/t)**	**Cu (%)**	**Pb (%)**	**Zn (%)**	**Ag (koz)**	**Au (koz)**	**Cu (t)**	**Pb (t)**	**Zn (t)**
Karlita	Measured	138	101.64	0.75	0.86	1.25	5.75	450.73	3.32	1,192.71	1,730.41	7,929.94
	Indicated	113	72.94	0.57	1.00	0.69	4.14	265.72	2.07	1,129.07	782.48	4,693.44
	Meas.+Ind.	251	88.70	0.67	0.92	1.00	5.02	716.46	5.40	2,321.79	2,512.90	12,623.37
	Inferred	5	94.57	0.41	0.73	0.64	5.84	13.78	0.06	33.16	28.99	264.90

	CoG	41	Grades					Contained Metal				
	Classification	**Tonnes (kt)**	**Ag (g/t)**	**Au (g/t)**	**Cu (%)**	**Pb (%)**	**Zn (%)**	**Ag (koz)**	**Au (koz)**	**Cu (t)**	**Pb (t)**	**Zn (t)**
Privatizadora	Measured	17	38.45	0.35	0.05	1.27	7.50	21.61	0.20	9.54	221.41	1,310.30
	Indicated	28	41.80	0.14	0.06	1.26	8.33	37.30	0.37	17.31	349.76	2,311.61
	Meas.+Ind.	45	40.50	0.39	0.06	1.26	8.01	58.90	0.57	26.84	517.17	3,621.91
	Inferred	6	58.06	0.36	0.06	1.97	6.67	11.88	0.07	3.69	125.48	424.45

	CoG	41	Grades					Contained Metal				
	Classification	Tonnes (kt)	Ag (g/t)	Au (g/t)	Cu (%)	Pb (%)	Zn (%)	Ag (koz)	Au (koz)	Cu (t)	Pb (t)	Zn (t)
Privatizadora	Measured	5	19.86	0.27	0.21	1.21	4.97	3.43	0.05	11.15	65.22	267.07
	Indicated	25	12.28	0.28	0.22	1.17	3.65	9.72	0.23	55.21	288.76	898.31
	Meas.+Ind.	30	13.64	0.28	0.22	1.18	3.89	13.15	0.27	66.35	353.98	1,165.38
	Inferred	1	4.77	0.24	0.24	0.99	3.47	0.08	0.00	1.28	5.18	18.13

(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. Gold, silver, copper lead and zinc assays were capped where appropriate.

(2) Mineral Resources are reported at unit value cut-offs (CoG) based on metal price assumptions, variable metallurgical recovery assumptions (variable metallurgical recoveries** as a function of grade and relative metal distribution in individual concentrates), generalized mining/processing costs.*

**Metal price assumptions considered for the calculation of unit values are: Gold (US$/oz 1,255.00), Silver (US$/oz 17.80), Copper (US$/lb 2.60), Lead (US$/lb 1.01) and Zinc (US$/lb 1.25)*

***Metallurgical recovery assumptions for the Yauricocha Mine are variable and dependent on the mineralization style and orebody type.*

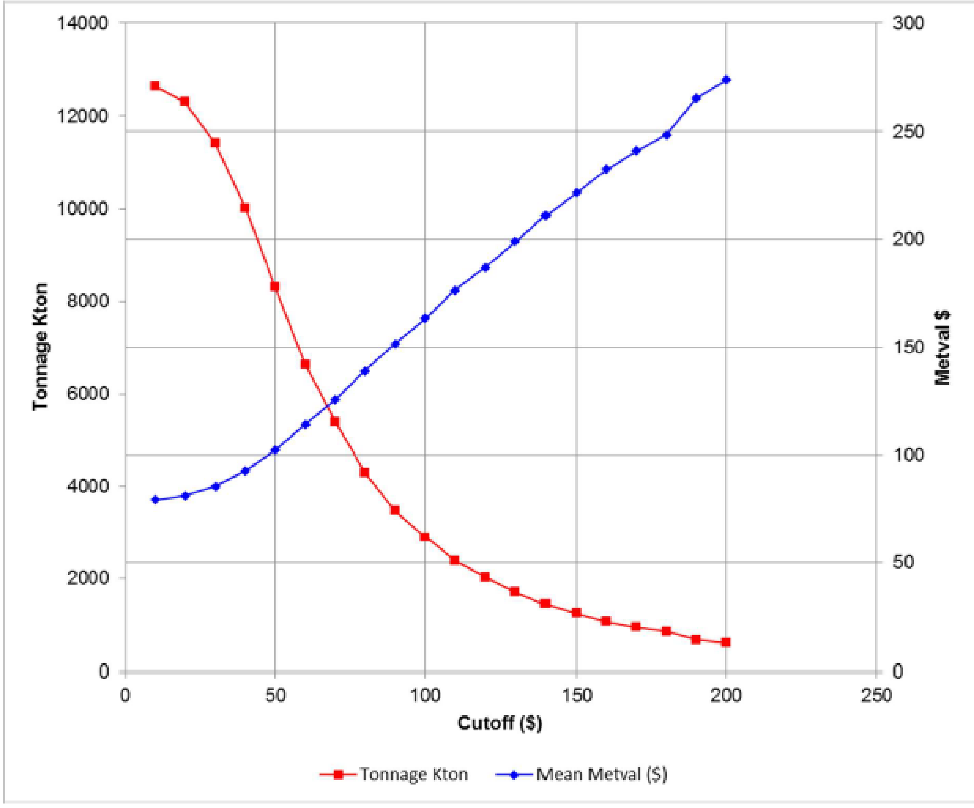
(3) The unit value CoG's for the Yauricocha Mine are variable and dependent on mining method. The vary US$ 41.00/t and US$ 48.00/t and are stated for each in the table

14.12 Mineral Resource Sensitivity

To demonstrate the sensitivity of the Mineral Resource estimations to factors such as changes in commodity prices or mining/processing costs, SRK has produced grade vs. tonnage charts at various unit value cut-offs for each area, for all categories of resource. This shows that the majority of the Mineral Resources defined in Mina Central, Esperanza, and Mascota have some sensitivity to the unit value cut-off (varying in degree between orebody), and that this should be considered in the context of the impact on changing cost assumptions with respect to the contained Mineral Resources.

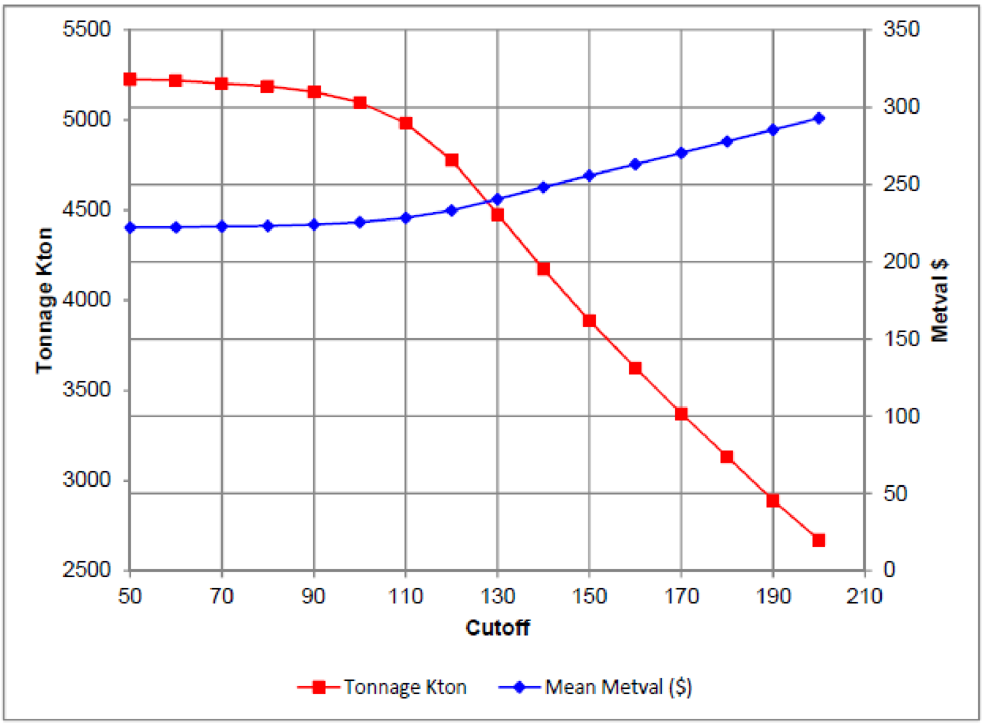
It should be noted that the grade tonnage charts for Elissa, Cachi-Cachi and the Cuerpos Pequenos are locally presented using much higher cut-offs that that stated for the Mineral Resource estimation, as the high grades in these orebodies give grade tonnage curves that change at much higher cut-offs. It can be assumed that, in general, these orebodies are not as sensitive to the current range of unit value cut-offs assumed to be relevant for the other areas.

The grade tonnage charts for each area are shown in Figure 14-26 through Figure 14-30.



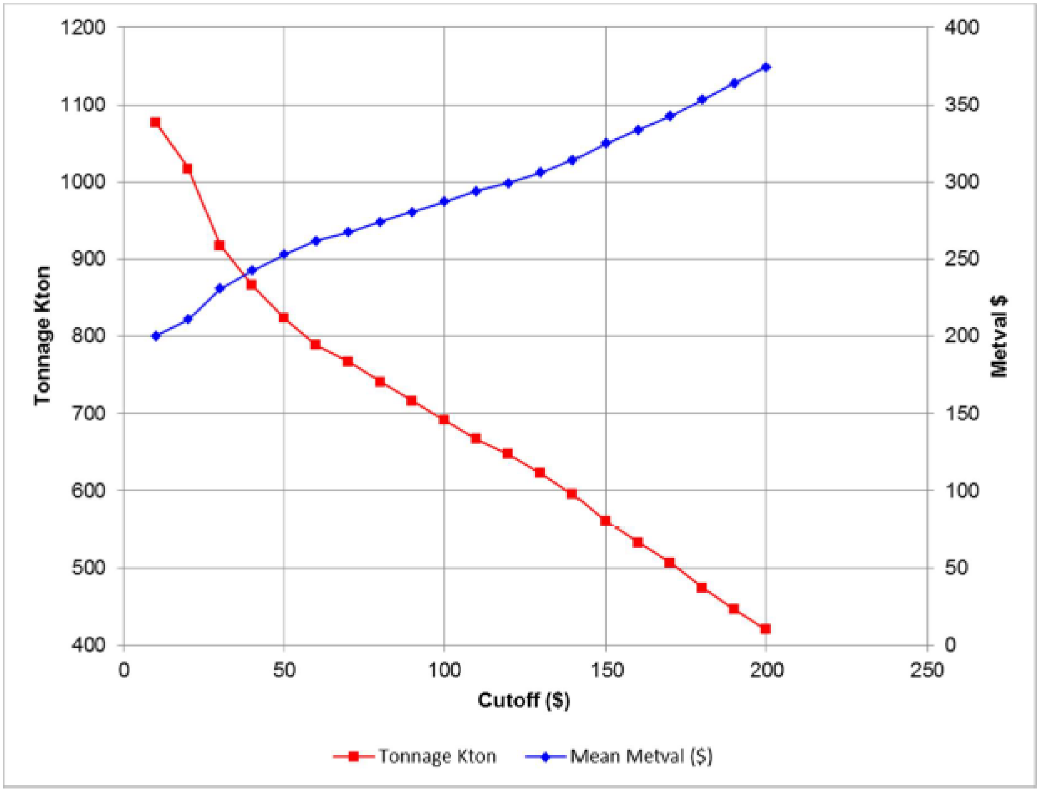
Source: SRK, 2017
Includes Mina Central (Antacaca, Catas, Rosaura, Antacaca Sur, and Antacaca Sur Oxides)

Figure 14-26 Mina Central Grade Tonnage Chart



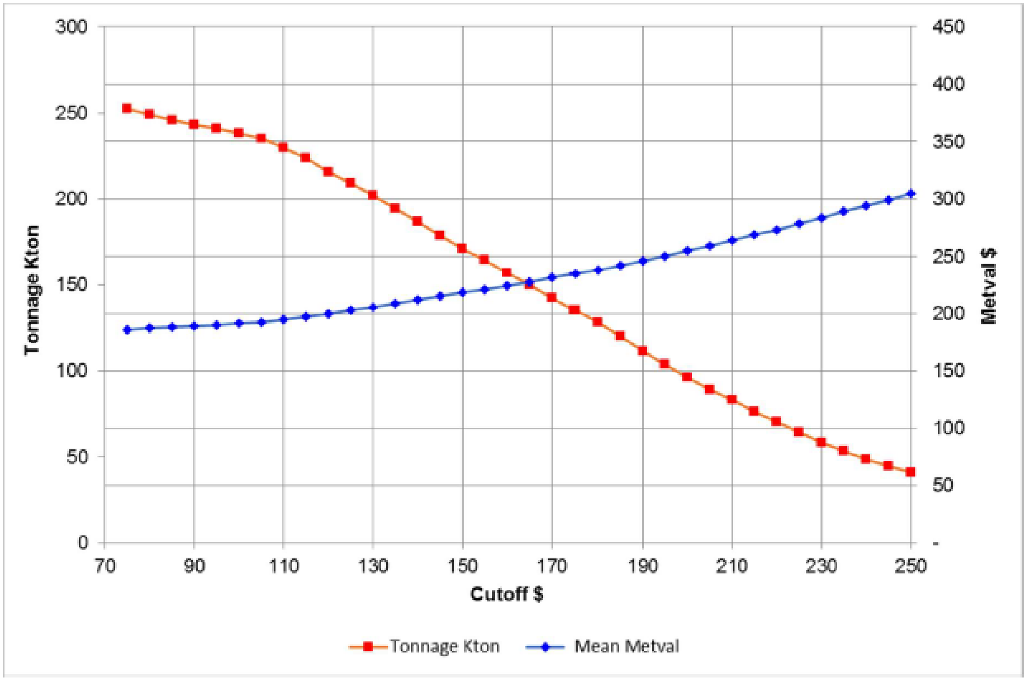
Source: SRK, 2017
Includes all Esperanza Areas.

Figure 14-27 Esperanza Grade Tonnage Chart



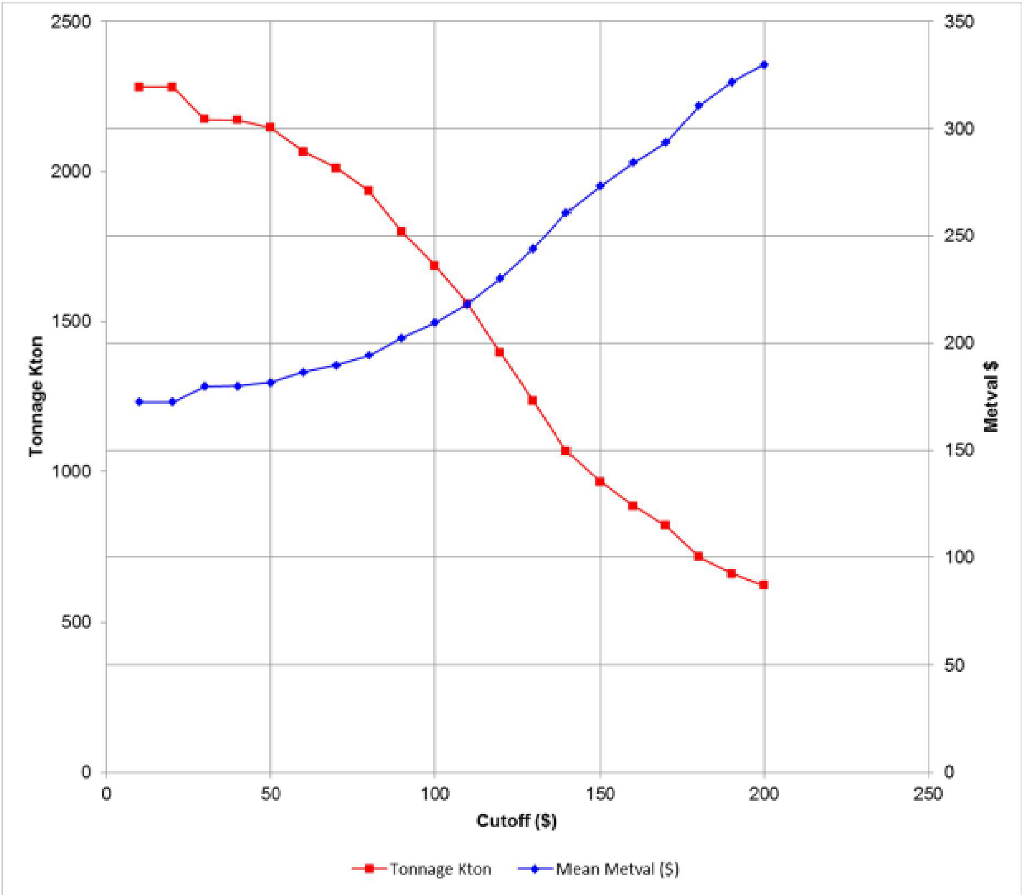
Source: SRK, 2017
Includes all Mascota Areas.

Figure 14-28 Mascota Grade Tonnage Chart



Source: SRK, 2017
Includes Angelita, Karlita, Celia, Escondida, and Privatizadora

Figure 14-29 Cachi-Cachi Grade Tonnage Chart



Source: SRK, 2017
Includes Cuye, Gallitos, Oriental, Occidental, Occidental Oxidos, and Butz.

Figure 14-30 Cuerpos Pequenos Grade Tonnage Chart

14.13 Relevant Factors

There are no other relevant factors that SRK is aware of that would affect the mineral resources.

15 Mineral reserve estimates

A Mineral Reserve is the economically mineable part of a Measured and/or Indicated Resource. It includes diluting material and allowances for losses, which may occur when the material is mined or extracted and is defined by studies at Prefeasibility or Feasibility level as appropriate that include application of Modifying Factors.

A Mineral Reserve has not been estimated for the Project as part of this PEA.

The PEA includes inferred mineral resources that are considered too speculative geologically to have the economic considerations applied to them that would enable them to be categorized as mineral reserves.

16 Mining Methods

The conceptual mine plan considered in this PEA includes inferred mineral resources that are considered too speculative geologically to have the economic considerations applied to them that would enable them to be categorized as mineral reserves, and there is no certainty that the PEA will be realized.

Instances of the word ‘economic’ in this section are intended to be conceptual only, and prospects for economic extraction have not been demonstrated.

16.1 Introduction

Mine production at Yauricocha is achieved using sub-level caving. Waste and mineral are hoisted from various levels to the Klepetko and Yauricocha tunnels on the 720 level and taken to surface by electric locomotive. Hoisting capacity is the principal restriction on increasing output at Yauricocha.

Redco was commissioned by SMCSA to evaluate how production at Yauricocha could be increased from 3,000 tpd. Redco undertook a trade-off analysis and determined that mineral output could be increased and that the optimal mineral output is 5,500 tpd. The following points are highlighted by Redco.

- Significant mine development is required to provide access to areas of the mine not currently in production; 8 months of mine development would be required before production can be sustainably increased to 5,500 tpd.
- All proposed production is from below the 720 level and requires hoisting. Hoisting capacity at the mine is currently close to capacity and it will not be possible to maintain current production rates and commence mine development required to increase production until additional hoisting capacity is available.
- Operating at 5,500 tpd will increase ventilation requirements significantly and ventilation systems will need upgrading to support the proposed 5,500 tpd operation.

SMCSA are developing the Yauricocha shaft which when complete will increase total hoisting capacity to 10,400 tpd. The Yauricocha shaft is expected to be completed by mid-2020.

Redco developed a mine plan for Yauricocha based on the last reported resource, prepared by SRK and dated July 31st, 2017. Many of the assumptions used in the PEA mine plan come from data prepared by SMCSA which are based on actual production figures. The footprint optimisation used to develop the mine plan is based on current operating costs. The footprint optimisation categorises blocks by Net Smelter Return (NSR) value; blocks with an NSR value greater than US$ 41.00/t are considered marginal and blocks with an NSR value greater than US$ 55.95/t are considered potentially economic. Marginal blocks are only included in the mine plan when they are adjacent to potentially economic blocks and their recovery does not require additional mine development.

NSR values considered planned and unplanned dilution (variable dilution between 10% and 20% respectively) and historical performance achieving mine recoveries of 80%.

16.2 Current Mining Methods

Sub-level caving has been used at Yauricocha for 17 years and approximately 98% current of mine production is via this method. The rest of mine production is achieved using mechanized overhand cut and fill (Table 16-1). The mine plan proposed in this PEA considers the phasing out of overhand cut and fill and that production will be 100% sub-level caving.

Table 16-1: Yauricocha mining methods by area

Mining Area	Body	Mining Method
Mina Central	Catas	Sublevel Caving
	Antacaca	
	Rosaura	
	Antacaca Sur	
Esperanza	Esperanza	Sublevel Caving
	Breccia	Cut & Fill
	Breccia 2	
	Cobre	
	Norte	Sublevel Caving
	Distal	Cut & Fill
Mascota	Oxido Ag-Pb	Sublevel Caving
	Polimetálico	Cut & Fill
Cuye	Cuye	Sublevel Caving
Cachi	Elissa	Cut & Fill
	Angelita	Sublevel Caving
	Celia	
	Escondida	Cut & Fill
	Karlita	Sublevel Caving
	Privatizadora	Cu & Fill
Cuerpos pequeños	Gallito	Cut & Fill
	Oriental	
	Occidental	
	CSM II	
	Butz	

16.2.1 Sub-level Caving

The sub-level caving mining method (Figure 16-1) is typically used when open-pit mining is not viable, and the geotechnical conditions of the ore and overlying rock are amenable to stoping and natural caving of the overlying rock. In sub-level caving, mining starts at the top of the orebody and progresses downwards. Mineral is mined from sub-levels spaced at regular intervals throughout the deposit. A series of rings are drilled and blasted from each sub-level and broken mineral is mucked out after each blast. Sub-level caving can be used in orebodies with very different properties and is easily mechanized. The sub-level caving method is normally used in massive, steeply-dipping orebodies with considerable strike length, and usually implies a high amount of dilution and relatively low recovery when compared to other mining methods.

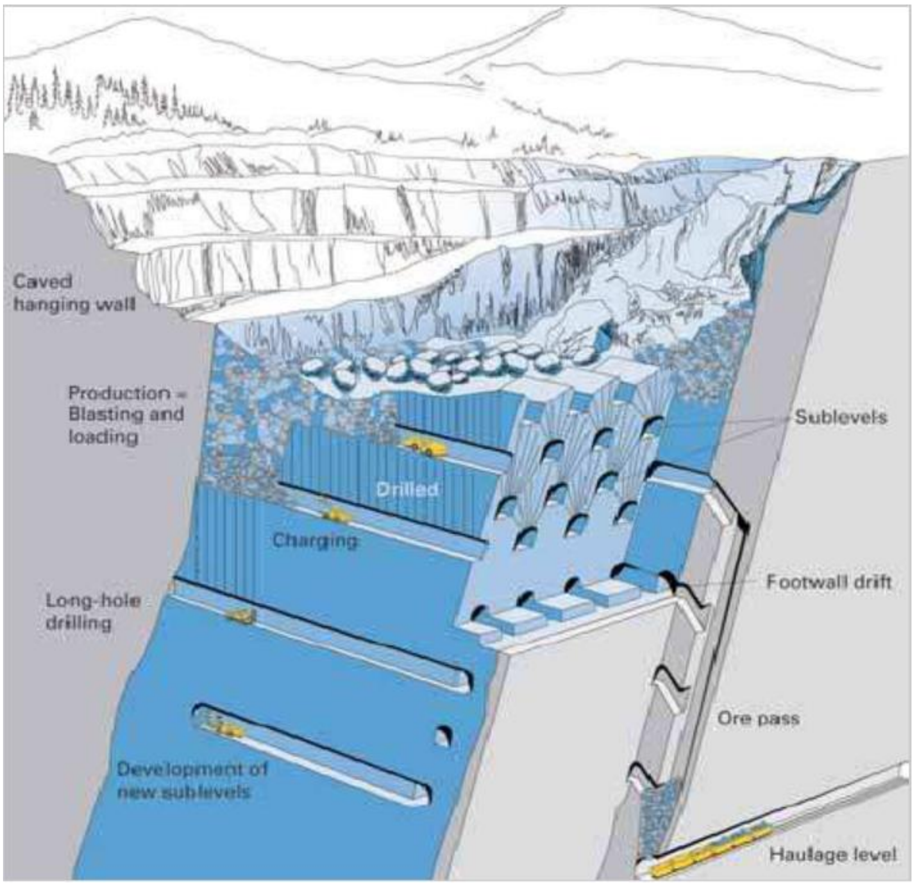
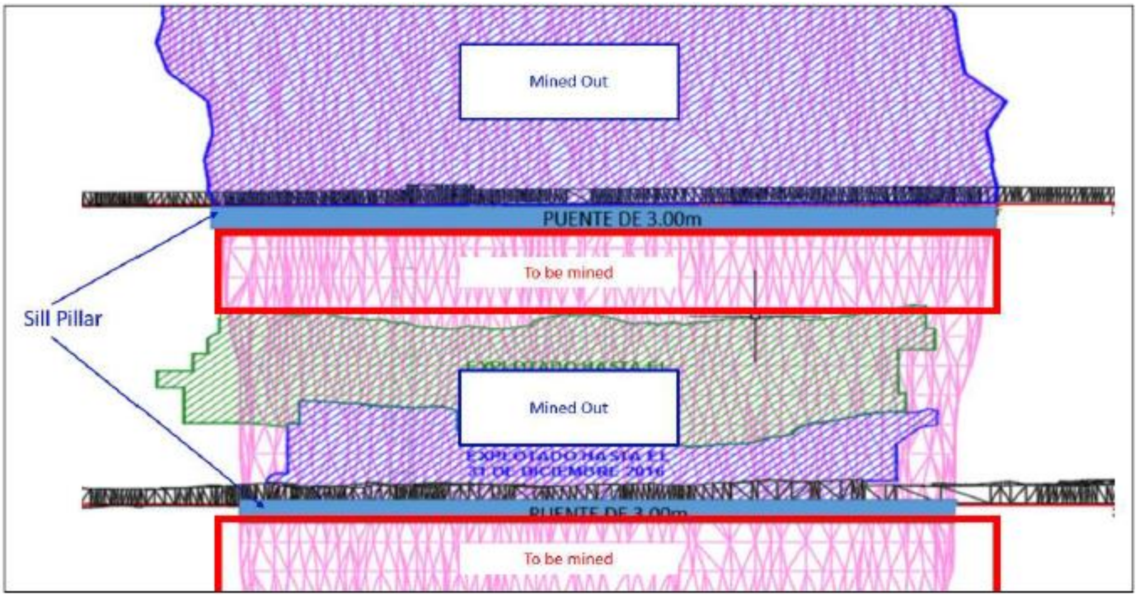


Figure 16-1: A graphic illustration of the sublevel caving mining method

At Yauricocha, sub-level caving is designed around 50 m blocks with planned sub-levels every 16.7 m. Blasted material caves and is recovered by remote controlled scoops from draw points (3.5 m wide and 3.0 m high) developed at 8 m intervals. Steel sets, shotcrete and bolting are used as ground support in the draw points. The length of a draw point is determined according to the thickness of the mineralised body. Draw points are staggered by 4 m from sub-level to sub-level.

16.2.2 Overhand Cut and Fill

Cut and fill mining is employed in parts of some mineralised bodies (Table 16-1). Typically, slices are mined 2.0 m wide x 3.0 m high in an overhand (ascending) technique where the lower levels are filled as mining progresses to the next sub-level above. Sill pillars are left between levels as mining comes up underneath the previously mined level. Based on geotechnical input, sill pillars are typically a minimum of 3 m deep. A longitudinal section of the Elissa mineral body is shown in Figure 16-2 which is mined using overhand cut and fill.



Source: Sierra Metals, 2017

Figure 16-2: Longitudinal section overhand cut-and-fill.

16.2.3 Mine Access and Materials Handling

Access to the mine is via shaft and tunnels. Production from below the 720 level, (including waste rock) is hoisted to the 720 level, from where it is hauled to surface on electric locomotive.

Three shafts are currently in use at Yauricocha (Central, Mascota and Cachi Cachi), which provide a combined hoisting capacity of 4,500 tpd. Hoisting capacity is a critical bottleneck to mine planning at Yauricocha as all waste and mineral must exit the mine via the hoisting system. At the current waste to mineral ratio of 0.5:1, approximately 1,500 tpd waste and 3,000 tpd are hoisted daily. There is essentially no available hoisting capacity currently available to increase mine development or production. If the waste to mineral ratio was to increase, the hoisting system would not be able to maintain mineral supply to the plant.

In addition to hoisting mine production, the Central Shaft is the principle ingress and egress for miners, with approximately 50% of the Central shaft's operational time utilized to move personnel. Table 16-2 summaries hoisting performance across the three shafts between January and September 2017.

Table 16-2 Summary of hoisted material – January to September 2017

Shaft	Monthly Average Hoisted tonnes	Daily Average Hoisted tonnes
Mascota	85,000	2,800
Central	21,000	700
Cachi Cachi	30,000	1,000
Total	136,000	4,500

Ramps connect levels and sub-levels in the primary mining areas as shown in Figure 16-3. Figure 16-4 shows sections from the Cachi-Cachi, Mascota and Mina Central areas of the mine; mined areas are shown in pink, existing development is shown in black, and proposed development is shown in blue. The main haulage level (720) is represented by a thick green line. Planned mining activity is focused below the 720.

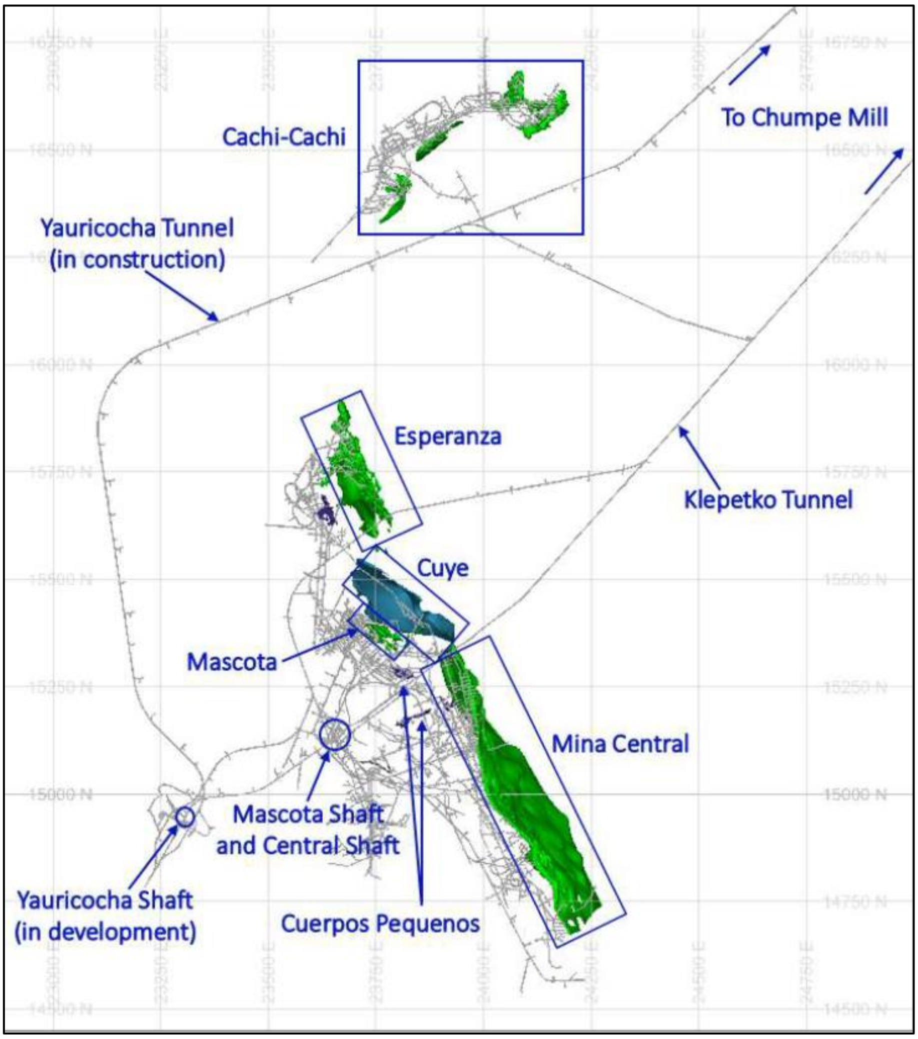


Figure 16-3: Yauricocha Mine Showing Mining Areas (Plan View) considered in the PEA

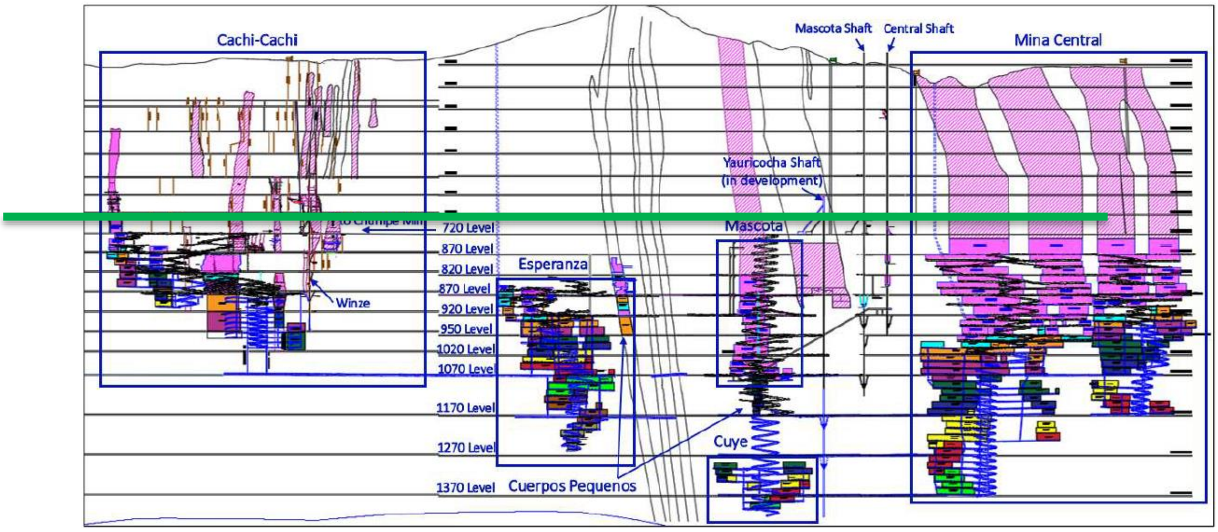


Figure 16-4: Yauricocha Long Section Showing Mining Areas and Mineralised Zones (Looking Northeast)

All mineral and waste from the Central mine is handled through a series of level passes into rail cars and then dumped into loading pockets in the Mascota shaft to be hoisted to the main haulage level (720 level). A winze at Cachi-Cachi hoists production from lower levels to the main haulage level.

16.3 Mine development and planning parameters

16.3.1 Geomechanics

The rock strength of various units at Yauricocha is well established. Geotechnical investigations have focused primarily on the Antacaca Sur deposit, a high mudrush-risk area. These findings have been applied to the Antacaca, Catas, Rosaura and Mascota mining areas. Table 16-3 presents the typical rock strength characteristics by rock type.

Table 16-3: Rock Strength Characteristics

Intact Rock Strength	Caliza Marmolizada	Caliza Grano Fino	Caliza Recristalizada	Caliza Grano Grueso	Intrusivo
Average UCS (MPa)	52.6	55	61.5	56.6	171.5
Average Young's Modulus (GPa)	13.87	16.47	17.15	14.52	21.75
Average Poisson's ratio	0.25	0.25	0.24	0.25	0.21
Average Tensile strength (MPa)	2.63	3.07	4.53		2.80

Mine planning is based on the layout defined in Table 16-4, which is based on the geotechnical parameters.

Table 16-4: Mine planning layout

Parameter	Solutions
Mining Method	Sublevel caving tabular dipping body (75° to 85°)
Sublevel draw height	16 m
Drawpoint spacing	8 m
Drawpoint size	3.5 x 3.0 m (width x height)
Drawpoint support	Steel-sets with blocking and lagging on 1 m spacing
	Fibre reinforced shotcrete with 2.5 m bolts on 1 m spacing
Development drift support	Spot bolting and mesh

Mud-rush is a recognised risk at Yauricocha, with wet areas and particularly the most southerly ore-bodies being most susceptible to mud-rush. The effects of mud-rush are mitigated with timber bulkheads or waste rock plugs to seal off inactive draw points as well as the use of remote controlled scoops. To further mitigate the potential for mud-rush, dewatering programs have been implemented to reduce groundwater pressures in mineral bodies prior to sub-level caving.

16.3.2 Hydrogeology

Various engineering groups have completed hydrological studies at Yauricocha, their studies focused on characterizing regional regimes of superficial and underground waters and the effects of mining on them (Table 16-5). Sierra Metals have a good understanding of hydrology and the impacts mining at Yauricocha has on the regional and local hydrogeological regimes. Sierra Metals recognise the implications of increased rates of inflowing water as mining continues to develop at depth; water infiltration is expected to increase by 20 to 25% for every 100 m of greater depth.

Table 16-5: Various hydrological studies completed at Yauricocha

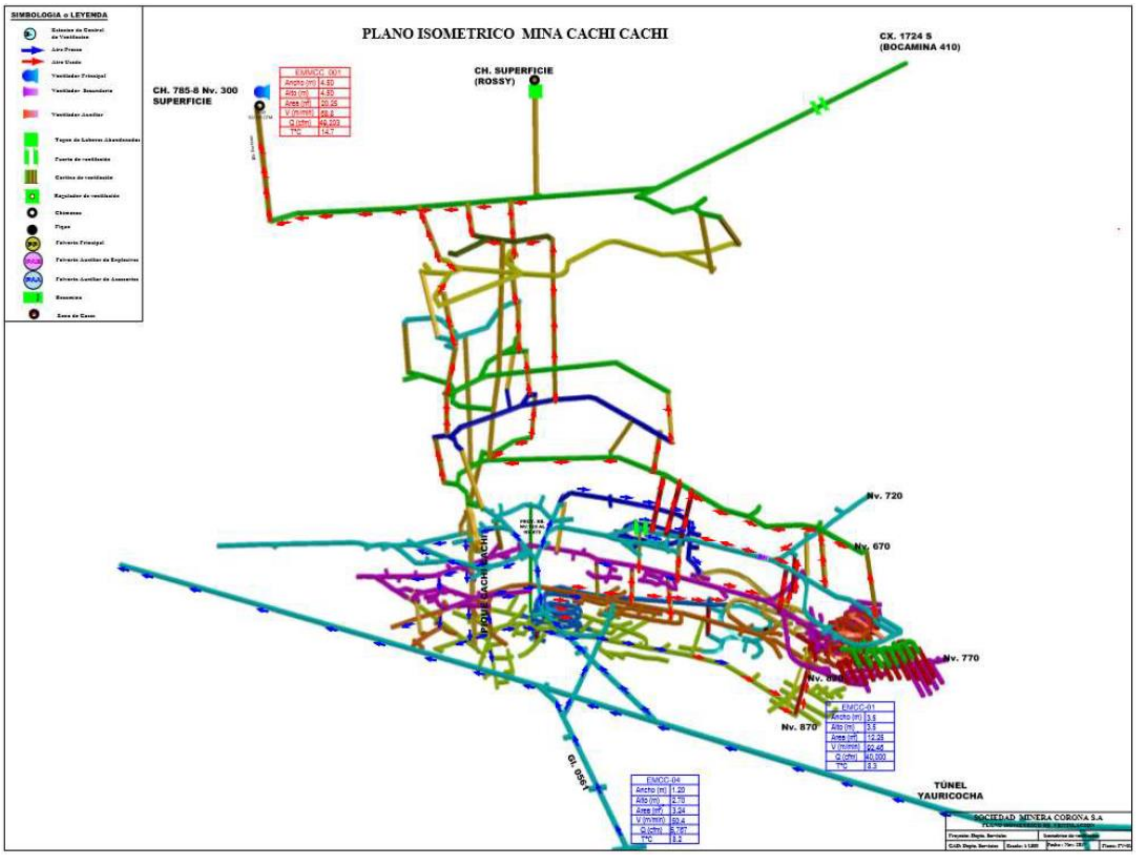
Company	Year	Reference
Geologic	2014	Geologic, 2014
Hydro-geo Consultores	2010	HGC, 2010
Geoservice Ingeneria	2008	GI, 2008

16.3.3 Mine Ventilation

Two underground ventilation systems are established at Yauricocha, supporting the Cachi-Cachi and Mina Central areas.

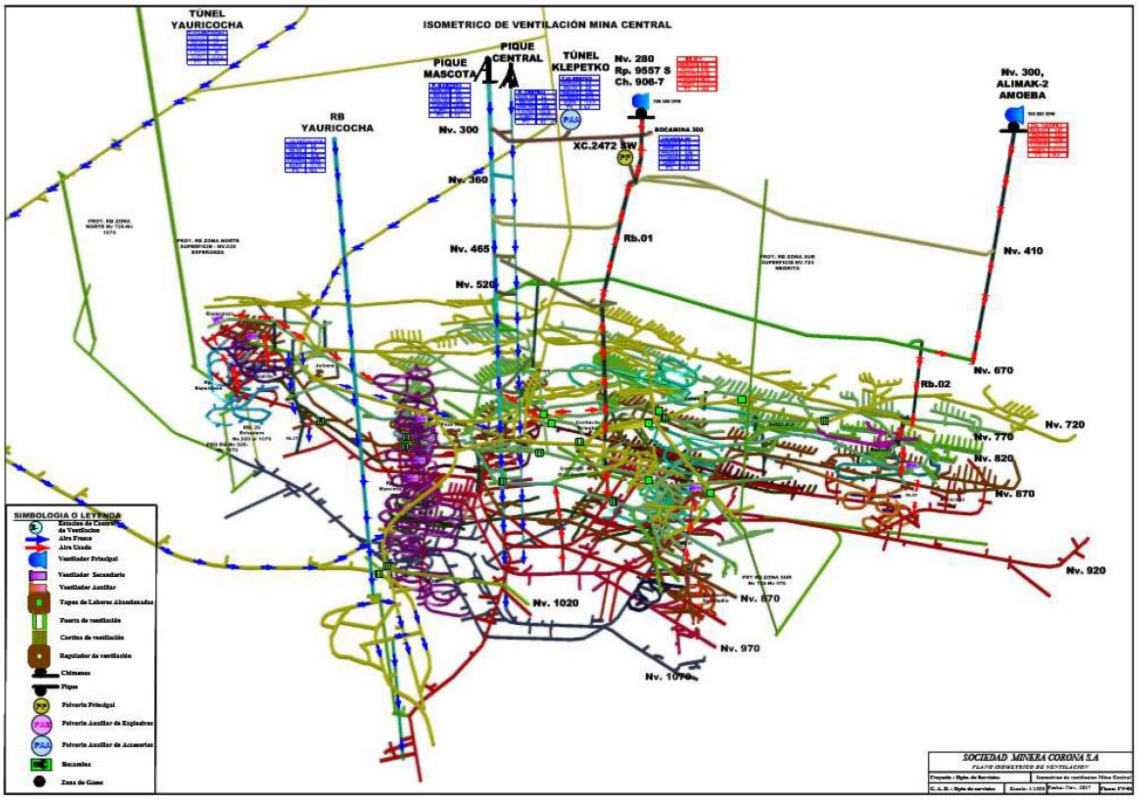
The Yauricocha ventilation system is divided into three zones: Zone II, Zone III, and Zone V. Figure 16-5 shows an isometric view of the Cachi-Cachi ventilation network (Zone III). Figure 16-6 shows an isometric view of the Mina Central ventilation network (Zone II and V):

- The ventilation system of Zone II includes 820 level to 920 level in the area of the Esperanza and Gallito bodies
- The ventilation system of Zone III covers 720 level to 920 level of the Cachi-Cachi Mine
- The ventilation system of Zone V includes 970 level to 1170 level of the Mascota, Catas, Antacaca, Rosaura, Antacaca Sur, CSM II and Butz mine areas.



Source: Minera Corona, 2017

Figure 16-5: Zone III Ventilation Isometric View



Source: Minera Corona, 2017

Figure 16-6: Zone II and Zone V Ventilation Isometric View

The Cachi-Cachi ventilation system draws fresh air through the Yauricocha tunnel, main Cachi-Cachi decline (Bocamina 410) and Cachi-Cachi shaft to production fronts. Air exhausts via the 191, Rossy and Raquelita raisebore holes. A primary fan in borehole 919 installed at the 300 level circulates air with the aid of ventilation doors and booster fans.

Air intake routes are summarised in Table 16-6 and exhaust routes are summarised in Table 16-7. Exhaust air is routed with ventilation doors and booster fans and is pulled to surface via two primary fans

Table 16-6: Yauricocha Mine Vent Intake Airway Sources

Intake Airway	Volume	Units
Yauricocha Tunnel	38,934	cfm
Yauricocha Raisebore	39,149	cfm
Mascota Shaft	43,439	cfm
Central Shaft	37,531	cfm
Klepteko Tunnel	21,176	cfm
Level 300 Bocamina	30,377	cfm
Total	210,606	cfm

Table 16-7: Yauricocha Mine Vent Exhaust Airway Sources

Exhaust Airway	Volume	Units
Alimak Amoeba	102,506	cfm
Raisebore # 1	95,376	cfm
Fortuna Shaft	49,203	cfm
Total	247,085	cfm

(1) Reported volumes are based on measured field values and have not been corrected for auto-compression or system calibration.

Source: Minera Corona, 2017

16.4 Proposed Mine Plan

16.4.1 Mine Access and Materials Handling

Sierra Metals are constructing a fourth shaft (“Yauricocha”) with an engineered hoisting capacity of 5,900 tpd. The Yauricocha shaft is expected to be completed in January-2020. With the addition of the Yauricocha shaft, hoisting capacity at the mine will increase to 10,400 tpd (

Table 16-8).

Table 16-8: Global hoisting capacity with the addition of the Yauricocha shaft.

Shaft	Average (tpm)	Maximum Capacity (tpm)	Maximum Capacity (tpd)
Mascota	76,257	85,000	2,800
Central	13,233	21,000	700
Cachi Cachi	22,681	30,000	1,000
Subtotal	**112,171**	**136,000**	**4,500**
Subtotal Mineral	74,781	90,667	3,000
Subtotal Waste	37,390	45,333	1,500
Yauricocha	177,000	177,000	5,900
Total	**289,171**	**313,000**	**10,400**
Total Mineral	192,781	208,667	6,900
Total Waste	96,390	104,333	3,500

16.4.2 Dilution and Recovery factors

Based on operational records, planned and unplanned dilution are considered in the Redco mine plan (Table 16-9):

- Planned dilution is material with a value below the cut-off, that has to be mined as it occurs within potentially economic material, such that when combined, the combined material value is above the cut-off.
- Unplanned dilution is not part of the mine design but is anticipated due to overbreak of material below the cut-off during blasting because of weak ground, faults or blast damage. Historic records for sub-level caving at Yauricocha indicate that unplanned dilution will range between 10 and 20%. In the proposed mine plan, Redco assumed 20% unplanned dilution which they consider conservative, yet offers operational flexibility.

Table 16-9: Dilution considered in the Redco Mine Plan

Planned Dilution %	Unplanned Dilution %
Variable by stope	20

Recovery of mineral is relatively low in the sub-level caving method compared with other mining methods. This is because a portion of the mineral blasted is caught up in the upper part of the extraction column or between draw points, mixing with dilution material and will not be recovered in a draw point (Figure 16-7). The recovery factor applied by Redco in the mine plan is 80%. This factor is based on historic sub-level caving records at Yauricocha, supplied by Sierra Metals.

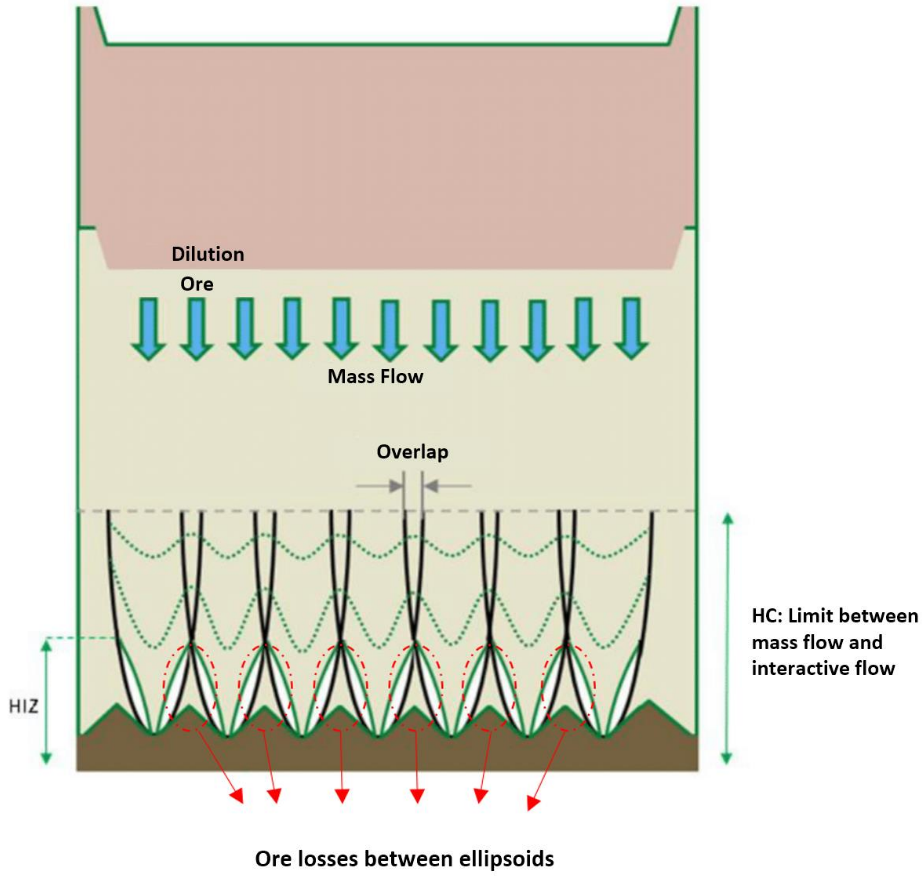


Figure 16-7: Flow scheme and areas not recovered

16.4.3 Cut-Off

The cut-off value applied by Redco in the mine plan for this PEA is based on current operating costs reported by Sierra Metals for Yauricocha (Table 16-10).

A marginal cut-off NSR value of US$ 41.00/t and a cut-off NSR value of US$ 55.95/t were applied during footprint optimisation. Blocks with an estimated value less than the marginal cut-off NSR value are not considered in the mine plan. Blocks with an NSR value less than the cut-off, but greater than the marginal cut-off are considered in the mine plan only if additional expenses such as access development are not required for their extraction.

Table 16-10: Calculation of the Cut-Off

Cut-off Calculation - Parameters	Value	Units
Development Cost		
Decline	2.18	US$/t
Safety Bays	0.07	US$/t
Stockpiles	0.30	US$/t
Ore and Waste Pass	0.75	US$/t
Ventilation Shaft	0.38	US$/t
Main sublevel	2.51	US$/t
Ore Cross-Cut	5.28	US$/t
Ore Pocket	0.96	US$/t
Crib	0.23	US$/t
Loading (Scoop + Dumper)	2.87	US$/t
Other (10%)	1.55	US$/t
Subtotal	17.09	US$/t
Mining Cost		
Sub-level Caving	4.79	US$/t
Secondary Blasting	0.23	US$/t
Drilling and Blasting	1.80	US$/t
Shaft Hoisting	0.60	US$/t
Waste Haulage by LHD	1.71	US$/t
Waste Haulage by Rails	2.05	US$/t
Others (10%)	1.12	US$/t
Subtotal	12.29	US$/t
Mining Services Costs		
Compressed air	0.38	US$/t
Electric power	0.48	US$/t
Pump	0.00	US$/t
Fans	0.05	US$/t
Cables, pipes, accessories, etc	0.09	US$/t
Subtotal	1.00	US$/t
Direct Mining Costs	**30.37**	**US$/t**
Indirect Mining Costs	**11.87**	**US$/t**
Processing Costs	**9.64**	**US$/t**
G&A Costs	**4.07**	**US$/t**
Cut off Value	**55.95**	**US$/t**
Marginal Cut-off Value	**41.00**	**US$/t**

The cut-off calculation formulas are the following:

- Cut-off = Direct Mining Costs + Indirect Mining Costs + Treatment Costs + Administrative Costs
- Marginal cut-off = Direct Mining Costs + Treatment Costs

16.4.4 Net Smelter Return

Based on the July 31st 2017 SRK resource, an NSR approach was used to assign values to blocks considered in the mine plan.

NSR is defined as the revenue of the sale of mineral products after deducting off-site expenses and is usually expressed in dollars per tonne. An NSR approach to mine planning is commonly used for polymetallic deposits and is considered best practice. Metal price assumptions were taken from the SRK resource estimate and discount factors (i.e. selling terms) and metallurgical recoveries were applied by Redco to determine NSR values for each block.

The following NSR formula was applied to each cell of the Yauricocha block model, based on calculated Revenue Factors for each metal (Table 16-11):

NSR (US$/t) = US$0.30 x Ag (g/t) + US$3.28 x Au (g/t) +

US$28.98 x Cu (%) + US$17.08 x Pb (%)+ US$20.19 x Zn (%)

Table 16-11: Calculation of the NSR

NSR Yauricocha		
Metal Prices		
Zn	US$/lb	1.25
Cu	US$/lb	2.60
Pb	US$/lb	1.01
Ag	US$/oz	17.8
Au	US$/oz	1,255
Metallurgical Recovery		
Zn	%	90
Cu	%	65
Pb	%	85
Ag	%	67
Au	%	16
Selling Terms		
Concentrate Treatment	US$/wmt	60.0
Concentrate Zn Grade	%	51.40
Zn Refinement	US$/t	30.0
Cu Refinement	US$/t	120
Pb Refinement	US$/t	48.00
Ag Refinement	US$/Oz	1.1
Au Refinement	US$/Oz	15.00
Concentrate Treatment Cost	US$/t	30.00
Concentrate Transportation Cost	US$/t	195.3
Concentrate Selling Cost	**US$/t**	**255.3**
Net Smelter Return		
RF Zn	US$/t/%	20.19
RF Cu	US$/t/%	28.98
RF Pb	US$/t/%	17.08
RF Ag	US$/t/g	0.30
RF Au	US$/t/g	3.28

16.4.5 Footprint Optimization

Based on measured, indicated and inferred resources, Redco used its in-house footprint optimization software “REDFOOT” to determine blocks with NSR values above the cut-offs and adjacent block with NSR values at or above the marginal cut-off value. Design parameters used to perform this calculation are given in

Table 16-12.

Table 16-12: Block Parameters used by Redco for Stope optimization

Parameter	Value	Units
Maximum allowable column height (HOD)	16	m
Vertical Mining Rate	80	m/yr
Interaction Zone Height	11	m
First dilution entry (Laubscher)	30	%
Density	Variable	t/m3

Based on the REDFOOT modelling, 13.9 Mt of mineral are considered in the mine plan, with over 40% of this material sourced from the Esperanza zone. Table 16-13 lists the volumes and grades of material, by area, considered in the mine plan.

Table 16-13: Conceptual economic envelope analysis PEA

Mineral Body	Tonnage (t)	Ag (g/t)	Au (g/t)	Cu (%)	Pb (%)	Zn (%)
Esperanza	5,775,317	58.565	0.457	1.625	1.054	2.639
Catas + Antacaca	2,960,189	21.618	0.580	0.544	0.251	2.131
Rosaura + Antacaca Sur	1,101,032	52.673	0.797	0.570	0.771	2.224
Mascota	1,060,338	75.921	0.528	1.984	1.696	5.520
Cuye	1,797,050	48.694	0.455	1.427	0.255	1.961
Elissa	111,843	49.994	0.169	0.099	1.129	3.955
Angelita	287,259	8.620	0.247	0.394	0.188	4.688
Celia	48,941	8.045	0.193	0.278	0.109	2.271
Escondida	262,743	50.850	0.318	0.133	1.559	3.852
Karlita	282,191	59.266	0.497	0.578	0.720	3.514
Privatizadora	61,412	23.602	0.262	0.036	0.797	4.945
Gallito	39,802	85.231	0.243	0.959	3.808	7.694
Oriental	51,446	87.138	0.178	0.420	0.867	5.917
Occidental	42,941	77.499	0.859	0.105	1.616	5.458
CSM II	48,025	88.256	0.184	0.142	4.398	6.367
Butz	24,388	8.892	0.182	0.130	0.749	2.400
Total	**13,954,915**	**49.007**	**0.503**	**1.197**	**0.808**	**2.780**

The values in Table 16-13 are based on cut off value of US$ 41.00/t which was calculated based on 3,000 tpd. With production increases to 5,500 tpd operational costs per tonne, and consequently cut off value, are expected to decrease due economies of scale.

16.4.6 Mine Productivity

A sub-level caving mining unit (Figure 16-8) was used to determine the development rate required to achieve 5,500 tpd. It consists of four draw points spaced every 8 metres, with column height of approximately 16 metres (Table 16-14). It is assumed that draw point length in mineral is 20 metres, and the waste cross-cut length is 50 metres. The average mineral density is 3.1 t/m3 and an average advance of 150 m/month is achieved for each working face. In addition, to avoid a greater dispersion of tonnage within the same level, a maximum rate of extraction of 400 tpd was applied per mining unit. Redco suggest that this is a conservative rate that allows greater control in the extraction and reduction of the risk of water entry.

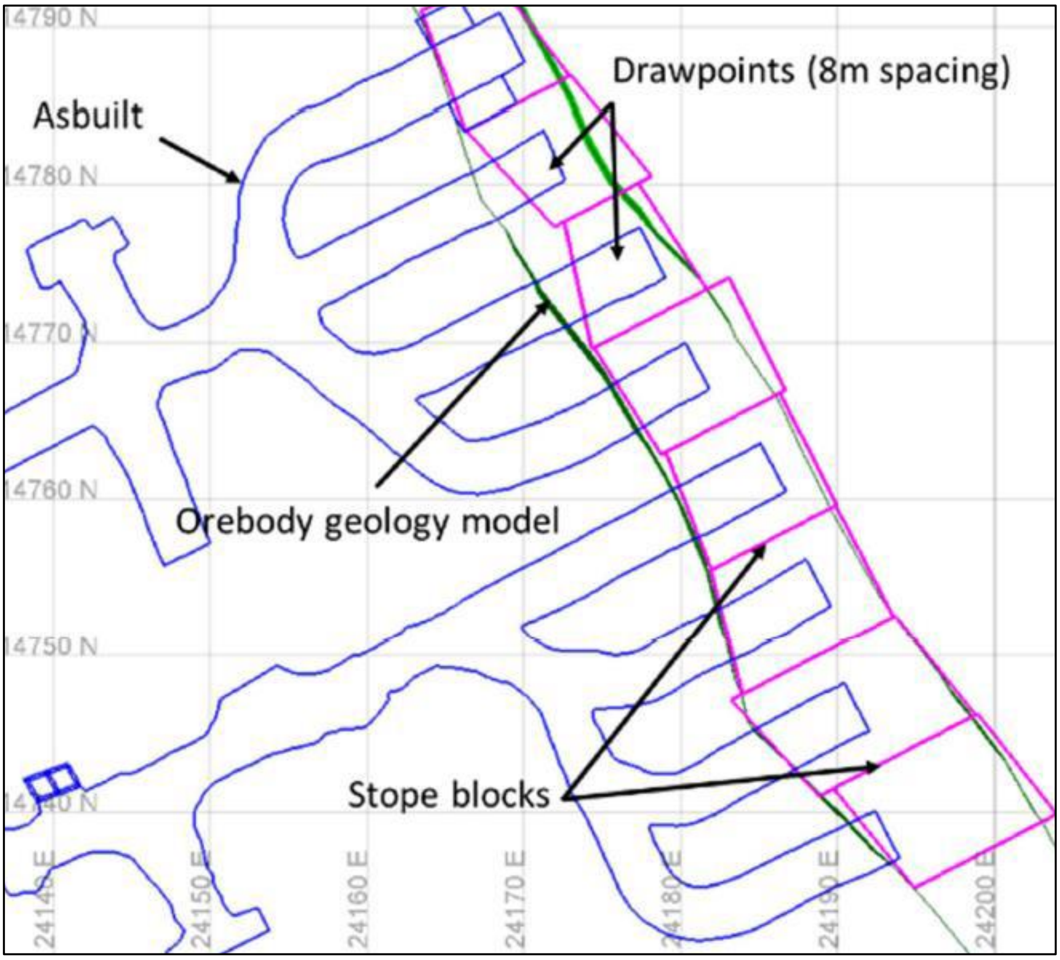


Figure 16-8 Sublevel Caving Mining Unit Schematic

Table 16-14: Mining Unit Parameters

Parameter	Value	Unit
Drawpoint	4	each
Pillar Width	8	m
Mineral Cross-Cut Length	20	m
Waste Cross-Cut Length	50	m
Mineral Density	3.10	t/m3
Column Height	16	m
Production rate	5,500	tpd
Advance Rate	150	m/month
Production Rate per Mining Unit	400	tpd

16.4.7 Mine Design

Mine areas were evaluated to determine infrastructure requirements associated with the 5,500 tpd objective. This evaluation considered; ramps, crosscuts, shafts and draw points, the dimensions for which are given in

Table 16-15. A maximum gradient angle of 12% was considered for all ramps.

Table 16-15: Cross-section of mine development

Development Type	Cross-Section (m)
Ramp	4.5 x 4.5
Cross-Cut	3.5 x 3.5
Safety Bay	1.5 x 2.0
Stockpiles	3.5 x 3.5
Service Raise	1.5 x 2.1
Vent Raise	2.4 Ø

Significant waste development is needed to gain access to areas not currently mined and to develop access to deeper levels of mineralised bodies currently being exploited.

Estimated development requirements for each mineralised zone were used to develop a mine development sequence to achieve 5,500 tpd production, the development rate used in the mine sequence is determined based on the following considerations:

- Strictly descending sequence.
- Access to the mineralized bodies is through draw points.
- Preparation must be done prior to the extraction of any mineralized column.
- The hoisting capacity of the different shafts of the material handling system.

16.4.8 Mine Schedule

The following constraints were applied to the mine schedule:

- Mining is strictly descending in all the bodies extracted from the mine to avoid stoping problems that trigger dilution or mud events.
- A maximum of 200 tpd can be extracted per draw point.
- Mining involves working on mining units composed of four draw points.
- Hoist capacity of 10,400 tpd cannot be exceeded.
- Mine development to support mine production of 5,500 tpd cannot start until the completion of the Yauricocha Shaft, expected mid-2020.

Based on the above constraints and the footprint optimisation exercise, Redco generated a production profile objective (

Table 16-16).

Table 16-16: Growth of Yauricocha Mine

Yauricocha				
From	Jan-18	Jul-18	Dec-19	Jan-21
To	Jun-18	Nov-18	Dec-20	End
Production rate	3,000	3,150	4,740	5,500

The Redco mine schedule considers a development time of 8 months (starting in January 2020), ahead of achieving 5,500 tpd mineral production by mid-2021.

The mine schedule determined by Redco, includes measured, indicated and inferred resources. The schedule establishes a Life of Mine (LoM) at Yauricocha of 9 years, with a maximum production rate of 5,500 tpd. This 9 year LoM considers 3.5 years' mine development, ramping up to 5,500 tpd between years 3.5 and 6.5 before production would reduce.

The mine schedule (waste and mineral) is shown in Figure 16-9 and Table 16-17.

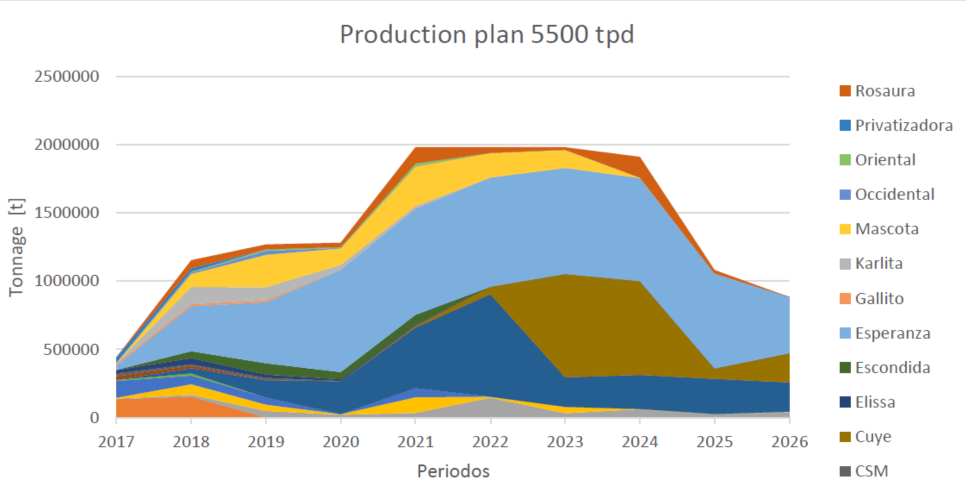


Figure 16-9: Mine Schedule – 5,500 tpd

Table 16-17: Production plan (5,500 tpd)

Item	Unit	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total
Mineral	t	1,152,002	1,267,500	1,281,000	1,980,000	1,980,000	1,980,000	1,910,000	1,080,000	882,966	13,954,916
Waste	t	540,884	530,529	492,164	383,548	284,910	278,291	259,611	135,976	205,933	3,343,074
Total	t	1,692,886	1,798,029	1,773,164	2,363,548	2,264,910	2,258,291	2,169,611	1,215,976	1,088,899	17,297,990
Waste Horizontal Development	m	19,039	19,139	18,132	15,094	10,570	10,172	9,694	5,468	9,201	124,572
Ore Horizontal Development	m	3,864	3,982	3,687	3,278	3,560	1,998	2,419	1,854	3,507	29,375
Vertical Development	m	928	959	1,352	733	915	809	447	680	186	8,463
Cu (mill feed)	%	0.807	1.252	1.159	1.059	1.189	1.423	1.474	1.245	1.267	1.200
Cu (mill feed)	t	9,302	15,871	14,850	20,973	23,543	28,167	28,156	13,448	11,183	167,009
Ag (mill feed)	g/t	49.454	52.415	50.485	51.390	45.950	45.574	53.606	52.320	36.234	49.01
Ag (mill feed)	oz	1,831,872	2,136,217	2,079,467	3,271,789	2,925,420	2,901,492	3,292,210	1,816,916	1,028,724	21,989,793
Au (mill feed)	g/t	0.519	0.507	0.580	0.563	0.469	0.470	0.461	0.510	0.524	0.50
Au (mill feed)	oz	19,237	20,643	23,877	35,851	29,829	29,926	28,301	17,709	14,884	225,776
Pb (mill feed)	%	1.1	1.2	1.2	1.0	0.4	0.5	0.5	0.9	0.8	0.81
Pb (mill feed)	t	12,338	14,781	15,037	19,227	8,660	10,840	10,093	9,715	7,007	112,798
Zn (mill feed)	%	3.3	3.7	3.5	2.9	2.4	2.7	2.1	2.3	2.2	2.78
Zn (mill feed)	t	38,277	46,779	44,711	58,324	47,116	53,554	39,677	25,202	19,040	387,946
NSR	$/t	125	148	141	124	105	120	111	116	106	121
Mined Mineral	t/day	3,200	3,521	3,558	5,500	5,500	5,500	5,306	3,000	2,453	
Mined Waste	t/day	1,502	1,474	1,367	1,065	791	773	721	378	572	
Total Mined	t/day	4,702	4,995	4,925	6,565	6,291	6,273	6,027	3,378	3,025	
Waste Development	m/day	55	56	54	44	32	31	28	17	26	
Ore Development	m/day	11	11	10	9	10	6	7	5	10	
Total Development	m	19,977	20,109	19,494	15,836	11,495	10,987	10,148	6,153	9,396	133,117

Development plans were generated for each mineralised body considered in the Redco mine plan. The summary mine development schedule is shown in Table 16-18.

Table 16-18: Mine development 5,500 tpd

Labor	Total metres	2018	2019	2020	2021	2022	2023	2024	2025
Vent. Access	1007	357	335	-	-	127	169	19	-
Decline	1918	571	18	-	197	437	373	322	-
Rooms	1098	489	96	-	58	149	195	111	-
Raise	146	49	-	-	-	-	39	58	-
Sublevel Access	1213	345	-	-	116	290	336	126	-
Main Sublevel	2954	528	1118	-	35	486	563	224	-
Waste Drawpoint	4017	460	379	460	538	712	552	587	329
Ore Drawpoint	7641	767	1191	1164	1081	932	1070	1037	399
Adit 5000	830	389	341	100	-	-	-	-	-
Raisebore Esp	286	-	125	-	-	-	161	-	
Rasibore Vent	648	452	-	-	-	-	196	-	-
Safety bay 5000	14	6	6	2	-	-	-	-	-
Cross-Cut 5000	225	67	138	20	-	-	-	-	-
Level 1170	430	-	-	-	-	-	430	-	-

16.5 Material Movements

The main constraint on the material movement is hoisting capacity at the Yauricocha Mine. The development phase of the mine schedule is considered high risk as it considers pushing hoisting capacity beyond the established capacity prior to the completion of the Yauricocha shaft.

Proposed material movement rates are presented in Table 16-19 on an annual basis. Redco consider that due to hoisting capacity limits, increasing production before the Yauricocha shaft completion is high risk (Figure 16-10). The development sequence is shown graphically in Figure 16-11.

Table 16-19: Material movement rates

Year	2018	2019	2020	2021	2022	2023	2024	2025	2026
Waste Movement (tpd)	1,502	1,474	1,367	1,065	791	773	721	378	572
Mineral Movement (tpd)	3,200	3,521	3,558	5,500	5,500	5,500	5,306	3,000	2,453
Total Movement (tpd)	4,702	4,995	4,925	6,565	6,291	6,273	6,027	3,378	3,025
Shaft Capacity (tpd)	4,500	4,500	7,110	10,400	10,400	10,400	10,400	10,400	10,400

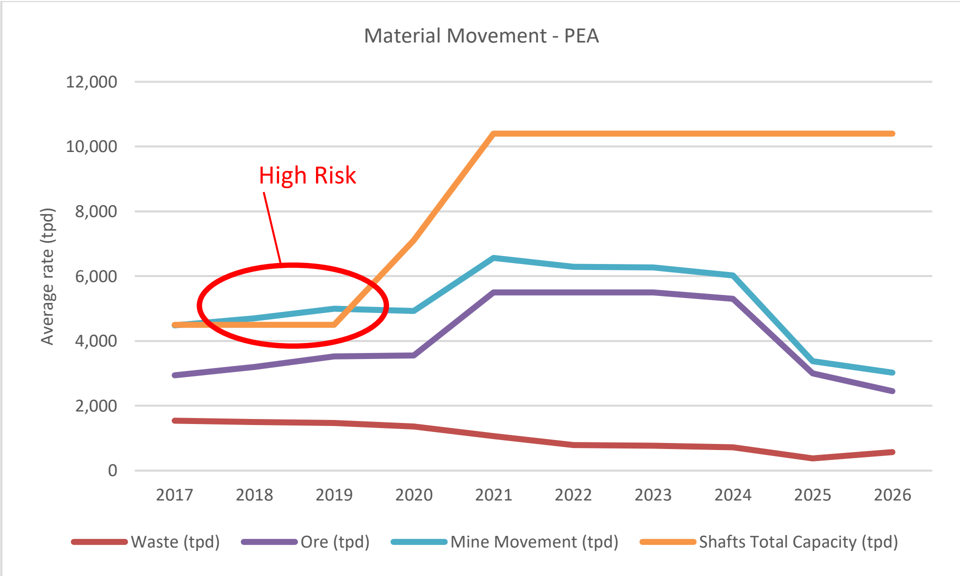


Figure 16-10: Material movement capacity vs Mine Schedule 5,500 tpd

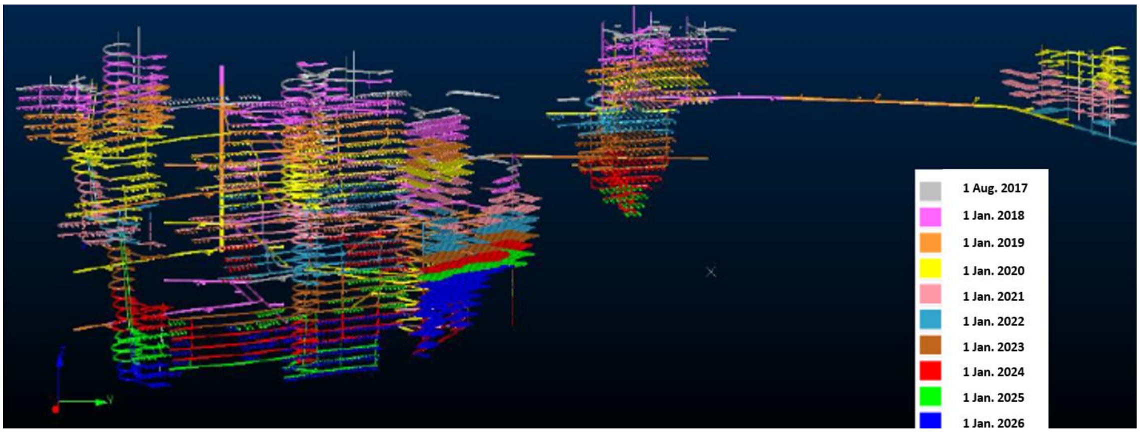


Figure 16-11: Development sequence 5500 tpd

The Redco mine plan considers a 4,200 tpd production rate between 2018 and 2019, which is greater than the established hoisting capacity at Yauricocha. This is a critical issue and other options to move material should be considered if the mine plan is to be achieved.

16.6 Waste and Stockpile Design

Waste is hoisted to the 720 level and transported on electric locomotive to surface through the Klepetko Tunnel. Waste is disposed of according to an established reclamation plan, whereby waste rock is either stored on approved waste dumps or used to back-fill abandoned open-pit mines on surface.

16.7 Mine Equipment

This section sets out the mine fleet required to sustain the mine plan developed by Redco.

Table 16-20 lists the equipment profile or mine fleet currently used at Yauricocha to support operations.

Table 16-20: Current equipment characteristics and fleet

Equipment	Units
Jumbo Advance	7
Jumbo Radial	9
Scoop 2.5 yd3	8
Truck 30 t	9

The current mine fleet supports 3,000 tpd production and is not sufficient to support production at 5,500 tpd. Therefore, a new equipment evaluation was conducted for Yauricocha to achieve 5,500 tpd.

Performance analysis was conducted for drills, scoops and trucks to determine the necessary number of each equipment type. The performance calculation is shown in Table 16-21, Table 16-22, Table 16-23 and

Table 16-24. All times are based on available hours and shifts per day as shown in Table 16-25.

Table 16-21: Performance calculation Jumbo of progress

Jumbo (Development)	Value	Units
Swell factor	30	%
Density	2.7	t/m³
Swelled Density	2.1	t/m³
Height	3.5	m
Width	3.5	m
Perimeter	14	m
Area	12.3	m²
Volume	51	m³
Drillholes per face	40	drillholes
Drillhole Length (average)	4.6	m
Total Metres per face	184	m/blast
Drillhole Efficiency	90%	%
Effective advance	4.14	m
Tonnage per advance metre	33	t/metre
Drilled metres	184.00	m/face
No. of drills per jumbo	1.00	#
Instantaneous drilling rate	0.45	m/min
Drilling time	408.89	min
Drill change time	0.67	min/drillhole
Losses	0.50	min/drillhole
Total Average time change drill bits and scaler	5.00	min
Total drilling time	**460.69**	**min**
Equipment Positioning Time	10	min
Total Drilling time per face	**7.84**	**hr/face**
Instant drilling performance	**562.92**	**m/d**
D: Mechanical availability	75%	%
U: Utilization	65%	%
Operational Factor	49%	%
Real drilling performance	**274.4**	**m/d**
Real drilling advance performance	**6.9**	**m/d**
Real drilling advance performance	**2,469.8**	**m/year**
Real drilling performance	**226.9**	**t/d**

Table 16-22: Calculation of radial jumbo performance

Jumbo (Production)	Value	Units
Swell factor	30	%
Density	3.1	t/m³
Swelled Density	2.4	t/m³
Height	16	m

Jumbo (Production)	Value	Units
Width	8	m
Burden	1.6	m
Perimeter	48	m
Area	128.0	m²
Volume	829	m³
Drillholes per face	15	drillholes
Drillhole Length (average)	7.2	m
Total Metres per face	108	m drilled
Drillhole Efficiency	90%	%
Effective advance	6.48	m
Tonnage per metre per drillhole	5.9	t/metre
Drilled metres	108.00	m/face
No. of drills per jumbo	1.00	#
Instant drilling velocity	0.45	m/min
Drilling time	240.00	min
Drill change time	1.00	min/drillhole
Losses	12.75	min/drillhole
Total Average time change drill bits and scaler	7.00	min
Total drilling time	**453.25**	**min**
Equipment Positioning Time	20	min
Total Drilling time per face	**7.89**	**hr/face**
Instant drilling performance	**328.62**	**m/d**
D: Mechanical availability	75%	%
U: Utilization	50%	%
Operational Factor	38%	%
Real drilling performance	**123.2**	**m/d**
Real drilling advance performance	**8.2**	**m/d**
Real drilling advance performance	**2,957.6**	**m/year**
Real drilling performance	**724.4**	**t/d**

Table 16-23: Calculation of LHD performance (Scoop)

Scoop 4yd3 Performance	Value	Units
Bucket capacity	4	yd³
Bucket capacity	9.5	t/bucket
Haulage distance	180	m
LHD Speed (Loaded)	6.9	km/hr
LHD Speed (Empty)	5	km/hr
Loading time	0.21	min
Dumping time	0.27	min
Travel time	3.73	min
Losses (5%)	0.21	min
Cycle time	**4.42**	**min/cycle**

Scoop 4yd3 Performance	**Value**	**Units**
Instant performance	**129**	**t/hr**
D: Mechanical availability	75%	%
U: Utilization	65%	%
F: Filling Factor	90%	%
Swelling	30%	%
Bucket Real Capacity	6.6	t/bucket
Real performance	**43.5**	**t/hr**

Table 16-24: Performance calculation Trucks

Truck 30t Performance	**Value**	**Units**
Chute capacity	12.5	yd³
Chute capacity	30	t/bucket
Haulage distance	1,000	m
Truck Velocity (Loaded)	9	km/hr
Truck Velocity (Empty)	10	km/hr
Loading time (cycle time scoop)	4.4	min
N° cycle to full load truck	3.1	cycle
Total Loading Time	13.8	min
Dumping time	2	min
Travel Time	12.7	min
Losses (5%)	1.8	min
Cycle time	**37.8**	**min/cycle**
Instant performance	**93**	**t/hr**
D: Mechanical availability	85%	%
U: Utilization	70%	%
F: Filling Factor	90%	%
Swelling	30%	%
Chute Real Capacity	20.5	t/bucket
Real performance	**38.4**	**t/hr**

Table 16-25: Shift Parameters

Shift	**Value**	**Value**	**Units**
Shift Hours Distribution			
Item	Shift 12 Hours	Shift 8 Hours	Unit
Shifts	2.00	3.00	shifts
Shift Hours	12.00	8.00	hr/shift
Travel to the mine	2.00	2.00	hr/shift
Available Hours	10.00	6.00	hr/shift
Travel to work faces	0.75	0.75	hr/shift
Equipment allocation	0.00	0.00	hr/shift
Safety Checklist and equipment observations	0.60	0.60	hr/shift
Mine Services	0.70	0.70	hr/shift
Available Hours	**7.95**	**3.95**	**hr/shift**

Based on the productivity assumptions listed in tables Table 16-21 to Table 16-25, an equipment profile was established to support a 5,500 tpd operation (Table 16-26):

Table 16-26: 5,500 tpd mine fleet profile

Equipment	2018	2019	2020	2021	2022	2023	2024	2025	2026
Jumbo (Development)	7	7	7	5	4	4	4	2	3
Jumbo (Production)	6	6	6	9	9	9	9	6	5
Scoop 4yd3 Performance	6	6	6	8	8	8	7	5	4
Truck 30t Performance	7	7	7	9	8	8	8	5	5
Personnel	200	200	222	343	343	343	331	187	153

Redco determined that to achieve 5,500 tpd, at least a 65% increase in the current mine fleet is required, which must be included as a capital investment throughout the life of the mine. Also, new equipment size will require new mining sections and resizing of the old mining sections. These changes are considered in the CAPEX estimation.

It is important to note that, although not dimensioned, service equipment is considered.

16.8 Ventilation

Currently, Yauricocha mine has a ventilation system for “Cachi Cachi” mine and another separate ventilation system for “Central” mine. The fresh air for “Central” mine comes from the main decline, Mascota shaft, Central shaft, RB # 3 and the Klepetko tunnel. The exhaust air is removed from the mine via Raisebore #1 and #2, by two primary fans located on the surface. Fresh air to Cachi Cachi mine is supplied via the Yauricocha tunnel and main decline (“Bocamina 410”). Exhaust air from Cachi Cachi is removed from the mine via 3 boreholes (3 metres diameter) to the surface.

The current total air requirement is 210,000 cfm and the air supplied is 247,000 cfm according to data from Minera Corona, 2017.

Airflow requirement to support 5,500 tpd production rate was estimated by Redco under the following assumptions (Table 16-27).

Table 16-27: Airflow Requirement by Item

Item	Amount	Total Diesel Engine Horsepower[hp]	Utilization[%]	AirFlow Personal [cfm]	AirFlow Equipment [cfm/hp]	Total [cfm]	Total [m3/s]
Dumper	9	1980	70		80	110,880	52.3
Jumbo Drill	7	1050	65		80	54,600	25.8
Jumbo Radial	9	1350	50		80	54,000	25.5
Scoop	8	1120	65		80	58,240	27.5
Personnel	343			50		17,150	8.1
Total						**294,870**	**139.2**

Then, taking into account the mine schedule and equipment profile, we have the following airflow requirement by period (Table 16-28).

Table 16-28: Airflow requirement 5,500 tpd

Airflow Requirement [m3/s]										
Equipment	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**
Jumbo Drill	11.1	25.8	25.8	25.8	18.4	14.7	14.7	14.7	7.4	11.1
Jumbo Radial	11.1	22.1	22.1	22.1	33.2	33.2	33.2	33.2	22.1	18.4
Scoop	10.3	20.6	20.6	20.6	27.5	27.5	27.5	24.1	17.2	13.8
Dumper	23.3	40.7	40.7	40.7	52.4	46.5	46.5	46.5	29.1	29.1
Personal	1.8	4.7	5.2	5.2	8.1	8.1	8.1	7.8	4.4	3.6
Total +10%	63.3	125.4	125.9	125.9	153.5	143.0	143.0	138.9	88.2	83.5
Total +10% [cfm]	133,947	265,452	266,552	266,662	325,017	302,885	302,885	294,217	186,725	176,847

Due to production rate and equipment fleet increases, air requirement increases to 325,000 cfm by the year 2021. To get this airflow it is necessary to keep current system at maximum capacity and at the same time adding a new ventilation circuit. This ventilation circuit is proposed in the vicinity of Esperanza and Cuye mines (Figure 16-12), which are the mines with greater depth and greater productivity for the end of the life of the mine. This system involves using a raisebore up to level 1270, to get 100,000 cfm of fresh air. The raisebore have a depth of 970 m which means US$ 2.91 M of investment at US$3,000 /m.

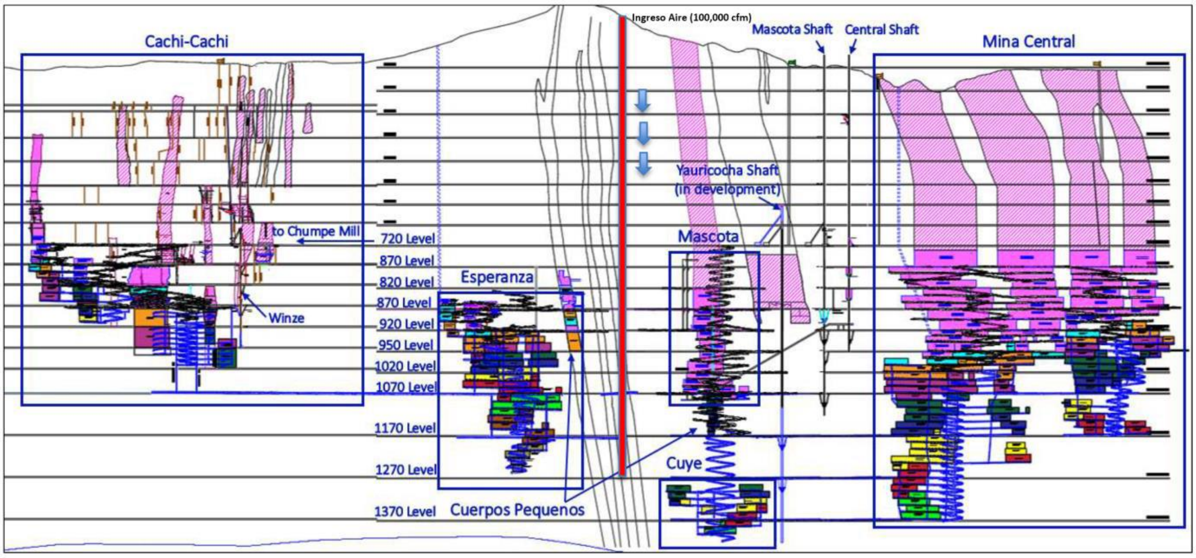


Figure 16-12 New Ventilation System

17 Recovery methods

The Chumpe plant is located approximately 1 km from the Yauricocha Mine, material is transported to the plant on rails. Mineral is processed using conventional two-stage crushing followed by grinding-classification and differential flotation circuit.

The Chumpe plant has been processing sulphide material from the Yauricocha Mine for more than 50 years. Four concentrates are produced at Chumpe, concentrate production for 2013 to 2017 is shown in Table 17-1.

Table 17-1: Yauricocha Polymetallic Circuit, 2013 to 2016 Performance

Period	Stream	Tonnes	Throughput (t/d)	Concentrate Grade					Metal Recovery				
				Au (g/t)	Ag (g/t)	Pb (%)	Cu (%)	Zn (%)	Au (%)	Ag (%)	Pb (%)	Cu (%)	Zn (%)
2013	Fresh Ore	641,268	1,757		83	1.5	0.7	4.1		100.0	100.0	100.0	100.0
	Cu Conc	12,728	35		1,058	2.8	23.2	6.4		25.2	3.7	70.6	3.1
	Pb Conc	14,258	39		1,300	53.4	1.8	5.9		34.7	80.0	6.3	3.2
	Zn Conc	45,412	124.4		122	0.6	1.0	50.8		10.4	3.0	10.8	88.7
2014	Fresh Ore	703,713	1,928		84	1.8	0.7	4.0		100.0	100.0	100.0	100.0
	Cu Conc	12,782	35		1,115	2.1	26.4	6.8		24.2	2.1	68.0	3.1
	Pb Conc	18,055	49		1,398	58.6	1.5	4.9		42.8	83.9	5.3	3.2
	Zn Conc	48,657	133.3		115	0.8	1.4	50.6		9.5	3.1	13.2	88.5
2015	Fresh Ore	618,460	1,694		79	1.6	0.6	3.4		100.0	100.0	100.0	100.0
	Cu Conc	8,145	22		1,278	2.3	27.8	4.1		21.4	1.8	65.3	1.6
	Pb Conc	14,463	40		1,656	59.5	1.1	4.3		49.3	85.7	4.7	2.9
	Zn Conc	37,587	103.0		91	0.6	1.2	50.7		7.1	2.1	13.4	90.1
2016	Fresh Ore	753,333	2,064	0.60	66	1.8	0.5	3.9	100.0	100.0	100.0	100.0	100.0
	Cu Conc	9,678	27	3.51	1,088	2.1	26.1	6.5	8.7	21.1	1.5	59.9	2.3
	Pb Conc	19,593	54	1.93	1,206	58.9	1.2	4.8	8.9	48.2	86.3	5.8	3.2
	Zn Conc	51,343	140.7	0.43	79	0.7	1.1	51.5	4.7	8.2	2.5	14.5	88.9
2017(1)	Fresh Ore	726,254	2,653	0.55	59	1.6	0.6	3.9	100.0	100.0	100.0	100.0	100.0
	Cu Conc	11,198	41	2.97	875	2.6	27.2	7.3	8.4	23.0	2.5	66.2	2.9
	Pb Conc	17,525	64	1.77	1,061	57.4	2.3	5.4	7.8	43.7	87.4	8.8	3.3
	Zn Conc	49,222	180	0.43	95	0.9	1.3	51.4	5.3	11.0	3.8	14.3	89.5

Source: SRK 2017

(1) January to September only

In 2017, typical recoveries were 66.2% Cu, 87.4% Pb and 89.5% Zn. Total silver recovery was 68% (43.7% deported to the Pb concentrate).

Planned adjustments to the Chumpe plant will not materially change the processing processes but will extend processing capacity from 3,000 tpd to 5,500 tpd.

Although proposed changes to the plant consider a 5,500 tpd throughput the crushing circuit will have capacity to process up to 6,000 tpd.

To date, tailings storage planning considers a mill throughput of 5,500 tpd. Investigations to expand plant throughput beyond 5,500 tpd must consider tailings storage capacity.

17.1 Current Operation

Material is delivered to the plant from the mine by locomotive and loaded into a 450t hopper and fed to the crushing circuit.

Crushing is two-stage crushing (jaw-crusher and cone-crusher) in open circuit. Material is classified through a series of three vibrating screens. Once material is reduced to a maximum of 1 ½" x 1" it is sent to the fine hoppers for storage.

Crushed mineral product is fed from fine hopper to the grinding circuit. Grinding is three-stage rod and ball mills in closed-circuit, material enters rod-mills and is reduced to 212 microns, high frequency screen classify material and Wilfley pumps transfer material to ball mills. Ball mills further reduce material to 120 microns, D-20 hydro-cyclones and centrifugal pumps classify material and Wilfley pumps transfer material to the flotation circuit.

Flotation consists of the following stages:

1. Flash flotation for coarse Pb concentrate
2. Rougher-Scavenger-Cleaner for Pb/Cu bulk concentrate
3. Differential flotation for Pb concentrate and Cu concentrate, and
4. Zn Rougher/Scavenger and Cleaner/Recleaner/Column cell for Zn concentrate

Pb/Cu are floated to produce a combined concentrate which is later separated using cyanide to produce two concentrates. Ag is principally deported to the Pb concentrate.

Zn is floated subsequently to a final grade of 60% Zn with one column cell.

Each concentrate stream is sent to a dedicated thickener where water content of concentrate is reduced to 10 to 12% moisture using drum and filter presses.

Flotation tailings are pumped to a 100 ft thickener and pumped to a conventional tailings storage facilities. Settled water is recycled back to the processing plant.

The circuit mentioned above is represented in Figure 17-1 and Figure 17-2.

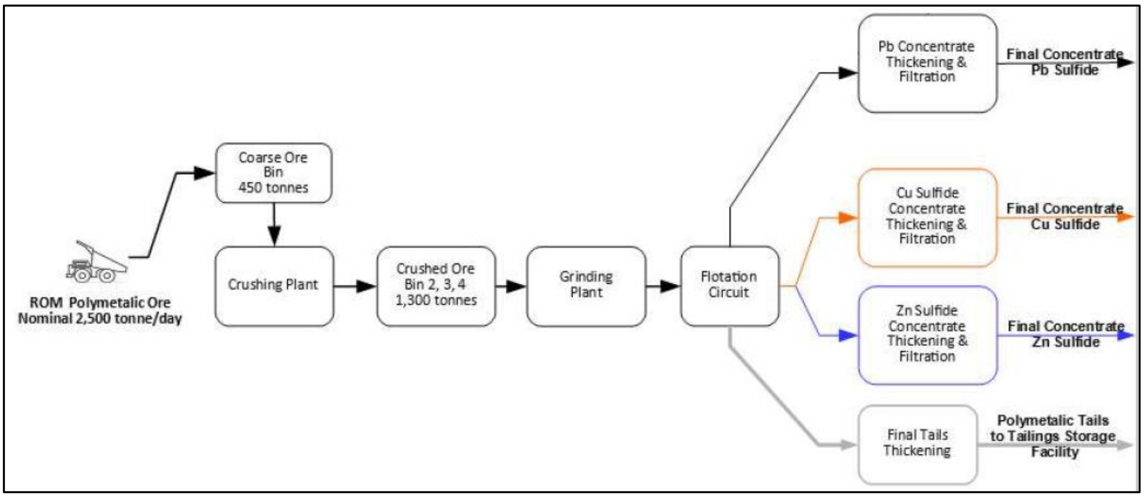


Figure 17-1 Above - Simplified processing Chumpe Plant

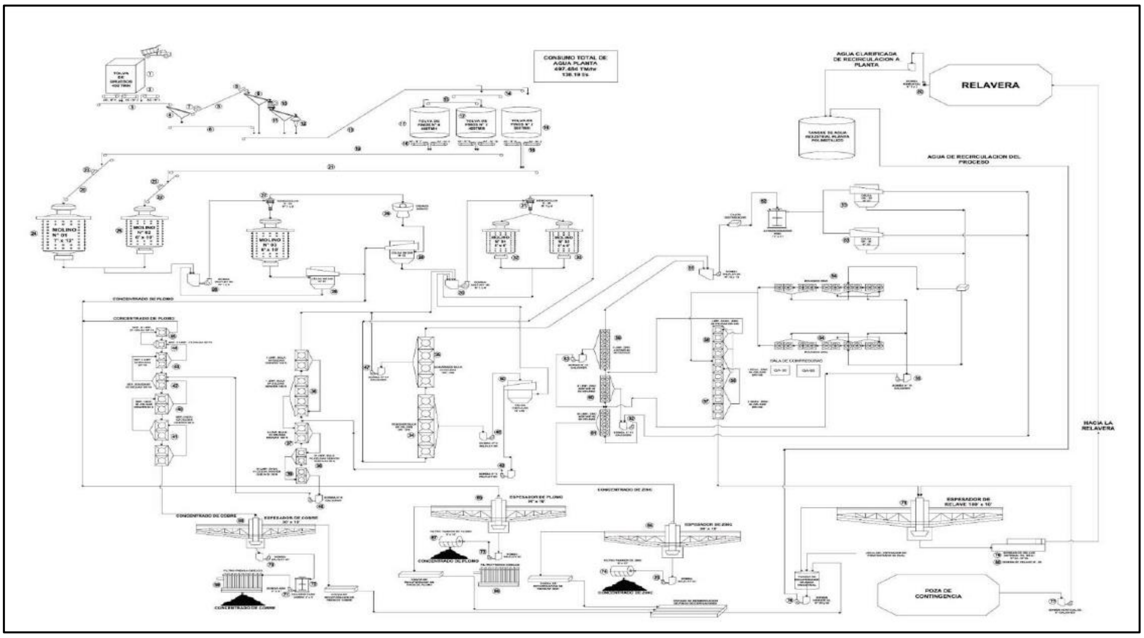


Figure 17-2 Chumpe Plant Work Flow

17.2 Proposed Operation

Mineral process techniques will not change materially, processing capacity will be increased at various stages to address bottlenecks identified by Sierra Metals. Proposed production increases are subject to permitting.

A key addition to the processing circuit is a regrinding circuit to treat bulk concentrate (scavenger concentrate) to improve metal recoveries. The proposed processing circuit is presented below.

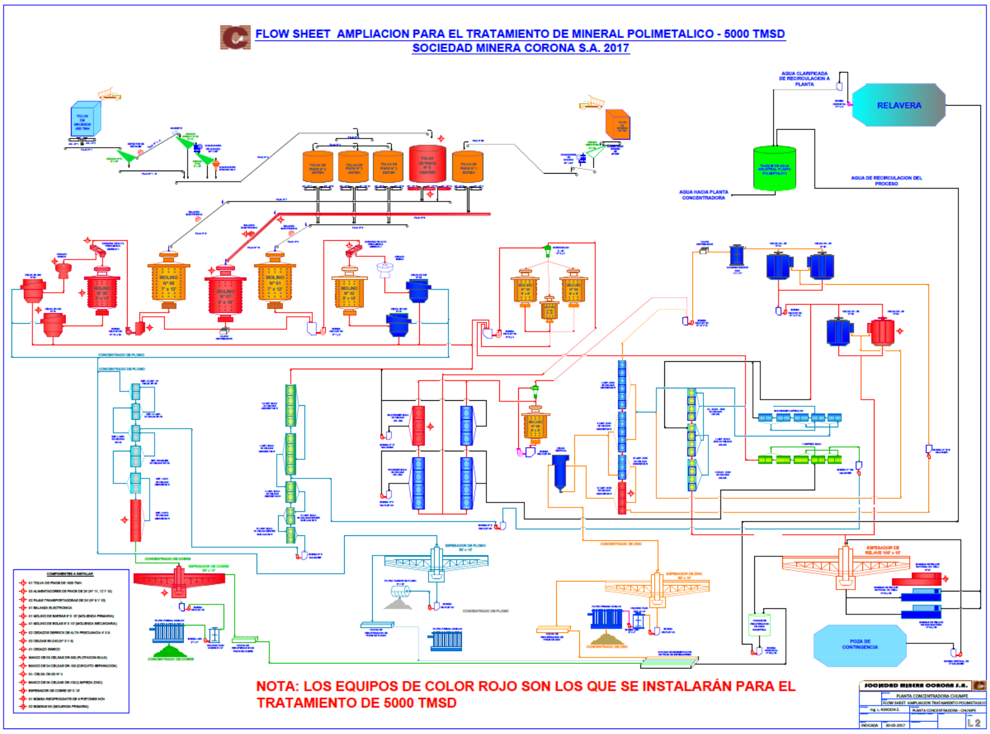


Figure 17-3 Proposed layout of the Chumpe Plant to achieve 5,500 tpd

A significant reconfiguration of the crushing and grinding circuit includes the proposed addition of a 22'x8.5 SAG mill circuit powered by 1.8-2.0 MW motor. The SAG mill will replace secondary crushing and two stage ball mills resulting in a significant decrease in power consumption and maintenance cost. Product from the primary crusher will feed the SAG mill. Rod mills currently in operation will be converted to closed circuit ball mills with hydro cyclones, these ball mills will be feed from discharge of the SAG mill.

Key pieces of equipment required to overcome bottlenecks and achieve 5,500 tpd are listed Table 17-2, quoted costs for this equipment amount US$ 8.94 M with 25% contingencies.

Table 17-2: Key pieces of equipment required to extend the processing capacity of the Chumpe mill to 5,500 tpd

Item	Comment	Cost US$
1000 t coarse bin	With this bin installed, coarse storage capacity will increase to 3,000 tpd the equivalent of 14hrs mill operation @ 5,000 tpd.	250,000
24" transportation belts	Various existing 18" transportation belts will be upsized to 24" and new one installed to new storage bin	45,000
Electronic Scales	Electronic scales will be installed on transportation belts to control the feed rates	15,000
Rod Mill 6' x 10'	Rod mill complete maintenance to improve grinding availability	Completed
Ball Mill 8' x 10'	A new ball mill will be installed	Completed
2 x High frequency 4' x 8' DERRICK Screens	This screen will be installed between the rod and ball mills	1,000,000
2 x SK 240 cells	SK 240 cells will be installed for Flash Flotation circuit	250,000
SWECO screen	The SWECO screen will be added to the grinding circuit	50,000
3 x DR300 Scavenger cells	These cells will be incorporated to the flotation circuit for scavenging	Completed
4 x DR100 cells	The cells will be incorporated to the bulk flotation circuit for extending retention time at rougher-scavenger	50,000
OK-30 Cell	Three OK-30 cells will be installed for rougher stage	Completed
X-Ray	On stream x-ray analyser will be installed to improve flotation conc grade due to ore variability	Completed
4 x DR100 cells	These four cells will be added to the cleaner phase of the bulk flotation circuit	50,000
50' x 10' Thickener tank	The thickener tank will be added to the copper circuit	250,000
8 Piston tailings pump	The piston pump will be added to transport tailings to tailings storage facilities	1,500,000
2 x Wilfley 8k pumps	These pumps will be used to pump material between the rod and ball mills in the grinding circuit	100,000
SAG mill circuit	Improve Assay and Metallurgical Lab	250,000
Assay Lab Met Lab.	22 x 8.5 SAG mill including conversion of rod mills to ball mills with corresponding feeders, screen, hydrocyclones, pumps and boxes	4,500,000
	TOTAL	**9,972,000**

For the disposure of tailings, were evaluated various option from those, the ones in

Table 17-3 were selected.

Table 17-3: Tailings Storage at Yauricocha

	Existing capacity Thickened tails 3,000 tpd	Expected date to be filled	Future capacity Thickened tails 5500 tpd	Date of Implementation	Future capacity Filtered tailings option / 5500 tpd
Stage 5	1.96 Mm3	January 2023			Filter plant water treatment filtered tailings deposition 10 yrs to December 2028
Stage 6	1.67 Mm3	April 2026	1.67 Mm3	November 2021	
Stage 7	1.84 Mm3	December 2029	1.84 Mm3	December 2023	
Stage 8 thru Stage 12			9.4 Mm3	December 2028	
CapEx Including tailings dam closure	US$ 18 M		US$ 42 M		US$ 28 M
Contingency	0		0		0

(*) Cost estimate by Tierra Group (2017 y 2018)

18 Project Infrastructure

Section 18 of this Report has largely been excerpted from a previous NI 43-101 Technical Report on the Yauricocha Mine, prepared by SRK (Consulting U.S., Inc), dated July 31, 2017 and is shown in italics. Standardizations have been made to suit the format of this report; any changes to the text have been indicated by the use of [brackets].

18.1 General

The Project is a mature producing mine and mill, with all required infrastructure in place and functional. The Project has highway access with two routes to support operational needs, the regional capital Huancayo (population 340,000) is within 100 km. Personnel travel by bus to site and are housed in one of four camps, in their current configuration these camps can house up to 2,000 personnel. Actually, approximately 1,700 personnel are housed at any one time split roughly 500 employees and 1,200 contractors, camps could host up to a further 300 personnel.

On-site facilities include the Chumpe processing plant, mine surface facilities, underground mine facilities, TSF, and support facilities. The processing facility includes crushing, grinding, flotation, dewatering and concentrate separation, concentrate storage, and thickening and tailings discharge lines to the TSF. The underground mine and surface facilities include headframes, hoist houses, shafts and winzes, ventilation structures, mine access tunnels, waste storage facilities, powder and primer magazines, underground shops, and diesel and lubrications storage. Support facilities include four camps, laboratory, change houses and showers, cafeterias, school, medical facility, engineering and administrative buildings, and miscellaneous equipment and electrical shops to support operations.

Water systems are installed to manage current water needs. Water is sourced from Ococha Lake and the Cachi-Cachi underground mine, and recycled/overflow water from the TSF depending on end use. Water treatment systems treat water for use as potable water or for service water in the plant. Additional systems treat the wastewater for further consumption or discharge.

Power (69 kV) is supplied via the national grid to a sub-station at site and power is distributed for use in mines and to the Chumpe processing facility. 12.75 MVA is the current load with approximately 70% of this consumed at the mine, the remainder is used at the plant and other facilities. In case of power blackouts, an 895 KW diesel generator is available to supply limited backup power.

A 149 KW compressor supplies compressed air for use underground.

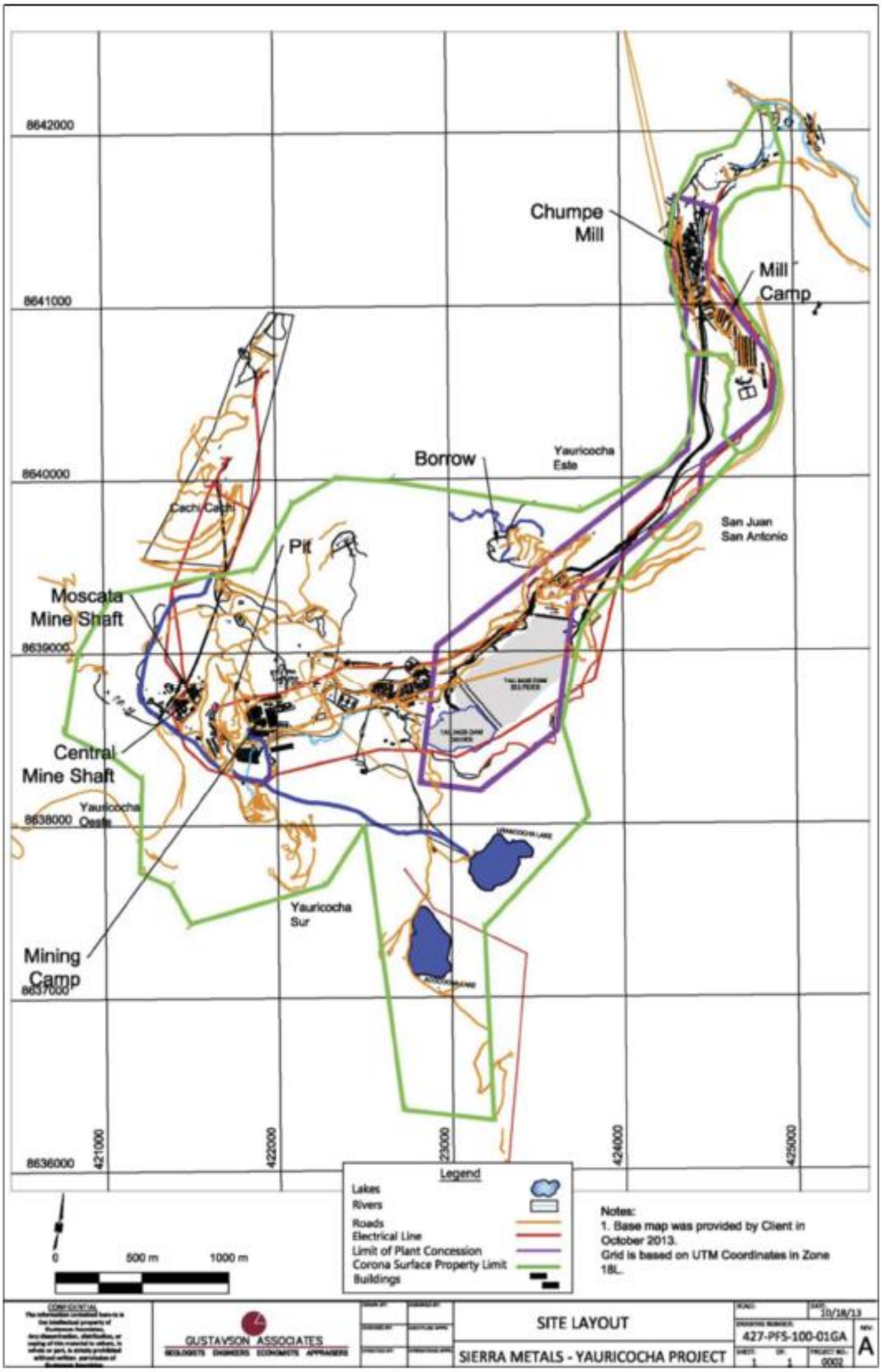
The site has permitted systems for handling of waste including a TSF, waste rock storage facility, and systems to handle other miscellaneous wastes. The TSF has a capacity for 11 months at the current production levels.

Tailings storage capacity is restricted, Tierra group evaluated tailings storage capacity and have designed three lifts to existing facilities, at 3,000 tpd this represent nine years storage and at 5,500 tpd 5.5 years storage. To support a proposed 5,500 tpd throughput at Chumpe, tailings storage capacity will be to be extended and this should be addressed as a matter of urgency.

An on-site industrial landfill is used to dispose of the Project's solid and domestic waste. The Project collects waste oil, scrap metal, plastic, and paper and it is recycled at off-site licensed facilities.

The site has an existing communications system that includes a fibre optic backbone with internet, telephone, and paging systems. On-site security is managed via a series of checkpoints including the main access road, processing plant, and at the camp entrances.

Logistics to and from site are primarily supported by truck. Concentrate is trucked to other customer locations in Peru. Materials and supplies needed for Project operation are procured in Lima and delivered by truck. A general location map showing the facilities is shown in Figure 18-1.

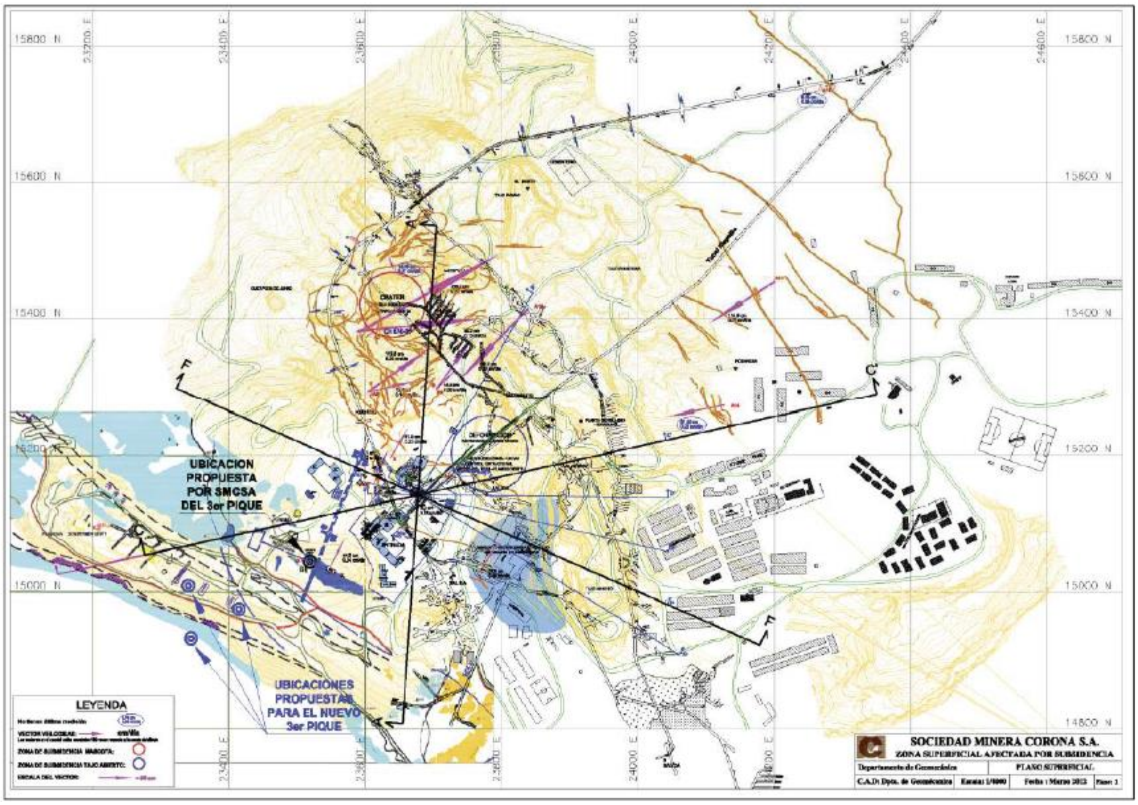


Source: Gustavson, 2015

Figure 18-1: Project Infrastructure Location

18.2 Mine Infrastructure – Surface and Underground

Surface facilities include; hoists, headframes, change houses, dry-facilities, engineering facilities and mine administrative facilities (Figure 18-2).



Source: Sierra Metals, 2013

Figure 18-2: Mining Area Infrastructure

18.2.1 Underground Access and Haulage

Access to underground workings is provided via shafts and tunnels. The site currently has three operational shafts; Central, Mascota, and Cachi-Cachi. An additional shaft (the Yauricocha Shaft) is under construction and is expected to be completed by mid-2020 and is budgeted to cost US$ 31.2 M.

Shafts are critical to mine infrastructure; personnel and material enter and leave the mine via the shafts. Mined material (mineral and waste) has to be hoisted from up to the 720 level and loaded on to rail carriages to be taken to surface.

Subsidence related to sub-level caving has impacted the Mascota and Central shafts, monitoring of this subsidence is ongoing and includes ground stations installed at surface. Plans to mitigate the effects of subsidence are being defined. If subsidence around these shafts is not mitigated it represents a significant project risk.

Monitoring of subsidence is ongoing, average movement are between 4.97 cm and 6.98 cm/yr which is within tolerable limits (Sociedad Minera Corona S.A. June 2018).

18.2.2 Tunnel Haulage

Underground haulage is primarily by 20t electric trolley locomotives with cars up to 4.5 m3. Material is hoisted to the 720 level and is hauled to surface along either the 4 km long the 4.7 km long Yauricocha tunnel.

18.2.3 Esperanza Orebody Access

The Esperance mineralised body which accounts for over 40% of material in the mine plan will be accessed via a planned 3,000 m drift and ramp from the 1070 level for an estimated cost of $4M

18.2.4 Ventilation

Two separate ventilation systems currently support the Cachi-Cachi and Central mine areas.

The Cachi-Cachi ventilation system is an intake system that pulls fresh air through the Klepetko Tunnel and the main decline (Bocamina 410) at Cachi-Cachi. Air exhausts through three boreholes to the surface. A SIVA 139HP primary fan pulls approximately 50,000 cfm. Air enters the mine through the main decline and down to lower levels of the mine through the shaft to producing faces, air circulation is completed by exhausting through vent raises and shafts to the surface. Ventilation doors are installed, and booster fans are used throughout the mine to maintain air quality.

The Central mine ventilation system intakes air from the central mine main decline as well as the Mascota and Central shafts, Raise Bore #3, and the Klepetko Tunnel. Air intake is approximately 159,000 cfm. Air exhausts through Raisebore #2 and Raisebore #1. Primary fans are located at these locations with a Joy 180 HP fan at Raisebore #1 and a Joy 200 HP fan at Raisebore #2. Air is pulled through the workings and routed with ventilation doors and booster fans to maintain air quality.

18.3 Water Systems

18.3.1 Water Supply

Water is sourced from Uñascocha Lake, Acochoa Lagoon, Mishquipuquio Spring, Kleptko Tunnel and recycle/overflow water from the TSF depending on end use. The location of the two lakes can be seen in Figure 18-1. The quantity of water and general use is summarized in Table 18-1. According to information in Table 18-1 current water requirements are 5.8 l/s and 46 l/sec are available which is more than sufficient to cover expected demands associated with the mine plan proposed in this PEA.

Table 18-1: Makeup Water Source and Use

Source	Quantity (L/sec)	Uses
Acococha Lagoon	4	Mining compressor and offices: 1.5 L/sec Yauricocha Camp: 1.5L/sec
Mishquipuqio Spring	2	Chumpe Camp: 1.5 L/sec
Klepetko Tunnel	40	Concentrator Plant: 1.3 L/sec

Source: Sierra Metals, 2017

18.3.2 Projected Water Demand

Water supply within the Yauricocha mine is more than sufficient to sustain current and proposed mining operations.

As throughput at the Chumpe plant increases from 3,000 tpd to 5,500 tpd, water demand is projected to increase from 133 lps to 223 lps. Dewatering from the mine supplies the plant with as much water as is needed. Recirculation of water from the tailings storage areas and thickeners can supply 130 lps to the plant, the balance will be piped from the mine as required.

Dewatering from the Cachi Cachi and Central Mine area average 50 lps, this more than sufficient to supply the Chumpe plant if throughput was expanded to 5,500 tpd.

18.4 Energy Supply and Distribution

18.4.1 Power Supply and Distribution

Power is provided to the Property by Sistema Interconectado Nacional (SINAC) and the Oroya Substation. A three phase, 60 hertz, 69 kV power line owned and operated by Statkraft (SN Power Peru S.A.) through its subsidiary, Electroandes S.A. delivers electricity from the Oroya Substation to the Property substation at Chumpe. Powerlines to the mine and plant were upgraded in 2017 to 69kV to provide more reliable power to the Property.

Current power requirements across the Property are approximately 12.75 MVA; approximately 9 MVA is supplied to the mine and 3.75 MVA is supplied to the processing plant.

Estimated power demand, associated with the proposed mine plan, is expected to increase by 6.5 MVA to 19.25 MVA; 3 MVA at the mine, 2 MVA with the completion of the Yauricocha Hoist, 1 MVA for additional water pumping and 0.5 MVA at the expanded Chumpe plant.

The additional power load will require the installation of transformers to increase the capacity to supply power to the mine and plant. Statkraft who own and operates Chumpe substation and distribution line from the Chumpe substation to the mine substation and to the processing plant substation are responsible for its maintenance.

Emergency backup power is provided by way of an 895 kW CAT (model 3512B) generator, an overhead ring line is installed that allows the backup generator to be used in emergencies to supply processing plant and the Cachi-Cachi mine zone.

18.4.2 Projected Electrical Demand

Electrical supply to the property will need to be upgraded to support increased mine production and plant throughput as proposed in this PEA.

Projected electrical demand exceeds the contracted supply of 12 MW (Table 18-2), a new revised contract for electrical supply is essential to the mine plan proposed in this PEA.

Table 18-2:Electrical demands - current and projected

	Electrical Demand Mine	Electrical Demand Plant	Total Demand
Actual (3,000 tpd)	5.3 MW	4.3 MW	9.6 MW
Projected (5500 tpd)	11.5 MW	7.1 MW	18.6 MW

18.4.3 Compressed Air

The mine uses compressed air for powering air chutes, drilling equipment, small pumps, and miscellaneous tools. The system includes compressors and tanks at the surface with piping distributing compressed air throughout the mine. A 149 kW Compressor will be added in 2018 to improve the compressed air system.

The mill has a smaller compressed air system to operate various tools.

18.4.4 Fuel

The site has diesel storage tanks on-site, with an approximate capacity to store 104,000l of fuel, for use as needed. Daily fuel consumption including surface and underground is up to 7570 l/d.

Fuel is purchased from vendors in Huancayo and transported to site by truck. During 2017 average fuel cost was approximately US$3.27/l. Table 18-3 and Table 18-4 show storage capacities of the two storage areas.

Table 18-3: Chumpe Diesel Storage Capacity (Gallons and Liters)

Chumpe Location	Gallons	Liters
Tank 01	3,384	12,810
Tank 02	1,127	4,266
Tank 03	2,230	8,441
Tank 04	2,230	8,441
Tank 05	3,064	11,598
Tank 06	6,000	22,712
Total Chumpe Capacity	**18,035**	**68,270**

Source: Sierra Metals, 2017

Table 18-4: Yauricocha Diesel Storage Capacity (Gallons and Liters)

Yauricocha Location	Gallons	Liters
Tank 07	4,354	16,482
Tank 08	1,643	6,219
Tank 09	1,457	5,515
Tank 10	2,042	7,730
Total Yauricocha Capacity	**9,496**	**35,946**

Source: Sierra Metals, 2017

18.5 Tailings Management Area

Sierra Metals contracted Tierra Group International, LTD (Tierra Group) to review the current TSF design and engineer lifts to increase available capacity.

Tailings from the Chumpe Mill are stored in on-site tailings facilities; tailings undergo flocculation and settling and are processed through a thickener and piped to the existing permitted Tailings Storage Facility (TSF). As of October 2017, permitted storage capacity is approximately 2.5 Mt, the current TSF with 3.5 m of freeboard has a capacity to store approximately 600,000 m3, effectively 11 months at 634,000 m3/yr. Tailings storage capacity will be extended further in 2018.

TSF capacity will need to significantly increase to handle the proposed plant throughput.

Tierra Group is the engineering company that designed and reviewed the construction and inspection of all works performed on the dam.

Construction Methodology

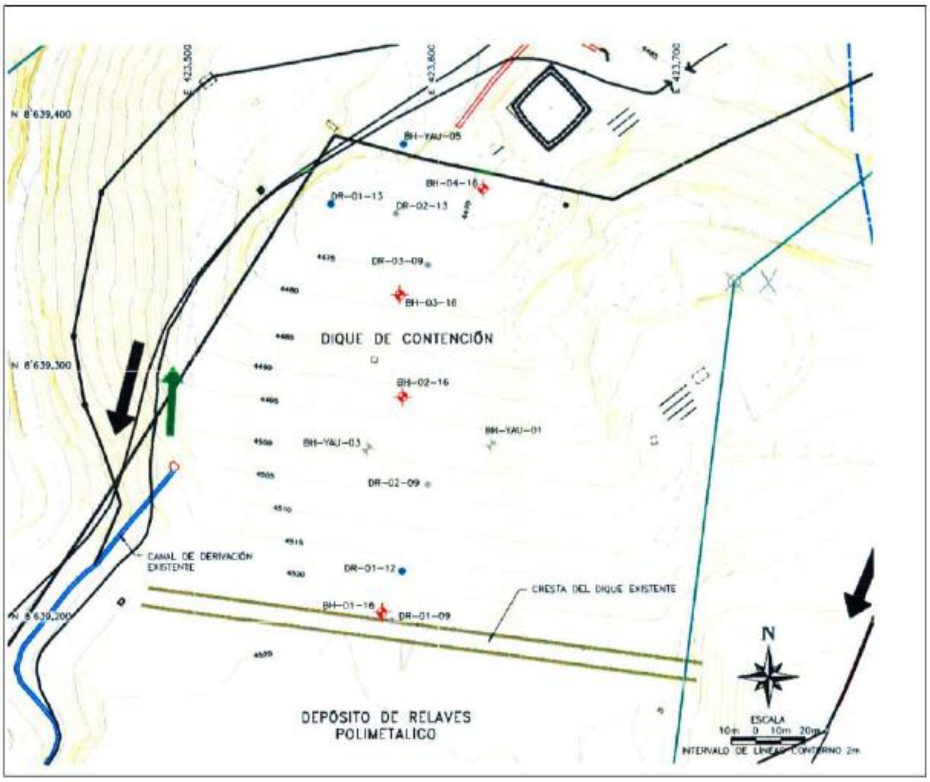
The embankment is a centreline/downstream construction built using 0.3 m lifts compacted using 10 t compactors. In areas near the mountain contacts, the lifts were 0.10 m.

Two materials types were used for the construction of the embankment. The first is a run-of-mine (RoM) material with most of the material being less than 13 mm with an average dry density of 2.116 g/cm3. The installed embankment with this material has a volume of 15.7 Mm3. During installation, the moisture content was estimated to be 8.5%.

The second material was crushed and screened on-site and is typically less than 76 mm in size. The material had an averaged dry density of 2.4 g/cm3 and a moisture content during installation of 8.7%.

A primary Terramesh system was installed with a volume of 0.46 km3 and an average density of 2.42 g/cm3. A second Terramesh system was installed with a 1.3 km3 volume.

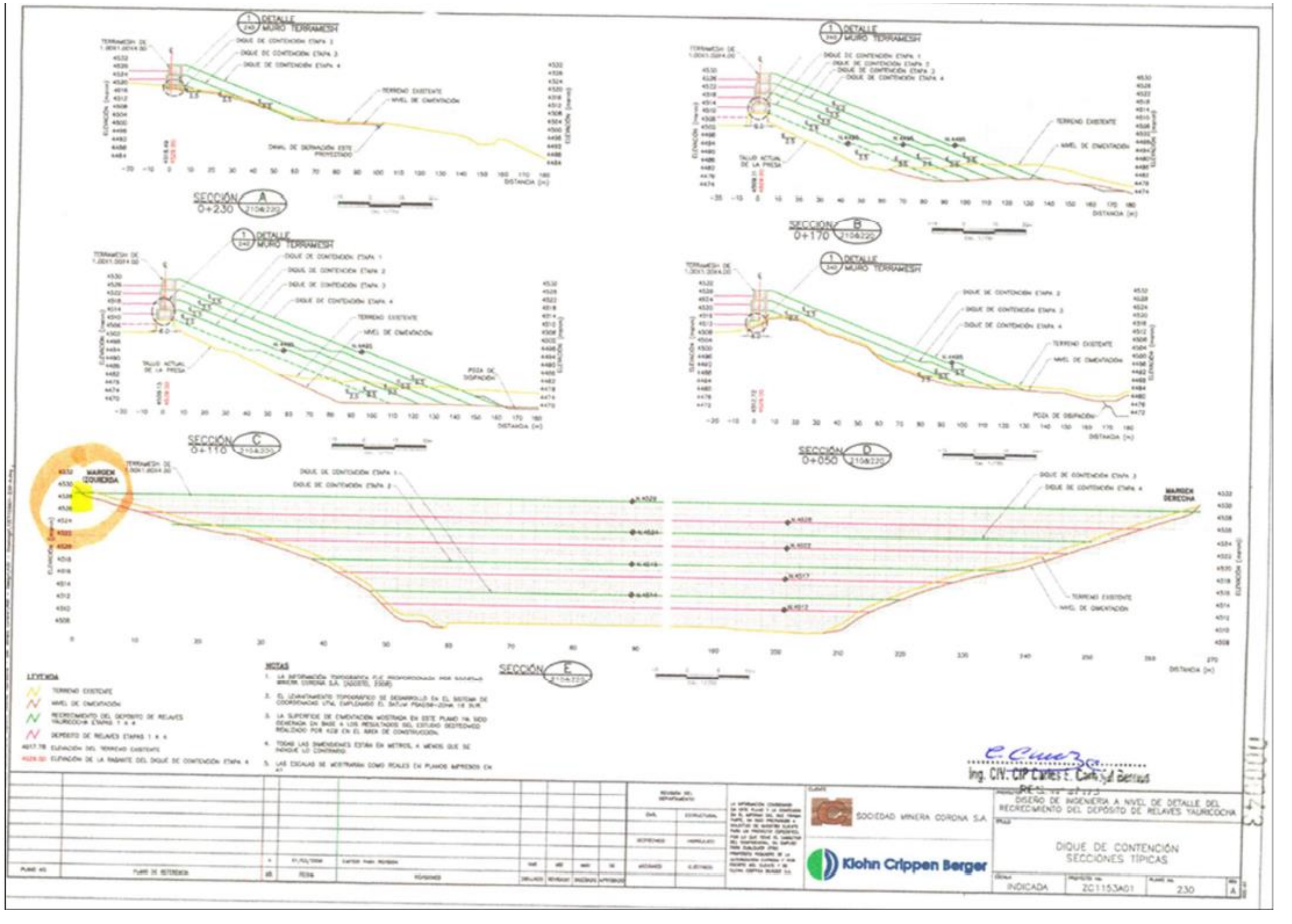
The total fill for Phase 4 of the dam is 130 Mm3. The top of the dam will be at an elevation of 4,529 and is approximately 44.5 m in height. The width of the crown is 7 m. The dike length is 267 m. Currently there are five piezometers working on the dam and three piezometers that are not working. Figure 18-3 shows the piezometer locations.



The piezometers are noted in red.
Source: Tierra Group, 2016

Figure 18-3: Piezometer Location in Stage 4 Tailings Storage Facility

Klohn Crippen Berger Engineering also provided support to construct the TSF. Figure 18-4 shows the as-built for the Terramesh.



Source: Tierra Group, 2016

Figure 18-4: Terramesh As-built Drawings

18.5.1 Expansion of Tailings Dam (Stage 5, 6 and 7)

Sierra Metals engaged Geoservice Ingenieria (GI) to design the tailings expansion for Stages 5-7 with a priority on the Stage 5 design that will be constructed in 2018. SRK didn't undertake a full review of the designs. GI was contracted in 2013 by Sierra Metals to design approximately 10 years of additional capacity. The future tailings storage for the Project will incorporate three additional 4 m raises to the existing TSF. The three raises are called Stage 5, 6, and 7. GI reviewed the previous design study by Klohn Crippen Berger (April 2009) and the GI report from October 2013. A topography surface was provided by Sierra Metals in 2013. GI reviewed the site hydrology, geology, hydrogeology, seismic risk, and designed the TSF facility raises. GI also performed a geotechnical analysis showing that the FoS of the design was adequate. Table 18-5 shows the results of the stability analysis.

Table 18-5: Yauricocha GI Stability Analysis for Stages 4, 5, 6, and 7.

Stage	Section of Analysis	End of construction		In Operation		
		Upstream	Downstream	Type of Failure	Static	Pseudo-static ag=0.20g
		FoS			FoS	
		Minimum: 1.3	Minimum: 1.3		Minimum: 1.3	Minimum: 1.3
4	Section A-A'	2.068	1.741	Local Global	2.403 1.773	1.577 1.213
5	Section A-A'	2.486	1.849	Local Global	2.488 1.977	1.697 1.367
6	Section A-A'	2.451	1.738	Local Global	2.648 2.083	1.448 1.152
7	Section A-A'	2.176	1.792	Local Global	2.615 2.086	1.713 1.176

Source: Sierra Metals, 2017

The TSF design for key design elements are summarized in Table 18-6.

Table 18-6: Yauricocha Key Design Elements for Stages 5, 6, and 7.

Design Item	Units	Stage 5	Stage 6	Stage 7
Altitude of crow, Previous Stage	masl	4,529	4,533	4,537
Maximum altitude of tailings, Previous Stage	masl	4,526	4,531	4,535
Height of extra elevation, this stage	m	4.0	4.0	4.0
Altitude of crown, this stage	masl	4,533	4,567	4,541
Maximum level of storage:	masl	4,531	4,535	4,539
Freeboard	m	2.0	2.0	2.0
Width of crown:	m	8.0	8.0	8.0
Length of Dam:	m	305.0	372.0	425.0
Inclination Upstream:	grade	Vertical	Vertical	Vertical
Inclination Downstream:	grade	2.5H:1.0V	2.5H:1.0V	2.5H:1.0V
Volume of Excavation/conformation	m3 excavation/ m3 fill	13,170 / 383,006.7	13,170 / 383,006.7	13,170 / 383,006.7
Storage	m3/t	2,046,385 / 2,864,939	1,789,140 / 2,504,796	1,930,550 / 2,702,770
Useful Life	years – (months)	3.22 (38.6)	2.82 (33.8)	3.04 (36.5)

Source: Sierra Metals, 2017

The designs of Stages 5, 6, and 7 yield a total storage of approximately 5.8 Mm3 or 8.1 Mt of tailings, which yields approximately nine years of storage at the projected annual tailings deposition rate of 633,971 m3/y and an average tailings density of 1.4 t/m3. Table 18-7 summarizes the results of the study and projected direct capital cost of the raises.

Table 18-7: Yauricocha Summary Design Results for Stages 5, 6, and 7.

Stage	Volume (m3)	Capacity (t)	Years	Direct Capital Cost (US$)	Unit Cost per Tonne Tailings
5	2,046,385	2,864,939	3.2	$3,736,749	$1.30
6	1,789,140	2,504,796	2.8	$1,958,392	$0.78
7	1,930,550	2,702,770	3.0	$2,493,605	$0.92
Total	5,766,075	8,072,505	9.1	$8,188,747	$1.01

Source: Sierra Metals, 2017

18.6 *Waste Rock Storage*

Waste rock generated by the Project is used as backfill underground with the remainder transported to the surface, primarily through the Klepetko Tunnel. There is an existing 1.2 Mm3 waste storage area on the surface and in historic open pits that are proximate to the shaft area that will be backfilled as a reclamation requirement. Some development material will be hoisted through the shafts to backfill the pit. The trucking of waste from the plant location into the open pit is ongoing with 2016 tonnage of 260,902 t and a 2017 tonnage of 321,372 t through September of 2017. There is a borrow area on site for general construction purposes and to support tailings construction.

18.7 *Other Waste Handling*

Two on-site landfills are used to dispose of the Project industrial and sanitary waste. The Project collects waste oil, scrap metal, plastic, and paper and it is recycled at off-site licensed facilities.

18.8 *Logistics*

Materials and supplies needed for the Project operation are procured in Lima and delivered by truck. Personnel are transported to the site on the existing highways and roads from Lima or Huancayo. The concentrates produced by the Project are transported overland by 30 to 40 t trucks to the refinery. Costs for transportation, insurance, and related charges are included in the treatment costs for concentrates. The concentrates are processed by a smelter in Peru with treatment and refining charges agreed to in advance under annual contracts.

18.9 *Off-site Infrastructure and Logistics Requirements*

The Project has no off-site infrastructure of substance and the five concentrate products are trucked to customer locations in Peru. The products consist of lead sulphide concentrate, copper concentrate (polymetallic), copper concentrate (campaign), zinc concentrate, and lead oxide concentrate.

18.10 Communications and Security

The site has an existing communications system that includes local internet, a fibre optic backbone, a telephone system, and an underground telephone system. A paging system is also available at the plant and mine. There are security checkpoints at the main access road, the mill site, and at the camp entrance.

18.11 Tailing Facilities

Sierra Metals requested Tierra Group International S.A.C. (Tierra Group) to undertake a trade-off study for various tailings storage options a Yauricocha. From an initial list of 9 options, Tierra Group forwarded five options for further consideration:

Option 1

This Alternative proposes to continue with the regrowth of the current Dam of Yauricocha tailings from Stage 8 to 12, in order to continue storing tailings in pulp, this option implies the regrowth of the current dam containment until stage 12, in addition two auxiliary dams must be built one to NW of the current tailings dam specifically in the sector where they are located the current camps and another one located to the North to contain the groundwater that can flow from the Uñascocha Lagoon and the bofedales that emerge in this sector.

Option 2

This option proposes the disposal of dry tailings downstream from the current TSF, on the Chumpe ravine.

Option 3

This option proposes the disposal of dry tailings in the skirt of Chumpe hill located to the NW of the current tailings dam.

Option 4

This option proposes the construction of a conventional tailings dam, with disposition of tailings in pulp on the Cachapusca creek to the SE of the current tailings facility.

Option 5

This option proposes the disposal of dry tailings on the current dam Yauricocha, it is proposed to store tailings progressively from the foot of the dam and regrowth towards the area of the reservoir.

19 Market studies and contracts

Yauricocha is a polymetallic operation that currently produces lead, zinc and copper concentrates, which are sold to various smelters with slightly different specifications. Yauricocha currently holds contracts for the provision of its various concentrates, these contracts were not reviewed by SRK, but their terms were included in the provided technical economic model. The terms appear reasonable and in line with similar operations SRK is familiar with. No material concentrate contract changes are expected in the foreseeable future.

The payable metals produced from the Yauricocha concentrates are zinc, copper, silver, lead and gold. These commodities are traded on various metals exchanges. Forecast metal prices were provided to Redco by Sierra and are based on an independent study commissioned by Sierra. The provided price curve has good adherence with recent metal prices and general consensus of market forecasters. Metal price assumptions applied by Redco for financial modelling are presented in Table 19-1.

Table 19-1: Projected Metal Prices

Year	Zn (US$/t)	Cu (US$/t)	Pb (US$/t)	Ag (US$/oz)	Au (US$/oz)
2018	3,108	7,033	2,359	18	1,329
2019	2,800	7,077	2,293	19	1,336
2020	2,646	7,209	2,227	19	1,328
2021	2,403	6,856	2,050	19	1,320
2022	2,403	6,856	2,050	19	1,320
2023	2,403	6,856	2,050	19	1,320
2024	2,403	6,856	2,050	19	1,320
2025	2,403	6,856	2,050	19	1,320
2026	2,403	6,856	2,050	19	1,320

Source: Redco, 2018

20 Environmental studies, permitting and social or community impact

20.1 Required Permit and Status

20.1.1 Required Permits

Sierra has all relevant permits required for the current mining and metallurgical operations to support a capacity of 3,000 tpd. These permits include operating licenses, mining and process concessions, capacity extension permits, exploration permits and their extensions, water use license, discharge permits, sanitary treatment plants permit, and environmental management instruments among others. Sierra also has a Community Relations Plan including annual assessment, records, minutes, contracts and agreements. Among the relevant permits, the following can be highlighted:

Land ownership titles;

Public registrations (SUNARP – Superintendencia Nacional de Registros Públicos, by its acronym in Spanish) of:

- *Process concession*
- *Mining concession*
- *Constitution of "Acumulación Yauricocha", and*
- *Land ownership and Records owned property (land surface) and lease; and*
- *2016 water use right proof of payment.*

20.1.2 State of Approved Permits

Table 20-1 lists Sierra's permits and licenses which has been prepared based on reports of the Ministry of Energy and Mines (MINEM), Public Registry of Mining (current INGEMMET), National Water Authority (ANA), National Public Registry Authority (SUNARP), General Directorate of Environmental Health (DIGESA), notary and information provided by Sierra.

The following permits were not available for review:

- *Mine ventilation permit;*
- *2016's Closure Plan financial guarantee accreditation;*
- *2016´s mining concessions proof of payment;*
- *2016´s processing concession proof of payment; and*
- *Landfill permit.*

Table 20-1 Approved Operation and Closure Permits

Item	Date	Expiry date	Status	Emitted by	Permits/licensees	Document
Environmental Management Instruments						
PMA, ITS and EIA						
	13/01/1997		Valid	MINEM	Approval of the PAMA (Plan de Adecuación y Manejo Ambiental), Environmental Adjustment and Management Program of the Yauricocha Production Unit of CENTROMIN located in the district of Alis, province of Yauyos and department of Lima	Directorate Resolution N° 015-97-EM/DGM
	23/05/2002		Valid	MINEM	Approval of the modification of the implementation of the PAMA of the Yauricocha Production Unit by CENTROMIN	Directorate Resolution N° 159-2002-EM-DGAA
	08/02/2007		Valid	MINEM	Approval of the implementation of the PAMA “Yauricocha" Administrative Economic Unit by SMCSA	Directorate Resolution N° 031-2007-MINEMDGM Report N° 963-2006-MINEM-DGM-FMI-MA
	09/06/2015		Valid	MINEM	Conformity of the Supporting Technical Report (ITS, Informe Técnico Sustentatorio) to the PAMA for "Expanding the capacity of the Processing Plant Chumpe of the Accumulated Yauricocha Unit from 2500 to 3000 TMD", presented by SMCSA	Directorate Resolution N° 242-2015-MINEMDGAAM Report N° 503-2015-MINEM.DGAAM-DNAMDGAM-D
	12/11/2015		Valid	MINEM	Conformity of the second Supporting Technical Report (ITS) to the PAMA for "Technological improvement of the domestic waste water treatment system " PAMA Accumulation Unit Yauricocha presented by SMCSA	Directorate Resolution N° 486-2015-MINEMDGAAM Report N° 936-2015-MINEM-DGAAM-DNAMDGAM-D
	03/07/2017		Valid	MINEM	Approval of the third amendment of the ITS to the PAMA for “Addition of new equipment and infrastructure in the Chumpe concentrator plant process” of the Yauricocha Mining Unit, presented by SMCSA	Directorate Resolution N° 176-2017-MINEMDGAAM Report N° 288-2017-MINEM-DGAAM-DNAMDGAM-D
Mine Closure Plan – PCM						
	24/08/2009		Valid	MINEM	Approval of the Mine Closure Plan (PCM) at feasibility level of the Yauricocha Mining Unit, presented by SMCSA	Directorate Resolution N° 258-2009-MINEMAAM Report N° 999-2009-MINEM-AAM-CAH-MESABR
	17/12/2013		Valid	MINEM	Approval of the Yauricocha Mining Unit Mine Closure Plan Update, presented by SMCSA	Directorate Resolution N° 495-2013-MINEMAAM Report N° 1683-2013-MINEM-AAM-MPC-RPPADB-LRM
	08/01/2016		Valid	MINEM	Approval of the amendment of the Closure Plan of the Yauricocha Mining Unit, presented by SMCSA	Directorate Resolution N° 002-2016-MINEMDGAAM Report N° 021-2016-MINEM-DGAAM-DNAMDGAM-PC
	15/01/2016	17/01/2017	Expired	SMCSA	Proof of payment for Mine Closure Plan guarantee. Amount 14'346,816.00 USD-Period 2016	Report N° 2570612
	08/02/2017		Valid	MINEM	Approval of the second amendment of the Closure Plan of the Yauricocha Mining Unit, presented by SMCSA	Directorate Resolution N° 063-2017-MINEMDGAAM Report N° 112-2017-MINEM-DGAAM-DNAMDGAM-PC
	29/12/2016	17/01/2018	Valid	SMCSA	Proof of payment for Mine Closure Plan guarantee. Amount 14'458,801.00 USD-Period 2017	Report N° 2669957
Mineral Process Concession						
	18/04/1996		Expired	MINEM	Definite authorization to operate the " Yauricocha Chumpe Processing Plant" at an installed capacity of 1350 TMD, CENTROMIN	Report N°164-96-EM-DGM-DPDM

Item	Date	Expiry date	Status	Emitted by	Permits/licensees	Document
	04/09/2008		Valid	MINEM	Authorization to operate the "Yauricocha Chumpe Processing Plant", including an additional lead circuit and expanding its capacity to 2010 TMD, SMCSA	Resolution N° 549-2008-MINEM-DGM-V Report N° 178-2008-MINEM-DGM-DTM-PB
	16/09/2009		Valid	MINEM	Authorization to raise the Yauricocha tailings deposit dam crest by an additional 20 m in 4 stages, SMCSA	Resolution N° 714-2009-MINEM-DGM-V Report 242-2009-MINEM-DGM-DTM-PB
	14/07/2010		Valid	MINEM	Authorization to operate the Mill No. 4 (8 'x 10') and the amendment of the "Yauricocha Chumpe" Benefit Concession to the expanded capacity of 2500 TMD, SMCSA	Resolution N°279-2010-MINEM-DGM-V Report N° 207-2010-MINEM-DGM-DTM-PB
	04/03/2011		Valid	MINEM	Operating license for the Ball Mill (5 'x 6') for regrinding, installed in "Yauricocha Chumpe Processing Plant, SMCSA	Resolution N°088-2011-MINEM-DGM-V Report N° 075-2011-MINEM-DGM-DTM-PB
	03/04/2012		Valid	MINEM	Authorization to operate the "Yauricocha" tailings deposit up to 4519 m in altitude (second stage) with a free board of 2 m, SMCSA	Resolution N° 112-2012-MINEM-DGM-V Report N° 112-2012-MINEM-DGM-DTM-PB
	29/04/2014		Valid	MINEM	Authorization to operate the raised "Yauricocha- Chumpe " tailings deposit up to 4522 m in altitude, SMCSA	Resolution N° 0159-2014-MINEM-DGM-V Report N° 128-2014-MINEM-DGM-DTM-PB
	03/08/2015		Valid	MINEM	Authorization to operate the raised "Yauricocha- Chumpe " tailings deposit up to 4524 m in altitude (third stage)	Resolution N° 0344-2015-MINEM-DGM-V Report N° 240-2015-MINEM-DGM-DTM-PB
	14/10/2015		Valid	MINEM	Authorization to build, implement equipment and operate the Chumpe Process Plant Extension Project 2500 to 3000 TMD of the "Yauricocha Chumpe" benefit concession, SMCSA	Resolution N° 0460-2015-MINEM-DGM-MV Report N° 326-2015-MINEM-DGM-DTM-PB
	29/08/2017		Valid	MINEM	Approval of the extension of the "Yauricocha Chumpe" benefit concession area. It was increased by 17,887 Ha. Also, authorization to build and operate civil and electromechanical works of the new equipment and auxiliary facilities of the "Yauricocha Chumpe" benefitconcession	Resolution N° 0366-2017-MEM-DGM Report N° 229-2017-MEM-DGM-DTM-PB
Land Ownership						
	-	12/21/2021	Valid	SMCSA	Vílchez Yucra family (way of passage and installations)	-
	-	03/07/2022	Valid	SMCSA	Varillas Vílchez family (56 ha for mining use)	-
	-	31/07/2037	Valid	SMCSA	San Lorenzo de Altis Community (696,6630 ha for mining use)	-
	-	Indefinite	Valid	SMCSA	Mineral processing concession: Yauricocha Chumpe processing plant (148.5 ha for mining use and an authorized capacity for 2500 TMD)	-
	-	Indefinite	Valid	SMCSA	Mining concession: “Acumulación Yauricocha” (18,777.9238 ha for mining use)	-
Water: Use, Discharge and Sanitation Facilities						
	2004		Valid		Water use license for population purposes in the Yauricocha Production Unit, whose collection point is the Laguna Acococha – Uñascocha	Administrative resolution N°249-2004-GR-LPDRA-MOC
	2003		Valid		Water use license for population purposes in the Yauricocha Production Unit whose collection point is the Huacuypacha spring	Administrative resolution N° 1355-2003-AG/DRALC/ATDR-MOC
	2004		Valid		Water use license for industrial purposes in the Yauricocha Production Unit whose collection point is the tunnel Klepetko	Administrative resolution N° 142-2004-GR-LPDRA-MOC
	2004		Valid		Water use license for mining purposes in the Yauricocha Production	Administrative resolution N° 249-2004-

Item	Date	Expiry date	Status	Emitted by	Permits/licensees	Document
					Unit	AG/DRALC/ATDR-MOC
	2005		Valid		Water use license for population purposes in the Yauricocha Production Unit	Administrative resolution N° 225-2005-GRLP/ DRA-MOC
	16/07/2007		Expired	DIGESA	Sanitary license of the treatment and disposal system for domestic wastes waters of the Yauricocha Production Unit, SMCSA	Directorate Resolution N° 256-2008-DIGESA-SA
	25/01/2008		Expired	DIGESA	Sanitary license for the treatment of potable water for the Yauricocha and Chumpe mining camps of the Yauricocha Production Unit	Directorate Resolution N° 256-2008-DIGESA-SA
	09/08/2016	2 years after, the operation of treatment plant	Valid	ANA	Authorization to reuse the treated domestic wastewater from Chumpe treatment plant to concentrator plant. Flow = 1.2 L/sec	Directorate Resolution N° 1132-2016-ANA-AAACAÑETE-FORTALEZA
	26/10/2016	2 years after, the operation of Treatment plant	Valid	ANA	Rectification of the authorization to reuse the treated domestic wastewater from Chumpe treatment plant to concentrator plant. (authorized to SMCSA by R.D. N° 1132-2016-ANA-AAA-CAÑETE FORTALZA, and modified by R.D. N° 1978-2016-ANA-AAACAÑETE FORTALZA),Correction: Flow = 0.95 L/sec	Directorate Resolution N° 1132-2016-ANA-AAACAÑETE-FORTALEZA
Proof of Payment for Surface Water Use						
	26/01/2016		Expired	ANA	Proof of payment for surface water use for the year 2015 in collection points authorized by the National Water Authority (ANA) for population, industrial and mining use.	-
	03/05/2016		Valid	ANA	Proof of payment for discharging treated industrial waste water for the year 2016 (Chumpe - Yauricocha treatment plant)	-
	07/11/2016		Valid	ANA	Proof of payment for surface water use for the year 2016	-
Mining Concessions and others						
	27/02/1991		Valid	Mining Public Register	Including the Yauricocha Chumpe Processing Plant and an area of 148.50 ha	-
	06/03/2002		Valid		Mining concessions transfer contract form CENTROMIN in favor of SMCSA (includes detail of mining concessions and inventory of the assets of Yauricocha Production Unit	-
	29/09/2008		Valid	SUNARP	Constitution of the “Accumulation Yauricocha Concession” (includes details of the Mineral Process Concession)	-
	03/07/2015			SMCSA	Inventory of Mining Rights	-
	30/11/2016		Valid	MINEM	Mining Operation Certificate (COM)	Dossier N° 2660533
Property Registrations and Contracts						
	07/03/2012		Valid	Notary	Lease by the Rods Vilches family	-
	27/08/2013		Valid	SUNARP	Property Registration Certificate: Land located on the right bank of the Huacuypacha creek and the road from Huancayo to Cañete	Supreme decree N° 035-94-JUS
	27/08/2013		Valid	SUNARP	Property Registration Certificate: Land located in the Chumpe region	Supreme decree N° 035-94-JUS
	27/08/2013		Valid	SUNARP	Property Registration Certificate: Located in the location Yauricocha	Supreme decree N° 035-94-JUS
	01/01/2014		Valid	Notary	Lease by – Los Arrendadores	-

Item	Date	Expiry date	Status	Emitted by	Permits/licensees	Document
Contracts, Acts and Agreements						
	01/03/2013		Valid	SMCSA	Agreement between the Tomas community and SMCSA (minutes for delivering sheet metal roofing as a donation is)	-
	16/04/2014		Valid	SMCSA	Agreement between the San Lorenzo de Alis community and SMCSA (proceedings of delivery of different materials)	-
	26/04/2014		Valid	SMCSA	Supplementary agreement between the Tinco community and SMCSA	-
	05/05/2014		Valid	SMCSA	Supplementary agreement between the Tomas community and SMCSA	-
	02/07/2014		Valid	SMCSA	Service contract	-
	2015		Valid	SMCSA	Service contract for personnel transport and minutes for delivering different materials as donation	-
	03/07/2015		Valid	SMCSA	Minute of the round table meeting between the Huancachi community and SMCSA. Minute for delivering 112 toilets and accessories.	-
	19/09/2015		Valid	SMCSA	Agreement between the San Lorenzo de Alis community and SMCSA (Minutes for delivering a concrete and metal bridge in Chacarupe and Ananhuichán Alis communities respectively)	-
	12/02/2016		Valid	SMCSA	Agreement between the Tomas community and SMCSA (construction contract)	-
	04/03/2016		Valid	SMCSA	Agreement between the rural community of San Lorenzo de Alis and SMCSA (Minute for delivering a pick-up TOYOTA 0 km and service contract).	-
	15/04/2016		Valid	SMCSA	Agreement between the Huancachi community and SMCSA (Minute for implementing the community center)	-
	21/04/2016		Valid	SMCSA	Agreement between the San Lorenzo de Alis community and SMCSA (Minutes for providing a service contract and sports equipment)	-
	30/09/2017		Valid	SMCSA	Agreement between the Tomas community and SMCSA	-
Community Relation Plans						
	2013		Expired	SMCSA	Annual Community Relations Plan - 2013 (including the total amount invested)	-
	2014		Expired	SMCSA	Annual Community Relations Plan - 2014 (including the total amount invested)	-
	2015		Expired	SMCSA	Annual Community Relations Plan - 2015 (including the total amount invested)	-
	2016		Valid	SMCSA	Annual Community Relations Plan - 2016 (including the total amount invested)	-
Others Documents						
	18/07/2007		Valid	Notary	Contract and right of use transaction between the San Lorenzo de Alis community and SMCSA	-
	15/07/2011		Valid	Yauricocha production unit	Reprogramming execution of works, communication works execution - 1st stage (the General Schedule for Yauricocha Tailings Deposit Regrowth, Stages II, III and IV)	Resolution N° 714-2009-MINEM-DGM-V
	03/12/2015		Valid	MINEM	Mining Operation Certificate (COM)	Dossier N° 2556310

Source: Prepared based on reports of Ministry of Energy and Mines (MINEM), Public Registry of Mining (current INGEMMET), National Water Authority (ANA), National Public Registry Authority (SUNARP), General Directorate of Environmental Health (DIGESA), notary and information provided by SMCSA.

The Environmental Adjustment and Management Program (PAMA), as established by the Supreme Decree Nº 016-93-EM, was the first environmental management tool that was created for mines and metallurgical operations existing before 1994 to adopt technological advances and / or alternative measures to comply maximum permissible limits for effluent discharge and emissions of mining and metallurgical activities. Since then, many environmental regulations have been enacted updating and/or replacing older regulations. The environmental certification for mining activities was transferred from the Ministry of Mining and Energy to the Ministry of Environment; specifically, to the National Service for Environmental Certification (SENACE) effective December 28, 2015.

Though SMCSA has updated its environmental baseline and adjusted its monitoring program by its Supporting Technical Report to the PAMA "Expanding the capacity of the Processing Plant Chumpe of the Accumulated Yauricocha Unit from 2,500 to 3,000 tpd" (Geoservice Ambiental S.A.C., ITS approved by Directorate Resolution N° 242-2015-MINEM-DGAAM), an important gap exists with reference to environmental and social impact assessment as referred to by the actual environmental protection and management regulation for operating, profit, general labor and mining storage activities (Supreme Decree N° 040-2014-EM, 11/12/2014).

In addition, SMCSA has two Supporting Technical Reports which authorize the construction of the technological improvement of the domestic waste water treatment system and the addition of new equipment and infrastructure in the Chumpe concentrator plant process. This last Supporting Technical Report (ITS) was approved in 2017 by Directorate Resolution N° 176-2017-MINEMDGAAM.

SMCSA applied to SENACE to start the evaluation process of the "Environmental Impact Study of the Metallurgical Mining Components Update Project" (Geoservice Ambiental S.A.C., 2017) within the framework of the Supreme Decree N° 016-1993-EM, as this study was initiated before the enforcement of the D.S N° 040-2014-EM and in application of an exceptional procedure established by it. Nevertheless, as SENACE has in place its procedures of admissibility and evaluation of environmental studies, this study will be subject to these requirements to be admitted, evaluated and approved.

In addition, the Peruvian environmental legislation contemplates that mine owners perform several studies to adjust to these new regulations, such as:

- *Environmental Quality Standards Compliance for Soils (Estudio de Calidad Ambiental-ECA de Suelos). SMCSA submitted this study to MINEM in compliance with the Supreme Decree N° 002-2014-MINAM, with register N° 2488477 (04/10/2015).*
- *Comprehensive plan for the adaptation and implementation of the activities to the permissible limits for liquid effluent discharge (Plan Integral para la Adecuación e Implementación de sus actividades a los Limites Permisibles para la descarga de efluentes líquidos). SMCSA submitted this study to MINEM in compliance the Supreme Decree N° 015-2015-MINAM, with register N° 2706233 (19/05/2017).*
- *Environmental Impact Assessment Update (Actualización del Estudio de Impacto Ambiental). This study has not been submitted to the MINEM (in compliance with the Supreme Decree N° 019-2009-MINAM) as MINEM did not publish its guideline for operations that operate with a PAMA.*
- *Sworn statement to the General Directorate of Mining Environmental Affairs (DGAAM), and Environmental Control Agency (OEFA) of the activities and/or*

processes and/or extensions and/or existing components to regularize (Declaración Jurada de los componentes por Regularizar). - In compliance with the Supreme Decree Nº 040-2015-EM all those activities, extensions, and/or components that have not been included in any Environmental Management Instrument had to be declared. SMCSA did not declare any component.

- *Detailed Technical Memorandum (MTD). - In compliance with the Supreme Decree Nº 040- 2015-EM, a MTD had to be submitted for all those activities, extensions, and/or components declared to be regularized to sworn statements mentioned above. Once the MTD approved, these components must be integrated into an Environmental and Social Impact Assessment or Environmental and Social Impact Assessment. As no components have been declared to be regularized, no MTD had to be presented.*

In those operations where the PAMA is the only principal environmental management tool, this has the category of an environmental certification similar as an environmental impact assessment and therefore, is subject of the presentation of the updated environmental impact study as established by the Supreme Decree N° 019-2009-MINAM. The Supreme Decree N° 040-2014-EM, in its First and Second Supplementary Final Provisions, regulates the integration and updating of the environmental impact assessment with the objective that each operating unit shall only have one updated environmental management tool. Therefore, it is likely that the Acumulación Yauricocha Unit will have to present a detailed environmental and social impact assessment in coordination with SENACE if seeking any expansion. This includes a social impact assessment including a social, economic, cultural and anthropological population baseline, hydrogeological pollutant transport model for short-, medium- and long-term scenarios, air quality and contaminant distribution assessment, archaeological survey report as for the certificate of nonexistence of archaeological remains (CIRA, certificado de inexistencia de restos arqueologicos), mitigation or compensation measures as applicable, among others.

20.2 Environmental Study Results

SMCSA updated, to some extent, its environmental base line and environmental monitoring program to adjust to the mandatory compliances by performing its Supporting Technical Report to the PAMA "Expanding the capacity of the Processing Plant Chumpe of the Accumulated Yauricocha Unit from 2,500 to 3,000 TMD" (Geoservice Ambiental S.A.C., 2015, ITS approved by Directorial resolution N° 242-2015-MINEM-DGAAM), an important gap prevails with reference to the environmental and social impact assessments with regards to the actual environmental protection and management regulation for operating, profit, general labor and mining storage activities (Supreme Decree N° 040- 2014-EM, 11/12/2014).

The monitoring program has been updated since July 2015 according to the ITS (Geoservice Ambiental S.A.C., 2015) and its Report N° 503-2015-MEM-DGAAM/DNAM/ DGAM/D and a First Quarter 2016 Environmental Monitoring Report (Equas, March 2016) has been performed. The following issues of importance are:

- *Land use capacity - Soils are suitable for cold climate grassland and protection;*
- *Actual land use - Is limited to urban (private or government), natural pastures and unproductive land;*
- *Wetlands - No reference was made to wetlands while these are likely to be present in the area and are protected in Peru;*

- *Soil quality - 32 samples from disturbed areas were analyzed and the results compared to the environmental quality standards for soil (Supreme Decree N° 002-2013-MINAM): arsenic, cadmium, lead and total petroleum hydrocarbons (TPH) exceed the environmental standards, as well as to a lesser extent also: benzene, xylene, naphthalene, toluene and ethylbenzene;*
- *Geology - There is predominantly presence of sedimentary rock such as sand-, silt- and claystones, conglomerates, limestones and dolomites;*
- *Biology - Terrestrial biology has been assessed in a dry and a wet season:*
    - *Flora - 12 species were identified listed as protected by Supreme Decree N° 043-2006-AG, among which categorized as Critical Endangered (CR): Ephedra rupestris, and as Endangered (EN): Nototriche tovari, as well as three species belonging to the CITES category II;*
    - *Birds - Four species were identified listed as protected by Supreme Decree N° 004-2014- MINAGRI, among which categorized as Endangered (EN): Vultur gryphus (Condor), seven species in the IUCN Red List and four species belonging to the CITES category I and II;*
    - *Mammals - Two species were identified listed as protected by Supreme Decree N° 004- 2014-MINAGRI, among which categorized as Endangered (EN): Puma concolor (Puma), Vicugna (Vicuña) and two species belonging to the CITES;*
    - *Reptiles and amphibians - Three endemic species were identified (gender: Lioalemus), but none is listed as protected;*
    - *Insects - Insects have not been assessed; and*
    - *Terrestrial biological monitoring - Though this monitoring in generally mandatory the N° 503-2015-MEM-DGAAM/DNAM/DGAM/D report does not include terrestrial biological monitoring: flora, birds, mammals, reptiles and amphibians, and insects.*
- *Hydrobiology - The ITS indicates that in both wet and dry season for most monitoring stations the diatom pollution tolerance index IDG results in moderated polluted water (eutrophication), while the EPT and BMWP indicate in wet season bad water quality with presence of organic matter and in the dry season good water quality with presence of trout (Onchorynchus mykiss). In some trout elevated concentrations of mercury and cadmium were found while in others retention of P, Na, Mg, K and Ca. Successive regular monitoring should be performed in the same five surface water quality monitoring stations for phytoplankton, zooplankton, benthos, periphyton and nekton. The N° 503-2015-MEM-DGAAM/DNAM/DGAM/D report does not indicate the frequency of monitoring;*
- *Hydrology - The Yauricocha project is located in eight micro-watersheds belonging to the Alis and Laraos rivers sub-watersheds which include mountain tops with elevations as high as 4,800 and 5,300 metres above sea level;*
- *Springs - The water of the Laraopuquio and Quilcasa springs are slightly acidic while the water from the Chumpe 1 spring exceeds the environmental quality standards for iron, lead and manganese according to the Supreme Decree N° 002-2008-MINAM, category 3 (irrigation of tall and short stem crops and animal's beverage);*
- *Regular monitoring established in the ITS has been performed by EQUAS S.A. for the first quarter of 2016 in accordance to:*
    - *Supreme Decree N° 040-2014-EM, Environmental protection and management regulation for operating, profit, general labor and mining storage activities;*
    - *Supreme Decree N° 015-2015-MINAM. - Amendment to the National Environmental Quality Standards for water and establishment of supplementary provisions;*

    - *Supreme Decree N° 010-2010-MINAM. - Maximum permissible limits for effluent discharge of metallurgical mining activities; and*
    - *Supreme Decree N° 002-2013-MINAM. - Environmental quality standards for soil.*
- *Surface water quality monitoring - Monthly monitoring is performed in five monitoring stations: M-2, M-4 (707), PM-11, PM-12 and PM13, and quarterly reported to the MINEM. The water quality analysis is performed for those parameters for which national environmental quality standards have been established as for category 3 - subcategory D1 irrigation of tall and short stem crops and D2 animal's beverage (Supreme Decree N° 002-2008-MINAM Supreme Decree N° 015-2015-MINAM). The First Quarter 2016 Environmental Monitoring Report (Equas, March 2016) indicates that the water quality of the Chumpe creek does not comply with the category 3 in the in PM-11 for low dissolved oxygen concentration and in PM-12 and PM-13 for high manganese concentrations while the water quality in the Tinco River complies with the category 3;*
- *Underground water quality monitoring - Quarterly monitoring is performed in seven monitoring stations: DR-01-13, DR-02-13, DR-03-13, PB-01-13, PB-02-13, PB-03-13 and PT-01-13. The ITS approval report indicates that the variables to be monitored are: pH, temperature, electrical conductivity, Dissolved oxygen, flow, grease and oils, CN-wad, CrVI, DBO, mercury, bicarbonates, carbonates, fluorides, chlorides, DQO, thermotolerant coliforms and total coliforms, e.coli, enterococci, helminths, phenols, phosphates, nitrates, nitrites, S.A.A.M., sulfur, sulfates, and as total metals: Al, Sb, As, Ba, Bi, Bo, Cd, Ce, Co, Cu, Cr, Sn, P, Fe, Li, Mg, Mn, Mo, Ni, Ag, Pb, Se, Na, Ta, Ti, Va, Zn. As no national environmental quality standards have been set for underground water, the water quality analysis is performed as for those parameters for which surface water national environmental quality standards have been set (category 3 - subcategory D1 irrigation of tall and short stem crops). The First Quarter 2016 Environmental Monitoring Report (Equas, March 2016) specifies that the underground water quality meets this reference quality;*
- *Effluent water quality - Monitoring is performed monthly, in one monitoring station: V-1 (705) and its quality is compared to Supreme Decree N° 010-2010-MINAM. The First Quarter 2016 Environmental Monitoring Report (Equas, March 2016) denotes that the effluent water quality complies with the maximum permissible limits for effluent discharge of metallurgical mining activities;*
- *Air quality - Bi-quaternary monitoring is performed in two monitoring stations: CA-01 (704) andCA-02, leeward from the processing plant and windward from the Chumpe mining camp respectively in accordance with Supreme Decree N° 003-2008-MINAM and Supreme Decree N° 074-2001-PCM. As to this new monitoring program no monitoring results are yet available;*
- *Noise: Bi-quaternary monitoring is performed in three monitoring stations: R-1, R-2 and R-3 in accordance with Supreme Decree N° 085-2003-PCM;*
- *Soil quality monitoring - Quaternary monitoring is performed in three monitoring stations: MI-01-UY, MI-03-UY and MI-06-UY and the results are compared with the environmental quality standards for soil, Supreme Decree N° 002-2013-MINAM. The monitoring results show thatMI-01-UY and MI-03-UY comply with the environmental quality standards for soil, while MI-06-UY exceeds the environmental quality standards for soil concentrations of arsenic and lead; and*
- *Hence, to enable a proper environmental evaluation monitoring should be reported over a longer time period.*

20.3 Environmental Issues

Data and information for this section is based on the PAMA (SGS, 1996), the Yauricocha Mining Unit Mine Closure Plan Update Report N° 1683-2013-MEM-AM/MPC/RPP/ADB/LRM, the ITS(Geoservice Ambiental S.A.C., 2015), ITS Report N°503-2015 MEM/DGAAM/DNAM/DGAM/D and the ITS (Geoservice Ambiental S.A.C., 2017), ITS Report N° 288-2017-MEM/DGAAM/DNAM/DGAM/ D. Accumulación Yauricocha is an underground mine operated by the method of ascending cut and fill stoping to extract its polymetallic mineral (sulfides) of lead, silver, copper, zinc and iron and lead silver oxide ore.

- *Mineral transport - The mineral is transported from the Klepetko tunnel to the hopper of the mineral Chumpe processing plant;*
- *Waste rock - Waste rock is hauled through the mine entrances and stored in the waste rock dump at Chumpe, which has a storage capacity of 320,000 m3 when reaching level 4156 (meters above sea level). Another 17 waste rock dumps are considered to be closed. Though the Closure Plan and its updates consider two types of covers for the closure of the waste rock dumps – one for non-acid rock drainage generating material (NPAG) and another for potential acid rock drainage generating material (PAG) – no comprehensive study on potential acid rock drainage was available to review as to whether the different waste rock dumps are NPAG or PAG. No mention was found on differentiating PAG waste rock from NPAG waste rock or its differentiated management. To prevent rainfall runoff from getting into contact with the waste rock the implementation of collecting channels have been foreseen as part of the closure design of the larger dumps. No information has been found on the water percolating through the waste rock dumps; and*
- *Mineral processing - The mineral is processed in the Chumpe mineral processing plant which has two separate flotation circuits:*
  - *One, of 2,500 tpd in capacity, to process polymetallic ores; and*
  - *Another, of 500 tpd in capacity, to process the lead and silver oxide ore.*

The process is conventional with stages of crushing, grinding, regrinding, selective flotation, and filtration, dispatch of concentrates and transport, and tailings storage.

- *Tailings - The tailings deposit is located at an elevation of 360 m and 2.6 km upstream of the existing processing plant and several camps and installations, in the location that once was the Yauricocha Lake. The tailings dam was built with compacted granular material of intrusive and metamorphic origin. The design considers growing the crest in five stages. According to the reports N° 1683-2013-MEM-AAM/MPC/RPP/ADB/LRM and N° 503-2015-MEMDGAAM/ DNAM/DGAM/D the global stability is stable under static and pseudo static conditions. SMCSA has obtained the authorization to operate the third stage of the tailings deposit and start the construction of the fourth stage. The PAMA and closure plan update indicate that the tailings are considered PAG, as tailings deposited from 1979 to 1988 contains 31.4% of pyrite and tailings deposited from 1989 to 1996 contains 17.6% pyrite. No additional recent data and no comprehensive study on the mineralogical composition and drainage quality in the short, medium and long term were available to review in order to have a better understanding of the tailings geochemical-physical characteristics and its environmental implications.*
  - *Regarding water management:*

- Water in the tailings pond is composed of water from the tailings pulp, direct rainfall and mine water from the Victoria tunnel; clarified water from the tailings pond is pumped to a tank and returned to the processing plant by gravity, closing the circuit;

- Filtrations are captured by a system of underdrains and sent towards the underdrain sump and pool for recirculation; and

- Channels on the right and left of the tailings deposit capture the rainfall runoff preventing them to enter in contact with the tailings.

  - *Regarding its management and control, SMCSA monitors the design parameters, the physical stability by piezometers installed in the tailings dam, and the cleaning of the rainfall runoff channels (SMCSA´s 2015 Annual Memory).*
- *Domestic and industrial solid waste - SMCSA operates a sanitary landfill for domestic wastes and has warehouses for temporary storage of recyclable waste. Recyclable non-hazardous solid waste and hazardous solid waste are delivered to a solid waste traders company (ECRS) and a solid waste server company (EPS-RS) respectively, both authorized by DIGESA, complying with the Regulations of the General Law of Solid Waste;*
- *Effluent, surface and groundwater management and control:*
  - *Mine water - The mine water from the Klepetko tunnel is collected in a channel and directed to the water treatment plant at Chumpe where it is neutralized by adding lime and its solid particles depressed by adding flocculants;*
  - *Wastewater control - SMCSA operates three domestic wastewater treatment plants called PTARD (the Spanish acronym) for residual domestic waste water treatment plant:*

- One with a capacity of 17 m3/day, installed in the area Chumpe, and another with a capacity of 40 m3/day, installed in the La Esperanza areas, operate by activated sludge and multiple aeration. The treated water seeps into the subsoil. Nowadays, In the ITS (Geoservice Ambiental S.A.C., 2017), ITS Report N° 288-2017- MEM/DGAAM/DNAM/DGAM/D, SMCSA indicate the replacement of these two PTARD for one PTARD with capacity of 50 m3/day,

- One with a capacity of 100 m3/day, installed in the Chumpe area, operates by means of sequential biological reactors. The treated water is incorporated in the mineral processing plant (zero effluent).

  - *Surface water quality control - Monthly monitoring of water for quarterly reporting to the MINEM and ANA includes verification of the compliance with Maximum Permissible Limits (Supreme Decree N°010-2010-MINAM) and Environmental Quality Standards for Water (Supreme Decree N° 002- 2008-MINAM, as amended by Supreme Decree N° 015-2015- MINAM); and*
  - *Groundwater quality control - Quarterly is monitored by nine piezometers.*
- *Emissions and dust control:*
  - *Bi-quaternary monitoring two monitoring stations: one leeward from the processing plant and the other windward from the Chumpe mining camp; and*
  - *Dust prevention by wetting the road surfaces (dirt roads) during the dry season (vehicle traffic).*

20.4 Operation and Post Closure Requirements and Plans

Sierra has a closure plan with three approved amendments:

- *Yauricocha Mine Unit Closure Plan, approved by Directorate Resolution N°258-2009-MEM/AAM (08/24/2009) and Report N°999-2009-MEM-AAM/CAH/ MES/ABR;*
- *Yauricocha Mine Unit Closure Plan Update, approved by Directorate Resolution N°495-2013- MEM-AAM (12/13/2013) and Report N°1683-2013-MEM-AAM/ MPC/ RPP/ADB/LRM;*
- *Yauricocha Mine Unit Closure Plan Modification, approved by Directorate Resolution N°002- 2016-MEM-DGAAM (01/08/2016) and Report N°021-2016-MEM-DGAAM/DNAM/DGAM/ PC; and*
- *Yauricocha Mine Unit Second Amendment of the Closure Plan, approved by Directorate Resolution N°063-2017-MEM-DGAAM (02/09/2017) and Report N° 112-2017-MEMDGAAM/*
- *DNAM/DGAM/ PC.*

In 2007, a feasibility-level Closure Plan for the Yauricocha Mining Unit was developed by CESEL S.A. following the requirements of the Peruvian legislation for mine closure, “Ley de Cierre de Minas”, Law N° 28090 and its Regulation, Supreme Decree N° 033-2005-EM and its amendments Supreme Decree N° 035-2006-EM and Supreme Decree N° 045-2006-EM. and based on the content recommended by the DGAAM in the Guideline for Preparation of Mine Closure Plans approved by Resolution R.D. N° 130-2006-AAM, dated April 2006.

This Closure Plan considers eight areas: Central, Cachi-Cachi, Éxito, El Paso, Ipillo, Chumpe, Yauricocha and Fortuna.

In 2012, pursuant to Peruvian regulations, the Mine Closure Plan was updated by Geoservice Ingeniería S.A.C. and approved in 2013.

Finally, in 2015 and in 2017 the time schedule of the Closure Plan has been modified in accordance with the mine’s life by its Closure Plan modification and second amendment respectively.

20.5 Post-Performance or Reclamation Bonds

On January 5, 2017, the bank guaranty for the compliance of the Mine Closure Plan regarding Yauricocha Mine Unit Closure Plan Update (approved by Directorate Resolution N° 002-2016- INEMDGAAM) has been renewed and increase from US$14,346,816.00 to US$14,458,801.00. The Second Amendment of the Closure Plan (approved by Directorate Resolution N°063-2017-MEMDGAAM, 02/28/2017) designates that the mining operator shall record the guarantee by varying annuities the first days of each year, so that the total amount required for final and post closure is recorded by January 2022 as shown in Table 20-2.

Table 20-2: Closure Plan - Annual Calendar for Guarantee Payment

Year	Annual	Accumulated	Situation
2017		14,458,801	constituted
2018	-411,510	14,047,291	To be constituted
2019	-353,534	13,693,757	To be constituted
2020	-274,787	13,418,970	To be constituted
2021	-154,459	13,264,511	To be constituted
2022	90,700	13,355,211	To be constituted

Table 20-3: Metal Prices

Year	Zn (US$/t)	Cu (US$/t)	Pb (US$/t)	Ag (US$/oz)	Au (US$/oz)
2018	3,108	7,033	2,359	18	1,329
2019	2,800	7,077	2,293	19	1,336
2020	2,646	7,209	2,227	19	1,328
2021	2,403	6,856	2,050	19	1,320
2022	2,403	6,856	2,050	19	1,320
2023	2,403	6,856	2,050	19	1,320
2024	2,403	6,856	2,050	19	1,320
2025	2,403	6,856	2,050	19	1,320
2026	2,403	6,856	2,050	19	1,320

Source: Redco, 2018

20.6 Social and Community

Sierra maintains a relationship with the communities of San Lorenzo de Alis, Huancachi, Tomas and Tinco, and have subscribed to various agreements with those communities. To some extent, Sierra maintains a relationship with the Santo Domingo de Larao community. The company assists with various projects but have not subscribed to any agreement as Santo Domingo de Larao do no permit developing mining activities in their community.

20.6.1 Agreements

In compliance with its social responsibility policy, Sierra has subscribed to various annual agreements with the surrounding communities including San Lorenzo de Alis, Huancachi, Tomas and Tinco. These commitments are intended to address the needs identified by these communities. The assistance primarily addresses sheep raising by introducing improved livestock. Additionally, activities are intended to improve irrigation infrastructure and local communication by implementing local bridges and some roads. Table 20-4 summarizes the annual agreements per community (2013 to 2016). Most of these commitments have been fulfilled with respect to the Delivery Acts.

Table 20-4: Annual Agreements per Communities 2013 - 2016 – Summary

Community	Agreements, Covenants and Letter	Obligations by Covenant / Agreement / Act / Letter	State of Projects
2013			
San Lorenzo de Alis	Covenant between San Lorenzo de Alis Community and Corona Mining Society. 2013	•Improvement of Chupurune irrigation system. •Corona will pay for the costs demanded by the construction of this irrigation system and they will execute it. • Installation of irrigation system by aspersion and pastures sowing in Chupurune. • Corona will deliver the materials required to repair the irrigation system by aspersion. • About earth movements. • Provide seeds and fertilizers to sowing 1 Ha of pastures. • Construction of Piscigranja bridge. • Corona will hire skilled and unskilled labor. • Construction of Lloclla and Cantuchaca bridges. • Corona will pay for the costs demanded by the construction of two bridges, one gate for both bridges and the improvement of the accesses to these bridges. • Purchase of sheep reproducers and implement one livestock medical kit. • Corona formalizes this agreement through the addendum covenant 2013 (04/28/14). • Provide money to buy reproducers and medical kit. • Support in health issue: perform 02 medical campaigns. • Support in educational issue: provide school supplies to students of Initial and First Grade from Alis.	Fulfilled
Huancachi	Act of Meeting. Round Table. Huancachi Community and Corona Mining Society. 2013	• Provide of 112 middle bathrooms. • Rubblering (filling) of the trail to the Huascacocha entrance.	Fulfilled
Tomas	Covenant between Tomas Community and Corona Mining Society. 2013	• Improvement of the Basic Educational Institution of Tomas population – Providing of 80 calamines. • Provide clothes for teachers of Santisima Trinidad Educational Institution. • Support in health issue: perform 02 medical campaigns	Fulfilled
	Conformable Commitment Covenant 2013 - Complementary	• Genetic improvement of herd (livestock). • Improvement of irrigation system – Sinhua Farm. • Installation of improved pastures – Sinhua. • Protection of terrain of pastures – Sinhua.	Fulfilled
Tinco	Complementary Covenant between Tinco Community and Corona Mining Society.	• Huaclacancha entanglement (Corona will provide materials required to entangling the terrain and will pay the 80% of the labor cost). • Elaboration of Local Communal technical profile (Corona will support the study elaboration).	Fulfilled
Tinco	Commitment between Company and Community	• Provide construction materials for the fence	Fulfilled
2014-2015-2016			
San Lorenzo de Alis	Covenant between San Lorenzo de Alis Community and Corona Mining Society 2014	• Provide construction materials and personal for the Chacarure and Ananhuichan bridges.	Fulfilled

Community	Agreements, Covenants and Letter	Obligations by Covenant / Agreement / Act / Letter	State of Projects
	Covenant between San Lorenzo de Alis Community and Corona Mining Society 2015	• Acquisition of van 4x4 to provide transportation service. • Corona will pay the cost of the van. • Elaboration of the Alis Communal Development Plan. • Corona will hire the Consultant to make this study. • Support in health issue: perform 01 medical campaign. • Support in educational issue: provide school supplies to students of Initial and First Grade.	Fulfilled
San Lorenzo de Alis	Covenant between San Lorenzo de Alis Community and Corona Mining Society 2016	• Strengthening of the productive activities which are currently being developed in San Lorenzo de Alis Community.	In Process
		• In health issue: perform 01 medical campaign. • In educational issue: provide school clothes to students of Basic and High School.	Fulfilled
		• Institutional strengthening: 03 training workshop in issues of community organization. • Citizen participation and Citizen oversight of participatory budgets.	In Process
Huancachi	Act of Meeting. Round Table. Huancachi Community and Corona Mining Society 2014 – 2015 - 2016	• Furniture for the Local Communal / Huancachi hotel (Corona is committed to get quotes for the Hotel furniture). • Elaboration of the Communal Development Plan. Corona will hire a Consultant to make this study.	In Process
		• Acquisition of van 4x4 to provide transportation service. Corona will pay the cost of the van.	Fulfilled
Tomas	Covenant between Tomas Community and Corona Mining Society 2014 - 2015	• Improvement of the infrastructure of the dairy processing establishment. • Elaboration of the Communal Development Plan. Corona will hire a Consultant to make this study. • Conservation of Natural Pastures Project.	In Process
		• Attention in matters of Health: 01 Medical Campaign (Corona will support the campaign economically). • Attention in matters of Education: Provide school packages to children of the initial and basic school.	Fulfilled

Source: UP Yauricocha, RRCC/SMCSA/ OCTOBER 2017

Community Relations Annual Plans are prepared and each program budgeted. Table 20-5 shows the investment for 2016.

Table 20-5: 2016's Community Relations Annual Plan Investment.

2015 Community Relations Annual Plan	Amount Budgeted (US$)	Amount Spent (US$)
Education	12,611.01	19,458.62
Healthcare	3,404.38	11,730.17
Local sustainable development	145,056.24	140,139.56
Basic infrastructure	5,644.14	41,983.51
Institutional and capabilities empowerment	4,736.53	4,736.53
Culture promotion	2,072.23	5,369.68
Total	**173,524.53**	**223,418.07**

Source: SMCSA, 2017, PLAN ANUAL_RRCC_2016

20.6.2 Assistance to Santo Domingo de Laraos Community

No agreements have been subscribed with the Santo Domingo de Laraos community as their authorities and people do not give the social license to perform mining activities in Ipillo and other points of interest to SMCSA. Nevertheless, SMCSA has supported various small projects and support schools and other aspects of the community as indicated in Table 20-6.

Table 20-6: Assistance to Santo Domingo de Laraos Community - Summary

Assistance	Status	Delivery Act
Renting a truck (0 km) they have acquired offering service to the mining unit	Fulfilled	Hire of truck August 26, 2014
Donation 01 melanime round table, a cabinet with decorative doors and 06 charis	Fulfilled	Record of Delivery, June26, 2014
Donation of 151 wooden poles 6” x 2.5 M.L.	Fulfilled	Record of Delivery, April 21, 2015
Improving 2.5 km of roads to enable vehicle access from the Laguna Pumacocha to the Rock Paintings of Qilcasca	Fulfilled	Record of Delivery, April 2, 2015
Donation of S/. 3000 for the anniversary of the community		Record of Delivery, August 31, 2015
Donation of 25 tracksuits for the magisterial community of the “avión” district	Fulfilled	Record of Delivery, July 6, 2015
Donation of the transport to deliver 50 recycled plastic cylinders for the construction of floating cages.	Fulfilled	Record of Delivery, June 29, 2015
Donation of 50 gallons of oil to the Municipal District of Laraos	Fulfilled	Record of Delivery, June 3, 2015
Donation of cleaning implements for Initial Educational Institution Laraos	Fulfilled	Record of Delivery, June 11, 2015
Donation of one truck of surplus wood for domestic use to the	Fulfilled	Record of Delivery, June 3,

possessors of the "Success" area		2015
Donation of 50 gallons of oil to the Community of Laraos	Fulfilled	Record of Delivery, March 19, 2015
Donation of a computer, printer and computer accessories	Fulfilled	Record of Delivery, March 29, 2015
Donation of 51 tracksuits for the students of the primary school of Laraos	Fulfilled	Record of Delivery, June 14, 2015

Source: UP Yauricocha, RRCC/SMCSA/ JUNIO 2016

20.7 Mine Closure

This section has been prepared based on the Yauricocha Mine Unit Closure Plan Update´s Report N°1683-2013-MEM-AAM/MPC/RPP/ADB/LRM and the Second Amendment of the Closure Plan, approved by Directorate Resolution N°063-2017-MEM-DGAAM (02/08/2017) and Report N° 112-2017-MEM-DGAAM/DNAM/DGAM/ PC.

SMCSA is committed to perform progressive closure activities starting in 2016 and finishing in 2022, final closure in a span of two years and post-closure in five years 2025 to 2029 (this latter is the minimum period required to achieve physical, geochemical and hydrological stability of the area occupied by the mining unit as per Peruvian legislation).

The mine closure objective is to recover conditions similar to pre-mining conditions and/or uses compatible with the surrounding environmental conditions. Specific objectives are:

- *Human health and safety. - Ensure public health and safety implementing measures to eliminate risks such as pollution caused by acid rock drainage or waste, that could be transported to populated areas by water or wind;*
- *Physical stability. - Implement environmental and technical measures to maintain physical stability of the mining components in the short, medium and long term (including mine entrances, chimneys, waste rock dumps, tailings deposits, etc.) that must withstand seismic and hydrological extraordinary events;*
- *Geochemical stability. - Implement measures to maintain chemical stability of the mining components in the short, medium and long term (including mine entrances, chimneys, waste rock dumps, tailings deposits, etc.) that must withstand ordinary and hydrological extraordinary hydrological events;*
- *Land use. - Implement measures to enhance post-mining beneficial land use, restoring gradually soil fertility for agriculture, livestock, landscape and / or recreational use, considering the topographical conformation and integration into the landscape;*

- *Water use. - Implement measures in the Production Unit Acumulación Yauricocha to prevent contamination of superficial and underground water, and focusing on restoring those water bodies, which have been potentially affected, by means of a strategic recovery for post-mining use.*

20.8 Reclamation Measures During Operations and Project Closure

20.8.1 Reclamation Measures During Operations and Project Closure

The Second Amendment of the Closure Plan (2017) considers:

- *Incorporating new mining components that were approved by the Directorate Resolution N°242-2015-MEM-DGAAM and the Directorate Resolution N°486-2015-MEM-DGAAM;*
- *Improving the closing activities of the Central, Amoeba and Maritza pits;*
- *Improving the closure of the mine portal level 330 Victoria; and*
- *Reprogramming the final closure of some components to progressive closure.*

20.8.2 Temporary Closure

In case of a temporary closure (for a period less than three years), ordered or not by the competent authority, SMCSA will develop a detailed care and maintenance plan considering future operations and evaluating the social impacts associated with it. The temporary closure considers:

- *Remove and save mobile equipment;*
- *Demolition, salvage and disposal - not applicable during temporary closure;*
- *Physical stability - maintain mine entrances, chimneys, tailing deposit, waste rock dumps, and infrastructure;*
- *Geochemical stability - maintain tailings deposit and waste rock dumps sedimentation ponds to capture any drainage;*
- *Hydrological stability - maintain canals and ditches in an operative state;*
- *Landform - profiling the outer slope of the tailing deposit;*
- *Social programs - mitigate impacts on local employment and local development implementing the following programs:*
    - *Communication, culture and participation program;*
    - *Environmental education and training program;*
    - *Health and responsible environmental management program; and*
    - *Citizenship: leadership, institutional strengthening and project transfers program.*

It will be adopted the following preventive measures:

- *Communicate to DGAAM any temporary closure program (indicating the causes);*
- *Final closure must be made if the closure needs to be prolonged over three years;*
- *Designate responsibilities for the safety and cleanliness of the facilities;*
- *Instruct the surrounding population on risk related to temporary closed facilities;*
- *Seal all areas that are potentially dangerous to the environment and the population, placing signs and symbols that indicate their danger for containing materials that could affect the environment;*
- *Perform facility inspections and establish a periodic schedule to perform the necessary maintenances (including wind erosion and sediment transport control, channels, ditches and sediment ponds), safety and environmental inspections, water quality monitoring and progressive reclamation monitoring;*
- *Perform safety inspections to prevent risks associated to the physical stability of underground workings and surfaces exposed to weathering, such as tailings deposits slopes;*
- *Implement measurements to prevent accidents (environmental or public) by:*
  - *implementing security berms;*
  - *blocking accesses to mine entrances; and*
  - *profiling slopes if needed.*

20.8.3 Progressive Closure

Progressive closure is performed simultaneously during operation and considers the following:

- *Dismantling - All materials in disuse will be dismantled.*
- *Demolition, salvage and disposal - Not applicable during progressive closure.*
- *Physical stability:*
  - *Open pits in disuse - the Mascota, Juliana, Pawac and Poderosa pits will be partially filled with surrounding waste rock and pit slopes will be stabilized by benching and the Central, Amoeba and Maritza pits will be closed.*
  - *Mine entrances - four mine entrances will be closed by a masonry wall without drainage, and in one land forming using waste rock and a proper cover will be applied (Type 2, see geochemical stability).*
  - *Waste rock dumps:*

    - Waste rock from the Mascota, Juliana and Triada dumps will be removed to the Central pit;

    - Waste rock from the Mariela dump will be removed to the Central pit and Mariela mine entrance;

- Waste rock from the Pawac dump will be removed to the Pawac pit;

- Waste rock from the Poderosa dump will be removed to the Poderosa pit; and

- The passive Triada waste rock dump and the Cachi-Cachi waste rock dump will be stabilized and covered.

- *Geochemical stability - implementing covers considering the material to be covered (i.e. its mineralogy, net neutralization potential, presence of acid drainage, granulometry, topography and slopes) considering two types:*
  - *Type 1, to cover non-acid generating materials: 0.20 m of organic material, revegetated; and*
  - *Type 2 to cover acid generating materials: 0.20 m of organic material, overlaying a layer of 0.20 m draining material, overlaying a layer of 0.20 m clay material, overlaying a 0.20 m thick layer of limestone; and revegetated.*
- *Hydrological stability - implementing collector channels considering two types:*
  - *Type 1 - trapezoidal masonry channel with base and height of 0.50 m and 0.50 m and slope of 1H: 2V (flow 0.45 m3/sec);*
  - *Type 2 - trapezoidal masonry channel with base and height of 0.60 m and 0.65 m and slope of 1H: 2V (flow 0.90 m3/sec);*
- *Landform - consist of leveling, re-contouring and organic soil coverage;*
- *Revegetation - planting native grasses such as Stipa ichu and Calamagrostis sp.;*
- *Social programs - programs are designed year by year considering the following topics:*
  - *Education;*
  - *Healthcare;*
  - *Local sustainable development;*
  - *Basic infrastructure;*
  - *Institutional and capabilities empowerment; and*
  - *Culture promotions.*

Table 20-7 lists components that have been closed as to October 2013 (as per report N°1683-2013- MEM-AAM/MPC/ RPP/ADB/LRM) and February 2017 (as per report N°112-2017-MEM-AAM/MPC/RPP/ADB/LRM).

Table 20-7: Closed Components

Type	Component	Description
		Juliana Open pit (1) Mascota Open pit (1) Pawac Open pit (1) Poderosa Open pit (1) Central Open pit T-1-MC-YA (2) Amoeba Open pit T-1-MA-YA(2) Maritza Open pit T-1-MM-YA(2) Level 300 Mine entrance 247-49-NW(2) Level 360 Mine entrance 4554-NW(2) Level 360 Mine entrance 1523-SW(2) Level 250 Mine entrance 1287-S (2) Level 210 Mine entrance 4010-NW (1)
	Chimneys	Chimenea 215-5 – superficie(1) Chimenea 301-6 – superficie(1)
Waste disposal	Waste rock dumps	Waste deposit Mascota(1) Waste deposit Juliana(1) Waste deposit Poderosa(1) Waste deposit Triada(1) Waste deposit Level 250(1)
Water treatment	Water treatment plant	Wastewater Treatment System Yauricocha(2) Wastewater Treatment System Chumpe(2)
Quarry	Quarry	Quarry N° 1(1) Quarry N° 2(2)

(1) Components declared in the Yauricocha Mine Unit Closure Plan Update´s report N°1683-2013-MEM-AAM/MPC/RPP/ADB/LRM

(2) Components declared in the report N° 112-2017-MEM-DGAAM/DNAM/DGAM/ PC

Source: Yauricocha Mine Unit Closure Plan Update´s report N°1683-2013-MEM-AAM/MPC/ RPP/ADB/LRM and report N° 112-2017-MEM-DGAAM/DNAM/DGAM/ PC

20.9 Final Closure

For Final Closure, a final Updated Closure Plan must be presented detailing the closure specifications and process of public consultation. The following components must be closed according to the last approved closure plan and its amendment:

- *Eight mine entrances - 4 in Central, 1 in Cachi-Cachi and 3 Ipillo;*
- *Twelve shafts - 6 in Central, 5 in Cachi-Cachi and 1 in Ipillo;*
- *One tailing deposit - in Central;*
- *Two shafts - Central and Mascota;*

- *Mineral processing plant - in Chumpe;*
- *Eight Waste rock dumps - 3 in Central, 1 in Cachi-Cachi. 3 in Ipillo and 1 Chumpe;*
- *Mine water treatment plant Chumpe (to treat 270 to 280 L/sec from the Klepetko tunnel);*
- *Domestic waste water treatment plant Chumpe (150 m3);*
- *C*
- *Two tunnel portals - Klepetko and Yauricocha (note, the Yauricocha tunnel is dry);*
- *One open pit - Cachi-Cachi pit;*
- *Other infrastructure:*
    - *Central Area - warehouse, compressors, shaft, winch, maintenance shop, carpentry, offices, chemical laboratory, camps (Vista Alegre, Esperanza, Americano Hotel and workers houses among others), and a sanitary and industrial landfill;*
    - *Chumpe Area - Mineral processing plant, central warehouse, fuel stock, junkyard, camps*
    - *(Chumpe and Huacuypacha), workers houses, employee's houses, school, stadium and market; and Ipillo Area - 2 concrete slabs and a trench and 1 cutting in Ipillo.*

Final closure is achieved when upon completion of the following:

- *Dismantling - An inventory of all reusable equipment will be prepared and all materials in disuse will be dismantled;*
- *Cleaning - All materials that have been in contact with dangerous substances will be completely decontaminated;*
- *Transfer of property program (e.g., transfer of access roads);*
- *Demolition, salvage and final disposal;*
- *Physical stability:*
    - *Open pits - the Central and Cachi-Cachi pits will be partially filled with surrounding waste rock and pit slopes will be stabilized by benching;*
    - *Mine entrances - the mine entrances will be closed by four types of plugs:*
        - *Type II, with a masonry wall and drainage;*
        - *Type III, of reinforced concrete without drainage;*
        - *Type V, filled with non-acid generating waste rock without drainage, and an hermetic plug of massive concrete.*
    - *Chimneys - Type I, of reinforced concrete;*
    - *Yauricocha´s tailings deposit - As to civil design for closing condition; and*
    - *Areas for material supply - will be developed utilizing stable slopes by benching.*
- *Geochemical stability - implementing covers considering the material to be covered (i.e. itsmineralogy, net neutralization potential, presence of acid drainage, granulometry, topography and slopes) considering two types:*

  - *Type 1 - to cover non-acid generating materials: 0.20 m of organic material; revegetated; and*
  - *Type 2 to cover acid generating materials: 0.20 m of organic material, overlaying a layer of 0.20 m draining material, overlaying a layer of 0.20 m clay material, overlaying a 0.20 m thick layer of limestone; and revegetated.*
    The Type 2 cover applies to the Yauricocha´s tailings deposit.
- *Hydrological stability - implementing collector channels considering five types:*
  - *Type 1 - trapezoidal masonry channel with base and height of 0.50 m and 0.50 m and slope of 1H: 2V (flow 0.45 m3/sec);*
  - *Type 2 - trapezoidal masonry channel with base and height of 0.60 m and 0.65 m and slope of 1H: 2V (flow 0.90 m3/sec);*
  - *Type 3 - trapezoidal masonry channel with base and height of 0.70 m and 0.75 m and slope of 1H:2V (flow 0.868 m3/sec); applies to the Yauricocha´s tailings deposit and San Antonio waste rock deposit;*
  - *Type 4 - trapezoidal masonry channel with base and height of 0.80 m and 0.80 m and slope of 1H: 2V (flow 1.661 m3/sec); applies to the Chumpe waste rock deposit; and*
  - *Type 7 - trapezoidal masonry channel with base and height of 0.90 m and 1.10 m and slope of 1H:2V (flow 3.047 m3/sec); applies to the Cachi-Cachi Pit waste rock deposit level 300.*
- *Landform - consists of leveling, recontouring and organic soil coverage;*
- *Revegetation - planting native grasses such as Stipa ichu and Calamagrostis sp;*
- *Social programs - programs are designed year by year considering the following topics:*
  - *Environmental education and training program;*
  - *Promote local sustainable development; and*
  - *Promote institutional and capabilities empowerment.*

20.10 Closure Monitoring

Operational monitoring continues until final closure is achieved (Section 20.2).

20.11 Post-Closure Monitoring

According to the Yauricocha Mine Unit Closure Plan Update´s Report N° 1683-2013-MEMAAM/MPC/RPP/ADB/LRM all post closure monitoring activities shall be performed as follows:

- *Physical stability monitoring - Monitoring of possible displacements and settlements, cracks, slip surfaces control in mine entrances, open pits, tailings deposit, waste rock dumps, camps and auxiliary related installations by topographic landmarks control (fixed concrete bases and stainless plates). The established monitoring frequency for the first two years is bi-annual, and for the following three years annually.*

- *Geochemical monitoring - Monitoring of tailings deposit, waste rock dumps, and open pits inspecting the cover´s surface for cracks and slip surfaces. The established monitoring frequency is bi-annual for the first two years and annually for the following three years;*
- *Hydrological monitoring - Inspection of the hydraulic components of the tailings deposit, waste rock dumps, and open pits for (structural) fissures, settlements, collapsing and flow obstructions. The established monitoring frequency for the first two years is bi-annual, and for the following three years annually.*
- *Water quality monitoring - In three monitoring stations (MA-1, MA-2, MA-3, see footnote 1) for: pH, electrical conductivity, total suspended solids, total dissolved solids, nitrates, alkalinity, acidity, hardness, total cyanide, cyanide wad, ammonium, sulfates, total metals (Al, As, Cd, Ca, Cu, Fe, Pb, Hg, Mo, Ni, Se and Zn), DBO5, DQO, dissolved oxygen. The established monitoring frequency for the first two years is quaternary, and for the following three years biannual. No groundwater quality monitoring has been contemplated.*
- *Sediments monitoring - Data from three monitoring stations (MA-1, MA-2, MA-3, see footnote) is analyzed for: total metals (Al, As, Cd, Ca, Cu, Fe, Pb, Hg, Mo, Ni, Se and Zn), total cyanide. The data collected shall be compared with reference values for the National Oceanic and Atmospheric Administration of the USA. The established monitoring frequency for the first two years is bi-annual, and annual for the following three years.*
- *Hydrobiological monitoring - In three monitoring stations (MA-1, MA-2, MA-3, see footnote) for: phytoplankton, zooplankton, bentos, macrophytas. The established monitoring frequency for the first two years is bi-annual, and annual for the following three years.*
- *Biological monitoring - Vegetation control to verify the effectiveness of the plant cover systems evaluating the extent of engraftment of the species, the success of the revegetation systems and the need for complementary planting, seeding, fertilization and vegetation control. The established monitoring frequency for the first two years is bi-annual, and annual for the following three years.*
- *Social monitoring - Monitoring to ensure the quality and accuracy of the information collected in the field, ensure the compliance with the goals and achievements of the objectives of the social activities and programs, and achieve its sustainability. The post closure social program monitoring is summarized in Table 20-8.*

Table 20-8: Post Closure Social Program Monitoring

Code	Activities and Tasks	Goals	Resources	Indicators	Proofs	Instruments	Frequency
001 training program to develop productive capacities	Selection of persons to participate in the program coordinating with the mining unit and with the beneficiaries,5	50 people trained annually, 150 people in trained three years	A specialist in development of productive capacities, educational materials, mobility, travel expenses	Number of participants, number of workshops held, field visits	List of attendees, photographic panel, readings and manuals	Convocation of the population of the area of influence and coordination with the stakeholders	Bi-annual/ annual

	workshops per year						
002 Educational environmental monitoring program	1 workshop to sensitize the population in the area of influence. Training in social monitoring using teaching modules	10 people trained annually for three years, 1 representative for each community as social monitor, 1 monitoring committee	Didactic materials, flipcharts, markers, multimedia, etc. a specialist in environmental education	Number of people of the population of the area of influence trained	List of workshop attendees and field visits, pictures, input and output proofs	Beneficiary population survey on perceptions	Bi-annual/ annual

Source: Yauricocha Mine Unit Closure Plan Update´s report N°1683-2013-MEM-AAM/MPC/ RPP/ADB/LRM and Yauricocha Mine Unit Second Amendment of the Closure Plan, approved by Directorate Resolution N°063-2017-MEM-DGAAM

20.12 Reclamation and Closure Cost Estimate

Table 20-9 and Table 20-10 summarize the results of the updated cost analysis.

Table 20-9: Closure Plan – Results of the Updated Cost Analysis (US$)

Description	Progressive Closure	Final Closure	Post Closure	Total
Direct costs	3,850,845.10	6,899,444.29	728,720.69	11,479,010.08
General costs	385,084.50	689,944.43	72,872.27	1,14,901.00
Utility	308,067.60	551,955.54	58,297.66	918,320.80
Engineering	154,033.80	275,977.77	29,148.83	459,160.40
Supervision, auditing & administration	308,067.60	551,955.54	58,297.66	918,320.80
Contingency	154,033.80	275,977.77	29,148.83	459,160.40
Subtotal	**5,160,132.43**	**9,245,255.35**	**976,485.72**	**15,381,873.50**
VAT	928,823.84	1,664,145.96	175,767.43	2,768,737.23
Total Budget	**6,088,946.27**	**10,909,401.31**	**1,152,253.15**	**18,150,610.73**

Source: Report N° 2668384 with reference to Response of the Observation N° 2. Report N°004-2017-MEM-DGM-DTM-PCM

Table 20-10: Closure Plan – Summary of Investment per Year (US$)

Year	Annual Investment	Total	Closure Stage
2016	25,647.60	5,160,132.43	Progressive
2017	976,708.10		
2018	941,514.60		
2019	997,143.24		
2020	1,184,381.80		
2021	567,310.54		
2022	467,425.51		
2023	3,724,908.73	9,245,255.35	Final
2024	5,520,346.51		
2025	278,995.92	976,485.82	Post
2026	278,995.92		
2027	139,497.96		
2028	139,497.96		
2029	139,497.96		
Total	**15,381,873.50**	**15,381,873.50**	

Source: Report N° 2668384 with reference to Response of the Observation N° 2. Report N°004-2017-MEM-DGM-DTM-PCM

21 Capital and Operating costs

Capital and operating cost estimates for underground mining were prepared by Redco to support the proposed mine plan.

Mining capital infrastructure, materials and labour cost estimates are based on vendor quotes and data relevant to the region as well as Sierra Metal's experience running the Yauricocha Mine.

The estimated Capital (CAPEX) requirement for mine equipment, infrastructure and processing plant required to achieve the 10-year LoM and 5500 tpd including mine closure is $238M, line items are presented in Table 21-1.

Projected operational expenses (OPEX) for the mine, plant and general and administrative areas, based on historic figures and projected efficiencies associated with the change in mining methodology and tonnage increases, are presented in

Table 21-2, Note that these are slightly different compared to the costs used to calculate the cut-offs applied to the mineral resource, as certain all-in mining costs are not incorporated in this calculation.

Table 21-1: Capex Estimation on US$ M

CAPEX	Total (US$)	2018	2019	2020	2021	2022	2023	2024	2025	2026
Development	117,000,000	19,038,676	19,138,915	18,131,858	15,093,603	10,570,248	10,172,379	9,694,133	5,468,019	9,200,680
Ventilation	11,000,000	1,020,255	1,055,289	2,942,606	2,261,381	1,006,075	890,020	491,714	748,106	204,641
Equipment	14,000,000	4,440,000		1,440,000	1,500,000	4,500,000	1,800,000			
Exploration drilling	12,000,000	2,712,770	1,000,000	2,850,000	2,850,000	2,850,000				
Dump (Sustaining)	1,000,000	500,000	500,000							
Dump (Growth)	6,000,000	835,281	1,271,456	1,271,456	1,271,456	1,271,456				
Concentrator Plant Sustaining	3,000,000	1,130,000	500,000	500,000	500,000	500,000				
Concentrator Plant Growth	10,000,000	515,344	1,319,115	154,185	7,983,356					
TSF Growth PEA	5,000,000					1,168,506	2,062,800	1,166,400	953,603	
Mining Camp	2,000,000	1,000,000	500,000	100,000	100,000	100,000	100,000	100,000	100,000	
Environmental (Sustaining)	2,000,000	188,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000	
Drain system	2,000,000		500,000	1,200,000						
RB+Decline Esperanza	10,000,000		2,000,000	7,500,000						
Mascota Shaft	2,000,000	1,756,007								
Waste Shaft	12,000,000			3,900,000	5,145,964	2,665,441				
Yauricocha Shaft	18,000,000	6,029,177	11,918,652							
Closure	13,000,000	997,143	1,184,381	567,310	467,425	3,724,908	5,520,346	278,995	278,995	
Total	**238,000,000**	**40,162,653**	**41,087,809**	**40,757,415**	**37,373,186**	**28,556,633**	**20,745,544**	**11,931,242**	**7,748,724**	**9,405,321**

Table 21-2: OPEX Estimation on US$ M

Opex Total	Total (US$)	2,018	2,019	2,020	2,021	2,022	2,023	2,024	2,025	2,026
Mining	437,363	57,496	53,970	49,238	55,823	55,823	55,823	53,849	30,449	24,894
Processing	114,873	11,105	11,793	11,529	16,232	16,232	16,232	15,658	8,854	7,238
G&A	40,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500
Total	592,737	73,102	70,263	65,267	76,554	76,554	76,554	74,007	43,802	36,632

22 Economic analysis

The preliminary economic assessment is preliminary in nature, that it includes inferred mineral resources that are considered too speculative geologically to have the economic considerations applied to them that would enable them to be categorized as mineral reserves, and there is no certainty that the preliminary economic assessment will be realized; the PEA calculates a Base Case after – tax Net Present Value (NPV) of US$ 393 M with an after-tax Return of Investment (ROI) of US$ 486 M using a discount rate of 8%. The total life of mine capital cost of the project is estimated to total US$ 238 M. The payback period for the LoM capital is estimated at 4.1 years. Operating costs of the LoM total US$ 593 M, equating to an operating cost of US$ 43.86 per tonne milled. Based on this economic analysis, the proposed mine plan should be investigated further and better refined.

Projected highlights and key parameters and potential economic outcomes from the mining and processing plan considered in this PEA are detailed in Table 22-1.

Table 22-1: Economic Analysis Key Values

PEA Highlights	Unit	Value
Net Present Value (After Tax 8% Discount Rate)	US$ M	393
Return on Investment (ROI)	ROI (M)	486
Mill Feed	Tonnes (Millions)	13.5
Mining Production Rate	t/year	1,800,000
LOM Project Operating Period	years	9
Total Capital Costs	US$ M	238
Net After – Tax Cashflow	US$ M	532
Total Operating Unit Cost	US$/t	43.86
LOM Gold Production (Payable)	oz	17,621
LOM Silver Production (Payable)	oz	11,408,281
LOM Lead Production (Payable)	t	87,881
LOM Zinc Production (Payable)	t	281,746
LOM Copper Production (Payable)	t	102,821

1.1 Variable metals values were applied to the economic analysis

Table 22-2: Projected Metal Prices used in the Economic Analysis

Year	Zn (US$/t)	Cu (US$/t)	Pb (US$/t)	Ag (US$/oz)	Au (US$/oz)
2018	3,108	7,033	2,359	18	1,329
2019	2,800	7,077	2,293	19	1,336
2020	2,646	7,209	2,227	19	1,328
2021	2,403	6,856	2,050	19	1,320
2022	2,403	6,856	2,050	19	1,320
2023	2,403	6,856	2,050	19	1,320
2024	2,403	6,856	2,050	19	1,320
2025	2,403	6,856	2,050	19	1,320
2026	2,403	6,856	2,050	19	1,320

Source: Redco, 2018

23 Adjacent Properties

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

24 Other relevant data and information

There is no other relevant information or explanation necessary to make the technical report understandable and not misleading.

25 Interpretation and Conclusions

Based on the resource base reported by SRK on July 31, 2017, the Yauricocha mine could conceptually be reconfigured to produce 5500 tpd with an optimal LoM of 10-years. Several critical factors will impact the proposed mine plan:

- The hoist system at Yauricocha is operating at capacity, any production increases are dependent on increased hoisting capacity expected with the completion of the Yauricocha shaft.
- Prior to increased production a period of advanced development is required to bring new areas of the mine into production. This period of advanced development will impact the hoisted waste to mineral ratio (currently 0.5:1). A period of 8 months advanced development is required before sustainable production of 5500 tpd can be achieved.
- Mining at increased depths will have multiple impacts operations:
  - Increased haulage distances
  - Increased demands on dewatering systems
  - Increased risks of mud-rush
  - Increased ventilation demands.
- The Chumpe processing plant will need to be reconfigured to handle the increased throughput, proposed reconfigurations will increase processing capacity to 5,000 tpd and are expected offer efficiencies and potential operational savings. Engineering work to increase plant throughput to 5500 tpd, to match planned mine output are not yet defined.
- Available tailings storage capacity would need to be significantly extended to handle processed waste material from the Chumpe plant as throughput increases from 3,000 to 5,000 tpd. Preliminary tailings engineering is based on a plant throughput of 5,000 tpd, if plant throughput was to expand to 5500 tpd to match the proposed mine output, planned tailings capacity (in terms of time) would significantly reduce and tailings planning should be projected further ahead.

Risks to the realisation of the mine plan proposed in this PEA include:

- Subsidence is recognised around two of the three hoist shafts and has the potential to impact hoisting capacity. If any of the shafts became unserviceable it would have a significant negative impact on the proposed mine plan and current production, the proposed mine plan does not consider contingency planning for a failed shaft. With the completion of the Yauricocha shaft, combined hoisting capacity is projected to be 10,400 tpd applying the current which is sufficient to realise the proposed mine plan.
- Yauricocha is permitted to extracted and process 3,000 tpd, increased production will only be possible once updated permits are approved.
- Contracted power supply will need to be increased to support increased demands from the mine and plant.

26 Recommendations

The results of this PEA support the continued advancement of investigations to increase mine production and processing plant throughput at the Property.

Further definitive studies are required to better define the economic potential of the Property to support increased production, include:

- Undertake detailed engineering to determine the operational risk and how to control the impact of subsidence around the Central and Mascota shafts.
- Detailed engineering to confirm mine infrastructure requirements (i.e. ventilation, compressed air, electrical and dewatering).
- Conduct infill-drilling of inferred resources considered in the PEA.
- Determine the requirements and timelines to acquire new permits or updated existing permits as required to operate at 5,000 tpd.
- Investigate, in detail, factors such as the cost of power, pumping, tailings and waste rock management, ventilation.
- Refine cut-off values based on the outcome of the studies and investigations recommended above.
- Any changes to the production rate of Yauricocha should be reflected in an updated waste management plan.

Investigation in to legal and permitting requirements to action mine plan changes

27 References

The following documents were used in this PEA study:

SRK, 2018 – NI43-101 Technical Report on Resource and Reserves Yauricocha Mine Yauyos Province, Peru, July 31, 2017

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Sierra, 2018 – Planta Concentradora Chumpe - Memoria Descriptiva - Ampliación 150,000 TMS/MES – Abril, 2018

TG, 2018 - Tierra Group – Memorandum Tecnico – March, 2018

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28 Appendices

28.1.1 List of Acronyms, and their meanings, that may have been used in the study

Abbreviation	Unit or Term
Ag	silver
Au	gold
AuEq	gold equivalent grade
°C	degrees Centigrade
CoG	cut-off grade
cm	centimetre
cm2	square centimetre
cm3	cubic centimetre
cfm	cubic feet per minute
° degree	degree (degrees)
dia.	diameter
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
Fos	Factor of Safety
g	gram
gal	gallon
g/l	gram per litre
gpm	gallons per minute
g/t	grams per tonne
g/t in conc.	gram per tonnes in concentrate
ha	hectares
hp	Horse power
ID2	inverse-distance squared
ID3	inverse-distance cubed
kg	kilograms
km	kilometre
km2	square kilometre
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
L	litre
lb	pound
LoM	Life-of-Mine
m	meter
m2	square metre
m3	cubic metre
masl	meters above sea level
mg/L	milligrams/litre
mm	millimetre

Abbreviation	Unit or Term
mm2	square millimetre
mm3	cubic millimetre
Moz	million troy ounces
Mpa	Mega Pascal
Mt	million tonnes
m.y.	million years
NI 43-101	Canadian National Instrument 43-101
NSR	Net Smelter Return
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
t	tonne (metric ton) (2,204.6 pounds)
t/h	tonnes per hour
t/d	tonnes per day
tpd	tonnes per day
t/y	tonnes per year
t/m3	tonnes per cubic metre
TSF	tailings storage facility
US$	American Dollars
US$/dmt	American Dollars per dry metric tonnes
US$/lb Pb	American Dollars per pound of Lead
US$/g Ag	American Dollars per gram of Silver
US$/g Au	American Dollars per gram of Gold
US$/lb Zn	American Dollars per pound of Zinc
US$/oz Au	American Dollars per troy ounce of gold
US$/oz Ag	American Dollars per troy ounce of silver
US$/oz	American Dollars per troy ounce
US$/t	American Dollars per tonne
US$/t/1%Pb	American Dollars per tonnes per 1% of Lead
US$/t/1%Zn	American Dollars per tonnes per 1% of Zinc
US$/wmt	American Dollars per wet metric tonne
V	volts
W	watt
yr	year
yd3	cubic yard

28.1.2 Glossary of technical terms used in this document

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	The NSR value of mineralized rock, which determines as to whether or not it is economic to recover its gold content by mining and 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 a mineralised body or slope.
Haulage	A horizontal underground excavation which is used to transport mined material.
Hydro-cyclone	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 material 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.
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.

Term	Definition
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).