Technical Review of
Constantine Metal Resources Ltd, Palmer Project, Alaska, USA
NI 43-101 Technical Report

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On behalf of
Rivers Without Borders

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1 Executive Summary

The Palmer Project is a zinc-copper-silver-gold deposit located in Southeast Alaska, USA near Haines and Klukwan. It has been proposed as a potential new mine by its owner, Constantine Metal Resources Ltd. Dowa Mining and Smelting, located in Japan, is the major investor in the project and has an exclusive option for smelting the zinc concentrates. In July 2019 Constantine released a NI 43-101 Technical Report for the Palmer Project performed by JDS Energy and Mining Inc. The Preliminary Economic Assessment (PEA) is based on indicated and inferred mineral resources of 14.3 million tonnes[1] at a zinc equivalent grade of 9.31%. Mining would be conducted using underground methods at a rate of from 2,700 tonnes per day (t/d) to 3,400 t/d for a period of 11 years. The mine plan includes two years of pre-production activities and one year following the end of production for reclamation. The mine would produce both zinc and copper concentrates that also contain silver and gold. The concentrates would be transported to a local port site, such as Skagway or a new port in Haines, and shipped for smelting. Additionally, the PEA includes a proposal to produce and market barite concentrates.

Based on the results of the Palmer Project PEA this report addresses the current viability of the project, identifies the extent to which the project addresses present and future minerals demand, and identifies the major technical and financial risks to the project. It is based on comparison of the results to industry recognized NI 43-101 technical standards and mining project economic thresholds, U.S. government and non-government organization estimates of future mineral needs, and recognition of the inherent technical and economic risks of all mining projects, as well as those specific to the Palmer Project.

Project Viability

The information provided in the PEA is consistent with Canadian Institute of Mining, Metallurgy and Petroleum (CIM) definitions for mineral resources and mineral reserves under NI 43-101. In accordance with NI 43-101 Standards of Disclosure for Mineral Projects the report explicitly notes that "***This PEA is preliminary in nature, 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, as such, there is no certainty that the PEA results will be realized. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.***" As required by NI 43-101, the PEA's authors have clearly stated that the report should not be used to demonstrate economic viability. The project will not have demonstrated economic viability until the present mineral resources are converted to mineral reserves, which will require both additional evaluation of the mineral deposit, as well as development of a viable technical plan for the project. Therefore, the PEA should not be utilized as the actual basis for future mine plans, environmental or social impact studies, or permitting applications, and should only be used with caution when considering the potential for a future mine to actually occur.

Future Minerals Demand

The PEA proposes to produce barite concentrate as a byproduct of zinc and copper concentrate production. The concept of byproduct production of barite from metal mining is highly novel and there are no other identifiable producers of barite that produce it as a byproduct. The PEA does not address the marketability of the proposed barite concentrate produced from metals mineralized sources in terms of comparable product quality from production from high-grade resources. If the barite

[1] As used in this report: tonnes = metric ton = 1,000 kg = 2,205 lb; tons = U.S. short ton = 2,000 lb.

concentrate contained metals as impurities it could result in adding an environmental contaminant such as lead, arsenic or other metals rendering the product unusable. Until bulk metallurgical testing is performed to produce barite as a concentrate, and it is analyzed and considered from a marketing standpoint in comparison to that produced from primary barite deposits, the marketing of barite from the project should be considered to be highly speculative.

The proposed project would produce silver and copper which are required to address anthropogenic climate change and transition to renewable energy. However, existing world and U.S. reserves of both metals are more than adequate to meet foreseeable future demand, and there is significant potential for additional reserves to be added to those presently known. There is not a significant need for the Palmer Project to meet future metals demand related to addressing climate change.

Major Technical and Financial Risks

The proposed Palmer Project would be highly sensitive to a variety of factors including metals prices, operating and capital cots, site specific risks, barite marketability, and environmental considerations.

The Palmer Project would be highly dependent on zinc prices as well as other metals prices. Fluctuating and uncertain metals prices are an inherent risk to nearly all metals mining projects and a major cause of project failure and in some cases ultimately company bankruptcy. Given the inherent volatility of metals prices, the Palmer Project, due to its high dependency on zinc prices, might prove to be uneconomic.

The proposed Palmer Project also includes site-specific risks related to capital and operating costs including costs related to weather and avalanches, remoteness of location, personnel and other aspects as described. These site-specific factors as well as normal factors affecting the entire mining industry suggest the proposed project will have a high likelihood of exceeding the estimated capital and operating costs, potentially by significant amounts (i.e. up to 50%). If that were to occur, the project would most likely not be economically viable.

The PEA identifies numerous site-specific risks including avalanche, portal construction, AG deposit metallurgy, site surface geotechnical conditions, water management, seismicity, geochemistry, dust management and post-closure site-specific risks. The PEA assumes the risks can be mitigated and does not include any additional contingencies or caveats with respect to their potential impact on the project. It is not apparent from the information provided in the PEA that the risks have been adequately assessed, mitigations identified, and residual risk considered relative to impacts to project costs and construction and/or production delays.

The PEA's suggestion that the barite contents are marketable is not adequately supported with information with respect to the future viability of the barite market for the quantity being suggested, the price used in the report, or by contracts for sale of the commodity to potential buyers and/or users. The inclusion of barite as a salable byproduct commodity from the proposed project is highly speculative as it is highly uncertain if the barite produced would be the equivalent of that presently marketed from high-grade primary barite resources.

The PEA appears to significantly underestimate potential environmental impacts and costs. It also does not evaluate additional costs such as for increased tailings storage if the barite concentrate is not

produced and sold. As a result, the actual project could incur up to several hundred million dollars in additional costs to both prevent and address environmental impacts.

Overall Conclusions

The Palmer Project, as described in the PEA, is a speculative mining project that would potentially produce zinc, copper, lead, silver and gold. It could also produce a barite concentrate, but marketing this product is extremely speculative. As such, the PEA does not demonstrate that the project currently is economically viable. The project is also not particularly needed to address future minerals demand. Finally, there are significant site-specific aspects that further make the project challenging. The project's economic indicators in terms of net present value (NPV) and internal rate of return (IRR) contained in the PEA, together with the combined project sensitivities as identified and discussed in this report, suggest a high level of inherent project risk and portend that the project, even after further development, may not ultimately be economically viable. If the project does prove to be economically viable significant additional work must be undertaken by the owners and ultimately the project plan will likely be significantly different from that described in the PEA including potentially in terms of mining methods, production rate and duration, commodities produced, tailings and waste rock storage capacity, environmental mitigations, and other aspects.

2 Introduction

Rivers Without Borders retained Kuipers & Associates to review and provide professional opinions concerning the economic evaluation of Constantine Metal Resources Ltd, Palmer Project, Alaska, USA. Specifically, the client requested that the following questions be addressed:

- *Is the proposed project technically and economically viable based on existing NI43-101 report filings by the company, or any other professional judgments by the assessor?*
- *To what extent is the project needed to address strategic minerals or minerals needed to address anthropogenic climate change?*
- *What are the major technical or financial risks to highlight at this stage?*

3 Qualifications

The author has an extensive background with more than 35 years involvement in mining metals and minerals including in the full-life cycle of exploration, project development, project permitting, construction, operations, reclamation, and closure. He graduated in 1983 with a B.S. in Mineral Processing from Montana School of Mines. In addition to growing up in a mining family and gaining practical experience prior to entering University, he worked as a senior engineer, chief metallurgist, mill superintendent, mine manager, project manager, and consulting engineer. Since 1996 he has been the principal consulting engineer with Kuipers & Associates. His work during that time has focused on providing technical expertise to public interest groups, tribes and First Nations, and governments concerning mining and environmental concerns. The primary areas of expertise provided have included site characterization, water quality predictions, mine planning and mitigations, tailing storage facilities, mine reclamation and closure, site investigations and remediation, water treatment, financial assurance, and economic evaluations.

The author is a registered Professional Engineer in Mining in the U.S. States of Montana and Colorado. He has been qualified as an expert witness in mining and related matters in numerous administrative hearings in the U.S. and Canada, and in U.S. Federal and State Courts. He has conducted numerous feasibility analysis and well as extensive reviews of similar analysis throughout his professional career and is highly familiar with the NI 43-101 Guidelines[2] and meets the definition of a "qualified person" consistent with the guidelines. His professional resume is attached as Exhibit A.

4 Documents and Other Information Relied Upon

The primary document reviewed in conducting this analysis was:

> PP 2019 TR. *NI 43-101 Technical Report*, *Palmer Project, Alaska, USA* by JDS Energy and Mining Inc. for Constantine Metal Resources Ltd., July 18th 2019.

In addition, the author has relied on commodity analysis performed by the United States Geological Survey (USGS) and other documents as referenced in this report.

[2] NATIONAL INSTRUMENT 43-101 STANDARDS OF DISCLOSURE FOR MINERAL PROJECTS, Rules and Policies, June 24, 2011. http://web.cim.org/standards/documents/block484_doc111.pdf (March 10, 2020)

5 Summary of Primary Documents

The results of the *NI 43-101 Technical Report*, *Palmer Project, Alaska, USA* by JDS Energy and Mining Inc. for Constantine Metal Resources Ltd. (PP 2019 TR) are summarized in Table 5.1.

Table 5.1 – Palmer Project, Alaska, Summary of Preliminary Economic Assessment Results

Mineral Resources	Indicated + Inferred, 14.3 Mt @9.31% Zn Eq (2,930Mt contained Zn Eq)
Production	
Mining and Processing	12.5 Mt @ 4.41% Zn, 0.81% Cu, 49.8 g/t Ag, 0.33g/t Au, 13.38% Ba
Zinc Concentrate	790 ktonnes, 484 ktonnes Zn, 6 ktonnes Cu, 124,333 kg Ag 823 kg Au
Copper Concentrate	363 ktonnes, 89 ktonnes Cu, 25 ktonnes Zn, 437,949 kg Ag, 2,027 kg Au
Barite Concentrate	2.9 Mtonnes, 52% Ba as $BaSO_4$
Revenue	
Metal Prices	$1.22/lb Zn, $2.82/lb Cu, $16.3/oz Ag, $1,296/oz Au, $220/tonne Ba
Copper Conc NSR	US$695 million
Zinc Conc NSR	US$931 million
Barite Conc NSR	US$252 million
NSR Royalty Payments	US$47 million
Net Revenue	US$1,831 million
Costs	
Capital Costs	US$418 million
Operating Costs	
Mill Feed per ton	US$54.17/t
Total	US$676 million
Financial Results	
Pre-Tax	
Cash Flow	US$738 million
IRR	24%
NPV @7%DR	US$354 million
Payback	3.1 years
Post-Tax	
Cash Flow	US$581 million
IRR	21%
NPV @7%DR	US$266 million
Payback	3.3 years

The technical report, consisting of a Preliminary Economic Assessment (PEA) for the project, follows National Instrument 43-101 (NI 43-101) rules and guidelines.

The project is based on indicated and inferred mineral resources of 14.3 million tonnes at a zinc equivalent grade of 9.31%. Mining would be conducted at a rate of from 2,700 tonnes per day (t/d) to 3,400 t/d for a period of 11 years. The mine plan includes two years of pre-production activities and one year following the end of production for reclamation.

The preliminary report suggests that mining would take place at the Palmer and AG Zone deposits using transverse and longitudinal long-hole (LH) stoping underground mining methods. The mine would use cemented paste backfill to fill stopes following mining. The mine would be operated using diesel trackless equipment and would be expected to run 365 days per year. Surface facilities would be located at the 680 Exploration Portal and/or the mill site.

Crushing will be performed underground. The process plant would operate at a rate of 3,500 t/d and produce copper, zinc and barite concentrates. The process plant is expected to operate 365 days per year with an estimated 92% availability. Processing would consist of grinding using a semi-autogenous grinding (SAG) mill followed by a ball mill operating in closed circuit to achieve a grind size of 80% passing 72 µm. The ground ore is then fed to sequential copper and zinc flotation circuits followed by pyrite flotation and then barite flotation. The pyrite flotation concentrate is filtered and mixed with paste tailings for deposition underground. The copper and zinc flotation concentrates are thickened and filtered to approximately 8% moisture and transported by truck to a local port and then sent to smelters. According to the technical report the barite concentrate would be dried to 1% moisture and bagged before being transported to Haines for barging to railhead at Prince Rupert, BC.

According to the report, as a large amount of tailings material would be produced as product if barite production is included, the majority (78%) of tailings will be utilized as underground backfill. The pyrite tailings separated by flotation and potentially acid generating (PAG) waste rock will be placed underground as components of backfill. Tailings from the process that are not placed as paste backfill in the mine would be dewatered and filtered for stacking in the filtered tailings facility.

Project infrastructure would include mine, mill and warehouse facilities as well as a liquid natural gas storage and power generation plant, water management facilities and water treatment plant. A filtered tailings management facility / waste rock storage facility (TMF/WRSF) has been designed at a site approximately 6 km from the Conveyor Portal to store the remaining portion of tailings and non-potentially acid generating (NPAG) waste rock not going underground. Tailings, and the portion of NPAG rock required for the construction of the TMF/WRSF, will be hauled and placed by truck.

According to the report, due to desulfurization and removal of deleterious minerals by flotation, tailings stored on surface are NPAG. According to the technical report, the TMF/WRSF is therefore not expected to require water treatment.

The projected revenue from sales of copper and zinc concentrates including contained gold and silver and barite concentrates is estimated to be $1.8 billion. The results suggested a pre-tax cash flow of $738 million, an internal rate of return (IRR) of 24% with a payback period of 3.1 years and a net present value (NPV) at 7% discounted rate of return (DROR) of $354 million. The results suggested an after-tax cash flow of $581, an internal rate of return (IRR) of 21% with a payback period of 3.3 years and a net present value (NPV) at 7% discounted rate of return (DROR) of $266 million.

The report included a sensitivity analysis which suggested the NPV is most sensitive to metal prices, zinc specifically, followed by operating costs, head grade and capital costs. In addition to these risks the report also identifies avalanche, portal construction, AG deposit metallurgy, site surface geotechnical conditions, water management, seismicity, geochemistry, dust management and post-closure site-specific risks.

6 Project Viability

6.1 Mineral Resources

The mineral resources from the PP 2019 TR for the project are summarized in Table 6.1 and discussed in the following section.

Table 6.1 - Palmer Project, Alaska, Summary of Mineral Resources

Mineral Resources	Tonnes (Mt)	Zn (%)	Cu (%)	Pb (%)	Ag (g/t)	Au (g/t)	Barite ($BaSO_4$%)
RW and South Wall							
Indicated	4.677	5.23%	1.49%		30.8	0.30	23.9%
Inferred	5.338	5.20%	0.96%		29.2	0.28	22.0%
AG Zone							
Inferred	4.256	4.64%	0.12%	0.96%	119.5	0.53	34.8%
Total							
Indicated	4.677	5.23%	1.49%	0.00%	30.8	0.30	23.9%
Inferred	9.594	4.95%	0.59%	0.43%	69.3	0.39	27.7%
Total	14.271	5.04%	0.88%	0.29%	56.7	0.36	26.4%
Contained Metal		**Zn (M lb)**	**Cu (M lb)**	**Pb (M lb)**	**Ag (M oz)**	**Au (K oz)**	**Barite (K Tonnes)**
Indicated		539	154	0	4.6	45.1	1,118
Inferred		1,047	124	90	21.4	120.6	2,655
Total		1,587	278	90	26	166	3,773

As was noted in the report, the mineral resource estimates were conducted following the CIM Definitions Standards for Mineral Resources in accordance with NI 43-101 Standards of Disclosure for Mineral Projects.[3] The CIM Definitions Standards[4] specifically contain the following information with respect to indicated and inferred mineral resources.

Inferred Mineral Resource

> **An Inferred Mineral Resource is that part of a Mineral Resource for which quantity and grade or quality are estimated on the basis of limited geological evidence and sampling. Geological evidence is sufficient to imply but not verify geological and grade or quality continuity.**
>
> **An Inferred Mineral Resource has a lower level of confidence than that applying to an Indicated Mineral Resource and must not be converted to a Mineral Reserve. It is reasonably expected that the majority of Inferred Mineral Resources could be upgraded to Indicated Mineral Resources with continued exploration.**

[3] https://www.bcsc.bc.ca/Securities_Law/Policies/Policy4/PDF/43-101_NI_May_9_2016/ (March 10, 2020)
[4] https://www.bcsc.bc.ca/uploadedFiles/For_Companies/Mining/CIM_DEFINITION_STANDARDS_MAY_10_2014.pdf?t=1558374601336 (March 10, 2020)

In particular the CIM Definitions Standards note that *"Inferred Mineral Resources must not be included in the economic analysis, production schedules, or estimated mine life in publicly disclosed Pre-Feasibility or Feasibility Studies, or in the Life of Mine plans and cash flow models of developed mines. Inferred Mineral Resources can only be used in economic studies as provided under NI 43-101."*

Indicated Mineral Resource

> **An Indicated Mineral Resource is that part of a Mineral Resource for which quantity, grade or quality, densities, shape and physical characteristics are estimated with sufficient confidence to allow the application of Modifying Factors in sufficient detail to support mine planning and evaluation of the economic viability of the deposit.**
>
> **Geological evidence is derived from adequately detailed and reliable exploration, sampling and testing and is sufficient to assume geological and grade or quality continuity between points of observation.**
>
> **An Indicated Mineral Resource has a lower level of confidence than that applying to a Measured Mineral Resource and may only be converted to a Probable Mineral Reserve.**

CIM Definitions Standards note that *"An Indicated Mineral Resource estimate is of sufficient quality to support a Pre-Feasibility Study which can serve as the basis for major development decisions."*

6.2 Conclusions

- The information provided in the PEA is consistent with CIM definitions for mineral resources and mineral reserves under NI 43-101.

- It is significant that only inferred and indicated mineral resources were identified in the report. In accordance with NI 43-101 Standards of Disclosure for Mineral Projects the report explicitly notes that "***This PEA is preliminary in nature, 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, as such, there is no certainty that the PEA results will be realized. Mineral Resources that are not Mineral Reserves do not have demonstrated economic viability.***" As required by NI 43-101, the PEA's authors have clearly stated that the report should not be used to demonstrate economic viability. The project will not have demonstrated economic viability until the present mineral resources are converted to mineral reserves, which will require both additional evaluation of the mineral deposit, as well as development of a viable technical plan for the project. Therefore, there is no certainty that the project will ever demonstrate economic viability.

- The mineral resources indicated for the project of 14.3 million metric tonnes at a grade of 5% zinc, 0.88% copper, 56.7g/t silver and 0.36g/t gold suggests the resource is of significant size and grade and has the potential to become comparable to other large resources regionally. However, in order for the project to eventually become economically viable, it is probable that additional resources will need to be added to those identified in the PEA. In that event, it is highly probable, if not certain, that the technical plan for the project, including mining methods, mining and processing rate, and size of tailings storage facilities as well as other major changes

will also be required. Therefore, the PEA should not be utilized as the actual basis for future mine plans, environmental or social impact studies, or permitting applications, and should only be used with caution when considering the potential for a future mine to actually occur.

7 Future Metals Demand

The project's economic viability is primarily based on the future demand for the metals to be produced as well as the viability of the mineral resources upon which the project is based. The future demand for the indicated and inferred mineral resources consisting of zinc, copper, lead, silver, gold and barite that would be mined from the proposed project are discussed in this section. While the PEA does not specifically address future metals demand, "Critical Minerals" and "Zero Carbon Minerals" as described herein are two distinctly different barometers for future metals demand.

7.1 Critical Minerals

Pursuant to Executive Order 13817 of December 20, 2017, ''A Federal Strategy to Ensure Secure and Reliable Supplies of Critical Minerals,'' the Secretary of the Interior on May 18, 2018, presented a final list of 35 mineral commodities deemed critical under the definition provided in the Executive Order.[5] The final list was prefaced by an explanation of critical minerals as follows: "The United States is heavily reliant on imports of certain mineral commodities that are vital to the Nation's security and economic prosperity. This dependency of the United States on foreign sources creates a strategic vulnerability for both its economy and military to adverse foreign government action, natural disaster, and other events that can disrupt supply of these key minerals." Based on an analysis by the U.S. Geological Survey (USGS) and other U.S. Government agencies, using multiple criteria, 35 minerals or mineral material groups have been identified that are currently (February 2018) considered critical.

Of the minerals to be produced from the proposed Palmer Project identified in the PEA, only barite can be identified as a critical mineral. According to the USGS[6], barite (barium sulfate, $BaSO_4$) is vital to the oil and gas industry because it is a key constituent of the mud used to drill oil and gas wells. Elemental barium is an additive in optical glass, ceramic glazes, and other products. Within the United States, barite is produced mainly from mines in Nevada. Imports in 2011 (the latest year for which complete data were available) accounted for 78 percent of domestic consumption and came mostly from China.

The USGS notes that barite deposits can be divided into the following four main types: bedded-sedimentary; bedded-volcanic; vein, cavity-fill, and metasomatic; and residual. Bedded-sedimentary deposits, which are found in sedimentary rocks with characteristics of high biological productivity during sediment accumulation, are the major sources of barite production and account for the majority of reserves, both in the United States and worldwide. In 2013, the latest year for which data is currently available, China and India were the leading producers of barite, and they have large identified resources that position them to be significant producers for the foreseeable future. The potential for undiscovered barite resources in the United States and in many other countries is considerable, however. According to the USGS, the expected tight supply and rising costs in the coming years will likely be met by increased production from such countries as Kazakhstan, Mexico, Morocco, and Vietnam. The USGS did not identify the U.S. as a significant future producer, however they do suggest that barite could be sourced from existing barite mines that are currently idle in the U.S.

[5] Federal Register / Vol. 83, No. 97 / Friday, May 18, 2018 / Notices, p. 23295-23296.
[6] https://pubs.usgs.gov/pp/1802/d/pp1802d.pdf (March 10, 2020)

Finally, the USGS notes that reserves of high-grade barite are being depleted, but they exceed demand by a large margin, both in the United States and worldwide, concluding that this mineral commodity is unlikely to become severely depleted in the foreseeable future.

Global and U.S. Consumption. Based on the latest (2019) USGS Mineral Commodities Summary for barite[7], Table 7.1 shows the relevant statistics for U.S. and global barite reserves, production, exports, and consumption.

Table 7.1 Barite Summary

Category	Global tons	U.S. tons	U.S. as % of Global
Reserves	320,000,000	No Data	
Resources	2,000,000,000	300,000,000	15.0%
Production			
Mine	9,500,000	480,000	5.1%
Imports		2,400,000	
Exports		74	
Consumption (apparent)	9,500,000	3,000,000	31.6%

The proposed Palmer Project would produce from 157,000 – 408,000 tonnes of barite concentrate per year. As compared to annual U.S. consumption of 3,000,000 tons per year the proposed production would be from 5% to 14% of annual U.S. consumption.

7.2 Zero-Carbon Minerals

According to the Institute for Sustainable Futures (ISF)[8], to meet the goals of the Paris Climate Agreement and increase the chance of keeping global temperature rise below 1.5 degrees, the transition to a 100% renewable energy system is urgently needed. However, renewable energy technologies, electric vehicles and battery storage require high volumes of environmentally sensitive materials. The ISF projects that renewable energy will lead to increased production of 14 metals. Based on annual estimated demand in 2050 as compared to current production, and cumulative demand compared to reserves and resources, those 14 metals were classified as high, moderate or low risk. Of the 14 metals classified as important to renewable energy transition, only silver (moderate risk), and copper (low risk) are present in potential production from the Palmer Project. The following sections provide a summary for the demand and resources for each of those metals.

Silver

Based on the latest (2019) USGS Mineral Commodities Summary for silver[9], in 2018 the U.S. produced 900 tons of silver while apparently consuming 5,500 tons of silver. Scrap (recycling) provided 1,000 tons of silver in the U.S. This compares to world-wide mining production and approximate apparent

[7] https://prd-wret.s3-us-west-2.amazonaws.com/assets/palladium/production/s3fs-public/atoms/files/mcs-2019-barit.pdf (March 10, 2020)
[8] https://earthworks.org/cms/assets/uploads/2019/04/MCEC_UTS_Report_lowres-1.pdf (March 10, 2020)
[9] https://www.usgs.gov/centers/nmic/silver-statistics-and-information (March 10, 2020)

consumption of 27,000 tons of silver in 2018. Current U.S. silver reserves are estimated at 25,000 tons as compared to worldwide reserves of 560,000 tons.

Copper

Based on the latest (2019) USGS Mineral Commodities Summary for copper[10], in 2018 the U.S. produced 1.2 million tons of copper while apparently consuming 1.85 million tons of copper. Scrap (recycling) provided 150,000 tons of copper in the U.S. This compares to world-wide mining production and approximate apparent consumption of 21.0 million tons of copper in 2018. Current U.S. copper reserves are estimated at 48.0 million tons of copper as compared to worldwide reserves of 830 million tons of copper. The USGS notes that current estimates indicate current resources estimates are 550 million tons of copper in the U.S.

7.3 Conclusions

- The PEA proposes to produce barite concentrate as a byproduct of zinc and copper concentrate production. The proposal to produce barite is based on meeting North American oil and gas industry associated demand. However, as noted by the USGS, the present status of barite in the U.S. as a critical mineral is entirely based on Chinese supply and trade issues, and historically the U.S. has relied on high grade barite deposits located in Nevada. The USGS also notes the expected tight supply and rising costs in the coming years will likely be met by increased production from such countries as Kazakhstan, Mexico, Morocco, and Vietnam from primary barite deposits where production costs are likely to be low. This makes supply of barite, even as a by-product from some other source such as metal mining, highly speculative, as there are plentiful existing resources of high-grade barite that can be produced at low cost and imported in the future to meet demands in North America. In the event barite prices become higher or if determined to be necessary for other reasons, there are existing resources of high-grade barite in the U.S. that can be utilized to meet current and future demands.

- The concept of byproduct production of barite from metal mining is highly novel and has not been subject to proof of concept. There are no other identifiable producers of barite that produce it as a byproduct stream of any type, including metals mining. The PEA does not address a plan for transport facilities for any of its concentrates, which is important as Haines currently does not have a deep water port with facilities to service Palmer. The report does not analyze the marketability of the proposed barite concentrate produced from metals mineralized sources in terms of comparable product quality from production from high-grade resources. Production from typical high-grade resources results in a high-product purity that in turn does not result in introduction of an environmental contaminant when barite is used as drilling mud. However, if the barite concentrate contained metals as impurities it could result in adding an environmental contaminant such as lead, arsenic or other metals rendering the product unusable. Until bulk metallurgical testing is performed to produce barite as a concentrate, and it is analyzed and considered from a marketing standpoint in comparison to that produced from primary barite deposits, barite sales from the project should be considered to be highly speculative.

[10] https://www.usgs.gov/centers/nmic/copper-statistics-and-information (March 10, 2020)

- The proposed project would produce silver and copper which are required to address anthropogenic climate change and transition to renewable energy. However, existing reserves of both metals are more than adequate to meet foreseeable future demand, and there is significant potential for additional reserves to be added to those presently known. There is not a significant need for the Palmer Project to meet future metals demand related to addressing climate change.

8 Major Technical and Financial Risks

As previously noted, the report included a sensitivity analysis which suggested the NPV is most sensitive to metal prices, zinc specifically, followed by operating costs, head grade and capital costs. In addition to these risks the report also identified avalanche, portal construction, AG deposit metallurgy, site surface geotechnical conditions, water management, seismicity, geochemistry, dust management and post-closure site-specific risks. This analysis has further identified the sale of barite and environmental factors as additional significant risks. The technical and financial risks are further discussed in the following sections.

In order to aid in the discussions, an Excel spreadsheet based cash-flow model was developed for the project. The model Base Case (Case 1) is provided in the Appendix together with the other cases analyzed in this review. The model Base Case is a very close approximation to the actual analysis performed in the PEA with a deviation of significantly less than 1% for all economic parameters and therefore provides for accurate comparative analysis of various risk factors with the base case project economics suggested by the PEA.

8.1 Metals Prices

The PEA utilized the metal prices shown in Table 8.1. Current metals prices (January 2020) are also shown for comparison.

Table 8.1 PEA and Current Metal Price

Commodity	Unit	PEA Base Price	Current Price	Source
Zinc	US$/lb	$1.22	$0.89[11]	LME
Copper	US$/lb	$2.82	$2.52[12]	LME
Silver	US$/oz	$16.26	$16.87[13]	LME
Gold	US$/oz	$1,296	$1,653[14]	LME
Barite	US$/tonne	$220	$77[15]	Est

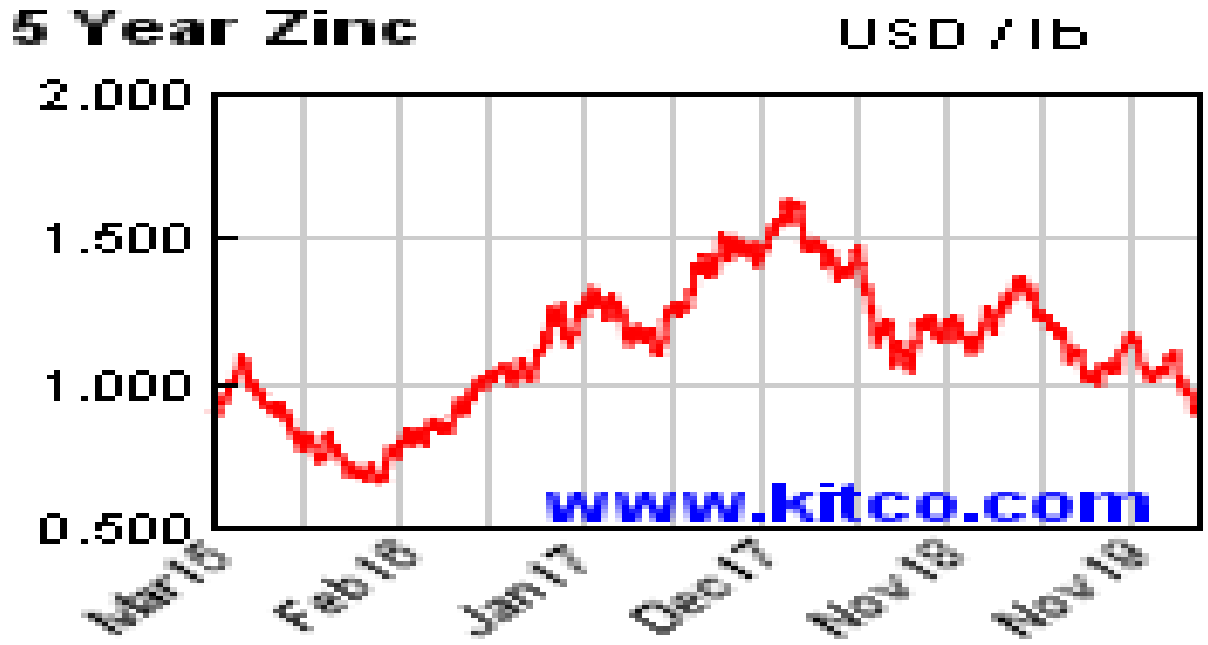
With the exception of barite, the July 2019 PEA was based on then current metals prices. Since that time, as indicated in the Current Price column, prices for zinc and copper have been significantly lower,

[11] http://www.kitcometals.com/charts/zinc.html (March 10, 2020)
[12] http://www.kitcometals.com/charts/copper.html (March 10, 2020)
[13] http://www.kitcosilver.com/ (March 10, 2020)
[14] https://www.kitco.com/ (March 10, 2020)
[15] https://galusaustralis.com/2020/02/483112/barite-products-market-in-deep-analysis-and-experts-review-report-2019-2025/ (March 10, 2020)

silver somewhat higher, and gold significantly higher. Barite is currently significantly lower than was estimated in the PEA

As noted in the PEA, the project NPV is most sensitive to the price of zinc. As shown in Figure 8.1, over the past five years the price of zinc has varied significantly from a low of less than $0.70/lb to a high of $1.63/lb, with the present price of $0.89 per lb approximately representing the lower 20th percentile price during the period. The volatility in zinc price presents a high risk in particular if during the initial years of production when capital costs are being repaid the price is below that predicted. It is not necessary to conduct a more detailed analysis to surmise that if that were to occur, project failure is a distinct possibility. And in that event the ability to resurrect the project during a period of higher prices becomes highly doubtful.

Figure 8.1 Historic Zinc Price



8.2 Other Site-Specific Risks

Other site-specific risks identified in the PEA for the Palmer Project include avalanche, portal construction, AG deposit metallurgy, site surface geotechnical conditions, water management, seismicity, geochemistry, dust management and post-closure site-specific risks.

Avalanche. The PEA acknowledges the significant risk of avalanches and has identified access to the 680 Exploration Portal site as being at risk of loss of access during period of high avalanche danger and during snow clearing operations. Mine infrastructure is located in low hazard zones and in other locations metal shed coverings are assumed for protection of workers and equipment. Secondary mine egress has been identified, mine access can continue via the 510 Conveyor Portal and an Operational Avalanche Safety Plan will be required.

Portal Construction. The PEA notes that the 510 Conveyor Portal, located to optimize the process plant and the orebody centroid, is collared into a less than ideal talus slope and could be more costly and time-consuming than currently considered in the PEA. The PEA suggests this was mitigated using ground penetrating radar analysis to locate the portal in minimum depth talus.

AG Deposit Metallurgy. No actual metallurgical testing has been conducted for the AG Zone deposit and the estimate for recovery is entirely based on mineralogical comparison. The actual metallurgical results can only be confirmed through testwork and the risk is further complicated by high lead contents in the AG Zone deposit, which may require additional treatment.

Site Surface Geotechnical Conditions. No site-specific sub-surface excavations or borings have been conducted for the mill site or Tailings/Waste Rock Facility. As noted by the PEA, characterization of foundation conditions is a key step during design to identify potential critical conditions. The PEA is based on assumptions based on surface observations.

Water Management. The PEA notes that water management currently is based on preliminary drilling and hydro-geologic information. Flows from some mine workings have not been defined or addressed in the water balance and water management and treatment requirements. Little information is available on the hydraulic conductivity of deeper sections of the ore deposits so sustained and peak flow rates cannot be estimated. The plan assumes the ability to differentiate between uncontaminated and contaminated water underground. The plan also assumes the waste rock and tailings will be relatively benign and not result in post-operations water treatment requirements. It should be noted that this assumption is not consistent with analogous projects in Alaska or elsewhere.

Seismicity. The mine site would be located in a high seismicity zone and the Tailings/Waste Rock Facility and other mine infrastructure could be at risk of deformation as a result of an earthquake.

Geochemistry. The assumption that the tailings and waste rock stored at the surface, as well as underground, will be benign is based on limited initial sampling and geochemical characterization as well as overall site modeling.

Dust Management. The PEA notes that wind-blown tailings could impact and exceed air quality standards if areas of the TMF/WRSF pile are left unmitigated. Although the TMF/WRSF design includes progressive reclamation and waste rock armoring of pile slopes, filtered tailings can be susceptible to dusting if left exposed. Temporary dust management alternatives prior to placement of a reclamation cover include: synthetic dust suppressants, wind fences and temporary sand and gravel erosion protection layers.

Post-Closure Site-Specific Risks. The PEA notes that long-term risks to water quality are not fully defined by short-term geochemical testing and the need for additional long-term water treatment measures is uncertain.

8.3 Operating and Capital Costs

Capital and operating costs are significant factors for any mining and processing operation regardless of commodity. Even for well-known tasks such as are proposed for this project for mining and processing there are inherent risks associated with the estimation of capital and operating costs. This estimate is further complicated by the need to account for the cost of construction and operations in an isolated

location, extreme environment, and needing to account for significant logistics such as the lack of existing port facilities. Experience at other sites has shown that significant changes to proposed mining methods, metallurgical processing, and transportation aspects have been necessary and resulted in additional operations and/or capital costs. Failure to adequately account for these and other factors has led to significant overruns at similar mines. For example, Export Development Canada[16] reported in 2016 that for mining projects, capital costs were typically exceeded by 37%. Operating costs similarly are commonly under-estimated, and are particularly subject to fluctuating economic conditions.

Cash flow model Case 3 and Case 4 (see Appendix) show the economic results if operating and capital costs were to increase by 25% or 50% respectively. As shown in Table 8.2, if the capital and operating costs were to increase 25% without other changes to the cost estimates, the pre-tax cash flow for the project would be reduced from $739M to $465M, while the NPV @ 7% discount rate would be reduced from $332M to $147M. The IRR would be reduced from 24% to 14%, and the payback increased from 3.1 years to 5.7 years. This is significant in that many analysts consider an IRR of 20% to be the benchmark for new mining projects considering the inherent risks. The post-tax cash flow for the project would be reduced from $579M to $306M, while the NPV @ 7% discount rate would be reduced from $248M to $63M. The IRR would be reduced from 21% to 10%, and the payback increased from 3.3 years to 6.5 years. Also as shown in Table 8.2, if the capital and operating costs were to increase 50% without other changes to the cost estimates, the pre-tax cash flow for the project would be reduced from $739M to $192M, while the NPV @ 7% discount rate would be reduced from $332M to $38M. The IRR would be reduced from 24% to 5%, and the payback increased from 3.1 years to 8.5 years. The post-tax cash flow for the project would be reduced from $579M to $32M, while the NPV @ 7% discount rate would be reduced from $248M to -$122M. The IRR would be reduced from 21% to 1%, and the payback increased from 3.3 years to 10.0 years.

Table 8.2. Comparison of Financial Results, Base Case and 25% and 50% Increase Capital and Operating Costs

	Unit	Base Case	25% Increase	50% Increase
Pre-Tax				
Cash Flow	US$M	739	465	192
NPV @7%DR	US$M	332	147	-38
IRR	%	24%	14%	5%
Payback	Years	3.1	5.7	8.5
Post-Tax				
Cash Flow	US$M	579	306	32
NPV @7%DR	US$M	248	63	-122
IRR	%	21%	10%	1%
Payback	Years	3.3	6.5	10.0

[16] http://www.cimmes.org/wp-content/uploads/2016/05/Capital-Cost-Overrun-and-Operational-Performance-in-Mining-Industry-Tin-Lwin-25May2016.pdf (March 10, 2020)

8.4 Head Grade

The PEA also identifies head grade as a significant economic risk. The head grade is the expected metal contents of the feed to the mill or concentrator for processing. The grade is based on computer models of the deposit that account for various factors including dilution. Dilution is the incidental inclusion of waste material or below cut-off grade material in the mined ore.

The mining industry is well aware of systemic geological and engineering calibration errors present in the computer models used to generate ore reserves for mining projects and their tendency towards over-estimation of head grades. The industry is also aware of issues with respect to dilution and it is notable that the PEA recognizes this with respect to the long-hole stoping methods that have been proposed for mining, estimating 12% average dilution.

8.5 Barite Market

As discussed in the previous section, the proposal to produce and sell barite as a byproduct of metal production is not typical for similar metals producing hardrock mines. Notably, despite present demand from North American oil and gas drilling, the Greens Creek Mine in Alaska, which is cited by the report as also being barite rich, has never produced barite as a product, despite being in operation for more than 30 years and similarly producing copper, zinc, gold and silver. It is also notable that the average price for primary barite from domestic mines and plants in the U.S. was $132 per tonne in 2015, the last year in which data was available from the USGS.[17] According to industry experts the current barite average price is about $77/tonne.[18]

The PEA itself provides very limited information on the viability of the barite market other than to say the barite price of $220/tonne used in the study was based on an “average price of competitive wholesale prices of barite concentrate” (page 19-5). It would most likely require a significant shortage of supply in the face of significant demand, which is not present in the current North American oil and gas drilling sector, for the price of barite to increase to the level projected in the PEA.

Cash flow model Case 2 (see Appendix) shows the economic results if barite were not included as a revenue stream for the project. As shown in Table 8.1, if the production of barite concentrate was eliminated without other changes to the cost estimates, the pre-tax cash flow for the project would be reduced from $739M to $486M, while the NPV @ 7% discount rate would be reduced from $332M to $188M. The IRR would be reduced from 24% to 18%, and the payback increased from 3.1 years to 4.8 years. The post-tax cash flow for the project would be reduced from $579M to $327M, while the NPV @ 7% discount rate would be reduced from $248M to $103M. The IRR would be reduced from 21% to 14%, and the payback increased from 3.3 years to 5.5 years. This is significant in that many analysts, as previously noted, consider an IRR of 20% to be the benchmark for new mining projects considering the inherent risks.

[17] https://s3-us-west-2.amazonaws.com/prd-wret/assets/palladium/production/mineral-pubs/barite/myb1-2015-barit.pdf (March 10, 2020)
[18] https://galusaustralis.com/2020/02/483112/barite-products-market-in-deep-analysis-and-experts-review-report-2019-2025/ (March 10, 2020)

Table 8.1. Comparison of Financial Results, Base Case and Without Barite Revenue

	Unit	Base Case	Without Ba
Pre-Tax			
Cash Flow	US$M	739	486
NPV @7%DR	US$M	332	188
IRR	%	24%	18%
Payback	Years	3.1	4.8
Post-Tax			
Cash Flow	US$M	579	327
NPV @7%DR	US$M	248	103
IRR	%	21%	14%
Payback	Years	3.3	5.5

8.6 Environmental Considerations

The PEA includes information (Section 20) on environmental studies, permitting and social or community impacts. It summarizes existing data on surface water quality sampling, surface hydrology monitoring, wetlands mapping, stream flow monitoring, aquatic life surveys, avian and mammal habitat surveys, cultural resource surveys, hydrogeology studies, meteorological monitoring, and acid base accounting studies. It also describes the permit requirements for the present as well as proposed project. It briefly describes the current social and community situation and potential impacts should the project be developed.

The section also describes mine reclamation and closure describing the applicable regulations but noting that no reclamation plan for the project has yet to be developed or cost estimate calculated. The PEA uses a cost estimate based on the 2019 cost estimate for the Greens Creek mine reclamation, excluding long-term water treatment. The Greens Creek estimate is $102.6M including $30M in long-term water treatment costs, whereas the Palmer Project PEA uses a scaled estimate of $30.8M excluding water treatment.

The Palmer Project environmental costs relative to both design and reclamation and closure are based on an assumption that the tailings and waste rock facility will not result in a discharge requiring treatment post-reclamation, and that the storage of potentially acid generating (PAG) waste tailings and waste rock underground will mitigate any adverse impacts. Given the geochemistry associated with the deposit and site-specific hydrology there is reason to believe this assumption will not be correct. As noted by the PEA, this is based on preliminary information. The Greens Creek mine which is noted as similar elsewhere in the PEA also originally predicted and was permitted on the presumption of no long-term water treatment. However, today it is recognized that long-term treatment, exceeding 100 years, will be required and is included as part of the financial assurance.

The PEA also does not address the potential increase in tailings and waste rock storage costs that would occur if the barite concentrate is not sold. If this occurs the capacity of the tailings impoundment would need to be increased by an additional approximately 25% to account for storage of the barite concentrate not being sold. It also does not address whether this would also impact the capacity of the underground mine to accept all PAG waste rock and tailings.

The PEA is highly optimistic in terms of potential environmental impacts and potential costs for both design aspects and mitigation. Based on similar projects it is highly probable that the actual costs will be significant and could result in as much as an additional $100M in up front costs for source controls such as lined facilities and other measures to reduce the potential for water quality impacts as part of the design of the project, in addition to as much as an additional $100M for reclamation and closure including for long-term water treatment. While the costs, because they occur at the end of the project life, only have limited implications of project economics, if unaccounted for, become a potential public liability.

8.7 Sensitivity

Sensitivity analyses are intended to demonstrate the degree of confidence in the estimate particularly with respect to the potential production, cost and revenue factors. To the extent the PEA addresses downside costs and revenues it limits the sensitivity analysis to +/-20% for singular circumstances affecting capital costs, operating costs or metals prices and does not consider combinations of downside events.

The approach taken by the PEA sensitivity analysis using +/- 10% and +/- 20% cases for singular changes in capital costs, operating costs and metals prices does little to reflect the actual project sensitivity to likely or potential conditions identified in the previous sections. According to Mackenzie and Cusworth, the "…principal purpose of a 'feasibility study' is to determine whether a development opportunity makes good business sense, not just whether it is technically possible."[19]

The author recommends that sensitivity analysis be performed which considers the following conditions:

- reduced rates of mine or mill production and/or lower head grades and/or concentrate grades (5% reduction overall)
- delays in revenue which might occur for example if copper concentrate cannot be sold at the rate it is produced (50% delay in concentrate sales)
- more significant increases in capital and operating costs of 25-50%
- more significant decreases in metals prices of 25%

"Both the Gypton (2002) and McCarthy (2004) studies indicate that only about half of projects meet expectations – be that of cost and time to build the project or be that overall business outcome. With a rather fatalistic outlook, Gypton concludes: "… we need to acknowledge the fact that feasibility studies, and their estimates, are flawed documents by necessity. We should be prepared to test the economics of our projects at capital levels of say +20-25 per cent over the base estimate, including the contingency, and honestly ask ourselves if the project can withstand this risk."[20]

8.8 Conclusions

Metals Prices. The Palmer Project would be highly dependent on zinc prices as well as other metals prices. Fluctuating and uncertain metals prices are an inherent risk to nearly all metals mining projects and a major cause of project failure and in some cases ultimately company bankruptcy. While the PEA

[19] The Use and Abuse of Feasibility Studies, W Mackenzie and N Cusworth, Project Evaluation Conference Melbourne, Vic, 19 - 20 June 2007.
[20] Ibid.

uses a relatively conservative current price for zinc of $1.22/lb, as noted, the price during the last five years has varied significantly from a low of less than $0.70/lb to a high of $1.63/lb. It is also notable that there are a number of proposed zinc mining projects world-wide, so any temporary increase in the price is likely to be short term and in the long-term result in more production which will limit future price increases. Given that future forecasts for zinc consumption in general do not suggest significantly increased demand, there is a significant likelihood that future zinc prices will continue overall at the base price used in the PEA or potentially in the lower range of between $0.70/lb and the PEA price. In that event the Palmer Project, due to its high dependency on zinc prices, might prove to be uneconomic.

Operating and Capital Costs. The proposed Palmer Project includes site-specific risks related to capital and operating costs including costs related to changes in mining methods and metallurgical processing, weather and avalanches, remoteness of location, port facilities, personnel and other aspects as described. These site-specific factors as well as normal factors affecting the entire mining industry suggest the proposed project will have a high likelihood of exceeding the estimated capital and operating costs, potentially by significant amounts (i.e. up to 50%). If that were to occur, the project would most likely not be economically viable.

Site Specific Risks. The PEA identifies numerous site-specific risks including avalanche, portal construction, AG deposit metallurgy, site surface geotechnical conditions, water management, seismicity, geochemistry, dust management and post-closure site-specific risks. The PEA assumes the risks can be mitigated and does not include any additional contingencies or caveats with respect to their potential impact on the project. It is not apparent from the information provided in the PEA that the risks have been adequately assessed, mitigations identified, and residual risk considered relative to impacts to project costs and construction and/or production delays.

Barite Marketability. The PEA's suggestion that the barite contents are marketable is not adequately supported with information with respect to the future viability of the barite market for the quantity being suggested, the price used in the report, or by contracts for sale of the commodity to potential buyers and/or users. The inclusion of barite as a salable byproduct commodity from the proposed project is highly speculative. The proposed project would potentially produce from 5% to 14% of annual U.S. consumption of barite. It should be noted that 100% of U.S. barite consumption could be met by other sources such as existing mines in Nevada. It is also highly uncertain if the barite produced from the Palmer Project would be the equivalent of that presently marketed from non-mineralized high-grade primary barite resources.

Environmental Considerations. The PEA appears to significantly underestimate potential environmental impacts and costs associated with potential water quality impacts and required reclamation and closure measures in terms of source controls and/or long-term water treatment. It also does not evaluate additional costs for tailings storage if the barite concentrate is not produced and sold. As a result, the actual project could incur up to several hundred million in additional costs to both prevent and address environmental impacts.

Appendix A
James R. Kuipers P.E.
Professional Resume

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SUMMARY OF EXPERIENCE

Over 35 years experience in mining and environmental process engineering design, operations management, regulatory compliance, waste remediation, reclamation and closure, and financial assurance. Over 20 years experience providing technical assistance to public interest groups and tribal, local, state and federal governments on technical aspects of mining and environmental issues.

EDUCATION

Montana College of Mineral Science and Technology, B.S. Mineral Process Engineering, 1983.

PROFESSIONAL REGISTRATION

Professional Engineer (PE Mining/Minerals): Colorado (No. 30262), Montana (No. 7809 & Corp. No. 197)

PROFESSIONAL EXPERIENCE

1996 to Present **Kuipers & Associates/J. Kuipers Engineering, Butte, MT.**

- *ABN AMRO Bank, Netherlands*: Consulting Engineer, confidential mine evaluation.
- *Amigos Bravos, Taos, NM*: Consulting Engineer, Molycorp Questa Mine, technical review committee and working group member in reclamation and closure/closeout permitting and bonding process.
- *Anaconda Deer Lodge County, MT*: Consulting Engineer/Project Manager, Anaconda Superfund Site, provide technical services related to institutional controls, property conveyance and redevelopment, property and facility operation and maintenance, review of regulatory documents, renewable energy development, air and water monitoring and other tasks related to county involvement in Superfund activities.
- *Bannock Technologies, Pocatello, ID*: Consulting Engineer, Shoshone Bannock Tribe mining oversight project studies.
- *Blackfoot Legacy, Lincoln, MT:* Consulting Engineer, McDonald Project, review of project feasibility and environmental issues.
- *Border Ecology Project, Santa Fe, NM:* Consulting Engineer, Cananea Project (Mexico), consulting engineer mine reclamation and closure planning.
- *Cabinet Resource Group, Noxon, MT*: Consulting Engineer, Rock Creek Project, review of proposed tailing impoundment.
- *Clark Fork River Technical Advisory Committee, Missoula, MT*: Technical Advisor, Clark Fork River and Milltown Reservoir Operable Units, Upper Clark Fork Basin Superfund Sites.

- *Center for Science in Public Participation, Bozeman, MT:* See separate description below.

- *Citizens' Technical Environmental Committee, Butte, MT:* Technical Advisor, Butte-Silver Bow Site Operable Units, Upper Clark Fork Basin Superfund Sites.

- *Cottonwood Resource Council, Big Timber, MT:* Consulting Engineer, Lodestar Mine and Mill, review of operating and MPDES permits, financial assurance and operations data.

- *Earthjustice, Bozeman, MT:* Consulting Engineer, Montanore and Rock Creek Projects permitting process.

- *Earthworks, Washington, D.C.:* Project Manager and co-author, Water Quality Predictions and NEPA/EIS Studies.

- *Environmental Defender Law Center, Bozeman, MT*: Expert Witness and Consulting Engineer, Boliden Promel, Chile arsenic waste disposal.

- *Gila Resources Information Project, Silver City, NM:* Consulting Engineer, Phelps Dodge Chino, Cobre and Tyrone Mines, reclamation and closure/closeout permitting and bonding process.

- *Great Basin Mine Watch, Reno, NV:* Expert Witness and Consulting Engineer, various NV projects, permitting and reclamation and closure/closeout permitting and bonding process.

- *Great Lakes Indian Fish and Wildlife Commission, Odinah, WI*: Gigotec Project and Polymet Project permitting.

- *ICF International, Stafford, VA*: Consulting Engineer, 108(b) rulemaking technical support contract including financial assurance cost estimation model evaluations.

- *Idaho Conservation League, Boise, ID*: Consulting Engineer, Atlanta Mine water treatment and permitting.

- *IEc, Boston, MA*: Consulting Engineer, mining and financial assurance technical support.

- *Institute for Governance & Sustainable Development, Washington, DC:* Consulting Engineer, reclamation and closure and financial assurance, U.S. Chile Mining Financial Assurance Seminar.

- *Initiative for Responsible Mining Assurance*: Consulting Engineer IRMA Standard for Responsible Mining.

- *Johnson County, KS:* Consulting Engineer, Sunflower Limestone Mine reclamation plan and financial assurance.

- *Little Salmon Carmacks First Nation, Yukon Territory, Canada*: Expert Witness and Consulting Engineer, Carmacks Copper Project.

- *Mining Watch Canada:* Consulting Engineer MEND Tailings Guide Review; Ecuador Mines Evaluations; Canada Carbon; Nouveau Monde Graphite.

- *Minnesota Center for Environmental Advocacy, Saint Paul, MN:* Consulting Engineer, PolyMet NorthMet Project, review permits, reclamation and closure, financial assurance, tailings facilities.

- *Montana Attorney Generals Office, Helena, MT:* Consulting Engineer, assist in defense of I-137 Open Pit Cyanide Mine Ban appeals.

- *Montana Department of Environmental Quality, Helena, MT*: General Contractor, Pony Mill Site Reclamation.

- *Montana Environmental Information Center, Helena, MT and National Wildlife Federation, Missoula, MT*: Expert Witness and Consulting Engineer, Golden Sunlight Mine, EIS Review and assist appeal of State operating permit.

- *Montana Environmental Information Center, Helena, MT*: Expert Witness, Bull Mountain Coal Mine appeal.

- *Montana Trout Unlimited, Missoula, MT*: Consulting Engineer, Trout Unlimited's Four Mines Campaign, review and provide technical assistance on McDonald, Crandon, New World and Rock Creek Mines.

- *Montana Trout Unlimited, Missoula, MT*: Consulting Engineer, I-147 initiative campaign; Black Butte Copper Proposal; Beal Mountain Mine Remediation.

- *Multicultural Alliance for a Safe Environment, Santa Fe, NM*: Consulting Engineer and Expert Witness, Homestake Uranium Mill and Mt Taylor Mine.

- *Natural Resources Defense Council*; New York State: Consulting Engineer, review of Oil & Gas Draft EIS.

- *New Mexico Environmental Law Center, Santa Fe, NM*: Consulting Engineer, Oglebay Norton Mica Mine reclamation and financial assurance; New Mexico Environment Department Copper Rules Stakeholder Process.

- *Nez Perce Tribe Fisheries Department, McCall, ID*: Consulting Engineer, Midas Gold Stibnite Project permitting.

- *Northern Plains Resource Council, Cottonwood Resource Council, Stillwater Protective Association, Billings. MT:* Consulting Engineer, Stillwater Mining Company Nye and East Boulder Mines, facilitate and perform technical aspects of Good Neighbor Agreement.

- *Northern Plains Resouce Council, Billings, MT; Wyoming Outdoor Council, Sheridan, WY:* Consulting Engineer, Montana Statewide and Wyoming Powder River Basin Coal Bed Methane EIS.

- *Northern Plains Resouce Council, Billings, MT:* Project Manager and co-author, Coal Bed Methane Produced Water Studies.

- *Northern Alaska Environmental Council, Fairbanks, AK:* Consulting Engineer, Pogo Mine NPDES permit negotiations.

- *Patagonia Area Resource Alliance, Patagonia, AZ*: Consulting Engineer, Arizona Mining, Remediation Plans

- *Picuris Pueblo, Penasco, NM:* US Hill Mica Mine Reclamation Plan and financial assurance cost estimate and site reclamation project management.

- *Powder River Basin Resource Council, Sheridan, WY/Steven Adami, Buffalo, WY:* Expert Witness, Kennedy Oil IMADA POD appeals.

- *Rivers Without Borders*: Consulting Engineer, Tulsequah Chief and Palmer Project financial analysis.

- *Rock Creek Alliance, Missoula, MT:* Expert Witness and Consulting Engineer, Rock Creek and Montanore Mines permitting.

- *Rudolfi Environmental, Seattle, WA*: Consulting Engineer, Pebble Project permitting.

- *Selkirk First Nation, Yukon Territory, Canada:* Expert Witness and Consulting Engineer, Minto Mine Project reclamation and closure and financial assurance; Casino Mine Proposal permit review.

- *Sheep Mountain Alliance, Telluride, CO*: Expert Witness and Consulting Engineer, Silver Bell Tailings remediation.

- *Shoshone-Paiute Tribes of the Duck Valley Reservation, NV:* Consulting Engineer, Rio Tinto Mine Reclamation and Closure.

- *Sierra Club and Mineral Policy Center:* Expert Witness, Cripple Creek and Victor Mining Company Clean Water Act case.

- *SKEO, Charlottesville, VA*: Consulting Engineer, mining and financial assurance technical support contract and EPA Region NEPA review and financial assurance support.

- *Southern Environmental Law Center, Charleston, SC*: Consulting Engineer, Haile Gold Mine permitting.

- *Systems Research and Applications Corporation, Fairfax, VA:* Consulting Engineer, mine cleanup and financial assurance guidelines subcontract to EPA.

- *Tohono O'odham Nation, San Xavier District, AZ:* Consulting Engineer, Mission Mine reclamation plan and financial assurance.

- *Trust for Public Lands, San Francisco, CA:* Consulting Engineer, Viceroy Castle Mountain Mine, evaluated pit backfill and reclamation alternatives for settlement agreement trust fund determination.

- *Tsilhqot'in National Government, Williams Lake, BC, Canada*: Consulting Engineer and Expert Witness, New Prosperity Project permitting.

- *Turner Ranch Properties, Ladder Ranch, NM*: Consulting Engineer Copper Flat Project Permitting, Expert Witness related water rights case.

- *Walz and Associates, Albuquerque, NM:* Expert Witness, assist in defense of NM Environment Department and Mining Minerals Division permitting and takings case (Manning v. NM).

- *Western Organization of Resource Councils, Billings, MT:* Oil and gas reclamation and financial assurance guide.

- *Western Resource Advocates, Salt Lake City, UT*: Expert Witness and Consulting Engineer, Red Leaf Resources oil shale project permitting.

- *Williams Lake and Soda Creek Indian Bands, British Columbia, Canada:* Consulting Engineer, Mount Polley Tailings Facility breach investigations and mine reopening permitting.

1997 to 2005 **Center for Science in Public Participation, Bozeman, MT.**

- *Canadian Earthcare Society, Vancouver, BC*: Consulting Engineer, Brenda Mine, assist appeal of reclamation and closure permit.

- *CEE Bankwatch, Budapest, Hungary*: Consulting Engineer, Rosario Montana Mine (Romania), economic feasibility study of mine proposal.

- *Friends of the Similkameen, Hedley, BC*: Consulting Engineer, Candorado Mine, assist appeal of reclamation and closure permit.

- *Fort Belknap Tribal Council and Environment Department, Fort Belknap, MT*: Consulting Engineer, Zortman and Landusky Mines, Alternative Reclamation and Closure Plan, multiple accounts analysis working group member and technical advisor during supplemental environmental impact statement.

- *Guardians of the Rural Environment, Yarnell, AZ*: Consulting Engineer, Yarnell Project, EIS review and assist appeal of State operating permit.

- *Mineral Policy Center, Washington, D.C.*: Technical Advisor on general mining issues and Author of MPC Issue Paper.

- *National Wildlife Federation, Boulder, CO*: Consulting Engineer authoring report on Hardrock Mining Reclamation and Closure Bonding Practices in the Western United States.

- *Sakoagan Chippewa Tribes, Mole Lake Reservation, Wisconsin*. Consulting Engineer, Crandon Project, permitting process review.

1993 - 1995 **Denver Mineral Engineers, Inc., Littleton, CO.**

- Manager, Process Engineering Department.

- Manager, Mining and Environmental Wastewater Treatment Program

- *Arrowhead Industrial Water Co., San Jose, CA*: Project Manager, evaluation of reverse osmosis for mine wastewater treatment.

- *Barrick Goldstrike, USA, Elko, NV*: Project Engineer, engineering design, construction and installation of 1.5 M oz/year stainless steel electrowinning system.

- *Battle Mountain Gold, Co., Battle Mountain, NV*: Project Manager, evaluation, pilot testing, and preliminary feasibility study of wastewater treatment options for groundwater remediation of Fortitude Mine tailings area.

- *Commerce Group Corporation, Milwaukee, WI*: Project Manager, San Sebastian Gold Project, El Salvador.

- *Independence Mining Corp, Jerritt Canyon, NV*: Project Manager, technical evaluation and feasibility study of column flotation for beneficiation of refractory ores.

- *Kennecott Utah Copper, Bingham Canyon, UT*: Project Manager, design and construct stainless steel solvent extraction mixer settlers for prototype SX/EW plant.

- *Israeli Chemical Corp., Beersheeba, Israel*: Project Manager, evaluation of bromine as an alternative to cyanide gold leaching and prototype design.

- *Marston and Marston, St Louis, MO*: Project Manager, Kommunar Gold Mill Modernization Project, Kommunar, Siberia, Russia (CIS) and Suzak Polymetal Leach Circuit Evaluation and Feasibility Study, Kazakhstan (CIS).

- *Nevada Goldfields Mining Co., Denver, CO*: Project Manager, Nixon Fork Mine Preliminary Engineering Design and Feasibility Study, Concentrate Marketing Study, and environmental permitting studies.

- *Southern Pacific Railroad, Denver, CO*: Project Manager, design, construction and installation of dissolved air flotation wastewater treatment system.

1991 - 1992 **Western States Minerals Corp.**

- Project Manager, Northumberland Gold Mine, Round Mountain, NV.

- Corporate Senior Metallurgist, Wheat Ridge, CO. Engineering design and feasibility evaluations.

1986 - 1991 **Western Gold Exploration and Mining Co. (WESTGOLD)/Minorco**

- Corporate Senior Metallurgist / Project Manager, WESTGOLD, Golden, CO. Acquisitions and engineering design and feasibility evaluations, corporate acquisitions and business development group.

- Project Manager, Shamrock Resources (WESTGOLD Subs.), Reno, NV. Evaluation, engineering design and feasibility study, and prototype plant operation of refractory gold ore bioleaching technology program.

- Project Manager, Balmerton Mine, Ontario: Refractory gold ore bioleaching project and feasibility evaluation.

- Project Engineer, Johannesburg South Africa: Evaluation of Anglo American Corp. Pumpcell Technology.

- Mill Superintendent, Austin Gold Venture (WESTGOLD), Austin, NV.

- Shift Foreman, Inspiration Consolidated Copper Co, Globe, AZ.

1984 - 1985 **Canyonlands 21st Century Corporation**

- Director of Metallurgy, Blanding, UT. Project Manager, Jarbidge, NV.

1983 - 1984 **Cumberland Mining Corporation**

- Mill Superintendent / Head Metallurgist, Basin and Virginia City, MT.

1974 – 1980 **Huckaba Construction**

- Summer employment as Underground and Surface Miner, Millwright, Mill Operator, Fire Assayer, Whitehall and Cooke City, MT. Family owned small mining operation.

PRESENTATIONS and PUBLICATIONS

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- *The Good Neighbor Agreement between Stillwater Mining Company and Northern Plains Resource Councils: An Example of Industry and Citizen Cooperation*, presented as a short course at Joint Engineers Conference, Helena, MT, November 2003.

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- *Reclamation and Financial Assurance from a Public Interest Perspective*, presented at U.S. Forest Service National Geofest, Park City, UT, September 2003.

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- *Novel Aspects of Gold Recovery Using Column Flotation at Austin Gold Venture*: Gold and Silver Recovery Innovations, Phase IV Workshop, Randol International Ltd, Sacramento, CA, 1989.

Appendix B
Case Studies

	Unit	LOM Total	Y-2	Y-1	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12
PRODUCTION																
Ore Mined/Milled																
Rate	ktonnes	12,482			990	924	1,219	1,249	1,259	1,177	1,260	1,235	1,260	1,244	665	
Cu	%	0.80%			1.16%	0.98%	0.67%	0.70%	0.60%	0.49%	1.00%	0.97%	0.58%	0.80%	1.18%	
Zn	%	4.24%			3.68%	4.43%	4.04%	4.98%	4.43%	4.86%	2.83%	3.50%	4.55%	4.37%	5.50%	
Ag	g/t	49.56			18.46	18.58	28.15	32.88	59.25	53.72	57.29	74.18	80.40	66.54	33.15	
Au	g/t	0.33			0.28	0.27	0.19	0.19	0.25	0.25	0.27	0.44	0.57	0.50	0.40	
Ba	%	13.31%			9.08%	10.68%	9.55%	9.27%	15.69%	13.73%	13.41%	16.45%	18.50%	13.76%	15.81%	
Contained Metal																
Cu	ktonnes	100			11.5	9.1	8.2	8.7	7.6	5.8	12.6	12.0	7.3	10.0	7.8	
Zn	ktonnes	529			36.4	40.9	49.2	62.2	55.8	57.2	35.7	43.2	57.3	54.4	36.6	
Ag	kg	618,572			18275.4	17167.9	34314.9	41067.1	74595.8	63228.4	72185.4	91612.3	101304.0	82775.8	22044.8	
Au	kg	4,094			277.2	249.5	231.6	237.3	314.8	294.3	340.2	543.4	718.2	622.0	266.0	
Ba	ktonnes	1,661			89.9	98.7	116.4	115.8	197.5	161.6	169.0	203.2	233.1	171.2	105.1	
Copper Concentrate																
Recovery to Conc	tonnes	362,780			41,506	32,766	29,710	31,774	27,059	20,859	45,570	43,138	26,316	35,623	28,459	
Cu	%	88.4%			88.9%	88.8%	88.5%	88.4%	88.4%	88.0%	88.5%	88.4%	88.0%	88.1%	88.6%	
Zn	%	4.8%			4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	
Ag	%	70.8%			70.8%	70.8%	70.8%	70.8%	70.8%	70.8%	70.8%	70.8%	70.8%	70.8%	70.8%	
Au	%	49.5%			49.5%	49.5%	49.5%	49.5%	49.5%	49.5%	49.5%	49.5%	49.5%	49.5%	49.5%	
Metal in Conc																
Cu	ktonnes	89			10.2	8.0	7.2	7.7	6.7	5.1	11.2	10.6	6.4	8.8	7.0	
Zn	ktonnes	25			1.7	2.0	2.4	3.0	2.7	2.7	1.7	2.1	2.8	2.6	1.8	
Ag	kg	437,949			12,939	12,155	24,295	29,076	52,814	44,766	51,107	64,862	71,723	58,605	15,608	
Au	kg	2,027			137.2	123.5	114.6	117.5	155.8	145.7	168.4	269.0	355.5	307.9	131.7	
Conc Grade																
Cu	%	24.5%			24.6%	24.5%	24.3%	24.3%	24.7%	24.3%	24.5%	24.5%	24.4%	24.6%	24.4%	
Zn	%	7.0%			4.2%	6.0%	8.0%	9.4%	9.9%	13.2%	3.8%	4.8%	10.5%	7.3%	6.2%	
Ag	g/t	1,207			312	371	818	915	1,952	2,146	1,122	1,504	2,725	1,645	548	
Au	g/t	5.59			3.31	3.77	3.86	3.70	5.76	6.98	3.70	6.24	13.51	8.64	4.63	
Zinc Concentrate																
Recovery to Conc	tonnes	790,036			55,295	62,044	73,766	92,749	83,410	84,748	52,622	63,956	85,247	80,992	55,207	
Zn	%	91.5%			93.1%	92.9%	91.8%	91.4%	91.6%	90.8%	90.3%	90.6%	91.2%	91.3%	92.5%	
Cu	%	6.3%			6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	
Ag	%	20.1%			20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	
Au	%	20.1%			20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	
Metal in Conc																
Zn	ktonnes	484			33.9	38.0	45.2	56.9	51.1	51.9	32.2	39.2	52.3	49.6	33.8	
Cu	ktonnes	6			0.7	0.6	0.5	0.6	0.5	0.4	0.8	0.8	0.5	0.6	0.5	
Ag	kg	124,333			3,673	3,451	6,897	8,254	14,994	12,709	14,509	18,414	20,362	16,638	4,431	
Au	kg	823			55.7	50.1	46.6	47.7	63.3	59.1	68.4	109.2	144.4	125.0	53.5	
Conc Grade																
Zn	%	61.3%			61.3%	61.3%	61.3%	61.3%	61.3%	61.3%	61.2%	61.2%	61.3%	61.3%	61.3%	
Cu	%	1.7%			1.3%	0.9%	0.7%	0.6%	0.6%	0.4%	1.5%	1.2%	0.5%	0.8%	0.9%	
Ag	g/t	343			66	56	94	89	180	150	276	288	239	205	80	
Au	g/t	2.27			1.01	0.81	0.63	0.51	0.76	0.70	1.30	1.71	1.69	1.54	0.97	
Barite Concentrate																
Recovery to Conc	tonnes	2,910,725			157,484	172,885	203,949	202,842	346,070	283,114	296,015	355,916	408,373	299,884	184,191	
Ba	%	91.1%			91.1%	91.1%	91.1%	91.1%	91.1%	91.1%	91.1%	91.1%	91.1%	91.1%	91.1%	
Metal in Conc																
Ba	ktonnes	1,514			81.9	89.9	106.1	105.5	180.0	147.2	153.9	185.1	212.4	155.9	95.8	
Conc Grade																
Ba	%	52.0%			52.0%	52.0%	52.0%	52.0%	52.0%	52.0%	52.0%	52.0%	52.0%	52.0%	52.0%	
REVENUES																
Metal Prices																
Cu	US$/lb	2.82			2.82	2.82	2.82	2.82	2.82	2.82	2.82	2.82	2.82	2.82	2.82	
Zn	US$/lb	1.22			1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	
Ag	US$/oz	16.26			16.26	16.26	16.26	16.26	16.26	16.26	16.26	16.26	16.26	16.26	16.26	
Au	US$/oz	1,296			1,296	1,296	1,296	1,296	1,296	1,296	1,296	1,296	1,296	1,296	1,296	
Ba	US$/tonne	220.00			220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	

Copper Concentrate																
Payable %																
Cu	%	96%			96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	
Zn	%	0%			0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Ag	%	88%			88%	88%	88%	88%	88%	88%	88%	88%	88%	88%	88%	
Au	%	71%			71%	71%	71%	71%	71%	71%	71%	71%	71%	71%	71%	
Payable Qty																
Cu	Mlbs	188			21.6	17.0	15.3	16.3	14.1	10.7	23.6	22.4	13.6	18.5	14.7	
Zn	ktonnes															
Ag	koz	12,345		0	365	343	685	820	1,489	1,262	1,441	1,828	2,022	1,652	440	
Au	koz	46			3	3	3	3	4	3	4	6	8	7	3	
Gross Revenue																
Cu	US$M	529.9			60.9	48.0	43.1	46.1	39.8	30.3	66.5	63.2	38.4	52.3	41.5	
Zn	US$M															
Ag	US$M	200.7			5.9	5.6	11.1	13.3	24.2	20.5	23.4	29.7	32.9	26.9	7.2	
Au	US$M	59.8			4.0	3.6	3.4	3.5	4.6	4.3	5.0	7.9	10.5	9.1	3.9	
Total	US$M	790.4			70.9	57.2	57.6	62.9	68.6	55.1	94.9	100.8	81.7	88.2	52.5	
Shipping and Refining																
Conc % Moisture	%	8%			8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	
Conc Shipping	US$/wmt	91.0			91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0	
Conc Shipping	US$M	35.7			4.1	3.2	2.9	3.1	2.7	2.1	4.5	4.2	2.6	3.5	2.8	
Cu Treatment	US$/dmt	86.0			86.0	86.0	86.0	86.0	86.0	86.0	86.0	86.0	86.0	86.0	86.0	
Cu Treatment	US$M	31.2			3.6	2.8	2.6	2.7	2.3	1.8	3.9	3.7	2.3	3.1	2.4	
Cu Refining	US$/#	0.09			0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	
Cu Refining	US$M	16.9			1.9	1.5	1.4	1.5	1.3	1.0	2.1	2.0	1.2	1.7	1.3	
Ag Refining	US$/oz	0.75			0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	
Ag Refining	US$M	9.3			0.3	0.3	0.5	0.6	1.1	0.9	1.1	1.4	1.5	1.2	0.3	
Au Refining	US$/oz	6.00			6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	
Au Refining	US$M	0.28			0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.04	0.05	0.04	0.02	
Zn Penalty	US$/tonne	6.00			0.42	3.99	7.91	10.79	11.8	18.32	0	1.63	12.91	6.66	4.34	
Zn Penalty	US$M	2.2			0.02	0.13	0.24	0.34	0.32	0.38	0.00	0.07	0.34	0.24	0.12	
Total	US$M	95.2			9.9	8.0	7.6	8.3	7.7	6.1	11.6	11.4	7.9	9.7	7.0	
Copper Conc NSR	US$M	695.2			61.0	49.2	50.0	54.6	60.9	48.9	83.3	89.4	73.8	78.5	45.5	
Zinc Concentrate																
Payable %																
Zn	%				85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	
Cu	%				0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Ag	%						0.2%		34%	26%	46%	47%	43%	38%		
Au	%				48.5%	43.2%	35.6%	27.8%	41.4%	38.9%	53.3%	57.3%	57.2%	55.9%	47.6%	
Payable Qty																
Zn	ktonnes	412			29	32	38	48	43	44	27	33	44	42	29	
Cu	Mlbs	0			0	0	0	0	0	0	0	0	0	0	0	
Ag	koz	1,250			0	0	0.3	0	162	108	216	280	279	204	0	
Au	koz	13			0.9	0.7	0.5	0.4	0.8	0.7	1.2	2.0	2.7	2.2	0.8	
Gross Revenue																
Zn	US$M	1,108			78	87	103	130	117	119	74	90	120	114	77	
Cu	US$M	0.0			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Ag	US$M	20.3			0	0	0	0	3	2	4	5	5	3	0	
Au	US$M	16.9			1	1	1	1	1	1	2	3	3	3	1	
Total	US$M	1,145.5			78.8	88.0	104.2	130.7	120.7	121.6	78.7	96.8	127.7	119.9	78.5	
Shipping and Refining																
Conc % Moisture	%	8%			8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	
Conc Shipping	US$/wmt	91.0			91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0	
Conc Shipping	US$M	77.6			5.4	6.1	7.2	9.1	8.2	8.3	5.2	6.3	8.4	8.0	5.4	
Zn Treatment	US$/dmt	172.0			172.0	172.0	172.0	172.0	172.0	172.0	172.0	172.0	172.0	172.0	172.0	
Zn Treatment	US$M	135.9			9.5	10.7	12.7	16.0	14.3	14.6	9.1	11.0	14.7	13.9	9.5	
Ag Refining	US$/oz	0.5			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Ag Refining	US$M	0.6			0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	
Au Refining	US$/oz	6.00			6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	
Au Refining	US$M	0.08			0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.02	0.01	0.00	
Total	US$M	214.2			15.0	16.8	19.9	25.1	22.6	23.0	14.3	17.4	23.2	22.0	14.9	

Zinc Conc NSR	US$M	931.3			63.8	71.2	84.3	105.6	98.1	98.7	64.4	79.4	104.5	97.9	63.6	
Barite Concentrate																
Payable %																
Ba	%				100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Payable Qty																
Ba	ktonnes	2,911			157	173	204	203	346	283	296	356	408	300	184	
Gross Revenue																
Ba	US$M	640			35	38	45	45	76	62	65	78	90	66	41	
Shipping and Refining																
Conc % Moisture	%	1%			1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	
Conc Shipping	US$/wmt	132.0			132.0	132.0	132.0	132.0	132.0	132.0	132.0	132.0	132.0	132.0	132.0	
Conc Shipping	US$M	388.1			21.0	23.0	27.2	27.0	46.1	37.7	39.5	47.5	54.4	40.0	24.6	
Total	US$M	388.1			21.0	23.0	27.2	27.0	46.1	37.7	39.5	47.5	54.4	40.0	24.6	
Barite Conc NSR	US$M	252.3			13.7	15.0	17.7	17.6	30.0	24.5	25.7	30.9	35.4	26.0	16.0	
Net Revenue																
Copper Conc NSR	US$M	695.2			61.0	49.2	50.0	54.6	60.9	48.9	83.3	89.4	73.8	78.5	45.5	
Zinc Conc NSR	US$M	931.3			63.8	71.2	84.3	105.6	98.1	98.7	64.4	79.4	104.5	97.9	63.6	
Barite Conc NSR	US$M	252.3			13.7	15.0	17.7	17.6	30.0	24.5	25.7	30.9	35.4	26.0	16.0	
Total NSR	US$M	1,878.8			138.4	135.4	151.9	177.8	189.0	172.1	173.4	199.6	213.7	202.4	125.0	
NSR Royalty Payments	US$M	46.9			3.4	3.4	3.8	4.4	4.7	4.3	4.3	5	5.4	5.1	3.1	
Net Revenue	US$M	1,831.9			135.0	132.0	148.1	173.4	184.3	167.8	169.1	194.6	208.3	197.3	121.9	
EXPENSES																
Capital																
Mining	US$M	162.9	14.3	41.1	18.1	20.7	11.2	7.5	10.1	9.2	9.4	8.3	7.2	3.8	2.0	
Site Development	US$M	12.7	10.5	1.7	0.1			0.4								
Mineral Processing	US$M	77.4	10.0	64.6			0.5	0.9			0.5	0.9				
Tailings Management	US$M	5.1	0.5	1.5	0.3	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.2		
On-Site Infrastructure	US$M	35.3	5.9	28.1				0.2	0.7	0.2		0.2				
Off-Site Infrasructure	US$M	0.4	0.3	0.1												
Project Indirects	US$M	26.4	4.1	22.3												
EPCM	US$M	32.2	17.7	14.5												
Owner Costs	US$M	7.5	0.5	7.0												
Closure	US$M	30.8														30.8
Salvage Value	US$M	-5.9														-5.9
Contingency	US$M	32.7	3.3	29.4												
Working Capital	US$M	0.0		13.3											-13.3	
Total CAPEX	US$M	417.5	67.1	223.6	18.5	21.1	12.1	9.3	11.1	9.7	10.2	9.7	7.5	4.0	-11.3	24.9
Operating																
UG Mining	US$M	362.7			26.7	29.7	36.1	36.2	36.2	35.4	36.0	35.6	38.3	35.3	17.2	
Processing	US$M	209.8			16.7	15.5	20.5	21.0	21.2	19.6	21.2	20.8	21.2	20.9	11.2	
G&A	US$M	103.2			10.0	9.6	9.8	9.6	9.6	9.5	9.8	9.6	9.5	9.4	6.8	
Total OPEX	US$M	675.7			53.4	54.8	66.4	66.8	67.0	64.5	67.0	66.0	69.0	65.6	35.2	
Total OPEX	US$/ton milled	54.1			53.9	59.3	54.5	53.5	53.2	54.8	53.2	53.4	54.8	52.7	52.9	
Net Expenses, Pre-Tax	US$M	1,093.2	67.1	223.6	71.9	75.9	78.5	76.1	78.1	74.2	77.2	75.7	76.5	69.6	23.9	24.9
Taxes	US$M	159.7	0.9	0.9	0.9	4.4	6.0	11.2	13.7	9.8	11.0	21.3	30.5	29.7	19.4	
Net Expenses, Post-Tax	US$M	1,252.9	68.0	224.5	72.8	80.3	84.5	87.3	91.8	84.0	88.2	97.0	107.0	99.3	43.3	24.9
ECONOMICS																
Pre-Tax Results																
Pre-Tax Net Cash Flow	US$M	738.7	-67.1	-223.6	63.1	56.1	69.6	97.3	106.2	93.6	91.9	118.9	131.8	127.7	98.0	-24.9
Cumulative Pre-Tax Net Cash Flow	US$M		-67.1	-290.7	-227.6	-171.5	-101.8	-4.5	101.7	195.3	287.2	406.1	537.9	665.5	763.6	738.7
Pre-Tax NPV @0% DROR	US$M	738.7														
Pre-Tax NPV @7% DROR	US$M	332.2														
IRR	%	24.3%														
Payback	Years	3.1														
Post-Tax Results																
Post-Tax Net Cash Flow	US$M	579.0	-68.0	-224.5	62.2	51.7	63.6	86.1	92.5	83.8	80.9	97.6	101.3	98.0	78.6	-24.9
Cumulative Post-Tax Net Cash Flow	US$M		-68.0	-292.5	-230.3	-178.6	-114.9	-28.8	63.7	147.5	228.4	326.0	427.3	525.2	603.9	579.0
Post-Tax NPV @0% DROR	US$M	579.0														
Post-Tax NPV @7% DROR	US$M	247.9														
IRR	%	21.1%														
Payback	Years	3.3														

	Unit	LOM Total	Y-2	Y-1	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12
PRODUCTION																
Ore Mined/Milled																
Rate	ktonnes	12,482			990	924	1,219	1,249	1,259	1,177	1,260	1,235	1,260	1,244	665	
Cu	%	0.80%			1.16%	0.98%	0.67%	0.70%	0.60%	0.49%	1.00%	0.97%	0.58%	0.80%	1.18%	
Zn	%	4.24%			3.68%	4.43%	4.04%	4.98%	4.43%	4.86%	2.83%	3.50%	4.55%	4.37%	5.50%	
Ag	g/t	49.56			18.46	18.58	28.15	32.88	59.25	53.72	57.29	74.18	80.40	66.54	33.15	
Au	g/t	0.33			0.28	0.27	0.19	0.19	0.25	0.25	0.27	0.44	0.57	0.50	0.40	
Ba	%	13.31%			9.08%	10.68%	9.55%	9.27%	15.69%	13.73%	13.41%	16.45%	18.50%	13.76%	15.81%	
Contained Metal																
Cu	ktonnes	100			11.5	9.1	8.2	8.7	7.6	5.8	12.6	12.0	7.3	10.0	7.8	
Zn	ktonnes	529			36.4	40.9	49.2	62.2	55.8	57.2	35.7	43.2	57.3	54.4	36.6	
Ag	kg	618,572			18275.4	17167.9	34314.9	41067.1	74595.8	63228.4	72185.4	91612.3	101304.0	82775.8	22044.8	
Au	kg	4,094			277.2	249.5	231.6	237.3	314.8	294.3	340.2	543.4	718.2	622.0	266.0	
Ba	ktonnes	1,661			89.9	98.7	116.4	115.8	197.5	161.6	169.0	203.2	233.1	171.2	105.1	
Copper Concentrate																
Recovery to Conc	tonnes	362,780			41,506	32,766	29,710	31,774	27,059	20,859	45,570	43,138	26,316	35,623	28,459	
Cu	%	88.4%			88.9%	88.8%	88.5%	88.4%	88.4%	88.0%	88.5%	88.4%	88.0%	88.1%	88.6%	
Zn	%	4.8%			4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	
Ag	%	70.8%			70.8%	70.8%	70.8%	70.8%	70.8%	70.8%	70.8%	70.8%	70.8%	70.8%	70.8%	
Au	%	49.5%			49.5%	49.5%	49.5%	49.5%	49.5%	49.5%	49.5%	49.5%	49.5%	49.5%	49.5%	
Metal in Conc																
Cu	ktonnes	89			10.2	8.0	7.2	7.7	6.7	5.1	11.2	10.6	6.4	8.8	7.0	
Zn	ktonnes	25			1.7	2.0	2.4	3.0	2.7	2.7	1.7	2.1	2.8	2.6	1.8	
Ag	kg	437,949			12,939	12,155	24,295	29,076	52,814	44,766	51,107	64,862	71,723	58,605	15,608	
Au	kg	2,027			137.2	123.5	114.6	117.5	155.8	145.7	168.4	269.0	355.5	307.9	131.7	
Conc Grade																
Cu	%	24.5%			24.6%	24.5%	24.3%	24.3%	24.7%	24.3%	24.5%	24.5%	24.4%	24.6%	24.4%	
Zn	%	7.0%			4.2%	6.0%	8.0%	9.4%	9.9%	13.2%	3.8%	4.8%	10.5%	7.3%	6.2%	
Ag	g/t	1,207			312	371	818	915	1,952	2,146	1,122	1,504	2,725	1,645	548	
Au	g/t	5.59			3.31	3.77	3.86	3.70	5.76	6.98	3.70	6.24	13.51	8.64	4.63	
Zinc Concentrate																
Recovery to Conc	tonnes	790,036			55,295	62,044	73,766	92,749	83,410	84,748	52,622	63,956	85,247	80,992	55,207	
Zn	%	91.5%			93.1%	92.9%	91.8%	91.4%	91.6%	90.8%	90.3%	90.6%	91.2%	91.3%	92.5%	
Cu	%	6.3%			6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	
Ag	%	20.1%			20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	
Au	%	20.1%			20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	
Metal in Conc																
Zn	ktonnes	484			33.9	38.0	45.2	56.9	51.1	51.9	32.2	39.2	52.3	49.6	33.8	
Cu	ktonnes	6			0.7	0.6	0.5	0.6	0.5	0.4	0.8	0.8	0.5	0.6	0.5	
Ag	kg	124,333			3,673	3,451	6,897	8,254	14,994	12,709	14,509	18,414	20,362	16,638	4,431	
Au	kg	823			55.7	50.1	46.6	47.7	63.3	59.1	68.4	109.2	144.4	125.0	53.5	
Conc Grade																
Zn	%	133.5%			61.3%	61.3%	61.3%	61.3%	61.3%	61.3%	61.2%	61.2%	61.3%	61.3%	61.3%	
Cu	%	1.7%			1.3%	0.9%	0.7%	0.6%	0.6%	0.4%	1.5%	1.2%	0.5%	0.8%	0.9%	
Ag	g/t	343			66	56	94	89	180	150	276	288	239	205	80	
Au	g/t	2.27			1.01	0.81	0.63	0.51	0.76	0.70	1.30	1.71	1.69	1.54	0.97	
Barite Concentrate																
Recovery to Conc	tonnes	0														
Ba	%	91.1%			91.1%	91.1%	91.1%	91.1%	91.1%	91.1%	91.1%	91.1%	91.1%	91.1%	91.1%	
Metal in Conc																
Ba	ktonnes	1,514			81.9	89.9	106.1	105.5	180.0	147.2	153.9	185.1	212.4	155.9	95.8	
Conc Grade																
Ba	%	417.2%			52.0%	52.0%	52.0%	52.0%	52.0%	52.0%	52.0%	52.0%	52.0%	52.0%	52.0%	
REVENUES																
Metal Prices																
Cu	US$/lb	2.82			2.82	2.82	2.82	2.82	2.82	2.82	2.82	2.82	2.82	2.82	2.82	
Zn	US$/lb	1.22			1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	
Ag	US$/oz	16.26			16.26	16.26	16.26	16.26	16.26	16.26	16.26	16.26	16.26	16.26	16.26	
Au	US$/oz	1,296			1,296	1,296	1,296	1,296	1,296	1,296	1,296	1,296	1,296	1,296	1,296	
Ba	US$/tonne	220.00			220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	

Copper Concentrate																
Payable %																
Cu	%	96%			96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	
Zn	%	0%			0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Ag	%	88%			88%	88%	88%	88%	88%	88%	88%	88%	88%	88%	88%	
Au	%	71%			71%	71%	71%	71%	71%	71%	71%	71%	71%	71%	71%	
Payable Qty																
Cu	Mlbs	188			21.6	17.0	15.3	16.3	14.1	10.7	23.6	22.4	13.6	18.5	14.7	
Zn	ktonnes															
Ag	koz	12,345		0	365	343	685	820	1,489	1,262	1,441	1,828	2,022	1,652	440	
Au	koz	46			3	3	3	3	4	3	4	6	8	7	3	
Gross Revenue																
Cu	US$M	529.9			60.9	48.0	43.1	46.1	39.8	30.3	66.5	63.2	38.4	52.3	41.5	
Zn	US$M															
Ag	US$M	200.7			5.9	5.6	11.1	13.3	24.2	20.5	23.4	29.7	32.9	26.9	7.2	
Au	US$M	59.8			4.0	3.6	3.4	3.5	4.6	4.3	5.0	7.9	10.5	9.1	3.9	
Total	US$M	790.4			70.9	57.2	57.6	62.9	68.6	55.1	94.9	100.8	81.7	88.2	52.5	
Shipping and Refining																
Conc % Moisture	%	8%			8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	
Conc Shipping	US$/wmt	91.0			91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0	
Conc Shipping	US$M	35.7			4.1	3.2	2.9	3.1	2.7	2.1	4.5	4.2	2.6	3.5	2.8	
Cu Treatment	US$/dmt	86.0			86.0	86.0	86.0	86.0	86.0	86.0	86.0	86.0	86.0	86.0	86.0	
Cu Treatment	US$M	31.2			3.6	2.8	2.6	2.7	2.3	1.8	3.9	3.7	2.3	3.1	2.4	
Cu Refining	US$/#	0.09			0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	
Cu Refining	US$M	16.9			1.9	1.5	1.4	1.5	1.3	1.0	2.1	2.0	1.2	1.7	1.3	
Ag Refining	US$/oz	0.75			0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	
Ag Refining	US$M	9.3			0.3	0.3	0.5	0.6	1.1	0.9	1.1	1.4	1.5	1.2	0.3	
Au Refining	US$/oz	6.00			6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	
Au Refining	US$M	0.28			0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.04	0.05	0.04	0.02	
Zn Penalty	US$/tonne	6.00			0.42	3.99	7.91	10.79	11.8	18.32	0	1.63	12.91	6.66	4.34	
Zn Penalty	US$M	2.2			0.02	0.13	0.24	0.34	0.32	0.38	0.00	0.07	0.34	0.24	0.12	
Total	US$M	95.2			9.9	8.0	7.6	8.3	7.7	6.1	11.6	11.4	7.9	9.7	7.0	
Copper Conc NSR	US$M	695.2			61.0	49.2	50.0	54.6	60.9	48.9	83.3	89.4	73.8	78.5	45.5	
Zinc Concentrate																
Payable %																
Zn	%				85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	
Cu	%				0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Ag	%						0.2%		34%	26%	46%	47%	43%	38%		
Au	%				48.5%	43.2%	35.6%	27.8%	41.4%	38.9%	53.3%	57.3%	57.2%	55.9%	47.6%	
Payable Qty																
Zn	ktonnes	412			29	32	38	48	43	44	27	33	44	42	29	
Cu	Mlbs	0			0	0	0	0	0	0	0	0	0	0	0	
Ag	koz	1,250			0	0	0.3	0	162	108	216	280	279	204	0	
Au	koz	13			0.9	0.7	0.5	0.4	0.8	0.7	1.2	2.0	2.7	2.2	0.8	
Gross Revenue																
Zn	US$M	1,108			78	87	103	130	117	119	74	90	120	114	77	
Cu	US$M	0.0			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Ag	US$M	20.3			0	0	0	0	3	2	4	5	5	3	0	
Au	US$M	16.9			1	1	1	1	1	1	2	3	3	3	1	
Total	US$M	1,145.5			78.8	88.0	104.2	130.7	120.7	121.6	78.7	96.8	127.7	119.9	78.5	
Shipping and Refining																
Conc % Moisture	%	8%			8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	
Conc Shipping	US$/wmt	91.0			91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0	
Conc Shipping	US$M	77.6			5.4	6.1	7.2	9.1	8.2	8.3	5.2	6.3	8.4	8.0	5.4	
Zn Treatment	US$/dmt	172.0			172.0	172.0	172.0	172.0	172.0	172.0	172.0	172.0	172.0	172.0	172.0	
Zn Treatment	US$M	135.9			9.5	10.7	12.7	16.0	14.3	14.6	9.1	11.0	14.7	13.9	9.5	
Ag Refining	US$/oz	0.5			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Ag Refining	US$M	0.6			0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	
Au Refining	US$/oz	6.00			6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	
Au Refining	US$M	0.08			0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.02	0.01	0.00	
Total	US$M	214.2			15.0	16.8	19.9	25.1	22.6	23.0	14.3	17.4	23.2	22.0	14.9	

Zinc Conc NSR	US$M	931.3			63.8	71.2	84.3	105.6	98.1	98.7	64.4	79.4	104.5	97.9	63.6	
Barite Concentrate																
Payable %																
Ba	%				100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Payable Qty																
Ba	ktonnes	0			0	0	0	0	0	0	0	0	0	0	0	
Gross Revenue																
Ba	US$M	0			0	0	0	0	0	0	0	0	0	0	0	
Shipping and Refining																
Conc % Moisture	%	1%			1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	
Conc Shipping	US$/wmt	132.0			132.0	132.0	132.0	132.0	132.0	132.0	132.0	132.0	132.0	132.0	132.0	
Conc Shipping	US$M	0.0			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total	US$M	0.0			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Barite Conc NSR	US$M	0.0			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Net Revenue																
Copper Conc NSR	US$M	695.2			61.0	49.2	50.0	54.6	60.9	48.9	83.3	89.4	73.8	78.5	45.5	
Zinc Conc NSR	US$M	931.3			63.8	71.2	84.3	105.6	98.1	98.7	64.4	79.4	104.5	97.9	63.6	
Barite Conc NSR	US$M	0.0			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total NSR	US$M	1,626.5			124.8	120.4	134.3	160.2	159.0	147.6	147.7	168.8	178.3	176.4	109.1	
NSR Royalty Payments	US$M	46.9			3.4	3.4	3.8	4.4	4.7	4.3	4.3	5	5.4	5.1	3.1	
Net Revenue	US$M	1,579.6			121.4	117.0	130.5	155.8	154.3	143.3	143.4	163.8	172.9	171.3	106.0	
EXPENSES																
Capital																
Mining	US$M	162.9	14.3	41.1	18.1	20.7	11.2	7.5	10.1	9.2	9.4	8.3	7.2	3.8	2.0	
Site Development	US$M	12.7	10.5	1.7	0.1			0.4								
Mineral Processing	US$M	77.4	10.0	64.6			0.5	0.9			0.5	0.9				
Tailings Management	US$M	5.1	0.5	1.5	0.3	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.2		
On-Site Infrastructure	US$M	35.3	5.9	28.1				0.2	0.7	0.2		0.2				
Off-Site Infrasructure	US$M	0.4	0.3	0.1												
Project Indirects	US$M	26.4	4.1	22.3												
EPCM	US$M	32.2	17.7	14.5												
Owner Costs	US$M	7.5	0.5	7.0												
Closure	US$M	30.8														30.8
Salvage Value	US$M	-5.9														-5.9
Contingency	US$M	32.7	3.3	29.4												
Working Capital	US$M	0.0		13.3											-13.3	
Total CAPEX	US$M	417.5	67.1	223.6	18.5	21.1	12.1	9.3	11.1	9.7	10.2	9.7	7.5	4.0	-11.3	24.9
Operating																
UG Mining	US$M	362.7			26.7	29.7	36.1	36.2	36.2	35.4	36.0	35.6	38.3	35.3	17.2	
Processing	US$M	209.8			16.7	15.5	20.5	21.0	21.2	19.6	21.2	20.8	21.2	20.9	11.2	
G&A	US$M	103.2			10.0	9.6	9.8	9.6	9.6	9.5	9.8	9.6	9.5	9.4	6.8	
Total OPEX	US$M	675.7			53.4	54.8	66.4	66.8	67.0	64.5	67.0	66.0	69.0	65.6	35.2	
Total OPEX	US$/ton milled	54.1			53.9	59.3	54.5	53.5	53.2	54.8	53.2	53.4	54.8	52.7	52.9	
Net Expenses, Pre-Tax	US$M	1,093.2	67.1	223.6	71.9	75.9	78.5	76.1	78.1	74.2	77.2	75.7	76.5	69.6	23.9	24.9
Taxes	US$M	159.7	0.9	0.9	0.9	4.4	6.0	11.2	13.7	9.8	11.0	21.3	30.5	29.7	19.4	
Net Expenses, Post-Tax	US$M	1,252.9	68.0	224.5	72.8	80.3	84.5	87.3	91.8	84.0	88.2	97.0	107.0	99.3	43.3	24.9
ECONOMICS																
Pre-Tax Results																
Pre-Tax Net Cash Flow	US$M	486.4	-67.1	-223.6	49.5	41.1	52.0	79.7	76.2	69.1	66.2	88.1	96.4	101.7	82.1	-24.9
Cumulative Pre-Tax Net Cash Flow	US$M		-67.1	-290.7	-241.2	-200.1	-148.1	-68.4	7.8	76.9	143.1	231.2	327.5	429.2	511.3	486.4
Pre-Tax NPV @0% DROR	US$M	486.4														
Pre-Tax NPV @7% DROR	US$M	187.7														
IRR	%	17.7%														
Payback	Years	4.8														
Post-Tax Results																
Post-Tax Net Cash Flow	US$M	326.7	-68.0	-224.5	48.6	36.7	46.0	68.5	62.5	59.3	55.2	66.8	65.9	72.0	62.7	-24.9
Cumulative Post-Tax Net Cash Flow	US$M		-68.0	-292.5	-243.9	-207.2	-161.2	-92.7	-30.2	29.1	84.3	151.1	216.9	288.9	351.6	326.7
Post-Tax NPV @0% DROR	US$M	326.7														
Post-Tax NPV @7% DROR	US$M	103.5														
IRR	%	13.6%														
Payback	Years	5.5														

	Unit	LOM Total	Y-2	Y-1	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12
PRODUCTION																
Ore Mined/Milled																
Rate	ktonnes	12,482			990	924	1,219	1,249	1,259	1,177	1,260	1,235	1,260	1,244	665	
Cu	%	0.80%			1.16%	0.98%	0.67%	0.70%	0.60%	0.49%	1.00%	0.97%	0.58%	0.80%	1.18%	
Zn	%	4.24%			3.68%	4.43%	4.04%	4.98%	4.43%	4.86%	2.83%	3.50%	4.55%	4.37%	5.50%	
Ag	g/t	49.56			18.46	18.58	28.15	32.88	59.25	53.72	57.29	74.18	80.40	66.54	33.15	
Au	g/t	0.33			0.28	0.27	0.19	0.19	0.25	0.25	0.27	0.44	0.57	0.50	0.40	
Ba	%	13.31%			9.08%	10.68%	9.55%	9.27%	15.69%	13.73%	13.41%	16.45%	18.50%	13.76%	15.81%	
Contained Metal																
Cu	ktonnes	100			11.5	9.1	8.2	8.7	7.6	5.8	12.6	12.0	7.3	10.0	7.8	
Zn	ktonnes	529			36.4	40.9	49.2	62.2	55.8	57.2	35.7	43.2	57.3	54.4	36.6	
Ag	kg	618,572			18275.4	17167.9	34314.9	41067.1	74595.8	63228.4	72185.4	91612.3	101304.0	82775.8	22044.8	
Au	kg	4,094			277.2	249.5	231.6	237.3	314.8	294.3	340.2	543.4	718.2	622.0	266.0	
Ba	ktonnes	1,661			89.9	98.7	116.4	115.8	197.5	161.6	169.0	203.2	233.1	171.2	105.1	
Copper Concentrate																
Recovery to Conc	tonnes	362,780			41,506	32,766	29,710	31,774	27,059	20,859	45,570	43,138	26,316	35,623	28,459	
Cu	%	88.4%			88.9%	88.8%	88.5%	88.4%	88.4%	88.0%	88.5%	88.4%	88.0%	88.1%	88.6%	
Zn	%	4.8%			4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	
Ag	%	70.8%			70.8%	70.8%	70.8%	70.8%	70.8%	70.8%	70.8%	70.8%	70.8%	70.8%	70.8%	
Au	%	49.5%			49.5%	49.5%	49.5%	49.5%	49.5%	49.5%	49.5%	49.5%	49.5%	49.5%	49.5%	
Metal in Conc																
Cu	ktonnes	89			10.2	8.0	7.2	7.7	6.7	5.1	11.2	10.6	6.4	8.8	7.0	
Zn	ktonnes	25			1.7	2.0	2.4	3.0	2.7	2.7	1.7	2.1	2.8	2.6	1.8	
Ag	kg	437,949			12,939	12,155	24,295	29,076	52,814	44,766	51,107	64,862	71,723	58,605	15,608	
Au	kg	2,027			137.2	123.5	114.6	117.5	155.8	145.7	168.4	269.0	355.5	307.9	131.7	
Conc Grade																
Cu	%	24.5%			24.6%	24.5%	24.3%	24.3%	24.7%	24.3%	24.5%	24.5%	24.4%	24.6%	24.4%	
Zn	%	7.0%			4.2%	6.0%	8.0%	9.4%	9.9%	13.2%	3.8%	4.8%	10.5%	7.3%	6.2%	
Ag	g/t	1,207			312	371	818	915	1,952	2,146	1,122	1,504	2,725	1,645	548	
Au	g/t	5.59			3.31	3.77	3.86	3.70	5.76	6.98	3.70	6.24	13.51	8.64	4.63	
Zinc Concentrate																
Recovery to Conc	tonnes	790,036			55,295	62,044	73,766	92,749	83,410	84,748	52,622	63,956	85,247	80,992	55,207	
Zn	%	91.5%			93.1%	92.9%	91.8%	91.4%	91.6%	90.8%	90.3%	90.6%	91.2%	91.3%	92.5%	
Cu	%	6.3%			6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	
Ag	%	20.1%			20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	
Au	%	20.1%			20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	
Metal in Conc																
Zn	ktonnes	484			33.9	38.0	45.2	56.9	51.1	51.9	32.2	39.2	52.3	49.6	33.8	
Cu	ktonnes	6			0.7	0.6	0.5	0.6	0.5	0.4	0.8	0.8	0.5	0.6	0.5	
Ag	kg	124,333			3,673	3,451	6,897	8,254	14,994	12,709	14,509	18,414	20,362	16,638	4,431	
Au	kg	823			55.7	50.1	46.6	47.7	63.3	59.1	68.4	109.2	144.4	125.0	53.5	
Conc Grade																
Zn	%	61.3%			61.3%	61.3%	61.3%	61.3%	61.3%	61.3%	61.2%	61.2%	61.3%	61.3%	61.3%	
Cu	%	1.7%			1.3%	0.9%	0.7%	0.6%	0.6%	0.4%	1.5%	1.2%	0.5%	0.8%	0.9%	
Ag	g/t	343			66	56	94	89	180	150	276	288	239	205	80	
Au	g/t	2.27			1.01	0.81	0.63	0.51	0.76	0.70	1.30	1.71	1.69	1.54	0.97	
Barite Concentrate																
Recovery to Conc	tonnes	2,910,725			157,484	172,885	203,949	202,842	346,070	283,114	296,015	355,916	408,373	299,884	184,191	
Ba	%	91.1%			91.1%	91.1%	91.1%	91.1%	91.1%	91.1%	91.1%	91.1%	91.1%	91.1%	91.1%	
Metal in Conc																
Ba	ktonnes	1,514			81.9	89.9	106.1	105.5	180.0	147.2	153.9	185.1	212.4	155.9	95.8	
Conc Grade																
Ba	%	52.0%			52.0%	52.0%	52.0%	52.0%	52.0%	52.0%	52.0%	52.0%	52.0%	52.0%	52.0%	
REVENUES																
Metal Prices																
Cu	US$/lb	2.82			2.82	2.82	2.82	2.82	2.82	2.82	2.82	2.82	2.82	2.82	2.82	
Zn	US$/lb	1.22			1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	
Ag	US$/oz	16.26			16.26	16.26	16.26	16.26	16.26	16.26	16.26	16.26	16.26	16.26	16.26	
Au	US$/oz	1,296			1,296	1,296	1,296	1,296	1,296	1,296	1,296	1,296	1,296	1,296	1,296	
Ba	US$/tonne	220.00			220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	

Copper Concentrate																
Payable %																
Cu	%	96%			96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	
Zn	%	0%			0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Ag	%	88%			88%	88%	88%	88%	88%	88%	88%	88%	88%	88%	88%	
Au	%	71%			71%	71%	71%	71%	71%	71%	71%	71%	71%	71%	71%	
Payable Qty																
Cu	Mlbs	188			21.6	17.0	15.3	16.3	14.1	10.7	23.6	22.4	13.6	18.5	14.7	
Zn	ktonnes															
Ag	koz	12,345		0	365	343	685	820	1,489	1,262	1,441	1,828	2,022	1,652	440	
Au	koz	46			3	3	3	3	4	3	4	6	8	7	3	
Gross Revenue																
Cu	US$M	529.9			60.9	48.0	43.1	46.1	39.8	30.3	66.5	63.2	38.4	52.3	41.5	
Zn	US$M															
Ag	US$M	200.7			5.9	5.6	11.1	13.3	24.2	20.5	23.4	29.7	32.9	26.9	7.2	
Au	US$M	59.8			4.0	3.6	3.4	3.5	4.6	4.3	5.0	7.9	10.5	9.1	3.9	
Total	US$M	790.4			70.9	57.2	57.6	62.9	68.6	55.1	94.9	100.8	81.7	88.2	52.5	
Shipping and Refining																
Conc % Moisture	%	8%			8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	
Conc Shipping	US$/wmt	91.0			91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0	
Conc Shipping	US$M	35.7			4.1	3.2	2.9	3.1	2.7	2.1	4.5	4.2	2.6	3.5	2.8	
Cu Treatment	US$/dmt	86.0			86.0	86.0	86.0	86.0	86.0	86.0	86.0	86.0	86.0	86.0	86.0	
Cu Treatment	US$M	31.2			3.6	2.8	2.6	2.7	2.3	1.8	3.9	3.7	2.3	3.1	2.4	
Cu Refining	US$/#	0.09			0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	
Cu Refining	US$M	16.9			1.9	1.5	1.4	1.5	1.3	1.0	2.1	2.0	1.2	1.7	1.3	
Ag Refining	US$/oz	0.75			0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	
Ag Refining	US$M	9.3			0.3	0.3	0.5	0.6	1.1	0.9	1.1	1.4	1.5	1.2	0.3	
Au Refining	US$/oz	6.00			6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	
Au Refining	US$M	0.28			0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.04	0.05	0.04	0.02	
Zn Penalty	US$/tonne	6.00			0.42	3.99	7.91	10.79	11.8	18.32	0	1.63	12.91	6.66	4.34	
Zn Penalty	US$M	2.2			0.02	0.13	0.24	0.34	0.32	0.38	0.00	0.07	0.34	0.24	0.12	
Total	US$M	95.2			9.9	8.0	7.6	8.3	7.7	6.1	11.6	11.4	7.9	9.7	7.0	
Copper Conc NSR	US$M	695.2			61.0	49.2	50.0	54.6	60.9	48.9	83.3	89.4	73.8	78.5	45.5	
Zinc Concentrate																
Payable %																
Zn	%				85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	
Cu	%				0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Ag	%						0.2%		34%	26%	46%	47%	43%	38%		
Au	%				48.5%	43.2%	35.6%	27.8%	41.4%	38.9%	53.3%	57.3%	57.2%	55.9%	47.6%	
Payable Qty																
Zn	ktonnes	412			29	32	38	48	43	44	27	33	44	42	29	
Cu	Mlbs	0			0	0	0	0	0	0	0	0	0	0	0	
Ag	koz	1,250			0	0	0.3	0	162	108	216	280	279	204	0	
Au	koz	13			0.9	0.7	0.5	0.4	0.8	0.7	1.2	2.0	2.7	2.2	0.8	
Gross Revenue																
Zn	US$M	1,108			78	87	103	130	117	119	74	90	120	114	77	
Cu	US$M	0.0			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Ag	US$M	20.3			0	0	0	0	3	2	4	5	5	3	0	
Au	US$M	16.9			1	1	1	1	1	1	2	3	3	3	1	
Total	US$M	1,145.5			78.8	88.0	104.2	130.7	120.7	121.6	78.7	96.8	127.7	119.9	78.5	
Shipping and Refining																
Conc % Moisture	%	8%			8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	
Conc Shipping	US$/wmt	91.0			91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0	
Conc Shipping	US$M	77.6			5.4	6.1	7.2	9.1	8.2	8.3	5.2	6.3	8.4	8.0	5.4	
Zn Treatment	US$/dmt	172.0			172.0	172.0	172.0	172.0	172.0	172.0	172.0	172.0	172.0	172.0	172.0	
Zn Treatment	US$M	135.9			9.5	10.7	12.7	16.0	14.3	14.6	9.1	11.0	14.7	13.9	9.5	
Ag Refining	US$/oz	0.5			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Ag Refining	US$M	0.6			0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	
Au Refining	US$/oz	6.00			6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	
Au Refining	US$M	0.08			0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.02	0.01	0.00	
Total	US$M	214.2			15.0	16.8	19.9	25.1	22.6	23.0	14.3	17.4	23.2	22.0	14.9	

Zinc Conc NSR	US$M	931.3			63.8	71.2	84.3	105.6	98.1	98.7	64.4	79.4	104.5	97.9	63.6	
Barite Concentrate																
Payable %																
Ba	%				100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Payable Qty																
Ba	ktonnes	2,911			157	173	204	203	346	283	296	356	408	300	184	
Gross Revenue																
Ba	US$M	640			35	38	45	45	76	62	65	78	90	66	41	
Shipping and Refining																
Conc % Moisture	%	1%			1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	
Conc Shipping	US$/wmt	132.0			132.0	132.0	132.0	132.0	132.0	132.0	132.0	132.0	132.0	132.0	132.0	
Conc Shipping	US$M	388.1			21.0	23.0	27.2	27.0	46.1	37.7	39.5	47.5	54.4	40.0	24.6	
Total	US$M	388.1			21.0	23.0	27.2	27.0	46.1	37.7	39.5	47.5	54.4	40.0	24.6	
Barite Conc NSR	US$M	252.3			13.7	15.0	17.7	17.6	30.0	24.5	25.7	30.9	35.4	26.0	16.0	
Net Revenue																
Copper Conc NSR	US$M	695.2			61.0	49.2	50.0	54.6	60.9	48.9	83.3	89.4	73.8	78.5	45.5	
Zinc Conc NSR	US$M	931.3			63.8	71.2	84.3	105.6	98.1	98.7	64.4	79.4	104.5	97.9	63.6	
Barite Conc NSR	US$M	252.3			13.7	15.0	17.7	17.6	30.0	24.5	25.7	30.9	35.4	26.0	16.0	
Total NSR	US$M	1,878.8			138.4	135.4	151.9	177.8	189.0	172.1	173.4	199.6	213.7	202.4	125.0	
NSR Royalty Payments	US$M	46.9			3.4	3.4	3.8	4.4	4.7	4.3	4.3	5	5.4	5.1	3.1	
Net Revenue	US$M	1,831.9			135.0	132.0	148.1	173.4	184.3	167.8	169.1	194.6	208.3	197.3	121.9	
EXPENSES																
Capital																
Mining	US$M	203.6	17.9	51.4	22.6	25.9	14.0	9.4	12.6	11.5	11.8	10.4	9.0	4.8	2.5	0.0
Site Development	US$M	15.9	13.1	2.1	0.1	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mineral Processing	US$M	96.8	12.5	80.8	0.0	0.0	0.6	1.1	0.0	0.0	0.6	1.1	0.0	0.0	0.0	0.0
Tailings Management	US$M	6.4	0.6	1.9	0.4	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.0	0.0
On-Site Infrastructure	US$M	44.1	7.4	35.1	0.0	0.0	0.0	0.3	0.9	0.3	0.0	0.3	0.0	0.0	0.0	0.0
Off-Site Infrasructure	US$M	0.5	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Project Indirects	US$M	33.0	5.1	27.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EPCM	US$M	40.3	22.1	18.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Owner Costs	US$M	9.4	0.6	8.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Closure	US$M	38.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38.5
Salvage Value	US$M	-7.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-7.4
Contingency	US$M	40.9	4.1	36.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Working Capital	US$M	0.0	0.0	16.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-16.6	0.0
Total CAPEX	US$M	521.9	83.9	279.5	23.1	26.4	15.1	11.6	13.9	12.1	12.8	12.1	9.4	5.0	-14.1	31.1
Operating																
UG Mining	US$M	453.4			33.4	37.1	45.1	45.3	45.3	44.3	45.0	44.5	47.9	44.1	21.5	0
Processing	US$M	262.3			20.9	19.4	25.6	26.3	26.5	24.5	26.5	26.0	26.5	26.1	14.0	0
G&A	US$M	129.0			12.5	12.0	12.3	12.0	12.0	11.9	12.3	12.0	11.9	11.8	8.5	0
Total OPEX	US$M	844.6			66.8	68.5	83.0	83.5	83.8	80.6	83.8	82.5	86.3	82.0	44.0	
Total OPEX	US$/ton milled	67.7			67.4	74.1	68.1	66.9	66.5	68.5	66.5	66.8	68.5	65.9	66.2	
Net Expenses, Pre-Tax	US$M	1,366.5	83.9	279.5	89.9	94.9	98.1	95.1	97.6	92.8	96.5	94.6	95.6	87.0	29.9	31.1
Taxes	US$M	159.7	0.9	0.9	0.9	4.4	6.0	11.2	13.7	9.8	11.0	21.3	30.5	29.7	19.4	
Net Expenses, Post-Tax	US$M	1,526.2	84.8	280.4	90.8	99.3	104.1	106.3	111.3	102.6	107.5	115.9	126.1	116.7	49.3	31.1
ECONOMICS																
Pre-Tax Results																
Pre-Tax Net Cash Flow	US$M	465.4	-83.9	-279.5	45.2	37.1	50.0	78.3	86.7	75.1	72.6	100.0	112.6	110.3	92.1	-31.1
Cumulative Pre-Tax Net Cash Flow	US$M		-83.9	-363.4	-318.2	-281.1	-231.1	-152.8	-66.1	9.0	81.5	181.5	294.2	404.4	496.5	465.4
Pre-Tax NPV @0% DROR	US$M	465.4														
Pre-Tax NPV @7% DROR	US$M	147.1														
IRR	%	13.8%														
Payback	Years	5.7														
Post-Tax Results																
Post-Tax Net Cash Flow	US$M	305.7	-84.8	-280.4	44.3	32.7	44.0	67.1	73.0	65.3	61.6	78.7	82.1	80.6	72.7	-31.1
Cumulative Post-Tax Net Cash Flow	US$M		-84.8	-365.2	-320.9	-288.2	-244.2	-177.1	-104.1	-38.8	22.7	101.4	183.6	264.1	336.8	305.7
Post-Tax NPV @0% DROR	US$M	305.7														
Post-Tax NPV @7% DROR	US$M	62.8														
IRR	%	10.2%														
Payback	Years	6.5														

	Unit	LOM Total	Y-2	Y-1	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12
PRODUCTION																
Ore Mined/Milled																
Rate	ktonnes	12,482			990	924	1,219	1,249	1,259	1,177	1,260	1,235	1,260	1,244	665	
Cu	%	0.80%			1.16%	0.98%	0.67%	0.70%	0.60%	0.49%	1.00%	0.97%	0.58%	0.80%	1.18%	
Zn	%	4.24%			3.68%	4.43%	4.04%	4.98%	4.43%	4.86%	2.83%	3.50%	4.55%	4.37%	5.50%	
Ag	g/t	49.56			18.46	18.58	28.15	32.88	59.25	53.72	57.29	74.18	80.40	66.54	33.15	
Au	g/t	0.33			0.28	0.27	0.19	0.19	0.25	0.25	0.27	0.44	0.57	0.50	0.40	
Ba	%	13.31%			9.08%	10.68%	9.55%	9.27%	15.69%	13.73%	13.41%	16.45%	18.50%	13.76%	15.81%	
Contained Metal																
Cu	ktonnes	100			11.5	9.1	8.2	8.7	7.6	5.8	12.6	12.0	7.3	10.0	7.8	
Zn	ktonnes	529			36.4	40.9	49.2	62.2	55.8	57.2	35.7	43.2	57.3	54.4	36.6	
Ag	kg	618,572			18275.4	17167.9	34314.9	41067.1	74595.8	63228.4	72185.4	91612.3	101304.0	82775.8	22044.8	
Au	kg	4,094			277.2	249.5	231.6	237.3	314.8	294.3	340.2	543.4	718.2	622.0	266.0	
Ba	ktonnes	1,661			89.9	98.7	116.4	115.8	197.5	161.6	169.0	203.2	233.1	171.2	105.1	
Copper Concentrate																
Recovery to Conc	tonnes	362,780			41,506	32,766	29,710	31,774	27,059	20,859	45,570	43,138	26,316	35,623	28,459	
Cu	%	88.4%			88.9%	88.8%	88.5%	88.4%	88.4%	88.0%	88.5%	88.4%	88.0%	88.1%	88.6%	
Zn	%	4.8%			4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	
Ag	%	70.8%			70.8%	70.8%	70.8%	70.8%	70.8%	70.8%	70.8%	70.8%	70.8%	70.8%	70.8%	
Au	%	49.5%			49.5%	49.5%	49.5%	49.5%	49.5%	49.5%	49.5%	49.5%	49.5%	49.5%	49.5%	
Metal in Conc																
Cu	ktonnes	89			10.2	8.0	7.2	7.7	6.7	5.1	11.2	10.6	6.4	8.8	7.0	
Zn	ktonnes	25			1.7	2.0	2.4	3.0	2.7	2.7	1.7	2.1	2.8	2.6	1.8	
Ag	kg	437,949			12,939	12,155	24,295	29,076	52,814	44,766	51,107	64,862	71,723	58,605	15,608	
Au	kg	2,027			137.2	123.5	114.6	117.5	155.8	145.7	168.4	269.0	355.5	307.9	131.7	
Conc Grade																
Cu	%	24.5%			24.6%	24.5%	24.3%	24.3%	24.7%	24.3%	24.5%	24.5%	24.4%	24.6%	24.4%	
Zn	%	7.0%			4.2%	6.0%	8.0%	9.4%	9.9%	13.2%	3.8%	4.8%	10.5%	7.3%	6.2%	
Ag	g/t	1,207			312	371	818	915	1,952	2,146	1,122	1,504	2,725	1,645	548	
Au	g/t	5.59			3.31	3.77	3.86	3.70	5.76	6.98	3.70	6.24	13.51	8.64	4.63	
Zinc Concentrate																
Recovery to Conc	tonnes	790,036			55,295	62,044	73,766	92,749	83,410	84,748	52,622	63,956	85,247	80,992	55,207	
Zn	%	91.5%			93.1%	92.9%	91.8%	91.4%	91.6%	90.8%	90.3%	90.6%	91.2%	91.3%	92.5%	
Cu	%	6.3%			6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	6.3%	
Ag	%	20.1%			20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	
Au	%	20.1%			20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	20.1%	
Metal in Conc																
Zn	ktonnes	484			33.9	38.0	45.2	56.9	51.1	51.9	32.2	39.2	52.3	49.6	33.8	
Cu	ktonnes	6			0.7	0.6	0.5	0.6	0.5	0.4	0.8	0.8	0.5	0.6	0.5	
Ag	kg	124,333			3,673	3,451	6,897	8,254	14,994	12,709	14,509	18,414	20,362	16,638	4,431	
Au	kg	823			55.7	50.1	46.6	47.7	63.3	59.1	68.4	109.2	144.4	125.0	53.5	
Conc Grade																
Zn	%	61.3%			61.3%	61.3%	61.3%	61.3%	61.3%	61.3%	61.2%	61.2%	61.3%	61.3%	61.3%	
Cu	%	1.7%			1.3%	0.9%	0.7%	0.6%	0.6%	0.4%	1.5%	1.2%	0.5%	0.8%	0.9%	
Ag	g/t	343			66	56	94	89	180	150	276	288	239	205	80	
Au	g/t	2.27			1.01	0.81	0.63	0.51	0.76	0.70	1.30	1.71	1.69	1.54	0.97	
Barite Concentrate																
Recovery to Conc	tonnes	2,910,725			157,484	172,885	203,949	202,842	346,070	283,114	296,015	355,916	408,373	299,884	184,191	
Ba	%	91.1%			91.1%	91.1%	91.1%	91.1%	91.1%	91.1%	91.1%	91.1%	91.1%	91.1%	91.1%	
Metal in Conc																
Ba	ktonnes	1,514			81.9	89.9	106.1	105.5	180.0	147.2	153.9	185.1	212.4	155.9	95.8	
Conc Grade																
Ba	%	52.0%			52.0%	52.0%	52.0%	52.0%	52.0%	52.0%	52.0%	52.0%	52.0%	52.0%	52.0%	
REVENUES																
Metal Prices																
Cu	US$/lb	2.82			2.82	2.82	2.82	2.82	2.82	2.82	2.82	2.82	2.82	2.82	2.82	
Zn	US$/lb	1.22			1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	1.22	
Ag	US$/oz	16.26			16.26	16.26	16.26	16.26	16.26	16.26	16.26	16.26	16.26	16.26	16.26	
Au	US$/oz	1,296			1,296	1,296	1,296	1,296	1,296	1,296	1,296	1,296	1,296	1,296	1,296	
Ba	US$/tonne	220.00			220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00	

Copper Concentrate																
Payable %																
Cu	%	96%			96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%	
Zn	%	0%			0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Ag	%	88%			88%	88%	88%	88%	88%	88%	88%	88%	88%	88%	88%	
Au	%	71%			71%	71%	71%	71%	71%	71%	71%	71%	71%	71%	71%	
Payable Qty																
Cu	Mlbs	188			21.6	17.0	15.3	16.3	14.1	10.7	23.6	22.4	13.6	18.5	14.7	
Zn	ktonnes															
Ag	koz	12,345		0	365	343	685	820	1,489	1,262	1,441	1,828	2,022	1,652	440	
Au	koz	46			3	3	3	3	4	3	4	6	8	7	3	
Gross Revenue																
Cu	US$M	529.9			60.9	48.0	43.1	46.1	39.8	30.3	66.5	63.2	38.4	52.3	41.5	
Zn	US$M															
Ag	US$M	200.7			5.9	5.6	11.1	13.3	24.2	20.5	23.4	29.7	32.9	26.9	7.2	
Au	US$M	59.8			4.0	3.6	3.4	3.5	4.6	4.3	5.0	7.9	10.5	9.1	3.9	
Total	US$M	790.4			70.9	57.2	57.6	62.9	68.6	55.1	94.9	100.8	81.7	88.2	52.5	
Shipping and Refining																
Conc % Moisture	%	8%			8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	
Conc Shipping	US$/wmt	91.0			91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0	
Conc Shipping	US$M	35.7			4.1	3.2	2.9	3.1	2.7	2.1	4.5	4.2	2.6	3.5	2.8	
Cu Treatment	US$/dmt	86.0			86.0	86.0	86.0	86.0	86.0	86.0	86.0	86.0	86.0	86.0	86.0	
Cu Treatment	US$M	31.2			3.6	2.8	2.6	2.7	2.3	1.8	3.9	3.7	2.3	3.1	2.4	
Cu Refining	US$/#	0.09			0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	
Cu Refining	US$M	16.9			1.9	1.5	1.4	1.5	1.3	1.0	2.1	2.0	1.2	1.7	1.3	
Ag Refining	US$/oz	0.75			0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	
Ag Refining	US$M	9.3			0.3	0.3	0.5	0.6	1.1	0.9	1.1	1.4	1.5	1.2	0.3	
Au Refining	US$/oz	6.00			6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	
Au Refining	US$M	0.28			0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.04	0.05	0.04	0.02	
Zn Penalty	US$/tonne	6.00			0.42	3.99	7.91	10.79	11.8	18.32	0	1.63	12.91	6.66	4.34	
Zn Penalty	US$M	2.2			0.02	0.13	0.24	0.34	0.32	0.38	0.00	0.07	0.34	0.24	0.12	
Total	US$M	95.2			9.9	8.0	7.6	8.3	7.7	6.1	11.6	11.4	7.9	9.7	7.0	
Copper Conc NSR	US$M	695.2			61.0	49.2	50.0	54.6	60.9	48.9	83.3	89.4	73.8	78.5	45.5	
Zinc Concentrate																
Payable %																
Zn	%				85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	
Cu	%				0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Ag	%						0.2%		34%	26%	46%	47%	43%	38%		
Au	%				48.5%	43.2%	35.6%	27.8%	41.4%	38.9%	53.3%	57.3%	57.2%	55.9%	47.6%	
Payable Qty																
Zn	ktonnes	412			29	32	38	48	43	44	27	33	44	42	29	
Cu	Mlbs	0			0	0	0	0	0	0	0	0	0	0	0	
Ag	koz	1,250			0	0	0.3	0	162	108	216	280	279	204	0	
Au	koz	13			0.9	0.7	0.5	0.4	0.8	0.7	1.2	2.0	2.7	2.2	0.8	
Gross Revenue																
Zn	US$M	1,108			78	87	103	130	117	119	74	90	120	114	77	
Cu	US$M	0.0			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Ag	US$M	20.3			0	0	0	0	3	2	4	5	5	3	0	
Au	US$M	16.9			1	1	1	1	1	1	2	3	3	3	1	
Total	US$M	1,145.5			78.8	88.0	104.2	130.7	120.7	121.6	78.7	96.8	127.7	119.9	78.5	
Shipping and Refining																
Conc % Moisture	%	8%			8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	8%	
Conc Shipping	US$/wmt	91.0			91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0	91.0	
Conc Shipping	US$M	77.6			5.4	6.1	7.2	9.1	8.2	8.3	5.2	6.3	8.4	8.0	5.4	
Zn Treatment	US$/dmt	172.0			172.0	172.0	172.0	172.0	172.0	172.0	172.0	172.0	172.0	172.0	172.0	
Zn Treatment	US$M	135.9			9.5	10.7	12.7	16.0	14.3	14.6	9.1	11.0	14.7	13.9	9.5	
Ag Refining	US$/oz	0.5			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Ag Refining	US$M	0.6			0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	
Au Refining	US$/oz	6.00			6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	
Au Refining	US$M	0.08			0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.02	0.01	0.00	
Total	US$M	214.2			15.0	16.8	19.9	25.1	22.6	23.0	14.3	17.4	23.2	22.0	14.9	

Zinc Conc NSR	US$M	931.3			63.8	71.2	84.3	105.6	98.1	98.7	64.4	79.4	104.5	97.9	63.6	
Barite Concentrate																
Payable %																
Ba	%				100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	
Payable Qty																
Ba	ktonnes	2,911			157	173	204	203	346	283	296	356	408	300	184	
Gross Revenue																
Ba	US$M	640			35	38	45	45	76	62	65	78	90	66	41	
Shipping and Refining																
Conc % Moisture	%	1%			1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	
Conc Shipping	US$/wmt	132.0			132.0	132.0	132.0	132.0	132.0	132.0	132.0	132.0	132.0	132.0	132.0	
Conc Shipping	US$M	388.1			21.0	23.0	27.2	27.0	46.1	37.7	39.5	47.5	54.4	40.0	24.6	
Total	US$M	388.1			21.0	23.0	27.2	27.0	46.1	37.7	39.5	47.5	54.4	40.0	24.6	
Barite Conc NSR	US$M	252.3			13.7	15.0	17.7	17.6	30.0	24.5	25.7	30.9	35.4	26.0	16.0	
Net Revenue																
Copper Conc NSR	US$M	695.2			61.0	49.2	50.0	54.6	60.9	48.9	83.3	89.4	73.8	78.5	45.5	
Zinc Conc NSR	US$M	931.3			63.8	71.2	84.3	105.6	98.1	98.7	64.4	79.4	104.5	97.9	63.6	
Barite Conc NSR	US$M	252.3			13.7	15.0	17.7	17.6	30.0	24.5	25.7	30.9	35.4	26.0	16.0	
Total NSR	US$M	1,878.8			138.4	135.4	151.9	177.8	189.0	172.1	173.4	199.6	213.7	202.4	125.0	
NSR Royalty Payments	US$M	46.9			3.4	3.4	3.8	4.4	4.7	4.3	4.3	5	5.4	5.1	3.1	
Net Revenue	US$M	1,831.9			135.0	132.0	148.1	173.4	184.3	167.8	169.1	194.6	208.3	197.3	121.9	
EXPENSES																
Capital																
Mining	US$M	244.4	21.5	61.7	27.2	31.1	16.8	11.3	15.2	13.8	14.1	12.5	10.8	5.7	3.0	0.0
Site Development	US$M	19.1	15.8	2.6	0.2	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mineral Processing	US$M	116.1	15.0	96.9	0.0	0.0	0.8	1.4	0.0	0.0	0.8	1.4	0.0	0.0	0.0	0.0
Tailings Management	US$M	7.7	0.8	2.3	0.5	0.6	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.3	0.0	0.0
On-Site Infrastructure	US$M	53.0	8.9	42.2	0.0	0.0	0.0	0.3	1.1	0.3	0.0	0.3	0.0	0.0	0.0	0.0
Off-Site Infrasructure	US$M	0.6	0.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Project Indirects	US$M	39.6	6.2	33.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EPCM	US$M	48.3	26.6	21.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Owner Costs	US$M	11.3	0.8	10.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Closure	US$M	46.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	46.2
Salvage Value	US$M	-8.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-8.9
Contingency	US$M	49.1	5.0	44.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Working Capital	US$M	0.0	0.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-20.0	0.0
Total CAPEX	US$M	626.3	100.7	335.4	27.8	31.7	18.2	14.0	16.7	14.6	15.3	14.6	11.3	6.0	-17.0	37.4
Operating																
UG Mining	US$M	544.1			40.1	44.6	54.2	54.3	54.3	53.1	54.0	53.4	57.5	53.0	25.8	
Processing	US$M	314.7			25.1	23.3	30.8	31.5	31.8	29.4	31.8	31.2	31.8	31.4	16.8	
G&A	US$M	154.8			15.0	14.4	14.7	14.4	14.4	14.3	14.7	14.4	14.3	14.1	10.2	
Total OPEX	US$M	1,013.6			80.1	82.2	99.6	100.2	100.5	96.8	100.5	99.0	103.5	98.4	52.8	
Total OPEX	US$/ton milled	81.2			80.9	89.0	81.7	80.2	79.8	82.2	79.8	80.2	82.1	79.1	79.4	
Net Expenses, Pre-Tax	US$M	1,639.8	100.7	335.4	107.9	113.9	117.8	114.2	117.2	111.3	115.8	113.6	114.8	104.4	35.9	37.4
Taxes	US$M	159.7	0.9	0.9	0.9	4.4	6.0	11.2	13.7	9.8	11.0	21.3	30.5	29.7	19.4	
Net Expenses, Post-Tax	US$M	1,799.5	101.6	336.3	108.8	118.3	123.8	125.4	130.9	121.1	126.8	134.9	145.3	134.1	55.3	37.4
ECONOMICS																
Pre-Tax Results																
Pre-Tax Net Cash Flow	US$M	192.1	-100.7	-335.4	27.2	18.1	30.4	59.2	67.1	56.5	53.3	81.1	93.5	92.9	86.1	-37.4
Cumulative Pre-Tax Net Cash Flow	US$M		-100.7	-436.1	-408.9	-390.7	-360.3	-301.1	-233.9	-177.4	-124.1	-43.0	50.5	143.3	229.4	192.1
Pre-Tax NPV @0% DROR	US$M	192.1														
Pre-Tax NPV @7% DROR	US$M	-38.0														
IRR	%	5.4%														
Payback	Years	8.5														
Post-Tax Results																
Post-Tax Net Cash Flow	US$M	32.4	-101.6	-336.3	26.3	13.7	24.4	48.0	53.4	46.7	42.3	59.8	63.0	63.2	66.7	-37.4
Cumulative Post-Tax Net Cash Flow	US$M		-101.6	-437.9	-411.6	-397.8	-373.4	-325.4	-271.9	-225.2	-182.9	-123.1	-60.1	3.0	69.7	32.4
Post-Tax NPV @0% DROR	US$M	32.4														
Post-Tax NPV @7% DROR	US$M	-122.3														
IRR	%	1.0%														
Payback	Years	10														